RUTGERS
New Jersey Agricultural Experiment Station

This is a section from the

2018 Mid-Atlantic Commercial Vegetable Production Recommendations

The manual, which is published annually, is **NOT** for home gardener use.

The **full manual**, containing recommendations specific to New Jersey, can be found on the Rutgers NJAES website in the Publications section:
http://njaes.rutgers.edu/pubs/publication.asp?pid=E001.

The **label** is a legally-binding contract between the user and the manufacturer. The user must follow all rates and restrictions as per label directions. The use of any pesticide inconsistent with the label directions is a violation of Federal law.

Cooperating Agencies: Rutgers, The State University of New Jersey, U.S. Department of Agriculture, and County Boards of Chosen Freeholders. Rutgers Cooperative Extension, a unit of the Rutgers New Jersey Agricultural Experiment Station, is an equal opportunity program provider and employer.

F. Commodity Recommendations

Pesticide Use Disclaimer

THE LABEL IS THE LAW
Before using a pesticide, check the label for up to date rates and restrictions.

Labels can be downloaded from: *http://www.cdms.net/, http://www.greenbook.net/* or *http://www.agrian.com/labelcenter/results.cfm*

Guide to the Recommended Pesticide Tables in the Following Crop Chapters:

1. Pesticides are listed by **group or code number based on chemical structure and mode of action**, as classified by the Weed Science Society of America (WSSA) for herbicides, the Insecticide Resistance Action Committee (IRAC) for insecticides, and the Fungicide Resistance Action Committee (FRAC) for fungicides.
   If the number is in bold font, the product may have resistance concerns.

2. For **restricted use pesticides**, the restricted active ingredients are labeled with a *****. See the Pesticide Safety chapter for more information.

3. **In addition to the pesticides listed below, other formulations or brands with the same active ingredient(s) may be available. ALWAYS CHECK THE LABEL:**

a) to ensure a pesticide is labeled for the same use,
b) to ensure the pesticide is labeled for the desired crop, and
c) for additional restrictions.

4. All pesticide recommendations are made for spraying a **broadcast area of 1 acre** (43,560 square feet). **Adjust the rate for banded applications** (for more information, see the Pest Management chapter, Calibrating Granular Applicators section).

5. Check the label for the maximum amount of pesticide per application and the maximum number of applications per year.

6. **Bee Toxicity Rating (Bee TR)**: N=nontoxic; L=minimum impact on bees; M=moderately toxic, can be used if dosage, timing and method of application are correct, but should NOT be applied directly to crop if bees are present; H=highly toxic, severe losses expected, -- = data not available.

Cole Crops: Broccoli, Brussels Sprouts, Cabbage, Cauliflower, Collards, Kale and Kohlrabi

Recommended Varieties (listed alphabetically)

	Variety	Hybrid	Days[1]	Black Rot[2]	Downy Mildew[2]	Hollow Stem[2]	Cold[2]	Heat[2]
Broccoli	Arcadia	Yes	63	X	X		X	X
	Bay Meadows	Yes	60				X	X
	BC1691	Yes	83					X
	BC1764	Yes	62					
	Belstar	Yes	66		X		X	
	Burney	Yes	60					X
	DeCicco	No	48				X	
	Diplomat	Yes	68		X	X	X	X
	Durapak 16	Yes	80					
	Eastern Crown	Yes	80					
	Emerald Crown	Yes	63				X	
	Emerald Jewel	Yes	85					
	Emerald Pride	Yes	74		X			
	Eureka	Yes	76	X	X		X	
	Everest	Yes	61		X		X	
	Fiesta	Yes	60				X	
	Green Magic	Yes	60					X
	Green Gold	Yes	80					X
	Gypsy	Yes	60		X		X	
	Imperial	Yes	72					X
	Ironman	Yes	78			X		
	Lieutenant	Yes	80			X		
	Luna	Yes	78					
	Marathon	Yes	70				X	
	Millennium	Yes	74					X
	Patron	Yes	63		X			
	Tradition	Yes	63					
	Windsor	Yes	68		X		X	X

[1]Days from transplant to first harvest. [2]X denotes some degree of resistance or tolerance to disease or environmental condition.

	Variety	Hybrid	Days
Brussels Sprouts	Dimitri	Yes	105
	Jade Cross E	Yes	85
	Churchill	Yes	90
	Nelson	Yes	90
	Franklin	Yes	100
	Hestia	Yes	93

Cabbage	Variety	Hybrid	Days	Pounds	Use[2]	Pest or Abiotic Stress Reaction[1]				
						Yellows	Black rot	Tip burn	Thrips	Split Head
Green Cabbage *(continued on next page)*	Bajonet	Yes	80	3-5	F	H				
	Benelli	Yes	78	4-10	F-P	H	M	M	M	H
	Blue Dynasty	Yes	75	4	F	H	H			H
	Blue Lagoon	Yes	68	3-5	F	H	M			
	Blue Thunder	Yes	80	4-5	F	H	M			H
	Blue Vantage	Yes	72	4	F	H	L	H	H	
	Bobcat	Yes	76	4-6	F	H		H	H	H
	Bravo	Yes	85	4-10	F, P	H	H			
	Bronco	Yes	78	3-5	F	H		M	M	
	Bruno	Yes	81	4	F	H	H			

Green Cabbage *(continued)*	Caraflex (pointed)	Yes	68	2-3	F	H			H	
	Cecile	Yes	80	6	P	H		H		
	Charmant	Yes	65	2.5-3	F	H	H		L	H
	Cheers	Yes	75	5	F	H	H		H	
	Early Thunder	Yes	72	3-4	F	H	M	M	H	
	Emblem	Yes	85	3-5	F	H	H	H		H
	Excalibur	Yes	78	5-7	P	H	H			
	Grand Vantage	Yes	79	5-6	F	H				
	Megaton	Yes	85	10-20	P	H		H		
	Padoc	Yes	70	5-8	P	H		H		
	Platinum Dynasty	Yes	70	4-10	F, P	H	H	H		H
	Primo Vantage	Yes	73	4-4.5	F	H				
	Quick Start	Yes	64	3-4	F	H		H	M	
	Ramada	Yes	83	3-6	F	H	H			
	Royal Vantage	Yes	79	3-5	F	H	H	H	H	
	Solid Blue 780	Yes	79	3-4	F	H	M	H	H	
	Superstar	Yes	85	3-4	F	H	H	H	M	
	Supreme Vantage	Yes	67	4-5	F, P	H				
	Thunderhead	Yes	74	3-5	F	H	H	H	H	
	Vantage Point	Yes	85	5-6	F	H	H	H	H	
	Viceroy	Yes	90	4-8	F, P	H	I	H	H	
Green Savoy Cabbage	Alcosa	Yes	62	2-4	F	H		H		
	Clarissa	Yes	78	2-3	F	H		H		
	Melissa	Yes	80	2-4	F	H		H		
	Miletta	Yes	88	3-4	F			H		
	Savoy Ace	Yes	78	3-4	F	M				
	Savoy Blue	Yes	85	3-5	F					
	Savoy King	Yes	80	4	F			H		
Red Cabbage	Azurro	Yes	78	3-4	F			H	H	
	Cairo	Yes	85	3-6	F	M		H	H	H
	Red Dynasty	Yes	75	5-12	F, P			H		H
	Red Jewel	Yes	75	3-5	F			H		
	Ruby Perfection	Yes	80	3-4	F	M	M	M	H	
	Rio Grande Red	Yes	83	4-5	F			M		
	Super Red 80	Yes	80	2-5	F		M	H		H
Red Savoy Cabbage	Deadon	Yes	105	3-5	F					

[1]M=Moderate or intermediate and H=high level of resistance or tolerance. [2]F=Fresh market, P=Processing (slaw, kraut).

	Variety	**Shape/Color**	**Hybrid**	**Days to maturity**
Chinese Cabbage	Blues	Napa (barrel)	Yes	57
	China Gold	Napa (barrel)	Yes	65
	China Express	Napa (barrel)	Yes	62
	Emiko	Napa (barrel)	Yes	55
	Optiko	Napa (barrel)	Yes	60
	Rubicon	Napa (barrel)	Yes	52
	Spring Crisp	Napa (barrel)	Yes	75
	Yuki	Napa (barrel)	Yes	67
	Jazz	Napa (barrel)	Yes	63
	Greenwich	Narrow	Yes	69
	Green Rocket	Narrow	Yes	70
	Jade Pagoda	Narrow	Yes	68
Pak Choi	Black Summer	Green petiole	Yes	45
	Mei Quing Choi	Green petiole	Yes	40
	Joi Choi	White petiole	Yes	50
	Win-Win Choi	White petiole	Yes	52

	Variety	Hybrid	Color	Days	Self Wrapping
Cauliflower	Absolute	Yes	White	70	Yes
	Accent	Yes	White	75	Partial
	Amazing	Yes	White	75	Yes
	Apex	Yes	White	70	Yes
	Artica	Yes	White	80	Yes
	Aquarius	Yes	White	70	Yes
	Attribute	Yes	White	67	Yes
	Bishop	Yes	White	65	Partial
	Candid Charm	Yes	White	68	Partial
	Casper	Yes	White	75	Yes
	Cheddar	Yes	Orange	80	No
	Fremont	Yes	White	62	Yes
	Freedom	Yes	White	67	Yes
	Graffiti	Yes	Purple	75	No
	Majestic	Yes	White	50	No
	Minuteman	Yes	White	53	No
	Snow Crown	Yes	White	55	No
	Steady (trial)	Yes	White	65	Partial
	Symphony	Yes	White	71	Partial
	Synergy	Yes	White	75	Yes
	Vitaverde	Yes	Green	71	No
	Whistler	Yes	White	78	No
	White Sails	Yes	White	68	Yes
	26-701 RZ	Yes	Green	75	No

