Great Lakes Fruit, Vegetable & Farm Market EXPO

Michigan Greenhouse Growers EXPO

December 9 - 11, 2014

DeVos Place Convention Center, Grand Rapids, MI

Cole Crops

Wednesday afternoon 2:00 pm

Where: Gallery Overlook (upper level) Room A & B

MI Recertification credits: 2 (1B, COMM CORE, PRIV CORE)
OH Recertification credits: 2 (presentations as marked)
CCA Credits: CM(2.0)

Moderator: Doug Horkey, MVC Board, Dundee, MI

2:00 pm Bacterial Blights of Mustard and Turnip Greens: Resistance and Actigard As Management Options (OH: 2B, 0.5 hr)

- Anthony Keinath, Clemson University Coastal Research & Education Center, Charleston, SC

2:30 pm Managing Thrips and Other Pests on Cabbage (OH: 2B, 0.5 hr)

- Celeste Welty, Entomology Dept., The Ohio State Univ.

3:00 pm Know the Diseases That Affect Cole Crops (OH: 2B, 0.5 hr)

- Charles Krasnow, Plant, Soil and Microbial Sciences Dept., MSU
- Mary Hausbeck, Plant, Soil and Microbial Sciences Dept., MSU

3:30 pm Cole Crop Herbicide Update (OH: 2B, 0.5 hr)

- Bernard Zandstra, Horticulture Dept., MSU

4:00 pm Session Ends

Managing Thrips and Other Pests on Cabbage

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Part 1: Thrips

The onion thrips has been causing increasing problems with processing and fresh market cabbage in northern Ohio for the past few years. Growers have expressed strong interest in adopting an aggressive program of insecticide control using registered products, and interest in the potential for using new products such as Exirel (cyazypyr), which was registered in January 2014. Insecticide trials were conducted in Ohio in 2012 and 2013 to evaluate Exirel and other alternatives for thrips control. The trial in 2012 focused on each of the insecticides used alone, while the trial in 2013 focused on how to use the products together in various programs.

Methods for thrips insecticide trial, 2013:

The standard thrips control program in 2013 was defined as eight spray applications using a sequence of four products: Movento (spirotetramat), Radiant (spinetoram), Assail (acetamiprid), and Lannate (methomyl), each with two consecutive applications at 10-day intervals, starting 2 weeks after transplanting.. All insecticides used for thrips control were assumed to have adequate activity for caterpillar control, with the exception of Movento; Dipel (*Bacillus thuringiensis*) thus was used with Movento to control caterpillars. Exirel was evaluated as a substitute for each of the four standard products.

The cabbage variety 'Score' (Bejo Seeds Inc.), a popular processing variety that is thrips susceptible, was transplanted on 8 May 2013 near Fremont, Ohio. Spray volume was 45.9 gallons per acre. Rates of insecticides and adjuvants used were:

- Exirel 10SE (cyazypyr), 16.9 fl oz/A, plus COC 0.5%;
- Radiant 1SC (spinetoram), 8 fl oz/A, plus LI-700 0.25%;
- Assail 30SG (acetamiprid), 4 oz/A, plus LI-700 0.25%;
- Lannate LV 2.4WSL (methomyl), 48 fl oz/A, plus COC 0.5%;
- Movento 2SC (spirotetramat), 5 fl oz/A, plus DyneAmic 0.25%, plus Dipel DF (*Bacillus thuringiensis*), 1 lb/A;

Treatments were evaluated for thrips damage at harvest on 15 August 2013 by rating a sample of five randomly selected heads per plot. Heads were weighed by processing standards, with wrapper leaves removed. Each head was cut in half, and 10 layers of leaf were then peeled back and examined individually for thrips injury. Thrips injury was rated on scale of 0 (no injury) to 5 (severe injury). Head weight and damage rating data were subjected to analysis of variance and mean comparisons by least significant difference (LSD) tests.

