

Age	30+	Number of people	12 people approximately	Topic	Synbio in agro
Date					
Purpose	People are encouraged to seek new methods for their agricultural problems. In addition to the evaluation of our project.		Time	120 minutes	
Name of the activity			Expected learning		
Agrohack			To learn about new sustainable alternatives for the protection of their crops		
sequence				Resources	
A) Proyect Presentation					
We made a presentation of the problematic, the proyect and what it consisted of. we made sure to mention all the changes we did through previous comments we had from them. This lastes around 30-40 min.				Presentation, Bluetooth Speaker	
B) Expert					
The Dr. Solís prepared beforehand a 30-40 min presentation on what he is working on, which is the use if micorrisas against <i>P.capsici</i> . He presented that via zoom to the attendees and had a space designated for questions.				Presentation, Bluetooth Speaker, Zoom	
C)Testimonies and Q & A					
Technically this is after the event, we spoke personally with 4 of the attendees so they could tell us what they thought of this event and to give us a little more specific comments or suggestions about our project.				No material required	

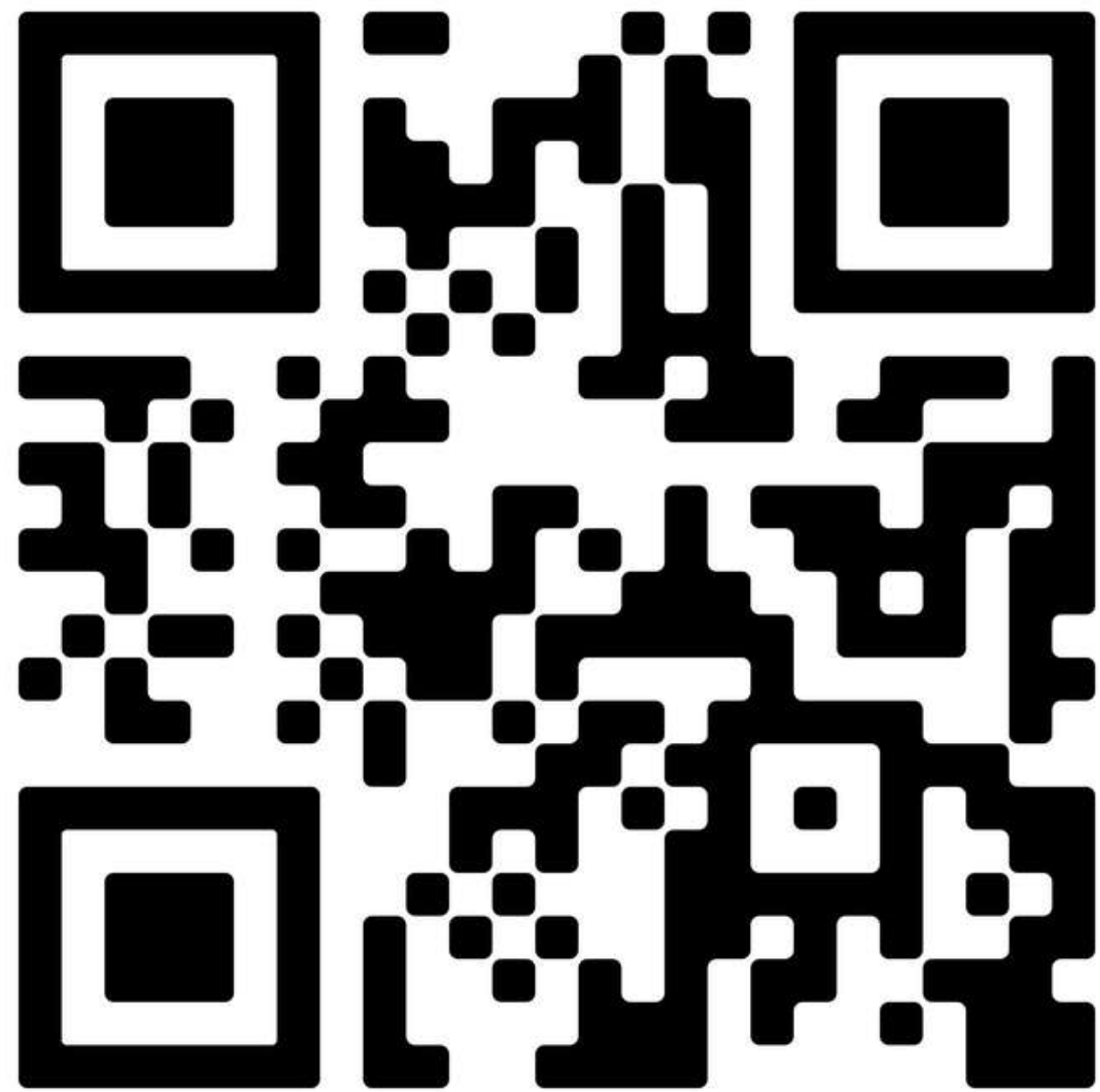
SYNTHETIC BIOLOGY

A SUSTAINABLE TOOL TO FIGHT CHILLI WILT

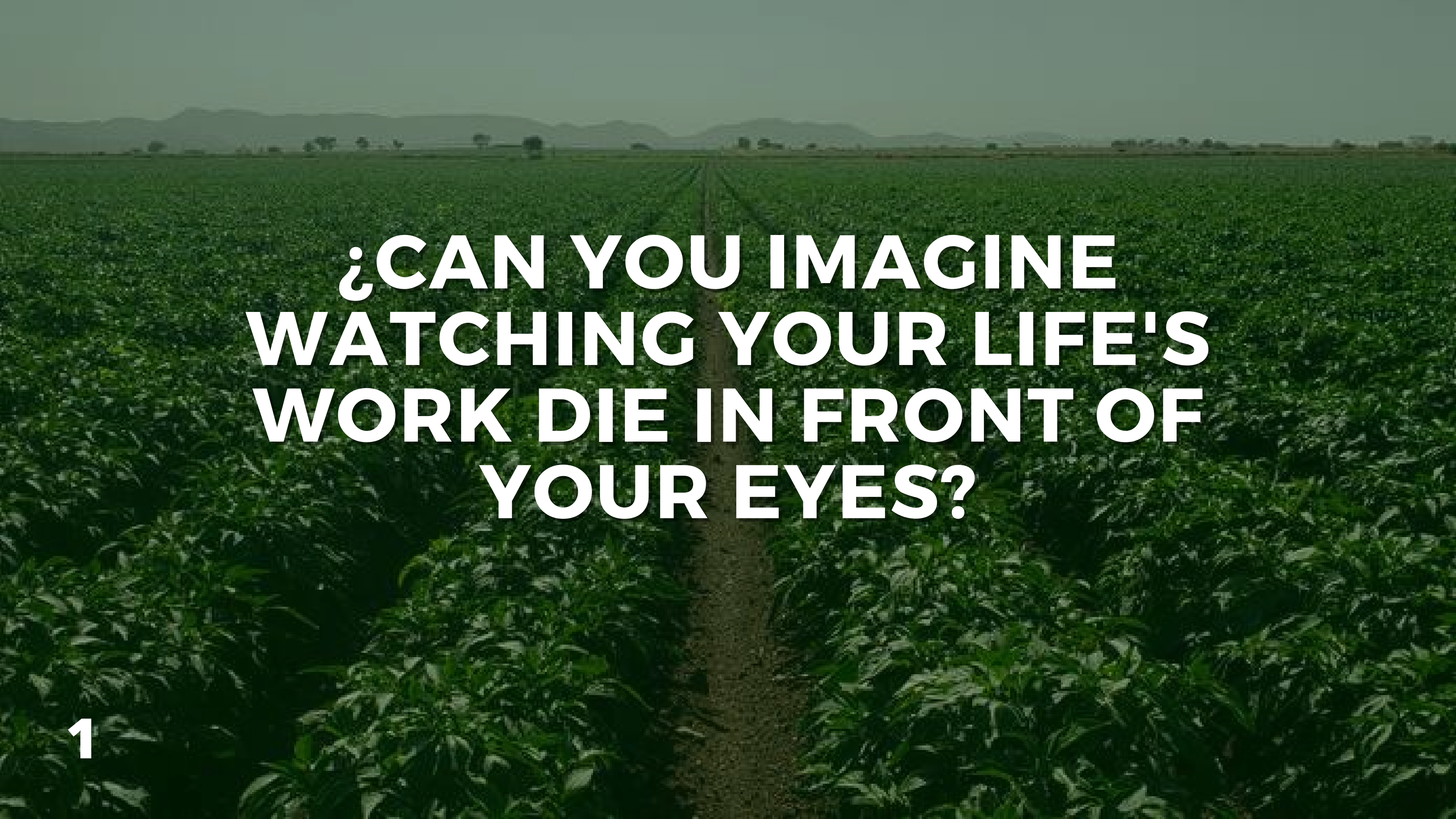


iGEM Tec-Chihuahua

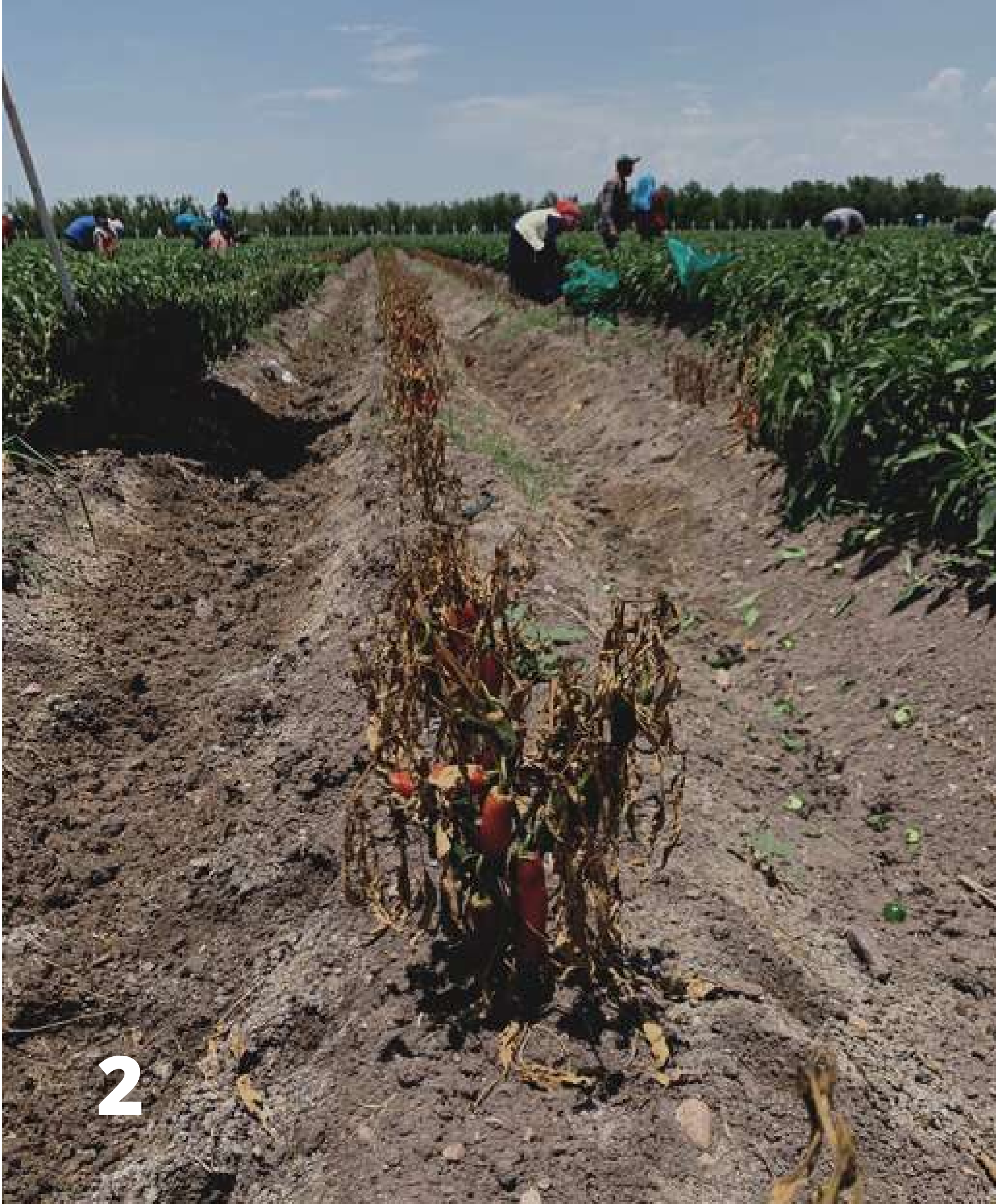




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code 6063 2142

A wide-angle photograph of a lush green field, possibly a cornfield, with a dirt path leading straight into the distance. In the far background, a range of low mountains is visible under a heavy, grey, overcast sky. The overall mood is somber and contemplative.

