UF UNIVERSITY of FLORIDA
IFAS Extension
2009-2010

Chapter 9.
Cucurbit Production in Florida

S.M. Olson, E.H. Simonne, W.M. Stall, A.J. Gevens, S.E. Webb, T.G. Taylor, S.A. Smith, J.H. Freeman

BOTANY

Nomenclature

Family - Cucurbitaceae
Cucumber - *Cucumis sativus*
Cantaloupe- *Cucumis melo*
Summer squash - *Cucurbita pepo*
Pumpkin (jack-o-lantern is *C. pepo*; some processing pumpkins are *C. maxima* and *C. moschata*)
Butternut squash - *Cucurbita moschata*
Tropical pumpkin (Calabaza) - *Cucurbita moschata*
Winter squash - *Cucurbita maxima* e.g. hubbard, buttercup, and Turk's Turban
Watermelon - *Citrullus lanatus*

Origin

Cucurbits originated in several different locations: cucumber (India); cantaloupe (Africa); summer squash (Mexico, Central America); butternut squash (Mexico, Central America); winter squash (South America); and watermelon (Central Africa).

Related Species

Several Oriental and specialty vegetables, including Chinese winter melon, calabash gourd, luffa gourd, bitter melon, and chayote are also included in the Cucurbitaceae family.

VARIETIES

Variety selection, often made several months before planting, is one of the most important management decisions made by the grower. Failure to select the most suitable variety or varieties may lead to loss of yield or market acceptability.

The following characteristics should be considered in selection of vine crop varieties for use in Florida:

Yield: The variety selected should produce crops equivalent to the best varieties available. In recent years, the average harvested yields per acre of vine crops in Florida have been: fresh market cucumber - 525 bu, processing cucumbers - 10 tons, cantaloupe -200 cwt, pumpkins - experimental yields average about 200 cwt, summer squash - 300 bu, Tropical pumpkin (calabaza) 500 cwt, and watermelon - 250 cwt. In most instances, however, harvested yield is usually much less than potential yield because of market constraints.

Disease Resistance: Varieties that combine disease resistance with other desirable horticultural characteristics should be selected when possible. Most modern cucumber varieties are resistant or tolerant to angular leaf spot, anthracnose, downy mildew, powdery mildew, cucumber mosaic virus, and scab. Some cantaloupe varieties have tolerance to downy and powdery mildew, and fruit should be resistant to fruit rots. Unfortunately, disease tolerance is limited in squash and pumpkin varieties at the present time. However, summer squash varieties resistant to a number of diseases, including viruses, are available to growers in limited numbers. Watermelon varieties selected for use in Florida should have resistance to anthracnose-race 1 and fusarium wilt. There is considerable variation among varieties in the degree of fusarium resistance; select varieties with high wilt resistance that have qualities compatible with other requirements.

Horticultural Quality: Slicing cucumber fruit should be smooth and uniformly dark green, have an appropriate length:diameter ratio, have small seeds that are slow to develop, and have a desirable flavor. Pickling cucumber fruit should be firm, medium to dark green in color, have a small seed cavity, an L/D ratio of about 3 at $1\frac{1}{4}$ in. diameter, and good brining qualities if it is to be brined. Gynoecious plants are preferred. Western-type cantaloupes should be sutureless (smooth) or nearly so, round to slightly oval, fully netted, and about 3 lb average weight with a thick deep-salmon interior, and should have a small tight seed cavity, high soluble solids (11% is required for the U.S. Fancy grade), and a pleasant aroma and taste. Eastern-type cantaloupes are sutured and have soft flesh. Desirable traits in pumpkin varieties include a deep orange rind that colors early, smooth fruit, a stem that is proportional to the fruit size and adheres tightly to the fruit, and freedom from fruit rots. Summer squash fruit should have color appropriate to the market requirements, retain their gloss as they mature, and be slow to develop seed. Winter squash fruit should be attractively colored; have a smooth, hard rind; deep orange flesh; be resistant to storage rot; and have an appropriate storage life. Watermelon fruit size and shape; rind color, thickness, and toughness; seed size, number, and color; and flesh color, texture, and soluble solids (10%

is required for designation as very good internal quality) are all important characteristics to be considered in selection of watermelon varieties. Ability to germinate in cold soils and general plant vigor may be important in certain situations.