Results and discussion for thrips insecticide trial, 2013:

There was significantly more injury by thrips in untreated plots than in the four insecticide treatments, as measured by the thrips total injury rating, which is the sum of individual ratings on each of the ten outermost head leaves ($P < 0.0001$; Table 1). Among the four insecticide programs, thrips injury did not vary significantly, but was least in the Radiant/

Exirel/ Assail/ Lannate treatment and greatest in the standard treatment of Movento/ Radiant/ Assail/ Lannate. The deepest leaf layer with an injury rating greater than 1, which ignores the lightest damage, showed the same trend, with all insecticide treatments significantly better than untreated plots, but no significant difference among the four insecticide programs (*P* = 0.0057). The other two injury variables showed similar trends but with some significant differences among the four insecticide programs. The number of leaves with any thrips injury was significantly less in the Radiant/ Exirel/ Assail/ Lannate treatment than in the standard Movento/ Radiant/ Assail/ Lannate treatment (P < 0.0001), and likewise the deepest layer with any thrips injury was significantly less in the Radiant/ Exirel/ Assail/ Lannate treatment than in the standard Movento/ Radiant/ Assail/ Lannate treatment (*P* = 0.0132).

From these results, we conclude that Exirel is a welcome alternative to other products for control of thrips as well as caterpillar pests. Exirel performed best when positioned second in the sequence of four products and when preceded by Radiant rather than Movento. Although Radiant had been positioned second in the sequence because this typically occurs at the cabbage cupping stage, which is the most critical for thrips control, the results of this trial suggest that Radiant earlier in the program might be more effective.

Table 1. Thrips injury on 'Score' cabbage heads and weight of cabbage heads at harvest on 15 August 2013 at Fremont, Ohio.

Treatment (sequence of products and number of sprays of each)	Thrips injury				**Weight per head, kg**
	Thrips total injury rating (sum of ratings on 10 leaves)[a]	Number of leaves with any injury[a]	Deepest layer with any injury[a]	Deepest layer with rating >1[a]	
Radiant(2)/ Exirel(2)/ Assail(2)/ Lannate(2)	1.2 B	0.8 C	1.2 C	0.6 B	2.78
Movento+Dipel(2)/ Radiant(2)/ Assail(2)/ Exirel(2)	1.8 B	1.2 BC	1.6 BC	0.7 B	2.74
Movento+Dipel (2)/ Exirel (2)/ Assail(2)/ Lannate(2)	2.3 B	1.2 BC	1.9 BC	1.2 B	3.09
Movento+Dipel (2)/ Radiant(2)/ Exirel(2)/ Lannate(2)	2.4 B	1.3 BC	2.0 BC	1.0 B	2.46
Movento+Dipel (2)/ Radiant(2)/ Assail(2)/ Lannate(2)	2.4 B	1.8 B	2.6 AB	1.0 B	2.59
Untreated	6.8 A	3.1 A	3.4 A	2.4 A	2.63
P value for treatment effect	*<0.0001*	*<0.0001*	*0.0132*	*0.0057*	*0.1572*

[a] Within each column, means followed by same letter are not significantly different (*P*>0.05); mean separations by LSD.

Part 2: Caterpillars

Caterpillar pests are ubiquitous on cole crops, on which they can reduce crop quality and yield. Diamondback moth populations can be difficult because some have become resistant to some insecticides. Populations of these pests on commercial farms are usually controlled by spraying insecticides. Caterpillars can be attacked by a variety of tiny wasp parasitoids that develop inside the body of the caterpillar and eventually kill it. The parasitoids can aid in control of the caterpillars, but they often have a short life span due to a shortage of nectar, their main food source. Parasitoids are often killed by commonly used insecticides.

Research in 2011 and 2012 by graduate student Emily Linkous focused on evaluation of natural biological control of caterpillars by parasitoid wasps, and whether or not parasitoid activity could be enhanced by using less harsh insecticides and planting strips of flowering plants within the field. Flowers are a nectar source that can increase the survival and longevity of parasitoids so that they can parasitize more caterpillars. Sweet alyssum is a good plant for these insectary strips because it flowers all summer long and is easy to maintain. To test these tactics for enhancing parasitoids, a field trial was conducted at three sites in Ohio. Two large plots of cabbage were planted at each site, one with alyssum strips and one without. Within each large plot, subplots were treated with cyfluthrin (a harsh insecticide), B.t. (a less harsh, biological insecticide), or nothing. Caterpillars were counted weekly to determine pest density, and subsets were collected to determine the parasitism rate. Parasitism of diamondbacks in main plots ranged from 30 to 41% (Table 2), and in subplots ranged from 20 to 43% (Table 3). Parasitism was only slightly higher in plots bordered with alyssum strips than in those with no alyssum strips. There were fewer caterpillars in the plot with alyssum strips than in the plot without the alyssum strips. Pest density in subplots treated with cyfluthrin and B.t. was never significantly different, which is important because it documented how well B.t. can work. The use of B.t. did not increase parasitism but did keep pest density low; use of lower rates of B.t. or longer spray intervals might increase parasitism while maintaining low pest density.