**¿CAN YOU IMAGINE
WATCHING YOUR LIFE'S
WORK DIE IN FRONT OF
YOUR EYES?**



Chilli producers report losses up
to a



in their crops due to wilt, a
disease caused by the
oomycete *Phytophthora capsici*

IMPORTANCE



In 2020 there was a
production of 723
thousand tons = 5,011
million pesos

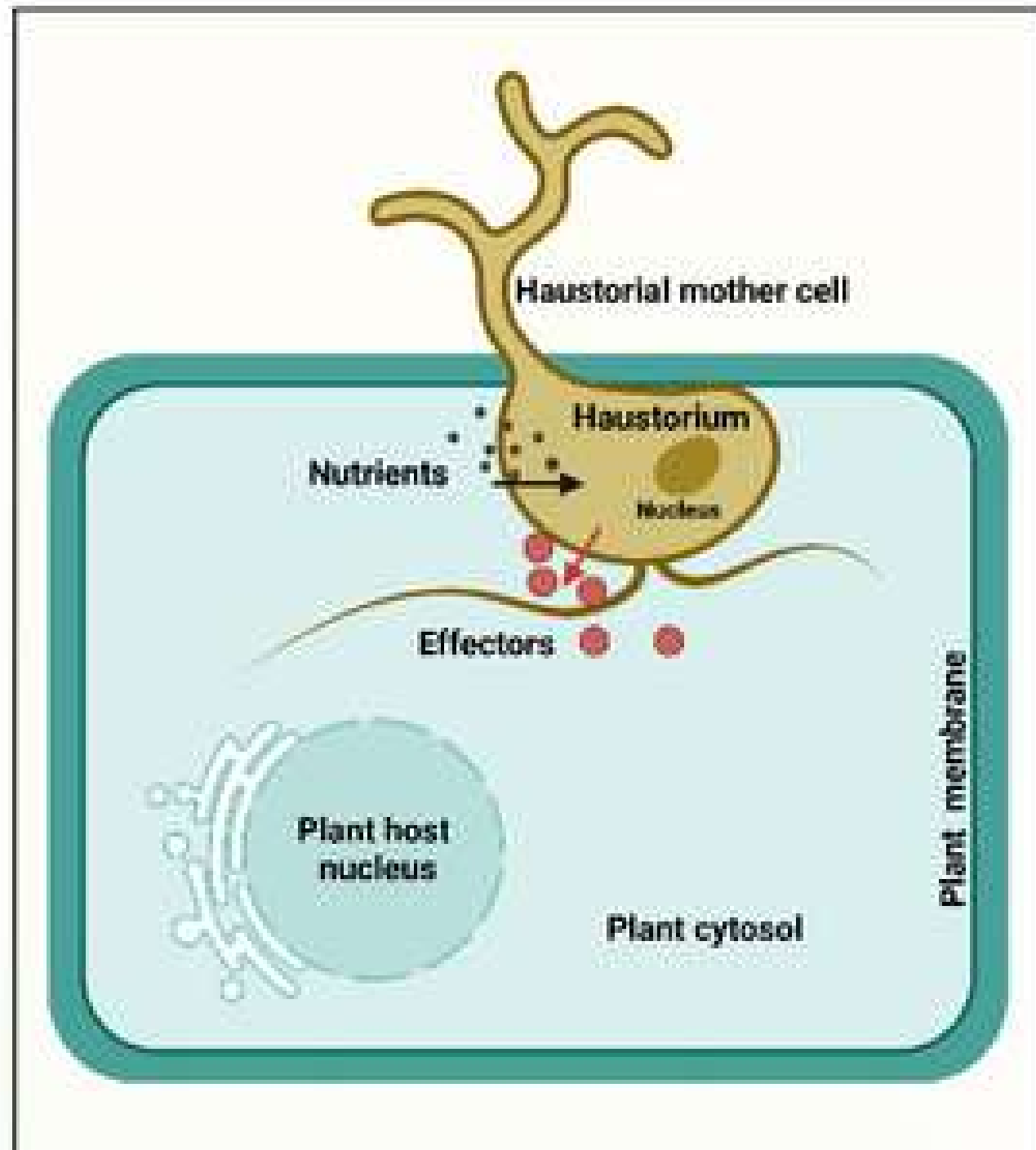


12,000 producers and
more than 30 million
laborers

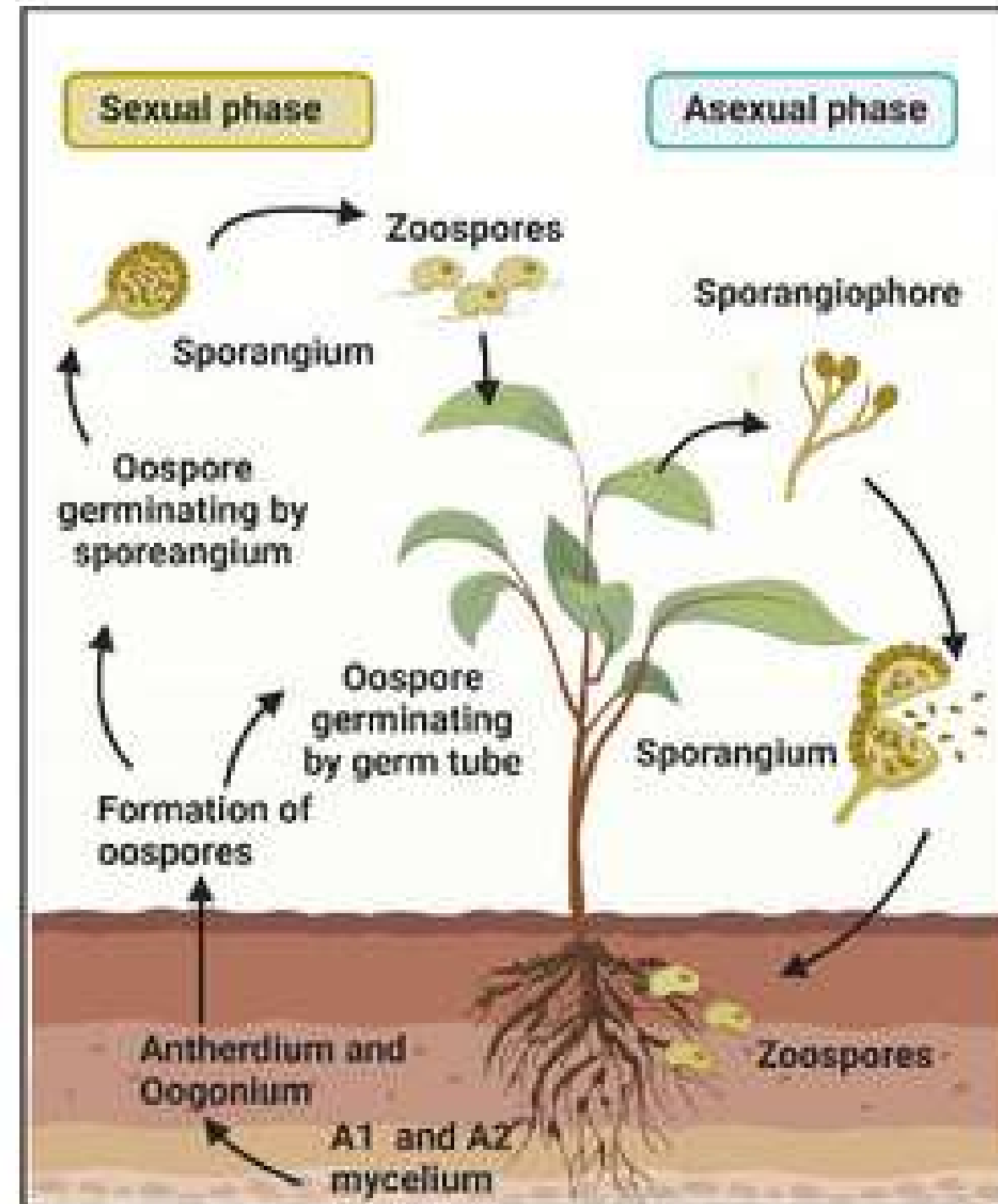


