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Preserving strains:

Traditional Cloning, Micropropagation and  
Strategies for the Future

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For commercial agriculture of any kind, there is a need for large numbers of plants that exhibit identical characteristics/growth habits.

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# SEEDS

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Are by their very biological nature genetic variants of their parental stocks, making each seed unique

Not desirable once a lineage is selected and uniform product is desired

And for cannabis – a seed cannot guarantee a female plant, which is extremely important for cannabis cultivation



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# The Solution - Cloning

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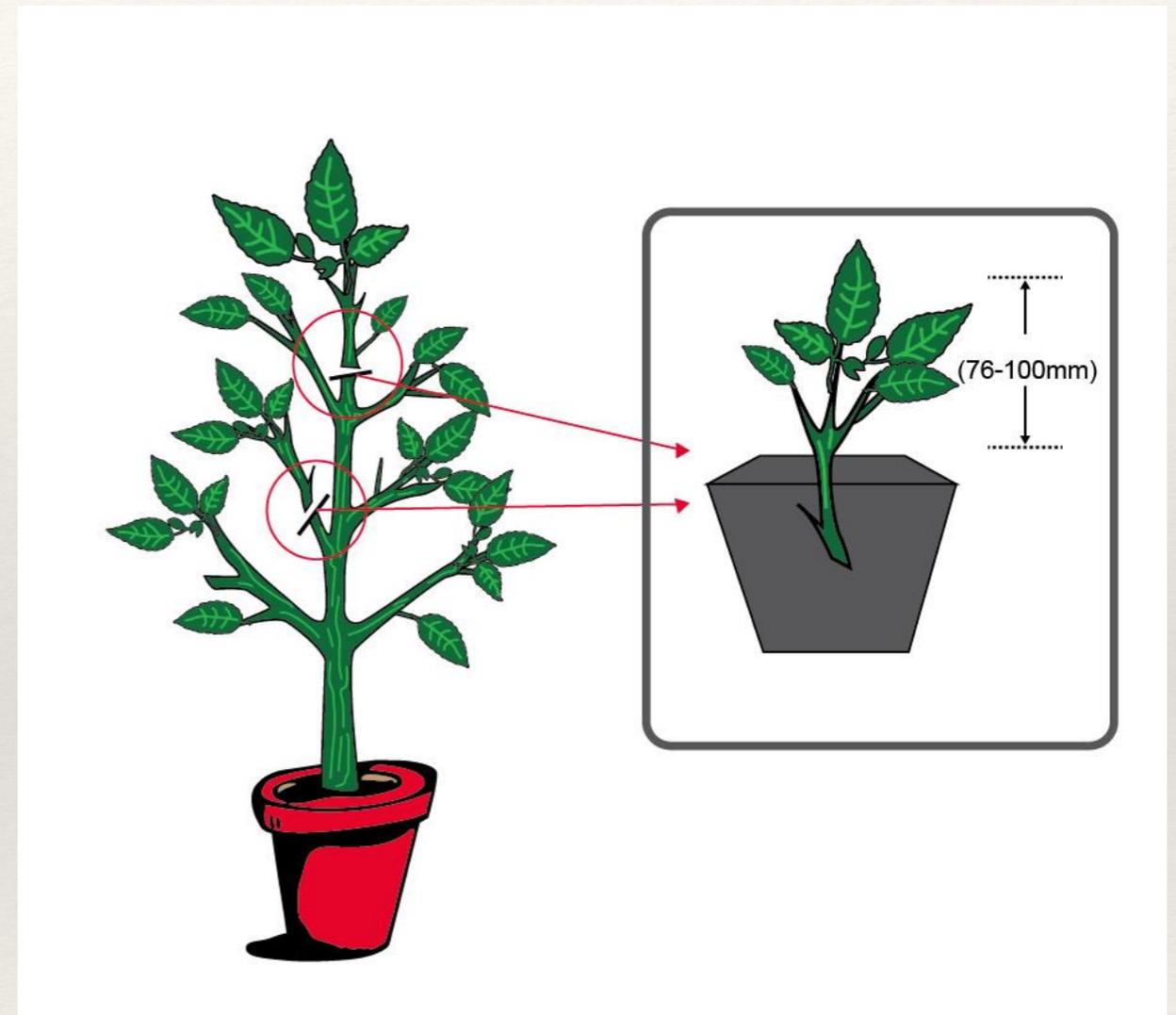
Cloning cannabis guarantees a female plant and it preserves and repeats the characteristics of your favorite plant

