

Non-Fumigant Nematicides Registered for Vegetable Crop Use¹

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Non-Fumigant Nematicides

Non-fumigant nematicides are formulated as liquids or water-soluble granules that are moved through the soil by water. Many of these products must be incorporated with soil or carried by water to be effective because they often inhibit nematodes through direct contact. Conversely, some non-fumigant nematicides are systemic (example: Vydate), meaning that the active ingredient is taken up by the plant and translocated to other parts of the plant. Nevertheless, most systemic nematicides, such as Vydate, are thought to primarily inhibit nematode damage through direct contact with the nematode in the soil profile, emphasizing the importance of adequate application uniformity to attain effective management. Generally, non-fumigant nematicides have a narrower spectrum of activity relative to that of soil fumigants, often preserving beneficial soil organisms responsible for essential soil ecosystem functioning, including nutrient cycling and natural regulation of pathogens and pests. Non-fumigant nematicides can be subdivided into two broad categories, chemical non-fumigant nematicides and biological non-fumigant nematicides.

Chemical Nematicides

Chemical nematicides inhibit nematodes through the action of synthetic compounds. Such nematicides can be divided into three different pesticide classes: carbamates, organophosphates, and 3-fluorine nematicides. Table

1 lists characteristics of active ingredients in chemical nematicides. Table 2 lists chemical nematicides currently registered for use in Florida on specific vegetable crops.

Carbamate

Carbamate nematicides available for vegetable production include Vydate L (Corteva Agriscience; active ingredient: oxamyl) and Vydate C-LV (Corteva Agriscience; active ingredient: oxamyl). These products are restricted-use pesticides and have a high level of toxicity towards non-target organisms (Gallego et al. 2019).

Organophosphate

Organophosphate nematicides available for vegetable production include MOCAP 15G (AMVAC Chemical Corporation; active ingredient: ethoprop), MOCAP EC (AMVAC Chemical Corporation; active ingredient: ethoprop) and Counter 20G (AMVAC Chemical Corporation; active ingredient: terbufos). These products are restricted-use pesticides and have a high level of toxicity towards non-target organisms.

3-Fluorine

Three-fluorine nematicides are a relatively new class of reduced-risk pesticides available to vegetable producers and include products such as Nimitz (ADAMA Agricultural Solutions; active ingredient: fluensulfone) and Velum Prime

1. This document is ENY-033, one of a series of the Entomology and Nematology Department, UF/IFAS Extension. Original publication date March 1999. Revised December 2012, December 2015, and April 2019. Visit the EDIS website at <https://edis.ifas.ufl.edu> for the currently supported version of this publication.

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(Bayer Crop Science; active ingredient: fluopyram). These products are safer to apply than carbamate and organophosphate nematicides and have significantly less toxicity towards most non-target organisms; however, fluopyram has been shown to reduce beneficial nematode populations densities in soil (Waldo et al. 2019).

Biological Nematicides

Biological nematicides inhibit nematodes through the use of natural compounds produced by microorganisms and plants. Such nematicides can be divided into microbe-based nematicides and plant-based nematicides. Table 3 lists biological nematicides currently registered for use in Florida on specific vegetable crops.

Microbe-Based

Microbe-based nematicides use the activity of microorganisms to suppress plant-parasitic nematodes. Products such as Majestene (Marrone Bio Innovations; active ingredient: heat-killed *Burkholderia rinojensis* strain A396) use a suspension of secondary metabolites produced by an antagonistic soil bacterium. Other products, such as MeloCon WG (Certis USA; active ingredient: *Purpureocillium lilacinus* strain 251) use live organisms that suppress hatching of nematode eggs.

Plant-Based

Plant-based nematicides use the activity of a diverse range of natural compounds produced by plants to suppress nematodes. This includes products such as Dazitol (Champon Millennium Chemicals Inc.; active ingredients: capsaicin and essential oil of mustard) and NemaKill (Excel Ag, Corp.; active ingredients: cinnamon oil, clove oil, and thyme oil).