Adaptability: Vine crops are well adapted to production in Florida for spring, early summer, and fall markets and to the winter market in the very warmest growing areas. Successful varieties must perform well under the range of environmental conditions encountered in these seasons and in various locations in Florida.

Market Acceptability: For all vine crops, growers must be aware of the needs of the particular market they intend to supply, and grow varieties that produce crops that satisfy that market.

VINE CROP VARIETIES FOR FLORIDA

Cucumber (Fig. 9-1)

Pickling:
- Calypso (H)[1] (GY)[2]
- Excel (H) (GY)
- Eureka (H) (MO)
- FMX 5020 (H)
- Jackson Classic (H) (GY)
- Napoleon Classic (H) (MO)
- Royal (H) (GY)
- Transamerica (H)

Slicing:
- Cobra (H) (GY)
- Dasher II (H) (GY)
- Daytona (H) (GY)
- General Lee (H) (GY)
- Indy (H) (GY)
- Lightning (H) (GY)
- Panther (H) (GY)
- Prancer (H) (GY)
- Speedway (H) (GY)
- Thunder(H) (GY)

[1](H=hybrid)
[2](Flower Habit - GY=gynoecious,MO=monoecious)

Cantaloupe (Fig. 9-2)

- Athena (H)
- Eclipse (H)
- Odyssey (H)
- Vienna (H)

[1](H=hybrid)

Halloween Pumpkin

Miniature:< 1 lb
- Jack-Be-Little
- Jack-Be-Quick
- Munchkin
- Wee-Be-Little (PVP)[1]

Small: 1-5 lb
- Baby Pam
- Little Lantern
- Trickster (H)[2]

Medium: 5-10 lb
- Autumn Gold (H)
- Jack of All Trades (H)
- Magician (H)
- Magic Lantern (H)
- Merlin (H)
- October (H)
- Wizard (H)

Large: 10-20 lb
- Big Autumn (H)
- Connecticut Field
- Gold Medal (H)
- ProGold 510 (H)

Giant: 25-80 lb
- Prizewinner (H)

[1](PVP=Plant Variety Protection)
[2](H=hybrid)

Squash

Summer (yellow):
- Dixie (H)[1] (CN)[2]
- Enterprise (H) (SN)[2]
- Gentry (H) (CN)
- Goldbar (H) (SN)
- Lemondrop L (H) (SN)
- Medalion (H) (CN)
- Prelude (H) (CN)
- Prelude II (H) (CN)
- Sunbrite (H) (CN)
- Sunglo (H) (CN)
- Suwannee (H) (CN)

Summer (zucchini):
- Cash Flow (H)
- Dividend (H)
- Envy (H)
- Green Eclipse (H)
- Payroll (H)
- Senator (H)
- Seneca Zucchini (H)
- Spineless Beauty (H)
- Springtime 843 (H)

Acorn (Fig. 27-3):
- Mesa Queen (H)
- Table Ace (H)
- TayBelle PM (H)

Squash continued

Butternut (Fig. 9-4):
- Ultra (H)
- Waltham
- Zenith (H)

[1](H=hybrid)
[2] (Type - CN=crookneck, SN=straightneck)

Tropical Pumpkin (Calabaza)
- Agriset 9001 - vining type
- El Dorado (H) - compact plant
- La Estrella (H) - compact plant

Watermelon

Diploid:
- Celebration (H)[1]
- Fiesta (H)
- Gold Strike (H) (orange flesh)
- Jamboree (H)
- Mardi Gras (H)
- Regency (H)
- Royal Star (H)
- Royal Sweet (H)
- Sangria (H)
- Sentinel (H)
- Summer Flavor 790 (H)
- Summer Flavor 800 (H)
- Summer Flavor 900 (H)

