

Cannabis growers as gardeners: results from a survey among Italian and British small-scale growers

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Acknowledgments: We thank the cannabis cultivators who have completed our online questionnaires and contributed their knowledge and experience to this work. Thanks also to all the people and organizations who supported and promoted our research. An earlier version of this paper was presented at the International Society for the Study of Drug Policy Conference in Leuven, Belgium, in 2023.

Declaration of Interest statement: the authors have no competing interest to declare.

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Abstract

Background: The horticultural nature of growing cannabis is often overlooked in the study of cannabis production, and subsequent policies. Little is known about whether growers' horticultural expertise influences cannabis cultivation methods, the growing of other psychoactive plants, substance use behaviors, or interactions with the criminal justice system. The trajectory of cultivation, in terms of whether cannabis is a gateway to more general gardening, or vice versa, is also unexplored. Studying individuals who combine cannabis cultivation with other gardening activities is valuable because it provides insights into the motivations and practices of cannabis growers as illegal drug market participants.

Methods: Data from 1,302 small-scale cannabis growers in Italy and the UK was collected through an online survey from 2020 to 2021. We ran two regressions to compare (1) those who only grow cannabis with those who also grow other plants and; (2) those who started growing cannabis and then grew other plants and vice versa.

Results: Most people in our sample grew cannabis and other plants (General Gardeners; 82%). In comparison with the Only-cannabis group (OCG), General Gardeners (GG) tended to be older, more educated, and more likely to be in a relationship. GG grew more cannabis crops outdoors, and the purposes for growing were more related to ecological or medical reasons rather than selling cannabis. The OCG group had higher odds of using stimulant drugs and meeting cannabis use dependence criteria compared to GG. Among GG, the majority (71%) started growing other plants and later moved to cannabis.

Conclusion: Gardening other plants is common among cannabis growers and precedes cultivating cannabis far more than the reverse pathway. As general gardeners appear focused on cannabis alone, concerns about spillover to growing other psychoactive plants or fungi may be overstated. Given the lower expected harms associated with general gardening, it could serve as a proxy for reduced supply involvement in legal assessments.

Keywords: Cannabis Cultivation, Marijuana, Drug Policy, Horticulture, Cannabis Growers, Cannabis Use Dependence, Online survey

List of abbreviations

Cannabis-First: cannabis growers who started with cannabis and moved to growing other plants
CI: confidence interval
COG: Cannabis-Only Growers
CUD: Cannabis Use Dependence
EMCDDA: European Monitoring Centre for Drugs and Drug Additions
GCCRC: Global Cannabis Cultivation Research Consortium
GG: Generalist gardeners growing both cannabis and other plants
LSD: Lysergic acid
MDMA: 3,4-Methylenedioxymethamphetamine
Other Plants-First: cannabis growers who started with other plants and later moved to growing cannabis.
SDS: Severity of Dependence Scale
UNODC: United Nations Office for Drugs and Crime

Introduction

Domestic cannabis cultivation occupies an ambiguous position in public discourse, criminalized in most jurisdictions as akin to drug production (Potter, 2010), yet sharing characteristics with gardening practices long associated with health and sustainability (Thompson, 2018). In contrast to countries like Uruguay, where home cultivation has been legal for over a decade (Aguiar & Musto, 2022), small-scale cannabis growers in many parts of the world face criminal sanctions despite often cultivating for personal or ideological reasons, rather than for profits (Søgaard et al., 2024). The global shift toward decentralized, domestic production (Potter, 2008; Potter, 2010; UNODC, 2021), enabled by indoor growing technologies and ideological motivations, has prompted a growing body of research on cannabis cultivators. However, cannabis policies often take a criminological approach to cannabis cultivation, overlooking its horticultural aspects (Barrett et al., 2025)

This study addresses this gap by examining small-scale cannabis growers in Italy and the UK. We explore the extent to which cannabis cultivation is part of wider home-gardening activity, and what this reveals about grower profiles, motivations, and substance use behaviors. In particular, we compare Cannabis-Only Growers (COG) to Generalist Gardeners (GG), those who also grow other plants. Among GG, we distinguish between those who began with cannabis (“Cannabis-First”) and those who began with other plants (“Other Plants-First”). This dual focus enables us to assess both the role of horticultural experience in shaping cannabis cultivation, and the possible influence of cannabis growing on broader gardening practices.

This inquiry is timely, as gardening itself is undergoing a resurgence in many countries, driven by concerns over food security, environmental sustainability, and personal autonomy. In Britain, nearly half of adults report gardening, often to grow food (Chalmin-Pui et al., 2021); in Italy, 37% of those over age 11 were active gardeners in 2006 (ISTAT, 2008) and their motivations include eating healthy food (50%), passion (20%), and saving money (10%) (Coldiretti-Censis, 2015)¹. Gardening is indeed linked to food security, better diets, and improved mental health (Hume et al., 2022). In times of economic uncertainty and growing environmental awareness, it has been re-legitimized as both a coping strategy and a political act (Burgin, 2018). Meanwhile, many cannabis growers, like gardeners more broadly, prioritize ecological methods, self-sufficiency, and product quality over profit (Potter, 2010; Weisheit, 1991; Lenton et al., 2024). This parallel opens up a possibility to reconceptualize cannabis cultivation not solely as illicit activity, but also as a form of domestic horticulture, historically rooted and ideologically motivated (Barrett et al., 2025). Small-scale home cultivation is increasingly seen as a viable, less harmful alternative to commercial supply, avoiding many of the pitfalls associated with for-profit cannabis markets (Belackova et al., 2019; Pardal et al., 2023). Yet the distinction between "natural" and "artificial" growing practices embedded in legislation often misrepresents the lived realities and commonsense approaches of home cultivators (Barrett et al., 2025). By attending more closely to the material practices of cultivation, drug policy can be better informed by grounded knowledge of how cannabis is actually grown, and thus avoid counterproductive regulations that hinder effective and sustainable home growing.

By situating cannabis growers within the wider context of home gardening, our study contributes a novel perspective to debates on drug policy. We examine not only cultivation methods and motivations, but also the relationship between gardening and Cannabis Use Dependence (CUD), psychoactive substance use, and experiences with the criminal justice system. In doing so, we offer evidence to support more differentiated and context-sensitive cannabis policies which recognize the diversity of grower practices and the broader social and ecological logics in which they are embedded.

¹ Recent data on gardening in Italy are limited and often come from interest groups, such as agricultural trade unions, which rarely provide detailed information on methodology or sample size.

Small-scale cannabis cultivation as domestic horticulture

As younger adults view gardening as an affordable form of domesticity (The Economist, 2018), cannabis cultivation may be considered as just a continuum in the spectrum of plants that can be grown by individuals interested in gardening. Within this broader turn toward domestic horticulture, cannabis emerges not as an anomaly, but as a particularly complex case—one that reflects wider socio-legal tensions around plant cultivation. Cannabis cultivation occupies a unique position in plant cultivation due to its legal, social, and cultural complexity, particularly in countries where legal access is restricted (Hakkarainen et al., 2015; Potter et al., 2015). Small-scale growers often cultivate cannabis for non-financial reasons, including ensuring quality, addressing health needs, cost savings, and ethical considerations, such as avoiding criminal markets (Pavarin, 2022). The Global Cannabis Cultivation Research Consortium (GCCRC) has extensively studied these growers, showing that motivations are largely ideological or practical rather than profit-driven (Potter et al., 2015).

Weisheit's (1991) study on Illinois growers and Hough et al.'s (2003) work in the UK highlighted the intangible rewards of cultivation, such as personal satisfaction and cultural values. Many small-scale growers align with cannabis culture's anti-commercial norms, contrasting with large-scale producers who focus on financial returns (Sandberg, 2012; Potter et al., 2015). Dissatisfaction with illicit market quality also drives cultivation, and improved growing methods among small-scale growers have reduced reliance on harmful chemicals (Lenton et al., 2024).

While most small-scale growers cultivate solely for personal use, some engage in social supply, distributing small quantities informally (Søgaard et al., 2024). Growers typically start in young adulthood after regular cannabis use (Potter et al., 2015). Motivations for cultivating often extend beyond consumption, reflecting a broader ethos tied to environmental sustainability and quality assurance.

