



IIT KHARAGPUR



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CERTIFICATION COURSES

Organic Farming for Sustainable Agricultural Production

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Lecture 19 : Level “C” Pest and Disease Management

Biological Control:

- Biological control or biocontrol is the use of natural enemies to manage populations of pests.
- It relies on predation, parasitism, herbivory, or other natural mechanisms (such as ladybird beetles, predatory gallmidges, hoverfly larvae against aphids and psyllids), but typically also involves an active human management role.



***Syrphus* hoverfly larva feed on aphids, making them natural biological control agents**

Types of biological pest control

1. Introduction

It involves the introduction of a pest's natural enemies to a new locale where they do not occur naturally.

2. Augmentation

Augmentation involves the supplemental release of natural enemies that occur in a particular area, boosting the naturally occurring populations there.

Ex: The egg parasite *Trichogramma* is frequently released to control harmful insects



Cards with *Trichogramma* :
Against corn fruit borer

3. Conservation

Natural enemies are already adapted to the habitat and to the target pest, and their conservation can be simple and cost-effective.

Ex: Nectar-producing crop plants grown in the borders of rice fields, provide nectar to support parasitoids and predators of planthopper pests.



Brown Planthopper



Predatory Bug, *Cyrtorhinus lividipennis*

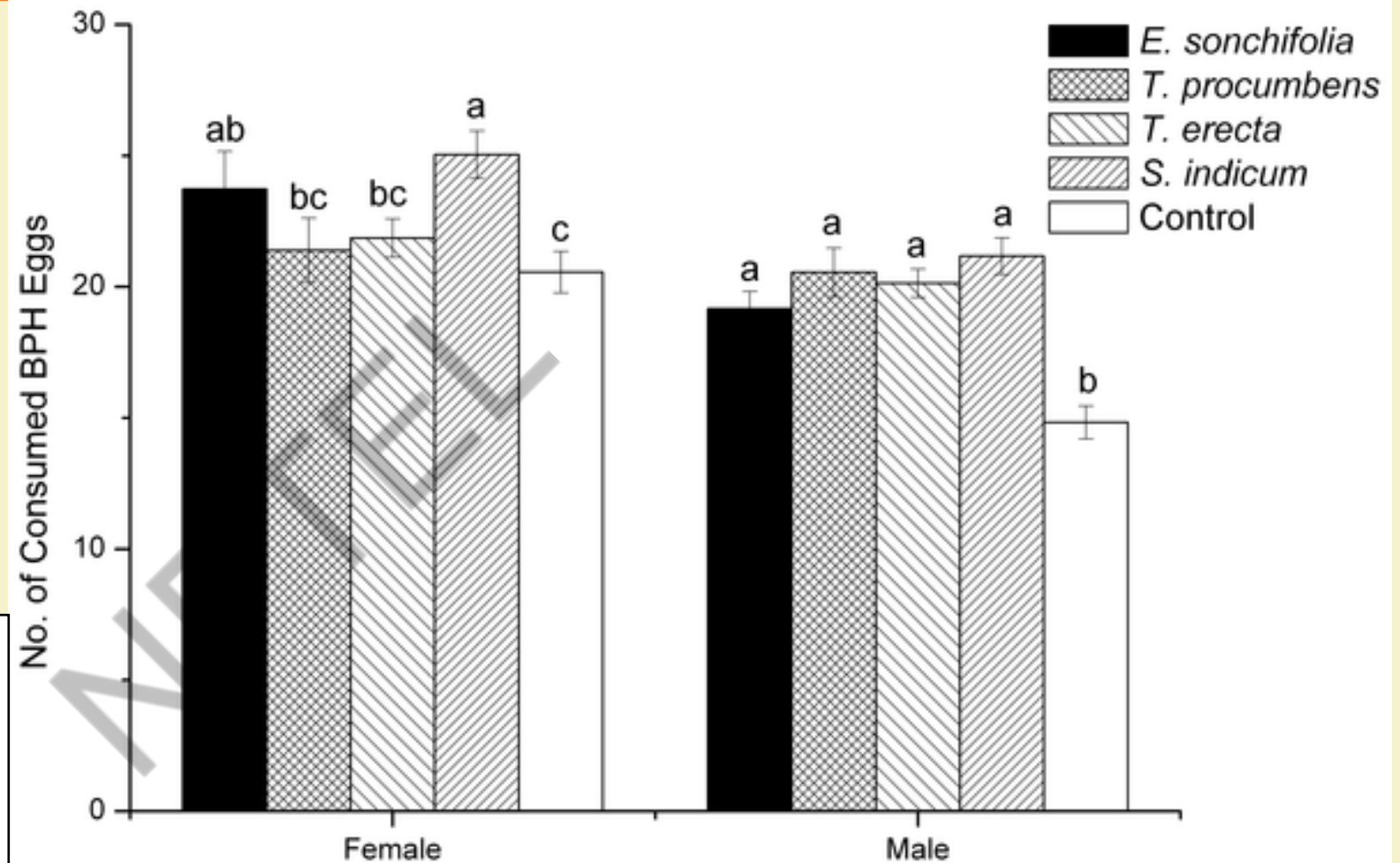
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Zhu P, Lu Z, Heong K, Chen G, Zheng X, et al. (2014) Selection of Nectar Plants for Use in Ecological Engineering to Promote Biological Control of Rice Pests by the Predatory Bug, *Cyrtorhinus lividipennis*, (Heteroptera: Miridae). PLOS ONE 9(9): e108669.
<https://doi.org/10.1371/journal.pone.0108669>
<http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0108669>