# What is Cloning?

Traditional cloning is the process of making an exact copy of a plant by taking a cutting

Cloning gives you genetic duplicates of your mother plant

This means that you can grow exact copies of a plant with your desired characteristics without having to plant a seed



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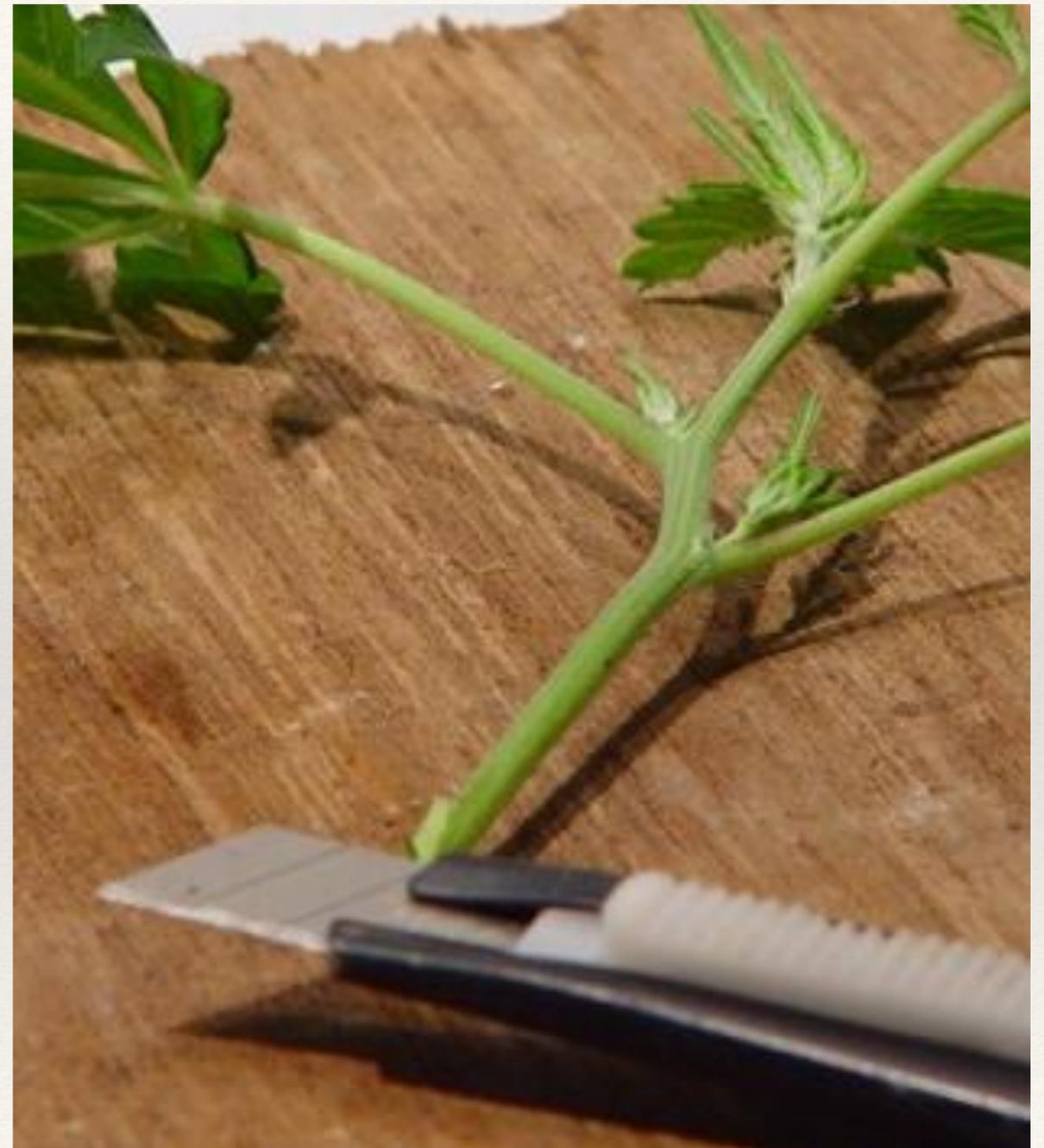
# Cloning as a Process

