Insecticide Resistance: A Major Concern in Insects-pests Control

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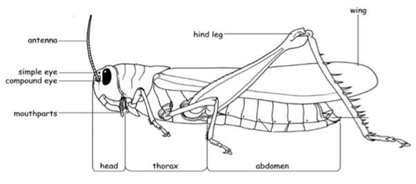
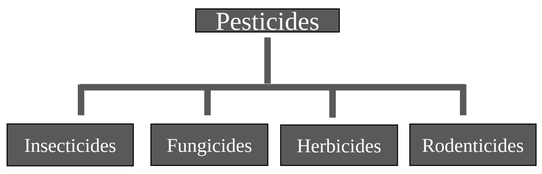
Background



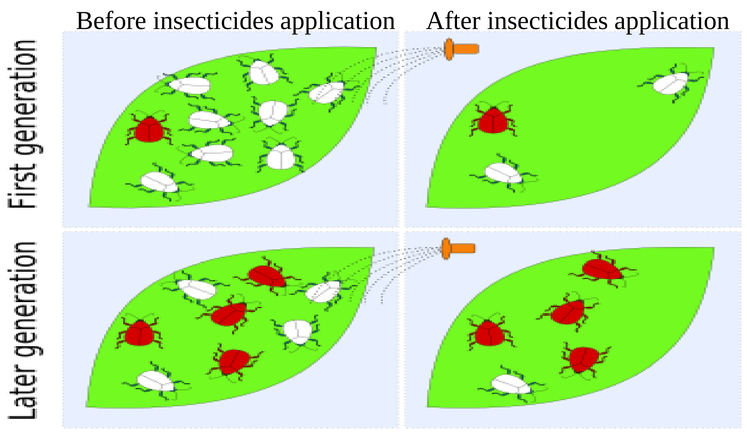
https://www.sciencepartners.info/



- Insecticides work through various mechanisms to kill insects such as neurotoxicity, impaired growth, respiratory inhibition, midgut interference, and chitin synthesis inhibition.
- Over time populations of insects can evolve to become less responsive to the insecticide that is used to control them.
- When insect population can no longer be controlled by a dose of insecticide which used to provide control of them is known as insecticide resistance.

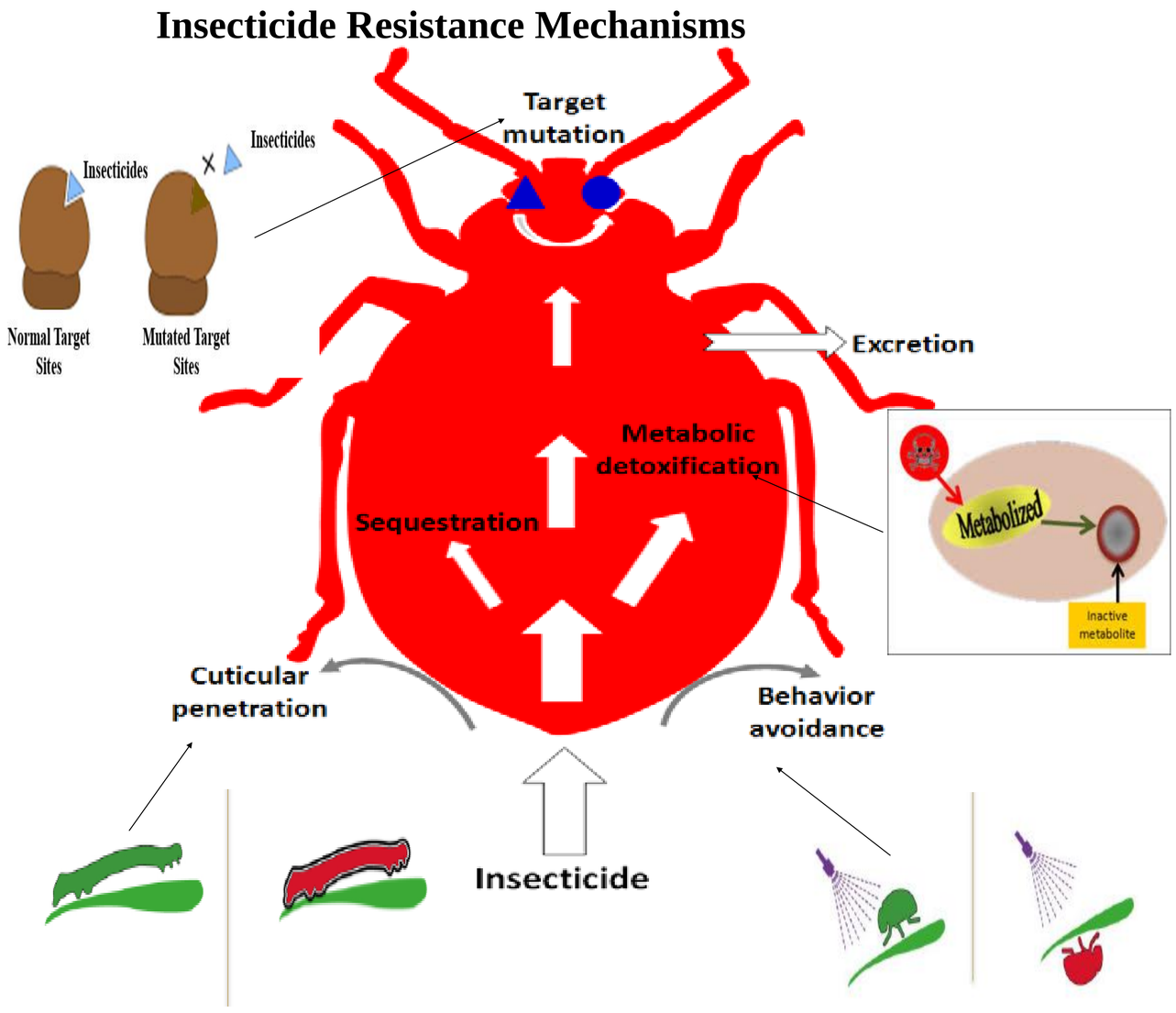
What Causes Insecticide Resistance?

