

Chapter 7.

Cole Crop Production in Florida

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BOTANY

Nomenclature

- Family** - Brassicaceae (Cruciferae)
Broccoli - *Brassica oleraceae* Italica group
Cabbage - *Brassica oleraceae* Capitata group
 (Fig. 7-1)
Cauliflower - *Brassica oleraceae* Botrytis group
 (Fig. 7-2)
Collards - *Brassica oleraceae* Acephala group
Kale - *Brassica oleraceae* Acephala group
Mustard - *Brassica juncea*
Turnip - *Brassica rapa* Rapifera group (Fig. 7-3)

Origin

It is believed that all of the crops within *B. oleraceae* evolved from a wild cabbage-like plant that was native to the British Isles and to the Mediterranean area of Europe.

Related Species

Other vegetables in the Brassicaceae family are horseradish, rutabaga, Brussels sprouts, kohlrabi, Chinese cabbage, radish, and watercress. Many ornamental plants and oil-bearing plants also are included in this family.

VARIETIES

Florida cabbage varieties are shown in Table 1. Other cole crop varieties are shown in Table 2.

Table 1. Some cabbage varieties grown in Florida.

Green		Red
Atlantis (H)	Green Cup (H)	Cardinal (H)
Augusta (H)	Isalco (H)	Red Dynasty (H)
Blue Dynasty (H)	Matsuma (H)	Red Success (H)
Bravo (H)	Pruktor (H)	Red Rookie (H)
Cheers (H)	Ramada (H)	
Ducati (H)	Rio Verde (H)	
Emblem (H)	Royal Vantage (H)	
Gideon (H)	Solid Blue 790 (H)	
Gloria (H)	Tropicana (H)	
Savoy		
Savoy Ace (H)		

H = hybrid.

SEEDING AND PLANTING

Seeding and planting information for cole crop production in Florida is given in Table 3.

FERTILIZER AND LIME

Soil test and fertilizer recommendations for cole crops grown on mineral soil are shown in Table 4.

For unmulched crops planted in single rows or beds, broadcast all P₂O₅, micronutrients, and 25 to 50% of N and K₂O before planting. Banding these fertilizers at planting might improve fertilizer efficiency. Sidedress remaining N and K₂O at 6 to 8-leaf stage.

For unmulched leafy cole crops planted in multi-row beds, broadcast P₂O₅, micronutrients, and 25 to 50% of the N and K₂O in the bed area. Topdress or band remaining N and K₂O when plants are 4 to 6 inches tall. Apply supplemental N and K₂O (as above) after leaching rain.

Table 2. Broccoli, cauliflower, collard, kale, mustard, and turnip varieties grown in Florida.

Broccoli:	Kale:
Arcadia (H)	Blue Ridge (H)
Marathon (H)	Vates
Major (H)	Mustard:
Packman (H)	Florida Broad Leaf
Patriot (H)	Green Wave
Pirate (H)	Red Giant
Cauliflower:	Southern Giant Curled
Majestic (H)	Tendergreen
White Passion (H)	Turnip:
Snow Crown (H)	Just Right (H)
Collards:	Southern Green
Blue Max (H)	Purple Top
Bull Dog (H)	Royal Crown (H)
Flash (H)	White Knight (H)
Georgia	Turnip Greens:
Top Bunch (H)	Seven Top
Top Pick (H)	
Vates	

H = hybrid.

Table 3. Seeding and planting information for cole crops in Florida.

Planting dates	Broccoli ¹	Brussels sprouts	Cabbage ¹	Cauliflower ¹
North Florida	Aug - Feb	Aug - Feb	Aug - Feb	Aug - Feb
Central Florida	Sept - Feb	Sept - Feb	Sept - Feb	Sept - Feb
South Florida	Oct - Jan	Oct - Jan	Sept - Jan	Sept - Jan
Seeding information				
Distance between rows (in)	24 - 40	24 - 40	24 - 40	24 - 40
Distance between plants (in)	10 - 15	18 - 24	9 - 16	12 - 18
Seeding depth (in)	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Seeding per acre for field (lb)	1 - 2	1 - 2	1 - 2	1 - 2
Seeding per acre for transplant (lb)	1.25 - 1.5	1.25 - 1.5	1	1.25 - 1.5
Days to maturity from seed	75 - 90	90 - 120	85 - 110	75 - 90
Days to maturity from transplant	50 - 70	70 - 90	70 - 90	50 - 70
Plant populations ² (per acre)	26,136	15,520	29,403	29,040
Planting dates	Collards	Kale	Mustard	Turnip
North Florida	Aug - Feb	Aug - Feb	Aug - Feb	Aug - Feb
Central Florida	Sept - Feb	Sept - Feb	Sept - Feb	Sept - Feb
South Florida	Sept - Jan	Sept - Jan	Sept - Jan	Sept - Jan
Seeding information				
Distance between rows (in)	24 - 36	18 - 24	12 - 36	12 - 36
Distance between plants (in)	12 - 24	8 - 12	5 - 10	2 - 6
Seeding depth (in)	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Seeding per acre for field (lb)	2 - 4	2 - 4	3 - 5	2 - 3
Seeding per acre for transplant (lb)	1.25 - 1.5	N/A ³	N/A ³	N/A ³
Days to maturity from seed	70 - 90	50 - 70	40 - 50	40 - 60
Days to maturity from transplant	50 - 70	—	—	—
Plant populations ² (per acre)	21,780	43,560	116,160	261,360

¹ Can be seeded in double rows per bed: 15 - 24 in between rows, 10 - 12 in within rows on 40 to 60-inch bed centers.

² Populations based on closest between and within row spacing.

³ Generally direct seeded.

For mulched crops with subsurface irrigation, incorporate all P₂O₅, micronutrients, and 20 to 25% of N and K₂O in the bed (Fig. 7-4). Apply remaining N and K₂O in a single groove (for twin-row) in bed center about 2 to 3 inches deep before mulching. Supplemental N and K₂O can be injected through mulch with a liquid fertilizer injection wheel.

For mulched crops with overhead sprinkler irrigation, incorporate all fertilizer in bed before mulching. Bed over fertilized soil with unfertilized soil so that fertilized soil will be deep enough (3 to 4 inches) to remain moist.

For Histosols, all P₂O₅, K₂O, and micronutrients can be broadcast just before planting, although banding P₂O₅ at planting might increase P efficiency. Some N might be needed for crops started under cool, winter conditions. A total of 40 to 50 lb N per acre might be needed at planting or as a sidedress early in the season (see Table 5).

For drip-irrigated crops, (broccoli, cauliflower, cabbage, collards) apply all P₂O₅, micronutrients, and up to 20 to 25% of N and K₂O in the bed at planting. Apply remaining N and K₂O through tube using schedules presented in Table 6a and 6b.

For leafy cole crops other than those listed here, follow recommendations for mustard.

PLANT TISSUE ANALYSIS

Plant tissue analysis for cole crops is listed in Table 7.

PETIOLE SAP TESTING

Fresh sap can be pressed from leaf petioles and analyzed for nitrogen and potassium concentrations. Results can be used to make adjustments in the fertilization program. Sufficiency ranges for sap testing broccoli and collards are presented in Table 8.

Table 4. Soil test results and fertilizer recommendations for cole crops on mineral soils.¹

Target pH	N lb/A	VL	L	M	H	VH	VL	L	M	H	VH
		P ₂ O ₅					K ₂ O				
		(lb/A/crop season)									
Broccoli/Cauliflower/Brussels sprouts											
6.5	175	150	120	100	0	0	150	120	100	0	0
Cabbage/Collards/Chinese cabbage											
6.5	175	150	120	100	0	0	150	120	100	0	0
Kale/Turnip/Mustard											
6.5	120	150	120	100	0	0	150	120	100	0	0

¹ See Chapter 2 section on supplemental fertilizer application and best management practices, pg 11.

Table 5. Soil test and fertilizer recommendations for cole crops grown on Histosols, with target pH 6.0 and N rate= 0 lb/A.

Crop	P index	P and K index and fertilizer rate					
		3	6	9	12	15	18
Broccoli, Cauliflower	P ₂ O ₅ (lb/A)	200	140	80	20	0	0
Cabbage	P ₂ O ₅ (lb/A)	200	140	80	20	0	0
Chinese cabbage	P ₂ O ₅ (lb/A)	280	220	160	100	40	0
	K index	50	80	110	140	170	200
Broccoli, Cauliflower	K ₂ O (lb/A)	200	140	80	20	0	0
Cabbage	K ₂ O (lb/A)	200	140	80	20	0	0
Chinese cabbage	K ₂ O (lb/A)	200	140	80	20	0	0

IRRIGATION

Slight variations exist in the water requirements of members of the cole crop family (see Chapter 3, *Principles and Practices of Irrigation Management for Vegetables*, Tables 4-6). Water use rates may approach ETo (see Chapter 3, Table 3) during the rapid growth and development period, decreasing to 85% of that value during final growth. Reductions in available water to the plants will result in reduced growth and development of leaves and shoots. Winter season water use in south Florida may average 0.10 inches per day (2700 gal/A/day), while in north Florida, requirements may average 0.06 inches per day (1600 gal/A/day), a 40% difference. Therefore, close attention to local climatic conditions is necessary for proper water management and irrigation scheduling.