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In the process of cloning cannabis, cuttings are taken from a “mother plant” in vegetative growth and are rooted to be grown as a new plant

This ensures product uniformity, but is relatively labor intensive and requires significant physical space for the rooting and hardening stages

Mother plants have a finite lifespan and limited number of cuttings they may provide, making the method relatively slow to scale up



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# Cloning Risks

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Traditional mother and cut cloning systems are susceptible to all of the same plant pathogens that can infect vegetating and flowering cannabis crops

Infestation of mother plants and clones can, in worst case scenarios, lead to the complete loss of strain stock – a serious risk for the grower

If the mothers are weakened or inferior, the clones are too



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# Cloning Pros

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Provides exact replicas of the mother plant,  
creates uniform offspring

Cuttings require constant monitoring and care

Easy to master – staff can be cross trained  
and process can easily be managed

Low capital investment in regards to  
equipment – but a lot of space is required



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# Cloning Cons

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Space intensive – for a large cultivation operation, many mothers are required!

Non-Sterile environment increases risk of pests and disease

Able to produce a limited amount of plants from one mother plant

Cloning Susceptible to genetic drift often experienced as a loss of vigor or drift in growth characteristics



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# Common Pests of Cannabis

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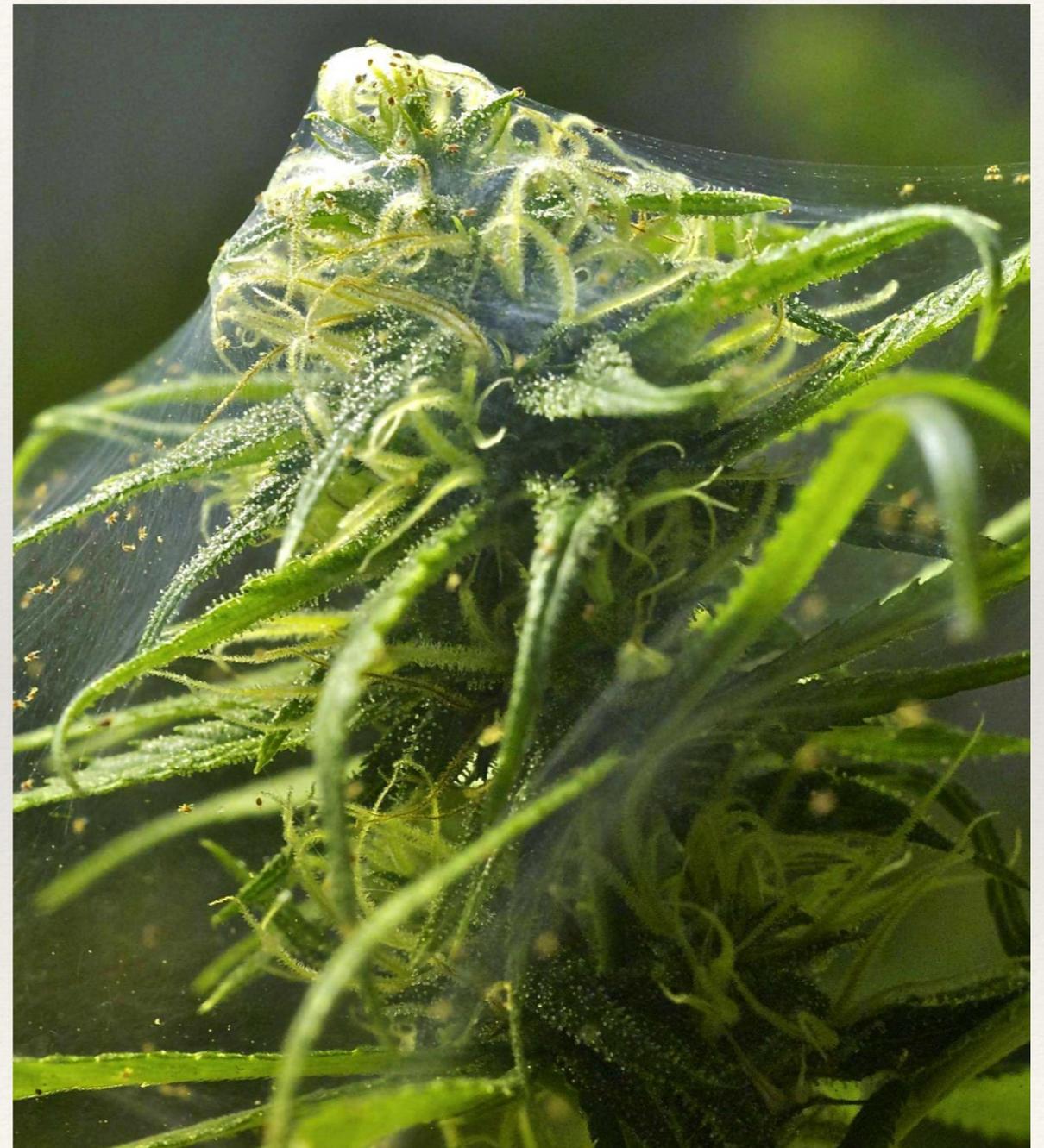
*Spider Mites*

