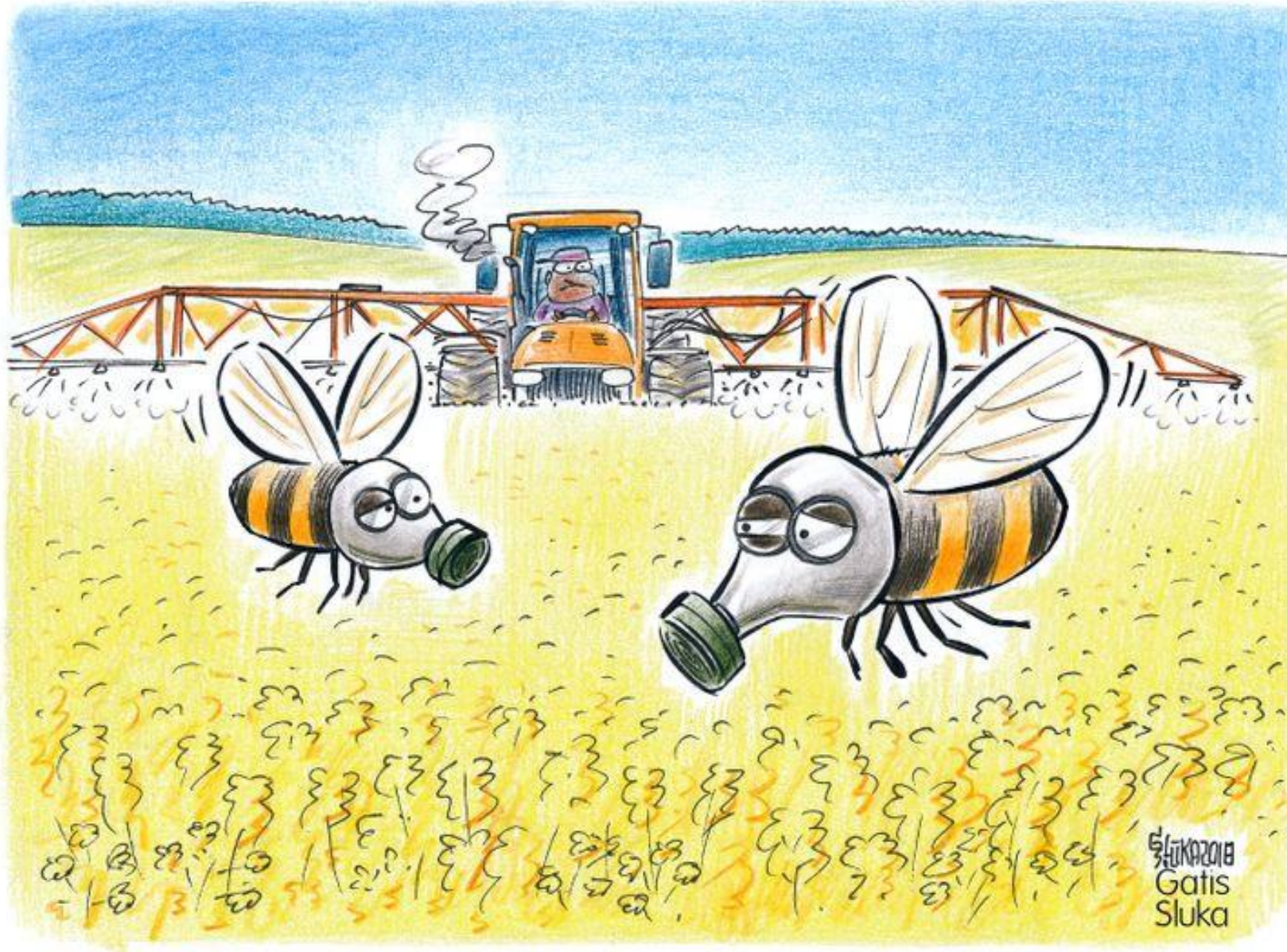


Pesticides and bees: How do pesticides affect bees?



