

# **Regulations of Pesticides in Cannabis**

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Degree of Master of Pharmacy*

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L-Università  
ta' Malta

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**Dedicated to my family, friends and colleagues**

## **Abstract**

Accurate determination of pesticide residues in medicinal cannabis is increasingly recognised as a necessary contributor to the safety of medicinal cannabis products.

The aims of the study were (i) to identify and compare analytical methods for the determination of pesticides in herbal products and cannabis, and (ii) to identify and compare regulations related to allowed pesticides and their limits in medicinal cannabis in different countries.

Systematic literature review was carried out to identify different analytical techniques for the detection of pesticides in herbal products and cannabis. Regulations for the use of pesticides in cannabis were identified using official government websites of different countries. Testing requirements, number of pesticides tested for and allowed limits were compared. Fifteen articles describing the analysis of pesticides in cannabis were identified. High-performance liquid chromatography is the most common (n= 9) analytical technique for the detection of pesticides in cannabis. QuEChERS was the most commonly (n = 3) used sample preparation technique, and Shimadzu was the most commonly used HPLC unit (n = 4). Gas chromatography (n = 4) and ultra-high-performance liquid chromatography (n = 2) were the other two analytical techniques identified.

Regulations for the use of pesticides in cannabis are found in 14 countries and a further two countries are currently drafting regulations for the use of pesticides in cannabis. In Thailand, analysis is done in accordance with the Thai Pharmacopoeia which sets residue limits for 70 pesticides. Malta, The Netherlands, Denmark, Germany, Australia and New Zealand follow the European Pharmacopoeia guidelines, which require testing of 69 pesticides and their allowed limits. In Morocco and Zimbabwe, in the cultivation of cannabis, authorised and licensed pesticides should only be used if use is justified. In

Israel, a registered pesticide may only be applied to cannabis if compliance with the instructions for use specified on the label is followed. In the United States of America, medicinal cannabis is legalised in 38 states. No pesticides are federally registered for use on cannabis; however, most states have their own guidelines and lists of approved pesticides. In Canada, 96 pesticides are to be tested for, each including different limits of quantification, depending on the dosage form. Jamaica and Costa Rica are currently in the process of drafting regulations for the use of pesticides in cannabis.

The study helped identify differences and similarities between analytical techniques and guidelines for the use of pesticides in cannabis. Harmonised regulations help improve the quality and safety of medicinal cannabis products.

## **Acknowledgement Page**

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## List of Abbreviations

CB <sub>1</sub>	Cannabinoid receptor 1
CB <sub>2</sub>	Cannabinoid receptor 2
CBD	Cannabidiol
CBG	Cannabigerol
DAD	Diode Array Detector
DDT	Dichlorodiphenyltrichloroethane
EPA	U.S. Environmental Protection Agency
ESI	Electron Spray Ionization
FDA	United States Food and Drug Administration
FID	Flame Ionisation Detection
GC	Gas chromatography
GC-MS	Gas chromatography mass spectrometry
HPLC	High-Performance liquid chromatography
LC	Liquid chromatography
LC-MS	Liquid chromatography mass spectrometry
LoQ	Limits of Quantification
MISPE	Molecularly Imprinted Solid Phase Extraction
MRL	Maximum Residue Levels
MS	Mass spectrometry
Ph. Eur.	European Pharmacopoeia
QuEChERS	Quick, Easy, Cheap, Effective, Rugged, Safe
TGO	Therapeutic Goods
THC	$\Delta^9$ -tetrahydrocannabinol
TLC	Thin Layer Chromatography
UHPLC	Ultra-High-Performance liquid chromatography
USA	United States of America

## **Chapter 1**

### **Introduction**

## **1.1 The Cannabis Plant**

The cannabis genus includes 3 species, *Cannabis sativa*, *Cannabis indica* and *Cannabis ruderalis*. The strain commonly referred to as *C. sativa*. (Schilling et al, 2020). *C. sativa* is a psychoactive drug that can be used medicinally and recreationally. Cannabis can be found commercially available as dry flowers, edibles and in oil products. Cannabis when smoked has a psychoactive effect within 30 seconds to a couple of minutes (Jett et al, 2018).

## **1.2 Medicinal Properties of Cannabis and Cannabinoids**

The legal use of medicinal cannabis is continuously growing globally (Whiting et al, 2015). Therapeutic applications of cannabis include the relief of chronic pain, nausea, muscle spasms, seizures and epilepsy (Zaami et al, 2018). There are among 113 phytocannabinoids and 120 terpenes in the cannabis plant.  $\Delta^9$ - tetrahydrocannabinol (THC) is the first phytocannabinoid that was isolated and is a psychoactive compound. Other cannabinoids having medicinal use include cannabidiol (CBD) and cannabigerol (CBG) (Atapattu & Johnson, 2020). THC is responsible for the effects of relaxation and euphoria and CBD is more commonly associated with anxiolysis.

Cannabinoids interact with the endocannabinoid system which is made up of a network of receptors, enzymes and signalling molecules. There are two main kinds of cannabinoid receptors in the endocannabinoid system, type 1 (CB<sub>1</sub>) and type 2 (CB<sub>2</sub>). CB<sub>1</sub> receptors are highly concentrated in the central nervous system and can also be found in smooth muscle while CB<sub>2</sub> receptors are concentrated in peripheral blood mononuclear cells. THC

is the main psychoactive component in cannabis which acts as an agonist on both types of receptors, decreasing cyclic adenosine monophosphate thus resulting in reduced neurotransmission, anti-inflammatory and analgesic effects. CBD does not directly act on CB1 and CB2 receptors, (Ebbert et al, 2018).

### **1.3 Dosage Forms of Cannabis**

Cannabis can also be administered via inhalation, topically, sublingually and orally (Sullivan et al, 2013). The two most common medicinal cannabis dosage forms that can be found on the market include; oils and dried flowers. A common aspect of most methods of administration of cannabis involves a heating step. Heating transforms the acidic cannabinoids into their more active forms. Depending on the method of administration, various alterations in the compound's original chemical profile might occur. These alterations can result from factors such as the degree of heating and the method of storage. These variations in the composition of a compound that eventually enters the bloodstream result in differing effects and the duration of such effects (Hazekamp et al, 2010).

### **1.4 Safety, Quality and Efficacy**

Ensuring safety, quality and efficacy of medicinal cannabis is important to safeguard patient health.. For appropriate quality control, accurate analytical methods need to be followed to determine contaminants in cannabis. Good Manufacturing Practices must be ensured in the manufacture of cannabis for medicinal use. Like with any other medications, accurate dosing and administration is also important, along with taking note

of any adverse events or drug-drug interactions (Martin et al, 2020). Efficient monitoring and determination of pesticide residues helps contribute towards the safety of medicinal cannabis. The preparation of cannabis using good manufacturing practices helps increase the applicability and reproducibility of pre-clinical and clinical data studies and testing (Sarma, 2020).

## **1.5 Pesticides**

Pesticides eliminate, repel, or minimise insects, rodents, weeds, fungi, bacteria, viruses, and other microbes. The term pesticide refers to fungicides, herbicides, and other substances used to control pests (van der Hoff et al, 1999).

Cannabis plants are susceptible to infestation by of pests and diseases; therefore, the use of pesticides is needed to preserve plant health. Inorganic pollutants can be actively sequestered from the environment by the cannabis plant (Craven et al, 2019).

Production of cannabis products is divided into 5 main processes: cultivation, processing, packaging, extraction and formulation. During cannabis cultivation, pesticides are commonly applied as a foliar spray, their residues often remaining on the harvested flowers (Goldman et al, 2021). The presence of pesticides in cannabis should be considered by cultivators, regulators, consumers and public health researchers (Luca et al, 2020).

Pesticides are often applied to plants to repel or even kill any unwanted organisms which can accumulate in cannabis throughout growth and processing stages. Pesticides can be classified into 7 groups based on their use; fungicides, acaricides, molluscicides,

rodenticides and nematocides. Pesticides can also be distinguished based on their chemical class such as carbamates and organophosphorus compounds (Taylor & Birkett, 2019).

Aphids, spider mites and thrips are some of the most frequent pests that can be found on the cannabis plant. Insecticides, acaricides and fungicides are the most common pesticides used on cannabis plants. Some of the pesticides that are used on cannabis plants include, diazinon, carbamate, bifenthrin, dichlorodiphenyltrichloroethane (DDT) and fenpyroximate (Taylor & Birkett, 2019).

### **1.5.1 Negative Effects of Pesticides**

Pesticide residues on cannabis plant material is especially concerning because cannabis can be smoked, ingested or dried. The health impacts of pesticide residues on humans remains largely unexplored, however there is increasing concern regarding their safety. Pesticides are commonly associated with negative effects on humans and the environment. Most of these effects may not be seen immediately, however, long-term adverse effects can occur after continuous re-exposure. The health hazards of pesticides depend on the type of pesticide, the dose, the duration of exposure and its absorption route (Cuypers et al, 2017). Since most pesticides target the central nervous system by binding to some receptors of the brain, pesticides are considered harmful in people with epilepsy or any other neurological disorders. Some pesticides have shown to be carcinogenic or have mutagenic effects on humans which may be lethal (Dryburgh et al, 2018). Due to these negative effects, maximum residue limits (MRL) of individual pesticides have been

set by legislation in the United States and the European Union to control the presence of pesticide residues in food and herbal products (Hernández et al, 2013).

## **1.6 Analytical Methods**

Analysis of pesticides cannabis is important since pesticides may also contain toxic metalloids and metals such as lead, cadmium, mercury and arsenic compounds. The cannabis plant can be referred to as being a hyperaccumulator since it can effectively take up toxic metals through the roots from the soil (Seltenrich, 2019).

In countries where the use of medical cannabis is legal, most regulatory bodies require product testing which is carried out by a third-party. The most common methods that are used in laboratories to analyse pesticides in cannabis products include, gas chromatography in combination with mass spectroscopy, and also liquid chromatography in combination with mass spectroscopy. Sample preparation of cannabis prior to analysis involves sample homogenization, which is followed by extraction methods. In Europe, one of the most commonly used extraction methods for the analysis of cannabis is QuEChERS (Craven et al, 2019). QuEChERS can be defined as a Quick, Easy, Cheap, Effective, Rugged and Safe extraction technique that is widely used in the analysis of pesticides on fruit and vegetables and also cannabis (Moulins et al, 2018).

Following QuEChERS, both liquid chromatography (LC) and gas chromatography (GC) along with tandem quadrupole detectors and mass spectrometry (MS) can be used for pesticide analysis. While LC-MS is used for ionic and polar pesticides, GC-MS is better suited for volatile pesticides (Craven et al, 2019).

### **1.6.1 Gas Chromatography**

Gas chromatography is a promising technique for rapid pesticide analysis. A wide range of pesticides can be analysed with extremely high resolution by the use of GC, which is frequently coupled with flame ionisation detection (FID) or mass spectrometry detection. GC is an ideal method for volatile materials due to its speed, high resolution and ease of use (McNair et al, 2019).

### **1.6.2 High-Performance Liquid Chromatography**

High-performance liquid chromatography is a kind of liquid chromatography. The main advantage that high-performance liquid chromatography has over gas chromatography is that its analytes do not have to be volatile. In HPLC, high pressure propels the mobile phase through the column, leading to quicker and more efficient component separation. Conversely, traditional liquid chromatography typically involves longer columns, with the separation process being slower because it relies on gravity. The employment of smaller particles in the stationary phase of HPLC not only allows for faster analysis but also enhances separation efficiency, providing higher resolution (Fanali et al, 2013).

## **1.7 Importance of Regulations**

Since cannabis is not legal in most countries of the world, not many regulations on the use of pesticides in cannabis cultivation have been published. Any regulations that are present differ greatly from country to country. The regulations also vary greatly between cannabis extracts, cannabinoid-based medicines and raw herbal cannabis. The United States Food and Drug Administration (FDA) along with several countries in Europe and

Canada have legalised the use of cannabinoid-based medicines, however both the FDA and the European Medicines Agency do not approve the use of herbal cannabis or its extracts (Abuhasira et al, 2018).

In recent years, countries have updated their legislations about medicinal cannabis and regulations are expected to change. The aim of new regulations is for medicinal cannabis to be more accessible and safer for the patient. In the USA, the use of certain pesticides on cannabis is now banned. An example of this is carbofuran which is a highly toxic insecticide which is not picked up by laboratory testing. Pesticides like carbofuran were used in illegal cultivation of cannabis (Wylie et al, 2020).

### **1.7.1 Regulations in Canada and the United States of America**

In America, the use of pesticides is regulated by the U.S. Environmental Protection Agency (EPA) which is overseen by each state and the local government. To this date, no pesticides have been registered or approved by EPA for use on cannabis specifically. The EPA has not studied pesticide products to see what health impacts they might have on cannabis that is applied topically, consumed or inhaled. As a result, it is unknown what health hazards employing these pesticides on cannabis plants may pose.

In America, each state has different guidelines, for example, in California 66 pesticides are regulated while in Oregon, 59 pesticides are regulated (Atapattu & Johnson, 2020). Since no pesticides have been registered for the use of cannabis, the pesticide's active ingredients must meet the limits of quantification. This is overseen by the Department of Pesticide Regulation in California, where pesticides are split into two categories depending on their harmful effects. Twenty-one pesticides are category I pesticides which are exempt from residue tolerance requirements and registration requirements and 45

category II pesticides with US EPA residue tolerance requirements (Seltenrich, 2019). Every batch produced must be tested for all 66 pesticides using analytical techniques such as HPLC, LC-MS and GC-MS (Valdes-Donoso et al, 2020).

In Canada, the use of pesticides is regulated by Health Canada. Ninety-six different pesticides have been mandated to be tested with limits of quantification in Canada. The limits of quantification have been set according to the cannabis product<sup>1</sup>.

### **1.7.2 Regulations in Europe**

Within the European Union, many countries have legalised or decriminalised the use of medicinal cannabis. Currently not many regulations have been published on the use of pesticides on cannabis specifically<sup>2</sup>. Directive 2009/128/EC explains the strict rules on the use of pesticides that need to be followed by EU countries and third countries. Until new regulations are published, the same rules on the use of pesticides on herbal products are being applied to the use of pesticides on cannabis<sup>3</sup>.

Directive 2009/128/EC explains the strict rules on the use of pesticides that need to be followed by EU countries and third countries. Until new regulations are published, the same rules on the use of pesticides on herbal products are being applied to the use of

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<sup>1</sup> Canada PHA of. Government of Canada [Internet]. Gouvernement du Canada; 2022 [cited 2024 Apr 19]. Available from: <https://www.canada.ca/en/public-health/services/publications/drugs-health-products/cannabis-testing-pesticide-requirements.html>

<sup>2</sup> European Parliament: MEP's Questions & Answers: (February-March 2019). European Food and Feed Law Review: EFFL. [Internet] 2019; 14(3): 303-308 [cited 2024 May 5]. Available from: <https://www-proquest-com.ejournals.um.edu.mt/docview/2280451492/fulltext/29C363C1C7B648A0PQ/1?accountid=27934>

<sup>3</sup> Anon. Pesticide residues. European Pharmacopoeia 9.6. [Internet] 2019; [cited on 2024 April 25]. Available from: [https://file.wuxuwang.com/yaopinbz/EP9/EP9.6\\_01\\_9.pdf](https://file.wuxuwang.com/yaopinbz/EP9/EP9.6_01_9.pdf)

pesticides on cannabis. Pesticide testing is usually carried out when the drug is still in its herbal form, prior to processing, ensuring pesticide residues are within the allowed limits.

## **1.8 Aims of study**

The aims of the study are: (i) to identify and compare analytical methods for the determination of pesticides in herbal products and cannabis and (ii) to identify and compare regulations related to pesticides in medicinal cannabis products.

## **Chapter 2**

### **Methodology**

## **2.1 Ethics Registration**

The study was registered with Faculty Research Ethics Committee (FREC) (MED-2021-00056) (refer to appendix 1).

## **2.2 Systematic Literature Review**

Systematic literature review on analysis of pesticides in herbal products and analysis of pesticides in cannabis was conducted from March 2022 until March 2023.

### **2.2.1 Systematic Literature Review on Pesticides in Herbal Products**

Literature was retrieved from databases ‘Hydi<sup>®</sup>’ and ‘Pubmed<sup>®</sup>’. The search made use of the following keywords: ‘analytical methods for pesticides in herbal products’, ‘analysis of pesticides in herbal products’ and ‘chromatographic analysis of pesticides in herbal products’ in the database and the results were filtered accordingly.

Peer-reviewed literature published between 2010 and 2021 was identified. Data was collected following the ‘Preferred Reporting Items for Systematic Reviews and Meta-Analysis’ (PRISMA) guidelines<sup>4</sup>.

Results of the systematic review on pesticides in herbal products, were grouped in tables according to the analytical method; gas chromatography, high-performance liquid chromatography and ultra-high-performance liquid chromatography. The following parameters were compared; product analysed, pesticides analysed, sample preparation

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<sup>4</sup>Anon. PRISMA Flow Diagram. PRISMA Transparent Reporting of Systematic Reviews and Meta-analysis. [Internet] 2020; [cited 2024 February 20]. Available from: <https://prisma-statement.org/prismastatement/flowdiagram.aspx>

technique, analytical method unit used, stationary phase, mobile phase and flow rate and detector used.

### **2.2.2 Systematic Literature Review on Pesticides in Cannabis**

Literature was retrieved from the online research databases 'Hydi®' and 'Pubmed®'. The search made use of the following keywords: 'analytical methods for pesticides in cannabis', 'analysis of pesticides in cannabis' and 'chromatographic analysis of pesticides in cannabis' in the database and the results were filtered accordingly.

Peer-reviewed literature published between 2010 and 2021 was identified. Data was collected following the 'Preferred Reporting Items for Systematic Reviews and Meta-Analysis' (PRISMA) guidelines.

Results of the systematic review on pesticides in cannabis, were grouped in tables according to the analytical method; gas chromatography, high-performance liquid chromatography and ultra-high-performance liquid chromatography. Results were compared in terms of: product analysed, pesticides analysed, sample preparation technique, chromatographic unit used, stationary phase, mobile phase and flow rate and detector used.

### **2.3 Literature Review on Regulations of Pesticides in Cannabis**

Literature review on regulations for the use of pesticides in cannabis in different countries was conducted during the months of October 2023 up to May 2024.

Countries in which cannabis is legalised for medical use were identified. Government websites and databases set up by respective health authorities of different countries or legal websites that outline the legal framework of the regulations of pesticides in cannabis were used to identify regulations for the use of pesticides in cannabis in these countries.

The results were tabulated and the following parameters were compared; testing requirements, minimum quality standard imposed, pesticides tested for and allowed limits, cannabis form to be tested, analytical techniques used, record keeping requirements, date of documents published and date of regulations in effect.

## **2.4 Publication**

An abstract of the study was submitted and accepted for poster presentation at the 82<sup>nd</sup> FIP World Congress of Pharmacy and Pharmaceutical Sciences, taking place between 1<sup>st</sup> and 4<sup>th</sup> September 2024 in Cape Town, South Africa (refer to appendix 2).

## **Chapter 3**

### **Results**

### 3.1 Analysis of Herbal Products

Three hundred and seventy articles were identified from Hydi<sup>®</sup> and 217 articles were identified from Pubmed<sup>®</sup>. After applying the inclusion criteria, 97 records were assessed for eligibility and a total of 24 studies were included in the review (refer to figure 3.1).

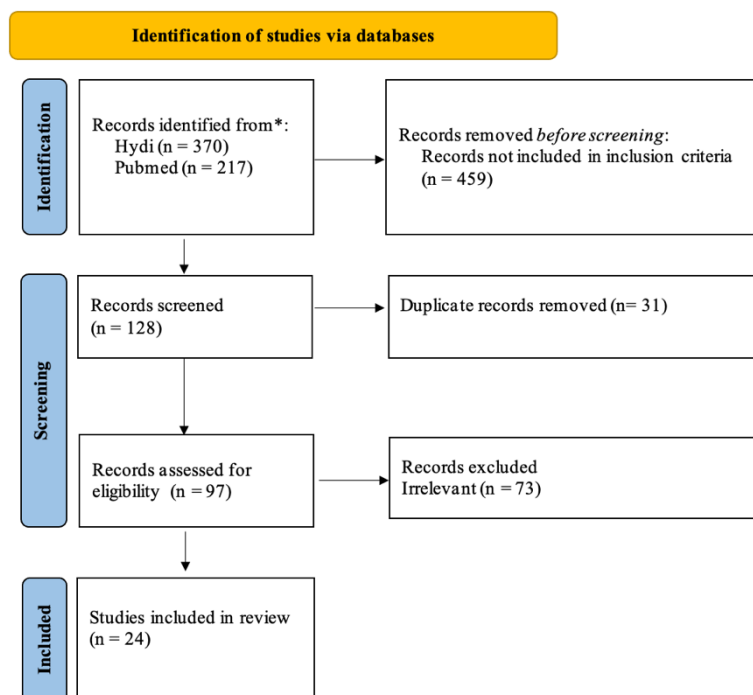


Figure 3.1 - PRISMA flowchart for the systematic literature review for the analysis of pesticides in herbal products

The articles were grouped according to analytical technique; gas chromatography, high-performance liquid chromatography and ultra-high-performance liquid chromatography.

#### 3.1.1 Gas Chromatography

Gas chromatography (GC) is the most common analytical technique for detection of pesticides in herbal products (refer to appendix 3, table 1). GC analytical methods were identified in 10 articles. Herbal products including: *Coriandrum sativum*, Daikenchuto,

Chinese herbal medicine and herbal teas such as green tea were analysed for pesticides such as; diphenylamine, malathion, diazinon and parathion. Solid phase extraction (SPE) was the most frequent sample preparation used (n = 4) and Agilent Technologies is the GC unit used most frequently (n = 4). The most common mobile phase used was helium gas (n = 3) and mass spectrometry was the identified as the most commonly used detector (n = 9).

### **3.1.2 High-Performance Liquid Chromatography**

Eight articles using high-performance liquid chromatography (HPLC) as an analytical technique for the detection of pesticides in herbal products were identified (refer to 3, table 2). Herbal products including: *Fritillaria thunbergii*, *Aristolochiae mollissima*, herbal teas and food supplements were analysed. Pesticides detected included: carbamates 6-CNA and bifenthrin. QuEChERS was the sample preparation technique most frequently used (n = 6). Agilent Technologies is the most common HPLC unit manufacturer identified (n = 4), and ACE Excel C18 column was most common column used (n = 2). The flow rate of the mobile phase ranged between 0.25-1mL/min. Mobile phases used were formic acid (n = 3) and acetonitrile (n = 3), ammonium formate (n = 4) and trifluoroacetic acid (n = 1). In 6 of the studies, mass spectrometry coupled with positive and negative ESI source was used as a detector.

### **3.1.3 Ultra-High-Performance Liquid Chromatography**

Ultra-high-performance liquid chromatography (UPLC) analytical methods were identified in 6 studies (appendix 3, refer to table 3). *Silybum marianum* and herbs used in traditional Chinese medicine such as *Ophiopogon japonicus* are some of the herbal products analysed pesticides including: acetamiprid, chlorpyrifos and epoxiconazole.

QuEChERS is the most common sample preparation technique used (n = 4), and Waters is the UHPLC unit most commonly identified (n=4). The most frequently used stationary phase is the Acquity C18 column (n = 2) and a mixture of formic acid and methanol is the mobile phase most commonly used (n = 3). Mass spectroscopy is the detector used in all 6 UHPLC methods.

### 3.2 Analysis of Cannabis

A total of 291 articles were identified. One hundred and eighty-one articles were identified from Hydi<sup>®</sup> and 110 articles were identified from Pubmed<sup>®</sup>. After applying the inclusion criteria, 56 records were assessed for eligibility and a total of 14 studies were included in the review (refer to figure 3.2).

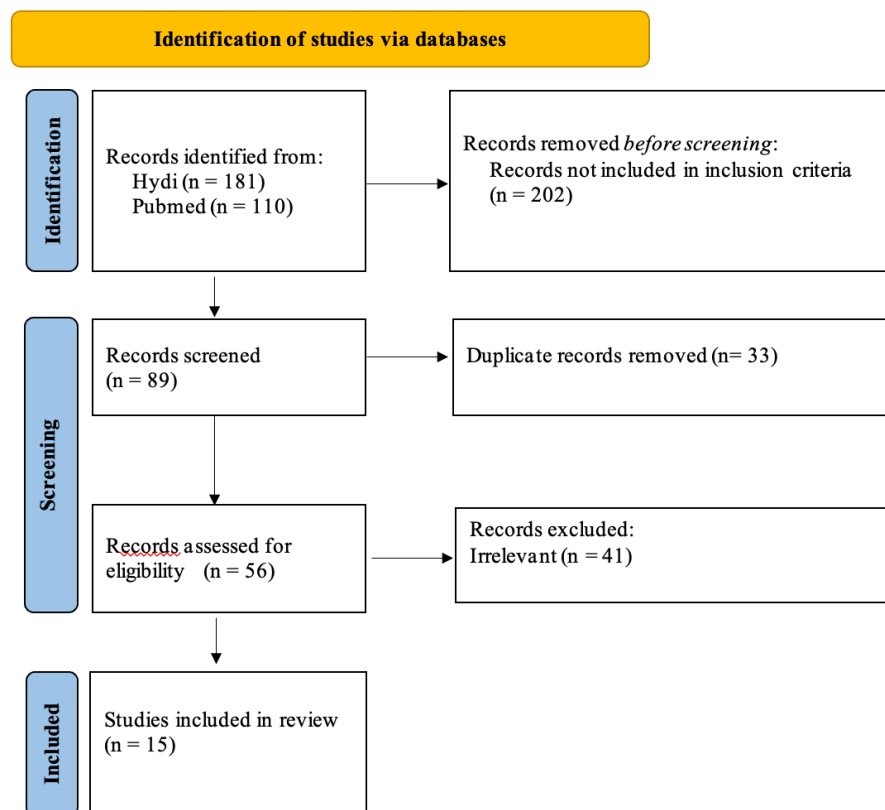


Figure 3.2 - PRISMA flowchart for the systematic literature review on analysis of pesticides in cannabis

The articles were grouped according to analytical technique. The articles were grouped according to analytical technique; gas chromatography, high-performance liquid chromatography and ultra-high-performance liquid chromatography.

#### **3.1.4 Gas Chromatography**

Four studies that made use of gas chromatography for the detection of pesticides in cannabis were identified (refer to appendix 4, table 4). Cannabis bud (n = 1), ground cannabis flower (n = 1) and hemp extracts (n = 1) are analysed in the studies, for various pesticides, including; atrazine (n = 1), bifenthrin (n = 1) and malathion (n = 1). Solid phase extraction is used as a sample preparation technique (n = 2) and Agilent 8890 GC was one of the GC units used (n = 1). Stationary phases used included; Phenomenex ZB5 MSi column (n = 1) and SHRXI-5MS Shimadzu column (n = 1). Helium gas at a flow rate of  $\approx 1.2\text{mL}/\text{min}$  was the carrier gas used as the mobile phase in most studies (n = 3). Mass spectrometry was the detector used in 3 studies, while diode array detector was used in 1 study.

#### **3.1.5 High-Performance Liquid Chromatography**

High performance liquid chromatography is the most common (n= 9) analytical technique for the detection of pesticides in cannabis (refer to appendix 4, table 5). HPLC was the analytical technique identified in 9 studies. Hemp extract (n = 2), marijuana plant (n = 1) and cannabis samples (n = 3) were tested for pesticides including carbendazim and chlorpyrifos. QuEChERS was the sample preparation technique used most frequently (n = 3), and Shimadzu was the most commonly used HPLC unit (n = 4). Examples of stationary phases used included; Phenomenex Kinetex5 (n = 1) u XB-C18 column (n = 1), Supelcosil LC-18 column (n = 1) and Raptor ARC-18 column (n = 1). Formic acid (n

= 5), acetonitrile (n = 2) and methanol (n = 4) are some of the mobile phases used. Mass spectrometry was commonly used as a detector (n = 7).

### **3.1.6 Ultra-High-Performance Liquid Chromatography**

Ultra-high-performance liquid chromatography was the analytical technique identified in 2 studies (refer to appendix 4, table 6). CBD capsules (n = 1) and vaping fluids of e-cigarettes (n = 1) were analysed for mycotoxins. QuEChERS was used as a sample preparation technique (n = 1) and UHPLC units used were Thermo Fischer Scientific UHPLC (n = 1) and Vanquish UHPLC (n = 1). Luna Omega (n = 1) and Hypersil GOLD (n = 1) were the stationary phases used along with formic acid, ammonium and methanol as mobile phases. Mass spectrometry was the detector used in both studies.

## **3.2 Guidelines for the use of Pesticides in Cannabis**

Medicinal cannabis is legalised in 54 countries. Regulations for the use of pesticides in cannabis are found in 14 of these countries, including; Malta, Germany, Denmark, the Netherlands, Australia, New Zealand, Morocco, Israel, Canada, South Africa, United States of America, Zimbabwe and Thailand. Two countries; Costa Rica and Jamaica, are currently drafting regulations for the use of pesticides in cannabis.

