Insect and Diseases on Brassica Crops

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Because of their cold-hardiness, Brassicas are among the first crops to be planted in the spring, and the last to be harvested in the fall. Some Brassicas are planted in multiple successions, while others are long-term residents in the field. Insect and disease pressure often increases over the course of the season. Although a 'calendar' of when to expect which insect or disease varies greatly with the season, thinking of management as a timeline can be useful. This is one crop that also requires regular field scouting, as most problem get their start hidden in the canopy, in and under the leaves, stems and roots.

Preplant considerations: *Alternaria* species, downy mildew and black rot can be seed-borne. As growers diversify their seed sources and may save their own seed for certain varieties, the possibility of introducing disease on seed increases. Disease can begin on one variety, and spread throughout the field. Select seed that has been certified as disease-free or treat seed with hot water (15- 30 minutes at 122˚ F) to eradicate pathogens, an effective tool to reduce disease risk and can be done on the farm. Some seed companies will treat on request.

Crop rotation is key with Brassicas as with many other crop families. It is good to avoid letting brassicas become too high a proportion of your crop acreage, as that will make it harder to stay out of Brassica crops for 3 years, which is best. Think not only about between-season rotation but also in-season rotation. Often there are major plantings in spring, and again for fall harvest. Plant these as far apart as possible. Flea beetles, caterpillars, *Alternaria*, black rot, cabbage root maggot fly – all of these have multiple generations; field separation can reduce the pressure on fall crops. Avoid planting onions and fall Brassicas in close proximity to prevent movement of onion thrips into Brassicas as onions decline.

Additional cultural practices for a healthy crop:

- Provide adequate fertility including boron. Brassicas are heavy feeders and often benefit from side-dressed N.
- Adjust planting density to reduce periods of leaf wetness which favor pathogen spread.
- Control cruciferous weeds, which harbor insects & pathogens.
- Select disease resistant cultivars; in broccoli, look for a tight, well-domed head.
- Locate seedbeds, transplant houses, and early Brassica successions so as to reduce the spread of wind-borne inoculum to later plantings.
- Avoid planting in fields that receive run-off from areas previously planted to crucifers.
- Do not locate cull piles near fields, transplant greenhouses, or storage areas. Better yet, compost, bury or remove all culled plant material.
- Let fields dry out before cultivating or harvesting.
- Use drip irrigation instead of overhead irrigation.

- Promptly and fully incorporate crop residues after harvest (in reduced till: mow, plant cover crops.)

Flea beetles: Beetles overwinter as adults in field edges near their fall feeding sites. Adults become active on the first warm days, and locate seedlings with uncanny speed and accuracy. They prefer *Brassica rapa* & *B. juncea* crops such as tatsoi, mizuna, bak choi, and mustard, but will also feed on the more waxy *Brassica oleracea* crops such as broccoli, cabbage, kale and collard. The crucifer flea beetle (*Phyllotreta cruciferae*) is uniformly black and shiny, about 2 mm in length, while the less-common striped flea beetle (*Phyllotreta striolata*) has two yellow stripes on its back. Egg, larval and pupal stages are hidden from sight, underground in the root zone, but the peak of adult feeding in late July and early August is due the emergence of a new generation from the soil. These adults feed heavily, may lay more eggs, and depart for field edges in Sept. If you see a third flush in September, this is likely a second generation emerging. **Row covers.** Floating row cover provides the most effective protection from flea beetles, especially in spring and early summer. It is expensive in materials and time, but it works and is widely used for salad mix. It is critical to seal the edges with soil or bags on all sides immediately after seeding or transplanting. Hoops are not needed. The cover has to be removed for cultivation and replaced the same day. 'Non-heating' insect barriers can extend this tool into the summer months but do not use over established crops because aphids are trapped in and beneficials are excluded. Flea beetles require a fine mesh, though not quite as fine as thrips. Fall turnips tend to produce distorted roots when grown under row cover. **Chemical control**. With foliar sprays, even if good control is achieved, re-infestations can occur rapidly and require additional sprays. Several pyrethroids, carbamates and neonicotinoids are labeled for flea beetle in Brassicas. Avoid repeated use of one type of chemistry over multiple generations or using both soil and foliar applications of the same group. Soil-applied systemic insecticides such as Admire Pro and Actara can provide longer term control against damage, although beetles may be present when scouting. Watch longer days to harvest intervals. For organically managed fields, efficacy of spinosad is well documented and it has a longer residual (5-7 days). Pyrethrin often shows poor efficacy in trials but does cause significant short-term knockdown and is a key alternative product. Kaolin reduces feeding damage and can be used early in crop growth before marketable leaves are present (cotyledons & young seedlings in direct seeded, young transplants) and it offers an affordable alternative product. Any of these can be mixed together. **Trap cropping:** Planting preferred hosts (*B rapa* and *B juncea* crops) to protect less preferred hosts (some *B napa*, all *B. olercaea* crops) works by concentrating adults in the preferred crop where they can be sprayed. Unsprayed traps have also been shown to reduce feeding on less preferred neighbor crops. Mixing trap crop species may work better than one species. Border trap crops help intercept incoming migrations, but strips within the field can also serve to collect higher numbers. Scout both 'trap' and 'main' crops to determine when sprays are needed in each. With timely, targeted sprays, 'trap' crops (eg bok choy, Chinese cabbage) can be fully marketable while also serving to reduce sprays on the 'main' crop.