An emerging concern is the relationship between cultivation and CUD. Research shows recreational growers may have higher Severity of Dependence Scale (SDS) scores compared to medical growers, suggesting different patterns of use and risk (Sznitman et al., 2023). These dynamics underscore the need for nuanced cannabis policies that consider the cultural and motivational diversity of growers.

This paper examines the relationship between domestic cannabis cultivation and involvement in other forms of home gardening, contributing to a more nuanced understanding of small-scale cannabis growers within drug policy debates. Our research aims to understand the motivations

for becoming a GG compared to a COG and how these motivations relate to the growing career trajectory. Additionally, we aim to address a crucial dimension of the “ideological” motivations and “intangible rewards” experienced by growers, as articulated by Weisheit (1991). By assessing the involvement in other gardening activities, the study aims to inform public health initiatives, harm reduction strategies, and policy responses tailored to different grower profiles. The findings will contribute not only to the growing body of research on drug policy and plant-human interactions, but also provide insights that could inform policy discussions related to cannabis cultivation.

Methods

Data collection

Data were collected by the GCCRC through an online survey of mostly small-scale growers, the International Cannabis Cultivation Questionnaire (ICCQ) 2.0, in 18 countries (n=11,479) in 2020-2021. For this paper, we draw on a sub-sample (n=1302) from Italy and the UK. These two countries included two extra questions on gardening activities²: Respondents were asked whether they grew “other plants besides cannabis” (asking people to select which types of plants they grew), and whether cannabis was the first plant they ever grew. Respondents could answer yes or no to this question and these data were used to create the following mutually exclusive cannabis user groups: cannabis growers who started with cannabis and moved to growing other plants (“Cannabis-First”) and cannabis growers who started with other plants and later moved to growing cannabis (“Other Plants-First”).

The methodology of data collection was based on the first wave of the survey (see Barratt et al. 2015). The survey was distributed between August 2020 and September 2021 in Italy and the UK and presented in both English and Italian. The inclusion criteria for the present study were being 18 years or older, having grown cannabis in the previous year, having completed at least 50% of the ICCQ 2.0 core questionnaire, and having answered the module on gardening. Ethical approval was granted by ethics committees at Curtin University, Australia (as the survey and data are hosted at Curtin via Qualtrics) and Lancaster University, UK.

The recruitment strategy included individual access links for each participating country to the survey via the GCCRC website (<https://worlwideweed.nl>) which were distributed via media

² The gardening module was mandatory for the Italian sample and optional for UK respondents (it was asked whether they want to answer two questions about gardening).

outlets specializing in cannabis-based products, and on Facebook and Twitter (now X). Different promotional strategies were implemented in Italy and the UK, such as launching feature articles and media releases (e.g. radio), engaging with cannabis communities through online forums and social media groups, and inviting cannabis-related shops to promote the survey either directly to their customers or online.

All data were self-reported. The questionnaire collected data on socio-demographics, cannabis use, growing methods, reasons for growing, use of other licit and illicit substances, involvement in other types of crime, and contact with the criminal justice system. Substance use was assessed over the previous year. Cannabis use frequency was collected as the monthly number of days of use.

Variables

The dependent variable for the full-sample analysis measures the type of cannabis grower in the past 12 months prior to the survey based on having grown other type of plants or not. According to the type of grower, participants are divided in two groups: Generalist Gardeners (GG) growing cannabis and other plants; and Cannabis-Only Growers (COG) who only cultivate cannabis.

The dependent variable for the second analysis measures the cultivation trajectory among those who grow both cannabis and other plants. Participants are divided into two groups: ‘Cannabis-First’ and ‘Other Plants-First’. See precise questions in appendix A.

To establish the differences across types (GG vs COG; Cannabis-First vs Other Plants-First), 30 variables of growers’ characteristics and growing experience were used based on the existing literature on gardening and cannabis growing: 29 binary variables and one continuous (age).

Sociodemographic and other control variables: We operationalized several sociodemographic measures: age, gender (including a non-binary category), employment status (employed vs. not in employment), education (beyond high school/technical trade diploma or not), location (urban vs non-urban) and whether they have a partner. Regarding substance use, we recorded past year use of alcohol, tobacco, and other illicit substances (0=no, 1=yes). Other illicit substances was recorded based on endorsement of use of any of the following substances: stimulants (methamphetamine, amphetamine, powder cocaine, crack cocaine, ecstasy/MDMA),

depressants (heroin, benzos/sedatives, other opioids), and hallucinogens (LSD, magic mushrooms)³.

Motivation variables: Respondents were asked about various motivations for growing cannabis. We focused on the following motivations for the current study which are all derived from the same multiple-choice question: to provide oneself with recreational and/or medical cannabis, to provide others for recreational and/or medical use, to sell, because it is cheaper than buying, for the pleasure of growing, for the beauty of the plant, because it is easy to take care of, to ensure high quality (no adulterants and to produce healthier product), for political reasons and for ecological/environmental reasons.

Growing methods variables: Respondents were asked about the techniques used to grow cannabis. We focused on those related to their ecological attitude and socialization, such as growing outdoor vs only growing indoor, avoiding chemicals, and growing with other people vs growing always alone.

Cannabis Use Dependence: The severity of their CUD (Severity of Dependence Scale [SDS]) was assessed by using a quantitative variable which is a sum of scores from 5 ordinal variables (4-point Likert scale). The variables measure whether across the past 3 months: i) their use of cannabis felt out of control, ii) if the prospect of missing a dose was worrying, iii) if their use troubled them, iv) if they wished they could stop (all from 0=never or almost never to 3=always or nearly always), and v) how difficult stopping might be (from 0=not difficult to 3=impossible). We identify growers with “problematic cannabis use” when their SDS scale score is equal to or greater than 3, following Swift et al. (1998).

Contact with Law Enforcement: Contact with the police for growing cannabis during their lifetime was also assessed in the first regression between GG and COG.

Other type of plants grown: Respondents who declared they grew other plants were asked about which type. In the second regression, we focused on two categories of plants: fruits and vegetables (food garden), and other psychoactive plants or fungi.

Statistical Analysis

For both analyses of this study, we used a seemingly unrelated bivariate probit regression to control for the potential differences between Italian and British respondents (Chiburis and

³ The taxonomy of substances is taken from McCandless, D. (2010). *Drugs World*. informationisbeautiful.net/visualizations/drugs-world/

Lokshin, 2007). This approach was based on two simultaneous equations with correlated error terms and robust standard errors. In the first equation, the factors associated with the country of residence were identified using a multivariable probit regression model. The second equation, adjusted for the country of residence, was estimated by maximum likelihood together with the previously identified first equation. In the second equation, we have tested all the variables which we found in the literature on gardening and cannabis growing which may affect the likelihood of growing other plants besides cannabis. Tables 2 and 3 present the second equation of this method. The full models are presented in Appendices B and C.

Results

The study sample includes 1302 participants who have been cannabis growers in the 12 months preceding the survey, and who reported living either in Italy (79.0%, n=1029) or the UK (21.0%, n=273). Descriptive statistics are presented in Table 1⁴.

[PLEASE INSERT TABLE 1 HERE]

Most participants had grown both cannabis and other plants (n=1069; 82.1%) while almost one fifth had grown only cannabis (n=233; 17.9%). The distribution of the sample shows a higher proportion of GG in the British sample than in the Italian one (89.0% versus 80.3%, p=0.001). The higher portion of gardeners among the British population is due to the gardening module being optional in the UK and mandatory in Italy. This led to a selection bias of gardeners among the British sample as those who are COG are less likely to agree to respond to a gardening module. Among them, the majority are food gardeners (55.0%) and are cultivating house plants (60.8%). About half are growing garden flowers or shrubs (47.8%), whereas only 6% are growing other drug plants or magic mushrooms. The Italian participants declare growing more garden flowers (71.8% versus 41.4%, p<0.001) and also more fruits (69.2 versus 51.2%, p<0.001) than those living in UK. The Italian respondents are much younger than those living in UK (median [first quartile – third quartile]: 23 [20-33] versus 48 [40-56], p<0.001). Results of the seemingly unrelated bivariate probit analysis on the growers presented in Table 2 shows that GG exhibited significantly lower SDS scores for cannabis use as well as a lower last-month use of stimulant drugs compared to those exclusively cultivating cannabis. GG are also associated with cultivating cannabis outdoors. In terms of purpose for growing cannabis, the results indicated that GG were more inclined to cultivate cannabis for their own medical use or

⁴ Due to non-responses to certain questions, the first regression has 192 missing observations, while the second multivariable regression has 124 missing observations.

for environmental reasons. Conversely, COG are more likely to cultivate cannabis for selling purposes. In terms of socio-demographics, the analysis revealed that GG were older on average compared to COG. GG were also more likely to possess a university degree and to be in a relationship or have a significant other compared to COG.