	Variety	Hybrid	Color	Comments
Collards	Bulldog	Yes	Dark Green	Lightly waved leaves
	Bluemax	Yes	Blue Green	Lightly savoyed leaves
	Hi-Crop	Yes	Deep Green	Semi-savoyed leaves
	Top Bunch	Yes	Blue Green	Lighly savoyed leaves
	Flash	Yes	Deep Green	Flat to lightly waved leaves
	Vates	No	Deep Green	Flat to lightly waved leaves
	Tiger	Yes	Deep Blue Green	Flat to lightly waved leaves
	Champion	No	Deep Green	Flat to lightly waved leaves
Kale	Dwarf Blue Curled (Vates)	No	Blue Green	Curled leaf
	Dwarf Siberian	No	Green	Light to medium curl, overwinters
	Red Russian	No	Blue Green-Red	Flat toothed leaf green with red midrib
	Winterbor	Yes	Dark Green	Curled leaf
	Blue Knight	Yes	Blue Green	Curled leaf
	Blue Armor	Yes	Blue Green	Very curled leaf
	Blue Ridge	Yes	Blue Green	Very curled leaf
	Redbor	Yes	Deep Red	Curled leaf
	Lacinato	No	Blue Green	Puckered strap-like lance leaf
	Black Magic	No	Dark Blue Green	Broader leaved lance leaf type
	Reflex	Yes	Deep Green	Very tight curled leaf
	Starbor	Yes	Blue Green	Curled leaf
Kohlrabi	Azure Star	Yes	Deep Blue-Purple	
	Grand Duke	Yes	Light Green	
	Kolibri	Yes	Deep Purple	
	Konan	Yes	Light Green	
	Quickstar	Yes	Light Green	
	Winner	Yes	Light Green	

Recommended Nutrients Based on Soil Tests

In addition to using the table below, check the suggestions on rate, timing, and placement of nutrients in your soil test report and the Soil and Nutrient Management chapter. Your state's soil test report recommendations and/or your farm's nutrient management plan supersede recommendations found below.

Cole Crops		Soil Phosphorus Level				Soil Potassium Level				
		Low	Med	High (Opt)	Very High	Low	Med	High (Opt)	Very High	
	N (lb/A)	P_2O_5 (lb/A)				K_2O (lb/A)				Nutrient Timing and Method
Broccoli	150-200	200	100	50	0[1]	200	100	50	0[1]	Total nutrient recommended
	50-100	200	100	50	0[1]	200	100	50	0[1]	Broadcast and disk-in
	50	0	0	0	0	0	0	0	0	Sidedress 2-3 weeks after planting
	50	0	0	0	0	0	0	0	0	Sidedress 4-6 weeks after planting
Brussels Sprouts, Cabbage, Cauliflower	100-150	200	100	50	0[1]	200	100	50	0[1]	Total nutrient recommended
	50-75	200	100	50	0[1]	200	100	50	0[1]	Broadcast and disk-in
	25-50	0	0	0	0	0	0	0	0	Sidedress 2-3 weeks after planting
Kale, Collards	100-200	200	100	50	0[1]	200	100	50	0[1]	Total nutrient recommended
	50-100	200	100	50	0[1]	200	100	50	0[1]	Broadcast and disk-in
	25-50	0	0	0	0	0	0	0	0	Sidedress after each cutting or stripping
Kohlrabi	25-50	0	0	0	0	0	0	0	0	Total nutrient recommended
	25-50	0	0	0	0	0	0	0	0	Sidedress if needed according to weather

For broccoli, apply 1.5-3 lb/A of boron (B). For Brussels sprouts, cabbage and cauliflower, apply 1.5-3 lb/A of B and 0.2 lb molybdenum (Mo) applied as 0.5 lb/A sodium molybdate with broadcast fertilizer; see also Table B-7 in the Soil and Nutrient Management chapter. Include 25-40 lb/A of sulfur in the fertilizer program for cole crops. [1]In VA, crop replacement values of 25 lb/A of P_2O_5 and 25 lb/A of K_2O are recommended on soils testing Very High.

Plant Tissue Testing

Plant tissue testing can be a valuable tool to assess crop nutrient status during the growing season to aid with in-season fertility programs or to evaluate potential deficiencies or toxicities. Critical cabbabe tissue test values for most recently matured leaves 8 weeks after transplanting: N 3-6%, P 0.3-0.6 %, K 2.0-4.0 %, Ca 1.5-2.0%, Mg 0.25-0.6% and S 0.3%. For additional nutrients, other cole crops and other growth stages consult with a tissue testing laboratory or this web link at the University of Florida: *http://edis.ifas.ufl.edu/ep081*

Seed Treatment

Check with your seed company if seed is hot water-treated for blackrot; see also Disease Control below.

Planting and Spacing

All cole crops may be direct seeded or transplanted.

Direct Seeding Precision seeders are recommended. Sow 15-20 days before the normal transplant date for the same maturity date.

Transplant Production and Handling for All Cole Crops Sow in 72-128 cell plug trays or in transplant production beds at 10 seeds/ft of row in rows 12-18 inches apart. Early transplant production will require heated greenhouse facilities or frames. Transplants for summer plantings may be produced in field beds. Transplants are ready in 4-6 weeks. Bare root transplants should be planted soon after lifting. Storage of pulled, field-grown cabbage transplants should not exceed 9 days at 32°F (0°C) or 5 days at 66°F (19°C) prior to planting in the field.

Broccoli - Fall Production

Direct field seeding: Rows 30-36 inches apart; seed: ½-1 lb/A so that plants are 12-18 inches apart in row. Make successive plantings June 20 to July 20 (June 20 to July 5 in PA and northern NJ).

Transplants: Successive plantings between July 15 and August 20, depending on location. Set transplants 12-18 inches apart in rows 36 inches apart (14,520 plants/A).

High population planting for bunched broccoli: 2-4 rows per bed, rows 18-20 inches apart, plants 9-10 inches in row (27,000-32,000 plants/A). Seed June 25 to July 10; transplant July 20 to August 15, depending on location.

For fall plasticulture double cropping, remove previous crop debris and set broccoli transplants 12-21 inches apart in double rows 10-12 inches apart. For larger heads allow greater in-row spacing. Set plants in late July through mid-August, depending on variety maturity and location.

Broccoli - Spring Production Spring production of broccoli is successful in cooler areas of the region but is limited by heat in southern areas. Use heat tolerant varieties. For spring production transplant April 1-April 20.

Brussels Sprouts Brussels sprouts are a long season crop grown for fall production. Transplant rows 3 ft apart; plants 15 inches apart in row. Start planting transplants June 20. Start field seeding June 1.

Cabbage Cabbage is planted from March through early August depending on location, variety, and intended harvest date. Early varieties require 85-90 days from seeding to harvest, and main-season crops require 110-115 days. Crops grown from transplants are 14-21 days earlier. Transplants are set in rows 2-3 ft apart and 9-15 inches apart in the row for early plantings and 9-18 inches apart for late plantings, depending on variety, fertility, and market use.

Cauliflower Transplants are set in rows 3-4 ft apart, and plants are set 18-24 inches apart in the row. Make successive plantings in the field between July 15 and August 20, depending on location. **Note**. In PA and other cool areas, early maturing cultivars can be grown in the spring. Transplant to the field in early April. Spring production in the southern part of the region is not recommended.

Collards Direct seeded: Seed at the rate of 2 lb/A. Transplanting: Transplants are set in rows 16-36 inches apart and 6-12 inches apart in the row. Use wider between-row and in-row spacing for multiple hand harvests by stripping leaves. Collards for spring and early summer harvest can be transplanted or seeded starting April 1 in VA and warmer, southern areas and April 20 in PA and normally cooler areas. Collards can be seeded starting in mid-July through late August for fall harvest. Collards for processing are planted in 4-6 row beds, 12-16 inches between rows at a rate of 10-16 seeds/ft of row.

Kale Direct Seeding: Sow seed at 3-4 lb/A in rows spaced 16-36 inches apart. Thin to 4-5 inches apart in the row. Transplanting: Transplants are set in rows 16-36 inches apart and 6-12 inches apart in the row. Use wider between-row and in-row spacing for multiple hand harvests by stripping leaves. Kale for spring and early summer harvest can be transplanted or seeded starting April 1 in VA and warmer, southern areas and April 20 in PA and normally cooler areas. Kale can be seeded or transplanted starting in mid-July through late August for fall harvest. Kale for processing is planted in 4-6 row beds, 12-16 inches between rows at a rate of 10-16 seeds per foot of row.

Kohlrabi Transplants may be used for a spring crop. Plant in the field at the same time as broccoli or cabbage. Fall crops can be established by direct-seeding between June 25 and July 15. Seed open-pollinated varieties at the rate of 2-3 lb/A and thin to 6-8 inches between plants in the row. Precision-seed hybrid varieties. Set transplants July 20 to August 15. Space rows 18-24 inches apart.

