UNIVERSITY OF FLORIDA
IFAS EXTENSION

ENY-462

Insect Management for Carrots[1]

S. E. Webb[2]

There are no major insect pests on carrot in Florida. The greatest concern for growers has been root damage from soil pests, particularly wireworms (southern potato and tobacco), cutworms (variegated, granulate, black), and mole crickets, all of which are sporadic. Occasional minor pests include leafminers (especially the vegetable leafminer), aphids (green peach and melon), and weevils (especially vegetable weevils). Other arthropods that may occasionally cause minimal damage to carrots in Florida include armyworms (fall, beet, and southern), field crickets, mites (especially twospotted spider mite), and plant bugs (including tarnished plant bug).

Flooding the field during the summer fallow, which was viable in the former muck production areas, has effectively controlled wireworms and other soil insects. However, with the transition from production on organic soils to the inorganic mineral soils of north Florida, flooding is no longer a feasible method of cultural control for most carrot growers. North Florida carrot production will likely require greater insecticide inputs for the management of soil insects.

Cutworms

Cutworms (Figure 1), a sporadic pest of carrots in Florida, can be a problem during seedling establishment. Cutworms, which are related to armyworms, are thick, dark caterpillars whose adult stage is a moth. They attack young seedlings, most actively at night, and may cut the stem off at the base. During the day, they remain hidden in debris on or just under the soil surface. When disturbed, cutworms curl into a C-shaped ball. Thorough soil preparation in advance of planting helps in cutworm control.

Wireworms, *Agriotus* spp., *Melanotus* spp. and other Elateridae

Description

Wireworms (Figure 2) are the shiny, hard-bodied, slender larvae of the click beetle. Larvae are brownish yellow and 1/2 – 1 1/2 inches long. Adults are large, brown beetles that make a clicking sound when they try to right themselves after being on their backs.

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2. S. E. Webb, associate professor, Entomology and Nematology Department, Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, 32611-0640.

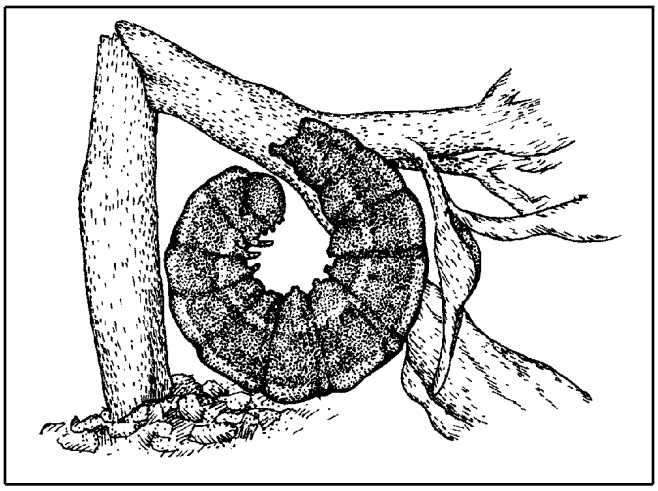

Figure 1. Cutworm.

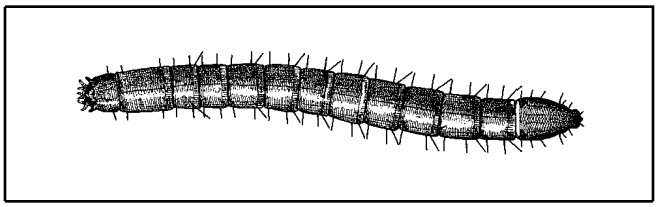

Figure 2. Wireworm larva.

Biology

Depending on species, wireworm larvae can stay in the soil for 1 to 5 years. Eggs are laid singly in soil 1 to 6 inches deep in spring or summer. Hatching takes place in 2 to 4 weeks. Because of the long egg-laying period, overlapping generations (larvae of different sizes) are present. Adults prefer to oviposit into grassy areas, which include rye, wheat, oats, mixed pastures, old fields, and sometimes potatoes.