### **3.2.1 Europe**

Four countries within the EU follow the Ph. Eur. guidelines. These countries include; Malta, Germany, Denmark and the Netherlands.

According to the European pharmacopoeia, cannabis preparations are classified as herbal medicinal products or herbal active substances. Directive 2001/83/EC, the European Pharmacopoeia (Ph. Eur.) and the HMPC guidelines for herbal medicinal products in Europe and are relevant to cannabis and cannabis preparations. Ph. Eur 2.8.13 stipulates that testing must be conducted at the herbal drug stage and the allowed limits must be ensured to be complied with. Unless specified in the monograph, the pesticide residues must be on an approved list which consists of 69 pesticides with their allowed limits (mg/kg) (refer to appendix 5, table 7) (Council of Europe, 2019).

In Malta, the Malta Medicines Authority is the regulatory framework that provides guidance and regulations for medicinal cannabis. The Malta Medicines Authority stipulates that tests must be carried out in accordance with the European Medicines Agency (EMA) guidelines; guideline on specifications: test procedures and acceptance criteria for herbal substances, herbal preparations and herbal medicinal products/traditional herbal medicinal products EMA/HMPC/162241/2005 and guideline on quality of herbal medicinal products/traditional herbal medicinal products EMA/HMPC/201116/2005<sup>5</sup>.

In Germany, cannabis is classified as a medicinal plant and therefore it must meet certain purity requirements, including those regarding pesticide residues. Cannabis can only be used if it is grown in accordance with Good Agricultural and Collection Practice and if it

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<sup>5</sup> Malta Medicines Authority. General Guidelines on the Production of cannabis for medicinal and research purposes. [Internet]. 2022 [cited 2024 April 15]. Available from: <https://medicinesauthority.gov.mt/cannabisformedicinalandresearchpurposes?l=1>

complies with the relevant guidelines. In April 2020, Eurofins identified Ph. Eur 2.8.13 as the complete catalogue of guidelines to be followed<sup>6</sup>.

The Office of Medicinal Cannabis in The Netherlands mandates pesticide testing according to Ph. Eur 2.8.13 for cannabis oil products and cannabis flowers<sup>7</sup>.

Denmark also follows the EU regulations, however, they have adapted the EU regulations and added more requirements. The Danish Medicines Agency forsee import of cannabis to Denmark, along with the rules on permitted pesticides. Pesticides are only allowed in the cultivation of cannabis primary products for oral use (ie. inhaled or ingested by mouth). All active ingredients within the pesticides, must meet the following 3 conditions; must be approved in the EU in accordance with Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market, must be mentioned on Annex IV of Regulation (EC) No 396/2005 of the European Parliament and of the Council of 23 February 2005 on maximum residue levels of pesticides in or on feed of plant and animal origin and food, and they must be included in Annex 2 of the Danish Agricultural Agency's Guide on organic agricultural production.

### **3.2.2 Australia and New Zealand**

Although they are outside of the EU, Australia and New Zealand also follow the Ph. Eur 2.8.13 guidelines for the use of pesticides in cannabis.

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<sup>6</sup> Eurofins Deutschland. Pesticide residues in medicinal cannabis. [Internet]. Eurofins; 2020 [cited 2024 Apr 15]. Available from: <https://www.eurofins.de/food-analysis/food-news/food-testing-news/pesticides-in-medicinal-cannabis/>

<sup>7</sup> Office of Medicinal Cannabis. Monograph Cannabis Flower. [Internet]. Ministry of Health, Welfare and Sport; 2021 [cited 2024 April 3]. Available from: <https://english.cannabisbureau.nl>

In Australia, medicinal cannabis products must conform with Therapeutic Goods (Standards for Medicinal Cannabis) (TGO 93) Order 17, which was compiled in December 2022. TGO 93 is a standard that identifies minimum quality requirements for medicinal cannabis products. TGO 93 states that pesticides need to be tested for and their allowed limits must be in accordance with Ph Eur 2.8.13. Analytical testing may involve one or more chromatographic procedures, including HPLC, TLC and GC<sup>8</sup>.

In New Zealand, the Misuse of drugs (Medicinal Cannabis) Regulations 2019, establishes the minimum quality standard for medicinal cannabis products. Testing for pesticides is among minimum quality standard sets testing maximum limits and testing requirements that medicinal cannabis products and their ingredients must adhere to prior to supply, export or import to New Zealand. Maximum limits and testing requirements are based on the European Pharmacopoeia, which provides quality standards for medicines and their components<sup>9</sup>.

### **3.2.3 Morocco**

In Morocco, ANRAC (Agence Nationale de Réglementation des Activités Relatives au Cannabis) published a document titled ‘Specifications Relating to the Cultivation and Production of Cannabis’, which is to be followed by the Authorisation Holder. This document states that the producer should only use pesticides that are on the list of

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<sup>8</sup> Department of Health and Aged Care. Therapeutic goods (standard for medicinal cannabis) (TGO 93) order 2017 [Internet]. 2022 [cited 2024 Apr 2]. Available from: <https://www.legislation.gov.au/F2017L00286/latest/text>

<sup>9</sup> Medicinal Cannabis Agency. Minimum quality standard. [Internet]. Manatū Hauora Ministry of Health; 2022 [cited 2024 April 3]. Available from: <https://www.health.govt.nz/our-work/regulation-health-and-disability-system/medicinal-cannabis-agency/medicinal-cannabis-agency-information-industry/medicinal-cannabis-agency-working-medicinal-cannabis/medicinal-cannabis-agency-minimum-quality-standard>

approved pesticides registered by the ONSSA (Office National de Sécurité Sanitaire des Produits Alimentaires). Cultivators must follow the instructions that are present on the label of the pesticides and the use of synthetic chemicals is prohibited<sup>10</sup>. The list of pesticides approved by ONSSA could not be identified.

### **3.2.4 Israel**

In Israel, The Plant Protection Regulations specify that a pesticide registered for use can only be used on particular pests and crops in accordance with the instructions on the product label<sup>11</sup>. Within the guideline, no list of approved pesticides or specifications for pesticide residue testing were identified.

### **3.2.5 Thailand**

In Thailand, cannabis preparations are classified as herbal medicinal products or herbal active substances. To meet regulatory and quality control standards, raw cannabis materials and products must be screened for 69 pesticides and any residues present must be within the stipulated allowed limits set by Thai Herbal Pharmacopoeia (refer to appendix 5, table 8). Samples must be tested immediately so as to avoid any degradation of pesticide residues. Methods of analysis were not specified; however quantitative and qualitative analysis of pesticide residues must be performed in accordance with the

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<sup>10</sup> Agence Nationale de Réglementation des Activités Relatives au Cannabis. Specifications Relating to the Cultivation and Production of Cannabis. [Internet]. 2022 [cited 2024 April 16]. Available from: <https://www.anrac.gov.ma/en/wp-content/uploads/sites/8/2023/10/2-CULTIVATION-AND-PRODUCTION-OF-CANNABIS.pdf>

<sup>11</sup> Ministry of Agriculture and Rural Development. Good News for Medical Cannabis Growers in Israel: The Ministry of Agriculture and Rural Development are Pushing Legislation for the Use of Pesticides in Medical Cannabis. [Internet]. Plant Protection and Inspection Services; 2021 [cited 2024 April 19]. Available from: [https://www.gov.il/en/pages/pesticides\\_medical\\_cannabis#:~:text=The%20Plant%20Protection%20Regulations%20](https://www.gov.il/en/pages/pesticides_medical_cannabis#:~:text=The%20Plant%20Protection%20Regulations%20)

analytical procedures issued by National Authorities or International Standard Organisations<sup>12</sup>.

### **3.2.6 South Africa**

SAHPRA (South African Health Products Regulatory Authority) has published a Guideline for Cultivation of Cannabis and Manufacture of Cannabis-related Pharmaceutical Products for Medicinal and Research Purposes. This guideline explains that pesticides may be used appropriately if approved. The use of these pesticides must be kept in the records documented for each batch. Analytical testing must be performed on cannabis to detect any pesticide residues. The guideline explains that both the European Pharmacopoeia general monograph and the American Herbal Pharmacopoeia cannabis monograph can serve as a foundation for establishing criteria for testing, analysis and quality control of cannabis<sup>13</sup>.

### **3.2.7 Canada**

In Canada, the Pest Management Regulatory Agency keeps track of all pesticides that are used, however only some of these pesticides are approved. Health Canada has issued an approved list of pesticide active ingredients that can be used on cannabis. This approved list consists of 96 pesticide active ingredients, each with limit of quantification (LoQ) for 3 different forms of cannabis; fresh cannabis and plants, dried cannabis and cannabis oil. Testing must be conducted for all 96 pesticide active ingredients with a LoQ and it must

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<sup>12</sup> Thai Pharmacopoeia: 7.22H Pesticide Residues [Internet]. Bureau of Drug and Narcotic, Department of Medical Sciences, Ministry of Public Health; 2020 [cited 2024 April 17]. Available from: <https://www.bdn.go.th/tp/ebook/qQIcZUt2pR9gC3q0GT5gMJq0qT5co3uw>

<sup>13</sup> Semete-Makokotlela B. Guideline for cultivation of cannabis and manufacture of cannabis-related pharmaceutical products for medicinal and research purposes. [Internet]. South African Health Products Regulatory Authority Department of Health [cited 2024 April 16]. Available from: <https://www.sahpra.org.za/wp-content/uploads/2021/02/General-guide-to-Medicinal-Cannabis-Cultivation-or-Manufacturing.pdf>

be performed on a representative sample of each batch or lot of cannabis and the licence holder must keep a small amount of the sample for at least a year after the date of the last sale to allow for a retest of the sample for pesticide analysis if needed. Pesticide analysis must be performed on cannabis plants, fresh cannabis and dried cannabis and on any cannabis extracts that are used in topicals or edibles. Analysis should be done using QuEChERS alone or in combination with SPE, followed by LC-MS or GC-MS, and all results and data related to pesticide residue testing must be maintained for at least 2 days after they were recorded (refer to appendix 5, table 9).

Under the Cannabis Act and the Pest Control Products Act, Health Canada has the authority to enforce these regulations and take legal action if an unauthorised pesticide is used not in accordance with the regulations set<sup>14</sup>.

### **3.2.8 United States of America**

Medicinal cannabis is legalised in 38 states. Up until May 2024, no pesticides are federally registered and approved by the EPA for use on cannabis. Each state has its own guidelines and list of approved pesticides. Guidelines for 18 different states were found.

In California, no pesticide is federally registered specifically for use on cannabis. Pesticides that meet the criteria by the Department of Pesticide Regulation can be used on cannabis. These pesticides are split into two categories; 21 pesticides are category I pesticides which are exempt from residue tolerance requirements and registration

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<sup>14</sup> Canada PHA of. Government of Canada [Internet]. Gouvernement du Canada; 2022 [cited 2024 Apr 19]. Available from: <https://www.canada.ca/en/public-health/services/publications/drugs-health-products/cannabis-testing-pesticide-requirements.html>

requirements and 45 category II pesticides with US EPA residue tolerance requirements. For each category II pesticides 2 maximum residue limits are set, depending on whether cannabis is inhalable or non-inhalable (refer to appendix 6, table 10). Every batch produced must be tested for all 66 pesticides using analytical techniques such as HPLC, LC-MS and GC-MS. A certificate of analysis must be filed by the laboratory that performed the tests<sup>15</sup>.

In Illinois, the Illinois Department of Agriculture has approved a list of 66 pesticide active ingredients along with a maximum concentration which can be used on cannabis plant (refer to appendix 6, table 10). These pesticides must be registered with the Department under the Illinois Pesticide Control Act<sup>16</sup>.

In Michigan, the Michigan Marijuana Pesticide List is provided as a guidance for the use of pesticides in Michigan. The published list consists of 161 pesticides, listed under their trade name (refer to table 10). All pesticides must be used according to the product label instructions<sup>17</sup>.

In Washington, only pesticides allowed under WAC 314-55-084, which is a list of approved pesticides, can be used in the production of cannabis, and they have to be registered by the Washington State Department of Agriculture (WSDA) under chapter

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<sup>15</sup>Cannabis, Hemp, and Pesticides [Internet]. [www.cdpr.ca.gov](http://www.cdpr.ca.gov) [cited 2024 March 9]. Available from: <https://www.cdpr.ca.gov/docs/cannabis/index.htm>

<sup>16</sup> [ilga.gov](http://www.ilga.gov). 2024 [cited 2024 March 11]. Available from: <https://www.ilga.gov/commission/jcar/admincode/008/00801300ZZ9996AR.html>

<sup>17</sup> Michigan Marijuana Pesticide List (Updated 2-28-24) [Internet]. [cited 2024 March 20]. Available from: <https://www.michigan.gov/mdard/-/media/Project/Websites/mdard/documents/pesticide-plant-pest/pesticide/Michigan-Marijuana-Pesticide-List.pdf?rev=5f9bada89bf8434bbba1186a2b9e2a5d&hash=EB279B71BDE95EF80F2D123E5E31FC93>

15.58 RCW. If a certified laboratory detects a pesticide that exceeds permitted levels, or is not allowed, in a sample from a specific lot or batch, that batch has failed quality control testing and could be recalled. A list of 57 pesticide active ingredients with correspondent action levels (refer to table 11). Any other approved pesticides that are not found in the list have action levels of 0.1 ppm<sup>18</sup>.

In Arkansas, every batch of cannabis intended for use by a qualified patient must be tested for a list of pesticides by a laboratory and made sure that residues levels are below the stipulated levels (refer to appendix 6, table 11). If a batch fails pesticide testing, the batch must be destroyed. Pesticide testing results must be reported, and the reports must include LoQ levels<sup>19</sup>.

In Vermont, the Cannabis Control Board sets requirements for allowable use of pesticides on cannabis. Pesticides need to be registered in the state of Vermont, active ingredients must be food tolerance exempt, meaning, the total quantity of the pesticide will pose no hazard to the public health. Any active ingredients must be on the list published by the Vermont Cannabis Control Board (refer to appendix 6, table 11). Pesticides must also be labelled for use on unspecified crops and commercial use<sup>20</sup>.

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<sup>18</sup> WAC 314-55-108: [Internet]. app.leg.wa.gov. [cited 2024 April 12]. Available from: <https://app.leg.wa.gov/wac/default.aspx?cite=314-55-108>

<sup>19</sup> Department of Health. Medical Marijuana Registration, Testing, and Labeling in Arkansas [Internet]. 2017 Jan [cited 2024 March 10]. Available from: [https://www.healthy.arkansas.gov/images/uploads/pdf/Medical\\_Marijuana.pdf](https://www.healthy.arkansas.gov/images/uploads/pdf/Medical_Marijuana.pdf)

<sup>20</sup> Pepper J, Hulburd J, Harris K, Hare B. PESTICIDE GUIDANCE MAY 2022 [Internet]. [cited 2024 April 10]. Available from: [https://ccb.vermont.gov/sites/ccb/files/2022-05/Pesticide.Guidance\\_FINAL.pdf](https://ccb.vermont.gov/sites/ccb/files/2022-05/Pesticide.Guidance_FINAL.pdf)

In Colorado, the Colorado Department of Agriculture (CDA) has set rules on which pesticides are allowed for the use of cannabis. In February 2024, the CDA published a list of 421 pesticides, including trade names and EPA number, active ingredients and their concentrations (refer to appendix 6, table 12). Maximum tolerance pesticide residues must be in accordance with tolerances established by EPA<sup>21</sup>.

The state of Arizona follows the Colorado list of pesticides that are approved for use on cannabis in Arizona in a bid to maintain consistency with neighbouring states and to give cannabis growers access to pesticides for the control of weeds, insects or illnesses. It is the grower's or applicator's obligation to confirm that the pesticide they plan to use is registered in Arizona<sup>22</sup>.

In Oregon, there are no pesticides specifically labelled for the production of cannabis. The Oregon Department of Agriculture compiled a list of 387 pesticides that can be used on cannabis (refer to appendix 6, table 12). This list was published in November 2023 and is sorted by active ingredient and trade name. The purpose of the list is to help growers identify which pesticides are acceptable under law to use on cannabis, and testing must be performed on marijuana, cannabinoid concentrates, extracts and products<sup>23</sup>.

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<sup>21</sup> Pesticide Use in Cannabis Production Information | Department of Agriculture [Internet]. ag.colorado.gov. [cited 2024 April 15]. Available from: <https://ag.colorado.gov/plants/pesticides/pesticide-use-in-cannabis-production-information>

<sup>22</sup> Pesticide Use on Cannabis | Arizona Department of Agriculture [Internet]. agriculture.az.gov. [cited 2024 April 16]. Available from: <https://agriculture.az.gov/news/pesticide-use-cannabis>

<sup>23</sup> State of Oregon: Pesticides and PARC - Cannabis and Pesticides [Internet]. www.oregon.gov. [cited 2024 April 20]. Available from: <https://www.oregon.gov/oda/programs/pesticides/pages/cannabispesticides.aspx>

In Massachusetts, pesticides may be used on cannabis providing that they follow the following conditions. Pesticides need to be registered with EPA, registered for use in Massachusetts, labelled for both hemp and tobacco and cultivators must follow the instructions on the label. The active ingredient must also be exempt from food residue tolerances<sup>24</sup>.

In Alaska, state laws require that pesticides must be used in accordance with the instructions on the label and pesticides must be registered with EPA. Pesticides must be exempt from food residue tolerance requirements. The Department of Environmental Health compiles list of pesticides that meet the criteria, and this list (refer to appendix 6, table 13) is updated yearly at minimum<sup>25</sup>.

In Maryland, the Maryland Department of Agriculture has published a list of pesticides, according to trade name, which are allowed for use on cannabis (refer to appendix 6, table 13). Pesticides must be registered with EPA, and pesticides must be used in accordance with label instructions<sup>26</sup>.

In Nevada, the Nevada Department of Agriculture compiled a list of pesticide active ingredients that may be used on cannabis (refer to appendix 6, table 13). The list is

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<sup>24</sup> Executive Office of Energy and Environmental Affairs , Baker C, Polito K, Card B, Lebeaux J. Pesticide Use on Marijuana [Internet]. The Commonwealth of Massachusetts . Department of Agricultural Resources; 2022 Nov. [cited 2024 April 29] Available from: <https://www.mass.gov/doc/cannabis-and-pesticide-policy/download>

<sup>25</sup> Program APC. Cannabis and Pesticides [Internet]. dec.alaska.gov. [cited 2024 May 2]. Available from: <https://dec.alaska.gov/eh/pest/cannabis/>

<sup>26</sup> Maryland Department of Agriculture. List of Pesticides Allowed in the Cultivation of Medical Cannabis [Internet]. [cited 2024 April 3] Available from: <mda.maryland.gov/plants-pests/Documents/List-of-Pesticides-Allowed-in-the-Cultivation-of-Medical-Cannabis.pdf>

categorised into 3 groups, EPA Minimum Risk-Exempt from Tolerance, EPA Registered Pesticide-Exempt from Tolerance and EPA Registered Pesticide-Tolerance is Monitored. The active ingredient must be registered for a food crop and for sale in the State of Nevada<sup>27</sup>.

In Connecticut, the Department of Energy and Environmental Protection (DEEP), states that any pesticide to be used on cannabis, must first be registered with the DEEP. All pesticide label requirements must be followed and the requirement of a tolerance for pesticide chemical residues must not apply to active components listed on the label of the pesticide. The list consists of 197 pesticides, with their trade name, EPA number, active ingredients and their respective concentrations<sup>28</sup> (refer to appendix 6, table 14).

In Maine, pesticides may only be used if usage is in strict accordance with the product label requirements and pesticides must be registered with the Maine Department of Agriculture. Pesticide storage and use must be in compliance with US EPA. Detailed records of all pesticides used must be kept and must be provided to the Maine regulatory state bodies upon request. A list of EPA registered pesticides that may be used on cannabis is published, however it is specified that this list does not serve as an

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<sup>27</sup> Sisolak S, Ott J. The Nevada Pesticide Applicator Act prohibits use of a pesticide in a manner inconsistent with the product labeling per NRS 586.335 [Internet]. 2019 May [cited 2024 April 2]. Available from: [https://agri.nv.gov/uploadedFiles/agrinvgov/Content/Plant/Environmental\\_Combpliance/Medical%20Marijuana%20Pesticide%20List%20\(Revised%20052919\).pdf](https://agri.nv.gov/uploadedFiles/agrinvgov/Content/Plant/Environmental_Combpliance/Medical%20Marijuana%20Pesticide%20List%20(Revised%20052919).pdf)

<sup>28</sup> Information for Hemp and Medical Marijuana Growers [Internet]. CT.gov - Connecticut's Official State Website. [cited 2024 April 30]. Available from: <https://portal.ct.gov/deep/pesticides/information-for-hemp-and-medical-marijuana-growers>

endorsement by the State of Maine or the Board of Pesticides Control to use the pesticides within the list<sup>29</sup> (refer to appendix 6, table 14).

In Hawaii, there are currently no pesticides registered for use on cannabis with the Hawaii State Department of Agriculture (HDOA). However, in 2017, the Department of Agriculture has published criteria for pesticides used in the production of medical cannabis. The criteria includes the following; pesticides must be registered with EPA and licensed by HDOA, product applied must be a minimum risk pesticide and active ingredients must be exempt from the requirements of a food tolerance. The HDOA states that the use of such pesticides must be in accordance with label instructions<sup>30</sup>.

In New Mexico, the New Mexico Department of Agriculture compiled a list of 103 pesticides including trade name and active ingredients (refer to appendix 6, table 15). The list is categorised into fungicides, herbicides and insecticides. All pesticides must be registered with EPA and label instructions must be followed<sup>31</sup>.

In the state of New York, testing is required on all cannabis products even beverages. According to the Office of Cannabis Management, testing must be performed for the pesticides included in the list published and pesticide residues must be below allowed

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<sup>29</sup> Medical Marijuana Pesticide License for Growers: Board of Pesticides: Plant Health and Pesticides: Maine ACF [Internet]. [www.maine.gov](http://www.maine.gov). [cited 2024 April 24]. Available from: <https://www.maine.gov/dacf/php/pesticides/applicators/MedicalMarijuana.html>

<sup>30</sup> S. Tsutsui S, Y. IGE D, E. Enright S, Shimabukuro-Geiser P. Criteria for Pesticides Used in the Production of Medical Marijuana in the State of Hawaii [Internet]. 2017 Jan [cited 2024 April 24]. Available from: <https://hdoa.hawaii.gov/pi/files/2013/01/Guidance-for-Medical-Marijuana-Jan-2017.pdf>

<sup>31</sup> Hemp Registered Chemistry [Internet]. Nmsu.edu. 2024 [cited 2024 April 12]. Available from: <https://nmdeptag.nmsu.edu/aes/hemp/cannabis-registered-pesticides-and-growth-regulators.html>

limits (refer to appendix 6, table 15). Any pesticides used in the cultivation of medicinal cannabis must be declared for targeted testing<sup>32</sup>.

### **3.2.9 Zimbabwe**

In Zimbabwe, all forms of cannabis, including fresh or dried cannabis, cannabis plants or seeds, should only be treated with pesticides that have been authorised and registered for use under the Plant Pests and Diseases Act. The use of these pesticides and herbicides should only be used if absolutely necessary<sup>33</sup>. The list of pesticides registered with Plant Pests and Diseases Act was not able to be identified. No specific guidelines for analysis and screening of pesticide residues has been established.

### **3.2.10 Costa Rica**

The Legislative Assembly of Costa Rica Republic have drafted a law titled ‘Research Law, Regulation and Control of Cannabis Plants and Hemp for medical use’. This draft states that inorganic pesticides and herbicides may be used only if in accordance with the Law on Development, Promotion and Development of Organic Farming Activity Act 8542<sup>34</sup>. No emphasis was given to the analysis of pesticide residues in cannabis products.

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<sup>32</sup> New York State Office of Cannabis Management . Required Testing of Each Lot of Adult Use Cannabis and Medical Cannabis Product [Internet]. [cited 2024 April 16]. Available from: <https://cannabis.ny.gov/system/files/documents/2024/07/ocm-testing-limits-final-7-10-24.pdf>

<sup>33</sup> Minister of Health and Child Care. Dangerous Drugs (Production of Cannabis for Medicinal and Scientific Use) Regulations 2018. [Internet]. Zimbabwean Government Gazette; 2018 [cited 2024 April 18]. Available from: [https://www.veritaszim.net/node/2390#:~:text=Home-.SI%202018%2D062%20%2D%20Dangerous%20Drugs%20\(Production%20of%20Cannabis%20for,into%20force%20on%20that%20date.](https://www.veritaszim.net/node/2390#:~:text=Home-.SI%202018%2D062%20%2D%20Dangerous%20Drugs%20(Production%20of%20Cannabis%20for,into%20force%20on%20that%20date.)

<sup>34</sup> Delgado MA. Research Law, Regulation and Control of Cannabis Plants and Hemp for Medical Use. [Internet]. Legislative Assembly of Costa Rica Republic Draft Law; [cited 2024 April 19]. Available from: [http://j.b5z.net/i/u/10233704/f/CR\\_MMJ\\_Bill\\_19256\\_en.pdf](http://j.b5z.net/i/u/10233704/f/CR_MMJ_Bill_19256_en.pdf)

### 3.2.11 Jamaica

In 2019, the Bureau of Standards of Jamaica published two drafts related to the cultivation and handling of medicinal cannabis. The draft of the Jamaican Code of Practice for Cultivation of Cannabis for Medical, Scientific and Therapeutic Use, states that cannabis should be grown on soil which is free from pesticides residues. If absolutely necessary, only approved herbicides, fungicides, arachnicides and pesticides may be used at the minimum effective level in accordance with the pesticide label. Any pesticides used must be recorded and data should be kept. Cultivators must abide by the maximum herbicide and pesticide residue limits requirements of both the cultivator's and the end-user's countries<sup>35</sup>.

The draft of the Jamaican Code of Practice for Processing and handling of medical cannabis products, states that finished products need to be tested for residual pesticides, and any residues should be within the limits. If the finished cannabis product contains an unapproved pesticide or a pesticide residue is above the maximum residue tolerance limits, these products must be recalled<sup>36</sup>.

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<sup>35</sup> Bureau of Standards Jamaica. Draft Jamaican Code of Practice for Cultivation of Cannabis for Medical, Scientific and Therapeutic Use.pdf [Internet]. [cited 2024 Apr 20]. Available from: [https://www.bsj.org.jm/sites/default/files/DJCP\\_347](https://www.bsj.org.jm/sites/default/files/DJCP_347)

<sup>36</sup> Bureau of Standards Jamaica. Draft Jamaican Code of Practice Processing and Handling of Medical Cannabis Product Public Enquiry.pdf [Internet]. [cited 2024 Apr 20]. Available from: [https://www.bsj.org.jm/sites/default/files/DJCP\\_347](https://www.bsj.org.jm/sites/default/files/DJCP_347)

## **Chapter 4**

### **Discussion**

## 4.1 Analysis of Pesticides

Analytical methods for cannabis and other herbal products employ chromatographic techniques for pesticide detection. These methods are favored for their robustness, sensitivity, and ability to provide detailed compound separation and identification (Craven et al, 2019).

In this study, high-performance liquid chromatography emerged as the predominant method for pesticide detection in cannabis (n = 9). The preference over gas chromatography, which was more commonly used in herbal products (n = 10), may be attributed to HPLC's suitability for non-volatile, thermally unstable pesticides with varied chemical properties which are often found in cannabis products (Dybowski et al, 2023).

Gas Chromatography, while more frequently used in the analysis of herbal products, was also applicable in studies on cannabis, especially for volatile pesticides. Solid phase extraction is often paired with GC to improve the purity of the sample before analysis, enhancing detection sensitivity and reliability (Badawy et al, 2022).

All 3 chromatographic analytical techniques are used to detect a wide range of pesticides, which can be categorised into different classes. Examples of some of the pesticides analysed using chromatographic techniques include; fungicides (e.g. propiconazole, boscalid, tebuconazole), insecticides (e.g. malathion, diazinon, imidacloprid) and acaricides (e.g. etoxazole, fenproximate, chlorfenvinphos) (Taylor & Birkett, 2019). The same classes of pesticides were analysed on both herbal products and cannabis. A difference in the number of pesticides analysed in herbal products and cannabis can be noted. Herbal products are analysed for a larger number of pesticides when compared to

cannabis products. This could be due to cannabis often requiring a controlled environment, which may predispose it to specific pesticides and diseases, necessitating the use of specialised pesticides. In contrast, traditional herbal products are derived from a variety of environments, each with unique pest challenges, leading to a broader spectrum of pesticide residues being analysed (Fleming et al, 2023).

Techniques such as solid-phase extraction and Quick, Easy, Cheap, Effective, Rugged, and Safe are commonly used for cannabis and other herbal products to prepare samples for analysis. These methods help in purifying and concentrating the analytes from complex matrices, thus enhancing the reliability of the subsequent chromatographic analysis (Moulins et al, 2018).

The QuEChERS sample preparation technique has become an increasingly common method for preparing cannabis samples due to its efficiency effectiveness and versatility for application to pesticides with diverse chemical properties. This method allows for the rapid preparation of samples with minimal solvent usage, reducing the time and cost associated with pesticide analysis. QuEChERS is often followed by HPLC and UHPLC as a method of analysis (González-Curbelo, 2015).