WEED MANAGEMENT

Herbicides labeled for weed control in cole crops are listed in Table 9.

DISEASE MANAGEMENT

Information on managing diseases of cole crops is given in Table 10.

INSECT MANAGEMENT

The key pest of cole crops in Florida is the diamondback moth. Resistance to insecticides, particularly to pyrethroids, is very common. If diamondback moth larvae are present, growers should avoid pyrethroids and use *Bacillus thuringiensis* products (both *aizawa* and *kurstaki* strains) as their main insecticides and tank mix or alternate with spinosad or emamectin benzoate. If cabbage looper is present, in addition to diamondback moth larvae, an application of methomyl may be necessary. Another choice is thiodicarb but this will be more damaging to beneficial insects than methomyl, which has a short residual effect. If diamondback moth is not present and cabbage looper is the main pest, a pyrethroid would be effective. Tebufenozide will also control cabbage looper but not diamondback moth larvae.

The insecticides currently approved for use on insects attacking cole crops are outlined in the following tables:

Cole crops - Table 11

Turnip - Table 12

PRODUCTION COSTS

Example breakeven production costs for cabbage are given in Table 13.

Table 6a. Injection schedule for N and K for cole crops planted two rows per bed on 6-foot centers on soils very low in K.

Crop	Total nutrients (lb/A) ³		Crop development		Injection (lb/A/day) ¹	
	N	K ₂ O	Stage	Weeks ²	N	K ₂ O
Broccoli	175	150	1	1	2.0	1.75
Cauliflower	175	150	2	9	2.5	2.25
Cabbage	175	150	1	3	2.0	2.0
Collards	175	150	2	6	2.5	2.5
Chinese cabbage	175	150	3	2	2.0	2.0

¹ All nutrients injected. Actual amounts may be lower depending on amount of N and K₂O placed in the bed, the K soil test result, and the crop N requirement.

² Starting from date of seedling emergence or transplanting. First two weeks worth of injecting can be omitted if 25% of total N and K₂O was applied preplant.

³ Seeds and transplants may benefit from applications of a starter solution at a rate no greater than 10 to 15 lbs/acre for N and P₂O₅, and applied through the plant hole or near the seeds.

Table 6b. Supplemental fertilization recommendations for cole crops grown in Florida on sandy soils testing very low in Mehlich-1 potassium (K₂O).

Production System	Nutrient	Recommended-Supplemental fertilization ²		
		Leaching rain ^{1,u}	Measured "low" plant nutrient content ^{x,w,u}	Extended harvest season ^{x,u}
Plasticulture	N	n/a	1.5 to 2 lbs/A/day for 7 days ^y	1.5 to 2 lbs/A/day ^{y,v}
	K ₂ O	n/a	1.5 to 2 lbs/A/day for 7 days ^y	1.5 to 2 lbs/A/day ^{y,v}
Bare ground	N	30 lbs/A ^s	30 lbs/A ^s	30 lbs/A ^v
	K ₂ O	20 lbs/A ^s	20 lbs/A ^s	20 lbs/A ^v

² 1 A = 7,260 linear bed feet per acre (6-ft bed spacing); for soils testing "very low" in Mehlich 1 potassium (K₂O)

^y Fertilizer injections may be done daily or weekly. Inject fertilizer at the end of the irrigation event and allow enough time for proper flushing afterwards.

^x Plant nutritional status may be determined with tissue analysis or fresh petiole-sap testing, or any other calibrated method. The "low" diagnosis needs to be based on UF/IFAS interpretative thresholds.

^w Plant nutritional status must be diagnosed every week to repeat supplemental application.

^v Plant nutritional status must be diagnosed after each harvest before repeating supplemental fertilizer application.

^u Supplemental fertilizer applications are allowed when irrigation is scheduled following a recommended method (see Chapter 3 on irrigation scheduling in Florida). Supplemental fertilization is to be applied in addition to base fertilization when appropriate. Supplemental fertilization is not to be applied "in advance" with the preplant fertilizer.

^t A leaching rain is defined as a rainfall amount of 3 inches in 3 days or 4 inches in 7 days.

^s Supplemental amount for each leaching rain.

Table 7. Plant tissue analysis for cole crops. Dry wt. basis.

Status	N	P	K	Ca	Mg	S	Fe	Mn	Zn	B	Cu	Mo
	Percent						Parts per million					
Broccoli - Most recently matured leaf sampled at heading												
Deficient	<3.0	0.3	1.1	0.8	0.23	0.2	40	20	25	20	3	0.04
Adequate range	3.0-4.5	0.3-0.5	1.5-4.0	0.8-2.5	0.23-0.40	0.2-0.8	40-300	25-150	45-95	30-50	5-10	0.04-0.16
High	>4.5	0.5	4.0	2.5	0.40	0.8	300	150	100	100	10	0.16
Cabbage - Most recently matured leaf sampled 8 weeks after planting												
Deficient	<3.0	0.3	2.0	0.5	0.20	0.3	30	20	30	20	3	0.3
Adequate range	3.0-6.0	0.3-0.6	2.0-4.0	0.8-2.0	0.25-0.60	0.3-0.8	30-60	20-40	30-50	20-40	3-7	0.3-0.6
High	>6.0	0.6	4.0	2.0	0.60	0.8	100	40	50	40	10	0.6
Cauliflower - Most recently matured leaf sampled at buttoning												
Deficient	<3.0	0.4	2.0	0.8	0.25	0.3	30	30	30	30	5	0.5
Adequate range	3.0-5.0	0.4-0.7	2.0-4.0	0.8-2.0	0.25-0.60	0.3-0.8	30-60	30-80	30-50	30-50	5-10	0.5-0.8
High	>5.0	0.7	4.0	2.0	0.60	1.0	100	100	50	50	10	0.8
Collards - Most recently matured leaf sampled at harvest												
Deficient	<4.0	0.3	3.0	1.0	0.40	0.3	40	40	25	25	5	0.3
Adequate range	4.0-5.0	0.3-0.6	3.0-5.0	1.0-2.0	0.40-1.00	0.3-0.8	40-100	40-100	25-50	25-50	5-10	0.3-0.8
High	>5.0	0.6	5.0	2.0	1.00	0.8	100	100	50	50	10	0.8

Table 8. Sufficiency ranges for petiole sap testing for broccoli and collard.

Crop Development Stage	Fresh Petiole Sap Concentration (ppm)	
	NO ₃ -N	K
Six-leaf stage	800-1000	NR ²
One week prior to first harvest	500-800	
First harvest	300-500	

² NR-No recommended ranges have been developed.

Table 9. Chemical weed controls: broccoli, cabbage, cauliflower, collards, mustard, turnips and kale.