Damage

Wireworms, a sporadic pest on carrots in Florida, are a greater problem on organic soils than on mineral soils. They can attack the developing carrots directly, causing severe loss, or can provide entry points for pathogens that cause secondary rots. See Table 1 for wire management suggestions.

Table 1. Wireworm

Managment Option	Recommendations
Scouting/ thresholds	To determine if wireworms are present before planting, 4 to 5 bait stations should be placed in the field 4 to 5 weeks before planting. A station is a hole, approximately 6 inches (15 cm) deep, with a cupful of *untreated* wheat and corn. The hole is covered and in 2 to 3 weeks is dug up and checked for the presence of wireworm larvae. One wireworm per station justifies a treatment.
Note(s)	Preplant applications of soil insecticides should be considered if an area has a history of soil insect problems (wireworms, mole crickets, cutworms).
Resistant varieties	None available.
Site selection	If possible, avoid areas with a history of wireworm problems.
Other cultural practices	Planting when the soil is warm will lessen the chances of wireworm injury.

Tawny Mole Cricket, *Scapteriscus vicinus;* Short-winged Mole Cricket, *S. abbreviatus*

Description

Of the 10 species of mole crickets (Figure 3), only a few are pests. The tawny mole cricket is the most damaging to vegetable crops. Meandering tunnels created by mole crickets are the most obvious sign of their presence. Approximately 1/2 inch in diameter, tunnels are just below the surface and resemble miniature ground mole tunnels.

Biology

In the southeastern United States, there is one generation per year. Eggs are laid in chambers, 4 to 12 inches underground, from April through June. Eggs hatch after about three weeks. The adults of the previous generation die off during May and June and most of the new generation reaches the adult stage in

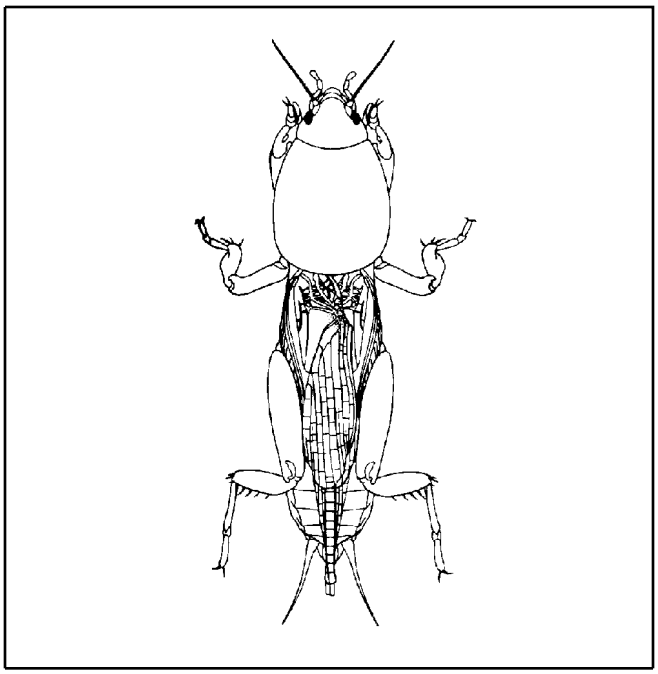

Figure 3. Mole cricket.

the fall and early winter. These adults overwinter and breed in the spring. For two to three months in the spring, tawny mole crickets are most commonly seen during their brief mating flights, which begin shortly after sunset.

Damage

Mole crickets mainly feed on plant roots. At night, in warm, wet weather, they will also feed on stems and leaves at surface level. Their tunneling in, around, and under the developing root system, in addition to feeding, is particularly damaging to young seedlings. Although some damage occurs from their feeding on the roots and on the stems and leaves of young plants, mole crickets are most damaging to carrot plants when they cut the stems of seedlings at or near ground level.

Management

In areas where mole crickets are known to cause problems, a preplant application of a soil insecticide that is incorporated into the soil is the most useful control measure. Because of the damage done to pastures and turf, much effort has gone into finding natural enemies of this pest in South America and releasing them in the United States.