*White Flies*

*Fungus Gnats*

*Aphids*

*Thrips*



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# Fungal Diseases of Cannabis

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Once spores are present/in the environment with your mother plant mold/mildew becomes nearly impossible to remediate – puts entire downstream production at risk.

Powdery Mildew

Gray mold or Botrytis

Leaf Septoria

Fusarium

Verticillium Wilt

Root Rot, also known as Pythium



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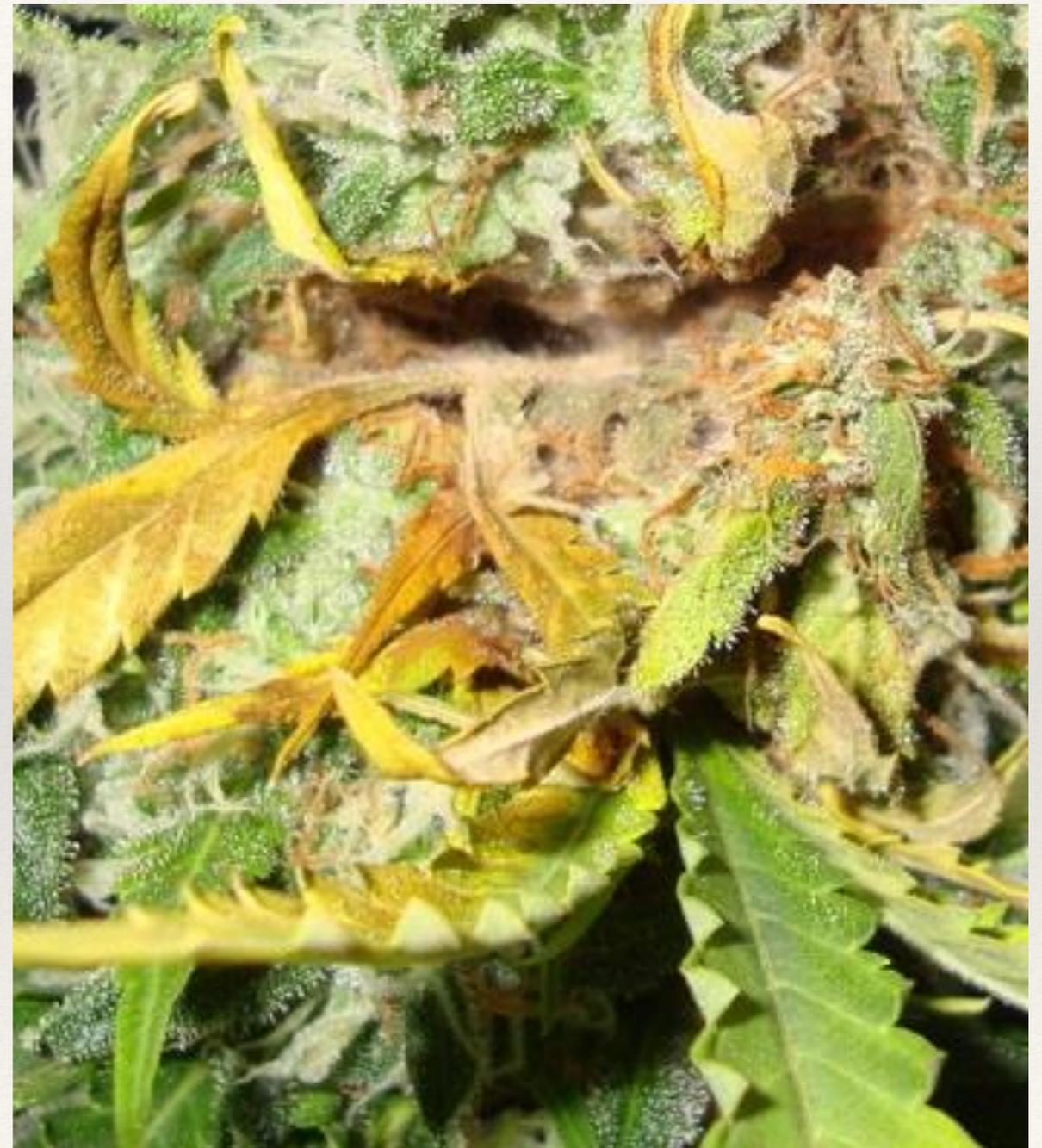
# Other Diseases of Cannabis