Mass spectroscopy is the most commonly used detector used amongst all identified methods of analysis amongst both herbal products and cannabis. This could be attributed to mass spectroscopy's precision, sensitivity and low detection limits, thus making it an ideal detector to detect pesticide residues at low concentrations (De Hoffmann, 2013).

Emerging analytical techniques, such as UHPLC and tandem mass spectrometry (MS/MS), are gaining prominence due to their enhanced sensitivity and faster processing times. Techniques like these are crucial for detecting low levels of pesticide residues in cannabis, which can be pivotal for ensuring consumer safety and regulatory compliance. The development of multi-residue methods enables simultaneous detection and quantification of numerous contaminants, making these techniques invaluable in the current landscape where comprehensive screening is essential (Tucker, 2022).

The presence of pesticide residues in herbal products, including cannabis, can pose significant health risks to consumers. Pesticides are often linked to a range of adverse health effects, including neurological disorders, reproductive issues, and even cancer, especially when products are used medicinally by populations with vulnerable health conditions (Panis et al, 2022). Reliable analytical techniques ensure that these products are safe for consumption, by detecting and quantifying pesticide residues to ensure they do not exceed the regulatory limits set for human safety.

#### **4.2 Regulations of Pesticides in Cannabis**

Regulations for the use of pesticides in cannabis were found in 14 countries. This highlights the lack of regulations on the use of pesticides, as regulations were only identified in one fourth of the countries where medicinal cannabis is legalised. This regulatory gap underscores the urgent need for a more harmonised global approach to pesticide regulation in the cannabis industry, to ensure safety standards that protect consumer health across all regions.

The European Pharmacopoeia 2.8.13 guidelines are the most commonly used guidelines. These guidelines serve as the standard for many nations, with six countries, including four within the EU (Malta, Denmark, Germany, and the Netherlands) and two outside (Australia and New Zealand), adhering to these standards. While the Ph. Eur. 2.8.13 guidelines serve as a common reference, treating cannabis merely as a herbal product might not address all specific safety concerns related to its use, particularly given its unique chemical complexity and consumption methods. Despite the introduction of cannabis-specific monographs (Ph. Eur. 3028 for cannabis flos and Ph. Eur. 3151 for cannabidiol isolate) in July 2024, no regulations on pesticides and the methodologies for detecting pesticide residues were included. Therefore, with regards to pesticides, the Ph. Eur. 2.8.13 guidelines are still followed. This recent introduction of cannabis-specific monographs signifies a move towards more tailored regulations, yet the lack of detailed pesticide guidelines within these monographs indicates a gap that might affect the uniformity and safety of cannabis products across Europe.

Consistency between the European guidelines and the guidelines followed in Thailand can be observed, as both countries classify cannabis as a herbal product. The lists of active ingredients and their limit (mg/kg) in both countries are identical. According to Thai regulations, samples must be tested immediately, while in Ph. Eur. 2.8.13 guidelines testing must be conducted at the herbal drug stage. Similarly, South Africa follows both the European and American Herbal Pharmacopoeia.

In the USA, the lack of federal oversight leads to a patchwork of state-specific regulations, complicating compliance and enforcement. Regulations for the use of pesticides in cannabis were found in 18 states, each state having its own state-specific

regulations. For instance, California requires testing for 66 pesticides, while Washington has its own limits for 57 pesticides. A similarity in regulations is observed between Washington and Arkansas, while Arizona follows the same list of approved pesticides published by Colorado. With regards to analytical techniques and testing requirements, only 4 states include these within their regulations. Inconsistencies in state-level regulations can result in a greater risk of contaminant exposure in some states. This lack of uniformity could pose challenges for interstate commerce and regulatory compliance, highlighting the need for federal guidelines.

Canada has the most advanced regulations on the use of pesticides in cannabis. The guidelines established by Health Canada include a comprehensive list of pesticide active ingredients along with the maximum permissible limits for each. This list is more detailed and extensive compared to the one in the European Pharmacopoeia, as it specifies different allowable limits for various cannabis product forms, including fresh cannabis, dried cannabis, and cannabis oil. Canada's early legalization of medical cannabis may have contributed to the development of such detailed regulations. Unlike the EU's list, which generally covers active ingredients in pesticides, Canada's guidelines provide specific limits tailored to different forms of cannabis products.

The current state of pesticide regulations in cannabis highlights a significant variation in how countries approach cannabis safety. The lack of global standardization leads to challenges in ensuring consistent product safety, especially in a market as dynamically evolving as cannabis. The slow pace of regulatory development in comparison to the rapid growth of the cannabis market globally suggests that more proactive measures are needed. Countries new to cannabis legalization might benefit from observing established markets

like Canada or the EU, yet there remains a clear opportunity for the development of international standards that could facilitate better regulatory alignment and safer products worldwide. This harmonization would facilitate safer global commerce in cannabis products, ensure consistent consumer protection, and reduce compliance intricacy for international businesses.

### **4.3 Limitations of this study**

The medicinal cannabis industry is still in its early stages. When collecting data on analytical techniques used for the detection of pesticides, considerably less articles specifically related to pesticides in cannabis were found. In some articles, certain information was not included such as the sample preparation technique used and the mobile phase.

In many of the countries where medicinal cannabis has been legalised, regulations are still under review and undergoing changes continuously, as more research and development is carried out.

The cultivation and production of cannabis have historically been illegal activities. Despite a shift from illicit to legal cultivation practices, this study highlights a noticeable lack of information in the regulations and guidelines governing cannabis cultivation. Additionally, the specific focus on pesticide use in cannabis has resulted in fewer published regulations compared to those for pesticides in other herbal products.

#### **4.4 Recommendations for future work**

Future studies should include a broader range of countries, particularly those newly legalizing medicinal cannabis, as more countries legalize medicinal cannabis, their emerging regulatory frameworks can offer new insights and data points for comparative analyses. Continuous monitoring of new regulations or updated regulations for the use of pesticides in cannabis, would be of benefit as it would provide a broader overview on the regulatory and practical approaches of analytical techniques of different countries on the use of pesticides in medicinal cannabis. The results of this study can be used to improve and update current regulations on the use of pesticides in cannabis.

The proposal of guidelines for the use of pesticides in cannabis adapted from the data collected would be beneficial, which could be implemented within the legal framework in different countries and locally. This would harmonise regulations amongst different countries making it easier for manufacturers and authorization holders to produce, import and export medicinal cannabis in accordance with all countries in which medicinal cannabis is legalised.

#### **4.5 Conclusion**

Analytical techniques are essential for ensuring that herbal products and cannabis products comply with international and national safety standards. Accurate and sensitive analytical methods are required to verify compliance with these standards. Regulatory bodies globally have established maximum residue limits for pesticides in medicinal cannabis products. The regulations set by the countries that were reviewed highlighted a lack of coherence with regards to the for the regulations for the use of pesticides in

cannabis. While the adoption of Ph. Eur. guidelines by several countries signifies a move towards harmonization, significant work remains to unify the regulatory frameworks globally. Ensuring the reliability of analytical methods and the consistency of regulatory approaches is essential for the efficacy and safety of cannabis as a medicinal product.

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## **List of Publications and Abstracts**

82<sup>nd</sup> FIP World Congress of Pharmacy and Pharmaceutical Sciences, between 1<sup>st</sup> and 4<sup>th</sup> September 2024 in Cape Town, South Africa.

## Appendices

# Appendix 1

## FREC approval

University of Malta Mail - The status of your REDP form (MED-2021-00056) has been updated to Acknowledged

29/03/2023, 07:52



L-Università  
ta' Malta

Audrey Muscat <audrey.muscat.19@um.edu.mt>

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### The status of your REDP form (MED-2021-00056) has been updated to Acknowledged

1 message

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**form.urec@um.edu.mt** <form.urec@um.edu.mt>  
To: audrey.muscat.19@um.edu.mt

14 March 2023 at 11:08

Dear Audrey Muscat,

Please note that the status of your REDP form (MED-2021-00056) has been set to *Acknowledged*.

This status change was accompanied by the following explanation/justification: *Dear applicant, Your research ethics application has been received. As indicated in the Research Ethics Review Procedures, submissions which have no self-assessment issues are kept for record and audit purposes only, so research may commence. Kindly note that FREC will not issue any form of approval as the responsibility for the self-assessment part lies exclusively with the researcher. Regards, MED FREC*

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## **Appendix 2**

FIP Abstract Acceptance

## **82<sup>nd</sup> FIP World Congress of Pharmacy and Pharmaceutical Sciences**

### **Regulations of Pesticides in Cannabis**

**Audrey Muscat, Janis Vella Szijj, Lilian M. Azzopardi**

**Title:** Regulations of Pesticides in Cannabis

**Background Information:** Accurate determination of pesticide residues in medicinal cannabis is increasingly recognised as a necessary contributor to the safety of medicinal cannabis products.

**Purpose:** To identify and compare regulations related to allowed limits of pesticides in medicinal cannabis in different countries.

**Method:** Regulations for the use of pesticides in cannabis were identified using official government websites of different countries. The following parameters were compared; testing requirements, pesticides tested for, allowed limits and analytical techniques used. Guidelines for the use of pesticides in cannabis are proposed.

**Results:** Nine countries with regulations on the use of pesticides in cannabis were identified. In Thailand, analysis is done in accordance with the Thai Pharmacopoeia which sets residue limits for 69 pesticides. Malta, The Netherlands, Australia and New Zealand follow the European Pharmacopoeia guidelines, which require testing of 69 pesticides and their allowed limits. Denmark sets 3 criteria for pesticides to be approved for cannabis: pesticides must be approved in the European Union, active ingredient must be within maximum levels and must be approved by the Danish Agricultural Agency. In Morocco, in the cultivation of cannabis, authorised and licensed pesticides should only be used if use is justified. In the United States of America, 17 states were identified, in

which no pesticides are federally registered for use on cannabis, however, each state has its own guidelines and lists of approved pesticides. No countries in South America have defined regulations. In Canada, 96 pesticides are to be tested for, each including different limits of quantification, depending on whether it is in dried cannabis, cannabis oil or cannabis inflorescence.

**Conclusion:** The study helped identify differences and similarities between guidelines and regulations for the use of pesticides in cannabis. Harmonised regulations help improve the quality and safety of medicinal cannabis products.

**Topic Area:** Regulatory sciences and quality

## **Appendix 3**

### Analytical Techniques for the Analysis of Pesticides in Herbal Products

**Table 1 - Gas Chromatographic Methods for Analysis of Pesticides in Herbal Products**

Gas Chromatographic Method for Analysis of Herbal Products (n = 10)							
Author, date	Herbal Product Analysed	Pesticides Analysed	Sample Preparation Technique	GC Unit Used	Stationary Phase	Mobile Phase and Flow Rate	Detector Used
Harris ES et al, 2011.	334 samples of Chinese herbal medicines	162 pesticides	QuEChERS	Waters Quattro GC system	n/a	n/a	MS
Sarkhail P et al, 2012.	<i>Zataria</i> <i>Matricaria chamomile</i> <i>Spearmint</i> <i>Cumin seed</i> <i>Borage</i>	Malathion Diazinon Primiphos methyl Parathion Caffeine	SPME	n/a	n/a	n/a	MS
Mosaddegh MH et al, 2014.	Children herbal medicine: GolGrip Senagol Caraway mixture Thymian Children Tussain	Diazinon Chlorpyrifos	SPME	Younglin model YL 6100	Technokroma (60m x 0.53mm, 1.25µm) column	Phase: Helium gas Flow rate: 300mL/min Flow rate: 300mL/min Hydrogen gas flow at 30mL/min	FID
Singh M et al, 2015.	<i>Coriandrum sativum</i>	31 pesticides	n/a	n/a	n/a	Phase: Hexane gas	MS
Singh M et al, 2015.	<i>Nardostachys jatamansi</i>	n/a	n/a	Agilent 7890A GC system (USA)	n/a	n/a	MS
Malinowska E et al, 2015.	<i>A. millefolium L.</i> <i>C. intybus L.</i> <i>E. arvense L.</i> <i>P. persicaria L.</i> <i>P. laceolata L.</i> <i>P. major L.</i>	Diphenylamine Tebuconazole Chlorpyrifos-ethyl	QuEChERS	Shimadzu GCMS-TQ8030EI	n/a	n/a	MS

Witczak A et al, 2017.	Green tea Herbal tea Black tea	Organochlorine pesticides	SPE	GC/MS HP 5973	HP-MS column (60m x 250 μm, 2.25μm)	<u>Phase:</u> Helium gas <u>Flow rate:</u> 0.8mL/min	MS
Yu IS et al, 2017.	155 decoctions of herbal products	o,p'-DDT p,p'-DDD p,p'-DDE p,p'-DDT Bifenthrin Chlorfenapyr Chlorothalonil Cyhalothrin Cypermethrin Dieldrin α-Endosulfan β-Endosulfan Endosulfan Sulfate Fenarimol Fenpropathrin Hexaconazole Isoprothiolane Kresoxim-methyl Methoxychlor Pendimethalin Procymidone Tetradifon Thifluzamide Tolyfluanide Triadimefon Acetamiprid Cyprodinil Iprobenfos Napropamid Tebuconazole	SPE	Agilent technologies HP6890N (USA)	DB-5 and DB-1701 capillary dual column	<u>n/a</u>	NDP μECD MS

		Tebufenpyrad Triadimenol Triazophos					
Nair J et al, 2018.	<i>Aegle marmelos (L.) Correa Psidium guajava Linn. Nigella sativa Linn.</i>	DDT 1,2,3,4,5,6- hexachloro cyclohexane Endosulfan Malathion Parathion Aflatoxin B1, B2, G1, G2	SPE	Agilent 7890 GC system (USA)	Silica column (30m x 0.25mm, 0.25 µm)	<u>Phase:</u> Helium gas <u>Flow rate:</u> 2.0mL/min	MS
Saegusa H et al, 2021.	Daikenchuto	91 USP-listed compounds	SPE	Agilent technologies (7890GC/7000B, CA, USA)	DB-XLB (30m x 0.25mm, 0.25µm) capillary column	n/a	MS

**Table 2 - High-Performance Liquid Chromatographic Methods for Analysis of Herbal Products**

High-Performance Liquid Chromatographic Method for Analysis of Herbal Products (n = 8)							
Author, date	Herbal Product Analysed	Pesticides Analysed	Sample Preparation Technique	GC Unit Used	Stationary Phase	Mobile Phase and Flow Rate	Detector Used
Fang N et al, 2020.	<i>Lonicerae japonicae</i> <i>Perillae folium</i> <i>Ginseng radix</i> <i>Leonuri herba</i>	Flupradifurone Difluoroethyl-amino-furanone 6-CNA	QuEChERS	Agilent 1260 HPLC (Santa Clara, CA, USA)	Agilent ZORBAX RRHD Eclipse Plus C18 column (3mm x 100mm, 1.8µm)	<u>Phase A:</u> formic acid <u>Phase B:</u> acetonitrile <u>Flow rate:</u> 0.3mL/min	MS equipped with an ESI source, performed in the positive and negative mode
Ip SP et al, 2010.	20-herb Chinese medicine (IBS-20 formula)	Aldrin Dieldrin Chlordane Dichlorodiphenyl-trichloroethane Endrin Heptachlor Hexachlorobenzene Hexachlorocyclohexane isomers Lindane Quintozene Aflatazons B1 Aflatoxins B2 Aflatoxins G1 Aflatoxins G2	n/a	Agilent 1100 HPLC system (Agilent Technologies, USA)	Alltech Alltima C18 column (4.6mm x 250mm, 5µm)	<u>Phase A:</u> trifluoroacetic acid <u>Phase B:</u> acetonitrile <u>Flow rate:</u> 1.0mL/min	MS
Mol HGJ et al, 2011.	Samples of a food supplement, silage, compound feed and a feed ingredient.	n/a	QuEChERS	Accela HPLC (Thermo Fischer Scientific, San Jose, CA, USA)	Waters Atlantis T3 LC column (100mm x 3 mm, 3 µm)	<u>Phase A:</u> water <u>Phase B:</u> methanol:water (95:5) both containing ammonium formate and formic acid	Orbitrap MS fitted with a HESI II ESI source, operated in positive and negative mode

						Flow rate: 300µL/min	
Pallarés N et al, 2021.	85 tablet samples of the most common medicinal herb dietary supplements	Mycotoxins: Enniatin B Enniatin A <sub>1</sub> Enniatin B <sub>1</sub> Ochratoxin A Beauvericin	QuEChERS	Agilent 1200 chromatography (Agilent Technologies, Palo Alto, CA, USA) equipped with 3200 QTRAP (Applied Biosystems, AB Sciex, Foster City, CA, USA)	Gemini-NX C18 (Phenomenex, 150mm x 4.6mm, 5µm)	Phase A: acidified water with ammonium formate and formic acid Phase B: acidified methanol with ammonium formation and formic acid Flow rate: 0.25mL/min	MS coupled with Turbo Ion Spray used in positive ESI mode
Wang C et al, 2021.	<i>Paeoniae Radix Alba</i>	Organophosphorus Organochlorine Carbamates	QuEChERS	Nexera X2 LC system (Shimadzu, Kyoto, Japan)	ACE Excel 2 C18 (100mm x 2.1mm, 1.7µm) column	Phase A: ammonium formate aqueous solution Phase B: methanol Flow rate: 0.3mL/min	MS coupled with both positive and negative ESI source
Wu T et al, 2021.	<i>Fritillaria thunbergii</i>	Carbendazim Thiophanatemethyl Dimethomorph Fluopyram Tebuconazole Propiconazole Difenoconazole	QuEChERS	Nexera X2 LC-30AD	ACE Excel 2 C18 (100mm x 2.1 mm, 2µm) column	Phase A: ammonium formate aqueous solution Phase B: methanol Flow rate: 0.3mL/min	MS performed using ESI and multiple reaction monitoring mode
Zhang J et al, 2020.	<i>Clematis armandii</i> <i>Akebia</i> <i>Asaram sieboldii</i> <i>Aristolchia mollissima</i> <i>Aristolochiae moupinensis</i>	Aristolochic acid I Aristolochic acid II	QuEChERS	Shimadzu LCMS-8040 system	Prevail C18 (150mm x 4.6mm, 5µm) column	Phase A: ammonium acetate in water Phase B: acetonitrile Flow rate: 0.4mL/min	SHIMADZU LCMS-8040 Tandem Quadrupole MS, equipped with an ESI source, under positive electrospray ionization mode

	<i>Aristolochia contorta</i> <i>Radix aristolochiae</i> <i>NBPL</i>						
Zhang R et al, 2020.	Herbal tea	Fenpropathrin Iambdacyhalothrin Fenvalerate Permethrin Bifenthrin	UETC-IL-DLLME	Waters 12695, American	ZORBAX Eclipse C18 column (4.6mm x 150mm, 5µm)	<u>Phase:</u> acetonitrile-water (78:22) <u>Flow rate:</u> 1.0mL/min	DAD

**Table 3 - Ultra-High-Performance Liquid Chromatographic Methods for Analysis of Herbal Products**

Ultra-High-Performance Liquid Chromatographic Method for Analysis of Herbal Products (n = 6)							
Author, date	Herbal Product Analysed	Pesticides Analysed	Sample Preparation Technique	GC Unit Used	Stationary Phase	Mobile Phase and Flow Rate	Detector Used
Fenclova M et al, 2019.	<i>Silybum marianum</i>	323 pesticides	n/a	Dionex UltiMate 3000 UHPLC (Thermo Scientific, Sunnyvale, CA, USA)	Accurocore™ aQ analytical column (150mm x 2.1mm, 2.6µm)	<u>Phase A:</u> acetonitrile <u>Phase B:</u> hexane	MS
Harris ESJ et al, 2011.	334 samples of Chinese herbal medicines	162 pesticides	QuEChERS	Waters Acquity UPLC system	n/a	n/a	MS
Li RX et al, 2020.	Traditional Chinese Medicine: <i>Ophiopogon japonicus</i> <i>Liliaceae</i> <i>Polygonatum odoratum</i> <i>Paeonia suffruticosa</i>	108 pesticides	QuEChERS	1290 Infinity UHPLC system	Agilent Poroshell 120 EC C18 column (100mm x 3mm, 2.7 µm)	<u>Phase A:</u> ammonium acetate <u>Phase B:</u> methanol <u>Flow rate:</u> 0.4mL/min	6495A Triple Quadrupole MS
Li SN et al, 2019.	<i>Paeoniae Radix Alba</i>	Azoxystrobin Epoxiconazole Difenoconazole	QuEChERS	Waters Co. (Milford, MA, USA)	Acquity UPLC BEH C18 column (2.10mm x 100mm, 1.7µm)	<u>Phase A:</u> methanol in water containing formic acid <u>Phase B:</u> methanol containing formic acid in water	Triple quadrupole MS system coupled with MRM mode using positive ESI

Qin Y et al, 2015.	<i>Hedyotis diffusa</i>	Acetamiprid Imidacloprid Imidaclothiz Nitenpyram Thiacloprid	QuEChERS	Waters Acquity UPLC (Waters, USA)	BEH C18 analytical column (50mm x 2.1mm, 1.7µm)	<u>Phase A:</u> methanol <u>Phase B:</u> formic acid <u>Flow rate:</u> 0.3mL/min	MS with ESI source performed in the positive ionization mode
Zhang R et al, 2019.	Herbal tea	Dichlorvos Phoxim Chlorpyrifosmethyl Chlorpyrifos Tolcofosmethyl Ediphenphos Ethion Profenofos	DLLME	UPLC Waters TS-Q (Milford, MA, American)	Acquity UPLC BEH C18 column (2.1mm x 50mm, 1.7µm)	<u>Phase A:</u> formic acid <u>Phase B:</u> methanol <u>Flow rate:</u> 0.3mL/min	MS carried out in the positive ESI mode and multiple reaction monitoring mode

## **Appendix 4**

### Analytical Techniques for the Analysis of Pesticides in Cannabis

**Table 4 - Gas Chromatographic Methods for Analysis of Pesticides in Cannabis**

Gas Chromatographic Method for Analysis of Cannabis (n = 4)							
Author, Date	Cannabis Product Analysed	Pesticides Analysed	Sample Preparation Technique	GC Unit Used	Stationary Phase	Mobile Phase and Flow Rate	Detector Used
Raber JC et al, 2015.	57 concentrate samples	Bifenthrin Carbaryl Diazinon Fluvalinate Malathion Myclobutanil Paclobutrazol Permethrin	n/a	GCMS (model QP2010 PLUS, Shimadzu, Kyoto, Japan)	SHRXI-5MS (Shimadzu) column (30m x 0.25mm, 0.25 µm)	n/a	MS
Wylie PL et al, 2020.	Samples of ground cannabis flower	95 pesticides	SPE clean up followed by a 125:1 dilution	Agilent 8890 GC	2 Agilent HP-5MS Ultra Inert columns (15m x 0.25mm x 0.25µm)	Helium is the carrier gas Flow rate 1: 1.2mL/min Flow rate 2: 1.4mL/min	Agilent 7250 high resolution accurate mass Q-TOF MS
Luca SV et al, 2020.	Hemp extract	59 pesticides	n/a	Nexis GC 2030 from Shimadzu (Tokyo, Japan)	Restek Rxi-642Sil MS (30m x 0.25mm, 1.4 µm)	Helium is the carrier gas	DAD
Myburgh P et al, 2021.	Cannabis bud sample	Atrazine Terbuthylazine Acetochlor Alachlor	MISPE procedure	PerkinElmer Clarus 680 GC	Phenomenex ZB5 MSi column (30m with a 5m guard column, 0.25mm, 0.25 µm)	Helium is the carrier gas Flow rate: 1.0mL/min	MS PerkinElmer Clarus SQ 8T detector equipped with an electron impact ion source

**Table 5 - High-Performance Liquid Chromatographic Methods for Analysis of Pesticides in Cannabis**

High-Performance Liquid Chromatographic Method for Analysis of Cannabis (n = 9)							
Author, Date	Cannabis Product Analysed	Pesticides Analysed	Sample Preparation Technique	HPLC Unit Used	Stationary Phase	Mobile Phase and Flow Rate	Detector Used
Russo EB, 2016.	26 cannabis samples (24 concentrates, 2 cannabis inflorescence)	Azoxystrobin Bifenazate Boscalid Carbaryl Carbendazim Clothianidin Diazinon Diuron Ethoprophos Etoxazole Fenpyroximate Imidacloprid Malathion Myclobutanil Permethrin Piperonyl butoxide Propargite Propiconazole Pyroclostrobin Pyriproxygen Triflumizole Trifloxystrobin Triticonazole Zoxamide	QuEChERS	Shimadzu Prominence HPLC	n/a	n/a	Shimadzu LCMS-8050 triple quadrupole MS
Cuypers E et al, 2017.	Cannabis from 43 illicit indoor cannabis plantations in Belgium	n/a	QuEChERS	Schimadzu UPLC-AB Sciex 3200 QTRAP	Restek Allure Propyl column (50mm x 2.1mm, 5 µm)	<u>Phase A:</u> ammonium formate and formic acid in water	MS

						<u>Phase B:</u> acetonitrile and ammonium formate in formic acid <u>Flow rate:</u> 0.5mL/min	
Nie B et al, 2019.	Marijuana plant sample	Methomyl Thiamethoxam Imidacloprid Dimethoate Acetamiprid Thiacloprid Carbofuran Ancymidol Carbaryl Chlorantraniliprole Azoxystrobin Systhane Propiconazole Etoxazole Fenpyroximate	n/a	Agilent Eclipse Plus	RRHD C18 (50mm x 2.1mm, 1.87µm)	<u>Phase A:</u> formic acid in water <u>Phase B:</u> formic acid in methanol	MS coupled with ESI under positive selected ion monitoring
Loffredo E et al, 2020.	Hemp seeds	Metalaxyl-M Bisphenol-A	n/a	Spectra System™ pump (Thermo Electron Corporation, San José, CA, USA)	Supelcosil™ LC-18 column (250mm x 4.6mm, 5 µm)	<u>Phase A:</u> acetonitrile/water <u>Flow rate:</u> 1.0mL/min	UV diode array detector and fluorescence detector
Luca SV et al, 2020.	Hemp extract	Abamectin B1a Abamectin B1b Acephate Acequinocyl Aldicarb Azoxystrobin Bifenazate Bifenthrin Boscalid Carbaryl Carbofuran Chlorantraniliprole	n/a	Agilent 1200 HPLC system (Santa Clara, CA, USA)	Phenomenex Kinetex5 u XB-C18 (100mm x 2.1mm, 5 µm) column	<u>Phase A:</u> ammonium formate <u>Phase B:</u> methanol with ammonium formate <u>Flow rate:</u> 0.3mL/min	MS operating in the positive ESI mode

		Chlorpfeapyr Chlorpyrifos Clofentezine Cyfluthrin Cypermethrin Daminozide Diazinon Dichlorvos Dimethoate Ethoprophos Etofenprox Etoxazole Fenoxycarb Fenpyroximate Fipronil Flonicamid Fludioxonil Hexythiazox Imazalil Imidacloprid Kresoxim methyl Malathion Metalaxyl Methiocarb Methomyl Methyl parathion MGK-264 Myclobutanil Naled Oxamyl Paclobutrazol Permethrins Phosmet Piperonylbutoxide Prallethrin Propiconazole					
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		Propoxur Pyrethrins cinerin I Pyrethrins cinerin II Pyrethrins jasmolin I Pyrethrins jasmolin II Pyrethrins pyrethrin I Pyrethrins pyrethrin II Pyridaben Spinosad spinosyn A Spinosad spinosyn D Spiromesifen Spirotetramat Spiroxamine Tebuconazole Thiacloprid Thiamethoxam Trifloxystrobin					
Luca SV et al, 2020.	Hemp extract	Abamectin B1a Abamectin B1b Acephate Acequinocyl Aldicarb Azoxystrobin Bifenazate Bifenthrin Boscalid Carbaryl Carbofuran Chlorantraniliprole Chlorpfenapyr Chlorpyrifos Clofentezine Cyfluthrin Cypermethrin Daminozide Diazinon	n/a	Prominence HPLC system from Shimadzu (Tokyo, Japan)	Poroshell 120 EC-C18 (3mm x 150mm, 2.7 µm)	n/a	n/a