The tachinid fly *Ormia depleta* has been evaluated for use in a classical biological control program for mole crickets, with initial releases made at Gainesville and Bradenton in 1988 and subsequent releases in other counties through 1992. Populations of the fly became established from Dade to Alachua counties but no farther north. This program is still in the experimental stage, with some work focusing on provision of appropriate nectar sources for the fly.

Presently, the most effective biological control agent for mole crickets is a steinernematid nematode introduced from South America. The parasitic nematode *Steinernema scapterisci* has shown promise for managing mole crickets in pasture and turf in Florida, and in the past has been available commercially for mole cricket control in turf. *Steinernema scapterisci* has been shown to be highly effective against tawny mole crickets and less effective against short-winged mole crickets. It is most effective as a biocontrol agent where mole cricket populations are highest, as in pastures. It can also be used as a biopesticide where mole cricket populations are lower, and it shows residual activity. The nematode is able to disperse well when applied and has shown good recovery years after its application. Populations have become established in small areas of several Florida counties. If it becomes established in pastures surrounding vegetable crop production areas, it is expected to keep mole cricket populations below damaging levels.

Leafminers, *Liriomyza sativae* and *L. trifolii*

Description and Biology

The adult leafminer (Figure 4) is a small fly, about 1/8 to 1/10 of an inch long with a yellow abdomen. The fly inserts her eggs in feeding punctures on the upper leaf surface. Larvae (maggots) feed between the upper and lower leaf surfaces, creating meandering mines that enlarge as the larvae grow. After approximately two weeks in warm weather the larva completes development and leaves the mine, dropping to the ground to pupate. The complete life cycle can be as short as 18 to 21 days. In Florida, leafminer generations are continuous during most of the year.

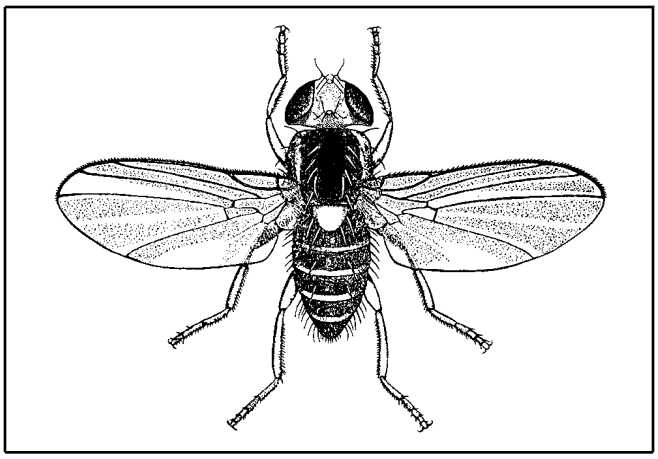

Figure 4. Vegetable leafminer.

Damage

Leafminers are a sporadic foliar pest on carrots in Florida. Infestations can be more severe late in the growing season, particularly if adults migrate out of nearby crop residue into late-planted fields. They are a problem on seedlings during the fall carrot season. Although healthy plants can usually tolerate substantial leafminer damage, heavy damage may cause leaf drop. Also, the exit holes in old mines may provide access to pathogens.

Management

Chemical control of leafminers is difficult, because during the feeding stage the pest remains protected within the leaf. Targeting small larvae results in better control. Several parasitic wasps naturally keep populations below damaging levels in Florida in the absence of broad-spectrum insecticide use.

Melon Aphid, *Aphis gossypii;* Green Peach Aphid, *Myzus persicae*

Aphids are also a minor and sporadic pest on carrots in Florida. The green peach aphid (*Myzus persicae*) is the species most often reported on the crop in the state. The melon aphid (*Aphis gossypii*), which has a wide host range, may also be found on carrots. The aphid *Hyadaphis coriandri*, which has recently been found in Florida, is damaging to several umbelliferous herbs and is capable of colonizing carrots, but there has been no state report on carrots.

Description

Aphids are soft-bodied insects, almost egg-shaped when viewed from above. The largest melon aphids (Figure 5) are not much more than one-sixteenth of an inch in length. The color of melon aphids can vary from pale yellow to orange to dark green to almost black. Green peach aphids (Figure 6) are larger (up to one-tenth of an inch long) and vary in color from pale yellow to medium green. A pair of small tube-like structures called cornicles extends backward and upward from the posterior of the aphid, above a small tail-like structure (cauda). The first individuals to colonize a plant will usually have wings, but then wingless aphids become the dominant form until crowding occurs or the plant deteriorates. Then winged aphids will be produced again to disperse to other plants.