In a related assessment, ten commercial cabbage farms in northern Ohio were surveyed monthly in the summers of 2011 and 2012 to determine what species of parasitoids were present. All caterpillars that were large enough to be parasitized were collected and held in the lab to see whether the parasitoid or the adult pest would emerge. Eleven parasitoid species were collected from commercial fields. Parasitoids were found on most commercial farms, including farms where insecticides are frequently used, although lower numbers and fewer species were found on farms that used harsher insecticides. The parasitoid community that attacked diamondback moth was composed of four species of wasps, with *Diadegma insulare* the most common species.

The results of these projects are useful to cabbage growers, particularly growers on small or organic farms who are looking for a way to decrease pesticide usage and increase biological control. Because parasitoid populations are enhanced by the insectary strips, their use along with B.t. sprays should allow a level of control similar to that usually seen with harsher insecticides. Reduced use of harsher insecticides would also benefit the environment.

Table 2. Diversity and relative contribution to overall parasitism rate of parasitoid species collected from larvae of *Plutella xylostella* (diamondback moth), *Pieris rapae* (imported cabbageworm), and *Trichoplusia ni* (cabbage looper) between main plots, 2011-2012. Within a row, means followed by the same letter are not significantly different (*P* > 0.05).

	Percent parasitism (N)			
	2011		2012	
	Alyssum main plots, 2011	No alyssum main plots, 2011	Alyssum main plots, 2012	No alyssum main plots, 2012
Plutella xylostella	40.6 (143)a	37.7(183)a	36.4 (459)a	30.3 (228)b
Diadegma insulare	32.9 (47)	31.1 (57)	21.4 (98)	24.6 (56)
Oomyzus sokolowskii	7.7 (11)	6.0 (11)	13.7 (63)	4.4 (10)
Cotesia plutellae	0.0	0.5 (1)	0.0	0.9 (2)
Conura spp.	0.0	0.0	1.3 (6)	0.4 (1)
Pieris rapae	32.4 (173)a	15.4 (143)b	33.9 (274)a	44.7 (206)a
Cotesia rubecula	12.1 (21)	8.4 (12)	8.8 (24)	21.8 (45)
Cotesia glomerata	3.5 (6)	0.7 (1)	5.1 (14)	3.8 (8)
Pteromalus puparum	5.2 (9)	0.7 (1)	11.7 (32)	6.8 (14)
Compsilura concinnata	0.0	0.0	2.9 (8)	4.4 (9)
Hyperparasitoid *Tetrastichus galactopus*	9.2 (16)	3.5 (5)	4.0 (11)	7.3 (15)
Hyperparasitoid *Conura spp.*	2.3 (4)	2.1 (3)	1.5 (4)	0.5 (1)
Trichoplusia ni	0.0 (4)	0.0 (2)	20.9 (129)a	26.9 (93)a
Voria ruralis	0.0	0.0	20.2 (26)	23.7 (22)
Copidosoma floridanum	0.0	0.0	0.8 (1)	3.2 (3)

Table 3. Diversity and relative contribution to overall parasitism rate of parasitoid species collected from larvae of *Plutella xylostella* (diamondback moth), *Pieris rapae* (imported cabbageworm), and *Trichoplusia ni* (cabbage looper) between subplots, 2011-2012. Within a row, means followed by the same letter are not significantly different (*P* > 0.05).

