

Insecticides for Organic Commercial & Backyard Vegetable Production

By Dr. Ayanava Majumdar (Extension Entomologist), Lloyd Chapman, James Miles, Chip East, Mike Reeves, Bethany O'Rear, Gary Gray, and Neil Kelly (Regional Extension Agents, ACES)

Selecting insecticide for organic crop production is not an easy task. Producers should always choose the right insecticide after correct pest identification. Also, proper insecticide rotation is the key to avoid insecticide resistance whether you are using organic or traditional chemical insecticides. There are hundreds of products available today but finding the right product can be difficult in a typical retail store where a biological or organic insecticide could be displayed adjacent to a chemical product (Fig. 1). This publication is meant to be a handy guide for organic vegetable producers and gardeners with examples of commercial products.

Organic crop production is not pesticide free!

Organic crop production is a difficult system in high pest pressure areas and producers must think about pest prevention rather than pest control. The USDA National Organic Program (NOP) practice standards suggest the use of systems-based practices (cultural practices, sanitation, crop rotation, trap crops) and mechanical practices (insect netting, row covers, and hand-picking) to prevent pest colonization and impact on crops (visit <http://tinyurl.com/cmr73v4> for more information).

Just as with traditional chemical insecticides organic insecticides should be used as a last resort, but they are vital in our battle against insects. It is important to know that the word 'organic' is not synonymous with 'pesticide-free'; rather, organic means the use of alternative pesticides that undergo a thorough review process by a government-approved agency. Organic insecticides may not be safe for beneficial insects, although organic formulations are sometime referred to as 'low impact' insecticides due to the nature of the formulation and their non-persistent action. Alternative insecticides, such as botanicals and microbial organisms, are effective but may require the use of high application rates and numerous repeat applications. This publication briefly describes the various modes of action and formulations of alternative insecticides that have been approved by the Organic Materials Review Institute (OMRI) for organic crop production.

Uniqueness of Organic Insecticides for Producers versus Gardeners

Organic producers have a range of products to choose from and OMRI-approved products are generally sold in bulk packaging and are often quite expensive. Bulk amounts of organic insecticides for crop production are available from some vendors (e.g., Helena, Crop Production Services, Monterey AgOrganics) and may not typically be available in retail stores.

Few OMRI-approved insecticides are available for gardeners and they could be hard to find at the retail stores. These are typically the ready-to-use (RTU) products and priced high for small packages. Home garden pesticides that are not OMRI-approved may bear an 'environment-friendly' mark on the package to indicate natural ingredients. So, read the label carefully and decide your course of action. Gardeners have the option of purchasing OMRI-approved commercial organic insecticides over the Internet, since these are general use products and do not require restricted use permits to purchase. Small gardeners can buy products online from various websites, e. g., Arbico Organics, Grow Organic, BioControl Network, Gardensalive.com, etc.

Product safety

Anything labeled as an insecticide should be considered a poison. And, there are no safe poisons! Organic insecticides are not necessarily safe to nontarget organisms like pollinators, predatory beetles and parasitoids. So care must be taken to minimize spraying over natural enemies; insecticide applications

should be directed toward the plant pests or specific plant parts. Treatments should be done in the evening hours and to the underside of leaves when the air is calm and pollinators are not active. Application in the evening hours can increase the persistence of the microbial insecticides. For specific non-target impacts and application techniques, consult the insecticide label and follow it strictly. **THE LABEL IS THE LAW!**

About microbial insecticides

There are a number of microbial insecticides available for organic farming. Microbial insecticides need to be handled and applied differently than the botanical insecticides and oils. Always mix microbial insecticides immediately before application and agitate the tank during spraying as the spores may settle. Application of living spores to the underside of leaves and stems is recommended in order to increase persistence of these products and to protect them from wash-off. Many microbial insecticides can be purchased directly from a distributor or manufacturer's website, while some may be available at the retail stores (e.g., Bt). Remember to check the expiration date on the containers before purchasing and always store products under cool dry conditions.

Additional resources

Organic crop producers or producers who are transitioning to organic systems should consult their certification agency for list of approved products. Please check the OMRI website for the most up-to-date listing of approved organic products; visit <https://www.omri.org/>. Another useful resource for locating pest-specific scouting and ecological pest management tactics is the National Sustainable Agriculture Information Service (ATTRA) website; visit <https://attra.ncat.org/index.php>. The Alabama Cooperative Extension System has an IPM newsletter (called the IPM Communicator) that producers can subscribe to for receiving pest alerts and management recommendations on a weekly basis. Alabama SARE Program has a website that provides information regarding events, project reports, and social media channels; visit <http://www.southernsare.org/SARE-in-Your-State/Alabama>

Formulation acronyms

Many of the commercial insecticide formulations mentioned in this bulletin have acronyms that indicate the type of formulation.