#1 on the scale of
world wide exportation
on chilli and peppers

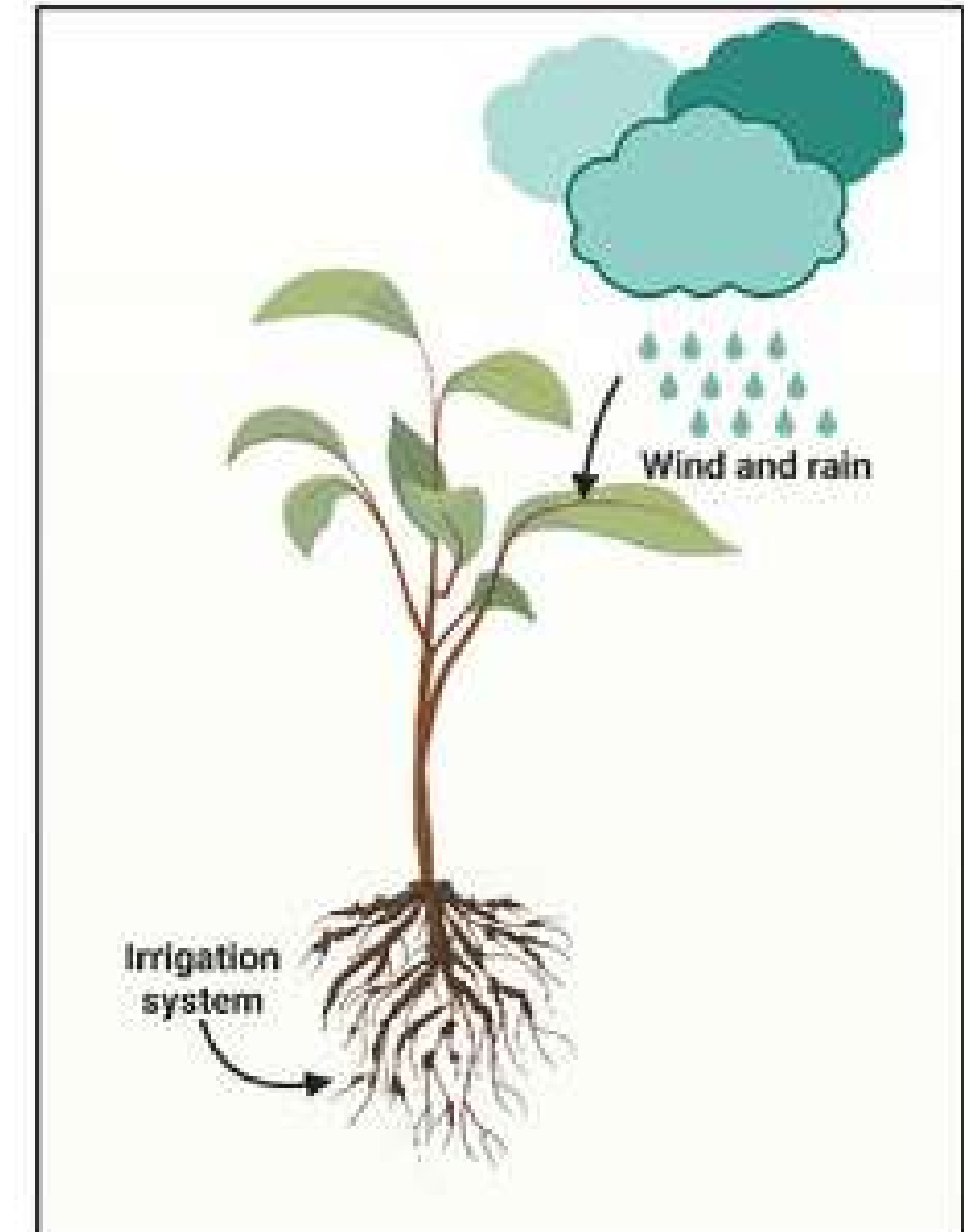
Mechanism of action of the omycete



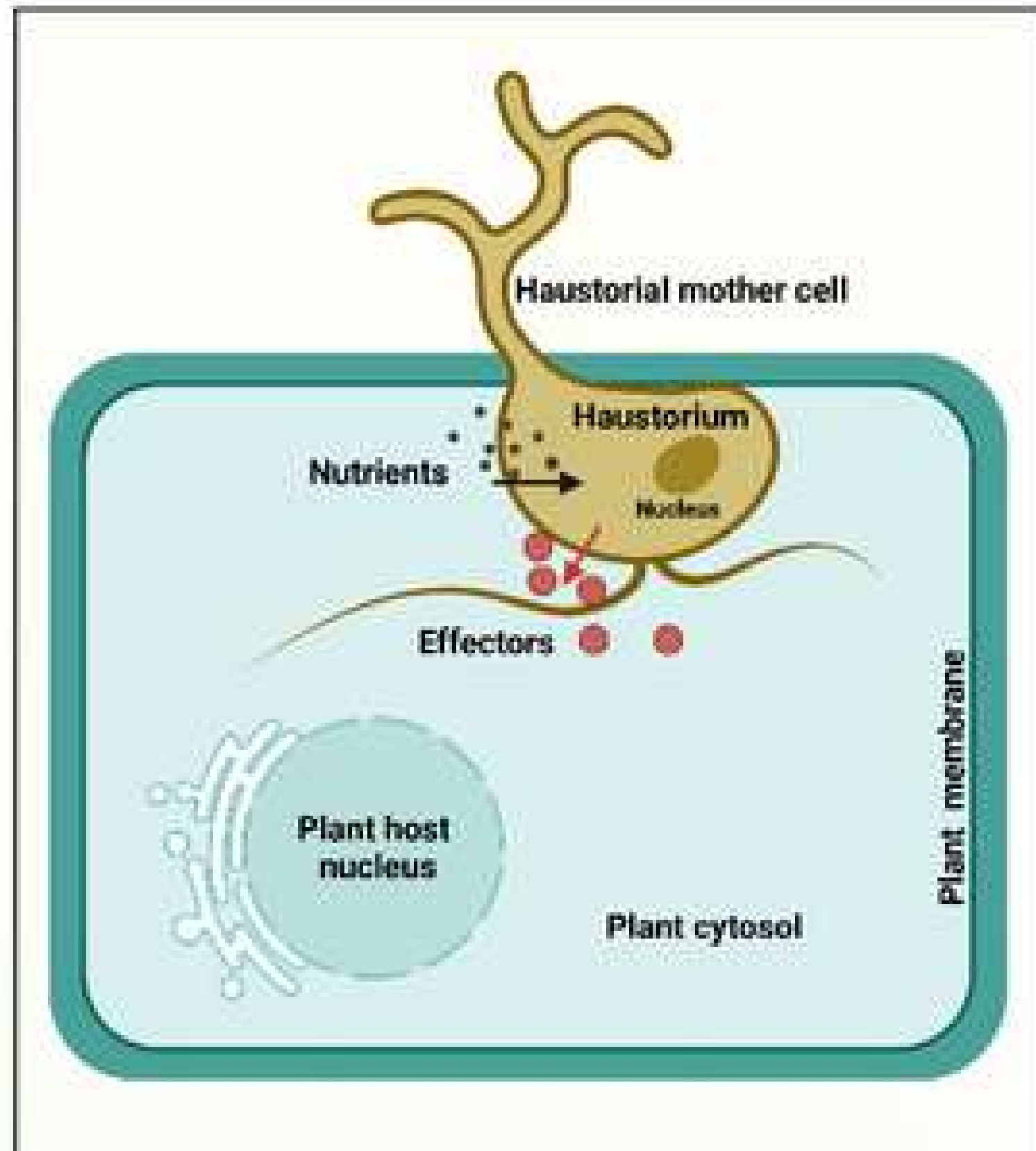
Phytophthora capsici life cycle



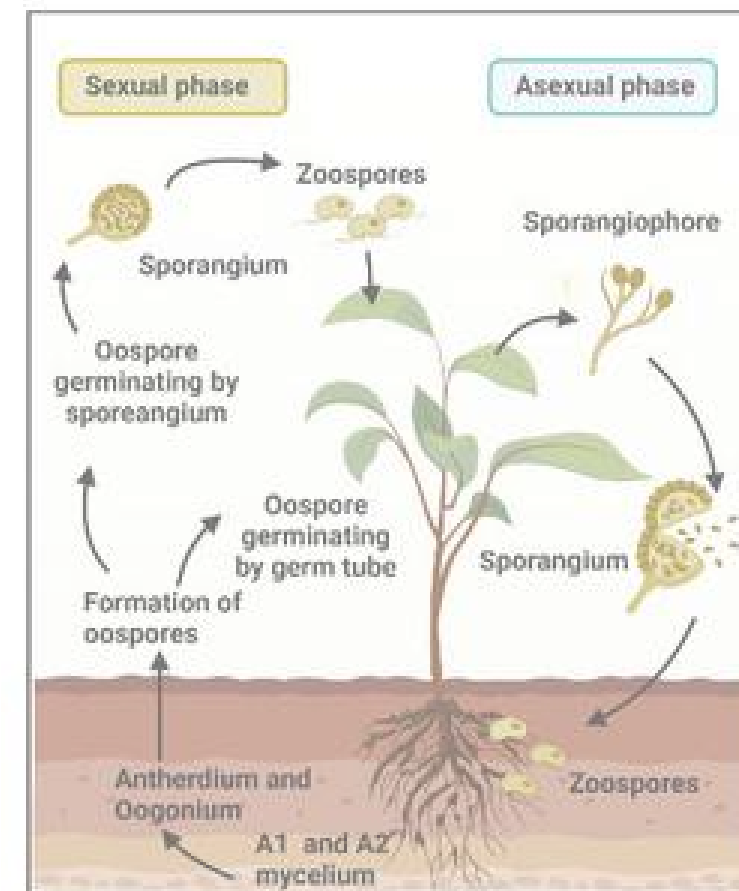
Transmission of the omycete



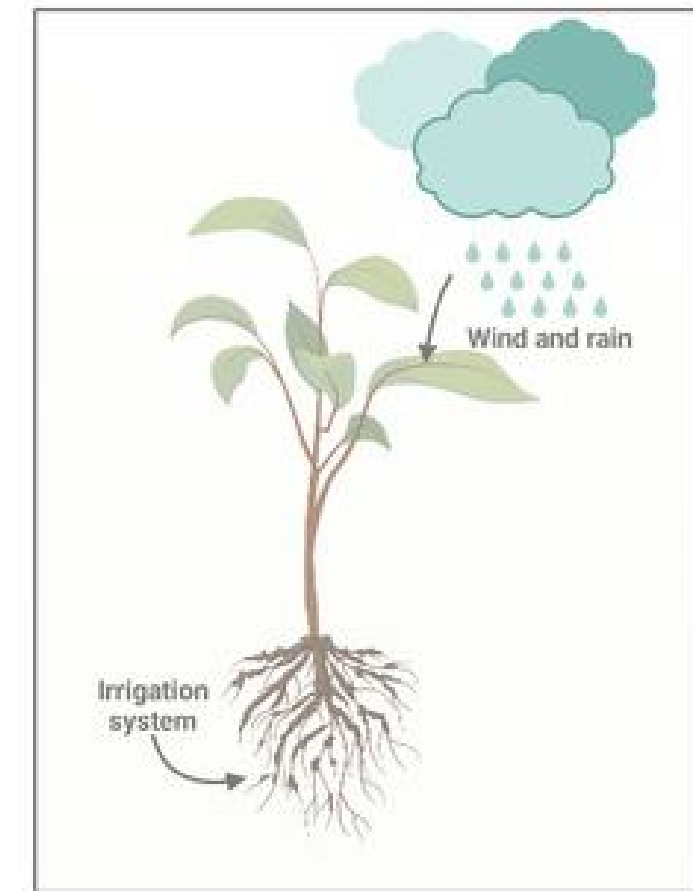
Mechanism of action of the omycete



Phytophthora capsici life cycle



