



# Botanicals in Integrated Pest Management



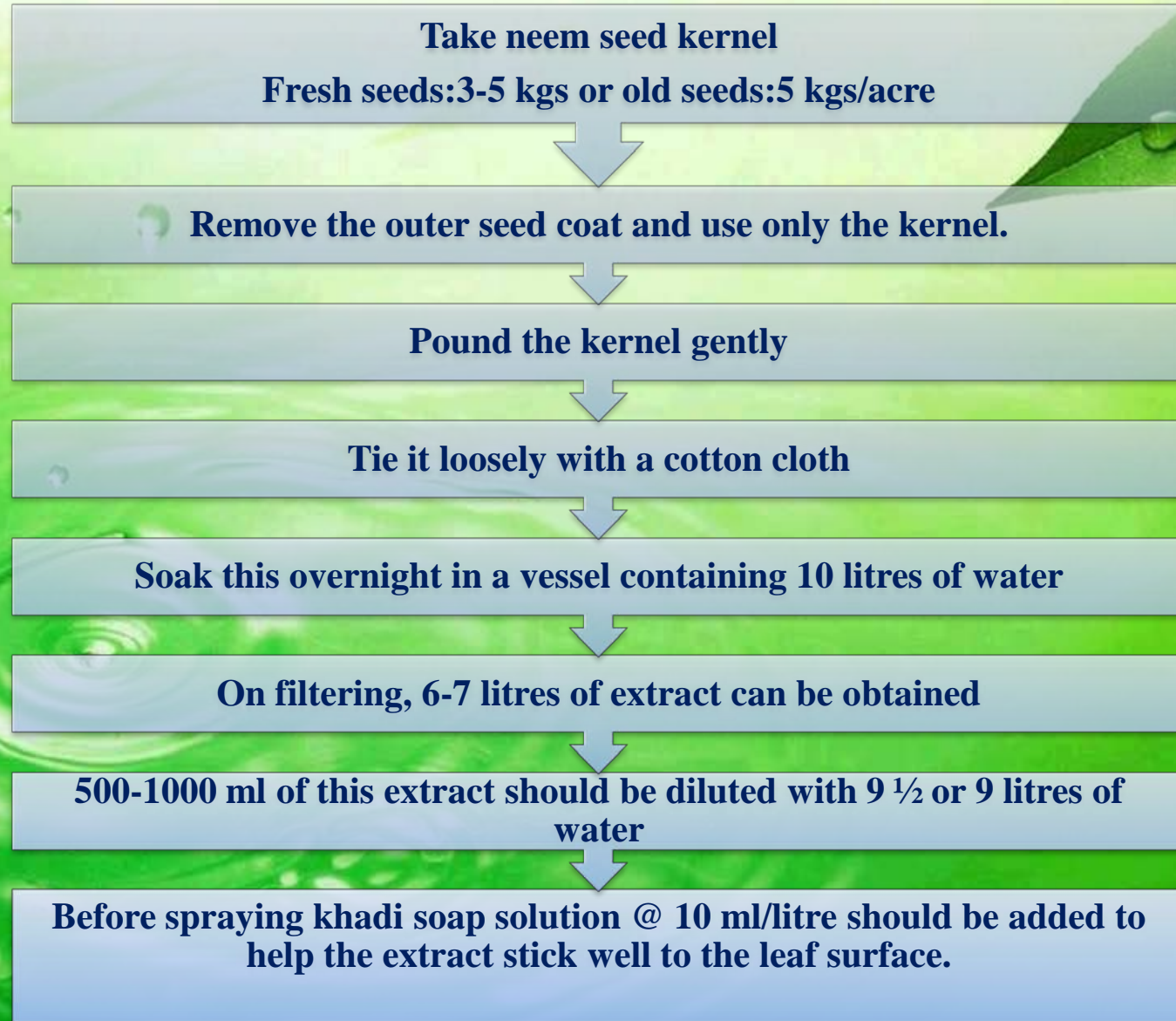
# Neem



- **Derived from seeds of *Azadirachta indica*.**
- **Active ingredient- Azadirachtin present in seeds and leaves.**
- **Concentration: Neem kernel based EC and oil.**
- **Neem oil, Neem cake, neem kernel extract and suspension.**
- **Ex: Gronim, Neemazal, Achook, Nimbecedine.**