No-Till / Conservation Tillage

Cabbage and broccoli have been successfully grown by transplanting into rolled or herbicide killed cover crops using a no-till transplanter.

Irrigation and Water Use

All cole crops benefit from irrigation to achieve the highest yields and quality. Cole crops require a seasonal total of 10-15 inches of water. Amounts will depend on planting date, seasonal variation, variety, and number of times the field is harvested. For spring crops highest demand is near harvest. For fall crops highest demand is mid-season Consistent soil moisture level is especially critical to achieve maximum quality in cauliflower. Any moisture stress, especially when plants reach the 6-7 leaf stage may cause cauliflower to button or form heads prematurely.

Common Physiological Disorders

Black Petiole in Cabbage

Black petiole or black midrib is an internal disorder of cabbage that has been observed in recent years. As heads approach maturity, the under side of the internal leaf petioles or midribs turn dark gray or black at or near the point where the midrib attaches to the main stem. It is believed that this disorder is associated with a potassium (K) - phosphorus (P) imbalance. Proper nutrient management and choice of cultivar will help minimize this condition.

Blanching and Off-Colors in Cauliflower
Heads exposed to sunlight may develop a yellow and/or red to purple pigment. Certain varieties such as Snow Crown are more predisposed to purple off-colors, especially in hot weather. Self-blanching varieties have been developed to reduce problems with curd yellowing. For open headed varieties, the usual method to exclude light is to tie the outer leaves when the curd is 8 cm in diameter. Leaves may also be broken over the curd to prevent yellowing. In hot weather, blanching may take 3-4 days, but in cool weather, 8-12 or more days may be required. Cauliflower fields scheduled to mature in cool weather (September and October) that are well supplied with water and planted with "self-blanching" cultivars do not require tying. Newer orange cauliflower and green broccoflower varieties are less susceptible to off-colors but can still turn purple under warm conditions.

Bolting/Buttoning Due to Low Temperatures in Broccoli, Cabbage, Cauliflower, Collards and Kale
Bolting in cabbage, collards and kale, and "buttoning" in cauliflower can occur if early-planted crops are subjected to low temperatures (between 35-50°F/2-10°C for 10 or more continuous days). Temperature-induced bolting responses depend on variety.

Boron Deficiencies
Cole crops have a high boron requirement. Boron deficiency results in cracked and corky stems, petioles and midribs for most cole crops. For broccoli, cabbage and cauliflower, stems can be hollow and sometimes discolored. Cauliflower curds become brown and leaves may roll and curl, while cabbage heads may be small and yellow.

Brown Floret (Bead) and Yellowing Floret in Broccoli
Brown Floret is thought to be caused by plant nutritional imbalances but also may be due to insect feeding damage (*e.g.*, harlequin bugs). Areas of florets do not develop properly, die and lead to brown discolored areas.
Yellowing florets may be due to over-maturity at harvest, high storage temperatures and/or exposure to ethylene. Any development of yellow beads ends commercial marketability. Bead yellowing due to senescence should not be confused with the yellow to light-green color of areas of florets not exposed to light during growth, sometimes called "marginal yellowing". Proper postharvest handling and packaging will help minimize this problem.

Curd Bracts in Cauliflower
Development of curd bracts or small green leaves between the segments of the curd in cauliflower is caused by high temperature or drought. Heat-resistant cultivars and proper water management can help minimize this condition.

Edema on Cole Crop Leaves
Edema is water blistering on cole crop leaves. The most common cause of edema is the presence of abundant, warm soil water and a cool, moist atmosphere. Proper water management can help to minimize this condition.

Hollow Stem in Broccoli and Cauliflower Not Caused by Boron Deficiency
This condition starts with gaps that develop in stem tissues. These gaps gradually enlarge to create a hollow stem. Ordinarily, there is no discoloration of the surface of these openings at harvest but both discoloration and tissue breakdown may develop soon after harvest. Some cultivars of hybrid cauliflower and broccoli may have openings from the stem into the head. Hollow stem increases with wider plant spacing and as the rate of nitrogen increases. The incidence of hollow stem can be greatly reduced by increasing the density of the plant population.

Lack of Heads in Broccoli and Cauliflower
During periods of extremely warm weather, *i.e.*, days over 86°F (30°C) and nights over 77°F (25°C), broccoli and cauliflower can remain vegetative due to inadequate cold exposure. This can cause a problem in scheduling the maturation and marketing dates for these crops.

Premature Heading (Buttoning) in Broccoli and Cauliflower
Losses are usually most severe when transplants have gone past the juvenile stage before setting in the field. Stress factors such as low soil nitrogen, low soil moisture, disease, insects, or micronutrient deficiencies can also cause this problem. Some cultivars, particularly early ones, are more susceptible to buttoning than others.

Ricing and Fuzziness in Cauliflower
"Riciness" and "fuzziness" in heads is caused by high temperatures, exposure to direct sun, rapid growth after the head is formed, high humidity, or high nitrogen. When "ricing" occurs, flower buds develop, elongate and separate, making the curd unmarketable. Proper cultivar and nutrient management can help minimize this condition.

Splitting in Cabbage
Cabbage splitting mainly occurs in early cabbage when moisture stress is followed by heavy rain. Rapid growth associated with rain, high temperatures and high fertility can cause splitting. Proper irrigation and deep cultivation may help prevent splitting. There are significant differences between cultivars in their susceptibility to this problem.

Tipburn in Cauliflower, Cabbage, and Brussels Sprouts
Tipburn is a breakdown of plant tissue inside the head of cabbage, individual sprouts in Brussels sprouts, and on the inner wrapper leaves of cauliflower. It is associated with an inadequate supply of calcium in the affected leaves, causing a collapse of the tissue and death of the cells. Calcium deficiency may occur where the soil calcium is low or where there is an imbalance of nutrients in the soil along with certain weather conditions (high humidity, low soil moisture, high potash and high nitrogen aggravate calcium availability). Secondary rots caused by bacteria can follow the onset of tipburn and heads of cauliflower can be severely affected. Some cabbage and cauliflower cultivars are relatively free of tipburn problems. This problem can cause severe economic losses.

Harvest and Post Harvest Considerations

Broccoli should be harvested when heads have reached maximum diameter and flower buds (beads) are still tight. Bunched broccoli heads are tied together in groups of 3-4 with a rubber band. Broccoli should be hydrocooled or packed in ice immediately after harvest and stored at 32°F (0°C) and relative humidity of 95-100% to maintain salable condition. Under these conditions broccoli should keep satisfactorily 10-14 days. For processing, broccoli has the potential to be machine harvested but due to uniformity differences at harvest, hand harvest produces the highest yields and best quality.
Cabbage is harvested when heads are tight and have reached the desired size for the variety and spacing. The head is harvested by bending it to one side and cutting the base with a knife. Harvesting knives should be sharpened frequently. The stalk should be cut flat and as close to the head as possible, yet long enough to retain 2-4 wrapper leaves. Extra leaves act as cushions during handling and may be desired in certain markets. Yellowed, damaged, or diseased wrapper leaves should be removed. Heads with insect damage and other defects should be discarded. It is important that unharvested immature heads are undamaged because fields will be harvested multiple times. Harvested cabbage can be placed in bags, boxes, wagons, or pallet bins, depending on the harvesting method. Holding cabbage too long past harvest maturity will result in head splitting. Store harvested cabbage at 32°F (0°C) and a relative humidity of 98-100%. For processing, cabbage has the potential to be machine harvested but due to uniformity differences at harvest, hand harvest produces the highest yields and the best quality.
Cauliflower is harvested while the heads are pure white and before the curds become loose and ricey. Most varieties are self-blanching. For those that are not, blanching is achieved by tying outer leaves over the heads when heads are 3 to 4 inches in diameter. Blanching takes about 1 week in hot weather and 2 weeks in cooler weather. Store harvested cauliflower at 32°F (0°C) and a relative humidity of at least 95%. Avoid bruising heads in harvest, handling and packing.
Kale and Collards are harvested by cutting off entire plants near ground level. Whole plants are then bunched, or lower leaves may be stripped from plants and packed individually. For processing, kale and collards are machine cut 4-6 inches from the ground when full tonnage has been achieved but before petioles have elongated. Multiple harvests are possible. Because of their perishability, kale and collards should be held as close to 32°F (0°C) as possible. At this temperature, they can be held for 10-14 days. Relative humidity of at least 95% is desirable to prevent wilting. Air circulation should be adequate to remove heat of respiration, but excessive air circulation will speed transpiration and wilting. Satisfactory precooling is accomplished by vacuum cooling or hydrocooling. These leafy greens are commonly shipped with package and top ice to maintain freshness. Kale packed in polyethylene-lined crates and protected by crushed ice keeps in excellent condition for 3 weeks at 32°F (0°C).
Kohlrabi is harvested when stems are full sized but before they begin to split.

Weed Control

THE LABEL IS THE LAW - See the Pesticide Use Disclaimer on page F 1.

Recommended Herbicides

1. Identify the weeds in each field and select recommended herbicides. More information is available in the "Herbicide Effectiveness on Common Weeds in Vegetables" Table (E-2) in the Pest Management chapter.

2. Minimize herbicide resistance development. Identify the herbicide site mode of action group and follow recommended good management practices. Include non-chemical weed control whenever possible.