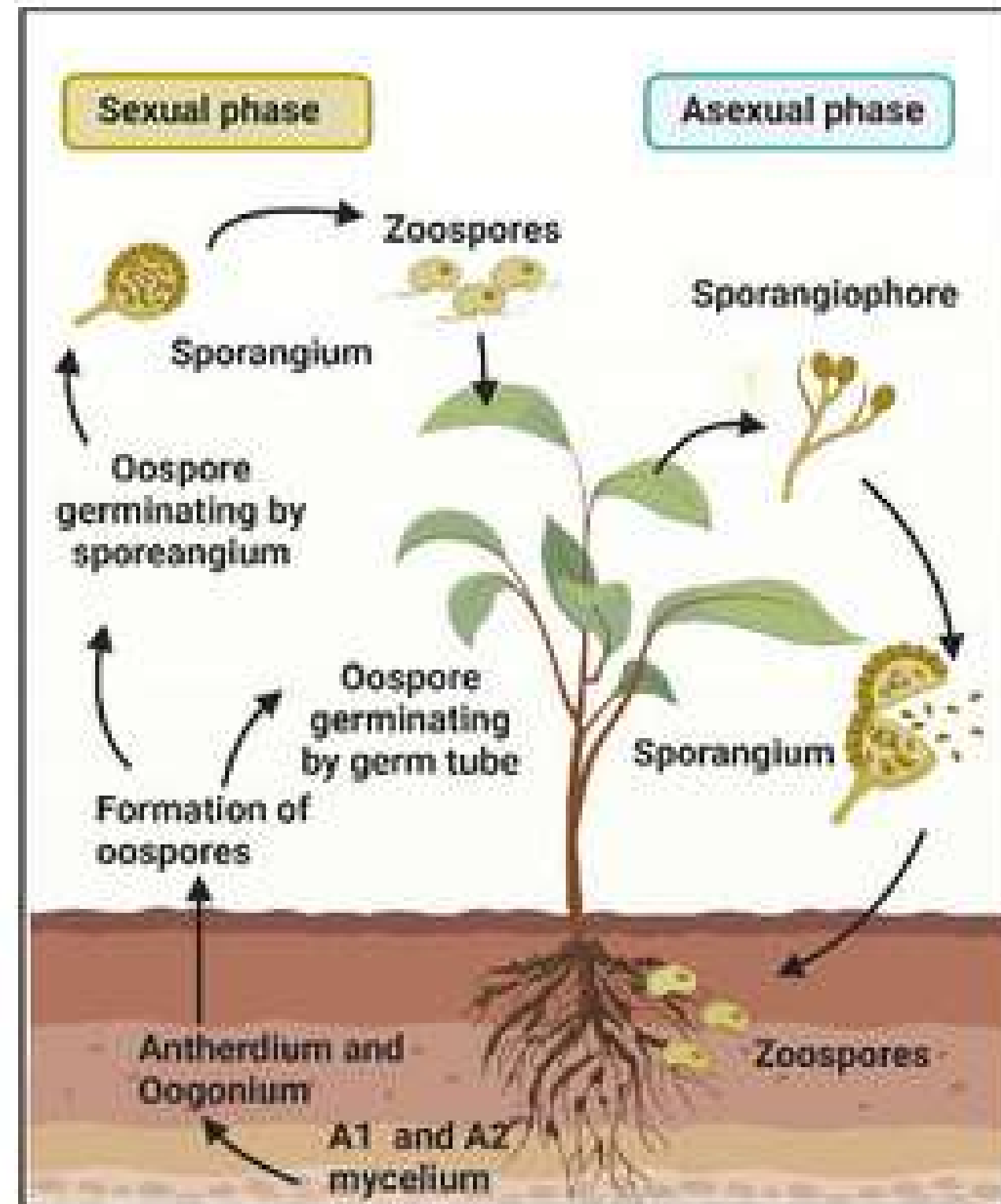
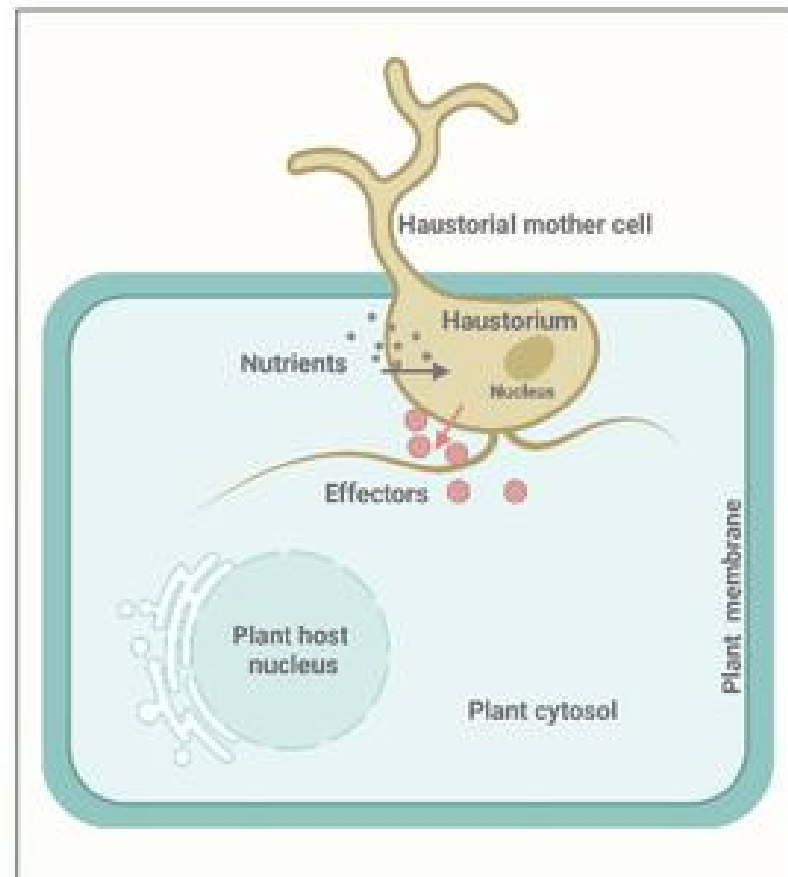
Transmission of the omycete



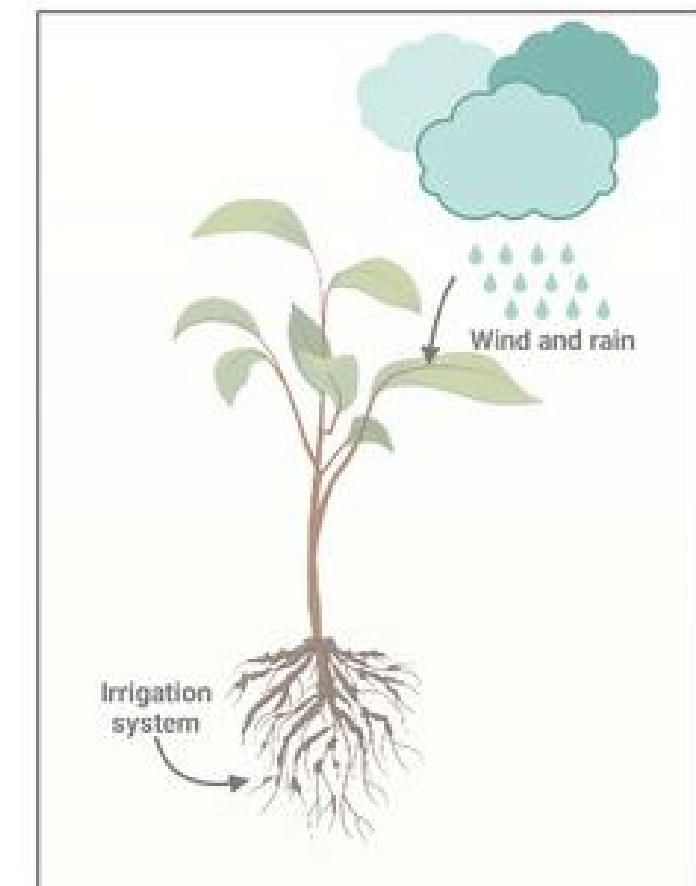
(Xu *et al.*, 2007; Jackson *et al.*, 2010)

Phytophthora capsici life cycle

Mechanism of action of the omycete

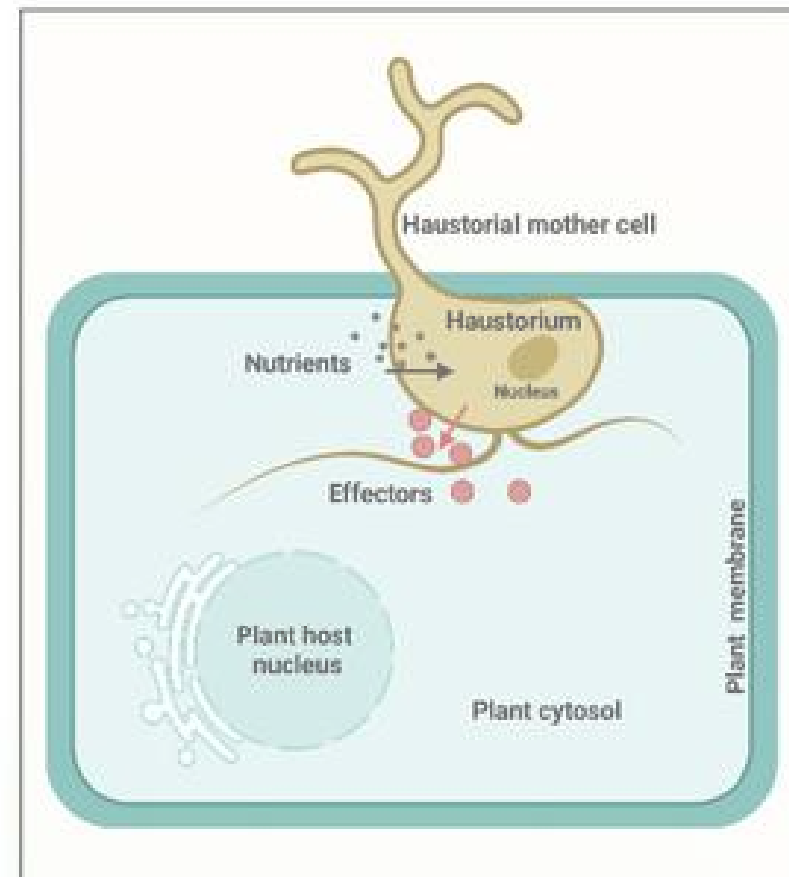


Transmission of the omycete

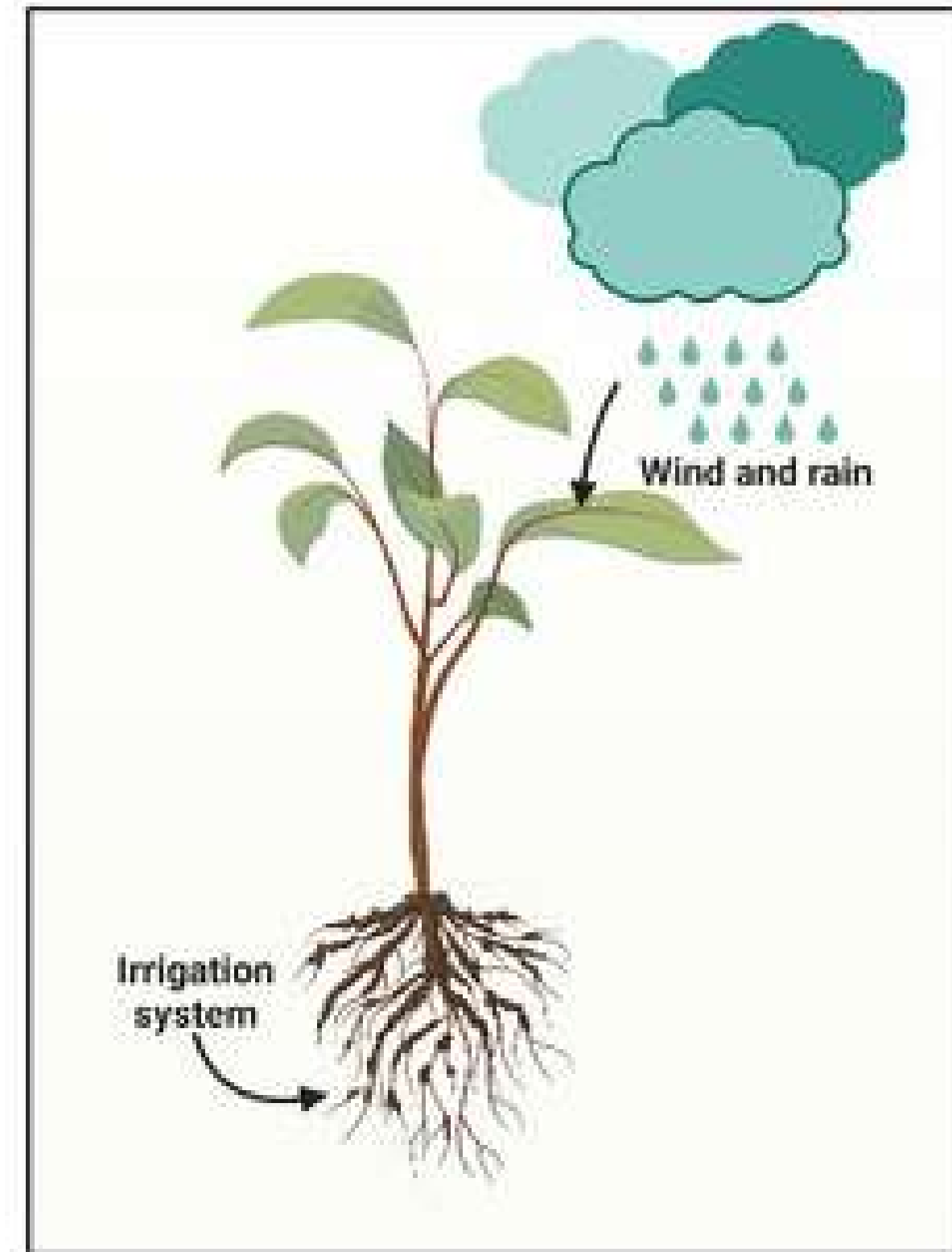
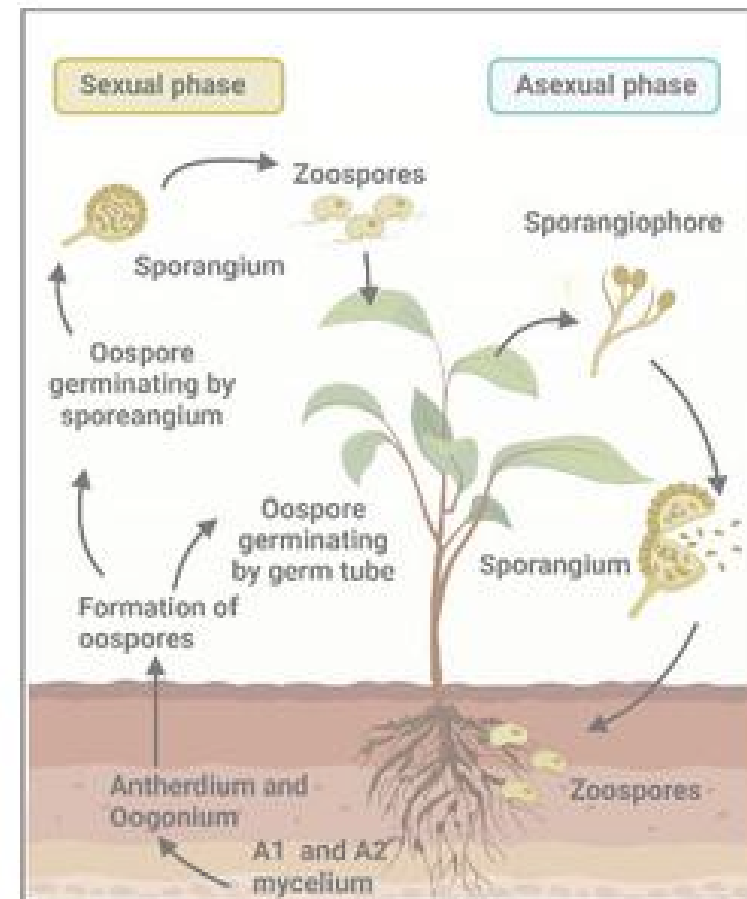