D = Dust

DF = Dry Flowable

EC = Emulsifiable Concentrate

WDG = Water Dispersible Granule

WG = Wettable Granule

WP = Wettable Powder

RTU = Ready-to-Use

Below are some common alternative insecticides available to organic crop producers and gardeners along with product names to serve as examples. Some products may become unavailable over time. All commercial product names have been highlighted for easy viewing.

***Bacillus thuringiensis* (Bt).** This is the largest selling commercial biological insecticide in the world. Commercial Bt products contain fermentation solids, bacterial spores and insecticidal toxins. Bt is a stomach poison that paralyzes the insect gut and causes infection in the body that kills the insect. The smaller the insect when Bt is applied, the better will be the control. Large caterpillars are very difficult to control and have generally already done the economic damage to crops. The liquid and water soluble formulations are easier to apply (at variable rates) to the underside of leaves using regular garden sprayers than the Bt dust commonly sold for home use. Apply living insecticides on the lower leaf surfaces to increase the persistence of these products. Bt should be prepared fresh before each application so the

infective spores are alive in solution. Certis USA and Valent BioSciences have several Bt formulations that are pest specific, for example,

- **Agree WG** contains Bt subspecies *aizawai* GC-91 for controlling caterpillar pests in ornamental, fruit, and vegetable crops
- **CoStar** and **Deliver** contains Bt subspecies *kurstaki* SA-12 for controlling caterpillar pests in row crops and vegetables
- **Crymax WDG** contains Bt subspecies *kurstaki* EG7841 for controlling caterpillar pests in vegetables, herbs, fruits and field crops.
- **Javelin WG** contains Bt subspecies *kurstaki* SA-11 for controlling caterpillar insect pests in many fruit, vegetable, and field crops.
- **Lepinox WDG** contains Bt subspecies *kurstaki* EG7826 and is not OMRI approved for organic production. Besides labeled use in fruit, vegetable and field crop production, Lepinox can be applied in pasture and hay crops.
- **DiPel DF** (54% active ingredient) contains Bt subspecies *kurstaki* ABTS-351 and is OMRI approved for use in organic vegetable production. This product can also be safely used on herbs and forage crops. **DiPel Pro DF** is labeled for greenhouse ornamental and nursery production. Dipel dust sold for home garden pest control is not OMRI approved, has less than 1% Bt, and it may not work for commercial organic growers.

For organic producers: **DiPel DF** (Fig. 2), **Xentari** (Valent BioScience), **Agree WG**, **CoStar**, **Crymax**, **Javelin WG** (Certis USA), **Safer Brand Caterpillar Killer** (Woodstream)

For home gardeners: **BT Worm Killer Concentrate** (Green light, 15% Bt), **Dipel D**, **Thuricide Concentrate** (Bonide), **Safer Brand Caterpillar Killer RTU** (Woodstream)

***Beauveria bassiana*:** This is another living insecticide that has spores of a fungus and is effective against aphids, thrips, whiteflies, caterpillars, etc. Do not tank mix *Beauveria* with fungicides because it may kill the living spores. Agitate the spray solution before spraying as the spores may settle out. *Beauveria* penetrates the exoskeleton (skin) of the target insects and enters the blood stream thereby poisoning the host.

For organic producers: **Mycotrol-O** (BioWorks, Fig. 3) is an organic formulation available in the USA, **BotaniGard** is not approved for organic production.

For home gardeners: None available specifically. Home gardeners can purchase biocontrol products from online retailers.

Neem-based insecticides: If you find a neem oil-based product with no azadirachtin in it (check the product label before buying!), then apply the product as you would any other insecticidal oil. Neem oil is a physical poison that can be applied against small and soft-bodied insects. Azadirachtin, an insect growth regulator, is the active ingredient in some neem formulations named below. Neem formulations can be rotated and/or tank-mixed with other organic insecticides. Repeat application may be necessary to keep certain insects under check, e.g., aphids. Certain formulations are approved for greenhouse pest control and may not be OMRI approved (e.g., **Neemazad and Azatin**).