Cabbage Root Maggot (*Delia radicum)***:** After spending the winter as pupae underground, adults emerge at the same time that yellow rocket weed blooms (late April to mid-May) and search out the earliest Brassica plantings. Temperature models, yellow sticky cards, and close-up field scouting for eggs help growers know when this fly is active. When leaves turn red, plants wilt and stop growing, or collapse completely it is a sign that larvae are feeding heavily on roots. Currently, insecticide chemistry is limited to organophosphates which are banded over the row,

and resistance has become a problem. Rotation, row covers, later planting dates, and cultivation that throws soil around the stems to encourage secondary root growth help reduce losses. Predatory nematodes (*Steinernema feltiae*) applied to transplants are a biocontrol option.

Imported cabbageworm and diamondback moth. The first to appear is *Pieris rapae*, the white cabbage butterfly that lays eggs singly on the leaves. There are 4-5 generations of imported cabbageworm (ICW) per year. In the past, these built up over the season but now they are kept partially in check throughout the Northeast by *Cotesia rubecula*. This parasitic wasp was introduced in 1988 and lays its eggs in small larvae. After killing its host, the immature *C. rubecula* spins a 2 cm long white cocoon. Diamondback moth *(Plutella xylostella)* appears in late spring or early summer, is smaller and wiggly when touched, causes small, round holes that tends to be spread across the foliage, as opposed to ICW, which feeds primarily in the plant center and the head. Both are best monitored with direct scouting of under the leaves. The most critical time for scouting and applying controls is just before heads form, but leafy greens should be checked throughout their growth.

Cross-striped cabbageworm (*Evergestis rimosalis*) builds in midsummer and is something new to watch out for. It has not historically been found in New England but has gradually extended its range northward. We first listed it in the New England Vegetable Management Guide in 2005, because it had become common in Connecticut. In 2012 it was found in Hampshire, Worcester and Norfolk Counties in MA. One of the major differences between this insect and the other Brassica caterpillars is that the eggs are laid and caterpillars feed in a group on one plant so that it's covered with big holes like buckshot. This moth is closely related to European corn borer, and the adults are similar in shape and coloring – straw-colored with a little purple and crossed by wavy lines. Since it flies at night, you will likely only notice the caterpillars and their damage. The clusters of 3 to 25 eggs are yellow, flattened, and attached to the lower leaf surfaces. The caterpillars are light bluish-grey on top and green underneath, with numerous black transverse bands across their backs and a yellow line down each side. Larvae grow to 3/4" long in 2 to 3 weeks. There are 2-3 generations per year, but generally it's only in late summer that numbers reach damaging levels. Larvae can produce small holes in leaves until only veins remain, feed in terminal buds and sprouts, or burrow into heads. Plants with larvae are often completely skeletonized. Adjacent plants may be left undamaged. Selective insecticides such as Bt's and spinosyns are effective.