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## Bacteria

Bacteria can sometimes get into a plant and then leave it mostly untouched unless the plant is weakened by external stresses, at which point they can quickly take down the whole plant

Cuttings' root development might stall or just never happen at all, or you run the risk of creating an environment favorable to damping off or root rot microorganisms that can ruin your cuttings based upon environmental factors



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# Tissue Culture

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When we say plant tissue culture, what we're really talking about is micropropagation

Micropropagation is a form of cloning plant tissue on a very small scale

In micropropagation a clone can be created from just a tiny leaf, bud, or root segment of the mother plant



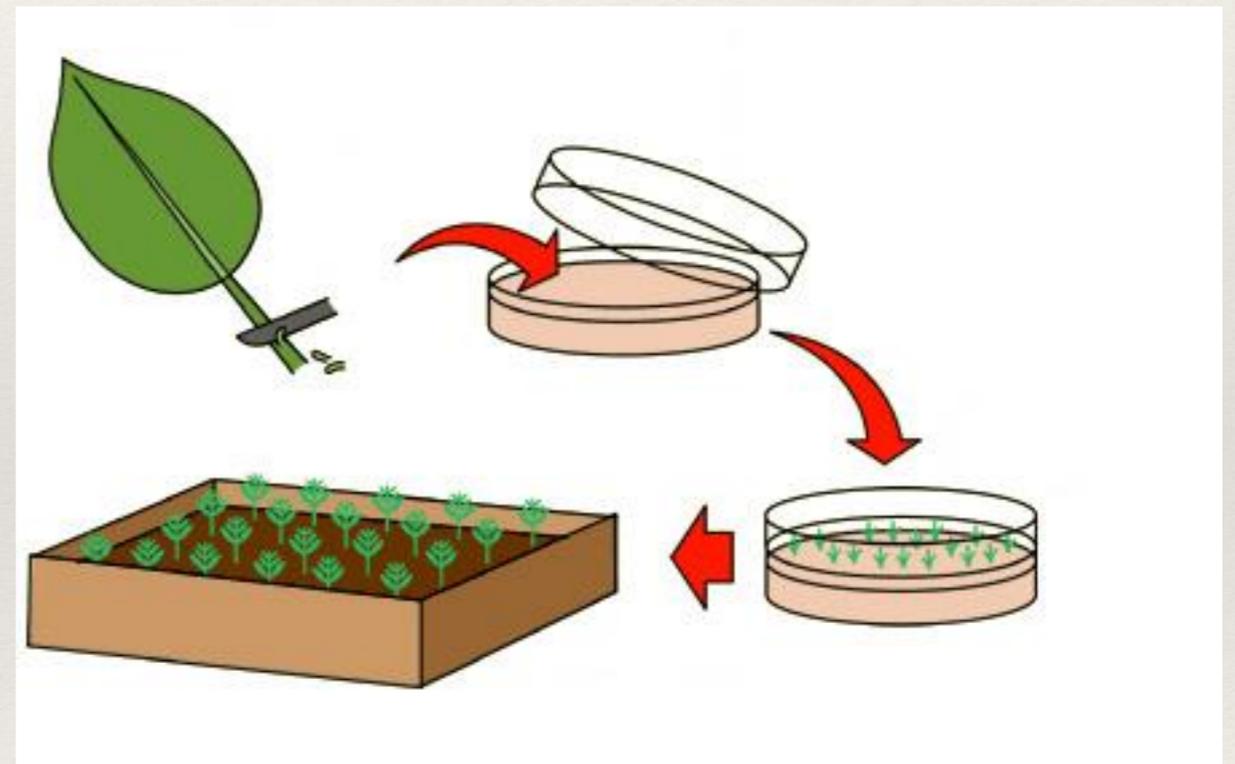
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# Tissue Culture

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Plant tissue culture has been around for decades, originating as a solution for hard-to-germinate orchids

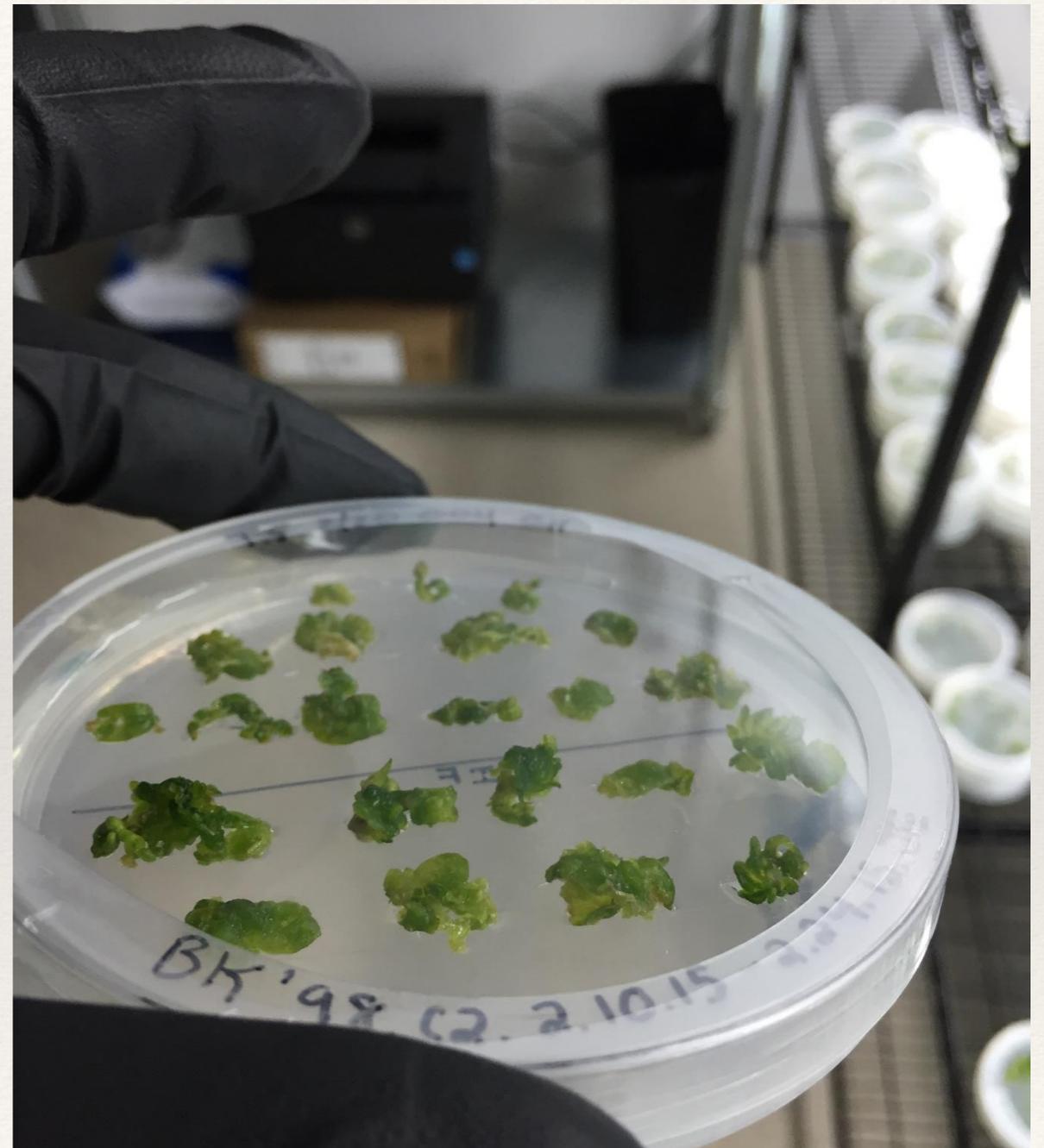
Plant tissue culture is now the standard for commercial nurseries and many commercial-scale cultivators, ranging from potatoes to flowers to fruit trees