1.a. Soil-Applied (Preplant Incorporated or Preemergence)

Group	Product Name	Product Rate	Active Ingredient (*=Restricted Use)	Active Ingredient Rate	PHI (d)	REI (h)
3	Dacthal 6F Dacthal W-75	6.0 to 14.0 pt/A 6.0 to 14.0 lb/A	**DCPA**	4.5 to 10.5 lb/A	--	12
-**Labeled for broccoli, Brussels sprouts, cabbage, cauliflower, collards, kale, and kohlrabi.** -Apply after seeding to a clean, weed-free soil. Primarily controls annual grasses and a few broadleaf weeds, including common purslane. Results have been most consistent when used in fields with coarse -textured soils low in organic matter, and when the application are followed by rainfall or irrigation. Maximum application not addressed on label.						
3	Treflan 4E	Seeded: 1.0 to 1.5 pt/A Transplanted: 1.0 to 2.0 pt/A	**trifluralin**	Seeded: 0.50 to 0.75 lb/A Transplanted: 0.5 to 1.0 lb/A	--	**12**
-**Labeled for broccoli, Brussels sprouts, cabbage, cauliflower, collards, and kale only.** Labeled seeded-crop as well as transplants. -Apply only as preplant incorporated and incorporate into 2-3 inches of soil within 8 hr after application. -Primarily controls annual grasses and a few broadleaf weeds. -**Do not** use (or reduce the rate) used when cold, wet soil conditions are expected, or crop injury may result. -Poor incorporation can reduce overall weed control. Maximum application not addressed on label.						
8	Prefar 4E	5.0 to 6.0 qt/A	**bensulide**	5.0 to 6.0 lb/A	--	12
-**Labeled for broccoli, Brussels sprouts, cabbage, cauliflower, collards, kale, and kohlrabi.** -**24(c) label for NJ only** allows applications up to 9 qt/A. Labeled for seeded-crop as well as transplants. Labeled for preplant incorporated or preemergence applications; **do not** incorporate more than 2 inches deep (1 inch is optimum). If applied preemergence, irrigate within 36 hrs of application with ½ inch of water; if not incorporated with irrigation or rainfall within 36 hrs, weed control maybe reduced. -Provides control/suppression of some annual grass weeds and some broadleaves including pigweeds, purslane, and lambsquarters. -**Do not** apply more than 6 lb ai/A per season.						
14	Goal 2XL or Galigan 2E GoalTender 4FL	1.0 to 2.0 pt/A 0.5 to 1.0 pt/A	**oxyfluorfen**	0.25 to 0.5 lb/A	--	24
-**Labeled for broccoli, cabbage, and cauliflower only.** -Labeled for transplanting only. Apply before transplanting and transplant through the herbicide on the soil surface -Use lower rates on coarse-textured soils low in organic matter. Cold, wet conditions in early spring may increase the risk of temporary crop injury which could delay maturity. Use of transplants less than 5 weeks old or use of succulent transplants grown in containers less than 1 inch square may increase severity of crop injury. -Goal control broadleaf weeds including common lambsquarters, common purslane, common ragweed, pigweed sp., and galinsoga. -Treflan or Dual Magnum may increase the potential for crop injury, especially when conditions are cold and wet, and it is not recommended for use prior to Goal application. -Delay cultivation after Goal application, when possible, to reduce deactivation of the Goal by incorporation. -**Do not** apply more than 1 pt/A per season of GoalTender or more than 2 pt/A of Goal 2XL.						
15	Devrinol 2-XT	2.0 qt/A	**napropamide**	1.0 lb/A	--	24
-**Labeled for broccoli, Brussels sprouts, cabbage, cauliflower, collards, and kale only. Recommended in PA ONLY!** -**Labeled for seeded-crop as well as transplants** -Apply preplant incorporated or preemergencs; if incorporated do no incorporate than seeding depth; if surface applied then irrigate within 72 hrs with sufficient water to we the soil to a depth of 4 to 8 inches. Primarily controls annual grasses and certain broadleaf weeds. -Tank-mix with minimum recommended rate of Treflan 4EC to improve the spectrum of broadleaf weeds controlled. -Use only on fine-textured soils such as silt or clay loams with more than 2% organic matter. Crop injury has occurred when used on coarse-textured soils low in organic matter. -**Do not** exceed 2 qt/A per crop cycle.						
15	Dual Magnum 7.62E	0.5 to 1.33 pt/A	**s-metolachlor**	0.48 to 1.27 lb/A	60	24
-**Labeled for transplanted cabbage in PA only!** -**A Special Local-Needs Label 24(c) has been approved for the use of Dual Magnum 7.62E and the use of this product is legal ONLY if a waiver of liability has been completed** (see *http://www.farmassist.com/*). -Apply before transplanting. **Do not** mechanically incorporate Dual Magnum prior to transplanting. -Risk of injury is less with post-transplanted applications than pre-transplant applications. Chinese cabbage varieties are more sensitive to Dual injury. -Make only 1 application per crop and **do not** apply more than 1.3 pt/A.						

1.b. Post-Transplant Application / Preemergence Control

Group	Product Name	Product Rate	Active Ingredient (*=Restricted Use)	Active Ingredient Rate	PHI (d)	REI (h)
3	Dacthal 6F Dacthal W-75	6.0 to 14.0 pt/A 6.0 to 14 lb/A	**DCPA**	4.5 to 10.5 lb/A	--	12
-**Labeled for broccoli, Brussels sprouts, cabbage, cauliflower, collards, kale, and kohlrabi.** -Apply after seeding or transplanting to a clean, weed-free soil. Labeled for over the top application of transplants without injury (will not control emerged weeds). Primarily controls annual grasses and a few broadleaf weeds, including common purslane. -Results have been most consistent when used in fields with coarse -textured soils low in organic matter, and when the application are followed by rainfall or irrigation. Maximum application not addressed on label.						
15	Dual Magnum 7.62E	0.5 to 1.33 pt/A	**s-metolachlor**	0.48 to 1.27 lb/A	60	24
-**Labeled for transplanted cabbage or emerged cabbage ONLY in NJ and PA! Transplanted broccoli, cabbage, cauliflower, collard, and kale in VA.** -**A Special Local-Needs Label 24(c) has been approved for the use of Dual Magnum 7.62E and the use of this product is legal ONLY if a waiver of liability has been completed** (see *http://www.farmassist.com/*). -Apply directly over the top of transplants within 48 hrs of transplanting. -**Do not** mechanically incorporate prior to transplanting. -May be applied over the top of direct-seeded cabbage after cabbage has developed 3 to 4 leaves. **Do not** apply to direct-seeded cabbage prior to the 3 to 4-leaf growth stage or the risk of crop injury may be increased. -Use of an adjuvant or another registered herbicide will increase the risk of injury from postemergence applications -Risk of injury is less with post-transplanted applications than pre-transplant applications. -Chinese cabbage varieties are more sensitive to Dual injury. -Dual Magnum will **not** control emerged weeds. Emerged weeds should be controlled by cultivation, hoeing, or postemergence herbicides prior to Dual Magnum application. -Make only 1 application per crop and **do not** apply more than 1.3 pt/A						

2. Postemergence

Group	Product Name	Product Rate	Active Ingredient (*=Restricted Use)	Active Ingredient Rate	PHI (d)	REI (h)
1	Select 2EC Select Max 0.97EC	6.0 to 8.0 fl oz/A 12.0 to 16.0 fl oz/A	**clethodim**	0.094 to 0.125 lb/A	30/14	24
	Poast 1.5EC	1.0 to 1.5 pt/A	**sethoxydim**	0.2 to 0.3 lb/A	30	12
-**Select 2EC**: use crop oil concentrate (COC) at 1% v/v (1 gal/100 gal of spray solution). **Select Max**: use nonionic surfactant (NIS) at 0.25% v/v (1 qt/100 gal of spray solution). **Poast**: Apply with COC at 1.0% v/v -**The use of COC may increase the risk of crop injury when hot or humid conditions prevail.** To reduce the risk of crop injury, omit additives or switch to nonionic surfactant when grasses are small and soil moisture is adequate. -Use lower labeled rates for annual grass control and higher labeled rates for perennial grass control. -Yellow nutsedge, wild onion, wild garlic, and broadleaf weeds will not be controlled. -Controls many annual and certain perennial grasses, including annual bluegrass, but Select will not consistently control goosegrass. Control may be reduced if grasses are large or under hot or dry weather conditions. -If repeat applications are necessary, allow 14 days between applications. -**Do not** tank-mix with or apply within 2 to 3 days of any other pesticide - unless labeled - as this may increase the risk of crop injury or reduce the control of grasses. -Pre-harvest interval of Select and Select Max for broccoli, Brussel sprouts, cabbage, cauliflower, and kohlrabi is 30 days; PHI for collards and kale is 14 days. -Rainfastness 1 hr. -**Do not** apply more than 8 fl oz of Select 2EC in a single application and **do not** exceed 2 pt/A for the season. -**Do not** apply more than 16 fl oz of Select Max in a single application and **do not** exceed 4 pt/A for the season. -**Do not** apply more than 1.5 pt/A Poast in single application and **do not** exceed 3 pt/A for the season.					
4	Stinger 3A	4.0 to 8.0 fl oz/A	**clopyralid**	0.047 to 0.188 lb/A	30	12
-Spray additives are not needed or required by the label, and are not recommended. -Stinger controls composite and legume weeds including galinsoga, ragweed species, common cocklebur, groundsel, pineappleweed, clover, and vetch. Perennials controlled include Canada thistle, goldenrod species, aster species, and mugwort (wild chrysanthemum). -Stinger is very effective on small seedling annual and emerging perennial weeds less than 2-4 inches tall, but is less effective and takes longer to work when weeds are larger. Use 2.0 to 4.0 fl oz/A to control annual weeds less than 2 inches tall. Increase the rate to 4.0 to 8.0 fl oz/A to control larger annual weeds. Apply the maximum rate of 8.0 fl oz/A to suppress or control perennial weeds. -Observe follow crop restrictions or injury may occur from herbicide carryover. -Rainfastness is 6 hrs. Maximum Stinger application per year is 2, but not to excel a total of 8 fl oz/A per season..						