Triploid (Seedless, Large):
- Dillion (H) for trial
- Freedom (H)

Watermelon continued

Triploid (Seedless, Large) continued:
- Genesis (H)
- Gypsy (H)
- Millionaire (H)
- Olympia (H)
- Revolution (H)
- Ruby Premium (H)
- SugarHeart (H)
- Sugar Shack (H)
- Sugar Time (H)
- Super Crisp (H)
- SummerSweet 5244 (H)
- SummerSweet 5544 (H)
- Super Seedless 7177 (H)
- Sweet Delight (H)
- Tri-X-212 (H)
- Tri-X-313 (H)
- Tri-X-Carousel (H)
- Tri-X-Palomar (H)
- Triton (H) (yellow flesh)

Triploid (Seedless, Mini):
- Extazy (H)
- Mohican (H)
- Petite Treat (H)
- Solitare (H)
- Valdoria (H)
- Vanessa (H)
- Wonder (H)

[1](H=hybrid)

Table 1. Seeding and planting information for cucurbits.

Planting dates	Cucumber	Cantaloupe	Pumpkin[1]	Squash[2]		Watermelon
North Florida	Feb - Apr; July - Aug	Feb 15 - Apr 15	Early July	Feb - Apr; Aug - Sept 15		Feb 15 - Apr 15
Central Florida	Jan - Mar; Sept	Jan 15 - Mar 15	Mid July	Jan - Apr; Aug - Sept		Jan 15 - Mar 15
South Florida	Sept - Feb	Dec 15 - Mar 1	Early August	Aug - Mar		Dec 15 - Mar 1
Seeding information				**Bush**	**Vining**	
Distance between rows[3] (in)	48 - 60	60 - 72	60 - 108	36 - 48	60 - 108	60 - 108
Distance between plants (in)	6 - 12	24 - 36	36 - 60	12 - 24	36 - 60	24 - 72
Seeding depth (in)	0.5 - 0.75	0.5 - 1.0	1.5 - 2.0	1.0 - 1.5	1.5 - 2.0	1.5 - 2.0
Seed per acre (lb)	2 - 4	1 - 2	4 - 5	2 - 3	1 - 1.5	1 - 3
Days to maturity from seed	40 - 65	85 - 110	80 - 100	40 - 50	85 - 120	80 - 100
Days to maturity from transplant	Not recommended	70 - 90	70 - 90	Not recommended	Not recommended	60 - 90
Plant populations[4] (acre)	21,780	4,356	2,904	14,520	2,904	4,356

[1] For Halloween market, for tropical pumpkin follow planting dates for squash.

[2] For vining types in fall, plant during July same as pumpkins

[3] Cucumber and squash can be grown in two rows per bed (especially mulch culture) with 12 to 18 inches between rows on the bed (Fig. 9-5).

[4] Populations based on closest between and within row spacing.

SEEDING AND PLANTING

Planting dates and seeding information for cucurbits are given in Table 1.

TRIPLOID WATERMELON PRODUCTION

Fruit of diploid watermelon varieties may contain as many as 1,000 seeds in each fruit. The presence of seeds throughout the flesh makes the removal of seeds while eating difficult. The seeds in slices or chunks of watermelon sold in retail stores or salad bars are a nuisance. One reason that seedless grapes are more popular with consumers than seeded varieties is that the consumer does not have to be concerned with and inconvenienced by the seeds while the fruit is being eaten. With proper care, seedless watermelons have a longer shelf life than seeded melons. This may be due to the fact that flesh break down occurs in the vicinity of seeds, which are absent, in seedless melons.