Gatis
Sluka

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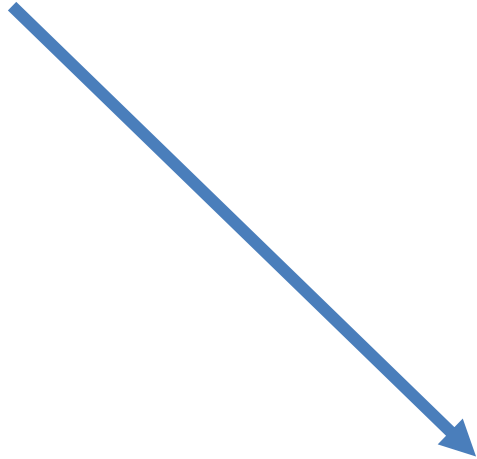
Asia's largest forest honey and native bee conference

5 - 10 November 2023

Ho Chi Minh City, Vietnam

Pesticides

What are we talking about?



Fertilizers are used to feed plants; they are not harmful to bees.



Pesticides are used to protect plants against parasites, pests or competitors; they can be harmful to bees.



Pesticides

What are we talking about?

Pesticides can be classified by target organisms.



Herbicides:
weeds



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Fungicides:
fungi



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Insecticides:
insects

Pesticides

Are pesticides dangerous to bees?

Bees are not a specific target of pesticide!

No pesticide has been specifically designed to control bees.

Unfortunately, pesticides are not only toxic to the group of organisms targeted.



Bees can be killed by pesticides not specifically designed against them!

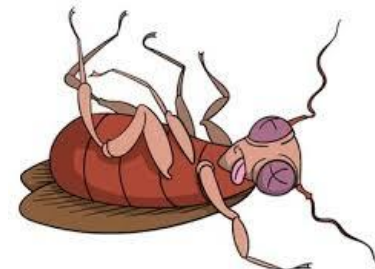
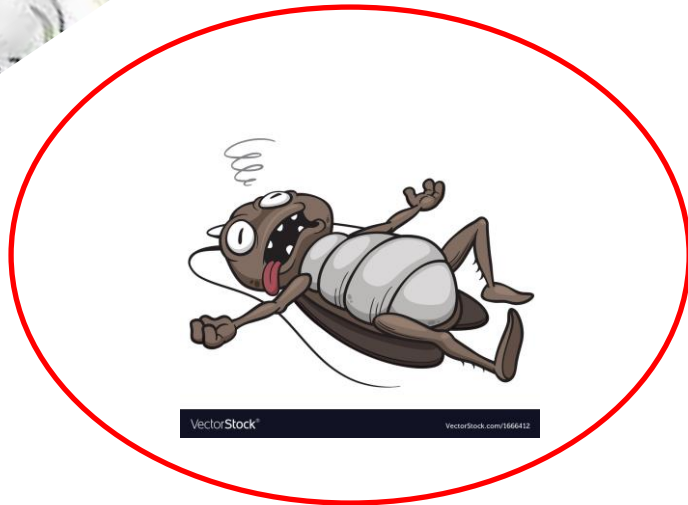


Pesticides

Are pesticides dangerous to bees?



Most of the pesticides sprayed affect other organisms!



It is considered that over 98% of sprayed insecticides reach a destination other than their target species (Tyler Miller, 2005).

Pesticides toxicity for bees

The dose and the time of exposure make the poison

Not all pesticides have the same effect on bees!

The dangerousness of a pesticide to bees depends on two factors:

1. The toxicity of the pesticide = the **pesticide dose** that causes death of bees



Small dose is enough to kill bees

=

Very dangerous pesticide!



Pesticide dose:

- **Acute toxicity of a pesticide (Lethal doses - LD50):** dose of a pesticide that kills 50% of individuals of a species
- **“Bee-toxic pesticides” : contact LD50 < 11µg/bee (EPA*)**

(*) United States Environmental Protection Agency



Large dose is required to kill bees

=

Less dangerous pesticide!





Can kill bees during a long period

=

Dangerous pesticide!



Pesticides toxicity for bees

The dose and the time of exposure makes the poison

2. How long the pesticide can affect bees after it has been applied to plants.



Can kill bees only during a short period

=

Less dangerous pesticide!



Persistence of pesticide (Half-life)

Time required for half of a pesticide to disappear:

- Some pesticides are dangerous for bees only a few days to a few weeks.
- Others can remain dangerous for several months.
- DDT = 17 years!