2. Postemergence continued on next page

2. Postemergence - continued

14	GoalTender 4F	4.0 to 6.0 fl oz/A	**oxyfluorfen**	0.125 to 0.188 lb/A	35	24

- **Labeled for use on broccoli, cabbage and cauliflower in DE, NJ, PA ONLY! A Special Local Needs 24(c) label for broccoli, cabbage, and cauliflower has been approved for the use of GoalTender postemergence in DE, NJ, and PA.**
- Apply after direct-seeded crops reach a minimum of 4 true leaves; for transplanted crops apply after a minimum of 2 weeks after transplanting. Expect some temporary crop injury (speckling and/or crinkling of foliage) after treatment.
- **Do not** tank-mix with any other pesticide or use any spray additive, or severe crop injury may result.
- **Do not** use any oxyfluorfen formulation other than GoalTender 4F, or severe crop injury may result.
- GoalTender will provide residual control, but **do not** cultivate after application, or the herbicide will be deactivated. Weeds controlled or suppressed include common groundsel, common lambsquarers, pigweeds, purslane, shepherdspurse, and annual sowthistle when applied to weeds with 1 to 4 true leaves.
- Rainfastness is not specified. Maximum GoalTender per application is 8 fl oz/A; a pre-transplant application followed by a post-transplant application can be made but the combined amount may not exceed 16 fl oz/A per season.

3. Postharvest

Group	Product Name	Product Rate	Active Ingredient (*=Restricted Use)	Active Ingredient Rate	PHI (d)	REI (h)
22	Gramoxone SL 2.0	2.25 to 3 pt/A	**paraquat***	0.56-0.75 lb/A	--	24

- **A Special Local-Needs 24(c) label has been approved for the use of Gramoxone SL 2.0 for postharvest crop desiccation in DE, NJ and VA.** Apply after the last harvest. Always include an adjuvant.
- Spray coverage is essential for optimum effectiveness. See the label for additional information and warnings.
- Rainfastness 30 minutes. A maximum of 2 applications for crop dessication are allowed.

4. Other Labeled Herbicides These products are labeled but limited local data are available; and/or are labeled but not recommended in our region due to potential crop injury concerns.

Group	Product Name	Active Ingredient (*=Restricted Use)
3	Prowl H2O / Prowl	**pendimethalin** (broccoli, Brussel sprouts, cabbage, cauliflower, collards, kale, kohlrabi)
13	Command	**clomazone** (cabbage)
14	Zeus	**sulfentrazone** (cabbage)

Insect Control

THE LABEL IS THE LAW - See the Pesticide Use Disclaimer on page F 1.

Recommended Insecticides

Soil Pests

Cabbage Maggots

Cabbage maggots overwinter as pupae. Overwintered adults (flies) emerge when yellow-rocket (mustard) first blooms, then begin laying eggs on roots or soil near roots. All cole crops are affected. Eggs hatch within 3-7 days. As maggots feed on roots, plants begin to wilt. Ultimately, infested plants become severely stunted, or die outright. This pest has 3-4 generations per growing season, although the first generation is often the most economically damaging. The last larval generation is in October, particularly in warmer years. Treatments for cabbage maggot must be done preventively, as once damage is evident, loss of plants is unavoidable. Barriers, such as row covers, may be useful in excluding flies from smaller plantings. Prompt and complete destruction of crop residue is helpful. Chemical treatments should be applied pre-plant, or at planting, depending on the product used.

Apply one of the following formulations:

Group	Product Name	Product Rate	Active Ingredient(s) (*=Restricted Use) and Crop Restrictions	PHI (d)	REI (h)	Bee TR
1B	Diazinon AG500	2.0 to 3.0 qt/A pre-plant broadcast **OR** 4.0 to 8.0 fl oz/ 50 gal transplant water	diazinon* - **not labeled for cabbage maggot control on collards and kale**	AP	96	H
1B	Lorsban Advanced	See specific rates on label based on method of application and crop. Preplant, at-plant, and post-plant applications are recommended.	chlorpyrifos* **- soil** (REI on cauliflower 72 h)	30	24/ 72	H
3A	Capture LFR	3.4 to 6.8 fl oz/A	bifenthrin* **- soil**	AP	12	H
28	Verimark	10.0 to 13.5 fl oz/A	cyantraniliprole **- soil**	AP	4	H

Cutworms - See also the Pest Management chapter, Insect Management section.
Cutworms are moth larvae (caterpillars) that live in the soil and feed on plant roots and stems. Cutworms chew through plant stems at or near the soil line, causing young plants to topple over. Larvae are typically active at night, and spend most of this stage belowground. Cutworms are favored by less disturbed soils and debris covered soil surfaces. Thus, conventional tillage and incorporation of crop debris into the soil helps reduce populations. There are several species of cutworm in New Jersey that are capable of causing injury to young plants. In general, there are two generations per season. If cutworm damage is anticipated, it is best to treat preventively with insecticide.

Apply one of the following formulations:						
Group	**Product Name**	**Product Rate**	**Active Ingredient(s) (*=Restricted Use) and Crop Restrictions**	**PHI (d)**	**REI (h)**	**Bee TR**
1A	Lannate LV	See label for rates and current registration status.	methomyl* - **not labeled for kohlrabi**	see label	see label	H
1B	Lorsban Advanced	Check specific rates on the label	chlorpyrifos* - **soil** (REI on cauliflower 72 hours)	30	24/ 72	H
3A	Baythroid XL	0.8 to 1.6 fl oz/A	beta-cyfluthrin* **- not labeled for collards and kale**	0	12	H
3A	Bifenture 2EC (or Sniper)	2.1 to 6.4 fl oz/A	bifenthrin* **- soil**	7	12	H
3A + **4A**	Leverage 360	3.0 fl oz/A	beta-cyfluthrin + imidacloprid	7	12	H
3A + 28	Besiege	5.0 to 8.0 fl oz/A	lambda-cyhalothrin+chlorantraniliprole* **- not labeled for collards and kale**	3	24	H

Aboveground Pests

Aphids

Aphids can occasionally become a problem, particularly as a contaminant in Brussels sprouts, cabbage and some types of kale. To prevent flare-ups, avoid overuse of pyrethroid (Group 3) insecticides for caterpillar control. If growing transplants for field use, control aphid populations in the greenhouse to avoid transplanting infested crops.

Apply one of the following formulations:						
Group	**Product Name**	**Product Rate**	**Active Ingredient(s) (*=Restricted Use) and Crop Restrictions**	**PHI (d)**	**REI (h)**	**Bee TR**
1B	Orthene 97	0.5 to 1.0 lb/A	acephate - **only labeled for Brussels sprouts and cauliflower**	14	24	H
3A + **4A**	Brigadier	3.8 to 6.1 fl oz/A	imidacloprid + bifenthrin*	7	12	H
3A + **4A**	Endigo ZC	4.0 to 4.5 oz/A	thiamethoxam + lambda-cyhalothrin* **- not labeled for collards and kale**	1	24	H
3A + **4A**	Leverage 360	3.0 fl oz/A	thiamethoxam + beta-cyfluthrin*	7	12	H
4A	Actara	1.5 to 3.0 fl oz/A	thiamethoxam (PHI on collards, kale, kohlrabi 7 d)	0/7	12	H
4A	Admire Pro	4.4 to 10.5 fl oz/A	imidacloprid **- soil**	21	12	H
4A	Admire Pro	1.3 fl oz/A	imidcloprid **- foliar**	7	12	H
4A	Assail 30SG	2.0 to 4.0 oz/A	acetamiprid	7	12	M
4A + 28	Durivo	10.0 to 13.0 fl oz/A	thiamethoxam + chlorantrinilaprole **- soil**	30	12	H
4A + 28	Voliam Flexi	4.0 to 7.0 oz/A	thiamethoxam + chlorantrinilaprole **- foliar** (PHI on collards and kale 7 days)	3/7	12	H
4C	Closer SC	1.5 to 2.0 fl oz/A	sulfoxaflor	3	12	H
4D	Sivanto 200SL	7.0 to 12.0 fl oz/A	flupyradifurone	1	4	M
9B	Fulfill 50W	2.75 oz/A	pymetrozine	7	12	N
9C	Beleaf 50SG	2.0 to 2.8 oz/A	flonicamid	0	12	L
23	Movento	4.0 to 5.0 fl oz/A	spirotetramat	1	24	L
28	Verimark	6.75 to 13.5 fl oz/A	cyantraniliprole **- soil**	AP	4	H
28	Exirel	13.5 to 20.5 fl oz/A	cyantraniliprole **- foliar**	1	12	H
N/A	Requiem (OMRI)	2.0 to 4.0 qt/A	*Chenopodium* extract	0	4	L

Caterpillar "Worm" Pests Including: Cabbage Loopers (CL), Diamondback Moths (DBM), Imported Cabbageworms (ICW), Cross-striped Cabbageworms, Cabbage Webworms, and Armyworms

Cole crops may require multiple treatments per season. **Not all materials are labeled for all crops, insects or application methods; be sure to read the label. Due to resistance development, pyrethroid insecticides (Group 3A) are not recommended for control of DBM or beet armyworm (BAW)**. Other insecticides may no longer be

effective in certain areas due to DBM resistance; consult your county Extension office for most effective insecticides in your area. Rotation of insecticides with different modes of action is recommended to reduce the development of resistance.