[PLEASE INSERT TABLE 2 HERE]

The second model compares the trajectory of cannabis cultivation. Among GG, 28% reported having started with cannabis before growing other plants, representing a significant minority within this group (Table 3). The results of the seemingly unrelated bivariate probit regression analysis on the differences between cannabis growers who initially began with cannabis cultivation and expanded to other plants, compared to those who started with other plants and later incorporated cannabis into their practices suggest that Cannabis-First is associated with gender, being significantly more likely to be male. The probability of starting to grow cannabis first decreases by 16 percentage points when the grower is female. Cannabis-First is also associated with not having a university degree, abstaining from alcohol use, growing cannabis for medical distribution, and not identifying as food gardeners.

[PLEASE INSERT TABLE 3 HERE]

Discussion

This study was carried out to investigate how growing cannabis relates to cultivating other plants across two European countries. Results reveal significant differences suggesting that GG are a distinctive group of cannabis growers. As far as we are aware, the current study is the first to test the factors which differentiate GG from COG. It is also the first which looks at their growing trajectory.

Generalist gardeners vs Cannabis-only Growers

GG are older, which may reflect a generational trend, with older individuals more likely to engage in gardening activities overall. Their age may also indicate that, over time, individuals have had more opportunities to develop a broader interest in plant cultivation. Additionally, they are more likely to have access to growing space and the leisure time necessary to engage in gardening activities. The association between being a GG and growing cannabis outdoors can be explained by several factors. First, the availability of outdoor spaces is an incentive for growing plants, and it is thus likely to increase the chances of growing any type of plant. Second, growing other plants outdoors lowers the likelihood of detection from law enforcement,

particularly from aerial patrols searching for drug crops. Lastly, growing different plants outdoors is a form of permaculture which reduces the dependence on external inputs (e.g., chemicals) and restores and maintains natural systems, such as soil quality and biodiversity (McLennon et al., 2021). This explanation is supported by the positive association between being a gardener and growing for environmental reasons. However, it is worth noting that the variable measuring whether growers avoid chemical inputs was not significantly associated with being a GG, suggesting that ecological motivations do not always translate into strictly organic or chemical-free practices. The environmental motivation is important also for gardeners who cite ecological concerns as one of the reasons behind their cultivation of cannabis and other plants (Mullins et al., 2021; Chalmin-Pui et al., 2021). GG are also more medicinally oriented and prefer to self-supply their own cannabis 'medicine', rather than buying it illicitly. This is linked to the fact that most GG in our sample are doing so also for food so they may see gardening as a way to eat healthier as they may see growing cannabis as a way to treat themselves with a healthier medicine. The fact that GG are more motivated by the pleasure of growing cannabis compared to COG can be explained from a different framing across these type of growers (Tversky and Kahneman, 1981). Those who engage in more diverse gardening activities are more driven by the pleasure derived from cultivating cannabis specifically. This contrasts with COG, as they lack the comparative experience with other plants. The pleasure associated with cultivating cannabis is thus accentuated when juxtaposed with the cultivation of commonplace plants like tomatoes. The last motivation which distinguishes GG from COG is growing for the purpose of selling cannabis. This is associated with COG and can be explained by the desire to maximize yield for those having a limited amount of space in their property. Other plants would reduce the space available for cannabis, in turn lowering the final yield and the revenues which can be obtained from the crop. Looking at their usage of cannabis, the analysis indicated that GG are less likely to be problematic cannabis users compared to COG. Moreover, they are less inclined to have engaged in the use of illicit stimulants within the past year. Both findings could be explained by the growing body of research showing the potential of horticultural therapy as a greenspace program to improve mental health and support people with problematic patterns of substance use (Masterton et al., 2022). Further research is needed to better understand this potential association. If confirmed, gardening could be considered as a component of harm reduction programs specifically targeted at individuals with problematic cannabis or stimulant use.

Is cannabis a gateway to gardening?

Turning to growing trajectory, most GG began by growing other plants before transitioning to cannabis. This pattern may be partly explained by early exposure to gardening through school-based programs, as well as by the greater horticultural confidence of green-fingered individuals, who already engage in plant cultivation which may reduce the perceived barriers to growing cannabis. Besides, for an initial interest in growing plants, the choice of an individual to perform gardening activities is determined by the availability of domestic space, the initial knowledge on plant cultivation, and the legal status of the plant. From a utilitarian perspective, the decision to enter gardening will thus depend on an intuitive cost-benefit analysis depending on the trade-off between the costs of gardening (e.g., operational and learning costs, time resources, legal risk) and the benefits obtained from the plant(s). For instance, it is unlikely that someone who uses cannabis occasionally will decide to start growing cannabis indoors using professional equipment (lights, etc.) given that operational costs can be considerably higher than for other plants. While the operational costs for outdoor growing are minimal and fairly similar across different plants, the legal cost of being caught growing cannabis makes it less desirable to begin with. Conversely, the benefits provided by a plant when used medically - such as cannabis - are widely considered most significant by their consumers compared to plants grown as foodstuffs or ornaments. Therefore, in a context which does not criminalize cannabis growing, the prevalence of people starting with cannabis and moving to other plants is likely to increase.

From our analysis, individuals who grew cannabis first do not appear very problematic. This growing trajectory is associated with providing medical cannabis to others, conceivably grounded in their inclination to invest efforts into learning plant cultivation if it could serve as a therapeutic modality for acquaintances. Furthermore, individuals who transition from cultivating cannabis to other plants exhibit a notable association with abstinence from alcohol. This pattern suggests a potentially distinctive trend among those who initially engage in cannabis cultivation before diversifying their horticultural pursuits. There is a need for further exploration into the factors and motivations that may underlie this connection, opening avenues for understanding the relationship between cannabis cultivation trajectories and alcohol abstinence among this particular cohort of individuals. Interestingly, people who report growing cannabis first are less likely to be food gardeners. This may suggest that food gardening is actually a gateway to cannabis growing rather than the contrary.

In terms of socio-demographics, men were significantly more likely to begin gardening by growing cannabis, which is not surprising given that men exhibit higher rates of cannabis use in general and are more likely than women to be involved in most types of crime (Diviák et al., 2020). People who grew cannabis first were also less likely to possess a university degree which suggests a potential association between lower educational attainment and the preference for cannabis as the initial cultivation choice. While this finding may in part reflect practical factors, such as university students being more likely to live away from home and lacking access to private outdoor space, it is also important to consider broader structural inequalities. Limited access to higher education and exclusion from formal employment opportunities may push some individuals toward informal economies, including small-scale cannabis cultivation. This perspective underscores the need to interpret cultivation trajectories not only in terms of individual choice, but also in relation to the social and economic contexts in which they occur.

Looking at the overall impact of gardening among the population, our study shows that there is a significant minority of GG in our cohort who have started from cannabis. The increased number of gardeners has both direct and indirect positive repercussions on the environment and on food security. Besides being an ecological behavior, home gardening exposure appears to increase environmental concerns, attitudes and pro-environmental behaviors (Sanvichith, 2011; Schupp & Sharp, 2012; Fisher-Maltese & Zimmerman, 2015; Pritchard et al., 2020; Richardson et al., 2020; Mackay and Schmitt, 2020). Food gardening has also been expanding rapidly after the Covid-19 pandemic as a form of food security (Lal, 2020). In a world where environmental and food system challenges are becoming increasingly pressing, even small-scale home gardening, such as growing herbs and vegetables, can represent a valuable step toward more sustainable lifestyles. While such initiatives cannot, on their own, address large-scale food insecurity, policies that discourage home cultivation may inadvertently reduce opportunities for individuals to engage with nature, strengthen their food autonomy, and adopt more sustainable habits.