Pesticides toxicity for bees

Toxicity of a few pesticides to bees



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Generally speaking, insecticides are more dangerous to bees than herbicides and fungicides

Pesticides toxicity for bees

Toxicity of a few pesticides to bees

Some insecticides are more dangerous than others for bees

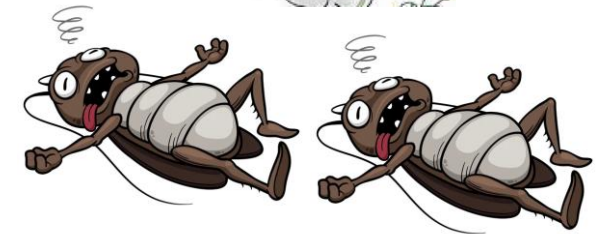
Insecticides X



Insecticides Y

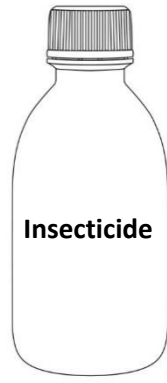
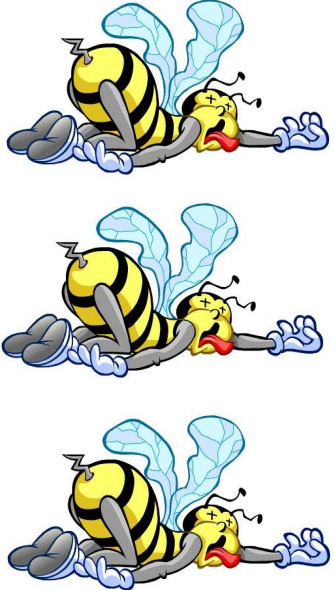
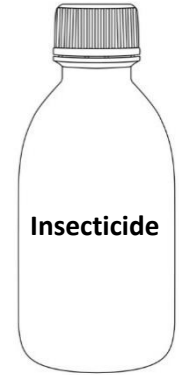


