We Don’t Rinse Cannabis

PESTICIDES & PUBLIC HEALTH

Exposure & Health Effects of Pesticides Used in the Cultivation of Cannabis

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PREVENTION, PLANNING, AND MITIGATION:
PUBLIC HEALTH THROUGH A PREPAREDNESS LENS

https://youtu.be/6z2HNCIsH zg
Outline

• Important Terms/Concepts
• Detection of Pesticides in Cannabis
• Lessons/Research From Tobacco & Pesticides
• Setting the Research & Policy Trajectory for the Ideal Cannabis Pesticide
Typical Pests in Cannabis Cultivation

- Insects
  - Mites
  - Thrips
- Fungus
  - Powdery mildew
Routes of Ingestion for Cannabis

- **Smoking (joints, pipes, water-pipes)**
  - Fast acting, easy titration

- **Oral ingestion**
  - Delayed onset, longer-lasting, more difficult to titrate, greater psychoactivity

- **Transdermal delivery**
  - Poor permeation, delayed onset, high concentrations required
  - Potential use as a topical anti-bacterial agent or localized analgesic

- **Vaporization**
  - Fast acting, easy titration

*Abrams et al, 2007*
Cannabis Forms & The Extraction Process
Pyrolysis

- decomposition brought about by high temperatures
What is a Pesticide?

• A pesticide is any substance intended to control, destroy, repel, or attract a pest
• This includes insecticides, fungicides, herbicides, rodenticides and sanitizers.
USA Pesticide Regulation

• The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) is a United States federal law
  • U.S. system of pesticide regulation to protect applicators, consumers, and the environment
• The EPA is responsible for regulating pesticides under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Food Quality Protection Act (FQPA)
LIFE CYCLE of a cannabis plant

1. Germination/Seed
   1-2 weeks
   Seeds ready for germination are dark brown, hard, and dry. Encourage sprouting by watering seeds in a paper towel.

2. Seedling
   2-3 weeks
   Move seeds into growing medium. Plants need the maximum light at this stage, and appropriate water levels. Cotyledon (seed leaves) and iconic fan leaves will grow.

3. Vegetative
   2-8 weeks
   Plants need flowing dry air, fresh warm water, and increased nutrients – especially nitrogen.

4. Flowering
   6-8 weeks
   Gradually reduce light exposure to produce medicinal qualities. Increase phosphorous levels and decrease nitrogen. Fertilizers can help stimulate bud formation.

5. Harvesting
   Trim and dry the buds – plant is ripe when buds turn from milky white to reddish orange. Harvest once 70-90% of pistils are browned for maximized taste and effect.
Timing of Pesticides within the Cultivation Lifecycle

• Spraying at different points in the lifecycle has different implications

• Spraying during the flowering phase ends up on the finished product

• How do we know?
Pesticides Have been Detected in Cannabis Smoke

- Chemical residues present on the cannabis flowers directly transfer into the mainstream smoke and ultimately to the end user (1)

- Pesticides are designed to degrade fairly quickly in the environment (2), but multiple studies note the distillation behavior of pesticides in smoke (1) (3)

- When comparing “a bong” to a glass pipe, the quantity of pesticide recovery was the highest in hand-held glass pipe
  - Route of ingestion is a consideration

(1) Nicholas Sullivan, 2013 (2) Purkis 2011 (3) Lorenz, 1987
Percent Recovery of Pesticides From The Smoke Stream of Different Devices

Sullivan, 2013
Tobacco is Filtered – Cannabis Typically is Not

• Prior study had a 7.5 g carbon filter cartridge

• According to Title 35, Article 9, C.R.S., Colorado is primarily using pesticides approved on tobacco

• False assumptions about consumer behavior may make pesticides used on tobacco a less viable regulatory comparison
- There are no pesticides registered specifically for use on cannabis.
- The use of pesticides on cannabis plants has not been reviewed for safety or human health effects.
Massachusetts - Sept 2018 – Case Study

• Code of Massachusetts Regulations explicitly stated that “application of any non-organic pesticide in the cultivation of marijuana is prohibited”

• MA Dept of PH ruled that “an immediate or serious threat to the public’s health, safety, or welfare” and issued a cease-and-desist and quarantine
Massachusetts - Sept 2018

- Pesticide regulations were modified after Management and Operations Profile (MOP) submitted
- Good Chemistry growing facility in Bellingham was using
  - Sulfur, pyrethrins and *Reynoutria sachalinensis* (giant knotweed extract)
  - All have been approved by the U.S. Environmental Protection Agency for other agricultural purposes
  - The states of Colorado, Nevada, Washington, and Oregon specifically allow these pesticides to be used on cannabis crops.
- Good Chemistry told the state what pesticides they planned to use in the MOP

