

Organic Pesticides

The science behind their efficacy



Pesticide modes of action

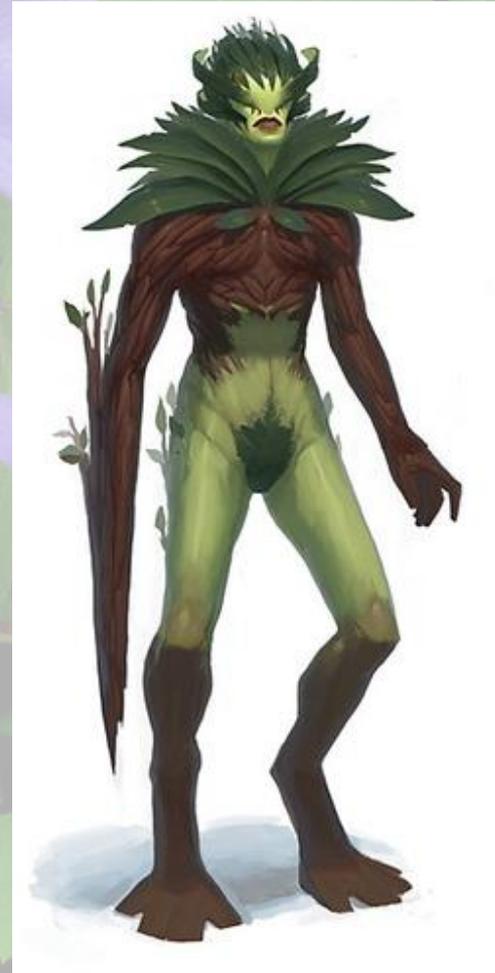
🚫 Preventative*

- 🚫 Feeding
- 🚫 Egg laying
- 🚫 Spore and seed germination

🚫 Curative

- 🚫 Suffocation
- 🚫 Starvation
- 🚫 Disruption of biochemical and/or physiological processes

*must be able to predict



Preventative - feeding



- 🚫 Odor
- 🚫 Repellant
- 🚫 Fear-inducing
- 🚫 Taste
- 🚫 Irritant
- 🚫 Repellent
- 🚫 Touch
- 🚫 Oily
- 🚫 Gritty

Preventative - egg laying & germination

🚫 Prevent insect egg laying

- 🚫 Make surface inaccessible
- 🚫 Make surface unpleasant



🚫 Prevent fungal spore germination

- 🚫 Make surface inaccessible
- 🚫 Change surface chemistry



Curative

🚫 Suffocation

🚫 Cover surfaces or clog pores

🚫 Starvation

🚫 Digestive system poisons

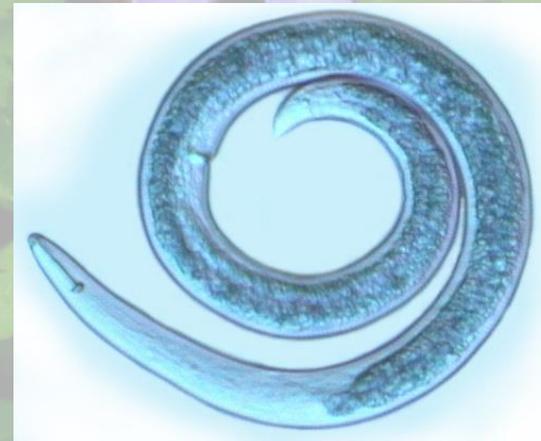
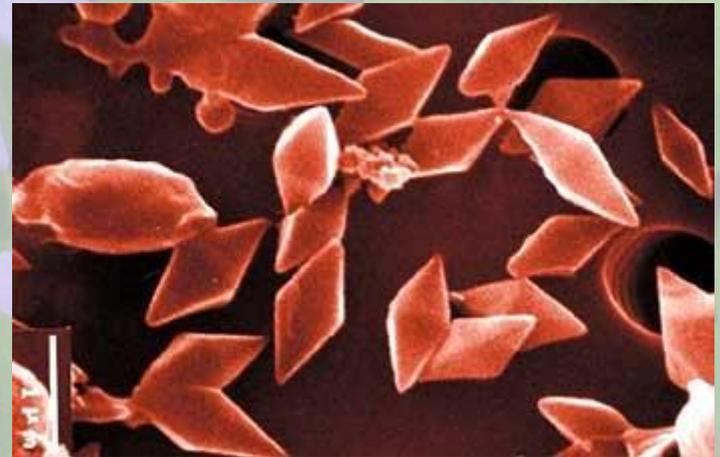
🚫 Disruption