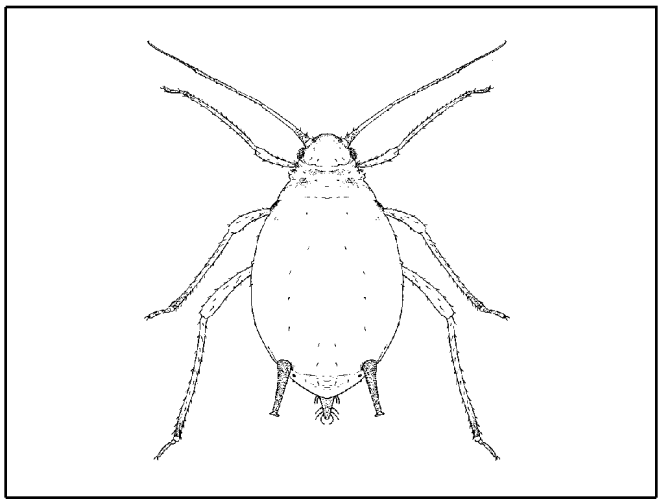

Figure 5. Melon aphid.

Damage

Aphids feed by piercing plant tissue with their needle-like mouthparts and sucking out water and nutrients. Toxins in their saliva, which can be injected into the plant tissue during feeding, may cause foliage to curl and deform. Aphids also deposit large amounts of honeydew on the plant surface, which encourages the growth of black sooty mold. A short life cycle and reproduction by asexual means and by live birth allow aphid populations to increase rapidly in Florida.

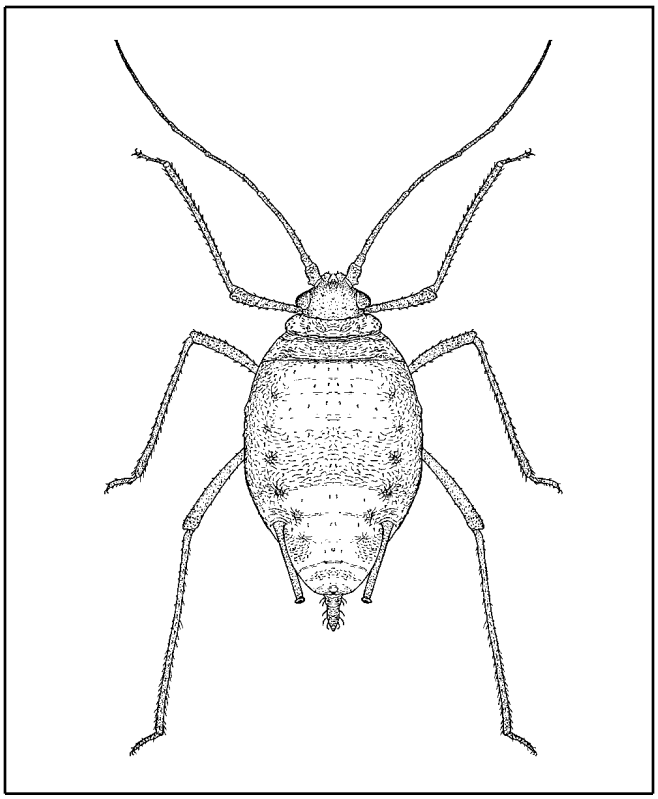

Figure 6. Green peach aphid.

Biological Control

Beneficial natural enemies such as lady beetles, lacewings, and larvae of syrphid flies feed on aphids. Tiny wasps lay their eggs in aphids. The wasp larva matures inside the living aphid and finally exits, leaving a gold or tan shell (aphid mummy) behind. Occasionally, fungi will infect aphids, drastically reducing populations.