It is also worth considering GG who cultivate other drug plants. Less than one in 20 were doing so in our sample, despite some of these types of plants being easier to hide from neighbors compared to cannabis plants. This finding may be explained by reference to the entry costs of starting growing other plants and the related difficulties in (1) finding seeds and cuttings; (2) growing these plants (as cannabis is relatively resilient to a range of environmental conditions); (3) processing the plants to extract a usable drug product; and (4) having enough space to produce a meaningful amount of drug. Another possible interpretation could be that the

satisfaction with the effects of cannabis may lower the interest for growing additional drug plants. Unfortunately, the lack of appropriate questions and the low number of individuals growing other drug plants does not allow us to test whether cannabis was a gateway to their cultivation. Future research with a larger sample and additional questions should look at this phenomenon.

Limitations

This study has several limitations. First, the survey is a self-selecting online convenience sample from two European countries that may not necessarily be representative of wider populations of cannabis cultivators, either within or beyond the two participating countries. Despite being unable to test its actual representativeness, in prior work sociodemographic and drug use characteristics of comparable convenience samples and matched sub-samples from representative surveys were similar for both cannabis growers (Barratt and Lenton, 2015) and consumers (Barratt et al, 2017). Overall, hidden and stigmatized populations often do not respond to general surveys, thus targeted sample strategies are considered the best way to reach them. Second, data are self-reported which implies attendant biases, such as recollection and social desirability. Yet anonymous surveys without payment incentives provide a more favorable setting for disclosing information on delicate topics (Kays et al., 2013). Moreover, a recent systematic review has shown that self-report is a reliable predictor of drug use when this was also measured using biological markers (Bharat et al., 2023). Third, gardening takes many forms across diverse spatial contexts, from private properties to public spaces, such as community gardens. In this article, we have not asked much about the magnitude of their gardening, but future surveys addressing this topic should design questions which take into account gardening scale and experience. Fourth, the questions we used did not allow an in-depth exploration of this topic. Future versions should ask more detailed questions about what GG grew (e.g., specifics on types of plants, number of plants), their motivations for growing different types of plant, as well as information on the progression of growing different categories of plants. Fifth, we administered the survey during the COVID-19 period, a time when home gardening significantly increased. However, the original idea of the study was related to examining the phenomenon in a normal period. Therefore, this article does not aim to contribute to the understanding of gardening trends in cannabis cultivation during the pandemic (Werse et al., 2024). Lastly, due to less than 7.0% of the sample (n=1302) who started growing cannabis and other plants at the same time (6.7%, n=71), a regrouping with participants

growing cannabis first (21.5%, n=228) had to be done (17.9%, n=233). Differences between within this group could therefore exist which may require further investigations.

Policy Implications

The differential characteristics of GG compared to COG has implications for those countries which adhere to the international treaty regime's provisions on cannabis. Our study shows that at least 4 out of 5 cannabis growers are GG and that food gardening may actually be a gateway to cultivating cannabis. As legislation eases around cannabis cultivation in many countries, it is possible that some gardeners may choose to add cannabis to their gardens, including as part of a broader interest in permaculture. While direct evidence on this trend remains limited, it is consistent with documented moves toward biodiversity-oriented and self-sufficient home-gardening practices (Delahay et al., 2023; Korpelainen 2023). Importantly, our findings suggest that GG are associated with lower levels of cannabis-related harms compared to COG. Using Greenfield and Paoli's (2013) typology of harms, and as shown by Paoli et al. (2015), large-scale, commercially oriented growers tend to cause greater harm, especially when operating indoors. By contrast, GG are less likely to grow for commercial purposes and more likely to adopt outdoor cultivation methods, which have a lower environmental footprint and pose fewer risks such as odor nuisance, fire hazards, or electricity theft (Mills, 2012; Paoli et al., 2015; Potter and Klein, 2020; Potter and Chatwin, 2012). In addition, GG are associated with lower levels of Cannabis Use Disorder (CUD) and are less likely to report the use of illicit stimulants. Rather than arguing for generalized leniency, we propose that the cultivation of other plants be considered—alongside other established factors such as cultivation scale and equipment sophistication—as a potential contextual indicator of non-commercial or less harmful intent. This could inform investigations and sentencing decisions, particularly in jurisdictions where personal cannabis cultivation is still regulated or criminalized. Naturally, this should not replace other key indicators of harmfulness but instead complement them as part of a more nuanced assessment.

In a legal market, a licensing system for small-scale cannabis growers could establish a requirement that the area cultivated with cannabis be matched by an equally sized area cultivated with other plants. This regulatory incentive for the cultivation of diverse plants may further incentivize healthier behaviors and act as a form of nudging to minimize CUD among growers.

Finally, an important insight is that very few cannabis growers also cultivate other illicit or psychoactive plants. This finding counters common assumptions that domestic cannabis cultivation may serve as a gateway to broader illicit plant production. In our sample, growers appear focused almost exclusively on cannabis, suggesting that personal cultivation is largely confined to this substance. Policymakers should therefore consider regulating cannabis cultivation on its own terms, without extending restrictive measures based on unfounded fears of multi-substance production. This more proportionate, evidence-based approach could enable clearer legal frameworks and better alignment between regulation, enforcement priorities, and the actual practices of small-scale cultivators.

CRedit author statement

Daive Fortin: Writing – original draft, Visualization, Validation, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Vincent Di Beo:** Formal analysis, Writing – review & editing, Methodology. **Michala Kowalski:** Writing – review & editing, Validation, Investigation, Conceptualization. **Eric Sevigny:** Writing – review & editing, Methodology, Investigation, Data curation. **Jodie Grigg:** Software, Data curation, Writing – review & editing, Investigation. **Camelia Protopopescu :** Writing – review & editing, Validation, Methodology. **Gary Potter:** Writing – review & editing, Validation, Methodology, Investigation, Conceptualization.

References

- Aguiar, S., & Musto, C. (2022). The regulation backyard: Home growing cannabis in Uruguay. *Contemporary Drug Problems*, 49(4), 478–490.
<https://doi.org/10.1177/00914509221124800>
- Barratt, M. J., & Lenton, S. (2015). Representativeness of online purposive sampling with Australian cannabis cultivators. *International Journal of Drug Policy*, 26(3), 323–326.
<https://doi.org/10.1016/j.drugpo.2014.10.007>
- Barratt, M. J., Potter, G. R., Wouters, M., Wilkins, C., Wersé, B., Perälä, J., & Blok, T. (2015). Lessons from conducting trans-national Internet-mediated participatory research with hidden populations of cannabis cultivators. *International Journal of Drug Policy*, 26(3), 238–249. <https://doi.org/10.1016/j.drugpo.2014.12.004>
- Barratt, M. J., Ferris, J. A., Zahnow, R., Palamar, J. J., Maier, L. J., & Winstock, A. R. (2017). Moving on from representativeness: Testing the utility of the Global Drug Survey. *Substance Abuse: Research and Treatment*, 11, 1178221817716391.
<https://doi.org/10.1177/1178221817716391>
- Barrett, L., Kearnes, M., McLauchlan, L., Lancaster, K., Mellor, R., & Ritter, A. (2025). Regulating the Plant Versus Regulating the Drug: Learning From Backyard Cannabis Cultivation in the Australian Capital Territory. *Contemporary Drug Problems*, 00914509251334927. <https://doi.org/10.1177/0091450925133492>