Effect of access to flowering plants of varying plant species on predation by *Cyrtorhinus lividipennis*

Population dynamics of pests and predators

- If populations of natural enemies present in the field are too small to sufficiently control pests, they can be reared in a laboratory or rearing unit
- The reared natural enemies are released in the crop to boost field populations and keep pest populations down.

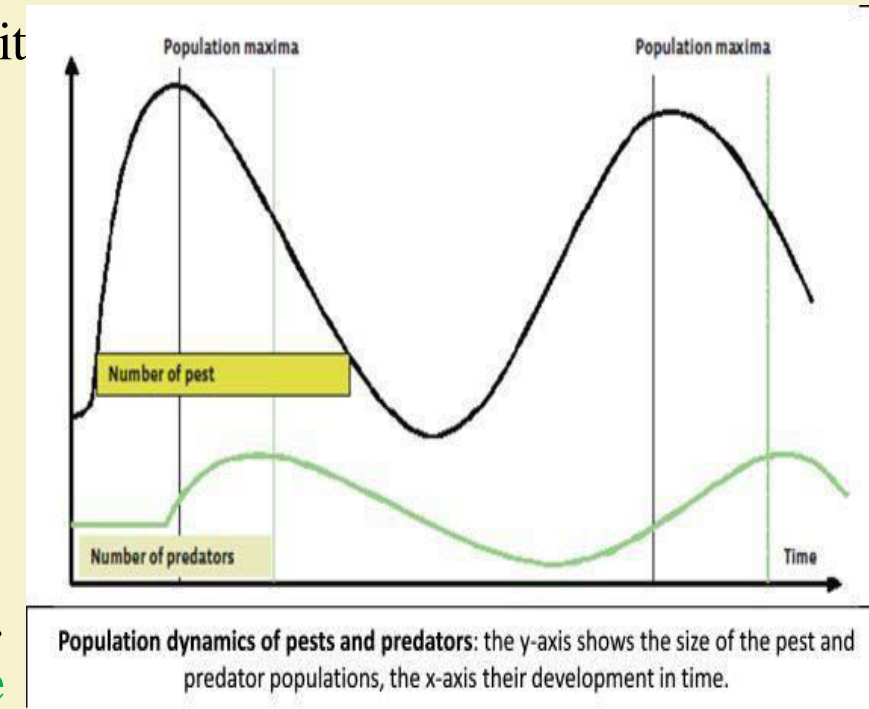
There are two approaches to biological control through the release of natural enemies:

Preventive release of the natural enemies at the beginning of each season:.

