CIGR 2018

XIX. World Congress of CIGR
(Commission Internationale du Génie Rural)

"Sustainable Life for Children"

22 - 25 April 2018

Antalya, Turkey

PROGRAM & ABSTRACTS' BOOK

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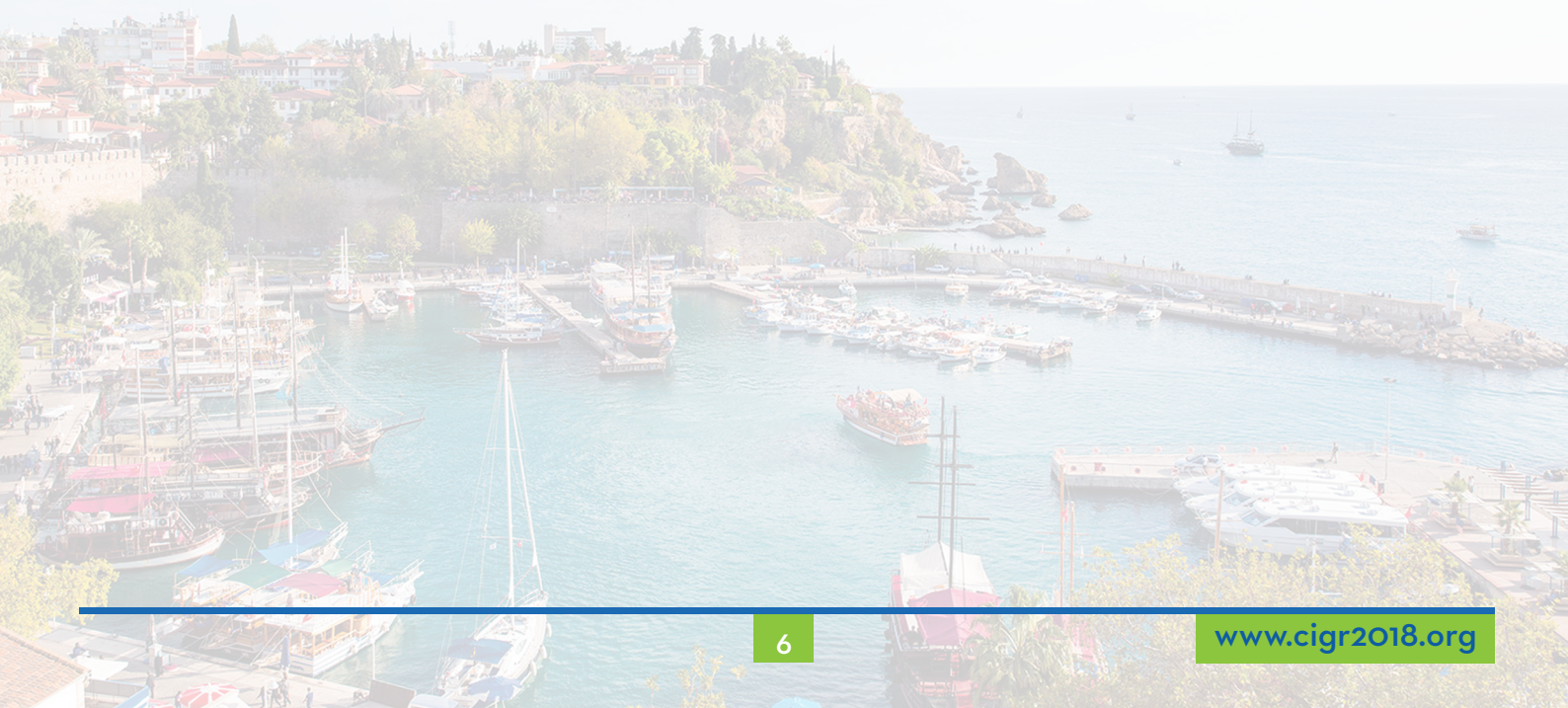

22 April 2018

TIME		HALLS FOR CIGR GOVERNANCE MEETINGS
10:00-12:00	REGISTRATION	CIGR PRESIDIUM MEETING
12:00-13:00		LUNCH
13:00-15:00		CIGR EXECUTIVE BOARD MEETING
15:00-17:00		CIGR TECHNICAL BOARD MEETING
17:00-19:00		FREE TIME
19:00-20:00	WELCOME RECEPTION	

23 April 2018

TIME	HALL A	HALL B	HALL C	HALLS FOR CIGR GOVERNANCE MEETINGS
09:30-11:00	OPENING CEREMONY 09:30-10:30 Opening Ceremony 10:30-11:00 iAABE induction Ceremony			
09:30-11:00	**COFFEE BREAK**			
11:30-13:00	**ORAL SESSION 1** **SECTION I - LAND AND WATER** Session Chairs: **Gerrit Carsjens, Netherlands - El Houssine Bartali, Morocco** OP-001 / Use of Unmanned Aerial Vehicles for Water Quality Monitoring **A. Bulent Koc, United States** OP-002 / DIMSUB: A decision support tool for design and pipe sizing microirrigation systems **Carmen Virginia Palau, Spain** OP-003 / Multioutlet hydrants typology for collective irrigation networks **Juan Manzano Juarez, Spain** OP-004 / Evaluation and Performance of Suface Irrigation on Pasture in a humid climate **Claudio Garcia, Uruguay** OP-005 / Effects of Deficit Irrigation Water and Different Boron Levels on the Yield and Some Physiological Properties of Cotton Plant **Hatice Delice, Turkey**	**ORAL SESSION 2** **SECTION II - STRUCTURES AND ENVIRONMENT** Session Chairs: **Malene Joergensen, Denmark - Kenan Büyüktaş, Turkey** OP-014 / Bovine Milk Progesterone Determination Using Near-infrared Spectroscopy during Milking **Patricia Iweka, Japan** OP-015 / The effect of heat stress on milk yield in an IPARD supported dairy cattle enterprise **Erkan Yaslıoğlu, Turkey** OP-016 / The effect of biochar covering on the emissions from animal manure **Maarit Hellstedt, Finland** OP-017 / Toxic effects of micropollutants in soil applied with biosolid: diclofenac and silver nanoparticles **Emel Topuz, Turkey** OP-018 / Emerging air pollutants from manure management: Volatile organic compounds and sulfur **Anders Feilberg, Denmark**	**ORAL SESSION 3** **WORKSHOP ON IMAGE ANALYSIS AND SPECTROSCOPY IN AGRICULTURE** Session Chairs: **Jose Blasco, Spain - Claus Grøn Sørensen, Denmark** OP-131 / Automated identification of anatomical landmarks of dairy cow in three-dimensional vision **Xiangyu Song, Netherlands** OP-132 / An Embedded Imaging System for Monitoring Drinking Behavior of Dairy Cows **Ta Te Lin, Taiwan** OP-133 / Cost benefit analysis of variable management in winter wheat in response to on-line recognition of yellow rust and fusarium head blight **Abdul M Mouazen, Belgium** OP-134 / Aerial machine vision, GIS and hue for pattern classification in agriculture **Marcel Pinton De Camargo, Brazil** OP-135 / Effects of fertilizers on the fluorescence compounds dynamic of carrot during the growing period **Mohammad Sumon Miah, Japan** OP-136 / Exploratory data analysis of fluorescence excitation emission matrix for patchouli oil geographical origin determination **Dimas Firmanda Al Riza, Japan**	
13:00-14:00	**LUNCH**			

23 April 2018

TIME	HALL A	HALL B	HALL C	HALLS FOR CIGR GOVERNANCE MEETINGS
14:00-14:30	**POSTER SESSION 1** **POSTERS OF "WORKSHOP ON IMAGE ANALYSIS AND SPECTROSCOPY IN AGRICULTURE"** P-087 / Characterization of microstructural and micromechanical properties of nopal spines to evaluate its potential as source of cellulose and lignin - **Liliana Edith Rojas Candelas, Mexico** P-088 / Image analysis and microscopy techniques applied to apple cultivars classification - **Liliana Edith Rojas Candelas, Mexico** P-089 / Study on the effectiveness of organophosphorus pesticides concentration based on reflectance spectra in water - **Ruijun Ma, China** P-090 / Determination of chemical properties in Agraz with NIR spectroscopy - **Andrés Felipe Silva Dimaté, Colombia** P-091 / Estimating the number of fruits harvested by a shaker in urban orange trees based on automatic image analysis - **Jose Blasco, Spain** P-092 / New robotic solution to detect asymptomatic plants infected by Candidatus Liberibacter solanacearum in horticultural crops using multispectral computer vision - **Jose Blasco, Spain** P-093 / Grape quality inspection using hyperspectral vision - **Ricardo Diaz, Spain** **POSTERS OF "SECTION I - LAND AND WATER"** P-001 / Assessment of Trends in Rainfall and Runoff at the La Mercy Catchments under Bare Fallow Conditions and Sugarcane Production - **Daniel Otim, South Africa** P-002 / Landcover effect for reducing nutrient load in organic farming fields with long-term historical climate data using APEX model - **Hyunchul So, South Korea** P-003 / A new approach to calculation of parcel index for Abdurrahmanlar district - **Kenan Büyüktaş, Turkey**			
14:30-16:00	ORAL SESSION 4 SECTION III - PLANT PRODUCTION Session Chairs: **Hiroshi Shimizu, Japan - Erdem Aykas, Turkey** OP-036 / Rice Harvesting Operation by Two Combine Robots **Michihisa Iida, Japan** OP-037 / Bench test and analysis for ramie stalk cutting **Cheng Shen, China** OP-038 / Optimized Pectin Extracting Technology from Aloe Skin with Acid Hydrolysis **Ke Chen, China** OP-042 / Modelling Of The Nitrogen Requirement Of Winter Wheat For Protein Content Using Optical Sensor **Uğur Yegül, Turkey** OP-043 / Effects of Leaf Surface Energy on Pesticidal Performance **Muhammed Cemal Toraman, Turkey**	ORAL SESSION 5 SECTION IV - ENERGY IN AGRICULTURE Session Chairs: **Mikio Umeda, Japan - Altunay Perendeci, Turkey** OP-049 / Biochemical Characterization of Switchgrass Varieties Grown in Turkey for Biofuel Production **Elcin Kokdemir Unsar, Turkey** OP-050 / Effects of Thermo-Chemical Pretreatment on Biogas Production from Switchgrass **Haşmet Emre Akman, Turkey** OP-051 / Biodiesel Production from Bovine Kidney Fat and Canola Oil **Aslihan Yilmaz, Turkey** OP-052 / A cold-climate biogas system for a sustainable eco-lodge in Nepal **James Houser, United States** OP-053 / Consumption Characteristics of Propionate in Anaerobic Digestate using Microbial Fuel Cells **Megumi Ueda, Japan**	ORAL SESSION 6 WORKSHOP ON IMAGE ANALYSIS AND SPECTROSCOPY IN AGRICULTURE Session Chairs: **Ta-Te Lin, Taiwan - Ufuk Türker, Turkey** OP-137 / Measuring floral responses to herbivory by machine vision and spectroscopy **Gerrit Polder, Netherlands** OP-138 / On-the-go hyperspectral imaging for vineyard monitoring: a new methodology for acquisition and processing **Salvador Gutiérrez, Spain** OP-139 / Evaluation of Salinity Stress on Date Palm Leaves Using Color Images Analysis **Sawsana H. Al Rahbi, Oman** OP-140 / Optimization of drying process of Coconut meat (Cocos nucifera) with aid of image analysis **Cestmir Mizera, Czech Republic** OP-141 / Study of astringency distribution in persimmon cv. 'Rojo Brillante' using VIS/NIR hyperspectral imaging **Jose Blasco, Spain**	

23 April 2018

TIME	HALL A	HALL B	HALL C	HALLS FOR CIGR GOVERNANCE MEETINGS
16:00-16:30	**COFFEE BREAK & POSTER SESSION 2** **POSTERS OF "SECTION I - LAND AND WATER"** P-004 / Economic and Environmental Assessment of Tractor Guidance Technologies - **Amanda J Ashworth, United States** P-005 / Different Tillage under Semi-Arid Mediterranean Conditions: Relationship Between Soil Organic Carbon, Total Porosity, Number of Mycorrhizea Spore and Microbial CO_2 Production of Soil - **Zeliha Bereket Barut, Turkey** P-006 / Changes in low-flow frequency under global warming in { tanada } catchments - **Shinichi Takeshita, Japan** P-007 / A deep neural network model for runoff analysis - **Tomoki Izumi, Japan** P-008 / Equations Developed to Estimate Evapotranspiration in Greenhouses - **Kenan Büyüktaş, Turkey** **POSTERS OF "SECTION II - STRUCTURES AND ENVIRONMENT"** P-009 / Micro-climatic analysis in pear orchard by insect-net size in South Korea - **Seokcheol Yu, South Korea** P-010 / Characteristics of Uplift Resistance for Greenhouse Continuous Foundation by Field test - **Seongyoon Lim, South Korea** P-011 / Test of point extraction in farrowing pens with different floor - **Malene Joergensen, Denmark** P-012 / Finite Element Analysis of a PTO Shaft used in an Agricultural Tractor - **H. Kursat Celik, Turkey** P-013 / Development of a Two-degree-of-freedom Manipulator Type of Orderly-throwing Transplanter for Transplanting Rice Potted-seedlings - **Ruijun Ma, China**			
16:30-18:00				MEETINGS OF CIGR TECHNICAL SECTIONS
18:00-19:00				MEETINGS OF CIGR JOURNAL & CIGR WORKING GROUPS
19:00-19:30	**POSTER SESSION 3** **POSTERS OF "SECTION II - STRUCTURES AND ENVIRONMENT"** P-014 / Smart Orchard Sprayer Design for Precision Agriculture - **Caner Koc, Turkey** P-016 / Characteristics of livestock odour in swine facility in Korea - **Eunchul Jeong, South Korea** P-017 / Did We Find a Way Out? Use of Insect Protein in Fish Feeds - **Cem Özkan, Turkey** P-018 / Did We Find a Way Out? Use of Two New Lepidopteran Insects in Fish Feeds - **Cem Özkan, Turkey** **POSTERS OF "SECTION III - PLANT PRODUCTION"** P-019 / Physical requirements for vineyard monitoring robots - **Veronica Saiz Rubio, Spain** P-020 / Faunistic studies on Aleyrodidae species of Republic of Northern Cyprus - **Murat Helvacı, Cyprus** P-021 / The Determination of Fruit Fly Species in Turkish Republic of Northern Cyprus - **Murat Helvacı, Cyprus** P-022 / The Effect of Different Furrow Opener Types on Emergence Performance and Seed Spacing Uniformity in Direct Seeding - **Zeliha Bereket Barut, Turkey** P-023 / Experimental study of the distribution of the heights of sugar beet root crown protrusion above the field surface level - **Jüri Olt, Estonia (Eesti)** P-024 / Comparison of Instant Mean Downforces of Commercially Available and Modified Furrow Opener Types in Field and Soil Bin Conditions - **Zeliha Bereket Barut, Turkey** **POSTERS OF "SECTION VII - INFORMATION TECHNOLOGY"** P-076 / Deep-learning based Obstacle Recognition and Tracking using Drone Image - **Kyeong Hwan Lee, South Korea** P-078 / 3D plant phenotyping using machine learning algorithm - **Myongkyoon Yang, South Korea** P-080 / Transplanting characteristics of rice crops using UAV image based deep learning - **Kyeong Hwan Lee, South Korea** P-082 / Development of a open-source platform for greenhouse control system - **Dae Hyun Jung, South Korea** P-085 / Analysis of durability of hydraulic mechanical transmission of agricultural tractor - **Jeong Hoon Jang, South Korea**			

24 April 2018

TIME	HALL A	HALL B	HALL C	HALLS FOR CIGR GOVERNANCE MEETINGS
09:00-09:30	**KEYNOTE SPEAKER** **Prof. Istvan SZABO, Hungary** Agriculture in the Age of Information Technology			
09:30-10:00	**KEYNOTE SPEAKER** **Prof. Umezuruike Linus OPARA, South Africa** Engineering a new agriculture for the 21st Century to build a sustainable life for children			
10:00-11:30	ORAL SESSION 7 SECTION V - SYSTEM MANAGEMENT Session Chairs: **Fedro S. Zazueta Ranahan, United States - Remigio Berruto, Italy** OP-067 / Agro-food traceability system granularity evaluation and the influencing factors analysis **Jianping Qian, China** OP-068 / Evaluation Postural Comfort Level of Conventional Cherry Harvesting **Maksut Barış Eminoğlu, Turkey** OP-070 / A tool to support decisions and policies on planting and cutting of planted forests at Paraná state in Brazil **Luiz Carlos De Abreu Rodrigues, Brazil** OP-071 / Working time requirement in the fattening of mountain ox during the green fodder harvest **Elisabeth Quendler, Austria** OP-072 / Natural ventilation's ability to prevent high indoor temperatures **Rikke Koch Hansen, Denmark**	ORAL SESSION 8 SECTION VI - BIOPROCESSES Session Chairs:**Da-Wen Sun, Ireland - Pietro Catania, Italy** OP-079 / Effect of Moisture Content on the Physical Properties of Pumpkin **Akindele Folarin Alonge, Nigeria** OP-080 / Friction Coefficients for Gundelia Tournefortii Seed on Various Surfaces **Abdullah Sessiz, Turkey** OP-081 / Determination of Time Dependent Stress Distribution on Potato Tubers at Mechanical Collision **H. Kursat Celik, Turkey** OP-082 / Determination of leaf breaking strength of variety candidates of common vetch **Mehmet Öten, Turkey** OP-083 / Impact of tillage practices on selected soil physicochemical, biological properties and yield attributes of maize in latosolic red soil of Southern China **Evans Asenso, China**	ORAL SESSION 9 SECTION VII - INFORMATION TECHNOLOGY Session Chairs: **Abdul M. Mouazen, Belgium - Istvan Szabo, Hungary** OP-109 / A comparison between RumiWatch noseband and neck-mounted accelerometer for automated measurement of cow ingestive-related behaviors **Said Benaissa, Belgium** OP-110 / Development of four elements variable rate application of fertilization based on maps **Xiaofei An, China** OP-113 / Satellite based predicting wheat harvest date using vegetation indexes **Hossein Navid, Iran** OP-129 / Use of simulation game in education environment: the case of agrifood logistics **Patrizia Busato, Italy** OP-130 / flipping the classroom for food technology students. evaluation of a two-years experience **Patrizia Busato, Italy**	

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TIME	HALL A	HALL B	HALL C	HALLS FOR CIGR GOVERNANCE MEETINGS
11:30-12:00	**COFFEE BREAK & POSTER SESSION 4** **POSTERS OF "SECTION III - PLANT PRODUCTION"** P-025 / Evaluation Methods for Vertical Seed Distribution Uniformity of Furrow Openers - **Davut Karayel, Turkey** P-026 / A Brief Overview to Agricultural Mechanization of Turkey - **Murad Canakci, Turkey** P-027 / An introduction to Design for Additive Manufacturing (DFAM) applied to small farms - **Luiz Carlos De Abreu Rodrigues, Brazil** P-030 / Experimental study of the distribution of the heights of sugar beet root crown protrusion above the field surface level - **Jüri Olt, Estonia (Eesti)** P-022 / Discrimination of soil water content using VIS-NIS sprectral reflectance from soybean leaves - **Oscar Leonardo García, Colombia** **POSTERS OF "SECTION IV - ENERGY IN AGRICULTURE"** P-031 / An approach to convert waste biomass into solid biofuels using low-temperature oxidation - **Takanori Itoh, Japan** P-032 / Investigation of The Quality Characteristics of Mixed Pellets Prepared Using Agricultural Residues - **Turkan Aktas, Turkey** P-033 / Computational Fluid dynamic analysis of microalgae cultivation pond system for biodiesel production - Il **Hwan Seo, South Korea** P-034 / Odour characteristics and contribution in solid refuse fuel production process - **Hun Joo An, South Korea** P-095 / Mathematical modeling of the thin layer solar drying of parsley - **Reza Tabatabaeekoloor, Iran**			
12:00-13:30	**ORAL SESSION 10** **SECTION I -** **LAND AND WATER** Session Chairs: **Carmen Virginia Palau, Spain - Claudio Garcia, Uruguay** OP-006 / Monitoring maize furrow irrigation using handheld remote sensing measurements **José Manuel Gonçalves, Portugal** OP-007 / Different Tillage under Semi-Arid Mediterranean Conditions: Some Physical Soil Quality Indicators and Their Relations **Zeliha Bereket Barut, Turkey** OP-008 / Verification of Runoff Volume and Peak Discharge from Sugarcane Fields Simulated using the {ACRU} Model **Daniel Otim, South Africa** OP-009 / A Pattern Recognition Approach Combined With Fuzzy Logic for Predicting Soil Properties and Function **Phillip Ray Owens, United States**	**ORAL SESSION 11** **SECTION II - STRUCTURES AND ENVIRONMENT** Session Chairs: **Maarit Hellstedt, Finland - Soo Nam Yoo, South Korea** OP-019 / Impact of slatted floor area on odor emissions in finishing swine buildings **Stephane Godbout, Canada** OP-031 / Identification of nutrient mixing control parameters for a small-scale recycling hydroponic crop cultivation system **Milon Chowdhury, South Korea** OP-021 / Improved ventilation by CFD prediction of thermal conditions among pigs **Bjarne Bjerg, Denmark** OP-022 / Improved slurry system for pig houses with straw application **Michael Jørgen Hansen, Denmark** OP-023 / Continuous on-farm measurement of Ammonia emissions in dairy barns **Hannu E. S. Haapala, Finland**	**ORAL SESSION 12** **SECTION III -** **PLANT PRODUCTION** Session Chairs: **Ali Bülent Koç, United States - Guangwei Wu, China** OP-034 / Determination of Threshing Performans of New Desing Threshing Unit for Lavandin (lavandula x intermedia emeric ex loisel.) **Deniz Yilmaz, Turkey** OP-035 / Determination of Separation Performance of New Design Separating Unit for Lavandin (Lavandula X Intermedia Emeric Ex Loisel.) **Deniz Yilmaz, Turkey** OP-039 / Effect of Variable Rate Fertilisation on Yield and Fertiliser Requirement of Table Olive **Bahattin Akdemir, Turkey** OP-040 / Utilization of struvite produced from human urine in agriculture as a natural fertilizer **Judit Nagy, Hungary** OP-041 / Effect of Spatial Variability on Fertiliser Requirement for Olive Orchard Cultivated for Oil Production **Cihangir Sağlam, Turkey**	**CIGR** **Strategic Directions Meeting**
13:30-14:30	**LUNCH**			

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TIME	HALL A	HALL B	HALL C	HALLS FOR CIGR GOVERNANCE MEETINGS
14:30-15:00	**POSTER SESSION 5** **POSTERS OF "SECTION IV - ENERGY IN AGRICULTURE"** P-035 / Lag-phase in anaerobic digestion of protein for high-efficiency biogas production - **Sanghun Kim, South Korea** P-036 / Is Switchgrass the New Ground-Breaking Energy Crop for Biofuel Production? - **Hilal Ünyay, Turkey** P-037 / Determination of The Effect of Boron Fertilizer as A Nutritional Supplement in Different Growth Medium Regarding to Its Potential to Biodiesel Feedstock Production - **Caner Koc, Turkey** P-038 / Design, Manufacturing and Testing of a Torrefication Equipment to Obtain Biocoal - **Turkan Aktas, Turkey** P-039 / A Research on the Determination of the Gasification Performance of Grass Pellets - **Birol Kayişoğlu, Turkey** P-040 / A Study on Seasonal Energy Utilization Indices for Raw Milk Cooling Systems - **Birol Kayişoğlu, Turkey** P-041 / Mathematical Modeling of Thin Layer Fig Fruits in Solar Tunnel Drier - **Sevil Karaaslan, Turkey** P-042 / Provision of solar system designing for high efficiency irrigation system and tunnel farming in agriculture sector of Pakistan - **Abdul Ghafoor, Pakistan** P-043 / Evaluation of pomegranate cultivation from energy production and environmental aspects in Antalya Province of Turkey - **Ibrahim Yılmaz, Turkey**			
15:00-16:30	**ORAL SESSION 13** **SECTION IV - ENERGY IN AGRICULTURE** Session Chairs: **Laurentiu Fara, Romania - James Houser, United States** OP-054 / New trends in monitoring and control of photovoltaic pumping systems **Laurentiu Fara, Romania** OP-055 / Integration of photovoltaic power plants into the historic city **Martin Libra, Czech Republic** OP-056 / Modeling the movement of hulled millet in agitated drum dryer with discrete element method **Dániel Horváth, Hungary** OP-057 / An investigation of ambient drying of {Eucalyptus grandis} logs **Charles Kinoshita, United States** OP-058 / Design of Parallel Connected Vacuum Tube Solar Air Collector **Recep Külcü, Turkey**	**ORAL SESSION 14** **SECTION V - SYSTEM MANAGEMENT** Session Chairs: **Elisabeth Quendler, Austria - Lalit Verma, United States** OP-073 / Investigation of R&D and Innovation Performance in the Agricultural Trailer Manufacturing Company **Fırat Kömekçi, Turkey** OP-074 / How agriculture 4.0 can be an opportunity for marginal areas? A case study in Tuscany **Stefania Lombardo, Italy** OP-075 / How to efficiently support adoption of new technologies in agriculture? **Hannu E S Haapala, Finland** OP-076 / Development of an innovative farm management system with parallel off-line and on-line capabilities **Dionysis Bochtis, Greece** OP-077 / Agricultural Mechanization in China's Rural Rejuvenation Strategy **Minli Yang, China** OP-078 / Assessing and Comparing the GHG Emissions, Energy and Economic Analysis of Conventional Tillage and No-tillage Soybean Culture in Sari Dashtnaz Agriculture Company **Alireza Taheri-Rad, Iran**	**ORAL SESSION 15** **SECTION VI - BIOPROCESSES** Session Chairs: **Amauri Rosenthal, Brazil - Leisa Jane Armstrong, Australia** OP-084 / Evaluation of Enzyme Doses on Ethanol Production from Raw Switchgrass Variety of Kanlow **İbrahim Alper Başar, Turkey** OP-085 / Optimization of antioxidant activity of extracts from New Zealand and Chinese Asparagus root cultivars using microwave assisted process **Alaa El-din Bekhit, New Zealand** OP-086 / Effect of Pressure and Temperature Level on Fat And Protein Content in Milk Powder Production **Aslıhan Yılmaz, Turkey** OP-087 / Multiple mycotoxins determination based on immunoassay in agro-food and feed **Zhaowei Zhang, China** OP-088 / Nanobody based immunoassay for mycotoxin determination in food and feed **Xiaoqian Tang, China**	ASABE Global Initiative Meeting

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TIME	HALL A	HALL B	HALL C	HALLS FOR CIGR GOVERNANCE MEETINGS
16:30-17:00	COFFEE BREAK			
17:00-18:30	**ORAL SESSION 16** **SECTION VII - INFORMATION TECHNOLOGY** Session Chairs: **Claus Grøn Sørensen, Denmark - Seishi Ninomiya, Japan** OP-114 / Assessment of Calibration and Validation of CropSyst model in winter wheat productivity in Mediterranean Environments **Ahmet Çilek, Turkey** OP-115 / Fruit Detection for Robotic Harvesting Combined Shape and Color Information **Xiangjun Zou, China** OP-116 / Design of a remotely-operated field robot to detect olive trees infected with Xylella fastidiosa using proximal sensing **Jose Blasco, Spain** OP-117 / A ROS-enabled out-door robotic perception system **Dionysis Bochtis, Greece** OP-118 / Issues in high-throughput drone crop phenotyping **Seishi Ninomiya, Japan**	**ORAL SESSION 17** **SECTION I - LAND AND WATER** Session Chairs: Isabel Maria Duarte, Portugal - Paula Pinto **Amador, Portugal** OP-010 / Farming strategies in inland aquaculture of Jakarta Metropolitan Area **Gerrit J. Carsjens, Netherlands** OP-011 / Biological risk assessment of irrigation with urban wastewater **Isabel Maria Duarte, Portugal** OP-012 / Environmental risk of livestock waste - case study of tetracycline resistant bacteria **Maria P. Amador, Portugal** OP-013 / Impact of Mesophilic Anaerobic Digestion on Swine Manure Composition **John Perkins Chastain, United States**	**ORAL SESSION 18** **SECTION VI - BIOPROCESSES** Session Chairs: **Margarita Ruiz Altisent, Spain - Naoto Shimizu, Japan** OP-089 / FT-IR imaging spectroscopy for measurement of the physical property of potato tuber **Wenhao Su, Ireland** OP-090 / Effect of high hydrostatic pressure processing on cold-brewed white tea characteristics **Sibel Uzuner, Turkey** OP-091 / The Relationship Between Rice Stem Cutting Resistance and Cracking Force of Rice Kernel **Abdullah Sessiz, Turkey** OP-092 / Relationships between grain structure and starch digestibility of cooked rice **Yukiharu Ogawa, Japan** OP-093 / Estimation of particle density of biomass pellets by image processing technique **Hasan Yılmaz, Turkey**	
18:30-19:00	**POSTER SESSION 6** **POSTERS OF "SECTION V - SYSTEM MANAGEMENT"** P-044 / Time Response Study of Electromagnetic Driven VRT Valves for Variable Rate Spraying System Improvement - **Arezou Lak, Iran** P-045 / Database of traction indicators of domestic and foreign tractors for OECD and ISO systems - **Maksim Nikolaevich Moskovskiy, Russia** P-046 / Foreign body detection approaches in food and beverage products - **Mohammad Reza Zarezadeh, Iran** P-047 / The Turkish Republic Of Northern Cyprus In Agricultural Markets And Cooperativity - **Hayati Başaran, Turkey** P-048 / Detection of foreign bodies in processed food and beverage by means of ultrasound - **Mohammad Reza Zarezadeh, Iran** P-049 / Examination Of The Cogeneration System In Terms Of Energy Saving In A Public Hospital - **Çiğdem Işıkyürek, Turkey** P-050 / Annoying frequency determining for laodelpha striatellus fallen pest - **Mohammad Reza Zarezadeh, Iran** P-051 / Study of the drying process for medicinal herbs - **Pietro Catania, Italy** P-052 / Analysis of almond and vine plants vegetative characteristics to design a compact orchard tractor equipped with a fixed ROPS (Rolling Over Protective Structure) - **Pietro Catania, Italy**			
19:00-19:30	AWARD CEREMONY			
19:30-21:00	FREE TIME			
21:00-00:00	GALA DINNER			

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TIME	HALL A	HALL B	HALL C	HALLS FOR CIGR GOVERNANCE MEETINGS
09:00-09:30	**KEYNOTE SPEAKER** **Prof. Mikio UMEDA (Japan)** Development of Mechanized and Smart Farming in Asia			
09:30-10:00	**KEYNOTE SPEAKER** **Prof. Margarita RUIZ ALTISENT (Spain)** Innovative Technologies in Postharvest			
10:00-11:30	**ORAL SESSION 19** **SECTION II - STRUCTURES AND ENVIRONMENT** Session Chairs: **Stephane Godbout, Canada - Michael Jørgen Hansen, Denmark** OP-024 / A Study of Poultry Dynamic Deep Body and Heart Rate Responses to Ambient Temperature and Air Velocity **Takoi Hamrita, United States** OP-025 / Application of Analytical Hierarchy Process to develop a weighting scheme for life cycle assessment of agri-food sector **Amin Nikkhah, Belgium** OP-026 / Landscape fragmentation in Europe: a comparative analysis **Vittorio Serra, Italy** OP-027 / Control system of an unmanned and remote-controlled harmful-fly collecting device for smart greenhouses **Won Jae Lee, South Korea** OP-028 / Greenhouse Ventilation Control with Artificial Neural Network Models **Dae Hyun Jung, South Korea**	**ORAL SESSION 20** **SECTION III - PLANT PRODUCTION** Session Chairs: **John Kenneth Schueller, United States - Davut Karayel, Turkey** OP-044 / DEM simulation of bed-shaper and furrow openers of pneumatic planter **Fiaz Ahmad, Pakistan** OP-045 / Mixed Seeding Performance of a Seed Drill at Different Mixture Ratios Under the Laboratory and Field Conditions **Erdem Aykas, Turkey** OP-046 / Design and Development of a Prototype Precision Metering Unit with Twin Vacuum Disks* for Improved Seed Spacing Uniformity at High Seeding Speeds **Bülent Çakmak, Turkey** OP-047 / Design and experiment of precision control system for winter wheat sowing machine with rotary tillage and stratified fertilization **Guangwei Wu, China** OP-048 / Development of ultrasonic pollination system **Hiroshi Shimizu, Japan** OP-020 / The Effect of Different Furrow Opener Types on Emergence Performance and Seed Spacing Uniformity in Direct Seeding **Zeliha Bereket Barut, Turkey**	**ORAL SESSION 21** **SECTION VI - BIOPROCESSES** Session Chairs: **Umezuruike Linus Opara, South Africa - Türkan Aktaş, Turkey** OP-094 / Distribution environment of exported peach fruit from Japan to Singapore **Eriko Yasunaga, Japan** OP-095 / Design of Automatic Gas Analysis System for Tunnel Type Composting System **Recep Külcü, Turkey** OP-096 / Facile design of ternary composites for AFB1 photocatalytic degradation **Jin Mao, China** OP-097 / Automatic Temperature Compensation and Diagnostic System for Electrical Conductivity and pH Probes in Recirculating Hydroponics **Woojae Cho, South Korea** OP-098 / Aflatoxin control in Agro-products in developing countries **Xiaoqian Tang, China**	

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TIME	HALL A	HALL B	HALL C	HALLS FOR CIGR GOVERNANCE MEETINGS
11:30-12:00	**COFFEE BREAK & POSTER SESSION 7** **POSTERS OF "SECTION VI - BIOPROCESSES"** P-053 / The Gas Exchange Modeling of Purge-type of Controlled Atmosphere Storage System - **Seokho Park, South Korea** P-054 / Evidence of Sulfide Oxidation in Manure Surface - **Frederik Rask Dalby, Denmark** P-055 / Quality indices, bioactive content, fatty acid composition and stability of pomegranate kernel oil - **Olaniyi Amos Fawole, South Africa** P-056 / Agricultural bioresources and biofabrication as an enabling strategy for agricultural and biological applications - **Jangho Kim, South Korea** P-057 / EPR mediated study of shelf life of pumpkin and sunflowers seeds roasted in microwave-vacuum roaster - **Adam Ekielski, Poland** P-058 / Microbial decomposition of deer carcasses using composting process - **Kazunori Iwabuchi, Japan** P-061 / Effect of ultrasound pre-treatment on brewing time of two types of tea - **Mohammad Reza Zarezadeh, Iran** P-062 / Fresh Minas probiotic cheese processed by high hydrostatic pressure: viability of probiotic and spoilage microrganisms - **Amauri Rosenthal, Brazil** P-065 / Physico-textural and nutritional properties of pomegranate kernel and aril as affected by drying - **Olaniyi Amos Fawole, South Africa** P-066 / Understanding the impact of heat-moisture treatment on the properties of rice flour using response surface methodology - **Michael Ngadi, Canada**			
12:00-13:30	ORAL SESSION 22 SECTION II - STRUCTURES AND ENVIRONMENT Session Chairs: **Yoshisuke Kishida, Japan - Zeliha Bereket Barut, Turkey** OP-029 / Stress distribution and flow pattern in a model grain silo with obstruction attached to the wall **Rafal Kobylka, Poland** OP-030 / The Power Transmission Characteristics of Overload Shafts with Different Friction Clutches and Spring Loading Conditions **Bülent Çakmak, Turkey** OP-032 / Environmental Importance of Olive Groves in Cultural Landscape, The Case Study of Antalya **Reyhan Erdoğan, Turkey** OP-033 / Urban Agriculture as a Tool for Environmental Protection **Reyhan Erdoğan, Turkey**	ORAL SESSION 23 SECTION VII - INFORMATION TECHNOLOGY Session Chairs: **Mehmet Topakçı, Turkey - Bart Ralph Sonck, Belgium** OP-119 / IOT based wearable sensing system monitoring working environment in swine house **Il Hwan Seo, South Korea** OP-120 / Monorail-based Autonomous Crop Monitoring System using Camera and Laser Rangefinder **Narayan Sharma, Japan** OP-121 / Development of an Electronic Control Unit for Smart Orchard Sprayer **Caner Koç, Turkey** OP-122 / Proximate Sensing and Application for Variable Rate Nitrogen Application on Corn Field **Ufuk Türker, Turkey**	ORAL SESSION 24 SECTION VI - BIOPROCESSES Session Chairs: **Akindele Folarin Alonge, Nigeria - Dariush Zare, Iran** OP-099 / Nutrition-Sensitive bean processing: Softening techniques and the nutritional cost of important minerals **Michael Ngadi, Canada** OP-100 / Cold atmospheric pressure plasma as a tool for influencing techno-functionality for processing healthy plant-based foods **Oliver K. Schlüter, Germany** OP-101 / Development and application of functional food for older people **Jozef Grochowicz, Poland** OP-102 / Novel and traditional technologies for the production of safe meat products: what we know and what we don't know **Alaa El-din Bekhit, New Zealand** OP-103 / Emerging monitoring and processing techniques for safe edible insect production **Oliver K. Schlüter, Germany** OP-142 / Authentication of edible oil based on fatty acidomics and chemometrics **Peiwu Li, China**	
13:30-14:30	**LUNCH**			

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TIME	HALL A	HALL B	HALL C	HALLS FOR CIGR GOVERNANCE MEETINGS
14:30-15:00	**COFFEE BREAK & POSTER SESSION 7** **POSTERS OF "SECTION VI - BIOPROCESSES"** P-067 / Effect of Pressure and Temperature Level on Nutrient Elements in Milk Powder Production - **Aslihan Yilmaz, Turkey** P-068 / Determination of Optimum Temperature Level of Spray Dried Microalgae (Chlorella vulgaris L.) in terms of Colour and Chlorophyll Content - **Aslihan Yilmaz, Turkey** P-069 / Mathematical modeling of moisture loss during the precooling process of fruits - **Sadegh Seiiedlou, Iran** P-070 / Modified humidity packaging design and application for strawberries - **Sadegh Seiiedlou, Iran** P-071 / Design and Fabrication of Mechanical Size Grading Machine for Onion - **Sadegh Seiiedlou, Iran** P-072 / "Drying of mulberry fruit with different methods" - **Sadiye Gozlekci, Turkey** P-073 / Effect of top cutting height of cotton stalk on cotton yield - **Abdullah Sessiz, Turkey** P-094 / Simulation of Hot Air-infrared Green Peas Drying Using Finite Element Method - **Mojtaba Nosrati, Iran** **POSTERS OF "SECTION VII - INFORMATION TECHNOLOGY"** P-074 / Interface for the automaton used for scarification of acorns and identification of pathological changes - **Tadeusz Juliszewski, Poland** P-075 / Information Technology And a Research About How Agricultural Extension Affected From That - **Ebru Irmak, Turkey**			
15:00-16:30	ORAL SESSION 25 SECTION IV - ENERGY IN AGRICULTURE Session Chairs: **Martin Libra, Czech Republic - R. Cengiz Akdeniz, Turkey** OP-059 / Energy equivalent of irrigation water in different delivery systems in agriculture **Mohammadali Maysami, Iran** OP-060 / Evaluation of green-house cucumber production sustainability in term of energy use efficiency **Nawal K. Al Mezeini, Oman** OP-061 / Determination of Energy Efficiency and Green-house Gas (GHG) Emissions in Organic Almond Production in Turkey **Osman Gökdoğan, Turkey** OP-062 / Energy Efficient Usage of ZigBee Networks in Solar Powered Field Data Acquisition Systems **Temuçin Göktürk Seyhan, Turkey**	ORAL SESSION 26 SECTION VII - INFORMATION TECHNOLOGY Session Chairs: **Bart Ralph Sonck, Belgium - Il Hwan Seo, South Korea** OP-123 / APIS: App to improve agricultural machine use and cost evaluation **Alessandro Sopegno, Italy** OP-124 / The Accuracy in Seed Spacing of a Seeder With Variable Ratio **Pınar Ercan Yıldız, Turkey** OP-125 / Precise Point Position-ing for a Robot Tractor using LEX signal Transmission from Quasi-Zenith Satellite System **Hao Wang, Japan** OP-126 / Research on Vegetable Pest Warning System Based on Multidimensional Large Data **Deqin Xiao, China**	ORAL SESSION 27 SECTION VI - BIOPROCESSES Session Chairs: **Yukiharu Ogawa, Japan - Can Ertekin, Turkey** OP-104 / Optimization of Intermittent Drying of Rough Rice in Combined FIR-dryer Using Finite Element Method **Mojtaba Nosrati, Iran** OP-105 / Investigation of Moisture Distribution of Rough Rice in Combined FIR-dryer Using Finite Element Method **Mojtaba Nosrati, Iran** OP-106 / Microencapsulation using Spray-drying: The Use of Fine Starch Solution for the Wall Material **Naoto Shimizu, Japan** OP-107 / Microwave Assisted Forced Convection Hot Air Drying of Teff (Eragrostis tef) **Tilahun Seyoum Workneh, South Africa** OP-108 / Appropriate and Sustainable Postharvest Integrated Postharvest Technologies for Perishable Commodities Handling in Supply Chain in Africa **Tilahun Seyoum Workneh, South Africa** OP-143 / Integrated post-harvest management system for tomatoes marketing in South African supply chains **Tilahun Seyoum Workneh, South Africa**	

25 April 2018

TIME	HALL A	HALL B	HALL C	HALLS FOR CIGR GOVERNANCE MEETINGS
16:30-17:00	**COFFEE BREAK & POSTER SESSION 9** **POSTERS OF "SECTION II - STRUCTURES AND ENVIRONMENT" / "SECTION IV - ENERGY IN AGRICULTURE" "SECTION VII - INFORMATION TECHNOLOGY"** P-077 / Design of a Nonlinear Fuzzy Control Algorithm For Greenhouse Conditions - **Nuri Caglayan, Turkey** P-015 / Pomegranate and Its Place in Landscape - **Sadiye Gozlekci, Turkey** P-079 / Cattle behavior monitoring and classification using inertial measurement unit - **Yingqi Peng, Japan** P-081 / A Research on Spatial Weed Mapping for Variable Rate Herbicide Application - **Ufuk Türker, Turkey** P-083 / Opportunity For The Using Of Nitrogen And Protein Sensors In Agriculture - **Uğur Yegül, Turkey** P-084 / Seeding performance comparison of three different prototypes of a seed singulator used in a precision vacuum seeder - **Hasan Yilmaz, Turkey** P-086 / Analysis of the Chemical Input Usage of Farmers in Pomegranate Production in Antalya Province - **Ibrahim Yılmaz, Turkey** P-096 / Comparison of Sieving Method and Image Processing Method Used to Determine the Size of Shredded Pruning Residues **Mete Yigit, Turkey**			
17:00-18:30	ORAL SESSION 28 SECTION IV - ENERGY IN AGRICULTURE Session Chairs: **Tadeusz Julizewski, Poland - Birol Kayışoğlu, Turkey** OP-063 / Assessment of Emissions and Combustion Efficiency of Palm Tree Pruning Residue Pellets **Hasan Yilmaz, Turkey** OP-064 / Performance of the valonia oak waste pellet production line **Oğulcan Esmer, Turkey** OP-066 / Investigation of Moisture Content, Particle Size and Pellet Die Geometry on Sawdust Pelletizing Characteristics By Means of The New Type Pelletizing Test Device **Sina Haghighat, Turkey**	ORAL SESSION 29 SECTION VII - INFORMATION TECHNOLOGY Session Chairs: Qin Zhang, United States - Bahattin **Akdemir, Turkey** OP-127 / A context change of agriculture in Japan **Sakae Shibusawa, Japan** OP-128 / Smart technologies as drivers for next generation agriculture **Leisa Armstrong, Australia** OP-111 / Prediction of Soluble Solids Content of Jackfruit Using Shortwave Near Infrared Spectroscopy **Nazmi Mat Nawi, Malaysia** OP-112 / An online DSS for optimisation of traffic in fields with controlled traffic farming (CTF) **Allan Leck Jensen, Denmark**		
18:30-19:00	CLOSING CEREMONY			
19:00-20:00	CIGR GENERAL ASSEMBLY			

26 April 2018

Technical Tour

Departure from the hotel - 09:30
Please do remember to bring your technical tour voucher which is delivered with your name badge

KEYNOTE SPEAKERS

Prof. Istvan SZABO
(Hungary)
Agriculture in the Age of Information Technology

Date: April 24, 2018, Tuesday
Time: 09:00-09:30
Hall: Hall A

Prof. Umezuruike Linus OPARA
(South Africa)
Engineering a new agriculture for the 21st Century to build a sustainable life for children

Date: April 24, 2018, Tuesday
Time: 09:30-10:00
Hall: Hall A

Prof. Mikio UMEDA
(Japan)
Development of Mechanized and Smart Farming in Asia

Date: April 25, 2018, Wednesday
Time: 09:00-09:30
Hall: Hall A

Prof. Margarita RUIZ ALTISENT
(Spain)
Innovative Technologies in Postharvest

Date: April 25, 2018, Wednesday
Time: 09:30-10:00
Hall: Hall A

ORAL PRESENTATIONS

Presenting Author	Country	Group	Presentation Number	Title
A. Bulent Koc	United States	Section I: Land and Water	OP-001	Use of Unmanned Aerial Vehicles for Water Quality Monitoring
Abdul M Mouazen	Belgium	Workshop on Image Analysis and Spectroscopy in Agriculture	OP-133	Cost benefit analysis of variable management in winter wheat in response to on-line recognition of yellow rust and fusarium head blight
Abdullah Sessiz	Turkey	Section VI: Bioprocesses	OP-080	Friction Coefficients for Gundelia Tournefortii Seed on Various Surfaces
Abdullah Sessiz	Turkey	Section VI: Bioprocesses	OP-091	The Relationship Between Rice Stem Cutting Resistance and Cracking Force of Rice Kernel
Ahmet Cilek	Turkey	Section VII: Information Technology	OP-114	Assessment of Calibration and Validation of CropSyst model in winter wheat productivity in Mediterranean Environments
Akindele Folarin Alonge	Nigeria	Section VI: Bioprocesses	OP-079	Effect of Moisture Content on the Physical Properties of Pumpkin
Alaa El-din Bekhit	New Zealand	Section VI: Bioprocesses	OP-085	Optimization of antioxidant activity of extracts from New Zealand and Chinese Asparagus root cultivars using microwave assisted process
Alaa El-din Bekhit	New Zealand	Section VI: Bioprocesses	OP-102	Novel and traditional technologies for the production of safe meat products: what we know and what we don't know
Alessandro Sopegno	Italy	Section VII: Information Technology	OP-123	APIS: App to improve agricultural machine use and cost evaluation

Presenting Author	Country	Group	Presentation Number	Title
Alireza Taheri-Rad	Iran	Section V: System Management	OP-078	Assessing and Comparing the GHG Emissions, Energy and Economic Analysis of Conventional Tillage and No-tillage Soybean Culture in Sari Dashtnaz Agriculture Company
Allan Leck Jensen	Denmark	Section VII: Information Technology	OP-112	An online DSS for optimisation of traffic in fields with controlled traffic farming (CTF)
Amin Nikkhah	Belgium	Section II: Structures and Environment	OP-025	Application of Analytical Hierarchy Process to develop a weighting scheme for life cycle assessment of agri-food sector
Anders Feilberg	Denmark	Section II: Structures and Environment	OP-018	Emerging air pollutants from manure management: Volatile organic compounds and sulfur
Aslihan Yilmaz	Turkey	Section IV: Energy in Agriculture	OP-051	Biodiesel Production from Bovine Kidney Fat and Canola Oil
Aslihan Yilmaz	Turkey	Section VI: Bioprocesses	OP-086	Effect of Pressure and Temperature Level on Fat And Protein Content in Milk Powder Production
Bahattin Akdemir	Turkey	Section III: Plant Production	OP-039	Effect of Variable Rate Fertilisation on Yield and Fertiliser Requirement of Table Olive
Bjarne Bjerg	Denmark	Section II: Structures and Environment	OP-021	Improved ventilation by CFD prediction of thermal conditions among pigs
Bülent Çakmak	Turkey	Section II: Structures and Environment	OP-030	The Power Transmission Characteristics of Overload Shafts with Different Friction Clutches and Spring Loading Conditions

Presenting Author	Country	Group	Presentation Number	Title
Bülent Çakmak	Turkey	Section III: Plant Production	OP-046	Design and Development of a Prototype Precision Metering Unit with Twin Vacuum Disks* for Improved Seed Spacing Uniformity at High Seeding Speeds
Caner Koc	Turkey	Section VII: Information Technology	OP-121	Development of an Electronic Control Unit for Smart Orchard Sprayer
Carmen Virginia Palau	Spain	Section I: Land and Water	OP-002	DIMSUB: A decision support tool for design and pipe sizing microirrigation systems
Cestmir Mizera	Czech Republic	Workshop on Image Analysis and Spectroscopy in Agriculture	OP-140	Optimization of drying process of Coconut meat (Cocos nucifera) with aid of image analysis
Charles Kinoshita	United States	Section IV: Energy in Agriculture	OP-057	An investigation of ambient drying of {Eucalyptus grandis} logs
Cheng Shen	China	Section III: Plant Production	OP-037	Bench test and analysis for ramie stalk cutting
Cihangir Sağlam	Turkey	Section III: Plant Production	OP-041	Effect of Spatial Variability on Fertiliser Requirement for Olive Orchard Cultivated for Oil Production
Claudio Garcia	Uruguay	Section I: Land and Water	OP-004	Evaluation and Performance of Suface Irrigation on Pasture in a humid climate
Dae Hyun Jung	South Korea	Section II: Structures and Environment	OP-028	Greenhouse Ventilation Control with Artificial Neural Network Models
Dániel Horváth	Hungary	Section IV: Energy in Agriculture	OP-056	Modeling the movement of hulled millet in agitated drum dryer with discrete element method

Presenting Author	Country	Group	Presentation Number	Title
Daniel Otim	South Africa	Section I: Land and Water	OP-008	Verification of Runoff Volume and Peak Discharge from Sugarcane Fields Simulated using the {ACRU} Model
Denï z Yilmaz	Turkey	Section III: Plant Production	OP-034	DETERMINATION OF THREHSING PERFORMANS OF NEW DESING THRESHING UNIT FOR LAVANDIN (lavandula x intermedia emeric ex loisel.)
Denï z Yilmaz	Turkey	Section III: Plant Production	OP-035	DETERMINATION OF SEPARATION PERFORMANCE OF NEW DESIGN SEPARATING UNIT FOR LAVANDIN (Lavandula X Intermedia Emeric Ex Loisel.)
Deqin Xiao	China	Section VII: Information Technology	OP-126	Research on Vegetable Pest Warning System Based on Multidimensional Large Data
Dimas Firmanda Al Riza	Japan	Workshop on Image Analysis and Spectroscopy in Agriculture	OP-136	Exploratory data analysis of fluorescence excitation emission matrix for patchouli oil geographical origin determination
Dionysis Bochtis	Greece	Section V: System Management	OP-076	Development of an innovative farm management system with parallel off-line and on-line capabilities
Dionysis Bochtis	Greece	Section VII: Information Technology	OP-117	A ROS-enabled outdoor robotic perception system
Elcin Kokdemir Unsar	Turkey	Section IV: Energy in Agriculture	OP-049	Biochemical Characterization of Switchgrass Varieties Grown in Turkey for Biofuel Production
Elisabeth Quendler	Austria	Section V: System Management	OP-071	Working time requirement in the fattening of mountain ox during the green fodder harvest

Presenting Author	Country	Group	Presentation Number	Title
Emel Topuz	Turkey	Section II: Structures and Environment	OP-017	Toxic effects of micropollutants in soil applied with biosolid: diclofenac and silver nanoparticles
Erdem Aykas	Turkey	Section III: Plant Production	OP-045	Mixed Seeding Performance of a Seed Drill at Different Mixture Ratios Under the Laboratory and Field Conditions
Eriko Yasunaga	Japan	Section VI: Bioprocesses	OP-094	Distribution environment of exported peach fruit from Japan to Singapore
Erkan Yaslıoğlu	Turkey	Section II: Structures and Environment	OP-015	The effect of heat stress on milk yield in a IPARD supported dairy cattle enterprise
Evans Asenso	China	Section VI: Bioprocesses	OP-083	Impact of tillage practices on selected soil physicochemical, biological properties and yield attributes of maize in latosolic red soil of Southern China
Fırat Kömekçi	Turkey	Section V: System Management	OP-073	Investigation of R&D and Innovation Performance in the Agricultural Trailer Manufacturing Company
Fiaz Ahmad	Pakistan	Section III: Plant Production	OP-044	DEM simulation of bed-shaper and furrow openers of pneumatic planter
Gerrit J. Carsjens	Netherlands	Section I: Land and Water	OP-010	Farming strategies in inland aquaculture of Jakarta Metropolitan Area
Gerrit Polder	Netherlands	Workshop on Image Analysis and Spectroscopy in Agriculture	OP-137	Measuring floral responses to herbivory by machine vision and spectroscopy
Guangwei Wu	China	Section III: Plant Production	OP-047	Design and experiment of precision control system for winter wheat sowing machine with rotary tillage and stratified fertilization

Presenting Author	Country	Group	Presentation Number	Title
H. Kursat Celik	Turkey	Section VI: Bioprocesses	OP-081	Determination of Time Dependent Stress Distribution on Potato Tubers at Mechanical Collision
Hannu E S Haapala	Finland	Section V: System Management	OP-075	How to efficiently support adoption of new technologies in agriculture?
Hannu E. S. Haapala	Finland	Section II: Structures and Environment	OP-023	Continuous on-farm measurement of Ammonia emissions in dairy barns
Hao Wang	Japan	Section VII: Information Technology	OP-125	Precise Point Positioning for a Robot Tractor using LEX signal Transmission from Quasi-Zenith Satellite System
Hasan Yilmaz	Turkey	Section IV: Energy in Agriculture	OP-063	Assessment of Emissions and Combustion Efficiency of Palm Tree Pruning Residue Pellets
Hasan Yilmaz	Turkey	Section VI: Bioprocesses	OP-093	Estimation of particle density of biomass pellets by image processing technique
Haşmet Emre Akman	Turkey	Section IV: Energy in Agriculture	OP-050	Effects of Thermo-Chemical Pretreatment on Biogas Production from Switchgrass
Hatice Delice	Turkey	Section I: Land and Water	OP-005	Effects of Deficit Irrigation Water and Different Boron Levels on the Yield and Some Physiological Properties of Cotton Plant
Hiroshi Shimizu	Japan	Section III: Plant Production	OP-048	Development of ultrasonic pollination system
Hossein Navid	Iran	Section VII: Information Technology	OP-113	Satellite based predicting wheat harvest date using vegetation indexes

Presenting Author	Country	Group	Presentation Number	Title
Ibrahim Alper Başar	Turkey	Section VI: Bioprocesses	OP-084	Evaluation of Enzyme Doses on Ethanol Production from Raw Switchgrass Variety of Kanlow
Il Hwan Seo	South Korea	Section VII: Information Technology	OP-119	IOT based wearable sensing system monitoring working environment in swine house
Isabel Maria Duarte	Portugal	Section I: Land and Water	OP-011	Biological risk assessment of irrigation with urban wastewater
James Houser	United States	Section IV: Energy in Agriculture	OP-052	A cold-climate biogas system for a sustainable eco-lodge in Nepal
Jianping Qian	China	Section V: System Management	OP-067	Agro-food traceability system granularity evaluation and the influencing factors analysis
Jin Mao	China	Section VI: Bioprocesses	OP-096	Facile design of ternary composites for AFB1 photocatalytic degradation
John Perkins Chastain	United States	Section I: Land and Water	OP-013	Impact of Mesophilic Anaerobic Digestion on Swine Manure Composition
Jose Blasco	Spain	Section VII: Information Technology	OP-116	Design of a remotely-operated field robot to detect olive trees infected with {Xylella fastidiosa} using proximal sensing
Jose Blasco	Spain	Workshop on Image Analysis and Spectroscopy in Agriculture	OP-141	Study of astringency distribution in persimmon cv. 'Rojo Brillante' using VIS/NIR hyperspectral imaging
José Manuel Gonçalves	Portugal	Section I: Land and Water	OP-006	Monitoring maize furrow irrigation using handheld remote sensing measurements
Jozef Grochowicz	Poland	Section VI: Bioprocesses	OP-101	Development and application of functional food for older people

Presenting Author	Country	Group	Presentation Number	Title
Juan Manzano Juarez	Spain	Section I: Land and Water	OP-003	Multioutlet hydrants typology for collective irrigation networks
Judit Nagy	Hungary	Section III: Plant Production	OP-040	Utilization of struvite produced from human urine in agriculture as a natural fertilizer
Ke Chen	China	Section III: Plant Production	OP-038	Optimized Pectin Extracting Technology from Aloe Skin with Acid Hydrolysis
Laurentiu Fara	Romania	Section IV: Energy in Agriculture	OP-054	New trends in monitoring and control of photovoltaic pumping systems
Leisa Armstrong	Australia	Section VII: Information Technology	OP-128	Smart technologies as drivers for next generation agriculture
Luiz Carlos De Abreu Rodrigues	Brazil	Section V: System Management	OP-070	A tool to support decisions and policies on planting and cutting of planted forests at Paraná state in Brazil
Maarit Hellstedt	Finland	Section II: Structures and Environment	OP-016	The effect of biochar covering on the emissions from animal manure
Maksut Barış Eminoğlu	Turkey	Section V: System Management	OP-068	Evaluation Postural Comfort Level of Conventional Cherry Harvesting
Marcel Pinton De Camargo	Brazil	Workshop on Image Analysis and Spectroscopy in Agriculture	OP-134	Aerial machine vision, GIS and hue for pattern classification in agriculture
Maria P. Amador	Portugal	Section I: Land and Water	OP-012	Environmental risk of livestock waste - case study of tetracycline resistant bacteria
Martin Libra	Czech Republic	Section IV: Energy in Agriculture	OP-055	Integration of photovoltaic power plants into the historic city
Megumi Ueda	Japan	Section IV: Energy in Agriculture	OP-053	Consumption Characteristics of Propionate in Anaerobic Digestate using Microbial Fuel Cells

Presenting Author	Country	Group	Presentation Number	Title
Mehmet Öten	Turkey	Section VI: Bioprocesses	OP-082	Determination of leaf breaking strength of variety candidates of common vetch
Mete Yigit	Turkey	Section IV: Energy in Agriculture	OP-065	Comparison of Sieving Method and Image Processing Method Used to Determine the Size of Shredded Pruning Residues
Michael Holm	Denmark	Section II: Structures and Environment	OP-020	Odour and ammonia abatement from finisher pigs by acidification and separation of the slurry
Michael Jørgen Hansen	Denmark	Section II: Structures and Environment	OP-022	Improved slurry system for pig houses with straw application
Michael Ngadi	Canada	Section VI: Bioprocesses	OP-099	Nutrition-Sensitive bean processing: Softening techniques and the nutritional cost of important minerals
Michihisa Iida	Japan	Section III: Plant Production	OP-036	Rice Harvesting Operation by Two Combine Robots
Milon Chowdhury	South Korea	Section II: Structures and Environment	OP-031	Identification of nutrient mixing control parameters for a small-scale recycling hydroponic crop cultivation system
Minli Yang	China	Section V: System Management	OP-077	Agricultural Mechanization in China's Rural Rejuvenation Strategy
Mohammad Sumon Miah	Japan	Workshop on Image Analysis and Spectroscopy in Agriculture	OP-135	Effects of fertilizers on the fluorescence compounds dynamic of carrot during the growing period
Mohammadali Maysami	Iran	Section IV: Energy in Agriculture	OP-059	Energy equivalent of irrigation water in different delivery systems in agriculture