	Percent parasitism (N)					
	2011			2012		
	Cyfluthrin, 2011	B.t., 2011	Untreated, 2011	Cyfluthrin, 2012	B.t., 2012	Untreated, 2012
Plutella xylostella	36.0 (50)	26.3 (57)	43.1 (218)	19.6 (51)	20.9 (86)	37.7 (536)
Diadegma insulare	28.0 (14)	21.1 (12)	35.8 (78)	7.8 (4)	15.1 (13)	24.4 (131)
Oomyzus sokolowskii	8.0 (4)	5.3 (3)	6.9 (15)	9.8 (5)	4.7 (4)	11.9 (64)
Cotesia plutellae	0.0	0.0	0.5 (1)	0.0	0.0	0.4 (2)
Conura spp.	0.0	0.0	0.0	2.0 (1)	1.2 (1)	0.9 (5)
Pieris rapae	9.1 (11)	0.0 (20)	26.7 (285)	9.1 (11)	50.0 (10)	38.2 (458)
Cotesia rubecula	0.0	0.0	11.2 (32)	0.0	10.0 (1)	14.0 (64)
Cotesia glomerata	0.0	0.0	2.7 (7)	0.0	0.0	4.8 (22)
Pteromalus puparum	9.1 (1)	0.0	3.2 (9)	9.1 (1)	20.0 (2)	9.4 (43)
Compsilura concinnata	0.0	0.0	0.0	0.0	20.0 (2)	3.3 (15)
Hyperparasitoid *Tetrastichus galactopus*	0.0	0.0	7.4 (21)	0.0	0.0	5.7 (26)
Hyperparasitoid *Conura spp.*	0.0	0.0	2.5 (7)	0	0	1.1 (5)
Trichoplusia ni	0.0 (1)	0.0 (3)	0.0 (2)	33.3 (21)	20.0 (55)	23.3 (146)
Voria ruralis	0.0	0.0	0.0	28.6 (6)	16.4 (9)	22.6 (33)
Copidosoma floridanum	0.0	0.0	0.0	4.8 (1)	3.6 (2)	0.7 (1)

Know the Diseases that Affect Cole Crops

Charles Krasnow and Dr. Mary Hausbeck, Professor, 517-355-4576
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Pathogens such as downy mildew, black rot, black-leg, *Alternaria* leaf spot, *Sclerotinia* white mold, and wire-stem can cause problems on cole crops. Protecting these crops from pathogens requires accurate identification and an integrated management approach.

Seedling diseases: Pathogens of brassica seedlings may infect the cotyledons, lower leaves, roots, or hypocotyls, and in some cases can move into the plant and remain there as latent or "quiet" infections. Infected cotyledons may fall off or go unnoticed, leaving apparently "healthy" looking seedlings. Subsequently, diseased transplants are planted into the field, leading to potential problems later in the growing season. As many seedling pathogens can also affect mature plants, recognizing the symptoms caused by these pathogens is important for timely and effective disease control. Black-leg (*Phoma lingam*) and black rot (*Xanthomonas campestris*) are two diseases which are frequently carried on the seed. Even a small number of infested seeds may lead to significant losses as these pathogens can quickly spread among closely spaced transplants in a seedling flat during overhead irrigation. Black-leg develops as inconspicuous gray lesions on the stems of transplants that may progress into collar rot in the field, resulting in plant wilting and death. Black rot, a bacterial disease, can also cause lesions on transplants; however, it tends to be favored by higher temperatures than black-leg. Wire stem is a seedling disease caused by *Rhizoctonia solani* that can be found in unsanitized seedling flats and survives well in plant debris in the field. Even mildly infected seedlings may appear to grow out of this disease, but may still result in economic losses by extending harvest dates and reducing head weight. The pathogens that cause dark leaf spot (*Alternaria* spp.) and downy mildew (*Peronospora parasitica*) can also be transmitted by seed and cause damping off of seedlings in severe cases. A small number of infected seedlings that are planted in the field can act as a reservoir of inoculum that will spread to neighboring plants when conditions favor disease (wet and humid). Limiting irrigation may reduce the incidence of these diseases in the greenhouse, especially with the pathogens that require leaf moisture or splashing for dispersal and infection. For example, the black-leg pathogen produces spores in small black "pimple-like" structures that form in lesions. These structures need free water to release their spores which are then splash dispersed. Back-to-back passes with an irrigation boom in the greenhouse could increase pathogen spread. One of the most effective preventive measures for seedling diseases is planting certified seed that has been produced in arid regions and hot-water treated or treated with appropriate fungicides. For growers treating their own seed, 50°C (122°F) water for 15-30 minutes has been shown to be effective at reducing most seed-borne crucifer pathogens. However, special care should be taken with old seed and broccoli/cauliflower seed, which are more delicate.