Systemic insecticides

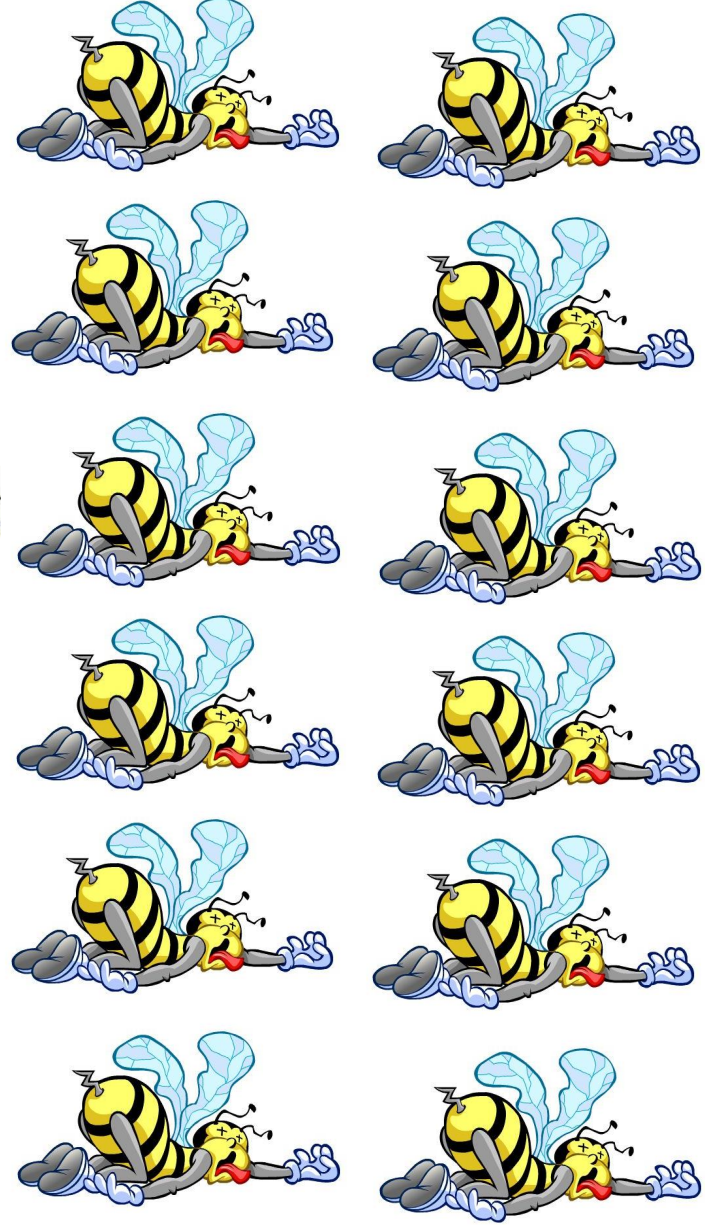


Pesticides toxicity for bees

Synergistic toxicity of pesticides: cocktail effect



+



The toxicity of certain insecticides can be enhanced in the presence of other pesticides which act as **synergists**.



Routes of exposure of bees to agricultural pesticides

Contact exposure

Contact exposure = the bee touches the pesticide!



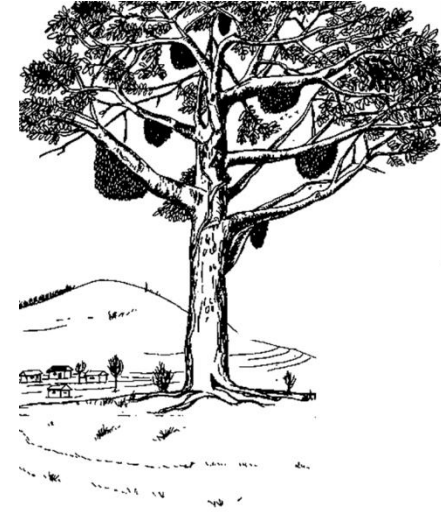
Bees might be intoxicated while:

1. flying across treated fields,
2. crawling over sprayed surfaces of plants.

Routes of exposure of bees to agricultural pesticides

Contact exposure

Bee colonies nesting downwind (up to hundreds of meters away) can also be intoxicated by pesticides droplets or contaminated dust particles.



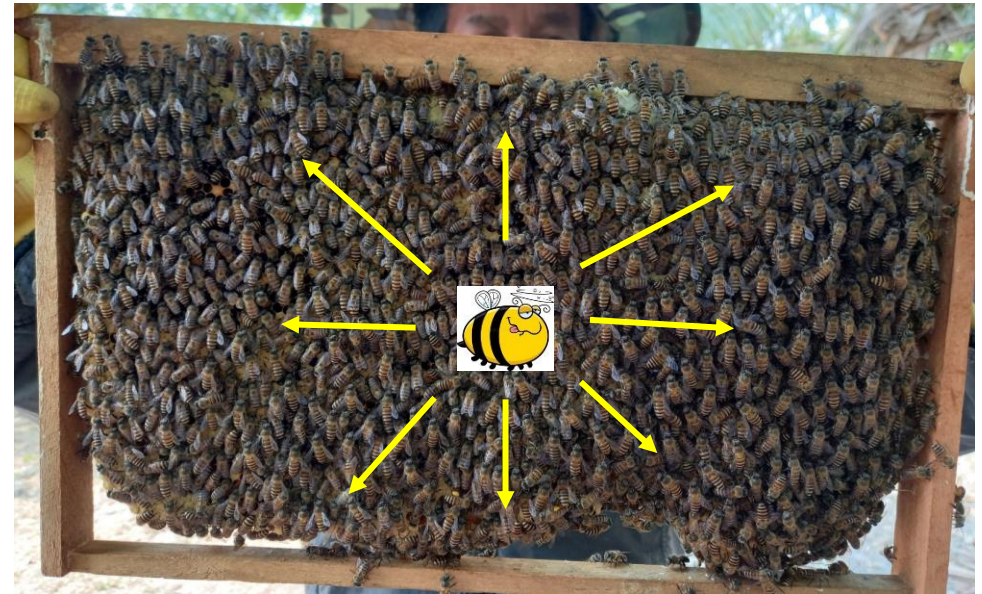
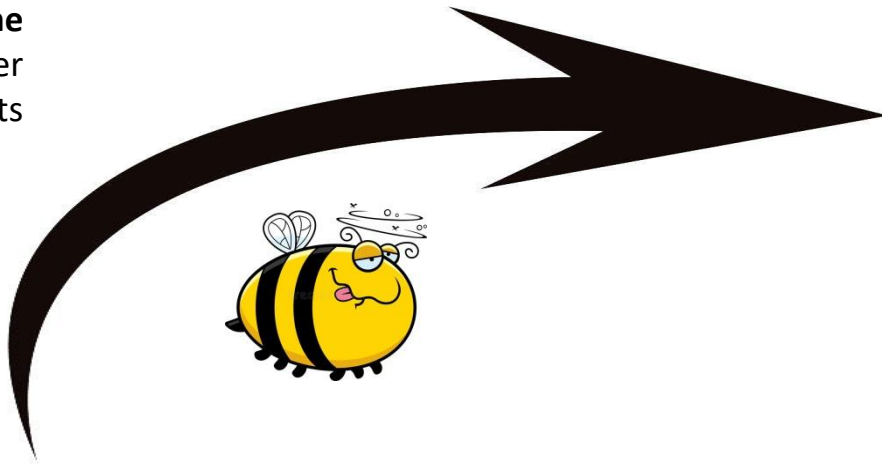
Wind