- Belackova V., Roubalova M., van de Ven K. (2019). Overview of ‘home’ cultivation policies and the case for community-based cannabis supply. *International Journal of Drug Policy*, 71, 36–46. <https://doi.org/10.1016/j.drugpo.2019.05.021>
- Bharat, C., Webb, P., Wilkinson, Z., McKetin, R., Grebely, J., Farrell, M., & Degenhardt, L. (2023). Agreement between self-reported illicit drug use and biological samples: A systematic review and meta-analysis. *Addiction*, 118(9), 1624–1648. <https://doi.org/10.1111/add.16200>
- Burgin, S. (2018). 'Back to the future'? Urban backyards and food self-sufficiency. *Land Use Policy*, 78, 29–35. <https://doi.org/10.1016/j.landusepol.2018.06.012>
- Chalmin-Pui, L. S., Roe, J., Griffiths, A., Smyth, N., Heaton, T., Clayden, A., & Cameron, R. (2021). "It made me feel brighter in myself"—The health and well-being impacts of a residential front garden horticultural intervention. *Landscape and Urban Planning*, 205, 103958. <https://doi.org/10.1016/j.landurbplan.2020.103958>
- Chiburis, R. C., & Lokshin, M. (2007). Maximum likelihood and two-step estimation of an ordered-probit selection model. *The Stata Journal*, 7(2), 167–182. <https://doi.org/10.1177/1536867X0700700202>
- Coldiretti & Censis. (2015). Italiani nell’orto con arrivo primavera. Retrieved from <https://www.coldiretti.it/archivio/crisi-coldiretticensis-46-italiani-nellorto-con-arrivo-primavera>
- Delahay, R. J., Sherman, D., Soyalan, B., & Gaston, K. J. (2023). Biodiversity in residential gardens: a review of the evidence base. *Biodiversity and Conservation*, 32(13), 4155–4179. <https://doi.org/10.1007/s10531-023-02694-9>
- Diviák, T., Coutinho, J. A., & Stivala, A. D. (2020). A man’s world? Comparing the structural positions of men and women in an organized criminal network. *Crime, Law and Social Change*, 74(5), 547–569. <https://doi.org/10.1007/s10611-020-09910-5>
- Fisher-Maltese, C., & Zimmerman, T. D. (2015). A garden-based approach to teaching life science produces shifts in students' attitudes toward the environment. *International Journal of Environmental and Science Education*, 10(1), 51–66.
- Greenfield, V. A., & Paoli, L. (2013). A framework to assess the harms of crimes. *British journal of criminology*, 53(5), 864–885. <https://doi.org/10.1093/bjc/azt018>
- Hakkarainen, P., Frank, V. A., Barratt, M. J., Dahl, H. V., Decorte, T., Karjalainen, K., & Wense, B. (2015). Growing medicine: Small-scale cannabis cultivation for medical purposes in six different countries. *International Journal of Drug Policy*, 26(3), 250–256. <https://doi.org/10.1016/j.drugpo.2014.07.005>
- Hough, M., Warburton, H., Few, B., May, T., Man, L. H., & Witton, J. (2003). *A growing market: The domestic cultivation of cannabis*. New York, NY: Joseph Rowntree Federation.
- Hume, C., Grieger, J. A., Kalamkarian, A., D’Onise, K., & Smithers, L. G. (2022). Community gardens and their effects on diet, health, psychosocial and community outcomes: A systematic review. *BMC Public Health*, 22(1), 1247. <https://doi.org/10.1186/s12889-022-13591-1>
- ISTAT. (2008). *Spettacoli, musica e altre attività del tempo libero. Indagine multiscopo sulle famiglie: “I cittadini e il tempo libero” - Anno 2006*. Roma: ISTAT. ISBN 9788845817302
- Kays, K. M., Keith, T. L., & Broughal, M. T. (2013). Best practice in online survey research with sensitive topics. In N. Sappleton (Ed.), *Advancing research methods with new technologies* (pp. 157–168). Hershey, PA: IGI Global. ISBN 9781466643027

- Korpelainen, H. (2023). The role of home gardens in promoting biodiversity and food security. *Plants*, 12(13), 2473. <https://doi.org/10.3390/plants12132473>
- Lal, R. (2020). Home gardening and urban agriculture for advancing food and nutritional security in response to the COVID-19 pandemic. *Food Security*, 12(4), 871–876. <https://doi.org/10.1007/s12571-020-01058-3>
- Lenton, S., Potter, G., Fortin, D., Granville, A., Grigg, J., Sevigny, E., & Barratt, M. (2024). Growing practices and the use of potentially harmful chemical additives from a web survey of mainly small-scale cannabis growers in 18 countries. *International Journal of Drug Policy*, 104, 104662. <https://doi.org/10.1016/j.drugpo.2024.104662>
- Mackay, C. M., & Schmitt, M. T. (2019). Do people who feel connected to nature do more to protect it? A meta-analysis. *Journal of Environmental Psychology*, 65, 101323. <https://doi.org/10.1016/j.jenvp.2019.101323>
- Masterton, W., Parkes, T., Carver, H., & Park, K. J. (2022). Exploring how greenspace programmes might be effective in supporting people with problem substance use: A realist interview study. *BMC Public Health*, 22(1), 1–19. <https://doi.org/10.1186/s12889-022-14063-2>
- McLennon, E., Dari, B., Jha, G., Sihi, D., & Kankarla, V. (2021). Regenerative agriculture and integrative permaculture for sustainable and technology-driven global food production and security. *Agronomy Journal*, 113(6), 4541–4559. <https://doi.org/10.1002/agj2.20814>
- Mills, E. (2012). The carbon footprint of indoor cannabis production. *Energy Policy*, 46, 58–67. <https://doi.org/10.1016/j.enpol.2012.03.023>
- Mullins, L., Charlebois, S., Finch, E., & Music, J. (2021). Home food gardening in Canada in response to the COVID-19 pandemic. *Sustainability*, 13(6), 3056. <https://doi.org/10.3390/su13063056>
- Paoli, L., Decorte, T., & Kersten, L. (2015). Assessing the harms of cannabis cultivation in Belgium. *International Journal of Drug Policy*, 26(3), 277–289. <https://doi.org/10.1016/j.drugpo.2014.12.003>
- Pardal M., Kilmer B., d'Auria S., Strabel T., Galimberti S., Hoorens S., Decorte T., & Senator B. (2023). *Alternative to profit-maximising commercial models of cannabis supply for non-medical use*. RAND Europe. https://www.rand.org/pubs/research_reports/RRA2190-1.html
- Pavarin, R. M. (2022). One for you, one for me: Cannabis self-cultivation in Italy. *Journal of Substance Use*, 1(6), 1–6. <https://doi.org/10.1080/14659891.2022.2153757>
- Potter, G. (2008). The growth of cannabis cultivation: Explanations for import substitution in the UK. In D. Korf (Ed.), *Cannabis in Europe: Dynamics in perception, policy, and markets* (pp. 35–52). Pabst: Lengerich.
- Potter, G. (2010). *Weed, need, and greed: A study of domestic cannabis cultivation*. London: Free Association Books. ISBN 9781853432208
- Potter, G., Barratt, M. J., Malm, A., Bouchard, M., Blok, T., Christensen, A.-S., Decorte, T., Hakkarainen, P., Klein, A., Lenton, S., Perälä, J., Werse, B., & Wouters, M. (2015). Global patterns of domestic cannabis cultivation: Sample characteristics and patterns of growing across eleven countries. *International Journal of Drug Policy*, 26(3), 226–237. <https://doi.org/10.1016/j.drugpo.2014.12.007>
- Potter, G. R., & Chatwin, C. (2012). The problem with “skunk.” *Drugs and Alcohol Today*, 12(4), 232–240. <https://doi.org/10.1108/17459261211286645>