***Pythium* root rot**: *Pythium* is a "root nibbler" and is common in soil and surface water. For example, *P. ultimum* and *P. irregulare* can infect many vegetable and agronomic crops and are "generalists" due to their wide host ranges. These *Pythium* spp. don't usually cause significant yield loss to mature plants, but plant stand can be reduced when seeds are planted into cool, wet soils that are infested with the pathogen. Recently, a *Pythium* sp. specific to cole crops was found in Michigan on cabbage seedlings. This particular *Pythium* (*P. polymastum*) is more aggressive on cole crops than other species of *Pythium* and infection at an early seedling stage may result in plant death while in the greenhouse. If diseased seedlings go unnoticed and are planted into the field, plants could remain stunted with yield loss. Management of this destructive *Pythium* includes sanitizing seedling flats or using only new plant containers. Flats that have had diseased seedlings should always be disposed of and not used for new seedlings. Additionally, *Pythium* species have been successfully controlled with mefenoxam (Ridomil Gold SL at 0.25-0.5 pt/A) shanked or banded into the soil prior to field planting. SoilGard can also be incorporated into potting mix for production of broccoli transplants in the greenhouse. In an MSU greenhouse trial, 3-week old 'Bronco' cabbage seedlings were reduced by greater than 30% (by weight) after growing for 2 weeks in soil infested with a *Pythium* species that infects cole crops.

Downy mildew can infect and kill brassica seedlings, but usually causes more significant losses late in the season on cabbage, broccoli, cauliflower, and greens. Infected leaves show yellow lesions on the surface with the white 'down' of downy mildew spores on the underside of the leaf. This white growth is most visible during mornings when high humidity or dew is present. Downy mildew is favored by cool, moist weather, and long dew periods which occur frequently in late summer. Fungicide applications can control this pathogen but should be applied preventively (Table 1). In some cases, downy mildew is overlooked at harvest and infection of heads and curds may develop in storage. Radish roots can also be infected by the pathogen, which causes a black discoloration of the external and internal root. Crop rotation is useful in reducing field inoculum as the pathogen produces overwintering oospores in infected plant debris.

Table 1. Fungicides labeled for downy mildew control on cole crops in the field.

Product	Active	Crops labeled	FRAC code[1]
Aliette WDG*	Fosetyl-Al	C, Bs, Br, Ca,G[2]	33
Presidio*	Fluopicolide	C, Bs, Br, Ca	43
Ridomil Gold Bravo*	Mefenoxam + Chlorothalonil	C, Bs, Br, Ca	4 + M5
Zampro*	Ametoctradin + Dimethomorph	C, Bs, Br, Ca	45 + 40
Manzate	Mancozeb	C, Br	M3
Flint	Trifloxystrobin	T	11
Badge	Copper hydroxide + oxychloride	Br, Bs, C, Ca,	M1
Forum	Dimethomorph	Br, Bs, C, Ca, G	40
Revus	Mandipropamid	Br, Bs, C, Ca, G	40
Phostrol	Phosphites	Br, Bs, C, Ca, G	33

* Materials marked with an asterisk are particularly recommended for problem infestations.
[1] The FRAC code separates fungicides by their mode of action and the likelihood of resistance development. Alternating fungicides that have different FRAC codes is recommended to delay pathogen resistance.
[2] C=cabbage, Br=broccoli, T=turnip, Bs=brussels sprouts, Ca=cauliflower, G=greens

***Alternaria* leaf spot**: Dark leaf spot is caused by the *Alternaria* pathogen which causes 'target spot' lesions on brassica foliage. These lesions may have a brown papery center that can fall out leaving a shot-hole appearance of the leaf. The pathogen increases rapidly on mature and senescent foliage, especially during warm and wet weather which favors spread of the airborne spores. *Alternaria* can also cause lesions on mature cabbage heads or curds of broccoli and cauliflower that serve as entry points for secondary pathogens in storage. The pathogen survives in plant debris and a 3-year rotation and full incorporation of crop debris immediately after harvest is recommended to reduce pathogen levels in the field. Fungicide applications using products listed in the MSU E-312 bulletin (available online at www.veginfo.msu.edu/e312/) are also recommended to manage this pathogen.