This is used when the natural enemies could not persist from one cropping season to another due to unfavourable climate or the absence of the pest. Populations of the natural enemy then establish and grow during the season.

Releasing natural enemies when pest populations start to cause damage to crops:

Pathogens are usually used in that way, because they cannot persist and spread in the crop environment without the presence of a host (pest).



Releasing Natural enemies

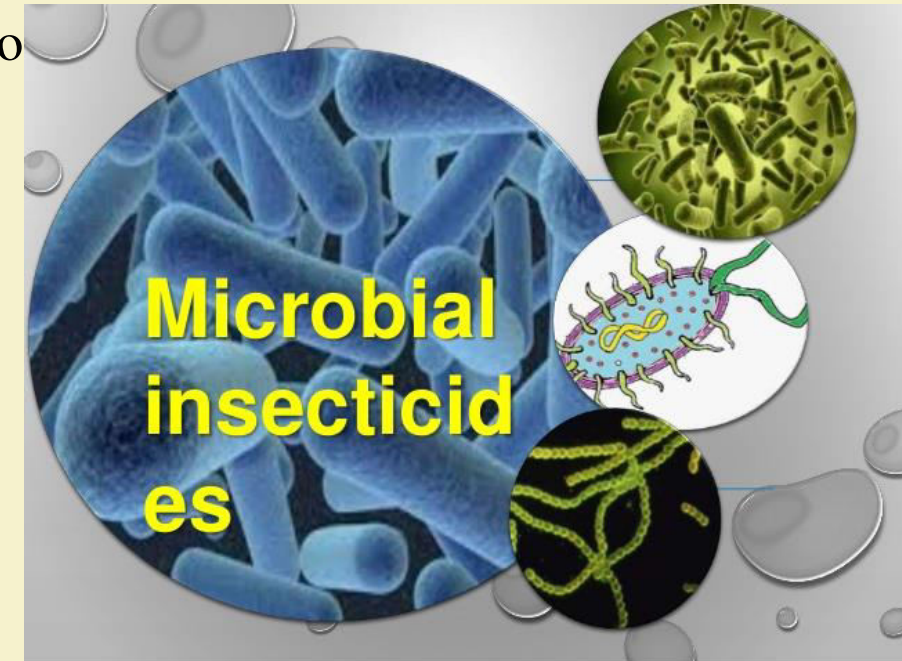
- Natural enemies that kill or suppress pests or diseases are often fungi or bacteria.
- They are called antagonists or referred to as microbial insecticides or biopesticides.

Microbial Insecticides:

Bacteria: *Bacillus thuringiensis* (Bt)

- ✓ Control of caterpillars
- ✓ Beetles in vegetables and other agricultural crops
- ✓ Mosquito and black fly control

Bacillus thuringiensis var. Kurstaki and *Bacillus thuringiensis* var. Aizawai against diverse **lepidopteran pests** (african armyworm. African bollworm. bean armyworm beet armyworm cabbage webworm green looper spiny bollworm pod borers tomato loopers etc.)



Fungi

Fungi that work against plant pathogens

- ✓ *Trichoderma* sp. Wildly used in Asia for prevention of soil-borne diseases such as damping off and root rots in vegetables.
- ✓ *Trichogramma* species against African bollworm.

Trichoderma harzianum:

- ✓ It is known to parasite important plant diseases like **damping off**
- ✓ *Trichoderma* species can affect plant diseases by antibiosis and competition
- ✓ It works as a **growth stimulant** and improves yields and product quality



Damping off

Fungi that work against insects

- **Beauveria bassiana** is an entomopathogenic fungi that causes white muscadine disease in a range of insects.
- **Strain Bb 147** is used for **control of corn borers in maize**
- **Strain GHA** is used against **whitefly thrips aphids and mealybugs** in vegetables and ornamentals.