Summary

Non-fumigant nematicides available for vegetable production in Florida include two broad categories, chemical nematicides and biological nematicides. Chemical nematicides can be divided into three pesticide classes: carbamates, organophosphates, and 3-fluorine nematicides. Biological nematicides include both microbe-based and plant-based products. Refer to EDIS publication ENY-065, *Fumigant and Non-fumigant Nematicides labeled for Agronomic Crops in Florida* (<https://edis.ifas.ufl.edu/in395>) for a list of nematicides registered for use on row crops in Florida. Refer to EDIS publication ENY-012, *Soil-Inhabiting Nematodes, Phylum Nematoda* (<https://edis.ifas.ufl.edu/in138>) for more information on nematode biology. For further information on nematode management, go to the Florida Nematode Management Guide (http://edis.ifas.ufl.edu/topic_nematode_management).

References

- Gallego, S., M. Devers-Lamrani, K. Rousidou, D. G. Karpouzias, and F. Martin-Laurent. 2019. "Assessment of the effects of oxamyl on the bacterial community of an agricultural soil exhibiting enhanced biodegradation." *Sci. Total Environ.* 651: 1189–1198.
- Waldo, B. D., Z. J. Grabau, T. M. Mengistu, and W. T. Crow. 2019. "Nematicide effects on non-target nematodes in bermudagrass." *J. Nematol.* 51: 1–12.

Table 1. Characteristics of chemical nematicides registered for vegetable crop use.

Active Ingredient	Trade Name(s)	Class	Systemic	Water Solubility	Mode of Action
Ethoprop	Mocap 15G, Mocap EC	Organophosphate	No	1,300 ppm	Acetylcholinesterase Inhibitor
Terbufos	Counter 20G	Organophosphate	Yes	5 ppm	Acetylcholinesterase Inhibitor
Oxamyl	Vydate L, Vydate C-LV	Carbamate	Yes	150,000 ppm	Acetylcholinesterase Inhibitor
Fluensulfone	Nimitz	3-Fluorine	Yes	545 ppm	Unknown
Fluopyram	Velum Prime, Velum Total	3-Fluorine	Yes	16 ppm	Succinate Dehydrogenase Inhibitor

Table 2. Chemical nematicides registered for specific vegetable crop use.

Vegetable	Chemical Nematicide						
	MOCAP 15G	MOCAP EC	COUNTER 20G	VYDATE L	VYDATE C-LV	NIMITZ	VELUM PRIME
Beans	yes						
Carrots				yes		yes	
Celery				yes		yes	
Corn, sweet	yes		yes				
Cabbage	yes					yes	yes
Brussels sprouts						yes	yes
Broccoli						yes	yes
Cauliflower						yes	yes
Cucumber	yes			yes		yes	yes
Melons				yes		yes	yes
Leafy vegetables						yes	yes
Squash				yes		yes	yes
Okra						yes	yes
Potatoes	yes	yes			yes	yes	yes
Potatoes, sweet	yes	yes		yes		yes	yes
Eggplant				yes		yes	yes
Strawberry						yes	yes
Tomato				yes		yes	yes
Pepper				yes		yes	yes

Table 3. Biological nematicides available for specific vegetable crop use.

Vegetable	Biological Nematicide			
	Majestene	MeloCon WG	Dazitol	NemaKill
Beans			yes	yes
Carrots	yes	yes	yes	yes
Celery	yes	yes	yes	yes
Corn, sweet	yes		yes	yes
Cabbage	yes	yes	yes	yes
Brussels sprouts	yes	yes	yes	yes
Broccoli	yes	yes	yes	yes
Cauliflower	yes	yes	yes	yes
Cucumber	yes	yes	yes	yes
Melons	yes	yes	yes	yes
Leafy vegetables	yes	yes	yes	yes
Squash	yes	yes	yes	yes
Okra	yes	yes	yes	yes
Potatoes	yes	yes	yes	yes
Potatoes, sweet	yes	yes	yes	yes
Eggplant	yes	yes	yes	yes
Strawberry	yes	yes	yes	yes
Tomato	yes	yes	yes	yes
Pepper	yes	yes	yes	yes