Hybrid triploid (seedless) watermelons have been grown for over 40 years in the United States. However, it was not until recently that improved varieties, aggressive marketing, and increased consumer demand created a rapidly expanding market for triploid watermelons. The seedless condition is actually sterility resulting from a cross between two plants of incompatible chromosome complements. The normal chromosome number in most living organisms is referred to as 2N. Triploid watermelons are produced on highly sterile triploid (3N) plants which result from crossing a normal diploid (2N) plant with a tetraploid (4N). The tetraploid is used as the female or seed parent and the diploid is the male or pollen parent (Diagram 1). Since the tetraploid seed parent produces only 5 to 10% as many seeds as a normal diploid plant, seed cost is considerably more than that of diploid, open-pollinated varieties and higher than diploid watermelon varieties. Tetraploid lines are usually developed by treating diploid plants with a chemical called colchicine.

Tetraploid parental lines normally have a light, medium, or dark green rind without stripes. By contrast, the diploid pollen parent almost always has a fruit with a striped rind. The resulting hybrid triploid melon will inherit a striped pattern. Growers may occasionally find a non-striped fruit in fields of striped triploid watermelons. These are the result of accidental self pollinations of the tetraploid seed parent during triploid seed production. Tetraploid fruit are of high quality but will have seeds and must not be sold as seedless. The amount of tetraploid contamination is dependent upon methods and care employed in triploid seed production.

Sterile triploid plants normally do not produce viable seed. However, small, white rudimentary seeds or seedcoats, which are eaten along with the fruit as in cucumber,

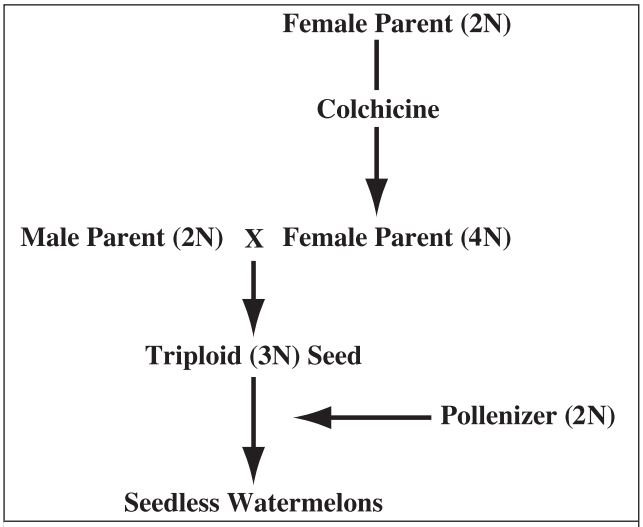

Diagram 1. *Steps involved in triploid watermelon seed production. To produce seed, a diploid (2N) female parent plant is treated with colchicine to produce the solid-colored female tetraploid (4N) parent; this is crossed with a striped male parent (2N) which results in triploid (triploid) watermelon seed (3N). To produce a crop of triploid watermelons, the 3N seed is interplanted with a 2N pollenizer variety.*

develop within the fruit. The number and size of these rudimentary seeds vary with variety. An occasional dark, hard, viable seed is found in triploid melons.

Triploid watermelons can be grown successfully in areas where conventional seeded varieties are produced. However, they require some very unique cultural practices for successful production.

Stand Establishment

Containerized production of triploid watermelon transplants is essential because of the special conditions required for seed germination, emergence, and early plant development not found in open-field situations. Furthermore, the extra cost of seedling production is justified because triploid watermelon seeds costs are about six times greater than those of diploid hybrid seeds and 60 times greater than open-pollinated diploid watermelon seeds. One seed per cell should be planted 1 inch deep with the radicle (pointed end) up to reduce seedcoat adherence to the cotyledons. Transplants have been successfully produced with peat pellets or in trays containing sterile media with 1 to 2 inch cell size. The tray is watered lightly to bring the seed and mix in contact. Stacked trays are placed in a germination chamber 85-90˚F for two days or until radicles are visible in the cell drainage holes. The trays are then arranged in a greenhouse with day temperature 70-80˚F and night temperature 65-70˚F where temperature control can be achieved. Plants are fertilized every three days with a solution containing 50 ppm N from $Ca(NO_3)_2$ and KNO_3 from cotyledon expansion until the first true leaf is fully expanded, then with a 200 ppm N

solution applied every other day until the second true leaf is fully expanded, finally the fertilizer is reduced for several days before transplanting to the field. Plants are ready for transplanting when the roots are sufficiently developed to permit removal from the cell with the entire growing mix volume intact. This will require three to five weeks depending on cell size and growing conditions.