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Mojtaba Nosrati	Iran	Section VI: Bioprocesses	OP-104	Optimization of Intermittent Drying of Rough Rice in Combined FIR-dryer Using Finite Element Method
Mojtaba Nosrati	Iran	Section VI: Bioprocesses	OP-105	Investigation of Moisture Distribution of Rough Rice in Combined FIR-dryer Using Finite Element Method
Muhammed Cemal Toraman	Turkey	Section III: Plant Production	OP-043	Effects of Leaf Surface Energy on Pesticidal Performance
Naoto Shimizu	Japan	Section VI: Bioprocesses	OP-106	Microencapsulation using Spray-drying: The Use of Fine Starch Solution for the Wall Material
Narayan Sharma	Japan	Section VII: Information Technology	OP-120	Monorail-based Autonomous Crop Monitoring System using Camera and Laser Rangefinder
Nawal K. Al Mezeini	Oman	Section IV: Energy in Agriculture	OP-060	Evaluation of greenhouse cucumber production sustainability in term of energy use efficiency
Nazmi Mat Nawi	Malaysia	Section VII: Information Technology	OP-111	Prediction of Soluble Solids Content of Jackfruit Using Shortwave Near Infrared Spectroscopy
Oğulcan Esmer	Turkey	Section IV: Energy in Agriculture	OP-064	Performance of the valonia oak waste pellet production line
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Oliver K. Schlüter	Germany	Section VI: Bioprocesses	OP-103	Emerging monitoring and processing techniques for safe edible insect production

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Osman Gökdoğan	Turkey	Section IV: Energy in Agriculture	OP-061	Determination of Energy Efficiency and Greenhouse Gas (GHG) Emissions in Organic Almond Production in Turkey
Patricia Iweka	Japan	Section II: Structures and Environment	OP-014	Bovine Milk Progesterone Determination Using Near-infrared Spectroscopy during Milking
Patrizia Busato	Italy	Section VII: Information Technology	OP-129	Use of simulation game in education environment: the case of agrifood logistics
Patrizia Busato	Italy	Section VII: Information Technology	OP-130	flipping the classroom for food technology students. evaluation of a two-years experience
Peiwu Li	China	Section VI: Bioprocesses	OP-087	Multiple mycotoxins determination based on immunoassay in agro-food and feed
Peiwu Li	China	Section VI: Bioprocesses	OP-142	Authentication of edible oil based on fatty acidomics and chemometrics
Phillip Ray Owens	United States	Section I: Land and Water	OP-009	A Pattern Recognition Approach Combined With Fuzzy Logic for Predicting Soil Properties and Function
Pınar Ercan Yıldız	Turkey	Section VII: Information Technology	OP-124	The Accuracy in Seed Spacing of a Seeder With Variable Ratio
Qin Zhang	United States	Section V: System Management	OP-069	Effects of Canopy Pruning Strategy on Crop Load, Light Interception, and Vibratory Harvesting in Fruiting-wall Apple Orchards
R. Cengiz Akdeniz	Turkey	Section V: System Management	OP-073	Investigation of R&D and Innovation Performance in the Agricultural Trailer Manufacturing Company

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Rafal Kobylka	Poland	Section II: Structures and Environment	OP-029	Stress distribution and flow pattern in a model grain silo with obstruction attached to the wall
Recep Külcü	Turkey	Section IV: Energy in Agriculture	OP-058	Design of Parallel Connected Vacuum Tube Solar Air Collector
Recep Külcü	Turkey	Section VI: Bioprocesses	OP-095	Design of Automatic Gas Analysis System for Tunnel Type Composting System
Reyhan Erdoğan	Turkey	Section II: Structures and Environment	OP-032	Environmental Importance of Olive Groves in Cultural Landscape, The Case Study of Antalya
Reyhan Erdoğan	Turkey	Section II: Structures and Environment	OP-033	Urban Agriculture as a Tool for Environmental Protection
Rikke Koch Hansen	Denmark	Section V: System Management	OP-072	Natural ventilation's ability to prevent high indoor temperatures
Said Benaissa	Belgium	Section VII: Information Technology	OP-109	A comparison between RumiWatch noseband and neck-mounted accelerometer for automated measurement of cow ingestive-related behaviors
Sakae Shibusawa	Japan	Section VII: Information Technology	OP-127	A context change of agriculture in Japan
Salvador Gutiérrez	Spain	Workshop on Image Analysis and Spectroscopy in Agriculture	OP-138	On-the-go hyperspectral imaging for vineyard monitoring: a new methodology for acquisition and processing
Sawsana H. Al Rahbi	Oman	Workshop on Image Analysis and Spectroscopy in Agriculture	OP-139	Evaluation of Salinity Stress on Date Palm Leaves Using Color Images Analysis
Seishi Ninomiya	Japan	Section VII: Information Technology	OP-118	Issues in high-throughput drone crop phenotyping

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Sibel Uzuner	Turkey	Section VI: Bioprocesses	OP-090	Effect of high hydrostatic pressure processing on cold-brewed white tea characteristics
Sina Haghighat	Turkey	Section IV: Energy in Agriculture	OP-066	Investigation of Moisture Content, Particle Size and Pellet Die Geometry on Sawdust Pelletizing Characteristics By Means of The New Type Pelletizing Test Device
Stefania Lombardo	Italy	Section V: System Management	OP-074	How agriculture 4.0 can be an opportunity for marginal areas? A case study in Tuscany
Stephane Godbout	Canada	Section II: Structures and Environment	OP-019	Impact of slatted floor area on odor emissions in finishing swine buildings
Ta Te Lin	Taiwan	Workshop on Image Analysis and Spectroscopy in Agriculture	OP-132	An Embedded Imaging System for Monitoring Drinking Behavior of Dairy Cows
Takoi Hamrita	United States	Section II: Structures and Environment	OP-024	A Study of Poultry Dynamic Deep Body and Heart Rate Responses to Ambient Temperature and Air Velocity
Temuçin Göktürk Seyhan	Turkey	Section IV: Energy in Agriculture	OP-062	Energy Efficient Usage of ZigBee Networks in Solar Powered Field Data Acquisition Systems
Tilahun Seyoum Worknehn	South Africa	Section VI: Bioprocesses	OP-107	Microwave Assisted Forced Convection Hot Air Drying of Teff (Eragrostis tef)
Tilahun Seyoum Worknehn	South Africa	Section VI: Bioprocesses	OP-108	Appropriate and Sustainable Postharvest Integrated Postharvest Technologies for Perishable Commodities Handling in Supply Chain in Africa

Presenting Author	Country	Group	Presentation Number	Title
Tilahun Seyoum Workneh	South Africa	Section VI: Bioprocesses	OP-143	integrated post-harvest management system for tomatoes marketing in South African supply chains
Ufuk Türker	Turkey	Section VII: Information Technology	OP-122	Proximate Sensing and Application for Variable Rate Nitrogen Application on Corn Field
Uğur Yegül	Turkey	Section III: Plant Production	OP-042	Modelling Of The Nitrogen Requirement Of Winter Wheat For Protein Content Using Optical Sensor
Vittorio Serra	Italy	Section II: Structures and Environment	OP-026	Landscape fragmentation in Europe: a comparative analysis
Wenhao Su	Ireland	Section VI: Bioprocesses	OP-089	FT-IR imaging spectroscopy for measurement of the physical property of potato tuber
Won Jae Lee	South Korea	Section II: Structures and Environment	OP-027	Control system of an unmanned and remote-controlled harmful-fly collecting device for smart greenhouses
Woojae Cho	South Korea	Section V: System Management	OP-097	Automatic Temperature Compensation and Diagnostic System for Electrical Conductivity and pH Probes in Recirculating Hydroponics
Xiangjun Zou	China	Section VII: Information Technology	OP-115	{"Fruit Detection for Robotic Harvesting Combined Shape and Color Information"}
Xiangyu Song	Netherlands	Workshop on Image Analysis and Spectroscopy in Agriculture	OP-131	Automated identification of anatomical landmarks of dairy cow in three-dimensional vision
Xiaofei An	China	Section VII: Information Technology	OP-110	Development of four elements variable rate application of fertilization based on maps

Presenting Author	Country	Group	Presentation Number	Title
Xiaoqian Tang	China	Section VI: Bioprocesses	OP-088	Nanobody based immunoassay for mycotoxin determination in food and feed
Xiaoqian Tang	China	Section VI: Bioprocesses	OP-098	Aflatoxin control in Agro-products in developing countries
Yukiharu Ogawa	Japan	Section VI: Bioprocesses	OP-092	Relationships between grain structure and starch digestibility of cooked rice

Presenting Author	Country	Group	Presentation Number	Title
Zeliha Bereket Barut	Turkey	Section I: Land and Water	OP-007	Different Tillage under Semi-Arid Mediterranean Conditions: Some Physical Soil Quality Indicators and Their Relations
Zeliha Bereket Barut	Turkey	Section III: Plant Production	OP-020	The Effect of Different Furrow Opener Types on Emergence Performance and Seed Spacing Uniformity in Direct Seeding
Zhaowei Zhang	China	Section VI: Bioprocesses	OP-087	Multiple mycotoxins determination based on immunoassay in agro-food and feed

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OP-001 [Section I: Land and Water]
USE OF UNMANNED AERIAL VEHICLES FOR WATER QUALITY MONITORING

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Nutrients and sediments are the two major pollutants of water in lakes and water bodies. These pollutants enter lakes as non-point source pollution mostly through runoff. Increased amounts of nutrients in water bodies reduce surface water quality by promoting algae growth, reducing water clarity, causing unpleasant odor and taste, reducing oxygen in water, causing fish kills and altering fisheries. In addition, toxins from cyanobacteria (blue-green algae) affect human and animal health. Continuous monitoring of water quality is necessary to implement control programs to minimize nutrient and sediment loadings of water resources. Monitoring water quality provides important information about the safety of water for human uses, including fishing, swimming and drinking. Water quality monitoring with UAVs would help identify the problems in water resources and allow the development of precision water quality maps to identify pollution sources.

The objective of this research was to develop an unmanned aerial vehicle system to conduct in-situ water quality measurements and collect water samples for laboratory analysis. A custom made hexacopter UAV was developed for this research. Electronic component of the UAV was coated with a water-resistant spray. With the use of flotation equipment, the UAV can land both on a water or ground surface. In one of the applications, the hexacopter was integrated with open source water quality measurement probes for in-situ measurement of electrical conductivity, dissolved oxygen, pH and temperature at a depth of 60 cm. The system was tested over a 1.1 ha fishing pond. The system was successfully land on the predefined 13 waypoints on water surface autonomously and made the measurements and returned to the launching location. In another application of the system, a thief-style water collection mechanism was developed and mounted on the UAV. The UAV was successfully launched, navigated to the predefined waypoint, collected 130 ml of water sample and returned to the launching location on the shore. The developed UAV-assisted water quality measurement system and water collection mechanism can be used in lakes that are not easily accessible by boats. Use of UAVs would also reduce the cost and time of water quality monitoring programs.

Keywords: Water quality, sample collection, monitoring, hexacopter, UAV

OP-002 [Section I: Land and Water]

DIMSUB: A DECISION SUPPORT TOOL FOR DESIGN AND PIPE SIZING MICROIRRIGATION SYSTEMS

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DIMSUB is a decision support tool (DST) for effectively study different hydraulic design alternatives in microirrigation systems. It is developed in Visual Basic for Applications for Excel environment and allows the creation of step-by-step specific functions to design irrigation subunits. Several alternatives can be considered such as different emitter types, different laterals and submain pipe sizes, irregular subunits shapes and topography slopes. As examples, this paper shows different practical cases under specific crop conditions for the design of drip irrigation subunits in citrus and almond orchards in the Mediterranean region (Valencia, Spain). Properly designed systems can eliminate poor uniformity flow emission. For this reason, specific uniformity criteria can be considered to achieve efficiency of water application. This user-friendly tool for study of hydraulics variables helps decision making. Lengths of run of lateral and submains, adequate hydrant join location, head pressure and head loss in tubing or pressure-compensating emitters can be assigned to evaluate results and range the best design alternative.

Keywords: microirrigation design, subunit, uniformity emission, drip

OP-003 [Section I: Land and Water]
MULTIOUTLET HYDRANTS TYPOLOGY FOR COLLECTIVE IRRIGATION NETWORKS

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A rational and correct usage of water resources in pressurized irrigation systems demands certain infrastructures to supply the required volumes of water from the upstream reservoirs to the plant. The pressurised irrigation systems, whether at collective or smallholding level, permit a high degree of control over the water applied, and guarantee a high rate of application efficiency. In the Mediterranean region, the production model is based on intensive farming of small and medium-sized plots of land. Commonly, collective irrigation networks use multioutlet hydrants to join the net to the field. Each singular outlet serve a farmer or plot. This irrigation facility permit to group elements together for water measuring, cutting off, automation, and pressure regulation of each user. Consequently improves the management and control of hydraulic variables. These multioutlet hydrants are critical points of the irrigation system. The correct operation of these hydraulic facilities guarantees appropriate pressure and flow to microirrigation systems. Thus, they are essential to the management and control of the network. Actually, multioutlet hydrants permit automatically organise collective irrigation systems and register farmer's water consumptions. Consequently, this hydraulic assembly needs to be properly design, characterise and model. This article identifies and establishes a well-defined classification of multioutlet hydrants according to the position of water meters, inlet pipe setting, or hydraulic elements included. This classification will allow:
- Analyzing operation current state: compiling the problems that are currently under such configuration.
- Analyzing technical standards that characterise this type of hydrants (UNE-EN 14267).
- Proposing hydraulic characterization tests for evaluating correct configurations and operations.
- Developing technical design specifications.
- Establishing the methodology for variable analysis of multioutlet hydrants to validate hydraulic performance before installation.

Keywords: pressurised, microirrigation, hydrant

OP-004 [Section I: Land and Water]
EVALUATION AND PERFORMANCE OF SUFACE IRRIGATION ON PASTURE IN A HUMID CLIMATE

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The potential of forage production systems in Uruguay is highly dependent on annual rainfall and its variability. Although annual precipitation ranges between 1200 and 1600 mm drought periods longer than 10 days induce water stress and yield losses during the spring and summer. Use of irrigation, mainly using gravity methods, is expanding to improve yields and forage quality. Guidelines for the design and operation of gravity irrigation systems under the humid conditions of Uruguay, with relatively steep field slopes, are currently unavailable. Hence, studies are being conducted with the objective of characterizing the hydraulic performance of border irrigation systems used for irrigated pastures. Field experiments were conducted during three irrigation seasons 2010-2013. This paper will present results from the first two seasons. The objective of the evaluations was to determine application efficiency and distribution uniformity, and to determine infiltration and hydraulic resistance parameters that can be used for subsequent irrigation modeling. Nine irrigation events were evaluated during the first irrigation season and four during the second. The experimental design consisted of randomized plots with three replicates where the treatments were different widths of check border (6, 9 and 12 m), which translate into different unit inflow rates. All plots were irrigated based on the same level of soil water depletion. Since producers typically end the irrigation based on water reaching the end of the field, the tests aimed to determine the best unit flow rate/border width configuration that would result in the best hydraulic performance. Application Efficiency (EA) and Distribution Uniformity (DU) results in both seasons were similar, in the ranges of 72 to 80% for the three treatments evaluated. Similar results were found when simulated, finding a high correlation (r2 greater than 0.84).

Keywords: border irrigation, application efficiency, pastures irrigated, evapotranspiration

OP-005 [Section I: Land and Water]

EFFECTS OF DEFICIT IRRIGATION WATER AND DIFFERENT BORON LEVELS ON THE YIELD AND SOME PHYSIOLOGICAL PROPERTIES OF COTTON PLANT

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The research was carried out to determine to which extent to the boron fertilizer enhances the fruit set of the cotton plant in deficit irrigation conditions in the Amik Plain (Hatay/Turkey). Treatment were planned split plot design with main plats consisting of irrigation level and subplots consisting of boron doses. Each treatment was composed of 15 m and 6 rows. Carisma variety is used.

The crop was exposed to four water regimes, I0; rainfed (witness), I66; 66% of full irrigation treatment, I33; %33 of which applied to the field capacity (full irrigation, I100). Boron fertilizer were applied by spraying 3 different doses at intervals of about 10 days only during the flowering period. Fertilizer doses were 75 ppm for B1, 300 ppm for B2, and 750 ppm for B3. Etidot 67 (28% B) (Disodium Octaborate Tetrahydrate) (Na2B8O13.4H2O) was used as the boron fertilizer.

Irrigation water were applied 306.5 mm, 612.9 mm and 928.7 mm in I33, I66 and I100, treatments respectively. Evapotranspiration range from 1015.1 mm (S100B1) to 216.6 mm (I0B0). Stomatal conductance values were measured as 574.54, 422.66, 342.54 and 245.06 mm2 m-2 sec-1 in I100, I66, I33 and I0, respectively. Leaf chlorophyll content were measured as 39.97, 47.52, 51.03, 52.11 µmol m-2 on average at irrigation levels (I100, I66, I33 and I0 respectively). The highest yield was obtained with I66B1 treatment (622.7 kgda-1) and the lowest yield with I0B0 treatment (182.4 kg da-1). Among the boron doses the highest yield (428.16 kg da-1) was obtained B1 (75 ppm) dose. The yields values of B0, B2 and B3 doses were obtained 381, 383, 391 kg da-1 respectively. The effect of boron doses on yield was statisticaly significant ($p<0.01$). Also, stomatal conductance and leaf chlorophyll content affected by boron doses ($p<0.01$).

Keywords: Water stress, cotton, chorophyll content, stomatal conductance, cotton yield

OP-006 [Section I: Land and Water]
MONITORING MAIZE FURROW IRRIGATION USING HANDHELD REMOTE SENSING MEASUREMENTS

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Remote sensing monitoring allows conducting practical, non-destructive and rapid measurements in irrigated agricultural fields, to detect crop water status and thus assess the irrigation distribution uniformity. Several water stress indicators based on canopy temperature assessed with infrared thermography are used for this purpose such as the Crop Water Stress Index (CWSI) and the Temperature Difference Air-Canopy (TDAC). Moreover, spectroradiometer measurements of green biomass allow the determination of the Normalized Difference Vegetation Index (NDVI), which assesses the aerial biomass accumulation and the evaluation of the potential crop transpiration and photosynthetic magnitude. This paper presents preliminary results from a research study aiming at improving irrigation management based on plant status monitoring based on the approaches described above. The experiment was conducted in 2017 on a furrow irrigated maize field of 1.3 ha (length of 150 m) of a private grower of the Lower-Mondego Valley, Portugal. The maize (Pioneer P0933) longitudinal uniformity was evaluated in three furrows, each one with three sampling plots of 4 m^2. Additionally, eight highly productive maize varieties were compared, each one seeded in eight rows, being its performance evaluated using one furrow per variety, with three sampling plots of 4 m^2 per furrow. Thermographic measurements were made manually approximately at solar noon to capture maximum stress levels. Plant temperature data were obtained using a handheld thermal camera FLIR model C3, with thermal image resolution of 80×60 pixels with an accuracy of about 0.1. The camera was placed over the canopy, at about 3 m above the soil. NDVI data were collected using a portable spectroradiometer GreenSeeker, Trimble. Measurements were carried out weekly, under the clear sky conditions, 1 m above the canopy. Soil water content was measured with a TDR probe at 1 m depth, at six plots, located in two furrows. Grain yield per plot was assessed at physiological maturity. Air temperature and other meteorological data were collected at a nearby automatic weather station to calculate ETo. The soil water balance was modelled by SIMDualKc. The relationship among plant water status, soil water content and yield were analyzed. In addition, an attempt was made to better understand the usefulness of infrared thermography monitoring to contribute to improving crop and irrigation management, and to compare maize varieties.

Keywords: infrared thermography, crop water stress index, NDVI, maize, furrow irrigation, Lower-Mondego Valley

OP-007 [Section I: Land and Water]

DIFFERENT TILLAGE UNDER SEMI-ARID MEDITERRANEAN CONDITIONS: SOME PHYSICAL SOIL QUALITY INDICATORS AND THEIR RELATIONS

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Saturated hydraulic conductivity (HC), soil bulk density (BD), aggregation index (AI) and penetration resistance (PR), and relationship between them based on six tillage practices were evaluated under semi-arid Mediterranean conditions. The experiment was conducted on a randomized complete block design with three replicates. The tillage methods were: conventional tillage with residue incorporated (CTS), conventional tillage with residue burned (CTB), reduced tillage with heavy tandem disc harrow (RTD), reduced tillage with rotary tiller (RTR), reduced tillage with heavy tandem disc harrow for the first crop + no-tillage for the second crop (RNT), and no tillage (NT). The study was conducted in wheat-corn-wheat-soybean and wheat crop rotations for two years.

In 2008, the effect of tillage systems on BD, HC, AS and PR was statistically different ($P<0.05$) while it was no significant at the beginning of the experiment for 0-30 cm soil depth. The hydraulic conductivity was higher (9.79x10-6 m sn-1) in CTS, and followed by CTB, RTR, RTD, RNT and NT practices, respectively. However, the AI, BD and PR values were higher (0.46 mm, 1.41 gr cm-3 and 2.15 MPa, respectively) in NT than the other plots. The relationship between HC with PR is better than the other soil properties with the highest coefficient of determination of 0.98. There is an inverse linear relationship between them.

Keywords: Bulk density, Hydraulic conductivity, Penetration resistance, Aggregation index, Tillage

OP-008 [Section I: Land and Water]

VERIFICATION OF RUNOFF VOLUME AND PEAK DISCHARGE FROM SUGARCANE FIELDS SIMULATED USING THE <I>ACRU MODEL

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The Agricultural Catchments Research Unit (*ACRU*) model is a daily time step physical conceptual agrohydrological model with various applications, design hydrology being one of them. Streamflow, soil water content and sediment yield simulated by the *ACRU* model have been extensively verified against observed data in southern Africa and internationally. Model verification is a measure of a model's performance and evaluates simulated and observed responses either in absolute output values or in terms of the relative sequences of output responses. For a simulation to be acceptable, the slope of the regression line of simulated flows should be close to unity and the Nash-Sutcliffe coefficient (R2) should exceed 0.50. The primary objective of this study is to verify simulated runoff volume and peak discharge against observed data from catchments under sugarcane production and various management practices. The study area is located at La Mercy on the site that now hosts the King Shaka International airport in South Africa. It consisted of four research catchments namely 101, 102, 103 and 104 which were under sugarcane cover and different management practices for the period 1984 – 1995. The data consists of daily rainfall, runoff and peak discharge records for the same period, and they were checked for errors with clarification of probable inconsistencies in observed data between catchments. The input parameters and variables for the *ACRU* model necessary for simulation of runoff volume and peak discharge were determined from the SugarCane Decision Support System and the performance of the model assessed under sugarcane land use. Simulation of runoff depth under sugarcane land cover resulted in acceptable simulations for each of the four catchments. The slopes of the regression lines of simulated runoff were 1.37, 0.97, 1.06 and 0.95 for Catchments 101, 102, 103 and 104 respectively while the R2 coefficients were 0.95, 0.91, 0.92 and 0.91 respectively. Simulation of peak discharge on the other hand resulted in very steep slopes of the regression lines while the R2 coefficients were within acceptable limits. The slopes of the regression lines of simulated peak discharge were 8.93, 5.34, 5.31 and 2.47 for Catchments 101, 102, 103 and 104 respectively while the respective R2 coefficients were 0.88, 0.80, 0.82 and 0.79. The steep slopes which indicate an over simulation could be attributed to the intensity distribution employed by the *ACRU* model in the derivation of rainfall intensity from daily rainfall data. Hence, this needs to be investigated further.

Keywords: {ACRU}, La Mercy, Peak Discharge, Streamflow, Sugarcane

OP-009 [Section I: Land and Water]

A PATTERN RECOGNITION APPROACH COMBINED WITH FUZZY LOGIC FOR PREDICTING SOIL PROPERTIES AND FUNCTION

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Soil in the integrator of surficial processes that control the physical, chemical and biologic responses on the earth's surface. Most soil information exists as point data or polygons with one value for soil organic carbon, soil texture, water holding capacity and bulk density to name a few. Understanding and predicting complex environmental interactions requires spatially explicit soil property predictions for model input and extrapolation of known responses. Geostatistical tools are the most common tool used to obtain continuous soil property predictions. Geostatistical tools are useful, but most areas lack the critical amount of georeferenced sampling points to predict soil differences at the field scale. The objectives of this research was: 1) to evaluate the accuracy of a hierarchal approach with pattern recognition and fuzzy logic to predict soil properties, 2) compare the new approach with traditional geostatistical tools and 3) relate to crop yield responses. This research was conducted on a 30 ha field with 60 georeferenced sampling points spaced at 30 m intervals. Soils were analyzed for texture, soil carbon and phosphorus. The georeferenced data was utilized with kriging techniques to create continuous soil property prediction at 10 m pixel resolution. The pattern recognition methodology was based on terrain algorithms of topographic wetness index, multiresolution valley bottom flatness index, ridgetop flatness index and topographic position index run in SAGA GIS. These unique terrain algorithms were groups based on common values occurring within regions of the field. The patterns were hardened and each of the 5 patterns were given unique values to represent the ideal pattern. Rules were created so that each 100% match received the ideal soil property prediction. Using fuzzy logic, all other predations were given weighted predictions based on the similarity to the pattern to create a continuous 10 m pixel resolution map. The results showed that the ordinary kriging geostatistical model performed the best giving a root mean square error of 0.25. The pattern recognition model had a root mean square error of 0.29. Even though the geostatistical model had a better statistical prediction, the pattern recognition model only relied on 5 of the 60 sample locations. The relationship to yield was more highly correlated with the pattern recognition soil property map when compared to the geostatistical map. This research has broad implications for creating continuous soil property data predictions with limited data which corresponds to biologic responses.

Keywords: Digital Soil Mapping, Soil Spatial Data, Soil Function

OP-010 [Section I: Land and Water]
FARMING STRATEGIES IN INLAND AQUACULTURE OF JAKARTA METROPOLITAN AREA

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Farming in metropolitan areas is challenging due to the economic pressure of other economic activities,typically associated with urbanization.Farmers in urbanized areas tend to adopt three types of strategies for more sustainable farming:sustainable intensification,valorisation and diversification.Sustainable intensification focuses on intensifying food production,using technological solutions to deal with economic,environmental and social issues.Sustainable valorisation focuses on opening up niche markets such as regional or biological products,using shorter connections between producers and consumers. Sustainable diversification focuses on new markets by offering other services,for instance care,leisure and educational activities. The strategies are context specific and need to be adapted to the type of farming and area.While studies have been done in the Netherlands,India and China,studies in many other countries are lacking. The objective of this study was to analyse the strategies taken by farmers in the metropolitan area of Jakarta,Indonesia,focusing on a case study of inland aquaculture in Bogor Regency.The different perspectives of stakeholders in the food chain of inland aquaculture were analysed.Therefore,a qualitative approach was chosen,using document study and semi-structured interviews. The document study focused on policy documents at two administrative levels,Bogor Regency and JMA.The interviews were held with individual farmers and representatives of farmer associations,local and regional government and a consumer organization.In total 15 interviews were conducted. The document study revealed that the total production of consumption fish in Bogor regency grew from 40,000 tons in 2010 to 120,000 tons in 2015.In the same period,the area of fish ponds grew from 600 ha to 1560 ha.The fish market is dominated by small farmer households,on average with 0.2 ha fish pond for the fattening stage and 0.5 ha for the spawning stage,while the average farm size grew with 18% and 35% respectively between 2010 and 2015.The interviews confirmed the findings of the document study,and showed that the farmers primarily focus on enlarging and intensifying production.Main reason for choosing more intensive methods of fish production is that farmers aim to reduce the production costs in order to get enough income from their farming activities.However,the results also showed the farming practices are not entirely sustainable.Fish farming activities are exempted from tax and the government supports members of farmer associations with local subsidies.Most members of these associations rely heavily on these subsidies,threatening the financial robustness on inland aquaculture.Moreover,some experts identified animal welfare issues due to overcrowded fish ponds,as a result of intensification of production.There is a general lack of domestic animal welfare standards and enforceable animal welfare regulations in Indonesia.The interviewees revealed that the stocking density of fish ponds can raise up to three times the amount of fish compared to traditional fish farms in the region. At present,the implications are low since the majority of consumers are merely interested in the price of fish. Moreover,the fish farms obtain the required water from the existing irrigation system,seepage water or spring water. In the dry season,which lasts for seven months,this results in a competition for water between fish farms and crop farms who also rely on water from the irrigation system. Furthermore,wastewater from fish ponds is discharged to the surface water without being properly treated,which is an issue of environmental concern,especially in the dry season. The local government aims to improve the sustainability of inland aquaculture by offering training programs.The interviewees from the local government claimed these programs increase the dissemination of innovative fish farming practices.Although this was confirmed by representatives of four farmer associations,individual farmers complained that the current training programs are too generic and not addressing their specific needs.However,the training programs seem to be a promising starting point for capacity building and improving the sustainability of inland aquaculture in JMA.

Keywords: Metropolitan agriculture, inland aquaculture, sustainable food systems

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OP-011 [Section I: Land and Water]
BIOLOGICAL RISK ASSESSMENT OF IRRIGATION WITH URBAN WASTEWATER

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Urban treated wastewater is an endogenous resource, compatible with diverse uses, mainly for irrigation, with potential to cope with water scarcity and to reduce the use of crop fertilizers due to the nutrients it contains. The present average wastewater reuse in Europe is 2.6% and the target for 2030 is 6%, exemplifying the worldwide trend in areas with limited water resources. However, wastewater also contain an organic and microbiological load, with an inherent hygienic-sanitary risk factor. Among the chemical pollutants, there are the antibiotic residues and respective resistant bacteria. Consequently, the use of treated wastewater requires feasibility and risk studies. The risk analysis and the definition of good practices play a decisive role in reducing the concerns on the minimum quality requirements for reclaimed water, which should be accomplished by a monitoring and control plan to minimize potential problems to environment, growers and consumers. This study aimed to assess the microbiological and ecotoxicological risks of antibiotic resistant bacteria for agriculture due to the irrigation with urban wastewater, to identify the critical hot pots. Treated wastewater samples were collected from the effluent of Coimbra city wastewater treatment plant (WWTP) located in the central region of Portugal. Ampicillin resistant Enterobacteriaceae were enumerated, isolated, tested for resistance profiles to common antibiotics. Additionally, the data records of chemical and biological quality of treated wastewater were analyzed. Preliminary results of this study revealed that the chemical and biological quality parameters of treated wastewaters are within the thresholds legally regulated. However, concerning the bacteria isolates sampled in the treated effluent and in the river, downstream the WWTP discharge point, they contained high rates of antibiotic resistance towards: amoxicillin/clavulanic-acid (53%), cefoxitin (52%), chloramphenicol (22%), cefpirome (19%), cefotaxime (17%), trimethoprim/sulfamethoxazol (16%), gentamicin(15%), meropenem (14%), aztreonam (13%), ceftazidime (9%), ciprofloxacin (8%), tetracycline (6%) and imipenem (4%). Samples also revealed a high frequency of multidrug resistance isolates (60%). Thus, critical environmental pollution might result from the spread of antibiotic resistance bacteria, through crop irrigation with this reclaimed water. This study will provide a contribution to the environment control of wastewater reuse, which is important for risk management of these contaminants. With the data currently available, the main risk factors will be identified. This study will assess different techniques to manage wastewater, based on water amounts and irrigation method operation, to outline the best management practices for maize and rice in Mondego Valley.

Keywords: irrigation with wastewater, water reuse, antibiotic, hygienic-sanitary risk, multidrug resistant bacteria

OP-012 [Section I: Land and Water]
ENVIRONMENTAL RISK OF LIVESTOCK WASTE - CASE STUDY OF TETRACYCLINE RESISTANT BACTERIA

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Pig farming represents 8.5% of national gross agriculture product in Portugal, 15% of which came from Beira Litoral. However, some environmental constrains are posed by the wastes resulting from intensive piggery production, including the storage winter period required in a Mediterranean climate, that impacts their usage timing as crop fertilizer. Some units with effluent treatment systems have technical limitations, resulting in potential contamination of water, soil and plants. These intensive raising systems require prophylactic and metaphylactic antibiotic administration resulting in the excretion through urine and faeces of active forms and metabolites, together with resistant bacteria. The main routes of environmental contamination with antibiotics, resistant bacteria and resistance genes are the agricultural sewage network. Therefore, slurry and manure with high levels of organic matter and microorganisms is especially suited for the growth and spread of antibiotic resistances being a vehicle to soil and water. The growing awareness that the intensive use of antibiotics are responsible for the presence of a wide range of antibiotic residues, detected by environmental monitoring, has recently put this problem at the top of environmental concerns. This research evaluates the potential contribution of intensive piggery to the spread of tetracycline resistance through the use of piggery slurry in the central region of Portugal. Slurry samples were collected from the treatment waste systems of three farms representative of this sector of activity between March 2016 and March 2017. Ampicillin resistant Enterobacteriaceae were enumerated and 75 were isolated, 25 from representative of each farm which had revealed non-redundant phenotypes. The isolates were tested for their resistance profiles to 14 antibiotics and for the presence of tetracycline resistance genes. The mean counts of resistant Enterobacteriaceae lied in between 3.4x105 and 17x105 cfu/mL. The highest isolates resistances were recorded to tetracycline (96%), trimethoprim/ sulfamethoxazole (75%) and chloramphenicol (64%). Among the 20 isolates investigated for TET resistance genes, tetA (80%) was the most prevalent, followed by tetM (25%), tetB (10%) and tetK (5%). Additionally, all sites revealed a high frequency of multidrug resistance isolates (60%). Thus, critical environmental pollution might result from the spread of antibiotic resistance bacteria, as slurry is frequently used for crop irrigation in the region. This paper provides an insight into the real contribution of livestock to the environment problem and confirmed that raw slurry for soil amendement is a pool for resistance bacteria with their genes.

Keywords: antibiotic, pig farming, intensive production, piggery slurry, tetracycline resistance, multidrug resistant bacteria.

OP-013 [Section I: Land and Water]
IMPACT OF MESOPHILIC ANAEROBIC DIGESTION ON SWINE MANURE COMPOSITION

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Anaerobic digestion of swine manure is a treatment process that can be used to reduce odor emissions, generate bioenergy, and reduce methane emissions. Studies and models are available that can be used to quantify methane production, and volatile solids (VS) reduction rates. Few provide information on the plant nutrient contents of digested manure. Such information is needed to develop nutrient management plans to use digester effluent to produce crops, biomass, or as a nitrogen source for making compost in an environmentally responsible manner. The objective of this study was to observe the reductions and transformations of solids (TS,VS), major plant nutrients (N, P, K), and selected minor plant nutrients (Ca, Mg, S, Cu, Mn, and Na) resulting from anaerobic digestion. Since nitrogen and phosphorous in swine manure exist in soluble and organic forms the reductions and transformations of soluble and organic forms of these nutrients were also observed. In particular, the concentrations of total N (TN), organic-N (Org-N), nitrate-N (NO_3-N), total ammonical N (TAN = NH_4+-N + NH_3-N), total P (TP) and soluble P (Sol-P) were measured before and after anaerobic digestion. Nine batch reactors were used to completely digest mixtures of lagoon water and swine manure using organic loading rates from 6.10 to 13.74 gVS/L. The mean VS reduction ratio (g VS destroyed/g VS added) for all nine reactors was 0.62, and was in excellent agreement with the literature and indicated that anaerobic digestion was complete. The mass of total N was not changed by anaerobic digestion, but the mass of Org-N was decreased by 36% as it was mineralized to TAN, and TAN was increased by a factor of 1.84. Denitrification also occurred as indicated by a reduction in nitrate-N by 40%. The impact of N transformations was to increase the plant available fraction of total-N from 33% before digestion to 58% after digestion. While an increase in plant available N may be beneficial for crop fertilization the elevated TAN content has the potential to increase ammonia emissions if the effluent storage is not covered. Anaerobic digestion was also observed to reduce the soluble fraction of P by 73%, and may reduce the potential for transport of P in runoff following land application. The only minor plant nutrient that was reduced by anaerobic digestion was S. The mass of S was reduced by 8% on the average presumably by the formation of small amounts of H_2S.

Keywords: anaerobic digestion, swine manure, nutrient management

OP-014 [Section II: Structures and Environment]
BOVINE MILK PROGESTERONE DETERMINATION USING NEAR-INFRARED SPECTROSCOPY DURING MILKING

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In the current dairy industry, an intensive demand for an estrus detection and an early diagnosis of pregnancy has been increasing. Progesterone is a steroid hormone that is secreted from corpus luteum into bovine blood and milk, and has a role of maintenance of estrus cycle and pregnancy. Therefore, progesterone concentration in bovine milk is used as an important indicator of an estrus detection and an early diagnosis of pregnancy. Current method for milk progesterone determination requires a hormone extraction procedure that is time consuming, various types of instruments, reagents management, and various assay methods which are destructive in nature. In contrast, near-infrared spectroscopy (NIRS) is a time saving and non-destructive analytical method that can be used for online real-time determination of milk constituents content such as milk fat, protein, lactose, milk urea nitrogen and somatic cell count. However, there has been limited study on using NIRS for online real-time determination of progesterone concentration in milk during milking. Thus, the objective of this study was to develop an online real-time NIR spectroscopic sensing system for milk progesterone determination during milking by using a specific enzyme immunosorbent assay as a reference (chemical) method. Milk spectra with a wavelength range of 700 to 1050 nm and milk samples were collected every 20 s during milking from four lactating Holstein cows using the NIR spectroscopic sensing system. Calibration models were developed using partial least squares analytical method and the precision and accuracy of the models was validated. Milk progesterone concentration for each milking was calculated by taking the progesterone concentration of the milk predicted values and milk yield obtained every 20 s, and was compared with the milk progesterone concentration chemical analysis value for one milking (bucket milk). The results obtained show that the measurement accuracy for one milking of milk progesterone concentrations was reasonably good. By installing the NIR spectroscopic sensing system developed in this study into a milking robot, it could predict milk progesterone concentration for one milking with almost the same accuracy as chemical analysis. Thus, recording this predicted value every milking and monitoring the continuous transition of the milk progesterone concentrations, it becomes possible to use it for the detection of estrus status and for the diagnosis of pregnancy of each cow.

Keywords: bovine milk, progesterone, estrus status, pregnancy diagnosis, trend monitoring, milking robot

OP-015 [Section II: Structures and Environment]
THE EFFECT OF HEAT STRESS ON MILK YIELD IN AN IPARD SUPPORTED DAIRY CATTLE ENTERPRISE

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In this study, the effect of heat stress on the milk yield in an operation supported by the IPARD fund by the Agricultural and Rural Development Support Institution (TKDK) was evaluated by means of temperature-humidity index. It is aimed to determine the effect of barn design on temperature-humidity index, and to find out relationship between milk yield and temperature-humidity index.
Between 18.12.2016 and 22.10.2017 in the Şahinköy district of Karacabey, Bursa province, the temperature-humidity index values were calculated based on the temperature and relative humidity values continuously measured with 1 hour intervals at 7 different points of milk production operation. As a result, it has been determined that milk yield decreases at higher humidity index values that exceed 72. It was observed that when the average index value was increased one unit the production of milk per animal is decreased by 0.15 kg. Similarly, Ravagnolo et al. (2000) emphasized that milk yield decreases by 0.2 kg per unit when THI exceeds 72.

Statistical analysis was performed to determine the time period in which the effect of THI values on milk yield was higher. West et al. (2003) reported that the THI two days prior to hot weather conditions had the greatest effect on milk yield, whereas an increasing effect for up to 5 days and the decreased effect after 5 days was observed according to the our results. As a result, it has been concluded that ventilation systems should be improved in order to control the high temperature humidity index values that cause economic losses.

The research was financially supported by the Scientific Research Projects Unit of Uludağ University through grant No. DDP(Z)-2016/3

Keywords: Dairy cattle, IPARD, Relative humidity, Temperature, THI, TKDK

OP-016 [Section II: Structures and Environment]
THE EFFECT OF BIOCHAR COVERING ON THE EMISSIONS FROM ANIMAL MANURE

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Gaseous emissions from manure cause local odour nuisance as well as leakage in the nutrient cycles of agriculture. Cover materials can be used during the storage of manure to reduce both the odour problem and to tighten the nutrient cycles. Peat is known as an effective cover material but its use as a non-renewable resource is questionable whereas biochar could have some additional benefits regarding e.g. the end-use of manure. In a laboratory test two different manures, liquid manure from dairy barn and solid manure from fur production were used. In liquid dairy manure tests the compared covering materials were biochar, peat, straw and light gravel. For fur manure (both mink and fox manure) mixtures of biochar and peat were used. The test period was one week in a climate chamber with three different ambient temperatures and constant relative humidy. The emissions of ammonia and methane gases from the mixtures were measured using an optical gas analyser (Innova™ Multi-gas analyser). During the test week the measurements were performed on a daily basis. The results show that biochar coverings reduced the ammonia emissions from both liquid dairy manure and fur manures. For liquid dairy manure the reduction was as efficient as that of peat and straw. On methane emissions from liquid dairy manure, however, all the compared cover materials had no significant effect. The fur manure acted differently so that all the used biochar mixtures had a significant effect on both ammonia and methane emissions. The magnitude of the reduction was dependent on the amount of biochar used. The more there was biochar in the cover mixture the more the ammonia or methane flux was reduced.

Keywords: manure, storage, emission

OP-017 [Section II: Structures and Environment]
TOXIC EFFECTS OF MICROPOLLUTANTS IN SOIL APPLIED WITH BIOSOLID: DICLOFENAC AND SILVER NANOPARTICLES

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Micropollutants have been a concern for the environment since two decades. The source of the micropollutants are usually the products which are consumed daily by human such as pharmecuticals and personal care products. Diclofenac is one of the most widely consumed pharmaceuticals and silver nanoparticles have been increasingly used in personal care products recently, therefore they are selected to study. Most of the studies are focused on their presence, potential toxic effects and removal in the aquatic media. However, their presence and potential toxic effects in the soil are relatively missing compared to the aquatic environment. Biosolids could be one of the ways for these micropollutants to enter the soil compartment since the removal of diclofenac is very low in wastewater treatment plant and silver nanoparticles persist in the treatment sludge. In addition to the silver nanoparticles, silver sulphide nanoparticles are produced during the treatment due to the sulphur rich environment in the treatment processes [1]. Land spread of biosolids to agricultural land might lead to the contamination of the soil with these micropollutants present in the biosolid. Hence, soil organisms might expose to the micropollutant residuals which could lead to the possible harms. This study aims to investigate the toxic effect of silver nanoparticles, its transformation product, silver sulphide nanoparticles, and diclofenac on a representative soil organism, Enchytraeus crypticus. Also, the toxicity of these micropollutants are detirmined in the absence of biosolid application to investigate any stimulating or preventive role of biosolid structure on the toxicity.

The effects of polyvinylpyrrolidone coated silver nanoparticles and silver sulphide nanoparticles, sodium salt of diclofenac on the survival and reproduction of *Enchytraeus crypticus* are tested by using the method explained in the study of Castro-Ferreira et al. [2]. Silver nitrate is tested as an ionic control for silver nanoparticles. Biosolid is taken from a wastewater treatment plant in Turkey and is applied at a rate of 500:3 to Lufa 2.2 soil that is used as exposure medium for toxicity studies. For the experiment in the absence of biosolid, Lufa 2.2 soil is used as exposure medium. The results of this study will provide the data of LC50 and EC50 values for the selected micropollutants and the possible effects of biosolid structure on the toxicity of the micropollutants.

Keywords: soil toxicity, micropollutant, biosolid

OP-018 [Section II: Structures and Environment]
EMERGING AIR POLLUTANTS FROM MANURE MANAGEMENT: VOLATILE ORGANIC COMPOUNDS AND SULFUR

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Manure management including livestock production is associated with gaseous emissions of greenhouse gases, ammonia, odor and dust. In recent years, it has been indicated by new data that livestock production is also a significant source of atmospheric volatile organic compounds (VOC) and volatile sulfur compounds. For example, Feilberg et al. (Nature Communications 8, 2017) demonstrated that in Denmark, a country with a high livestock density, the livestock contribution of hydrogen sulfide emissions exceeded known sources of volatile sulfur (emitted as sulfur dioxide). However, there is a pronounced scarcity of data on emissions of total VOC and total sulfur from livestock production and manure management. Nevertheless, VOC data is currently being estimated for EU countries and included in databases on emissions. These databases may form the basis for future regulation of emissions, and they should therefore be carefully considered with respect to the quality and representativeness of the underlying data. Currently, the EU 2030 goals for reduction of sulfur (only sulfur dioxide considered) and VOC emissions are 79% and 40%, respectively. With recent estimates showing significant agricultural contributions, these goals require emission reduction in the agricultural sector as well as other sectors.

In this overview, a review of existing data is presented together with a critical assessment of quantification methods and potential shortcomings and pitfalls in the analytical methods applied. Knowledge gaps and needs for future research within this area will be addressed and recommendations for obtaining relevant emission estimates will be provided. Based on full-scale tests, the effect of a number of environmental technologies on agricultural sulfur and VOC emissions are provided and discussed.

Keywords: emission, livestock production, mitigation, analysis methods

OP-019 [Section II: Structures and Environment]
IMPACT OF SLATTED FLOOR AREA ON ODOR EMISSIONS IN FINISHING SWINE BUILDINGS

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In swine production, future buildings should be designed and built to minimize odor emissions. Low emission buildings will improved rural community acceptability. However, the influence of building design on odor emissions is misunderstood. Only few studies present results related to the impact of the building design on odour emissions. Moreover, in these studies, buildings are not fully described and emission values varied on a large range making difficult a comparative analysis of these results. However, in agreement with the literature, the floor type seems to play a key role on odour emissions. Consequently, the present project focus on the impact of floor types on odour emissions and more specifically, aims to measure emissions from buildings having full and partly slatted floors. The hypothesis of the project was a full slatted floor building emits significantly less odour then a partly slatted floor building. Following a preliminary study to determine sampling period and validate flow measurement technic, an odour emission measurement campaign was carried out on 14 fattening swine buildings (seven fully slatted floor buildings and seven 1/3 slatted floor buildings) located in Quebec province (Canada). Buildings with similar operational characteristics were selected: mechanical ventilation (linear opening at one side and exhaust fans at opposite side wall), 80 kg minimal swine average weight and all-in/all-out management. Moreover, indoor conditions of each building were characterised. One room per barn was selected and every fan was monitored to obtain the total airflow from the selected room. The pig population of the room was the same for all the campaign. Depending of the barn, the room population ranged from 45 to 358 pigs. Artificial lung technic was used for air sampling in TedlarTM bags. Odor concentration was measured by dynamic olfactometry. For every barn, 6 samples at the exhaust and 1 sample at the inlet were taken per day between 10h00 and 14h00 at three different days between May and October 2017. Averaged odor emissions were 3.6 and 6.7 O.U./s-pig from fully slatted floor and partly slatted floor barns, respectively. Difference (46%) was statistically significant according to a mixed linear model fitted to the data in each group. Consequently, fully slated floor should be considered by producers to reduce odour emissions from swine buildings.

Keywords: air quality, odor emissions, cohabitation, social licence, swine building, slatted floor

OP-020 [Section III: Plant Production]
THE EFFECT OF DIFFERENT FURROW OPENER TYPES ON EMERGENCE PERFORMANCE AND SEED SPACING UNIFORMITY IN DIRECT SEEDING

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This study was conducted to determine the effect of four different types of furrow openers (hoe, chisel, double disc, inverted T) which were mounted on a direct seeding machine on emergence performance and seed spacing uniformity. The study was conducted in Çukurova University Agriculture Faculty Research Farm for two years (2012-2013). A four rowed pneumatic direct seeding machine was used for corn seeding. Mean emergence date, emergence rate index and percentage of emergence as indicators of emergence performance were calculated. The seed spacing uniformity was investigated based on multiple index, miss index and quality feed index. The inverted T type furrow opener gives the best results in mean emergence date (5.42 days), emergence rate index (2.53 plant day-1 m-1) and the percentage of emergence (92.67 %). While the best multiple index (3.28%), miss index (3.98%) and quality feed index (92.74%) were determined in double disc furrow opener. The type of furrow openers were statistically significant on emergence performance and seed spacing uniformity ($p<0.01$). Results were shown that combination of different furrow opener types will able to give best results in direct seeding.

Keywords: Furrow opener, direct seeding, emergence performance, spacing uniformity

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OP-021 [Section II: Structures and Environment]
IMPROVED VENTILATION BY CFD PREDICTION OF THERMAL CONDITIONS AMONG PIGS

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Negative pressure ventilation with diffuse air inlet through a layer of mineral wool in the ceiling is the dominant ventilation method in Danish pig productions. The method constitutes a simple way to generate appropriate thermal conditions among the animals, especially in periods with relatively low outdoor temperatures. To increase the chilling of animals in warmer periods newer finisher pig units are often equipped with an additional ceiling air inlet above each pen. These inlets direct a concentrated air jet directly down in the animal occupied zone, and are usually closed at outdoor temperatures below approximately 20 °C, and fully open at higher outdoor temperatures. Earlier research indicated that negative consequences of high temperature may occur at significant lower outdoor temperature than 20 °C if the sole air intake is through the porous material in the ceiling. The problem is most evident in pig pens with solid floor in the lying area, where warm conditions increase the risk of fouling the pen floor, and may cause impaired pen hygiene and air quality as well as increased emissions and workload. To investigate options to provide suitable thermal conditions at outdoor temperatures between 10 and 20 °C the earlier research included CFD to predict the effect of a gradually adjustment of the ceiling inlet opening depending on the outdoor temperature. The results indicated that it was possible to design and locate a ceiling inlet where the opening flap is controlled to maintain the effective temperature among the pigs within the desired level at outdoor temperatures up to around 19 °C. The study also indicated that an air jet attached to the ceiling, deflected by a back wall and continued attached to the back wall down in the animal occupied zone chilled the animals more effectively than a free jet directly from the inlet to the animal occupied zone. This result led to the hypothesis that it would be more effective to move the inlet closer to the back wall so the distance from the inlet becomes shorter, and so the inlet could be more open before the jet changed from an attached jet to a free jet. In this research, results obtained by a new CFD model confirmed the mentioned hypothesis, and indicated that the effective temperature among the pigs can be maintained at a desired level at outdoor temperatures up to around 22 °C.

Keywords: Ventilation, CFD, finisher pigs, effective temperature, diffuse air inlet, ceiling jet inlet

OP-022 [Section II: Structures and Environment]
IMPROVED SLURRY SYSTEM FOR PIG HOUSES WITH STRAW APPLICATION

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According to Danish legislation, pigs should have permanent access to rooting materials in order to ensure the animal welfare. Application of rooting materials may have a significant influence on the pen function and slurry system. The aim of the present study was to investigate the effect of straw application in pig houses for finishing pigs on the pen function, to test an automatic straw application system, and to develop a slurry system that can handle large amounts of straw. The experiments were carried out in experimental pig houses with 30 pigs in each. The pen function was tested with four levels of straw application (20, 50, 100 and 200 g straw day-1 pig-1) in pig houses with fully and partly slatted floor. The amount of straw did not influence the fouling behavior, but in pens with partly slatted floor there was 30% fouling in the resting area compared to fully slatted pens with only 3% fouling. Application of 20 and 50 g straw day-1 pig-1 did not influence the clogging of the slats, but with partly slatted floor there was significant clogging at 100 and 200 g straw day-1 pig-1. The precision and function of an automatic straw application system was tested with four levels of straw application (10, 25, 50 and 100 g straw day-1 pig-1) and four straw length (1, 3, 4 and 7 cm). At 1 cm, the deviation was below 5%, whereas the deviation was between 15-20% for 3-4 cm. A straw length at 7 cm was not applicable for the automatic application system. A slurry system was developed where u-shaped slurry trays placed below the slatted area of the pens were scraped three times a day. The slurry system was tested with up to 100 g straw day-1 pig-1. Technically the scraper system was able to handle the extra amount of straw ending up at the slurry trays. On average, the ammonia emission was approximately 20% lower in the scraper based slurry system compared to pig houses with a normal slurry pit with vacuum flushing. In conclusion, it is possible to apply up to 100 g straw day-1 pig-1 without clogging of the slats and with a relatively high precision and a low emission slurry system with scrapers can handle the extra amount of straw in the slurry system.

Keywords: Straw, pigs, pen function, slurry system, emission

OP-023 [Section II: Structures and Environment]
CONTINUOUS ON-FARM MEASUREMENT OF AMMONIA EMISSIONS IN DAIRY BARNS

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Accurate assessment of national gaseous emissions requires measurements from different practical situations. The measurements need to be done in a proper way so that the results represent the actual situations accurately enough.

In this study, measurements of Ammonia emissions were conducted in Finland at insulated and uninsulated stationary and loose-housing dairy barns that utilized different manure management and littering systems. The emission measurement instrumentation was done with a new setup enabling accurate results in both space and time. Finally, usability of the measurement results and instrumentation was assessed.

One-week measurement sessions were done in a total of 24 sessions, i.e. six barns during all the four seasons. Continuously measuring Dräger PAC 7000 Ammonia monitors with a range of 0 to 300 ppm and a resolution of 1 ppm were used. The detection rate was set to 2 minutes in order to better detect the dynamics of the emission. The Ammonia monitors together with CO2, temperature and RH gauges were placed inside the barns at three elevations (0.1, 1.0 and 2.5 meters) and in four to six locations, depending on the size of the barn. The ventilation rate in the barns was derived out of measured C02 balance. The Ammonia emission was then calculated based on the measured Ammonia concentrations and the calculated ventilation rate.

According to the emission measurement results the loose-housing barns had significant differences in Ammonia emissions both during the seasons and between the farms as well, the level being mostly under 5 g/cow/day. In stationary barns the emission was less, under 3.5 g/cow/day. The emission level for loose-housing barns is considerably lower than the figures that have been previously used in national calculations utilizing European models with correction coefficients. For stationary barns the situation is opposite. Loose-housing, however, is the dominant housing system in future. Consequently, the Ammonia emission level in Finland might be much lower than projected in the previous modelling.

The results concerning the implementation point out the importance of understanding the local circumstances and the ability to make the measurement design accordingly. Since there were several instrumentation locations the positioning of sensors could be evaluated. The dense detection rate could be used to reveal emission fluctuations and assess the effect of different detection rates on the reliability of measurements.

Instrument locations need to be derived from the barn layout and space. The continuous measurement principle with dense detection rate and relevant instrument locations allowed the researchers to find daily and momentous fluctuations in emission rate that were caused by the individual management practices on the farms and disturbances in them. These might explain the large variation in emission measurements that have been done before with inadequate instrumentation, i.e. using random locations or unsuitable detection rates.

The utilized principle of emission measurement enables a more precise analysis of the differences of barns. However, the price-quality ratio of instrumentation limits the practical usability of methods. Research and inspection have different requirements from those of farm level appliances, e.g. air conditioning control. Continued studies are needed to develop optimised methods for each use at farm level.

Keywords: ammonia emission, measurement, accuracy, dairy production

OP-024 [Section II: Structures and Environment]
A STUDY OF POULTRY DYNAMIC DEEP BODY AND HEART RATE RESPONSES TO AMBIENT TEMPERATURE AND AIR VELOCITY

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There's a growing interest in the literature in dynamic control of poultry housing environmental conditions using physiological responses from the birds. Studies which examine the impact of environmental conditions on birds' physiology are a prerequisite for such research. In this study, we investigate poultry deep body temperature and heart rate dynamic responses to steps changes of ambient temperature under natural and forced convection. Using five commercial breed broilers, an experimental tunnel ventilation enclosure placed inside an environmentally controlled chamber, implanted radio telemetry sensors, and a programmable logic controller (PLC), several experimental trials were conducted subjecting the birds to various conditions. Results led to the following CONCLUSIONS: (1) DBTs of individual birds were found to have a 0.83 correlation, which suggests that a small number of birds could be used to estimate the average DBT of all birds exposed to the same environmental conditions. (2) DBT was found to somewhat follow a first-order exponential decay rate when birds were subjected to step changes in ambient air temperature. The models and the actual data had a correlation of 0.88. (3) Heart rates of individual birds had a correlation of 0.15 with each other, which indicates that it would be difficult to use a small number of birds to estimate the average heart rate of all birds exposed to the same environmental conditions. (4) Average DBT and average heart rates did not correlate well, except in two of six experiments when the birds were under natural convection, which had correlations of 0.49 and 0.86. Average DBT and average heart rate were not found to correlate well, but the average DBT and inverse of the average heart rate had a significant correlation of 0.61, 0.77, and 0.68 in three of six experiments. Overall, these studies suggest that using DBT as a variable to manipulate air velocity within poultry housing is a promising approach. The use of heart rate, though informative, may not be as promising.

Keywords: Poultry, Environmental Control, Deep Body Temperature, Heart rate, Tunnel Ventilation

OP-025 [Section II: Structures and Environment]

APPLICATION OF ANALYTICAL HIERARCHY PROCESS TO DEVELOP A WEIGHTING SCHEME FOR LIFE CYCLE ASSESSMENT OF AGRI-FOOD SECTOR

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The Impact Assessment (IA) step in Life Cycle Assessment (LCA) studies is classified into three steps of characterization, normalization and weighting. In this study, the different impact categories were weighted using Analytic Hierarchy Process (as a multi criteria decision making tool). Iranian tobacco production system was the example agricultural system. The data for LCA analysis were collected from 225 farms. The data for AHP analysis were gathered by surveying 12 LCA experts. The results indicated that on-farm emissions of CO2, CH4, N2O, NH3, NOx and SO2 were accounted for 25, 96, 93, 99, 21 and 2% of the total emissions (cradle to farm gate), respectively. The characterization indices for the impact categories of global warming, terrestrial eutrophication, acidification, fossil resources depletion, phosphate resources depletion and potash resources depletion for one tone tobacco production were determined to be 1883.90 kgCO2eq, 19.69 kgNOxeq, 13.87 kgSO2eq, 59659.23 MJ, 4.19 kgP2O5 and 6.14 kgK2O, respectively. The LCA+AHP showed that the fossil resources depletion impact category was attributed the highest negative environmental impacts of tobacco production followed by depletion of phosphate resources.

Keywords: Environmental impact, Global warming, Life cycle assessment, Multi criteria decision making

OP-026 [Section II: Structures and Environment]
LANDSCAPE FRAGMENTATION IN EUROPE: A COMPARATIVE ANALYSIS

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Landscape fragmentation (LF) has been acknowledged as one of the main causes of biodiversity loss. The phenomenon consists of large-scale transformation of habitat patches in smaller fragments that tend to be more isolated over time. LF can be due to transport and mobility infrastructures (TMIs), and affects local climatic conditions, habitat quality, and isolation of animal and plant species. The literature supplies scholars with various indicators able to quantify the ecological impact of LF.

In this work, we assess and compare LF in four landscape units (LUs) of approximately the same surface area –two LUs in Wales (the UK) and two in Sardinia (Italy)- belonging to quite different ecological and institutional European contexts. We apply the Barrier Fragmentation Index (BFI), which takes into account the barrier effect of road infrastructures with reference to the perception of the hedgehog (Erinaceus europaeus L), a target species quite common in both the countries. We also measure LF through the Urban Fragmentation Index (UFI), which appreciates the effect of urbanized areas. While measuring the BFI, we take into account the number of patches, the length of TMIs traits without discontinuities such as bridges and tunnels, the perimeter and area of the LUs, and the probability of barrier effect that varies according to the type of TMIs. We quantify the UFI taking into account area of the LUs and the extent and perimeter of urbanized areas.

We measured the highest values of BFI and UFI, respectively, in the 'North East Wales' (299733.70) and in 'South East Wales' (7.06). We registered the lowest values of the same indicators in the inner mountainous LU of 'Limbara' (1441.57 for BFI, and 0.24 for UFI), in Sardinia. These results are a clear sign that coastal and more populated LUs are the most fragmented. These indications are key for planners and decision makers towards proper courses of actions toward defragmentation.

Keywords: Landscape fragmentation, Fragmentation indices, Urban Fragmentation Index, Barrier Fragmentation Index.