- Potter, G. R., & Klein, A. (2020). Coming out of the closet: Risk management strategies of illegal cannabis growers. In A. Klein & C. J. Levy (Eds.), *Risk and Substance Use* (pp. 201–221). Routledge. ISBN 9780367353366
- Pritchard, A., Richardson, M., Sheffield, D., & McEwan, K. (2020). The relationship between nature connectedness and eudaimonic well-being: A meta-analysis. *Journal of Happiness Studies*, 21(3), 1145–1167. <https://doi.org/10.1007/s10902-019-00118-6>
- Richardson, M., Passmore, H. A., Barbett, L., Lumber, R., Thomas, R., & Hunt, A. (2020). The green care code: How nature connectedness and simple activities help explain pro-nature conservation behaviours. *People and Nature*, 2(3), 821–839. <https://doi.org/10.1002/pan3.10117>
- Sandberg, S. (2012). The importance of culture for cannabis markets: Towards an economic sociology of illegal drug markets. *British journal of criminology*, 52(6), 1133-1151. <https://doi.org/10.1093/bjc/azs031>
- Sanvichith, J. L. (2011). Do gardens make you green? Home gardens, identity and pro-environmental behavior among southeast Asian American UC Berkeley students. *Theses*. University of California, Berkeley.
- Schupp, J. L., & Sharp, J. S. (2012). Exploring the social bases of home gardening. *Agriculture and Human Values*, 29, 93–105. <https://doi.org/10.1007/s10460-011-9321-2>
- Swift, W., Copeland, J., & Hall, W. (1998). Choosing a diagnostic cut-off for cannabis dependence. *Addiction*, 93(11), 1681–1692. <https://doi.org/10.1046/j.1360-0443.1998.931116816.x>
- Sznitman, S. R., Potter, G. R., Grigg, J., Granville, A., Hakkarainen, P., Decorte, T., ... & Sevigny, E. L. (2023). Are cannabis use problems comparable across individuals using for recreational and medical purposes? An international cross-sectional study of individuals who use self-grown cannabis. *International Journal of Drug Policy*, 104, 104263. <https://doi.org/10.1016/j.drugpo.2023.104263>
- Søgaard, T. F., Brummer, J. E., Wilkins, C., Sznitman, S. R., Sevigny, E. L., Frank, V. A., ... & Kirtadze, I. (2024). Global patterns in small-scale cannabis growers' distribution practices: Exploring the grower-distributor nexus. *International Journal of Drug Policy*, 104463. <https://doi.org/10.1016/j.drugpo.2024.104463>
- The Economist. (2018). Instead of houses, young people have houseplants. Retrieved from <https://www.economist.com/graphic-detail/2018/08/06/instead-of-houses-young-people-have-houseplants>
- Thompson, R. (2018). Gardening for health: A regular dose of gardening. *Clinical Medicine*, 18(3), 201–205. <https://doi.org/10.7861/clinmedicine.18-3-201>
- Tversky, A., & Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science*, 211(4481), 453–458. <https://doi.org/10.1126/science.7455683>
- UNODC. (2021). *World Drug Report 2021*. Vienna: United Nations Office on Drugs and Crime. Sales No. E.21.XI.8. ISBN 9789211483611
- Weisheit, R. A. (1991). The intangible rewards from crime: The case of domestic marijuana cultivation. *Crime & Delinquency*, 37(4), 506–527. <https://doi.org/10.1177/0011128791037004006>
- Werse, B., Kamphausen, G., Søgaard, T. F., Bear, D., Audran, M., Wilkins, C., Potter, G., Fontin, D., Hakkarainen, P., Faria, R., Quintas, J., Grigg, J., Jauffret-Roustide, M., & Barratt,

M. J. (2024). Impact of the COVID-19 pandemic on cannabis cultivation and use in 18 countries. *International Journal of Drug Policy*, Article 104652.
<https://doi.org/10.1016/j.drugpo.2024.104652>

Tables

Table 1: Descriptive statistics of participants' characteristics, whole sample and by country (n=1302)

	All N=1302 N (%)	Italy (n=1029, 79%) n (%)	UK (n=273, 21%) n (%)	P-value Chi-square test
Cannabis-Only Growers (COG)	233 (17.9)	203 (19.7)	30 (11.0)	0.001
Generalist Gardeners (GG)	1069 (82.1)	826 (80.3)	243 (89.0)	
House plants	792 (60.8)	616 (59.9)	176 (64.5)	0.166
Garden flowers/shrubs	622 (47.8)	426 (41.4)	196 (71.8)	<0.001
Fruit/vegetables	716 (55.0)	527 (51.2)	189 (69.2)	<0.001
Other drug plants/mushrooms	78 (6.0)	59 (5.7)	19 (7.0)	0.448
Cultivation methods				
Outdoors (vs only indoors)	715 (55.4)	617 (60.5)	98 (36.0)	<0.001
Using chemical products	234 (18.4)	141 (14.0)	93 (35.0)	<0.001
Social growing (vs growing alone)	353 (27.3)	330 (32.4)	23 (8.4)	<0.001
Motivation				
To provide myself with cannabis for recreational use	825 (63.4)	650 (63.2)	175 (64.1)	0.790
To provide others with cannabis for recreational use	97 (7.5)	62 (6.0)	35 (12.8)	<0.001
To provide myself with medical cannabis	499 (38.4)	309 (30.1)	190 (69.6)	<0.001
To provide others with medical cannabis	140 (10.8)	75 (7.3)	65 (23.8)	<0.001
Pleasure from growing cannabis	1012 (77.8)	780 (75.9)	232 (85.0)	0.001
Plant beauty	872 (67.0)	698 (67.9)	174 (63.7)	0.193
Product quality (Healthier or without contaminants)	1132 (87.0)	908 (88.3)	224 (82.1)	0.006
Easy to take care of the plant	209 (16.1)	160 (15.6)	49 (17.9)	0.340
For political reasons	423 (32.5)	333 (32.4)	90 (33.0)	0.857
For ecological/environmental reasons	334 (25.7)	264 (25.7)	70 (25.6)	0.989

Cheaper than buying	792 (60.9)	628 (61.1)	164 (60.1)	0.760
For selling	53 (4.1)	46 (4.5)	7 (2.6)	0.156
Health behavior (Use of cannabis and other addictive substances)				
Problematic Cannabis Use (SDS score \geq 3)	473 (37.9)	409 (41.3)	64 (24.8)	<0.001
Tobacco	904 (69.8)	789 (77.1)	115 (42.3)	<0.001
Alcohol	1018 (78.5)	842 (82.2)	176 (64.7)	<0.001
Hallucinogen drugs (LSD, mushrooms)	159 (12.3)	114 (11.1)	45 (16.5)	0.016
Other stimulant drugs (Amphetamine, Methamphetamine, Powder Cocaine Crack Cocaine, Ecstasy/MDMA)	121 (9.3)	95 (9.3)	26 (9.6)	0.887
Other depressant drugs (Heroin, Other opioids, Benzos/sedatives)	59 (4.6)	48 (4.7)	11 (4.0)	0.651
Socio-demographics				
Sex: Male	1093 (86.3)	865 (87)	228 (83.8)	0.187
Female	163 (12.9)	120 (12.1)	43 (15.8)	
Non-binary	10 (0.8)	9 (0.9)	1 (0.4)	
Age (continuous) ¹	27 [21-42]	23 [20-33]	48 [40-56]	<0.001
Living in rural or semi-rural location	821 (64.3)	646 (64.2)	175 (64.8)	0.840
Employed	621 (47.7)	473 (46.0)	148 (54.2)	0.015
Having a university degree	293 (22.7)	199 (19.5)	94 (34.7)	<0.001
Having a partner	463 (36.3)	307 (30.5)	156 (58.0)	<0.001
Criminal Justice System Involvement				
Found guilty for cannabis cultivation	59 (4.7)	32 (3.2)	27 (10.1)	<0.001

¹ For age (continuous variable), median [first quartile – third quartile] are used instead of n (%), and Mann-Whitney test was used instead of Chi-square test.
LSD: Lysergic acid; MDMA: 3,4-Methylenedioxymethamphetamine; SDS: Severity of Dependence Scale.

Table 2: Factors associated to cultivate cannabis with other plants (n=1069; 82.1%), comparing to cannabis only (n=233; 17.9%), seemingly unrelated bivariate probit regression models (n=1302)

	Univariable regression (n=1302)		Multivariable regression (n=1110)		margins
	Coef [95% CI]	p-value	aCoef [95% CI]	p-value	
Country					
Italy	-		ref.		
UK	-		-0.85 [-1.80 ; 0.10]	0.080	
Cultivation methods					
Outdoors (vs only indoors)	0.41 [0.25 ; 0.57]	<0.001	0.30 [0.09 ; 0.51]	0.005	0.067
Using chemical products	-0.09 [-0.31 ; 0.12]	0.404	0.01 [-0.24 ; 0.26]	0.935	
Social growing (vs growing alone)	-0.10 [-0.28 ; 0.08]	0.261	0.02 [-0.20 ; 0.24]	0.875	
Motivation					
To provide myself with cannabis for recreational use	-0.23 [-0.41 ; -0.05]	0.010	-0.20 [-0.41 ; 0.02]	0.075	
To provide others with cannabis for recreational use	0.14 [-0.17 ; 0.46]	0.374	0.37 [-0.04 ; 0.79]	0.079	
To provide myself with medical cannabis	0.45 [0.24 ; 0.66]	<0.001	0.60 [0.36 ; 0.84]	<0.001	0.134
To provide others with medical cannabis	0.22 [-0.08 ; 0.51]	0.148	-0.03 [-0.37 ; 0.30]	0.840	
Pleasure from growing cannabis	0.33 [0.15 ; 0.51]	<0.001	0.38 [0.13 ; 0.63]	0.003	0.085
Plant beauty	0.18 [0.02 ; 0.35]	0.032	0.04 [-0.19 ; 0.27]	0.727	