# Tissue Culture

Tissue culture from plants involves taking a small amount of plant tissue which is induced to return to- and maintained in- a primitive stage of development

These cultures can be propagated indefinitely in defined synthetic media. When plantlets are desired, some of the cultures are taken out and then induced to differentiate into a complete plant



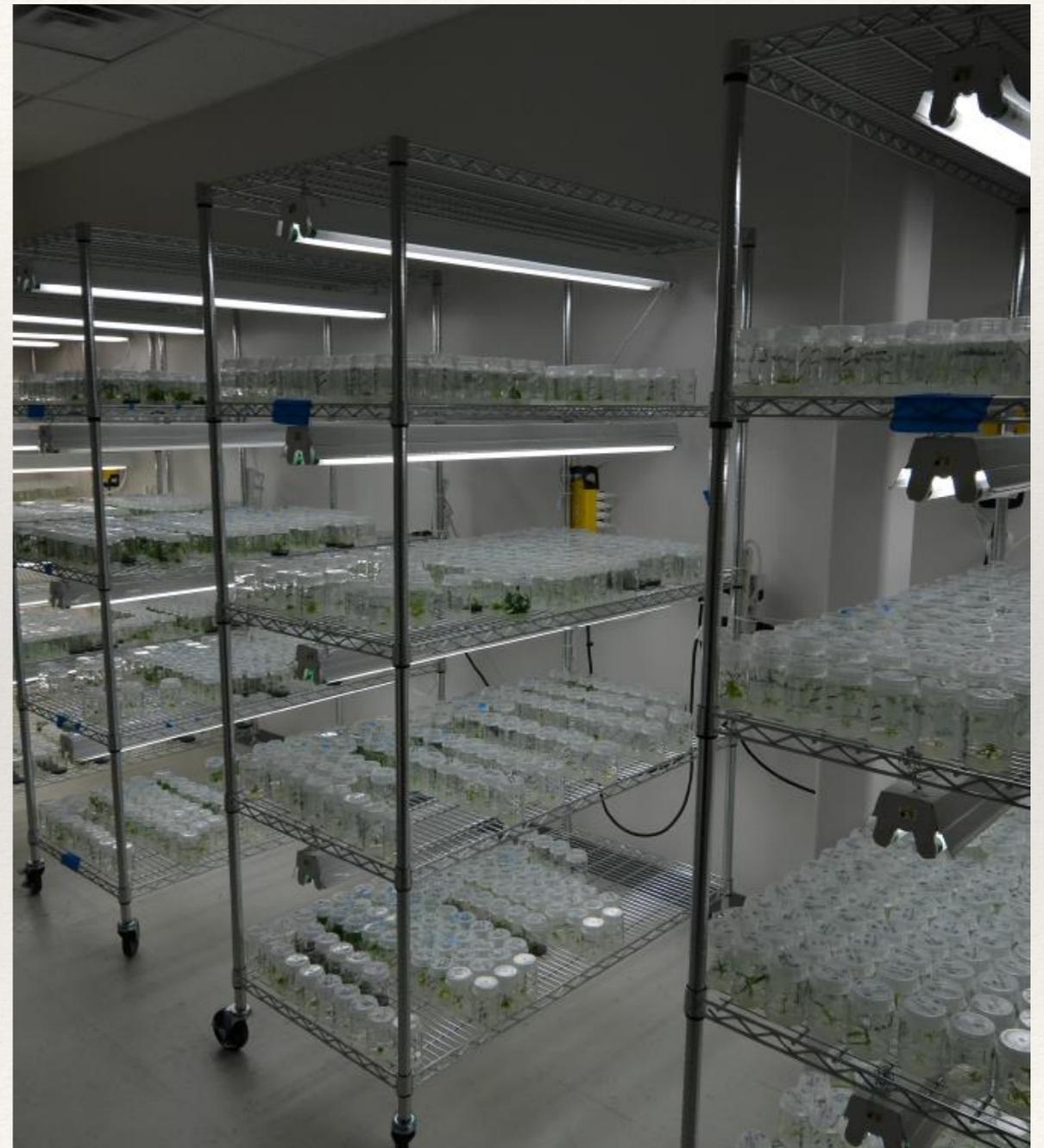
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# Tissue Culture

