

CUTWORMS

species:	Order: Lepidoptera	= complete metamorphosis = pests as larvae = harmless nectar-feeding adults
	examples	– black, redbacked, spotted and variegated cutworms – vs “armyworms”
identification:		
larvae		greasy-bodied, smooth-skinned, gray-brown w/darker longitudinal lines & spots up to 1 ½-inches long, curl into "C" shape when disturbed
adults		dark, drab moths with muted spots and stripes, 1 to 2-inch wing span
host plants:		garden flowers, vegetables, berries & fruits
symptoms:		feed at night, hide by day // worst damage during spring stem-cutters & defoliators (leaf chewers) as caterpillars
	surface cutworms	sever tender seedlings at soil surface
	climbing cutworms	defoliation & leaf-bud feeding
biology:		eggs & larvae O/W on garden trash and weedy grasses several generations per year (depends on species)

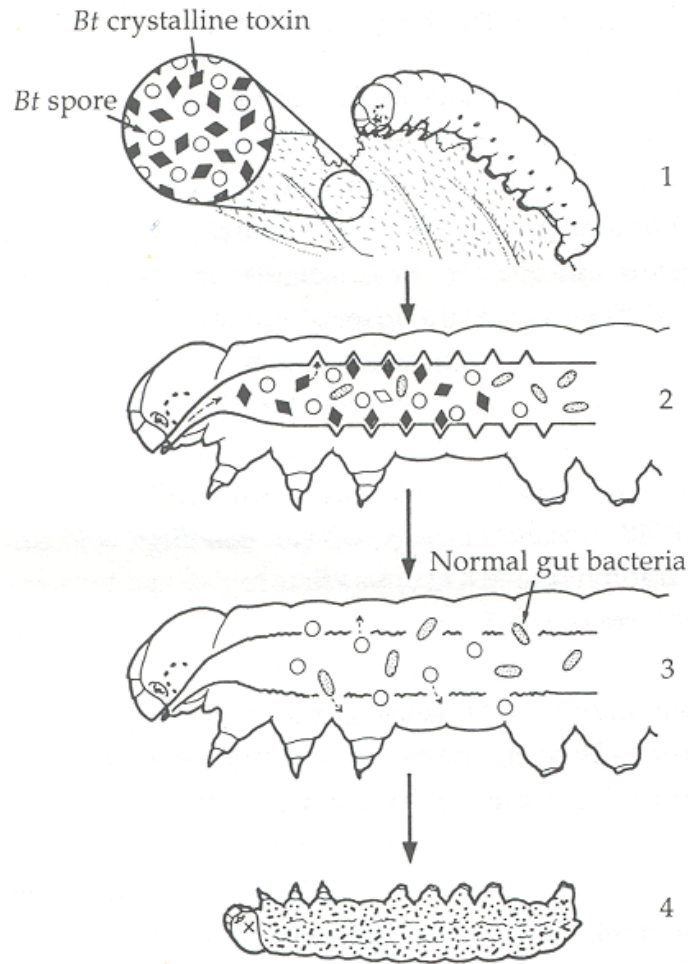
CONTROL OPTIONS

physical:	hand-pick at night (inspect plants & soil surface after dusk w/flashlight) larval habitat traps transplant collars & hotcaps
cultural:	destroy O/W sites via cultivation, composting, weeding
biocontrol:	conserve native predatory and parasitic insects
least-toxics:	<i>Bt kurstaki</i> microbial insecticides (Dipel, Thuricide) spinosad
insecticides:	carbaryl (Sevin), cyfluthrin (Bayer Advanced Garden Power Force Multi Insect Killer), esfenvalerate (Bug-B-Gon Multi-Purpose Insect Killer)

ALWAYS READ THE LABEL!

Never recommend a pesticide unless both pest and target site (plant) are listed

Bacillus thuringiensis [insect-killing bacterial product]



How BT Kills Caterpillars

- Step 1. Caterpillar eats foliage treated with BT crystalline toxin
- Step 2. High pH (alkaline) conditions in gut activate BT toxin. Toxin binds to receptor sites on the gut (like a key fitting into a lock)
- Step 3. Gut lining breaks down and normal bacteria in gut leak into the body
- Step 4. Caterpillar dies of septicemia (blood poisoning) within a few days.