Viruses

NPV (nuclearpolyhedrosis) virus effective for control of several caterpillar pest species. .
Every insect species requires a specific NPV-species
e.g The armyworm *Spodoptera exigua* is major problem in Indonesia. SeNPV specific for *S. Exigua*.

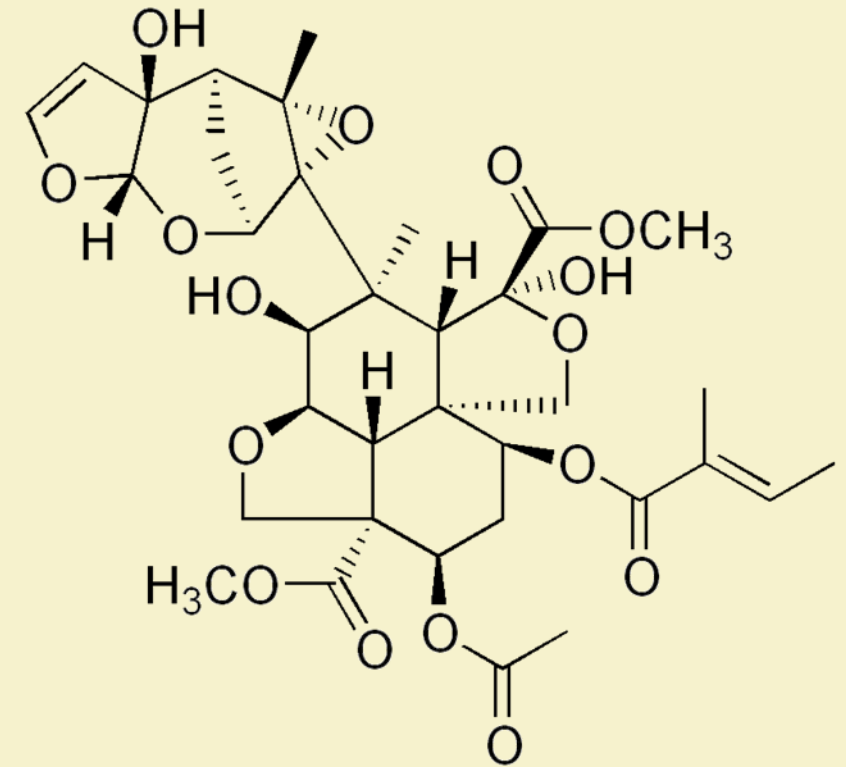
Bio-pesticides

- Some plants contain components that are **toxic to insects**. When these plant extracts applied on infested crops, they are called **botanical pesticides**.
- **Azadirachtin** (Neem), **Pyrethrins** (*Chrysanthemum* sp.), **Rotenone** (*Derris* sp.), **Nicotine** (Tobacco), **Limonene** (Citrus) have been used as botanical pesticides.
- Most botanical pesticides are contact, respiratory, or stomach poisons. Therefore, they are not very selective, but target a broad range of insects.
- Botanical pesticides are generally highly bio-degradable so that they become inactive within hours or a few days. This reduces again the negative impact on beneficial organisms and they are environmentally safe compared to chemical pesticides.