Threshold: For fresh-market cabbage, Brussels sprouts, broccoli and cauliflower, treat when 20% or more of the plants are 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. Spray coverage under the leaves is essential for effective control particularly with *Bacillus thuringiensis* and contact materials. With boom-type rigs, apply spray with at least 3 nozzles per row - one directed downward and one directed toward each side. Evaluate effectiveness to consider need for further treatment.

Apply one of the following formulations:						
Group	**Product Name**	**Product Rate**	**Active Ingredient(s) (*=Restricted Use) and Crop Restrictions**	**PHI (d)**	**REI (h)**	**Bee TR**
1A	Lannate LV	See label for rates and registration status.	methomyl* **- not labeled for kohlrabi**	see label	see label	H
1B	Orthene 97S	1.0 lb/A	acephate **- only labeled for Brussels sprouts and cauliflower**	14	24	H
3A	Baythroid XL	1.6 to 3.2 fl oz/A	beta-cyfluthrin* - **not labeled for collards and kale - not recommended for DBM, BAW**	0	12	H
3A	Bifenture 2EC (or Sniper)	2.1 to 6.4 fl oz/A	bifenthrin* **- not recommended for DBM, BAW**	7	12	H
3A	Warrior II	0.96 to 1.60 fl oz/A	lambda-cyhalothrin* **- not labeled for collards and kale - not recommended for DBM, BAW**	1	24	H
3A+**4A**	Brigadier	3.8 to 6.1 fl oz/A	bifenthrin + imadacloporid* **- not recommended for DBM, BAW**	7	12	H
3A+**4A**	Endigo ZC	4.0 to 4.5 oz/A	thiamethoxam + lambda-cyhalothrin* **- not labeled for collards and kale - not recommended for DBM, BAW**	1	24	H
3A+**4A**	Leverage 360	3.0 fl oz/A	thiamethoxam + beta-cyfluthrin* **- not recommended for DBM, BAW**	7	12	H
3A+28	Besiege	5.0 to 8.0 fl oz/A	lambda-cyhalothrin + chlorantraniliprole* **- not labeled for collards and kale**	3	24	H
4A+ 28	Durivo	10.0 to 13.0 fl oz/A	thiamethoxam + chlorantrinilaprole - **soil**	30	12	H
4A +28	Voliam Flexi	4.0 to 7.0 oz/A	thiamethoxam + chlorantrinilaprole - **foliar** (PHI for collards and kale 7 d)	3/7	12	H
5	Entrust (OMRI)	3.0 to 6.0 fl oz/A	spinosad	1	4	M
5	Radiant SC	5.0 to 10.0 fl oz/A	spinetoram	1	4	H
6	Proclaim 5 SG	3.2 to 4.8 oz/A	emamectin benzoate* (PHI on collards and kale 14 d)	7/14	12	H
11A	Dipel (OMRI)	1.0 lb/A	*Bacillus thuringiensis kurstaki*	0	4	N
15	Rimon 0.83 EC	6.0 to 12.0 fl oz/A	novaluron* - **not labeled for collards and kale**	7	12	N
18	Confirm 2F	6.0 to 8.0 oz/A	tebufenozide	7	4	M
18	Intrepid 2F	4.0 to 8.0 fl oz/A	methoxyfenozide	1	4	N
22A	Avaunt 30 WDG	2.5 to 3.5 oz/A	indoxacarb	3	12	H
28	Coragen 1.67 SC	3.5 to 5.0 fl oz/A	chlorantraniliprole	3	4	L
28	Verimark	5.0 to 10.0 fl oz/A	cyantraniliprole - **soil**	AP	4	H
28	Exirel	7.0 to 13.5 fl oz/A	cyantraniliprole - **foliar**	1	12	H

Flea Beetles

Treat if the population reaches 1 beetle per transplant or 5 beetles per 10 plants during cotyledon stage. Crop rotation, management of wild hosts (wild mustard, rocket etc.) and prompt destruction of crop residue are helpful in population suppression. Sequential plantings of host crops can result in population build-up.

Apply one of the following formulations:						
Group	**Product Name**	**Product Rate**	**Active Ingredient(s) (*=Restricted Use) and Crop Restrictions**	**PHI (d)**	**REI (h)**	**Bee TR**
1A	Sevin XLR Plus	0.5 to 1.0 qt/A	carbaryl (PHI on collards and kale 14 d) **- not labeled for Chinese cabbage**	3/14	12	H

Flea Beetles continued on next page

Flea Beetles - continued

3A	Baythroid XL	2.4 to 3.2 fl oz/A	beta-cyfluthrin* **- not labeled for collards and kale**	0	12	H
3A	Bifenture 2EC (or Sniper)	2.1 to 6.4 fl oz/A	bifenthrin*	7	12	H
3A	Warrior II	1.28 to 1.92 fl oz/A	lambda-cyhalothrin* **- not labeled for collards and kale**	1	24	H
3A + **4A**	Brigadier	3.8 to 6.1 fl oz/A	bifenthrin + imadacloporid*	7	12	H
3A + **4A**	Endigo ZC	4.0 to 4.5 oz/A	thiamethoxam + lambda-cyhalothrin* **- not labeled for collards and kale**	1	24	H
3A + **4A**	Leverage 360	3.0 fl oz/A	thiamethoxam + beta-cyfluthrin*	7	12	H
3A + 28	Besiege	6.0 to 9.0 fl oz/A	lambda-cyhalothrin + chlorantraniliprole* **- not labeled for collards and kale**	3	24	H
4A	Actara 25 WDG	1.5 to 3.0 oz/A	thiamethoxam (PHI on collards, kale and kohlrabi 7 d)	0/7	12	H
4A	Admire Pro	1.3 fl oz/A	imidacloprid **- foliar**	7	12	H
4A	Venom 70 SG	5.0 to 6.0 fl oz/A	dinotefuran **- soil** **- not labeled for collards and kale**	21	12	H
4A + 28	Durivo	10.0 to 13.0 fl oz/A	thiamethoxam + chlorantrinilaprole **- soil**	30	12	H
4A + 28	Voliam flexi	4.0 to 7.0 oz/A	thiamethoxam + chlorantrinilaprole **- foliar** (PHI on collards and kale 7 d)	3/7	12	H
28	Verimark	5.0 to 10.0 fl oz/A	cyantraniliprole **- soil**	AP	4	H

Harlequin Bugs

These orange, black and white stinkbugs can be quite destructive, particularly on leafy cole crops like collards. Egg masses consist of numerous white and black barrel-shaped eggs in neat rows. Nymphs remain clustered near the eggs until molting. Infestations, can be quite heavy. Feeding results in pale blotches with scalloped edges on foliage.

Apply one of the following formulations:

Group	Product Name	Product Rate	Active Ingredient(s) (*=Restricted Use) and Crop Restrictions	PHI (d)	REI (h)	Bee TR
1A	Sevin XLR Plus	0.5 to 1.0 qt/A	Carbaryl (PHI on collards and kale 14 d) **- not labeled for Chinese cabbage**	3/14	12	H
3A	Baythroid XL	2.4 to 3.2 fl oz/A	beta-cyfluthrin* **- not labeled for collards and kale**	0	12	H
3A	Bifenture 2EC (or Sniper)	2.1 to 6.4 fl oz/A	bifenthrin*	7	12	H
3A	Warrior II	1.28 to 1.92 fl oz/A	lambda-cyhalothrin* **- not labeled for collards and kale**	1	24	H
3A + **4A**	Endigo ZC	4.0 to 4.5 oz/A	thiamethoxam + lambda-cyhalothrin* **- not labeled for collards and kale**	1	24	H
3A + **4A**	Leverage 360	3.0 fl oz/A	thiamethoxam + beta-cyfluthrin*	7	12	H
3A + 28	Besiege	6.0 to 9.0 fl oz/A	lambda-cyhalothrin + chlorantraniliprole* **- not labeled for collards and kale**	3	24	H
4A	Admire Pro	1.3 fl oz/A	imidacloprid **- foliar**	7	12	H
4A	Belay 2.13 SC	9.0 to 12.0 fl oz/A	clothianidin **- soil**	AP	12	H
4A	Venom 70 SG	1.0 to 4.0 fl oz/A	dinotefuran **- foliar** **- not labeled for collards and kale**	1	12	H

Thrips

The small size of thrips, their habit of feeding near growing points, and the waxy nature of cole crop foliage can result in poor control with contact insecticides. The addition of a wetting agent may improve efficacy.