Black rot is a bacterial disease that continues to be a problem in cole crop production. The pathogen can enter brassica fields by numerous means including infested seeds, seedlings, soil, plant debris, and crucifer weeds. If infected transplants are planted into the field, the pathogen can remain unnoticed in the plant until hot and humid weather occurs. Foliar blight of cabbage reduces head weight and yield. Symptoms of this pathogen on the foliage of mustard, collards, and Chinese cabbage render them unmarketable for the fresh market. V-shaped lesions along the margins of leaves are characteristic of the black rot disease. Using certified treated seed is highly recommended to reduce black rot occurrence.

Club root can be a persistent problem due to long-lived resting spores produced by the pathogen. During the growing season, the club root pathogen produces swimming zoospores that can move along the drainage pattern of a field infecting large numbers of plants. One of the difficulties in managing club root is that foliar symptoms may not be apparent until late in the season or during periods of high heat when the plant cannot uptake sufficient water due to deformation of the roots. Infected roots are enlarged and distorted into "clubs." Maintaining the pH of the soil above 7 and increasing calcium and boron levels has been reported to reduce club root severity, however, this practice does not always control the pathogen and tends to be more effective when the amount of spores in the soil is low. Cultivating infested fields last and rogueing diseased plants are good management practices, as the clubbed roots contain numerous resting spores which may be released into the soil. Cultivars of cole crops with resistance to club root are available.

***Sclerotinia* white mold** or "watery rot" is caused by a pathogen that has an extremely wide host range, including many vegetables and weeds. This pathogen can cause epidemics during warm and wet conditions, especially in areas of a field that are poorly drained or are weedy. When the pathogen infects from airborne spores, detached petals and pollen from weeds serve as a nutrient source (needed for infection). Infected weeds that come in contact with the crop may also serve as a point of infection. Plants infected at the soil level by direct contact with the fungus in the soil wilt and the water-soaked lesions become covered with white mycelium (fungal threads) and small black sclerotia (bead-like structures), which overwinter in the soil. Numerous sclerotia are produced on rotting plant tissue. If cabbage is infected near harvest, the heads may rot during storage and spread to neighboring heads. Care should be exercised when making passes through the field to cultivate or apply pesticides, as even minor bruises on cabbage heads are easily colonized by the white mold fungus.

Fungicide management: The foliage of cole crops can present a challenge when managing diseases with fungicides. Many cole crops (cabbage, broccoli, cauliflower, kale, etc.) have a thick waxy "bloom" which is composed of leaf surface-waxes. This waxy layer makes the foliage difficult to wet, as is often apparent with morning dew or rain drops which form beads of water on the leaf surface. When applying foliar sprays it is important to use the appropriate nozzle type and pressure at the boom. If drops are too big, they may bounce off of the leaf surface, while drops that are too small may drift away from the target. Products formulated as wettable powders (WP) or soluble concentrates (SC) may perform better when mixed with an adjuvant. The spread of certain diseases such as black rot and *Phoma* black-leg can be increased if powerful air blast sprayers are used. Applying fungicides when foliage is dry using a boom sprayer limits splash dispersal of pathogens.

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Cole Crop Herbicides for 2015

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EXPO 2014
Grand Rapids, MI

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The Current Status of Cole Crop Weed Control

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Which are the "cole" crops?