🚫 Cuticle abrasion

🚫 Growth and development

🚫 Enzyme poisoning

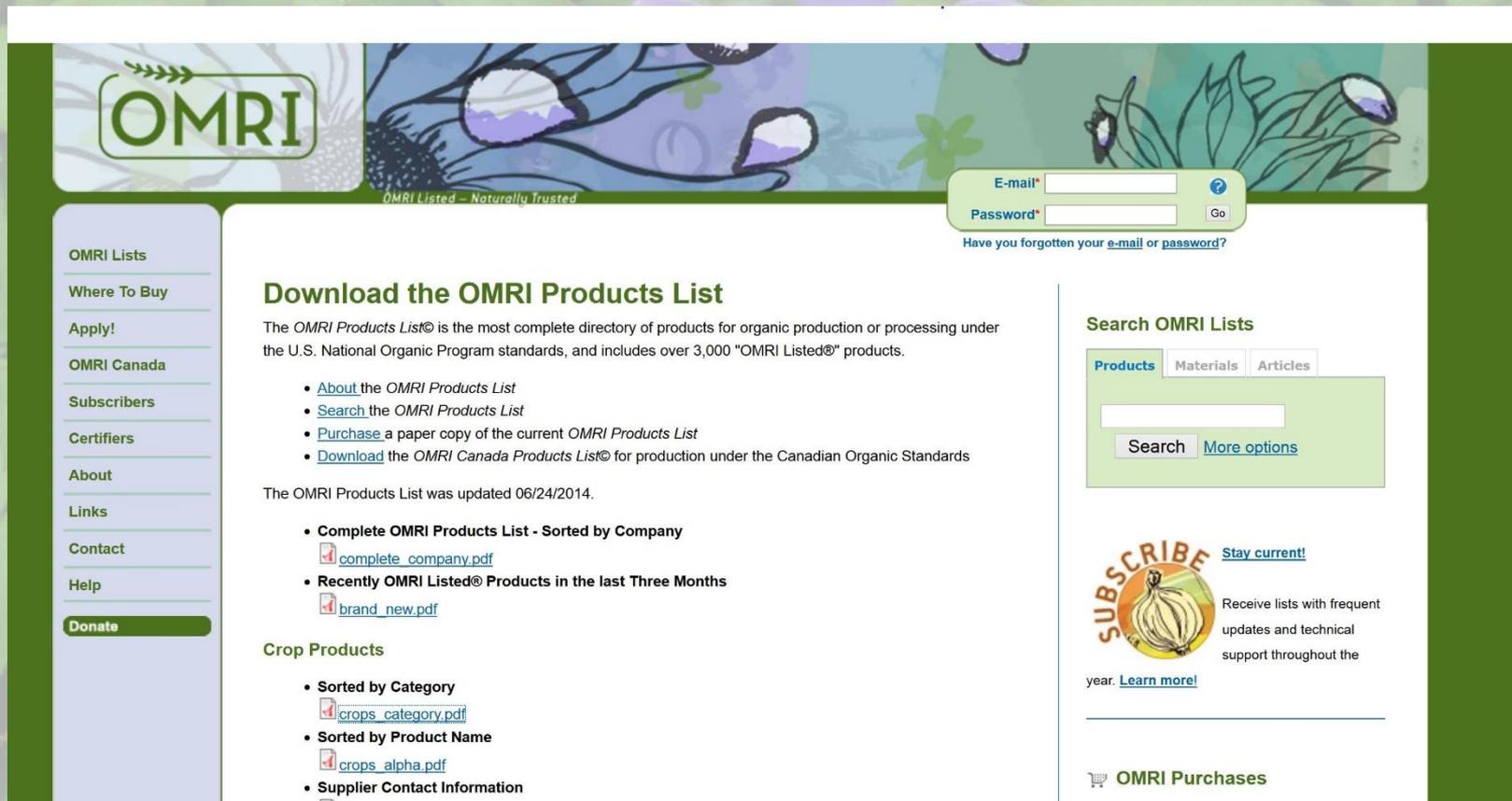
🚫 Neurotoxin



Study parameters

- ❌ Compiled information from scientific databases
- ❌ Included only materials certified as organic through OMRI (Organic Materials Review Institute)
- ❌ Focus on materials with potential, practical use for landscapes and gardens

OMRI website



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Crop Pest, Weed, and Disease Control pages 36-50

processing equipment, seed and asexually propagated planting material. Also permitted in hydrogen peroxide formulations as allowed in § 205.601(a) and 205.601(i) at a concentration of no more than 6% as indicated on the pesticide product label.