Routes of exposure of bees to agricultural pesticides

Contact exposure

Bees may also carry the pesticide to their nest either as dust particles or droplets attached on their body.



Inside the nest, other bees might be **poisoned by contact** with contaminated bees.

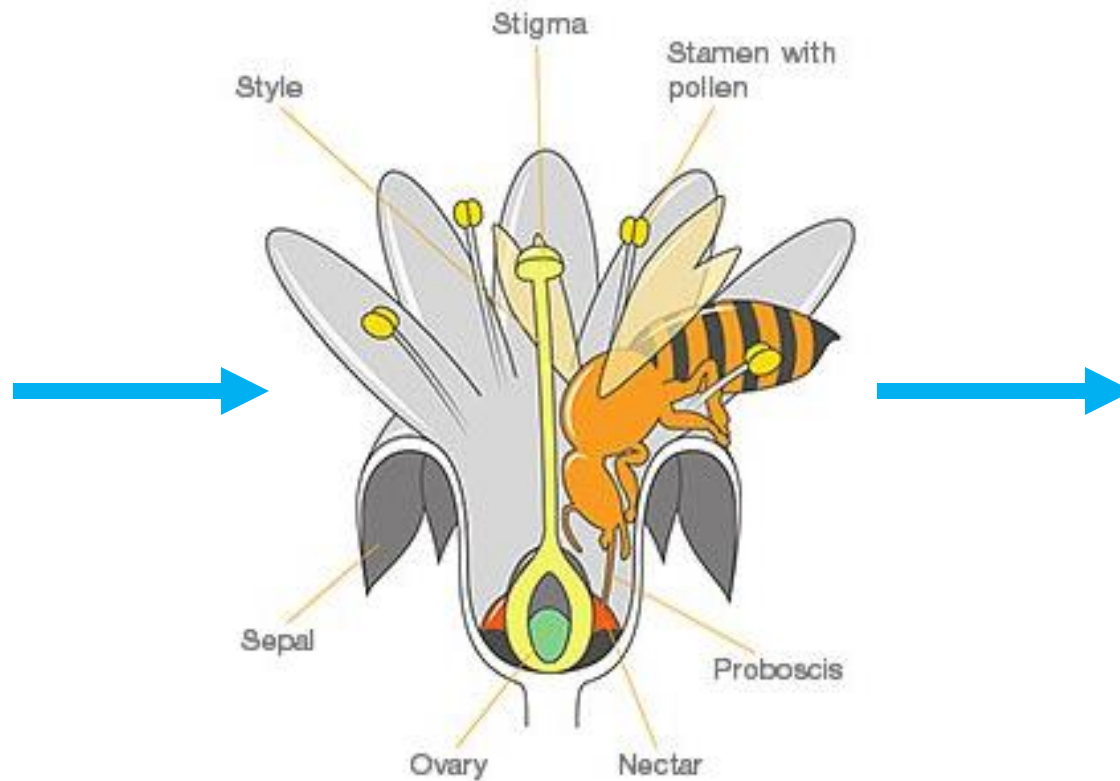
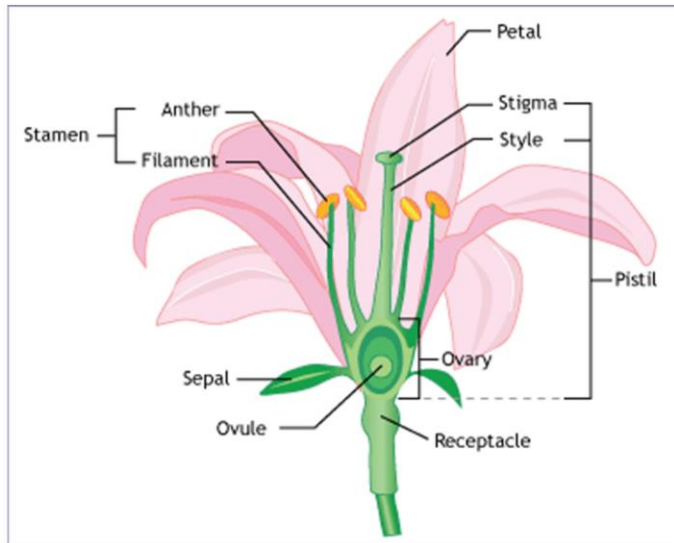