Commonly used botanicals pesticides

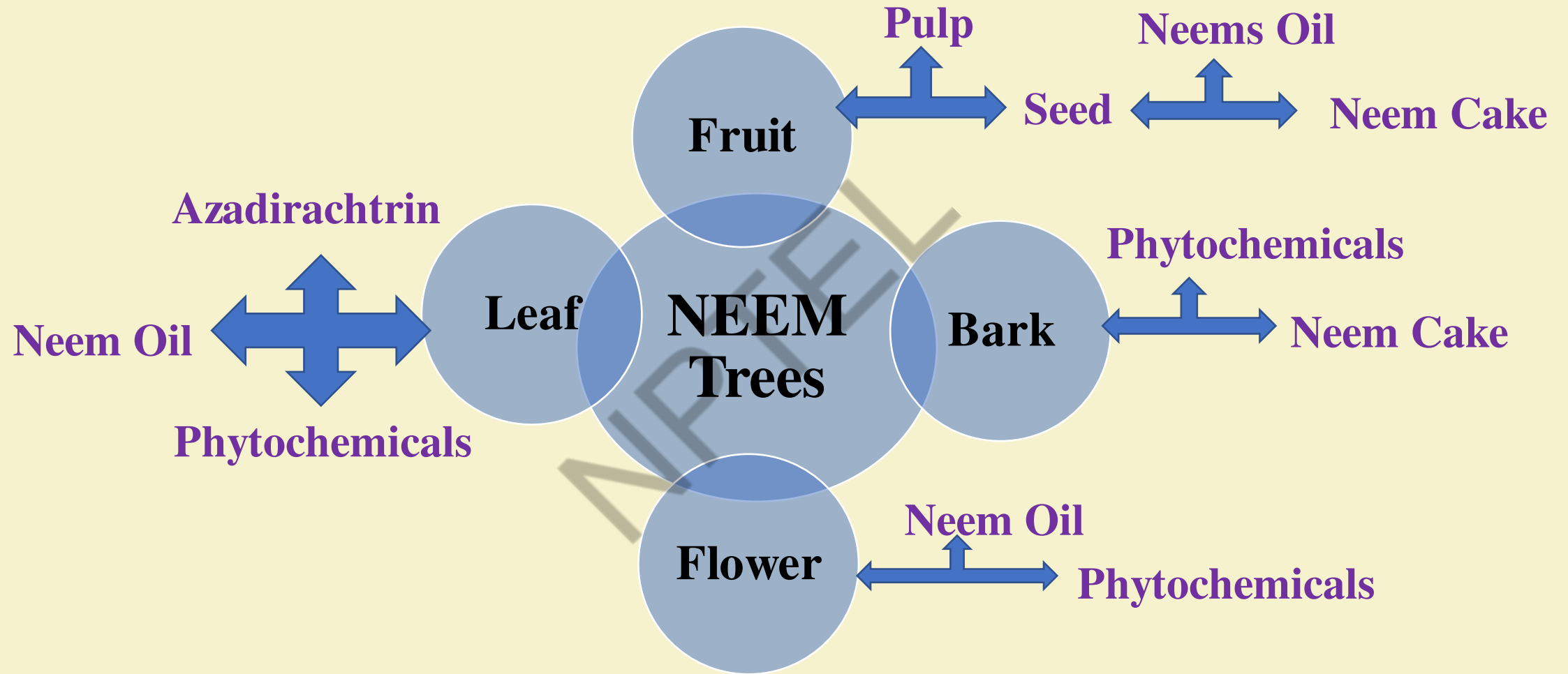
Neem:

- Active ingredient is **azadirachtin**. Both deters and kills many species of caterpillars thrips and whitefly.
- Neem seeds contain a higher amount of neem oil.
- A neem solution loses **its effectiveness within about 8 hrs** after preparation and when exposed to direct sunlight.
- Most effective to apply neem in the evening directly after preparation under humid conditions.