BioSide™ HS 15% (Enviro Tech Chemical Services Inc)

REPLETE-O (Acqua Concepts, Inc.)

Surestand Hydrogreen (Summit Seed Coatings LLC)
Surestand Seed Coating (Summit Seed Coatings LLC)

POSSIBLY FLOWERS (Pest Control King International, LLC)

Crop Pest, Weed, and Disease Control

Azadirachta indica

May be used as a pesticide if the requirements of 205.206(e) are met, which requires the use of preventative, mechanical, physical, and other pest, weed, and disease management practices.

NeemAzad® 1% EC Insect Growth Regulator (Certis USA)

ψ: Products with this symbol are liquid fertilizers that have been inspected and approved for use in NOP organic production by OMRI.

Δ: Products with this symbol are certified 'organic' or '100% organic' by a USDA accredited certifier.

Ж: Products with this symbol are not permitted for use as a pesticide in the USA.

http://www.omri.org/sites/default/files/op_l_pdf/crops_category.pdf

Pesticide realities

- ❌ Pesticide registration does not include product efficacy testing
- ❌ Success in lab testing does not guarantee success in the field



Key to symbols

-  Robust science behind use 
-  Research results are mixed 
-  Research does not support use in study context 
-  Research does not support use 

Inorganic chemicals

- 🚫 Boric acid ★
- 🚫 Copper (fixed and -sulfate) ★
- 🚫 Diatomaceous earth ★
- 🚫 Ferric phosphate (iron EDTA) ★
- 🚫 Hydrogen peroxide ■
- 🚫 Kaolin ★
- 🚫 Lime sulfur (calcium polysulfide) ★
- 🚫 Potassium bicarbonate ★
- 🚫 Potassium silicate ?
- 🚫 Sodium carbonate peroxyhydrate (sodium percarbonate) ■
- 🚫 Sodium chloride ■
- 🚫 Sulfur ★

Organic chemicals

-  Citric acid 
-  Limonene 
-  Oils (no biological activity) 
-  Peracetic acid 
-  Soap (sodium lauryl sulfate) 
-  Sucrose octanoate ester 
-  Vitamin D3 (cholecalciferol) 

Botanical derivatives

- 🚫 Azadirachtin ★
- 🚫 Castor oil ★
- 🚫 Cinnamon oil ?
- 🚫 Garlic ?
- 🚫 Pyrethrum (aka pyrethrins) ★
- 🚫 Rosemary oil ?
- 🚫 Sesame oil ★
- 🚫 Thyme oil ?
- Black pepper oil ?
- Cedar oil ?
- Clove oil ?
- Peppermint oil ?
- Reynoutria extract ★
- Sabadilla ★
- Soapbark tree extract ★
- Wintergreen oil ?

Biocontrol organisms

Bacteria

Bacillus amyloliquefaciens ★

Bacillus subtilis ★

Bacillus thuriengensis ★

Chromobacterium subtsugae ★

Paenibacillus popilliae ★

Pantoea agglomerans ★

Pseudomonas spp. ★

Streptomyces acidiscabies - no research

Streptomyces griseoviridis ★

Streptomyces lydicus ★

Biocontrol organisms

Fungi and related species

- Beauveria bassiana* ★
- Coniothyrium minitans* ★
- Gliocladium catenulatum* ★
- Gliocladium virens* ★
- Myrothecium verrucaria* ★
- Nosema locustae* ★
- Paecilomyces fumosoroseus* ★
- Paecilomyces lilacinus* ★
- Pythium oligandrum* ★
- Trichoderma harzianum* ★
- Ulocladium oudemansii* ★

Biocontrol organisms

Nematodes

Steinernema carpocapse ★

Steinernema glaseri ★

Virus sprays

Coddling moth granulosis virus ★

Helicoverpa zea single capsid NPV ❌

Spodoptera exigua NPV ❌

Biological products

Animal

Blood (dried) 

Coyote/fox urine 

Egg solids (putrescent) 

Pheromones 

Microbial (bacterial)