Herbicide	Labeled crops	Time of application to crop	Rate (lbs. AI./Acre)	
			Mineral	Muck
Bensulide (Prefar 4E)	Brassica (cole) leafy vegetables Cabbage, Chinese cabbage (Napa, bokchoy), broccoli, Chinese broccoli, Brussel sprouts, cauliflower, all Chinese brassica crops collards, kale, kohlrabi, mezuna, mustard greens, rape greens	Preplant incorporate, Preemergence	5-6	--
Remarks: Preplant incorporate using power driven rotary cultivations or apply preemergence and incorporate with irrigation. Controls many grass weeds. Provides fair to good control of lambsquarter, purslane, and some amaranths. May be applied under polyethylene mulch.				
Clethodim (Select 2 EC) (Arrow) (Intensity) (Select Max)	Head and Stem Brassicas Brassica Leafy Vegetables	Postemergence	0.09-0.25	
Remarks: Postemergence control of actively growing annual grasses. Apply at 6-16 fl oz/acre (Select, Arrow) or 9-16 fl oz/acre (Select Max). Higher rates are listed for perennial grasses. Use a crop oil concentrate for Select and Arrow, but a non-ionic surfactant may be used for Select Max. Do not apply within 30 days of harvest for head and stem brassicas (see definition) and 14 days for Brassica leafy greens.				
Carfentrazone (Aim)	Brassica Leafy Vegetables (All)	Preplant Directed-Hooded Row-middles	0.031	0.031
Remarks: Aim may be applied as a preplant burndown treatment and/or as a post-directed hooded application to row middles for the burndown of emerged broadleaf weeds. May be tank mixed with other registered herbicides. May be applied at up to 2 oz (0.031 lb ai). Use a quality spray adjuvant such as crop oil concentrate (coc) or non-ionic surfactant at recommended rates.				
Clopyralid (Stinger)	Brassica Leafy Vegetables (All)	Postemergence	0.094-0.187	0.094-0.187
Remarks: Make 1 to 2 applications per crop per year at 1/4 to 1/2 pint per acre, not to exceed 1/2 pint per acre per year. Do not use a surfactant. Do not apply within 30 days of harvest. Check plant back restrictions.				
DCPA (Dacthal W-75) (Dacthal DF)	Broccoli, Brussels Sprouts, Cabbage, Cauliflower and all other BRASSICA (cole) leafy vegetables*	At seeding or Transplanting	6-8	---
* Including: Chinese broccoli, Broccoli raab (rapini), Chinese cabbage (bok choy, napa), Chinese mustard cabbage (gai choy), collards, kale, kohlrabi, mustard greens and rape greens.				
Remarks: Can be sprayed directly over transplants without injury. Application should be made prior to weed seed germination. If weeds have emerged, soil should be clean cultivated or weeded prior to application. Can be preplant incorporated.				
Glyphosate (Roundup, Durango Touchdown, Glyphomax)	Brassica Leafy Vegetables	Chemical fallow Preplant, pre emergence, Pre transplant	0.3 - 1.0	---
Remarks: Roundup, Glyphomax and Touchdown have several formulations. Check the label of each for specific labeling directions.				
S - Metolachlor (Dual Magnum)	Transplanted head and stem Brassica subgroup (broccoli, Chinese broccoli, Brussels sprouts, cabbage, Chinese cabbage [napa], Chinese mus- tard, cauliflower, kohlrabi)	Posttransplant Transplanted	0.64-1.91	1.91
Remarks: Label is a third party registration by TPR, Inc. The label is issued by TPR and is valid only when a grower indemnification agreement is signed. Application should be made immediately after transplanting to plants that are at least 5 weeks old or grown in 1" diameter cells or larger. Use 0.64 lb ai (.67 pints) on soils relatively coarse-textured or low in organic matter. Use higher rate (2 pints) on fine textured soils or high in organic matter. In order to protect ground water resources, do not apply more than 1.91 lb ai (2.0 pints) of Dual Magnum per crop on sandy soils or 3.81 lb ai (4.0 pints) of Dual Magnum per crop on organic soils. Chinese varieties are more sensitive to Dual Magnum injury. Use lower rates as determined for soil type.				
S-Metolachlor (Dual Magnum)	Direct-seeded cabbage	Preemergence Postemergence (direct-seeded)	0.76 - 1.26	1.91 - 3.82
Remarks: Label is Third Party Registration by TPR, Inc. May be applied preemergence or postemergence to direct seeded tight-headed cabbage. Preemergence applications should be made immediately after seeding at 0.8 to 1.33 pints/A on sandy soils or 2.0 to 4.0 pints or organic soils. Postemergence applications should be made at least 20 days after seeding. Apply once per crop season. Chinese varieties are more sensitive to Dual Magnum injury. Use the lower rates. The use of Dual Magnum may result in leaf crumbling or cupping and twisting. Delayed maturity can be anticipated at higher rates. Climatic conditions during the growing season will affect efficacy and phytotoxicity. Postemergence application should be made at least 20 days after seeding. Apply once per crop season.				

Table 9. Continued.

Herbicide	Labeled crops	Time of application to crop	Rate (lbs. AI./Acre)	
			Mineral	Muck
Napropamide (Devrinol 50DF)	Broccoli, cabbage, brussel sprouts, cauliflower	Posttransplant	2.0	---
Remarks: Apply to weed-free surface as a surface spray after transplanting. Sprinkler irrigate within 24 hours using sufficient water to wet the soil to a depth of 2 to 4 inches. Not labeled for direct-seeded in Florida.				
Paraquat (Gramoxone Inteon)	Cabbage (including tight headed Chinese Cabbage)	Postemergence Directed/shielded	0.312-0.47	0.312-0.47
Remarks: Apply as a postemergence directed spray/shielded to control emerged annual broadleaf weeds and grasses and for top kill and suppression of emerged perennial weeds after crop emergence or establishment. Apply as a directed spray using 1.2 pts/acre in 40 to 70 gals. spray mix. Do not allow spray to contact cabbage plants as injury or excessive residue may result. Outer leaves should be stripped at time of harvest. Add a nonionic surfactant or crop oil to spray volume.				
Pelargonic acid (Scythe)	Brassica crops (broccoli, cabbage, cauliflower, collards, kale, greens (mustard and turnip)	Preplant, Preemergence, Directed-Shielded	3-10% v/v	3-10% v/v
Remarks: Product is a contact, non-selective, foliar applied herbicide. There is no residual control. May be tank mixed with soil residual compounds. Consult label for rates and other information.				
Oxyfluorfen (Goal 2XL) (Goaltender)	Broccoli, Cabbage, Cauliflower	Pretransplant	0.25 - 0.50	---
Remarks: Controls certain annual broadleaf weeds such as: carpetweed, redroot pigweed, common purslane and Pennsylvania smartweed. May provide suppression of galingosa, common lambsquarter and wild mustard.				
Note: Crop injury may result with the use of transplants less than 5 weeks old and grown in containers less than 1 inch square. Do not apply to fields that have had acetanilide (Dual, Lasso, Ramrod) application during the current growing season. Severe crop injury may occur.				
Paraquat (Gramoxone Inteon) (Firestorm)	Broccoli, Cabbage, Chinese cabbage, Collards, Turnip, Cauliflower	Preplant Preemergence	0.5 - 0.1	0.5 - 0.1
Remarks: Apply as a band treatment over the crop row or as a broadcast treatment before, during or after planting, but before the emergence of the crop. Weeds emerging after the application will not be controlled. Crop plants emerged at the time of application will be killed. Use a non-ionic surfactant in the spray mixture.				
Paraquat (Gramoxone Inteon)	Cabbage (including tight headed Chinese cabbage)	Postemergence Directed/shielded	0.312 - 0.47	0.312 - 0.47
Remarks: apply as a postemergence directed spray/shielded to control emerged annual broadleaf weeds and grasses adn for top kill and suppression of emerged perenial weeds after crop emergence or establishment. Apply as a dusted spray using 1 1/2 pts/acre in 40 to 70 gals. spray mix. Do not allow spray to contact cabbage plants as injury or excessive residue may result. Outer leaves should be stripped at time of harvest. Do not apply where Gramoxone Extra has been used as a pre-emergence spray. Add a nonionic surfactant or crop oil to spray volume.				
Sethoxydim (Poast)	Broccoli, Cabbage, Cauliflower, and all other Brassica (cole) leafy vegetables*	Postemergence	0.188-0.28	0.188-0.28
* Including: Chinese broccoli, Broccoli raab (rapini), Chinese cabbage (bok choy, napa), Chines mustard cabbage (gai choy), collards, kale, kohi-rabi, mustard greens and rape greens.				
Remarks: Controls actively growing grass weeds. A total of 3 pts. product per acre may be applied in one season. Do not apply within 30 days of harvest. Apply in 5 to 20 gallons of water adding 2 pts. of crop oil concentrate per acre. Unsatisfactory results may occur if applied to grasses under stress. Use 0.188 lb. ai. (1 pt.) on seedling grasses and up to 0.28 lb. ai. (1.5 pts.) on perennial grasses emerging from rhizomes, etc. Consult label for grass species and growth stage for best control.				
Trifluralin (Trifluralin) (Treflan) (Trust)	Broccoli, Cabbage, Brussels Sprouts, Cauliflower Turnip Greens (for processing), Collard, Mustard, Kale	Preplant incorporated (Direct-seeded and Transplanted) Preplant incorporated (Direct-seeded)	0.5 - 0.75 0.5 - 0.75	--- ---
Remarks: Controls germinating annuals, especially grasses. Incorporate 4 inches or less within 8 hours. Results in Florida are erratic on soils with low organic matter and clay contents. Note precautions of planting non-registered crops within 5 months.				

Table 10. Disease management cole crops.