		Dichlorvos Dimethoate Ethoprophos Etofenprox Etoxazole Fenoxycarb Fenpyroximate Fipronil Flonicamid Fludioxonil Hexythiazox Imazalil Imidacloprid Kresoxim methyl Malathion Metalaxyl Methiocarb Methomyl Methyl parathion MGK-264 Myclobutanil Naled Oxamyl Paclobutrazol Permethrins Phosmet Piperonylbutoxide Prallethrin Propiconazole Propoxur Pyrethrins cinerin I Pyrethrins cinerin II Pyrethrins jasmolin I Pyrethrins jasmolin II Pyrethrins pyrethrin I Pyrethrins pyrethrin II					
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		Pyridaben Spinosad spinosyn A Spinosad spinosyn D Spiromesifen Spirotetramat Spiroxamine Tebuconazole Thiacloprid Thiamethoxam Trifloxystrobin					
Reyes-Garces N et al, 2021.	Chocolate samples in pulverised form	n/a	SPE	Shimadzu 8060 (Kyoto, Japan) coupled to a Nexera UHPLC pump	Raptor ARC-18 column (2.1mm x 100mm, 2.7µm) connected to a Raptor ARC-18 EXP guard column (5mm x 2.1mm, 2.7 µm)	<u>Phase A:</u> formic acid <u>Phase B:</u> methanol <u>Flow rate:</u> 0.5mL/min	MS
Stempfer M et al, 2021.	93 seized cannabis samples	Boscalid Carbendazim Chlorantraniliprole Chlorpyrifos Chlorotoluron Cyprodinil Diflubenzuron Ethiofencarb sulfoxide Hexythiazox Iprodione Metalaxyl Pyrimethanil Terbutryn Thiophanate methyl Trifloxystrobin Mycotoxin	QuEChERS	Waters Acquity UPLC	Kinetex biphenyl column (2.6 µm, 100 Å, 100 x 2.1mm)	Acetic acid solution <u>Flow rate:</u> 200µL/min	MS in positive ESI mode

Dalmia A et al, 2021.	Hemp matrix	66 pesticides regulated by California state in cannabis	Simple solvent extraction with acetonitrile	n/a	n/a	<u>Phase A:</u> formic acid, ammonium formate in water <u>Phase B:</u> formic acid, ammonium formate in methanol	MS with dual ESI
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**Table 6 - Ultra-High-Performance Liquid Chromatographic Methods for Analysis of Pesticides in Cannabis**

Ultra-High-Performance Liquid Chromatographic Method for Analysis of Cannabis (n = 2)							
Author, Date	Cannabis Product Analysed	Pesticides Analysed	Sample Preparation Technique	UHPLC Unit Used	Stationary Phase	Mobile Phase and Flow Rate	Detector Used
Narváez A et al, 2020.	Ten different CBD gelatin capsules	Mycotoxins	QuEChERS	Thermo Fischer Scientific UHPLC	Luna Omega (50µm x 2.1µm, 1.6µm) column	<u>Phase A:</u> formic acid and ammonium formate in water <u>Phase B:</u> formic acid and ammonium formate in methanol <u>Flow rate:</u> 0.4mL/min	High resolution Q-Orbitrap MS
Lu SJ et al, 2021.	Vaping fluids of e-cigarettes (cannabis oil)	Mycotoxins	n/a	Vanquish UHPLC	Hypersil GOLD (100mm x 2.1mm, 1.9µm) column	n/a	MS operating in the positive-ion ESI mode

## **Appendix 5**

### **Regulations for Pesticides in Cannabis in Different Countries**

**Table 7 - Regulations for Pesticides in Cannabis in Europe**

	<b>Europe</b>	
<b>Testing Requirements and Minimum Quality Standard Imposed</b>	Cannabis preparations are herbal active substances or herbal medicinal products. Thus, the Directive 2001/83/EC and the HMPC guidelines for herbal medicinal products in Europe and the European Pharmacopoeia are relevant.	
	Testing conducted at the herbal drug stage and the permissible limits must be ensured to be complied with. The limits set for dried or fresh plants are also applied to preparations made from them, taking into account the drug-extract ratio.	
<b>Pesticides Tested For and Allowed Limits</b>	<b>Substance</b>	<b>Limit (mg/kg)</b>
	Acephate	0.1
	Alachlor	0.05
	Aldrin and dieldrin	0.05
	Azinphos-ethyl	0.1
	Azinphos-methyl	1
	Bromophos-ethyl	0.05
	Bromophos-methyl	0.05
	Bromopropylate	3
	Chlordane	0.05
	Chlorfenvinphos	0.5
	Chlorpyrifos-ethyl	0.2
	Chlorpyrifos-methyl	0.1
	Chlorthal-dimethyl	0.01
	Cyfluthrin	0.1
	λ-Cyhalothrin	1
	Cypermethrin	1
	DDT	1
	Deltamethrin	0.5
	Diazinon	0.5
	Dichlofluanid	0.1
	Dichlorvos	1
	Dicofol	0.5
	Dimethoate + Omethoate	0.1
	Dithiocarbamates	2
	Endosulfan	3
	Endrin	0.05
	Ethion	2
	Etrimphos	0.05
	Fenchlorophos	0.1
	Fenitrothion	0.5
	Fenpropathrin	0.03
	Fensulfothion	0.05
	Fenthion	0.05
	Fenvalerate	1.5
	Flucytrinate	0.05
	τ-Fluvalinate	0.05
	Fonophos	0.05
	Heptachlor	0.05
	Hexachlorbenzene	0.1
	Hexachlorocyclohexane	0.3
Lindan	0.6	
Malathion + Malaoxon	1	
Mecarbam	0.05	
Methacriphos	0.05	
Methamidophos	0.05	

	Methidathion	0.2
	Methoxychlor	0.05
	Mirex	0.01
	Monocrotophos	0.1
	Parathion-ethyl + paraoxon-ethyl	0.5
	Parathion-methyl + paraoxon-methyl	0.2
	Pendimethalin	0.1
	Pentachloranisol	0.01
	Permethrin	1
	Phosalone	0.1
	Phosmet	0.05
	Piperonyl butoxide	3
	Pirimiphos-ethyl	0.05
	Pirimiphos-methyl + <i>N</i> -desethyl- pirimiphos-methyl	4
	Procymidone	0.1
	Profenophos	0.1
	Prothiophos	0.05
	Pyrethrum	3
	Quinalphos	0.05
	Quintozene	1
	S-421	0.02
	Tecnazene	0.05
	Tetradifon	0.3
	Vinclozolin	0.4
<b>Analytical Techniques Used</b>	Sampling and identification is carried out using suitable methods. TLC is mostly used to identify extracts along with other chromatographic techniques.	

**Table 8 - Regulations for Pesticides in Cannabis in Thailand**

<b>Thailand</b>		
<b>Testing Requirements and Minimum Quality Standard Imposed</b>	In Thailand, to meet regulatory and quality control standards, raw cannabis materials and products must be screened for 69 pesticides and any residues present must be within the stipulated allowed limits set by Thai Herbal Pharmacopoeia.	
<b>Pesticides Tested For and Allowed Limits</b>	<b>Substance</b>	<b>Limit (mg/kg)</b>
	Acephate	0.1
	Alachlor	0.05
	Aldrin and dieldrin (sum of)	0.05
	Azinphos-ethyl	0.1
	Azinphos-methyl	1
	Bromide, inorganic	125
	Bromophos-ethyl	0.05
	Bromophos-methyl	0.05
	Bromopropylate	3
	Chlordane (sum of cis-, trans-, and oxychlorodane)	0.05
	Chlorfenvinphos	0.5
	Chlorpyriphos-ethyl	0.2
	Chlorpyriphos-methyl	0.1
	Chlorthal-dimethyl	0.01
	Cyfluthrin and isomers (sum of)	1
	λ-Cyhalothrin	1
	Cypermethrin and isomers (sum of)	1
	DDT	1
	Deltamethrin	0.5
	Diazinon	0.5
	Dichofluanid	0.1
	Dichlorvos	1
	Dicofol	0.5
	Dimethoate and omethoate (sum of)	0.1
	Dithocarbamates	2
	Endosulfan (sum of isomers and endosulfan sulphates)	3
	Endrin	0.05
	Ethion	2
	Etrimphos	0.05
	Fenchlorophos (sum of fenchlorophos and fenchlorophos-oxon)	0.1
	Fenitrothion	0.5
	Fenpropathrin	0.03
	Fensulfothion (sum of)	0.05
	Fenthion (sum of)	0.05
	Fenvalerate	1.5
	Flucythrinate	0.05
	τ-Fluvalinate	0.05
	Fonophos	0.05
	Heptachlor (sum of)	0.05
Hexachlorbenzene	0.1	
Hexachlorocyclohexane (sum of isomers)	0.3	
Lindan	0.6	
Malathion and maloxon (sum of)	1	
Mecarbam	0.05	
Methacriphos	0.05	

	Methamidophos	0.05
	Methidathion	0.2
	Methoxychlor	0.05
	Mirex	0.01
	Monocrotophos	0.1
	Parathion-ethyl and paraoxon-ethyl (sum of)	0.5
	Parathion-methyl and paraoxon-methyl (sum of)	0.2
	Pendimethalin	0.1
	Pentachloranisole	0.01
	Permethrin and isomers (sum of)	1
	Phosalone	0.1
	Phosmet	0.05
	Piperonyl butoxide	3
	Pirimiphos-ethyl	0.05
	Pirimiphos-methyl (sum of pirimiphos-methyl and N-desethyl-pirimiphos-methyl)	4
	Procymidone	0.1
	Profenophos	0.1
	Prothiophos	0.05
	Pyrethrum (sum of cinerin I, cinerin II, jasmolin I, jasmolin II, pyrethrin I, pyrethrin II)	3
	Quinalphos	0.05
	Quintozene (sum of quintozene, pentachloroaniline, methyl pentachlorophenyl sulfide)	1
	S-421	0.02
	Tecnazene	0.05
	Tetradifon	0.3
	Vinclozolin	0.4
<b>Analytical Techniques Used</b>	Qualitative and quantitative analysis of pesticide residues must be performed in accordance with the analytical procedures issued by National Authorities or International Standard Organisations.	

**Table 9 - Regulations for Pesticides in Cannabis in Canada**

<b>Canada</b>																																																																																																																																																																																								
<b>Testing Requirements and Minimum Quality Standard Imposed</b>	<p>Testing conducted on representative sample of each lot or batch of cannabis, licence holder must retain a portion of the sample for at least a year after the date of the last sale to enable a retest of the sample for pesticide analysis.</p> <p>Testing must be conducted at minimum for all pesticide active ingredients with a LoQ.</p>																																																																																																																																																																																							
<b>Pesticides Tested For and Allowed Limits</b>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="background-color: #d3d3d3;"><b>Active Ingredient</b></th> <th colspan="3" style="background-color: #d3d3d3;"><b>LoQ (parts per million)</b></th> </tr> <tr> <th style="background-color: #d3d3d3;"><b>Fresh Cannabis and Plants</b></th> <th style="background-color: #d3d3d3;"><b>Dried Cannabis</b></th> <th style="background-color: #d3d3d3;"><b>Cannabis Oil</b></th> </tr> </thead> <tbody> <tr><td>Abamectin</td><td>0.25</td><td>0.1</td><td>0.25</td></tr> <tr><td>Acephate</td><td>0.05</td><td>0.02</td><td>0.05</td></tr> <tr><td>Acequinocyl</td><td>0.05</td><td>0.03</td><td></td></tr> <tr><td>Acetamiprid</td><td>0.05</td><td>0.1</td><td>0.05</td></tr> <tr><td>Aldicarb</td><td>0.5</td><td>1</td><td>0.5</td></tr> <tr><td>Allethrin</td><td>0.1</td><td>0.2</td><td>0.1</td></tr> <tr><td>Azadirachtin</td><td>0.5</td><td>1</td><td>0.5</td></tr> <tr><td>Azoxystrobin</td><td>0.01</td><td>0.02</td><td>0.01</td></tr> <tr><td>Benzovindiflupyr</td><td>0.01</td><td>0.02</td><td>0.01</td></tr> <tr><td>Bifenazate</td><td>0.05</td><td>0.02</td><td>0.01</td></tr> <tr><td>Bifenthrin</td><td>0.1</td><td>1</td><td></td></tr> <tr><td>Boscalid</td><td>0.01</td><td>0.02</td><td>0.01</td></tr> <tr><td>Buprofezin</td><td>0.01</td><td>0.02</td><td></td></tr> <tr><td>Carbaryl</td><td>0.025</td><td>0.05</td><td>0.025</td></tr> <tr><td>Carbofuran</td><td>0.01</td><td>0.02</td><td>0.01</td></tr> <tr><td>Chlorantranilipole</td><td>0.01</td><td>0.02</td><td></td></tr> <tr><td>Chlorphenapyr</td><td>0.1</td><td>0.05</td><td>1.5</td></tr> <tr><td>Chlorpyrifos</td><td>0.01</td><td>0.04</td><td>0.5</td></tr> <tr><td>Clofentezine</td><td>0.01</td><td>0.02</td><td>0.01</td></tr> <tr><td>Clothianidin</td><td>0.025</td><td>0.05</td><td>0.025</td></tr> <tr><td>Coumaphos</td><td>0.01</td><td>0.02</td><td>0.01</td></tr> <tr><td>Cyantraniliprole</td><td>0.01</td><td>0.02</td><td>0.01</td></tr> <tr><td>Cyfluthrin</td><td>1</td><td>0.2</td><td></td></tr> <tr><td>Cypermethrin</td><td>1</td><td>0.3</td><td></td></tr> <tr><td>Cyprodinil</td><td>0.25</td><td>0.25</td><td>0.01</td></tr> <tr><td>Daminozide</td><td>0.05</td><td>0.1</td><td></td></tr> <tr><td>Deltamethrin</td><td>1</td><td>0.5</td><td></td></tr> <tr><td>Diazinon</td><td>0.01</td><td>0.02</td><td></td></tr> <tr><td>Dichlorvos</td><td>0.05</td><td>0.1</td><td>0.05</td></tr> <tr><td>Dimethoate</td><td>0.01</td><td>0.02</td><td>0.01</td></tr> <tr><td>Dimethomorph</td><td>0.05</td><td>0.05</td><td></td></tr> <tr><td>Dinotefuran</td><td>0.05</td><td>0.1</td><td>0.05</td></tr> <tr><td>Dodemorph</td><td>0.05</td><td>0.05</td><td></td></tr> <tr><td>Endosulfan sulfate</td><td>0.5</td><td>0.05</td><td>2.5</td></tr> <tr><td>Endosulfan-alpha</td><td>0.1</td><td>0.2</td><td>2.5</td></tr> <tr><td>Endosulfan-beta</td><td>0.5</td><td>0.05</td><td>2.5</td></tr> <tr><td>Ethoprophos</td><td>0.01</td><td>0.02</td><td>0.01</td></tr> <tr><td>Etofenprox</td><td>0.01</td><td>0.05</td><td></td></tr> <tr><td>Etoxazole</td><td>0.01</td><td>0.02</td><td></td></tr> <tr><td>Etridiazole</td><td>0.01</td><td>0.03</td><td>0.15</td></tr> <tr><td>Fenoxycarb</td><td>0.01</td><td>0.02</td><td>0.01</td></tr> <tr><td>Fenpyroximate</td><td>0.02</td><td>0.02</td><td></td></tr> <tr><td>Fensulfothion</td><td>0.01</td><td>0.02</td><td>0.01</td></tr> <tr><td>Fenthion</td><td>0.01</td><td>0.02</td><td>0.01</td></tr> </tbody> </table>	<b>Active Ingredient</b>	<b>LoQ (parts per million)</b>			<b>Fresh Cannabis and Plants</b>	<b>Dried Cannabis</b>	<b>Cannabis Oil</b>	Abamectin	0.25	0.1	0.25	Acephate	0.05	0.02	0.05	Acequinocyl	0.05	0.03		Acetamiprid	0.05	0.1	0.05	Aldicarb	0.5	1	0.5	Allethrin	0.1	0.2	0.1	Azadirachtin	0.5	1	0.5	Azoxystrobin	0.01	0.02	0.01	Benzovindiflupyr	0.01	0.02	0.01	Bifenazate	0.05	0.02	0.01	Bifenthrin	0.1	1		Boscalid	0.01	0.02	0.01	Buprofezin	0.01	0.02		Carbaryl	0.025	0.05	0.025	Carbofuran	0.01	0.02	0.01	Chlorantranilipole	0.01	0.02		Chlorphenapyr	0.1	0.05	1.5	Chlorpyrifos	0.01	0.04	0.5	Clofentezine	0.01	0.02	0.01	Clothianidin	0.025	0.05	0.025	Coumaphos	0.01	0.02	0.01	Cyantraniliprole	0.01	0.02	0.01	Cyfluthrin	1	0.2		Cypermethrin	1	0.3		Cyprodinil	0.25	0.25	0.01	Daminozide	0.05	0.1		Deltamethrin	1	0.5		Diazinon	0.01	0.02		Dichlorvos	0.05	0.1	0.05	Dimethoate	0.01	0.02	0.01	Dimethomorph	0.05	0.05		Dinotefuran	0.05	0.1	0.05	Dodemorph	0.05	0.05		Endosulfan sulfate	0.5	0.05	2.5	Endosulfan-alpha	0.1	0.2	2.5	Endosulfan-beta	0.5	0.05	2.5	Ethoprophos	0.01	0.02	0.01	Etofenprox	0.01	0.05		Etoxazole	0.01	0.02		Etridiazole	0.01	0.03	0.15	Fenoxycarb	0.01	0.02	0.01	Fenpyroximate	0.02	0.02		Fensulfothion	0.01	0.02	0.01	Fenthion	0.01	0.02	0.01
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	Fenvalerate	0.10	0.10	
	Fipronil	0.01	0.06	0.01
	Flonicamid	0.025	0.05	0.025
	Fludioxonil	0.01	0.02	0.01
	Fludioxonil	0.01	0.02	0.01
	Fuopyram	0.01	0.02	0.01
	Hexythiazox	0.01	0.01	
	Imazalil	0.01	0.05	0.01
	Imidacloprid	0.01	0.02	0.01
	Iprodione	0.5	1	0.5
	Kinoprene	0.05	0.5	1.25
	Kresoxim-methyl	0.01	0.02	0.15
	Malathion	0.01	0.02	0.01
	Metalaxyl	0.01	0.02	0.01
	Methiocarb	0.01	0.02	0.01
	Methomyl	0.05	0.05	0.025
	Methoprene	1	2	
	Mevinphos	0.025	0.05	0.025
	MGK-264	0.05	0.05	
	Myclobutanil	0.01	0.02	0.01
	Naled	0.2	0.1	
	Novaluron	0.025	0.05	0.025
	Oxamyl	1.5	3	1.5
	Paclobutrazol	0.01	0.02	0.01
	Parathion-methyl	0.03	0.05	
	Permethrin	0.5	0.5	
	Phenothrin	0.025	0.05	
	Phosmet	0.01	0.02	
	Piperonyl butoxide	0.25	0.2	1.25
	Pirimicarb	0.01	0.02	0.01
	Prallethrin	0.05	0.05	
	Propiconazole	0.01	0.1	
	Propoxur	0.01	0.02	0.01
	Pyraclostrobin	0.01	0.02	0.01
	Pyrethrins	0.025	0.05	
	Pyridaben	0.025	0.05	0.02
	Quintozene	0.01	0.02	
	Resmethrin	0.02	0.1	0.05
	Spinetoram	0.01	0.02	0.01
	Spinosad	0.01	0.1	0.01
	Spirodiclofen	0.25	0.25	
	Spiromesifen	0.05	3	
	Spirotetramat	0.1	0.02	0.01
	Spiroxamine	0.01	0.1	
	Tebuconazole	0.01	0.05	0.01
	Tebufenozide	0.01	0.02	0.01
	Teflubenzuron	0.025	0.05	0.025
	Tetrachlorvinphos	0.01	0.02	0.01
	Tetramethrin	0.05	0.1	
	Thiacloprid	0.01	0.02	0.01
	Thiamethoxam	0.01	0.02	0.01
	Thiophanate-methyl	0.03	0.05	
	Trifloxystrobin	0.01	0.02	0.01
<b>Analytical Techniques Used</b>	Pesticide active ingredients analysis methods need to clean the sample using QuEChERS alone or in combination with SPE, then analysed using GC-MS or LC-MS.			

## **Appendix 6**

### **Regulations for Pesticides in Cannabis in Different States in USA**

**Table 10 - Regulations for Pesticides in Cannabis in California, Illinois and Michigan**

	<b>California</b>	<b>Illinois</b>	<b>Michigan</b>
<b>Testing Requirements and Minimum Quality Standard Imposed</b>	<p>No pesticide is federally registered for use on cannabis. In California, certain pesticide products that meet the criteria by the Department of Pesticide Regulation can legally be used on cannabis.</p> <p>Category I pesticides include the active ingredients exempt from residue tolerance requirements and registration requirements.</p> <p>Category II pesticides have residue tolerance requirements which are set by the US EPA.</p> <p>Every batch of cannabis must be tested for the 66 pesticides by the distributor holding the license before delivering product to retailers. Certificate of analysis is filed by the laboratories after testing.</p>	<p>In Illinois, the Illinois Department of Agriculture has approved a list of pesticide active ingredients which can be used on cannabis plant. These pesticides must be registered with the Department under the Illinois Pesticide Control Act.</p>	<p>In Michigan, the Michigan Marijuana Pesticide List is provided as a guidance for the use of pesticides in Michigan. The pesticides in the list are just a guidance and they have not been approved by the Michigan Department of Agriculture &amp; Rural Development.</p> <p>All pesticides must be used according to the product label instructions.</p>
	<b>Category I Residual Pesticide</b>	<b>Active Ingredients</b>	<b>Trade Names</b>
<b>Pesticides Tested For and Allowed Limits</b>	<p>Aldicarb Carbofuran Chlordane Chlorfenapyr Chlorpyrifos Coumaphos Daminozide DDVP (dichlorvos) Diemethoate Ethoprophos Etofeprox Fenoxycarb Fipronil Imazalil</p>	<p>Azadirachtin Bacillus pumilus strain GHA 180 Bacillus subtilis MBI 600 Bacillus subtilis GB03 Bacillus subtilis QST713 strain Bacillus subtilis var. amyloliquefaciens strain D747 TGAI Bacillus thuringiensis ssp. Aizawai Bacillus thuringiensis ssp. Israelensis Bacillus thuringiensis ssp. Kurstaki I Bacillus thuringiensis ssp. Kurstaki 7481 Bacillus thuringiensis ssp. Kurstaki strain SA-12</p>	<p>70% Neem Oil Agro Pest All Phase Almighty Ancora Athena IPM  Athena Mildew Control Axxe Broad Spectrum Herbicide Aza Guard AzaMax AzaPRO</p>

Methiocarb Methyl parathion Mevinphos Paclbutrazol Propoxur Spiroxamine Thiacloprid			Canola oil Chromobacterium sub strain PRAA4-1 Cinnamon Cinnamon oil Citric acid Citronella oil Clarified hydrophobic extract of neem oil	AzaSOL Azatin O Biological Insecticide Banish Big Time Exterminator BioCeres WP BioSafe Disease Control (concentrate) Bonide All Seasons Horticultural & Dorman Spray Oil Concentrate Bonide All Seasons Horticultural & Dorman Spray Oil Ready to Spray Bonide Neem Oil Fungicide Miticide Insecticide Concentrate Bonide Rose Rx3 in 1 Concentrate Bonide Neem Oil Ready to Use
<b>Category II Residual Pesticide</b>	<b>Action Level (<math>\mu\text{g/g}</math>) for Inhalable Cannabis and Cannabis Products</b>	<b>Action Level (<math>\mu\text{g/g}</math>) for Non- Inhalable Cannabis Products</b>	Copper octanoate Corn oil Cottonseed oil Cytokinins Dried ferm. Slids/slbs of Myrothecium verrucaria	Bonide Rose Rx3 in 1 Concentrate Bonide Neem Oil Ready to Use Brandt Ecotect Plus Brandt Organics Aleo BT Now BushDoctor Force of Nature Fungicide BushDoctor Force of Nature Insect Repellent BushDoctor Force of Nature Miticide Captain Jack's Neem Oil Ready to Use Captiva Captiva Prime Carbon Defense Cinnaction Circadian Sunrise Copper Soap Debug Turbo Decco Ag PAA/Deccosan 15 DiPel DF Biological Insecticide DiPel PRO DF Biological Insecticide Double Nickel LC Double Nickel 55 Earth's Ally 3-in-1 Plant Spray (RTU)
Abamectin Acephate Acequinocyl Acetamiprid Azoxystrobin Bifenazate Bifenthrin Boscalid Captan Carbaryl Chlorantraniliprole Clofentezine Cyfluthrin Cypermethrin Diazinon Dimethomorph Etoxazole Fenhexamid Flonicamid Fludioxonil	0.1 0.1 0.1 0.1 0.1 0.1 3 0.1 0.7 0.5 10 0.1 2 1 0.1 2 0.1 0.1 0.1 0.1	0.3 5 4 5 40 5 0.5 10 5 0.5 40 0.5 1 1 0.2 20 1.5 10 2 30	Farnesol Garlic oil/powder Geraniol Gibberellic acid Gliocladium virens G-21 Hydrogen peroxide (dioxide) IBA (indole-3-butyric-acid) Iron phosphate Isaria fumosorosea Jjoba oil Kaolin Mineral oil/petroleum distillate Mineral oil/petroleum distillate light Monopotassium phosphate Neem oil cold pressed Nerolidol Oil of clove Oil of rosemary Oil of sesame Oil of thyme	

Hexythiazox	0.1	2	Oregano oil	Earth's Ally Insect Control Concentrate
Imidacloprid	5	3	Peppermint	Eco-1 40
Kresoxim-methyl	0.1	1	Peroxyacetic acid	Eco-1 Fruit & Vegetable Spray
Malathion	0.5	5	Mono- and di-potassium salts of phosphoric acid	Eco-1 Fruit & Vegetable Spray Concentrate
Metalaxyl	2	15	Piperonyl butoxide	Eco-1 Garden Spray Concentrate
Methomyl	1	0.1	Potassium bicarbonate	Eco-1 Garden Spray RTU
Myclobutanil	0.1	9	Potassium laurate	EcoGarden
Naled	0.1	0.5	Pyrethrins	EcoVia 3-in-1 Emulsifiable Concentrate
Oxamyl	0.5	0.2	Pythium oligandrum DV 74	EcoWorks EC
Pentachloronitrobenzene	0.1	0.2	Reynoutria sachalinensis	Ecozin Plus 1.2% ME
Permethrin	0.5	20	Rosemary herbs	
Phosmet	0.1	0.2	Sesame plant ground	Eliminator
Piperonylbutoxide	3	8	Sodium ferric EDTA	Essentria All Purpose Insect Concentrate
Prallethrin	0.1	0.4	Sorbic acid potassium salt	Essentria IC4 Insect Concentrate
Propiconazole	0.1	20	Sorbitol octanoate	Exile
Pyrethrins	0.5	1	Soybean oil	Exponent Insecticide Synergist
Pyridaben	0.1	3	Streptomyces griseoviridins strain K61	FireWorxx
Spinetoram	0.1	3	Streptomyces lydicus WYEC 108	Fosphite Fungicide
Spinosad	0.1	3	Sulfur	Fungi-Phite
Spiromesifen	0.1	12	Thyme herbs	FungOUT
Spirotetramat	0.1	13	Trichoderma asperellum strain ICC 012	Furious
Tebuconazole	0.1	2	Trichoderma gamsii strain ICC 080	Garden Safe Brand Fungicide 3 Concentrate
			Trichoderma harzianum Rifai strain KRL-AG2	Garden Safe Brand Neem Oil Extract
			Trichoderma virens strain G-41	Concentrate
Thiamethoxam	5	4.5		Gargoil
Trifloxystrobin	0.1	30		Garland
				General Hydroponics Defguard
				BioFungicide/Bactericide
				General Hydroponics Prevasyn Insect
				Repellent/Insecticide
				General Hydroponics Trishield Insecticide,
				Miticde & Fun
				Golden Pest Spray Oil
				Grandevo CG
				Grandevo WDG

			<p>Green Cleaner (concentrated)  Grower's Ally Crop Defender 3 (RTU)  Grower's Ally Crop Defender 3 Concentrate  Grower's Ally Fungicide (RTU)  Grower's Ally Fungicide Concentrate  Grower's Ally Spider Mite Control (RTU)  Grower's Ally Spider Mite Control Concentrate  Growsafe Biopesticide: Insecticide-Miticide-Fungicide  Guarda  Guard'nSpray  Harrell's ProtectMAX Title Phyte Systemic Fungicide  HomePlate  Howler Fungicide  Huma Gro ProMax  Huma Gro Proud 3  Hydroxycide 527  Javelin WG Biological Insecticide  Jet-Ag  Jet-Ag 5%  Judgement  KeyPlex Ecotrol Plus  Kopa Insecticidal Soap  Lost Coast Plant Therapy  Maggie's Farm Simply Effective 3-in-1 Garden Spray  Magic Flower Bud Finisher &amp; Pest Control  Mammoth CannControl  Mammoth Garden Protect Me</p>

		Mildew Cure Mite-Phite ZM Molt-X Natria Insecticidal Soap Ready-to-Use Nature-Cide All Purpose Commercial Concentrate Nature-Cide All Purpose Insecticide NimBioSys Neem Oil (Ag use) Nuke'Em Omni Supreme Spray OrganiShield Orgacide Bee Safe 3-in-1 Garden Spray RTU OxiDate 2.0 Oxine OxiPhos Peragreen 15% Peragreen 5.6% PERpose Plus Pest Out PFR-97 10% ES PrizeFighter Procidic2 (Procidic C) Pro-Mix Biofungicide + Mycorrhizae Pro-Mix BRK20 Biofungicide + Mycorrhizae Pro-Mix BX Biofungicide + Mycorrhizae Pro-Mix FPX Biofungicide Pro-Mix HPCC Biofungicide + Mycorrhizae Protection Plus PureCrop 1 Rampart 6.8 Rampart Fungicide
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		Reset Revitalise Bio Fungicide Concentrate Root Cleaner Concentrated Safer Brand Insect Killing Soap Concentrate II Safer Brand Insect Killing Soap with Seaweed Extract II Safer Brand Neem Oil Concentrate Safer Brand Neem Oil RTU SaferGro Mildew Cure SaniDate 12.0 SaniDate HC SePro Ornazin 3% EC Botanical Insecticide Serenade Garden Disease Control Ready to Spray Smite SNS203 Concentrated Natural Pesticide Soil Drench/Spray SNS 209 All Natural Systemic Pest Control Concentrate SNS 217 All Natural Ready to use Spider Mite Control SNS 217C All Natural Spider Mite Control Concentrate SNS 244 All Natural Ready to Use Fungicide SNS 244C All Natural Concentrated Fungicide Sporan EC2 Stop Bugging Me! Nematode Ready to Spray Stop Bugging Me! Nematode RTU Suerte Suppress Herbicide EC Surround WP Agricultural Crop Protectant TCC-IPM
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			<p>TerraClean 5.0  TetraCURB Concentrate  TetraCURB Organic  Thyme Guard  Thymox Control Fungicide and Bactericide Concentrate  Thymox Control Organic Fungicide and Bactericide Concentrate  Triathlon BA  Trifecta Crop Control  Trifecta Ready to Use Crop Control  Trilogy  Triple Action Neem Oil  Typhoon  Weed Warrior Concentrate  Zealous  ZeroTol 2.0  ZeroTol HC</p>
<b>Analytical Techniques Used</b>	Testing is done using analytical techniques such as HPLC, GC-MS and LC-MS.	No mention of analytical techniques.	No mention of analytical techniques.