105 CMR 725.105(B)(1)(d)
New Mexico – Case Study

- Product labeling shall identify “pesticide(s) used in the production of the cannabis or cannabis-derived products.”
  - No additional specification of best practices or forbidden chemical compounds has been made

- Laboratory validation is expensive
  - Confirmatory tests for pesticide are expensive - even for NM Scientific Laboratories
The Inherent Fragility Of The Medical Cannabis Patient Population

- Patients with compromised immune systems
  - At risk of bacterial and fungal infections
  - Strains of Aspergillus and Fusarium mold and pathogenic strains of Enterobacter, Streptococcus, Klebsiella and Salmonella

- Exposure to pesticides may create additional health complications and interfere with other health care approaches

Sullivan, 2014
Tashkin, 2002
Taylor, 1982
Ungerleider, 1962
Leadership: California, Colorado, Canada

• Under **California** law
  • the only pesticide products on cannabis are those that contain an active ingredient that is exempt from residue-tolerance requirements

• Under **Colorado** law
  • use of a pesticide in a manner inconsistent with the product labeling is prohibited
  • Employees working in an area where plants have been treated with pesticides or who mix or apply pesticides have the right to know.

• Under **Canadian** law ...there is MANDATORY Pesticide TESTING

3 CCR section 6400
35-10-117(1)(i)C.R.S
Cannabis Act (S.C. 2018, c. 16)
Canada will require producers to have an independent lab test all products for 100 different pesticides before they can be sold.

Cannabis Act (S.C. 2018, c. 16)
PyGanic®
Crop Protection EC 1.4ll

Specimen Label

- Contains pyrethrum—a botanical insecticide derived from chrysanthemums
- Provides rapid knockdown and kill of plant pests
- For use on growing crops and ornamentals
- Can be used on day of harvest
- Kills key livestock pests
- Controls more than 100 insects

For Organic Production

KEEP OUT OF REACH OF CHILDREN
CAUTION PRECAUCIÓN
Si usted no entiende la etiqueta, busque a alguien para que le explique a usted en detalle.
(If you do not understand the label, find someone to explain it to you in detail.)

ACTIVE INGREDIENT:
Pyrethrins .......................................................... 1.40%
OTHER INGREDIENTS ........................................ 98.60%
100.00%
The Role the Environmental Protection Agency (EPA) in Regulating Cannabis Cultivation

• US Environmental Protection Agency (US EPA) determines what pesticide levels on food crops are allowed. The Federal Department of Agriculture (FDA) and the US Department of Agriculture (USDA) take care of the control of crops.

• Federal Pesticide Worker Protection Standard (WPS)

• Pyrolysis studies

40 CFR 152.25(f)
EPA Exempt Status (25b) = Exempted from FIFRA

• **Minimum Risk Pesticides**
  
The EPA has identified certain "minimum risk pesticides," commonly referred to as “25(b) pesticides,” which pose little to no risk to human health or the environment. The EPA has exempted this specific subclass of pesticides from the registration requirement under FIFRA.

• “... An exemption from a **tolerance** (max amount allowed on a food crop) shall be granted when it appears that the total quantity of the pesticide chemical in or on all raw agricultural commodities for which it is useful under conditions of use currently prevailing or proposed will involve no hazard to the public health.”

• 6 conditions need to be met to be considered 25b

40 C.F.R., Part 180, Subpart D: 180.900
Federal Food and Drug Cosmetic Act, U.S.C. Title 21, Section 408.
Conditions for Minimum Risk Pesticides

- **Condition 1**: The product's active ingredients must only be those that are listed in 40 CFR 152.25(f)(1).

- **Condition 2**: The product's inert ingredients may only be those that have been classified by EPA as:
  - Listed in 40 CFR 152.25(f)(2)
  - commonly consumed food commodities, animal feed items, and edible fats and oils as described in 40 CFR 180.950(a), (b), and (c); and
  - certain chemical substances listed under 40 CFR 180.950(e).

- **Condition 3**: All of the ingredients (both active and inert) must be listed on the label. The active ingredient(s) must be listed by label display name and percentage by weight. Each inert ingredient must be listed by label display name.

- **Condition 4**: The product must not bear claims either to control or mitigate organisms that pose a threat to human health, or insects or rodents carrying specific diseases.

- **Condition 5**: The name of the producer or the company for whom the product was produced and the company’s contact information must be displayed prominently on the product label.

- **Condition 6**: The label cannot include any false or misleading statements.
What is the ideal pesticide?