Chemical (active ingredient)	Fungicide Code ¹	Max. Rate/ Acre /		Min. Days to Harvest	Diseases or Pathogens	Remarks ²
		Applic.	Season			
COLE CROPS						
Head and Stem Crops: Broccoli, Brussels Sprouts, Cauliflower, Chinese Broccoli and Chinese Cabbage;						
Leafy Crops: Collards, Kale, Mustard and Turnip; and Watercress.						
(copper compounds) Many brands available: Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ F2 FL, Champ WG, Champion WP, C-O-C DF, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 3000, Kocide 2000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 50WP, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	M1	SEE INDIVIDUAL LABELS		1	Alternaria leaf spot Black rot Downy mildew	Mancozeb or maneb enhances bactericidal effect of fix copper compounds. See label for restrictions and details.
(sulfur) Many brands available: Cosavet DF, Kumulus DF, Micro Sulf, Microfine Sulfur, Microthiol Disperss, Sulfur 6L, Sulfur 90W, Super Six, That Flowable Sulfur, Tiolux Jet, Thiosperse 80%, Wettable Sulfur, Wettable Sulfur 92, Yellow Jacket Dusting Sulfur, Yellow Jacket Wettable Sulfur	M2	SEE INDIVIDUAL LABELS		0	Powdery mildew	Products are available for most cole crops; See label for restrictions and details.
(maneb) Many brands available: Maneb 75DF, Maneb 80WP, Manex	M3	SEE INDIVIDUAL LABELS		7	Alternaria leaf spot Downy mildew	Not labeled for collards, mustard, turnip or watercress. See label for restrictions and details.
(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720)	M5	SEE INDIVIDUAL LABELS		7	Alternaria leaf spot Downy mildew	Not labeled for leafy cole crops or watercress. See label for restrictions and details.
Iprodione 4L AG Rovral 4F (iprodione)	2	2 pts (broccoli) 1 pt (Chinese mustard)	4 pts	0	Black leg (Leptosphaeria maculans) on broccoli; Alternaria leaf-spot (Alternaria spp.) on Chinese mustard	Only labeled for broccoli and Chinese mustard. Limit is 2 appl for broccoli and 4 appl for Chinese mustard. See labels for details
Folicur 3.6F Monsoon Orius 3.6F Toledo 3.6F (tebuconazole)	3	4 fl oz	16 fl oz	7	Cercospora leaf spot Powdery mildew Alternaria leaf spot	Not labeled for watercress or head and stem cole crops. Apply prior to infection when environmental conditions are favorable.
Procure 480 SC (triflumizole)	3	8 fl oz	18 fl oz	0 (leafy) 1 (head & stem)	Powdery mildew Anthracnose	Not labeled for watercress. See supplemental label for restrictions and details.

Table 10. Continued.

Chemical (active ingredient)	Fungicide Code ¹	Max. Rate/ Acre /		Min. Days to Harvest	Diseases or Pathogens	Remarks ²
		Applic.	Season			
Ridomil Gold SL (mefenoxam)	4	2 pts (soil) 0.25 pts (foliar)	2 pts (soil) 1 pt (foliar)	7	Pythium & Phytophthora diseases (soil) Downy mildew	Not labeled for watercress; Use only in a tank mix with another effective fungicide (non FRAC code 4). See label for details
Apron XL (mefenoxam)	4	See label			Pythium & Phytophthora diseases (soil)	Seed treatment only; Not labeled for watercress. See label for details.
Ultra Flourish (mefenoxam)	4	4 pts	4 pts		Pythium & Phytophthora diseases (soil)	Soil applied as a preplant treatment or following transplanting.
Ridomil Gold Bravo Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	4 + M5	1.5 lbs	See label	7	Alternaria leaf spot Downy mildew	Not labeled for leafy cole crops or watercress. Limit is 4 applications per crop. See labels for details.
Endura (boscalid)	7	9 oz	18 oz	0 (head and stem brassicas) 14 (leafy green brassicas)	Alternaria blight Gray mold Sclerotinia rot Powdery mildew Rhizoctonia rot	Not labeled for watercress; Limit is 2 appl/crop. See label for details.
Switch 62.5WG (cyprodinil + fludioxonil)	9 + 12	14 oz	56 oz	7	Alternaria blight Cercospora leaf spot Powdery mildew	No more than 2 sequential appl. before rotating to a different mode of action for at least 2 appl; 30 day plant back for off label crops; See label for details
Inspire Super (cyprodinil + difenoconazole)	9 + 3	20 fl oz	80 fl oz	7	Alternaria leaf spot Downy mildew Powdery mildew	Begin applications prior to disease development, and continue on a 7 – 10 day interval. Make no more than 2 sequential applications before rotating to another effective fungicide with a different mode of action. Do not exceed 80 fl oz per season.
Amistar (azoxystrobin)	11	5 oz	30 oz	0	Alternaria leaf spot	Not labeled for watercress; No more than 1 sequential appl. See label for details.
Quadris (azoxystrobin)	11	15.5 fl oz	93 fl oz	0	Anthracnose Black leg	
Cabrio EG (pyraclostrobin)	11	16 oz	64 oz	0	Cercospora leaf spot Downy mildew Powdery mildew Rhizoctonia blight Ring spot White rust White leaf spot	Not labeled for collards, kale, mustard or watercress; No more than 2 sequential appl/crop. See label for details.
Reason 500SC (fenamidone)	11	8.2 oz	24.6 oz	2	Downy mildew (<i>Peronospora parasitica</i>) Cercospora leaf spot (<i>Cercospora brassicicola</i>) White rust (<i>Albugo candida</i>)	Not labeled for turnip or watercress. Limits are no more than 1 sequential appl. See label for details.
Maxim 4FS (fludioxonil)	12	See label			Fusarium and Rhizoctonia root rots	Seed treatment only; Not labeled for turnip or watercress. See label for details.

Table 10. Continued.

Chemical (active ingredient)	Fungicide Code ¹	Max. Rate/ Acre /		Min. Days to Harvest	Diseases or Pathogens	Remarks ²
		Applic.	Season			
Blocker 4F Terraclor 400 Terraclor 75WP Terraclor FL (PCNB)	14	See label	30 lbs a.i.		Club root Rhizoctonia rot	Not labeled for leafy cole crops or watercress. See label for details.
Omega 500F (Fluazinam)	29	2.6 pts soil appl.; 6.45 fl oz/100 gal transplant drench	3.85 pts	20 days (leafy greens) 50 days (head and stem)	Club root	Not labeled for watercress. Treated turnip roots are not fit for human or livestock consumption. 2 day REI. See label for restrictions and details.
Aliette 80WG Linebacker WDG (fosetyl-al)	33	5 lbs	35 lbs	3	Downy mildew	Not labeled for turnip or watercress. Limit is 7 appl/crop. Do not tank mix with copper fungicides, surfactants, or foliar fertilizers.
K-phite 7LP Fosphite Fungi-phite Helena Prophyte Phostrol Topaz (mono-and di-potassium salts of phosphorous acid)	33	SEE INDIVIDUAL LABELS		0	<i>Phytophthora</i> spp. <i>Pythium</i> spp. <i>Fusarium</i> spp. Rhizoctonia <i>Xanthomonas campestris</i> Anthracnose Downy mildew Powdery mildew	Not labeled for watercress. Do not apply with copper based fungicides. See label for details.
Acrobat (dimethomorph)	40	6.4 oz	32 oz	0	Downy mildew	Not labeled for head and stem cole crops. Only 5 appl. per season. See supplemental label for restrictions and details.
Forum (dimethomorph)	40	6 oz	30 oz	0	Downy mildew	Not labeled for turnip or watercress. Only 5 appl. per season.
Revus (mandipropamid)	40	8 fl oz	32 fl oz	1	Downy mildew	Not labeled for turnip or watercress. Limit is no more than 2 sequential appl. or 4 total appl. See label for details.
Presidio (fluopicolide)	43	4 fl oz	12 fl oz	2	Downy mildew <i>Phytophthora</i> spp.	Not labeled for watercress. Limit is no more than 2 sequential appl. or 4 total appl. per season; Use only in a tank mix with another effective fungicide; 18 month plant back for off label crops. See label for details.
Cease Serenade ASO Serenade Max Rhapsody (<i>Bacillus subtilis</i> strain QST 713)	44	See label	See label	0	Xanthomonas leaf spot Alternaria leaf spot Downy mildew Powdery mildew	See label for details. OMRI listed.
Actigard 50 WG (acibenzolar-S-methyl)	P	1 oz	4 oz	7	Downy mildew Black rot (<i>Xanthomonas campestris</i> ; suppression only)	Apply preventively; limit is 4 appl/crop on a 7-day schedule. See label for details.
Regalia (Extract of <i>Reynoutria sachalinensis</i>)	P	See label	See label	0	See label	See label for details. OMRI listed.
Actinovate (<i>Streptomyces lydicus</i> WYEC 108)	NC	See label	See label	0	See label	See label for details. OMRI listed

Table 10. Continued.

Chemical (active ingredient)	Fungicide Code ¹	Max. Rate/ Acre /		Min. Days to Harvest	Diseases or Pathogens	Remarks ²
		Applic.	Season			
Armicarb 100 Kaligreen Milstop (potassium bicarbonate)	NC	See label	See label	0	Powdery mildew Downy mildew Alternaria leaf spot Botrytis Phoma blackleg and leafspot Anthracnose	See label for details.
PlantShield HC RootShield G (<i>Trichoderma harzianum</i> Rifai strain KRL-AG2)	NC	See label	See label	0	See label	See label for details. OMRI listed.
Oxidate (hydrogen peroxide)	NC	1:100 dilution	-	0	Alternaria leaf spot Downy mildew Powdery mildew	See label for details..
Sonata Taegro (<i>Bacillus</i> sp.)	NC	See label	See label	0	Xanthomonas leaf spot Alternaria leaf spot Downy mildew Powdery mildew	See label for details. OMRI listed.
Soilgard 12G (<i>Gliocladium virens</i> GI-21)	NC	See label	See label	0	See label	See label for details. OMRI listed
Trilogy (Neem oil)	NC	See label	See label	0	See label	See label for details. OMRI listed

¹ FRAC code (fungicide group): Numbers (1-44) and letters (M, NC, U, P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. M = Multi site inhibitors, fungicide resistance risk is low; NC = not classified, includes mineral oils, organic oils, potassium bicarbonate, and other materials of biological origin; U = Recent molecules with unknown mode of action; P = host plant defense inducers. Source: FRAC Code List 2009; <http://www.frac.info/> (FRAC = Fungicide Resistance Action Committee).

² Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

Table 11. Selected insecticides approved for use on insects attacking cole crops.

Trade Name (Common Name)	Rate (product/acre)	REI (Hours)	Days To Harvest	Insects	MOA Code ¹	Notes
Actara (thiamethoxam)	1.5-5.5 oz	12	0 -head & stem 7 - leafy	aphids, flea beetles, thrips, whiteflies	4A	Do not use if other 4A insecticide has been applied.
Admire Pro (imidacloprid) (see appropriate labels for other brands)	4.4-10.5 fl oz	12	21	aphids, leafhoppers, foliage-feeding thrips, whiteflies	4A	Do not apply more than 0.38 lb ai per acre per year.
Agree WG (<i>Bacillus thuringiensis</i> subspecies <i>aizawai</i>)	0.5-2.0 lb	4	0	lepidopteran larvae (caterpillar pests)	11	Apply when larvae are small for best control. Can be used in greenhouse. OMRI-listed ² .
*Ambush 25W³ (permethrin)	3.2-6.4 oz 3.2-12.8 oz – cabbage and Chinese cabbage only	12	1	cabbage aphid (suppression), cabbage looper, diamondback moth ³ , imported cabbageworm	3	Do not apply more than 51.2 oz/acre per season. Head and stem Brassica crops only.
*Ammo 2.5 EC³ (cypermethrin)	2.5-5.0 fl oz	12	1	armyworms, crickets, cutworms, corn earworm, loopers, <i>Lygus</i> bug, flea beetles, imported cabbage worm, leafhoppers, saltmarsh caterpillar, stink bugs, aids in control of aphids and whiteflies	3	Maximum of 30 oz of product/acre per season.
*Asana XL (0.66 EC)³ (esfenvalerate)	2.9-9.6 fl oz – head and stem Brassicas, 5.8- 9.6 oz –collards, 9.6 – mustard greens	12	3-head & stem 7-collards, mus- tard greens	beet armyworm (aids in control), cabbage looper, cutworms, flea beetles, grasshoppers, imported cabbageworm	3	Do not apply more than 0.4 lb ai/acre per season for head and stem Brassicas or 0.2 lb ai/acre per season for collards and mustard greens.
Assail 70WP Assail 30SG (acetamiprid)	0.8-1.7 oz 2.0-4.0 oz	12	7	aphids, thrips, whiteflies, suppression of diamondback moth	4A	Begin applications for whiteflies when first adults are noticed. Do not apply more than 5 times per season or apply more often than every 7 days.
Avaunt (indoxacarb)	2.5-3.5 oz	12	3	beet armyworm, cabbage looper, cabbage webworm, cross-striped cabbageworm, diamondback moth, imported cabbageworm	22	Do not apply more than 14 oz per acre per crop. Add a wetting agent to improve coverage. Do not use in greenhouse or in crops grown for transplant.
Aza-Direct (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	aphids, beetles, caterpillars, leafhoppers, leafminers, thrips, weevils, whiteflies	un	Antifeedant, repellent, insect growth regulator. OMRI-listed ² .
Azatin XL (azadirachtin)	5-21 fl oz	4	0	aphids, beetles, caterpillars, leafhoppers, leafminers, thrips, weevils, whiteflies	un	Antifeedant, repellent, insect growth regulator.
*Baythroid XL (beta-cyfluthrin)	0.8-3.2 fl oz	12	0	beet armyworm (1 st & 2 nd instar), cabbage looper, cabbage webworm, cutworms, diamondback moth larvae ³ , flea beetle, grasshoppers, imported cabbageworm, potato leafhopper, southern armyworm (1 st & 2 nd instar), stink bugs, thrips, yellowstriped armyworm	3	Maximum per crop season: 12.8 fl oz/A.
Belay 50 WDG (clothianidin)	1.6-2.1 oz	12	7	aphids, flea beetles, harlequin bug, leafhoppers, stink bugs, whiteflies (suppression)	4A	Do not apply more than 6.4 oz per acre per season. Do not use an adjuvant. Toxic to bees.

Table 11. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (Hours)	Days To Harvest	Insects	MOA Code ¹	Notes
Belay 50 WDG (clothianidin)	4.8 -6.4 oz (soil application)	12	Apply at planting	aphids, flea beetles, harlequin bug, leafhoppers, leafminers (suppression), thrips, whiteflies (suppression)	4A	Do not apply more than 6.4 oz per acre per season. See label for application instructions.
Beleaf 50 SG (flonicamid)	2.0-2.8 oz	12	0	aphids, plant bugs	9C	Do not apply more than 8.4 oz/acre per season. Begin applications before pests reach damaging levels.
Biobit HP (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5-2.0 lb	4	0	caterpillars (will not control large armyworms)	11	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed.
BotaniGard 22 WP, ES (<i>Beauveria bassiana</i>)	WP: 0.5-2 lb/100 gal ES: 0.5-2 qts/100 gal	4	0	aphids, thrips, whiteflies	--	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
*Brigade 2 EC³ (bifenthrin)	2.1-6.4 fl oz	12	7	aphids, armyworms, corn earworm, crickets, cucumber beetles, cutworms, diamondback moth, flea beetles, ground beetles, imported cabbageworm, leafhoppers, loopers, mites, saltmarsh caterpillar, stink bugs, thrips, tobacco budworm, whitefly	3	Do not apply more than 0.4 lb ai/acre for leafy or 0.5 lb ai/acre for head and stem.
Checkmate DBM-F (pheromone)	3.1-6.2 fl oz	0	0	diamondback moth	--	For mating disruption. Does not affect larvae and eggs already on plants.
Confirm 2F (tebufenozide)	6-8 fl oz	4	7	armyworms, cabbage looper, cabbage webworm, cross-striped cabbageworm, garden webworm, imported cabbageworm	18	If diamondback moth is also present another, or an additional, insecticide should be considered. Do not exceed 56 ounces of product per season.
Coragen (rynaxypyr)	3.5-5.0 fl oz	4	3	beet armyworm, cabbage looper, corn earworm, cross-striped cabbageworm, diamondback moth, Hawaiian beet webworm, imported cabbageworm	28	For best results, use an adjuvant when using as a foliar spray. Can be applied to soil at planting. See label for diamondback moth resistance management.
Courier 40SC (buprofezin)	9.0-13.6 fl oz	12	1	leafhoppers, planthoppers, whiteflies	16	Do not make more than 4 applications per year. Head and stem brassicas only.
Crymax WDG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5-2.0 lb	4	0	caterpillars	11	Use high rate for armyworms. Treat when larvae are young.
*Danitol³ (fenpropathrin)	10.67-16 fl oz	24	7	cabbage looper, imported cabbage-worm, yellowstriped armyworm	3	Do not apply more than 42.67 fl oz per acre per season. Head and stem brassicas only.
Deliver (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.25-1.5 lb	4	0	caterpillars	11	Use higher rates for armyworms. OMRI-listed ² .

