



What's Bugging My Brassicas? *Managing Cole Crop Pests*

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Cabbage, broccoli, cauliflower, Brussels sprouts, kale, collards, arugula, bok choy, radish, broccoli raab are some of the many brassicas popular with consumers – and insects, some of which can quickly destroy seedlings or make even a mature crop unmarketable. Following are some tips on how to plan for and manage the most common insect pests in cole crops.

Caterpillars are among the most common pests of brassicas. Learning to distinguish among them can reduce costs and improve control. **Imported cabbageworm (ICW)**, **cabbage looper (CL)**, and **diamondback moth (DBM)** are the most common. ICW feeds on cole crops, related weeds and some ornamentals. The dark green caterpillars are somewhat velvety, well-camouflaged on leaves and reach just under 1 ¼". Eggs, laid under leaves, have a bullet shape, turning from almost white to dark yellow or orange with age. The adult is the familiar butterfly seen during the day from mid-spring onwards, white with small, black spots on the forewings. CL caterpillars are medium-green, with whitish stripes along the sides and back that fade in the oldest stage, and a 'looping' or inchworm-like habit when walking unlike caterpillars on brassicas, reaching almost 1 ½" when full-grown. Hosts include brassicas, summer squash, tomatoes, chrysanthemums, lambsquarters, and many others. The grey-brown moth bears a small, silvery figure '8' on the forewing, and is active at night. Eggs are like pinhead-sized white pearls lightly stuck to the leaf underside. CL overwinters in the SE US, migrating north each year. On Long Island CL typically appears around early to mid-July; populations vary considerably from one year to the next. DBM has become a serious world-wide pest due to insecticide resistance. Hosts include most brassicas, especially collards, as well as some related weeds. The caterpillars are pale or gray-green, somewhat segmented, tapering at both ends with hind legs projecting like a forked 'tail'. They reach only about 1/3" full-grown and when disturbed often wriggle rapidly and drop, hanging by a fine thread. Eggs are pale yellow, round, and very small so rarely seen. Adults are small, brownish moths, about 1/3" long, slender with diamond-shaped coalescing paler spots on the back. They are most active during dawn and dusk and often observed when plants are disturbed. There is evidence DBM overwinters at least as far north as Long Island, but also migrates to northern areas annually. Pheromone traps are available for CL and DBM and may be helpful to alert growers to these more difficult-to-control species.

Saltmarsh caterpillar and (in more southern areas) **beet armyworm** are occasional pests of cole crops. The former sometimes is found in groups on one or a few plants causing extensive damage, but rarely a widespread problem in the field. Beet armyworm can be a serious pest where it occurs. The caterpillars will feed directly on the growing point and are known for tolerance to some insecticides.

Many natural controls regulate 'worm' levels in brassicas. Intercropping, trap crops (such as yellow rocket for DBM), hand-collecting, barriers, and removing alternate hosts are among the cultural techniques growers can use. Where insecticides are needed action thresholds help determine when treatment makes sense. On Long Island, fresh-market cabbage, Brussels sprouts, broccoli and cauliflower thresholds used are $\geq 20\%$ plants infested with any species during seedling stage, then 30% infestation from early vegetative to cupping stage. From early head to harvest in cabbage and Brussels sprouts use a 5% threshold. For broccoli and cauliflower, use 15% at curd initiation/cupping, then 5% from curd development to harvest. Adjust these to personal preferences and tolerances. For example, kraut cabbage for processing can tolerate higher levels near harvest as wrapper leaves with holes are generally removed. Growers now have many insecticide options. *Bacillus thuringiensis kurstaki* (DiPel, Deliver, Javelin) or *B.t. aizawai* (Agree) –based materials can work well for all worms in both conventional and organic production but coverage under leaves is essential. Include a wetting agent or sticker where foliage is waxy. For heavy infestations, where loopers are large or if spray coverage under leaves is poor a material with contact or better residual activity may be needed. Entrust (for organic production), Avaunt, chlorantraniliprole (Durivo/soil, Voliam flexi or Xpress/foliar or Coragen soil/foliar), Verimark, Orthene/acephate (Brussels sprouts and cauliflower only), Proclaim, fluendiamide (Belt, Synapse, Vetica), Radiant, Rimon, or Intrepid are options. Pyrethroids (Baythroid XL, Warrior II, Bifenture, Asana XL, etc.) will control ICW and CL but are generally less effective against DBM.

Cabbage maggot (CM) larvae feed on roots of many brassicas and are the bane of many brassica growers, particularly in organic production. Older plants may tolerate some injury but younger ones can be killed. Even light damage to radishes or turnips can render them unmarketable. CM is similar to and slightly smaller than a house fly, sometimes observed resting on or laying eggs near the base of host plants. Many brassicas including canola and weeds (e.g. wild radish) are hosts, but not all cruciferous weeds are suitable. Adult flies emerge in mid-spring in upstate NY, peaking around mid-May with at least four flights per year. Although the first generation is often most damaging, significant damage can occur from successive broods. One study found peak flight times for each generation correlated with peak bloom of various wild plants, useful when scheduling plantings and planning for protection: yellow rocket (winter cress) (1st generation), wild daylily (2nd), Canada thistle or early goldenrod (3rd) and more roughly New England aster (4th) around late September to early October. Cornell's NEWA website also has an updated cabbage maggot model to help growers determine when flights occur based on degree-day accumulations from weather stations (<http://newa.cornell.edu> - Pest Forecasts). A pheromone attractant for *Delia* spp. flies (including CM) is available for monitoring fly activity but also attracts seedcorn maggot flies, which can be extremely abundant and a bit difficult to separate from CM.