**Table 11 - Regulations for Pesticides in Cannabis in Washington, Arkansas and Vermont**

	Washington	Arkansas	Vermont																																																																																					
<b>Testing Requirements and Minimum Quality Standard Imposed</b>	<p>Only pesticides allowed under WAC 314-55-084 may be used in the production of cannabis, and they must be registered by the Washington State Department of Agriculture (WSDA) under chapter 15.58 RCW.</p> <p>If a certified lab identifies a pesticide that is not allowed or is above the action levels provided, that lot or batch from which the sample was deducted has failed quality control testing and thus may be subject to recall.</p>	<p>Cannabis needs to be tested for the pesticides in the table below. Random samples from each batch must be tested for pesticides and their allowed limits.</p>	<p>Pesticides must be approved by EPA, registered in Vermont and meet strict state label requirements. The pesticide products shall only contain the active ingredients listed below.</p>																																																																																					
<b>Pesticides Tested For and Allowed Limits</b>	<table border="1"> <thead> <tr> <th>Active Ingredient</th> <th>Action Levels (ppm)</th> </tr> </thead> <tbody> <tr><td>Abamectin</td><td>0.5</td></tr> <tr><td>Acephate</td><td>0.4</td></tr> <tr><td>Acequinocyl</td><td>2</td></tr> <tr><td>Acetamiprid</td><td>0.2</td></tr> <tr><td>Aldicarb</td><td>0.4</td></tr> <tr><td>Azoxystrobin</td><td>0.2</td></tr> <tr><td>Bifenazate</td><td>0.2</td></tr> <tr><td>Bifenthrin</td><td>0.2</td></tr> <tr><td>Boscalid</td><td>0.4</td></tr> <tr><td>Carbaryl</td><td>0.2</td></tr> <tr><td>Carbofuran</td><td>0.2</td></tr> <tr><td>Chlorantraniliprole</td><td>0.2</td></tr> <tr><td>Chlorphenapyr</td><td>1</td></tr> <tr><td>Chlorpyrifos</td><td>0.2</td></tr> <tr><td>Clofentezine</td><td>0.2</td></tr> <tr><td>Cyfluthrin</td><td>1</td></tr> </tbody> </table>	Active Ingredient	Action Levels (ppm)	Abamectin	0.5	Acephate	0.4	Acequinocyl	2	Acetamiprid	0.2	Aldicarb	0.4	Azoxystrobin	0.2	Bifenazate	0.2	Bifenthrin	0.2	Boscalid	0.4	Carbaryl	0.2	Carbofuran	0.2	Chlorantraniliprole	0.2	Chlorphenapyr	1	Chlorpyrifos	0.2	Clofentezine	0.2	Cyfluthrin	1	<table border="1"> <thead> <tr> <th>Active Ingredient</th> <th>Action Levels (ppm)</th> </tr> </thead> <tbody> <tr><td>Abamectin</td><td>0.5</td></tr> <tr><td>Acephate</td><td>0.4</td></tr> <tr><td>Acequinocyl</td><td>2</td></tr> <tr><td>Acetamiprid</td><td>0.2</td></tr> <tr><td>Aldicarb</td><td>0.4</td></tr> <tr><td>Azoxystrobin</td><td>0.2</td></tr> <tr><td>Bifenazate</td><td>0.2</td></tr> <tr><td>Bifenthrin</td><td>0.2</td></tr> <tr><td>Boscalid</td><td>0.4</td></tr> <tr><td>Carbaryl</td><td>0.2</td></tr> <tr><td>Carbofuran</td><td>0.2</td></tr> <tr><td>Chlorantraniliprole</td><td>0.2</td></tr> <tr><td>Chlorfenapyr</td><td>1</td></tr> <tr><td>Chlorpyrifos</td><td>0.2</td></tr> <tr><td>Clofentezine</td><td>0.2</td></tr> <tr><td>Cyfluthrin</td><td>1</td></tr> </tbody> </table>	Active Ingredient	Action Levels (ppm)	Abamectin	0.5	Acephate	0.4	Acequinocyl	2	Acetamiprid	0.2	Aldicarb	0.4	Azoxystrobin	0.2	Bifenazate	0.2	Bifenthrin	0.2	Boscalid	0.4	Carbaryl	0.2	Carbofuran	0.2	Chlorantraniliprole	0.2	Chlorfenapyr	1	Chlorpyrifos	0.2	Clofentezine	0.2	Cyfluthrin	1	<table border="1"> <thead> <tr> <th>Active Ingredient</th> </tr> </thead> <tbody> <tr><td>Acetic acid</td></tr> <tr><td>Azadirachtin/neem</td></tr> <tr><td>Ammonium soaps for higher fatty acids</td></tr> <tr><td>Bacillus spp.</td></tr> <tr><td>Beauveria bassiana spp.</td></tr> <tr><td>Isaria spp.</td></tr> <tr><td>Streptomyces spp.</td></tr> <tr><td>Trichoderma</td></tr> <tr><td>Citric acid</td></tr> <tr><td>Cytokinins</td></tr> <tr><td>Diatomaceous Earth</td></tr> <tr><td>Geraniol</td></tr> <tr><td>Gibberellic acids</td></tr> <tr><td>Hydrogen dioxide</td></tr> <tr><td>Hydrogen peroxide</td></tr> <tr><td>Indole-3-butyric-acid</td></tr> </tbody> </table>	Active Ingredient	Acetic acid	Azadirachtin/neem	Ammonium soaps for higher fatty acids	Bacillus spp.	Beauveria bassiana spp.	Isaria spp.	Streptomyces spp.	Trichoderma	Citric acid	Cytokinins	Diatomaceous Earth	Geraniol	Gibberellic acids	Hydrogen dioxide	Hydrogen peroxide	Indole-3-butyric-acid
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Cypermethrin	1	Cypermethrin	1	Canola oil
Daminozide	1	Daminozide	1	Mineral oil
Dichlorvos (DDVP)	0.1	DDVP (dichlorvos)	0.1	Soybean oil
Diazinon	0.2	Diazinon	0.2	Castor oil
Dimethoate	0.2	Dimethoate	0.2	Cinnamon oil
Ethoprophos	0.2	Ethoprophos	0.2	Clove oil
Etofenprox	0.4	Etofenprox	0.4	Cottonseed oil
Etoxazole	0.2	Etoxazole	0.2	Garlic oil
Fenoxycarb	0.2	Fenoxycarb	0.2	Mint oils
Fenpyroximate	0.4	Fenpyroximate	0.4	Rosemary oil
Fipronil	0.4	Fipronil	0.4	Sesame oil
Flonicamid	1	Flonicamid	1	Thyme oil
Fludioxonil	0.4	Fludioxonil	0.4	Peroxyacetic acid
Hexythiazox	1	Hexythiazox	1	Potassium bicarbonate
Imazalil	0.2	Imazalil	0.2	Potassium salts of fatty acids
Imidacloprid	0.4	Imidacloprid	0.4	Mono and di-potassium salts of phosphorus acid
Kresoxim-methyl	0.4	Kresoxim-methyl	0.4	Reynoutria sachalinensis
Malathion	0.2	Malathion	0.2	
Metalaxyl	0.2	Metalaxyl	0.2	
Methiocarb	0.2	Methiocarb	0.2	
Methomyl	0.4	Methomyl	0.4	
Methyl parathion	0.2	Methyl parathion	0.2	
MGK-264	0.2	MGK-264	0.2	
Myclobutanil	0.2	Myclobutanil	0.2	
Naled	0.5	Naled	0.5	
Oxamyl	1	Oxamyl	1	
Paclobutrazol	0.4	Paclobutrazol	0.4	
Permethrin (sum of isomers)	0.2	Permethrins	0.2	
Phosmet	0.2	Phosmet	0.2	
Piperonyl butoxide	2	Piperonyl butoxide	2	
Prallethrin	0.2	Prallethrin	0.2	
Propiconazole	0.4	Propiconazole	0.4	
Propoxur	0.2	Propoxur	0.2	
Pyrethrins (sum of isomers)	1	Pyrethrins	1	
Pyridaben	0.2	Pyridaben	0.2	

	Spinosad (sum of isomers) 0.2 Spiromesifen 0.2 Spirotetramat 0.2 Spiroxamine 0.4 Tebuconazole 0.4 Thiacloprid 0.2 Thiamethoxam 0.2 Trifloxystrobin 0.2 The action levels for all other pesticides that are not listed in the table is 0.1ppm.	Spinosad 0.2 Spiromesifen 0.2 Spirotetramat 0.2 Spiroxamine 0.4 Tebuconazole 0.4 Thiacloprid 0.2 Thiamethoxam 0.2 Trifloxystrobin 0.2	
<b>Analytical Techniques Used</b>	No mention of analytical techniques.	No mention of analytical techniques.	No mention of analytical techniques.

**Table 12 - Regulations for Pesticides in Cannabis in Colorado and Oregon**

	<b>Colorado</b>		<b>Oregon</b>	
<b>Testing Requirements and Minimum Quality Standard Imposed</b>	In Colorado, the Colorado Department of Agriculture has set rules on which pesticides are allowed for the use of cannabis.		In Oregon, there are no pesticides specifically labelled for the production of cannabis. The ODA compiled a list of 387 pesticides that can be used on cannabis. This list was updated November 1, 2023. The list is there to assist growers in distinguishing which pesticides are legally allowed to be used in cannabis.	
<b>Pesticides Tested For and Allowed Limits</b>	<b>Trade Name</b>	<b>Active Ingredients</b>	<b>Trade Name</b>	<b>Active Ingredients</b>
	70% Neem Oil	Clarified hydrophobic extract of neem oil	20% Vinegar Herbicide for Control of Weeds	Acetic acid
	Agree WG	Bacillus thuringiensis SPP. Aizawai	Fleischmann's Vinegar Weed Control	Acetic acid
	AgriDiatomSil	Diatomaceous Earth	Green Gobbler 20% Vinegar Weed & Grass Killer	Acetic acid
	Agro Pest	Thyme oil, rosemary oil	Harris Vinegar Grass & Weed Killer II	Acetic acid
	All Phase	Potassium sorbate, sodium lauryl sulfate	Vinagreen	Acetic acid
	AlliCURB MAX	Castor oil, garlic oil	Vinegar Weed & Grass Killer	Acetic acid
	Almighty	Geranoil	Weed-aside Herbicidal Soap	Ammoniated soap of fatty acids
	Ancora	Isaria fumosorosea	Axxe Broad Spectrum Herbicide	Ammonium nonanoate
	Annihilation	Soybean oil, rosemary oil, clove oil	Azazol WSP	Azadirachtin
	Asperello T34 Biocontrol	Trichoderma asperellum strain T34	AZA-Direct Botanical Insecticide	Azadirachtin
	Athena IPM	Citric acid, peppermint oil, lemongrass oil, geraniol	AZAGuard	Azadirachtin
	Athena Mildew Control	Geranoil	Azamax	Azadirachtin
	Athena Spider Mite Control	Geranoil, peppermint oil, cottonseed oil, rosemary oil	Azapro	Azadirachtin
	Atrevia 3.0% SL	Azadirachtin	Azazol Ecozin Plus 1.2% ME	Azadirachtin
	Attack Back!	Corn oil, thyme oil, cinnamon oil, rosemary oil, clove oil	Molt-X	Azadirachtin
	Axiom Harpin Proteins	Harpin alpha beta	Ornazin 3% EC Botanical Insecticide	Azadirachtin
	Axxe Broad Spectrum Herbicide	Ammonium nonoate	Ecogarden	Azadirachtin

Aza-Direct Biological Insecticide	Azadirachtin	Debug Turbo	Azadirachtin, cold pressed neem oil
AzaGuard	Azadirachtin	Azera Insecticide	Azadirachtin, pyrethrins
AzaMax	Azadirachtin	Azera Pro	Azadirachtin, pyrethrins
AzaPRO	Azadirachtin	Revitalize Biofungicide Concentrate	Bacillus amyloliquifaciens
AzaSol	Azadirachtin	Revitalize Biofungicide Raedy To Use	Bacillus amyloliquifaciens
AzaSol WSP	Azadirachtin	Stargus	Bacillus amyloliquifaciens
Azatin O Biological Insecticide	Azadirachtin	Arber Biofungicide	Bacillus amyloliquifaciens F727
Azera Gardening	Azadirachtin	Double Nickel 55 Biofungicide	Bacillus amyloliquefaciens strain D747
Azera Insecticide	Azadirachtin, pyrethrins	Double Nickel LC	Bacillus amyloliquefaciens strain D747
Azera Pro	Pyrethrins, azadirachtin	Triathlon BA	Bacillus amyloliquefaciens strain D747
BellaTrove Companion Maxx WP	Bacillus amyloliquefaciens strains ENV503	General Hydroponics Defguard Biofungicide/Bactericide	Bacillus amyloliquefaciens strain D747
BH-B BotanoHealth Fungicide	Thyme oil	Monterey Complete Disease Control Brand	Bacillus amyloliquefaciens strain D747
Big Time Exterminator	Citric acid	Monterey Complete Disease Control Brand RTU	Bacillus amyloliquefaciens strain D747
BioAdvanced Science-Based Solutions Organics Brand Disease & Fungus Control RTU	Octanoic acid	Companion Maxx Liquid Biological Fungicide	ENV503
BioCeres EC	Beauveria bassiana strain ANT-03	Amplitude ST	Bacillus amyloliquefaciens strain F727 cells and spent fermentations media
BioCeres GR	Beauveria bassiana strain ANT-03	Zorda WG Biological Fungicide	4838
BioCeres WP	Beauveria bassiana strain ANT-03	Lifegard WG	Bacillus mycooides isolate J
BioLink Insect & Bird Repellant	Garlic	Pro-mix Biofungicide + Mycorrhizae-BRK Peat/Bark Based Growing Medium	Bacillus pumilus strain GHA 180
BioSafe Weed & Grass Killer	Ammonium nonanoate	Pro-mix Biofungicide + Mycorrhizae-BRK 20t/Bark Based Growing Medium	Bacillus pumilus strain GHA 180

Bonide All Seasons Horticultural & Dormant Spray Oil Concentrate	Mineral oil	Pro-mix Biofungicide + Mycorrhizae BX General Purpose Growing Medium	Bacillus pumilus strain GHA 180
Bonide All Seasons Horticultural & Dormant Spray Oil Ready to Spray	Mineral oil	Pro-mix Biofungicide + Mycorrhizae HP General Purpose Growing Medium	Bacillus pumilus strain GHA 180 Bacillus pumilus strain QST 2808 (spores, solids, solubles, water)
Bonide Diatomaceous Earth Crawling Insect Killer	Diatomaceous Earth	Sonata	
Bonide Eight Insect Control Home & Garden Ready to Use	Sulfur, pyrethrins	Pro-mix Biofungicide - FPX Growing Medium	600
Bonide Garden Rich Root & Grow Root Stimulator and Plant Starter 4-10-3	IBA (Indole-3-butyric acid)	Pro-mix Biofungicide - PGX Growing Medium	600
Bonide Insecticidal Soap Multi-Purpose Insect Control Ready to Use	Potassium laurate	Pro-mix Biofungicide - YP Growing Medium	600
Bonide Neem Oil Fungicide Miticide Insecticide Concentrate	Clarified hydrophobic extarct of neem oil	Rhapsody	Bacillus subtilis QST713 strain
Bonide Rose Rx3 in 1 Concentrate	Clarified hydrophobic extarct of neem oil	Serenade ASO	Bacillus subtilis QST713 strain
Bonide Rose Rx3 in 1 Ready to Use	Clarified hydrophobic extarct of neem oil	Serenade Garden Disease Control Concentrate	Bacillus subtilis QST713 strain
BotaniGard 22WP	Beauveria bassiana strain GHA	Serenade Garden Disease Control Ready-to-Spray	Bacillus subtilis QST713 strain
BotaniGard ES	Beauveria bassiana strain GHA	Serenade MAX	Bacillus subtilis QST713 strain
Botanigard Maxx	Pyrethrins, beauveria bassiana strain GHA	Serenade OPTI	Bacillus subtilis QST713 strain
BotaniGard Optima ES	Beauveria bassiana strain GHA	BT NOW	Bacillus thuringiensis spp.
BoteGHA ES	Beauveria bassiana strain GHA	Agree WG Biolgoical Insecticide	Bacillus thuringiensis spp. Aizawai
BoteGHA Optima ES	Beauveria bassiana strain GHA	Xentari Biological Insecticide Dry Flowable	Bacillus thuringiensis spp. Aizawai
BotryStop WP	Ulocladium oudemansii	Summit B.T.I. Granules	Bacillus thuringiensis spp. Israelensis
Brandt Ecotec Plus	Rosemary oil, geraniol, peppermint oil	Gnatrol WDG Biological Larvicide Water Dispersable Granule	Bacillus thuringiensis spp. Israelensis

Brandt Organics Aleo	Garlic oil	Dipel DF Biological Insecticide Dry Flowable	Bacillus thuringiensis spp. Kurstaki 0
Brandt Turfzilla	Mono- and di-potassium salts of phosphorous acid	Biobit HP BIO Insecticide Wettable Powder	Bacillus thuringiensis spp. Kurstaki 1
BT Now	Bacillus thuringiensis SPP. Kurstaki	Dipel PRO DF Biological Insecticide Dry Flowable	Bacillus thuringiensis spp. Kurstaki 1
Bug Buster-O	Pyrethrins	Crymax Biological Insecticide	Bacillus thuringiensis spp. Kurstaki 7841
BushDoctor Force of Nature Fungicide	Cottonseed oil, corn oil, garlic oil	Bioprotec Plus	Bacillus thuringiensis spp. Kurstaki strain EVB-113-19
BushDoctor Force of Nature Insect Repellent	Garlic oil	Leprotec	Bacillus thuringiensis spp. Kurstaki strain EVB-113-19
BushDoctor Force of Nature Miticide	Cottonseed oil, clove oil, garlic oil	Monterey B.t. RTU	Bacillus thuringiensis spp. Strain SA-12
Captain Jack' s Neem Oil Ready to use	Clarified hydrophobic extract of neem oil	Javelin WG Biological Insecticide	Bacillus thuringiensis, subspecies Kurstaki strain SA-11 solids, spores, and lepidopteran active toxins
Captiva	Capsicum oleoresin extract, garlic oil, soybean oil	Bioceres EC	Beauvariana bassiana ANT-03
Captiva Prime	Capsicum oleoresin extract, garlic oil, canola oil	Bioceres WP	Beauvariana bassiana
Carbon Defense	Potassium silicate	Botanigard ES	Beauvariana bassiana strain GHA
Carb-O-Nator	Potassium bicarbonate	BotaniGard Optima ES	Beauvariana bassiana strain GHA
Cease	Bacillus subtilis QST713 Strain	Mycotrol WPO	Beauvariana bassiana strain GHA
CHS Unlocked	Cytokinin (Kinetin), IBA (indole-3-butyric acid), gibberellins (Gibberellic acid)	Velifer Fungal Contact Insecticide/Miticide	Beauvariana bassiana strain PPRI5339
CHS Unlocked PRO	Homobrassinolide, indole-3-butyric acid, gibberellins (gibberellic acid)	Mighty	Canola oil, pyrethrins
Cinnaction	Cinnamon oil	Take Down Garden Spray	Canola oil, pyrethrins
Cinnerate	Cinnamon oil	Take Down Garden Spray-RTU	Canola oil, pyrethrins
Circadian Sunrise	Corn oil, peppermint oil	BurnOut Formula II Fast Acting Weed and Grass Killer Concentrate	Caprylic acid, capric acid
Clonex Rooting Gel	IBA (Indole-3-butyric acid)	BurnOut Formula II Fast Acting Weed and Grass Killer Ready to Use	Caprylic acid, capric acid

Confine Extra	Mono- and di-potassium salts of phosphorous acid	Suppress Herbicide EC	Caprylic acid, capric acid
Corry's Slug & Snail Killer	Sodium ferric EDTA	Captain Jack's Deadweed Brew Concentrate	Caprylic acid, capric acid
Crest	Cytokinin (Kinetin), IBA (indole-3-butyric acid), gibberellins (Gibberellic acid)	Captain Jack's Deadweed Brew Ready to Use	Caprylic acid, capric acid
Critter-Maxx	Castor oil	Fireworxx	Caprylic acid, capric acid
Crymax	Bacillus thuringiensis SPP. Kurstaki	Homeplate	Caprylic acid, capric acid
Cueva Fungicide Concentrate	Copper octanoate	Captiva	Capsaicin, garlic oil, powder, soybean oil
Cuts	IBA (Indole-3-butyric acid)	Ortho Mole B Gon Mole and Vole Repellent Ready-to-Spray	Castor oil, geraniol, peppermint oil
Cyclone	IBA (Indole-3-butyric acid)	Liquid Fence Mole Repellent Concentrate <sup>3</sup>	Castor oil, sodium lauryl sulfate
Cygin	Cytokinin (Kinetin), auxin, gibberellins (Gibberellic acid)	Biorend	Chitosan
Cygin PRO	Homobrassinolide, indole-3-butyric acid, gibberellins (gibberellic acid)	Ecohalt	Chitosan, thyme oil
Cytokin Bioregulator Concentrate	Cytokinin (Kinetin)	Grandevo CG	Chromobacterium sub strain PRAA4-1 cells
Cytoplex HMS	Cytokinin (Kinetin), IBA (indole-3-butyric acid), gibberellins (Gibberellic acid)	Grandevo WDG	Chromobacterium subtsugae
Dart Fungicide EC	Capric acid, caprylic acid	Long Shadow	Cinnamon oil
Debug ON	Cold pressed neem oil	Canelys	Cinnamon oil
Debug Turbo	Azadiracthin, cold pressed neem oil	Cinnerate	Cinnamon oil
Debug-On	Cold pressed neem oil	Dr. Earth Final Stop Weed & Grass Herbicide Omri	Cinnamon oil, citric acid, clove oil, rosemary oil, sesame oil, thyme oil
Debug-Optimo	Neem oil, cold pressed azadiracthin	Dr. Earth Final Stop Yard & Garden Insect Killer Concentrate Omri	Cinnamon oil, garlic oil, peppermint oil, rosemary oil, sesame & sesame oil, thyme oil
Debug-Tres	Neem oil, cold pressed azadiracthin	Dr. Earth Final Stop Yard & Garden Insect Killer Omri	Peppermint oil, rosemary oil, sesame & sesame oil, thyme
Decco AG PAA	Peroxyacetic acid, hydrogen peroxide	Big Time Exterminator	Citric acid

Defender PM	Citric acid, thyme oil	Chester Boone's All Purpose	Citric acid
Deliver Biological Insecticide	Bacillus thuringiensis SPP. Kurstaki	Citriboost	Citric acid
Desect AG Diatomaceous Earth Insecticide	Diatomaceous Earth	Earth's Ally Disease Control	Citric acid
Desect AG Diatomaceous Earth Insecticide (25lb - crop uses)	Diatomaceous Earth	Earth's Ally Disease Control Concentrate	Citric acid
Des-X Insecticidal Soap Concentrate	Potassium laurate	Eliminator	Citric acid
DiPel DF Biological Insecticide	Bacillus thuringiensis SPP. Kurstaki	Fungout	Citric acid
DiPel PRO DF Biological Insecticide	Bacillus thuringiensis SPP. Kurstaki	Grower's Ally Fungicide	Citric acid
DiTera DF Biological Nematicide Dry Flowable	Myrothecium verrucaria	Grower's Ally Fungicide Concentrate	Citric acid
Doktor Doom Total Release Fogger	Pyrethrins, piperonyl butoxide	Nuke EM	Citric acid
Double Nickel LC	Bacillus amyloliquefaciens strain D747	Procidic	Citric acid
DoubleNickel55	Bacillus amyloliquefaciens strain D747	Procidic C	Citric acid
Dr Earth Final Stop OMRI Disease Control Fungicide (RTU)	Rosemary oil, clove oil, peppermint oil	Procidic2	Citric acid
Dr Earth Final Stop OMRI Disease Control Fungicide	Rosemary oil, clove oil, peppermint oil	Protection Plus	Citric acid
Dr Earth Final Stop OMRI Fruit Tree Insect Killer (RTU)	Rosemary oil, sesame oil, peppermint oil, thyme oil, cinnamon oil, garlic oil	Bonide Burnout Fast Acting Weed and Grass Killer Conc.	Citric acid, clove oil
Dr Earth Final Stop OMRI Fruit Tree Insect Killer Concentrate	Rosemary oil, sesame oil, peppermint oil, thyme oil, cinnamon oil, garlic oil	Bonide Burnout Fast Acting Weed and Grass Killer RTU	Citric acid, clove oil
Dr Earth Final Stop OMRI Rose and Flower Insect Killer (RTU)	Rosemary oil, sesame oil, peppermint oil, thyme oil, cinnamon oil, garlic oil	Burnout II Fast Acting Weed and Grass Killer Concentrate	Citric acid, clove oil
Dr Earth Final Stop OMRI Vegetable Garden Insect Killer (RTU)	Rosemary oil, sesame oil, peppermint oil, thyme oil, cinnamon oil, garlic oil	Captain Jack's Deadweed Brew CA Ready to Use	Citric acid, clove oil

Dr Earth Final Stop OMRI Vegetable Garden Insect Killer Concentrate	Rosemary oil, sesame oil, peppermint oil, thyme oil, cinnamon oil, garlic oil	Athena IPM	Citric acid, peppermint oil, lemongrass oil, geraniol
Dr Earth Final Stop OMRI Weed and Grass Herbicide (RTU)	Rosemary oil, sesame oil, peppermint oil, thyme oil, cinnamon oil, garlic oil	Biomite	Citronella oil, farnesol, geraniol, nerolidol
Dr Earth Final Stop OMRI Yard and Garden Insect Killer (RTU)	Rosemary oil, sesame oil, peppermint oil, thyme oil, cinnamon oil, garlic oil	Ortho Tree & Shrub Fruit Tree Spray Concentrate	Clarified hydrophobic extract of neem oil, piperonyl butoxide, pyrethrins
Dr Earth Final Stop OMRI Yard and Garden Insect Killer Concentrate	Rosemary oil, sesame oil, peppermint oil, thyme oil, cinnamon oil, garlic oil	Captain Jack's Neem Oil Concentrate	Clarified hydrophobic extract of neem oil
Dr Earth Final Stop Weed and Grass Killer Herbicide (RTU)	Cinnamon oil, citric acid, clove oil, rosemary oil, sesame oil, thyme oil	Captain Jack's Neem Oil Ready to Use	Clarified hydrophobic extract of neem oil
Drexel Phiticide	Mono- and di-potassium salts of phosphorous acid	Monterey Neem Oil RTU	Clarified hydrophobic extract of neem oil
Earth's Ally 3-IN-1 Plant Spray (RTU)	Thyme oil	Natural Guard Brand by Ferti-Lome Neem	Clarified hydrophobic extract of neem oil
Earth's Ally 3-IN-1 Plant Spray Concentrate	Thyme oil	Triact 70 Fungicide/Insecticide/Miticide	Clarified hydrophobic extract of neem oil
Earth's Ally Disease Control (RTU)	Citric acid	Ferti-Lome Triple Action	Clarified hydrophobic extract of neem oil, pyrethrins
Earth's Ally Disease Control Concentrate	Citric acid	Ferti-Lome Triple Action Ready-to-Spray	Clarified hydrophobic extract of neem oil, pyrethrins
Earth's Ally Insect Control (RTU)	Rosemary oil, clove oil, peppermint oil	Monterey Fruit Tree Spray Plus	Clarified hydrophobic extract of neem oil, pyrethrins
Earth's Ally Insect Control Concentrate	Rosemary oil	Shield-All Plus Broad Spectrum Insecticide, Fungicide and Miticide	Clarified hydrophobic extract of neem oil, pyrethrins
Eco-1 40	Linseed oil, rosemary oil, thyme oil	Nature-Cide All Purpose Insecticide	Clove oil, cottonseed oil
Eco-1 Fruit & Vegetable Spray	Linseed oil, rosemary oil, thyme oil, peppermint oil	Bonide Mite-X RTU	Clove oil, cottonseed oil, garlic oil
Eco-1 Fruit & Vegetable Spray Concentrate	Linseed oil, rosemary oil, thyme oil, peppermint oil	Pest Out	Clove oil, cottonseed oil, garlic oil
Eco-1 Garden Spray	Linseed oil, thyme oil, peppermint oil	Safegro Pest-Out	Clove oil, cottonseed oil, garlic oil
Eco-1 Garden Spray Concentrate	Linseed oil, thyme oil, peppermint oil	Power SI Control	Clove oil, peppermint oil