Apply one of the following formulations:

Group	Product Name	Product Rate	Active Ingredient(s) (*=Restricted Use) and Crop Restrictions	PHI (d)	REI (h)	Bee TR
3A	Baythroid XL	0.8 to 1.6 fl oz/A	beta-cyfluthrin* **- not labeled for collards and kale**	0	12	H
3A	Bifenture EC	2.1 to 6.4 fl oz/A	bifenthrin*	7	12	H
3A + **4A**	Brigadier	3.8 to 6.1 fl oz/A	imidacloprid + bifenthrin*	7	12	H
3A + **4A**	Endigo ZC	4.0 to 4.5 oz/A	thiamethoxam + lambda-cyhalothrin* **- not labeled for collards and kale** Tank mix with Actara for thrips control.	1	24	H

Thrips continued on next page

Thrips - continued

3A + **4A**	Leverage 360	3.0 fl oz/A	thiamethoxam + beta-cyfluthrin*	7	12	H
4A	Actara	1.5 to 3.0 fl oz/A	thiamethoxam (PHI on collards, kale, kohlrabi 7 d)	0/7	12	H
4A	Admire Pro	4.4 to 10.5 fl oz/A	imidacloprid **- soil**	21	12	H
4A	Assail 30SG	4.0 oz/A	acetamiprid	7	12	M
4A	Belay 2.13SC	9.0 to 12.0 fl oz/A	clothianidin **- soil**	AP	12	H
4A	Venom	5.0 to 6.0 oz/A	dinotefuran **- soil** **- not labeled for collards and kale**	21	12	H
4A + 28	Durivo	10.0 to 13.0 fl oz/A	thiamethoxam + chlorantrinilaprole **- soil**	30	12	H
4A + 28	Voliam Flexi	4.0 to 7.0 oz/A	thiamethoxam + chlorantrinilaprole **- foliar** (PHI on collards and kale 7 d)	3/7	12	H
4C	Closer SC	5.75 fl oz/A	sulfoxaflor (suppression only)	3	12	H
5	Entrust SC (OMRI)	4.0 to 10.0 fl oz/A	spinosad	1	4	M
5	Radiant SC	6.0 to 10.0 fl oz/A	spinetoram	1	4	H
23	Movento	4.0 to 5.0 fl oz/A	spirotetramat	1	24	L
28	Verimark	10.0 to 13.5 fl oz/A	cyantraniliprole **- soil**	AP	4	H
28	Exirel	13.5 to 20.5 fl oz/A	cyantraniliprole **- foliar**	1	12	H

[1] Resistance concerns with western flower thrips only

Whiteflies

Due to insecticide resistance issues with several species, rotation among insecticide groups is essential for control and management of resistance in local populations. Thorough coverage, use of wetting agents, and initiation of treatment at low population levels will all improve control.

Apply one of the following formulations:						
Group	**Product Name**	**Product Rate**	**Active Ingredient(s) (*=Restricted Use) and Crop Restrictions**	**PHI (d)**	**REI (h)**	**Bee TR**
3A + **4A**	Brigadier	6.1 fl oz/A	imidacloprid + bifenthrin*	7	12	H
3A + **4A**	Endigo ZC	4.5 oz/A	thiamethoxam + lambda-cyhalothrin* **- not labeled for collards and kale** Tank mix with Actara for whitefly control.	1	24	H
3A + **4A**	Leverage 360	3.0 fl oz/A	thiamethoxam + beta-cyfluthrin*	7	12	H
4A	Actara	1.5 to 3.0 fl oz/A	thiamethoxam (PHI on collards, kale, kohlrabi 7 d)	0/7	12	H
4A	Admire Pro	4.4 to 10.5 fl oz/A	imidacloprid **- soil**	21	12	H
4A	Admire Pro	1.3 fl oz/A	imidcloprid **- foliar**	7	12	H
4A	Assail 30SG	2.5 to 4.0 fl oz/A	acetamiprid	7	12	M
4A	Venom	5.0 to 7.5 oz/A	dinotefuran **- soil; not labeled for collards and kale**	21	12	H
4A	Venom	#1 - 1.0 to 4.0 oz/A #2 - 2.0 to 3.0 oz/A	dinotefuran **- foliar; rate #1 - head and stem cole crops; rate #2 - leafy cole crops**	1	12	H
4A + 28	Durivo	10.0 to 13.0 fl oz/A	thiamethoxam + chlorantrinilaprole **- soil**	30	12	H
4A + 28	Voliam Flexi	4.0 to 7.0 oz/A	thiamethoxam + chlorantrinilaprole **- foliar** (PHI on collards and kale 7 d)	3/7	12	H
4C	Closer SC	4.25 to 5.75 fl oz/A	sulfoxaflor	3	12	H
4D	Sivanto 200SL	10.5 to 14.0 fl oz/A	flupyradifurone	1	4	M
7C	Knack	8.0 to 10.0 fl oz/A	pyriproxifen	7	12	N
9B	Fulfill 50W	2.75 oz/A	pymetrozine	7	12	N
15	Rimon 0.83 EC	12.0 fl oz/A	novaluron*- **not labeled for collards and kale**	7	12	N
16	Courier SC	9.0 to 13.6 fl oz/A	buprofezin	1	12	L
23	Movento	4.0 to 5.0 fl oz/A	spirotetramat	1	24	L
28	Verimark	6.75 to 13.5 fl oz/A	cyantraniliprole **- soil**	AP	4	H
28	Exirel	13.5 to 20.5 fl oz/A	cyantraniliprole **- foliar**	1	12	H

Disease Control

THE LABEL IS THE LAW - See the Pesticide Use Disclaimer on page F 1.
Recommended Pesticides

Nematodes - See the Soil Fumigation and Nematodes sections in the Pest Management chapter

Seed Treatment

Purchase hot water treated seed, or request hot water seed treatment by the seed company. If you are unsure whether your seeds have been treated, consult a qualified seed testing service.

Hot water seed treatment is a non-chemical alternative to conventional chlorine treatment which only kills pathogens on the surface of the seed. Heat-treatment done correctly kills pathogens inside the seed as well. If done incorrectly, it may not eradicate pathogens and may reduce germination and vigor. For cole crops, it is especially important to follow treatment protocols as seeds can split.

Seed heat treatment follows a strict time and temperature protocol and is best done with thermostatically controlled water baths. Two baths are required: one for pre-heating, and a second for the effective (pathogen killing) temperature. For cole crops, the initial pre-heating is at 100°F (38°C) for 10 minutes. The effective temperature is 122°F (50°C). Soaking at the effective temperature should be done for 20 minutes for broccoli, cauliflower, collards, kale, and Chinese cabbage, and 25 minutes for Brussels sprouts and cabbage. Immediately after removal from the bath, seeds should be rinsed with cool water to stop the heating process. After that, seeds should be dried on a screen or paper. Pelleted seeds are not recommended for heat treatment. **Only treat seed that will be used immediately.**

As an alternative to hot water seed treatment, use 1 part Alcide (sodium chlorite), 1 part lactic acid, and 18 parts water as a seed soak. Treat seed 1-2 minutes and rinse for 5 minutes in running water at room temperature.

Following hot water or chlorine treatment, dust the dried seed with Captan 50WP or Thiram 480DP at 1 level tsp/lb of seed (3 oz/100 lb).

Damping-off caused by *Pythium*, *Phytophthora*, and *Rhizoctonia*

Apply one of the following formulations:						
Code	**Product Name**	**Product Rate**	**Active Ingredient(s) (*=Restricted Use)**	**PHI (d)**	**REI (h)**	**Bee TR**
After seeding, apply one of the folowing in a band up to 7 inches wide. See labels for rates based on row spacing.						
Phytophthora and Pythium root rot						
4	Ridomil Gold 4SL	0.5 to 1.0 pt/A	mefenoxam	AP	48	N
Phytophthora, Pythium, and Rhizoctonia root rot						
4 + 11	Uniform 3.66SE	0.34 fl oz/1000 ft row. Avoid direct seed contact, which may cause delayed emergence.	mefenoxam + azoxystrobin	AP	0	N
Rhizoctonia root rot						
11	azoxystrobin 2.08F	0.40 to 0.80 fl oz/1000 ft row	azoxystrobin	AP	4	N

Bacterial and Fungal Diseases

Bacterial Head Rot

Bacterial head rot can be a problem on broccoli. The only effective control strategy is to plant tolerant varieties. Tolerant varieties to bacterial head rot have dome-shaped, tight heads with very small beads.

Black Rot

Black rot caused by a bacterium, *Xanthomonas campestris*, and can cause serious losses. Symptoms of black rot include large, V-shaped chlorotic lesions that develop on the margins of leaves and its development is favored by warm, wet weather. The pathogen can be seed borne, thus purchase certified seed or use hot water seed treatment.

For black rot control, rotate at least 2 years between plantings. Fixed copper sprays (1.0 lb active ingredient/A) will reduce spread of black rot if treatments are started as soon as the disease is present. Some coppers are OMRI-approved and may help suppress these diseases in organic production systems. Copper applied at high rates may cause phytotoxicity for some cabbage cultivars in the form of flecking on the wrapper leaves.

Blackleg

Blackleg (Phoma Stem Canker) is caused by the fungus, *Phoma lingan*, and can survive in the soil for up to 3 years and on related weed hosts. On seedlings, pale gray lesions develop near the soil line causing the seedling to die off. On infected stems, elongated light brown sunken lesions with purple margins develop. Spores are spread rapidly via rainfall and overhead irrigation. Blackleg can be seed borne, thus purchase certified seed or use hot water seed treatment. For blackleg control, rotate fields to allow 4 years between plantings and control related weeds.