Product quality (Healthier or without contaminants)	0.07 [-0.17 ; 0.30]	0.583	-0.07 [-0.38 ; 0.25]	0.678	
Easy to take care of the plant	0.32 [0.09 ; 0.56]	0.008	0.23 [-0.06 ; 0.53]	0.124	
For political reasons	0.29 [0.11 ; 0.46]	0.001	-0.02 [-0.26 ; 0.22]	0.876	
For ecological/environmental reasons	0.58 [0.37 ; 0.79]	<0.001	0.47 [0.19 ; 0.75]	0.001	0.105
Cheaper than buying	-0.04 [-0.20 ; 0.13]	0.665	-0.14 [-0.35 ; 0.07]	0.196	
For selling	-0.62 [-0.96 ; -0.28]	<0.001	-0.66 [-1.10 ; -0.22]	0.003	-0.148
Health behavior (Use of cannabis and other addictive substances)					
Problematic Cannabis Use (SDS score ≥ 3)	-0.24 [-0.41 ; -0.07]	0.005	-0.22 [-0.41 ; -0.04]	0.020	-0.050
Tobacco	0.05 [-0.15 ; 0.25]	0.623	0.01 [-0.23 ; 0.26]	0.918	
Alcohol	0.14 [-0.06 ; 0.34]	0.163	0.22 [-0.02 ; 0.47]	0.072	
Hallucinogen drugs (LSD, mushrooms)	-0.10 [-0.33 ; 0.14]	0.410	0.12 [-0.20 ; 0.44]	0.456	
Other stimulant drugs (Amphetamine, Methamphetamine, Powder Cocaine Crack Cocaine, Ecstasy/MDMA)	-0.21 [-0.46 ; 0.05]	0.111	-0.33 [-0.66 ; -0.01]	0.049	-0.074
Other depressant drugs (Heroin, Other opioids, Benzos/sedatives)	0.29 [-0.12 ; 0.71]	0.170	0.44 [-0.14 ; 1.02]	0.135	
Socio-demographics					
Female (vs Male)	0.18 [-0.08 ; 0.43]	0.172	0.15 [-0.14 ; 0.44]	0.301	
Non-binary (vs Male)	0.40 [-0.64 ; 1.45]	0.450	-0.01 [-1.33 ; 1.32]	0.990	
Age (continuous)	0.02 [0.01 ; 0.04]	0.003	0.02 [0.00 ; 0.04]	0.010	0.005

Living in rural or semi-rural location	0.04 [-0.12 ; 0.21]	0.616	0.07 [-0.13 ; 0.26]	0.512	
Employed	0.12 [-0.04 ; 0.28]	0.145	0.00 [-0.20 ; 0.20]	0.993	
Having a university degree	0.38 [0.16 ; 0.59]	0.001	0.45 [0.18 ; 0.72]	0.001	0.102
Having a partner	0.41 [0.20 ; 0.61]	<0.001	0.38 [0.13 ; 0.62]	0.002	0.084
Criminal Justice System Involvement					
Found guilty for cannabis cultivation	0.08 [-0.43 ; 0.50]	0.715	0.03 [-0.45 ; 0.51]	0.909	

The first equation of the model regarding the factors associated with the country of residence is presented in Appendix B.

Coef: coefficient ; acoef: adjusted coefficient ; CI: confidence interval

LSD: Lysergic acid; MDMA: 3,4-Methylenedioxymethamphetamine; SDS: Severity of Dependence Scale.

Table 3. Factors associated with Growing Cannabis First (n=299, 28.2%) VS Growing Other Plants First (n=760, 71.8%), seemingly unrelated bivariate probit regression model (n=1059)

	Univariable regression (n=1059)		Multivariable regression (n=925)		margins
	Coef [95% CI]	p-value	aCoef [95% CI]	p-value	
Country					
Italy	-		ref.		
UK	-		-0.26 [-0.89 ; 0.37]	0.418	
Cultivation methods					
Outdoors	-0.19 [-0.36 ; -0.02]	0.031	-0.16 [-0.36 ; 0.04]	0.113	
Using chemical products	0.22 [0.00 ; 0.43]	0.050	0.19 [-0.05 ; 0.43]	0.114	
Social grower	-0.09 [-0.28 ; 0.1]	0.371	-0.19 [-0.40 ; 0.03]	0.090	
Type of plants					
Other drug plants and/or mushrooms	0.26 [-0.04 ; 0.56]	0.088	0.22 [-0.14 ; 0.57]	0.233	
Fruit and vegetables	-0.39 [-0.57 ; -0.22]	<0.001	-0.53 [-0.73 ; -0.34]	<0.001	-0.165
Motivation					
To provide myself with cannabis for recreational use	-0.02 [-0.19 ; 0.14]	0.781	-0.12 [-0.32 ; 0.09]	0.256	
To provide others with cannabis for recreational use	0.10 [-0.20 ; 0.41]	0.495	-0.04 [-0.40 ; 0.31]	0.808	
To provide myself with medical cannabis	0.07 [-0.11 ; 0.25]	0.433	0.00 [-0.21 ; 0.21]	0.976	

To provide others with medical cannabis	0.30 [0.05 ; 0.56]	0.020	0.34 [0.04 ; 0.64]	0.027	0.105
Pleasure from growing cannabis	0.36 [0.14 ; 0.57]	0.001	0.43 [0.14 ; 0.72]	0.004	0.132
Plant beauty	0.10 [-0.08 ; 0.28]	0.275	-0.10 [-0.33 ; 0.14]	0.413	
Product quality (Healthier or without contaminants)	0.13 [-0.12 ; 0.38]	0.317	-0.05 [-0.37 ; 0.26]	0.740	
Easy to take care of the plant	0.15 [-0.06 ; 0.35]	0.174	0.09 [-0.15 ; 0.34]	0.448	
For political reasons	0.02 [-0.15 ; 0.19]	0.794	-0.09 [-0.31 ; 0.14]	0.458	
For ecological/environmental reasons	0.12 [-0.06 ; 0.29]	0.206	0.17 [-0.06 ; 0.39]	0.158	
Cheaper than buying	0.18 [0.01 ; 0.35]	0.041	0.12 [-0.09 ; 0.33]	0.259	
For selling	0.16 [-0.30 ; 0.62]	0.489	0.08 [-0.42 ; 0.58]	0.745	
Health behaviors (Use patterns related to cannabis and other substances)					
Problematic Cannabis Use (SDS 3+)	0.18 [0.00 ; 0.35]	0.049	0.04 [-0.15 ; 0.23]	0.675	
Tobacco	0.08 [-0.12 ; 0.28]	0.437	0.06 [-0.17 ; 0.29]	0.609	
Alcohol	-0.24 [-0.44 ; -0.04]	0.017	-0.33 [-0.56 ; -0.11]	0.004	-0.103
Hallucinogen drugs (LSD, mushrooms)	0.27 [0.02 ; 0.51]	0.032	0.16 [-0.15 ; 0.48]	0.319	
Other stimulant drugs (Amphetamine, Methamphetamine, Powder Cocaine Crack Cocaine, Ecstasy/MDMA)	0.02 [-0.27 ; 0.31]	0.885	-0.03 [-0.37 ; 0.32]	0.879	
Other depressant drugs (Heroin, Other opioids, Benzos/sedatives)	0.20 [-0.16 ; 0.57]	0.281	0.16 [-0.29 ; 0.60]	0.493	
Socio-demographics					

Female (vs Male)	-0.47 [-0.74 ; -0.21]	0.001	-0.40 [-0.69 ; -0.11]	0.006	-0.124
Non-binary (vs Male)	0.32 [-0.61 ; 1.25]	0.496	1.26 [-0.01 ; 2.53]	0.053	
Age (per increase year)	-0.01 [-0.02 ; 0.00]	0.103	0.00 [-0.02 ; 0.01]	0.736	
Living in rural or semi-rural location	-0.14 [-0.31 ; 0.03]	0.112	-0.01 [-0.21 ; 0.18]	0.900	
Employed	-0.13 [-0.30 ; 0.03]	0.110	-0.15 [-0.34 ; 0.04]	0.121	
Having a university degree	-0.32 [-0.52 ; -0.12]	0.002	-0.32 [-0.55 ; -0.09]	0.006	-0.099
Having a partner	-0.02 [-0.20 ; 0.16]	0.823	-0.01 [-0.22 ; 0.21]	0.962	

The first equation of the model regarding the factors associated with the country of residence is presented in Appendix C.