Rhamnolipid biosurfactants 

Spinosad 

Streptomycin sulfate 

Tetracycline 

Bactericides

☒ *Pantoea agglomerans*

☒ *Pseudomonas spp.*

☒ Streptomycin sulfate

☒ Tetracycline



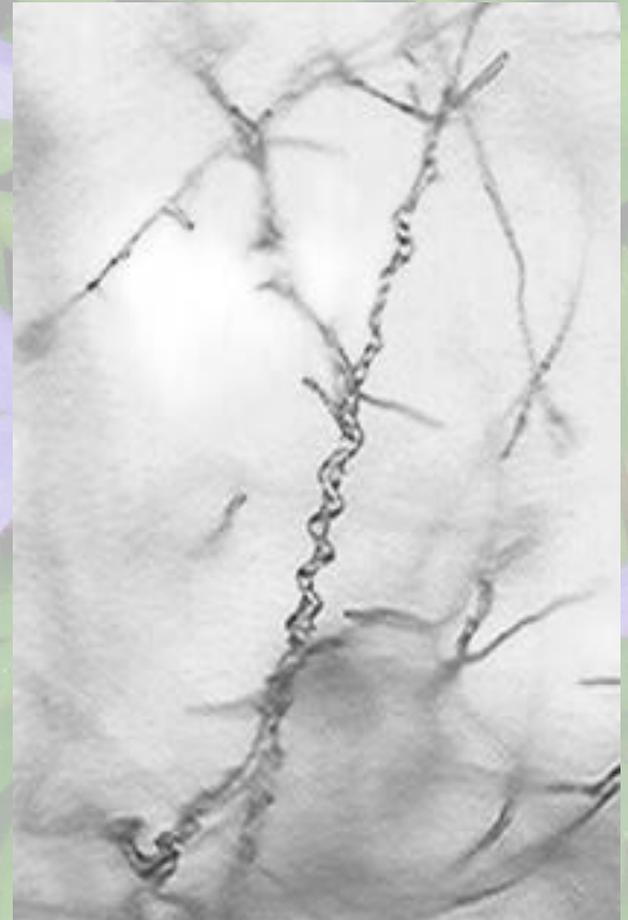
Fungicides

- 🚫 Boric acid
- 🚫 Copper
- 🚫 Kaolin
- 🚫 Neem
- 🚫 Oils (physical)
- 🚫 Potassium bicarbonate
- 🚫 Reynoutria
- 🚫 Soap/saponins
- 🚫 Sulfur/lime sulfur



Fungal antagonists

- ❌ *Bacillus amyloliquefaciens*, *B. subtilis*
- ❌ *Coniothyrium minitans*
- ❌ *Gliocladium catenulatum*
- ❌ *Gliocladium virens*
- ❌ *Myrothecium verrucaria*
- ❌ *Pythium oligandrum*
- ❌ *Streptomyces griseoviridis*
- ❌ *Streptomyces lydicus*
- ❌ *Trichoderma harzianum*
- ❌ *Ulocladium oudemansii*



Herbicides

🚫 *Myrothecium verrucaria*

🚫 Oils (physical)

🚫 Reynoutria

🚫 Soap/saponins



Insecticides

- 🚫 Azadirachtin/neem
- 🚫 Boric acid
- 🚫 Diatomaceous earth
- 🚫 Kaolin
- 🚫 Neem
- 🚫 Oils (physical)
- 🚫 Pheromones
- 🚫 Pyrethrum
- 🚫 Sabadilla
- 🚫 Soap/saponins
- 🚫 Spinosad
- 🚫 Sucrose octanoate ester



Insecticides

- ❌ *Bacillus thuriengensis*
- ❌ *Beauveria bassiana*
- ❌ *Chromobacterium subtsugae*
- ❌ Coddling moth GV
- ❌ *Paenibacillus popilliae*
- ❌ *Nosema locustae*
- ❌ *Paecilomyces fumosoroseus*
- ❌ *Steinernema carpocapse*
- ❌ *Steinernema glaseri*



Other pesticides

- 🚫 Molluscicide - Ferric phosphate
- 🚫 Nematicide - *Paecilomyces lilacinus* (recently renamed *Purpureocillium*)
- 🚫 Rodenticide - Vitamin D3



Deterring browsers

Modes of action

- ❌ **Neophobia** (meat and bone meal) -rapid habituation when feeding pressure is high
- ❌ **Conditioned aversion** (addition of chemicals such as thiram that cause gastric upset)
- ❌ **Irritation** (capsaicin)
- ❌ **Flavor modification** (blood meal)