Acknowledgement

Much of the information above was taken from the Department of Food Science and Human Nutrition, IFAS Publication, *Florida Crop/Pest Management Profiles: Carrots*, CIR 1243 (http://edis.ifas.ufl.edu/PI033).

Table 2. Selected insecticides approved for use on insects attacking carrot.

Chemical	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Actara (thiamethoxam)	1.5-3.0 oz	12	7	aphids, flea beetles, leafhoppers	4A	Do not exceed 8 oz product/acre/season.
Admire 2F (imidacloprid)	10-24 fl oz	12	21	aphids, flea beetles, leafhoppers, whiteflies	4A	Limited to one soil application.
Admire Pro	4.4-10.5 fl oz					
Agree WG (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	lepidopteran larvae (caterpillar pests)	11B1	Apply when larvae are small for best control. OMRI-listed[2].
***Asana XL 0.66EC** (esfenvalerate)	5.8-9.6 fl oz	12	7	aster leafhopper, cutworms, leafhoppers, carrot weevil	3	Do not apply more than 0.5 lb ai/acre per season.
Aza-Direct (azadirachtin)	1-2 pts, (max 3.5 pts)	4	0	aphids, beetles, caterpillars, leafhoppers, leafminers, mites, stink bugs, thrips, weevils, whiteflies	26	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
Azatin XL (azadirachtin)	5-21 fl oz	4	0	aphids, beetles, caterpillars, leafhoppers, leafminers, thrips, weevils, whiteflies	26	Antifeedant, repellant, insect growth regulator.
***Baythroid 2** (cyfluthrin)	1.6-2.8 fl oz	12	0	aster leafhopper, black cutworm, carrot weevil	3	Do not exceed 5 applications per season.
Biobit HP (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	caterpillars (will not control large armyworms)	11B2	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed[2].
BotaniGard 22 WP, ES (*Beauveria bassiana*)	**WP:** 0.5-2 lb/100 gal **ES:** 0.5-2 qts/100 gal	4	0	aphids, thrips, whiteflies	--	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
Crymax WDG (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	caterpillars	11B2	Use high rate for armyworms. Treat when larvae are young.
Deliver (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-1.5 lb	4	0	caterpillars	11B2	Use higher rates for armyworms. OMRI-listed[2].

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Chemical	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
***Diazinon 4E, AG500, 50W** (diazinon)	**AG500, 4E:** 1-4 qt **50W:** 2-8 lb	24	preplant	cutworms, mole crickets, wireworms	1B	
***Diazinon 4E, AG500, 50W** (diazinon)	**Foliar: AG500, 4E:** 1 pt **50W:** 1 lb	24	14	aphids	1B	Do not make more than 5 foliar applications per year.
***Diazinon 4E, Ag500, 50W** (diazinon)	**Preplant: AG500, 4E:** 1-4 qt **50W:** 2-8 lb	24	pre- or at planting	carrot rust fly, cutworms, mole crickets, wireworms	1B	
DiPel DF (*Bacillus thuringiensis* subspecies *kurstaki*)		4	0	caterpillars	11B2	Treat when larvae are young. Good coverage is essential.
Endosulfan 3EC (endosulfan)	0.66-1.33 qt	24	7	aphids, armyworms, flea beetles, leafhoppers, whiteflies	2	Do not make more than 1 application per year. Do not use tops for food or feed.
Intrepid 2F (methoxyfenozide)	6-16 fl oz	4		armyworms, loopers, saltmarsh caterpillar, webworms	18	Do not apply more than 64 fl oz per acre per season.
Javelin WG (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12-1.50 lb	4	0	most caterpillars, but not *Spodoptera* species (armyworms)	11B2	Treat when larvae are young. Thorough coverage is essential. OMRI-listed[2].
***Lannate LV, *SP** (methomyl)	**LV:** 0.75-3.0 pts **SP:** 0.25-1.0 lb	48	1	armyworms, aster leafhopper, beet armyworm, variegated cutworm	1A	
Lepinox WDG (*Bacillus thuringiensis* subspecies *kurstaki*)	1.0-2.0 lb	12	0	most caterpillars, including beet armyworm (see label)	11B2	Treat when larvae are small. Thorough coverage is essential.
M-Pede (potassium salts of fatty acids)	1-2% V/V	12	0	leafminers, aphids, thrips, whiteflies	--	OMRI-listed[2].
Neemix 4.5 (azadirachtin)	4-16 fl oz	12	0	aphids, armyworms, cabbage looper, cutworms, leafminers, whiteflies	26	Acts as IGR and feeding repellent. OMRI-listed[2].