Table 11. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (Hours)	Days To Harvest	Insects	MOA Code ¹	Notes
*Diazinon AG-500, *50 W (diazinon)	AG500 preplant: 1-4 qt 50W: 2-8 lb	96	preplant	cutworms, mole crickets, wire- worms	1B	See label for crops (broccoli, cabbage, cauliflower, collard, kale, mustard greens). See label for depth to incorporate.
*Dibrom 8 EC (naled)	1 pt	48	1	aphids, diamondback moth, imported cabbageworm	1B	Apply no more than 1 pt per acre in Florida. Do not apply more than 10 pt per acre per season. See label for crops - not for all brassicas.
Dimethoate 4 EC (dimethoate)	0.5-1 pt – broc- coli, cauliflower; 0.5 pt – kale, mustard greens	48	7 – broccoli, cauliflower, 14 – kale, mus- tard greens	aphids	1B	Highly toxic to bees. For broc- coli, cauliflower, kale, and mustard greens only.
*Dimilin 2L (diflubenzuron)	2-4 fl oz	12	7	grasshoppers	15	All Brassica crops. No more than 4 applications per season. May be applied only to turnip varieties that do not produce a harvestable root.
DiPel DF (<i>Bacillus thur- ingiensis</i> subspecies <i>kurstaki</i>)	0.5-2.0 lb	4	0	caterpillars	11	Treat when larvae are young. Good coverage is essential. OMRI-listed ² .
*Di-Syston 8 EC (disulfoton)	1.1-2.1 fl oz/1000 ft of row	48	42	aphids, flea beetles, root aphids	1B	Cabbage and tight-heading Chinese cabbage only - soil application.
Durivo (thiamethoxam, chlorantraniliprole)	10-13 fl oz	12	30	aphids, caterpillars, flea beetles, thrips, whiteflies	4A, 28	May be applied via one of sev- eral different soil applications methods.
Entrust (spinosad)	0.5-3 oz	4	1	armyworms, cabbage looper, diamondback moth, imported cab- bageworm, leafminers, thrips	5	See label for resistance man- agement. Do not apply more than 9 oz per acre per crop. OMRI-listed ² .
Esteem Ant Bait (pyriproxyfen)	1.5-2.0 lb	12	1	red imported fire ant	7C	Apply when ants are actively foraging.
Extinguish ((S)-methoprene)	1.0-1.5 lb	4	0	fire ants	7A	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
Fulfill (pymetrozine)	2.75 oz	12	7	cabbage aphid, green peach aphid, turnip aphid, whiteflies	9B	Apply when aphids and white- flies first appear. Provides suppression of whiteflies. Maximum of 2 applications per crop.
Intrepid 2F (methoxyfenozide)	4-16 fl oz, depending on pest	4	1	beet armyworm, cabbage looper, cabbageworm, cross-striped cab- bageworm, fall armyworm garden webworm, imported cabbageworm, southern armyworm, true army- worm, yellowstriped armyworm	18	Do not apply more than 64 oz per acre per season.

Table 11. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (Hours)	Days To Harvest	Insects	MOA Code ¹	Notes
Javelin WG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.12-1.50 lb	4	0	most caterpillars, but not <i>Spodoptera</i> species (armyworms)	11	Treat when larvae are young. Thorough coverage is essential. OMRI-listed ² . See label for crops (most cole crops).
Knack (pyriproxyfen)	8-10 fl oz	12	7	whiteflies (immatures)	7C	Limited to 2 applications per season.
Kryocide (cryolite)	8-16 lb	12	depends on crop 7-14	cabbage looper, cutworms, diamond back moth, flea beetles, imported cabbage worm, yellow-striped armyworm	un	Do not exceed 96 lb per acre per season. (broccoli, cabbage, cauliflower, collards, kohlrabi)
*Lannate LV; *SP (methomyl)	LV: 0.75-3.0 pt SP: 0.25-1 lb	48	Cabbage – 1, broccoli and cauliflower – 3, others –10	Beet armyworm, diamondback moth, fall armyworm, imported cabbageworm, loopers, variegated cutworm (pests vary by specific crop)	1A	Do not make more than 10 applications per crop (8 for collards, kale, mustard and turnip greens). For use on broccoli, cabbage, cauliflower, Chinese cabbage, fresh market collards, kale, mustard and turnip greens.
*Larvin 3.2 (thiodicarb)	16-40 fl oz	48	7	beet armyworm, cabbage looper, diamondback moth, flea beetles, imported cabbageworm	1A	Do not exceed more than 4.0 lb active ingredient per acre per season. (160 fl oz) For broccoli, cabbage, and cauliflower only.
Lorsban 50 W, 75WG, (chlorpyrifos)	50W: 2 lb 75WG: 0.67-1.33 lb	24 72 for cauliflower	21	armyworms, beet armyworm, cabbage aphid, cutworms, flea beetles, imported cabbageworm	1B	For use on broccoli, cabbage, cauliflower, collards, kale, kohlrabi. See label for specific crop directions.
Lorsban 15G, 75WG, Advanced	See labels for rates	24, 72 for cauliflower	21, except cauliflower (30)	root maggots. If preplant (Lorsban Advanced), also billbugs, cutworms, grubs, symphylans, wireworms	1B	Only one application per season. See label for restrictions and specific crop directions.
Malathion 8F (malathion)	1.5-2.5 pt	12	7, except broccoli (3)	aphids, cabbage looper, imported cabbageworm	1B	
Movento (spirotetramat)	4-5 fl oz	24	1	aphids, whiteflies	23	Limited to 10 oz/acre per season.
M-Pede 49% EC (soap, insecticidal)	1-2 % V/V	12	0	aphids, leafhoppers, mites, thrips, whiteflies	--	OMRI-listed ² .
*MSR Spray Concentrate (oxydemeton-methyl)	1.5-2 pt	7 days	7	aphids, thrips	1B	Broccoli, cabbage, cauliflower - See label for restrictions.
*Mustang (zeta-cypermethrin)	2.4-4.3 oz	12	1	aphids (some), armyworms, cabbage looper, cabbage webworm, corn earworm, crickets, cucumber beetles, cutworm, flea beetles, grasshoppers, imported cabbageworm, leafhoppers, saltmarsh caterpillar, southern cabbageworm, stink bugs, aids in control of whiteflies	3	Do not make applications less than 7 days apart. Diamondback moth populations in Florida have been found to be resistant to pyrethroids.
Neemix 4.5 (azadirachtin)	4-16 fl oz	12	0	aphids, armyworms, cabbage looper, caterpillars, cutworms, diamondback moth, dipterous leafminers, leafminers, imported cabbageworm, thrips, whiteflies	un	IGR and feeding repellent. Greenhouse and field. OMRI-listed ² .

Table 11. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (Hours)	Days To Harvest	Insects	MOA Code ¹	Notes
Oberon 2 SC (spiromesifen)	7.0-8.5 fl oz	12	7	whiteflies	23	Maximum amount per crop: 25.5 fl oz/acre. No more than 3 applications.
Platinum Platinum 75SG (thiamethoxam)	5.0-11 fl oz 1.66-3.67 oz	12	30	aphids, flea beetles, thrips, whiteflies	4A	Soil application.
*Pounce 25 WP³ (permethrin)	See label for crop-specific rates.	12	1	armyworms, cabbage looper, diamondback moth, imported cabbageworm, plant bugs, thrips	3	Broccoli, cabbage, cauliflower, Chinese broccoli, collards, turnips.
*Proaxis Insecticide³ (gamma-cyhalothrin)	1.92-3.84 fl oz	24	1	aphids ⁽²⁾ , armyworm, beet armyworm ⁽¹⁾ , cabbage looper, cabbage webworm, corn earworm, cutworms, diamondback moth, fall armyworm ⁽¹⁾ , flea beetles, grasshoppers, imported cabbageworm, leafhoppers, southern cabbageworm, spider mites ⁽²⁾ , stink bugs, thrips ⁽²⁾ , vegetable weevil (adult), whiteflies ⁽²⁾ , yellowstriped armyworm	3	(¹) First and second instars only. (²) Suppression only. Do not apply more than 1.92 pints per acre per season. Head and stem brassicas only.
*Proclaim (emamectin benzoate)	2.4-4.8 oz	12	7 - head & stem 14 - leafy	beet armyworm, cabbage webworm, corn earworm, cross-striped cabbageworm, diamondback moth, fall armyworm, imported cabbageworm, loopers, suppression of leafminers	6	Do not make more than 2 sequential applications without rotating to another product with a different mode of action. Do not apply by aircraft. Not for turnips grown for roots.
Provado 1.6F (imidacloprid)	3.8 oz	12	7	aphids, whiteflies	4A	Do not apply more than 0.5 lb ai per year.
Pyganic 5.0 (pyrethrins)	4.5-18 oz	12	0	insects	3	Harmful to bees. Can be used in greenhouses. OMRI-listed. ²
Pyrellin EC³ (pyrethrins + rotenone)	1-2 pt	12	12 hours	aphids, dipterous leafminers, flea beetles, leafhoppers, leafminers, loopers, Lygus bug, mites, plant bugs, thrips, whiteflies	3, 21B	Harmful to foraging bees.
Radiant SC (spinetoram)	5-10 fl oz	4	1	armyworms, cabbage looper, diamondback moth, imported cabbageworm, <i>Liriomyza</i> leafminers, thrips	5	Do not apply to seedlings grown for transplant.
Requiem 25EC (extract of <i>Chenopodium ambrosioides</i>)	2-4 qt (no more than 2% v/v)	4	0	green peach aphid, turnip aphid, whiteflies	un	
Rimon 0.83 EC (novaluron)	6-12 fl oz	12	7	armyworms, cabbage looper, cabbage webworm, corn earworm, cucumber beetles, diamondback moth, imported cabbageworm, lepidopteran and dipteran leafminers, stink bugs, vegetable weevil, suppression of: thrips, whiteflies	15	No more than 3 applications or 24 fl oz per acre per season. Head and stem Brassica only.
Saf-T-Side, others (Oil, insecticidal)	1-2 gal/100 gal	4	up to day of harvest	aphids, leafhoppers, mites, plant bugs, thrips, whiteflies	--	OMRI-listed ² .
Sevin 80S; XLR, 4F (carbaryl)	80S: 0.63-2.5 lb XLR, 4F: 0.5-2 qts	12	3 or 14, depending on specific crop	armyworms, corn earworm, diamondback moth, flea beetles, harlequin bug, imported cabbage worm, leafhoppers	1A	Up to 4 applications, at least 7 days apart. See label for specific crops.