Some biocontrols feed on CM and populations fluctuate over time, but we have found in most years organic and conventional growers can expect significant damage. Eliminating alternate (weed) hosts such as wild radish may help where practical. We have run many field trials in the past decade or so to evaluate new and alternative treatments (e.g. seed treatment, row covers) with only limited success. Spun-bonded row cover placed over transplants provided nearly 100% control, but ends need to be well-sealed, deer or other animals, which can leave holes, excluded and it is best used on rotated ground. High tunnels may provide similar protection if possible

entry points for flies are well-sealed. Lorsban can be applied pre-, at or post-planting and appears in our trials to provide the most consistent and effective control. Diazinon is applied pre-plant broadcast or in transplant water. Capture LFR is labeled for banded application over the seed furrow at planting. Verimark also can be applied to transplants in trays, as a surface spray, or by other methods. In one trial Entrust applied to transplants in flats suggests some benefit but this is not yet a labeled use.

Crucifer and striped flea beetles are familiar to most growers. The adults overwinter, emerging as air temperatures reach 57F and initially appear at field edges, moving deeper into the field as conditions warm. A second generation of adults appears later in summer into fall. Feeding on foliage can kill seedlings and causes shotholing in older leaves. In cabbage, transmission of *Alternaria* has been associated with flea beetles and late-season populations can significantly damage heads. Flea beetle larvae feed on roots but damage appears to be minor. Yellow sticky traps can be used to monitor activity, placed in or around the crop and just above the canopy. Scout for the beetles when cool and sunny (early morning), taking care to avoid allowing a shadow to fall over the plants. One threshold for cabbage seedlings is 1 beetle per plant; treatment after plants have 6 leaves until early headfill may not be needed, but watch for heavy infestations and later damage to marketable portions. Soil treatment with a systemic (imidacloprid –Admire Pro) can provide long-term control. Foliar applications include pyrethroids (Baythroid XL, Brigade, Warrior II, Mustang Max, etc.) and carbaryl/Sevin. For organic growers, Entrust can suppress infestations or rowcovers placed to exclude beetles while crops are small. Washington State University suggests planting a more attractive trap crop of pac choi, rape or mustard nearby to protect broccoli (see references).

Cabbage aphid (CA) is the most notorious aphid in brassicas in our region. Large numbers of the dusty gray-green insects sometimes cause foliage to curl or just contaminate leaves and heads. Most popular cole crops are hosts. Brussels sprouts are a particular concern as heading starts, since control can be nearly impossible once aphids have entered developing sprouts. CA overwinters as eggs on brassica crop residue or weeds. Infestations in spring are often very spotty or localized, but can become widespread. Some natural enemies help keep CA populations in check but outbreaks still occur. Destroy old crop residue in fall or early spring and monitor fields twice a week – initially check upwind of field borders and along areas with older cole crops. University of California has a sequential sampling plan for Brussels sprouts to assess whether control is needed (see references) using a 40% infestation threshold up to 2 weeks prior to harvest and suggests broccoli and cauliflower can tolerate up to 100 aphids prior to heading, with a nearly zero tolerance after. In cabbage, tolerances during growth are low, 1 – 2% infestation. When treatments are needed, current controls for aphids include Acephate/Orthene (Brussels sprouts and cauliflower), Assail, Verimark (soil), Exirel (foliar), Beleaf, Admire Pro or generic (foliar), Endigo, Fulfill, Movento, Closer, Durivo (soil), Voliam flexi (foliar), and Actara. Organic growers can use M-Pede or a horticultural oil (e.g. SuffOil-X, Sunspray UFO).

A Note on Crop Groupings

Choosing among insecticide products for control of vegetable crop pests can be confusing. Most labels now organize uses by 'crop groupings.' For example, uses for pests on tomatoes, peppers, and eggplant are often listed together on labels under 'fruiting vegetables' (crop group 8). For brassicas the situation is a bit confusing, since different ones fall under various groups. You can find the entire list of crop groups and search where particular crops are listed at <http://ir4.rutgers.edu/other/CropGroup.htm>. Following is a summary of the groups and respective crops included:

Group 1 - Root and Tuber Vegetables, includes:

Subgroup 1A radish (roots) and horseradish; Subgroup 1B radish (tops)

Group 4 - Leafy Vegetables (except Brassica vegetables)

This actually includes some brassicas in

Subgroup 4A leafy greens – arugula, garden and upland cress

Group 5 - Brassica (Cole) Leafy Vegetables includes:

Subgroup 5A Head and Stem Brassica - Broccoli; broccoli, Chinese; Brussels sprouts; cabbage; cabbage, Chinese (napa); cabbage, Chinese mustard; cauliflower; cavalo broccolo; kohlrabi

Subgroup 5B Leafy Brassica Greens - Broccoli raab; cabbage, Chinese (bok choy); collards; kale; mizuna; mustard greens; mustard spinach; rape greens

Product trade names are used for convenience only. No endorsement of products is intended nor is criticism of unnamed products implied. Information presented is not a substitute for pesticide labeling. Always read and understand the product label before using any pesticide.

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