Routes of exposure of bees to agricultural pesticides

Oral exposure



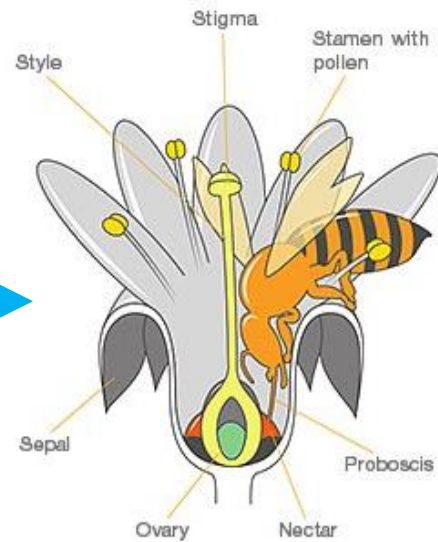
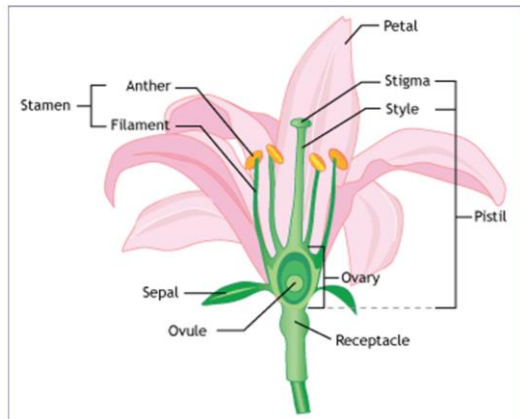
Oral exposure = bee ingests the pesticides



Foragers are poisoned by ingesting poisoned nectar or pollen!