OP-027 [Section II: Structures and Environment]
CONTROL SYSTEM OF AN UNMANNED AND REMOTE-CONTROLLED HARMFUL-FLY COLLECTING DEVICE FOR SMART GREENHOUSES

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Greenhouse is getting more popular for the year-round high quality production and yield crops under controlled environments using information and communication technologies. The conditions favorable to crops, however, cause increase of diseases, insects, and harmful flies, in some cases In the study, a control system of an unmanned and remote-controlled harmful-fly collection device for smart greenhouses was developed and the performance was evaluated. The harmful-fly collection device consisted of a driving motor to move the device along the monorail installed in the greenhouses, blowing fans to create outward winds to detach the flies from the crop surfaces and move in the air and also inward suction air flow into the collection device, a LED lamp and electronic mesh-wired bracket to attract and kill the flies at the entrance of the collection part and an UV lamp sterilizing the air to reduce ambient diseases and viruses. The control system consisted of a sensing, a control, a wireless communication, and a central management part. The sensing part collected information on ambient environments and operating status. Operating status included the location of the device using a pressure reducing plate and an infrared distance sensor and component operation using air flow sensors and current sensors. The control parts included power supply units and relays, and the driving and fan motors were controlled using the PWM method. The wireless communication part was designed to send the sensing information to and receive the control commands from the central management part using ZigBee modules. In this way, users could monitor and control the collection device at remote locations and in real time. The device location was successfully monitored using the infrared sensor. The total power consumption of the collector was 120 W. The wind speed was 5.9 m/s with the maximum output of the fan motor. Field tests confirmed the performance of the short distance wireless communication with 100% success ration within 50 m. The number of pulses on the back of the leaves of the crops in one third of the greenhouse was measured at three sites. When the operation was carried out at 5 times at the wind speed of 3 m / s of the collector, the effect of controlling up to 30% was shown. Therefore, it is expected that enough pest control will be possible if workers use it more than 5 times at night when they do not work.

Keywords: Greenhouse, Whitefly, Pest control, Automatic control system

OP-028 [Section II: Structures and Environment]
GREENHOUSE VENTILATION CONTROL WITH ARTIFICIAL NEURAL NETWORK MODELS

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Greenhouses have been commonly used to provide plants with good environmental conditions to grow. However, one of the biggest challenges facing in the current greenhouse crop cultivation is how to effectively manage the operation of cooling and heating systems for crop growth while considering both economic costs and productivity. Without a method of removing excess heat, temperature may increase to levels detrimental to crop growth. Ventilation is an important task used to maintain temperature inside the greenhouse in an optimal level while protecting a rapid increase or decrease in temperature by hot or cold climates. This research describes an artificial neural network (ANN) model that can be used in a precision ventilation control system to effectively vary the opening areas of multiple windows based on the prediction of temperature change in advance inside a greenhouse. The model database was built using greenhouse climatic data collected in a farmer greenhouse of cultivating strawberry. A prediction model was developed based on the ANN model algorithm that uses external climate data and operation data of actuators as input parameters. Results of a comparison between the predicted results and actual experimental data indicated that the developed ANN model would be suitable to predict the changes of greenhouse temperature in advance. In simulation, the newly developed inverse-ANN model could determine the optimal opening levels of the windows to reach the target temperature with an acceptable level. Future studies include application of the developed ANN-based ventilation control algorithm to actual greenhouse cultivation.

Keywords: Greenhouse Ventilation, Neural Network Optimizer, Temperature Control

OP-029 [Section II: Structures and Environment]
STRESS DISTRIBUTION AND FLOW PATTERN IN A MODEL GRAIN SILO WITH OBSTRUCTION ATTACHED TO THE WALL

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For design purpose of storage silos an axially symmetric distribution of stress inside the granular material is usually assumed. However, asymmetry in pressure distribution is not uncommon because of such factors as: eccentric filling or/and discharge, non-uniform humidity and caking of the material, or additional construction elements inside the silo. Inserts are used to assure reliable flow, decrease wall pressures or induce required flow pattern to decrease the frictional grinding of the wall in silos holding abrasive materials.

A study was performed to numerically evaluate the effect of obstruction in the form of annular segment attached to the silo wall on flow pattern and stress distribution inside the stored material as well as on construction members of the silo. Model silo was a cylinder with diameter 0.16 m and height 0.48 m filled with 200 000 spherical particles with random uniform distribution of diameters dp=3.79±0.05 mm. An obstruction was full ring shaped element with width of 3, 6, 9 and 12 dp.

In the no-insert configuration an angle of the dead zone was found of 55°±3°. Attachment of an insert resulted in elevation of areas of stagnant material below and above an obstruction and gradually shifting from mass to funnel flow. In storage condition, insert 9dp wide placed at H/D of 0.95 reduced normal wall pressure from 1.1 kPa (no-insert) to 0.8 kPa and vertical shear stress from 0.25 kPa to 0.17 kPa. Averaged wall pressure at early phase of discharge below an insert was reduced from 1kPa to 0.6 kPa, and shear stress from 0.2 kPa to 0.07 kPa. All inserts produced decrease of the bottom load during discharge. In the case of the placement at 0.31D and the widest insert bottom load decreased from 25.5N to 8 N.

Attachment of an ring shaped obstruction to the silo walls resulted in a decrease of normal and vertical stresses below an insert, while increasing its stiffness. Such a design might be useful as well if the load on the bottom of the silo is an issue and must be lowered. DEM simulation appear a promising tool for estimation of a change in stress distribution due on internal elements immersed in granular material filling a silo, as well as in visualization of flow patterns within the silo.

Keywords: DEM, storage silo, stress, flow pattern, internal obstruction

OP-030 [Section II: Structures and Environment]
THE POWER TRANSMISSION CHARACTERISTICS OF OVERLOAD SHAFTS WITH DIFFERENT FRICTION CLUTCHES AND SPRING LOADING CONDITIONS

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The power take-off (PTO) drive shafts, is one of the main ways to transfer power from the tractor to drive implements. To avoid overloads the PTO shaft must be implemented with a protective friction clutch. The friction clutch mechanisms has an important role particularly to a safety clutch for protecting machine drive lines especially useful in connecting the drive shafts of agricultural implements such as tractors or the like. A clutch particularly suitable for machine drives in agricultural implements including a clutch hub, a clutch sleeve, and spring-loaded members operative to engage and disengage for controlling torque transmission through the clutch. The friction discs within the clutch when the maximum torque is exceeded automatically disengaged the clutch. Upon achievement of a nominal torque which is spring-loaded in the clutch hub, may automatically re-engage the clutch. In this study, load carrying characteristics of shafts with overloading clutches used in agricultural machineries were examined. Three shafts with overloading clutches which were made for different friction loaded by spring were mounted to the PTO shaft of the tractor and tested according to the TS 10990. The hydraulic dynamometer was used for breaking of shafts. Different compression strokes for spring were applied for loading friction clutch for comparison of slippage torque and transmitted power of clutches under loading. Regression equations were obtained using slippage torques and power transmission data for different spring compressions strokes. By using these equations, one can adjust properly usable storks of spring for limiting torques of friction clutches.

Keywords: shaft, overloading clutch, slippage torque, compression spring

KÖTÜ HAVA ŞARTLARI MİLYONLARI AÇ BIRAKABİLİR

BİLİM İNSANLARIMIZ BUNU KABUL ETMİYOR

Önümüzdeki 20 yıl içerisinde dünya nüfusu 9,8 milyarı bulacak. Kişi başına düşen ekilebilir tarım alanları azaldıkça, yer küredeki her insana yetecek kadar verimli ve sağlıklı gıdanın elde edilmesi için gıda üretimini yüzde 70 artırmak şart… Tarımsal mahsuller de değişen zorlu hava koşulları nedeniyle tehdit altında. Değişen şartlara uygun olarak biz, tarım ürünleri çeşitlerimizin dayanıklı olmasını ön planda tutuyoruz.

Tarımsal üretimin her aşamasında çiftçilerimizi destekliyor; tohum, kimyasal ve biyolojik bitki koruma alanlarında tarım hizmetleri sunuyoruz. Tarım sektörünü geniş deneyimimizle beslerken, sofralarımızı da gıdasız bırakmamak üzere çalışıyoruz! İnovasyonlarımızın daha iyi bir yaşama nasıl hizmet ettiğini öğrenmek için: www.bayer.com/ewdq1903

BAYER

Daha İyi Bir Yaşam İçin Bilim

OP-031 [Section II: Structures and Environment]
IDENTIFICATION OF NUTRIENT MIXING CONTROL PARAMETERS FOR A SMALL-SCALE RECYCLING HYDROPONIC CROP CULTIVATION SYSTEM

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Hydroponic crop production systems for plant factories and greenhouses are getting more popular, and nutrient recycling is very important to minimize the costs and environmental pollution due to excessive and discharged nutrients, respectively. Nutrient mixing control need to be optimized system-specifically because it cannot be universal for different systems with different components and design specifications. In the study, control parameters were identified for a small-scale recycling hydroponic crop cultivation system. The nutrient supply system tested in the study consisted of tanks for used nutrients, nutrients A and B, distilled water, and mixed nutrients for supply, ISE sensors for N, P, K, and Ca, diaphragm pumps and pipes, and a controller. The controller consisted of an Arduino microcontroller, relays, variable flow control valves, and a LabVIEW-coded program. Three control methods of P, PID, and Fuzzy-PID were implemented and the coefficients were identified through mathematical simulations and laboratory tests. Performance was evaluated by the control accuracy and response time.Mathematical simulation showed that parameters of the nutrient control methods could be successfully identified and optimized. Target concentrations of the N, P, K, and Ca ion were set as 210, 31, 235, and 200 ppm, respectively, and the concentrations of other micronutrients were calculated by the mass balance relationships. With the P method, the target ion concentrations were maintained with the error of 5, 11, 7, and 13% for N, P, K, and Ca, respectively, and about 200 s was required to complete a single cycle. PID control parameters were adjusted, stability time was 110 s, overshoot was 5.5%, and the oscillation duration was 25 s, while the Fuzzy-PID control took 90 s to stabilize, the oscillation duration was 20 s, and the overshoot was 3%. Further study on verification under various conditions and field tests would be necessary for successful implementation of efficient control methods.

Keywords: Hydroponics, Nutrient supply system, Mixing control, Proportional, PID, Fuzzy-PID

OP-032 [Section II: Structures and Environment]
ENVIRONMENTAL IMPORTANCE OF OLIVE GROVES IN CULTURAL LANDSCAPE, THE CASE STUDY OF ANTALYA

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Olive (Olea europaea), is a tree species unique to the Mediterranean climate, which is eaten with its fruit. Olive groves which have importance in terms of the sustainability of urban ecosystems are essential for the planning of the Mediterranean cities. Urban vegetation in olive groves increase property values improve privacy and provide many environmental benefits. They reduce heating and cooling costs, reduce pollution, take up carbon dioxide, produce oxygen, provide habitat for wildlife, hold water and reduce soil erosion. Antalya is the Mediterranean city. It has been the center of culture, art, architecture and mythology throughout its history. With its nature made up of dark blue seas, spectacular Taurus mountains, fervent waterfalls and world known holiday villages is what makes Antalya the capital of Tourism. There are too many hotels and new tourism facilities have still been built in the city. The rise of the building sector affects all the planning actions all over the city. Because of this, in urban areas hard surface density is rising and by the conclusion of this process affects the urban areas. Under these conditions, the identities of the cities are lost and decrease of the green areas like olive groves affect life quality of the public. Antalya has very important olive grove which is called "Zeytinpark" is the largest green space in a city in Turkey. There are 23 thousand olive trees in Zeytinpark in the size of 280 hectares. This area was declared as " Grade 1 Natural Protected Area" by Antalya Cultural and Natural Heritage Protection Board on 26.10.1998. This area was separated as 'Agricultural Qualities Protection Area' with the decision of the protection board on 14.06.2007. Despite all this, Zeytinpark is in danger of losing its original quality. Human impact on natural landscapes through urbanization era is becoming more and more dramatic and is the cause of serious environmental problems in Antalya as well as in Turkey. In this research olive grove which is valuable for urban ecosystem was defined on urban structural plan for Antalya. It was proposed some suggestions for protecting and using Zeytinpark olive grove. The olive grove an important landscape component. However, the area that are represent of the agricultural Mediterranean vegetation are facing extinction in urban because of rapid urbanization in Antalya. Zeytinpark should be preserved as it is with the existing properties. It must be transferred to future generations with a sustainable management understanding.

Keywords: Olive groves, Mediterranean, urbanization, protection, environment.

OP-033 [Section II: Structures and Environment]
URBAN AGRICULTURE AS A TOOL FOR ENVIRONMENTAL PROTECTION

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Urban agriculture is an activity which is using plantation, animal rearing along with input production and distribution, processing and marketing of produced goods for the purpose of income generation and providing the required fresh food. Urban agriculture is an integral part of the city's ecological and economic system which uses typical possibilities unique to the city itself. It has the potential to change food safety, the benefits of conservation of nature, and even the form of the city. As a sustainable environmental tool, it can improve the heat islands and effects in cities, creates green areas, reduce flood floods and improve air quality. Since food production takes place locally, there is also the potential to reduce energy, quality, crop loss and pollution from transport. There are 800 million people across the globe who is working on urban agriculture. Furthermore %15 of the world's food need is provided by urban agriculture. Farming systems are continuously changing in European peri-urban fringes and planning strategies specifically designed for a sustainable development of the urban-rural interface have been proposed in an increasing number of cities. Urban agriculture is being thought to as an alternative model in Turkey and especially Antalya. Agricultural activities continue in Antalya city, even in small scale. it is also important for Antalya to have access to clean food, for the children to be involved in the growth processes of the plants and to experience being a producer and a self-sufficient society. Urban must have an understanding of agriculture that is renewable, sustainable, ethical, supports recycling, protects limited water resources, gives priority to ecological balance, gives maximum benefit to areas, chooses nature compatible material, refuses to use chemical drugs and supports causal relationship. The new understanding of agricultural design, in which urbanites share this process with landscape architects, should actually aim to be a part of our lives. For this reason, agricultural activities should be widespread on small scales as well as on large scales. Roofs, terraces, and even balconies, must be made out of idle spaces. These areas can give new life spots to urban areas where all these headings are applied and not only drowned by aesthetic concerns. Urban agriculture areas should be protected in Antalya and urban agriculture should be supported. We should not turn regional citrus, olive and mulberry gardens of Antalya into shopping centre, business centre, residence or car park for rent.

Keywords: Urban agriculture, environmental protection, Antalya

OP-034 [Section III: Plant Production]
DETERMINATION OF THREHSING PERFORMANS OF NEW DESING THRESHING UNIT FOR LAVANDIN (LAVANDULA X INTERMEDIA EMERIC EX LOISEL.)

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In this study, the threshing system performances required for Lavandin (Lavandula X Intermedia Emeric Ex Loisel.) have been determined. Physico-mechanical properties used in the design of the threshing system were determined in three different moisture range for sage plant and the system design has been made according to the harvest moisture values. In this study, threshing efficiency, work efficiency, power requirement and specific energy consumption values of the threshing unit developed were determined. In order to determine the threshing performance of the prototype, experiments were made at 3 different moisture ranges, 3 different drum speed, 3 different drum-concave open and 3 different feeding rates. Each experiment was performed in 3 replicates. As a result, a total of 243 experiments were carried out for a plant in the threshing experiments. According to the study results, threshing efficiency for Lavandin (Lavandula X Intermedia Emeric Ex Loisel.) in the study has been changed between 45.69% and 95.56%. Work efficiency of threshing units has been changed between 0.67 kg/h and 12.27 kg/h. Power requirements and specific energy consumption of threshing units have been determined as 0.199- 0.948 kW and 0.03-0.59 kWh/kg respectively

Keywords: Lavandin (Lavandula X Intermedia Emeric Ex Loisel.), threshing, design, aromatic plant

OP-035 [Section III: Plant Production]
DETERMINATION OF SEPARATION PERFORMANCE OF NEW DESIGN SEPARATING UNIT FOR LAVANDIN (LAVANDULA X INTERMEDIA EMERIC EX LOISEL.)

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Lavender, from Lamiaceae family in the form of shrubby, is a perennial, valuable and essential oil plant and is grown primarily in Mediterranean and Balkan countries and in many countries around the world. Lavandin species (e.g. Grosso, Provence, Giant Hidcote, Phenomenal) are a cross between the Lavender and spike lavender varieties.

For many years, mechanization of harvesting and threshing has been successfully implemented for various crops and has been developed depending on technological progress. However, the processes of threshing, separating and cleaning of medicinal aromatic plants are carried out by conventional methods (by hand) after the products are dried. This case leads to damage to the product, loss of labor and yield. In order to help to overcome these disadvantages and separate the dried products from the foreign materials such as stalk, spall and dust special separating systems designed depending on the plant are needed.

In this study, the separation-cleaning performances required for Lavandin (Lavandula X Intermedia Emeric Ex Loisel.), for our country and the Mediterranean Region, have been determined. Performance values and working limits of the separating unit have been determined. The separation system consists of two sieves which have adjustable vibrating, velocity and inclination features.

The separating unit is consists of chassis, mainframe, sieve housings, inclination adjusting mechanism and material outlet unit. The performance as separating efficiency, work efficiency and specific power consumption of separating unit were determined.

In order to determine the separation performance of the separating unit, 3 different sieve type experiments were performed depending on the amount of 3 different feedings. Experiments were carried out at 3 different sieve speeds and 3 different sieve slopes for lavandin. Each trial was performed in 3 replicates.

According to the study results, separating efficiency for Lavandin (Lavandula X Intermedia Emeric Ex Loisel.) used in the study has been changed between 48.88% and 90.82%. Work efficiency of separation units has been changed between 0.44 kg/h and 3.79 kg/h. In different operations, the specific power consumption of separation unit has been changed between 3.48 kW/kg and 39.04 kW/kg.

Keywords: Lavandin (Lavandula X Intermedia Emeric Ex Loisel.), separating, design, aromatic plants

OP-036 [Section III: Plant Production]
RICE HARVESTING OPERATION BY TWO COMBINE ROBOTS

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In order to solve shortage and aging of working force in Japanese agriculture,automation and robotalization of agricultural machinery are promoted rapidly. To improve the efficiency of farming operation much more, cooperative harvesting system by combination of two robots is proposed in this study. Therefore, two robots, that are 4-row head-feeding combines, were developed to automate rice harvesting work in Japan. They have installed a multi-GNSS receiver, a GPS compass, and an IMU as navigation sensors. Additionaly, To avoid collision each robot, 760MHz wireless modems are employed to communicate position, attitude, and working status of each combine. In order to evaluate performance of these systems, field test was conducted in a rice paddy field. Two harvesting methods were compared regarding the working efficiency of harvesting. One is that two robots harvest crop side-by-side(side-by-side harvesting). The other is each robot harvests crop areas divided into two blocks independently(block harvesting). As the result, the working efficiency of the block harvesting method is 24% higher than that of the side-by-side harvesting. Furthermore,test results indicated that the autonomous combine can harvest rice crop safely while avoiding collision.

Keywords: combine harvester, automation, multi-robot, work planning, working efficiency

OP-037 [Section III: Plant Production]
BENCH TEST AND ANALYSIS FOR RAMIE STALK CUTTING

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As a basis in the field of design and research of harvester prototype, bench cutting test is to provide best parameters for the cutter design. In order to obtain the optimal parameters of cutter of the ramie harvester, cutting tests on ramie stalk were conducted to examine the influences of different geometrical parameters (length and edge type) of blade, different cutting speeds and stalk feeding speeds of reciprocating single movable blade and reciprocating double movable blades on the cutting performances (cutting power, cutting quality and synthesis score) by using self-designed test bench. According to features of different test factors, multi-factors orthogonal test was applied to determine the best combination of blade length, blade edge type and number of movable blade. Then with these parameters fixed, the optimal parameters of cutting speed and stalk feeding speed were obtained by quadratic-regression rotatable orthogonal test. In multi-factor orthogonal test, the optimal combination of factors was reciprocating double movable blades with long (120 mm) and serrated-edge. In quadratic-regression rotatable orthogonal test, for cutting power, when cutting speed was 0.8789 m/s, stalk feeding speed was 0.8624 m/s, the cutting power would be minimum, i.e. 281.4084 W/m; for cutting quality, the evaluation index was number of failed stubbles, and when cutting speed was 1.1614 m/s, stalk feeding speed was 0.7117 m/s, the number of failed stubbles would be minimum, i.e. 6.2110/m2; for synthesis score, when cutting speed was 1.0920 m/s, stalk feeding speed was 0.7229 m/s, the score was highest, i.e. 86.7180, at this situation, the cutting power was 318.8145 W/m, and the number of failed stubble was 6.6463/m2. According to the test results, the best condition of ramie stalk cutting was that using cutter with reciprocating double movable blades of long (120 mm) and serrated-edge at cutting speed of 1.0929 m/s and stalk feeding speed of 0.7229 m/s. The optimum parameters of bench test were verified in the subsequent field test and analysis results can be applied into related researches on ramie harvesters.

Keywords: ramie, stalk, test-bench, cutting, parameters

OP-038 [Section III: Plant Production]
OPTIMIZED PECTIN EXTRACTING TECHNOLOGY FROM ALOE SKIN WITH ACID HYDROLYSIS

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In order to make usage of aloe skin discarded from processing of aloe stalk meataloe skin dry powder was adopted as raw material in the study. Acid extraction and alcohol precipitation method was used to extract aloe pectin. Single factor test and response surface optimization experiment were carried out to finish the extraction process. The results showed that acid extraction and alcohol extraction of aloe pectin precipitation method was feasible. Optimum extraction technology was ratio of liquid to material 30:1, the pH value of solution was 3.5, the acid hydrolysis time was about 120min and acidolysis temperature was 75, and extraction rate of pectin was 22.6%. Some major characters like galacturonic acid, viscosity and molecular weight of the pectin were tested, either. Further conclusion was drawn and the most important results analyzed at the end.

Keywords: Aloe skin, Pectin extraction technology, Major characters analysis

OP-039 [Section III: Plant Production]
EFFECT OF VARIABLE RATE FERTILISATION ON YIELD AND FERTILISER REQUIREMENT OF TABLE OLIVE

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Objective of this research is to investigate precision farming possibilities in table olive orchard and to compare with conventional production. A field experiment was carried out for 2 years. Materials were olive, multiple mineral fertilizer spreaders with variable rate controller, Real Time Kinematic– Global Positioning System (RTK GPS), and fertilizers in this research. There were 132 olive trees in the orchard for production table olive. Fertilizer application methods were variable rate and constant rate. Orchards were dived grids which includes 4 olive trees. Soil and leaves samples were taken for each grid and 0-0.3 m and 0.3-0.6 m soil depth. Nutrient contents of soil and leaf sample were analyzed and created maps by using ArcGIS software. Fertilizer requirement of each grid were calculated due to requirement of olives. Suggested pure N, P and K rates were determined for olive from the literature. Fixed amounts of N, P and K were applied to trees for the conventional fertilizers applications. Suggested rates were 0.75 kg/tree for N, 0.275 kg/tree for P (in form of P2O5) and 1.5 kg/tree for K (in form of K2O) (Haifa Group, 2015). For the variable fertilizer applications, rates were calculated by the leaf analysis. A regression formula for each macro element (N, P and K) was formed by using minimum and maximum values from leaf analysis By the calculations; amount of pure nutrient requirements of variable rate applications results were; Nitrogen (N) 11.82 kg, diphosphorus pentoxide (P2O5) 5.97 kg, and potassium oxide (K2O) 25.74 kg. Optimal rates for N, P and K were obtained for fertilizers application rates by using a regression equation. K values in that region were high in soil and leaf analysis also indicated those results. So only, 10% of the required amount of K was applied for each tree, assuming maximum 10% of K could be uptaked from the soil. Application rates for N, P and K were calculated from the commercial forms of the fertilizers. Half of required nitrogen was applied in form of urea (46% N) and other half was applied in form of ammonium nitrate (33% N). Phosphorus was applied in form of triple super phosphate (42% P2O5) and potassium was applied in form of K2SO4 (51% K2O). Fertilizer prescription maps for N, P and K were created by using developed agricultural inputs application software. Fertilizer distribution machine and variable rate control system worked according to created prescription maps.

Pure nutrient amount of constant rate of applications were 12.75 kg N, 4.67 kg P2O5, 25.5 kg K2O. Yield data showed that variable rate application was better than constant rate fertilizer application. Mean yield for a tree was 7.78 kg for variable rate application and 6.85 kg for conventional constant rate fertilizer application.

Keywords: olive, fertilization, precision agriculture, variable rate application, yield map

OP-040 [Section III: Plant Production]

UTILIZATION OF STRUVITE PRODUCED FROM HUMAN URINE IN AGRICULTURE AS A NATURAL FERTILIZER

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Most of the nutrients in municipal wastewater originate from urine. Nevertheless, in the agriculture chemical fertilizers are commonly used instead of urine. There are some problems related to the direct utilization of urine, such as micropollutants present in urine, odour and storage of large volume of urine. In wastewater, phosphorus has been shown to significantly contribute to the pollution of the aquatic systems, and wastewater treatment techniques are focusing on removing phosphorus. Phosphorus is collected in the sludge either by a chemical or by a biological process. The sludge can be further treated to improve its quality, e.g. stability and spreadability, as a fertilizer. With a growing concern of the micropollutants present in sludge, the use of sludge has been gradually decreasing. Due to this concern phosphorus content in sludge is not recycled efficiently to reduce the use of limited mineral phosphorus ressources. To overcome these issues, urine could be collected separately and struvite could be produced. This would recover about 90% of phosphate in urine. In this paper the usage of human urine and struvite as a fertilizer in the agriculture and the production of struvite will be introduced. A few existing fertilizer raw materials will be compared with struvite. Results show that the struvite could be an efficient natural fertilizer.

Keywords: human urine, struvite, agriculture, dry toilets, urine-diversion dry toilets, sustainable development

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OP-041 [Section III: Plant Production]
EFFECT OF SPATIAL VARIABILITY ON FERTILISER REQUIREMENT FOR OLIVE ORCHARD CULTIVATED FOR OIL PRODUCTION

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Aim of this research was to determine effect of spatial variability of soil texture, pH, salt, and plant nutrient contents of soil and leaves on fertiliser requirement of an oil olive orchard which has 102 olive trees. Soil and leaf samples were taken from 29 locations to determine spatial variability. Soil texture, pH, salt, lime, organic matter, nitrogen (N), phosphorous (P), potassium (K), calcium (Ca), magnesium (Mg), iron (Fe), copper (Cu), zinc (Zn) and manganese (Mn) amounts were determined from soil samples taken from 0-30 cm and 30-60 cm soil depths. N, P, K, Ca, Mg, Fe, Cu and Mn were also determined from leaf samples. Suggested pure N, P and K rates were determined from the literature. Fixed amounts of N, P and K were determined as the conventional fertilizers applications. Suggested rates were 0.75 kg/tree for N, 0.275 kg/tree for P (in form of P2O5) and 1.5 kg/tree for K (in form of K2O) Reference potassium amounts were given double the amount of nitrogen applied to the orchards as suggested according to the literature. For the variable fertilizer applications, rates were calculated by the leaf analysis. A regression formula for each macro element (N, P and K) was formed by using minimum and maximum values from leaf analysis Optimal rates for N, P and K were obtained for fertilizers application rates by using a regression equation. K values in that region were high in soil and leaf analysis also indicated those results. So only, 10% of the required amount of K was applied for each tree, assuming maximum 10% of K could be uptake from the soil. Application rates for N, P and K were calculated from the commercial forms of the fertilizers. Half of required nitrogen was assumed that will be applied in form of urea (46% N) and other half will be applied in form of ammonium nitrate (33% N). Phosphorus was applied in form of triple super phosphate (42% P2O5) and potassium was applied in form of K2SO4 (51% K2O). Fertilizer prescription maps for N, P and K were created by using developed agricultural inputs application software. For the fixed rate fertilization scenario, 0.75 kg (N), 0.275 kg (P2O5) and 1.5 kg (K2O) per tree were applied. Total fertilizer requirements for fixed rate applications were determined for the whole orchard in commercial form. They were calculated 82.34 kg for urea, 114.77 kg for ammonium nitrate, 66.13kg triple super phosphate and 29.71 kg K2SO4. Total fertilizer requirements for variable rate fertilisation scenario were determined for the whole orchard in commercial form. They were calculated 85.07 kg for urea, 118.69 kg for ammonium nitrate, 67.75 kg triple super phosphate and 33.28 kg K2SO4.

Fixed rate and variable rate scenarios were compared by using soil and leaf analyses. Difference between variable rate and fived rate fertiliser application was not so much but there were spatial variability due to trees positions.

Keywords: olive, precision farming, spatial variability, variable rate fertilisation

OP-042 [Section III: Plant Production]
MODELLING OF THE NITROGEN REQUIREMENT OF WINTER WHEAT FOR PROTEIN CONTENT USING OPTICAL SENSOR

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Technological aspects of variable rate nitrogen fertilization receive much attention nowadays. The ability to estimate grain protein content in bread wheat prior to harvest can benefit grain growers. Protein content can take advantage of price premiums so it is a very important quality component of grains. The protein content of wheat grains approximately ranges from 8 to 20%. Optical methods are fast and non-destructive. In this study, optical sensors were used in order to determine the content of chlorophylls and flavonols in bread wheat. Leaf flavonoids content and leaf chlorophyll content were determined using Dualex Sensor (Force-A, Paris, France). Research has shown that grain protein levels were mainly affected by N availability. This paper presents a model which was develop to determine the optimum rate of nitrogen for protein content through using different indices from nitrogen sensor in winter wheat. This model will allow for mid season N estimation and therefore enable variable rate application of N fertilizer. For this purpose, an experiment was established to determine the effect of nitrogen on protein content using a randomized block design by applying five different rates of nitrogen (0, 80, 120, 160, 200 kgN/ha) in two different varieties of wheat. A quadratic polynomial model was best described the relationship between nitrogen protein content for optimum nitrogen rate and The results show that wheat quality is greatly affected by nitrogen fertilizer.

Keywords: Winter wheat, protein content, nitrogen use efficiency, precision agriculture, variable rate fertilizing

OP-043 [Section III: Plant Production]
EFFECTS OF LEAF SURFACE ENERGY ON PESTICIDAL PERFORMANCE

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Surface energy is widely used in the industry to predict behavior of spray droplets on solid surfaces. The targets of pesticide applications which are used extensively in agricultural production are mainly plant leaf surfaces. Researches related to pesticide application have mostly focused on studies such as epicuticular wax, epidermal cell structure, wax crystals, amount of wax, shape, composition, the leaf surface, leaf roughness, leaf hairs, general shape of epidermal cells, cuticle folds, hairs (trichomes). It is understood that some other similar studies do not meet the universality principle, and that models which give erroneous results in determining surface energy are used. Characterization of plants through a parameter that is a combination of physicochemical properties of the leaves, determining the impact rates of the changes in spray behavior applied to an object based on the model that produces the best results will make the results more sensible. Digitization of leaf surfaces to estimate the spread and adhesion of a pesticide application is an important approach in providing descriptive information. In this regards, from intensive agricultural products Triticum aestivum L., Citrus sinensis, Fragaria ananassa, Vitis vinifera L., Cucumis sativus, Capsicum annuum L. culture plants, Elymus repens and Sinapis arvensis from weeds were used to determine surface energy. The leaf surface energies were determined by evaluating the contact angles of the drips while obtained from surface tension and its components from known liquids pure water, diiodomethane and formamide liquids on the surface of the leaves according to five different methods. when the results should be directly proportional for the conversion of contact angles to surface energy, with the exception of models the Wu's and Equation of state methods, have produced antiparallel results with the contact angles. It is understood that other methods outside these two models produce erroneous results. The use of surface energy values with a certain numerical range instead of constant quantitative data for defining objects will be a more correct approach because of the definition of surface energy, which is not a definite case. Accordingly, the surface energies of the leaves and the application liquid surface tension value should be compared, since the application liquid with low surface tension can help droplets to more easily attach, spread and adhere to the leaf surfaces for leaves with low surface energy, it should be taken into consideration as an important factor for its use. Since the plant leaves with high surface energy will spread to the surface further, the use of liquids with higher surface tension will produce better results in preventing the leakage of the application fluid. Elymus repens and Triticum aestivum L. plants among the statistically three significant grouped leaves were reduce the spreading and sticking of droplets applied on the leaves by providing a more spherical droplet formation. The Fragaria ananassa leaves have encouraged the higher surface energy that they have the spread of the drips on the leaf surface.

Keywords: Contact angle, Diiodomethane, Leaf, Spray, Surface tension, Wu

OP-044 [Section III: Plant Production]
DEM SIMULATION OF BED-SHAPER AND FURROW OPENERS OF PNEUMATIC PLANTER

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Timely unavailability of labor for manual sowing of the maize crop leads to reduction in yield. Manual sowing of maize not only expensive but also causes the seed cost and wastage of time. Pneumatic maize planter is considered as precision planting machine. However, still adoption of the pneumatic planter is a problem at field level. Important factor of the pneumatic seed-metering device is its uniformity of seed spacing and blockage of seed placement tube in the furrow opener. Besides the design of the metering devices, field and operational parameters affect the precision distribution of seeds such as lack of synchronization of seed bed preparation and planter requirements. Due to this problem seed placement is effected and ultimately it is difficult to maintain the plant population. DEM simulation is considered the best method for simulation of granular material. To enhance the performance of pneumatic maize planter, DEM simulation of bed shaper and furrow opener of pneumatic maize planter using EDEM software was carried out to reduce blockage of seed tube with soil and thus to increase the sowing uniformity. Hertz Mindlin contact model with bonding was applied for simulation to fulfill the condition of moisture and cohesiveness among the soil partials. Simulated and field experimental data were compared to determine the applicability in the different working conditions. The model results validated the ability of simulation the Hertz-Mindlin contact model with bonding. The calibrated value of normal and shear stiffness was 5x107 N•m-1. This simulation will provide the guide line to modify the bed-shaper and furrow openers in pneumatic maize planter.

Keywords: Precision Planter, DEM Simulation, Bed-shaper, Furrow Opener, Sowing Uniformity

OP-045 [Section III: Plant Production]
MIXED SEEDING PERFORMANCE OF A SEED DRILL AT DIFFERENT MIXTURE RATIOS UNDER THE LABORATORY AND FIELD CONDITIONS

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The objective of this study was to evaluate the applicability of a seed drill for mixed seeding under the laboratory and field conditions. The performance of the seeder was determined using pure barley (Hordeum vulgare L.), pure common vetch (Vicia sativa L.), and mixtures of both seeds at different seed mixture ratios. The indicators of seeding quality, flow uniformity, and seed distribution uniformity across the rows were determined by the measurement of seed weights. The other indicator, in-row seed spacing uniformity, was investigated by sticky belt tests under the laboratory conditions while in-row plant spacing uniformity was determined after emerging of the plants in the field. Five different mixture rates of barley:vetch (100:0, 75:25, 50:50, 25:75, and 0:100) were used in the laboratory and field experiments. Experiments in the laboratory were conducted at three forward speeds (1.0, 1.5, and 2.0 m s-1) while the field experiments were achieved at 1.5 ms-1. Flow evenness and seed distribution uniformity across the rows were evaluated based on the coefficient of variation (CV). In-row seed/plant spacing uniformity was determined using the variation factor (Vf) and goodness criterion (λ). In laboratory conditions, the CV values of flow evenness were found to range from 1.0% to 5.5% for barley and from 0.3% to 2.1% for vetch. Seed distribution uniformity values of each row unit were found to range from 4.2% to 10.7% and from 0.4% to 1.4% for barley and vetch, respectively. Goodness criterion values were between 66.4% and 86.0% for laboratory conditions, while these values were 78% and 86% for field conditions. The variation factor values ranged from 0.43 to 1.28 and from 0.36 to 0.77 for laboratory and field conditions, respectively. Based on the experimental results and calculations, it was found that the combined seed drill could be used effectively for seeding of barley and vetch mixtures at different seed mixture ratios in laboratory and field conditions.

Keywords: Barley, Common vetch, Mixture ratio, Seed distribution uniformity

OP-046 [Section III: Plant Production]
DESIGN AND DEVELOPMENT OF A PROTOTYPE PRECISION METERING UNIT WITH TWIN VACUUM DISKS* FOR IMPROVED SEED SPACING UNIFORMITY AT HIGH SEEDING SPEEDS

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The objective of this study was to design and develop a prototype twin vacuum disk metering unit so that seeding can be achieved at higher forward speeds while reducing the peripheral speed of the vacuum disk for improved seed spacing uniformity performance and increased field work capacity. In order to meet this objective, a new precision seeding unit with twin vacuum disks, each mirrored view of the other and geometrically the same, was designed in an animated drafting software and then was manufactured and used for the laboratory experiments. Three crop seeds were used to determine the performance of the new metering unit in the lab on sticky belt test stand. The data obtained in the lab included three replications and five levels of peripheral speed of the vacuum disk, hole diameter and vacuum were tested. two alternative measures were used to quantify the seed spacing accuracy and polynomial functions using the principles of Response Surface Methodology were developed to calculate the optimum level of the variables. The tests performed in the laboratory at 2, 3 and 4 ms-1 forward speeds resulted in improved seed spacing accuracy values while the quality of feed index measure went down once the forward speed increased from 2 to 4 ms-1. The quality of feed index with new metering unit was obtained to be 100% at 2 ms1 while it was almost 98% for all crop seeds at 3 ms-1. The forward speed of 4 ms-1 resulted in quality of feed index values of 92, 96 and 96% for cotton, sunflower and corn seeds, respectively. It is believed that the twin vacuum disk metering system will help operating in the field at higher forward speeds with an increased seed spacing accuracy.

* Patent pending (Turkish Patent and Trademark Office, Application Number: 2015/15817)

Keywords: Accuracy, Respond surface methodology, Optimisation, Precision seeding

OP-047 [Section III: Plant Production]

DESIGN AND EXPERIMENT OF PRECISION CONTROL SYSTEM FOR WINTER WHEAT SOWING MACHINE WITH ROTARY TILLAGE AND STRATIFIED FERTILIZATION

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Winter wheat is the most important crop in Huanghe-Huaihe-Haihe (HHH) zone of China. Fertilization is an important process of wheat production, which directly affects the yield of crops, reasonable and effective use of chemical fertilizer can improve the yield of crops. At present, the automation level of wheat sowing and fertilization is very low in China, most of the sowing and fertilization machines are driven by ground wheels, the amount of sowing and fertilizer can not be controlled accurately which caused the uneven distribution.In order to reduce the amount of fertilizer and improve the work quality in wheat production, agronomic method and precision control technology must be used to improve the performance of the sowing and fertilization machines. The method of stratified fertilization and sowing is a an ideal agronomic method of winter wheat production in HHH zone of China. The study design a sowing machine with rotary tillage and stratified fertilization, the machine can make wheat seeds and fertilizer stratified, the wheat seed is the first layer, the shallow fertilizer is second layers, and the deep fertilizer is third layers. The precision control system was design to achieve the requirements of the precision operation. Its working principle is hydraulic motor driven sowing and fertilization, the amount was adjusted according to the change of the machine's speed obtained by GPS. The amount of the seed, the shallow fertilizer and the deep fertilizer can be controlled independently.The study has tested the sowing and fertilization working performance of the control system in static and dynamic condition. The coefficient of variation of each row quantity is 2.5%,2.1%, 2.3%, 1.9% in the speed of 10 r/min, 20 r/min, 30 r/min, 40 r/min. the total amount deviation of the seed, the shallow fertilizer and the deep fertilizer is within 3%, 3.5%, 3.8%.The result shows the amount of sowing and fertilization consistency is good and relatively constant, variation coefficient of each row is small at the same speed, which can meet the requirement of the actual production.

Keywords: precision control system, winter wheat, stratified fertilization and sowing, rotary tillage

OP-048 [Section III: Plant Production]
DEVELOPMENT OF ULTRASONIC POLLINATION SYSTEM

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An ultrasonic pollination device was developed to achieve effective artificial pollination of strawberries in artificial light type plant factories. A stress in the traveling direction of the ultrasonic wave is generated on the object surface when an object is blocking the progression of the ultrasound, and this phenomenon is call as "Acoustic Radiation Pressure". However, acoustic radiation pressure generated from one ultrasonic transducer is weak. Then hundreds of ultrasonic transducer was used to obtain several tens of force [mN]. The phase of each transducer was appropriately controlled, and focused on one point in space. The focused point can be changed any position in space by regulating the phase of each transducer. In other ward, it is possible to generate a force at any position in space from a remote location. The force was modulated at 30 Hz which is the characteristic frequency of strawberry flower. The pollination experiment was conducted using the strawberry variety F1 Elan (Fragaria × ananassa). The pollination experiment was carried out in two experiment plots. One was the pollination with the developed ultrasound device and the other one was performed with a contact-type vibration machine for pollination (TS-550, Takii & Co. Ltd., Japan) as the control experiment. Hanging on a tag to bud, and bud number, number of flowers, fruit number and number of harvest was recorded. Then flowering rate, fruit set rate and harvest rate were calculated. The strawberry fruit which didn't meet the criteria in weight and quality did not put in a number of harvest. The numbers of flower bud and flowering were in the same range, and it can be said that there were no difference in the experimental conditions of two experimental plots. However, the difference of the pollination methods between the developed ultrasonic and the conventional contact vibration method was observed in the numbers of fruit-setting and harvest. Number of the fruit was higher in the control group, but the number of strawberries harvested was greater in the ultrasonic pollination plot. We estimated the newly developed ultrasonic pollination device comparing to the conventional contact vibration device. A positive result was obtained in the number of fruit harvest and the harvest rate with the ultrasonic pollination device, and there may be a chance of the use of the ultrasonic pollination device in artificial light type plant factory.

Keywords: Acoustic radiation pressure, Artificial pollination, Phased array, Plant factory, Strawberry

OP-049 [Section IV: Energy in Agriculture]

BIOCHEMICAL CHARACTERIZATION OF SWITCHGRASS VARIETIES GROWN IN TURKEY FOR BIOFUEL PRODUCTION

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Switchgrass is a perennial energy crop and forage plant originated from North America. It has low soil nutrient and low water demand. In addition, due to its high carbohydrate content, it covenants a renewable energy potential via biochemical methods. These propeties of switchgrass makes it an advantagous energy crop for the development of non-agricultural rural areas. Therefore, as a North America originated crop, switchgrass adaptation to Turkey has been investigated by the cultivation of 8 different varieties of switchgrass to 9 geographically different locations of Turkey. Cultivated varieties of switchgrass are called Trailblazer, Cave in Rock, Alamo, Shawnee, Kanlow, Shelter, Long Island and Bo Master. By this adaptation investigation of switchgrass varieties, it was aimed to find out the value addition potential of switchgrass to Turkey from the point of utilizing the low quality soil and renewable energy production.

In this study, biochemical characterizations of 8 varieties grown in Konya – Karapınar location were determined and their bioethanol and methane production potentials were experimentally measured. To determine the biochemical characterization of the varieties, the amount of dry matter (TS) and organic matter (VS); the components of lignin, cellulose, hemicellulose and soluble matter; acid soluble and acid insoluble lignin; total Kjeldahl nitrogen (TKN); soluble carbohydrate concentration as glucose and soluble reducing sugar; structural carbohydrate profile; protein concentration and extractive matter including lipids were quantified. Elemental compositions (CNHS) along with the total carbon, inorganic carbon and total organic carbon contents were determined. Simultaneous saccharification and fermentation (SSF) and biochemical methane potential (BMP) test for each varieties were performed. The aim of this study is to reveal characterization differences between the Switchgrass varieties. This is the first study in literature which investigates the characterization properties of switchgrass varieties grown in Turkey. Alamo determined to have the highest TS and VS content with 98.59% and 92.01%, respectively amongst all varieties. However, it was measured that Alamo has the lowest BMP with 189.46 mLCH4/gVS and Shawnee has the highest BMP with 307.35 mLCH4/gVS. According to the results, Switchgrass can be a significant alternative energy crop with a careful selection of varieties for renewable energy production in Turkey.

Keywords: Bioethanol, Biofuel, Characterization, Methane, Switchgrass

OP-050 [Section IV: Energy in Agriculture]
EFFECTS OF THERMO-CHEMICAL PRETREATMENT ON BIOGAS PRODUCTION FROM SWITCHGRASS

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Energy demand is increasing rapidly parallel to the population growth in the World. On the other hand, fossil fuel resources are gradually decreasing in reverse proportion to this increase. For this reason, renewable energy sources have been used to supply some of this energy needs. In the production of biogas from renewable energy sources, the usage of energy plants, which have a high carbon content, increases biogas yield. However, the fact that these plants are resistant to degradation of their lignocellulosic structures, causing a delay in the production of biogas. A continuous increase in the amount of organic and lignocellulosic residues makes pretreatment processes more essential before anaerobic digestion (AD). A variety of physical (comminution, hydrothermolysis), chemical (acid, alkali, solvents, ozone), physico-chemical (steam explosion, ammonia fiber explosion) and biological pretreatment techniques have been developed to improve the accessibility of enzymes to cellulosic fibers

Switchgrass is lignocellulosic and a perennial plant with high carbon content. It shows high resistance to drought conditions and could be used as a precaution against wind erosion in some regions of Turkey. There are limited studies in the literature on pretreatment processes applied to enhance the amount of methane that can be produced from the switchgrass. Eventhough thermochemical pretreatment has been applied to different kinds of lignocellulosic biomass to enhance biogas production, there is no work investigating optimization of thermal-Ca(OH)2 pretreatment with the combination of biogas production from switchgrass in literature.

In this study, the effects of thermal - Ca(OH)2 pretreatment on the enhancement of biogas production from switchgrass were investigated. Central Composite Design (CCD) was used to illustrate the nature of the response surface in the selected experimental region and elucidate the optimal conditions of the most significant variables in the thermal- Ca(OH)2 pretreatment. The variables; reaction temperature (50-100°C), Ca(OH)2 concentration (0-2%), initial solid loading (3-7%) and reaction time (6-16 hours) were applied.Pretreatment process was evaluated according to soluble reducing sugar (sRedSugar) and BMP as objective functions, which are related to pretreatment yield. Maximum sRedSugar increase was obtained at 50°C reaction temperature, 16 h reaction time, 0% Ca (OH) 2 concentration and 3% initial solid loading of switchgrass.

Keywords: Biogas Production, Optimization, Pretreatment, Switchgrass

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OP-051 [Section IV: Energy in Agriculture]
BIODIESEL PRODUCTION FROM BOVINE KIDNEY FAT AND CANOLA OIL

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Although the population is increasing day by day, due to the ever-decreasing fossil fuels use of alternative energy is coming much more important for our world. Factors such as the growing transport sector and environmental pollution have made biofuel usage important today. It is known that biodiesel which is the most important biofuels can be obtained from fatty seeds as well as from fatty organic wastes. In this study, biodiesel was obtained by transesterification method from both canola oil and bovine kidney fat. In the experiments, 1,85 g, 1,75 g and 1,5 g of catalyst were used together with 200, 150 and 100 ml of methanol. In the process of obtaining biodiesel from canola oil, sodium hydroxide to prevent turbidity was used as a catalyst. In the biodiesel production from bovine kidney fat, potassium hydroxide, which provides a higher yield as a catalyst, was utilized. The technical properties of biodiesels were measured, comparatively. For this purpose, density, pH, kinematic viscosity, copper rod corrosion, cetane number, thermal value, flash point, ester content, brix, nD, yield etc. were determined. Whereas the kinematic viscosities of biodiesel from canola oil ranged from 3,81 to 3,89 mm^2s^1, the kinematic viscosities of biodiesel from bovine kidney fat were found to be between 2,91 and 3,19 mm^2s^1. Similarly, the lower thermal values of canola biodiesel were measured between 39.974,33 and 40.012,33 kJ kg^1, while the lower thermal values of biodiesel produced from bovine kidney fat varied between 40.154,33 and 40.184,33 kJ kg^1. In addition, the yield of biodiesel from canola oil ranged from 92,33% to 99,67% whereas biodiesel yield from bovine kidney fat varied between 84,67% and 96,33%. Besides, the pH values of canola biodiesel were found between 7,26 and 8,15 while the pH values of biodiesel from bovine kidney fat were measured between 6,32 and 7,07. In addition, negative and positive linear relationships of the technical properties with each other were investigated in this study.

Keywords: Biodiesel, bovine kidney fat, canola oil, transesterification.

OP-052 [Section IV: Energy in Agriculture]
A COLD-CLIMATE BIOGAS SYSTEM FOR A SUSTAINABLE ECO-LODGE IN NEPAL

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Every year, thousands of hikers pass through the Langtang valley in Nepal, spreading pollution and depleting water resources. Yet, lodges that service hikers are a major form of livelihood. In 2015 the region was devastated by an earthquake. Most of Langtang village disappeared. We are creating a team to assist local Nepalese in the development of an eco-lodge as a case example for others who want to run their lodges in a sustainable way reducing environmental impact. The goal is to build a cottage in traditional Nepalese style, along with local people, using local materials - wood and stone. Innovations revolve around three ideas: off grid energy, waste management and water sustainability. There will be a zero-plastic policy, and a water ozonization system for purifying water. There will be an anaerobic digester (AD) collecting organic and toilet waste to produce biogas for cooking and heating. Finally, the lodge will be fitted with solar collectors and a newly developed ultra-compact hydropower turbine for a nearby stream. Extra energy will be channeled into a small greenhouse for growing vegetables. We are currently working to help Appalachian farmers in the United States extend their growing season by developing greenhouse heating solutions from biomass waste streams. We have implemented greenhouse heating systems that incorporate solar thermal, biochar production and AD, with thermal storage and delivery. Most importantly for application in the Langtang valley, we have analyzed a variety of techniques for optimizing biogas production in the cold climate of high-altitude regions. Insulated and earth-sheltered digester designs were assessed as well as the incorporation of sustainable supplementary heat sources. Passive solar thermal heating and compost-based heat capture systems were examined. We constructed a 700-gallon PVC bag to serve as a plug-flow digester and tested it in an insulated and partially buried culvert equipped with heat exchangers. A static compost pile with heat exchangers was used to deliver heat to the AD to increase digester temperature during cold weather. It was found that static-pile compost heat systems provided consistent temperatures over 38 C for a number of months (even during the winter), and that this heat could be used to maintain the AD within the mesophilic range (above 30 C) for significant biogas production. It was concluded from these results that an insulated AD incorporated with a compost heating system has the potential to produce biogas in the high-altitude cold climate of the Langtang valley.

Keywords: sustainable development, cold-climate anaerobic digestion,appropriate technology, greenhouse production, biomass heating systems, village technology

OP-053 [Section IV: Energy in Agriculture]
CONSUMPTION CHARACTERISTICS OF PROPIONATE IN ANAEROBIC DIGESTATE USING MICROBIAL FUEL CELLS

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The anaerobic digestion technology can produce combustible biogas and liquid fertilizer from waste biomass such as livestock manures and agricultural residues. However, excessive pretreatment of raw biomass and high loading operation to improve fermentation efficiency often cause environmentally fatal change in the anaerobic reactor and brake the balance of microbial community then result in the accumulation of propionate. Propionate is one of organic acids produced intermediately in anaerobic digestion process and decompose more slowly than other intermediate products. Since accumulation of propionate cause to lower pH and stop whole fermentation reaction, it is desirable to avoid its accumulation or reduce the concentration promptly. Microbial fuel cells (MFC) has been developed to produce electricity using anaerobic bacteria from organic wastewater. MFC dominated with anaerobically digested slurry as a bacterial source can generate electricity by consuming propionate in culturing media, while the process of decomposition has not been reported yet minutely. The purpose of this report is to clarify the consumption characteristics of propionate in MFC comparing with ordinary anaerobic digestion process. The experimental reactor prototyped of acrylic transparent plate has two chambers of 300 cm^3 in volume separated with a cation exchange membrane. One chamber was an anode of MFC filled with activated carbon granules. The other chamber is a cathode mounted with carbon cloths of 800 cm^2 in surface area. Anode and cathode were connected with a lead wire through the electric resistance for MFC. Bacterial source supplied to form the anode was collected in the mud of paddy field. Anode was dominated with the bacteria being cultured by replacing propionate solution gradually increased from 0.6 to 6 mmol/L in several days interval for 20 days as pretreatment of experiment. Culturing media of 12 mL at the propionate concentration of 6, 10 and 15 mmol/L as substrate was replaced every day in the anode chamber to observe the consumption rate of propionate and electricity generation in the consumption experiment. Electricity generated in MFC was logged every 30 seconds. Experimental results was evaluated by the energy recovery efficiency, consumption rate of propionate and changes in microbial community for propionate concentrations. The consumption characteristics of propionate was discussed to adapt the MFC for controlling the anaerobic digestion process in the biogas production.

Keywords: microbial fuel cells, anaerobic digestion, propionate

OP-054 [Section IV: Energy in Agriculture]
NEW TRENDS IN MONITORING AND CONTROL OF PHOTOVOLTAIC PUMPING SYSTEMS

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Main concepts: Photovoltaic (PV) pumping systems allow the development of high performance irrigation technologies for agricultural soils without the need for an electrical grid. The structure of a solar pumping system is mainly characterized by DC motors, powered by electronic converters to track the maximum power point (MPPT), in order to extract the whole energy generated by PV panels for different environmental conditions, such as solar irradiation and temperature.

Methodology: The authors followed the control and monitoring of specific parameters of the solar pumping system by implementing the MPPT algorithm for the studied PV application. An original method is used to identify the maximum power point using acquisition data, essentially defined by the pumping flow rate. These data are processed by a specialized NI 6008 controller, developed by National Instruments and operated by the LabVIEW software, taking into account the operational optimization of the PV pumping system for irrigation of agricultural crops. Modeling and simulation of the solar pumping system was accomplished using the Matlab / Simulink and LabVIEW simulation environments.

Main results: The maximum power of the photovoltaic system, obtained through MPPT and controlled with the NI 6008 hardware, is permanently monitored, allowing the time evolution of the specific system parameters, both on short term (during a sunny day) and on medium term (during the period of the irrigation seasons).
- The use of optimized control for pumping system by frequency converter and Pulse Width Modulation (PWM) has improved the performance of the PV pump, respectively the specific parameters and the power-flow rate characteristics.
- The authors performed a comparison of the simulation results with experimental data from literature based on the MPPT method. This comparison allowed establishing the feasibility and efficiency of the proposed method.
Conclusions: This study contributes to an innovative solar pumping methodology with implications for monitoring and control the power and specific parameters of the photovoltaic pumping system.
- The authors intend to continue this research study in the next future by modelling and dimensioning a complex photovoltaic pumping system, which would have both the storage of the produced electrical power and the accumulation of an additional amount of water needed for irrigation under unfavorable conditions. Such an approach would help to further improve the overall efficiency of the complex photovoltaic pumping system.

Keywords: photovoltaic pumping system, irrigation technologies, maximum power point tracking, efficiency, feasibility, control and monitoring

OP-055 [Section IV: Energy in Agriculture]
INTEGRATION OF PHOTOVOLTAIC POWER PLANTS INTO THE HISTORIC CITY

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Facades of roofs and building are considered as a suitable place to install small photovoltaic power plants. In historic cities, however, the installation of photovoltaic panels must not compromise the concept of architecture. We have designed a number of photovoltaic systems with photovoltaic panels installed on fixed and movable stands and inclined to the south. Prague, however, is a historic city, and in its center such a arrangement of the power plant was not possible. This article presents two photovoltaic power plants with a very similar design, which are located in Prague. Due to location in the city's historical center. Flexible photovoltaic strips based on amorphous silicon thin films were used. The strips are arranged horizontaly over the roof and are not normally seen from street. The article describes the design of both photovoltaic power plants and presents the results of the 7-year monitoring of data by the monitoring system developed by the authors.

Keywords: Photovoltaics, solar system, photovoltaic panel, energy

OP-056 [Section IV: Energy in Agriculture]

MODELING THE MOVEMENT OF HULLED MILLET IN AGITATED DRUM DRYER WITH DISCRETE ELEMENT METHOD

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There are several technologies in the agricultural, food, chemical and pharmaceutical industries for mixing granular materials. In these processes the homogenization of the particle fractions or the prevention of arch building process plays the very important roles. To select appropriate mixers' motors installed in certain devices, it is necessary to specify the rotational speed of the mixer and the power requirement of the propulsion engine. This selection is a difficult task nowadays for mechanical engineers without measurement or an appropriate method for the estimation of power requirement. In researches available in the literature, the determination of the mixing power requirement is solely analytical and only for devices of particular design and geometry, in the case of mixing of certain substances. The main purpose of this research is to improve a simulation model for determining the power requirement of an agitated drum dryer, which can be used commonly for modeling the mixing process of various moisture-containing granular materials. By mixing hulled millet, laboratory measurements were made and the results were approximated by the simulations based on discrete element method (DEM). In order to give an exact estimation of the power requirement of a given mixer, accurate geometry of the drum dryer and the appropriate micro-mechanical and physical parameters of the discrete particle assembly are required. With the results of the angle of repose and the direct shear box tests in laboratorial conditions and DEM simulations, certain material properties of the utilized particles have been determined. In laboratory tests, the mixing power requirements of the agitated drum dryer were determined at various rotational speeds (0.32 ÷ 1.58 rev/s) using hulled millet with different moisture contents on wet basis (9.6 ÷ 29.5%) with different drum loading factors (5 ÷ 25%). Based on results it can be stated that the mixing power requirement is greatly influenced by the moisture content of the material and the rotational speed of the agitator. Additionally, the demand of torque was decreased with increasing the rotational speed. The preliminary DEM simulations and parameter sensitivity tests revealed which micro-mechanical parameters of the contact model should be changed in order to simulate the power requirements with good approximation.

Keywords: hulled millet, agitated drum dryer, moisture content, mixing, discrete element method

OP-057 [Section IV: Energy in Agriculture]
AN INVESTIGATION OF AMBIENT DRYING OF <I>EUCALYPTUS GRANDIS LOGS

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Research is reported on the results of field drying of *Eucalyptus grandis* logs in Hawaii, with the aim of developing or validating simple models to predict moisture loss over time as a function of measurable parameters such as solar insolation, ambient temperature, and precipitation.

At the time of harvest, most high-yielding grass and tree energy-crop species have relatively high (~50% to 80%, wet basis) moisture content. If the biomass feedstock is combusted without pre-drying to generate thermal energy for industrial processing and/or electric power generation, each percentage point in moisture content results in ~1% loss in process heat or electricity generated. High biomass moisture content poses even greater challenges in thermal gasification, which has difficulty operating autothermally when the moisture content significantly exceeds 20%. As a result, different strategies have been employed to reduce biomass feedstock moisture content, including using process heat (e.g., boiler or gas turbine exhaust gases) to pre-dry the feedstock prior to burning or gasifying. Such practices often are effective, but preclude the use of process heat for other purposes. Under appropriate conditions, field drying represents a practical means for reducing biomass moisture substantially without placing a parasitic burden on conversion efficiency, particularly with processed (chipped or shredded) feedstocks that have high surface area:volume ratio, which facilitates mass transfer; however, feedstocks with lower surface area:volume ratio, such as wood logs, pose greater challenges in field drying.

The results of experiments involving field drying of *Eucalyptus grandis* logs in Hawaii, and empirical models to predict moisture loss over time in terms of measurable ambient conditions are reported. In the experiments, which spanned more than a year, eucalyptus logs of different diameters were suspended at two locations -- representing a wet environment and a dry environment -- and log weights were measured hourly. Weight change, attributed to changes in moisture content, was empirically modeled using solar insolation, ambient temperature, and precipitation data collected at nearby weather stations to predict log moisture content over time. The ability of the different models to predict moisture loss in eucalyptus logs based on key measurable environmental parameters, is discussed and compared. The results show that (1) the empirically-based drying models developed using logs at one location (wet or dry environment) can accurately predict drying of other logs at the same location, and (2) models developed using data from wet locations predict trends in dry locations better than vice versa (i.e., than models developed using data from dry locations predicting trends in wet locations).

Keywords: drying, Eucalyptus grandis, experiment, modeling, moisture content

OP-058 [Section IV: Energy in Agriculture]
DESIGN OF PARALLEL CONNECTED VACUUM TUBE SOLAR AIR COLLECTOR

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Due to an increase in conventional energy prices and environmental effects, such as air pollution, depletion of the ozone layer and greenhouse effects, the use of solar energy has increased, following the energy crisis in the 1970s. Solar energy is being seriously considered for satisfying part of the energy demand in Turkey, as in the world. Solar collectors are used in the production of hot water and hot air by using solar energy. Solar collectors are produced with flat place or cylindrical surface (vacuum tube). Vacuum tube solar collectors collect more solar energy than the flat plate collectors with cylindrical absorber surface. Energy loses vacuum tubes are low level because of less convection of thermal energy. By these features the usage of vacuum tube solar heater collectors are becoming more common. However these collectors are used only for water heating systems.