Transmission of the oomycete

Mechanism of action of the oomycete



Phytophthora capsici life cycle



SYMPTOMS

The symptoms of the disease are divided into 2 main categories: Symptoms that appear before the seed germinates and symptoms that appear after the germination. During the first stage, seeds can't germinate and they go rot. On the second, they can germinate and get rot before cotyledons appear




AGRO CHEMICALS

Currently, farmers use chemicals that result harmful to the environment, human health and create pathogenic resistance



ENVIRONMENTAL EFFECTS

	SHORT TERM	LONG TERM
CLOSE ENVIRONMENT	Immediate contamination of the abiotic environment such as land, water bodies and air	Death of the vulnerable organisms that affect physiological equilibrium of the exposed living beings and resistance development in organisms
FAR ENVIRONMENT		New contaminants that take years to degrade, indirect exposition, persistence in food and harming of the trophic nets



Effects on the trophic net
(Gobierno de México, s.f.)

BIOLOGIC CONTROL

DISADVANTAGES

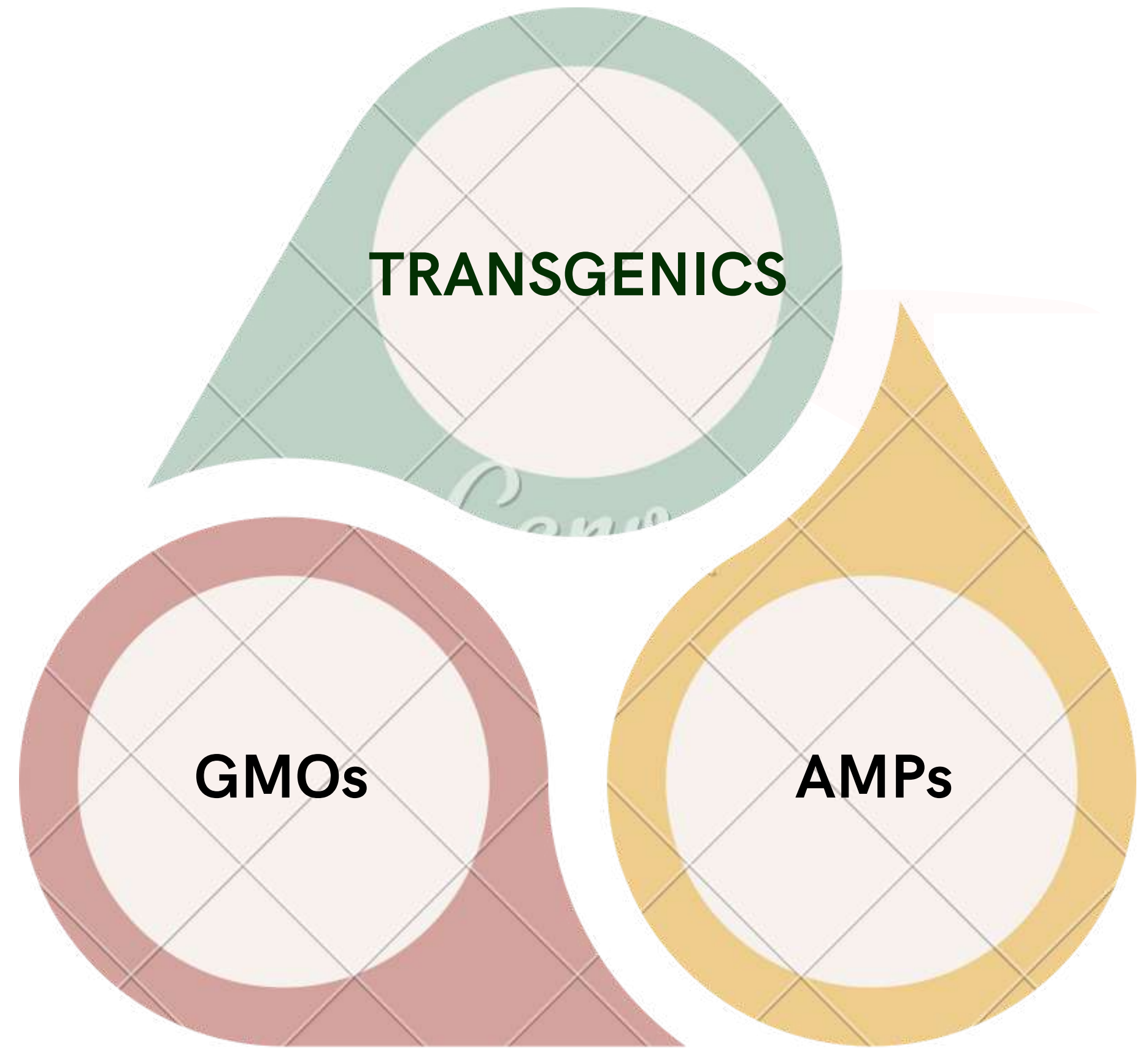
It requires time, it's a slow response

Must have the proper knowledges to apply this type of control

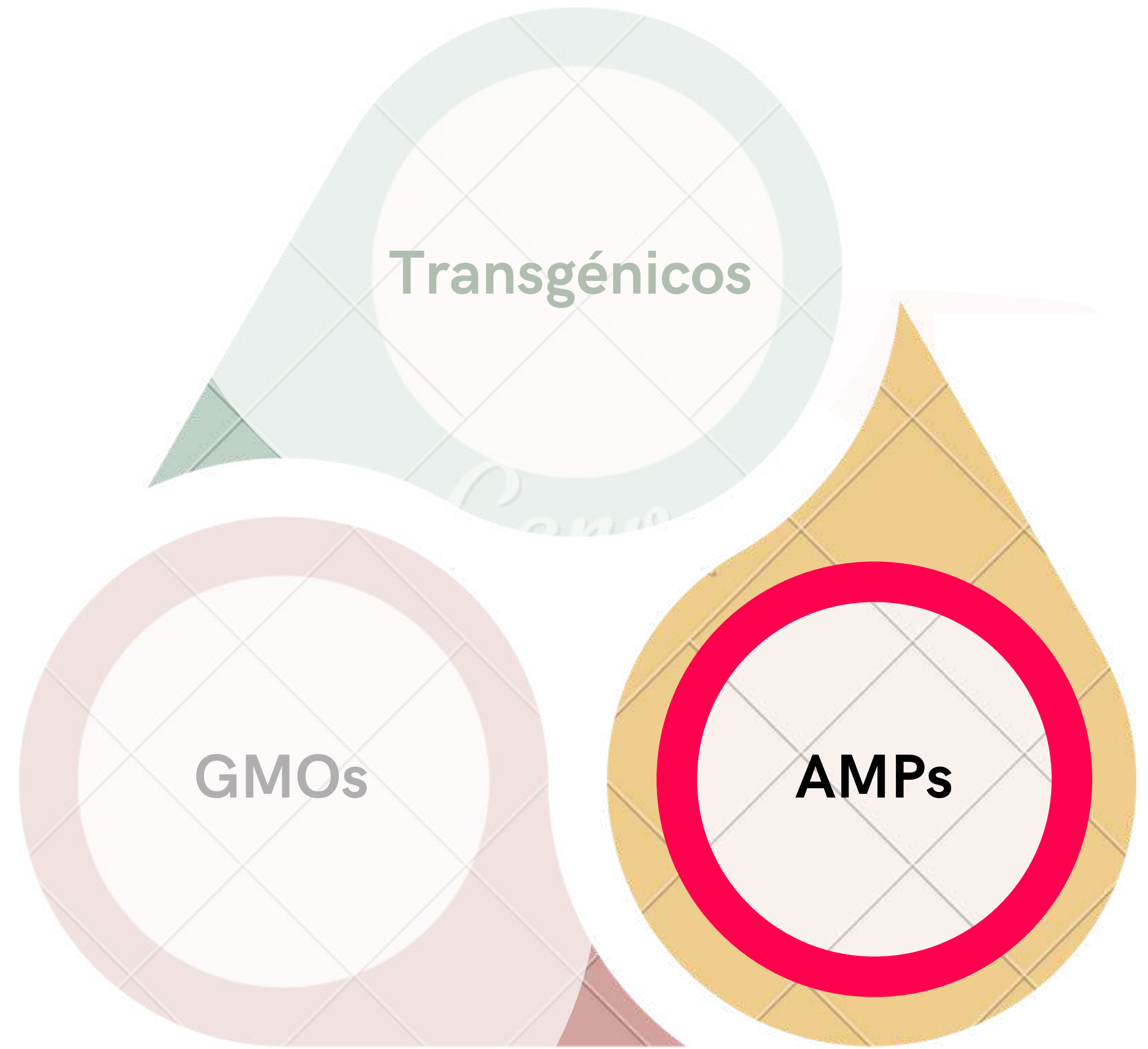
To find the right one, biological knowledge is necessary



NEW ALTERNATIVES THAT CAME UP THANKS TO SYNTHETIC BIOLOGY



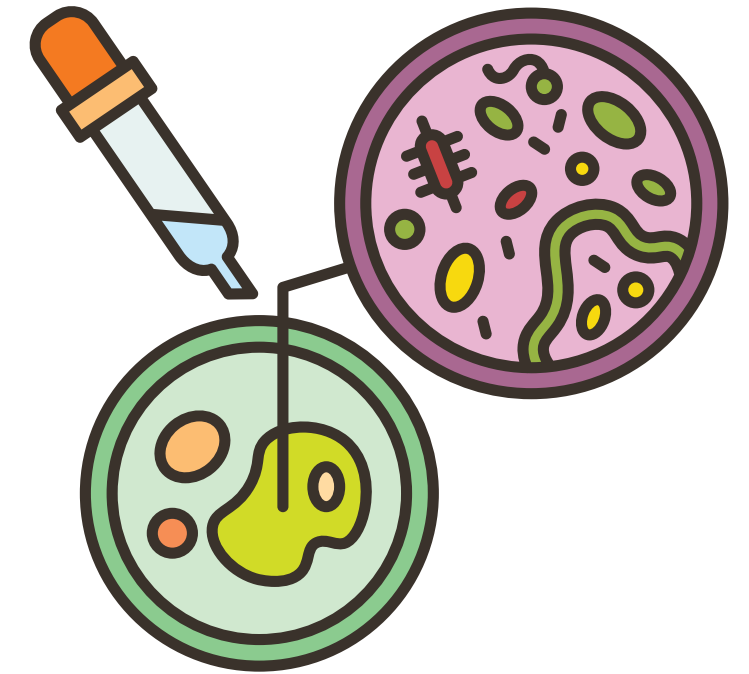
NEW ALTERNATIVES THAT CAME UP THANKS TO SYNTHETIC BIOLOGY



"SynBio" is a recent and upcoming discipline that allows the designing or re-designing of biological systems to give them new or enhanced qualities.