Routes of exposure of bees to agricultural pesticides

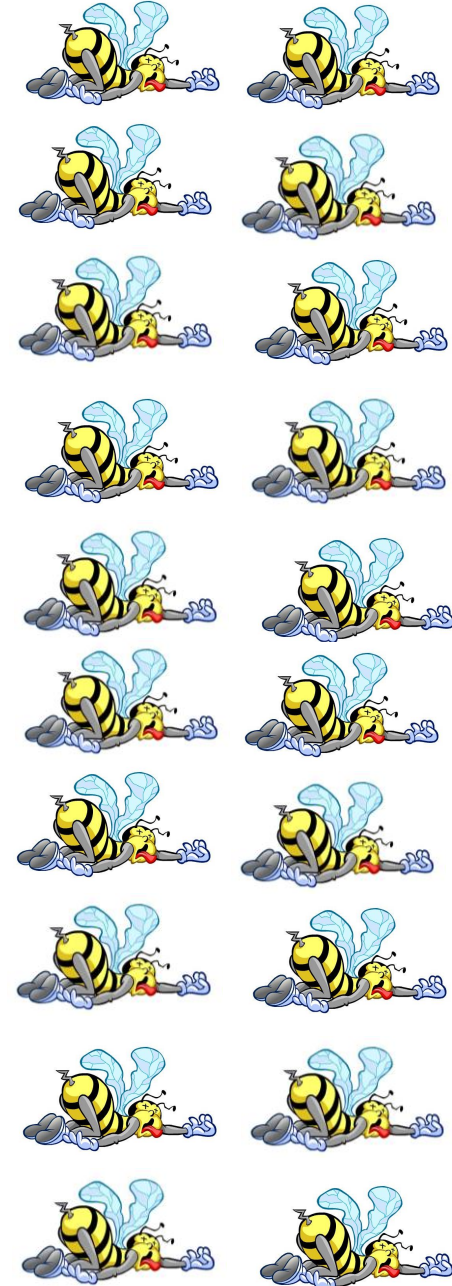
Oral exposure



Pesticide residues in pollen and nectar might also be **taken by forager bees to their nests...**

Routes of exposure of bees to agricultural pesticides

Oral exposure



Inside the nest, other bees, included larvae and the queen can be poisoned by ingesting poisoned food.

This may lead to the death of the colony!



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Systemic insecticides

The whole plant is toxic

The most dangerous insecticides for bees!!!!

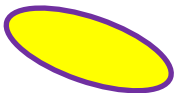
As systemic pesticides are **water-soluble**:

- absorbed by the crop plants as they grow,
- residues are present in **all parts of the treated plant**, including flowers (pollen and nectar) and guttation drops (e.g. maize).

Often used as coated seeds.



Coated seed

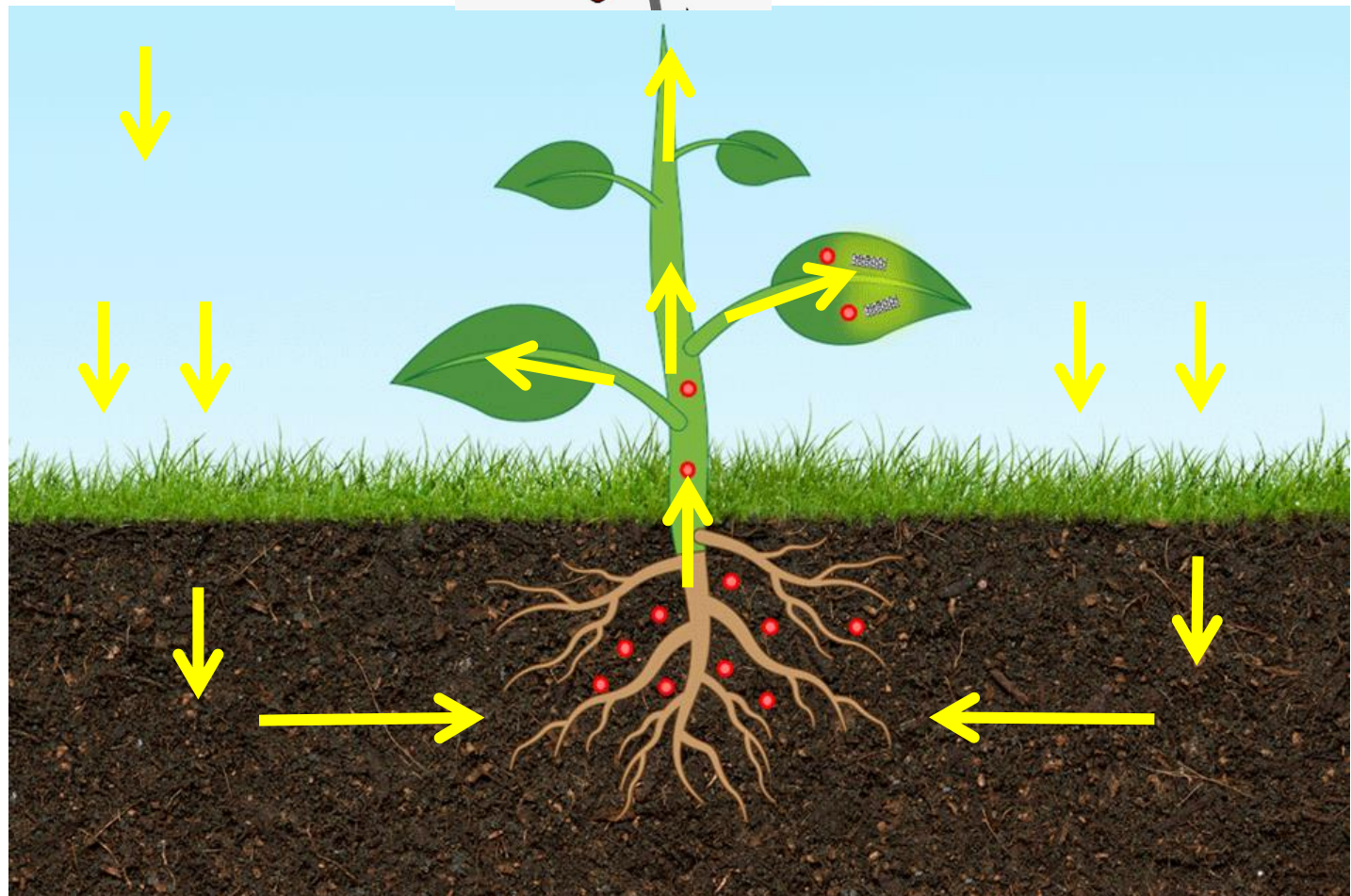
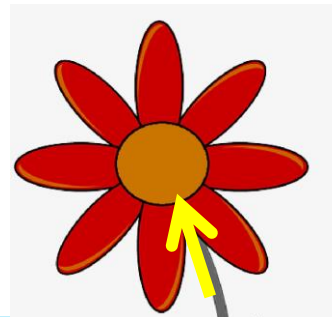