In this study, it was aimed to design an air heating collector using vacuum tubes. In the design, vacuum tubes are connected parallel to each other and air flow channels are formed inside the vacuum tubes. Thermal tests of the prototype collector were performed in a solar simulator. Experiments performed at 570 and 1300 W / m^2 irradiation conditions and 2,76 and 5,53 m3/h air flow rates. The thermal success of the collector was found to be high. As a result, it has been determined that the parallel connection vacuum tube heat collector developed in the study can be used as an alternative to the conventional (flat plate) collectors. This study was supported by TÜBITAK (The Scientific and Technological Research Council of Turkey, Project No: 1919B011402976).

Keywords: Vacuum tube, air heater, parallel connected tube

OP-059 [Section IV: Energy in Agriculture]

ENERGY EQUIVALENT OF IRRIGATION WATER IN DIFFERENT DELIVERY SYSTEMS IN AGRICULTURE

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The energy input for irrigation and water supply depends greatly on the delivery systems. Corresponding to the LCA methodology, the direct and indirect energy consumed in the construction, maintenance, operation and decommissioning of entire facilities (which may include dam, channels, land preparing, pipelines, and water pumps), should be taken into account. There are very few studies applying LCA to different irrigation systems. Furthermore, in the existing reports, the full life cycle of the systems has not been analysed. In some studies, the consumed energy has been calculated theoretically by the use of standard equations governing the operation of electric or internal combustion motors. In some others, a value of 0.63 or 1.1 MJ m-3 water were used to calculate the energy input from irrigation, without determining the irrigation system, but seems to be the energy equivalent of irrigation from dams and their channels. In this research some farms in northwest of Iran were studied which have irrigation wells with depth up to 200 meters. According to this empirical study on water delivery through deep irrigation wells, electric or diesel energy consumption was calculated much higher than the above mentioned values and up to 8.3 MJ m-3 water (primary energy based) in some areas. It reveals a very low pump efficiency calculated around 10%. According to results, using a fixed energy equivalent for irrigation water near to those of channels leads to an overmuch underestimate of energy consumption in many agricultural farms in the areas with water scarcity such as Iran.

Keywords: energy equivalent, irrigation systems, dam and channels, water well

OP-060 [Section IV: Energy in Agriculture]
EVALUATION OF GREENHOUSE CUCUMBER PRODUCTION SUSTAINABILITY IN TERM OF ENERGY USE EFFICIENCY

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Sustainable agriculturalproduction could be assessedthrough energy-use efficiency (energy input-output ratio).Thus, this paper aimsto evaluatethe energy-use patterns for cucumbergreenhouse production in Oman.Data were collected using aface-to-face questionnaire method. Results indicated that total energy inputs(e.g. electricity, water, fertilizers and agrochemicals) and total energy output(cucumber yield) were1159726.0 MJ ha-1 and 89942.9 MJ ha-1, respectively. The highest energy inputin greenhouse cucumber production was electricity consuming 88% of total energy input. This indicates that electricity had again the highest impact in cucumber greenhouse production.When all energy inputs were classified into direct and indirect, and renewable and non-renewable, the highest share of total energy forms in greenhouse cucumber production was for direct and non-renewable energy. The energy ratio and energy productivity were found to be 0.07 and 0.10 kg MJ-1, respectively.Energy use in greenhouse cucumber production was inefficient and solar energy need to be implemented to improve the sustainability of cucumber greenhouse production.

Keywords: Energy use efficiency, cucumber greenhouse, energy productivity,energy forms.

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OP-061 [Section IV: Energy in Agriculture]

DETERMINATION OF ENERGY EFFICIENCY AND GREENHOUSE GAS (GHG) EMISSIONS IN ORGANIC ALMOND PRODUCTION IN TURKEY

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The purpose of this study is to make the energy efficiency and greenhouse gas (GHG) emissions of organic almond production. This study was performed for 2016 production season in Adıyaman province of Turkey in 2017. The data provided from study were collected from 93 different farms by face to face surveys with full count method. The agricultural input energies and output energies used in organic almond production were calculated to determine the energy efficiency analysis. According to the research findings, the energy inputs in organic almond production were calculated respectively as 7320.30 MJ ha-1 (37.21%) diesel fuel energy, 5421.17 MJ ha-1 (27.56%) machinery energy, 3818.86 MJ ha-1 (19.41%) human labour energy, 1632 MJ ha-1 (8.30%) irrigation energy, 1344 MJ ha-1 (6.83%) farmyard manure energy, 128.15 MJ ha-1 (0.65%) organic chemicals energy and 5.94 MJ ha-1 (0.03%) lime energy. Total input energy was calculated as 19670.42 MJ ha-1. Energy value of organic almond yield were calculated as 39811.80 MJ ha-1. Energy efficiency, specific energy, energy productivity and net energy calculations were calculated respectively as 2.02, 14.05 MJ kg-1, 0.07 kg MJ-1 and 20141.38 MJ ha-1. The consumed total energy input in organic almond production could be classified as 64.93% direct, 35.07% indirect, 34.54% renewable and 65.46% non-renewable. Total GHG emission was calculated as 2518.46 kgCO2eq ha-1 for organic almond production with the greatest portions for human labour (54.16%). The human labour followed up machine usage (15.28%), diesel fuel consumption (14.25%), water consumption of irrigation (10.80%), farmyard manure usage (5.16%), organic chemicals usage (0.34%) and lime usage (0.02%), respectively. Additionally, GHG ratio value was calculated as 1.80 kgCO2eq kg-1 in organic almond production.

Keywords: GHG emisssions, GHG ratio, energy efficiency, organic almond, Adıyaman, Turkey

OP-062 [Section IV: Energy in Agriculture]
ENERGY EFFICIENT USAGE OF ZIGBEE NETWORKS IN SOLAR POWERED FIELD DATA ACQUISITION SYSTEMS

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Wireless Sensor Networks (WSNs) are being paid great attention in agricultural applications for more precise data acquisition for farmers. When using WSNs for field applications, energy consumption is one of the common problems. This paper presents a new design of a solar powered wireless sensor node which uses ZigBee networks and gives the hardware layout and software flowchart. In this design, Digikey XBee S2 modules working as routers was turned on and off as a sleep cycle. Coordinator sends a sleep duration to all sensor nodes and put them into sleep mode. A microcontroller wakes up every second and counts a timer to turn on the power of the ZigBee module. When all of the sensor nodes wake up, they build up the network again to each other to reach to the coordinator using tree or mesh networking topology in only 20-25 seconds. With this method, power consumption of a sensor node including a temperature/relative humidity sensor and weighing equipment was lowered to 40 µA for 1 second during sleep, 1.4 mA for 30 ms during short wake up process (sensors active) and 40 mA for long wake up process for 30 to 60 seconds (XBee S2 active). Energy consumption of a sensor node was measured as 25 mWh per day.

Keywords: Wireless sensor networks, zigbee, energy efficiency

OP-063 [Section IV: Energy in Agriculture]

ASSESSMENT OF EMISSIONS AND COMBUSTION EFFICIENCY OF PALM TREE PRUNING RESIDUE PELLETS

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The production of biomass pellet fuel has increased recent years because it is an alternative to fossil fuels. In order to be able to use biomass resources as efficiently as possible it is necessary to evaluate the resources which are abundant in the region. In worldwide wood pellets which are producing from forest product residues have largest share in the pellet sector. Beside it, pruning residues and agricultural residues have great potential for use as a biomass source. In this study, pellets of pruning residues of palm tree (*Washingtonia robusta*) growing in regional climatic conditions are used for combustion in domestic pellet stove. During the combustion process of pellets, gas emissions, flue-gas temperature and combustion efficiency were measured by flue gas analyzer. Before the combustion operation pellet moisture content was found as 7 %. According to data at the end of the experiment, CO and NOx emissions and combustion efficiency were found between 232-247 ppm, 16-17 ppm and 64-76 %, respectively. As a result of this, palm tree pruning residue pellets can be used for residential heating when evaluated in terms of evaluated environmental aspects and pollution threats.

Keywords: Palm tree, pellet, stove, emission, biomass

OP-064 [Section IV: Energy in Agriculture]
PERFORMANCE OF THE VALONIA OAK WASTE PELLET PRODUCTION LINE

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In Turkey, Valonia oak is evaluated for its ingredient which has vital importance for leather industry. The Valonia oak processing plant needs heating energy for extracting some chemical compounds. Because of increase in the energy costs, the most economical way is to overcome the difficulties, using of this process waste as an energy source for the company. This waste is evaluated after pelletizing and part of the products are sold to other companies as a solid fuel. The Valonia oak contains 3972-4287 cal/gr energy which is important for using heating energy purposes.

In this research, the pelletizing of the waste of valonia oak processing plant and the pellet properties were investigated. The material and energy flow diagram, the output capacity, specific energy requirement were determined. The temperatures of the machine and pellets were examined, the physical properties of pellets (diameter, length and weight) and mechanical durability were measured as to two ways: free fall tests and durability tester.

During the research the energy analysis of the pellet production line was determined.

Keywords: wood pellet, energy analysis, solid fuel, pellet durability, pellet properties, valonia oak waste

OP-066 [Section IV: Energy in Agriculture]

INVESTIGATION OF MOISTURE CONTENT, PARTICLE SIZE AND PELLET DIE GEOMETRY ON SAWDUST PELLETIZING CHARACTERISTICS BY MEANS OF THE NEW TYPE PELLETIZING TEST DEVICE

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As the bulk density of sawdust is low, storage, transport and usage problems are encountered during applying it as fuel. So, to overcome these problems, densification process is necessary. The volumetric heating value of sawdust is increased by densification process. One of the major methods for biomass densification is pelletizing. As it is known, there are a lot of independent parameters which affect the pelletizing process. Among these parameters the material moisture content, particle size and pellet die diameter to length ratio have a great roll on pelletizing process. Therefore, in this study the effect of material moisture content at three level (8%, 15% and 20%), particle size at three level (Ø<1.6 mm, Ø<1 mm and Ø<0.5 mm) and pellet die diameter to length ratio at three levels (6, 8 and 10) are studied on pellet durability index, pelletizing capacity, density of pellets and energy consumption of pelletizing process by the new type pelletizing test device. The effects of independent variables on dependent variables are evaluated by means of ANOVA Variance Analysis at the confidence level of %95. Also, in this study the mathematical models related to pelletizing process are created among the independent and dependent variables. In laboratory scale, biomass pelletizing tests are done by means of simplified pelletizing apparatus. Unfortunately these apparatus, can not completely illustrate pelletizing process. So, in this study in order to clarify pelletizing process much more effectively the new type pelletizing device which is developed by authors is used.

Keywords: Moisture Content, Particle Size, Pellet Die Geometry, Pelletizing Process, Sawdust, New Type Pelletizing Test Device

OP-067 [Section V: System Management]
AGRO-FOOD TRACEABILITY SYSTEM GRANULARITY EVALUATION AND THE INFLUENCING FACTORS ANALYSIS

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Driven by concerns for food safety and quality and by regulatory, social, economic, and technological concerns, mandatory or voluntary traceability systems (TS) are now being enforced worldwide. Evaluating the efficacy of the TS plays an important role not only for planning system implementation before development, but also for analyzing system performance once the system is in use. In previous work, a comprehensive and quantifiable model to evaluate TS granularity was presented to determine the efficacy of the TS. In the present work, we evaluate the granularity via an empirical analysis of vegetable companies to determine the factors that influence TS granularity. We use the 80 vegetable companies in Tianjin city as examples. The TS platform used was a mandatory platform but the performance level depended on the amount of information recorded and the company desires. Granularity indicators were collected mostly by the TS platform to ensure the objectivity of the data, and the granularity score was evaluated by using a TS-granularity model. The results show a clear imbalance in the distribution of companies as a function of score. The number of companies (21) scoring in the range [50,60] exceeded the number in the other score ranges. Furthermore, the factors and their influence on traceability and granularity were analyzed by using a rough set method based on nine factors pre-selected by using a published method. The results show that the factor "number of TS operation staff" is deleted because it is unimportant. The remaining factors rank according to importance as follows: Expected revenue > Supply chain (SC) integration degree > Cognition of TS > Certification system > Company sales > Informationization management level > System maintenance investment > Manager education level.

Keywords: traceability,granularity,influence factors, empirical analysis, vegetable companies

OP-068 [Section V: System Management]
EVALUATION POSTURAL COMFORT LEVEL OF CONVENTIONAL CHERRY HARVESTING

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In Turkey, especially edible fruit harvesting has been done by conventional method. Workers use ladders and picking buckets in conventional fruit harvesting. When they are harvesting cherry, they stay at static posture for minutes. Also they repeat same picking movements during harvesting cherry. Postural comfort level of workers was evaluated with Rapid Entire Body Assessment (REBA) and Body Part Discomfort Score (BDPS) methods. And workers were evaluated cherry harvesting operation with Overall Discomfort Rating (ODR). Visual records of workers were divided parts which long five minutes. Then repeated harvest positions were determined. REBA scores was calculated for each worker. A body map was used for determining body part discomfort score. Overall discomfort rating was determined with overall discomfort rating scale. REBA scores showed that cherry harvesting by conventional method have been at medium risk level in terms of working posture. According to body part discomfort score, all workers suffered from upper back, mid back, shoulder on dominant hand side and legs. Cherry harvesting by conventional harvesting was found at acceptable strain level with respect to overall discomfort rating.

Keywords: Working posture, REBA, discomfort scale, strain

OP-070 [Section V: System Management]
A TOOL TO SUPPORT DECISIONS AND POLICIES ON PLANTING AND CUTTING OF PLANTED FORESTS AT PARANá STATE IN BRAZIL

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This paper aims to find the minimum area required to meet the market demands for wood, pulp, paper, and log. The definition of the required minimum total area of planted forest implies in the definition of which species will be planted in the different regions of a Brazilian state, in addition to the forest management policy that could be applied to each species. Literature review allows to identify that the use of Operational Research for improving forest planting and fostering policies in this area is still incipient in Brazil and abroad. Considering the diversity of the various biomes in Brazil, there is need to model its specific planted forest problems. In Brazil, data on forestry and agriculture production can be accessed from the Brazilian Institute of Geography and Statistics (IBGE). Since planted forests is an important economic activity at the state of Paraná, in Brazil, a mathematical model has been developed aiming to support decisions on planting and cutting of forests planted at this state of Brazil. This state was represented on ten regions, where it is possible to plant Eucalyptus Grandis, Pinus Taeda, and Mimosa Scabrella. The goal is to identify how to minimize the total planted area. This will indicate which species of trees to plant and which cutting decisions that can maximize productivity at a given demand scenario. On a certain sense, it is intended to indirectly analyze how well land is being used for planted forest purposes. Operations Research – by means of Linear Programming – is used to solve the proposed problem. A conclusion is that it is already possible to analyze simple scenarios, but the availability of more detailed information will enable new simulations and deeper scenario analysis. The total area was calculated from the hypothesis (albeit unreal) that the demand will be constant over the years, with a uniform distribution of tree ages. Such a consideration was taken by the difficulty of making future predictions. But it allows the comparison between this ideal hypothesis and the actual planted area. However, the model also allows to consider any other demand projections.

Keywords: Optimization, Mathematical Programming, Planted forests, Decision Support Systems, Brazil

OP-071 [Section V: System Management]
WORKING TIME REQUIREMENT IN THE FATTENING OF MOUNTAIN OX DURING THE GREEN FODDER HARVEST

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Due to the worldwide increasing interest in high-quality beef and the cost pressure, an efficient work performance during the green fodder harvest on the mountain ox fattening farms is absolutely necessary. The working time requirement for the fattening of mountain ox during the harvest time has not yet been evaluated. Existing values for working time requirement are limited to the conventional ox fattening.

The objective of this study was therefore to determine the working time requirement for the fattening of mountain ox during the green fodder harvest on farms in Styria, in South of Austria.

The data were collected by means of a semi-standardized questionnaire covering 19 mountain ox fattening farms. These farms had on average 26.7 steers (MIN = 3.00, MAX = 76.0, STD = 17.0)

The data were descriptively and analytically analyzed and described in the spreadsheet program Microsoft Excel and SAS Enterprise Guide 4.2 with the parametric and non-parametric ANOVA testing methods.

The working time requirement for stable work were determined by feeding, cleaning out of the stables, littering and management, in all on average 3.46 APmin per animal per day (MIN = 0.66, MAX = 7.64, STDEV = 2.07). The working time requirement for fodder harvesting were determined by mowing, turning, swathing, transport and storage operations, averaging 3.96 MPh per cut per hectare (MIN = 1.25, MAX = 9.50, STDEV = 2.28). The variations in completing these processes were greatly affected by the degree of mechanization. Grazing in the summer months was practiced by 90% of the farms, and they spent an average of 25.6 APmin per day (MIN = 5.00, MAX = 120, STDEV = 28.5) for pasture as well as animal and fence control activities. Almost half (47%, 9/19) of the farm managers were engaged in work outside of the farms. The external workload outside of the farms was mainly determined by various types of secondary employment and averaged 4.48 MPh per day (MIN = 1.43, MAX = 7.86, STDEV = 1.79). Preparing of food averaged 2.50 MPh per day (MIN = 0.92, MAX = 3.75, STDEV = 0.73). This resulted in an average working time requirement for farming, alimentation and secondary employment of 21.6 MPh per day (MIN = 9.54, MAX = 31.1, STDEV = 6.63). The average working time requirement per ox was 2.42 MPh per day (MIN = 0.48, MAX = 6.32, STDEV = 1.60). The working time requirement varied greatly with the degree of mechanization, intensity of part time farming and the fodder quality. Overall, the working time requirements were similar to ones of conventional steer fattening in Austria.

Keywords: fattening of mountain ox, working time requirement, green fodder harvest, beef production

OP-072 [Section V: System Management]
NATURAL VENTILATION'S ABILITY TO PREVENT HIGH INDOOR TEMPERATURES

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A desire to reduce energy consumption associated with mechanical ventilation in conventional pig housing has led to the development of a new hybrid ventilated building design, where large adjustable openings for natural ventilation are combined with a mechanical ventilation system for under floor removal and subsequent cleaning of a limited amount of air. To ensure competitive construction costs the building is designed with large building width (>50 m) which potentially is a challenge in relation to obtain sufficient ventilation in the entire animal occupied zone. Therefore, the aim of this study was to investigate to which extend it was possible to ensure satisfactory low ambient temperature for the animals in a wide hybrid ventilated building for finisher pigs when Danish summer conditions were considered. Measurements were conducted in one 22 m long and 51 m wide section of the first hybrid ventilated building for finisher pigs, designed by the Danish company Agrifarm. Measured temperatures in six different pens were compared with outdoor temperature, room air temperature, and with estimated values for achievable pen temperatures by maximised utilization of the openings. The applied threshold for exceeding pen temperature was 24°C. The data covered a warm summer period with small finisher pigs (336 hours), and a relative chilly summer period with large finisher pigs (850 hours). The average pen temperature was above 24°C in 60% of the time for the two periods together and for that percentage of time, the average pen temperature was 26.5°C and 26.7°C, which was 3.2°C and 5.4°C higher than the outdoor temperature for the two periods, respectively. In addition, there was a statistical significant difference of 2°C and 1.7°C between highest and lowest average measured pen temperature, for small and large pigs, respectively. The potential opening area for natural ventilation was fully utilised in 348 of the 535 hours where the average pen temperature was above 24°C. Calculated in relation to all 535 hours with pen temperature above 24°C the maximum achievable decrease was only 0.2°C. In conclusion, the hybrid ventilated building was unable to keep the animals' ambient temperature down at a sufficient level for more than half the time, during summer, and full utilisation of the natural ventilation had a negligible influence on reducing this temperature. To meet this challenge, it is suggested to investigate supplementary cooling methods.

Keywords: natural ventilation, finisher pigs, thermal comfort zone, exceeding ambient temperature

OP-073 [Section V: System Management]

INVESTIGATION OF R&D AND INNOVATION PERFORMANCE IN THE AGRICULTURAL TRAILER MANUFACTURING COMPANY

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The purpose of this study is to determine the current situation of a company that produces agriculture trailers in the Aegean Region in terms of both production techniques and R & D and innovation, and to suggest solutions for determined problems. Within the scope of this research, the "Face to Face Survey" method was applied. In the first part of the questionnaire survey, there are general information about the company, business information, personnel status, production status, finance - marketing - sales and export. In the second part, an "innovation self-assessment" study was carried out in which the company in Turkey can see their current situation with a total of 24 parameters that they can evaluate themselves in R & D and innovation factors. The survey was conducted with the senior management of the company. As a result of study; organizational structure, technical and technological sub-structures used in manufacturing, raw material input and procurement structure, human resources structure, R & D and innovation work situation, relations with universities and research institutions are compared with other companies in the region and sector. So, the innovation report was determined.

Keywords: Agricultural machinery, technology level, transportation

OP-074 [Section V: System Management]
HOW AGRICULTURE 4.0 CAN BE AN OPPORTUNITY FOR MARGINAL AREAS? A CASE STUDY IN TUSCANY

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Precision agriculture (PA), smart farming, ICT in agriculture are puzzle pieces known as Agriculture 4.0, in other words a system of spatial intelligence, augmented knowledge and precise management. Usually this set of innovative technologies are associated to agroindustry or urban farming, but, what happen in marginal areas? What are the factors and indicators that could determine a first approach to this set of innovative system for a conventional and more for a marginal territory? In the Tuscany agricultural scenario farms are scattered in several supply chains, size and type of management. The paper focuses on the opposite cases that may represent two main lines of innovation's development. The study identifies several common factors and indicators to define the technology innovation's need in marginal areas and specifically at opposite ends study cases in Tuscany. One in the extreme north, Lunigiana; a small family farm, with few hectares and one in the extreme south, Valdichiana; a hundred hectare farm, an agroindustry roughly approach with capital intensive farm mechanization. It goes without saying that availability of expenditure and in the possibility to have a R&D division in-house depends on farm size and incomes, so it is important to understand if there is a ready to use network service on PA in Tuscany and if there are some gaps to fill and if big farms are qualified to be used as one of the node of the PA service's network. The research investigated firstly the PA tools in charge of the farms, secondly, the presence (quantity) and the distance (proximity) from the farm's study cases to PA services, PA retailer, educational system focused on PA (Universities departments, Agricultural School), research centre and public territorial offices for knowledge transfer and innovation in agriculture. This was done through a geospatial analysis on regional cartography, creating layers, database and vectors of study case farms. To visualize and understand at a glance connections and proximity between all these actors georeferenced points were buffered. Thirdly, it was checked and added to the database the georeferenced data of quality of internet infrastructure through a dedicated internet web service and tested the net in field for farms considered. The result is a replicable PA's service network map that underlines limits and point of strength of the Agriculture 4.0 system in Tuscany.

Keywords: Agriculture 4.0 management, Precision agriculture service network, Geospatial precision agriculture analysis, map

OP-075 [Section V: System Management]
HOW TO EFFICIENTLY SUPPORT ADOPTION OF NEW TECHNOLOGIES IN AGRICULTURE?

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Increased automation is needed in agriculture. Automation replaces heavy and dangerous work and enhances quality of life. If correctly chosen, automation simultaneously reduces negative environmental effects and raises effectiveness of production. To be real innovations, however, the new solutions need to achieve wide adoption. Adoption of new beneficial technologies is generally regarded slower than wanted. This is apparent in automated systems such as those of Precision Agriculture, both in arable and livestock applications.

The paper concludes results from two research projects on agricultural innovations: the OECD Joint Research Program research ´Speeding up innovation in agriculture´ (2011-2012) and EU HORIZON2020 project ´AgriSpin´ (2015-2017).

Conclusions of ´Speeding up innovations in agriculture´ pointed out the most important hinders. Automation, as all new technologies in agriculture, faces obstacles of adoption. Poor adoption includes mainly problems in acceptability. Usability issues are important. Farmers also face problems in integrating the new technologies in the existing systems at the farm level. They have mistrust on new technology as a whole. The education of engineers, designers, marketers and end-users of automation need to include more user-centered elements. They also need to interact better during R&D process. User-Centered Design (UCD) is promoted.

´AgriSpin´ was a forerunner in Multi-Actor Approach in HORIZON2020. Cross Visit methodology including thorough analysis of 50 innovation cases in Europe was applied and improved during the project. Spiral of Innovation was used to illustrate the cases and to communicate them to wider audience. Pearls, Puzzlings and Proposals were reported for each case in Final Symposiums where relevant stakeholders were informed about the findings and challenged for developing the local innovation environment of agriculture. Conclusions include that agricultural innovations, although technological in nature, are developed, realized, disseminated and embedded through a social process. This process should be understood better to be able to support it correctly. Multi-Actor Approach is needed since the application environment is complex.

New technologies including e.g. robotics, autonomous vehicles and automation need to be introduced in such an appropriate way that the adoption of the required changes happen effectively. Research is needed to better understand the restrictions of innovation in agriculture. Supporting actions that build on actual end-user requirements need to be introduced. New kind of advisory and consultation that cope with the systems level challenges is to be introduced. Demonstrations, Living Labs and user networks have a central role in this development. Educational needs of all actors involved need to be met.

Keywords: automation, technology, adoption, user-centered design, multi-actor approach

OP-076 [Section V: System Management]

DEVELOPMENT OF AN INNOVATIVE FARM MANAGEMENT SYSTEM WITH PARALLEL OFF-LINE AND ON-LINE CAPABILITIES

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Recent advances in farm machinery telematics, wireless broadband, cloud computing and mobile devices provide a significant opportunity to automate and streamline much of the complexity surrounding Knowledge based Agriculture. In this light, software, tools and practices must be adapted to the overwhelming flow of information. Moreover, farm management information systems (FMIS) need to be able to comply with various standards and formats of data sets and inputs as well as provide targeted output to human and non-human clients. The groundwork for such a system was laid to provide a stable and at the same time expandable system that will facilitate the receiving of information, the processing of data and finally the distribution of information to the stakeholders that will benefit from accurate and, wherever applicable, upstream information. Besides the human stakeholders documenting information to the system, the proposed architecture involves an extended array of information sources that cover the agricultural activities in a multi spectrum set. Unmanned ground and aerial vehicles (UGV & UAV) will execute extensive and repetitive measuring work and provide an interactive real time application platform for further integration of automatization in the agricultural industry. The data refreshment and the repeated measurements constitute a dynamic and real time monitoring system, capable of short response times to systemic events and when possible for pre-emptive actions also. Data collected will be processed by algorithms that will extract information in formats fit for application by human or non-human actors of the system. Combining real time data, scientific interpretation and human generated information results to an integrated DSS that is capable of outlining actions utilising multi criteria systems, thus increasing reliability besides efficiency and automatization. Additionally, more practical aspects of the production system are integrated to provide a central reference point for the actors of the system. In this light, financial data regarding equipment and its use is pre-calculated in relation to common field work. This paper addresses both technical and functional structure of the developed FMIS. Furthermore, the applicability of the developed FMIS is demonstrated by use of the tools that were developed to enhance management practices.

Keywords: Farm management system, Decision support systems, Off-line planning, On-line monitoring

OP-077 [Section V: System Management]
AGRICULTURAL MECHANIZATION IN CHINA'S RURAL REJUVENATION STRATEGY

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China is a large farming nation and agriculture is the foundation of the national economy. There are challenges to the food supply and environment in China, such as population growth coupled with rising living standards, increasing urbanization, a declining rural labor force and increasing feminization of agriculture, ageing farming population, growing scarcity of fresh water resources, resource degradation and loss of biodiversity, increasing energy costs and declining farm incomes, climate change, high levels of post-harvest losses, etc. It's significantly important to meet growing food demands, respond to impacts of demographic change in rural areas, use natural resources in a more sustainable way, increase energy efficiency, innovate to enhance resilience, and implement post-harvest loss reduction strategies. The Chinese government has launched a rural rejuvenation strategy. The strategy contents include industries prosper, pleasant living environment, custom civilization, effective governance and be well off. The strategic objectives are as follows: (1) by 2020, important progress will be made in rural revitalization, and the institutional framework and policy system will be basically formed; (2) by 2035, the revitalization of rural areas will make decisive progress and the modernization of agricultural and rural areas will be basically realized; (3) by 2050, the countryside will be fully revitalized, and the powerful agriculture, good rural environment and rich farmers will be fully realized. The rural rejuvenation strategy has put forward new requirements for agricultural mechanization. However, there are still some problems in the development of agricultural mechanization in China. Such as the development of agricultural mechanization is unbalanced and insufficient, efficient supply of agricultural machinery and equipment is insufficient, the socialized service system of agricultural machinery is not perfect, construction of farmland infrastructure lags behind and leading to low efficiency of current agricultural production. Therefore, it is necessary to improve the quality of agricultural mechanization. The Chinese government has promulgated a series of policies to promote the development and quality of agricultural mechanization, including increasing investment in technology research and development, pilot demonstration and personnel training of agricultural mechanization.

Keywords: agricultural mechanization, rural rejuvenation strategy, China

OP-078 [Section V: System Management]

ASSESSING AND COMPARING THE GHG EMISSIONS, ENERGY AND ECONOMIC ANALYSIS OF CONVENTIONAL TILLAGE AND NO-TILLAGE SOYBEAN CULTURE IN SARI DASHTNAZ AGRICULTURE COMPANY

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The study explores inputs consumption, energy flow, costs and environmental impacts of soybean culture in two different systems of no-tillage and conventional tillage in Sari Dashtnaz Agricultural Company (SDAC), Iran. This was conducted in the crop year 2017-18. The data were collected through field measurements at SDAC. Three inputs of labor, agricultural machinery and diesel fuel were the variable inputs of soybean culture system in two methods of no-tillage and conventional tillage soybean culture. In addition, greenhouse gas (GHG) emissions from agricultural machinery and diesel fuel factors were calculated. The results showed that the average fuel consumption in conventional system was 41.0 liters; while, the average fuel consumption in no-tillage culture was 25.6 liters. Machinery use in conventional cultivation was 3.3 hours, more than twice as much as the amount in no-tillage cropping. The high percentage of energy inputs and greenhouse gas emissions in soybean system production were due to the high diesel fuel consumption. While a small percentage of variable costs was due to diesel fuel inputs. The amounts of energy saving, mitigation of GHG emissions and the reduced cost of soybean production system by no-tillage system for 300 hectares (Soybean cultivating area in no-tillage cropping method in SDAC) were 293.7 GJ, 15.1 tons of carbon dioxide equivalent and 16000 dollars respectively, compared to the conventional system.

Keywords: Energy saving, Cropping method, Variable inputs

OP-079 [Section VI: Bioprocesses]
EFFECT OF MOISTURE CONTENT ON THE PHYSICAL PROPERTIES OF PUMPKIN

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Fluted pumpkin is a creeping vegetable shrub that spread low across the ground with large lobed leaves and long twisting tendrils harvesting of fluted pumpkin takes place 120-150days, after sowing. The seed contains 13% oil and is used for cooking, manufacturing and cookie formulation. One Hundred samples of fluted pumpkin (telfairia occedentalis) seeds used in this study were obtained from the University of Uyo farm, Akwa Ibom State, Nigeria. The samples use manually cleaned and screened in the Food Engineering Laboratory (where the practical was carried out), to remove foreign matter dust, dirt immature and broken seeds. The screened samples were used in the determination of physical properties at four (4) different moisture levels. In this research work, the size, dimensions, volume, bulk and porosity, were evaluated for fluted Pumpkin seed as a function of moisture content in the range of 8.20 to 4.14 (d.b%). Few physical properties of the pumpkin seed was significantly affected by moisture content variation. The length, width, thickness and unit mass of Fluted pumpkin seed decreased from 3.169 to 2.756 mm, 1.137 to 0.837 mm, 3.106 to 2.760 mm and 8.15 to 4.23 g, respectively, as the moisture content decreased. While the sphericity, geometric mean diameter, bulk density and porosity decreased from 71.7 to 69.7%; 2.23 to 1.92 mm; 2.68 to 2.24 g mm-3; 39 to 35%, respectively. The results indicated that the modifications of moisture content of Fluted Pumpkin seeds caused a variation with linear regression in its dimensions, volume, unit mass, sphericity, for filling and emptying for the variety.

Keywords: Moisture content, physical, pumpkin, properties

OP-080 [Section VI: Bioprocesses]
FRICTION COEFFICIENTS FOR GUNDELIA TOURNEFORTII SEED ON VARIOUS SURFACES

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Gundelia tournefortii, as known kenger in Anatolia, is a thorny plant that grows naturally. It is grown primarily in Southeastern Anatolian region of Turkey and many Middle East countries. It both green parts and roots are consumed by people as vegetables and also, its seeds is consumed as an animal feed. Because, as the gundelia tournefortii seeds's increases milk production and quality, both green parts and seeds has consumed as animal feed. It is also used as a medicinal plant and gum in addition to its use as food and feed. So, the demand for this plant is increasing rapidly. If we consider this plant as an industrial product in future, we have to know exactly some engineering properties of the gundelia tournefortii seeds. One of the important engineering properties is the friction coefficients. The knowledge of frictional properties of plant material is essential for designing mechanical units in agricultural machinery and equipment of related harvest and post-harvest industries. However, there is no friction data about this plant and seeds. Therefore, exact determination of friction coefficients of the crop on different contact surfaces can be useful in performance optimization of mechanical equipment (conveyors, separation, cleaning, drying, bins and storing tools), and consequently, reduction and increment of harmful damages and economic efficiency, respectively. The friction coefficient of agricultural products depend on moisture content, length of cut, normal pressure, surface condition and the sliding velocity.

The main objective of this study was to determine the static coefficient of friction (μs) and kinetic coefficient of friction (μk) for gundelia tournefortii seeds at 9.60%, 16.20%, 31.30 % and 42.30% moisture content (all moistures are % wet basis) on four contact surfaces namely, chromium, galvanized steel, rubber and, PVC, five different sliding velocities (5, 10, 15, 25, 50 mm/s) and three level of loading force (15, 20 and 25 N pressure). The naturally grown the Gundelia Tournefortii seeds used in this study were collected from nature, location of Silvan, Diyarbakır province, Turkey, 2017. Friction force was measured by Lloyd instrument test machine at various moisture content and different contact surface. Each experiment was accomplished in five replications.

In general, for all tested contact surfaces, μs and μk increased with increasing moisture content and applied load. While the highest static and kinetic coefficients were found on rubber surface as 0.647 and 0.606, respectively, the lowest values were obtained on chromium surface as 0.470 and 0.430, respectively. There was not found significant effect of sliding velocity on both static and kinetic friction coefficients.

Keywords: friction coefficient, sliding velocity, contact surface, design, gundelia tournefortii

OP-081 [Section VI: Bioprocesses]

DETERMINATION OF TIME DEPENDENT STRESS DISTRIBUTION ON POTATO TUBERS AT MECHANICAL COLLISION

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This study focuses on determining internal stress progression and the realistic representation of time dependent deformation behaviour of potato tubers under a sample mechanical collision case. A reverse engineering approach, physical material tests and finite element method (FEM)-based explicit dynamics simulations were utilised to investigate the collision based deformation characteristics of the potato tubers. Useful numerical data and deformation visuals were obtained from the simulation results. The numerical results are presented in a format that can be used for the determination of bruise susceptibility magnitude on solid-like agricultural products. The modulus of elasticity was calculated from experimental data as 3.12 [MPa] and simulation results showed that the maximum equivalent stress was 1.40 [MPa] and 3.13 [MPa] on the impacting and impacted tubers respectively. These stress values indicate that bruising is likely on the tubers. This study contributes to further research on the usage of numerical-methods-based nonlinear explicit dynamics simulation techniques in complicated deformation and bruising investigations and industrial applications related to solid-like agricultural products.

Keywords: Bruise progression, deformation simulation, finite element method, explicit dynamics, potato tuber

OP-082 [Section VI: Bioprocesses]
DETERMINATION OF LEAF BREAKING STRENGTH OF VARIETY CANDIDATES OF COMMON VETCH

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The study was conducted to determine whether there is a difference in leaf breaking resistance between variety candidates of common vetch in order to minimize leaf breaks which causes large loss in common vetch forage production. The experiment was carried out in the Bati Akdeniz Agricultural Research Institute, at Department of Field Crop in 2017-2018. The experiment was established by randomized block design. Breaking resistance of the leaves and pinnule leaf were measured using a universal testing machine. Measurement was done with 10 plants for each replication, on 3 pinnule leaves on the fourth leaf on the main stem belongs to 4 different variety candidates of common vetch. In addition, the thickness of the leaf stalk, stalk of green and dry sample rupture energy with green and dry samples rupture stress is calculated. As a result of the experiment, wide variation among candidates of common vetch was determined. It can be said that the determination of the rupture resistance between variety candidates is important for low yield loss.

Keywords: Common vetch, Breaking Strength, Mechanical Properties

OP-083 [Section VI: Bioprocesses]

IMPACT OF TILLAGE PRACTICES ON SELECTED SOIL PHYSICOCHEMICAL, BIOLOGICAL PROPERTIES AND YIELD ATTRIBUTES OF MAIZE IN LATOSOLIC RED SOIL OF SOUTHERN CHINA

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Tillage practices influence physical, chemical and biological properties of the soil and have a major impact on soil productivity and sustainability. This study was conducted to determine the effects of different tillage practices on soil physicochemical, biological characteristics and the impact of such tillage practices on yield attributes of maize in a typical latosolic red soil of southern China on a middle term (7 years) consistent tillage practice. Subsoiling (SS), two passes of rotary tillage (2RT), subsoiling + rotary tillage (SS+2RT) and zero tillage (ZT) were studied in a randomized complete block design with three replications. After a two-year successive monitoring in 2016 and 2017, tillage practices showed positive effects on soil properties, crop yield and its attributes. Highest physical parameters, SOM and nutrient levels in their total and available forms (N, P, and K) were recorded in the ZT. Subsequently, analysis of soil microbial count showed that ZT recorded the highest levels of bacterial and actinomycetes at the soil depth of 0-30 cm, whilst SS increased the fungal count in the soil depth of 0-40 cm. Maximum biomass (ton ha-1), grain yield (ton ha-1), harvest index (%) and 1000-grain weight (g) were recorded under SS. The highest fuel consumption was observed as 28.4 Lha-1 in the 2RT practice whereas 6.5 Lha-1 in the SS. The results suggest that SS was found to be more suitable for achieving higher yield with minimal cost in latosolic red soil resulting in a sustainable agricultural system.

Keywords: Tillage, bulk density, SOM, nutrient, microbial count, maize yield

OP-084 [Section VI: Bioprocesses]

EVALUATION OF ENZYME DOSES ON ETHANOL PRODUCTION FROM RAW SWITCHGRASS VARIETY OF KANLOW

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Switchgrass is a perennial energy crop which has high potential in producing biomass, vast adaptation capability and C4 carbon fixation mechanism. It is capable of growing in drought or wet climate conditions and in poor soil. Owing to its agricultural advantages and high structural carbohydrate profile, switchgrass is a suitable feedstock for ethanol fermentation. Lignocellulosic bio-ethanol is one of the most environmentally friendly fuel which can be used alone or as a supplement for gasoline. Because of its rigid structure, it is hard to reach sugars in lignocellulose. However, this structure can be destroyed by enzymatic hydrolysis.

Aim of this study is to determine the optimum cellulase and glucosidase enzyme amounts to reach the maximum ethanol yield from raw switchgrass. In this study, a species of Panicum virgatum L. (Switchgrass), Kanlow was used as feedstock. Kanlow was obtained from Konya and milled to 0.5 mm size before use. Saccharomyces cerevisiae, inoculum, for ethanol fermentation was incubated at 36 °C and 100 rpm for 12 hours in yeast extract – peptone – dextrose broth. Simultaneous saccharification fermentation (SSF) assays were carried out in 100 mL working volume containing 5% (w/v) dry Kanlow, 1M citrate buffer to stabilize pH at 4.8 and KH2PO4, (NH4)2SO4, MgSO4 as nutrients for yeast. Cellulase and glucosidase were used 25, 50, 75 EGU and 20, 50, 80 IU per gram of dry matter, respectively. To determine the amount of ethanol produced via enzymatic hydrolysis, an experiment without enzyme was conducted and used as control. SSF was performed at 36 °C for 144 hours in a rotary shaking incubator with an agitation speed of 150 rpm. Aliquots were taken at 0, 12, 24, 48, 72, 96, 120, 144 hours and analyzed by HPLC to determine the amount of produced ethanol.

When the results were evaluated it has been seen that maximum ethanol yield was reached at maximum enzyme doses which were 75 EGU cellulose and 80 IU glucosidase per gram dry switchgrass. Maximum ethanol production was measured as 26.44 L/tonne switchgrass at the 48th hour of fermentation which corresponds to 11.86% of theoretical ethanol yield. Ethanol production in the experiment without enzyme was 0.99 L/tonne switchgrass, corresponding 0.43% of theoretical ethanol yield. According to these results, it has been calculated that enzymatically hydrolised sample produced approximately 26 times more ethanol, compared to the sample fermentated without enzymes. The addition of enzymes increased production potential of ethanol from switchgrass. Applying these enzyme doses after a high yielded delignifying pretreatment would enhance the ethanol production from Kanlow greatly.

Keywords: Enzymatic hydrolysis, Ethanol fermentation, Lignocellulosic ethanol, Switchgrass

OP-085 [Section VI: Bioprocesses]

OPTIMIZATION OF ANTIOXIDANT ACTIVITY OF EXTRACTS FROM NEW ZEALAND AND CHINESE ASPARAGUS ROOT CULTIVARS USING MICROWAVE ASSISTED PROCESS

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Optimization of the antioxidant activity of asparagus root extract (ARE) and caffeic acid (AC) from New Zealand and China AR cultivars was carried out using a Central Composite Design (CCD) combining with microwave-assisted extraction (MAE). The determination of caffeic acid was conducted to use HPLC under the optimum extraction variables. The optimal extraction variables (extraction time 56.5 s, ethanol 62.6%, microwave power 436 W and solid: liquid ratio 1:58.3) generated the maximum total phenolic content (TPC) (17.6-68.6 mg GAE/g), 2,2-azinobis(3-ethylbenzo-thiazoline-6-sulfonate) (%ABTSsc) (11.4-43.2%), β-carotene bleaching assay (%βsc) (12.2-57.2%), superoxide anion radical (%O2-sc) scavenging capacity (4.9-20.1%) and ferric reducing antioxidant power assay (FRAP) (0.42-1.63 µmol/g), produced the highest total flavonoids content (TFC) (4.3-11.9 mg RE/g) under the conditions of extraction time 69 s, ethanol 67.4%, microwave power: 440 W and solid: liquid ratio 1:42 and the highest total saponin content (TSC) (0.13-0.7 mg RE/g) under the conditions of extraction time 57s, ethanol 63%, microwave power 460w and the solid: liquid ratio 1:68. For methanol, extraction conditions viz. microwave power at 480 w for 57.6 s using 64.9% methanol at the solid: liquid ratio of 1:50 obtained maximum TPC (15.1-62.6 mg GAE/g), %ABTSsc (9.5-38.8%), %βsc (13.7-53.9%), %O2-sc (4.8-19.1%) and FRAP (0.15-0.63 µmol/g. Extraction power at 400 W for 59 s with 72% methanol at the solid: liquid ratio of 1:52 obtained the highest TFC (2.6-10.7 mg RE/g) and extraction power at 436 W for 58s with 645 methanol at the solid: liquid ratio of 1:62 obtained maximum TSC (0.06-0.68 mg RE/g). The content of caffeic acid from ARC ranged from 0.46 to 2.89 mg/g with ethanol and from 0.41 to 2.64 mg/g with methanol extraction.

Keywords: Asparagus roots, China, New Zealand, bioactives, MAE

OP-086 [Section VI: Bioprocesses]
EFFECT OF PRESSURE AND TEMPERATURE LEVEL ON FAT AND PROTEIN CONTENT IN MILK POWDER PRODUCTION

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In this study, full fat cow milk was dried at combinations of 30 and 75 kPa pressure and 120, 130, 140, 150, 160, 170, 180, 190 and 200°C inlet temperature conditions using a spray drying system. According to the results of the study, there was a negative correlation of 87.20% between the protein content and the fat determined in different temperature and pressure combinations. At an inlet temperature of 130°C and a pressure of 75 kPa, the protein content was the highest level (27.03%), while the fat content considerably reduced (6.93%). In contrast, at 200°C inlet temperature and 75 kPa pressure combination, there was a significant loss of protein content of milk powder (22.30%) while the fat content was at the highest level (14.24%). Under the conditions that the system pressure was 75 kPa, the highest protein contents with values of 27.03% and 25.79% were obtained at the inlet temperatures of 130 and 120°C, respectively. On the other hand, under the conditions that the system pressure is 30 kPa, the highest protein content was determined as 24.26%, 24.13% and 24.10% in the inlet temperatures of 160, 170 and 180°C, respectively. Under 75 kPa pressure and 200 and 190°C inlet temperature combinations, the fat contents were found as 14.24% and 14.00%, respectively. However, under the condition that the system pressure is 30 kPa, the fat content of the milk powder with values of 12.74% and 12.40% were obtained at the inlet temperature conditions of 120 and 190°C, respectively. In this study, there was found a nonlinear relationship between brightness (L) and both fat and protein content. Accordingly, it was determined that the R^2 of the nonlinear relationship between L and protein content was 95.80% at the 30 kPa pressure, whereas the R^2 of the nonlinear relationship between L and the fat content was 88.71%. On the condition that the system pressure was 75 kPa, the linear relationship between L and fat ratio and between L and protein content were 71.19% and 81.22%, respectively. In this study, a significant relationship was found between the particle radius of milk powder and both protein and fat content.

Keywords: Fat content, milk powder, pressure, protein, spray drying, temperature

OP-087 [Section VI: Bioprocesses]
MULTIPLE MYCOTOXINS DETERMINATION BASED ON IMMUNOASSAY IN AGRO-FOOD AND FEED

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Mycotoxins with strong carcinogenesis and toxicity are fatal threats to human and animal health. Rapid assay and arbitration method are important to monitor the mycotoxin contamination of food and feed. In fact, it is frequently found the co-occurrence of mycotoxins in food and feed, requiring rapid detection for multi-mycotoxins. Based on the home-made monoclonal antibody and nanobody, the rapid multi-mycotoxin detection methods were introduced, allowing the highly specificity, sensitivity and high throughput. First, gold nanoparticle was employed in typical test strip to determine single or multi-mycotoxins (as aflatoxin B1, zearalenone, and ochratoxin A), allowing a rapid screening with the aid of a portable gray-imaging reader. Also, gold nanoparticle was introduced in the homogeneous turn-on assay for aflatoxin B1 based on binding triggered DNA hybridization/dissociation. Secondly, the Eu-microsphere or quantumn dot-microsphere were employed in the rapid assay for the multiple mycotoxins. Based on the Eu-microsphere, the time-resolved fluorescence immunoassay (TRFIA) was established for single or multi-mycotoxins detection. Aflatoxin M1 in raw milk, for an example, could be detected with absence of any sample preparation in 6 min, allowing ultra-lower limit of detection. TRFIA was also employed to detect multi-mycotoxin/pesticide (aflatoxin B1, zearalenone, and chlorothalonil) within 12 min. Quantum dot-microsphere was conducted for the single or multi-mycotoxin, improving sensitivity and the linear range. All these methods depend on the antibodies and nanoparticle labels, allowing considerable detection limits, working ranges, recoveries, precision, repeatability, and reproducibility. Real agro-food and feed samples were further used to validate these method. It could suggest that these practical methods would be extensively employed to monitor agro-food and feed safety.

Keywords: rapid assay, arbitration method, mycotoxin, food and feed safety

OP-088 [Section VI: Bioprocesses]
NANOBODY BASED IMMUNOASSAY FOR MYCOTOXIN DETERMINATION IN FOOD AND FEED

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The detection of mycotoxin plays a key role for protecting food safety, especially the rapid detection based on immunoassay with the advantage of low cost, short detection time and ease of use. It is suitable and widely used for the vast sample screening in the development countries. Most of these rapid immunoassay require high-quality antibodies. Conventional antibodies, including polyclonal antibody and monoclonal antibody could not meet the requirements of rapid detection due to their instability. Nanobodies or VHH antibodies is a single domain heavy chain antibodies, when compared with usually antibodies, the employment of nanobodies in agro-food safety gained considerable attention due to its high resistance against temperature and organic solvent. This could be attributed to the smaller size, resulting in the better stability and reliability. This work described the studies on the advanced immunoassay for single and multiple mycotoxins by using nanobodies. These two type of nanobodies were developed in our own lab. For one, the nanobody Nb26 was designed to specifically bind aflatoxin B1-BSA, while for another, the anti-idiotypic antibodies VHH2-5 and VHH-8# was used to recognize monoclonal antibody against aflatoxin B1 and zearalenone (ZEN), respectively. Based on the as-prepared nanobodies, three immunoassay method were investigated. These two strategies for aflatoxins analysis, including an ELISA based on either a VHH coating antigen, and a conventional ELISA, showed an IC50 of 0.16 and 0.754 ng/mL, respectively. A real-time immuno polymerase chain reaction (IPCR) assay was introduced for the accurately quantitative detection of aflatoxins in agri-products, based on a M13 phage containing aflatoxin anti-idiotypic nanobody and its encoding DNA. The limit of detection (LOD) was 0.02 ng/mL, a 4-fold improvement compared with traditional phage ELISA. Additionally, a quantitative and simultaneous detection of aflatoxin B1 and ZEN was developed based on a time-resolved fluorescence immunochromatographic assay. It provided a quantitative relationship range of 0.13-4.54 and 0.20-2.77 ng/mL, with a LOD of 0.05 and 0.07 ng/mL, for AFB1 and ZEN, respectively. Therefore, it would have a broader prospect for solving the rapid detection problems in the developing countries based on the nanobody technology.

Keywords: Nanobody, immunoassay, mycotoxin, food and feed

OP-089 [Section VI: Bioprocesses]
FT-IR IMAGING SPECTROSCOPY FOR MEASUREMENT OF THE PHYSICAL PROPERTY OF POTATO TUBER

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Time series spectroscopic and physical property data were obtained from 5 varieties of tuber samples during microwave baking. These data were analyzed using evolutionary computing methods including partial least square discriminant analysis (PLSDA), partial least square regression (PLSR) and locally weighted partial least squares regression (LWPLSR). PLSDA was able to discriminate the tuber samples into three separate classes corresponding to their spectral properties. The predictability of spectra in full wavenumber region (4000–600 cm−1) and fingerprint region (1500–900 cm-1) were calculated using PLSR and LWPLSR and the relative performances of developed models were compared. It was observed that similar or even better predictions were obtained by models using spectra in the fingerprint region. Then, first-derivative and mean centering iteration algorithm (FMCIA) was carried out to select potential effective wavelengths and these selected wavelengths were further simplified using successive projections algorithm (SPA) for improving the model efficiency. Based on the FMCIA-SPA method for wavelength selection, the optimized models were established using LWPLSR for determination of tuber textural property (TTP) in terms of hardness, resilience, springiness, cohesiveness, gumminess and chewiness, with correlation coefficient of prediction (RP) of 0.797, 0.881, 0.584, 0.574, 0.728 and 0.690, respectively. The results of this study demonstrated that FTMIR-ATR spectroscopy could be used reliably and rapidly for the non-destructive assessment of physical property of microwave baked tuber.

Keywords: FTMIR-ATR, Textural property, Potato, Multivariate regression, Non-destructive testing

OP-090 [Section VI: Bioprocesses]
EFFECT OF HIGH HYDROSTATIC PRESSURE PROCESSING ON COLD-BREWED WHITE TEA CHARACTERISTICS

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Tea (Camellia sinensis) is a commonly consumed beverage globally. Steeping tea leaves in hot water is widely used in the cold tea production. However, loss of aroma compounds and degradation of bioactive compounds occur with the process. The potential of alternative processing technologies is being investigated for the cold tea production. High hydrostatic pressure (HHP) processing is an emerging technology of food preservation, and its application to making cold tea for an extraction purpose has not been explored yet. Therefore, this study aims to quantify the potential use of HHP technology in the production of ready-to-drink cold tea using white tea leaves.

The present study analyzed the impact of HPP processing on cold-brewed white tea characteristics. Response surface methodology (RSM) was utilized to optimize pressure, tea leaves/water ratio, and brewing time with respect to caffeine content and antioxidant activity. Operational conditions for HHP processing of cold-brewed white tea involved different ranges of pressure (300-500 MPa), tea leaves/water ratio (0.01-0.03%) and brewing time (120-600 sec). The most important factor was determined as tea leaves/water ratio with the highest coefficients for caffeine content (11.48%) and antioxidant activity (5.09%). The HHP processing exerted a negative effect on antioxidant activity. The RSM-based optimization led to 367 MPa, 0.017%, and 120 sec as the optimum brewing conditions which resulted in 18.3% caffeine content and 95% antioxidant activity. HHP processing of cold-brewed white tea appears to be a promising alternative to achieve minimum caffeine content and maximum antioxidant activity.

Keywords: high pressure processing, desirability approach, white tea, cold brewing

OP-091 [Section VI: Bioprocesses]
THE RELATIONSHIP BETWEEN RICE STEM CUTTING RESISTANCE AND CRACKING FORCE OF RICE KERNEL

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Two important rice varieties, Karacadağ Karakılçık and Karacadağ Beyaz rice varieties, are grown, upper Mesopotamia, in Southeastern part of Turkey. Although these rice varieties' physical and mechanical characteristics are different each other, they are harvested with the same harvester and thresher. So, high kernel losses and energy consumption are occurring during the harvesting stage. To reduce grain losses and energy consumption, it is need to know rice stem cutting and kernel cracking properties for each variety. The exact knowledge of stem cutting energy and kernel cracking energy are the main parameters for optimizing design of cutting elements in harvesting, threshing, sorting, transporting and milling machines. The aim of this study was to compare the relationships between rice stem cutting properties and kernel cracking force for two local rice varieties, Karacadağ Karakılçık and Karacadağ Beyaz. In this study, cutting energy of rice stem was examined at different internode positions. The experiments were conducted at stem moisture contents of 70.81 %, 41.60 % and 7.5 w.b, and kernel moisture contents of 24.10 %, 19.30 % and 8.7 % w.b. and three internode positions lower (N1), medium (N2) and higher (N3) mm down from the panicles for Karacadağ Karakılçık and Karacadağ Beyaz rice varieties. The stem cutting fore and kernel cracking forces were measured with an Llyood Universal Testing Machine. The results showed that the energy requirement for shearing of Karacadağ Karakılçık variety is more than Karacadağ Beyaz variety. The cracking force and energy were found differences between horizontal side and vertical side. It was found that the cracking force of rice at the horizontal orientation higher than those at the vertical orientation.

Keywords: rice stem, kernel, cracking, shearing, force, energy.

OP-092 [Section VI: Bioprocesses]
RELATIONSHIPS BETWEEN GRAIN STRUCTURE AND STARCH DIGESTIBILITY OF COOKED RICE

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Rice (Oryza sativa L.) is one of the major carbohydrate sources especially in Asian countries. Different from other cereals, rice is consumed as a cooked grain. Therefore, the grain structure influences on the cooked rice properties, e.g. textural characteristics during chewing. Usually, it is thought that the grain structure is destructed by chewing, the structure in microscale such as cell matrix is, however, partly maintained after chewing and swallowing. Such grain tissues would be related with cooked rice digestibility, because it is consisted of dietary fiber. The aim of this study is to investigate the relationships between structural characteristics and starch digestibility of cooked rice grain. The intact cooked rice grain was used as a structural grain sample. In contrast, the homogenized slurry of cooked grain was regarded as a structure-less sample. Kinetic analysis of starch hydrolysis (%) and microscopy approaches during in vitro digestion were employed to evaluate starch digestibility of cooked samples in this study. The kinetic analysis showed that the kinetic constant of the homogenized sample, which was regarded as an estimated starch digestion rate, was approximately eight times higher than the intact one, whereas the equilibrium starch hydrolysis (%) of both intact and homogenized samples were comparable. The microscopic observation clarified that the starch granules in the homogenized slurry disappeared at an early stage of small intestinal digestion. However, the starch portion in intact grain seemed to be maintained by the grain outer layer and, thus, it disappeared slowly relative to the slurry sample. These results indicated that the grain and cell structure had strongly relations with the starch digestibility of cooked rice.

Keywords: rice, grain, plant tissue, cell matrix, dietary fiber, in vitro digestibility

OP-093 [Section VI: Bioprocesses]
ESTIMATION OF PARTICLE DENSITY OF BIOMASS PELLETS BY IMAGE PROCESSING TECHNIQUE

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One of the most important quality indicators of biomass pellets is particle density which is directly related to compression ratio of grounded biomass material and obtained pellets. While high density biomass pellets are resistant to physical effects during transport and storage operations, low density pellets have weak physical structure and they provide low combustion efficiency. According to relevant standards and studies, particle density of biomass pellets measured with ratio of pellets' weight and volume, assuming that ideal cylinder. The value of volume is achieved by measuring the length and diameter of each pellet. To reflect the accurate density value of pellet type it is necessary to a large number of pellets must be measured. The average density value of measured pellets gives the density of pellets of each biomass material.

In this study, the length and diameter of the pellets were calculated by image processing method to avoid of measuring the density parameters of a large numbers of pellet one by one. The correction formula for each type of pellets were found by performing regression analysis between the measured pellet volume and estimated volume from image processing. The density value was estimated by ratio of average pellet weight and corrected volume. As a result of comparison between measured and estimated densities, high accuracy was obtained with the differences of 0.3% - 7 %.

The experiments were conducted using three kinds of biomass pellets which were made of sawdust, palm tree residues and greenhouse tomato residues. The length and diameter values of randomly selected 50 pellets from each sample were manually measured with digital caliper with three replications. Then, all pellets from each pellet sample were individually weighted. Average and total pellet weight were calculated. The measured volume and particle density values compared with estimated volume and particle density values by image processing software (ImageJ 1.50i) which is an open-source application provided by National Institues of Healts, USA.

Keywords: Biomass, pellet, image processing, particle density

OP-094 [Section VI: Bioprocesses]
DISTRIBUTION ENVIRONMENT OF EXPORTED PEACH FRUIT FROM JAPAN TO SINGAPORE

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In recent years, exporting fruits and vegetables abroad has been promoted in Japan. Generally, airplanes are the main means of exporting from Japan to Singapore, and ship transportation to fruits and vegetables is rarely carried out. Because it takes about 2 weeks to transport to Asia, it is difficult to maintain the quality of fruits and vegetables during shipping, so it has not been put to practical use. In this study, we aimed to clarify the environment where fruits and vegetables are exposed in actual distribution process and to clarify the influence of distribution environment on quality of peach fruit. In export demonstration experiments, peach fruits were used only for fruits classified as having a brix of 14 degrees or more by non-destructive inspection with a light sensor at Japanese agricultural cooperatives. In the distribution environment, the domestic transportation period by truck in both Japan and Singapore was shorter than the international transportation period, but it was shown that the vibration of the domestic transportation period by truck was larger than the international shipping period. During shipping, it was shown that both temperature and humidity were controlled at an optimum conditions for maintaining freshness of peach fruits. As a result of carrying out the distribution demonstration test using cradle-shaped packaging materials, a bruise caused by the fruit net on the fruit was not confirmed and the fruit hardness after distribution was also maintained. We have revealed that peach fruit after distribution keeps its commercial value until the fifth day of arrival. It was shown that the developed cradle-shaped packaging material absorbed vibrations generated by truck transport rather than ordinary cardboard boxes, and the utility could be verified.

Keywords: packaging material, vibration, hardness, shipping

OP-095 [Section VI: Bioprocesses]
DESIGN OF AUTOMATIC GAS ANALYSIS SYSTEM FOR TUNNEL TYPE COMPOSTING SYSTEM

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The amount of wastes has been increasing rapidly and they create risks for human health and environmental problems. The major part of the collected wastes is organic. Composting and biogas technologies are commonly used for utilization of residential, agricultural and industrial wastes. Microorganisms degrade wastes and transform it to compost while maintaining the oxygenated conditions in a pile of organic wastes. Compost is used for soil conditioner, soil nutrients and substrates for mushroom growers. Compost is produced from residential and agricultural wastes in Turkey. However, the technologies developed for compost production in Turkey have their own problems in this sector. Only one agricultural machinery company in Turkey manufactures a windrow turner for composting process. The equipment for static and closed structured systems for composting is exported.

In this study, it is aimed to produce domestic technologies for closed systems for composting sector in Turkey. Oxygen level of in the pile should not fall below 5% in the composting process. In modern composting plants the oxygen level of the air in the pile is monitored and controlled. In this study, a gas measurement automation system which can be used in tunnel type composting plants was developed and tested. The automation system consists of PLC processor, oxygen sensors, gas conditioning unit and solenoid valves. The software and hardware of the developed system are prepared within the scope of the study. This study was supported by TÜBITAK (The Scientific and Technological Research Council of Turkey, Project No: 214O266).