Blackleg continued

Code	Product Name	Product Rate	Active Ingredient(s) (*=Restricted Use)	PHI (d)	REI (h)	Bee TR
Apply one of the following at the first sign of disease and continue every 7-10 days. Rotate between fungicides with different modes of action as long as conditions favor disease development.						
M1	Copper (OMRI)[1]	See labeled rates	copper	0	48	N
3	tebuconazole	3.0 to 4.0 fl oz/A	tebuconazole	7	12	N
3 + 9	Inspire Super 2.82SC	16.0 to 20.0 fl oz/A	difenoconazole + cyprodinil	7	12	--
3 + 11	Quadris Top 2.72SC	12.0 to 14.0 fl oz/A	difenoconazole + azoxystrobin	1	12	--
7 + 11	Priaxor 4.17SC	6.0 to 8.2 fl oz/A	fluxapyroxad + pyraclostrobin	3	12	N
11	Cabrio 20EG[2]	12.0 to 16.0 oz/A	pyraclostrobin	0/3[2]	12	N

[1]Some coppers are OMRI-approved and may help suppress some fungal diseases in organic production systems. Copper applied at high rates may cause phytotoxicity for some cabbage cultivars in the form of flecking on the wrapper leaves.[2]For Cabrio, PHI=0 d for broccoli, Brussels sprouts, cabbage, tight-heading varieties of Chinese cabbage, cauliflower and kohlrabi; PHI=3 d for Collards and Kale.

For blackleg control in <u>broccoli only</u>: use iprodione 4L at 2.0 lb/A immediately after thinning as a directed spray to the base of the plant and adjacent soil surface. A second application may be made up to the day of harvest.

Clubroot

Use of irrigation water containing clubroot spores is the principal way the disease is spread to other fields. If clubroot occurs, clean and disinfest all equipment. Adjust soil pH with hydrated lime to as close to 7.0 as possible. Improve the drainage in the field and grow the crop on raised beds.

Code	Product Name	Product Rate	Active Ingredient(s) (*=Restricted Use)	PHI (d)	REI (h)	Bee TR
Use Terraclor 75WP in one of the following ways. Do not use the Terraclor 2EC formulation.						
14	Terraclor 75WP	**Option 1:** Use 30.0 lb/A or 37.0 oz/1000 ft of row. Apply in a 12-15 inch band and incorporate 4-6 inches deep before planting **Option 2:** Use 40.0 lb/A, broadcast and incorporate 4-6 inches deep before planting, **Option 3:** Use 2.0 lb/100 gal of solution and 0.5 pt/plant as a transplant solution.	PNCB	AP	12	N
In addition, Ranman 3.33SC can be used in the following ways, see label for additional instructions.						
21	Ranman 3.33SC	**Option 1:** 12.9 to 25.75 fl oz/A use as a transplant soil drench **Option 2:** 20.0 fl oz/A use incorporated into the soil	cyazofamid	0	0	L

Downy Mildew

Downy mildew can cause serious losses if left uncontrolled. Symptoms include light green, chlorotic spots on the upper leaf surface. During periods of high humidity, grayish white spores may develop on the underside of leaves. High humidity, fog, drizzling rains, and heavy dew favor disease development. Optimum conditions for disease development are night temperatures of 46-61°F for 4 or more successive nights, and day temperature ~75°F or lower. Control related weeds and avoid overhead irrigation. Initiate fungicide applications prior to the onset of disease symptoms and continue as long as weather conditions favor disease development. Rotate and/or tank mix chlorothalonil 6F with one of the following fungicides. Rotate between fungicides with different modes of action.

Code	Product Name	Product Rate	Active Ingredient(s) (*=Restricted Use)	PHI (d)	REI (h)	Bee TR
M5	chlorothalonil 6F (not labeled for Collards, Kale, and Kohlrabi)	1.5 pt/A	chorothalonil	7	12	N
11	azoxystrobin 2.08F	6.0 to 15.5 fl oz/A	azoxystrobin	0	4	N
11	Cabrio 20EG	12.0 to 16.0 oz/A	pyraclostrobin	0/3[2]	12	N
21	Ranman 3.33SC	2.75 fl oz/A	cyazofamid	0	0	L
33	Phosphite	1.0 to 3.0 qt/A	phosphite	0	4	N
33	Aliette 80WDG	3.0 to 5.0 lb/A (every 14 d)	fosetyl-Al			N
40	Revus 2.08SC	8.0 fl oz/A	mandipropamid	1	4	--
40 + 45	Zampro 4.38SC	14.0 fl oz/A	dimethomorph + ametoctradin	0	12	--
43	Presidio 4SC	3.0 to 4.0 fl oz/A	fluopicolide	2	12	L
Actigard is a plant defense activator. Begin applications 7-10 d after thinning and reapply every 7 d for a total of 4 applications per season.						
P1	Actigard 50WG	1.0 oz/A	acibenzolar-S-methyl	7	12	N

Leaf Spots (Caused by *Alternaria* and *Pseudocercosporella*)

Leaf spots can cause serious losses if left uncontrolled. Leaf spots caused by *Alternaria* and *Pseudocercosporella* are favored by long extended periods of cool, wet weather and favored by rain, heavy dews, and overhead irrigation. Symptoms of *Alternaria* spp. include yellow, dark-brown to black circular leaf spots with target like, concentric rings. *Pseudocercospora capsallae,* also known as White leaf spot, causes tannish-white, irregular or roundish spots develop on infected leaves, especially near leaf tips and edges, spots later become ash-gray to white with a brownish margin and sometimes have a yellowish halo. Initiate fungicide applications prior to the onset of disease symptoms and continue as long as weather conditions favor disease development. Rotate and/or tank mix chlorothalonil 6F at 1.5 pt/A with one of the following fungicides.

Code	Product Name	Product Rate	Active Ingredient(s) (*=Restricted Use)	PHI (d)	REI (h)	Bee TR
Tank mix one of the following with chlorothalonil at the first sign of disease and continue every 7-10 days. Rotate between fungicides with different modes of action as long as conditions favor disease development.						
M1	Copper (OMRI)[1]	See labeled rates	copper	0	48	n
3 + 9	Inspire Super 2.82SC	16.0 to 20.0 fl oz/A	difenoconazole + cyprodinil	7	12	--
3 + 11	Quadris Top 2.72SC	12.0 to 14.0 fl oz/A	difenoconazole + azoxystrobin	1	12	--
4 + M5	Ridomil Gold Bravo 76.5WP	1.5 lb/A (14-day schedule)	mefenoxam + chlorothalonil **- not labeled for Collards, Kale and Kohlrabi**	7	48	N
7	Endura 70WG[2]	6.0 to 9.0 oz/A	boscalid	0/14[1]	12	--
7	Fontelis 1.67SC	14.0 to 30.0 fl oz/A	penthiopyrad	0	12	L
7 + 11	Priaxor 4.17SC	6.0 to 8.2 fl oz/A	fluxapyroxad	3	12	N
9 + 12	Switch 62.5WG	11.0 to 14.0 oz/A	cyprodinil + fludioxonil	7	12	N
11	azoxystrobin 2.08F	6.0 to 15.5 fl oz/A	azoxystrobin	0	4	N
11	Cabrio 20EG[3]	12.0 to 16.0 oz/A	pyraclostrobin	0/3[2]	12	N

[1]There are a number of copper based products with OMRI labels. See labels for specifics. Copper applications may help suppress some fungal pathogens in organic production systems. [2]See Endura label for specific recommendations. [3]For Cabrio, PHI=0 d for broccoli, Brussels sprouts, cabbage, tight-heading varieties of Chinese cabbage, cauliflower and kohlrabi; PHI=3 d for Collards and Kale.

White Mold

Code	Product Name	Product Rate	Active Ingredient(s) (*=Restricted Use)	PHI (d)	REI (h)	Bee TR
Apply Contans 5.3WG 3-4 months prior to the onset of disease to allow the active agent to reduce inoculum levels of sclerotia in the soil. Following application, incorporate 1-2 inches deep but do not plow before seeding cole crops to avoid untreated sclerotia in lower soil layers from infesting the upper soil layer. See label for specifics.						
Bio.	Contans 5.3WG (OMRI)	2.0 to 4.0 lb/A	*Coniothyrium minitans*	--	--	NA
Alternatively, during seasons when soils remain wet for an extended period of time apply one of the following preventatively:						
7	Endura 70WG	6.0 to 9.0 oz/A	boscalid	0/14[1]	12	--
7	Fontelis 1.67SC	16.0 to 30.0 fl oz/A	penthiopyrad	0	12	L

[1]See Endura label for specific recommendations.

Yellows (*Fusarium*) Use resistant varieties when possible and practice long crop rotations.

For Immediate Medical Attention

Call 911

For a Pesticide Exposure Poisoning Emergency Call

For All States

This number will automatically connect you to the poison center nearest you.
Anyone with a poisoning emergency can call the toll-free telephone number for help. Personnel at the Center will give you frst-aid information and direct you to local treatment centers if necessary.

For Pesticide Spills

Small Spills: See the product label for cleanup advice.
Large spills: Call the National Response Center at 1-800-424-8802 or CHEMTREC at 800-424-9300 (24 hours) - Industry assistance with emergency response cleanup procedures for large, dangerous spills.
Be aware of your responsibility to report spills to the proper state agency.