BT kurstaki

trade names: *Caterpillar Attack, Caterpillar Killer, Dipel, Thuricide, Worm Attack, Worm Ender* and others

target pests: leaf-feeding caterpillars [exposed larvae of butterflies and moths]

NOT sawfly larvae

Leaf-feeding caterpillars w/chewing mouthparts:

butterflies & moths (ORDER: Lepidoptera)

**2, 3, 4 or 5 pair fleshy prolegs
w/crochets**



sawflies (ORDER: Hymenoptera)

**6 or more pair fleshy prolegs
w/out crochets**



beetles (ORDER: Coleoptera)

**NO fleshy prolegs;
true thoracic legs PRESENT**



NOTE: *Bacillus thuringiensis tenebrionis* products
vs certain leaf-feeding beetle larvae

NOT cryptic (hidden) larvae

(i.e., NOT leafrollers & leaf-tiers, leaf miners & stem borers)

safety: no infectivity or toxicity at highest oral doses tested

notes: stomach poison - must be eaten to be effective
- thorough coverage of foliage

causes immediate paralysis, larva dies w/in 1-2 days

sensitive to heat, desiccation, sunlight
- breaks down w/in 1-2 days

timing critical - the younger (smaller) the caterpillar better

does not re-cycle - requires repeated application

CATERPILLARS (cole crops)

species:	diamondback moth, <i>Plutella xylostella</i> imported cabbageworm, <i>Pieris rapae</i> cabbage looper, <i>Trichoplusia ni</i>
	ORDER LEPIDOPTERA – defoliators (leaf chewers) as caterpillars – nectar-feeders as butterflies & moths
identification:	
DBM	5/16-inch yellow-green caterpillar, wriggle violently & drop off leaf on silk thread
ICW	1-inch velvety green caterpillar w/thin yellow orange stripe down back sluggish crawling behavior (compare w/diamondback moth [above]) adult is day-flying white butterfly w/black tipped front wings
CL	1 ½-inch green caterpillar w/thin white stripe along each side & down back crawl in characteristic looping motion
host plants:	broccoli, brussels sprouts, cabbage, cauliflower, collards [edible and ornamental] weedy mustards (Crucifer family) commercial canola (diamondback moth) flowers & vegetables (loopers)
symptoms:	tiny feeding hole "windows" on lower leaf surface → ragged irregular holes → total defoliation between leaf veins copious dark green fecal pellets [frass]
biology:	ICW & CL O/W as pupae in plant debris (DBM O/W???) 2-3 generations per year

CONTROL OPTIONS

physical:	floating row covers // handpick & crush
cultural:	compost culls and plant debris after harvest // eliminate weedy crucifers soil tillage kills O/W pupae interplant crucifers w/tomatoes garden site selection (avoid infestation sources from nearby canola fields) early planting avoids late-season looper and cabbageworm
biocontrol:	conserve natural predatory insects and parasitoids <i>Trichogramma</i> egg parasitoid mass-releases
least-toxics:	<i>Bt kurstaki</i> microbial insecticides / spinosyn / pyrethrin
insecticides:	see listings for CUTWORMS

ALWAYS READ THE PESTICIDE LABEL!
Never recommend a pesticide unless both pest and target site (plant) are listed

ROOT MAGGOTS

species:	Order: Diptera (flies) = complete metamorphosis
	pests as immatures (rasping mouthhooks) cabbage maggot, onion maggot, seedcorn maggot
	harmless adults (sponging mouthparts)
identification:	
adults	gray, bristly flies smaller than common house fly
larvae	whitish, fleshy, legless, wedge-shaped grubs
host plants:	beans, beets, cole crops, corn, onions, peas, radishes
symptoms:	above ground wilting (esp. during dry weather), yellowing, stunting below ground root feeding, tunnels, secondary root rots
	3 factors that increase susceptibility – seedling plants – cool, wet springs – high organic matter in soil
biology:	pupae O/W in soil, cull piles 2-3 generations per year (1st generation early-season most damaging)