Azadirachtin for organic producers: **Neemix 4.5** (Certis USA, Fig. 4), **AZA-Direct** (Gowan), **Molt-X** (BioWorks, Fig. 5), **Azatrol** (PBI/Gordon)

Azadirachtin for home gardeners (cold-pressed neem): **GreeNeem Oil** (GreeNeem Agri), **70% Neem Oil** (Monterey)

Neem oil for organic producers: **Trilogy** (Certis), **Monterey 70% Neem Oil** (Lawn and Garden Products)

Neem oil for home gardeners: **Green Light Neem Concentrate** (Green Light), **Neem Oil RTU** (Monterey)

Insect killing soap (neem-derivative): **Concern Insect Killing Soap RTU** (Woodstream)

Spinosad: Spinosad is derived from a bacterial fermentation process and commercial formulations contain a mixture of spinosyns. Spinosad has a fast knock-down and is an excellent insecticide for alternating with other ‘softer’ products like oils and Bt. Spinosad is very effective insecticide against caterpillars, flea beetles and thrips. Spinosad is not toxic to predatory insects since it is a stomach poison. Spinosad can be highly toxic to pollinators and products should be applied during evening hours when bees are not around to reduce environmental impacts. At least one product called **Seduce** (Certis USA) is available as granular bait that can be applied around the perimeter of the vegetable crops to serve as a ‘barrier’ against cutworms and earwigs. Seduce can also be scattered in-between rows if insects have entered the area before application.

For organic producers: **Entrust Naturalyte** with 80% spinosad (Dow Agrosciences, Fig. 6), **Monterey Garden Insect Spray** (Lawn and Garden Products), **Seduce Insect Bait** (Certis USA)

For home gardeners: **Spinosad Garden Insect Spray** (Monterey), **Conserve Naturalyte Insect Control** (Southern Agricultural Insecticides), **Monterey Garden Insect Spray RTU** (Lawn and Garden Products)

Pyrethrum (pyrethrin): This is a popular botanical insecticide that provides quick knockdown of a number of small insects. Larger insects may recover from treatment. Pyrethrin is a contact poison and needs to be applied several times throughout the season to get full control of target pests. Pyrethrin formulation with piperonyl butoxide (PBO) are not approved for organic production.

For organic producers: **PyGanic Crop Protection 1.4EC, 5EC** (MGK Co.), **Concern Multi-Purpose Insect Killer II** (Woodstream)

For home gardeners: **Concern Multi-Purpose Insect Killer RTU**, **Concern Tomato & Vegetable Insect Killer II RTU** (Woodstream)

Garlic extract: Garlic is an insect repellent and does not necessarily kill insects. Check the internet for availability of garlic-based products and try them on a limited area in your garden before heavy usage. Extremely mobile insects will recolonize the plants once the product wears off.

For organic producers: **Garlic Barrier AG+** (Garlic Research Lab), **BioRepel** with 10% garlic oil (JH Biotech), **GC-Mite** with cottonseed oil, clove oil, and garlic oil (JH Biotech)

For home gardeners: **Garlic Barrier AG+** (Garlic Research Lab)

Other natural oils and blends: Many new products containing blends of plant oils are available for home gardeners to control insect pests and mites. Bayer’s Natria brand products contain plant oils that act as physical poisons. Some of these products are available in ready-to-use spray bottles only and may not be suitable for large organic farmers. Apply formulations to few plants to check for phytotoxicity before applying to a large area.

For organic producers: **Bayer Advanced Natria Multi-insect Control Concentrate** (96% canola oil); **Golden Pest Spray Oil** (Stoller Enterprises, 93% soybean oil)

For home gardeners: **Monterey All Natural General Purpose Garden Spray RTU** (blend of rosemary, peppermint, clove oil, sesame oil, thyme and cinnamon oil), **Bayer Advanced Natria Multi-insect Control RTU** (96% canola oil)

Paraffinic oils: A few products that contain highly refined petroleum oil or distillates can be used as organic insecticides. These products do not kill the target pests (e.g., aphids, mites, and whiteflies) but affect their ability to feed and transmit diseases. Treatments need to be initiated at the first detection of target insects and applied weekly. In certain crops, sprays may be needed right after germination (e.g., cucurbits). Do not apply paraffinic oils when temps exceed 90F or when plants are drought stressed.