Examples

- Drugs
- Gene therapy
- Biorremediation
- Bio sensors
- Bio factories



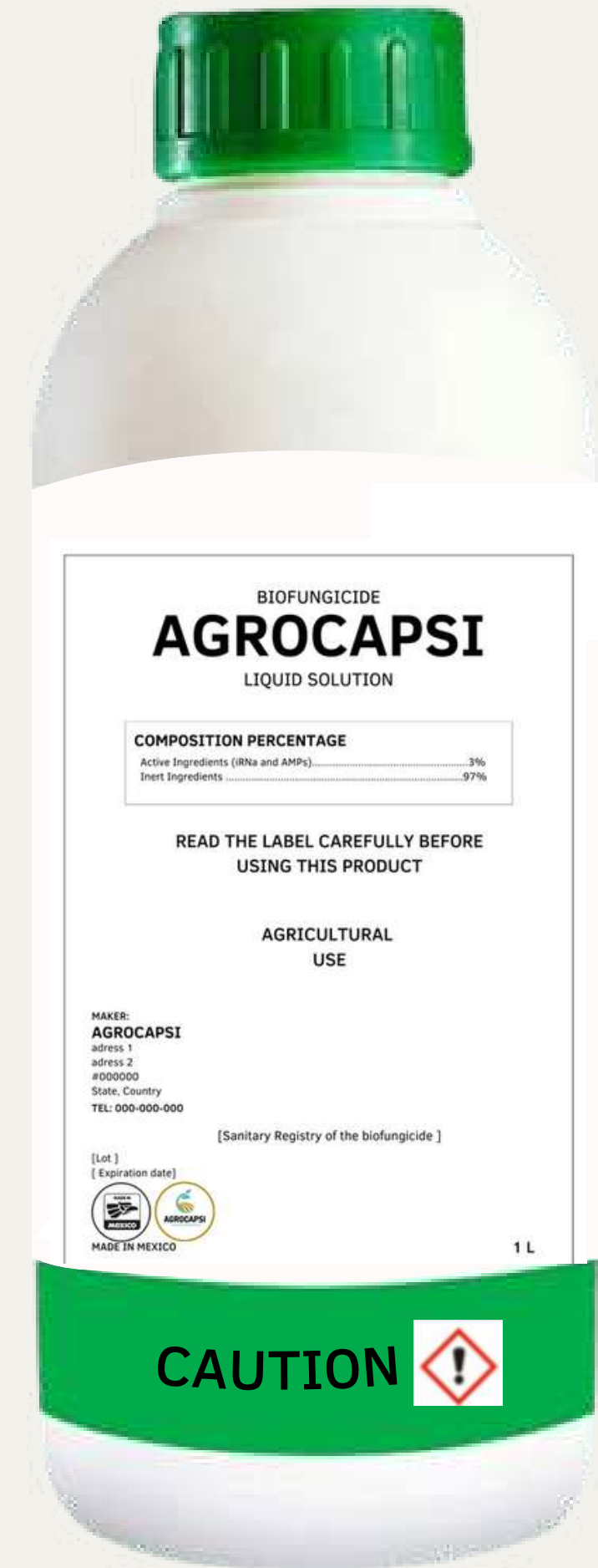
(Muñoz-Miranda *et al.*, 2019)

THAT'S HOW OUR PROJECT WAS BORN

AGROCAPSI

A biofungicide that controls and eliminates *P. capsici* through SynBio

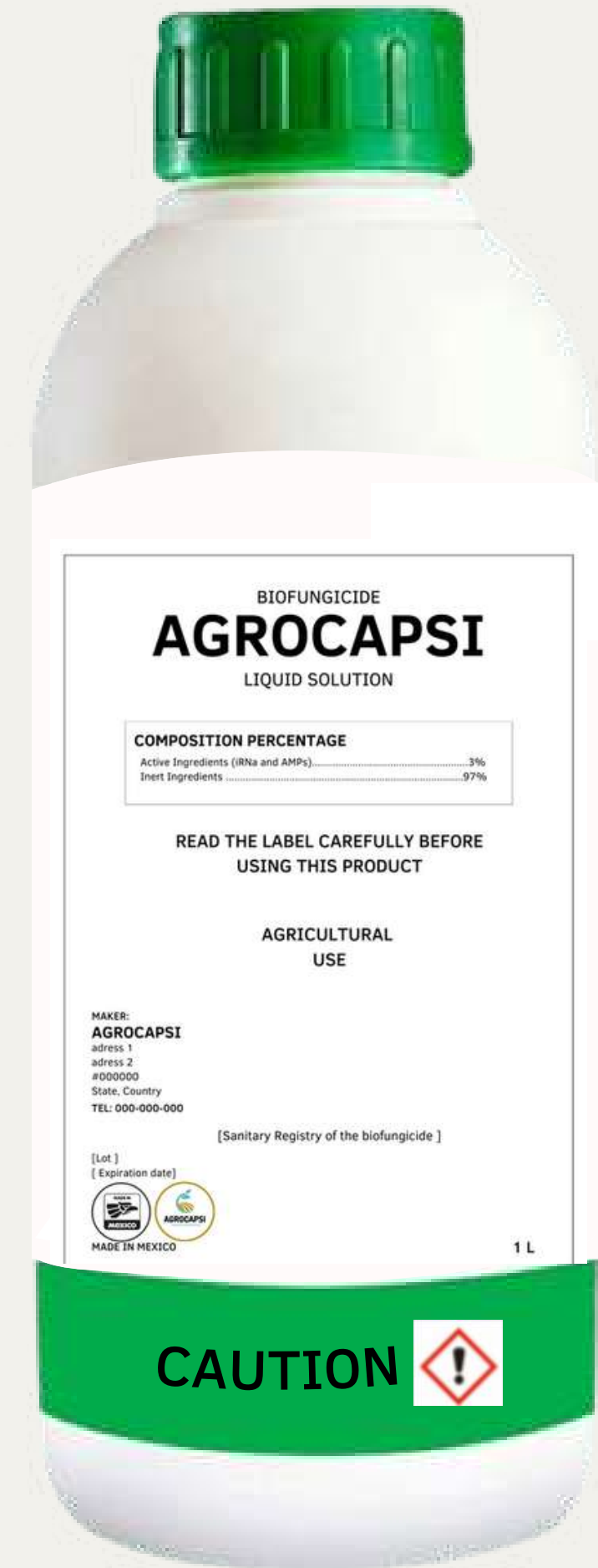
- ☑ Effective against *P. capsici*
- ☑ Environmentally responsible
- ☑ Not a risk to human health



ACTIVE INGREDIENTS

Antimicrobial peptides and
interference RNA

- Osmotin
- Dermaseptin
- iRNA



ACTIVE INGREDIENTS

Dermaseptin DrsB1

It is a peptide naturally produced by *Phyllomedusa bicolor* (bicolor frog). It is not toxic in any way

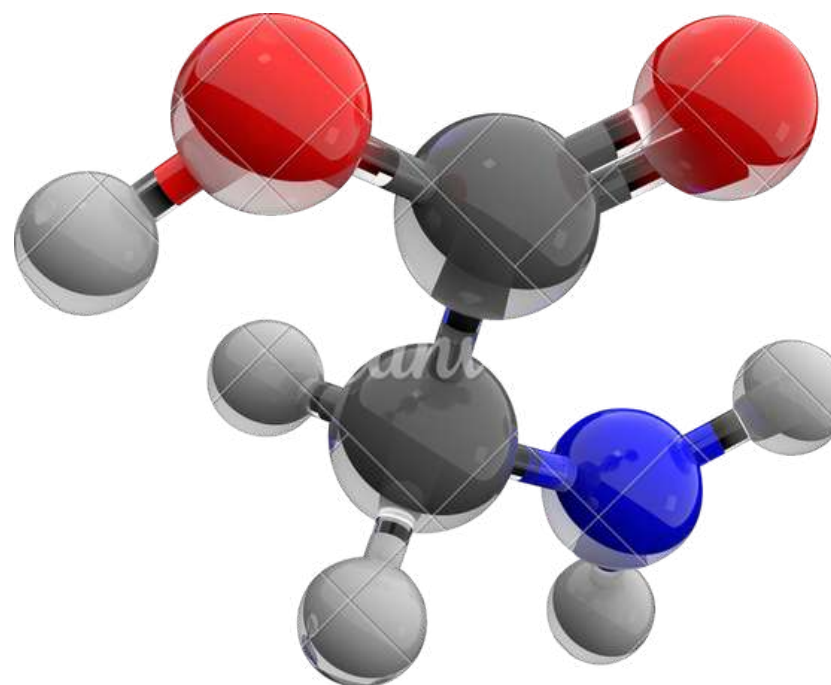
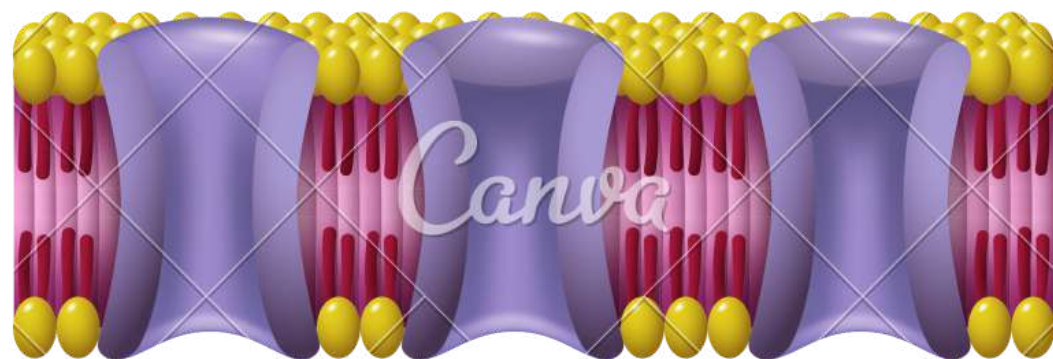
Destabilizes the membrane