Normally, members of the species *Brassica oleracea.*

Includes:	Other *B. oleracea* crops:
Broccoli	Collards
Brussel Sprouts	Kale
Cabbage	Chinese kale
Cauliflower	Kohlrabi

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Other Related Species in *Brassicaceae* family

- *Brassica juncea*: mustard
- *Brassica napus*: vegetable rape, rutabaga
- *Brassica rapa*: pak choi (Chinese cabbage), turnip, mizuna, canola
- *Raphanus sativus*: radish, daikon
- *Armoracia rusticana*: horseradish
- *Nasturtium* officinale: watercress
- *Eruca* sativa: arugula
- *Wasabia japonica*: wasabi

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EPA Crop Groupings that include *Brassicaceae* crops

Group	Name	Crops
1	Root and Tuber Vegetables	Horseradish, radish, rutabaga, turnip
4-14	Leafy Vegetables	Arugula (rocket salad), garden cress, upland cress, collard, kale, kohlrabi, mizuna, gai choi, mustard greens, rape greens
5-14	Head and stem *Brassica* vegetables	Brussel sprouts, broccoli, cabbage, pak choi, napa cabbage, cauliflower

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Current Herbicides Labeled for Cole Crops - Preemergence

Treflan	Devrinol XT
Dual Magnum	Command
Prowl H_2O	GoalTender
Spartan	(Dacthal)

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Treflan 4 EC (trifluralin)

1. Chemical family: dinitroaniline
2. MOA: mitosis inhibitor; 3 (K1)
3. Yellow EC
4. Rate: 1 – 2 pt/A PPI
5. Safe on all *Brassica* crops; labeled on many crops
6. Weeds: annual grasses; COCW, COLQ, COPU, RRPW
7. Causes root stunting in cold soil; do not use in soil < 60˚F; 3 – 4 wk weed control

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Devrinol 50 DF-XT (napropamide)

1. Chemical family: amide
2. MOA: long chain fatty acid inhibitor; 15 (K3)
3. 50% Dry Flowable – new formulation resists photodegradation
4. Rate: 2 lb/A; PPI or Post-TP
5. Safe on broccoli, Brussel sprouts, cabbage, cauliflower
6. Weeds: annual grasses, COCW, COGR, COPU, RRPW
7. Safe in cool soils; 3 – 4 wk weed control

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Dual Magnum 7.62 EC (s-metolachlor) MI 24(c) indemnified

1. Chemical family: acetamide
2. MOA: long chain fatty acid inhibitor; 15 (K3)
3. 7.62 EC; concentrated petroleum solvent
4. Rate: 0.5 – 1.3 pt/A; Pre-TP or within 48 hrs after TP

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Dual Magnum 7.62 EC (s-metolachlor) MI 24(c) indemnified

5. Safe in Brussel sprouts, broccoli, cabbage, cauliflower, mustard, collard, kale, kohlrabi, turnip greens, radish, rutabaga, turnip
6. Weeds: an. grass, EBNS, LATH, RRPW, YENS
7. 4 – 5 wk weed control; do not apply with GoalTender Post-TP
8. Indemnified label: www.farmassist.com

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Prowl H_2O 3.8 CS (pendimethalin)

1. Chemical family: dinitroaniline
2. MOA: mitosis inhibitor; 3 (K1)
3. 3.8 ACS; yellow water-based formula
4. Rate: 1 – 2.1 pt; between rows after TP, or 2 – 4 LS of seeded crops
5. Safe on broccoli, Brussel sprouts, cabbage, cauliflower
6. Weeds: annual grasses, COCW, COLQ, SPSP, RRPW
7. 4 – 6 wk weed control; may cause crop stunting

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GoalTender 4 SC (oxyfluorfen)

1. Chemical family: diphenylether
2. MOA: PPO inhibitor (enzyme in chlorophyll synthesis); 14 (E)
3. 4 SC; water-based formula
4. Rate: 0.5 – 1 pt; Pre-TP only
5. Safe on broccoli, cabbage, cauliflower
6. Weeds: CAWE, COLQ, COGR, COPU, CORW, RRPW
7. 4 – 8 wk weed control; do not use with Dual Magnum

Command 3 ME (clomazone)

1. Chemical family: isoxazolidinone
2. MOA: inhibit chlorophyll synthesis; 13 (F4)
3. 3 ME (microencapsulated); water-based formula
4. Rate: 0.7 – 1.3 pt; Pre-TP
5. Cabbage only on label
6. Weeds: annual grasses, COLQ, COPU, CORW, VELE
7. 4 -6 wk weed control; space restriction - 1200 ft from houses, fruit, greenhouses, nurseries

Spartan 4 F (sulfentrazone)

