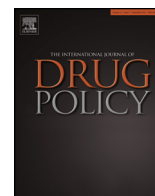




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Research paper

Into the void: Regulating pesticide use in Colorado's commercial cannabis markets

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ABSTRACT

Background: In 2014, Colorado implemented the world's first seed-to-sale recreational cannabis market under a commercial model. This paper aims to provide a thick descriptive account that gives insight into the issues and complexities of Colorado's pioneering and evolving attempt to regulate the use of pesticides on commercial cannabis plantations.

Methods: The paper examines multiple data sets including: (i) Colorado State Government documents; (ii) recreational cannabis regulations; (iii) mass and niche media publications (n = 175); (iv) face-to-face interviews with key stakeholders, including seniors, regulators and industry executives (n = 8); and (v) field notes from relevant conferences and cultivation facility tours in Denver in October, 2016.

Results: Two key issues are identified. First, a public safety threat has arisen relating to application of pesticides on cannabis with intensified toxicity in concentrated products of particular concern. Second, as a pioneering jurisdiction, Colorado faces a considerable knowledge gap. To expand collective learning on this issue, for which no regulatory template and little research exists, state regulators tapped industry and other stakeholder expertise while attempting to ensure public safety goals were achieved and regulatory capture by industry was limited.

Conclusion: Four years since the recreational cannabis market in Colorado was legalised, the State continues to grapple with the pesticide issue as testing regulations and cultivation standards are yet to be finalised. While more work is needed, Colorado has made significant progress in developing regulations relating to this complex matter. As governments of countries such as Canada and US states, including California, contemplate changes to recreational cannabis laws, Colorado's experience can assist regulators in other jurisdictions considering policy change.

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Introduction and background

In 2014, Colorado became the first jurisdiction internationally to legalise non-medical (recreational) cannabis for adults from "seed to sale". Standards for regulating cannabis plant cultivation appear not to have been addressed in the medicinal markets emerging in the US before 2010 (see e.g. *Law Atlas*, 2016). This can be linked to the memo of former Deputy Attorney General, David Ogden (*Ogden*, 2009), that clarified the prosecution of patients with serious illnesses or their caregivers in compliance with state laws on medical marijuana, will not be a priority for federal resources (*Stout & Moore*, 2009, October 19). As such, the Colorado State Government was among the first authorities to tackle the

issue. The initial 2013 Task Force Report on the Implementation of Amendment 64 (A64) raised concerns about pesticide contamination, noting there existed "no standards of practice for ensuring product safety in the marijuana industry" (*Brohl & Finlaw*, 2013, p.66). A key objective of regulating cannabis is ensuring retail products are as safe as possible for consumption (*Pacula, Kilmer, Wagenaar, Chaloupka, & Caulkins*, 2014). In the pre-legalisation black market there were no applicable standards in place to test product quality and there have been numerous claims of nefarious cultivating practices (see e.g. *DeAngelo*, 2015; *McLaren, Swift, Dillon, & Allsop*, 2008; *Voelker & Holmes*, 2015) to combat the threat of pest infestation (*Cervantes*, 2006). *Danko* (2010, p.49) has contended "... growers sometimes find themselves quite overwhelmed by pest issues [and] many more resort to nuclear tactics than are willing to admit it".

Reflecting this lack of legislative framework, the literature on policy regulation templates for pesticide use on cannabis is thin, although recently *Feldman* (2014–15) has provided an overview of

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pesticide laws in states with legalised cannabis production as at 2014. Furthermore, the US federal prohibition on cannabis has meant that guidance from the US Food and Drug Administration and the Environmental Protection Association is legally unavailable (US Environmental Protection Agency, 2016b; US Food and Drug Administration, 2016). Indeed, no pesticide is currently registered in the US specifically for cannabis (Stone, 2014; Thomas & ElSohly, 2015). To begin to address this void, Kilmer (2014) noted that regulators need to consider purity as it relates to residual levels of solvents used for extracting tetrahydrocannabinol (THC) from plant matter, pesticides, and the presence of other contaminants such as fungi, bacteria, and mould. It would also seem logical to draw lessons from the regulation of tobacco, which, like cannabis, can be smoked or vapourised and is susceptible to pest infiltration (Barry & Glantz, 2016; Daley, Lampach, & Sguerra, 2013; McDaniel, Solomon, & Malone, 2005). However, it is not apparent that Colorado regulators have examined this potential resource in relation to cultivation standards. The specific issue of pesticide use (and abuse) on cannabis crops has received significant coverage in local media reports in Colorado as the State Government attempts to create workable policy that reconciles the delicate relationship between public safety and crop protection. The potential public health threat of pesticide usage on these crops was explicitly recognised by Governor Hickenlooper's executive order in November, 2015 that required state agencies to address the issue of contaminated cannabis (Colorado Department of Revenue, 2015).