Table 11. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (Hours)	Days To Harvest	Insects	MOA Code ¹	Notes
SpinTor 2 SC (spinosad)	3-10 fl oz	4	1	armyworms, cabbage looper, diamondback moth, imported cabbageworm, leafminers, thrips	5	Do not apply to cole crops grown within a greenhouse or screenhouse for transplant. Do not make more than 2 consecutive applications.
Synapse (flubendiamide)	2 oz	12	1	armyworms, diamondback moth, imported cabbageworm, loopers	28	Do not apply more than 4 oz/acre per season.
*Telone C-35 (dichloropropene + chloropicrin)	See label	5 days - See label	preplant	symphylans, wireworms	--	See supplemental label for use restrictions for south and central Florida.
*Telone II (dichloropropene)						
*Thionex 3EC (endosulfan)	1-1.33 qt	96	broccoli and cabbage – 7, cauliflower - 14	armyworms, cabbage aphid, cabbage looper, cross-striped cabbageworm, cutworms, diamondback moth, flea beetles, harlequin bug, imported cabbageworm, leafhoppers, stink bugs, whiteflies	2	Do not make more than 2 applications per season or exceed 2.0 lb ai/acre per season. For broccoli, cabbage, cauliflower.
No product label available online in 2010.						
*Thionex 3EC (endosulfan)	1-1.33 qt, except kale (1 qt)	48	21	armyworms, aphids, cabbage looper, diamondback moth, flea beetles, harlequin bug, imported cabbageworm, whitefly	2	Do not make more than one application per season or apply more than 1.0 lb ai/acre per season (0.75 lb for kale). For collards, mustard greens, kale.
No product label available online in 2010.						
Trigard (cyromazine)	2.66 oz	12	7	leafminers	17	Limited to 6 applications.
Trilogy (extract of neem oil)	0.5-2% V/V	4	0	aphids, mites, suppression of thrips and whiteflies	un	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed ² .
Venom Insecticide (dinotefuran)	foliar: 1-4 oz soil: 5-6 oz	12	foliar - 1 soil - 21	cabbage aphid, green peach aphid, leafminer, whiteflies	4A	Use one application method, not both (soil or foliar). Foliar: Do not apply more than 0.268 lb ai per acre per season. Soil: Do not apply more than 0.536 lb ai per acre per season.
Venom 20 SG	foliar: 0.44-0.895 lb soil: 1.13-1.34 lb					For head and stem brassicas only.
Voliam Flexi (thiamethoxam and chlorantraniliprole)	4-7 oz	12	head and stem – 3, leafy Brassica greens - 7	aphids, beet armyworm, cabbage looper, cabbage webworm, corn earworm, diamondback moth, fall armyworm, flea beetles, imported cabbageworm, thrips, whitefly, yellowstriped armyworm	4A, 28	Highly toxic to bees exposed to direct treatment or residues on blooming crops.
*Warrior II³ (lambda-cyhalothrin)	0.96-1.92 fl oz	24	1	aphids ⁽¹⁾ , beet armyworm ⁽²⁾ , cabbage looper, cabbage webworm ⁽¹⁾ , corn earworm, cutworms, diamondback moth, fall armyworm ⁽²⁾ , flea beetles, grasshoppers, imported cabbageworm, leafhoppers, mites ⁽¹⁾ , plant bugs, stink bugs, thrips, whiteflies ⁽¹⁾ , yellowstriped armyworm	3	Do not apply more than 0.24 lb ai/acre per season. ⁽¹⁾ suppression only ⁽²⁾ 1 st and 2 nd instar only
						For head and stem Brassicas only.

Table 11. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (Hours)	Days To Harvest	Insects	MOA Code ¹	Notes
Xentari DF (<i>Bacillus thuringiensis</i> subspecies <i>aizawai</i>)	0.5-2.0 lb	4	0	caterpillars	11	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.

The pesticide information presented in this table was current with federal and state regulations at the time of revision. The user is responsible for determining the intended use is consistent with the label of the product being used. Use pesticides safely. Read and follow label instructions.

¹Mode of Action codes for vegetable pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 6.1 August 2008.

- 1A. Acetyl cholinesterase inhibitors, Carbamates (nerve action)
- 1B. Acetyl cholinesterase inhibitors, Organophosphates (nerve action)
- 2A. GABA-gated chloride channel antagonists (nerve action)
- 3. Sodium channel modulators (nerve action)
- 4A. Nicotinic acetylcholine receptor agonists (nerve action)
- 5. Nicotinic acetylcholine receptor allosteric activators (nerve action)
- 6. Chloride channel activators (nerve and muscle action)
- 7A. Juvenile hormone mimics (growth regulation)
- 7C. Juvenile hormone mimics (growth regulation)
- 9B and 9C. Selective homopteran feeding blockers
- 10. Mite growth inhibitors (growth regulation)
- 11. Microbial disruptors of insect midgut membranes
- 12B. Inhibitors of mitochondrial ATP synthase (energy metabolism)
- 15. Inhibitors of chitin biosynthesis, type 0, lepidopteran (growth regulation)
- 16. Inhibitors of chitin biosynthesis, type 1, homopteran (growth regulation)
- 17. Molting disruptor, dipteran (growth regulation)
- 18. Ecdysone receptor agonists (growth regulation)
- 22. Voltage-dependent sodium channel blockers (nerve action)
- 23. Inhibitors of acetyl Co-A carboxylase (lipid synthesis, growth regulation)
- 28. Ryanodine receptor modulators (nerve and muscle action)
- un. Compounds of unknown or uncertain mode of action

² OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production.

³ Diamondback moth in Florida has been found to be resistant to pyrethroids.

* Restricted Use Only.

Table 12. Selected insecticides approved for use on insects attacking turnips.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code ¹	Notes
Actara (thiamethoxam)	1.5-4.0 oz	12	7	aphids, flea beetles, leafhoppers, whiteflies	4A	Use higher rate for whiteflies. For turnips grown for roots. Do not exceed 8 oz/acre per season.
Admire Pro (imidacloprid)	4.4-10.5 fl oz	12	21	aphids, flea beetles, leafhoppers, thrips, whiteflies		One application, no more than 10.5 oz/acre.
Agree WG (<i>Bacillus thuringiensis</i> subspecies <i>aizawai</i>)	0.5-2.0 lb	4	0	lepidopteran larvae (caterpillar pests)	11	Apply when larvae are small for best control.
*Ambush 25W² (permethrin)	3.2-6.4 oz	12	1	cabbage aphid (suppression), cabbage looper, diamondback moth (larvae), imported cabbageworm	3	Do not exceed 4 applications. For turnips grown for roots.
*Asana XL (0.66 EC) (esfenvalerate)	5.8-9.6 fl oz	12	7	armyworm, flea beetles, imported cabbageworm	3	Do not apply more than 0.4 lb ai per acre per season.
Aza-Direct (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	aphids, beetles, caterpillars, leafhoppers, leafminers, mites, stink bugs, thrips, weevils, whiteflies	un	Antifeedant, repellent, insect growth regulator. OMRI-listed ³ .
Azatin XL (azadirachtin)	5-21 fl oz	4	0	aphids, beetles, caterpillars, leafhoppers, leafminers, thrips, weevils, whiteflies	un	Antifeedant, repellent, insect growth regulator.
*Baythroid XL² (beta-cyfluthrin)	0.8-3.2 fl oz	12	0	beet armyworm (1 st & 2 nd instar), cabbage looper, cabbage webworm, cutworms, diamondback moth larvae, fall armyworm (1 st & 2 nd instar), grasshoppers, imported cabbageworm, southern armyworm (1 st & 2 nd instar), thrips, yellowstriped armyworm	3	Maximum amount per season - 12.8 fl oz/A. Note: For turnip greens only, not roots.
Biobit HP (<i>Bacillus thuringiensis</i> sub-species <i>kurstaki</i>)	0.5-2.0 lb	4	0	caterpillars (will not control large armyworms)	11	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed ³ .
BotaniGard 22 WP, ES (<i>Beauveria bassiana</i>)	WP: 0.5-2 lb/100 gal ES: 0.5-2 qt/100 gal	4	0	aphids, thrips, whiteflies	--	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
Checkmate DBM-F (pheromone)	3.1-6.2 fl oz	0	0	diamondback moth	--	For mating disruption. Does not affect eggs and larvae already on plants.
Confirm 2F (tebufenozide)	6-8 fl oz	4	7	armyworms, cabbage looper, cabbage webworm, cross-striped cabbageworm, garden webworm, imported cabbageworm	18	If diamondback moth is also present another, or an additional, insecticide should be considered. Do not exceed 56 ounces of product per acre per season.