ACTIVE INGREDIENTS

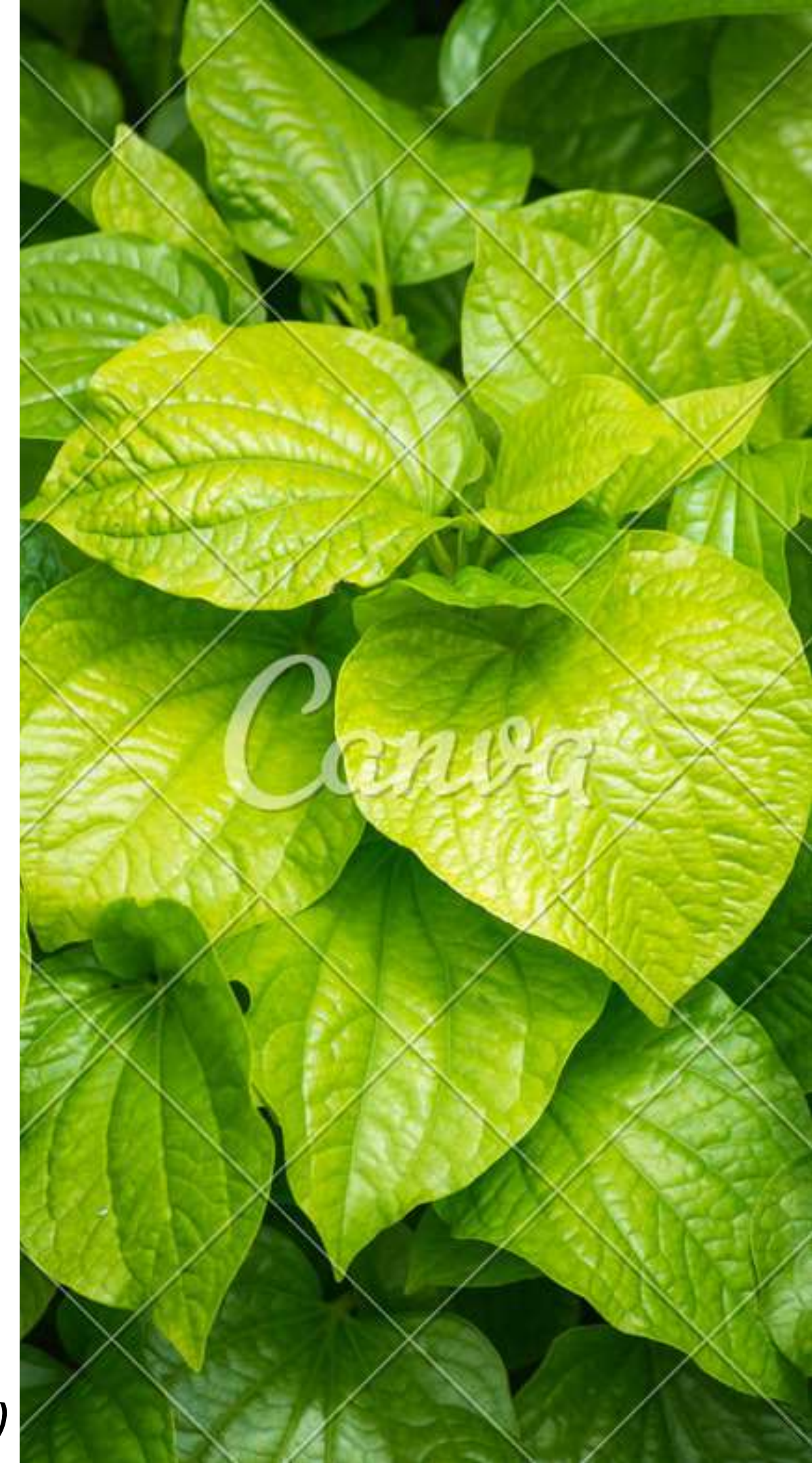
Osmotin PcOSM

It is a peptide naturally found in *Piper colubrinum*. This is one of the few chilli species that are naturally resistant to this oomycete.



Destabilizes the membrane

Induces ROS

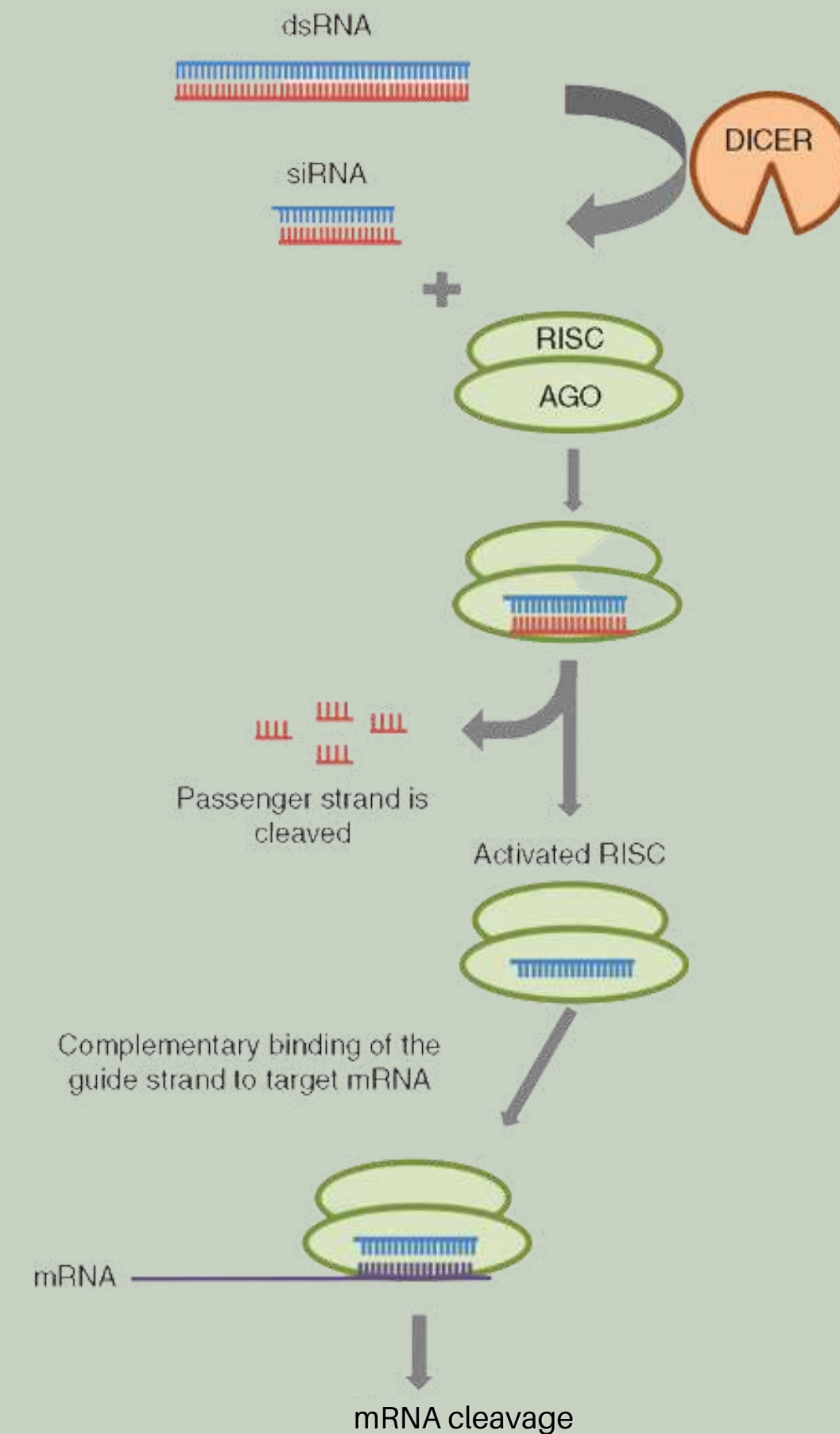


ACTIVE INGREDIENTS

siRNA RXLR1

Assays on transitory over expression and promotion of the infection indicates that the gene RXLR1 could promote pathogenic infection.

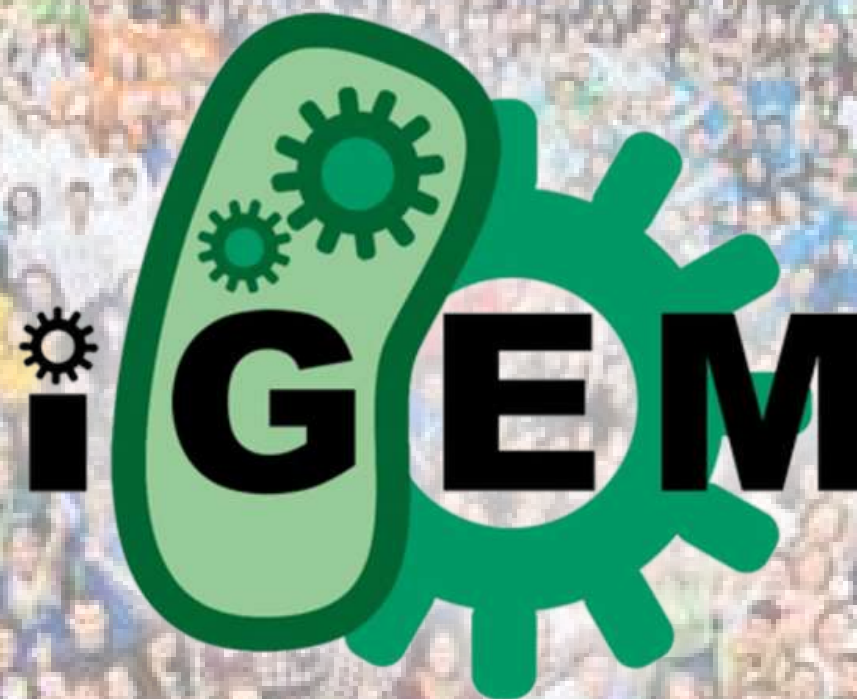
Genetic silencing



(Cheng *et al.*, 2022; Edwards *et al.*, 2020; Demirer *et al.*, 2020)

¿What is iGEM?

The known limits of SynBio are exceeded to solve different problems faced world wide. The point is to solve complex situations through bioremediation, therapeutics and sustainable materials. The idea of SynBio goes beyond the laboratory; there exists a compromise with the stake holders, local communities and iGEM teams through different collaborations.



Synthetic Biology can enhance the sustainability in crop production while rescuing an icon of our Mexican identity.



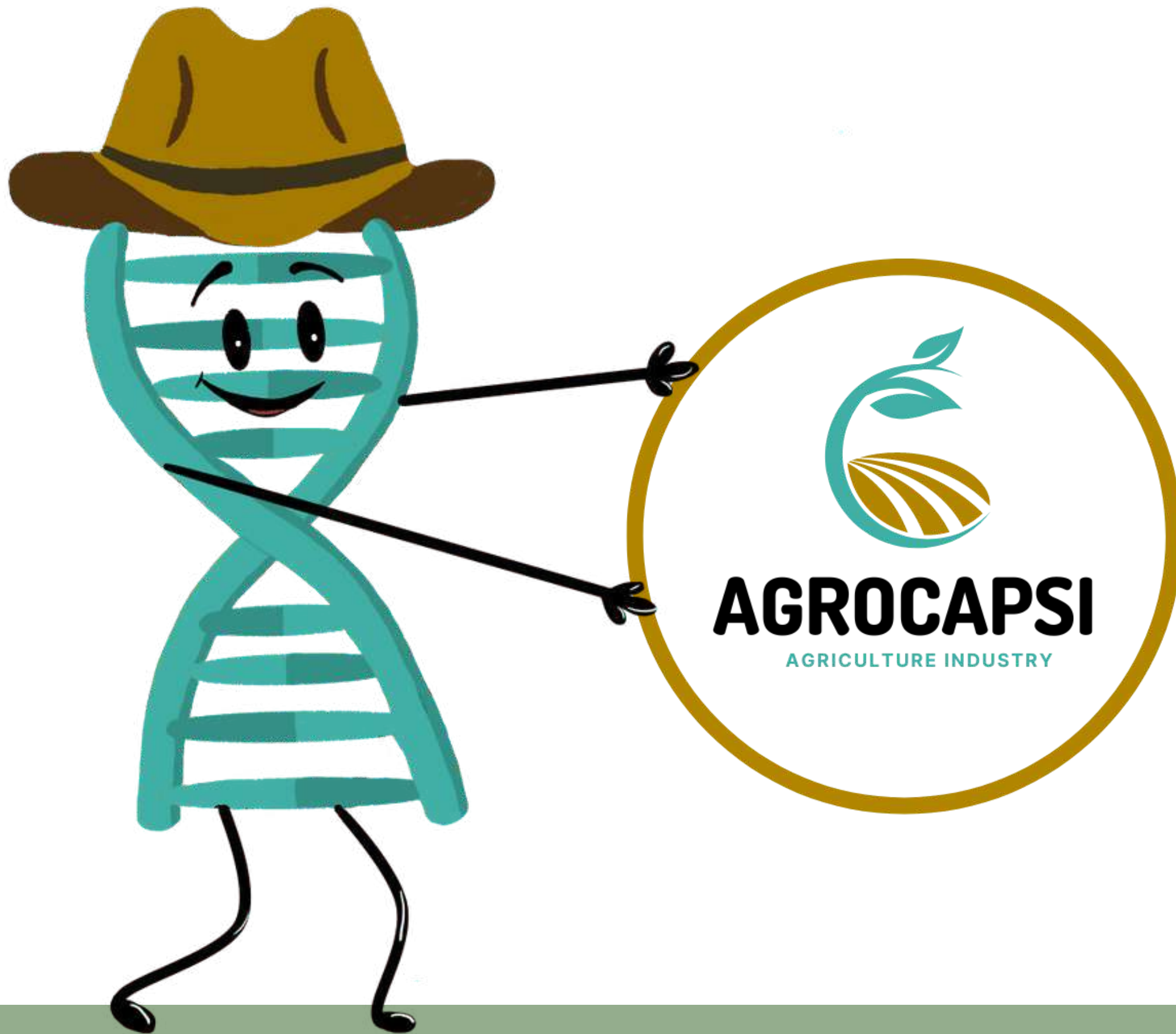


Manuals:

- **Main problems in chilli production**



¿Questions?