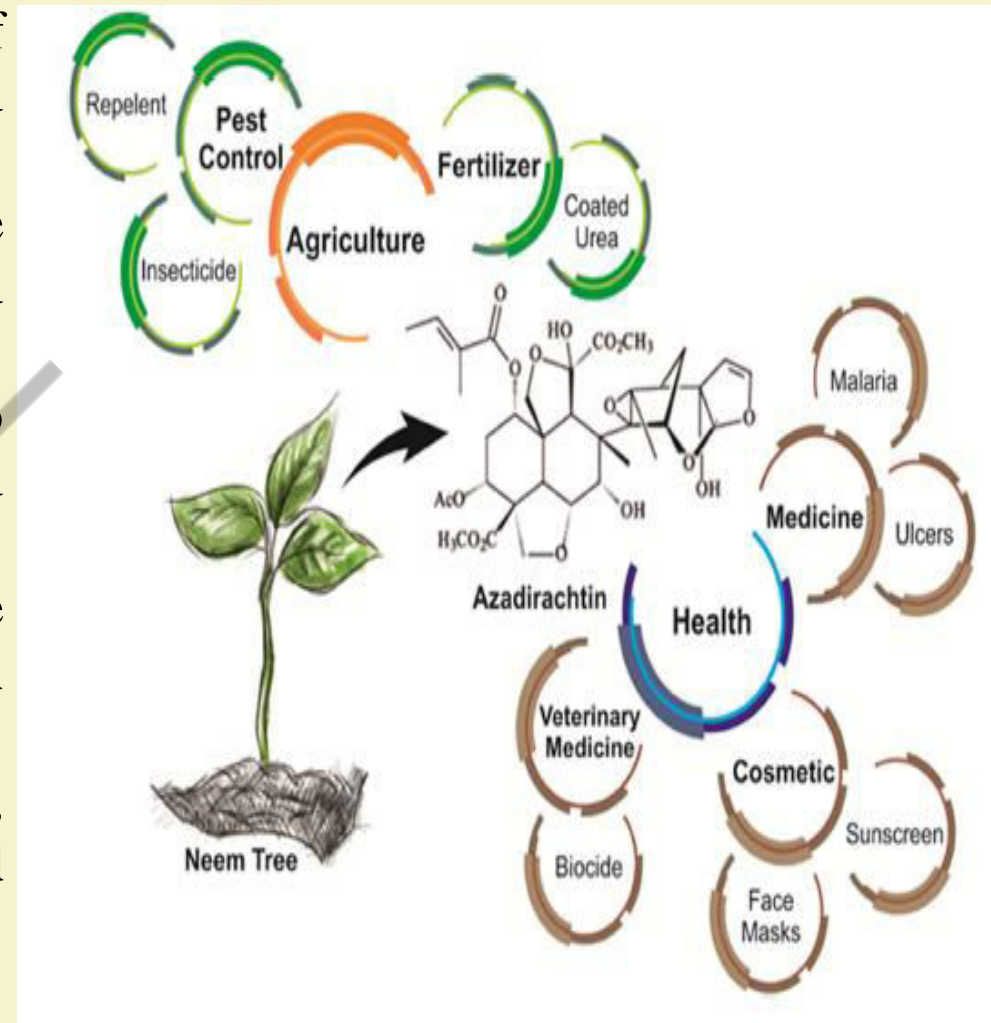
Azadirachtin

Neem Products as for pest control



Neem Applications

- ❑ Neem has been used in **folk medicine** for the treatment of conditions such as malaria, ulcers, cardiovascular disease, and skin problems
- ❑ In the **cosmetics and hygiene sector**, neem is used in the composition of face masks, lotions, sunscreens, soaps, and toothpastes
- ❑ It has a powerful **insect growth regulator (IGR)** that also affects many other organisms (such as nematodes and fungi) and can act as a **plant fertilizer**
- ❑ Neem seed cake can be used as a **biofertilizer**, providing the **macronutrients** essential for plant growth that **improve soil quality and enhance the quality** of crops.
- ❑ Due to their compositional complexity, act as **anti-feedants**, **growth regulators**, **sterilants**, **anti-oviposition agents**, and **repellents**.



Neem applications and commercial products available worldwide

Application	Product	Manufacturer in India
Fertilizer	Ozoneem cake	Ozone biotech
	Ozoneem coat	Ozone biotech
	Parker neem coat	Parker Neem
	Neem Urea Guard	Neemex
Agrochemical	Subhdeep Neem Oil	King Agro Food
	Ozoneem Oil	Ozone Biotech

Application	Product	Manufacturer in World
Fertilizer	Fortune neem cake	Fortune biotech (USA)
	Fortune neem coat	Fortune biotech (USA)
	Neem cake	Uniball Corporation (Russia)
Agrochemical	Fortune Aza 3% EC	Fortune biotech (USA)
	Azamax	UPL Ltd. (Brazil)
	Safer Brand 3 in 1	Wood stream Corp. (Canada)



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