Keywords: Composting, gas monitoring system, tunnel composting system

OP-096 [Section VI: Bioprocesses]
FACILE DESIGN OF TERNARY COMPOSITES FOR AFB1 PHOTOCATALYTIC DEGRADATION

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Aflatoxins are toxic, cancerogenic and teratogenic natural pollutant, which are extremely stable and refractory in environment. Many kinds of chemical, physical and biological approaches have been applied to reduce aflatoxins. However, chemical and physical measures often need the strong alkali or oxidant and high temperature. In addition, the biological measures showed the high efficiency and selectivity, but these may have difficult to be reutilized on a large scale. Recently, semiconductors photocatalysis has been regarded as a potentially green, sustainable and environmental-friendly approach to remove or degrade pollutants from environment in mild condition. Herein, we designed a novel and highly efficient three-components composite consisting of dispersive WO3 nanowires, g-C3N4 nanosheet and reduced graphene oxide as solid electron mediator. The composites exhibited markedly enhanced activity for the photocatalytic degradation of aflatoxin B1 under visible-light irradiation compared with single and binary catalysts. It was found that the synergistic effects coexisted in this ternary composites that depended on the geometric architecture and interface combination of components, and the •O2-, h+ and •OH were main active radicals during photodegradation of AFB1 over ternary composites. Moreover, photocatalytic degradation products of AFB1 and Z-scheme mechanism of ternary composites were also proposed. This work may not only provide beneficial information to design and synthesis of effective composites system for pollutant degradation, but also present a new and potential way to remove the refractory natural pollutant in future practical application.

Keywords: Z-scheme, photocatalytic degradation, composites, aflatoxin B1

OP-097 [Section V: System Management]

AUTOMATIC TEMPERATURE COMPENSATION AND DIAGNOSTIC SYSTEM FOR ELECTRICAL CONDUCTIVITY AND PH PROBES IN RECIRCULATING HYDROPONICS

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Hydroponics has been widely used in modern horticulture due to the several advantages such as fewer diseases, less pesticides, and higher yields. In particular, recirculating hydroponic solution is considered to be a more effective method to reduce the waste of the fertilizers and minimize the environmental impact of hydroponic systems. In closed systems, the nutrient solutions are reused based on the measurement of pH and electrical conductivity (EC) using portable or bench top analyzers equipped with electrode probes to effectively maintain the nutrient status of the reused solution in an optimal level for crop growth. However, a main problem with this practice is that the EC and pH probes can provide inconsistent sensitivity responses to varying solution temperatures and signal drifts can be induced when they are immersed in the solution for a long time. Frequent calibration and temperature compensation with pH and EC measurements would allow more accurate monitoring of nutrients for crop growth in closed systems. In addition, the implementation of an automatic electrode diagnostic system with an alarm function would be useful in a remotely operated hydroponic nutrient management system due to the ability to alert the grower to detect the malfunctions or failures of the electrodes. In this study, an automated calibration and diagnostic system with the capability of temperature compensation for the EC and pH probes was developed to more accurately monitor changes in pH and EC values in hydroponic solutions. The system could check the status of the pH and EC probes based on the measurement of their sensitivities by automatic introduction of calibration solutions with known concentrations. Both hardware and software techniques to compensate for temperature effects on electrode response were developed. The pH and EC measurements were conducted before supplying the nutrient solutions to the growing bed of plants. The effectiveness of the developed system was evaluated by a comparison to a standard method involving sampling and laboratory analysis while growing lettuce plants based on the ebb and flow method. Application of the developed system to a closed hydroponic cultivation system proved to be feasible in precision hydroponic nutrient management due to an improvement in the accuracy of the pH and EC measurements by the implementation of temperature compensation and automatic electrode diagnosis techniques.

Keywords: Electrical conductivity, pH, Automation, Compensation, Diagnostic system

OP-098 [Section VI: Bioprocesses]
AFLATOXIN CONTROL IN AGRO-PRODUCTS IN DEVELOPING COUNTRIES

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Aflatoxins are the secondary metabolites produced by toxigenic fungi that contaminated a variety of grain and oil crop products. For their strong toxicity and carcinogenicity, aflatoxin contamination agro-products have been recognized as a world-wide problem, especially in developing countries. The planting area of grain and oil crops is large and covers a wide range of regions, for example in China across nearly 49 latitudes and 62 longitudes. Many modes of production have been formed to fit different ecological environment. Additionally, the production of aflatoxin is the joint action of various factors, including toxigenic fungi, crop varieties, and environment (moisture, temperature, etc.), and can occur throughout the entire food chain. So the prevention and control of aflatoxins has been a worldwide agricultural topic. Moreover, we believed that special funds from national governments is essential to promote related scientific research activities, which can provide the key technical supports for prevention and control of aflatoxins in agro-products. Since 2013, "Safety on the tip of the tongue" is listed as one of China national strategies. As is well known that agro-products is the origin of the food chain and is the key to control food safety. To meet the needs of government supervision, an array of scientific researches on quality and safety of agricultural products has been promoted. In this article, we reviewed the recent advances on aflatoxin contamination control technologies for agro-product safety. (1) development of aflatoxin-resistant variety breeding (such as Zhonghua 6, etc.); (2) development of analytical technologies for risk monitoring (time-resolved fluorescence immune-chromatographic assay (TRFICA), gold-nanoparticle multi-immunoassay, enhanced immune-affinity fluorescence assay, and multi-immuno-affinity column-UPLC-MS/MS, etc.); (3) development of prediction and risk assessment (non-parametric probability assessment method based on Monte Carlo simulation and Bootstrap sampling, prediction model based on associated environmental factors); (4) development of prevention and reduction technologies for aflatoxin contamination (such as adsorption and degradation of nanomaterials, biocontrol agents, photocatalytic and degradation of microorganism, automated physical sorting, controlled atmosphere storage, etc.). Based on the above developed, using aflatoxin in peanuts as an example, the contamination control system including a series of control technologies and their corresponding standards from farm to table has been formed in China, which provide a classic and useful case for the control of aflatoxin contamination in the world.

Keywords: Aflatoxin control, Agro-products, developing countries

OP-099 [Section VI: Bioprocesses]

NUTRITION-SENSITIVE BEAN PROCESSING: SOFTENING TECHNIQUES AND THE NUTRITIONAL COST OF IMPORTANT MINERALS

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Common beans are important source of plant protein and micronutrients with huge health benefits. Prolonged cooking time is a primary limitation to beans utilization and consumption. Application of softening techniques has been used to lower the cooking time. In this study, the elemental trade-off of three softening techniques (soaking, and the addition of NaCl and K2CO3 salts during cooking) were examined. The results showed that just cooking of beans without any softening technique could take up to 180 min plus significant reduction in the native mineral elements (potassium, 55%; iron, 43%, zinc, 10% and magnesium 26%). Applying softening techniques led to a 42.8 and 57.2% reduction in cooking time after soaking and cooking with K2CO3 salt, respectively. On the other hand, the addition of NaCl salt increased cooking time by 16%. Also, the rate of K, Fe, and Zn degradation during soaking was found to be 0.014, 0.089 and 0.008 mg/100g for every hour of soaking at room temperature. At higher soaking temperature (> 45oC), the rate of degradation increased by at least 146% per hour of soaking. The addition of K2CO3 salt during the beans cooking process was the most effective softening technique. However, it had the most detrimental effect on the minerals. It depleted the Fe and Zn content by 53 and 26%, respectively. A strong positive correlation (at least 0.78) was found between the rate of softening and the degree of minerals degradation in all the softening techniques applied.

Keywords: Nutrition-sensitive processing, common beans, micro-nutrients, softening techniques

OP-100 [Section VI: Bioprocesses]
COLD ATMOSPHERIC PRESSURE PLASMA AS A TOOL FOR INFLUENCING TECHNO-FUNCTIONALITY FOR PROCESSING HEALTHY PLANT-BASED FOODS

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Increased life expectancy is one of the major challenges in the context of demographic change. Therefore it is of immanent importance to prepare the middle age group (50 to 70 years) for the period of old age (70 to 90+ years) in order to allow them to fully enjoy the gain in life expectancy with an active and healthy living. Thus, we are convinced that adherence to nutritional guidelines based on current knowledge can lead to a longer, healthier life. The NutriAct cluster in Germany addresses the question of nutrition in the context of healthy aging and within the scientific projects (1) provide the scientific basis for age-oriented nutritional interventions, (2) acquire recommendations for realizable guidelines, (3) explore strategies for a successful implementation of such guidelines and (4) engineer palatable products that facilitate age-oriented healthy nutrition. Techno-functionality and nutritional value are influenced by structural alterations that are unavoidable or applied in a targeted fashion to food processing and consequently, must be adjusted and optimized. The aim of this study was to investigate effects of plasma treatment by means of a diffuse coplanar surface barrier discharge on techno-functional properties of different flour fractions from grain pea (Pisum sativum) and on yield, function, composition and structure of soluble pea proteins. Therefore, pea testa flour (PTF), pea protein flour (PPF) and pea protein isolate (PPI) were exposed to an atmospheric pressure cold air plasma (300 W) with treatments ranging from 1 to 15 minutes. Direct treatment of PTF causes significant reduction in protein yield as well as changes in structure and composition of soluble pea proteins. Fractions of potentially allergenic globulins were decreased while pea albumin 2 (PA2) content increased. The assumption of structural changes was confirmed by a decrease in tryptophan fluorescence intensity (TFI) as well as by a shift to higher wavelengths (red shift). Furthermore, pH reduction and modified particle size distributions were found, as water binding and swelling capacity were increased, Direct and semi-direct treatments of PPF resulted in a marked reduction in protein yield. Composition of proteins was changed by decreasing band intensities of globulin fractions, especially vicilin and an increase of PA2. A red-shift as well as an increase in TFI and tryptophan concentration was measured. The capability of CAPP to improve texturizing properties of dry pea flour was shown and further possibilities for the modification of other food and feed matrices by CAPP are indicated.

Keywords: postharvest processing, product properties, legumes, quality

OP-101 [Section VI: Bioprocesses]
DEVELOPMENT AND APPLICATION OF FUNCTIONAL FOOD FOR OLDER PEOPLE

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Introduction. The paper presents the technological and nutritional aspects of functional products designed for the elderly persons in the international cross-section. Nutritional recommendations propagated in European countries and addressed to people are very different. The acceptance and willingness to buy functional foods by consumers has been widely studied, but no research has been carried out on the attitude of older consumers towards innovative products with health consequences. This study looks at how older consumers perceive functional food and new health-improving products, how willing they are to buy these products and what factors affect their purchase. The continuous development of the functional food products market is being observed. Another factor is change in the consumer's attitude towards functional food products with a lifestyle changes. Consumers increasingly believe that food contributed to the health-oriented changes in their eating habits. Objective and Methods. The first part of the study contains a review of functional products available on the market, manufactured exclusively for the elderly and their characteristics against the background of varied nutritional needs of older people. It also contains an overview of the current state in terms of legal provisions and the labelling of these products on the European market. In the second part of the research, the opinion of seniors on the role and place of special food for the elderly in their diet as well as possibilities and limitations were analyzed. Conclusions. The research shows that the market for older consumers is not homogeneous. Based on a qualitative, in-depth approach, the study distinguishes consumer groups with different understanding of health and attitudes towards health-improving products that affect the readiness of people to buy such products. These groups include consumers looking for healthy products, critical and cautious consumers and consumers of natural healthy products. Different motives and barriers to using products with health claims have also been identified.and described.

Keywords: functional food, design, nutrition of older people

OP-102 [Section VI: Bioprocesses]
NOVEL AND TRADITIONAL TECHNOLOGIES FOR THE PRODUCTION OF SAFE MEAT PRODUCTS: WHAT WE KNOW AND WHAT WE DON'T KNOW

Alaa El-din Bekhit

Alaa El-Din Bekhit

A worldwide interest in production of safe and nutritious food led to rapid development of a range of new technologies, such pulsed electric field, high pressure treatment, microwave dielectric, irradiation, and ohmic heating, that have been coined as "emerging technologies" in literature. Most of these technologies have been investigated for their effects on sensory, nutritional and microbiological properties of meat products and to a lesser extent for their toxicological effects. Some of these technologies indeed have several clear advantages that make them appealing for commercial use. Parallel to the increased interest in these novel technologies, a decline in the use of more traditional preservation methods, such as the use of natural products for preservation, appear to be evident from research outputs. These research directions appear to be serving communities that are capable of supporting the use of these novel technologies in terms of cost, technology, on-going maintenance and troubleshooting, while oversight the needs of less developed societies, where food safety is a prevalent problem. Furthermore, the safety risks of some of these technologies are not completely profiled and more information is needed before commercialization. This presentation will discuss some of the critical issues related to both novel and traditional technologies with the aim of highlighting urgent research needs for safer meat products.

Keywords: pulsed electric field, high pressure, transfer, safety

OP-103 [Section VI: Bioprocesses]
EMERGING MONITORING AND PROCESSING TECHNIQUES FOR SAFE EDIBLE INSECT PRODUCTION

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The increasing demand for protein caused by the increasing world population and meat consumption brings insects into focus as alternative protein source. Insects are nutrient-rich and in some cases have high protein and fat contents when compared to other animal foods (pork, beef, and poultry). However, the use of insects as food entails potential microbiological risks because insects can serve as vectors for microorganisms pathogenic to humans, animals, and plants. Up to now, the risks associated with the use of insects in the production of foods and food ingredients have not yet been investigated sufficiently. There is a lack of scientifically based knowledge of insect processing to ensure food safety, especially when these processes are carried out on an industrial scale. Microbial and chemical contaminations of insects and insect products are depending on insect species, rearing conditions, the substrate used for feeding, harvest point, growth stadium and processing steps. The nutritional composition of the insects may also be influenced by the feed/rearing substrate applied. Insects possess a potent innate immune system which encompasses the synthesis of a broad spectrum of antimicrobial peptides. These immunity-related effector molecules contribute to the control of the insect gut microbiota, the sanitation of the gut prior to pupation and to self-medication. The presentation will briefly summarize the recent state of the art and focus on features that are promising for the development of strategies to prevent the outbreak of infections without the application of antibiotics thereby achieving beneficial carry-over effects for the consumer. Recent insights into trans-generational immune-priming and nutritional immunology of farmed insects such as the Black soldier fly Hermetia illucens and the mealworm Tenebrio molitor will be highlighted and further examples will be discussed. Additionally, cold atmospheric pressure plasma (CAPP) offers a potential for improvements in hygienic insects processing. Plasma sources and devices were introduced for different applications along the entire insect processing chain. The effects of CAPP on insects and insect based products will be demonstrated.

Keywords: food and feed, sustainable production, insects, quality and safety attributes, cold plasma

OP-104 [Section VI: Bioprocesses]

OPTIMIZATION OF INTERMITTENT DRYING OF ROUGH RICE IN COMBINED FIR-DRYER USING FINITE ELEMENT METHOD

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Fissure formation of kernels during rough rice drying was studied in a laboratory scale infrared-assisted vibratory bed dryer. Experimental factors included FIR intensity (without radiation, 1000 and 2000 W.m^2), inlet air temperature (30, 40 and 50˚C), drying time (15, 30 and 40 min), and tempering ratio (0, 2, 4 and 6). Drying duration, percentage of cracked kernel (PCK), specific energy consumption (SEC) and bending strength of non-fissured brown rice kernel were measured and evaluated to specify the optimum drying treatment. Based on the result of experiments, the optimum drying condition was introduced to be the intermittent drying having duration of 30 min with tempering ratio of 4, for FIR intensity of 1000 W.m^2 and inlet air temperature of 40˚C. Based on Fick's law, diffusion moisture transfer equation was solved by Finite Element Method (FEM) to describe two-dimension moisture distribution within an individual kernel during drying and tempering process. Moisture content gradient (MCG) inside the kernel was also surveyed to have minimum kernel fissure. The results shown that the amount of 11.6 %d.b/mm can be considered as an index for the critical value for MCG. MCGs which are more than the critical value caused increasing of cracks even at high tempering ratio. Tempering ratio of 4 and 6 caused to eliminate MCGs about 70% to 90%, respectively. However, there is no significant difference between tempering ratio of 4 and 6 when PCK examined. The simulation results were in good agreement with experimental data. The FEM results provided useful information for determination of optimal drying and tempering condition of rough rice drying to achieve high milling quality of grain kernels.

Keywords: Rough rice, Moisture diffusion, Far-infrared radiation, Tempering, Cracked kernels, Finite element method

OP-105 [Section VI: Bioprocesses]
INVESTIGATION OF MOISTURE DISTRIBUTION OF ROUGH RICE IN COMBINED FIR-DRYER USING FINITE ELEMENT METHOD

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Rough rice was dried under combined far-infrared radiation (FIR) conditions. Based on Fick's law, diffusion moisture transfer equation was used to model the single kernel drying rate. Finite element method was employed in solving the equation to simulate moisture movement within individual kernel. A new numerical approach was developed to determine diffusion coefficients of three basic components of rough rice including starchy endosperm, bran and husk. The diffusion coefficients were determined at temperatures ranging from 30 to 50 0C and FIR intensities ranging from 0 to 2000 W/m2. A Polynomial-Arrhenius type general equation was developed to correlate diffusion coefficient of kernel components with drying parameters and the diffusion coefficient values varies between 1.07×10-10 to 4.37×10-9. Based on FEM results, rough rice moisture content can be predicted with high accuracy during drying process.

Keywords: Rough rice, Diffusion, Far-infrared radiation, Single kernel model, Finite element method

OP-106 [Section VI: Bioprocesses]
MICROENCAPSULATION USING SPRAY-DRYING: THE USE OF FINE STARCH SOLUTION FOR THE WALL MATERIAL

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A fine waxy rice starch solution was spray-dried as a wall material for microencapsulation. For this process, the primary solution of mixed core and wall materials needs a low viscosity. Low molecular weight polysaccharides have been commonly used as the wall material. In the present study, a starch solution prepared by a hydrothermal process at 100 °C and fine starch solutions prepared by compressed hot water process at 140, 160, and 180 °C were investigated. The compressed hot water process reduced the viscosity of the fine starch solution and its particle size to produce a uniformly fine spray-dried powder. Inulin hydrolysate powder was also obtained using a 160 °C starch solution with dextrin hydrate as the wall material. The differences in the particle size and appearance of these microencapsulated powders are thought to be affected by the viscosity of the primary solution. Finally, difructose anhydrides (DFAs) were microencapsulated by spray-drying. Previously, preparing DFAs powder through spray-drying and freeze-drying has been difficult because DFAs adhere to the inside surface of the drying chamber. Microencapsulation of DFAs using a 160 °C fine starch solution as the wall material produced powder efficiently and enhanced its handling properties.

Keywords: Viscosity, Compressed hot water, Particle size, Crystallinity index, Difructose anhydrides (DFAs)

OP-107 [Section VI: Bioprocesses]
MICROWAVE ASSISTED FORCED CONVECTION HOT AIR DRYING OF TEFF (ERAGROSTIS TEF)

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The thin layer drying kinetics of teff kernels was investigated at a microwave power density of 2.08 W/g combined with hot air drying at 50, 60, and 70°C and an air velocity of 1.0 m/s. The drying rate at 60 and 50°C was higher than at 70°C for the first twenty minutes after which 70°C showed the highest drying rate followed by 60°C and 50°C in that order. The moisture content was reduced to below 5% after 60 minutes. The drying data was fitted into 12 thin layer drying models. Logarithmic model gave the best fit for the drying data with R2 values of 0.9983, 0.9978, and 0.9973 at 50°C, 60°C, and 70°C respectively. Page model, Henderson and Pabis, two-term, diffusion, and modified Midilli 1; all had R2 values greater than 0.99 at all temperature levels. The effective moisture diffusivity for teff was 3.364 × 10-10 m2/s, 3.05 × 10-10 m2/s, and 3.51 × 10-10 m2/s at 50°C, 60°C, and 70°C respectively. Whereas, the activation energy was 13.3049 kJ/mol. The drying of teff took place predominantly during the falling rate period hence could be reliably modelled by diffusion based models. The low activation energy shows that microwave assisted forced hot air circulation drying is an energy and cost effective way of drying teff. Micro-wave heating facilitates rapid heating and hence significantly increases the rate of mass transfer from the grain surface to the surrounding while the hot air carries moisture away. Based on this analysis, microwave assisted hot air circulation draying of small grain teff is highly efficient in terms of cost and energy saving. The time requirement to dry the grain to low safe moisture content was also extremely low compared to the time required by conventional hot air circulation drying without microwave heating. In conclusion, integration of microwave heating to hot air circulation small grain drying is recommended.

Keywords: Activation energy, effective moisture diffusivity, microwave, teff, thin-layer drying

OP-108 [Section VI: Bioprocesses]

APPROPRIATE AND SUSTAINABLE POSTHARVEST INTEGRATED POSTHARVEST TECHNOLOGIES FOR PERISHABLE COMMODITIES HANDLING IN SUPPLY CHAIN IN AFRICA

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Perishable commodities are becoming important for income generation both by commercial and subsistence farmers in Africa. Fruit and vegetables are also missing from children meals in in most Sub-Saharan regions due to high postharvest losses that reduces availability of this group of food. However, these produces are highly perishable and they needs effective postharvest handling systems. Perishable commodities continue respiring even after harvest unless they are subjected to good postharvest management systems. The main reason for high postharvest losses of fruit and vegetables in hot and dry regions of Africa is mainly due to lack of availability of proper packaging technologies, cold storage and standard transport systems throughout the supply chain. As the result, postharvest loses of fruit and vegetables range from 25 up to 40%. To reduce these losses, the complete supply chain for fruit and vegetables need proper postharvest technology and management systems including pre-packaging and packaging treatments, cooling and protective transportation. Temperature and relative humidity are the two most important environmental factors that are responsible for the occurrence of other factors that lead to produce losses. Reducing temperature decreases physiological, biochemical, and microbiological activities, that are known to be the causes of quality (i.e. flavour, texture, colour, and nutritive value) deterioration. It is, therefore, essential and a priority task in postharvest handling to control the temperature and relative humidity in a micro-environment of perishable produces during storage as they are the main causes of most deterioration. These factors remained to be a constriction for the development of small scale farmers led fruit and vegetables industry in Sub-Saharan Africa. Forced air-cooling, ice cooling, and adiabatic cooling can reduce the surrounding air temperature and that of produces. However, most of these cooling technologies, with the exception of adiabatic cooling, are expensive for especially small-scale farmers, retailers, and wholesalers. As an alternative low-cost evaporative cooling systems have been developed and the technologies are appropriate for small scale fruit and vegetables producers were found to be effective for short term storage and during transportation. The evaporative cooling system reduced the temperature by 8.4 - 13.4°C below ambient temperature, with a rise of relative humidity up to 91% depending on weather conditions. Storage in the evaporativelly cooled store resulted in increased shelf lives from 4 to 24 days in hot season of the region. The low-cost cooling evaporative cooling technologies developed have been integrated with suitable low-cost disinfection treatments. Combining chlorinated water or anolyte water dipping treatments with evaporative cooling during storage, effectively maintained freshness by controlled the tomato fruit weight loss. Anolyte water combined with evaporative cooling gave tomatoes with comparable changes in TSS, pH value, colour, and visual appearance to fruit treated with chlorinated water, but with better visual appearance and marketability. Overall, the marketability of tomatoes harvested at green mature stage has been increased to three to four weeks with an integrated postharvest technology. An integrated postharvest technology for small producers are recommended for implementation in arid and semi-arid regions.

Keywords: fruit and vegetables, cooling technologies, appropriate and sustainable, postharvest treatments

OP-109 [Section VII: Information Technology]

A COMPARISON BETWEEN RUMIWATCH NOSEBAND AND NECK-MOUNTED ACCELEROMETER FOR AUTOMATED MEASUREMENT OF COW INGESTIVE-RELATED BEHAVIORS

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Changes in ingestive-related behaviors (e.g., feeding and ruminating) are key indicators for assessing health and well-being in cattle. The aim of this study was to compare two different sensors for the measurement of feeding and ruminating behaviors of dairy cows. Collar-mounted accelerometers and RumiWatch noseband sensors were used to distinguish between three behavioral categories: feeding, ruminating and other activity (non-ingestive). Ten multiparous dairy cows were used in this study. The cows were housed in an area of 36x13m2 with individual cubicles and concrete slatted floor. The cows were fed roughage ad libitum. Drinking water was available ad libitum. A RumiWatch noseband sensor and a collar-mounted accelerometer were attached to each cow. Direct observations of the cows' behaviors were made from 9:00 AM to 03:00 PM. The observation data were used to validate the sensor data. The clocks of the observer, the RumiWatch noseband, and the accelerometers were synchronized at the start and at the end of the observation period. Both sensors were programmed to log data at 10 Hz. For the RumiWatch noseband sensor, the recording files contain already the classification of the behaviors at 10 Hz. However, for the accelerometer, a new decision-tree algorithm was developed to classify the raw data. The decision-tree algorithm was selected for its low computational costs, which make it implementable on the on-cow nodes. Thus, the sensor wirelessly sends only the classified behavior and not all the raw data. This considerably extends the lifetime of the monitoring system. Results show that the two sensors have similar classification performances for the three behavioral categories, with overall accuracy of 86 % for the accelerometer and 87 % for Rumiwatch noseband sensor. The precision, sensitivity, and specificity measures varied between 78 % and 92 % for the precision, 79 % and 92 % for the sensitivity, and 85 % and 93 % for the specificity. These preliminary findings illustrate the potential of the collar-mounted accelerometer to classify feeding and ruminating behaviors with performances comparable to the Rumiwatch noseband sensor. The use of a simple decision-tree algorithm would optimize the power consumption of the sensors by transmitting just the behavior of the cow instead of all the raw data to the backend system. Moreover, farmers may prefer to use collar-mounted sensors rather than noseband halters. Measurements are being continued in order to validate the reported results.

Keywords: Accelerometer, RumiWatch noseband sensor, dairy cows, machine learning, behaviors classification

OP-110 [Section VII: Information Technology]

DEVELOPMENT OF FOUR ELEMENTS VARIABLE RATE APPLICATION OF FERTILIZATION BASED ON MAPS

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In order to solve the fertilizer layered problem caused by the different density of mixed pellet fertilizer in Heilongjiang province, a four elements variable rate fertilization control system was developed based on 2BJM fertilizer machinery. According to the four different speeds of fertilizer feed shafts the control system could work on either setting value or fertilizer maps condition by electro-hydraulic proportional control technology. The total factor device of variable rate fertilization was designed, including fertilizer box, distributing device, mechanical transmission device, driving device, electric control device. And Communication protocol based on CAN bus was developed, complete system information interaction of upper machine and lower machine. The vehicle terminal was selected, including selection of the new Han VMC1000 car terminal as PC, GNSS positioning module integration, obliquity sensor connection extension. Vehicle terminal control software system of variable rate fertilization was developed based on the Windows XPE, including all elements of the control algorithm of variable rate fertilization, job status information collection and processing, based on the Spatialite fertilizer prescription map query technology method, fertilization, fertilization homework management process configuration, and distributing calibration control and so on. The system could calculate the target speed of the hydraulic motor in real time according to the target value, and send the speed instruction to the fertilizer controller synchronously. Once the system received motor speed signal, the opening of proportional valve could be adjusted automatically. And then four element synchronization variable fertilization (nitrogen, phosphorus, potassium, and micronutrient fertilizer) could be carried out. All the experiments were conducted on Zhaoguang farm in northeast china in 2016. The growth of maize was sampled during the growing period of maize. The area ratio of variable fertilization to conventional fertilization was 1:5, the number of sampling sites were also arranged according to 1:5. After sampling, the detection data included maize plant height, leaf area, leaf dry weight, stem dry weight, aboveground biomass and SPAD value. The results of field experiment showed that the errors of the fertilizer tubes were less than 3.0%, and the variation coefficient was less than 5.0%. Compared with the traditional machinery area, though the maize growth indexes of height, weight, aboveground biomass and SPAD didn't increase significantly, all the variable coefficient reduced obviously. The nitrogen and phosphorus fertilization contents reduced from 216.68 kg/hm2,231.78 kg/hm2 to 150.13 kg/hm2, 200.17 kg/hm2 respectively. The potassium fertilization content increased from 79.41 kg/hm2 to 108.42 kg/hm2. The final yield data was 12200.25 kg/hm2, increasing 1.81%. All the experiments showed that the four elements variable rate fertilization control system could solve the fertilizer layered problem and satisfy the need in practice.

Keywords: Variable rate fertilization, Control system, Precision agriculture

OP-111 [Section VII: Information Technology]

PREDICTION OF SOLUBLE SOLIDS CONTENT OF JACKFRUIT USING SHORTWAVE NEAR INFRARED SPECTROSCOPY

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Soluble solids content (SSC) is an important quality attributes for jackfruit. This attribute is mainly used to determine the maturity of the fruit. However, there is no reliable and low-cost technology available which can be used by farmers for quick maturity screening at a field. This preliminary research aimed to explore the potential application of low-cost shortwave near infrared (SWNIR) spectroscopy to non-destructively predict SSC of jackfruit from their outer skin. Spectral data was collected from 120 outer skin surfaces of four jackfruit samples. The spectral data collected from each outer skin surface were later correlated with its SSC (°Brix) of jackfruit flesh. Partial least square (PLS) method was used to develop both calibration and prediction models to correlate the spectral data with SSC data. For the calibration model, it was found that the coefficient of determination (R2) and root mean square of calibration (RMSEC) was 0.82 and 2.54 respectively. While for the prediction model, the coefficient of determination (R2) and root means square error of prediction (RMSEP) were 0.76 and 2.98 respectively. These results indicated the SWNIR spectroscopy has the potential to be applied to predict SSC of jackfruit from outer skin surface to predict the maturity level of the fruit.

Keywords: Jackfruit, Soluble Solids Content (SSC), Skin Scanning, SWNIR Spectroscopy, Reflectance Technique

OP-112 [Section VII: Information Technology]
AN ONLINE DSS FOR OPTIMISATION OF TRAFFIC IN FIELDS WITH CONTROLLED TRAFFIC FARMING (CTF)

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Controlled Traffic Farming (CTF) is an important agricultural practice to mitigate soil compaction caused by in-field traffic with heavy machinery. Fields are laid out with fixed width paths and all the machines applied for the cropping must follow these paths for all operations. This implies that both the track width and the working width of the machines must be a multiple of the path width. Since the same machines are used in multiple CTF fields, it is complex to determine the optimal path layout for a given field. The shape of the field and its borders must be taken into account. Once the path layout (*path plan*) has been decided, the actual driving pattern (*route plan*) in the field can be optimised for each operation, depending on machine performance measures, like minimum turning radius, loading capacity, etc.

A web-based software tool for real-time optimisation of path and route plans for specific combinations of field, machine and operation is presented. The user interface allows the user to specify the input for the optimisations and step by step create a path and route plan:

1. Upload coordinates of the field border. The field border is displayed on a map and it is stored in a so-called *envelope* following the xml grammar Geography Markup Language (GML)
2. Calculate the optimal path plan based on the machine width. The plan is displayed on the map as a set of parallel tracks covering the field. The path plan is also included in the envelope
3. Add headlands, i.e. areas for turning and driving outside the main cropping area
4. Calculate an optimal route plan and add it to the envelope. The route plan is an optimal sequential ordering of the paths such that the field is covered as efficiently as possible. This depends on the type of operation as well as the kinematic characteristics of the machinery. Therefore, the user inputs the minimum turning radius and for capacitated operations tank capacity and the application rate. The locations of field entrances and depots are marked on the map.

A distributed architecture has been selected for the DSS: The user interface has been implemented on a web server, which communicates with web services at Wageningen University to develop path plans and web services at Aarhus University to develop route plans. Data are stored for the session in the envelope, which the user can download and reuse later.

Keywords: path planning, route planning, field traffic optimisation, logistics

OP-113 [Section VII: Information Technology]
SATELLITE BASED PREDICTING WHEAT HARVEST DATE USING VEGETATION INDEXES

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The accurate prediction of wheat harvest date can help farmers and producers to make advanced arrangements for labor and machinery. This minimizes timeliness loss. The aim of this study was to determine wheat harvest date using satellite images. The field data was gathered through 100 plots (farms) located in the west of Iran at frequency of 2 days. The day with maximum yield was wheat optimum harvest date (WOHD). Also, Landsat 8 images were analyzed during wheat growing seasons in 2015 and 2016. Spectral VIs including NDVI, SAVI, GreenNDVI, NDWI, EVI, EVI2, CVI and CIgreen were extracted from Landsat 8 imagery. The fitting between these VIs and determined appropriate harvest date was investigated using correlation coefficients. The regression models were developed base on vegetation indices to prediction of WOHD using 85% of data. The results showed that most of VIs obtained from 7 and 10 June had maximum correlation coefficients with WOHD. EVI2, NDWI and NDVI were selected for the modeling. R2 value of structured stepwise regression model was 0.79. Validation of model performed using 15% of data. There was good fitting between predicted and observed WOHD. R2 and RMSE were 0.77 and 1.54 day, respectively. Finally, results showed that satellite imagery has the ability to predict the accurate harvest date of wheat.

Keywords: Harvest date, Satellite imagery, Stepwise Regression model, Wheat

OP-114 [Section VII: Information Technology]
ASSESSMENT OF CALIBRATION AND VALIDATION OF CROPSYST MODEL IN WINTER WHEAT PRODUCTIVITY IN MEDITERRANEAN ENVIRONMENTS

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This study aims to evaluate CropSyst model for winter wheat without irrigation in a Mediterranean Environment. In this study, we examine from a set of representative sites how soil influences wheat yields simulated with a process-based crop model, and climate variability observed within the South-east of Cukurova Plain in Turkey. CropSyst, a process-based simulation model, was used to simulate the growth and development of potential for winter wheat. The CropSyst model was calibrated and validated for winter wheat grown in 1999/2000, 2000/2011 and 2011/2002 at previous fields studies of Lower Seyhan Plain (LSP). The LSP was mapped by soil series, the lowest and most detailed soil classification units. Soil profiles, profile depth, pH values, organic matter, salinity texture, soil volume and total porosity have been studied in detail for the soil series in the study area. During the 1999-2000 winter period, simulated LAI values were calibrated by the model for wheat, and a similar distribution was modelled. It was observed that the times of plant development stages such as bolting, flowering, and physiological maturity were identical to measurement data. Tillering stage was reached 20 days after plantation, bolting stage was reached on day 103, flowering on day 129, and physiological maturity stage was reached on day 158. The reason for this was the early flowering in the model. However, a 2-day difference was found in the physiological maturity times. While there was a 100 kg/ha difference between the measurements and the model results in the 2000-2001 winter period, the calculated results were similar to the measured values between 2000-2002.

Keywords: crop modelling, CropSyst, Mediterranean, wheat

OP-115 [Section VII: Information Technology]
FRUIT DETECTION FOR ROBOTIC HARVESTING COMBINED SHAPE AND COLOR INFORMATION

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"Robust fruit detection was challenging due to changing illumination conditions, heavy occlusion by leaves, branches or other fruits, varying size of fruits, etc., and thus was a key step in automatic harvesting. To address detection problem and therefore guide harvesting robot to work, this paper presented a novel fruit detection method based on both shape and color information, which mainly included three steps. First, naïve Bayes classifier on HSV values was used to remove trivial pixels that were unlikely to the target fruits in color. Next, edge images were extracted by gPb detector, and then generalized Hough transformation (GHT) was performed to search possible locations of fruits. Finally, texture feature for each hypothesis was extracted and classified by support vector machine (SVM) to exclude false positives. To evaluate detection performance, We provided four challenging datasets for bell pepper, chili pepper, eggplant and citrus respectively, each obtaining 100 images. Detection experiments showed that our method could obtain promising results in complex environment. Also, our method was applied to the RB03 robot with an original end-effector, where spatial locations of target fruits were determined by use of the triangulation of stereo vision, and harvesting test was carried out on a citrus tree indoors. Harvesting experiment demonstrated that the proposed method could effectively help RBO3 robot to achieve picking task. However, as fruits on trees had varying sizes, which made GHT conducting a moderately time-consuming scale-space search, further research should be focused on improving efficiency of GHT."

Keywords: naïve Bayes classifier, generalized Hough transformation, support vector machine, harvesting robot.

OP-116 [Section VII: Information Technology]

DESIGN OF A REMOTELY-OPERATED FIELD ROBOT TO DETECT OLIVE TREES INFECTED WITH *XYLELLA FASTIDIOSA* USING PROXIMAL SENSING

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A small electric field robot has been designed and built to transport proximal sensing equipment to allow the monitoring of olive trees in search of an early infection by Xylella fastidiosa. The robot is operated remotely. Two batteries allow continuous use for six hours, which allows the inspection of a field of approximately 4 ha. Due to the height of the trees, a system of elevation of the cameras has been designed so that they can be raised up to 200 cm. An encoder connected to the axis of one of the motors measures the distance travelled by the vehicle allowing the computer to trigger the cameras at programmable intervals. A series of tests have been carried out in an olive testing orchard in the region of Apulia, (southern Italy), which showed mild symptoms of Xf infection. The sensing equipment consisted of a digital SLR camera, another digital SLR camera modified to capture NDVI images and a multispectral camera capable of acquiring eight wavelengths in the region of 550 to 850 nm. The system was programmed to capture an image for each meter of the robot's advance. In addition, a 2D LIDAR scanner was used to obtain three-dimensional (3D) structural characteristics of the trees. Preliminary tests were carried out in which the robot captured images and data with all the sensors in different atmospheric conditions (from intense sun to intense rain). The vehicle advanced in each row acquiring the images of the trees on one side and returning in the same row acquiring the images of the trees on the other side, thus obtaining information of the whole tree. These tests served to adjust all the developed software, electronics, and sensors, as well as to improve some key aspects of the robot in terms of battery life and ease of operation. In addition, the sensors worked correctly and the collected data is now serving to create different spectral and vegetative maps, which will then be compared with in situ observations and molecular analyzes of collected leaves.

Keywords: Robotics, computer vision, multispectral imaging, Lidar, asymptomatic detection

OP-117 [Section VII: Information Technology]
A ROS-ENABLED OUT-DOOR ROBOTIC PERCEPTION SYSTEM

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In tandem with cost deduction and production efficiency, Unmanned Guided Vehicles (UGVs) are documented to be a radical advancement in outdoor procedures related with precision farming. Combining state of the art sensors with innovative technologies which denote the automated navigation in outdoor environments, UGVs' are able to perform complicated tasks without supervision. The implementation of the automated system took place with Robot Operating System (ROS). ROS is a graph-based middleware which explores the potentials of each individual robot with the advantage of third party hardware and software support. To that end, with various of implemented low level algorithms we were able to schedule and operate high level activities such as the implementation of path and position finding algorithms, image and pattern recognition and goal assignment. With the use of a depth RGB (RGB-D) camera and a laser scan sensor, an algorithm for the detection and registration of tree-entities in orchards was developed. The algorithm takes advantage of image recognition software which identifies regions of interest within the visible camera range along with their relative coordinates. These regions are registered into a database and they represent the current image of the farmable area. The developed algorithm combines the procedure above with the mapping procedure which incorporates the capabilities of Gmapping algorithm simultaneously with the Adaptive Particle Filter (APF) for the localization of the UGV and the mapping of the surrounding environment. Moreover, the algorithm facilitates the UGV's movement with the implementation of a pseudo-random movement using a mathematical formula moving the UGV to the direction with the largest angle increment while at the same time avoiding both static and dynamic obstacles. As a next step, an algorithm for precision scanning was developed. The resulting database indicates the exact position of the trees in relation to the UGV. Thus, all subsequent actions will occur considering the current image of the farmable area enabling precise execution of procedures. Additionally, it is possible to assign extended information for each individual registration indicating current tree-state and actions that should subsequently take place. Moreover, the overall UGV's navigation to the outdoor environment is governed by the ability to avoid dynamic obstacles. Should an obstacle appear, the UGV re-calculates its optimized path to the assigned goal and avoids the obstacle. Finally, the user can supervise all stages of the automated navigation with the option to interact with the system to prevent any unscheduled activities.

Keywords: Out-door environment perception, Autonomous navigation, Orchard mapping algorithm

OP-118 [Section VII: Information Technology]
ISSUES IN HIGH-THROUGHPUT DRONE CROP PHENOTYPING

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High-throughput field phenotyping technologies have advanced dramatically for accelerating breeding programs, resulting in publishing large number of papers on the topic. The papers are usually scientifically reasonable, of course, but usually they emphasize only the advantages of the newly developed technologies often without stating the issues left. In fact, when we try to apply the proposed methods practically, we often meet some difficulties. One of the examples is 3D reconstruction of drone images by SfM and MVS which is now becoming very popular in plant phenotyping studies. The 3D reconstruction technology seems to be promising, but mainly because of the limitations of accuracy in the identification of corresponding points among images, reconstructed 3D point clouds are sometimes not good enough to generate accurate field mosaic images. The inaccuracy causes incomplete plot partitions of breeding fields particularly when the plot size is small. This results in large systematic error in phenotyping per plot. Another example is the use of machine learning which is now commonly used in plant phenotyping. Machine learning, particularly deep learning seems to be definitely powerful once a good quality training data set is available. But, provision of such a data set is usually laborious, and we need to discuss about "high-throughput training data set development". We also need to discuss about the extrapolation capability of machine learning. In breeding, we sometimes seek for crop performance outside of what we have ever observed, and interpolation does not help it. This paper discusses a few of such issues we may face when we need to apply high-throughput phenotyping technologies in the real breeding process.

Keywords: Drone phenotyping, accuracy, machine learning, training data set

OP-119 [Section VII: Information Technology]
IOT BASED WEARABLE SENSING SYSTEM MONITORING WORKING ENVIRONMENT IN SWINE HOUSE

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The pig farming industry in Korea have concentrated on the improvement of the productivity, and the environmental load is large both on animal and workers. The working environment inside swine house is very poor due to bad environmental conditions compounds such as high humidity, dust, and harmful gas. Working on the bad condition increases the sudden accidents and occupational diseases for workers. In Korea, safety insurance policy for farmers have been started from 2016, prevention of safety accidents and disease have been important public issue. However, there is a lack of adequate measurement data about human health damage related to environmental condition. Integrated environment monitoring system is very important to secure basic data related to working environment. Considering poor sensing condition in terms of humidity, temperature, dust, and gases, stationary sensors have limitations on their durability and reliability. And a small number of fixed sensor inside swine house could not explain the environmental condition in whole area. Wearable equipment attaching workers'cloth can be a good alternative plan by monitoring real-time exposed environmental condition for workers including moving line by GPS and working time. Wearable sensing system can be used to make an integrated control system for working and environmental conditions inside as well as outside swine house based on IoT (internet of things) and big data processing. In this study, the working environment inside swine house was analyzed by field monitoring using fixed sensors and mobile sensors. The monitoring data was used to validate CFD (computational fluid dynamics) model, evaluate working conditions, and develop how to make wearable sensing system in terms of durability, sensing range, type of sensors, and so on.

Keywords: CFD, ICT, odour, smartfarm

OP-120 [Section VII: Information Technology]
MONORAIL-BASED AUTONOMOUS CROP MONITORING SYSTEM USING CAMERA AND LASER RANGEFINDER

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Most of the conventional field monitoring systems cover a narrow field and remain stationary to collect the field data. They fails to provide sufficient field information because they are inadequate to extract a wider range of information. The use of mobile vehicles in crop monitoring is costly, consumes fuels, less applicable in highly terraced and elevated land surface of hilly fields such as Himalayan regions. UAV-based field monitoring systems waste a lot of energy and time, as well as one person should be assigned to monitor and maintain its activities on regular operations. In our research, we try to solve above issues by using an autonomous 3D field monitoring system with monorail based movable device. To accomplish this we use an HD camera, Hokuyo URG-04LX laser rangefinder device, a software program with a controller Raspberry Pi 2B and a drive motor to carry them simultaneously via monorail track. We choose the combination of HD camera and a moving 2D laser range finder because they are lightweight, cheap and can provide an easy setup procedure to obtain overall field situation and a real time structural information of various plants in the field. The limitation of color information in laser rangefinder and structure information in camera can be easily overcome by using this method. Our approach also provides an efficient way to monitor plain and elevated lands by using low-power devices which operates at 5V using solar energy. Maintenance and operating cost for our device is low if we compare it with UAVs and other fuel based monitoring vehicles. We made several successive scans with different sample crops in plain and elevated lands using our device. The field experiment and results showed that the proposed system stably obtained 3D structural data of plants.

Keywords: Field monitoring, Monorail track, Laser rangefinder, 3D crop scanning

OP-121 [Section VII: Information Technology]
DEVELOPMENT OF AN ELECTRONIC CONTROL UNIT FOR SMART ORCHARD SPRAYER

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A variable width smart orchard sprayer prototype was designed, modeled and fabricated. The sprayer is equipped with a microcontroller, electrostatic spraying unit, GPS, CCD camera and solenoid operated spray nozzles. Individually controlled sprayer nozzles make the machine suitable for variable rate chemical applications. A hydraulic control unit allows the operator to change the swath width of the sprayer between 2.1 and 2.6 m. The remote monitoring and control of the sprayer is accomplished with an electro-hydraulic control unit and a mobile phone application. The mobile application allowed the operator to set the desired application rate, monitor and control the nozzles using an electronic device or over the internet. The mobile application is suitable for smart phones and tablet computers using Android operating systems. All the functions of the developed sprayer were tested in field conditions successfully. Details of the developed sprayer will be presented in this paper.

Keywords: Orchard sprayer, precision agriculture, simulation, electrostatic charging system, Android, image analysis

OP-122 [Section VII: Information Technology]

PROXIMATE SENSING AND APPLICATION FOR VARIABLE RATE NITROGEN APPLICATION ON CORN FIELD

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The potential economic and environmental benefits of site-specific nutrient management which is known as Precision agriculture have been widely reported during the development of precision farming by reducing over and under application of fertilizer mainly nitrogen (N) in the field. Accurate and efficient tools are required to determine the varying crop N demand within a field. Existing methods of soil and plant analysis have been proven to be costly and time consuming to deliver information on the actual N demand at the required spatial resolution. Proximate sensing is seen as a technologly to supply this information quickly and precisely.

In this study, a multispectral proximate sensor was mounted to a tractor to determine corn crop N status as it varies across the field by measuring the reflectance from crop canopies in a approximately 40 ha corn field in Çukurova region. To determine N efficieny, six different level of N application plots were established in 500 m long and 18 row wide test plots in the field. Each plot has been scanned by sensor and harvested separately with a combine harvester that implemented with yield mapping system and DGPS (Differantial Global Positioning System). Economic optimum N level was found to be approximately 310 kg/ha for this field after economical analyses. But it has been proved that the field has three different production level according to the previous soil and yield maps. To match this conditions, a proximate sensor connected to a modified variable rate row fertilizer spreader. This modified unit was then used to apply variable rate N according to actual demand as on-line, in real time mode. In the first year of the study, 20% of N has been saved without any yield loss. This application enabled farmer to have more uniform growth and yield in his field in the first year.

Keywords: Precision Agriculture, Proximate sensing for nitrogen application, Variable rate fertilizer application, Site specific fertilizer management.

OP-123 [Section VII: Information Technology]
APIS: APP TO IMPROVE AGRICULTURAL MACHINE USE AND COST EVALUATION

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The authors previously developed a web app for mobile, named AMACA. Although the APP was very easy to use, the customers observed that the developed app to calculate the agricultural machine cost (AMACA) lacked some features. Among the most requested ones, there was the use of an existent database to compare different machines configurations, the presence of typical self-propelled machines (as cereal harvesters), and a more user-friendly interface to make machines' choices at different operational levels. The new version of the app, now called APIS (Application Pocket Information System) is now equipped with all these items. The end user may arrange different types of evaluations: tactical (e.g. ploughing with a different tractor or plough types), strategic (e.g. a machine change because the operation is too expensive) or dynamically evaluative (e.g. the output of the costs curve which permits to understand what is the highest area to irrigate). As AMACA, APIS is free, but it is now necessary to log in to have access to the machines database. Also, because of the login, the calculations made by the user are saved in the cloud and can be retrieved any time by him for making further comparisons.

Keywords: Agricultural machinery cost, Agricultural operations, Machinery management, cross-platform application

OP-124 [Section VII: Information Technology]
THE ACCURACY IN SEED SPACING OF A SEEDER WITH VARIABLE RATIO

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In this project, a new single grain seeder is disgned and prototype is manufactured. In this design vertical disc of seeder system of single grain seeder gets rotation movement from a servo motor that is assembled on the machine inspite of existent tractor's wheel. Thus in case of necessity machine's seeder system disc can be rotated independent of tractor's going speed. The rotation speeds of seeder system disc are determinated according to distance of grain (like 10cm, 20cm,28cm and ect.) for cotton, corn and sunflower. Seeder system can be returned at the desired level by servo motor. Location of the seeder can be determined with GPS which is assembled on seeder. The field to be tested is decided and prepared its yield map. According to this yield map the field divided different yield zones and the zone's distances of seeding are determinated. The software of automatic control system is prepared with GPS,yield map, determination of seeder system rotation datas. With this sofware, the machine can seed with variable ratio according to different yield zones. The performance of the machine is determinated with laboratory and field experiments. In this article, the seeder's accurcy seeding spacing is tested in laboratory at different rotation speeds. To determinate accury seed spacing; the distance between thrown grain are measured, nominal planting distance and the deviation of these are established, acceptable grain distance % rate are determinated with the aim of establishing the row grain distribution uniformity trials on sticky belt. Thus the seeder performance of accuracy in seed spacing is exposed.

Keywords: Seeder, Servo Motor, Variable Ratio

OP-125 [Section VII: Information Technology]
PRECISE POINT POSITIONING FOR A ROBOT TRACTOR USING LEX SIGNAL TRANSMISSION FROM QUASI-ZENITH SATELLITE SYSTEM

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This paper addresses problems of automatic guidance of the robot tractor for precision farming. Robust and precise kinematic positioning is fundamental to the robot tractor that utilizes Global Navigation Satellite System (GNSS) as the main positioning method. However, this is somewhat problematic in Australia, where the farms usually locate in remote and sparsely populated areas in which reference stations are sparse and mobile network is difficult to access reliably. Therefore, classical solutions of real-time kinematic GPS (RTK-GPS) can hardly be adopted in these cases. On the contrary, the precise point positioning (PPP) technique is a viable approach to tackle this problem. PPP positioning with ambiguity resolution (PPP-AR) gets the ambiguity resolution within 30 minutes and achieves centimeter level horizontal positioning accuracy for dynamic receivers. This paper describes a robot tractor system developed for the Australian sugar industry to plough, fertilize or spray crops automatically. The navigation sensors of the robot tractor consist of an inertial measurement unit and a GNSS receiver, which utilizes real-time correction messages from the L-band Experiment (LEX) signal transmitted by the Japanese Quasi-Zenith Satellite System (QZSS). The robot tractor is able to follow the planned route with 5cm (RMS) accuracy at the speed of 6.6 km/h.

Keywords: autonoumus vehicle, QZSS, GPS, PPP, PPP-AR, precise agriculture

OP-126 [Section VII: Information Technology]
RESEARCH ON VEGETABLE PEST WARNING SYSTEM BASED ON MULTIDIMENSIONAL LARGE DATA

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Pest early warning technology is part of the prerequisite for timely and effective control of pest outbreaks.Traditional pest warning system with artificial mathematical statistics, radar and remote sensing exists large scale, low precision and short timeliness. In the paper, the major pests of southern vegetables such as Bemisia tabaci, Phyllotreta striolata, Plutella xylostella, and Thrips tabaci were selected as the main research objects. Using multi-dimensional information such as soil, environment and climate collected from real-time and fine-grained vegetables to build a vegetable pest warning system based on multi-dimensional big data. Pest and environmental data from Guangzhou Dongsheng Bio-Park were collected from June 2016 to February 2017. The number of pests consisted of four warning levels I. II, III and IV using the k-means algorithm, and five key influencing factors of rainfall, carbon dioxide concentration, soil temperature, air temperature and foliar humidity were found out. Finally, using BP neural network for classification prediction. The result shows: I-level warning accuracy was 96.14%, recall rate was 97.56%; II-level pest warning accuracy was 95.34%, the recall rate was 96.45%; III-level pest warning accuracy of 100%, the recall rate was 96.28%; IV-level pest warning accuracy of 100%, recall rate was 100%. It proves that the early warning system can effectively predict vegetable pests and achieve early warning of vegetable pests requirements, with high availability.

Keywords: Pest early warning, Data preprocessing, Feature selection and extraction, Neural Networks

OP-127 [Section VII: Information Technology]
A CONTEXT CHANGE OF AGRICULTURE IN JAPAN

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A new context is emerging in application of the community-based precision agriculture which is expanding across different research fields or trans-sectors in Japan. People call those new projects by other phrases, such as "smart agriculture", "AI (agro-informatics or artificial) agriculture", "ICT agriculture", and "intelligence-oriented farm management". "Community" implies here a self-governance group of practitioners and/or players which directs to an agricultural policy of government, and "precision agriculture" is an evidence-based farm management inducing technology innovations. Goals of the project are also different respectively, such as "cost-effective and market-in farm management", "restoring/rehabilitation from disasters", "agro-medical foods for health and life", "water conservation agriculture", and "GAP for farm assurance/food security". The food chain of Japan is changing with development of precision agriculture. A new ICT strategy of the government was issued for precision agriculture to enhance the interoperability and portability of data/information collected from the field. The administration focused on standardization of data/information protocol, common terminology to share the information and knowledge. Intellectual properties produced by collaboration of growers and industry, such patents and know-hows, are also issues to be handled. On the basis of a platform of agricultural information some value-chains should be produced. One could be the positive information on such functional foods or agro-medical food, and another will be the risk information on such GLOBAL G.A.P. Agro-medical foods are defined as agricultural products with a high content of functional materials with evidence of effects on health and wellness produced by precision agriculture, and they are created by the agro-medical initiative. The agro-medical initiative is a research group of medical, agricultural, and engineering scientists, aiming at the cure of lifestyle-related disease by having agricultural products with a high content of functional materials. The agricultural sector supplies fairly controlled products to the medical sector, which requires controlled protocols of production with traceable management. The medical sector confirms the evidence of effectiveness against disease prevention and wellness in medical science. The nutrition and dietetics sector provides personalized diets using agro-medical foods. The business sector commercializes the agro-medical foods and diets. The engineering sector provides bio-sensing and control technology to manage the system and communicate beyond disciplines.

Keywords: transdisciplinary, portability, interoperability, food chain, agro-medical food

OP-128 [Section VII: Information Technology]
SMART TECHNOLOGIES AS DRIVERS FOR NEXT GENERATION AGRICULTURE

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Agriculture has a significant role in society by providing food security and contributing to economic growth. The continued growth in the global population has led to the need to find better solutions to improve crop and animal production and increase food quality. Computing technologies can provide knowledge based smart solutions to assist farmers to monitor and respond to seasonal variability and market drivers. This position paper explores solutions that have been found to show some potential and effectiveness in contributing agricultural productivity and driving the next generation of agriculture. The paper will discuss technologies such as Internet of Things devices (Iot), Aerial Unmanned Vehicles (UAV), Aerial Grounded Vehicles (UGV), Image Processing, Machine Vision and Robotics which are now being adopted by farmers in their everyday activities. The paper will provide examples of these technologies and discuss the drivers and barriers to their global uptake and propose a framework for adoption of smart technologies for the next generation of agriculture. The paper will also draw conclusions on the future of these smart technologies for agriculture.

Keywords: Technology adoption, Internet of Things; Image Processing, Drones, Crop Production.

OP-129 [Section VII: Information Technology]
USE OF SIMULATION GAME IN EDUCATION ENVIRONMENT: THE CASE OF AGRIFOOD LOGISTICS

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The problem of matching production and demand of fresh fruit produce is actual, and often people do not realise the implication of this issue on supply chain performance regarding profit, food waste, and shelf life. The objective of the activity was to teach the power of matching orders and demand with production. Both production and demand have random pattern studied and validated with data from the packing industry. Production is influenced by weather and by cultivation practices (e.g. irrigation, trimming, time of harvesting). Also, fruit size varies a lot. Ordering and demand had their pattern that could be varying by channels and influenced profoundly by promotion. The authors implement a discrete event model that allows the student to perform some order and demand adaptation to match the production. Actions to modify the demand imply promotion (that double sales but decrease the profit to 20% of the typical case), finding channels for different sizes of the fruits. The model also considers lead times for product packing and transportation and show the effect of the student's choices on supply chain performance regarding supply chain profit, food waste, and shelf life. The model work step by step over a period of 40 days, allowing day by day decision from the user and plotting demand, storage and production day by day, in a stochastic way. The comparision performance of students that were exposed to the use of the model is presented in the paper.

Keywords: Simulation, orders, production, demand, matching

OP-130 [Section VII: Information Technology]
FLIPPING THE CLASSROOM FOR FOOD TECHNOLOGY STUDENTS. EVALUATION OF A TWO-YEARS EXPERIENCE

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This study compared the performance and preference of students of a food chain logistics agricultural engineering course learning using a flipped classroom and a traditional face-to-face lecture mode of instruction. Two contiguous modules were developed in both modes of instruction. Students were divided into two groups, each group learning the course material using one module in each mode of instruction. The study showed that students learning by the flipped classroom model of instruction achieved significantly higher and more uniform test scores. Mean percentage scores for the flipped classroom ranged from 97.6% to 100% while mean scores under the conventional lecture ranged from 62% to 78.5%, with standard deviations ranging from 0% to 2.16 and 18.76 to 23.66, respectively. Also, a high level of significance ($p<0.0001$) was found showing a preference for the flipped classroom model of instruction for the subject group. Students perceived they learn more, in less time, under the flipped classroom model. The results of this study suggest that agricultural engineering education outcomes could be improved by appropriate use of the flipped classroom model of teaching and learning were appropriate. Based on this evidence a two-year trial (2016/2017 and 2017/2018) was conducted to assess a complete course. Including student performance, retention, critical thinking and preferences of students. The course was managed to provide different incentives for participation in voluntary in-class and collaborative activity amongst students. The performance compared to the traditional class format outcomes (year 2015/2016) are analyzed. The results of the comparison are presented in this trial.

Keywords: flipped class, agrifood logistics, performance, incentives, traditional class

OP-131 [Workshop on Image Analysis and Spectroscopy in Agriculture]
AUTOMATED IDENTIFICATION OF ANATOMICAL LANDMARKS OF DAIRY COW IN THREE-DIMENSIONAL VISION

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Three-dimensional (3-D) vision is widely used to measure the size of dairy cow for body weight prediction and condition scoring. When analysing 3-D images, it is important to find the protruding anatomical bony landmarks on a cow's body, because the precision of finding these bones influences the body size measurements. The objective of this study was to test the precision of automated identification of dairy cow hook and pin bones in 3-D images.

Consecutive top-view 3-D images of the rump of a life-size plastic cow model were recorded, while the cow was moved along a 3 x 3 grid of 50 mm in X (i.e. latero-lateral) and Y (i.e. cranial-caudal) directions, resulting in nine unique locations. In four steps, images were analysed automatically in MATLAB to identify the hook and pin bones. First, each image was processed by background subtraction, noise removal, rotation, and point-cloud interpolation. Second, the image was separated into four regions, containing left hook bone (left front), left pin bone (left rear), right hook bone (right front), and right pin bone (right rear) respectively. Third, in each region, the highest lines in the X and Y directions were selected and their cross point was defined as the centre of the hook or pin bone. Last, all images from the nine locations were overlapped to the centre grid point and the standard deviations of the X and Y coordinates were considered as the precision of the bone identification.

The average standard deviations of hook bones in X and Y directions were 2.4 mm and 2.7 mm, and for the pin bones 2.8 mm and 8.6 mm. The precision of identifying hook and pin bones is close to the 3-D image resolution (2.2 mm), except for the pin bones in Y direction. The latter was probably caused by parts of the pin bones not being in the camera view. Our results show a promising precision of an automated identification of protruding bones when the cows are standing at different positions to the camera. By using a model cow, we ensured a controlled and measurable cow movement which cannot be achieved when recording a live cow. Future studies should focus on factors of live cows that influence the precision of identification, such as texture and colour of cow fur.