Table 2. Selected insecticides approved for use on insects attacking carrot.

Chemical	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Provado 1.6F (imidacloprid)	3.5 oz	12	7	aphids, flea beetles, leafhoppers, whiteflies	4A	Maximum of 3 applications.
Pyrellin EC (pyrethrins + rotenone)	1-2 pt	12	12 hours	aphids, flea beetles, leafhoppers, leafminers, lygus bug, mites, plant bugs, stink bugs, thrips, vegetable weevil, whiteflies	3, 21	
Pyronyl Crop Spray (pyrethrins + piperonyl butoxide)	1-12 fl oz	12	0	ants, aphids, armyworms, cabbage looper, corn earworm, crickets, flea beetles, leafhoppers, thrips, whiteflies	3	
Sevin 80S; XLR; 4F (carbaryl)	**80S:** 0.63-2.5 lb **XLR, 4F:** 0.5-2 qt	12	7	armyworms, aster leafhopper, corn earworm, cutworms, fall armyworm, flea beetles, leafhoppers, lygus bug, spittlebugs, stink bugs, tarnished plant bug	1A	Highly toxic to bees. Repeat applications, as needed up to 6 times, at least 7 days apart.
Spintor (spinosad)	3-6 oz	4	3	armyworms, flea beetles, leafminers, loopers, thrips	5	Do not apply more than 21 oz per acre per crop. Limited to 4 applications per year.
***Telone C-35** (dichloropropene + chloropicrin)	See label	5 days - See label	preplant	symphylans, wireworms	--	See supplemental label for use restriction in south and central Florida.
***Telone II** (dichlorpropene)						
Trilogy (extract of neem oil)	0.5-2.0% V/V	4	0	aphids, mites, suppression of thrips and whiteflies	26	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed[2].
Xentari DF (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	caterpillars	11B1	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
The pesticide information presented in this table was current with federal and state regulations at the time of revision. The user is responsible for determining the intended use is consistent with the label of the product being used. Use pesticides safely. Read and follow label instructions.						

Table 2. Selected insecticides approved for use on insects attacking carrot.

Chemical	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes

[1] Mode of Action codes for vegetable pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v.3.3 October 2003.

1A. Acetylcholine esterase inhibitors, Carbamates
1B. Acetylcholine esterase inhibitors, Organophosphates
2A. GABA-gated chloride channel antagonists
3. Sodium channel modulators
4A. Nicotinic Acetylcholine receptor agonists/antagonists, Neonicotinoids
5. Nicotinic Acetylcholine receptor agonists (not group 4)
6. Chloride channel activators
7A. Juvenile hormone mimics, Juvenile hormone analogues
7D. Juvenile hormone mimics, Pyriproxifen
9A. Compounds of unknown or non-specific mode of action (selective feeding blockers), Cryolite
9B. Compounds of unknown or non-specific mode of action (selective feeding blockers), Pymetrozine
11B1. Microbial disruptors of insect midgut membranes, *B.t.* var *aizawai*
11B2. Microbial disruptors of insect midgut membranes, *B.t.* var *kurstaki*
12B. Inhibitors of oxidative phosphorylation, disruptors of ATP formation, Organotin miticide
15. Inhibitors of chitin biosynthesis, type 0, Lepidopteran
16. Inhibitors of chitin biosynthesis, type 1, Homopteran
17. Inhibitors of chitin biosynthesis, type 2, Dipteran
18. Ecdysone agonist/disruptor
20. Site II electron transport inhibitors
21. Site I electron transport inhibitors
22. Voltage-dependent sodium channel blocker
23. Inhibitors of lipid biosynthesis
25. Neuroactive (unknown mode of action)
26. Unknown mode of action, Azadirachtin

[2] OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted Use Pesticide**