	EcoGarden	Azadiracthin	Sierra Natural Science SNS 203 Soil Drench/Foliar Spray	Clove oil, rosemary oil
	Ecotrol G	Clove oil, thyme oil, cinnamon oil	Sierra Natural Science SNS 244C Fungicide Concentrate	Clove oil, rosemary oil, thyme oil
	EcoVia 3-in-1 Emulsifiable Concentrate	Thyme oil, geraniol. Cinnamon oil, peppermint oil	Ecotrol G	Clove oil, thyme oil, cinnamol oil
	EcoWorks EC	Cold pressed neem oil	Ecoworks EC	Cold pressed neem oil
	Ecozin Plus 1.2% ME	Azadiracthin	Rango	Cold pressed neem oil
	Eliminator	Citric acid	Optify/Stretch	Complex polymeric polyhydroxy acids, cytokinin
	Elimator Snail & Slug Killer	Sodium ferric EDTA	Bonide Liquid Copper Fungicide Concentrate	Copper octanoate
	EpiShield	Peppermint oil, clove oil, sodium lauryl sulfate	Bonide Liquid Copper Fungicide Ready to Use	Copper octanoate
	Essentria All Purpose Insect Concentrate	Rosemary oil, peppermint oil	Camelot O	Copper octanoate
	Essentria IC Pro	Sodium lauryl sulfate, geraniol, clove oil, cornmint oil	Cueva Fungicide Concentrate	Copper octanoate
	Essentria IC-3 Insect Concentrate	Rosemary oil, geraniol, peppermint oil	Miracle-GRO Nature's Care Garden Disease Control	Copper octanoate
	Essentria IC4 Insect Concentrate	Geraniol	Natural Guard Brand by Ferti-Lome Copper Soap Liquid Fungicide Concentrate	Copper octanoate
	Evergreen Crop Protection EC 60-6	Pyrethrin, piperonyl butoxide	Ortho Disease B Gon Copper Fungicide Concentrate	Copper octanoate
	Evergreen Pro 60-6	Pyrethrins, piperonyl butoxide	Bonide Liquid Copper Fungicide Ready to Use	Copper Soap
	Evergreen Pyrethrum Concentrate	Pyrethrins	Captain Jack's Copper Fungicide Ready to Use	Copper Soap
	Evios Foliar Spray	Cloves	Bonide Maize Weed Preventer RTS	Corn Gluten Meal
	Exponent Insecticide		Mildrew Cure	Corn oil, cottonseed oil, garlic oil
	Synergist	Piperonyl butoxide	Circadian Sunrise Horticultural Spray Oil	Corn oil, peppermint oil
	Extinguish Professional Fire Ant Bait	s-methoprene		

Ferti-Lome Dipel Dust Biological Insecticide (RTU)	Bacillus thuringiensis SPP. Kurstaki Pyrethrins, piperonyl butoxide, clarified hydrophobic extract of neem oil	Flock Free Tank Mix GrowSafe Biopesticide: Insecticide, Miticide, Fungicide	Corn oil, peppermint oil, white pepper, garlic oil, clove oil, rosemary oil, thyme oil, sodium chloride
Ferti-Lome Fruit Tree Spray Ferti-lome Triple Action (concentrate)	Clarified hydrophobic extract of neem oil, pyrethrins	Mammoth Cancontrol	Corn oil, soybean oil
Ferti-lome Triple Action Ready-to-Spray	Clarified hydrophobic extract of neem oil, pyrethrins	Mammoth Garden Protect me	Corn oil, thyme oil
Finalsan Herbicidal Soap	Ammoniated soap of fatty acids	Bushdoctor Force of Nature Fungicide	Cottonseed oil, corn oil, garlic oil
FireWorxx	Capric acid, caprylic acid	Bushdoctor Force of Nature Miticide	Cottonseed oil, corn oil, garlic oil
Fortify PC	Citric acid	Safegro Mildrew Cure	Cottonseed oil, corn oil, garlic oil
Fosphite Fungicide	Mono- and di-potassium salts of phosphorous acid	Foliar Triggrr Plant Growth Regulator	Cytokinins
Fruit Tree Spray Plys	Clarified hydrophobic extract of neem oil, pyrethrins	Celite 610	Diatomaceous earth
Fungi-Phite	Mono- and di-potassium salts of phosphorous acid	Bonide Diatomaceous Earth Crawling Insect Killer	Diatomaceous earth
FungOUT	Citric acid	Arber Bio Protectant	Extract of Reynoutria Sachalinensis
Furious	Geraniol, peppermint oil, cottonseed oil, rosemary oil	Alluma	Garlic oil
Garden Friendly Fungicide	Bacillus amyloliquefaciens strain D747	Brandt Organics Aleo	Garlic oil
Garden Safe Brand Fungicide 3 Concentrate	Clarified hydrophobic extract of neem oil	Bushdoctor Force of Nature Insect Repellent	Garlic oil
Garden Safe Brand Insecticidal Soap Insect Killer	Potassium laurate	Almighty	Geraniol
Garden Safe Brand Multi-Purpose Garden Insect Killer 2	Pyrethrins, canola oil	Banish	Geraniol
Garden Safe Brand Neem Oil Extract Concentrate	Clarified hydrophobic extract of neem oil	Zealous	Geraniol
GardenTech RootBoost	IBA (Indole-3-butyric acid)	Mitexstream	Geraniol, Citronellol
Rooting Hormone		Smite Spider Mite Miticide	Geraniol, peppermint oil, cottonseed oil, rosemary oil
Gargoil	Cinnamon oil, garlic		

Garland	Garlic oil Helicoverpa zea nucleopolyhedrovirus ABA-NPV-U	Furious	Geraniol, peppermint oil, cottonseed oil, rosemary oil
Gemstar LC General Hydroponics DEFGUARD		GIB-4%	Gibberellic acid
Biofungicide/Bactericide 1 General Hydroponics DEFGUARD	Bacillus amyloliquefaciens strain D747	N-Large Plant Growth Regulator Solution	Gibberellic acid
Biofungicide/Bactericide 1 General Hydroponics Exile	Potassium salts of fatty acids Capsicum oleoresin extract, garlic, soybean oil	Lalstop G46 WG	Gliocladium catenulatum strain J1446
Insecticide/Fungicide/Miticide General Hydroponics		Prestop WG	Gliocladium catenulatum strain J1446
Trishield Insecticide, Miticide & Fungicide Concentrate	Soybean oil, sodium lauryl sulfate, citric acid	Soilgard Microbial Fungicide	Gliocladium Virens G-21
Golden Pest Spray Oil	Soybean oil Chromobacterium sub strain PRAA4-1 cells	Spear T Liquid Concentrate	GS-OMEGA/KAPPA/HXTX-HV1A
Grandevo CG	Chromobacterium sub strain PRAA4-1 cells	Spear-LEP	GS-OMEGA/KAPPA/HXTX-HV1A
Grandevo WDG		Axiom Harpin Proteins	Harpin proteins Heat-killed burholderia spp. strain A396 cels and spent fermentation media
Green Cleaner (concentrated)	Soybean oil, sodium lauryl sulfate	Majestene	Heat-killed burholderia spp. strain A396 cels and spent fermentation media
Grower's Ally Crop Defender 3 (RTU)	Thyme oil	Venerate CG	Heat-killed burholderia spp. strain A396 cels and spent fermentation media
Grower's Ally Crop Defender 3 Concentrate	Thyme oil	Venerate XC	Heat-killed burholderia spp. strain A396 cels and spent fermentation media
Grower's Ally Fungicide (RTU)	Citric acid	Arber Bio Insecticide	Heat-killed burholderia spp. strain A396 cels and spent fermentation media
Grower's Ally Fungicide Concentrate	Citric acid	Helicovex	Helicoverpa armigera nucleopolyhedrovirus strain BV-003
Grower's Ally Spider Mite Control (RTU)	Rosemary oil, clove oil, peppermint oil	Homobrassinolide	Homobrassinolide

Grower's Ally Spiter Mite Control Concentrate	Rosemary oil, clove oil, peppermint oil	Oxidate 2.0	Hydrogen dioxide, peroxyacetic acid
Guarda	Thyme oil	Zerotol 2.0	Hydrogen dioxide, peroxyacetic acid
Guard'nSpray	Rosemary oil, cinnamon oil, sesame oil, citric oil	Perpose Plus	Hydrogen peroxide, hydrogen dioxide
Harrell's ProtectMAX Title Phyte Systemic Fungicide	Mono- and di-potassium salts of phosphorous acid	Jet-AG	Hydrogen peroxide (dioxide), peroxyacetic acid
Harris *Since 1922* 20% Vinegar Weed Killer	Acetic acid	Evocade	Hydrogen peroxide, peroxyacetic acid
Harvest 6.0	Hydrogen peroxide, peroxyacetic acid	Harvest 6.0	Hydrogen peroxide, peroxyacetic acid
Helicovex	Helicoverpa zea nucleopolyhedrovirus strain BV-0003	Oxidate 5.0	Hydrogen peroxide, peroxyacetic acid
Heligen	Helicoverpa zea nucleopolyhedrovirus ABA-NPV-U	Sanidate 12.0	Hydrogen peroxide, peroxyacetic acid
Hi-Yield Snake Eyes Dusting Wetable Sulfur	Sulfur	Sanidate 15.0	Hydrogen peroxide, peroxyacetic acid
HomePlate	Caprylic acid, capric acid	Sanidate 5.0	Hydrogen peroxide, peroxyacetic acid
Hormex Rooting Powder No. 16	Indole-3-butyric acid	Sanidate HC	Hydrogen peroxide, peroxyacetic acid
Hormodin 1	IBA (Indole-3-butyric acid)	TerraStart HC	Hydrogen peroxide, peroxyacetic acid
Hortus IBA Water Soluble Salts (20%)	IBA (Indole-3-butyric acid)	Zerotol HC	Hydrogen peroxide, peroxyacetic acid
Howler EVO Fungicide	Pseudomonas chlororaphis strain AFS009	Bonide Bontone II Rooting Powder	IBA (Indole-3-butyric acid)
Howler Fungicide	Pseudomonas chlororaphis strain AFS009	Clonex Rooting Gel	IBA (Indole-3-butyric acid)
Howler Lawn and Garden Fungicide	Pseudomonas chlororaphis strain AFS009	Gardentech Root Boost Rooting Hormone	IBA (Indole-3-butyric acid)
Howler Lawn and Garden Organic Fungicide	Pseudomonas chlororaphis strain AFS009	Hormodin 1	IBA (Indole-3-butyric acid)
Hydroxycide 1522	Hydrogen peroxide, peroxyacetic acid	Hortus IBA Water Soluble Salts (20%)	IBA (Indole-3-butyric acid)
Hydroxycide 527	Hydrogen peroxide, peroxyacetic acid	Miracle-Gro Fast Root 1 Dry Powder	IBA (Indole-3-butyric acid)
Hygropunch	Soybean oil, cinnamon oil, thyme oil	Rooting Hormone	IBA (Indole-3-butyric acid)
		RapidGrow Rootburst powder	IBA (Indole-3-butyric acid)

Insect Annihilator (concentrate)	Rosemary, thyme oil, clove oil, cinnamon oil	Rhizopan AA No.2 (0.2)	IBA (Indole-3-butyric acid)
Insect Control	Pyrethrins, canola oil	Athena Cuts Rooting Compound	IBA (Indole-3-butyric acid)
Insect Dust	Diamtomaceous Earth	EZ-Clone Rooting Compound	IBA (Indole-3-butyric acid)
Insect Soap	Potassium salts of fatty acids	Hormex Rooting Powder No 8	IBA (Indole-3-butyric acid)
Isarid	Isaria fumosorosea	K-L-N Rooting Concentrate	IBA (Indole-3-butyric acid), 1-naphthaleneacetic acid
Javelin WG Biological Insecticide	Bacillus thuringiensis SSP. Kurstaki	Ferrox AQ	Iron phosphate
Jet-Ag	Hydrogen peroxide, peroxyacetic acid	Sluggo	Iron phosphate
Jet-Ag 5%	Hydrogen peroxide, peroxyacetic acid	Sluggo MAXX	Iron phosphate
Judgegment	Thyme oil	Captain Jack's Slug Magic Makes Slugs	
KeyPlex Ecotrol Plus	Rosemary oil, geraniol, peppermint oil	Disappear	Iron phosphate
Kopa Insecticidal Soap	Potassium salts of fatty acids	Bonide Slug Magic Makes Slugs	
LALSTOP G46	Gliocladium catenulatum strain J1446	Disappear	Iron phosphate
LALSTOP K61 WP	Streptomyces strain K61	Leaf Life Sluggo Snail and Slug Bait	Iron phosphate
Leaf Life Gavicide Green 415	Mineral oil	Ancora	Isaria fumosorosea
Leprotec	Bacillus thuringiensis SSP. Kurstaki	PFR-97 10% ES	Isaria fumosorosea apopka strain 97
Lesco Horticultural Oil Plus	Mineral oil	PFR-97 20% WDG	Isaria fumosorosea apopka strain 97
LifeGard WG	Bacillus mycoides isolate J	Ancora	Isaria fumosorosea apopka strain 97
Long Shadow	Cinnamon oil	Nofly WP	Isaria fumosorosea strain FE 9901
Lost Coast Plant Therapy	Soybean oil, peppermint oil	Isarid	Isaria fumosorosea strain FE 9901
MAC's Miracle Mildew Wash (powdered concentrate)	Citric acid	Surround WP Agricultural Crop protectant	Kaolin
Mad Farmer Root It	Indole-3-butyric acid	Flat line	Lemon grass oil, garlic oil
Maggie's Farm Simply	Thyme oil, geraniol, cinnamon oil, peppermint oil	Ratchet	LCO SP104
Effective 3-in-1 Garden Spray		Torque IF	LCO SP104
Magic Flower Bud Finisher & Pest Control	Sesame oil, cinnamon, garlic, clove	ECO-1 40	Linseed oil, rosemary oil, thyme oil
Magic Gardener Biological	Bacillus amyloliquefaciens strain PTA-4838	ECO-1 Fruit & Vegetable Spray	Linseed oil, rosemary oil, thyme oil, peppermint oil
Disease Control		ECO-1 Fruit & Vegetable Spray Concentrate	Linseed oil, rosemary oil, thyme oil, peppermint oil

Mammoth CannControl	Corn oil, thyme oil	ECO-1 Garden Spray Concentrate	Linseed oil, thyme oil, peppermint oil
Mammoth Garden Protect Me	Corn oil, thyme oil	ECO-1 Ready to Use Garden Spray	Linseed oil, thyme oil, peppermint oil
MegaGro L	IBA (Indole-3-butyric acid), cytokinin (Kinetin)	Protec-T	Methyl mercaptan
Mighty	Pyrethrins, canola oil	Bonide All Seasons Horticultural & Dormant Sprat Oil Concentrate	Mineral oil
Mighty Mint Plant Protectio	Peppermint oil, rosemary oil, geraniol	RTSA Horticulture Oil	Mineral oil
Mildew Cure	Cottonseed oil, corn oil, garlic oil	Narrow Range 415 Spray Oil	Mineral oil/petroleum distillate
Milstop SP	Potassium bicarbonate	Leaf Life Gavicide	Mineral oil/petroleum distillate
Miracle-Gro Nature's Care Garden Disease Control	Copper octanoate	Master Nursery Pest Fighter Year-Round Spray Oil	Mineral oil/petroleum distillate
Miracle-Gro Nature's Care Insectical Soap	Potassium salts of fatty acids	Summit Year Round Spray Oil Kills Garden Insects	Mineral oil/petroleum distillate
Mite Xstream	Geranoil, citronellol	Biocover SS	Mineral oil/petroleum distillate light
Mite-Phite ZM	Phosphorous acid	Biocover UL	Mineral oil/petroleum distillate light
Molt-X	Azadiracthin	Glacial Spray Fluid	Mineral oil/petroleum distillate light
Monterey Complete Disease Control Brand	Bacillus amyloliquefaciens strain D747	Master Nursery Pest Fighter Ready-to-Use Year-Round Spray Oil	Mineral oil/petroleum distillate light
Monterey Complete Disease Control Brand RTU	Bacillus amyloliquefaciens strain D747 Mono- and dibasic sodium, potassium and ammonium phosphites	Mite-E-Oil Insecticide-Miticide Spray	Mineral oil/petroleum distillate light
Monterey Garden Phos		Monterey Horticultural Oil	Mineral oil/petroleum distillate light
Monterey Horticultural Oil	Mineral oil	OMNI Supreme Spray (Insecticide-Mitiicide) Liquid	Mineral oil/petroleum distillate light
Monterey Horticultural Oil RTU	Mineral oil	Suffoil-X	Mineral oil/petroleum distillate light
Monterey Liquid Copper Fungicide RTU	Copperoctanoate	Ready-to-Use Year-Round Spray Oil	Mineral oil/petroleum distillate light
Monterey Neem Oil RTU	Clarified hydrophobic extract of neem oil	TRITEK	Mineral oil/petroleum distillate light
Monterey Take Down Garden Spray RTU	Canola oil, pyrethrins	Resist 57	Mono- and di-potassium phosphite
M-Pede Insecticide Miticide Fungicide	Potassium laurate	Sysstem-K Blue	Mono- and di-potassium phosphite
Multi	Sodium lauryl sulfata, rosemary oil, clvove oil, thyme oil	Valley-Phite	Mono- and di-potassium phosphite

Mycostop Biofungicide	Streptomyces strain K61	Confine Extra	Mono- and di-potassium salts of phosphorous acid
Mycotrol ESO	Beauveria bassiana strain GHA	Fosphite Fungicide	Mono- and di-potassium salts of phosphorous acid
Mycotrol Optima ESO	Beauveria bassiana strain GHA	Fungi-phite	Mono- and di-potassium salts of phosphorous acid
Mycotrol WPO	Beauveria bassiana strain GHA	Phospho-Jet	Mono- and di-potassium salts of phosphorous acid
Natria Disease & Fungus Control Concentrate	Octanoic acid	Rampart Potassium Phosphite Fungicide	Mono- and di-potassium salts of phosphorous acid
Natria Disease & Fungus Control Ready-to-Use	Octanoic acid	Rampart T&O Potassium Phosphite Fungicide	Mono- and di-potassium salts of phosphorous acid
Natria Insecticidal Soap Ready-to-Use	Potassium salts of fatty acids	Reliant Systemic Fungicide - Agriculture Use	Mono- and di-potassium salts of phosphorous acid
Natria Neem Oil Concentrate	Clarified hydrophobic extract of neem oil	TKO Maxx Systemic Fungicide	Mono- and di-potassium salts of phosphorous acid
Natria Neem Oil Ready-to-Use	Clarified hydrophobic extract of neem oil	OXIPHOS	Mono- and di-potassium salts of phosphorous acid, hydrogen peroxide
Natural Guard Brand by Ferti-lome Insecticidal Soap Concentrate	Potassium salts of fatty acids	Drexel Phiticide	Mono- and dibasic sodium, potassium and ammonium salts of phosphorous acid
Natural Guard Brand by Ferti-lome Neem	Clarified hydrophobic extract of neem oil	Alude Fungicide	Mono- and dibasic sodium, potassium and ammonium salts of phosphorous acid
Natural Guard Insecticidal Soap (concentrate)	Potassium laurate	Organocide Plant Doctor	Mono- and dibasic sodium, potassium and ammonium salts of phosphorous acid
Nature-cide All Purpose Commercial Concentrate	Clove oil, cottonseed oil	Phostrol Agricultural Fungicide	Mono- and dibasic sodium, potassium and ammonium salts of phosphorous acid
Nature-cide All Purpose Insecticide	Clove oil	Nutrol 0-50-32	Monopotassium phosphate
Nature-Cide OUTDOOR	Cedar oil, cinnamon oil	Ennoble	Muscodor albus strain SA-13 and spent and unspent fermentation media
Neem Oil 3n1	Clarified hydrophobic extract of neem oil	Ditera DF Biological Nematicide Dry Flowable	Myrothecium verrucaria dried ferm. SLDS/SLBS

N neem Oil Fungicide-Miticide-Insecticide RTU	Clarified hydrophobic extract of neem oil	Nimbiosys Neem Oil	Neem oil cold pressed
Neemix 4.5 Insect Growth Regulator	Azadiracthin	Lost Coast Plant Therapy Natural Concentrate	Organic oyebean oil, organic peppermint oil, citric acid
NimBioSys Neem Oil (Ag Use)	Cold pressed neem oil	Green Cleaner	Organic soybean oil, sodium lauryl sulfate
NimBioSys Neem Oil (Residential Use)	Cold pressed neem oil	Beloukha Garden Herbicide	Pelargonic acid
NOFly WP	Isaria fumosorosea	Peppermint Fury	Peppermint oil
Nuke Em	Citric acid	Bioside HS 15% Antimicrobial Solution	Peroxyacetic acid, hydrogen peroxide
Nutrol 0-50-32	Monopotassium phosphate	Reset	Peroxyacetic acid, hydrogen peroxide
Obtego Fungicide and Plant Symbiont	Trichoderma asperellum strain ICC 012, Trichoderma gamsii strain ICC 080	Mite-Phite ZM	Phosphorous acid
Omni Supreme Spray	Mineral oil	Exponent Insecticide Synergist	Piperonyl butoxide
Onward	Cytokinin (kinetin), gamma aminobutyric acid (GABA), choline chloride	Bushdoctor Force of Nature Insecticide	Piperonyl butoxide pyrethrins
Optify/Stretch	Complex polymeric polyhydroxy acid (CPPA), cytokinin (kinetin)	Foxfarm Don't Bug Me Home & Garden Insect Spray	Piperonyl butoxide pyrethrins
OrganiShield	Sucrose octanoate esters	Pyrethrium TR Total Release Insecticide	Piperonyl butoxide pyrethrins
Ortho Tree & Shrub Fruit Tree Spray Concentrate	Clarified hydrophobic extract of neem oil	Gemstar LC Insecticidal Virus	Polyhedral occlusion bodies (OBS) of the nuclear polyhedrosis virus of helioverpa zea (corn earworm)
OxiDate 2.0	Hydrogen peroxide, peroxyacetic acid, piperonyl butoxide, pyrethrins	Bi-carb Old Fashioned Fungicide	Potassium bicarbonate
OxiDate 5.0	Hydrogen peroxide, peroxyacetic acid	Carb-o-nator	Potassium bicarbonate
OxiPhos	Mono- and di-potassium salts of phosphorous acid, hydrogen peroxide	Kaligreen	Potassium bicarbonate
PathoCURB	Thyme oil	Milstop SP	Potassium bicarbonate
Peragreen 15%	Peroxyacetic acid, hydrogen peroxide	Bonide Insecticidal Soap Multi-puprose	Potassium salts of fatty acids
Peragreen 5.6%	Peroxyacetic acid, hydrogen peroxide	Insect Control RTU	Potassium salts of fatty acids
PerCarb	Sodium carbonate peroxyhydrate	DES-X Insecticidal Soap Concentrate	Potassium salts of fatty acids
Perma-Guard Crawling Insect Control	Diamtomaceous Earth	General Hydroponics Exile	Potassium salts of fatty acids
		Insecticide/Fungicide/Miticide	Potassium salts of fatty acids
		Whitney Farms Insecticidal Soap 1	Potassium salts of fatty acids

Permatrol	Linseed oil	Natural Guard By Ferti-Lome Insecticidal Soap Concentrate	Potassium salts of fatty acids
Perpose Plus	Hydrogen peroxide	KOPA Insecticidal Soap	Potassium salts of fatty acids
PERPpose Plus	Hydrogen peroxide	M-PEDE Insecticide Miticide Fungicide	Potassium salts of fatty acids
Pest Out	Cottonseed oil, clove oil, garlic oil	Ferti-Lome Insecticidal Soap	Potassium salts of fatty acids
PFR-97 10% ES	Isaria fumosorosea	Miracle Gro Nature's Care Insecticidal Soap	Potassium salts of fatty acids
PFR-97 20% WDG	Isaria fumosorosea	Safer Brand Insect Killing Soap Concentrate II	Potassium salts of fatty acids
Phostrol Agricultural Fungicide	Mono- and di-potassium salts of phosphorous acid	Whitney Farms Insecticidal Soap	Potassium salts of fatty acids
Power SI	Thyme oil, peppermint oil, cinnamon oil	Safer Brand Pyrethrin and Insecticidal Soap Concentrate II	Potassium salts of fatty acids, pyrethrins
Pride Lands Defense	Garlic, clove, cinnamon, peppermint, white pepper	Safer Brand 3-in-1 Concentrate II	Potassium salts of fatty acids, sulfur
Procidic2	Citric acid	Carbon Defense	Potassium silicate
ProGibb TVO Plant Growth Regulator	Gibberellins (gibberellic acid)	Sil-Matrix	Potassium silicate
ProMax	Thyme oil	Typhoon	Potassium sorbate
PRO-MIX Bio-Fungicide	Bacillus pumilus strain GHA 180	All Phase	Potassium silicate, sodium lauryl sulfate
Pro-Mix Bio-Fungicide + Mycorrhizae	Bacillus pumilus strain GHA 180	Howler	Pseudomonas chlorroaphis
Pro-Mix BRK Bio-Fungicide + Mycorrhizae	Bacillus pumilus strain GHA 180	Bug Buster-O	Pyrethrins
Pro-Mix BRK20 Bio-Fungicide + Mycorrhizae	Bacillus pumilus strain GHA 180	Pyganic Crop Protection EC 1.4 II	Pyrethrins
Pro-Mix BX Bio-Fungicide + Mycorrhizae	Bacillus pumilus strain GHA 180	Pyganic Crop Protection EC 5.0 II	Pyrethrins
PRO-MIX FPX Bio-fungicide	Bacillus pumilus strain GHA 180	Pyganic Gardening	Pyrethrins
Pro-mix HP Biofungicide + Mycorrhizae	Bacillus pumilus strain GHA 180	Pyganic Specialty	Pyrethrins
Pro-Mix HPCC Biofungicide + Mycorrhizae	Bacillus pumilus strain GHA 180	Tersus Insecticide	Pyrethrins

PRO-Mix MP Biofungicide + Mycorrhizae	Bacillus pumilus strain GHA 180 Cytokinin (kinetin), gamma aminobutyric acid (GABA), choline chloride	BotaniGard Maxx	Pyrethrins, beauveria bassiana strain GHA
Promote	Citric acid	Espoma Insect!	Pyrethrins, canola oil
Protection Plus	Thyme oil	Mighty	Pyrethrins, canola oil
Proud 3	Thyme oil, garlic oil, corn oil, geraniol, clove oil, citric acid, peppermint oil, rosemary oil, sodium chloride	Pycana	Pyrethrins, canola oil
PureAg Pest Control Food Grade (concentrate)		Pyola Insect Spray	Pyrethrins, canola oil Pyrethrins, piperonyl butoxide, technical clarified hydrophobic extract of neem oil
PureAg PM	Thyme oil, clove oil	Bonide Bon-Neem II Fungicide Miticide Insecticide RTU	Pyrethrins, piperonyl butoxide
PureCrop 1	Soybean oil, corn oil	Doktor Doom Total Release Fogger	Pyrethrins, piperonyl butoxide
Purely Green Bio-Pesticide Super Concentrate	Soybean oil, peppermint oil, cinnamon oil, lemon grass oil, garlic oil	Spectracide Triazicide Insect Killer for Landscapes and Gardens Outdoor Fogger	Pyrethrins, piperonyl butoxide
Pycana	Pyrethrins, canola oil	Bonide Citrus, Fruit & Nut Orchard Spray Concentrate	Pyrethrins, sulfur
Pyganic Crop Protection EC 1.4 II	Pyrethrins	Bonide Citrus, Fruit & Nut Orchard Spray Ready to Spray	Pyrethrins, sulfur
Pyganic Crop Protection EC 5.0 II	Pyrethrins	Cease	QST 713
PyGanic Gardening	Pyrethrins	Regalia Biofungicide	Reynoutria sachalinensis
Pyganic Specialty	Pyrethrins	Regalia CG	Reynoutria sachalinensis
Pyronyl Crop Spray	Piperonyl butoxide, pyrethrins	Zonix Biofungicide	Rhamnolipid biosurfactant
Rampart 6.8	Mono- and dipotassium phosphite	Sierra Natural Science SNS 209 Systemic Pest Control Concentrate	Rosemary oil
Rampart Fungicide	Mono- and di-potassium salts of phosphorous acid	Sierra Natural Science SNS 217 Systemic Pest Control Concentrate	Rosemary oil
Rango	Cold pressed neem oil	Sierra Natural Science SNS 217c Spider Mite Control Concentrate	Rosemary oil
Rapidgrow Rootburst Powder	IBA (Indole-3-butyric acid)	Tetracarb Concentrate	Rosemary oil
Regalia Biofungicide (concentrate)	Reynoutria sachalinensis	Dr Earth Final Stop Disease Control Fungicide	Rosemary oil, clove oil, peppermint oil
Regalia CG Biofungicide	Reynoutria sachalinensis	Earth's Ally Insect Control	Rosemary oil, clove oil, peppermint oil