• As with medications, the ideal pesticide is safe in terms of human and ecosystem health and effective at controlling the target species

• USDA Definition of Certified Organic Products
  • organic operations must demonstrate protecting natural resources, conserving biodiversity, and using only approved pesticide substances
Integrated Pest Management

• The EPA defines Integrated Pest Management (IPM) as an environmentally sensitive approach to pest management

• California is a leader in this
  • The lifecycles of pests are used to interrupt and control infestations

• New York is a leader in IPM
  • Cornell University

• Manage pests while simultaneously introducing the least possible risk human health, property, and the environment

Radcliffe, 2019
Occupational Health & WPS

• Federal Worker Protection Standards (WPS) offer guidelines to reduce risk in occupational settings

• WPS measures include restricted-entry intervals, use of personal protective equipment, and postings that notify workers of pesticide applications and re-entry times

• Employers should provide a safe workplace and training to workers in a language they can understand. This includes filing a pesticide-related workplace complaint or contacting a local county agricultural commissioner

Stone, 2014
Farm Bill 2018

• Allows industrial hemp cultivation
• This could produce federal-level cannabis pesticide regulations
  • On August 12, 2016, The United States Department of Agriculture (USDA) in consultation with the U.S. Drug Enforcement Administration (DEA) and the U.S. Food and Drug Administration (FDA), published a guidance document on the organic production of USDA certified industrial hemp.
• Instead of addressing production standards for the consumable product, the USDA has addressed the industrial product

Section 7606 of the Agricultural Act of 2014/Hemp Farming Act of 2018
7 C.F.R. § 205.501 General Requirements for Accreditation
Take Home Messages

- Regulating pesticides will be difficult but we have a playbook (USDA organic and USP) and experience regulating pesticides already!

- Route of ingestion - matters
- Temperature - matters (burning may be better than vaporization...)
- Concentration – matters (concentrates may be worse than flower)
- When you spray – matters (don’t spray during flower cycle)

- We don’t want to retrofit our regulations – as we’ve done for alcohol & tobacco

Richter, 2014
References

- **California - Legal Pest Management Practices for Cannabis Growers in California**
- **Colorado - Management Best practices**
- **McDaniel PA, Solomon G, Malone RE. The tobacco industry and pesticide regulations: case studies from tobacco industry archives. Environ Health Perspect. 2005;113(12):1659-1665.**
# Approved Pesticide Count by State

<table>
<thead>
<tr>
<th>State</th>
<th>Number of permitted pesticides registered (approved)</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td></td>
</tr>
<tr>
<td>Colorado</td>
<td>12,000 (200)</td>
</tr>
<tr>
<td>OR</td>
<td>(362) – test 59</td>
</tr>
<tr>
<td>Canada</td>
<td>Test 100</td>
</tr>
<tr>
<td>Washington</td>
<td>(330)</td>
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Active Ingredients Exempted Under 25(b) of the Federal Insecticide, Fungicide, & Rodenticide Act

- Castor oil (U.S.P. or equivalent)*Linseed oil Cedar oil Malic acid
  Cinnamon and cinnamon oil*Mint and mint oil Citric acid*Peppermint and peppermint oil*Citronella and Citronella oil2-Phenethyl propionate (2-phenylethyl propionate)Cloves and clove oil*Potassium sorbate*Corn gluten meal*Putrescent whole egg solids Corn oil*Rosemary and rosemary oil*Cottonseed oil*Sesame (includes ground sesame plant) and sesame oil*Dried Blood Sodium chloride (common salt) *Eugenol Sodium lauryl sulfate Garlic and garlic oil*Soybean oil Geraniol*Thyme and thyme oil*Geranium oil White pepper Lauryl sulfate Zinc metal strips (consisting solely of zinc metal and impurities)Lemongrass oil

Wang, 2014
California Restricted Materials

DPR designates certain pesticides as California restricted materials (3 CCR section 6400). A pesticide can be considered a restricted material for many reasons including designation as a federal Restricted Use Pesticide. Many of these products have product labels that clearly state "Restricted Use Pesticide." Consult your local CAC to determine whether a product is a restricted material. Examples of California restricted materials include:

- Abamectin
- Bifenthrin
- Brodifacoum
- Bromodiolone
- Cyfluthrin
- Difenacoum
- Difethialone
- Fipronil
- Naled
Management Best Practices

• Limiting ventilation can also be helpful to biosecurity efforts and in minimizing exposure to contaminants, possibly reducing reliance on pesticides or fungicides.