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The first benefit from the method is that these cultures can be maintained in large quantities in relatively small volumes and can be expanded to hundreds of thousands of cultures very quickly

The second benefit is in scalability; thousands of plantlets can be induced in less time and effort than creating mere hundreds of cuttings



# Tissue Culture

A crucial third benefit of tissue culture over traditional cloning methods is that by stringent control of the maintenance conditions, appropriate growth media additives, and proper handling techniques combined with good facility sanitation practices, strains can be maintained and propagated free of detectable pathogens indefinitely

(Tissue culture methods require aseptic handling and the presence of pathogens are readily detected and eliminated)



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# An Overview of the Tissue Culture Process

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A sterile environment/workspace cannot be emphasized enough - this is critical to successful tissue culture

Equally as important is full environmental control: temperature, humidity, and light intensity control are all necessary for successful micropropagation



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# Tissue Culture Pros

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Space Saver; much less storage is required to preserve genetics

Provides exact replicas of the mother plant, creates uniform offspring

Sterile Environment reduces risk of pests and disease

Able to produce an endless amount of plants from one “cutting” (explant).

Minimal daily care

Allows for year-round propagation

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# Tissue Culture Cons

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Steep build-out investment for a large-scale operation

Requires patience, takes more time than traditional cloning to get started (but scales rapidly once up and running)

Requires extreme attention to detail

Sterile/controlled environment is necessary

It's a new beast to master – requires trained, knowledgeable staff

Cannabis is notoriously difficult to tissue culture

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# Conclusion

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Large scale agriculture is at its most efficient when it has a reliable, uniform supply of juvenile plants to grow from

Cannabis culture is no different

Seeds are unreliable for cannabis

Traditional cloning is labor and space intensive as well as risky

Tissue Culture is a standard in the commercial nursery industry

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# Conclusion

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Tissue Culture is the future of plant propagation for cannabis

Many large scale cultivators often source their tissue cultured clones from an experienced nursery (Fruit trees, potatoes for example)

As the cannabis industry expands farms are likely to follow a similar model

But implementing tissue culture labs at every farm is somewhat impractical

From an investment standpoint tissue culture should stay in a nursery setting

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Thank You!