Reliant Systemic Fungicide	Mono- and di-potassium salts of phosphorous acid	Grower's Ally Spider Mite Control	Rosemary oil, clove oil, peppermint oil
Reset	Peroxyacetic acid, hydrogen peroxide	Grower's Ally Spider Mite Control Concentrate	Rosemary oil, clove oil, peppermint oil
Resist 57	Mono- and di-potassium salts of phosphorous acid	Tetracarb Organic	Rosemary oil, clove oil, peppermint oil
Revitalise Biofungicide Concentrate	Bacillus amyloliquefaciens strain D747	Brandt Ecotec Plus	Rosemary oil, clove oil, peppermint oil
Rhapsody	Bacillus subtilis QST713 strain	Keyplex Ecotrol Plus	Rosemary oil, geraniol, peppermint oil
Rhizopan AA #2 (0.3)	IBA (Indole-3-butyric acid), rosemary oil, peppermint oil	86 Mites and Mold Prevention and Treatment Concentrate	Rosemary oil, lemon grass, cinnamon oil, cottonseed oil
Ridex	Cinnamon oil, rosemary oil, sesame oil	86 Mites and Mold Prevention and Treatment Ready to Use	Rosemary oil, lemon grass, cinnamon oil, cottonseed oil
Romea	Cerevisane	Method 1-PPS	Rosemary oil, peppermint oil
Root Cleaner Concentrated	Sodium lauryl sulfate, soybean oil	Mantis EC Botanical Insecticide/Miticide	Rosemary oil, peppermint oil, soybean oil
RootShield Plus+ Granules	Trichoderma harzianum rifai strain KRL-AG2, trichoderma virens strain G-41	Dr Earth Final Stop Fruit Tree Insect Killer	Rosemary oil, sesame oil, peppermint oil, thyme oil, cinnamon oil, garlic oil
Biological Fungicide	Trichoderma harzianum rifai strain KRL-AG2, trichoderma virens strain G-41	Dr Earth Final Stop Pest Control Killer Spray	Rosemary oil, sesame oil, peppermint oil, thyme oil, cinnamon oil, garlic oil
RootShield Plus+ WP	Trichoderma harzianum rifai strain KRL-AG2, trichoderma virens strain G-41	Dr Earth Final Stop Vegetable Garden Insect Killer	Rosemary oil, sesame oil, peppermint oil, thyme oil, cinnamon oil, garlic oil
Biological Fungicide	Trichoderma harzianum rifai strain KRL-AG2	Dr Earth Final Stop Yard & Garden Insect Killer	Rosemary oil, sesame oil, peppermint oil, thyme oil, cinnamon oil, garlic oil
RootShield WP Biological Fungicide	Trichoderma harzianum rifai strain KRL-AG2	Dr Earth Final Stop Yard & Garden Insect Killer Concentrate	Rosemary oil, sesame oil, peppermint oil, thyme oil, cinnamon oil, garlic oil
Russett	Peppermint oil, sodium lauryl sulfate	Sporan EC2	Rosemary oil, thyme oil, clove oil, cinnamon oil, peppermint oil
Safer Brand 3-in-1 Concentrate II	Potassium salts of fatty acids, sulfur	Ecodefence	Rosemary oil, thyme oil, clove oil, peppermint oil
Safer Brand 3-in-1 Garden Spray II	Potassium salts of fatty acids, sulfur	Dr Earth Proactive Final Stop Snail & Slug Killer Spray	Rosemary, sesame, peppermint, thyme, cinnamon, garlic
Safer Brand Garden Fungicide for Flowers, Fruit, and Vegetables, Concentrate	Sulfur		
Safer Brand Garden Fungicide II for Flowers, Fruits and Vegetables	Sulfur		

Safer Brand Insect Killing Soap Concentrate II	Potassium salts of fatty acids	Organocide Bee Safe 3-in-1 Garden Spray	Sesame oil
Safer Brand Insect Killing Soap with Seaweed Extract II	Potassium salts of fatty acids	Organocide Bee Safe 3-in-1 Garden Spray Concentrate	Sesame oil
Safer Brand Neem Oil Concentrate	Clarified hydrophobic extract of neem oil	Organoice Bee Safe Insect Killer	Sesame oil
Safer Brand Neem Oil RTU	Clarified hydrophobic extract of neem oil	MagicFlower Bud Finisher & Pest Control	Sesame oil, cinnamon powder, garlic powder, clove powder
Safer Brand Rose & Flower 3-in-1 Garden Spray II	Potassium salts of fatty acids, sulfur	Ecologic Diatomaceous Earth Crawling Insect Killer Granular	Silicon dioxide
Safer Brand Tomato & Vegetable 3-in-1 Garden Spray	Potassium salts of fatty acids, sulfur	Doctor Kirchner Natural Weed Killer	Sodium chloride
Safer Brand Yard & Garden Insect Killer II	Potassium salts of fatty acids, pyrethrins	Earth's Ally Weed Control	Sodium chloride
SaferGro Mildew Cure	Corn oil, cottonseed oil, garlic oil	Corry's Slug & Snail Killer	Sodium ferric EDTA
SaferGro Pest Out	Cottonseed oil, clove oil, garlic oil	Ferroxx Slug and Snail Bait	Sodium ferric EDTA
SaniDate 12.0	Hydrogen peroxide, peroxyacetic acid	Ironfist Slug and Snail Bait	Sodium ferric EDTA
SaniDate 12.0	Hydrogen peroxide, peroxyacetic acid	Ironworxx Sliug & Snail Bait	Sodium ferric EDTA
Seican	Cinnamaldehyde	Prosper D2M	Sodium lauryl sulfate, cinnamon oil
SePro Ornazin 3% EC			Sodium lauryl sulfate, geraniol, clove oil, cornmint oil
Botanical Insecticide	Azadirachtin	Essentria IC PRO	
Serenade Garden Disease Control Concentrate	Bacillus subtilis QST713 Strain	Golden Pest Spray Oil	Soybean oil
Serenade Garden Disease Control Ready to Spray	Bacillus subtilis QST713 Strain	Whitney Farms Weed & Grass Control	Soybean oil
Serifel NG Biological Fungicide	Bacillus amyloliquefaciens strain MBI 600	Purecrop 1	Soybean oil, corn oil
Sil-Matrix	Potassium silicate	Purely Green Bio-pesticide Super Concentrate	Soybean oil, peppermint oil, cinnamon oil, lemongrass oil, garlic oil
Sil-Matric LC	Potassium silicate	Soyote	Soybean oil, sodium lauryl sulfate
SNS 203 Concentrated Natural Pesticide Soil Drench/Spray	Clove oil, rosemary oil	Mycostop Biofungicide	Streptomyces griseoviridis strain K61

SNS 209 All Natural Systemic Pest Control Concentrate	Rosemary, rosemary oil	Mycostop Biofungicide for Vegetable and Ornamental Crops	Streptomyces griseoviridis strain K61
SNS 217C All Natural Spider Mite Control Concentrate	Rosemary oil	Lalstop K61 WP	Streptomyces griseoviridis strain K61
SNS 244 All Natural Ready to Use Fungicide	Thyme oil	Organishield Safer Brand Garden Fungicide Concentrate for Flowers, Fruits & Vegetables	Sucrose octanoate esters
SNS 244C All Natural Concentrated Fungicide	Clove oil, rosemary oil, thyme oil	Requiem EC	Sulfur Terpene constituents of the extract of chenopodium ambrosioides as synthetically manufactured Terpene constituents of the extract of chenopodium ambrosioides as synthetically manufactured
Socoro	Cold pressed neem oil	Requiem Prime	Thyme oil
Sonalan HFP		Guarda	Thyme oil
Soyote	Soybean oil, sodium lauryl sulfate	Judgement	Thyme oil
Spear T Liquid Concentrate	GS-omega/kappa-Hctx-Hv1a	Pathocurb	Thyme oil
SPEAR-LEP	GS-omega/kappa-Hctx-Hv1a	Proud 3	Thyme oil
Spear-RC	GS-omega/kappa-Hctx-Hv1a	Reckoning Sporicide	Thyme oil
Sporan EC2	Rosemary oil, clove oil, thyme oil, peppermint oil	Sierra Natural Science SNS 244 Fungicide Ready to Use	Thyme oil
Stargus	Bacillus amyloliquefaciens strain F727	Thyme Guard	Thyme oil
SteraMist BIT 0.35%	Hydrogen peroxide	Thymox Control Fungicide and Bactericide Concentrate	Thyme oil
Stop Bugging Me! Nematode Ready to Spray	Cinnamon oil, geraniol	Thymox Control Organic Fungicide and Bactericide Concentrate	Thyme oil
Stop Bugging Me! Nematode RTU	Cinnamon oil, geraniol	Protex	Thyme oil, citric acid
SuffOil-X	Mineral oil	Biotime	Thyme oil, clove oil
Sugar Mover Premier	Cytokinin (kinetin)	Trifecta Crop Control Ready to Use	Thyme oil, clove oil, garlic oil, peppermint oil, corn oil, geraniol, citric acid, rosemary oil
Summit Year-Round Spray Oil	Mineral oil		

	Sunergist EBR	24-Epibrassinolide	Trifecta Crop Control Super Concentrate	Thyme oil, clove oil, garlic oil, peppermint oil, corn oil, geraniol, citric acid, rosemary oil
	Suppress Herbicide EC	Caprylic acid, capric acid	Flock Free Mosquito Control Concentrate	Thyme oil, garlic oil, corn oil, geraniol, clove oil, citric acid, peppermint oil, rosemary oil, sodium, chloride
	Surround WP Agricultural Crop Protectant	Kaolin	Pureag Pest Control	Thyme oil, garlic oil, corn oil, geraniol, clove oil, citric acid, peppermint oil, rosemary oil, sodium, chloride
	Surround WP Crop Protectant	Kaolin	Bio-Tam 2.0	Trichoderma asperellum strain ICC 012 , trichoderma gamsii strain ICC 080
	System-K Blue	Mono- and di-potassium salts of phosphorous acid	Tenet WP	Trichoderma asperellum strain ICC 012 , trichoderma gamsii strain ICC 080
	Take Down Garden Spray (concentrate)	Canola oil, pyrethrins	Rootshield Granules Biological Fungicide	Trichoderma harzianum rifai strain KRL-AG2
	TCC-IPM	Thyme oil, clove oil, garlic oil, peppermint oil, corn oil, geraniol, citric acid, rosemary oil	Rootshield WP Biological Fungicide	Trichoderma harzianum rifai strain KRL-AG2
	Tenet WP	Trichoderma asperellum strain ICC 012, Trichoderma gamsii strain ICC 080	Triatum P Biological Fungicide	Trichoderma harzianum rifai strain KRL-AG2
	TerraClean 5.0	Hydrogen peroxide, peroxyacetic acid	Rootshield Plus Granules Biological Fungicide	Trichoderma harzianum rifai strain KRL-AG2, trichoderma virens strain G-42
	Tersus Insecticide	Pyrethrins	Rootshield Plus WP Biological Fungicide	Trichoderma harzianum rifai strain KRL-AG2, trichoderma virens strain G-42
	TetraCURB Concentrate	Rosemary oil	Plant Shield HC	Trichoderma harzianum rifai strain T-22
	TetraCURB Max	Castor oil, rosemary oil, clove oil, peppermint oil		
	TetraCURB Organic	Rosemary oil, clove oil, peppermint oil		
	Theia Fungicide	Bacillus subtilis strain AFS032321		

Thuricide N/G	Bacillus thuringiensis SSP. Kurstaki
Thyme Guard	Thyme oil
Thymic	Thyme oil
Thymox Control Fungicide and Bactericide Concentrate	Thyme oil
Thymox Control Organic Fungicide and Bactericide Concentrate	Thyme oil
Tidal Grow Spectra	Chitosan
Triact 70	Clarified hydrophobic extract of neem oil
Trianum P Biological Fungicide	Trichoderma harzianum rifai strain KRL-AG2
Triathlon BA	Bacillus amyloliquefaciens strain D747 Thyme oil, clove oil, garlic oil, peppermint oil, corn oil, geraniol, citric acid, rosemary oil
Trifecta Crop Control	Thyme oil, clove oil, garlic oil, peppermint oil, corn oil, geraniol, citric acid, rosemary oil
Trifecta Crop Control Super Concentrate	Thyme oil, clove oil, garlic oil, peppermint oil, corn oil, geraniol, citric acid, rosemary oil
Trifecta Ready to Use Crop Control	Thyme oil, clove oil, garlic oil, peppermint oil, corn oil, geraniol, citric acid, rosemary oil
Trilogy	Clarified hydrophobic extract of neem oil
Triple Action Neem Oil	Clarified hydrophobic extract of neem oil
TriTek	Mineral oil
Typhoon	Potassium sorbate
Vacciplant	Laminarin IBA (Indole-3-butyric acid), cytokinin (Kinetin)
VaRx Brand MavRx	
Venerate CG	Burkholderia sp strain A396
Venerate XC	Burkholderia sp strain A396
Vinegar Weed & Grass Killer	Acetic acid
WarHammer	Chitosan

	Weed Slayer Weed Warrior Concentrate Grass and Weed Killer Weed Warrior Concentrate Grass and Weed Killer (Ag Use) Whitney Farms Insecticidal Soap Wizard's Brew Concentrate Wizard's Brew Root Drench XenTari Biological Insecticide Dry Flowable Zealous ZeroTol 2.0 ZeroTol HC Zonix Biofungicide Zonix Biofungicide	Eugenol Ammonium salts of higher fatty acids Ammonium salts of higher fatty acids Potassium laurate Cinnamon oil, lemongrass oil, rosemary oil, castor oil, sodium lauryl sulfate Rosemary oil, cedar oil, castor oil, sodium lauryl sulfate Bacillus thuringiensis SSP. Aizawai Geraniol Hydrogen peroxide, peroxyacetic acid Hydrogen peroxide, peroxyacetic acid Rhamnolipid biosurfactant Rhamnolipid biosurfactant	
<b>Analytical Techniques Used</b>	No mention of analytical techniques.	No mention of analytical techniques.	

**Table 13 - Regulations for Pesticides in Cannabis in Alaska, Maryland and Nevada**

	<b>Alaska</b>	<b>Maryland</b>	<b>Nevada</b>
<b>Testing Requirements and Minimum Quality Standard Imposed</b>	State laws require that pesticides must be used in accordance with the instructions on the label and pesticides must be registered with EPA. Pesticides must be exempt from food residue tolerance requirements. The Department of Environmental Health compiles list of pesticides that meet the criteria, and this list is updated yearly at minimum.	Laws require that the below pesticides may be used on cannabis but must be in accordance with the instructions on the label and pesticides must be registered with EPA.	The Nevada Department of Agriculture compiled a list of pesticide active ingredients that may be used on cannabis.
<b>Pesticides Tested For and Allowed Limits</b>	<b>Trade Name</b>	<b>Trade Name</b>	<b>Active Ingredients</b>
	70% Neem Oil Alude Fungicide Axiom Plant Growth Stimulator AzaGuard AzaMax AzaSol Azera Gardening Azera Insecticide Biobit HP Biological Insecticide Wettable Powder Bonide All Seasons Horticultural and Dormant Spray Oil Concentrate Bonide Bontone II Rooting Powder Bonide Citrus Fruit & Nut Orchard Spray Conc. Bonide Citrus Fruit & Nut Orchard Spray R-T-Spray Bonide Diatomaceous Earth Crawling Insect Killer Bonide Insecticidal Soap Multi-Purpose Insect Control R-T-U Bonide Liquid Copper Fungicide Ready to Use Bonide Mite-X RTU Bonide Neem Oil Concentrate Bonide Neem Oil RTU	70% Neem Oil Actino-Iron Biological Fungicide Actinovate AG Actinovate SP Agree WG Agri-Fos Systemic Fungicide Alude Fungicide Alude Systemic Fungicide Ancora Axiom  Aza-Direct Biological Insecticide AzaGuard AzaSol  Azatin O Biological Insecticide Biobit HP Biological Insecticide Wettable Powder  BioCeres WP BioSafe Disease Control (Concentrate) BioSafe Disease Control RTU Bio-Tam 2.0	<b>EPA Minimum Risk-Exempt from Tolerance</b> Castor oil Cinnamon and cinnamon oil Citric acid Cloves and clove oil Corn gluten meal Corn oil Cottonseed oil Eugenol Garlic and garlic oil  Geranoil Geranium oil Lauryl sulfate  Lemongrass oil Linseed oil  Malic acid Mint and mint oil Peppermint and peppermint oil 2-phenethyl propionate

	<p>Bonide Slug Magic</p> <p>Botanigard ES</p> <p>BushDoctor Force of Nature Fungicide          BushDoctor Force of Nature Insecticide          BushDoctor Force of Nature Miticide          Cease          Clonex Rooting Gel          Corry's Slug &amp; Snail Killer          Desect Diatomaceous Earth Insecticide          Dr. Earth Final Stop Disease Control Fungicide</p> <p>Dr. Earth Final Stop Snail &amp; Slug Killer Spray          Dr. Earth Final Stop Vegetable Garden Insect Killer          Dr. Earth Final Stop Yard &amp; Garden Insect Killer          Earth's Ally 3-in-1 Plant Spray          Earth's Ally 3-in-1 Plant Spray Concentrate          Earth's Ally Disease Control Concentrate          Earth's Ally Disease Control RTU          Earth's Ally Insect Control Concentrate          Earth's Ally Insect Control RTU          Ecozin Plus 1.2% ME          Eliminator Snail &amp; Slug Killer          Evergreen Crop Protection EC 60-6          Evergreen PRO 60-6          Fortify Fungicide          Fosphite Fungicide          Garden Safe Insecticidal Soap Insect Killer          Garden Safe Neem Oil Extract Conc          Garden Safe Takeroot Rooting Hormone          Gnatrol WDG Biological Larvicide          Golden Pest Spray Oil</p>	<p>Bonide Insecticidal Soap Multipurpose Insect Control Concentrate          Bonide Insecticidal Soap Multipurpose Insect Control Ready to Use          Bonide Mite X Ready to Use          Bonide Slug Magic          Botanical Concentrated Bacteriostat &amp; Fungistat          BotaniGard 22WP          BotaniGard ES          BotryStop          BotryStop Biofungicide          BotryStop WP Biofungicide</p> <p>BT Now          Camelot O</p> <p>Captiva          Captiva Prime          Cease          Companion Liquid Biological Fungicide          Corry's Slug &amp; Snail Killer          Debug Turbo          Des-X Insecticidal Soap Concentrate          Dipel DF Biological Insecticide Dry Flowable          DiTera DF Biological Nematicide          Double Nickel LC          Double Nickel 55          Drexel Phiticide          Earth-tone Insecticidal Soap          Eco-1 Garden Spray Concentrate          Ecozin Plus 1.2% ME          Eliminator Snail &amp; Slug Killer          Fungi-Phite          Garde Safe Brand Neem Oil Extract Concentrate</p>	<p>Potassium sorbate</p> <p>Rosemary and rosemary oil</p> <p>Sesame          Sodium chloride          Sodium lauryl sulfate          Soybean oil          Thyme and thyme oil          White pepper          Zinc metal strips</p> <p><b>EPA Registered Pesticide-Exempt from Tolerance</b></p> <p>Azadirachtin          Bacillus amyloquefaciens</p> <p>Bacillus lichemformis          Bacillus megaterium          Bacillus pumilius strain QST 2808          Bacillus subtilis          Bacillus thuringiensis          Beauveria bassiana strain ANT-03          Beauveria bassiana strain GHA          Beauveria bassiana Candia          Burkholderia spp. Strain A396          Capsicum oleoresin          Chromobacterium substsugae          Copper octanoate          Copper oxychloride          Copper hydroxide          Gliocladium catenulatum strain J1446          Hydrogen dioxide          Hydrogen peroxide          Kaolin</p>
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Grandevo CG	General Hydroponics Defguard Biofungicide/Bactericide	Metarhizium anisopliae strain F52
Grandevo WDG	General Hydroponics Exile Insecticide/Fungicide/Miticide	Mineral oil
Grower's Ally Crop Defender 3	General Hydroponics Prevasyn Insect Repellent/Insecticide	Mono- and di-potassium salts of phosphorus acid
Grower's Ally Crop Defender 3 Concentrate	GibGro 4LS	Neem oil
Grower's Ally Fungicide Concentrate	Gnatrol WDG Biological Larvicide	Paecilomyces fumosoroseus (Isaria fumosorosea)
Grower's Ally Fungicide RTU	Grandevo CG	Paraffinic oil (mineral oil)
Grower's Ally Spider Mite Control Concentrate	Grandevo PTO	Peroxyacetic acid
Grower's Ally Spider Mite Control RTU	Grandevo WDG	Potassium bicarbonate
Hormex Rooting Powder No. 1	Grotto	Potassium salts of fatty acid
Hormex Rooting Powder No. 3	Grower's Ally Crop Defender 3	Potassium silicate
Hormex Rooting Powder No. 8	Guarda	Reynoutria sachalinensis
Hormodin 1	Hormex Rooting Powder No. 1	Sodium carbonate peroxyhydrate
Kaligreen	Hormex Rooting Powder No. 3	Streptomyces griseoviridis strain K61
Lost Coast Plant Therapy	Hormex Rooting Powder No. 8	Streptomyces lydicus VVYEC 108
Mammoth CannControl	Howler Fungicide	Sucrose octanoate
Milstop Broad Spectrum Foliar Fungicide	Isarid	Sulfur
Miracle-Gro Nature's Care Garden Disease Control	Javelin WG Biological Insecticide	Swinglea glutinosa
Miracle-Gro Nature's Care Insecticidal Soap	LALGuard M52 GR	Trichoderma harzianum
Monterey B.t.RTU/Organic Gardening	LALGuard M52 OD	Trichoderma reesei
Monterey Horticultural Oil	LalStop G46 WG	Trichoderma virens
Monterey Neem Oil – RTU/Organic Gardening	LalStop K61 WP	Trichoderma asperellum
Monterey Take Down Garden Spray	Met52 EC Bioinsecticide	Trichoderma gamsii
NimBioSys Neem Oil	Milstop Broad Spectrum Foliar Fungicide	Ulocladium oudemansii
Nuke Em	Milstop SP Foliar Fungicide	<b>EPA Registered Pesticide-Tolerance Monitored</b>
Ornazin 3% EC Botanical Insecticide	Molt-X	Acequinocyl
Ortho Tree & Shrub Fruit Tree Spray Conc	Monterey Complete Disease Control Brand	Bifenazate
Oxidate 2.0	Monterey Complete Disease Control Brand RTU	Cyfluthrin and beta-cyfluthrin
Phostrol Agricultural Fungicide	Monterey Garden Phos	Dimethomorph

Pro-Mix Biofungicide + Mycorrhizae Pro-Mix BRK Biofungicide + Mycorrhizae Pro-Mix BRK20 Biofungicide + Mycorrhizae Pro-Mix BX Biofungicide + Mycorrhizae Pro-Mix BX Biofungicide Pro-Mix HP Biofungicide + Mycorrhizae  Pro-Mix with Biofungicide Pyganic Crop Protection EC 1.4 II Pyganic Crop Protection EC 5.0 II Pyganic Speciality Pyrethrum TR Total Release Insecticide Pyronyl Crop Spray Regalia Biofungicide Regalia CG Rootshield Granules Safer Brand Garden Fungicide Conc for Flowers, Fruits & Vegetables Safer Brand Insect Killing Soap Concentrate II Safer Brand Pyrethrin & Insecticidal Soap Concentrate II Serenade ASO Serenade Garden Disease Control Concentrate Serenade Garden Disease Control Ready to Spray Serenade MAX Serenade OPTI Smite SNS 217 RTU Spider Mite Control Subtilex NG Biological Fungicide Sunspray Ultra-fine Spray Oil Tersus Insecticide	M-Pede Insecticide Miticide Fungicide Mycostop Biofungicide Mycostop WP Mycotrol ESO Mycotrol WPO Natural Guard Brand by Ferti-lome Insecticidal Soap Concentrate Natural Guard Brand by Ferti-lome Neem Natural Guard Brand Neem Neemix 4.5 Insect Growth Regulator NimBioSys Neem Oil (Ag Use) NoFly WP Obtego Fungicide and Plant Symbiont Optify/Stretch Organic JMS Stylet-Oil Organocide 3-in-1 Garden Spray Organocide Plant Doctor  Ornazin 3% EC Botanical Insecticide OxiDate 2.0  OxiPhos PerCarb Perpose Plus PERpose Plus PFR-97 10% ES Phostrol Agricultural Fungicide PreFense Biofungicide Preferak Prescription Treatment Brand Ultra-Pure Oil PreStop WG	Etoxazole Fenhexamid Flonicamid Fludioxonil Imidacloprid Myclobutanil  Pentachloronitrobenzene (quintozene) Piperonyl butoxide Pyrethrin Spinetoram Spinosad Spirotetramat Thiamethoxam Trifloxystrobin
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	<p>Triact 70  Triathlon BA  Trishield Insecticide, Miticide &amp; Fungicide Concentrate  Venerate CG  Venerate XC Bioinsecticide  Whitney Farms 3-in-1 Rose &amp; Flower Care 1  Whitney Farms Insecticidal Soap  Whitney Farms Slug &amp; Snail Killer 1  Year Round Spray Oil  Zerotol 2.0  Zonix Biofungicide</p>	<p>Procidic 2  Pro-Mix Biofungicide + Mycorrhizae  Pro-Mix BRK Biofungicide + Mycorrhizae    Pro-Mix BRK20 Biofungicide + Mycorrhizae  Pro-Mix BX Biofungicide + Mycorrhizae  Pro-Mix HP Biofungicide + Mycorrhizae  Pro-Mix HPCC Biofungicide + Mycorrhizae  Rampart Fungicide  Regalia CG  Regalia PTO Biofungicide  Reliant Systemic Fungicide  Rootshield Plus Granules  Roothshield Plus WP  Safer Brand 3-in-1 Concentrate II  Safer Brand Insect Killing Soap Concentrate II  Sanidate 5.0    Serenade Garden Disease Control Concentrate  Serenade Garden Disease Control Ready to Spray  Serenade Garden Disease Control Ready to Use  Stargus Biofungicide  Suffoil-X  Suppress Herbicide EC  System-K Blue Agricultural Fungicide  Tenet WP  TerraClean 5.0  TerraStart  Triact 70  Triatum-P Biological Fungicide  Triathlon BA  Trilogy</p>	
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		Triple Action Neem Oil TriShield Valent Professional Products DiPel Pro DF Biological Insecticide Dry Flowable ZeroTol 2.0 ZeroTol HC Zonix Biofungicide	
<b>Analytical Techniques Used</b>	No mention of analytical techniques.	No mention of analytical techniques.	No mention of analytical techniques.