Field Arrangement

There are two methods that can be used to incorporate pollenizer plants into the field. Dedicated row pollenizer plantings place the pollenizer variety in the outside row and then every third row. An alternative is to plant the pollenizer between every third and fourth plant in-row without changing plant spacing. When this latter method is chosen, the use of a special pollenizer is recommended. The use of standard diploid varieties planted in-row may decrease yields of closely associated triploid plants. Special pollenizer varieties have been developed solely for pollen production and most do not produce marketable fruit. The use of special pollenizers planted in-row allows the field to be 100% seedless. Special pollenizer varieties found to perform well in Florida are listed below.

Triploid Watermelon Pollenizers

SP-1

Jenny

Patron

Pinnacle

Sidekick

When using pollenizer plants arranged in dedicated rows, it is important to use a pollenizer variety that is marketable because up to one-third of all melons produced in the field will be of this variety.

When dedicated rows are used, special pollenizer plants should be transplanted at the same times as triploid plants.

Cultural Practices

Plant spacing requirements vary depending on variety selection, growing area, time of planting, and soil type. In general, early growth of triploid plants is slower than that of diploid plants. However, triploid plant size eventually exceeds that of diploid plants. Seed development in fruit of diploid varieties inhibits further flowering and fruit set. This inhibition does not exist in triploids; therefore, plants continue to produce fruit as long as viral infection does not occur, insects and foliar diseases are controlled and environmental conditions are favorable. Triploid plant population density may be 10 to 20% less than that recommended for production of diploid watermelon varieties. Triploid watermelon production has been successful with 25-30 sq. ft. per plant.

All methods of irrigation including overhead, drip, seepage, and furrow are used successfully in producing triploid watermelons. Maintaining soil moisture at optimum levels is critical for triploid watermelon production. Water stress (drought) can increase the incidence of blossom-end rot and result in poorly shaped, bottle-neck fruit. Excessive field moisture has been associated with hollowheart, a disorder which seems to be more severe in some varieties of triploid melons than in diploid varieties.

FERTILIZER AND LIME

For unmulched crops, incorporate all P_2O_5, micronutrients, and 25 to 50% of N and K_2O in the bed area. Apply no more than 25% N and K_2O broadcast for subsurface irrigated crops. This “modified broadcast” method improves fertilizer efficiency. Apply remaining N and K_2O as a sidedressing when squash has four to six true leaves or when vines begin to run.

For mulched crops under subsurface irrigation, broadcast all P_2O_5, micronutrients, and 20 to 25% of N and K_2O in the bed area. Apply remaining N and K_2O in bands in grooves (2 to 3 inches deep) and 8 to 10 inches from row. Use a single band in bed center for twin-row crops and two shoulder bands for single-row crops.

For mulched crops with sprinkler irrigation, incorporate all fertilizer in bed before mulching. Cover with unfertilized soil so fertilized soil is likely to remain moist. Plastic mulch might need to be perforated to provide irrigation infiltration on deep, droughty sands. Supplemental N and K_2O can be applied by liquid fertilizer injection wheel.

For drip irrigated crops, broadcast all P_2O_5, micronutrients, and up to 20 to 25% of N and K_2O in the bed. Apply remaining N and K_2O through the irrigation tube.

Soil test and fertilizer recommendations for cucurbits on mineral soils are given in Table 2. An injection schedule for N and K for cucurbits grown on soils testing very low in K is given in Table 3a and 3b.

PLANT TISSUE ANALYSIS

Plant tissue analysis information for cucurbits is given in Table 4. The analysis was done at the early bloom stage, using the most recently matured leaf.