• Universal wastes are a subset of hazardous wastes that have reduced management standards as defined by federal, state and local laws, regulations, rules or other requirements. These include mercury-containing lighting and ballasts, many types of pesticides or other chemicals used in the cultivation process, or other chemicals used in the production of cannabis concentrates.

• Purchasematerials in smaller quantities and buy no more than a one-year supply of product. This helps avoid excess material expiring or becoming obsolete as regulations change.

• In nearly all cases, production of cannabis crops relies on the use of biological control agents ("BCAs"), as the goal of zero pesticide residues is favorable for product quality and patient health.

Citation: CDPHE, 2018
Questions

• What are your policy and environmental health ideas?
• Could cannabis cultivation be an allegory for climate change and responsible stewardship of natural resources?
• What would you still like to know?
Why do we care about pesticides?
Human Health

• Pests have plagued humankind since the beginning of time, as recorded in the ancient writings of the Chinese, Egyptian, and Hebrew peoples. (locusts ate all the plants in the land)

• Diseases such as plague and malaria—both propagated by pests—have changed the course of human history (McNeill, 1976; Zinsser, 2007).

• As with medications, the ideal pesticide is safe in terms of human and ecosystem health and effective at controlling the target species.

• Health effects of pesticide exposure is an emerging field
  • Safety sensitive product (consider the safety sensitive workplace)
Occupational health – cross disciplinary view

Burning Pesticides - Heating pesticides can change their composition. ...

• Sugar cane – worker exposure
• Link this all back to occupational health topics present here in our school.
Integrated pest management

- A philosophy as old as Rachel Carson
- Bug on bug warfare
How Not to Die ...video

• https://nutritionfacts.org/video/pesticides-in-marijuana/?utm_source=NutritionFacts.org&utm_campaign=ecd04992e7-RSS_VIDEO_DAILY&utm_medium=email&utm_term=0_40f9e497d1-ecd04992e7-25723773&mc_cid=ecd04992e7&mc_eid=1af7f5bccd
Pesticides in cannaabi smoke

• Jeff raber, werc shop
How are pesticides regulated/tested – generally?

• **The label is the law**

• If you apply pesticides to a field, you must obtain an operator identification number from the County Agricultural Commissioner

• Then, submit pesticide use reports to that office. (FAC § 11408; 3 CCR § 6622; 3 CCR § 6626.)
How *could* pesticides be regulated for cannabis?

- U.S. EPA designates certain pesticide products as federally “Restricted Use” products when they determine those products may cause unreasonable adverse effects.

- California “Restricted Materials”
- require a permit issued by the County Agricultural Commissioner. Permits will not be issued for cannabis cultivation sites. (FAC § 14001, et seq.; 3 CCR § 6400.)

- Permit only minimum risk pesticide under FIFRA section 25(b) and 3 CCR § 6147. (FAC §§ 12973, 12995; 3 CCR § 6490)

- Integrated pest management Approach? What is the real practicability of this?
Pesticides and the Consumer

• Lighting pesticides on fire and then consuming them is not typical
• Pyrolosis studies do exist at the EPA
• (see paper for more)
• Dose-response relationship ...needs is being established in a natural experiment ....
Product Labeling & Lab Testing

• What we might have tolerated in the illegal market in the past, we no longer accept in a medical mainstream
  • Illegal, tolerated = coffee shop (pesticides, heavy metals, bacteria/mold, variability in strength
  • Legal = pharmacy

• Colorado currently has produces label for pesticides
• (not health effects)
• Many labs can not test for pesticides because it is very expensive
Is this a global health issue?

• India uses very little pesticide compared to other countries – what are there cultivation capabilities?
Student videos about pesticides

- Spraying pesticides on cherrios
- Spraying a field
Chemicals serve as natural pesticides & protect the plant from predators

• Thc
• B-caryophyllene
Another fun student video – lyme
Is this true?

- The federal government refuses to address pesticides and other contaminants in cannabis because marijuana is an illegal Schedule One substance.
Tobacco Additive - pyrolysis products of tobacco additives

• https://www.ncbi.nlm.nih.gov/pubmed/27622657

• US EPA allows 37 different pesticides on tobacco, but there are no limits on the maximum quantity of pesticides on tobacco
bifenthrin

- Found on cannabis 1600x.
Cigarette smokers at least have filters

- Tobacco smokers often use cigarettes with cotton filters.
Edibles have been recalled for pesticides

• Baca and Migoya, 2015
• Recall of contaminated marijuana batches from pesticides
Pesticide levels are 10x in concentrates

- Voelker and Holmes (2015)
- Light, Orens, Lewandowski (2014)
Growers sometimes resort to nuclear tactics

- Quite overwhelmed by pest issues
- Danko (2010) p.49