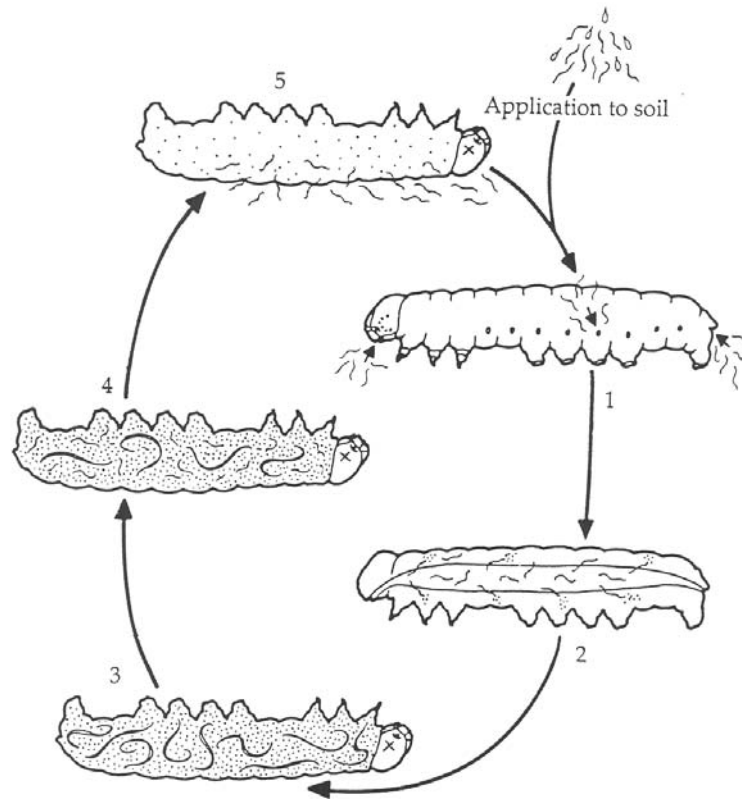
CONTROL OPTIONS

physical:	protect new plants from egg-laying via hot caps, plant collars, row covers
cultural:	avoid planting in wet soils w/partially decomposed plant debris plant after flies emerge & lay eggs fall tillage
biocontrol:	conserve native predatory insects
least-toxics:	predatory nematodes
insecticides:	???

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nematodes (Phylum Nematelminthes - microscopic multicellular aquatic roundworms)

life cycle [mode-of-action]



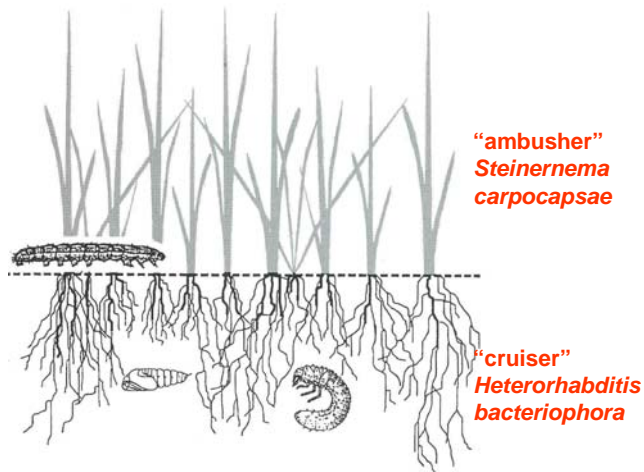
HOW NEMATODES KILL INSECTS. Step 1. Nematodes enter insect body through natural openings or directly through body wall. Step 2. Nematodes release insect-killing *Xenorhabdus* bacteria. Step 3. Bacteria multiply and kill insect; nematodes feed on bacteria and develop to adults. Step 4. Nematodes develop through several generations within cadaver. Step 5. Infective juveniles leave cadaver and infect new host insects in the environment.

nematode species (types)

Steinernema feltia
(= *Neoaplectana carpocapsae*) sit-and-wait "ambusher"

Heterorhabditis bacteriophora
(= *H. heliothidis*) search-and-destroy "cruiser"

Heterorhabditis riobravis intermediate between ambusher & cruiser



commercial nematode products

trade names: *BioSafe, BioVector, Scanmask*

packaging: infective juvenile nematodes suspended in polymer gel or impregnated on sponges

target pests: soil insects, borers & cryptic (hidden) pests
harmless to earthworms

trees/shrubs black vine weevil*, strawberry root weevil, fungus gnats, borers**

* container-grown potted plants (homes & greenhouses)

** injection into trunk at initial point-of-entry

lawns bluegrass billbug, cutworms, sod webworm, white grubs

vegetables carrot rust fly, cutworms, root maggots, wireworms

notes: nematodes recycle in environment
- single application gives control lasting days to weeks to months

sensitive to heat and sunlight and esp. desiccation

- apply early a.m./late p.m.

- pre / post-application watering

active at soil temperatures between 55 and 95 F

- apply to warm soils

± compatibility w/chemical pesticides

☹ conventional insecticides

☺ herbicides

can apply via conventional (pressurized) spray equipment