Table 2. Soil test and fertilizer recommendations for cucurbits on mineral soils.[1]

Target pH	Bed spacing (ft)	N lb/A[3]	P_2O_5[3] VL	L	M	H	VH	K_2O[3] VL	L	M	H	VH
			(lb/A/crop season)									
Cucumber												
6.5	6	150	120	100	80	0	0	120	100	80	0	0
Muskmelon												
6.5	5	150	150	120	100	0	0	150	120	100	0	0
Pumpkin												
6.5	8	150	120	100	80	0	0	120	100	80	0	0
Squash[2]												
6.5	6	150	120	100	80	0	0	120	100	80	0	0
Watermelon												
6.0	8	150	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.

[2] Summer and winter

[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 P_2O_5, and applied through the plant hole or near the seeds.

Table 3a . Injection schedule for N and K for cucurbit crops grown on soils testing very low in K.

Crop	Bed spacing (ft)	Total nutrients (lb/A) N	K_2O	Crop development Stage	Weeks[2]	Injection (lb/A/day)[1] N	K_2O
Cucumber	6	150	120	1	1	1.0	1.0
				2	2	2.0	1.5
				3	6	2.5	2.0
				4	1	2.0	1.5
Muskmelon	5	150	150	1	2	1.0	1.0
				2	3	2.0	2.0
				3	3	2.5	2.5
				4	2	2.0	2.0
				5	2	1.0	1.0
Squash	6	150	120	1	2	1.5	1.0
				2	5	2.5	2.0
				3	4	1.5	1.5
Watermelon	8	150	150	1	2	1.0	1.0
				2	2	1.5	1.5
				3	4	2.5	2.5
				4	3	1.5	1.5
				5	2	1.0	1.0

[1] All nutrients injected. Actual amounts may be lower depending on amount of N and K_2O placed in the bed and the K soil test result.

[2] Starting from date of seedling emergence or transplanting. First two weeks worth of injecting can be omitted if 25% of total N and K_2O was applied preplant.

Table 3b. Supplemental fertilization recommendations for cucurbit crops grown in Florida on sandy soils testing very low in Mehlich-1 potassium (K_2O).

		Recommended-Supplemental fertilization[z]		
Production System	**Nutrient**	**Leaching rain[t,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_2O	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_2O	20 lbs/A[s]	20 lbs/A[s]	20 lbs/A [v]

[z] 1 A = 7,260 linear bed feet per acre (6-ft bed spacing); for soils testing "very low" in Mehlich 1 potassium (K_2O)

[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 4. Plant tissue analysis at early bloom stage for cucurbits. Dry weight basis.

	N	P	K	Ca	Mg	S	Fe	Mn	Zn	B	Cu	Mo
Status	**Percent**						**Parts per million**					
Cucumber												
Deficient	<2.5	0.25	1.6	1.0	0.3	0.3	40	30	20	20	5	0.2
Adequate range	2.5 -5.0	0.25 -0.6	1.6 -3.0	1.0 -3.5	0.3 -0.6	0.3 -0.8	40 -100	30 -100	20 -50	20 -60	5 -10	0.3 -1.0
High	>5.0	0.6	3.0	3.5	0.6	0.8	100	100	50	60	20	2.0
Toxic (>)								900	950	150		
Cantaloupe												
Deficient	<4.0	0.4	5.0	1.0	0.35	0.2	40	20	20	20	5	0.6
Adequate range	4.0 -5.0	0.4 -0.7	5.0 -7.0	1.0 -2.0	0.35 -0.45	0.2 -0.8	40 -100	20 -100	20 -60	20 -80	5 -10	0.6 -1.0
High	>5.0	0.7	7.0	2.0	0.45	0.8	100	100	60	80	10	1.0
Toxic (>)								900		150		
Pumpkin												
Deficient	<3.0	0.3	2.3	0.9	0.35	0.2	40	40	20	25	5	0.3
Adequate range	3.0 -6.0	0.3 -0.5	2.3 -4.0	0.9 -1.5	0.35 -0.60	0.2 -0.4	40 -100	40 -100	20 -50	25 -40	5 -10	0.3 -0.5
High	>6.0	0.5	4.0	1.5	0.6	0.4	100	100	50	40	10	0.5
Summer Squash												
Deficient	<3.0	0.25	2.0	1.0	0.3	0.2	40	40	20	25	5	0.3
Adequate range	3.0 -5.0	0.25 -0.5	2.0 -3.0	1.0 -2.0	0.3 -0.5	0.2 -0.5	40 -100	40 -100	20 -50	25 -40	5 -20	0.3 -0.5
High	>5.0	0.5	3.0	2.0	0.5	0.5	100	100	50	40	20	0.5
Watermelon												
Deficient	<2.5	0.25	2.7	1.0	0.25	0.2	30	20	20	20	5	0.3
Adequate range	2.5 -3.5	0.25 -0.50	2.7 -3.5	1.0 -2.0	0.25 -0.50	0.2 -0.4	30 -100	20 -100	20 -40	20 -40	5 -10	0.3 -0.5
High	>3.5	0.5	3.5	2.0	0.5	0.4	100	100	40	40	10	0.5