Blood

- 🚫 Effective against deer when added directly to foliage (flavor modification)
- 🚫 Can be phytotoxic
- 🚫 Ineffective against rabbits



Coyote/fox urine

- ❌ Coyote urine
 - ❌ effective against deer, mountain beaver, and possum browsing
 - ❌ inconsistent against rodents
- ❌ Fox urine effective against gray squirrels
- ❌ Urine from non-predators ineffective
 - ❌ Diet composition important for the repellency of predator odors

Putrescent egg solids

- ❌ Limited effectiveness against elk (5 weeks)
- ❌ Limited effectiveness against deer
- ❌ Limited effectiveness against cattle (3 weeks)
- ❌ Most effective when browsing intensity is low



Essential oils

🚫 Black pepper

🚫 Clove

🚫 Garlic

🚫 Peppermint

🚫 Thyme

Cedar

Cinnamon

Limonene

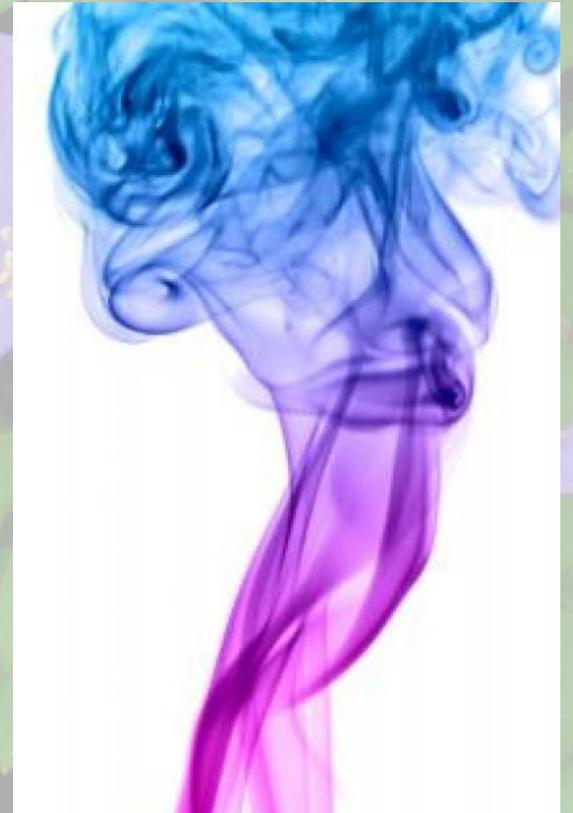
Rosemary

Wintergreen



Essential oils

- ❌ Volatile, so short-lived in landscape
- ❌ Work best in enclosed areas, like beehives
- ❌ Can be phytotoxic
- ❌ Generally not cost effective



Popular mixed essential oil products

- 🚫 “...blending extracts...does not ensure enhanced biological activity.”
- 🚫 “...numerous plant-derived essential oil products...have not been subject to rigorous evaluation.”
- 🚫 “Products vary in their effectiveness against certain arthropod pests...and are phytotoxic.”

ST. GABRIEL LABORATORIES

Sharp Shooter
MADE FROM PLANT OILS

NEW & IMPROVED FORMULA!

KILLS HOUSEPLANT & GARDEN BUGS

Ants (including fire ants)
Aphids
Earwigs
Mosquitoes
Whiteflies

Active Ingredients	
Clove Oil	0.5%
Sodium Lauryl Sulphate	1.0%
Inert Ingredients	
(Mineral Oil, Orange Oil, Lecithin, Water, Citric Acid)	98.5%
Total.....	100.0%

READY-TO-USE

KEEP OUT OF REACH OF CHILDREN
See back panel for additional precautionary statements.

24 Fl. Oz. (710 ml)

FOR USE IN AND AROUND THE HOME AND GARDEN

Phytotoxic oils



- ❌ Species-specific
- ❌ Too much applied
- ❌ Temperature too high
- ❌ Test first!



Potential drawbacks - big and small

- ❌ Broad spectrum pesticides can kill beneficials, other non-target organisms
- ❌ More frequent application often needed
- ❌ Pests can develop resistance
- ❌ Some products phytotoxic







Linda Chalker-Scott

Organic Pesticides: Reviewing the Science Behind their Efficacy



CF - 14 - 054

0.75 A,U,T,M,L,Bs

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