Keywords: dairy cattle, machine vision, bone landmark, automation, image processing

OP-132 [Workshop on Image Analysis and Spectroscopy in Agriculture]
AN EMBEDDED IMAGING SYSTEM FOR MONITORING DRINKING BEHAVIOR OF DAIRY COWS

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For tropical and subtropical climate zone, one of the difficulties in the management of dairy farms is the negative effect of heat stress on dairy cows, which includes lameness, mastitis, and most of all, the decrease of milk production. This research presents an image processing algorithm and system to continuously monitor the drinking behavior of dairy cows which reflects the level of heat stress in cattle. An embedded imaging system based on Raspberry Pi 3 was built integrating camera and environmental sensors. The system is equipped with wireless transmission capability to send data to a cloud server for further data processing, analysis, and remote access. The imaging modules are installed on the top of water troughs in a 25-cow farm for continuous monitoring of drinking behavior of the herd. Image processing algorithm was developed to detect the head of dairy cattle over the water trough during drinking. The image processing procedure includes the steps of histogram equalization, background subtraction, binarization, Gaussian blur, and blob analysis. A voting scheme is also applied to reduce the detection error caused by false alarm. The computation is completed in real time and the timestamp is recorded and sent to the server with the still image. The detection accuracy (ACC) is 84% and the F1 score is 0.85 based on the analysis of confusion matrix. Temperature and relative humidity information are also acquired and the Temperature Humidity Index (THI) is calculated. The detection of water drinking event allows for the analysis of the frequency and drinking time of the herd under various microclimate conditions. Experimental results in the dairy farm show that the drinking behavior can be quantitatively and accurately characterized. Significant difference was observed for drinking frequency and time between hot and cold days, and they are highly correlated with THI. The proposed system provides important information to improve dairy farm management and it can also be incorporated with the environmental control system of dairy farms to reduce the heat stress of dairy cattle.

Keywords: Embedded System, Image Processing, Motion Detection, Heat Stress, Lactation

OP-133 [Workshop on Image Analysis and Spectroscopy in Agriculture]
COST BENEFIT ANALYSIS OF VARIABLE MANAGEMENT IN WINTER WHEAT IN RESPONSE TO ON-LINE RECOGNITION OF YELLOW RUST AND FUSARIUM HEAD BLIGHT

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Significant wheat yield losses are caused by yellow rust and fusarium head blight. Financial profits are reduced from quantitative yield losses, and from reduced grain quality due to reduced proteins and high mycotoxin levels. In severe epidemics, yellow rust, can reduce yields by up to 7 tonne ha-1, whereas fusarium head blight, can result in mycotoxin contamination. The conventional approach of crop protection is a series of homogeneous rate fungicide applications (HRFA) over the entire field area. But, levels of crop disease can vary over small distances, which necessitates the need for mapping the spatial distribution of these two fungal diseases at high sampling resolution. This study reports on the use of an on-line hyperspectral sensor for mapping these two crop diseases in winter wheat, for deriving management zone (MZ) maps for variable rate fungicide application (VRFA) at timing 1 (T1) and timing 2 (T2) in response to yellow rust presence and timing 3 (T3) in response to fusarium head blight presence. The MZ maps were also used for selective harvest (SH), where healthy grain areas were proposed to be harvested separately from areas, suspected of reduced quality and mycotoxin contamination in response to yellow rust and fusarium head blight presence. The high spatial resolution data on yellow rust and fusarium head blight, were fused together with high resolution data of key soil properties, yield, and crop canopy properties. Cost-benefit analysis was carried out to calculate the economic benefits for VRFA and SH. Results showed the on-line hyperspectral sensor, coupled with partial least squares regression analysis to provide good prediction accuracies for recognition of both crop diseases. Fusarium was more successfully predicted with photo interpretation assessment (PIA) method with a residual prediction deviation (RPD) of 2.27 and R2 values of 0.82, whereas yellow rust was more successfully predicted with infield visual assessment (IVA) method with a RPD of 2.19, and R2 of 0.78. Virtual cost-benefit analysis for SH (assuming different selling price between healthy and downgraded grain) and VRFA (performed at the fungicide application timings T1, T2, and T3) showed a gross profit of combining SH and VRFA of £83.35 ha-1 year-1. Results also showed that VRFA, when compared to HRFA, allowed for reductions in fungicide application of 22.24% at T1 and T2 and 25.93% at T3. It can be recommended to adopt this management zone concept for VRFA and SH, as economic and environment benefits are feasible.

Keywords: On-line hyperspectral imagery, yellow rust, fusarium head blight, cost-benefit analysis, variable rate fungicide, selective harvest

OP-134 [Workshop on Image Analysis and Spectroscopy in Agriculture]
AERIAL MACHINE VISION, GIS AND HUE FOR PATTERN CLASSIFICATION IN AGRICULTURE

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In this novel we aim to achieve cybernetic cohesion information flow in precision agriculture, integrating machine learning methods, computer vision, geographical information system and UAV-photogrammetry in an irrigated area with slaughterhouse wastewater, under five treatments (T1 - irrigation with superficial water and 100% of mineral nitrogen fertilization, T2, T3, T4 and T5 - irrigation with treated effluent from slaughterhouse and addition of 0, 33, 66 and 100% of mineral nitrogen fertilization, respectively) and four replications on grassland (Cynodon dactylon (L.) Pers.). Several images (between one hundred and two hundred) with RGB color model were captured utilizing an quadcopter flying at 20 meter altitude and obtaining spatial resolution of 1 centimeter on a surface of approximately 0.5 ha. The images were orthorectified together with nine ground control points done by differential GPS, both processed in the Agisoft PhotoScan software. Nine photogrammetric projects were done over time with 30-day revisit, the root mean square error was used as accuracy measurement, and reached values lower than 5 centimeter for x, y and z axis. The orthoimage obtained with UAV-photogrammetry was changed from RGB to HSV color model, and the hue color space was chosen due to independence of illumination, beyond it has a good description of exposure of soil and vegetation, but it is dependent of light source temperature, so dificult to stabilish a static threshold, so we selected an unsupervised classification method, K-Means, to classify the unknown patterns along the area. Polygons were drawn delimiting the area represented by each parcel and a supervised classification method based on entropy was used, the decision tree, to explore and find patterns that recognize each treatment. These steps are also displayed in form of georeferenced thematic maps and were executed in the open source softwares Python, QGIS and WEKA. Comparison between usage of RGB color model and the hue space color are also made during classification, and the correctly classified instances are high for both ways, reaching an accuracy of 100% on the training set, so the rules defining the patterns are reliable. This methodology shows a great potential for analysis of data in precision agriculture.

Keywords: Precision Agriculture, Aerial Machine Vision, Geographical Information System, Hue Color Space, UAV-Photogrammetry, Slaughterhouse Wastewater

OP-135 [Workshop on Image Analysis and Spectroscopy in Agriculture]
EFFECTS OF FERTILIZERS ON THE FLUORESCENCE COMPOUNDS DYNAMIC OF CARROT DURING THE GROWING PERIOD

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The aim of this research was to monitor the fluorescence characteristic of carrot during the growing period with different fertilizer treatment which will enable to develop a method for tracking the harvested carrot fertilizer treatment. To simulate different fertilizer treatments, five treatments were selected in this research, i.e. chemical fertilizer; organic fertilizer; mix of chemical and organic fertilizer; mix chemical plus organic fertilizer plus lime; and control. The cultivar was kouten nigou and three sampling periods were carried out at 56, 87, and 117 days after seeding (DAS). Optical information by mean of fluorescence excitation-emission matrix (EEM) characteristic of different part of carrot has been obtained from the right-angle method. Three fluorescence intensity peaks region were observed which may belong to tocopherol, riboflavin and, chlorophyll. The treatment of chemical plus organic and organic fertilizer showed the higher fluorescence intensity of all peaks compared to other treatments. In addition, a principal component analysis (PCA) has been used to explore the EEM data structure of each treatment of fertilizer. It was found that two PCs enough to represent 98% of the sample variance. Furthermore, PCA score-plot showed each treatment make clear cluster and possible to identify the treatment of fertilizer applied during the growing period of carrot. This result showed that fluorescence spectroscopy has a potentiality to identify the fertilizer treatment of harvested carrot.

Keywords: Fertilizer, treatment identification, spectroscopy, fluorescence, carrot, PCA

OP-136 [Workshop on Image Analysis and Spectroscopy in Agriculture]
EXPLORATORY DATA ANALYSIS OF FLUORESCENCE EXCITATION EMISSION MATRIX FOR PATCHOULI OIL GEOGRAPHICAL ORIGIN DETERMINATION

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The increasing of the consumer awareness on the authenticity of products led to the demand for a rapid measurement method as a supporting tool for a high-value commodities traceability. In this research, fluorescence excitation-emission matrix (EEM) characteristic has been measured for patchouli oil samples from the different geographical origin of Indonesia. Front face method was chosen to avoid the inner filter effect in the measurement of a highly concentrated sample. The raw EEM spectra then were corrected using calibrated light source and Rhodamine-B data. Before analysis, the EEM spectra were converted to Raman Unit based on distilled water Raman peak at 350 nm that were obtained on each measurement day as a pre-processing method for data normalization. Principle Component Analysis (PCA) has been used to explore the excitation-emission matrix (EEM) data structure of the sample and 3D eigenvector value thresholding was proposed to indicate important variable for discrimination. The principal component that was indicate scattering information has been excluded for the important region selection to ensure the classification model only based on the fluorescence spectra. It was found that there are five important EEM regions for discriminating each patchouli sample class. Furthermore, Principle components (PC) score plot shows the possibility of clustering the sample classes from different island or region. This result shows that the front-face Fluorescence spectroscopy has a potential to be used as a supporting tool for geographical origin indication of patchouli oils.

Keywords: spectroscopy, fluorescence, patchouli oil, geographical origin, PCA

OP-137 [Workshop on Image Analysis and Spectroscopy in Agriculture]
MEASURING FLORAL RESPONSES TO HERBIVORY BY MACHINE VISION AND SPECTROSCOPY

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To maximise reproductive output, plants need to maintain interactions with pollinators, and at the same time deal with insect herbivores. To attract pollinators, plants use a variety of flower traits such as size and shape of flowers, color intensity and patterns, and nectar guides - very low ultraviolet (UV) reflection invisible to humans - on the petals. To defend against insect herbivores, plant species can produce toxic metabolites. Since flower traits share resources with defensive traits, it is expected that herbivore induction will change flower traits, with potential negative effects on pollinator visitation. The current knowledge on effects of herbivore-induced plant responses on flower traits, are limited. The aim of this study was to investigate how plant responses of the annual Black mustard (*Brassica nigra*) to different insect herbivores affected flower morphology and color. We infested flowering plants with one of five different insect herbivores: two chewing herbivores (*Athalia rosae* and *Plutella xylostella*), two aphids (*Brevicoryne brassicae* and *Lipaphis erysimi*), and one root herbivore (*Delia radicum*), or left plants uninfested (control). For each plant, we measured 6 flowers, and each treatment was replicated 9 times. For each flower, we measured the spectral reflection between 300 and 700nm in the upper and lower part of each petal, and a number of shape characteristics. Spectral reflection was measured with a spectrometer. Surface area and shape characteristics were measured by imaging each individual whole flower, and each petal separately with an eight-band multispectral camera. Our results show that flower color and morphology are affected by herbivory. Flowers of plants infested with the sawfly larvae *A. rosae* reflected less yellow - 570 to 650nm - compared to all other treatments. This reduction was 5% in the top part of petals, and 7% in the bottom part of petals. Flowers of plants infested with both aphid species reflected about 10% more UV - 310 to 370nm - compared to uninfested control plants. Flowers of plants infested with the caterpillar *P. xylostella* had larger area, with an 10% increase compared to uninfested plants. Petals of herbivore-infested plants had lower aspect ratios and eccentricity than uninfested plants. Changes in color intensity, projected area and petal shape have the potential to influence pollinator visitation, as pollinators have been shown to use these traits in flower selection. If the herbivore-induced changes in flower traits identified in this study are strong enough to do so, needs further study.

Keywords: herbivory,polinator,flower traits,color,morphology,ultra violet

OP-138 [Workshop on Image Analysis and Spectroscopy in Agriculture]
ON-THE-GO HYPERSPECTRAL IMAGING FOR VINEYARD MONITORING: A NEW METHODOLOGY FOR ACQUISITION AND PROCESSING

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Accurate information about the status of a vineyard can be obtained using new and powerful technologies under field conditions. With the development of new, non-invasive, proximal sensors, their deployment in real-case scenarios could be very helpful for the acquisition of data related to different agronomical and physiological parameters. The goal of this work was to develop a new methodology for vineyard monitoring by processing hyperspectral images acquired on-the-go, to obtain differentiated spectral information of several grapevine canopy elements, such as leaves, clusters and wood. The experiment was carried out in a commercial vertically shoot positioned (VSP) vineyard located in La Rioja, Spain. Grapevine canopies were imaged on-the-go with a hyperspectral camera (spectral range 400-1000 nm) mounted on an all-terrain vehicle moving at 5 km/h. Hyperspectral images were acquired under uncontrolled, natural light from a lateral point of view of the canopy at a distance of 1.2 m. Afterwards, an unsupervised algorithm was developed for the automatic segmentation of hyperspectral grapevine canopy images into different canopy elements, managing the different conditions of outdoor scenarios that strongly alter the hyperspectral acquisition sensibility, such as light intensity. The outputs from the processing algorithm properly classified each pixel in the hyperspectral image into the different canopy elements previously defined. Spectra of leaves, grapes and wood were successfully identified, and any other pixel that did not fit into those classes was discarded. Additionally, a comparison with a simpler segmentation technique was performed to analyze how the described approach increases the accuracy. The obtained results suggest that this methodology could be a powerful first step in a full hyperspectral system for the automatic prediction of agronomical and physiological parameters of the vineyard.

Keywords: new technologies, segmentation, correlation, leaves, grapes, wood

OP-139 [Workshop on Image Analysis and Spectroscopy in Agriculture]
EVALUATION OF SALINITY STRESS ON DATE PALM LEAVES USING COLOR IMAGES ANALYSIS

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Salinity is one of the main factors affecting the growth and yield of date palms in arid and semi-arid zones. Timely and cost-effective monitoring method would be highly beneficial in rescuing stressed date palm trees. The main objective of this study was to investigate the efficiency of color imaging in evaluation of salinity stressed date palm leaves, in the lab, as a primary experiment for aerial imaging technique. One hundred and sixty two leaflet samples were collected from three randomly selected date palm trees planted in six different sites.. Sites locations were randomly selected from 0.5 km to 4 km inland distance from the shore of sea of Oman. Color images were taken for each leaf sample using RGB color camera. The images were analyzed in Matlab software and 20 color features were extracted from each image. The color features were used to classify leaf samples into *""Not-stressed ""*, *""Stressed ""* and *""Highly-stressed ""* using Linear Discriminant Analysis (LDA). The classification accuracies were 63%, 68% and 40% for *""Not-stressed ""*, *""Stressed ""* and *""Highly-stressed ""* classes respectively. LDA was also used to classify the leaf samples into two classes (*""Not-stressed ""* and *""Stressed ""*) which yielded an overall classification accuracy of 80.2%. In a pairwise model, the highest classification accuracy of 90.7% was obtained between *""Not-stressed ""* and *""Stressed classes ""*. The developed system can be improved by extracting texture features and can be used for further analysis of aerial images.

Keywords: Date Palm, Salinity, Color Features, LDA

OP-140 [Workshop on Image Analysis and Spectroscopy in Agriculture]
OPTIMIZATION OF DRYING PROCESS OF COCONUT MEAT (COCOS NUCIFERA) WITH AID OF IMAGE ANALYSIS

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The aim of this study was focused on the optimization of drying process of Coconut (Cocos nucifera) meat (copra) with regard to energy consumption and final product quality. Copra, originally from Indonesia, were used in this experiment. With aid of image analysis using HD camera the quality of final dried product was described and compared with quality standards. Acquired pictures were analysed by the digital image analyses using ImageJ software that utilises java based image processing. The default threshold method based on IsoData algorithm was used in this experiment. Copra in three variants of particle size (2.99 ± 0.96, 9.33 ± 1.54 mm and 16.89 ± 2.96 mm) were dried at different air temperatures (40, 60, 80, 100, 120 °C). Experimental drying curves at different temperatures, drying rate and particle size were determined and energy consumption were measured. The measured values of weight loss for different drying temperatures were analysed with computer program Mathcad 14, uses Levenberg-Marquardt algorithm for data fitting. The determined models of drying curves were statistically verified by using ANOVA. Based on the determined data optimal conditions of copra drying process were determined. It was found, that the drying temperature should lie within the range 40 – 60 °C. Under higher temperatures, the colour of the copra was changed which is undesirable in terms of the final quality of food products. Form this conducted research it is evident, that determined model could be used as a background for further research focused on copra utilization with respect on final product quality.

Keywords: copra, energy, curve, model, conditions, optimal

OP-141 [Workshop on Image Analysis and Spectroscopy in Agriculture]
STUDY OF ASTRINGENCY DISTRIBUTION IN PERSIMMON CV. 'ROJO BRILLANTE' USING HYPERSPECTRAL IMAGING

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The astringency of persimmon is due to the high content of soluble tannins. This fruit can not be consumed until it reaches a high degree of over-ripeness after harvest. But this process is long and produces an excessively soft fruit. In recent years post-harvest treatments have been developed that allow the elimination of astringency while preserving the firmness of the flesh. The most used in the industry is based on exposing fruits to high concentrations of CO2 for 24 h. The current way to know the effectiveness of a treatment with CO2 is through the destructive measurement of the content of soluble tannins in randomly chosen fruits. The fruit is cut in half and pressed against a paper impregnated with FeCl3 to obtain an impression of the content and distribution of the tannins. But this method is subjective, costly and destructive and, therefore, the development of alternative methods is needed. This work used hyperspectral images as a non-destructive tool to detect and obtain the distribution of astringency in persimmon cv. 'Rojo Brillante' after a CO2 treatment. The fruits were harvested in three different stages of commercial maturity and were exposed to four CO2 treatments with different duration to obtain fruit with different levels of astringency. The reference analysis of the content of soluble tannins was carried out using the Folin-Denis method and the distribution was obtained using the commercial method based on a paper impregnated with FeCl3.

Hyperspectral images of each complete fruit were acquired in the range of 460-1020 nm. Four astringent fruits (without treatment) and four non-astringent fruits (24-hour treatment) were used to construct a PLSR model. As astringency accumulates mainly in the lower part of the fruit, to assure the capture of purely astringent and non-astringent pixels, a region of interest (ROI) of approximately 10,000 pixels was selected in the bottom of the astringent fruits and another in the top of non-astringent fruits. Each pixel was assigned to 0 (astringent) and 1 (non-astringent). 70% of these pixels were used to build and calibrate the model, while the remaining 30% was used for the validation of a PLSR model. As a result of the prediction on the validation set, an R2P of 0.90 was obtained. Later, the model was projected on the value of each pixel in the images of all the fruits not used to build the model to predict the probability of being astringent. This prediction was projected on the images using a scale of colors depending on the probability of each pixel of being astringent, thus achieving maps of the distribution of tannin content (astringency) in fruits. Subsequently, these maps were visually compared with the marks left by the fruits in the papers impregnated with FeCl3.
These results point to hyperspectral imaging as a promising technology to assess the effectiveness of the deastringency treatments.

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Keywords: Diospyros kaki, internal fruit quality, soluble tannins, astringency, classification, computer vision

OP-142 [Section VI: Bioprocesses]
AUTHENTICATION OF EDIBLE OIL BASED ON FATTY ACIDOMICS AND CHEMOMETRICS

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Economically motivated adulteration (EMA) of food is the intentional adulteration of food for financial advantage. High-price edible vegetable oils such as olive oil in Europe and sesame oil in Asia are the most frequently counterfeited food. Generally, traditional adulteration detection or authentication method was conducted to classify authentic and adulterated edible oils with the help of chemometric methods. However, both the main edible oil and its adulterant are usually unknown in practice. The traditional binary classification method could not satisfy the requirement of adulteration detection. Therefore, it is necessary to develop a robust model for authentication of edible oils and determine the lowest detectable adulteration level (LDAL).

In this study, random forests (RF) and one-class partial least squares were combined to identify the authenticity of edible oils by fatty acidomics. Based on the previous studies, 28 fatty acids were identified and quantified for edible oils. Classification model was built by RF for five kinds of edible oils. Subsequently, the OCPLS model was established for these five kinds of edible, respectively. Moreover, fault oils adulterated with different levels of other oils were simulated by Monte-Carlo method and employed to determine the lowest detectable adulteration level of OCPLS classifier. The validation results that the RF could identify the all kinds of edible oils and OCPLS classifier could completely detect the adulterated oils and are therefore employed to authenticity assessment. As an example, the LDAL of OCPLS model was determined as 3% for sesame oil. The built model is helpful in quality inspection of high-price edible oil for protecting the customers far from adulterated edible oil.

Keywords: Edible vegetable oils, Random Forests, One-class partial least squares, Fatty acidomics, Authentication, Chemometrics

OP-143 [Section VI: Bioprocesses]
INTEGRATED POST-HARVEST MANAGEMENT SYSTEM FOR TOMATOES MARKETING IN SOUTH AFRICAN SUPPLY CHAINS

Tilahun Seyoum Workneh, Kipchumba Cherono

Decipline of Bioresources Engineering, University of KwaZulu Natal

This study sought to develop a transportation planning model based on the shelf-life of tomato fruit of various maturity stages under various transportation and storage temperature regimes. The model was developed based on quality kinetics of fruit under different transportation and storage conditions. Fruit firmness, hue angle and ascorbic acid concentration were used as quality attributes that would be imposed on the constraints and used as a basis for selecting fruit that would be of acceptable quality for different consumers. Based on industry data on production costs and revenue, the model was implemented in two configurations. One configuration strictly enforced the quality constraints, while the other configuration relaxed quality constraints. In both configurations, the model maximized revenue from the quantities of fruit of different maturity stages selected from each of the growers. The developed models will potentially improve revenue to growers as established in this study, with the model in some cases improving profits by 8685.5281 ZAR for a truckload of fruit. The model can be adjusted to incorporate other farms in the growers' sourcing networks, costs and quality constraints.

Keywords: Tomato, supply chain, south Africa, postharvest handling, modelli

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Jüri Olt	Estonia (Eesti)	Section III: Plant Production	P-030	Experimental study of the distribution of the heights of sugar beet root crown protrusion above the field surface level
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Zeliha Bereket Barut	Turkey	Section III: Plant Production	P-024	Comparison of Instant Mean Downforces of Commercially Available and Modified Furrow Opener Types in Field and Soil Bin Conditions

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P-001 [Section I: Land and Water]

ASSESSMENT OF TRENDS IN RAINFALL AND RUNOFF AT THE LA MERCY CATCHMENTS UNDER BARE FALLOW CONDITIONS AND SUGARCANE PRODUCTION

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Rainfall plays a dominant and driving role of hydrological processes. Runoff generally increases non-linearly with rainfall and rainfall-runoff models are very sensitive to rainfall input. Errors in rainfall data are magnified in simulated runoff, hence the need for accurate and consistent rainfall records in order to verify acceptable simulations. The aim of this research is to assess trends and relationships of rainfall and runoff at the La Mercy catchments under bare fallow conditions and sugarcane production for different management practices. The study area is located at La Mercy on the site that now hosts the King Shaka International airport in South Africa. It consisted of four research catchments namely 101, 102, 103 and 104 which were under bare fallow conditions and sugarcane cover. The data consists of daily rainfall and runoff records for the period 1978 – 1995 for the La Mercy catchments. Rainfall from the La Mercy catchments was consistent with rainfall from two nearby stations while comparisons between daily rainfall and runoff data from the catchments showed that a phasing problem existed. Lumping both rainfall and runoff into discrete events helped eliminate this problem. However, low runoff depths were still evident and it is postulated that this could have been a result of omissions when recording runoff data for the low runoff events. Under bare fallow conditions, runoff data from Catchments 101, 102 and 103 were found to be consistent and may be used in further analyses with confidence while runoff data for Catchment 104 were only found to be consistent up to 1980. It is therefore postulated that poor calibrations in the measuring equipment could have caused these inconsistencies. The effect of overland flow distance was evident on the generated runoff while there was no evidence linking catchment steepness to increases in runoff generation. Hence, it is postulated that effects of overland flow distance on generation of runoff overshadow the effects of catchment steepness under bare fallow conditions. During periods when the catchments were under sugarcane land cover, runoff from the four catchments was found to be relatively consistent although a break in trend occurred in September 1987 which was a result of floods that occurred then. Effects of minimum tillage and strip planting on runoff reduction were evident while the effect of conservation structures on runoff reduction was not evident. Hence, it is hypothesized that crop cover masks the effects of conservation structures on runoff reduction.

Keywords: hydrological response, bare fallow, sugarcane production, consistency, La Mercy catchments, South Africa

P-002 [Section I: Land and Water]

LANDCOVER EFFECT FOR REDUCING NUTRIENT LOAD IN ORGANIC FARMING FIELDS WITH LONG-TERM HISTORICAL CLIMATE DATA USING APEX MODEL

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The research on water quality of applying organic farming systems in Korea has not been sufficiently conducted. The objectives of this study were to monitor organic farming upland compared with conventional upland field and to evaluate nutrient loads reduction of landcover effect with long-term historical climate data. APEX model was validated with experimental data and the model was used to evaluate selected landcover effect scenarios for 30-year simulation periods. The values of RMSE, RMAE, R^2 and EI for runoff were 1.25-2.02 kg/ha, 0.27-0.69 kg/h, 0.85-0.86 and 0.60–0.93 in two treatments, respectively. Those for water quality (nitrogen) were 0.05-0.12 kg/ha, 0.59-0.76 kg/h, 0.64-0.72 and 0.55–0.66 in two treatments, respectively, and the validated model showed good agreement with the observed runoff and nitrogen. When decreasing the landcover rate of organic farming field to 60%, 40%, 20%, and 0% (conventional farm), average annual runoff increased by 6%, 14%, 22% and 34% compared with organic farming field, respectively. When decreasing the landcover rate of organic farming field to 60%, 40%, 20%, and 0% (conventional farm), average annual nitrogen loads increased by 2.9 times, 4.4 times, 6.2 times, and 8.9 times compared with organic farming field, respectively. In general, this study showed that it is possible to present an appropriate land cover ratio to maintain conventional production and minimize diffuse pollution for organic farming system, although long-term monitoring is needed to determine its effects on environmental concerns and crop competition between weed and crop.

Keywords: Organic, landcover, APEX model, pollution

P-003 [Section I: Land and Water]

A NEW APPROACH TO CALCULATION OF PARCEL INDEX FOR ABDURRAHMANLAR DISTRICT

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One of the most important steps in the land consolidation process the parceling process should be done so that the owners will be satisfied. Therefore, in order to a fair distribution a new place having the same value with the old places should be given to the landowners. For this purpose, the parcel index value is determined for each parcel in the land consolidation projects and the parcels are evaluated on this value. In the present condition, the parcel index is determined by taking 70% of soil index and adding the efficiency score of 10 points and the location score among 0-30 points in the land consolidation projects. In this system which is regulated for narrow purposes and mainly developed for the purpose of land consolidation and distribution, the deficient parts of the parcel index calculations are being discussed and tried to be developed even today. In this study, the effect on the number of parcel by determining of the parcel index as detailed method in land consolidation of Abdurrahmanlar district was determined. For this purpose, 14 different questions were asked to determine the value of parcels in terms of socio-economic, cultural and physical aspects of the each of plots located in Abdurrahmanlar district and other criteria points were determined as a result of these questions. Then, 50% of the soil score and 50% of the other criteria score were added and the parcel index classified for each parcel was determined. Using the parcel index obtained, the parcel value numbers of each parcel were determined and the results were compared with the parcel value numbers obtained by the present method. As a result of this study, parcel value numbers calculated with new equation of 38% of parcels in Abdurrahmanlar district were found more than existing equation.

Keywords: Abdurrahmanlar, land consolidation, parcel index, criteria

P-004 [Section I: Land and Water]
ECONOMIC AND ENVIRONMENTAL ASSESSMENT OF TRACTOR GUIDANCE TECHNOLOGIES

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Tractor guidance (TG), a precision agriculture technology, allows more precise applications of seed, fertilizer, and agro-chemicals, although whole-farm benefits are difficult to quantify. Hence, a decision support software called TG Analysis (TGA), soon to be online, was developed using on-farm efficiency gain measurements under field-operations to investigate the feasibility and environmental impact of this technology. Partial budgeting for TG are tailored to farm-specific conditions for up to three user-selected crop enterprises for profitability estimates based on equipment (e.g., age, annual use, purchase price, etc.). Environmental impacts are measured by tracking technology-driven changes in fertilizer, fuel, seed, labor, and chemical inputs, which are translated to their carbon equivalent (CE) footprint (N_2O, CH4, and CO2) to assess changes in global warming potential. Consequently, TGA software was run on three farm scenarios to identify annual impacts of integrating TG on: i) 500 ha of cotton (Gossypium hirsutum), ii) soybean (Glycine max), and iii) 250 ha of both cotton and soybean. For scenario i), seed, agrochemical, and operating costs were reduced $3,485, $61,027, and $1,573, respectively. Tractor use and man hours declined by 82h. CE savings for this enterprise were 4.86 kg ha-1 [5.79 l ha-1, 6.5 kg ha-1, 40.91 kg ha-1 reductions from fuel, fertilizer (including NOx emissions from N applications), and agrochemical applications, respectively]. Under scenario ii), profitability of TG at standard yield was $17,455 ($2,282, $13,688, and $440 for seed, agrochemical, and operating costs, respectively). Overall tractor use declined by 31h. Savings of CE were 1.89 kg ha-1 (2.24 l ha-1, 0.45 kg ha-1, and 7.95 kg ha-1 kg ha-1 from fuel, fertilizer, and agrochemicals). Finally, under scenario iii), estimated TG profitability was $45,489 for the 500 ha farm ($2,884, $37,358, and $1,007 for seed, agrochemical, and operating costs, respectively). Tractor use declined by 56h. CE savings for enterprise iii) were 3.38 kg ha-1 (4.02 l ha-1, 3.47 kg ha-1, and 24.43 kg from fuel, fertilizer, and agrochemicals). Consequently, total farm reduction of CE were 26.08, 5.13, and 15.61 metric tonnes for cotton, soybean, and cotton/soybean operations. General TGA results suggest: i) less accurate and cheaper technology is more profitable on smaller operations, albeit with fewer carbon footprint reductions; ii) more input-intensive enterprises (e.g. cotton) have larger carbon footprint reductions; and, iii) TG is less profitable with used equipment. Hence, the use of automatic TG systems has potential to improve agricultural sustainability by reducing agro-chemical inputs and maintaining or improving yields.

Keywords: Tractor Guidance Technology; Economic and Environmental Decision Support Software; Greenhouse Gas Emissions; Precision Agriculture.

P-005 [Section I: Land and Water]

DIFFERENT TILLAGE UNDER SEMI-ARID MEDITERRANEAN CONDITIONS: RELATIONSHIP BETWEEN SOIL ORGANIC CARBON, TOTAL POROSITY, NUMBER OF MYCORRHIZEA SPORE AND MICROBIAL CO2 PRODUCTION OF SOIL

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Soil organic carbon (SOC), total porosity (TP), number of mycorrhizea spore (NMS) and microbial CO2 production (MCO), and relationship between them based on six tillage practices were evaluated under semi-arid Mediterranean conditions. The experiment was conducted on a randomized complete block design with three replicates. The tillage methods were: conventional tillage with residue incorporated (CTS), conventional tillage with residue burned (CTB), reduced tillage with heavy tandem disc harrow (RTD), reduced tillage with rotary tiller (RTR), reduced tillage with heavy tandem disc harrow for the first crop + no-tillage for the second crop (RNT), and no tillage (NT). The study was conducted in wheat-corn-wheat-soybean and wheat crop rotations for two years. The relationship between MCO with SOC is better than the other soil properties with the highest coefficient of determination of 0.93. There is a linear relationship between them. NMS and TP followed this based on soil organic carbon content, respectively. The effects of the tillage on SOC, TP, NMS and MCO were significant at soil depth of 0-30 cm. Although the total porosity was higher in CTS, the SOC, NMS and MCO values were higher in NT than the other plots.

Keywords: Soil organic carbon, Total porosity, Number of mycorrhizea spore, microbial CO2 production, Tillage

P-006 [Section I: Land and Water]
CHANGES IN LOW-FLOW FREQUENCY UNDER GLOBAL WARMING IN <I> TANADA CATCHMENTS

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In Japan, terraced paddy fields (known as *Tanada* in Japanese) span an area of over 20,000 ha. Because most terraced paddy fields are located on mountain slopes, irrigation water is withdrawn from mountain streams with small catchments. As a possible outcome of global climate change, reductions in precipitation could directly decrease surface water streamflow and exacerbate the irrigation water demand by terraced paddy fields. This paper presents the results of an investigation of the impact of these effects on Sakamoto Tanada in southeastern Japan. The investigation examined the effects of precipitation and streamflow changes, especially the low-flow frequency, under global warming. Streamflow was simulated using the hydrological model TOPMODEL using large ensemble climate simulations. Before the numerical simulation, the adequacy of TOPMODEL was verified using observational data. The Database for Policy Decision-Making for Future Climate Change (d4PDF) dataset was used as global warming simulation data, which is intended for use in impact assessment studies and adaption planning for global warming, has many ensembles of 20-km regional climate model simulations over Japan. The results of the 3000 members of past climate simulations and 5400 members of global warming climate simulations were compared, and the change in low-flow frequency was analyzed. After comparing the probability density distributions of annual total precipitation and discharge, the simulated distribution of increased temperature spread upward. Although the probability density distribution of total precipitation and discharge in the irrigation period during May to September did not change in the simulation of warmer climate, the distribution spread on both sides, indicative of the increased occurrence frequency of both floods and droughts. Furthermore, the occurrence frequency increased for consecutive days without rain lasting at least 15 days. Moreover, the return period for 30 consecutive days without rain decreased from 19 years to 9 years. Finally, the return period of a low-flow frequency of less than 1.4 mm/day changed under global warming from 11.8 years to 8.7 years. Overall, these results indicate that the risk of drought in terraced paddy fields in Japan will increase under global warming.

Keywords: terraced paddy field, hydrological simulation, return period, drought, irrigation period

P-007 [Section I: Land and Water]
A DEEP NEURAL NETWORK MODEL FOR RUNOFF ANALYSIS

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A deep neural network (DNN) to represent the nonlinear relation between rainfall and river discharge is developed. DNN is composed of one input layer, five middle layers and one output layer, and predicts a dairy river discharge from input data of a day unit. Generally, a time series of rainfall data is used as input data in runoff analysis. In this study, however, the soil water index (SWI) is used instead of rainfall data to reflect a time history of rainfall in the output of dairy river discharge more accurately. SWI represents a condition of soil water content and is calculated from rainfall data by use of the tank model consisting of three tanks. The number of nodes in input layer is set as 10 for the same purpose above mentioned. The number of nodes in middle layers is set as 17 by trial and error in order to obtain the minimum error between the model output and training data. In order to avoid the problem of "gradient vanishing" resulting from multilayering, ReLU (Rectified Linear Unit) function is employed as the activation function instead of the sigmoid function that is usually used. DNN model developed is applied to runoff analysis in Shigenobu River basin, Ehime Prefecture, Japan, and the training and generalization (prediction) errors are investigated. The period 50 years (1961–2010) of SWI data is used for the training (Case 1) and 25 years (1986–2010) of SWI data is also used for the training for the purpose of comparison (Case 2). The number of training runs are at most five hundred thousand. SWI data from 2011 to 2013 is used for the prediction. From the results, it is found that the training and prediction errors in Case 1 are smaller than that in Case 2 and that the training and prediction errors in each case become small as the number of training runs increases.

Keywords: Runoff analysis, Neural network, Deep learning

P-008 [Section I: Land and Water]
EQUATIONS DEVELOPED TO ESTIMATE EVAPOTRANSPIRATION IN GREENHOUSES

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It is estimated that the world population will be 9.6 billion by 2050. In order to meet the food needs of the growing population, it is necessary to increase the yield taken from existing agricultural land. As the greenhouse provides a more controlled environment, the yield taken from the unit area is higher than the field conditions. For this reason, the greenhouse cultivation has been increased in recent years. Irrigation is one of the most important cultural applications for increasing efficiency from the unit area. It is important that crop water requirement should be determined correctly for proper irrigation scheduling in greenhouse. The use of climate based equations to determine evapotranspiration has been increased in recent years. In this study, it was examined that estimation performances of ET equations based on the reference crop (Penman, Hargreaves, FAO-24-Radiation, Priestley-Taylor, FAO-Penman Monteith, FAO24-Pan Evaporation) and main crop (Stanghellini, Fynn, Takakura, Simplified Model) developed from the past to the present day. As a result of the study, it is seen that there is no standard method in greenhouse conditions to determine ET of a specific crop. The reason for this is that greenhouse climate changes depending on greenhouse type, location, direction, cover material, greenhouse volume, ventilation mechanism, usage of thermal curtain and shadow powder and even cultural applications such as hanging. However, it is not possible to develop new equation or calibrate existing equations for each different greenhouse in the same region. Therefore, it is suggested that ET equations to be used should be selected depending on the type of greenhouses commonly used in the region and, if necessary, modified according to these conditions.

Keywords: Aerodynamic resistance, climate data, crop evapotranspiration, reference evapotranspiration, vapour pressure deficit

P-009 [Section II: Structures and Environment]
MICRO-CLIMATIC ANALYSIS IN PEAR ORCHARD BY INSECT-NET SIZE IN SOUTH KOREA

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Korea's pear cultivation area is 11,820 hectares as of 2015, and its production amounted to 261,000 tons. If you are growing a pear, you should put the bagging it so that it is clear and transparent. However, because of the aging of the rural areas, the labor force is insufficient and the time bagging is similar to other agriculture working periods such as fruit cutting, making the bagging work more difficult. The disaster prevention facility is necessary because damage such as typhoon and hail occurs every year due to weather disaster. In order to develop pest control facilities for pest control and labor saving, consideration should be given to the effect of net facilities for no-bagging the growth environment of crops. Considering the insect pest size, we analyzed the micro-climatic temperature, humidity, and solar radiation inside the 2mm and 4mm mesh net.

As a result, the temperature and humidity were not significantly different between the control(bagging) and the test area (2mm/4mm net), but the solar radiation tended to decrease as the net size decreased. It is necessary to perform comparative analysis because fruit growth, fruit loss and quality of fruits are influenced by future micro-climatic.

Keywords: Pear orchard, no-bagging, Insect-net

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P-010 [Section II: Structures and Environment]
CHARACTERISTICS OF UPLIFT RESISTANCE FOR GREENHOUSE CONTINUOUS FOUNDATION BY FIELD TEST

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There is no anti-disaster standard of foundation for greenhouse according to strong winds and heavy snow in South Korea. The uplift resistance for greenhouse continuous foundation usually obtained in field tests which simulate real construction conditions(reclaimed land). Therefore, field test for behavior characteristics of continuous greenhouse foundation were carried out to ensure stable facility cultivation. The soil of ground was characterized as silty (ML) based on the Unified Soil Classification System (USCS). The grain size distribution of the silty was also poor; the 4.76 mm sieve passing quantity was >100% and the 0.074 mm sieve passing quantity was >65%. The uplift resistance test were carried out following the specifications of ASTM D3689-07, with the ground having a target compaction relative density of 70%.

The field test condition was different in the embedded depth 30cm, 40cm, 50cm and the spacing 50cm, 60c, 70cm. As a result of the uplift resistance field tests using the load control method, minimum uplift resistance to be over 0.9kN and uplift resistance displacement 9.4mm. Uplift resistance of the continuous greenhouse foundation was in the range of 0.9~1.8kN according to embedded depth and spacing, was no constant trend uplift resistance by testing condition. The reason for this was unlike the displacement control method, maybe this is because the load control method appears to as much displacement as load.

Keywords: Uplift resistance, Continuous foundation, Single span plastic greenhouse

P-011 [Section II: Structures and Environment]
TEST OF POINT EXTRACTION IN FARROWING PENS WITH DIFFERENT FLOOR

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Earlier studies with point extraction system (ventilation system) in three full scale tests with finishing pigs have shown, that it can collect the main part of ammonia (between 52 to 65 percent and odour (between 44 to 53 percent) emissions in a small amount of air that can subsequently be cleaned. Point extraction system combined with air cleaning, point extraction permits cost-efficient reductions of ammonia and odour from pig houses. Due to the air flow pattern, the highest concentrations of ammonia and odour are found in the slurry pits underneath the lying area, which is where the suction points of the point extraction system are placed. The aim of the present study was to test the point extraction system in full scale at two different farms with farrowing units designed with partly solid floor (36 pens) and full slatted floor (56 pens). The point extraction system was established in each trial farrowing unit and were compared with a farrowing unit without point extraction at each farm. The suction points were placed between the solid floor and the slats, so the suction points were placed underneath the sow in the slurry channel. In the pens with full slatted floor the suction points were placed at the back of the farrowing pen in the slurry channel. Ammonia and odour concentration were measured in periods throughout the year. Furthermore, the ventilation rate, temperature in the farrowing unit and outside temperature were measured continuously. The results showed that in the farrowing unit with partly solid floor it was possible to collect 53 percent of the ammonia emission and 41 percent of the odour emission in the point extraction system with an average airflow of 36 m3/hour/sow. In the farrowing unit with full slatted floor it was possible to collect 32 percent of the ammonia emission and 23 percent of the odour emission in the point extraction system with an average airflow of 38 m3/hour/sow. The lower efficiency of the point extraction system in the farrowing unit with full slatted floor can be explained with the placing of the suction points (not underneath the sow) and a higher opening area of the slats compared with farrowing pens established with partly solid floor. There was no relation to the season variation (summer/winter) in relation to the efficiency of the point extraction system. There was no correlation between temperature and ventilation rate on the efficiency of the point extraction system. In conclusion, the point extraction system efficiency was highest in the farrowing pens established with partly solid floor.

Keywords: Ammonia, Odour, Emisison, Environment, Pig Production

P-012 [Section II: Structures and Environment]
FINITE ELEMENT ANALYSIS OF A PTO SHAFT USED IN AN AGRICULTURAL TRACTOR

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This study describes a finite element method (FEM) based deformation simulation procedure for a power take off (PTO) shaft in an agricultural tractor. The agricultural tractor is a mobile power source in agricultural fields. The Agricultural tractor transmits power to the working implement through several systems independently. Most especially, rotary elements used in agricultural machinery take the required power and movement from the tractor take off (PTO) shaft. During this operation, the PTO shaft experiences a high dynamic loading condition such as excessive instant (impact) loading. This may cause an undesired failure case for the PTO shaft. In order to prevent such undesired failures, loading condition and stress distribution on the component should be described properly, however, an accurate description of the structural stress distribution on the shaft becomes an important problem. In this content, a case study was carried out on a failed PTO shaft, as described in this paper. The aim of this case study is to exhibit the stress distribution on the PTO shaft through finite element analysis under a torsional loading case which may be considered as the main cause of the failure. Visual outputs from the simulation results revealed a better understanding of the failure zone on the shaft. The maximum equivalent stress magnitude obtained from the simulation was 632.08 [MPa] (which was lower than the fracture point) on the shaft under maximum PTO torque, however, it was concluded that the main reason for the failure was excessive shock torsional loading. This work contributes to further research into usage of numerical method based deformation simulation studies for the transmission elements used in agricultural tractors/machinery.

Keywords: Design of agricultural machinery, finite element analysis, stress analysis, engineering simulation, PTO shaft failure, shock loading.

P-013 [Section II: Structures and Environment]

DEVELOPMENT OF A TWO-DEGREE-OF-FREEDOM MANIPULATOR TYPE OF ORDERLY-THROWING TRANSPLANTER FOR TRANSPLANTING RICE POTTED-SEEDLINGS

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Rice potted-seedling throwing transplanting was one of the three main agronomic patterns to plant rice in China, the other two were rice direct seeding and traditional rice transplanting. Adopting the rice potted-seedling throwing transplanting pattern, seedlings would have some strengths that had developed root system, rooted fast, more tiller, higher spike rate, no or shorter recover period. To meet the requirement of such an agronomic pattern, this paper presented a two-degree-of-freedom (TDOF) manipulator type of orderly-throwing transplanter for transplanting rice potted-seedlings. And it mainly introduced the working principle and structures of this transplanter. The transplanter was composed of a walking mechanism, a set of single-chip control system, an automatic feeding mechanism (AFM), a TDOF manipulator and two sets of seedling guide tubes (SGT). During the operation in the field, the walking mechanism was manually driven to complete the work path planning while the transplanting operations were completely finished by the program controlled TDOF manipulator. The TDOF manipulator consisted of three major components: a horizontal movable mechanical arm (HMMA), a vertical synchronous inverted mechanism (VSIM) and two clamp-shaped grippers (CG). The transplanting scheme with required kinematic indexes was achieved through flexible programming controlled by the single-chip control system. Based on the designed prototype, preliminary experiments have proved that the design of the transplanter was feasible.

Keywords: agricultural machinery, orderly-throwing transplanter, manipulator for transplanting, rice potted-seedlings

P-014 [Section II: Structures and Environment]
SMART ORCHARD SPRAYER DESIGN FOR PRECISION AGRICULTURE

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In this study, an orchard sprayer prototype was developed that can be used in vineyard spraying. The developed prototype has a 1000 l tank capacity, an independent tower on the right and left, and a fan to create air flow in the center. In the prototype developed, a tower chassis was manufactured with a solenoid valve on each nozzle. The working width of the machine and the auxiliary air-flow rate from each nozzle are adjustable. The work width of the prototype machine can be changed with a mobile phone application developed on the Android operating system via the right and left hydraulic cylinders, electronic control card and Bluetooth. The developed prototype can be adjusted in the work width of the machine from 2.1 m in closed position to 2.6 m after opening

Keywords: Orchard sprayer, precision agriculture, simulation, Android,

P-015 [Section II: Structures and Environment]
POMEGRANATE AND ITS PLACE IN LANDSCAPE

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Pomegranate (Punica granatum L.) is an important tree; actually it is a bush in nature, in the tropical and subtropical zones of the world mainly commercial production regions in the Mediterranean Basin. It is highly valuable for its delicious fruits and attractive flowers. During its systematic development, several varieties were generated from this species, including P. granatum L. 'Nana' which is a dwarf variety, and more valuable for its ornamental characteristics of numerous small flowers and long flowering period. Pomegranate is a plant that symbolizes abundance and fertility in many cultures. It is also symbolizes the rightness in Judaism. In Christianity, it is believed that the forbidden fruit that causes Adam and Eve to be expelled from heaven is not apple but actually pomegranate. Pomegranate is one of the most used motifs in religious portraits. According to Islam, the pomegranate is one of the fruit that is found in the paradise like the palm date. There is a huge interest in this plant throughout the world especially for its potential with ecologic, economic, visual value and health care function. It is a good choice for reforesting mountain slopes and has been used to ameliorate erosion. Pomegranate, which is usually grown as a fruit tree, has widespread use as an ornamental plant in landscape architecture because of decorative characteristics. From Babylon's hanging gardens to orchards and parks, in cities and places in the Near East and Central Asia, pomegranates have long been prized for the beauty. It is suitable for bonsai construction because it is suitable for pruning and trimming. Pomegranate also gave its name to Granada city of Spain and Side of Antalya. Side was called "pomegranate" in old times. Side is the Mediterranean city. It has been the center of culture, art, architecture and mythology throughout its history. Its nature made up of dark blue sea and world known holiday villages is famous. There are too many hotels and new tourism facilities have still been built in the city. The restoration of the old city is about to be completed successfully. This study emphasizes the importance of using in the planting restoration of the old city. In this study, the use possibilities of pomegranate, a symbolic cult plant, in landscape architecture were examined in the case of Side historical urban texture. Materials and design recommendations for planting design with using pomegranate were introduced.

Keywords: Punica granatum, Pomegranate, Mediterranean, Historical city, Side

P-016 [Section II: Structures and Environment]
CHARACTERISTICS OF LIVESTOCK ODOUR IN SWINE FACILITY IN KOREA

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Along with the quality of life and the expansion of the city, odours in the community have become a major problem associated with civil complaints in Korea. Livestock odours emitted from swine facilities were measured to investigate the odour characteristics of pigs, facility types, shapes, and deodorant use. The livestock odour monitoring had conducted for pig farms located in Gyeonggi-do from August to November in 2016. Samples were collected by the indirect sampling method according to odour measurement and analysis method in Korean national standard. The collected samples were tested by the air dilution olfactory method. The averaged odour concentrations were 435 OU(odor unit) for growing pig, 227 OU for sows, and 195 OU for piglet by type of pig houses. According to the type of growing pig house, the odour concentration in opened pig house (424 OU) was lower than that in closed pig house (505 OU). Odor characteristics according to the floor type were in the order of slurry (461 OU) > scraper (453 OU) > concrete (394 OU). The odour concentration in the pig houses using microbes and deodorants was 436 OU, which was similar to 428 OU of control group without any compounds. There was no significant differences in the livestock odour concentration according to the type of pig house, floor type, and deodorants use by using the non-parametric test (Mann-Whitney test). It is necessary to preferentially select growing pig, which generates more odours than other facilities, dealing with reduction measures against livestock odour.

Keywords: emission factor, manure treatment, odour intentisty, pig house

P-017 [Section II: Structures and Environment]
DID WE FIND A WAY OUT? USE OF INSECT PROTEIN IN FISH FEEDS

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Feed quality and cost are the main determinants of success in aquaculture production. Many organizations and researchers, especially FAO, are publishing highly pessimistic projections on the supply of fishmeal and fish oil, the main raw material of feed, while producers are strongly affected by increasing prices and this wave of influence reaches up to the last consumer. The solution is to produce high quality feeds as cheap as possible. It is also inevitable for global competitiveness to act with eco-friendly approach. Insects and various insect production waste have high potential for being a valuable source for fish because they contain high protein and fat. In the United States at the beginning of 2017, the use of insect larvae in fish feeds was legally granted, and in July 2017 Canada responded positively to the application of European entrepreneurs for the same product. Finally, a UK-based company has gained a great impetus with this consent by the European Union Commission. Currently 21 insect meal/oil companies make contribution to livestock and fish feeds with their products which are not new but has recently become popular. Turkey, which exports to 56 countries worldwide and has over 250 thousand tonnes of annual aquaculture production, should closely monitor these developments to protect its leadership position.

Keywords: Animal feed, fish nutrition, insect meal

P-018 [Section II: Structures and Environment]
DID WE FIND A WAY OUT? USE OF TWO NEW LEPIDOPTERAN INSECTS IN FISH FEEDS

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Similar to the rapid growth in finfish aquaculture, the aquarium hobby sector has reached up to a market value of 15 billion US dollars in the world and 10 million US dollars in Turkey. Feeds are at the forefront of common problems in both sectors. Turkey is over 92% import dependent for ornamental fish feeds. Even if they offer economic options, local products fall behind imported ones in terms of quality. The starting points of this study were the potential of aquaculture economy as a really fast growing sector and the global bottleneck in fish meal supply and continuously rising prices of fish feeds. Edible insects as a promising source of protein both for animal and human have increasing interest but very limited high value commercial products are released yet. To establish the availability of insects in fish feeds there is the necessity to examine health issues, raw material procurement and economy. We examined the potential of two new lepidopteran insects (Ephestia kuehniella and Cadra cautella) as fish feed material for the first time over the world. These two species are currently used in order to rear several natural enemies for biological control in plant protection. Although they have economic value, the adults die after spawning and they are waste. These wastes were processed into insect meal and used as animal protein in feeds for ornamental fishes in a series of experimental studies. The results so far suggest that these two insect wastes are promising to be used as animal protein source in ornamental fish feeds.

Keywords: Fish meal, insect meal, Lepidoptera, waste, fish nutrition

P-019 [Section III: Plant Production]
PHYSICAL REQUIREMENTS FOR VINEYARD MONITORING ROBOTS

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The global market for service robots is steadily growing, and its growth is expected to sky-rise in the next two decades. Among them, agricultural robots in particular are getting much attention for the actual benefits of automating repetitive tasks in harsh, low-populated environments. However, endowing agricultural equipment with autonomous navigation involves overcoming a series of reliability and safeguarding challenges of difficult solution. To face them, the VineScout project, an EU-funded initiative that features an industry-academia consortium of five partners, has committed to design a market-ready monitoring robot for the wine industry by 2020. The new robot follows a user-centered design according to the instructions given by the project end-user. The Vinescout concept departs from a Technology Readiness Level (TRL) of 6/7, and is expected to reach the commercial stage at TRL 9. The vineyard robot weighs 100 kg, and has been conceived to be cost-efficient and energy-saving, with only electric drives, lithium batteries, and solar panels. This paper describes the advances carried out during the first year of the project, where a compact design has been proposed to protect internal electronics, and a 4-wheel independent suspension system with customized springs assures the necessary agility to monitor vineyards at a rate of one hectare per hour. Preliminary rolling and vehicle dynamics results obtained after testing the prototype in the university experimental vineyard demonstrate that the robot is ready for the intense data acquisition season in the summer of 2018 in a Portuguese commercial vineyard.

Keywords: Autonomous navigation, agricultural robots, vineyard monitoring, proximal sensing, robot architecture, precision agriculture

P-020 [Section III: Plant Production]
FAUNISTIC STUDIES ON ALEYRODIDAE SPECIES OF REPUBLIC OF NORTHERN CYPRUS

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Whitefly (Aleyrodidae) are small. Usually inconspicuous, sap-sucking insects that contain many important agricultural pests. Sometimes they couse plant damages results from direct feding, through contamination by excreted honeydew and secondary colonization by sooty mold, and by transmitting plant virus diseases. Faunistic study on whiteflies in Turkey started with Aleurolobus olivinus in 1968 and have continud to present day. In this study it was aimed to determine Aleyrodidae fauna in Republic of Northern Cyprus.

In total 12 aleyrodid species were found and among them nine species, namely Aleurothrixus floccosus (Maskell), Bemisia afer (Priesner & Hosny), Dialeurodes citri (Ashmead), Tetraleurodes bicolor Bink-Moenen, T. neemani Bink-Moenen, Trialeuordes lauri (Signoret), T. vaporariorum Westwood ve S. phyllirea Haliday were first time recorded for Repuclic of Northern Cyprus Aleyrodidae fauna.

Keywords: Whitefly, Aleyrodidae, Fauna, Republic of Northern Cyprus

P-021 [Section III: Plant Production]
THE DETERMINATION OF FRUIT FLY SPECIES IN TURKISH REPUBLIC OF NORTHERN CYPRUS

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The order Diptera includes flies. These insects are distinguished from other species with distinctive characteristics. Tephritidae family shows large distribution in Diptera around the world. Tephritidae species are mostly known as fruit flies, which cause economically important damages on some fruits. The Drosophilidae are a diverse and cosmopolitan family in Diptera, which includes fruit flies. The determine to presence of fruit fly species which are at several locations on the Lefke (Yeşilırmak) and Güzelyurt (Kalkanlı and Güzelyurt), located in the Turkish Republic of Northern Cyprus, the traps baited with vinegar were set at 1.5-2 m height to the south-southeast periphery of fruit trees which include persimnon, apple, plum, apricot, peach, valencia orange, pomegranate, fig and locust trees. All fruit fly specimens were collected and transferred to 75% ethanol for further laboratory observation. The pests were identified by us based on morphological identification of the species have done using a stereomicroscope.

The study was conducted on persimmon, apple, plum, apricot, peach, olive, orange, fig, locust tree, pomegranate orchards on the Lefke (Yeşilırmak) and Güzelyurt (Kalkanlı and Güzelyurt), located in the Turkish Republic of Northern Cyprus. In the results, Ceratitis capitata (Wiedemann), Trupanea amoena (Frauenfeld), Bactrocera zonata (Saunders), B. oleae (Gmel.) and Euleia heraclei (Linnaeus) which belong to Tephritidae and Drosophila suzukii (Matsumura) which belong to Drosophilidae have been recorded. According to findings of this study, Ceratitis capitata, Drosophila suzukii and Bactrocera zonata were widespread and abundant on orchards in the research area.

Keywords: Cyprus, Drosophilidae, Fruit Fly, Tephritidae

P-022 [Section III: Plant Production]

DISCRIMINATION OF SOIL WATER CONTENT USING VIS-NIS SPRECTRAL REFLECTANCE FROM SOYBEAN LEAVES

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Soil moisture content is one of the main factors for plant growth and grain production. The water deficit detection through spectral reflectance is a fast and economic non-destructive diagnostic tool to determine water deficit in extensive cropping areas. The crop productivity and the photosynthetic capacity are affected by factors such as water, because the plants close their stomata and the CO2 exchange is slower, this condition can be identified in the leaves with measurements of spectral reflectance through the techniques of chemometrics that detect stress due to water deficit. However, there are other processes that can detect soil water deficit and modify the spectral curve in the water absorption spectrum that can be identified in the infrared region (NIR). The experiment was carried out in the municipality of Villavicencio, Colombia under a greenhouse conditions where three soybean *Glycine max* genotypes and three water levels (near field capacity, near wilting point and in between the previous two levels) were evaluated in pots filled with *Typic Hapludox* soil. The experiment was layed out in a complete randomized block design with seven replicates. During the plant growth stages, the spectral reflectance between 350-2500 nm were measured weekly in the younger trifoliolate leaf from each stage. Soil moisture content was kept within the treatment levels. Linear discriminant analysis was used to analyze the set of hyperspectral variables. A set of five classification factors were obtained from the three soil moisture groups. The model precision was 82.54% when validated using cross-validation during the pod filling growth stage. The objective of this work is to develop a discriminant model between soil moisture ranges, with measurements of spectral reflectance in soybean leaves and PLS-DA chemometric analysis. The visible region (VIS) contains wavelengths with high loadings in the classification model due to changes in the chlorophyll content, however, the shortwave infrared region (SWIR) the high loadings are due to changes in slope in the spectral curve associated with the quantity of absorbed radiation by liquid water in the foliage

Keywords: Soil moisture, Soybean, hyperspectral data, Spectral discrimination

P-023 [Section III: Plant Production]

EXPERIMENTAL STUDY OF THE DISTRIBUTION OF THE HEIGHTS OF SUGAR BEET ROOT CROWN PROTRUSION ABOVE THE FIELD SURFACE LEVEL

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The results of the experimental studies and operational tests of the sugar beet harvesting work process carried out recently reveal that the latest models of beet harvesters produced in Europe and America cause considerable loss of the sugar-bearing mass. The source of this loss is mainly the poor topping of the crowns of standing sugar beet roots, more specifically their excessively low cutting off, which results in the straightforward loss of sugar-bearing mass. The aim of this study is to reduce the loss of sugar-bearing mass in the process of topping sugar beet root crowns. The results of the experimental research into the distribution of the heights of protrusion of the root crowns above the soil surface level have confirmed the hypothesis that it follows the normal distribution law. Basing on the results of the accomplished measurements, it has been established that this distribution has a range of statistical performance variation with the following limits: mean deviation σ = 20...30 mm, mathematical expectation m = 40...60 mm. The developed experimental unit and the field studies performed with its use have provided sufficient grounds for the development of a new system of automated topping height adjustment on state-of-the-art root crop harvesters.

Keywords: sugar beet, harvester, loss, sugar-bearing mass, height of protrusion, statistical distribution

P-024 [Section III: Plant Production]
COMPARISON OF INSTANT MEAN DOWNFORCES OF COMMERCIALLY AVAILABLE AND MODIFIED FURROW OPENER TYPES IN FIELD AND SOIL BIN CONDITIONS

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Three different types of furrow openers (hoe, chisel, double disc) which are commercially already available and a modified furrow opener (inverted T) were mounted on a direct seeding machine to determine the instant mean downforces in field and soil bin conditions. The study was conducted in Çukurova University Agriculture Faculty Research Farm and in Department of Agricultural Machinery and Technologies Engineering Atelier. A four rowed pneumatic direct seeding machine was used for corn seeding. Two soil humidity contents (25% and 19%) were arranged both in field and in soil bin trials. The distribution of the downforces on the furrow opener types does not differ statistically in the field conditions according to soil bin conditions in both the soil humidity contents. It is determined that the instant mean downforce values obtained in soil bin experiment were lower than the field trials for hoe type and chisel type furrow openers in 25% soil moisture content. In the 19% soil humidity content, among the furrow opener types, the lowest mean downforces were recorded (5069.87 N and 5058.80 N) in the modified inverted T type furrow opener in both conditions. Thus this type of furrow openers may be preferred on direct seeding machines in low moisture content due to their structural properties.