Table 12. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code ¹	Notes
Crymax WDG (<i>Bacillus thuringiensis</i> sub- species <i>kurstaki</i>)	0.5-2.0 lb	4	0	caterpillars	11	Use high rate for armyworms. Treat when larvae are young.
Deliver (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.25-1.5 lb	4	0	caterpillars	11	Use higher rates for armyworms. OMRI-listed ³ .
Dimethoate 4EC (dimethoate)	4EC: 0.5 pt	48	14 - greens & roots	aphids, leafhoppers, leaf- miners	1B	Highly toxic to bees.
Dimilin 2L (diflubenzuron)	2-4 oz	12	7	grasshoppers	15	Dimilan is an insect growth regu- lator – insects must ingest and molt before effects are seen. Apply when grasshoppers are in the 2 nd to 3 rd nymphal stage. Turnip greens only.
DiPel DF (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5-2.0 lb	4	1	caterpillars	11	Treat when larvae are young. Good coverage is essential. OMRI- listed ³ .
Entrust (spinosad)	0.5-3.0 oz (greens) 1.0-2.0 oz (roots)	4	1 - greens 3 - roots	armyworms, cabbage looper, diamondback moth, imported cabbageworm, leafminers, thrips	5	Do not apply to cole crops grown within a greenhouse or screenhouse for transplant. OMRI- listed ³ .
Extinguish (S)-methoprene)	1.0-1.5 lb	4	0	fire ants	7A	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and elimi- nated after 8 to 10 weeks. May be applied by ground equipment or aerially.
Fulfill (pymetrozine)	2.75 oz	12	7	cabbage aphid, green peach aphid, turnip aphid, whiteflies	9B	Apply when aphids and whiteflies first appear. Provides suppression of whiteflies. Maximum of 2 appli- cations per crop. Greens only.
Intrepid 2F (methoxyfenozide)	4-8 fl oz if grown for greens 6-16 fl oz if grown for roots	4	1 - greens 14 - roots	beet armyworm, cabbage looper, cabbageworm, cross-striped cabbage- worm, fall armyworm garden webworm, imported cabbageworm, southern armyworm, true armyworm, yellowstriped armyworm	18	Do not apply more than 64 oz per acre per season.
Javelin WG (<i>Bacillus thuringiensis</i> sub- species <i>kurstaki</i>)	0.12-1.50 lb	4	0	most caterpillars, but not <i>Spodoptera</i> species (army- worms)	11	Roots only. Treat when larvae are young. Thorough coverage is essential. OMRI-listed ³ .
*Lannate LV, *SP (meth- omyl)	LV: 1.5-3.0 pt SP: 0.5-1.0 lb	48	10	beet armyworm, cabbage looper, cabbageworm, dia- mondback moth (larvae), imported cabbageworm	1A	Greens only.
Lepinox WDG (<i>Bacillus thuringiensis</i> sub- species <i>kurstaki</i>)	1.0-2.0 lb	12	0	for most caterpillars, including beet armyworm (see label)	11	Treat when larvae are small. Thorough coverage is essential.

Table 12. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code ¹	Notes
Lorsban 15 G, 75G (chlorpyrifos)	See labels for rates	24	at planting	root maggots	1B	One application per season.
M-Pede 49% EC (Soap, insecticidal)	1-2% V/V	12	0	aphids, leafhoppers, mites, plant bugs, thrips, whiteflies	--	OMRI-listed ² .
Neemix 4.5 EC (azadirachtin)	4-16 fl oz	12	0	aphids, armyworms, cabbage looper, cutworms, diamondback moth (larvae), imported cabbageworm, leafminers, thrips, whiteflies	un	IGR and feeding repellent. Greenhouse and field use. OMRI-listed ³ .
Platinum 75SG (thiamethoxam)	5-12 fl oz 1.7-4.01 oz	12	at planting	aphids, flea beetles, leafhoppers, whiteflies	4A	Do not exceed a total of 12 fl oz per acre per season or 4.01 oz (75SG).
*Pounce 25 WP (permethrin)	3.2-9.6 oz	12	1	aphids (suppression), armyworms, beet armyworm, cabbage looper, corn earworm, cutworms, diamondback moth (larvae), fall armyworm, imported cabbageworm, leafhoppers, leafminers, southern armyworm, southern white butterfly	3	Roots only. Do not apply more than 0.45 lb ai/acre per season.
*Proclaim (emamectin benzoate)	2.4-4.8 oz	12	14	beet armyworm, cabbage webworm, corn earworm, cross-striped cabbageworm, diamondback moth, fall armyworm, imported cabbageworm, cabbage looper, suppression of <i>Liriomyza</i> leafminers	6	Greens only.
Provado 1.6F (imidacloprid)	3.5 oz	12	7	aphids, flea beetles, whiteflies	4A	Do not use in conjunction with Admire. Maximum of 10.5 fl oz. per acre per season.
Pyrellin EC (pyrethrin + rotenone)	1-2 pt	12	12 hours	aphids, leafhoppers, leafminers, loopers, mites, plant bugs, thrips	3	
Radiant (spinetoram)	6-8 - roots 5-10 - tops	4	3	armyworms, diamondback moth, imported cabbageworm, <i>Liriomyza</i> leafminers, loopers, thrips	5	See label.
SpinTor 2 SC (spinosad)	3-6 fl oz	4	1 - tops 3 - roots	armyworms, cabbage looper, diamondback moth, imported cabbageworm, leafminers, thrips	5	Do not apply to cole crops grown within a greenhouse or screenhouse for transplant.
Sulfur 80% W, others	See label	24		mites	--	
*Telone C-35 (dichloropropene + chloropicrin)	See label	5 days - See label	preplant	symphylans, wireworms	--	See supplemental label for use restrictions in south and central Florida.

Table 12. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code ¹	Notes
*Telone II (dichloropropene)						
Trigard (cyromazine)	2.66 oz	12	7	leafminers	17	Limited to 6 applications. Turnip greens only.
Trilogy (extract of neem oil)	0.5-2.0% V/V	4	0	aphids, mites, suppression of thrips and whiteflies	un	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed ³ .
Xentari DF (<i>Bacillus thuringiensis</i> sub-species <i>aizawai</i>)	0.5-2.0 lb	4	0	caterpillars	11	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.

The pesticide information presented in this table was current with federal and state regulations at the time of revision. The user is responsible for determining the intended use is consistent with the label of the product being used. Use pesticides safely. Read and follow label instructions.

¹ Mode of Action codes for vegetable pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 6.1 August 2008.

- 1A. Acetylcholinesterase inhibitors, Carbamates (nerve action)
- 1B. Acetylcholinesterase inhibitors, Organophosphates (nerve action)
- 2A. GABA-gated chloride channel antagonists (nerve action)
- 3. Sodium channel modulators (nerve action)
- 4A. Nicotinic acetylcholine receptor agonists (nerve action)
- 5. Nicotinic acetylcholine receptor allosteric activators (nerve action)
- 6. Chloride channel activators (nerve and muscle action)
- 7A. Juvenile hormone mimics (growth regulation)
- 7C. Juvenile hormone mimics (growth regulation)
- 9B and 9C. Selective homopteran feeding blockers
- 10. Mite growth inhibitors (growth regulation)
- 11. Microbial disruptors of insect midgut membranes
- 12B. Inhibitors of mitochondrial ATP synthase (energy metabolism)
- 15. Inhibitors of chitin biosynthesis, type 0, lepidopteran (growth regulation)
- 16. Inhibitors of chitin biosynthesis, type 1, homopteran (growth regulation)
- 17. Molting disruptor, dipteran (growth regulation)
- 18. Ecdysone receptor agonists (growth regulation)
- 22. Voltage-dependent sodium channel blockers (nerve action)
- 23. Inhibitors of acetyl Co-A carboxylase (lipid synthesis, growth regulation)
- 28. Ryanodine receptor modulators (nerve and muscle action)
- un. Compounds of unknown or uncertain mode of action

² Avoid pyrethroids if diamondback moth is a problem. Larvae have been shown to be resistant.

³ OMRI listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted Use Only.**

Table 13. Breakeven production costs for cabbage at various yield levels in the Hastings, FL area, 2008-2009.

	Cost per acre	Yield (50 lb units/acre)				
		660	680	700	720	740
Variable Costs	\$1,794.37	\$2.72	\$2.64	\$2.56	\$2.49	\$2.42
Fixed Costs	\$690.52	\$1.05	\$1.02	\$0.99	\$0.96	\$0.93
Harvest Cost/unit		\$3.70	\$3.70	\$3.70	\$3.70	\$3.70
Total Cost/unit		\$7.46	\$7.35	\$7.25	\$7.15	\$7.06