**Table 14 - Regulations for Pesticides in Cannabis in Connecticut and Maine**

	<b>Connecticut</b>		<b>Maine</b>	
<b>Testing Requirements and Minimum Quality Standard Imposed</b>	In Connecticut, the Department of Energy and Environmental Protection (DEEP), states that any pesticide to be used on cannabis, must first be registered with the DEEP. All pesticide label requirements must be followed and the requirement of a tolerance for pesticide chemical residues must not apply to active components listed on the label of the pesticide.		Pesticides may only be used if usage is in strict accordance with the product label requirements and pesticides must be registered with the Maine Department of Agriculture. Pesticide storage and use must be in compliance with US EPA. Detailed records of all pesticides used must be kept.	
<b>Pesticides Tested For and Allowed Limits</b>	<b>Trade Name</b>	<b>Active Ingredients</b>	<b>Trade Name</b>	<b>Active Ingredients</b>
	Agree WG	Bacillus thuringiensis SSP. Aizawai	Howler Evo Fungicide	Pseudomonas chlororaphis strain AFS009
	Ancora	Isaria fumosorosea	Theia Fungicide	Bacillus subtilis strain AFS032321
	Asperello T34 Biocontrol	Trichoderma asperellum strain T34	Heligen	Helicoverpa zera nucleopolyhedrovirus ABA-NPV-U
	Aza-Direct Biological Insecticide	Azadirachtin	Bioceres WP Biological Mycoinsecticide	<i>Beauveria bassiana</i> strain ANT-03
	AzaGuard	Azadirachtin	Bioceres Biological Mycoinsecticide	<i>Beauveria bassiana</i> strain ANT-03
	AzaMax	Azadirachtin	Helicovex	<i>Helicoverpa armigera</i> nucleopolyhedrovirus strain BV-0003:
	AzaSol	Azadirachtin	Guarda	Thyme oil
	Azatin O Biological Insecticide	Azadirachtin	Bioworks Rootshield Plus+ WP Biological Fungicide	Trichoderma harzianum Rifai strain T-22
	Azera Insecticide	Azadirachtin, pyrethrins	Rootshield Plus+ Granules Biological Fungicide	Trichoderma virens Rifai strain G-41
Azera Pro	Pyrethrins, azadirachtin	Bioworks Rootshield WP Biological	Trichoderma harzianum Rifai strain T-22	
BioCeres WP	Beauveria bassiana strain ANT-03	Botrystop WP Biofungicide	<i>Ulocladium oudemansii</i> (U3 Strain)	
BioCeres WP	Beauveria bassiana strain ANT-03	PBO-8 Synergist	Piperonyl butoxide	
BioSafe Disease Control (Concentrate)	Hydrogen peroxide, peroxyacetic acid	Carb-o-Nator	Potassium bicarbonate	

Bonide All Seasons Horticultural & Dormant Spray Oil Ready to Spray	Mineral oil	Crymax Bioinsecticide (WDG)	<i>Bacillus thuringiensis</i> spp <i>kurstaki</i>
Bonide Diatomaceous Earth Crawling Insect Killer	Diatomaceous Earth	Gemstar LC Insecticidal Virus	Polyhedral occlusion bodies of the nuclear polyhedrosis virus of <i>Helicoverpa zea</i> (corn earworm)
Bonide Insecticidal Soap Multi-Purpose Insect Control Ready To Use	Potassium Laurate	Lifeguard WG Biological Plant Activator	<i>Bacillus mycooides</i> Isolate J 6516
Bonide Rose Rx 3 in 1 Concentrate	Clarified Hydrophobic Extract of Neem Oil	Sil-matrix LC Fungicide/Miticide/Insecticide	Potassium silicate
BotaniGard 22WP	Beauveria bassiana Strain GHA	PFR-97 10% ES Microbial Insecticide	<i>Isaria fumosorosea</i> Apopka Strain 97
BotaniGard ES	Beauveria bassiana Strain GHA	Botanigard ES Mycoinsecticide	<i>Beauveria bassiana</i> strain GHA
Botanigard Maxx	Pyrethrins, Beauveria bassiana strain GHA	Botegha ES Mycoinsecticide	<i>Beauveria bassiana</i> strain GHA
BoteGHA ES	Beauveria bassiana Strain GHA	Mycotrol ESO Mycoinsecticide	<i>Beauveria bassiana</i> strain GHA
Brandt Turfzilla	Phosphorous Acid, Mono- and Di-Potassium Salts of	Botanigard 22 WP Mycoinsecticide	<i>Beauveria bassiana</i> strain GHA
Bug Buster-O	Pyrethrins	Mycotrol WPO Mycoinsecticide	<i>Beauveria bassiana</i> strain GHA
Captain Jack's Neem Oil Ready to Use	Clarified Hydrophobic Extract of Neem Oil	Promote	Cytokinin (as kinetin) Gamma Aminobutyric Acid ((GABA) Choline Chloride
Captiva	Capsicum Oleoresin Extract, garlic oil, soybean oil	Ecoworks EC Botanical Insecticide, Miticide, Nematicide, Fungicide	Cold pressed neem oil Ethyl acetate
Captiva Prime	Capsicum Oleoresin Extract, garlic oil, canola oil	Vinegar weed & grass killer	Acetic acid
Carb-O-Nator	Potassium Bicarbonate	General Hydroponics Defguard Biofungicide/Bactericide	<i>Bacillus amyloliquefaciens</i> strain D747
Cinnaction	Cinnamon Oil	General Hydroponics Prevasyn Insect Repellent/Insecticide	Soybean oil Resins, oleo-, capsicum Garlic oil
Clonex Rooting Gel	IBA (Indole-3-Butyric Acid)	Botanigard 22 WP (Mycoinsecticide)	<i>Beauveria bassiana</i> strain GHA

Confine Extra	Phosphorous Acid, Mono- and Di-Potassium Salts of	Botanigard ES (Mycoinsecticide)	<i>Beauveria bassiana</i> strain GHA
Copper Soap	Copper Octanoate	Botegha ES Emulsifiable Suspension Mycoinsecticide	<i>Beauveria bassiana</i> strain GHA
Corry's Slug & Snail Killer	Sodium Ferric EDTA	Mycotrol ESO	<i>Beauveria bassiana</i> strain GHA
Decco Ag PAA	Peroxyacetic Acid, hydrogen peroxide	Mycotrol WPO	<i>Beauveria bassiana</i> strain GHA
Deliver Biological Insecticide	Bacillus thuringiensis SSP. Kurstaki	Grandevo CG Bioinsecticide	<i>Chromobacterium subtsugae</i> strain PRAA4-1 & spent fermentation media
Desect AG Diatomaceous Earth Insecticide	Diatomaceous Earth	Grandevo WDG Bioinsecticide	<i>Chromobacterium subtsugae</i> strain PRAA4-1 & spent fermentation media
Des-X Insecticidal Soap Concentrate	Potassium Laurate	Regalia Biofungicide	Extract of <i>Reynoutria sachalinensis</i>
DiPel DF Biological Insecticide	Bacillus thuringiensis SSP. Kurstaki	Regalia CG Biofungicide	Extract of <i>Reynoutria sachalinensis</i>
DiPel PRO DF Biological Insecticide	Bacillus thuringiensis SSP. Kurstaki	Stargus Biofungicide	<i>Bacillus amyloliquefaciens</i> strain D727
DiTera DF Biological Nematicide	Myrothecium verrucaria	Exponent Insecticide Synergist	Piperonyl butoxide
Double Nickel LC	Bacillus amyloliquefaciens Strain D747	Debug-on Emulsifiable Concentrate	Fats and Glyceridic Oils Margosa (Cold Pressed Neem Oil)
DoubleNickel55	Bacillus amyloliquefaciens Strain D747	Azamax Botanical Insecticide, Miticide, Nematicide	Azadirachtin
Dr. Earth Final Stop OMRI Fruit Tree Insect Killer (RTU)	Rosemary Oil, sesame oil, peppermint oil, thyme oil, cinnamon oil, garlic oil	Bellatrove Companion Maxx WP	<i>Bacillus amyloliquefaciens</i> strain ENV503
Dr. Earth Final Stop OMRI Fruit Tree Insect Killer Concentrate	Rosemary Oil, sesame oil, peppermint oil, thyme oil, cinnamon oil, garlic oil	Zorda WG Biological Fungicide	<i>Bacillus amyloliquefaciens</i> strain PTA-4838
Drexel Phiticide	Phosphorous Acid, Mono- and Di-Potassium Salts of	Spear-LEP Biological Fungicide	GS-omega/kappa - Hctx-Hv1a (spider venom peptides)
Earth's Ally 3-IN-1 Plant Spray (RTU)	Thyme oil	Spear-T Liquid concentrate	GS-omega/kappa - Hctx-Hv1a (spider venom peptides)
Earth's Ally 3-IN-1 Plant Spray Concentrate	Thyme oil	Biological Insecticide/Miticide	Oils Margosa (Cold Pressed Neem Oil)
Earth's Ally Disease Control (RTU)	Citric Acid	Spear-T Liquid Concentrate	
		Leprotec Aqueous Biological Insecticide	<i>Bacillus thuringiensis ssp. kurstaki</i> strain EVB-113-19

Earth's Ally Disease Control Concentrate	Citric Acid	
Earth's Ally Insect Control Concentrate	Rosemary Oil, clove oil, peppermint oil	
Earth's Ally Insect Control Concentrate	Rosemary Oil	
EcoWorks EC	Neem Oil, Cold Pressed	
Ecozin Plus 1.2% ME	Azadirachtin	
Eliminator Snail & Slug Killer	Sodium Ferric EDTA	
Essentria IC-3 Insect Concentrate	Rosemary Oil, geraniol, peppermint oil	
Essentria IC4 Insect Concentrate	Geraniol	
Evergreen Crop Protection EC 60-6	Pyrethrins, piperonyl butoxide	
Evergreen Pyrethrum Concentrate	Pyrethrins	
Exponent Insecticide Synergist	Piperonyl Butoxide	
Ferti-lome Fruit Tree Spray	Pyrethrins, piperonyl butoxide, clarified hydrophobic neem oil	
Finalsan Herbicidal Soap	Ammoniated soap of fatty acids	
FireWorxx	Caprylic Acid, capric acid	
Fungi-Phite	Mono- and Di-Potassium Salts of phosphorous acid	
Garden Safe Brand Insecticidal Soap Insect Killer	Potassium Laurate	
Garden Safe Brand Multi-Purpose Garden Insect Killer2	Pyrethrins, canola oil	
Garland	Garlic Oil	
Gemstar LC	Helicoverpa zea nucleopolyhedrovirus ABA-NPV-U	
General Hydroponics DEFGUARD Biofungicide / Bactericide1	Bacillus amyloliquefaciens Strain D747 D747	

General Hydroponics Prevasyn Insect Repellent / Insecticide2	Capsicum Oleoresin Extract, garlic oil, soybean oil	
General Hydroponics Trishield Insecticide, Miticide & Fungicide Concentrate	Soybean Oil, sodium lauryl sulfate, citric acid	
Golden Pest Spray Oil	Soybean Oil	
Grandevo CG	Chromobacterium Sub Strain PRAA4-1 Cells	
Grandevo WDG	Chromobacterium Sub Strain PRAA4-1 Cells	
Green Cleaner (Concentrated)	Soybean Oil, sodium lauryl sulfate	
Grower's Ally Crop Defender 3 (RTU)	Thyme oil	
Grower's Ally Crop Defender 3 Concentrate	Thyme oil	
Grower's Ally Fungicide (RTU)	Citric Acid	
Grower's Ally Fungicide Concentrate	Citric Acid	
Guarda	Thyme oil	
Harrell's ProtectMAX Title Phyte Systemic Fungicide	Phosphorous Acid, Mono- and Di- Potassium Salts of	
HomePlate	Caprylic Acid, capric acid	
Hormodin 1	IBA (Indole-3-Butyric Acid)	
Hortus IBA Water Soluble Salts (20%)	IBA (Indole-3-Butyric Acid)	
Howler Fungicide	Pseudomonas chlororaphis strain AFS009	
Howler Lawn and Garden Fungicide	Pseudomonas chlororaphis strain AFS009	
Howler Lawn and Garden Organic Fungicide	Pseudomonas chlororaphis strain AFS009	
Isarid	Isaria fumosorosea	
Javelin WG Biological Insecticide	Bacillus thuringiensis SSP. Kurstaki	
Jet-Ag 5%	Hydrogen Peroxide, peroxyacetic acid	

KeyPlex Ecotrol Plus	Rosemary Oil, geraniol, peppermint oil
Kopa Insecticidal Soap	Potassium Salts of Fatty Acids
Leptotec	Bacillus thuringiensis SSP. Kurstaki
Lesco Horticultural Oil Plus	Mineral Oil
LifeGard WG	Bacillus mycoides isolate J
Mad Farmer Root It	Indole-3-butyric acid
Mammoth CannControl	Corn Oil, thyme oil
Mammoth Garden Protect Me	Corn Oil, thyme oil
Milstop SP	Potassium Bicarbonate
Miracle-Gro Nature's Care	Copper Octanoate
Garden Disease Control	
Mite-E-Oil	Mineral Oil
MiteXstream	Geraniol, citronellol
Molt-X	Azadirachtin
M-Pede Insecticide Miticide	Potassium Laurate
Fungicide	
Mycostop Biofungicide	Streptomyces Strain K61
Mycotrol ESO	Beauveria bassiana Strain GHA
Natural Guard Brand by Ferti-	Potassium Salts of Fatty Acids
lome Insecticidal Soap	
Concentrate	
Nature-Cide All Purpose	Clove Oil, cottonseed oil
Commercial Concentrate	
Nature-Cide All Purpose	Clove Oil
Insecticide	
Nature-Cide OUTDOOR	Cedar Oil, cinnamon oil
Nature-Cide Pest Management	Cedar Oil, cinnamon oil
Commercial Concentrate	
Neemix 4.5 Insect Growth	Azadirachtin
Regulator	
NimBioSys Neem Oil (Ag	Neem Oil, Cold Pressed
Use)	
NOFly WP	Isaria fumosorosea
Nuke Em	Citric Acid
Obtego Fungicide and Plant	Trichoderma asperellum Strain ICC 012,
Symbiont	Trichoderma gamsii strain ICC 080

Omni Supreme Spray Onward	Mineral Oil Cytokinin (Kinetin), GABA, choline chloride	
OxiDate 2.0 OxiPhos	Hydrogen Peroxide, peroxyacetic acid Mono- and Di-Potassium Salts of phosphorous acid, hydrogen peroxide	
Peragreen 15% Peragreen 5.6%	Peroxyacetic Acid, hydrogen peroxide Peroxyacetic Acid, hydrogen peroxide	
Perpose Plus PERpose Plus	Hydrogen Peroxide Hydrogen Peroxide	
PestXpert Pyrethrum PBO Plus Concentrate	Pyrethrins	
PFR-97 10% ES PFR-97 20% WDG	Isaria fumosorosea Isaria fumosorosea	
Phostrol Agricultural Fungicide	Phosphorous Acid, Mono- and Di- Potassium Salts of	
Power SI Control PrizeFighter	Clove Oil Ammonium Nonanoate	
ProGibb TVO Plant Growth Regulator	Gibberellins (Gibberellic Acid)	
PRO-MIX Bio-Fungicide Pro-Mix BRK Biofungicide + Mycorrhizae	Bacillus pumilus Strain GHA 180 Bacillus pumilus Strain GHA 180	
Pro-Mix BRK20 Biofungicide + Mycorrhizae	Bacillus pumilus Strain GHA 180	
PRO-MIX FPX Bio-Fungicide Pro-Mix HPCC Biofungicide + Mycorrhizae	Bacillus pumilus Strain GHA 180 Bacillus pumilus Strain GHA 180	
Promote Protection Plus	Cytokinin (Kinetin) Citric Acid	
Pycana Pyganic Crop Protection EC 1.4 II	Pyrethrins Pyrethrins	
Pyganic Crop Protection EC 5.0 II	Pyrethrins	
Pyganic Specialty	Pyrethrins	

Pyronyl Crop Spray Rampart 6.8 Rampart Fungicide	Piperonyl Butoxide mono- and dipotassium phosphite Phosphorous Acid, Mono- and Di- Potassium Salts of	
Rango Regalia Biofungicide (concentrate)	Neem Oil, Cold Pressed Reynoutria sachalinensis	
Regalia CG Biofungicide Reliant Systemic Fungicide	Reynoutria sachalinensis Phosphorous Acid, Mono- and Di- Potassium Salts of	
ReLoad Fungicide	Mono- and dibasic sodium, potassium, and ammonium phosphites	
Rhapsody Root Cleaner Concentrated	Bacillus subtilis QST713 Strain Sodium Lauryl Sulfate	
RootShield Plus+ Granules Biological Fungicide	Trichoderma harzianum Rifai Strain KRL-AG2	
RootShield Plus+ WP Biological Fungicide	Trichoderma harzianum Rifai Strain KRL-AG2	
Safer Brand #567 Pyrethrin & Insecticidal Soap Concentrate II	Potassium Salts of Fatty Acids, pyrethrins	
Safer Brand Garden Fungicide II for Flowers, Fruits, and Vegetables	Sulfur	
Safer Brand Insect Killing Soap ConcentrateII	Potassium Salts of Fatty Acids	
Safer Brand Neem Oil Concentrate	Clarified Hydrophobic Extract of Neem Oil	
SaniDate 12.0	Hydrogen Peroxide, peroxyacetic acid	
Seican	Cinnamaldehyde	
SePro Ornazin 3% EC Botanical Insecticide	Azadirachtin	
Serenade Garden Disease Control Concentrate	Bacillus subtilis QST713 Strain	
Serenade Garden Disease Control Ready to Spray	Bacillus subtilis QST713 Strain	

Serifel NG Biological Fungicide	Bacillus subtilis MBI 600
Sil-Matrix	Potassium Silicate
Sil-Matrix LC	Potassium Silicate
Spear T Liquid Concentrate	GS-omega/kappa-Hctx-Hv1a
SPEAR-LEP	GS-omega/kappa-Hctx-Hv1a
Sporan EC2	Rosemary Oil, clove oil, thyme oil, peppermint oil
Stargus	Bacillus amyloliquefaciens Strain F727
Stargus	Bacillus amyloliquefaciens Strain F727
Stop Bugging Me! Nematode Ready to Spray	Cinnamon Oil, geraniol
Stop Bugging Me! Nematode RTU	Cinnamon Oil, geraniol
Suerte	Ammonium Nonanoate
SuffOil-X	Mineral Oil
Summit Year-Round Spray Oil	Mineral Oil
Surround WP Agricultural Crop Protectant	Kaolin
Surround WP Crop Protectant	Kaolin
Tenet WP	Trichoderma asperellum Strain ICC 012
TerraClean 5.0	Hydrogen Peroxide
TerraNeem EC	Neem Oil, Cold Pressed
Tersus Insecticide	Pyrethrins
Thuricide N/G	Bacillus thuringiensis SSP. Kurstaki
Thymic	Thyme oil
Trianum P Biological Fungicide	Trichoderma harzianum Rifai Strain KRL-AG2
Triathlon BA	Bacillus amyloliquefaciens Strain D747
Trilogy	Clarified Hydrophobic Extract of Neem Oil
TriTek	Mineral Oil
Typhoon	Potassium Sorbate

	Valent Professional Products DiPel Pro DF Biological Insecticide Dry Flowable Venerate CG Venerate XC Vinegar Weed & Grass Killer Weed Warrior Concentrate Grass and Weed Killer Whitney Farms Insecticidal Soap XenTari Biological Insecticide Dry Flowable ZeroTol 2.0 ZeroTol HC Zonix Biofungicide	Bacillus thuringiensis SSP. Kurstaki  Burkholderia sp strain A396 Burkholderia sp strain A396 Acetic Acid Ammonium Salts of Higher Fatty Acids  Potassium Laurate  Bacillus thuringiensis SSP. Aizawai  Hydrogen Peroxide, peroxyacetic acid Hydrogen Peroxide, peroxyacetic acid Rhamnolipid Biosurfactant	
<b>Analytical Techniques Used</b>	No mention of analytical techniques.		No mention of analytical techniques.

**Table 15 - Regulations for Pesticides in Cannabis in New Mexico and New York**

	<b>New Mexico</b>	<b>New York</b>		
<b>Testing Requirements and Minimum Quality Standard Imposed</b>	In New Mexico, the New Mexico Department of Agriculture compiled a list of 103 pesticides including trade name and active ingredients (refer to table 15). The list is categorised into fungicides, herbicides and insecticides. All pesticides must be registered with EPA and label instructions must be followed.	Testing is required on all cannabis products even beverages. Testing must be performed for the pesticides below and residue must be below allowed limits. If cultivator makes use of any pesticide on medicinal cannabis it must be declared for targeted testing.		
<b>Pesticides Tested For and Allowed Limits</b>	<b>Trade Name</b>	<b>Active Ingredients</b>	<b>Active Ingredient</b>	<b>Allowed Limit (ppm)</b>
	<b>Fungicides</b>		Abamectin	0.5
	Milstop SP	Potassium bicarbonate	Acephate	0.4
	Double Nickel LC	Bacillus amyloliquefaciens	Acequinocyl	2
	Carb-O-Natur	Potassium bicarbonate	Acetamiprid	0.2
	Lifeguard WG	Bacillus mycoides isolate J	Aldicarb	0.4
	Regalia Biofungicide	Extract of Reynoutria sachalinensis	Azadirachtin	1
	Regalia CG	Extract of Reynoutria sachalinensis	Azoxystrobin	0.2
	Arber Bio Protectant	Extract of Reynoutria sachalinensis	Bifenazate	0.2
	Stargus	Bacillus amyloliquefaciens strain F727	Bifenthrin	0.2
	Arber Bio Fungicide	Bacillus amyloliquefaciens strain F727	Boscalid	0.4
	General Hydroponics Defguard Biofungicide/Bactericide	Bacillus amyloliquefaciens strain D747	Captan	1
	Defguard Biofungicide/Bactericide 1	Bacillus amyloliquefaciens strain D747	Carbaryl	0.2
	Guarda	Thyme oil	Carbofuran	0.2
	Zerotol 2.0	Hydrogen peroxide, peroxyacetic acid	Chlorantranilprole	0.2
	Asperello T34 Biocontrol	Trichoderma asperellum, strain T34 (dried conidia)	Chlordane	1
	Oxidate 2.0	Hydrogen peroxide, peroxyacetic acid	Chlorfenapyr	1
	TerraClean 5.0	Hydrogen peroxide, peroxyacetic acid	Chlormequat chloride	1
	Double Nickel 55	Bacillus amyloliquefaciens strain D747	Chlorpyrifos	0.2
	Procidic 2	Citric acid	Clofentezine	0.2
Mammoth CannControl	Corn oil, thyme oil	Coumaphos	1	
BotryStop WP	Ulocladium oudemanssi (U3 strain)	Cyfluthrin	1	

Triathlon BA	Bacillus amyloliquefaciens strain D747	Cypermethrin	1
Typhoon	Potassium sorbate	Daminozide	1
TKO Maxx Systemic Fungicide	Mono- and di-potassium salts of phosphoric acid	Diazinon	0.2
Rango	Cold pressed neem oil	Dichlorvos (DDVP)	1
Zorda WG Biological Fungicide	Bacillus amyloliquefaciens strain PTA-4838	Dimethoate	0.2
Theia Fungicide	Bacillus subtilis stratin AFS032321	Dimethomorph	1
Vacres	Potassium bicarbonate	Ethoprop(hos)	0.2
Grower's Ally Fungicide Concentrate	Citric acid	Etofenprox	0.4
Socoro	Cold pressed neem oil	Etoazole	0.2
Lalstop G46 WG	Gliocladium catenulatum strain J1446	Fenhexamid	1
Bella Trove Companion Maxx UP	Bacillus amyloliquefaciens strain ENV503	Fenoxycarb	0.2
Lost Coast Plant Therapy Concentrate	Citric acid, Peppermint Oil, Soybean Oil	Fenpyroximate	0.4
Reliant Systemic Fungicide	Mono- and di-potassium salts of phosphoric acid	Fipronil	0.4
OxiPhos	Hydrogen peroxide, Mono- and di-potassium salts of phosphorous acid	Fonicamid	1
Cease	Bacillus subtillis strain QST 713	Fludioxonil	0.4
PERpose Plus	Hydrogen peroxide	Hexythiazox	1
RootShield Plus WP Biological Fungicide	Trichoderma harzianum Rifai strain T-22, Trichoderma virens strain G-41	Imazalil	0.2
RootShield Plus Granules Biological Fungicide	Trichoderma harzianum Rifai strain T-22, Trichoderma virens strain G-41	Imidacloprid	0.4
Tidal Grow Spectra	Chitosan	Indole-3-butyric acid	1
AmyloShield Biological Fungicide	Bacillus amyloliquefaciens strain PTA-4838	Kresoxim-methyl	0.4
Magic Gardener Bioloical Disease Control	Bacillus amyloliquefaciens strain PTA-4838	Malathion	0.2
<b>Herbicides</b>		Metalaxyl	0.2
Fireworxx	Caprylic acid, Capric acid	Methiocarb	0.2
Homeplate	Caprylic acid, Capric acid	Methomyl	0.4
Green Gobbler 20% Vinegar Weed Killer	Acetic acid	Methyl parathion	0.2

Vinegar Weed & Grass Killer	Acetic acid	Mevinphos	1
Sonalan HFP	Ethlsfluralin	MGK-264	0.2
Onward	Cytokinin, Gamma Aminobutyric acid, Choline chloride	Myclobutanil	0.2
Onward Max	Cytokinin, Gamma Aminobutyric acid, Choline chloride	Naled	0.5
Ratchet	Lipo-chitooligosaccharide	Oxamyl	1
<b>Insecticides</b>		Paclobutrazol	0.4
Ancora	Isaria fumosorosea Apopka Strain 97	Pentachloronitrobenzene	1
PFR-97 20% WDG	Isaria fumosorosea Apopka Strain 97	Permethrin	0.2
Gemstar LC	Polyhedral occlusion bodies of the nuclear polyhedrosis virus of Helicoverpa zea (corn earworm)	Phosmet	0.2
Crymax	Bacillus thuringiensis subspecies kurstake strain EG7841 solids, spores and lepidopteran active toxins	Piperonyl butoxide	2
Debug Turbo	Fats and glyceridic oils, margosa	Prallethrin	0.2
Debug Optimo	Fats and glyceridic oils, margosa: Azadirachtin	Propiconazole	0.4
Debug Tres	Fats and glyceridic oils, margosa: Azadirachtin	Propoxur	0.2
Debug-On	Fats and glyceridic oils, margosa	Pyrethrins	1
Azamax	Azadirachtin	Pyridaben	0.2
Ecogarden	Azadirachtin	Spinetoram	1
Spear T Liquid Concentrate	GS-omega/kappa-Hctx-Hv1a	Spinosad	0.2
Spear-LEP	GS-omega/kappa-Hctx-Hv1a	Spiromesifen	0.2
BT Now	Bacillus thuringiensis subspecies kurstake strain EVB-113-19	Spirotetramat	0.2
Leptotec	Bacillus thuringiensis subspecies kurstake strain EVB-113-19 fermentation solids, spores and insecticidal toxins	Spiroxamine	0.2
Seican	Cinnamaldehyde	Tebuconazole	0.4
Azanguard	Azadirachtin	Thiacloprid	0.2
Bioprotec Plus	Bacillus thuringiensis. Kurstakin strain EVB-113-19	Thiamethoxam	0.2

	<p>Bioceres WP Brandt Ecotec Plus Agree WG</p> <p>BoteGHA Optima ES Mycotrol Optima ESO Botanigard ES BoteGHA ES Mycotrol ESO Ecoworks EC Growers Ally Spider Mite Control Concentrate Captain Jack's Rose Rx 4 in 1 Ready to Use General Hydroponics TriShield Insecticide, Miticide &amp; Fungicide Concentrate Isarid Deliver</p> <p>Javelin WG</p> <p>Grandevo WDG</p> <p>Grower's Ally Crop Defender 3 Concentrate Grower's Ally Crop Defender 3 Ready to Use Trifecta Crop Control Ready to Use</p> <p>Trifecta Crop Control Super Concentrate</p>	<p>Beauveria bassiana strain ANT-03 Rosemary oil, geranoil, peppermint oil Bacillus thuringiensis subspecies aizawai strain GC 91</p> <p>Beauveria bassiana strain GHA Beauveria bassiana strain GHA Beauveria bassiana strain GHA Beauveria bassiana strain GHA Beauveria bassiana strain GHA Cold pressed neem oil Rosemary oil, clove oil, peppermint oil</p> <p>Cold pressed neem oil</p> <p>Citric acid, sodium lauryl sulfate, soybean oil</p> <p>Isaria fumosorosea strain FE 9901 Bacillus thuringiensis subspecies kurstaki strain SA-12 Bacillus thuringiensis subspecies kurstaki strain SA-11 solids and Lepidoteran active toxins Chromobacterium subtsugae strain PRAA4-1</p> <p>Clove oil, peppermint oil, rosemary oil, thyme oil Clove oil, peppermint oil, rosemary oil, thyme oil Citric acid, clove oil, corn oil, garlic oil, geraniol, peppermint oil, rosemary oil, thyme oil Citric acid, clove oil, corn oil, garlic oil, geraniol, peppermint oil, rosemary oil, thyme oil</p>	<p>Trifloxystrobin</p> <p>0.2</p>
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	Essentria IC Pro Grower's Ally Spider Mite Control Ready To Use BotaniGard Optima ES Debug Optimo Debug Tres BioCeres EC IPM Debug-ON Fortify PC Soyote NemaClean 10% WP Molt-X Debug Turbo The Amazing Doctor Zymes Eliminator Bioceres GR	Clove oil, cornmint oil, geraniol, sodium lauryl sulfate Clove oil, peppermint oil, rosemary oil Beauveria bassiana strain GHA Azadirachtin, fats and glyceridic oils, margosa Azadirachtin, fats and glyceridic oils, margosa Beauveria bassiana strain ANT-03 Citric acid, geranium oil, lemongrass oil, peppermint oil Fats and glyceridic oils, margosa Citric acid Sodium lauryl sulfate, soybean oil Purpureocillium lilacinum strain PL11 Azadirachtin Azadirachtin, fats and glyceridic oils, margosa Citric acid Beauveria bassiana strain ANT-03	
<b>Analytical Techniques Used</b>	No mention of analytical techniques.		No mention of analytical techniques.