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 for cucurbit crops are presented in Table 5.

IRRIGATION

Cucurbit water requirements are slightly lower than those of other vegetable crops. Peak water requirements during rapid growth and development may average 90% of reference evapotranspiration levels (ETo), decreasing to 70% of ETo during the final growth period (Tables 3 to 6, Chapter 3, *Principles and Practices of Irrigation Management for Vegetables*). Many of these crops have extensive root systems and can obtain available ground moisture, thus reducing irrigation requirements. It is important to note that excessive irrigation can reduce crop yields by leaching crop nutrients or promoting disease. However, plant stress from limited water availability will also reduce fruit size and quality.

POLLINATION OF CUCURBITS

Cucurbit plants have separate male (staminate) and female (pistillate) flowers (Fig. 9-6). Male flowers generally appear on the plants several days before female flowers. The female flower is easily recognized by the presence of a miniature fruit below the flower petals. Pollen from the male flower must be transferred to the female flower for pollination and subsequent fruit development to occur.

Therefore, it appears that a sufficiently high honeybee population is necessary to insure that each flower is visited at least eight times. How does this translate into hives per acre? Recommendations from various sources range from two hives per acre to one hive per 5 acres (Fig. 9-7). Under most conditions, however, one strong hive per 2 acres should result in sufficient bee activity to effect needed pollination.

Cucurbit flowers open shortly after sunrise and remain open until late afternoon or early evening. Accordingly, each flower is open for only a few hours. The period of maximum honeybee - the most common and effective pollinator of cucurbits - activity closely coincides with the period when the flower is open. Honeybee visitation begins an hour or two after sunrise and continues until mid-afternoon. If temperatures are very warm, bee activity may decline about noon. Research on cantaloupe pollination conducted in California showed that bee visitations increased until 10 a.m. and then declined until 3 p.m. when activity almost ceased.

Research on watermelon at the Central Florida Research and Education Center-Leesburg showed that the number of bee visitations was more important than the length of time that each bee stayed on the flower. Well-shaped, fully expanded fruit occurred following eight bee visitations to a female flower (Fig. 9-8). Fruit set was significantly reduced when only four or two bee visitations were made. Hives should be spaced around the perimeter of large fields to provide distribution of bees over the entire field. To maintain the health and activity of the bee colonies, pesticide applications to the crop should be made when bees are not present in the field, usually at dusk or after dark.

Table 5. Sufficiency ranges for petiole sap testing for cucurbits.

Crop development stage	Fresh petiole sap concentration (ppm)	
	NO_3-N	K
Cucumber		
First blossom	800-1000	NR[1]
Fruit three-inches long	600-800	
First harvest	400-600	
Cantaloupe		
First blossom	1000-1200	3000-3200[1]
Fruits two-inches long	800-1000	—
First harvest	700-800	—
Squash		
First blossom	900-1000	NR[1]
First harvest	800-900	
Watermelon		
Vines 6" in length	1200-1500	4000-5000
Fruits 2" in length	1000-1200	4000-5000
Fruits one-half mature	800-1000	3500-4000
At first harvest	600-800	3000-3500

[1]NR-No recommended ranges have been developed.