1. Chemical family: arlytriazinone
2. MOA: PPO inhibitor; 14 (E)
3. 4 F; water-based formula
4. Rate: 2.3 – 6 fl oz/A; Pre-TP
5. Processing cabbage only
6. Weeds: COCW, COLQ, COPU, EBNS, RRPW, LATH
7. May cause early stunting

Current Herbicides Labeled for Cole Crops - Postemergence

GoalTender
Stinger
Poast
Select Max

GoalTender 4 SC (MI 24c)

1. Rate: 4 – 8 fl oz
2. Safe on broccoli, cabbage, cauliflower
3. Weeds: Most Broadleaves
4. Max. 8 fl oz (0.125 lb ai)/application; 2 appl.
5. 35 day PHI

Stinger 3 L (clopyralid)

1. Chemical family: picolinic acid (pyridine carboxylic acid)
2. MOA: auxin disruption
3. 3 L soluble salt
4. Rate: 4 – 8 fl oz; 2 appl/yr; max. 8 fl oz/yr; 30 day PHI
5. Safe on all heading and leafy *Brassica* crops.
6. Weeds: composites, nightshades, legumes, smartweed

POST Grass Control

- Poast 1.5 E: 1 – 1.5 pt/A x 2 appl; 30 day PHI
- Select Max: 0.5 – 1 pt/A x 4 appl; 30 day PHI

Cabbage Results – 2014 (1)

		Rate lb ai/A		Rating 6/13	Rating 6/26	Total kg/plot
1	Prowl H2O	1	PRTP	1.0	1.3	24
2	Prowl H2O	1	POTP	1.3	1.7	25
3	Devrinol XT	2	POTP	1.3	1.0	31
4	Zidua	0.13	PRTP	1.7	2.7*	23
5	Command		PRTP	2.7	2.0	27

Cabbage Results – 2014 (2)

		Rate lb ai/A		Rating 6/13	Rating 6/26	Total kg/plot
6	Spartan	0.19	PRTP	1.3	1.7	30
7	GoalTender	0.5	PRTP	1.0	1.7	34
8	Dual Magnum GoalTender	1.2 0.5	PRTP PRTP	2.3*	3.3*	33
9	Dual Magnum GoalTender Select Max	0.95 0.125 0.07	PRTP POST POST	1.0	2.7*	31
10	Handweeded			1.0	1.0	30

Chinese Cabbage Results – 2014 (1)

		Rate lb ai/A		Rating 6/13	Rating 6/26	Total kg/plot
1	Prowl H2O	1	PRTP	1.7	1.3	17
2	Prowl H2O	1	POTP	3.3*	1.7	17
3	Devrinol XT	2	POTP	1.0	1.3	19
4	Zidua	0.13	PRTP	3.7*	3.0*	16
5	Command		PRTP	5.0*	3.3*	23

Chinese Cabbage Results – 2014 (2)

		Rate lb ai/A		Rating 6/13	Rating 6/26	Total kg/plot
6	Spartan	0.19	PRTP	2.7*	2.3	13
7	GoalTender	0.5	PRTP	6.7*	6.7*	10
8	Dual Magnum GoalTender	1.2 0.5	PRTP PRTP	6.3*	6.3*	7
9	Dual Magnum GoalTender Select Max	0.95 0.125 0.07	PRTP POST POST	1.3	6.0*	20
10	Handweeded			1.0	1.0	15

Recommendations for 2014 (1)

Cabbage, broccoli, Brussel sprouts, cauliflower
(as labeled)

1. Early (soil temp < 60 F) – Devrinol PO-TP
2. Later (soil temp > 60 F) –
   1. Devrinol + GoalTender PR-TP, or
   2. Treflan PPI + GoalTender PR-TP
   3. Dual Magnum PR-TP or PO-TP

Recommendations for 2014 (2)

Cabbage only

- Soil temp > 60 F
  - Command + GoalTender PR-TP
  - Spartan + GoalTender PR-TP

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Recommendations for 2014 (3)

Postemergence on small weeds

1. GoalTender 4-8 fl oz x 2 appl; 35 day PHI
2. Stinger 4-6 fl oz; 30 day PHI
3. Poast OR Select Max for grasses

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Questions?