Black Rot of Brassicas, *Xanthomonas campestris* pv. *campestris*, is a bacterial disease that plugs the water-conducting tissue of the plant with xanthan, a mucilaginous sugar. It usually develops after warm, wet weather in midseason, but can occur earlier. It can explode after heavy rains. The optimum temperature for the pathogen to grow is from 80ºF to 86ºF. Water, in the form of rain, irrigation, or dew, is required for the disease to establish, grow and spread. Symptoms appear as yellow, V-shaped lesions that extend from the leaf margin toward the base of the leaf, resulting in wilt and necrosis. It can also occur mid-leaf, as darkened dead patches of tissue between the veins. Symptoms on root crops may not be visible on foliage, but blackened veins appear in the roots. On heading crops, infection may spread into the leaves of the head. **Spread.** The most important means of transmission is in seed, and as little as 0.03% infection can cause epidemics. Surface treatment of seed is not sufficient; hot water treatment reaches bacteria under the seed coat. The bacteria can persist in infected plant debris for up to two years, especially in cabbage and Brussels sprout debris; it survives on its own in the soil for 40-60 days.

Infected seedlings may be symptomless, allowing infected plants to be transplanted into the field or transported to new farms. It is favored by warm temperatures and spread within the field by splashing water, wind, equipment, people, and insects. **Chemical control**: Copper products are most effective when used before infection is widespread and with continued sprays at 7-10 day intervals after symptoms develop. It can't cure an existing infection, but it may slow it. Aim for good coverage of lower leaf surfaces.

Cabbage looper *(Trichoplusia ni)* arrives in migratory flights from farther south and does not show up until late July or August, though some years they are not found at all or earlier flights occur. Adult moths fly at night and are rarely seen unless monitored with pheromone traps. Caterpillars are light green, with wavy white or light yellow lines down the back and sides, reach 1.5 to 2 inches and make ragged, large holes in foliage, on both frame leaves and heads. They also feed in lettuce, chard and spinach. Controls are the same as for ICW and DBM.

Alternaria leaf spot is a fungal disease that affects all cultivated brassicas, causing small black spots that grow into large lesions with characteristic concentric rings on leaves, stems and heads. The most damaging Alternaria species in Brassicas are *A. brassicae* and *A. brassicicola*. Disease development is favored by cool temperatures (60-78° F) and long periods of leaf wetness or high relative humidity (12 hours of RH> 90%), thus it tends to become especially damaging in late summer and fall crops. The main means of introduction into new areas is on infested seed (remedied by hot water treatment and seed fungicide treatements). Once established, *Alternaria* species overwinter primarily in diseased crop debris. Spread from one infected crop into nearby crops occurs easily, as the fungi sporulate profusely and are moved by wind, splashing water, equipment, and workers. Manage with cultural controls, resistant varieties, and preventative fungicides. Biological disease control products are being studied at UMass and Cornell.

Onion thrips (*Thrips tabaci***)** are most likely to build up in fall Brassicas after onion crops reach maturity. Their rasping mouthparts open wounds on the undersides of leaves, causing raised brown scars. This may also occur within cabbage heads; some varieties are more resistant. As with most diseases and insects in Brassicas**, scouting the undersides of leaves is critical** in order to catch and manage this problem. Spinosad (Entrust and other products) and spinetoram (Radiant) are effective.

Downy Mildew of Brassicas can affect any crop stage and may spread from seed, infected living crops & weeds, or long-lasting resting spores. Disease development is encouraged by cool, moist conditions. Infections on seedlings and transplants can become systemic and dormant; returning later in the field when conditions are favorable and decreasing crop yields. Winter greenhouses can be conducive and can be a living bridge. Strict sanitation, rotation, weed control, environmental management in the GH are critical as chemical management is not sufficient for this increasingly common disease.

Swede Midge is established in Northern Vermont, western NYS, Quebec and Ontario and causes severe damage to head and stem Brassicas in those areas. Adults are active all season long. Row cover, long-distance rotation, timing, and insecticide applications are current management options. Get to know what to look for, and see resources http://web.entomology.cornell.edu/shelton/swede-midge/.