Continuous selection pressure of insecticides



https://en.wikipedia.org/

Insecticide Resistance Mechanisms



(Zhu et al. 2014; IRAC, 2024; https://pesticidestewardship.org/)

Behavior avoidance → Insect can detect and avoid insecticides.

Cuticular penetration → Cuticle become thick or create barrier to prevent entering insecticides inside body.

Sequestration → Store toxins before reaching to target sites within insect bodies

Excretion → Ability of insects to efficiently eliminate toxic substances from their bodies

Metabolic detoxification → Toxic substances become detoxify before reaching target sites.

Target-site modification → Target sites become mutated so that insecticide can't bind the sites.

Insecticide Resistance Profiles in Different Arthropods

Table 1. The most resistance arthropods based on the number of resistance insecticides (APRD, 2022)

S. N.	Insect species	Pest type	Resistance insecticides (N)
1	Diamondback Moth (*Plutella xylostella*)	Crops	101
2	Red spider mite (*Tetranychus urticae*)	Crops	96
3	Green peach aphid (*Myzus persicae*)	Crops	81
4	Whitefly (*Bemisia tabaci*)	Crops	65
5	House Fly (*Musca domestica*)	Medical	65
6	Colorado potato beetle (*Leptinotarsa decemlineata*)	Crops	56
7	Cotton bollworm (*Helicoverpa armigera*)	Crops	52
8	Tick (*Rhipicephalus microplus*)	Medical	50
9	European Red Mite (*Panonychus ulmi*)	Crops	48
10	Beet armyworm (*Spodoptera exigua*)	Crops	43

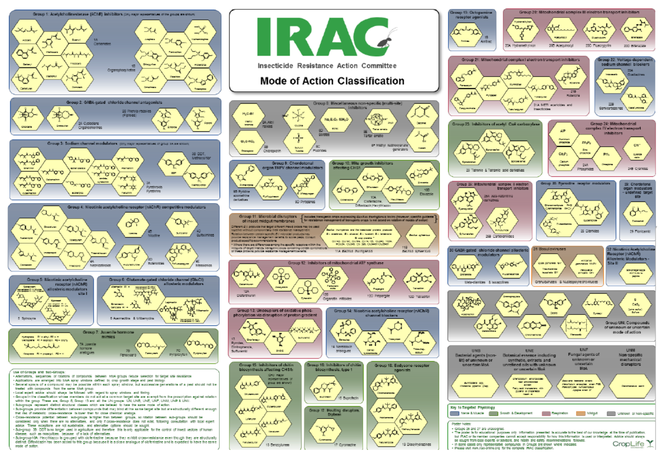
Insecticide Resistance Issues in Taiwan

Table 2. Insect species with number of insecticides resistance reported in Taiwan

S.N.	Insect species	Resistance insecticides (N)	References
1	Diamondback moth (*Plutella xylostella*)	>22 (Indoxacarb, Chlorantraniliprole, Spinosad)	Pudasaini et al. 2022, Hsu et al. 2016, Hsu et al. 2012, Liu et al. 1981
2	Oriental fruit fly (*Bactrocera dorsalis*)	> 10 (Naled)	Hsu et al. 2016, Hsu et al. 2004, Kuo et al. 2015, Hsu et al. 2008
3	House flies (*Musca domestica*)	10 (Cypermethrin, Chlorpyrifos)	Pai et al. 2023
4	Mosquitoes (*Aedes albopictus*)	> 9 (Cypermethrin, Permethrin)	Pai et al. 2023
5	Mosquitoes (*Aedes aegypti*)	6 (Cypermethrin, Fipronil	Pai et al. 2023, Chun et al. 2022, Chang et al. 2012
6	Brown planthopper (*Nilaparvata lugens*)	5 (Malathion, Permethrin)	Sun et al. 1984
7	Pink stem borer (*Sesamia inferens*)	2 (Spinosad, Permethrin)	Li et al. 2011
8	Striped rice stem borer (*Chilo suppressalis*)	2 (Carbofuran, cartap)	Cheng et al. 2010
9	German cockroach (*Blattella germanica*)	2 (Permethrin, Fipronil)	Pai et al. 2023
10	American cockroach (*Periplaneta americana*)	1 (Fipronil)	Pai et al. 2023

How to Manage Insecticide Resistance?

- Regularly monitoring of insect-pests and follow economic thresholds levels.
- Follow Integrated Pest Management (IPM) approach
- Apply insecticides correctly and follow recommendation guidelines properly.



- Follow alternations, rotations, or sequences of different insecticide mode of action classes
- Preserve susceptible genes

(IRAC, 2024)

Conclusions

❖ Insecticide resistance poses a significant challenge in insect pests control, therefore, it is essential to implement proper strategies for effective pest control and insecticide resistance management.