For organic producers: **BVA Spray 10** (BVA Inc.), **Organic JMS Stylet-Oil** (JMS Flower Farms), **Suffoil-X** (BioWorks, Fig. 7)

For home gardeners: **Organic JMS Stylet-Oil** (JMS Flower Farms)

Sulfur: One of the oldest pesticides in the world, sulfur has broad mode of action as a contact and stomach poison. It is effective against thrips, psyllids, scales, and spider mites but some products can cause leaf burn on hot days. Some RTU formulations are premixes that have low levels of sulfur.

For organic producers:

For home gardeners: **Bayer Advanced Insect, Disease, and Mite Control RTU** (sulfur and pyrethrin pre-mix)

Insecticidal soap: These products are the potassium salts of fatty acids and they are specifically labeled for use on crops. Dishwashing detergents, often used by home gardeners, are not labeled for use on fruits and vegetables. Dishwashing detergents are highly reactive products that can damage the crop or leave off-flavor to the edible produce. Do not apply insecticidal soap during hot days with temps over 85F. Repeat applications of insecticidal soap and thorough coverage of plant parts are essential for keeping soft-bodied insects in check. **DES-X** (Certis USA) is a product labeled for use in the greenhouses.

For organic producers: **M-Pede** (Dow AgroSciences), **Safer Brand Insect Killing Soap** (Woodstream)

For home gardeners: **Safer Brand Insect Killing Soap RTU** (Woodstream), **Safer Brand End ALL Insect Killer RTU** (Woodstream, has insecticidal soap, neem oil and pyrethrin)

Kaolin clay: This clay is a natural, white mineral that is produced naturally in earth by weathering of rocks rich in aluminum silicate. It is often used at high rates to protect crops from heat stress or to prevent sunburn to fruiting vegetables. Kaolin clay may not kill insects but repel and confuse them due to the unfamiliar coating on the plant or fruit surface. Heavy rainfall, wind erosion, and new growth will affect product efficacy. Thorough coverage of target plants or plant parts is essential along with repeat spraying after every rainfall. Tank-mixing with other insecticides like pyrethrin and insecticidal soap may result in settling of the product. **Screen-Duo** (Certis USA) with 97.5% aluminum silicate is not approved for organic vegetable production.

For organic producers: Surround WP (95% aluminum silicate, Engelhard Corp.)

For home gardeners: Only bulk packaging is available.

Pathogenic viruses: Insect pathogenic viruses are species specific. Popularly available virus formulations target small caterpillars and infection results from ingestion of virus particles (some nerve damage in insects also occurs due to toxins). The infected caterpillars become sluggish and transparent; in advanced stages of infection the skin may rupture to release additional virus particles. Due to slow infection, caterpillars may continue to feed. It is best to apply these formulations ahead of an outbreak so that pest populations remain below economic thresholds. Proper insect identification is extremely important before using virus formulations since they are very species specific. .

For organic producers: Spod-X LC for controlling beet armyworm (Certis USA), Gemstar LC for controlling corn earworm (Certis USA)

For home gardeners: No specific product.

For updated information on organic insecticides and crop production practices, check with the Regional Extension Agent in your area. Names of commercial insecticides in this publication do not indicate endorsement of those products by the Alabama Cooperative Extension System. Name of online resources is not all inclusive.

FIGURES & CAPTIONS



Fig. 1. It is a jungle out there! Biological and chemical insecticides can be hard to distinguish in a typical retail store. Use Extension publications when making a purchase decision and call for help from a Regional Extension Agent before buying. (Image: A. Majumdar, ACES)



Fig. 2. DiPel DF is a very popular OMRI-approved microbial insecticide containing *Bacillus thuringiensis* (Bt). (Image: A. Majumdar, ACES)



Fig. 3. Mycotrol-O (organic formulation) and BotaniGard ES contain live spores of the fungus, *Beauveria bassiana*. (Image: A. Majumdar, ACES)



Fig. 4. Neemix 4.5 (Certis USA) is a popular azadirachtin-containing insecticide that acts as a contact poison against soft-bodies sucking insect pests and small caterpillars. (Image: Arbico Organics)



Fig. 5. Molt-X is a relatively new neem-based insecticide containing 3.0% azadirachtin. (Image: A. Majumdar, ACES)



Fig. 6. Entrust is the organic formulation of a mixture of spinosyn A & D. It is very effective against thrips, armyworms, pinworm, leafminers, etc. (Image: Arbico Organics)



Fig. 7. Suffoil-X is a product containing 80% petroleum oil that can be used as an insecticide, miticide, and fungicide. (Image: A. Majumdar, ACES)