Keywords: Inverted-T, furrow opener, downforce, soil bin, direct seeding machine

P-025 [Section III: Plant Production]
EVALUATION METHODS FOR VERTICAL SEED DISTRIBUTION UNIFORMITY OF FURROW OPENERS

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A furrow opener is an important component of seed drills, planters or transplanters. Furrow opener of a seed drill or planter place seed at a given seeding depth. In general, a furrow opener cuts a furrow and allows seeds or seedlings to be deposited before being partially covered with soil. Seed distribution in the soil is an important factor in evaluating its performance. Furrow openers directly affect sowing depth and lateral seed scatter of seeds.

The aim of this study was to evaluate the methods of determining seed distribution uniformity of furrow openers by characterizing the spatial distribution of seeds within the seedbed. Different methods such as measuring seeding depth relative to soil surface, vertical distribution area of seeds developed by Karayel and Özmerzi (2005) and measuring the chlorophyll-free length of seedlings are compared and evaluated.

Özmerzi (1986) evaluated the performance of shoe, hoe, single disc and double disc furrow openers with respect to seed distribution in the horizontal and vertical planes. He characterized the vertical distribution of seeds in the furrow by the standard deviation of the chlorophyll-free length and measuring the vertical distance between soil surface and seed after digging the soil and finding the seeds in the furrow. These methods, measuring the chlorophyll-free length or vertical distance between seeds and soil surface, was able to evaluate seed distribution in a mono dimensional way.

Karayel and Özmerzi (2005) determined seed distribution area of seeds in the soil using ellipse and integral criteria. The criterion, seed distribution area, was able to evaluate seed distribution in a two dimensional way. Seed distribution areas computed by integral criterion were significantly higher than by ellipse criterion. Seed distribution area calculated by the integral criterion was closer to actual seed distribution area, but the ellipse criterion gave detailed information about main source (lateral seed scatter or variation in sowing depth) of distribution area of seeds.

Seed distribution area determined by ellipse and integral criteria characterized both seeding depth and lateral seed scatter of seeds. Conventional criteria (measuring the chlorophyll-free length or vertical distance between seeds and soil surface) for examining vertical seed distribution characterized only sowing depth. The new criterion also gave visual information about seed distribution in soil by plotting orthogonal projection of seeds on a vertical plane perpendicular to the row.

Keywords: Seed drill, planter, seed distribution, furrow opener

P-026 [Section III: Plant Production]
A BRIEF OVERVIEW TO AGRICULTURAL MECHANIZATION OF TURKEY

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In this article, giving general information of Turkey agriculture and its mechanization was aimed. Turkey is one of the important agricultural centers in the World and its current agricultural land in total is about 24 million ha approximately. When examined on the basis products, it is seen that the main crops are wheat, barley, maize, sunflower, cotton and forages in the field crops, and olive, grape, apple and orange are the most common fruits. Tomato, cucumber, pepper, cucumber, and melon are the most common cultivated crops among vegetables. However, Turkey's southern coast is an important greenhouse-growing center due to favorable climatic conditions. Also, animal production is a significant sector, and plant and animal production is carried out mostly together with in many farms. It is known that tractors are the main power sources in the agricultural production, number of these vehicles and machinery driven by tractors is important in terms of mechanization level indicator for a country or region. The numbers of agricultural vehicles has increased and today, tractors' number exceeded 1.27 million. However, some agricultural machinery numbers have increased or decreased faster in recent years. Machine utilization for harvesting operations have increased in the recent years due to the insufficient human power, and higher cost of worker. While the cotton fields were widely harvested by hand 15 years ago, nowadays cotton pickers are worked for this operation. Increasing application of drip irrigation system is one of the indicators of the level of use of technology in agriculture. However, some machinery has old technology or powered by animal has been started to abandoned by Turkish farmers. When evaluating conditions of today's, it can be said that the farms are mostly mechanized for some cereal crops. Especially, some big farms dealing with greenhouse, fruit, field crops and animal production are trying to move to full automation. However, some operations such as hoeing in the small scale farms, planting in the vegetables, harvesting fruits, vegetables and some field crops and pruning fruit and vegetable productions are done commonly by hand. In Turkey, small scale and divided areas negatively effects to the agricultural production, and limits farmer's income. It is known that having machinery of small farms is not economic every time. If the purchasing method was not economic, different usage method should be determined such as renting and partnership etc. The methods of multi-farm use of machinery are important in this stage.

Keywords: agricultural production, agricultural mechanization, Turkey,

P-027 [Section III: Plant Production]
AN INTRODUCTION TO DESIGN FOR ADDITIVE MANUFACTURING (DFAM) APPLIED TO SMALL FARMS

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Additive manufacturing (AM), also known as 3D printing is a production process characterized by the successive addition of material layers, whereby a product can be directly fabricated from its 3D model. Design for Additive Manufacturing (DFAM) is a general design method applied in parts design for AM process fabrication, aiming to improve functional performance, manufacturability, reliability, and cost due to the capabilities of AM technologies. This concept emerges due to the enormous design freedom provided by AM technologies. As an example, small farms in Brazil can try to adapt low cost irrigation systems, as the ones proposed by Embrapa in Brazil. Some of these low-cost irrigation systems seek to reuse (recycle) spare parts already or easily available; and there is risk that some parts can be missing or unfitting. Therefore, in an attempt for more efficient use of resources (e.g, water, electricity, and labor) in agriculture, DFAM can be used to supply unavailable and/or unfitting irrigation parts, for example. The problem is that in developing countries (and even in developed ones) it is not easy for small farmers to adopt this technique (DFAM) due to the high initial capital cost of the system installation and other costs associated to it. So, we believe that there is an opportunity for service companies to provide small farmers with their needed AM parts. This work aims to present DFAM principles and how it can be used to support the niche of small farmers as a supply for low-cost and customized parts development. Although, this work is at its first stages, this concept could possibly be applied to help poverty alleviation in many areas of the world.

Keywords: Design, Additive manufacturing, 3D, small farms

P-030 [Section III: Plant Production]

EXPERIMENTAL STUDY OF THE DISTRIBUTION OF THE HEIGHTS OF SUGAR BEET ROOT CROWN PROTRUSION ABOVE THE FIELD SURFACE LEVEL

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The results of the experimental studies and operational tests of the sugar beet harvesting work process carried out recently reveal that the latest models of beet harvesters produced in Europe and America cause considerable loss of the sugar-bearing mass. The source of this loss is mainly the poor topping of the crowns of standing sugar beet roots, more specifically their excessively low cutting off, which results in the straightforward loss of sugar-bearing mass. The aim of this study was to reduce the loss of sugar-bearing mass in the process of topping sugar beet root crowns. The results of the experimental research into the distribution of the heights of protrusion of the root crowns above the soil surface level have confirmed the hypothesis that it follows the normal distribution law. The subject of this research was the work process of topping sugar beet roots standing in the field by cutting off their tops without feeling. The results of the accomplished measurements have been processed with the use of statistical methods on a PC. We worked out the structural layout of the actual testing device for the performance of field experiment studies. The system of gyroscopes and accelerometers was engineered for the investigation of the impact of the beet harvester's oscillations on the stability of performance of the sugar beet root harvesting implements. We have developed the structural layout of the measuring apparatus and manufactured the electronic module to control the process of measuring the parameters of the sugar beet root crown position above the level of soil surface. The measuring apparatus includes the sugar beet root detection feelers and the feelers that identify the position of the machine's wheelbase and the height of protrusion of the sugar beet root crown above the soil surface level. The experimental research was conducted in different beet fields with different yields of sugar beet roots and haulm, different geometry of the field surface and different mechanical-and-physical properties of the soil. Based on the results of the accomplished measurements, it has been established that distribution of height of protrusion has a range of statistical performance variation with the following limits: mean deviation σ = 20-30 mm, mathematical expectation m = 40-60 mm. The developed experimental unit and the field studies performed with its use have provided sufficient grounds for the development of a new system of automated topping height adjustment on state-of-the-art root crop harvesters.

Keywords: sugar beet, harvester, loss, sugar-bearing mass, height of protrusion, statistical distribution

P-031 [Section IV: Energy in Agriculture]
AN APPROACH TO CONVERT WASTE BIOMASS INTO SOLID BIOFUELS USING LOW-TEMPERATURE OXIDATION

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This study aimed to establish a new methodology for upgrading biomass quality using low-temperature (below 100 °C) oxidation to achieve simultaneous drying and decomposition. Sterilized manure (63% wet basis) was heated at 90 °C for 49 days under an oxidative environment. The obtained solid and moisture reduction curves indicated that drying and decomposition proceeded simultaneously. The biomass was decomposed by oxidation with the release of water, carbon dioxide, and volatile fatty acids such as acetic acid. The oxidation process stopped when the biomass was dehydrated, indicating that the water originally present in the biomass governed the process. Elemental and calorific analyses revealed no remarkable increase in carbon content or increased heating value, and a slight decrease in oxygen content. Although the severity of the process was insufficient to produce an optimum solid fuel due to the low temperature used, the process would enable the stabilization of waste biomass with low energy consumption such as using waste heat.

Keywords: Bioenergy, Biomass valorization, Low-temperature oxidation, Waste biomass

P-032 [Section IV: Energy in Agriculture]
INVESTIGATION OF THE QUALITY CHARACTERISTICS OF MIXED PELLETS PREPARED USING AGRICULTURAL RESIDUES

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In this research, hemp stalk, hazelnut husk and rice husk generated from agricultural fields were used directly in neat form and also mixtures of hemp stalk with other materials in different ratios (mix 1: 30 % hemp, mix 2: 50 % hemp and mix 3: 70 %) to make the pellet. Dried hemps stalk, hazelnut husk, rice husk and mixes of these materials having different moisture content were used in the experiment and 6-8 kg of pellets were obtained from 9 different materials. Physical properties such as pellet bulk density, pellet particle density, durability resistance, compressive resistance, shatter resistance, moisture sorption resistance and chemical properties such as moisture content, calorific value, ash content, exhaust gas emissions (O2, CO2, CO, SO2 and NO2) were determined to compare pellet quality characteristics and also elemental analysis of pellets were performed. In addition, all pellets were kept in hermetically sealed vessels under room conditions before test. Cylindrical pellets were produced with a diameter range 6,04-6,09 mm depending on material type and moisture content of raw material. The bulk density and particle density of pellets were found between 511,9 -730,5 kg/m3 and 1137,4-1331,9 kg/m3 depending on material type and moisture content, respectively, and pellet densities were decreased with increasing moisture content. The result of physical tests showed that the produced pellets were quite strong structure and the highest values were obtained in unmixed hazelnut husk and mix 1 pellets, the lowest values were obtained in hemp stalk pellets. When chemical test results of pellets were examined, the best results in terms of calorific value and ash contents were obtained in hemps stalk pellets (4455,3 cal/g - 1,01 %), the lowest results were obtained in rice husk stalk pellets (3810,3 cal/g –16,15 %). According to elemental analysis results of unmixed and mixed pellets, generally carbon, hydrogen and oxygen contents (dry matter basis) varied between 38-55%, 5-6,5% and 32-35,5%, respectively.

Keywords: Biomass, hemp stalk, agricultural residues, pellet, physical, chemical properties

P-033 [Section IV: Energy in Agriculture]
COMPUTATIONAL FLUID DYNAMIC ANALYSIS OF MICROALGAE CULTIVATION POND SYSTEM FOR BIODIESEL PRODUCTION

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As a source of biodiesel, microalgae have high growth efficiency and have a much higher productivity per unit area than conventional grains such as corn and soybean. Microalgae is attractive as a stable third-generation biofuel in terms of the characteristics that cannot be confronted with conventional food crops. Microalgae grow by consuming atmospheric carbon dioxide and aquatic nutrients including nitrogen and phosphorus. One of main public concern in Korea is water eutrophication due to the discharge of many livestock manure. Therefore microalgae cultivation system for biodiesel production is a future-oriented technology that can help to fix carbon dioxide, produce energy, and improve the environment. Microalgae productivity is high when microalgae are cultured under uniform environmental conditions on small scale cultivation system. However, in order to scale up microalgae to a large-scale culture facility, physical and biological problems should to be solved in practical ways due to productivity drop. Although light, carbon dioxide concentration, temperature, and nutrients should be provided uniformly for photosynthesis of microalgae, it is very difficult to secure suitability, uniformity, and stability of growth environment factors in large scale culture facilities. In this study, a 10-ton scale raceway pond was simulated by computational fluid dynamics in order to analyze internal flow pattern in terms of fluid velocity and turbulent characteristics. The possible problems based on the pond cultivation system were investigated. A system for efficiently harvesting microalgae was considered for various structures based on computational fluid dynamics simulation. The proposed structure will be verified through field tests and a method to induce accumulation in a specific area is considered in terms of turbulent characteristics, and microalgae flocculation.

Keywords: Chlorella vulgaris, bioreactor, Growth model, Volume of fluid

P-034 [Section IV: Energy in Agriculture]
ODOUR CHARACTERISTICS AND CONTRIBUTION IN SOLID REFUSE FUEL PRODUCTION PROCESS

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Recognition of the need for alternative energy to reduce environmental pollution and produce energy is increasing in line with government policies. Implementation of the Fundamental Law for recycling of resources has been an opportunity to increase energy production using waste in response to greenhouse gas reduction and climate change. The solid refuse fuel (SRF) manufacturing facility discharges a bad odour related in civil complaints. In this study, the characteristics of the odourous substances were investigated in the SRF production facilities using municipal wastes. The monitoring was conducted for two SRF facilities that produce municipal waste as solid fuel. The odour concentrations were monitored by odour measurement and analysis method in Korean national standard. Odour measurement points were waste storage, machine sorting facility, drying facility, impure storage, and SRF product storage where odour concentrations were considered to be high. As the measurement result, the odour concentration in each process were different according to the characteristics of the municipal waste and the sorting process. There was the high level of odour in the waste storage (1,442 OU, odour unit) and in the dryer (30,000 OU) resulting in over the emission standards of 1,000 OU. As the result of the contribution analysis by process, the odour contributing substances in the waste storage were sulfur compounds (43%), trimethylamine (34%) and aldehydes (20%). Those in the drying facility were trimethylamine (66%), fatty acids (23%) and aldehydes (11%). When choosing a facility to prevent odour, it is necessary to consider the sources for managing odours and technology with high efficiency of removal of trimethylamine and aldehydes.

Keywords: alternative energy, odour management, SRF

P-035 [Section IV: Energy in Agriculture]
LAG-PHASE IN ANAEROBIC DIGESTION OF PROTEIN FOR HIGH-EFFICIENCY BIOGAS PRODUCTION

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Biogas production is influenced by proximate composition (carbohydrate, protein, and fat etc.) and characteristics of the initial organic materials that give significant effects on the decomposition efficiency of the anaerobic organic materials and methane production. Protein and carbohydrate are the macromolecular organic matters which account for more than 60% of the total organic matter. The purpose of this study was to examine the effect of protein on the performance of biogas production. Specifically, the effects of the biogas production and degradation rates of the protein which is one of the proximate composition were investigated, and lag-phase of Diauxic growth was defined. This study was conducted using gelatin as a protein material. Biochemical methane potential tests (BMP tests) were performed at a feed to microorganism ratio(F/M) of five each other levels(0.2. 0.4, 0.6, 0.8, 1.0) under the mesophilic condition. The biogas production patterns, lag phase, VFA/alkalinity and times taken for 90% biogas production (T90) were used for the evaluation of the biogas production with biochemical methane potential(BMP) test. Biogas productions were decreased in the initial 7 days and then showed a lag-phase for several days. The lag-phase might be due to the rapid of volatile fatty acids(VFAs) in the digestion. However, when the VFA in the initial digester is low (less than about 2000 mg/L), the lag-phase recovery seems to be fast. The definition of the initial lag-phase in the anaerobic digestion of proteins could be used as a basic date for studies of the high-efficiency biogas production through minimization of the lag-phase.

Keywords: biogas, proximate composition, anaerobic digestion, lag-phase, protein-based material, BMPs

P-036 [Section IV: Energy in Agriculture]
IS SWITCHGRASS THE NEW GROUND-BREAKING ENERGY CROP FOR BIOFUEL PRODUCTION?

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Researches show that world is already in the peak-oil situation to meet the energy demand which is increasing with the continuous growth. The solution comes with working on renewable energy sources from biomass like bioethanol for the biofuels, which will cause a decrease in the price and dependency of petroleum-based fuels. To supply this demand, rise on the uses of biomass as a raw material like corn, wheat or sugar cane can cause an increase in prices of food and feed industries. Therefore, it is more logical to select biomass types which could only be a feedstock for energy production such as switchgrass. In addition to, the previous researches show that the theoretical ethanol yield of switchgrass is 2-3 times more than corn starch or wheat. Furthermore, switchgrass has the least CO2 emission. Therefore, switchgrass (Panicum virgatum L.) is investigated as a newer source of feedstock to produce bioethanol and another valuable biofuel, biogas. Switchgrass is a perennial warm-season lignocellulosic biomass native to North America which has an impressive high productivity, potentially low requirements for nutrients and water, environmental benefits and multiple uses opportunity.

The production of bioethanol from lignocellulosic biomass includes pretreatments, hydrolysis, and fermentation steps. Enzymatic hydrolysis is a preferring way to upgrade the bioethanol yield but also efficiency of enzymatic hydrolysis is reduced due to limited accessibility of the enzymes to cellulose. For lignocellulosic materials, chemical and physical pretreatments are required to break up lignin bonds and enhance accessibility of enzymes to cellulose and hemicellulose fractions. Because of that, before the enzymatic hydrolysis some pretreatments like physical (grinding, milling, chipping, thermal, hydrothermal) and chemical (usage of acidic, basic and oxidative agents) processes can be applied for higher bioethanol yield. Bioethanol is a high-octane fuel so it's usage in petroleum based-fuels enhance the octane amount in petrol. Higher octane amount gives higher performance for the suitable engines also reduces polluting emissions. The mixing ratio is generally seen as 10% of ethanol and 90% of petroleum (E10).

The purpose of this study briefly can be defined as to review the published papers on the conversion of switchgrass into bioethanol and biomethane via pretreatment and fermentation processes. Also comparison of the results and suggesting the best fitting method for the higher biofuel yield is aimed as well.

Keywords: Bioethanol yield, Fermentation, Pretreatment processes, Switchgras

P-037 [Section IV: Energy in Agriculture]

DETERMINATION OF THE EFFECT OF BORON FERTILIZER AS A NUTRITIONAL SUPPLEMENT IN DIFFERENT GROWTH MEDIUM REGARDING TO ITS POTENTIAL TO BIODIESEL FEEDSTOCK PRODUCTION

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Large-scale production of microalgae is a costly process because of high costs of microalgae feed, artificial lighting and operational costs. Boron tailing is one of the industrial waste materials which contains high amounts of minerals and is considered as a feed source for Chlorella vulgaris. The objective of this research was to determine the effects of boron fertilizer biomass production of Chlorella vulgaris. Chlorella vulgaris was produced in four different growth medium of 1) Blue Green Medium(BG11) Chlorella vulgaris 2) Blue Green Medium(BG11) boron fertilizer (CW) Chlorella vulgaris 3) Bold's Basal Medium (BMM) Chlorella vulgaris and 4) Tap water(TW) Chlorella vulgaris. At the end of the 15-day trial, the highest number of cells, biomass, and proportional fat were tried to be determined. Preliminary studies have been conducted to investigate the potential of boron fertilizer to be used as a food source in the production of chlorella vulgaris.

Keywords: Microalgae, photobioreactor, chlorella vulgaris, boron tailing, biomass

P-038 [Section IV: Energy in Agriculture]
DESIGN, MANUFACTURING AND TESTING OF A TORREFICATION EQUIPMENT TO OBTAIN BIOCOAL

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Carbonization (Torrefaction) which is one of the thermochemical conversion methods is not only an alternative fuel source by the product features but it also provides new job opportunities. In general it is the process of carbonisation of various biomass resources in zero oxygen environment between 220-350 oC. Biochar is obtained from biomass by Carbonization (Torrefaction). The obtained biocoal is cleaner alternative energy source in terms of the energy that is derived from fossil fuels. In this research, in order to produce of better quality biocoal, to realize faster process in controlled conditions chemical and physical torrefaction process feautures are indicated and instead of classical method that is used in bio-coal production, electrically driven biochar machine was worked on so as to maintain mass production. Samples, which are designed for bio-coal experiments, are manufactured, are taken from carbonization device, are analyzed for short periods and the results are compared to the products that are sold in the markets. According to the results of analyses, bio-coal sample that has the highest heating value, which has been obtained from carbonization machine, is the sixth sample having a value 7135 cal/g obtained at 300 oC whereas the product having the least heating value is of 5421,33 cal/g in the second line. Furthermore the sixth number sample, obtained at 300 oC, has outdistanced the home product which is sold commercially speaking with the help of having the rate of ash and moisture. In the samples that are obtained at 220 oC and 300 oC has volatile substance ratio %70-%80, fixed carbon ratios %20-%25. It's been observed in all analyses that calorific value will increase and the ratio of moisture and coal will decrease if applied heating increases. In conclusion, prototype that is formed in the name of bio-coal production has been successful in terms of producing the samples and the quality of the samples. It's degraded the duration of buying the product from 20-40 days (in classical method) to 7-8 munites. Prototype that is open to development and change, it's a leading figüre for research and development areas in the long run and it is expected to contribute into the country's economy.

Keywords: Biocoal, Carbonisation, Energy

P-039 [Section IV: Energy in Agriculture]
A RESEARCH ON THE DETERMINATION OF THE GASIFICATION PERFORMANCE OF GRASS PELLETS

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Gasification is the process of converting hydrocarbon fuels such as coal, petroleum, biomass and solid wastes, which mainly contain carbon, into gases such as CO, H_2, CO_2 and CH_4 by partial oxidation. In this study, pelleted grass was gasified at two different levels, ER = 0.29 and ER = 0.36, and gasification performances were determined. Gasification was carried out in a micro-scale gasification system manufactured in the Department of Biosystems Engineering. During the gasification process, the temperature in the core zone varied between 700-800 °C. The lower heating value of the synthesis gas obtained as a result of gasification was 3831,7 kJ/Nm^3 (ER = 0,29) and 3925,5 kJ/Nm^3 (ER = 0,36), respectively. Biomass feed rates (FCR) were 8,6 kg/h and 6,5 kg/h, respectively. The gas output rates (AFR) were calculated as 10,01 Nm^3/h and 9,23 Nm^3/h. The amounts of syngas produced per unit biomass (GMb) were 1,57 Nm3/kg (ER = 0,29) and 1,96 Nm3/kg (ER = 0,36). The thermal efficiencies in gasification were found to be 39% and 50%, respectively. The performance values obtained by gasification of grass pellets were compared with those obtained by gasification of different biomass in previous studies. According to results obtained by gasification of grass pellets were more suitable than for (ER=0,36) levels.

Keywords: Gasification, biomass, syngas, grass pellet

P-040 [Section IV: Energy in Agriculture]
A STUDY ON SEASONAL ENERGY UTILIZATION INDICES FOR RAW MILK COOLING SYSTEMS

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The goal of this study is to understand of how seasonal electric energy is used by raw milk cooling systems.The seasonal effect of electricity consumption is identified in this study according to Energy Utilization Indıces (EUIs). The study is carried out in a modern raw milk production enterprise in Tekirdağ. The enterprise has 960 milking cows and a cooling capacity of 25000 liters. In order to determine the EUIs values of cooling system, electric energy monitoring system (EEMS) is established, which is including energy analyser, converter, electric panel and current transformer. Data transfer is perfomend wtih connection between the converter and computer. The average electrical energy consumed data are recorded per unit time (15 minutes) by EEMS during summer and winter months. Consequently, this study showed the seasonality of EUIs and energy efficient period is evulated either summer or winter according to the results.

Keywords: Raw Milk, Cooling, Milk Production, Energy, EUI

P-041 [Section IV: Energy in Agriculture]
MATHEMATICAL MODELING OF THIN LAYER FIG FRUITS IN SOLAR TUNNEL DRIER

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In this study, a solar tunnel dryer was designed and improved for studying the drying kinetics of fig fruits. Drying of thin layer fig fruits was studied using a solar tunnel dryer under the ecological conditions of Isparta, Turkey. An experimental solar dryer with a flat plate solar collector has been constructed at the Department of Agricultural Machinery and Technologies Engineering at Suleyman Demirel University. During the drying process, solar irradiation, drying air temperature, relative humidity, and air velocity were measured constantly in different parts of the dryer. The change of fig fruits mass was measured daily. In this study, the fresh fig fruit samples were selected, graded, washed in water and then divided into halves and quarters before dried. The drying characteristic curves were evaluated against ten mathematical models and the Midilli and Kucuk model was found to be the best descriptive model for whole and four divided fig samples except for two divided samples. Verma model equation was also found to be the best descriptive model for two divided samples.

Keywords: Drying characteristics, fig fruits, solar tunnel drier, mathematical modeling

P-042 [Section IV: Energy in Agriculture]

PROVISION OF SOLAR SYSTEM DESIGNING FOR HIGH EFFICIENCY IRRIGATION SYSTEM AND TUNNEL FARMING IN AGRICULTURE SECTOR OF PAKISTAN

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Pakistan is an agricultural country producing five major crops like wheat, cotton, maize, rice and sugarcane alongwith variety of fruits and vegetables. About 70% population of the country is living in rural areas of Pakistan and are associated directly or indirectly with agriculture sector. The GDP and food security of Pakistan is strongly linked with agriculture. Most of agricultural activities are associated with intensive energy consumption and availability of quality water supply. Unfortunately, from the last few years, Pakistan is facing severe energy crises and water deficit in agriculture sector which has resulted huge losses to agriculture sector and its associated agro-industries. The excessive ground water pumping for agriculture sector is also threating which is depleting natural water reserves. In order to cope with this arising issue, the Government has taken some serious initiatives to promote sustainability in agriculture sector. In this regard, the Government of the Punjab has announced PKR 100 billion for agriculture and rural development. One of the objective of this program is to provide subsidies to the farmers on solar PV system, high efficiency irrigation system and tunnel farming. The government is providing 60% subsidy on drip irrigation system, 50% subsidy on tunnel farming and 80% subsidy on solar PV system to promote green and renewable energy in agriculture sector. This is a great initiative of the Government to revamp the agriculture sector of the country. In the first phase, the solar system coupled with HEIS will be installed on 20,000 acres in different districts of the Punjab. In order to ensure the use of solar energy only for drip irrigation, the maximum limit for provision of solar system is 10hp centrifugal or submersible pump. During 2017-2018, the solar systems have been installed successfully on an area of 5000 acres. The walk-in tunnel system is also installed to on HEIS to grow cucumber, chilli, tomato and other vegetables to promote highly profitable business for the farmers. In order to design a solar system coupled with HEIS, a user-friendly design software has been developed in order to ensure that the crop water requirement is successfully met throughout the cropping season. The design approval is provided only after simulation passes and ensuring that daily, monthly and yearly water requirement of the crop is met successfully. During the field testing and monitoring of the system for its proper functioning, the successful results have been achieved.

Keywords: Agriculture Sector, Renewable Energy, Solar PV, HEIS, Subsidy.

P-043 [Section IV: Energy in Agriculture]

EVALUATION OF POMEGRANATE CULTIVATION FROM ENERGY PRODUCTION AND ENVIRONMENTAL ASPECTS IN ANTALYA PROVINCE OF TURKEY

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Pomegranate cultivation has been popular particularly in recent years in Turkey. Pomegranate cultivation area increased 13.4% annually in the last decade. In the same period Antalya where research was conducted climbed from the tenth place to the top among provinces in pomegranate production in Turkey. The aims of this study are (1) investigating the input-output energy balances and to determine the scale effect, (2) calculating GHG emission of pomegranate production that contributes to climate change mitigation efforts, (3) specifying a relationship between input and output energies, in addition to specifying functional analysis of the energy inputs on pomegranate production in Antalya, Turkey. The data used in the study are obtained from 75 farms by face-to-face interview method. The differences among the estimated mean values of the energy inputs, outputs per hectare, and the energy efficiency and productivity ratios by groups are also statistically tested in the study. The characteristic structure of pomegranate cultivation in the research area is small family farming. The average pomegranate garden size was calculated as 0.21 hectares and average pomegranate yield was found 19696.8 kg per hectare in the surveyed farms. The results indicated that 50605.5 MJ ha-1 of total energy input is required for 76252.3 MG ha-1 pomegranate energy output. 1.51 unit energy output was provided by using 1 unit energy input. 1 unit energy output and 1 kg pomegranate require 0.66 unit and 2.57 MJ energy input, respectively. The average CO2 emission amount is also calculated to be 1.73 t CO2 per hectare and 88.1 kg CO2 per 1000 kg pomegranate production. Parallel to total energy input use, the CO2 emission decreases as farm size increases, with the smallest amounts of CO2 emission on large farms. Electricity, fertilizers and pesticides are the highest contributors to GHG emissions. Both total energy input usage and GHG emission amounts have been found to be decreasing as the farm size increases. Increasing scale of pomegranates orchards will not only increase energy efficiency and productivity but also will decrease environmental pollution and damages. The regression analysis revealed that, excessive use of machinery and fuel inputs result in a decline in energy production in pomegranate.

Keywords: Energy analysis, Energy productivity, Greenhouse gases, Energy production function, Pomegranate.

P-044 [Section V: System Management]
TIME RESPONSE STUDY OF ELECTROMAGNETIC DRIVEN VRT VALVES FOR VARIABLE RATE SPRAYING SYSTEM IMPROVEMENT

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The invariant distribution of herbicides makes it possible to treat weed free areas, areas with low weed density and high weed density areas the same. One of the main defects of overusing herbicides is transfer of these chemicals to food through the soil, causing dangerous diseases such as cancer in humans. Variable rate spraying systems which are currently used in the world do not have satisfactory efficiency in Duty cycles of less than 20% due to pressure variations and therefore variations in particle diameter. As a result, the range of spraying changes gets limited. For investigating the mentioned points, a variable rate spraying system was firstly created by using the PWM method and then diagrams of response time of valve is obtained via an oscilloscope. By studying the output circuit response, it was determined that the voltage did not immediately reach a specified value and the valve open with a delay time. So before the valve is completely opened, the time set for the valve to be opened by the duty cycle is over and it is closed, thus it results in the pressure changes in the lower duty cycles. It is indicated that the reason is decreasing of the average voltage level and the response time of the valve circuit. In the current study, in order to increase the range of spraying, instead of a voltage of 12 volts, high voltages were used. If the voltage rises, the time to reach the specified working voltage will decrease, so the valve will open earlier. By exploring the response time of the valve, it was found that if high frequencies are used, the time between successive openings will decrease. As a result, the pressure changes of the lower duty cycles will reduce, consequently the number of winding coil per unit of length decreased. Unfortunately, this has a reverse effect on electromagnetic power. For fulfilling the both effects, the length of the winding core increased, and simultaneously the number of rounds was kept constant, the ratio of the round per unit of length was reduced. 20% of the diameter of the wire was reduced to increase the resistance value. The experiments showed that simultaneous changing the frequency (15 Hz) and raising the voltage in lower duty cycles can reduce the duty cycle to 5% without effective decreasing in pressure.

Keywords: Variable rate spraying, Duty cycle, Response time, Herbicides

P-045 [Section V: System Management]

DATABASE OF TRACTION INDICATORS OF DOMESTIC AND FOREIGN TRACTORS FOR OECD AND ISO SYSTEMS

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Scientific object: Now days there are more than one hundred models of imported tractors on the Russian market, it makes necessary to consider their characteristics. These characteristics would be obtained under comparable conditions, on the one hand, and would allow us to evaluate the efficiency of using these models in specific national conditions at the same time. Traction indicators of agricultural tractors should be included in list of such characteristics. To evaluating this situation, it is necessary to analyze two test systems for tractors, which can be named one as European, based on ISO standards, and the second, internationally recognized, based on "OECD standard codes for the official testing of agricultural and forestry tractor CODE 2». Research aim: Aim of developing database of traction indicators of agricultural tractors is use for harmonizing two systems ISO and OECD standards, as well as for predicting the performance of MTAs with foreign tractors in Russia's economic conditions. Methods: We use methods of the collection of data, systematization, the formation of databases, computer processing and development of database management software. Results of research: We have been developed method for adapting the technical characteristics of agricultural tractors according to the standards of organization for economic co-operation and development (OECD) to the Russian classification indicators of agricultural tractors. We created the database "Traction indicators of national and foreign tractors determined by International (ISO) and OECD standards with maximum engine performance", which contained five information blocks and a control unit, which allow to implement a number of information requests (on the operational weight, on the maximum traction power, etc.). Conclusions 1. Method has been developed for harmonizing the traction indicators of domestic and foreign tractors, which for the first time presents an agreed assessment of their characteristics according to the CODE 2 of OECD standard on concrete and according to the International Standard GOST 30745-2001 (ISO 789-9-90) on stubble classified according to traction classes in accordance with GOST 27021.
2. A database of the results of traction calculations carried out according to ISO and OECD standards, obtained by theoretical and experimental methods, was developed.
3. The classification of technical equipment according to traction classes allows us to recommend to rational using of foreign tractors in accordance with the traction classes listed in the Russian System of Machines and Technologies.

Keywords: rolling resistance coefficient, agricultural tractor, database, traction tests, matching technique, background.

P-046 [Section V: System Management]
FOREIGN BODY DETECTION APPROACHES IN FOOD AND BEVERAGE PRODUCTS

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Foreign bodies (FBs) are the biggest single source of customer complaints for many food manufacturers, retailers and enforcement authorities; so foreign bodies are quite rightly a matter of concern to all food manufacturers and retailers. They mostly include pests, metal, glass, plastic pieces, bone etc. However they may be a healthy eating and drinking but are not main product such existing a bean in canned tomato paste. To prevent any potential harm to consumers and also brand reputation and maintain consumer's confidence, it is necessary for food industries that all foreign bodies are detected and removed from food products before they reach the consumers. In this work, we evaluate and discuss about using different approaches for detection of foreign bodies. There are many non-destructive methods to detect them ranging from simple to complex which the most important of them are include optical, microwave reflectance, nuclear magnetic resonance imaging, electrical, ultrasound, X-rays etc. The objective of this work was summarizing the mentioned approaches to food quality assurance with respect to foreign body detection. Each mentioned methods and technologies come with their own strengths and weaknesses and in this work we compromise between these approaches.

Keywords: foreign body detection, food safety, FB, non-destructive, food quality

P-047 [Section V: System Management]
THE TURKISH REPUBLIC OF NORTHERN CYPRUS IN AGRICULTURAL MARKETS AND COOPERATIVITY

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The Turkish Republic of Northern Cyprus is an island country. The agriculture sector maintains and continues to be an important sector in the country's economy. The country, under the influence of typical Mediterranean climate, has frequent droughts. The country is dominated by small family businesses and climate limits the diverse production. Due to the drought, there is a high rate of change in crop production. The share of agricultural production in the GNP is also highly variable, depending on this change. The share of agriculture in GNP has declined in recent years to 6% as of 2016. Approximately 12,000 families are involved in the agricultural sector. Approximately 4% of the country's registered employment is in the agricultural sector. The most important commodity group of foreign exports is citrus and dairy products. The country's share of the export value of agricultural products was 73% in 2016. In the country, the agricultural industry is not sufficiently developed. Chemical fertilizers, pesticides and feed raw material with canned food, wheat and sunflower are supplied through import. Problems encountered in exports and the narrowness of the domestic market create problems in the marketing of agricultural products. To overcome these problems, barley, potatoes and raw milk are purchased by state-owned enterprises. The price determinants of the products bought in these institutions are political power. Price policy is to find solutions to short-term worries, usually consist of high price support measures for producers. It is one of the important actors of the cooperatives market in supplying agricultural inputs and financing. Almost every village has a cooperative. The most important activity of cooperatives is to supply chemical fertilizers. Approximately 60% of the country's fertilizer consumption is provided by cooperatives. Supply of inputs through imports the cost of agricultural production in the Turkish Republic of Northern Cyprus is rising. The small size of the business, the higher the cost of financing and the low efficiency level increase the costs. The high intervention purchase prices are leading to competition in foreign markets and high food prices in the domestic market. In this study; the market structure and cooperatives of the agricultural sector in the Turkish Republic of Northern Cyprus will be examined. In addition, analyzes on the trade of agricultural products will be made.

Keywords: s; cooperative, agricultural business, agricultural products market, import export

P-048 [Section V: System Management]
DETECTION OF FOREIGN BODIES IN PROCESSED FOOD AND BEVERAGE BY MEANS OF ULTRASOUND

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Detection of foreign bodies (FBs) in food and drinking products play an important role in quality assurance and customer satisfaction. Of course, at first of all, accordance with some principles such as HACCP, manufacturers should prevent the entry of any foreign objects into packaging in production lines. There are many approaches to detect and identification of foreign bodies which each one has advantages and disadvantages. However ultrasound-based measurement ways, have showed potential in various food processing applications, such as concentration gauging, flow measurement, level detection, food shelf life monitoring, food properties assessment and FBs detection. The basis of ultrasound diagnosis and FBs detection is transmitting ultrasound waves to tested canned food and beverage with specific frequency and power, then returned signals processing and analyzing. Ultrasound is non-destructive and does not spoil foods physically or hygienically. Ultrasound approach can be very useful when other approaches such optical approach is not possible. In this work, we investigated the advantages, disadvantages and applications of the ultrasonic method in identifying foreign bodies in food and beverage in production lines. The approach demonstrates that ultrasound has potential for application in many industrial food and beverage packaging environments where foreign bodies need to be detected.

Keywords: foreign body detection, food safety, FBs, non-destructive, ultrasound

P-049 [Section V: System Management]
EXAMINATION OF THE COGENERATION SYSTEM IN TERMS OF ENERGY SAVING IN A PUBLIC HOSPITAL

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In this study, energy analysis of a cogeneration facility that is being thought to be built in a 983 bed capacity hospital that occupies a 218 thousand m2 of covered area in Antalya, Turkey. This study examined the electricity and natural gas consumption of the hospital for one year. The selection of the appropriate equipment and the parameters to be attended by the proposed system has been determined in this study As a result of the study, the maximum electricity and heat energy can be generated from the cogeneration plant. This system uses gas engine with the engine's power consumption of 2000 kW and mechanical power of 2056 kW. This engine has a fuel consumption of 4577 kW (+5%), exhaust temperature of 972 kW (±8%), jacket water temperature of 1040 kW (±8%), intercooler heat output of 142 kW (±8%).The electricity efficiency obtained by this engine is estimated as 43.70%, the thermal efficiency is 47.06% and the total efficiency is 90.76%.

Keywords: Energy, energy saving, renewable energy, hospital, cogeneration system

P-050 [Section V: System Management]
ANNOYING FREQUENCY DETERMINING FOR LAODELPHA STRIATELLUS FALLEN PEST

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Pests cause considerable damages in crops and store-products yearly. According to audible frequencies for each pest and changing of them, it can be attempted to control pest. Achieving this target will be possible with some specific devices and methods. The aim of this study was annoying frequency determining for Laodelphax striatellus fallen which is destructive pest in rice, wheat, barley etc. fields. In this study, an ultrasound transmitter electronic system was designed and constructed. The system included 5 transmitters and was capable to transmit ultrasound waves from 15 to 100 kHz. Transmitters had clockwise and counter clockwise rotary motion by a step motor. Experiments were done on L. striatellus pest in laboratory conditions and the percentage of repelled pests from wave source, were calculated and analyzed. Experiments were done in five different frequencies and two different periods, 5 and 20 hours, in three replicates. Results showed that repellency effects of 30 and 35 kHz frequencies have significant differences (P<5%) with other frequencies, decreasing frequency from 30 kHz or increasing from 35 kHz, caused loses in percentage of repelling. Also, there was significant difference (P<1%) between 5 and 20 hours experiments. It can be concluded that L. Striatellus Fallen pest is controllable by means of ultrasound waves effectively and practical precedures should be used in fields and greenhouses to control them.

Keywords: Repellency, Pest, Laodelpha striatellus, Ultrasound, Frequency

P-051 [Section V: System Management]
STUDY OF THE DRYING PROCESS FOR MEDICINAL HERBS

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The aim of the research was to study the drying process of medicinal herbs such as laurel, sage and rosemary, in a oven and to determine the time required to obtain them as a finished product ready for commercialization. Since no data were found on the sizing of drying plants in the literature, we intend to provide a contribution aimed at defining the fresh biomass density to be adopted inside the oven to achieve a preliminary design of the plant. The results obtained indicate that the optimal density of fresh biomass to be inserted inside the oven is 3 kg / m2 for all the species examined. Considering that this density has an overall height equal to 0.10 m and that there must be a light between the different layers of the herbs equal to three times the height of the biomass space (0.30 m) in order to ensure a good forced ventilation, the useful volume (net of service lanes and technical spaces) necessary for the drying of 3 kg of fresh product is 1.2 m3. The useful volume of 1.2 m3 referred to a fresh biomass density of 3 kg / m2 allows to define a preliminary design of the drying plant according to the annual quantity of fresh product obtainable in the farm.

Keywords: laurel, rosemary, sage, oven drying

P-052 [Section V: System Management]

ANALYSIS OF ALMOND AND VINE PLANTS VEGETATIVE CHARACTERISTICS TO DESIGN A COMPACT ORCHARD TRACTOR EQUIPPED WITH A FIXED ROPS (ROLLING OVER PROTECTIVE STRUCTURE)

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The first step of the study concerned a survey on the use of safety systems for tractors in order to identify their critical issues causing injuries to the operators driving the machines while performing crop operations. This survey showed that tractor overturning is the first cause of serious, often fatal, accidents in agriculture. Overturning is caused by different factors and the injuries severity is often due to the absence, or non-use, of protection (ROPS, Rolling Over Protective Structure; FOPS, Falling Object Protective Structures) and operator retention systems (safety belts). The protective structure, in combination with a regularly fastened safety belt, retains the driver and protects him from the risk of crushing in case of overturning. Orchard and vineyard farms are the most exposed to this risk because they generally use narrow-track tractors equipped with two post roll-bar that can be lowered to facilitate the vehicle passage under the trees. Unfortunately, very often these roll-bars are not vertically repositioned after being tilted, neutralizing their protective function. The aim of the research was to define the vegetative structure of almond and vine plants, in order to design a compact orchard tractor equipped with a fixed ROPS. The research is part of the Italian TRACLAS project funded by INAIL (National Insurance Institute for Occupational Accidents) involving the Universities of Palermo, Milan, Bari, Tuscia and CREA-ING of Treviglio. The surveys carried out in a sample of almond and vineyard farms allowed to define the cultivation parameters that will be used to design the compact orchard tractor prototype equipped with a fixed ROPS.

Keywords: Orchard, Overturnig, Safety, Tractor

P-053 [Section VI: Bioprocesses]

THE GAS EXCHANGE MODELING OF PURGE-TYPE OF CONTROLLED ATMOSPHERE STORAGE SYSTEM

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The O2 and CO2 concentrations inside controlled atmosphere (CA) storage rooms are determined by the respiration of the apples and the airtightness of the CA room. The gas in the CA room is controlled by O2 removal, CO2 removal, the CO2 increase and O2 decrease by respiration of the apples. The purpose of this study was to evaluate the validity of the gas exchange models for O2 removal, CO2 removal and the rate of O2 decrease and CO2 increase by respiration of apples and airtightness of CA room. It took 17.5 hours to reduce O2 concentration from 20.9% to 2.0% after loading 4.3 tons of Fuji apples into the CA room, which was 4.2 hours longer than the 13.3 hours of the model formula. After the CO2 concentration rose to 0.5% by the respiration of the apple, it took 4.7 hours to lower the CO2 concentration to 0.2%, which was 0.6 hours longer than that of model equation. The rate of CO2 increase by respiration of apple was 0.021%/h, which was not much different from 0.017%/h of model equation. At this time, the O2 concentration also decreased by 0.1%, which was similar to 0.13% of the model equation. The results of this study can be used in the design of the purge type of CA storage system, which is first introduced in Korea.

Keywords: Controlled atmosphere storage, gas exchange modeling, oxygen removal, carbon dioxide removal

P-054 [Section VI: Bioprocesses]
EVIDENCE OF SULFIDE OXIDATION IN MANURE SURFACE

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Emission of hydrogen sulfide from livestock production can be harmful to the environment, human health, and cause corrosive damage to pipeline systems. Hydrogen sulfide in livestock waste is produced primarily by sulfate reducing bacteria and consumed again by sulfide oxidizing bacteria or by means of chemical oxidation. Aeration of manure is one way of increasing the sulfide oxidation rate, but it is not clear whether these processes occur solely in the surface or also in the bulk manure. Furthermore, the reaction kinetics and adaptation to aerobic/anaerobic environments have not been thoroughly described in livestock wastes. In this study we used PTR-MS and oxygen micro sensors to obtain detailed, high time resolution information about sulfide oxidation and how it is controlled in the surface film of swine manure. By periodically alternating between flushing nitrogen or air through the headspace of batch reactors containing swine manure, a high-resolution emission profile was obtained from, which the half-life of sulfide was estimated to 1.5 min and the total sulfide oxidation rate was 1.21±0.02 mmol•L manure-1 h-1. When inhibiting biological sulfide oxidation with microbial inhibitors, the half-life increased to 5 minutes. Furthermore, repeated alternations between nitrogen and air in the headspace resulted in a half-life periods of down to 1 min for both sulfide in the gasphase and oxygen in the manure surface layer. Oxygen concentration profiles revealed a completely anoxic environment 200 µm below the manure surface and that oxygen consumption rates matched the half-life of sulfide in the gas phase. Supplementation of 5 mM Fe+2 reduced sulfide emission by 80-90 % suggesting chemical oxidation strongly depended on the presence of a metallic catalyst. Therefore, the study indicated that biological sulfide oxidation in the surface layer controlled the emission of sulfide from the swine manure.

Keywords: Sulfide, Oxidation, Kinetics, Manure, PTR-MS, Micro sensor

P-055 [Section VI: Bioprocesses]
QUALITY INDICES, BIOACTIVE CONTENT, FATTY ACID COMPOSITION AND STABILITY OF POMEGRANATE KERNEL OIL

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Pomegranate fruit has extensively been exploited by processors and nutritionists due to its health benefits. However, very little emphasis is focussed on the utilisation of waste generated during processing. This study investigated the value adding potential of pomegranate fruit with special interest on pomegranate kernel oil (PKO). Effects of extraction solvents namely; n-hexane, petroleum ether and acetone on the yield, quality attributes and fatty acid profile, as well as functional properties of PKO obtained from three commercially grown pomegranate cultivars were examined. The stability of PKO stored at 25°C and 60°C was also studied. The yield of PKO ranged between 16.59 – 27.39% and was in the order 'Acco' > 'Herskovitz' > 'Wonderful', regardless of extraction solvent. PKO extracted with acetone had the least yellow colour and high contents of phenolics, tocol, linolenic acids and para-anisidine value. Punicic acid was the predominant fatty acid (59.90 – 69.85%) in PKO investigated. However, punicic acid content varied with extraction solvents, in the order petroleum ether > n-hexane > acetone. All investigated PKO showed good radical scavenging activity (89.50 – 91.60%). Moreover, storage temperature of PKO affected its quality attributes and functional properties. PKO stored at 60°C contained higher levels of conjugated dienes and trienes and para-anisidine value compared with those stored at 25°C. Furthermore, there was a remarkable reduction in punicic acid and increment in α- and γ-linolenic acids in PKO stored at 60°C. Nonetheless, the low values of index of atherogenicity (0.04 – 0.05) and thrombogenicity (0.02 – 0.04) of PKO stored for 30 days indicated that the oil may still be safe for consumption, regardless of 25°C or 60°C storage temperature. This study provided basis for exploration of pomegranate oil for commercial applications in food, nutraceutical and cosmeceutical industries.

Keywords: Antioxidant, para-Anisidine, Pomegranate, Punicic acid, Ultrasonication

P-056 [Section VI: Bioprocesses]
AGRICULTURAL BIORESOURCES AND BIOFABRICATION AS AN ENABLING STRATEGY FOR AGRICULTURAL AND BIOLOGICAL APPLICATIONS

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Agricultural bioresources have usually been regarded as waste and overlooked. However, they are being recognized as emerging functional platforms with micro- and nanotechnologies that can find applications in engineering fields. In particular, biofabrication-based agricultural bioresource platforms is now being highlighted in agricultural and biological engineering for improving functions of living systems such as animals, plants, and humans. In this work, we will present multidisciplinary efforts directed towards the development of agricultural bioresources-based micro- and nanoengineered platforms for biological and agricultural applications. Specifically, we will present about i) our current efforts on developing a series of agricultural bioresources-based engineering platforms inspired by the unique architectures of native tissues and cellular environments, and ii) their applications for better understanding of the function of living cells (e.g., tissue regeneration of animal and human tissues, and plant growth) as well as for development of advanced engineering devices for agricultural engineering (e.g., active targeted delivery platforms for controlled delivery of agriculture pesticides and biocontrol agents). Finally, iii) we will present opinions on the principal challenges and future prospects for the use of new agricultural bioresources-based engineering platforms for agricultural and biological applications.

Keywords: Agricultural bioresources, biofabrication, micro- and nanotechnology, Engineering platforms

P-057 [Section VI: Bioprocesses]

EPR MEDIATED STUDY OF SHELF LIFE OF PUMPKIN AND SUNFLOWERS SEEDS ROASTED IN MICROWAVE-VACUUM ROASTER

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Introduction. Roasting high fat content (HFC) seeds is commonly encountered practice in food processing. This process is used to improve the nutritional properties, taste, texture, color and aroma of the final product. The roasting process improves the general acceptance of the product. The roasting process can be carried out in convection ovens that use resistance or induction sets to generate heat. Another technology for roasting the fresh seeds is the use of microwave radiation in conjunction with the lowered pressure in the roaster. The heating of HFC-seeds engenders the risk of accelerating the fats oxidation processes, especially from the group of unsaturated compounds. The fat oxidation process is a sequence of reactions beginning with the formation of free radicals. The amount of these free radicals, once quantified, can be used as indicator of method and process suitability for HFC-seed roasting. The free radicals concentration can be estimated by means of electron paramagnetic resonance spectroscopy (EPR), which in turn can be used for comparison of different technologies used for HFC-seed roasting.

Objective and Methods. The research materials used in this study were sunflower seeds and pumpkin seeds, roasted in a microwave-vacuum oven and in a traditional convection oven (treatment time 2, 5, 7, and 10 minutes). Heat-treated seeds were packed in hermetic packaging made of metallic foil. The weight of each sample was 100 g. The samples were placed in two controlled-climate chambers at 20 and 40 degrees Celsius. At weekly intervals, one package of each package of the research material was picked out from the climatic chamber. The EPR spectra were measured in a 335 MT induction magnetic field. The frequency of the electromagnetic wave was 9.55GHz, frequency modulation f = 100 kHz. Radiation with such parameters is appropriate for studying the concentration of free radicals. In addition to it, examination of the level of rancidity of seeds was done using a sensory panel.

Conclusions. The studies show significant smaller changes in the amplitude of the spectrum of the EPR signal, in the case of the microwave-vacuum treated seeds as compared to the seeds treated in traditional convection oven. Irradiation of the samples with microwaves significantly slowed the formation of free radicals in the samples. Due to the correlation of the amount of free radicals and the degree of oxidation of fat, this treatment can be recommended as influencing the extension of durability of the tested products. Pumpkin seeds have a higher durability onto the oxidation process than the tested sunflower seeds. One of the reasons may be longer exposure time to microwave radiation, despite similar process temperature as in the case of sunflower seeds. Based on our observations in EPR spectra of microwave and convection oven roasted seeds, it can be concluded that microwave –vacuum roasted technology offers a better alternate to the traditional convection roasting technology, especially in the case of HFC seeds.

Keywords: pumpkin seeds, sunflower seeds, microwave roasting, shelf life

P-058 [Section VI: Bioprocesses]
MICROBIAL DECOMPOSITION OF DEER CARCASSES USING COMPOSTING PROCESS

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Due to uncontrolled populations of wild herbivorous deer in Hokkaido island, Japan, the agricultural and forestry products received some significant damages. This issue cannot be overlooked as the damage amount reached about 6 billion yen (5.3 million US$) in a year and 1818 cases of deer-related traffic accidents recorded in 2013. In addition, the deer sometime overrun in urban areas, which are not their proper habitat. In order to continue the coexistence of human being with wild animals, controlling of the deer populations by hunting is a necessary solution. Since many deer carcasses are generated by hunting, it will be required to establish carcasses treatment system with low environmental burden. For this, we have determined the microbial decomposition characteristics of deer carcasses by using dairy cattle manure compost bed that provides a lot of microbes for biodegradation.

The compost was used as microbial agent to decompose deer carcasses degradation. The compost was produced by mechanical agitation for 6 months at a farm. The portion of deer lean meat, fat and stomach contents were separately used as experimental materials. This is due to different decomposition rate of each portion of deer carcass during our preliminary experiments. The compost was placed at the bottom of six-litter volume reactor vessel and the experimental material was put on the compost. Finally, the compost was covered again on the experimental materials to envelope the material completely, which can enhance microbial decomposition. Then, the vessel was ventilated to accelerate microbial decomposition. The material temperature, oxygen concentration and carbon dioxide concentration in the exhaust gas were automatically measured every 5 minutes. Ammonia concentration in the exhaust gas was also measured twice a day with gas detector tube system.

The lean meat was decomposed 60 to 70% by the 17th day, while the stomach contents was about 30% even after one month. Ammonia was produced from the lean meat and remarkably emitted more than when dairy cattle manure was composted. As most of the stomach contents are herbaceous, the amount of ammonia generated was significantly lower than that of lean meat.

Keywords: deer carcass, decomposition, compost bed, meat, stomach contents

P-061 [Section VI: Bioprocesses]
EFFECT OF ULTRASOUND PRE-TREATMENT ON BREWING TIME OF TWO TYPES OF TEA

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Tea (Camellia sinensis) is one of the most common beverages in the world and Iran after drinking water. Therefore, quality improvement of that, can have an important effect on people's health. So far, much research have been done related to quality improvement of tea. One of the most important quality factors of tea is brew quality and consequently its color. The aim of this study was to evaluate the effect of powered ultrasound pre-treatment method on the brewing quality of "Camellia sinensis var. assamica" and "Kenya C.T.C. Camellia sinensis var. assamica ". One MHz ultrasonic waves were used to achieve this goal. Dried tea samples were treated by the waves at 4 different time intervals (10, 20, 30 and 40 seconds) inside the water at room temperature. Treated samples were dried naturally to reach the initial moisture content (before treatment). Then the dried samples were brewed at 1, 2, 3 and 4 minute intervals and taken pictures were compared with the control sample. Color quality comparison of samples were done by extracting and evaluating the color component (RGB) using MATLAB-R2011b software. The results were analyzed using SPSS-16 software. The results showed that 20 seconds pre-treating with ultrasound waves and then brewing for 2 minutes, was the best treatment for brewing quality. Also the results revealed that in terms of color quality of brewed samples there was no significant difference between the treatments. In addition the lowest color quality was for 40 seconds treatment.

Keywords: Camellia sinensis, tea, ultrasound, quality

P-062 [Section VI: Bioprocesses]

FRESH MINAS PROBIOTIC CHEESE PROCESSED BY HIGH HYDROSTATIC PRESSURE: VIABILITY OF PROBIOTIC AND SPOILAGE MICRORGANISMS

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Probiotic bacteria are applied to cheese to confer benefits to the consumer health and provides market differentiation to the product. High Hydrostatic Pressure (HHP) can be applied to fresh cheese aiming at inactivating pathogenic or spoilage microorganisms and extending shelf life. This work has as objective the selection of probiotic bacteria and HHP process conditions to enhance the preservation of Minas Frescal cheese besides maintaining probiotic viability. Miniature cheeses were used to carry out laboratory analyses, thus allowing better control of cheese preparation. The probiotic cultures used were Bifidobacterium animalis subsp. lactis BCL1 (SACCO, Italy), Lactobacillus acidophilus LA-5 (Chr. Hansen, Denmark) and Lactobacillus ramnhosus BRM038563 (Embrapa Goat and Sheep culture collection, Brazil). Analyzes were carried out to evaluate the effect of two different combinations of pressure and processing time (200 MPa/5 min. or 350 MPa/5 min.) on the characteristics of cheese and on the viability of probiotic cultures throughout the refrigerated storage (5°C). BLC1 was selected from initial studies for presenting satisfactory levels of microbial counts during cheese storage, besides being more viable when submitted to the HHP than the other probiotics, without negatively affecting physicochemical characteristics of the cheese. No Salmonella sp, Staphylococcus aureus and Coliforms 45 °C were detected in the samples. After 28 days of storage, the control (not pressurized) presented 4.43 Log CFU/g of psychrotrophics, while cheese processed at 200 MPa/5 min resulted in 3.81 Log CFU/g and in 1.49 Log CFU/g at 350 MPa/5 min. Regarding Bifidobacterium ssp lactis viability, cheeses processed at 200 MPa/5 min and 350 MPa/5 min resulted in 7.38 and 6.26 log CFU/g, respectively, while the non-pressurized control presented 8.13 Log CFU/g. Up to 28 days of storage, there was a reduction of less than 2 Log in all treatments, reaching 6.98 Log CFU/g for Control, 5.93 Log CFU/g for 200 MPa/5 min. and 4.52 Log CFU/g for 350 MPa/5min. No significant differences were observed ($p>0.05$) for moisture, pH and total acidity. HHP was able to inhibit the growth of spoilage microorganisms, maintaining a relevant concentration of probiotics throughout the Minas Frescal cheese storage.

Keywords: Minas Frescal cheese, Probiotics, High Hydrostatic Pressure

P-065 [Section VI: Bioprocesses]

PHYSICO-TEXTURAL AND NUTRITIONAL PROPERTIES OF POMEGRANATE KERNEL AND ARIL AS AFFECTED BY DRYING

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The purpose of this study was to explore the value adding potential of pomegranate kernels and arils of three commercially grown pomegranate cultivars (Wonderful, Acco and Herskovitz). The physical and textural properties of fresh and dried pomegranate aril and kernel extracted form 'Wonderful', 'Acco' and 'Herskovitz' fruits were examined. Following that, the drying kinetics of the aril and kernel were also studied. The nutritional properties of kernel of the three pomegranate cultivars were also investigated. All investigated physical properties of the kernels decreased after drying except for kernel index and shape index which increased from 10.83 – 15.19% to 22.13 – 24.60% and 2.16 – 2.34 to 2.22 – 2.33, respectively. The compressibility properties of kernels of 'Wonderful' and 'Herskovitz' also increased after drying. On the contrary, the hardness, toughness and bioyield of kernels of 'Acco' decreased from 182.00 to 156.04 N, 130.75 to 95.33 N mm and 26.43 to 22.82 N, respectively, after drying. Among the fresh kernels, cv. Acco was the hardest, although dried kernels of 'Wonderful' and 'Herskovitz' were harder than those of 'Acco'. Drying kinetics revealed that pomegranate kernels dried faster than the arils and drying beyond 12 h (for kernels) and 24 h (for arils) influenced the physical and textural properties of both arils and kernels. According to the proximate compositions, 'Acco' kernels contained the highest yield of oil (27.39%), proteins (18.73%), energy (1655.60 kJ/100 g), moisture (0.24%), ash (3.55%) and dietary minerals. However, 'Wonderful' and 'Herskovitz' had the highest contents of carbohydrate (30.65%) and dietary fibre (36.48%), respectively. Overall, the mineral compositions in pomegranate kernels were in the order of Nitrogen > Potassium > Phosphorus > Magnesium > Calcium > Sodium > Iron > Zinc > Copper > Manganese > Boron and these were within the recommended daily allowance ranges proposed by the European Union and United States of America. This study provides important information on the processing of pomegranate aril and kernel. Furthermore, the research findings suggest that pomegranate kernels could contribute substantially to human dietary nutrition, hence the need to explore their utilisation in food systems.