This paper has the broad aim of examining multiple data sets to provide insight into the issues and complexities of Colorado's pioneering and evolving attempt to regulate the use of pesticides on commercial cannabis plantations. First, drawing on existing literature, an outline is provided of what is currently known regarding the regulation of pesticide usage on cannabis cultivation with specific focus on: (i) stipulating a clear definition of pesticide and related issues; (ii) the potential public health threat of pesticide use; (iii) basic methodologies of testing for pesticides; and (iv) outlining concepts related to developing quality assurance guidelines for cultivators. Second, relevant Colorado Government documents and the Retail Marijuana Code (RMC) are reviewed to explore the current regulatory status of pesticide use in Colorado. Third, samples of relevant articles from the Denver Post and cannabis industry niche media, together with interviews with key stakeholders and field notes from relevant conferences and facility tours in Denver, October 2016, are brought together to explore issues relating to pesticide use since the introduction of the recreational cannabis market.

Defining pesticide and issues relating to cannabis crops

The use of pesticides on cannabis crops is a complex and confusing issue for a range of stakeholders, including cultivators, regulators, retailers, testers, consumers, and public health researchers. While cannabis growers are interested in pest management to defend crops (referring to pest in the widest sense as invertebrates, weeds, pathogens, and insects), regulators are concerned with pesticide management and reducing the potential for risk to public health, in particular to consumers and workers (Ehler, 2006). In Colorado, some products, such as federally banned plant growth regulator (PGR) daminozide (described below), have been classified simultaneously as “pesticides” (Buffington & McDonald, 2006) and “harmful chemicals”. The distinction appears to be in line with EPA labelling guidelines (United States Environmental Protection Agency, 2014) and is important because, to complicate things further, the Colorado State government offers separate license types for cannabis testing labs tasked with analysing plant matter for these different kinds of

contamination. To incorporate all relevant issues, this paper defines pesticides in the broadest sense, following the *British Pharmacopoeia* (2016) as it relates to herbal drugs:

A pesticide is any substance or mixture of substances intended for preventing, destroying or controlling any pest, unwanted species of plants or animals causing harm during or otherwise interfering with the production, processing, storage, transport or marketing of herbal drugs. The item includes substances intended for use as growth-regulators, defoliant or desiccants and any substance applied to crops, either before or after harvest, to protect the commodity from deterioration during storage and transport. **Volume IV Appendices Appendix XI L. Pesticide Residues**

Potential public health threat

Cannabis can be consumed in a variety of ways. Smoking is thought to be the most toxic mode of delivery (Hall & Fischer, 2010), and remains the predominant method of consumption for recreational users (Pacula, Jacobson, & Maksabedian, 2015). In a study testing toxicity from three common pesticides, Sullivan, Elzinga, and Raber (2013) demonstrated that chemical residues will transfer into mainstream smoke, and therefore the end-user, at levels ranging from 1 to 10% for filtered water pipes and up to 60–70% for unfiltered glass pipes. Although it remains unknown precisely how damaging these chemicals are to humans, the fact they are present in smoke at such high levels should be concerning. A study of pesticide use on cannabis crops in Oregon found a wide range of pesticide types and high levels of residual chemicals in harvested cannabis (Voelker & Holmes, 2015). The study also found support for the hypothesis that cannabinoid extraction processes for creating high THC products (such as oils and waxes, some of which are also used in cannabis confectionaries or ‘edibles’) intensify the levels of pesticides in those concentrates. Cannabis concentrates are generally manufactured by extracting THC from ‘trim’ or left over leaves of the plant, which are otherwise a waste-product of the cannabis cultivation process that aims to produce flowering heads (Light, Orens, Lewandowski, & Pickton, 2014). Voelker and Holmes (2015) found that pesticide levels were approximately 10x higher in concentrated cannabis products than the flower heads. This is concerning because concentrates are growing in popularity in Colorado and are often “dabbed”, a process of smoke or vapour inhalation of “dabbed concentrate” involving a specialised glass or ceramic pipe (for details see Kleiman, 2015; Stogner & Miller, 2015; Subritzky, Pettigrew, & Lenton, 2016).

Plant growth regulators (PGR)

Included in the definition of pesticide above are “growth regulators”. Well known industry publication *High Times* described the PGR class of products as chemicals used to produce shorter, more uniform plants with a higher density (and therefore yield) of buds/flowers per plant (Sirius, 2016, January 26). They have been shown to increase the effectiveness of growing from cuttings or ‘cloning’, a long-used practice in cannabis cultivation (Lata, Chandra, Khan, & ElSohly, 2010; Slusarkiewicz-Jarzina, Ponitka, & Kaczmarek, 2005). These chemicals, while apparently widely used in growing commercial and personal cannabis crops, are also of interest to those seeking to produce pharmaceutical grade (standardised) cannabis (Logroño, 2014). However, it is claimed they present public health threats including infertility, liver damage, and cancer (Cervantes, 2015; Huang & Stone, 2003; Sirius, 2016, January 26). Two of these chemicals, paclobutrazol and daminozide, are of particular concern in the cannabis cultivation arena as they have been found unlisted in a number

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