# Preparation of Neem Seed Kernel extracts 500 to 2000 ml per tank (10 litres capacity)



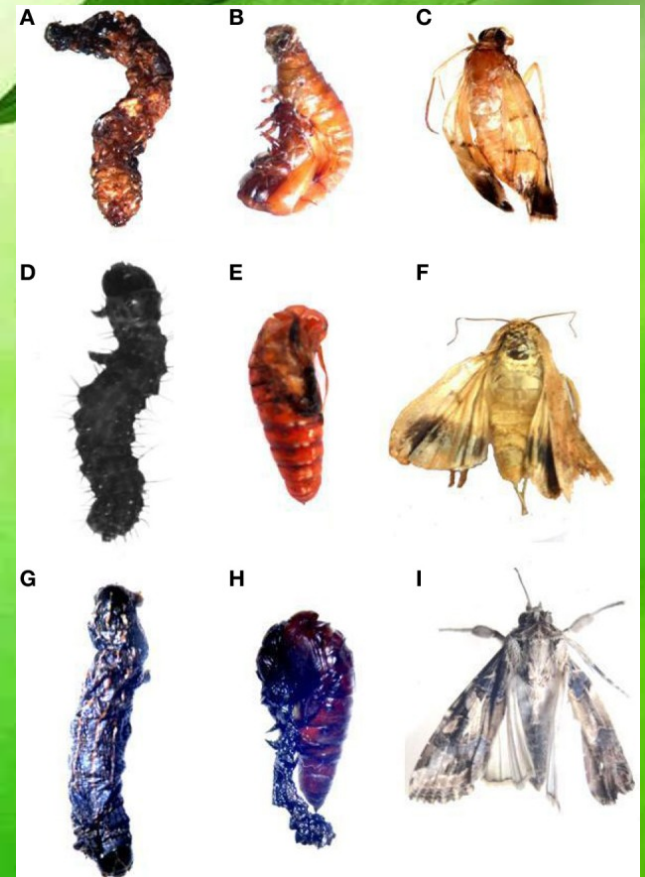
## Commercially produced Neem-based pesticides in India

	Trade name	Formulation(s)		Trade name	Formulation(s)
1	Achook	0.5 % aza, nimbicinol, epinimbocinol	8	Neemax	Seed powder (300 ppm aza)
2	Bioneem	0.03 % aza	9	Neemicide	300 ppm
3	Econeem	0.3 % aza, 1.0 % aza	10	Ozoneem	300, 1500, 3000, 10,000, 50,000 ppm aza
4	Limonool	75 EC (0.3% aza)	11	RD-9 Repelin	100 EC aza, <i>Pongamia</i> , <i>Annona</i>
5	Margocide- CK	20 EC (0.15% aza)	12	Shaktiman	0.05 % aza
6	Margocide-O	80 EC (0.03% aza)	13	Neemosan	0.03 % aza
7	Neem gold	0.15 % aza	14	Neemrich	0.03 % aza



# Mode of Action

- Affect insect vigour, longevity and fecundity.
- Antifeedant action, insect growth regulatory activity, oviposition deterrent, repellent action reduction of life span of adults and intermediates formation (Larval-pupal, nymphal-adult and pupal-adult).



Larval deformities of  
Lepidoptera

# Rotenone

- Isolated from roots of leguminous plants *Lonchocarpus* or *Derris elliptica*.
- Broad spectrum contact and stomach poisons.
- Target pests: Caterpillars, aphids, suckers and other pests.
- MoA: inhibits respiratory metabolism (electron transport chain in the mitochondria).
- Use: Dust 0.75 – 1.5 % rotenone.





# Sabadilla



- Derived from seeds of tropical lily, *Schoenocaulon officinale*.
- Alkaloids → Cevadine + Veratridine = Veratrine  
2 : 1
- Contact poison.
- Mode of action: nerve cell membrane action, causing loss of nerve cell membrane action, causing loss of nerve function, paralysis and death.
- Sabadilla is effectively synergized by PBO or MGK 264.

# Ryanodine

- Extracted from woody stems of south American shrub, *Ryania speciosa*.
- Alkaloid with insecticidal activity---- Ryanoids.
- Act as muscular poison by blocking the conversion of ADP to ATP in striated muscles.
- Slow acting stomach poisons.
- Target pests: thrips and worms.
- Dust: 20-40 %.





# Nicotine

- Obtained from tobacco plants, *Nicotiana tobaccum* and *N. rustica*
- Mode of action: mimics acetylcholine in the nerve synapse causing tremors, loss of co-ordination and eventually death.
- Extremely fast acting, causing sever disruption and failure of nervous system.
- Fumigant (Nicotine) or Dust (Nicotine sulphate).
- Available as nicotine sulphate 40 % (Black leaf 40).
- Target pests: thrips, leaf hoppers, mealy bugs and leaf miners.



# Pyrethrum

- Dried flowers of *Chrysanthemum cinerarifolium*.
- Toxic constituents → Pyrethrins
- Mode of action: Pyrethrins exert their toxic effects by disrupting the sodium and potassium ion exchange process in insect nerve fibres and interrupting the normal transmission of nerve impulses.
- Pyrethrins applied with PBO (Piperonyl butoxide).





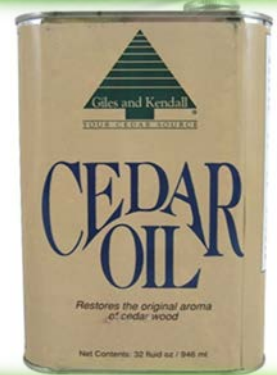
# Limonene and Linanool

- Citrus peel extracts.
- **Limonene**: a terpene, purified from oil by steam distillation.
- **Linanool**: terpene alcohol, found in small quantities in citrus peel.
- **Target pests**: aphids, mites and fleas
- **Act as nerve toxin and stomach poisons**(Limonene)
- **Affects ion transport and release of acetylcholine esterase** (Linanool).