Can also be sprayed.

Systemic insecticides

The whole plant is toxic

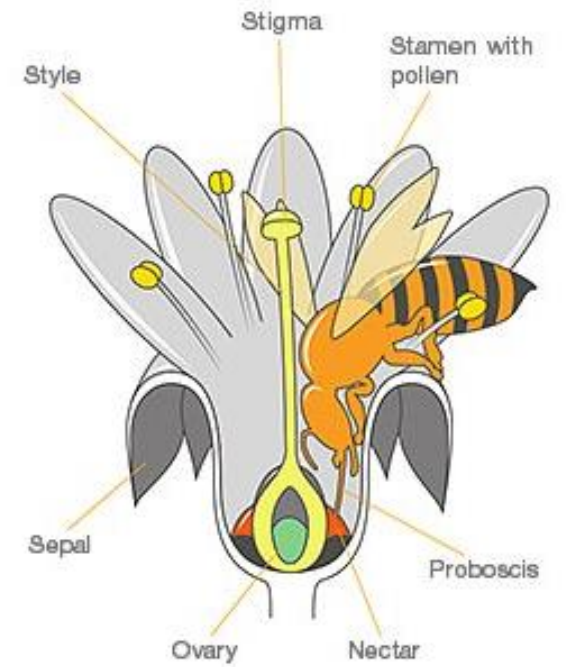


Systemic insecticides

The whole plant is toxic



When bees feed on the plant, they ingest the insecticide!



Systemic insecticides

Higher toxicity and longer persistence

Very high toxicity



Systemic insecticides pose a risk to bees, not only because of their particular mode of action but also due to their **higher toxicity*** and **longer persistence** than most pesticides.

(*) Oral LD50 for bees: 4ng/bee for most neonicotinoids

4ng = **3.000 times lower** than the limit set up by the EPA for bee-toxic pesticides.

Very long persistence



Half life of fipronil : **142 days (= 4.5 months)**

Systemic insecticides

Not only the crop is toxic

Only a small part of the insecticide is absorbed by the crop, the remaining is absorbed by other plants or ends up in water bodies.



Eric Guerin

Not only the crop plants but also the **weeds and bushes** that grow in or near the field as well as **water bodies** are contaminated by systemic pesticides.



Eric Guerin

Systemic insecticides

Sub-lethal doses

Sub-lethal doses of neonicotinoids:

- increase foragers disorientation (less efficiency in the collection of pollen and nectar),
- weaken bee immune system (predispose bees to diseases),
- shorten the lifespan of adult bees,
- reduce egg-laying by the queen and drones fertility.

Colonies feeding on honey, pollen or water contaminated with systemic insecticides may succumb to the combined effects of chemicals and diseases.