Coef: coefficient ; acoef: adjusted coefficient ; CI: confidence interval

LSD: Lysergic acid; MDMA: 3,4-Methylenedioxyamphetamine; SDS: Severity of Dependence Scale.

Appendices

APPENDIX A: Questions on gardening activities

1. Do you grow other plants besides cannabis [tick all that apply]?

- Yes – house plants
- Yes – garden flowers/shrubs
- Yes – fruit/vegetables
- Yes – other drug plants/mushrooms (e.g. opium poppy, tobacco, hallucinogenic cactus etc)
- Yes - other
- No
- I don't know

2. Was cannabis the first plant you have ever grown?

- No, I was growing other plants and I start growing cannabis afterwards
- Yes, I was growing cannabis and I start growing other plants afterwards
- Yes, I start growing cannabis and other plants at the same time
- I don't know
- Prefer not to say

APPENDIX B. Unrelated bivariate probit regression full model: factors associated with cultivate cannabis with other plants (comparing to cannabis only)

	Multivariable regression	
	aCoef [95%CI]	p-value
First equation: factors associated with living in the UK (rather than in Italy)		
Cultivation methods		
Outdoors (vs only indoors)	-0.68 [-0.93 ; -0.44]	<0.001
Motivation		
To provide myself with medical cannabis	0.61 [0.38 ; 0.84]	<0.001
Health behavior (Use patterns related to cannabis and other substances)		
Tobacco	-0.61 [-0.84 ; -0.38]	<0.001
LSD or mushrooms	0.80 [0.42 ; 1.18]	<0.001
Demographics		
Age (per increase year)	0.07 [0.06 ; 0.08]	<0.001
Second equation: factors associated with cultivating cannabis with other plants (comparing to cannabis only)		
Country		
Italy	ref.	
UK	-0.85 [-1.80 ; 0.10]	0.080

Cultivation methods

Outdoors	0.30 [0.09 ; 0.51]	0.005
Using chemical products	0.01 [-0.24 ; 0.26]	0.935
Social grower	0.02 [-0.20 ; 0.24]	0.875

Type of plants

Other drug plants and/or mushrooms	-0.20 [-0.41 ; 0.02]	0.075
Fruit and vegetables	0.37 [-0.04 ; 0.79]	0.079

Motivation

To provide myself with cannabis for recreational use	0.60 [0.36 ; 0.84]	<0.001
To provide others with cannabis for recreational use	-0.03 [-0.37 ; 0.30]	0.840
To provide myself with medical cannabis	0.38 [0.13 ; 0.63]	0.003
To provide others with medical cannabis	0.04 [-0.19 ; 0.27]	0.727
Pleasure from growing cannabis	-0.07 [-0.38 ; 0.25]	0.678
Plant beauty	0.23 [-0.06 ; 0.53]	0.124
Product quality (Healthier or without contaminants)	-0.02 [-0.26 ; 0.22]	0.876
Easy to take care of the plant	0.47 [0.19 ; 0.75]	0.001
For political reasons	-0.14 [-0.35 ; 0.07]	0.196
For ecological/environmental reasons	-0.66 [-1.10 ; -0.22]	0.003
Cheaper than buying	-0.22 [-0.41 ; -0.04]	0.020
For selling	0.01 [-0.23 ; 0.26]	0.918

Health behaviors (Use patterns related to cannabis and other substances)

Problematic Cannabis Use (SDS 3+)	0.22 [-0.02 ; 0.47]	0.072
Tobacco	0.12 [-0.20 ; 0.44]	0.456
Alcohol	-0.33 [-0.66 ; -0.01]	0.049
Hallucinogen drugs (LSD, mushrooms)	0.44 [-0.14 ; 1.02]	0.135
Other stimulant drugs (Amphetamine, Methamphetamine, Powder Cocaine Crack Cocaine, Ecstasy/MDMA)	0.15 [-0.14 ; 0.44]	0.301
Other depressant drugs (Heroin, Other opioids, Benzos/sedatives)	-0.01 [-1.33 ; 1.32]	0.990

Socio-demographics

Female (vs Male)	0.02 [0.00 ; 0.04]	0.010
Non-binary (vs Male)	0.07 [-0.13 ; 0.26]	0.512
Age (per increase year)	0.00 [-0.20 ; 0.20]	0.993
Living in rural or semi-rural location	0.45 [0.18 ; 0.72]	0.001
Employed	0.38 [0.13 ; 0.62]	0.002
Having a university degree	0.03 [-0.45 ; 0.51]	0.909

Coef: coefficient ; acoef: adjusted coefficient ; CI: confidence interval

LSD: Lysergic acid; MDMA: 3,4-Methylenedioxymethamphetamine; SDS: Severity of Dependence Scale.

APPENDIX C: Unrelated bivariate probit regression full model: Factors associated with growing first cannabis (comparing to growing other plants first)

	Multivariable regression	
	aCoef [95%CI]	p-value
First equation: factors associated with living in the UK (rather than in Italy)		
Cultivation methods		
Outdoors (vs only indoors)	-0.61 [-0.87 ; -0.36]	<0.001
Motivation		
To provide myself with medical cannabis	0.56 [0.31 ; 0.80]	<0.001
Health behavior (Use patterns related to cannabis and other substances)		
Tobacco	-0.68 [-0.93 ; -0.44]	<0.001
LSD or mushrooms	0.89 [0.49 ; 1.28]	<0.001
Demographics		
Age (per increase year)	0.07 [0.06 ; 0.08]	<0.001
Having a child	0.33 [0.06 ; 0.60]	0.016
Second equation: factors associated with growing first cannabis (comparing to growing other plants first)		
Country		
Italy	ref.	
UK	-0.26 [-0.89 ; 0.37]	0.418

Cultivation methods

Outdoors (vs only indoors)	-0.16 [-0.36 ; 0.04]	0.113
Using chemical products	0.19 [-0.05 ; 0.43]	0.114
Social growing (vs growing alone)	-0.19 [-0.40 ; 0.03]	0.090

Motivation

To provide myself with cannabis for recreational use	0.22 [-0.14 ; 0.57]	0.233
To provide others with cannabis for recreational use	-0.53 [-0.73 ; -0.34]	<0.001
To provide myself with medical cannabis		
To provide others with medical cannabis	-0.12 [-0.32 ; 0.09]	0.256
Pleasure from growing cannabis	-0.04 [-0.40 ; 0.31]	0.808
Plant beauty	0.00 [-0.21 ; 0.21]	0.976
Product quality (Healthier or without contaminants)	0.34 [0.04 ; 0.64]	0.027
Easy to take care of the plant	0.43 [0.14 ; 0.72]	0.004
For political reasons	-0.10 [-0.33 ; 0.14]	0.413
For ecological/environmental reasons	-0.05 [-0.37 ; 0.26]	0.740
Cheaper than buying	0.09 [-0.15 ; 0.34]	0.448
For selling	-0.09 [-0.31 ; 0.14]	0.458
Health behavior (Use of cannabis and other addictive substances)	0.17 [-0.06 ; 0.39]	0.158
Problematic Cannabis Use (SDS 3+)	0.12 [-0.09 ; 0.33]	0.259
Tobacco	0.08 [-0.42 ; 0.58]	0.745

Alcohol		
Hallucinogen drugs (LSD, mushrooms)	0.04 [-0.15 ; 0.23]	0.675
Other stimulant drugs (Amphetamine, Methamphetamine, Powder Cocaine Crack Cocaine, Ecstasy/MDMA)	0.06 [-0.17 ; 0.29]	0.609
Other depressant drugs (Heroin, Other opioids, Benzos/sedatives)	-0.33 [-0.56 ; -0.11]	0.004
Socio-demographics		
Female (vs Male)	-0.03 [-0.37 ; 0.32]	0.879
Non-binary (vs Male)	0.16 [-0.29 ; 0.60]	0.493
Age (continuous)		
Living in rural or semi-rural location	-0.40 [-0.69 ; -0.11]	0.006
Employed	1.26 [-0.01 ; 2.53]	0.053
Having a university degree	0.00 [-0.02 ; 0.01]	0.736
Having a partner	-0.01 [-0.21 ; 0.18]	0.900

Coef: coefficient ; acoef: adjusted coefficient ; CI: confidence interval

LSD: Lysergic acid; MDMA: 3,4-Methylenedioxymethamphetamine; SDS: Severity of Dependence Scale.