Keywords: Dietary fibre, Hardness, Mineral analysis, Proximate composition, Value-addition

P-066 [Section VI: Bioprocesses]

UNDERSTANDING THE IMPACT OF HEAT-MOISTURE TREATMENT ON THE PROPERTIES OF RICE FLOUR USING RESPONSE SURFACE METHODOLOGY

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Currently, rice flours have been utilized in the production of novel and traditional food products such as infant foods, puffed grains and gluten free products. However, rice flour, in its native form, has limited application in the industry due to negative aspects of the flour such as poor resistance to shear force and low elastic gel forming properties. Today's market has therefore seen a surge in the demand of modified flours required to meet the versatile demand of the growing industry. In this study, flours from selected non-waxy rice grain source (with 20, 30 and 35% moisture content) were exposed to heat-moisture treatment (HMT) at 85, 100, and 115 °C for 1, 2 and 3 h in order to explore whether there were variations in their susceptibility to modification by HMT and, if any, to evaluate the main reasons of the variations. In order to describe the relationship between the dependent and independent variables (moisture, time and temperature), the response values were fitted by second order polynomial models. Overall, response surface methodology (RSM) analysis showed that the effect of moisture, time and temperature on the physicochemical, thermal and rheological properties of the modified flour samples were significant ($p < 0.05$).

Keywords: Flour, HMT, RSM, Rheology, Modification

P-067 [Section VI: Bioprocesses]
EFFECT OF PRESSURE AND TEMPERATURE LEVEL ON NUTRIENT ELEMENTS IN MILK POWDER PRODUCTION

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In this study, full fat cow milk was dried at combinations of 30 and 75 kPa pressure and 120, 130, 140, 150, 160, 170, 180, 190 and 200°C inlet temperature conditions using a spray drying system. At different pressure and temperature combinations, amount of potassium, calcium, magnesium, sodium, iron, copper, zinc, manganese and boron in milk powder were measured. At 200°C inlet temperature and 75 kPa pressure combination, iron, copper and manganese were measured at the highest levels with value of 31.69, 1.91 and 0.92 ppm, respectively. Also, the combination of 150°C-30 kPa level, potassium and manganese were determined at the highest levels with the value of 5997.31 and 681.77 ppm, respectively. Furthermore, in the study, the best combination levels for zinc, sodium, phosphorus, calcium and boron were determined to be 120°C-30 kPa, 190°C-75kPa, 170°C-75kPa, 120°C-75kPa and 200°C-30kPa, respectively. At the level of 170°C-30 kPa, it was determined that potassium, calcium, magnesium and copper highly decreased with value of 4795.32, 6454.09, 589.31 and 0.176 ppm, respectively. The worst combination level for phosphorus iron and zinc was 160°C-75 kPa. On the other hand, it was determined that the combination of 180°C-75 kPa negatively affects sodium and boron levels. Furthermore, it was detected that the 190°C-30 kPa combination level caused a significant decline in manganese. Moreover, linear and nonlinear relations of nutrient elements with each other were investigated in this study.

Keywords: Milk powder, nutrient elements, pressure, spray drying, temperature.

P-068 [Section VI: Bioprocesses]

DETERMINATION OF OPTIMUM TEMPERATURE LEVEL OF SPRAY DRIED MICROALGAE (CHLORELLA VULGARIS L.) IN TERMS OF COLOUR AND CHLOROPHYLL CONTENT

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In this study, microalgae (Chlorella vulgaris L.), which has concentration of 30%, was dried at combinations of 41.66 kPa constant spray pressure and inlet temperatures of 140, 160 and 180°C using a spray drying system. Colour measurements were made on a LAB scale using a colorimeter (Konica Minolta CR10) and chlorophyll of samples were made on Spad method using a Spadmeter (Konica-Minolta SPAD 502-Plus). Both color and chlorophyll measurements were made 20 times at each combination level. The results are statistically subjected to the LSD test. At this above mentioned conditions, the colour parameters (L, a, b, C and α) at 41.66 kPa pressure and 180°C temperature combination, the greenness (a) parameters were found to be closest to the fresh product with the value of -4.583. This was followed by the combination of 160°C - 41.66 kPa, 140°C - 41.66 kPa spray drying and natural drying with the values of -4.400, -4.233 and -3.717, respectively. The highest greenness was measured in fresh microalgae with a value of -6.083. Similarly, the highest chlorophyll concentration was detected in fresh product. The closest chlorophyll concentration to fresh microalgae was obtained with value of 57.15 SPAD at 160°C - 41.66 kPa spray drying combination. This was followed by 180°C - 41.66 kPa spray drying, 140°C - 41.66 kPa spray drying and natural drying with values of 53.60, 44.35 and 40.78 SPAD, respectively.

Keywords: Colour parameters, chlorophyll, microalgae, pressure, spray drying, temperature

P-069 [Section VI: Bioprocesses]
MATHEMATICAL MODELING OF MOISTURE LOSS DURING THE PRECOOLING PROCESS OF FRUITS

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Precooling is one of the postharvest processes that reduces the fruits decay. In the most researches, the moisture loss of fruits was assumed to be negligible and developed mathematical models and simulation process was based on this assumption. However, the results of these studies indicated that there are some differences between the simulated and experimental data. One justification for this error is related to the model assumption such as no moisture loss during the cooling process. The aim of this research was the simulation of the precooling process of strawberry with considering the moisture loss during the cooling process and compering the date with the models without this term. Therefore, the previously developed models by authors was modified and the term of moisture loss was added in the boundary condition of the heat transfer equation and the simulation was carried out based on the simultaneous an airflow and heat transfer process inside the cooling system using the proper software. In this study the precooling of strawberry was performed in the new designed packages using the forced-air cooling system in a cold room. The experiments was performed to record the fruit temperature variation and moisture loss during the cooling process. The central fruit temperature were recorded in the different points of package and used for model validation. The results indicated that the moisture loss of strawberry during the cooling process is not negligible and by considering this term in the modeling, the cooling rate increased and the cooling time decreased (31%). However, the moisture loss did not affect the heterogeneity of cooling process. In addition, a good agreement was observed between the experimental temperature of fruits and that of simulated model with the moisture loss term. The parameters of R^2 and RMSE were in the range of 0.9534 to 0.9921 and 0.9487 to 0.9573, respectively. As a conclusion, the term of moisture transfer must be consider in the precooling simulation of fruit that have high moisture loss after harvesting.

Keywords: Moisture loss, Precooling, Strawberry, Simulation

P-070 [Section VI: Bioprocesses]
MODIFIED HUMIDITY PACKAGING DESIGN AND APPLICATION FOR STRAWBERRIES

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Respiration and transpiration are two important physiological phenomena having a great effect on the shelf life of harvested horticultural crops such as fresh fruits and vegetables. Modified atmosphere packaging (MAP) is a well-known concept dealing with controlling the respiration rate within the fresh produce package. MAP can lead to accumulation and condensation of moisture lost by produce, especially in the case of high transpiration rate products. In this study the effect of fresh produce packaging using non-perforated and perforated packaging film on atmosphere composition, relative humidity and water condensation inside the package as well as fruit mass loss, were predicted using a developed computer simulation program based on integrative mathematical modeling. By compromising the atmosphere modification, desired transmission rate of water vapor through packaging film and thereby modified humidity packaging (MHP) was achieved using macro-perforated packaging films. Simulation results showed that in-package relative humidity was controlled less than 100% and hence, condensation of water vapor was prevented for different packaging designs having 20, 30, 40 and 50 perforations of 3 mm diameter, containing 450±50 g strawberry under different ambient conditions of 5, 15 and 25°C temperature and 50% relative humidity. Packaging of strawberries with 40 perforations could control inside relative humidity around 95% in different packaging and environmental conditions, while maintaining fruit mass less than 3% of initial mass after 5 days of storage. Experimental application of designed package with 40 perforations for 458 g strawberries resulted in a good agreement between measured and predicted inside relative humidity (94.1% and 95.6% respectively) and fruit mass loss (10.98 g and 10.22±0.35 g respectively). No condensation was observed in strawberry packages as predicted by mathematical simulations.

Keywords: packaging, atmosphere, relative humidity, perforation, moisture condensation

P-071 [Section VI: Bioprocesses]
DESIGN AND FABRICATION OF MECHANICAL SIZE GRADING MACHINE FOR ONION

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In the developing countries such as Iran, lack of sorting operations for vegetables and particularly fruits are considerable. Onion, as the fifth Iranian export product, is facing the same issue. According to the published statistics, about 18-20% of produced onion in Iran is being lost annually due to numerous reasons. Since, the large part of onion loss is the result of not applying the proper sorting and preservation operations. The most significant aim of this study was designing and developing a grading machine especially for the indigenous red onion. Among the diverse mechanisms for size grading the spherical and pseudo spherical agricultural products, by taking into account of pros and cons of each mechanism, mechanical grading was opted. Not only mechanical grading has higher capacity and efficiency but also it will provide better marketing for the onion because of the reasonable price of grading operation and also the value addition for the product. The literature review in this field reveals that grading machines in Middle Eastern countries have lower efficiency and the grading time is considerably short. Since the shape of red onion is mostly pseudo spherical, the orientation of it comes with a great value. Therefore, the vibrating screens with slider crank mechanism were chosen because the vibrating motion would ease the passing process of onions through the screen holes with minimal rub and damage and will also have the optimum grading time. The frequency and amplitude of the vibration were calculated 1.57 Hz and 28mm respectively. Moreover, in this research the feasibility study for best mechanisms of different machine components was conducted. Thus, round-hole screens with the length of 2 meters and width of 1 meter was designed for the size grading part. According to the standards and calculations the diameter of the screen holes was designed 70 and 50 mm. The designed machine was driven by a 1hp electric motor. Also, the power transmission of this electric motor was applied with pulleys and belts. Onions after passing through the size grading section consequently will be graded in to three grades and each grade will be led into divided collecting boxes. The machine was designed with the capacity of approximately 2.8 t/h, which suits the indigenous production volume. Last but not the least, the used materials for fabrication was selected with observing hygienic principles and also matching the standards for post-harvest machines.

Keywords: Onion, Post-Harvest, Size Grading, Vibration, Screens

P-072 [Section VI: Bioprocesses]
DRYING OF MULBERRY FRUIT WITH DIFFERENT METHODS

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Natural sun drying is used as the most common preservation method till the ancient times. But, the desired result by using this method generally can not be achieved due to the product quality and hygiene as well as the various adverse effects of the products. In recently, the black mulberry which it takes place an important antioxidant capacity fruits, unfortunately there are only limited studies for drying of this fruit. In this study, black mulberry dried by hot air, infrared, hot air-microwave, hot air-infrared and under vacuum at different conditions, in addition natural drying under shadow and sun by using pre-treatment or not. These methods were compared with drying kinetics, antosiyanin capacity and fenolic contents. According to the results, drying efficiency was 19.6% and 21.8% for pre-treated or 16.6% and 15.8% for not treated dried under shadow and sun, respectively. Fresh black mulberry fruits fenolic matter amount was 500 mgGAE/100 g fresh product and increased after all drying methods. Total flavonoid amount was 100.3 mg CTE/100 g fresh fruit and changed between 100 and 700 mg CTE/100 g dried fruits. The highest amount of flavonid was obtained under vacuum drying at 1 bar pressure and 80 oC temperature. Total antosiyanin amount was 400.4 mg SR/100 g fresh fruit. Antioxidan activity was reached its highest value for fresh products as 28.34 mg sample/mg DPPH. The lowest activity value was at vacuum drying method as 5.01-5.02 mg sample/mg DPPH. In contrast, antioxidan activity of the natural dried products were close to fresh fruit samples.

Keywords: Black mulberry, Drying, Microwave, Infrared, Hot air, Vacuum

P-073 [Section VI: Bioprocesses]
EFFECT OF TOP CUTTING HEIGHT OF COTTON STALK ON COTTON YIELD

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It is reported that in the literature and by cotton farmers the cut of the top part of the cotton plant provides significant advantages to improve cotton yield. To reduce production cost and increase yield, we have to develop a new suitable cutting and pruning machine. So, firstly, we must determine to cutting properties of cotton stalk. The objective of this study was to determine the effect of different top cutting height of cotton stalk on cotton (Gossypium hirsutum L.) yield and cutting properties such as cutting force and cutting strength. In accordance with this purpose, the field experiment was designed according to randomized complete block design with three replications at a commercial farm in 2017 at the Bismil district, Diyarbakır province, Southeast part of Turkey, where cotton production is intensively done. Experimental field consisted of 18 plots with each measuring 15 m x 6 m with an inter row spacing of 0.7 m distance. Cotton BA-440 variety was planted as experimental material on 12 April in 2017 by a pneumatic planter. Cotton topping cut is done by worker during the vegetation period. For this purpose, cutting tests were carried out at 5 cm intervals from the top of four different the plant height and cutting force and cutting strength were determined during the vegetation period depend on stalk diameter and cross-section area, respectively. The tests materials were obtained from experimental area during the cut top heights of cotton stalk. Cutting test was made by Instrument test machine in laboratory. The results of an analysis of variance showed that the effect of cutting top height of cotton stalk was found significant on cotton yield and cotton force. The differences between cutting top heights were found significant. While the maximum cotton yield were obtained at pix chemical application as 6.440 hg/ha, the lowest cotton yield were obtained at 25 cm cutting top height as 5.316 kg/ha. Also, the maximum cutting force and cutting strength were obtained at 6.00 mm diameter (25 cm cutting height) as 91.16 N and 3.12 N/mm2, respectively, according to Duncan's multiple range tests.

Keywords: Cotton, stalk topping, yield, cutting force.

P-074 [Section VII: Information Technology]
INTERFACE FOR THE AUTOMATON USED FOR SCARIFICATION OF ACORNS AND IDENTIFICATION OF PATHOLOGICAL CHANGES

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Prior to their planting in tree nurseries, oak seeds (acorns) are scarified and evaluated in terms of their usefulness for reproduction. In Poland, some five million seeds are planted in tree nurseries; these seeds are earlier manually scarified, and visually evaluated. The preparation of seeds for planting takes approx. two months (from March to April). The efficiency of worker amounts to approx. 20 acorns per minute. Manual labour was replaced by automating device (automaton). The programming of the automaton and the recording of work parameters are done via interface. The ergonomic assumption of the project were as follows:
(1) operating the automaton (interface) is periodical (approx. two months per year) + operator of the interface uses it irregularly,
(2) diagrams of the device and pictograms (inscriptions) on the interface should correspond to the technological scheme of automaton's work (i.e. the sequence of the placement of particular working elements),
(3) operating the interface should be intuitive i.e. correspond to operating procedures in commonly applied interfaces (e.g. in cellular phones),
(4) interface of the automaton should take into account the rules of compatibility as well as normative recommendations.
The interface also enables the programmed recording of the following work parameters of the automaton:
(1) Identification data of seeds delivered for scarification
(2) Description of seeds delivered for scarification
(3) Description of seeds delivered as indicated in evaluation certificate
(4) Description of seeds resulting from the work of automaton

Keywords: Interface, automaton, scarification of acorns

P-075 [Section VII: Information Technology]

INFORMATION TECHNOLOGY AND A RESEARCH ABOUT HOW AGRICULTURAL EXTENSION AFFECTED FROM THAT

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Throughout human history, every era has unique feature. The most fundamental characteristic of the era we are in is the development of the information industry. Especially 21st century has been developed on communication sector. Wide spreading of computer and internet usage has been speed up the transportation of information. As a result of this, the concept of 'digital' so 'numerical' has emerged in the provision of information in education, in publishing, in every sector. Although the use of internet in the agricultural sector is still perceived as 'innovation', this issue is evolving just like any other sectors. Agriculture; production of herbal and animal products, improvement of their quality and yields, maintenance, evaluation and marketing of these products under appropriate conditions. Starting from this basic definition; products have been produced in today's technology with the seed-to-food, customers can easily see every stage of the program products have been developed. Increasing the quality and efficiency is only possible with the use of technology. Today, satellites are used in predicting climate and weather conditions. Such concepts like e-commerce and e-market have emerged along with internet usage in product marketing area. A new process adoption by the manufacturer is generally a time-consuming process. With many reasons can be evincible such as the low level of education, the difficulty of adopting adults' innovation, the low level of income or the inability to take risks can be shown as fundamental justifications. In order to break these reasons, accessibility of internet and information, access to in-depth information, and continuous and easy communication are effective. The purpose of our study is to examine communication technology in computer, internet, e-commerce and information access in agriculture sector in changing and developing technologies.

Keywords: Information Technology, Agriculture Sector, Internet, Computer, Communication

P-076 [Section VII: Information Technology]
DEEP-LEARNING BASED OBSTACLE RECOGNITION AND TRACKING USING DRONE IMAGE

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The existing autonomous driving system of agricultural vehicle have difficulties identifying hazards when driving. Although a number of sensors are mounted on a mobile agricultural robot, the detection range of the sensors is limited and the accuracy in identifying the hazards is low. Therefore, this study was aimed to recognize dynamic and static obstacles and then track them using deep-learning technology in a drone based aerial field-of-view. A wire drone equipped with multi cameras was connected to a mobile agricultural robot. The aerial images around the robot at an altitude of 10m was analyzed through an image processing board mounted in the wire drone. To extract the features of dynamic and static obstacles, the histogram of oriented gradient and the randomized Hough transform were used. The feature information was trained by a convolution neural network with 1,000 sample images in each dynamic and static obstacle condition to recognize obstacles. The motion vector of the recognized obstacles was obtained by monitoring the position of the obstacles and thus the obstacles could be tracked. The performance of recognizing and tracking obstacles was assessed using mean average precision (MAP) and recall. Test results showed that the MAP of 77% and recall of 85%. In future, the algorithms used for recognizing and tracking obstacles in this study will be tested in more various environments to improve performance.

Keywords: deep-learning, feature extraction, obstacle tracking, direction prediction, CNN

P-077 [Section VII: Information Technology]
DESIGN OF A NONLINEAR FUZZY CONTROL ALGORITHM FOR GREENHOUSE CONDITIONS

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Environmental and climate control have always been important factors for plant production in greenhouses. The greenhouses no depend on the weather condition, reducing the risk by increasing control systems and producing a year-round harvest. The main purpose of implementing control systems in greenhouses is to provide required light, CO_2, temperature, relative humidity and irrigation independent from outer environmental conditions.

Nowadays, it is seen that the applications of artificial intelligence have improved and changed the agricultural production. Artificial intelligent approaches including neural networks and fuzzy inference have been used widely to model expert behavior. Fuzzy logic can control nonlinear systems that would be difficult or impossible to model mathematically. This opens door for control system that would normally be deemed unfeasible for automation.

This paper will present a design of fuzzy logic based controller, which optimizes the Greenhouse heating, energy and water consumption. System input variables are indoor air temperature, relative humidity, level of CO2, photosynthetically active radiation (PAR) and plant growth stage. Here, the Fuzzy Inference System (FIS) prototype is based on a Mamdani controller and it will be built on the MATLAB software. In this study, the membership functions of the Fuzzy Inference System will be established and the behavior of the design control system will be analyzed.

Keywords: Fuzzy Inference System, Temperature, Photosynthetically Active Radiation, CO2, Greenhouse Climate Control

P-078 [Section VII: Information Technology]
3D PLANT PHENOTYPING USING MACHINE LEARNING ALGORITHM

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A development of analysis technology using fusion technology is required to increase agricultural competitiveness and produce crops stably, in order to cope with the rapidly changing climate environment. In response to these needs, an importance of phenomics which is a research field covering a plant's phenotype is emerging. Morphology is an important factor in a plant's phenotyping, and 3D image analysis of plants is also becoming important. In this study, 3D reconstruction was performed using several images of plant, and automated image segmentation and phenotypic parameter measurement of plants were attempted. The target plant rotating on the turntable was photographed through a camera in a fixed position to obtain images in various directions, and 3D reconstruction was performed using the obtained images. A preprocessing process was carried out using the 3D point cloud of plant, and a plant analysis algorithm for plant segmentation was developed to obtain the morphological trait. For the extraction of plant parts, optimal algorithm combination for noise and 3D image is obtained by using K-means Clustering, ExG, Otsu's threshold using color information. For the convenience of analysis, plants alignment was performed by coordinate transformations using PCA. Several machine learning algorithms were used to separate stem and leaf, calculate leaf size, angle, plant height. The accuracy of the algorithm was analyzed through comparison between the calculated and actual measured values. Although it did not reach the error of 6% which was measured manually, it contributed to the automated analysis of 3D plant images and various analyzes will be possible if combined with other artificial intelligence algorithms.

Keywords: High Throughput Phenotyping, 3D Reconstruction, Kinect v2, Machine Vision, Structure from Motion.

P-079 [Section VII: Information Technology]
CATTLE BEHAVIOR MONITORING AND CLASSIFICATION USING INERTIAL MEASUREMENT UNIT

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Since digital technologies highly developed, livestock's monitoring system are becoming a potential tool for continuous monitoring cattle's behavior instead of human observation. However, existing classification models are only successful in limited behavior types and little attention has been paid to Social behavior. In this study, we aimed to develop a convolution neural network (CNN) model to monitor and classify cattle behavior patterns using inertial measurement unit (IMU). Those models were training by using motion data obtained from 6 male cattle. Each cattle was fitted with an inertial measurement unit inside a waterproof box on a collar upon its neck. Classified behavior classes included feeding, lying, ruminating (lying), ruminating (standing), licking salt, moving, social licking and butting. IMU data were labelled if the data was matched to the corresponding video activity. Labelled IMU data of 8 behaviors were classified with CNN model using tensor flow across 3 window sizes (64,128 and 256). The overall classification accuracy of those 3 window sizes were respectively 84.6%, 84.2% and 80.0%. The results of 3 window sizes revealed the periodic changing behavior classes were classified accurately. The classification performance was improved when behavior changing period closed to the window size. In the best performance model (window size64), feeding (96.1%), ruminating (lying) (86.5%), ruminating (standing) (89.8%), licking salt (87.3%) and lying (90.4%) had high classification precision. The accuracy was lower for butting (80.7%), moving (79.1%) and social licking (68.4%). Those physically resemble behaviors were easily misclassified with each other. In this study, it has been shown CNN can be used to recognize cattle's behavior including social interaction. In the future, collar could be developed to fit cattle neck more stable to improve the IMU data quality. Also, other sensors like microphone can be added to cattle to improve the performance of the monitoring.

Keywords: behavior classification, convolution neural network, inertial measurement unit, precision livestock farming

P-080 [Section VII: Information Technology]

TRANSPLANTING CHARACTERISTICS OF RICE CROPS USING UAV IMAGE BASED DEEP LEARNING

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The high efficiency for management of rice crop is a major challenge to agriculture in Korea. With the development of drone and image analysis technology, it is possible to monitor field condition and crop growth status in fields using unmanned aerial vehicle (UAV). In this study, we propose to recognize each rice plant with a specific coordination and analyze the transplanting characteristics of the plants such as planting density, miss-planted rate, and space between plants. The images were acquired in a rice field of 26*84 m using a low altitude UAV right after transplanting. More than 2,500 images of rice plants and 1,400 background images were analyzed to extract the features of rice plants using Histogram of Gradients (HoG) technique and then deep-learned to recognize rice plants. The accuracy of recognizing rice plant was 88.3%, compared to that of manual counting. The recognized plant with each coordination can be managed each-by-each later. The planting density also could be obtained based on UAV images and the miss-planted rate was about 10.1%. The average space between plants were 18.4±2.82cm. It is believed that analysis of UAV images based on HoG and deep-learning can be useful tool for management of rice crops.

Keywords: UAV, planting density, Histogram of Gradients (HoG), deep learning, transplanting characteristics

P-081 [Section VII: Information Technology]
A RESEARCH ON SPATIAL WEED MAPPING FOR VARIABLE RATE HERBICIDE APPLICATION

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For years weed management inputs were applied uniformly to whole fields, like most other crop soil and pest management practices. However, growers have long recognized that weeds are not spread uniformly across fields. Spraying herbicides uniformly across a field where target weeds are not uniformly distributed can waste resources and add to the social, environmental and economic drawbacks about herbicide use. Precision farming offers a powerful set of tools for addressing these concerns and increasing the efficiency of weed management. In this study, weed maps were developed for the winter wheat field in Ankara province for variable rate herbicide application. Weed species that were manually collected as listed respectively; Alopecurus myosuroides, Sinopis arvensis, vicia satira, bifora radians avena sterilis, lolium multiflorum, vicia sativa, bromus tectorum. 10 species per square meter threshold were applied and recorded via GPS and handheld computer. This study has indicated that weeds were spread nonuniformly across the field and herbicide application could be made to 35-40 % of the whole field comparing with the conventional herbicide aplication.

Keywords: Site specific weed management, weed variability, spatial weed mapping, variable rate herbicide application

P-082 [Section VII: Information Technology]
DEVELOPMENT OF A OPEN-SOURCE PLATFORM FOR GREENHOUSE CONTROL SYSTEM

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Greenhouse control system consists of various components (sensors, actuators, etc.) to manage greenhouse environment in order to improve crop productivity. Since lack of common data exchange interface, it is impossible to interact with components from different manufacturers. We developed an open-source platform for greenhouse control system in order to improve the interoperability of a greenhouse control system. The platform was designed as a module-based system. The hardware part of the system consists of a baseboard and four modules (processing, A/D converting, digital input, and digital output). The baseboard takes responsibility for communication between each module. Operating software has four applications and communication libraries. It is possible to change the communication library in order that an application communicates with another application for different component. In addition, the system supports various communication methods such as shared memory, database and RESTful API. And it also supports a rule-based control function to handle actuators. This method, to suggest a reference platform, could contribute to improve interoperability between various components for smart farming.

Keywords: Greenhouse control system, Interface standard, Open source, Smart farming, IoT

P-083 [Section VII: Information Technology]
OPPORTUNITY FOR THE USING OF NITROGEN AND PROTEIN SENSORS IN AGRICULTURE

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Precision management of nitrogen (N) may increase yield and quality (protein) content in wheat or some other crops. Adjusting N fertiliser rates according to wheat yields and quality could reduce over-fertilisation. Grain yield and quality are directly affected by several agronomic and environmental factors. Wheat yield and protein contents depend strongly on the crop N uptake during the vegetative growth of the wheat crop. Sensors such as GreenSeeker NDVI (Normalized Difference Vegetation Index) and Force-A (protein) can be used to predict grain yield and quality. In accordance with different areas across the field, the fertilizing costs can be noticeably reduced by adjusting the fertilizing application with actual requirements of this area. (Talebpour et al., 2014). The fluorescence NBI index determined well the nitrogen content, but it was not sensitive to crop density. Assessing the fluorescence data, the data show high correlation with leaves biomass (r = 0.76), Leaf area index was correlated with NBI (r = 0.81) (Galambosa et al., 2014). This study is aimed to develop a relation through sensor readings with N content of crop.

Keywords: Wheat yield, Wheat protein content, nitrogen use efficiency, precision agriculture, variable rate fertilizing

P-084 [Section VII: Information Technology]

SEEDING PERFORMANCE COMPARISON OF THREE DIFFERENT PROTOTYPES OF A SEED SINGULATOR USED IN A PRECISION VACUUM SEEDER

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Nowadays, the additive manufacturing technology is becoming a very popular prototyping and manufacturing method in various manufacturing industries. The technology promises many advantages when it is compared to traditional production methods specifically for the components which have complex structural features, however, it would not be wrong to say that this technology has not been actively utilised in the agricultural machinery design and manufacturing industry yet. In a mechanised seeding operation, pneumatic precision seeders have been commonly used in agricultural production. In the seeding process, seed singulator components are the key functional components of the seeders. The seed singulator is an equipment that is positioned in seed metering unit to hold single seed in each hole while the disc rotates. It is important to keep the seeds with negative air pressure on each hole on the seed disc during the seeding operation, however, due to the physical structure of the seeds and singulator design, seed singulator may not work efficiently and it may cause doubling the seeds on one hole or the seed can not be vacuumed on a hole of the disc. This significantly affects the seed uniformity and crop yield. In this study, three different seeding singulators were modelled and their prototypes were produced by additive manufacturing technique (FDM: fused deposition modelling). Physical experiments were conducted with corn seeds on the prototypes in order to observe their seeding performance. Physical prototypes produced through additive technology provided easy and deeper understanding of seeding performance. Quality of feed index and total of multiple and miss index of singulators mounted on the disc are determined by the video capturing technique. Finally the quality of feed indexes of the original (C) and newly generated (P1, P2, P3) seed singulator models have been compared. According to captured images from video for each singulator experience C, P1, P2 and P3 singulators performances (quality of feed index) have been found as 96.35%, 97.92%, 97.92% and 99.48%, respectively. The results showed that newly generated singulator prototypes performances were found higher than the original singulator. Besides, P3 singulator performance were found highest than the other prototypes. The results are presented in a format which can be used in future research and industry in design of seeders components.

Keywords: Precision vacuum seeder, seed simulators, seed metering, additive manufacturing, rapid prototyping

P-085 [Section VII: Information Technology]

ANALYSIS OF DURABILITY OF HYDRAULIC MECHANICAL TRANSMISSION OF AGRICULTURAL TRACTOR

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Tractors are agricultural machines that perform various farming operations. As the tractors work on various terrains such as slope land, and reclaimed land, uneven field, various types of transmission have been used. Gears are components of transmission and transmit the power of an engine to a machine and offer numerous speed ratios, a compact structure, and high efficiency of power transmission. In the automotive and construction machinery field, powertrain design uses simulation software. However, transmission of tractor design for agricultural applications uses the empirical method because of the wide range of load fluctuations in agricultural fields. Recently, continuously variable transmissions have been used in field tractors widely. The continuously variable transmission is composed of planetary gear system, helical gear sets, hydrostatic unit, and hydraulic values. Planetary gears system is composed of planetary gears, carriers, sun gears, and ring gears, and have various gear ratios according to various combinations of gears. However, planetary gear system has difficulty in designing and assembling. So, virtual modeling and analysis of planetary gear system using simulation software are needed. In this study, the planetary gear system used in continuously variable transmission of agricultural tractor was developed by using the gear analysis software Romax DESIGNER. In addition, durabilities such as safety factor and lifetime of planetary gear system were evaluated in various input load conditions. Finally, safety factor and lifetime of planetary gear system were compared in various conditions.

Keywords: Agricultural tractor, Tractor powertrain, Gear, Safety factor

P-086 [Section VII: Information Technology]

ANALYSIS OF THE CHEMICAL INPUT USAGE OF FARMERS IN POMEGRANATE PRODUCTION IN ANTALYA PROVINCE

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Compared with developed countries, Turkey has emerged that the use of chemical inputs in agriculture have lower levels and inadequate. These low levels of input use cause low productivity and inefficiencies in production, while at the same time causing various problems due to unconscious use. In the cultivation of agricultural crops, chemical inputs use amounts, habits and attitudes of farmers are great importance in terms of productivity, quality, marketing, cost and profitability in production and sustainable production issues. In addition, the use of agricultural chemicals is inevitably one of the main issues in terms of human health and possible adverse effects on the environment. In this research, it is aimed to investigate the attitudes and behaviors of the farmers about the use of agricultural chemicals in pomegranate cultivation and the usage levels of such inputs. The population of this study constitutes farmers producing pomegranate in the districts of Central and Serik where approximately ¾ of the production in Antalya is carried out. In the study, data obtained by stratified sampling and randomly selected 75 farmer survey methods were used. As a result of the study, farmers were found to have applied a total of 549.6 kg of pure fertilizer on an average of 254.6 kg of nitrogen, 164.2 kg of phosphorus and 130.8 kg of potassium at one hectare pomegranate garden. Average 69.4 kg ha-1 pesticides are used in pomegranate gardens. The most used chemicals are insecticides with 34.3 kg ha-1. The insecticides are followed by herbicides with 15.2 kg ha-1 and Bordeaux mixture with 11.0 kg ha-1. Farmers have had considerable experience in the use of chemical inputs due to their long pomegranate production. As a result, most of the farmers consider themselves to have sufficient knowledge in the use of pesticides and fertilizers. Accordingly, it has been determined that the vast majority of producers do not obey the proposed doze, do not take the necessary safeguards for spraying and fertilizing applications, and put away packaging which may be harmful to the environment. Farmers mostly obtain the necessary information for the use of pesticides and fertilizers from retailers of chemical inputs. Pomegranate producers state that the primary cause of overdose pesticides use is that the recommended dose does not lead to sufficient impact regarding the diseases or insects and pathogens.

Keywords: Pomegranate production, Chamical input management, Pesticides, Fertilizer.

P-087 [Workshop on Image Analysis and Spectroscopy in Agriculture]
CHARACTERIZATION OF MICROSTRUCTURAL AND MICROMECHANICAL PROPERTIES OF NOPAL SPINES TO EVALUATE ITS POTENTIAL AS SOURCE OF CELLULOSE AND LIGNIN

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Nopal is a cactus that grow in arid and semiarid lands and it is widely cropped and consumed Central America and the main commercial variety is Opuntia ficus-indica (OFI). Food industry generate large volumes of wastes and currently, in Mexico City each year are generated by the prickly removal around 40,000 tons of wastes and even not exist an alternative route for its reutilization, given the scarce information about this waste. Nopal spines as other wastes, contain polymers with economical potential value. Structurally are formed mainly by arrangements of cellulose-lignin complex that it is found in a wide variety of plant materials including leaves, bark, wood, non-wood straws and roots. For these reason is necessary an integral characterization of its physical, chemical, microstructural and micromechanical properties, they can be useful to building of new biodegradable nanomaterials and biopolymer reinforcing. The objective of this work was to evaluate some physical, chemical, microstructural and micromechanical properties of nopal spines in order to provide useful information to utilization of this waste. Spines were obtained from nopal wastes by dried to 40°C and sieved. Physical and chemical assays and microscopy techniques were used in order to know of the role of microstructural arrangement on the local micromechanical properties. Transversal section (TS) and longitudinal section (LS) of the spines were studied by means of indentation and microscopy. Spines shows higher density than pines wood. Environmental scanning electron microscopy was helpful to characterize the overall structure of spines. Confocal laser scanning microscopy was useful to know the distribution cellulose and lignin into spines and it was associated to its micromechanical properties. From atomic force microscopy, TS have lower roughness (Ra 3.08 ± 0.75 nm) than LS (Ra 24.56 ± 1.60 nm). While, TS (0.43 ± 0.02 GPa) have hardness lower than LS (0.48 ± 0.07 GPa). Contrariwise, elastic modulus of LS (8.63 ± 3.18 GPa) was lower than TS (14.26 ± 5.78 GPa). Hardness of LF and SE is influenced by distribution of cellulose and lignin into the spines. The microstructural arrangement and the distribution of cellulose and lignin on the TS provided higher hardness values in comparison with woods. The current study provided a novelty structural characterization of nopal spines and its micromechanical properties. This waste can be a cheap and non-wood source of cellulose with good mechanical properties and helpful to design novel biomaterials to reinforce of biopolymers with applications in agricultural sector.

Keywords: Nopal spines, microstructure, indentation, microscopy techniques

P-088 [Workshop on Image Analysis and Spectroscopy in Agriculture]
IMAGE ANALYSIS AND MICROSCOPY TECHNIQUES APPLIED TO APPLE CULTIVARS CLASSIFICATION

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Apple is an important crop at world scale. There is a large diversity of apple cultivars; they have different color and texture. Firmness of apples is associated to the cellular microstructure of parenchymatic tissue. The cultivars have differences in their physicochemical properties and cellular structure. These confer to each cultivar different features that can be used for their classification. The aim of this work was to evaluate different physicochemical properties and microstructural parameters in four apple cultivars (Golden Delicious, Granny Smith, Red Delicious and Gala) by microscopy techniques, image and multivariate analysis to classify them at laboratory scale. Total soluble solids (TSS), titratable acidity (TA), firmness (F) were evaluated to obtain the ripening index (RPI). Weight, displacement volume and color of apples were determined. Light and scanning electron microscopy images were obtained from parenchymatic tissue and were analyzed by image analysis. Some image parameters were extracted such as Feret diameter (FD), aspect ratio (AR), circularity (C), fraction area of pores and pores density. Apples firmness ranged from 20.59 (Golden Delicious) to 24.69 (Red Delicious). RPI oscillated from 6.03 (Red Delicious) to 7.29 (Granny Smith). Regards displacement volume and weight, Red Delicious reached 238.3 cm3, 216.14 g, while Golden Delicious had 149.7 cm3, 137.76 g. The color was used as reference due to the apples cultivars had large differences (red, yellow, green and bicolor marbled). Image analysis of parenchymatic tissue showed that Granny Smith apple had large size cells (FD= 233 micras, AR=1.49, C=0.70) with irregular shape, while Red Delicious had small size cells with circular shape (FD= 195 micras, AR=1.38, C=0.74). Pearson analysis showed that apples firmness had a high correlation with cellular porosity and size cellular, it can be assumed that small cells provided a high firmness on fruit texture, due to a better packaging of parenchymatic tissue. Microstructural differences could be associated to consistence perception of each cultivar. Physicochemical and image parameters of apple tissue were analyzed by using principal component analysis (PCA), it allows classifying the apple cultivars. So, Granny Smith cultivar has a larger separation distance in the principal bi-dimensional components space in relation with the other cultivars, this was used as sorting criterion. Results could be useful to evaluate the quality of apples and as a preliminary study to sorting of cultivars at laboratory scale. However, to development of an efficient method of classification is necessary to obtain continuous data collection during some season crop.

Keywords: Apple cultivars, principal component analysis, microscopy images, microstructure

P-089 [Workshop on Image Analysis and Spectroscopy in Agriculture]

STUDY ON THE EFFECTIVENESS OF ORGANOPHOSPHORUS PESTICIDES CONCENTRATION BASED ON REFLECTANCE SPECTRA IN WATER

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There are many kinds of organophosphorus pesticides (OPPs) and its application is very wide in agricultural production, so the pesticide residues caused serious harm to the environment. In recent years, many methods have been used to detect the pesticide residues of OPPs. In this study, we tried to use hyperspectral imaging technology to detect the concentration of organophosphorus pesticides (OPPs). This system was operated in the UV/Vis/NIR region (350-2500nm). Hyperspectral imaging data of OPPs samples was obtained from ASD FieldSpec3 and extracted from ViewSpec software. In this experiment, we detected four commonly used organophosphorus pesticides, namely, chlorpyrifos, dimethoate, dichlorvos and trichlorfon and the experimental samples concentration of the fore pesticides was set to 5-75 mg L-1 with a interval of 5 mg L-1. Partial least square regression (PLSR) and principal component regression (PCR) models were built on the basis of the full spectral wavelengths. Experiments results in terms of PLSR calibration model show that the coefficient of determination (R2) is 0.97, 0.8174, 0.5577 and 0.0946, with the root mean square error (RMSE) is 3.821, 11.4, 12.52 and 13.11, respectively. The R2 is 0.9248, 0.8035, 0.2357 and 0.1585 of the PCR calibration model and the RMSE is 5.719, 9.817, 9.896 and 10.88, respectively. These results demonstrated that the hyperspectral imaging system built by ASD FieldSpec3 is a potential method for non-destructive detection of chlorpyrifos residues with the minimum concentration of 5 mg L-1 in water environment. However, this method is not suitable for detecting dimethoate, dichlorvos and trichlorfon residues in the same experimental conditions. In addition, the effectiveness of hyperspectral detection of other common organophosphorus pesticides such as octhion, dithiophosphorus and malathion are remains to be studied.

Keywords: Ultra violet/Visible/Near infrared hyperspectral imaging, organophosphorus pesticides (OPPs), partial least square regression (PLSR), principal component regression (PCR)

P-090 [Workshop on Image Analysis and Spectroscopy in Agriculture]
DETERMINATION OF CHEMICAL PROPERTIES IN AGRAZ WITH NIR SPECTROSCOPY

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The Agraz cultivation (*Vaccinium meridionale*) has increased in the last years in Colombia, mainly because of its nutraceutical properties. The use of NIR spectroscopy to determine postharvest properties in agricultural products such as agraz is presented as an alternative to the traditional destructive methods that require a lot of time, costs, use of reagents and the waste of huge amounts of product. The aim of this research was the creation of prediction models to total soluble solids (TSS) and tritable acidity (TA) in agraz with NIR spectroscopy. The agraz sample was taken in the maturity state of 3, in two different periods, the first one was in November of 2016 and the second one in September of 2017. The product was selected according to its phytosanitary state and was stored at room conditions for 19 days in which these characteristics were monitored continually. All the samples were measured with a spectroradiometer in a wavelength range between 700 and 2500 nm. To generate a proper calibration and validation models, standard test were applied. For the calibration set, 500 samples were used and for the validation set 162 samples were used. For the creation of models, the partial least squares regression (PLSR) was used and to evaluate the models, the coefficient of determination (R2) and the root mean square deviation (RMSE) were used as criterion. Finally, prediction and validation models were obtained for the two studied variables. In the case of TSS a prediction model with RMSE = 0,8684 and R2 = 0,8747 was obtained and a validation model with RMSEP = 1.1921 and R2 = 0.7517 was obtained. For the TA a prediction model with RMSE = 0.2409 and R2 = 0.3672 was obtained, while at the same time the validation model with RMSEP = 0.2533 and R2 = 0.2056 was obtained. The obtained model for TSS got a good prediction capacity, so that the spectroscopy could replace the traditional tests to determine this variable; nevertheless, the model for TA must be improved because of its low prediction level.

Keywords: Colombian Blueberry, near infrared, postharvest, quality, PLS regression.

P-091 [Workshop on Image Analysis and Spectroscopy in Agriculture]
ESTIMATING THE NUMBER OF FRUITS HARVESTED BY A SHAKER IN URBAN ORANGE TREES BASED ON AUTOMATIC IMAGE ANALYSIS

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The citrus harvesting by the tree shakers allows to reduce the high costs of this task when it is done manually. To measure the efficiency of these machines and optimize their adjustments, the percentage of fallen fruit is generally estimated. But this is a slow and expensive task, since it involves counting and weighing both the harvested fruit and the one left in the tree. In addition, in certain situations this task is complicated to perform, as is the case of the harvesting of ornamental orange trees in large cities, since machines and operators have to work very close to traffic and pedestrians, which hinders the process of counting all the fruits. Therefore, a quick and automatic estimation by analyzing images of the trees before and after the vibration can be a very important tool to obtain an estimate of the work performance. This work presents the preliminary results of an automated system based on computer vision to estimate the number of fruits in urban ornamental orange trees and the percentage of these fruits that are collected using a shaker. The color of the fruits at the time of harvest is orange, which contrasts with the green of the leaves and allows their detection in the tree. However, one of the main problems encountered in cities is that the color and structure of the background of the images, composed of buildings, posters or street furniture, is very diverse. Sometimes, other objects whose color is similar to that of oranges are present in the image, making it difficult to quickly segment the image based only on color characteristics. Several tests have been carried out using different devices to find the most convenient one from the point of view of an industrial application. They include a GoPro camera to capture videos, a color DLSR camera, a modified DLSR camera to capture NDVI images and a multispectral camera capable of obtaining eight monochromatic images in the visible and near infrared range. The algorithm to segment the images and count the fruit in the tree in real time before and after the harvest is under development. The first results suggest that it is possible to create an automatic tool to count the number of fruits collected and estimate the total weight based on image analysis. Connected to a GPS will allow to visualize the information in a map.

Acknowledgements
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Keywords: yield prediction, citrus fruits, image processing, mechanical harvesting, ornamental orange trees

P-092 [Workshop on Image Analysis and Spectroscopy in Agriculture]
NEW ROBOTIC SOLUTION TO DETECT ASYMPTOMATIC PLANTS INFECTED BY *CANDIDATUS* LIBERIBACTER SOLANACEARUM IN HORTICULTURAL CROPS USING MULTISPECTRAL COMPUTER VISION

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A field robot has been designed and built to automate the capture of images and the mapping of a horticultural field using different computer vision equipments. The robot moves by the impulse of two electric motors coupled to the front wheels and is operated by remote control. A telescopic system allows adapting the width of the robot to the needs of the field in a range between 100 and 200 cm. The robot equips three digital reflex cameras, two of them modified to capture images in NIR (near infrared) and blue NDVI (normalized difference vegetation index), a thermal camera and a multispectral camera capable of capturing eight monochromatic images in different VIS-NIR wavelengths.

The cameras have been placed facing the ground (the plants) at a distance of approximately one meter from the plants. To avoid the influence of sunlight, the scene is protected from outside light by a canvas. In addition, four halogen spotlights illuminated the scene to provide artificial light. A GPS has been used to geolocate the images and to be able to reference each plant in the images with its physical location in the field. The cameras and the GPS are connected to an industrial computer. An application running on the industrial computer captures the signal from an inductive sensor coupled on a robot wheel and triggers the cameras to synchronise the image acquisition with the robot's advance.

Surveys were carried out in two experimental carrot plots located in Villena (Spain) with the aim of detecting asymptomatic plants infected with 'Candidatus Liberibacter solanacearum', a vascular bacterium that causes vegetative disorders in Apiaceae and Solanaceae plants. The plot 1 was inspected monthly at different vegetative status while the plot 2 was inspected only once before harvesting, with the robot carrying the proximal sensing equipment. Several maps of the field have been created using spectral indexes at a resolution of 0.5 mm/pixel using the images captured by the DSLR cameras, and 2.5 mm/pixel using the images captured by the other cameras.

During the last survey of the field, 100 plants were marked to be later identified in the images. These plants were collected separately and taken to the laboratory to undergo a spectral analysis with a hyperspectral camera and a molecular analysis using specific real-time PCR, to determine the presence or absence of infection in the leaves and compare them with the maps created by the robot.

Acknowledgements
The work was supported by funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 635646 POnTE (Pest Organisms Threatening Europe)

Keywords: Field robot, computer vision, multispectral imaging, proximal sensing, asymptomatic detection

P-093 [Workshop on Image Analysis and Spectroscopy in Agriculture]
GRAPE QUALITY INSPECTION USING HYPERSPECTRAL VISION

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World grape production reached 75.8 million tons in 2016. However, only 5 countries accounted for 50% of world vineyard (Spain, China, France, Italy and Turkey). While Spain, France and Italy are the major grape producers for wine, China, Turkey or India are the main producers for fresh consumption. Approximately, 50% of grapes grown in the world are intended for wine production, whereas 38% are intended for table grapes (data from the OIV). Regardless the destination of the grape, there is an increasing interest in improving the quality and reducing loss due to bad quality produce. In the case of table grape, the fruit is bought directly by the consumer, so the internal and external quality is extremely important because it has a direct impact on the purchase decision. In the case of wine grape, the selection of the best product is decisive because an oenologist can make good wines only with good grapes. Instead, a bad selection can spoil the final quality of a batch intended to quality table wine.

Currently, most of the analysis that can be performed at the reception of grapes in wineries or fruit processing factories are based on bunches or batches, but to obtain the highest quality in the final products (wine or table grape), attention should be paid to the grape itself. Some of the main quality parameters currently measured are Brix degrees and absence of diseases, such as botrytis, for every grape. In this study, a hyperspectral imaging system was used to determine its application to measure these two parameters in a non-destructive way in real time. Reference measurements were measured using a refractometer and visual inspection, respectively, for every grape to be correlated to the signal obtained for each grape using the NIR hyperspectral imaging system. Regression and classification models were developed (PLS and PLSDA) to predict the values of these quality parameters of the grapes based on the NIR spectra and good results were obtained for both parameters. Thus, the results of this study have proven that a hyperspectral imaging system could be used as a quality inspection tool in wineries and fruit processing factories, in the reception of the grape, to keep a high standard quality in the grapes used for wine elaboration or packaged table grape.

Keywords: grape, quality, wine, hyperspectral, NIR, spectroscopy

P-094 [Section VI: Bioprocesses]
SIMULATION OF HOT AIR-INFRARED GREEN PEAS DRYING USING FINITE ELEMENT METHOD

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The mathematical modeling of mass transfer and experimental validation of green peas drying were studied in an infrared assisted-hot air dryer. Experimental factors included drying air temperatures (30, 40 and 50), FIR intensity (0 as a control, 0.2, 0.4 and 0.6 W/cm2) and drying air flow rate (0.5, 1 and 1.5 m/s). The experiments were conducted in three replications for combinations of different levels of factors. A mathematical model was proposed for predicting the moisture distribution in the drying sample. The governing equations as well as initial and boundary conditions were developed for the drying process of green peas. By finite element method and using Galerkin approach a system of first order differential equations were obtained for the drying process. The equations were solved simultaneously by finite difference method. The model was validated by comparing the simulated results with the experimental data. The effect of drying air temperature, FIR intensity and also drying air flow rate were investigated and discussed. The average predicted moisture content was in good agreement with the experimental data. This model can be applied to provide more information on kinetics of drying process.

Keywords: Green peas, Finite element method, Drying, Mass transfer, Mathematical modelling

P-095 [Section IV: Energy in Agriculture]
MATHEMATICAL MODELING OF THE THIN LAYER SOLAR DRYING OF PARSLEY

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Using renewable energy in food industry and especially in drying process is drastically growing. This paper is concerned with the mathematical modeling of thin layer solar drying process of parsley. For this purpose, a solar dryer with auxiliary heat pump was developed and equipped with instrumentation to collect data for evaluation. All experiments were conducted at air temperatures of 35 ºC, 45 ºC and 55 ºC and air velocities of 1, 2 and 3 m s-1. The drying data was fitted to five different mathematical models. Among the models, the Middili et al. model with the coefficient of determination was 0.997 was found to best explain thin layer drying behavior of the parsley leaves. The performance of these models was investigated by comparing the determination of coefficient (R), reduced-chi square and root mean square error (RMSE) between the observed and predicted moisture ratios.

Keywords: Solar drying, parsley, mathematical modeling

P-096 [Section IV: Energy in Agriculture]

COMPARISON OF SIEVING METHOD AND IMAGE PROCESSING METHOD USED TO DETERMINE THE SIZE OF SHREDDED PRUNING RESIDUES

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Pruning residues after shredding operations can be evaluated in many different ways, such as biomass for energy production, shredding, mulch, compost and mixing to soil to improve soil properties, and usage of raw materials for some industrial plants. It is important to know and classify the dimensions of the disintegrated material when the residues are used in different shapes. However, it is important that the dimensions of the particles are accurately measured during storage and transport of the shredded material. The size of the particles cannot be precisely measured by the sieving method, which is often used in conventional particle size determination methods. Instead of the elimination method which takes into account the single dimension of the particles, measurement of particle sizes using image processing method enables more accurate measurements to be made.

In this study, the screening method and the image processing methods used to determine the sizes of the palm chipped pruning residues were compared with each other. At the end of the study, the average particle size measured with image processing method was found 17% larger than the sieving method

Keywords: pruning residues, image processing, sieving.

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ALPLER AGRICULTURAL MACHINERY is the largest agricultural machinery producer in Turkey, and is one of the few leading companies in the world in the agricultural equipment sector. The company is operating in its modern facilities, established on a total area of 120.000 square meters located in Organized Industrial Zone of Aydin. ALPLER AGRICULTURAL MACHINERY is marching into the future with reliance on the synergy created by its more than 400 creative, productive and well experienced employees, working with the ambition and enthusiasm to manufacture better and higher quality products day by day.

As a result of many years of experience, ALPLER AGRICULTURAL MACHINERY has the widest manufacturing and after-sales service program in Turkey. The company has adopted a customer oriented administration and Total Quality policy, and provides it equipment to the farmers in Turkey, throughout its more than 300 dealers all around the country. Today ALPLER exports its products to 70 different countries in 5 different continents all around the World.

Since 1926 ALPLER AGRICULTURAL MACHINERY has remained a private enterprise, and today the company is in its third generation of ownership by the Özalp family. Great importance is attached to integration with worldwide advanced production technologies and research to satisfy market needs. Much of the fabrication work involves the use of robot welders and CNC machining, enabling a high degree of quality assurance to be maintained during production. Additionally ALPLER AGRICULTURAL MACHINERY conducts its operations in compliance with the technical requirements of the European Union, and has been operating under the ISO 9001 quality system since 2004.

In its sector, ALPLER AGRICULTURAL MACHINERY is the only plant which operates IN-HOUSE production conditions in Turkey with custom design equipment for different needs of individual soil conditions for domestic and foreign fields.

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ANTALYA METROPOLITAN MUNICIPALITY

www.antalya.bel.tr/?l=en

ANTALYA CHAMBER OF COMMERCE AND INDUSTRY

english.atso.org.tr

Antalya Chamber of Commerce and Industry (ACCI), which is among the oldest Chambers of Commerce and Industry in Turkey, was established under the name of "Commission of Agriculture and Commerce" on April 3, 1882.

ACCI has 29.927 active members as of April 2018. ACCI has agencies in Serik, Kemer, Korkuteli, Elmalı, Gazipaşa, and Akseki districts of Antalya.

There are 49 professional committees in ACCI, members of which are elected every four years. Also, the Chamber has an Assembly of 111 members, who are elected by the professional committees, an Executive Board comprising 11 members, and 119 chamber staff.

ANTALYA COMMODITY EXCHANGE

www.antalyaborsa.org.tr/en

Antalya Commodity Exchange was established in 23.06.1920, started activities on 07.02.1920 as Antalya Commodity and Grain Exchange.

Our Exchange is the third oldest in our country, most developed of the lakes region.

Our Exchange adapted to the Law No: 655 in 1924, Law No: 4355 in 1944, Law No: 5590 in 1950 an earned the title of Antalya

Commodity Exchange and adapted to the Law No: 2567 in 1981.
Our Exchange had 45 members in founded, the number of members continiously increased.

ANTALYA GOVERNORSHIP

www.antalya.gov.tr

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TURKISH POULTRY MEAT PRODUCERS AND BREEDERS ASSOCIATION (BESD-BIR)

www.besd-bir.org/en

BESD-BIR is an association founded by the Turkish poultry meat producers, broiler hatcheries and breeder (parent stock) companies. 28 member companies represent the 95% of the Turkish poultry meat production. The main objectives of BESD-BIR are; to maintain the coordination between government and industry, to create the policies for the development of the poultry industry for the benefit of the country, to produce the statistics, to promote the high quality and safety production, to create the demand to poultry products and spend efforts to increase the consumption of healthy and nutritious poultry products all over the country, to organize the conferences, seminars and symposiums, collaborate with the other associations and to represent Turkish poultry meat sector internationally on this regards.

DOĞA TARIM (AGRICULTURE)

www.dogatarim.com

Çevreye ve insana saygıyı ön planda tutarak Türk Tarımına yenilikler kazandırmak amacı ile kurulan Doğa Tarım, en kaliteli ürün ve hizmetleri müşterilerimize sunarak, dürüst ve yenilikçi firma imajı ile 25 yıldır Türk Tarımına hizmet etmektedir.

GROW FIDE (SEEDLINGS)

Güney Agripark
Tarımsal Araştırmalar
Sanayi ve Ticaret Ltd. Şti.

www.growfide.com/eng/index.html

Grow Fide Üretim ve Ticaret A.Ş. was founded in 2001 in Antalya with participation of Turkish partners and Grow Group B.V., a company of Dutch origin which is one of the World's leading vegetable plant growers.

Grow Fide produces healthy and highly productive vegetable and flower seedlings that the growers need to produce high quality products. The Company is the pioneering establishment in Turkey in the field of grafted seedlings and is known by its highest technology and quality in the sector. It is not only the first company producing grafted eggplant and watermelon seedlings in Turkey, but it also trains Turkish farmers about growing these seedlings and benefiting from this technology.

Though Grow Fide is a relatively new company, it has shown a rapid development and has been able to expand its production fields to a total of 100.000 (of which 10.000 are used as special grafting laboratory) square meters from 13.000 in 2001.

Grow Fide, which has reached an annual capacity of about 100 million seedlings, produces all kinds of grafted and non-grafted vegetable seedlings as well as seasonal flower seedlings. The Company, with its products grown with state-of-the-art technology, has in a short time become a world-wide known producer of grafted seedlings. Along with its domestic sales, the Company also makes exports to some European and Middle East countries.

KONYA COMMODITY EXCHANCE

www.ktb.org.tr/?cat=61

Konya Commodity Exchange established in 1907 and it is one of the biggest Exchange around Turkey, Konya Commodity Exchange has eight branch office and one center in Konya.

Konya Commodity Exchange maintain different committees that are specialized on specific products and issues. The commitee members are big traders or producers of the mentioned goods whom are selected. Special Commitees are Cereal, Pulse, Feeders , Live Stocks Traders , Butchers, Leather, Wheat Flour, Dairy Products, Vegetable Oil, Fleece producers and traders Committes.

Konya Commodity Exchange is one of the most valuable exchange of Turkey. All mentioned goods are processing but KEC specialized especially on Cereals. Because Konya has the biggest plantation for cereals and Pulse. In Konya 12 % of Wheat production and 14 % of Barley production held.

Daily Prices are determined according to the transactions on Our Exhange Hall. Goods bring into Exchange and sold by auction. On the Crop season nearly 4000-5000 MT of Goods to be sold.

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Spices (cumin etc.)
Cereal Products (Wheat Flour , Pounded Wheat..etc)
Textile raw materials (mohair, wool,…etc)
Live Stocks (catle', sheep')
Raw Leather (animal leathers)
Oil Seeds (sunflower, flax, hemp)
Vegetable Oil (vegetable butter)
Pyrene (Apricot, almond pyrene etc)
To arrange and register the trade of commidities and to establish and announce daily prices,
To create general rules and decisions, with the acceptance of TOBB, about obligation of delivery, taking delivery and payment, arbitration procedures in conflicts.
To follow and communicate with domestic and foreign exchange s and markets.
To construct laboratory and technical offices to establish types and qualities of materials that are traded in the exchange,
To arrange and announce the custom and practices of exchange and make duties given by other regulations and ministry of industry and trade.

THE TURKISH ASSOCIATION OF AGRICULTURAL MACHINERY & EQUIPMENT MANUFACTURERS (TARMAKBIR)

TARMAKBİR
Türk Tarım Alet ve Makineleri İmalatçıları Birliği
The Turkish Association of Agricultural Machinery and Equipment Manufacturers

www.tarmakbir.org/en/about-us.html

TARMAKBIR, The Turkish Association of Agricultural Machinery & Equipment Manufacturers, is an initiative of Turkish private sector and founded in 1978. Being the representative of the Turkish agricultural machinery industry, currently it has around 250 members those are senior manufacturers of tractors and agricultural equipments.

TARMAKBIR is one of the oldest member associations in "Mechanical Industry Sector Platform of TURKEY" and has been entitled to use the word "Turkish" at the beginning of its title by a former decision of the Turkish Council of Ministers.
Being in a continuous interaction with governmental bodies and national & international organizations, TARMAKBIR serves as a common platform for the industry and supports its members through regulations, technical and scientific improvements, commercial issues, environmental issues and data providing.

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It is a unique NGO of feed manufacturers in Turkey and acts for sustainable development of Turkish compound feed sector, it aims to increase the sector competitiveness around the world and provide opportunities to citizens for their healthy and affordable protein consumption.

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Considering the agricultural needs of our country, Minos Agricultural Machinery has put the Mixer-Feeders into service with the quality, privilege, guarantee and assurance of Minos, which are designed to have strong and reliable structures, be easy to use and eco-friendly machines.

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ÜNLÜ

www.unluziraat.com.tr/about-150.html

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In all regions of Turkey, and in overseas there's many our dealers so they serving and solving our clients problems with portable services.

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FOCUSED TO HAVE OUR PRODUCERS BENEFIT MORE

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As a producer we know very well that growing agricultural products intense as of labor and costly business line at the same time. When we think of today's competitive environment, as a breeder we have to obtain more healthy and quality products from the unit area in order to be able to receive the salvation of our labor after the harvest. In order to be able to achieve this, we have to reduce input. With this understanding, we have focused on to have our producers operate more profitably by providing them the products of licensors abroad or products produced with the research and development activities of chemists who are in the field.

EXPORTING ABROAD

YSL Agriculture Foreign Trade is proud to add value to the thousands of farmers who prefer our products in our country and to the producers in different regions of the world using our exported products. We took to offer quality, economical, humanitarian and nature-friendly products to our producers and the producers located in different geographical areas in the World as a mission in the field of Plant Nutrition. Our vision is to develop new formulations as a result of continuous research and development activities, and to continue to be the pioneer of the industry by providing superior products developped within the country or abroad to the service of producers.

As YSL Agriculture Foreign Trade Corporation; we use our products which we have produced with many years of experience in our own land in the province of Kayseri (Yeşilhisar). We also provide service to our farmers to whom we reach by our distributors.


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