# Other essential plant oils: Herbal repellents and insecticides

- **Repellents:** oils of cedar, lavender, eucalyptus, pennyroyal, and citronella.
- **Target pests:** pets and humans to repel fleas and mosquitoes.
- **Citronella :** sold in the form of candles to repel mosquitoes.





# Mechanism of action of pesticides of plant origin

Compound	Plant source	System	Mechanism of action
Essential oils	<i>Azadirachta indica</i> , <i>Mentha spp.</i> , <i>Lavendula spp.</i>	Cholinergic system	Inhibition of Acetylcholinesterase
Nicotine	<i>Nicotiana spp.</i> , <i>Haloxylon salicornicum</i> , <i>Stemona japonicum</i>	Cholinergic system	Cholinergic acetylcholine nicotinic receptor Agonist/antagonist
Pyrethrin	<i>Chrysanthemum cinerariaefolium</i>	Mitochondrial system	Sodium and potassium ion exchange disruption
Rotenone	<i>Lonchocarpus spp.</i>	Mitochondrial system	Inhibitor of cellular respiration (mitochondrial complex I electron transport inhibitor (METI))
Ryanodine	<i>Ryania spp</i>	Mitochondrial system	Affect calcium channels
Sabadilla	<i>Schoenocaulon officinale</i>	Mitochondrial system	Affect nerve cell membrane action
Azadirachtin	<i>Azadiractina indica</i>	Miscellaneous	Hormonal balance disruption

# Utilization of Botanicals in Pest Management



- Direct spray applications of extracts of biologically effective plant products.
- Used as soil amendment → Soil inhabiting pests: white grubs and root knot nematodes.
- Intercropping/mixed cropping: Marigold with tomato or brinjal → minimize incidences of root knot nematodes.
- Used as grain/potato protectants against insects in storage. Eg: Azadirachtin, kernel powder or oil, leaves of senwar, bel, wild sage, lantana.
- Used as synergists/ binders for synthetic pesticides to enhance the biological activity of the pesticides. Eg: Pyrethrum with piperonyl butoxide; sesamum oil with permethrin dusts and neem oil.
- Use of botanical based synthetic/ commercial formulations neem and tobacco.



# Neem extracts and recommendation

Crop	pests	Recommended botanical
Cotton	Jassids, aphids, thrips, Whiteflies, bolloworm	Neem products @ 1500 ppm
Rice	Stem borer, hoppers	NSKE 5%
Rice	Thrips	2% neem oil or 10% neem cake extract
Groundnut	Defoliators and mites	5 % NSKE or Crude neem oil + 2 % teepol
Pigeonpea	Pod borer	5% NSKE
Chickpea	Helicoverpa	5% NSKE
Brinjal	Sucking pests	5% NSKE 3 sprays
Okra	Leaf hopper, whiteflies and mites	5% NSKE 3 sprays
Cabbage and Cauliflower	-	5% NSKE
Coconut	Mites	Neem formulation (5ml) + <i>Hirsutella thompsonii</i> (5g)

## Neem Cake and its recommendation in different crops

Crops	Dose	Target organisms
Orange	200 kg/ha	Citrus nematode
Paddy	2.5q/ha or 100 g/m <sup>2</sup>	<i>Meloidogyne graminicola</i>
Sugarcane	200 kg/ha	Root grubs
Banana	200 kg/ha	Root knot nematodes
Tomato	200 kg/ha	Seedling nematodes



# **Advantages of botanical pesticides over synthetic pesticides**

- **Low mammalian toxicity thus constitute least or no health hazards and environmental pollution.**
- **No risk of developing pest resistance.**
- **Less hazards to non-target organisms.**
- **No adverse effect on plant growth, seed viability and cooking quality of the grains.**
- **Less expensive and easily available because of their natural occurrence especially in oriental countries.**

## **Drawbacks and barriers to commercialization**

- **Sustainability of the botanical resource**
- **Standardization of chemically complex extracts**
- **Regulatory approval**
- **Rapid degradation**
- **Market opportunities for botanical pesticides**
- **Weather conditions**



# Integration with other tactics

## 1. Integration with biological control :

- eg: application of NSKE against *S. litura* did not affect the emergence of egg parasitoids *Telenomus remus* and predator *Brinckochrysa scelestes*.
- Neem oil application in chinaberry and custard apple and Neem extract in rice against stem borer and hoppers:
  - no adverse affect on predatory spider *Lycosa pseudoannulata* and slightly toxic to mirid bug predator *Cyrtorhinus lividipennis*.
- First field trial with neem oil: sorghum aphid *Melanopsis sacchari* no adverse affect on syrphids and coccinellids.
- Neem oil 50% has no adverse effect on *Chrysoperla cornea* and *Tetrastichus howardi*