Thanks!



igemtecchih



igemtecchih



iGEM Tec-Chihuahua



iGEM Tec-Chihuahua

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TEC-CHIHUAHUA
IGEM 2022

MAIN PROBLEMS OF CHILI PRODUCTION

State of Chihuahua



July 2022

<https://2022.igem.wiki/tec-chihuahua/>

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Introduction

Chili is one of the most emblematic products of Mexico since it is used as a primary ingredient in food, which is present in almost all Mexican food dishes, due to its color, flavor and texture qualities^[1].

The production of chili is of great importance both in the cultural area of Mexico and in the economic development of the country. Nationally, a production of 3,296,874 tons has been registered in an estimated area of 161,285 hectares, generating a production value of more than 29 billion pesos^[2]. Being part of the 5 countries with the highest production of fresh chili worldwide together with China, the Netherlands, Belgium and Turkey^[3].

Among the states with the highest production of chili in Mexico is Chihuahua, which ranks first in production with more than 820 thousand tons and about 6,300 million pesos^[4].

However, its productive potential has been affected by various diseases caused by bacteria, viruses and fungi^[2]. In the state of Chihuahua there has been a high incidence of problems with pests such as weevils and diseases such as powdery mildew and wilt and/or damping off.

PEPPER WEEVIL *Anthonomus eugenii* Cano

Insect native from Central America, which nowadays has spread throughout the continent, representing an economic problem since it can cause damages of **up to 100% in chili cultivation**^[5]

Life cycle of the pepper weevil

The weevil is capable of generating 350 eggs during its life cycle. The biological cycle is classified in the egg period (3 to 5 days), then presents 3 larval stages (13-17 days), pupae (3-6 days), adult (2-4 days to emerge), to finish with mating.

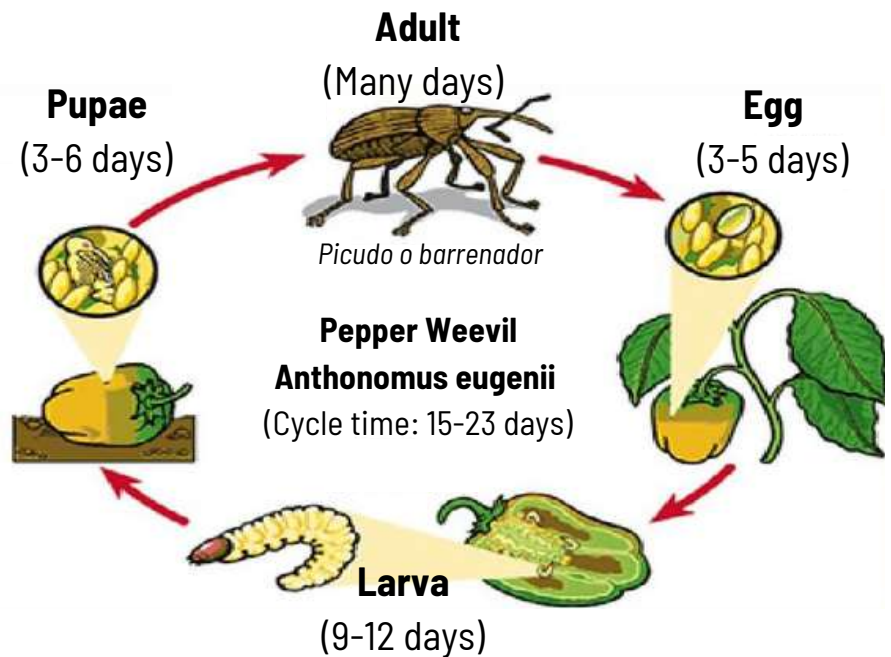
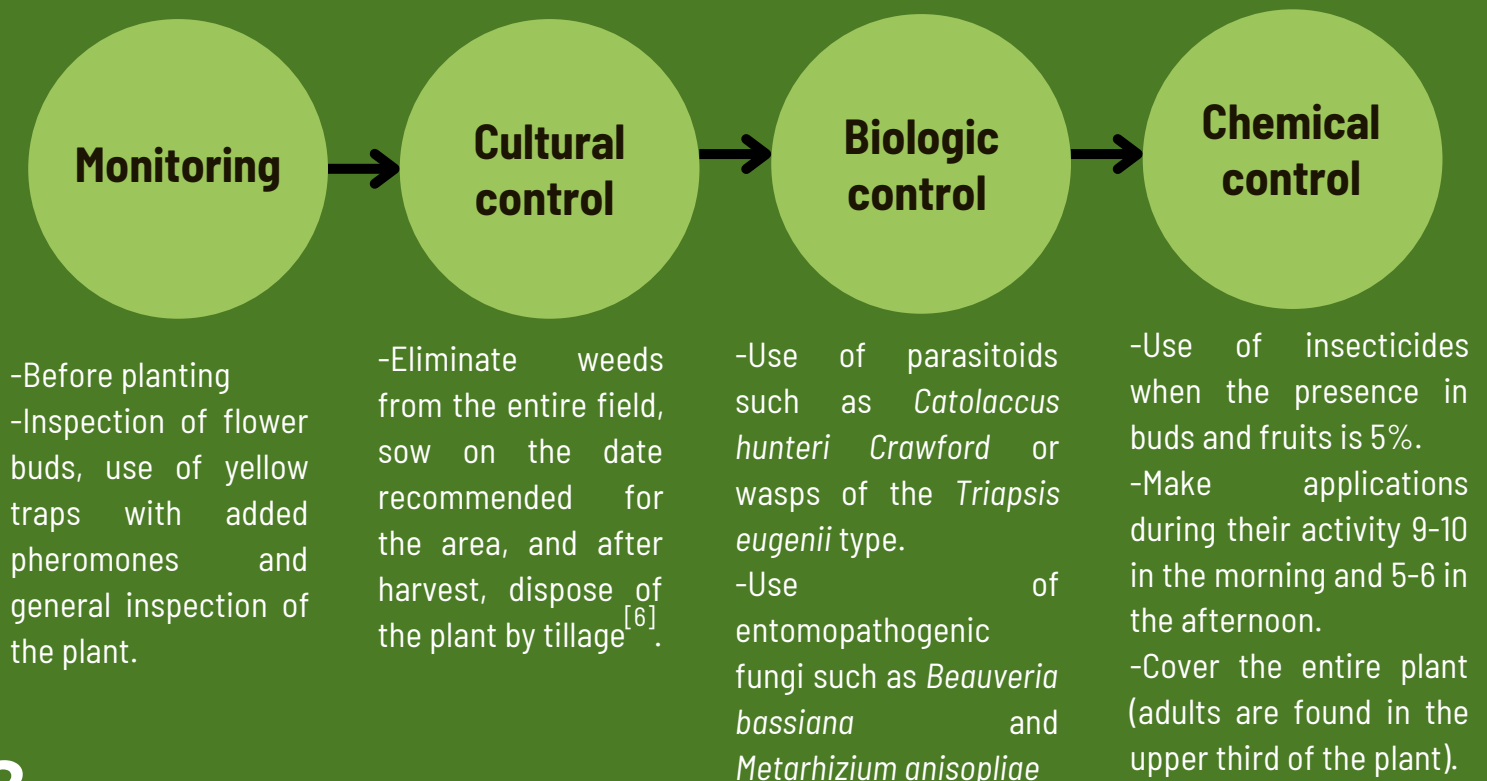


Figure 1. Biological cycle of the weevil^[6]

Integrated Management of the Chile Weevil



DAMPING – OFF

ALSO KNOWN AS DRYNESS

Damping-off is a common disease that affects all vegetable crops in the early stages of planting, on other words, during germination. There is no single pathogen responsible of it as it can be one or several microorganisms, but most are fungi and oomycetes^[7].

Rhizoctonia solani, *Thielaviopsis basicola*, *Pythium spp.* and *Phytophthora capsici* are the main microorganisms responsible for this condition. Expert evaluation is required to determine what is causing it, however, the symptoms and treatment are very similar to other plant diseases.

Symptoms

This disease symptoms fall into two main categories: symptoms that appear before the seeds can germinate and symptoms that appear after germination. During the first stage, seeds may not germinate and rot, or they may start to germinate (root) and rot before cotyledons appear^[8].



Figure 2. Damping off. Taken from Consejo Regulador I.G.P. Pimiento Asado del Bierzo

Prevention

- Plant the seeds in a nursery or field when conditions are best for their development. It depends on the species.
- Pay attention to the level of humidity in the seedbed or field, since soils that are too wet are more susceptible to this disease.
- Use the highest quality seed as it will be more vigorous and uniform.
- Buy pre-treated seeds.
- Ensure a good drainage system.
- When planting in a nursery or seedbed, ensure that the germination mix is pre-sterilized by the manufacturer.



¿WILT OR DAMPING OFF?

Damping off occurs in seedlings, that is, it is the phenomenon that occurs to plants in their youthful state. On the other hand, wilting occurs in mature plants^[9].

Both can be caused by the following microorganisms: *Phytophthora*, *Fusarium*, *Pythium* and *Rhizoctonia*^[10]. The symptoms are similar, although some differ by the stage in which the plant is^[9].

Table 1. Symptoms of Damping-off and wilting.

Damping off	Wilting
Losses of seeds, seedlings and young plants	Losses of mature plants and fruits
Leaf wilt, yellowing and curling	Leaf wilting and sometimes they fall off or get stuck
Roots do not develop properly and rot	The roots rot
Stem necrosis	Stem necrosis



Figure 3. Wilting of chili.

In the same way, the symptoms can change depending on the microorganism that is present in the soil^[10].



Figure 4. Fruit mummification due to wilting.

IMPORTANCE OF THE IRRIGATION SYSTEM

Crop rotation and the use of a technical irrigation system are alternatives that help control the appearance of diseases such as wilting or drying^[11]. There are several irrigation systems that have a certain efficiency, in table 2 you can see the most common.

The drip irrigation system is one of the most efficient systems since it avoids flooding and allows pouring the right amount of products such as fertilizers and water at the right time, reducing economic costs and without leaching into the mantles. It also prevents the development of diseases caused by fungi and oomycetes, since the level of humidity that is generated is lower than that caused by irrigation systems such as furrows^[12]. This prevents microorganisms such as *Phytophthora capsici* can be spread from one plant to the rest through irrigation^[11].

Table 2. Irrigation system

Irrigation system	Efficiency
Furrow	45%
Californian	65%
Aspersión	75%
Microsprinkler	85%
Drip	90%



Figure 5. Drip irrigation system through strip.

The use of irrigation methods with higher efficiency reduces direct evaporation from the soil and improves the microenvironment around the roots of the crop, which promotes better plant development and increases water productivity. Which takes great importance for arid regions such as the state of Chihuahua where the resource is scarce^[13].

CROP ROTATION

Growing only one or two types of plants on large tracts of land generates negative consequences for the soil, since it depletes its nutrients, leaving it weak and unable to support the good growth of plants, which means that synthetic fertilizers have to be added. It also creates new opportunities for pests and diseases that a landscape with greater biodiversity would normally suppress on its own, but due to monoculture, it provokes the need to apply more and stronger chemicals to eliminate them^[14].

In the case of chili, the monoculture system or successive planting of similar crops generates a predisposition for the crops to be invaded by pathogens, mainly omycetes such as *Phytophthora capsici*, which causes slight wilting of the plant and in three or four days it wilts completely^[15].



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