WEED MANAGEMENT

Herbicides labeled for weed control in cucurbit crops are listed in Table 6.

DISEASE MANAGEMENT

Chemicals approved for disease management in cucurbits are listed in Table 7.

INSECT MANAGEMENT

Insecticides approved for use on cucurbit crops are outlined in Table 8.

PRODUCTION COSTS

Example breakeven production costs for cucurbits grown in Florida are given in Tables 9, 10, 11, and 12.

Table 6. Chemical weed controls: cucurbit crops (muskmelons, cucumbers, squash, watermelon)

Herbicide	Labeled crops	Time of application to crop	Rate (lbs. AI./Acre) Mineral	Muck
Bensulide (Prefar 4E)	Cucurbit Vegetable group: Cucumbers, Melons, Squash (summer and winter), Pumpkins, edible gourds, bitter melon	Preplant incorporated, Preemergence	5.0-6.0	---
Remarks: Controls germinating grasses. Incorporate 1 to 2 inches. Note precautions of reapplying within 12 months and planting non-registered crops within 18 months. Label states control of crabgrass, foxtail, goosegrass, fall panicum and sprangletop.				
Bensulide + Naptalam (Prefar 4E + Alanap)	Cantaloupes, Muskmelons, Cucumbers, Watermelons	Preplant or Preemergence	5.0 (Bensulide) + 3.0-4.0 (Naptalam)	---
Remarks: Combination (tank mix) will provide wider range of weed control than either material alone. Incorporate into the soil lightly (0.5 to 1.0 inch) with suitable equipment prior to planting or incorporate preemergent treatments with overhead irrigation. Follow all precautions on both labels.				
Carfentrazone (Aim)	Cucurbit Crop Group (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 spary adjuvant such as crop oil concentrate (coc) or non-ionic surfactant at recommended rates.				
Clethodim (Select) (Arrow) (Select Max)	Cucurbits (cucumber, squash, melons and all commodities in crop group)	Postemergence	0.1-0.125	---
Remarks: Use Select for the control of annual and perennial grasses. Use a crop-oil concentrate at 1% v/v in the finished spray volume. Do not apply more than 8 fl. oz. product/A per application. Do not apply within 14 days of harvest. Rate for Select Max is 9-16 floz/A with the use of a non-ionic surfactant.				

Table 6. Continued.

Herbicide	Labeled crops	Time of application to crop	Rate (lbs. AI./Acre) Mineral	Muck
Clomozone (Command 3 ME)	Summer squash Winter squash	Preemergence Preemergence Row Middles	0.15 0.25-0.75 0.75	---
Remarks: Labeled rate for summer squash if 0.25 lb a.i. Bleaching has been seen under adverse conditions at this rate. Suggest use as tank mix to increase efficacy. May be applied to winter squash and processing pumpkins. See label for varieties and cultivars where application is prohibited. Do not use on Jack-O-Lantern type pumpkins. May be used on processing type varieties. Read disclaimer on the label before use.				
DCPA (Dacthal W-75)	Seeded Melons: Cantaloupe, Honeydew, Watermelon; Cucumber, Squash: Summer, Winter	Early postemergence	6-8	---
Remarks: Apply only when plants have 4 to 5 true leaves, well established and growing conditions are favorable for good plant growth. Does not control emerged weeds. If weeds have emerged, cultivate prior to application. Do not incorporate.				
Ethalfluralin + Clomozone (Strategy)	Cucumber, Melons, Watermelons, Squash, Pumpkins	Preemergence and Post-directed	2-3 pts	---
Remarks: Strategy is a premix of ethalfluralin and clomozone at 1.5 + 0.5 lbs/gal. Apply 3 pts. product post-seeding to surface prior to weed and crop emergence. Must be applied no later than 2 days after seeding. Soil incorporate with overhead irrigation at ½ inch, or with a rain(s) at no less that ½ inch within 5 days. Excessive rains or irrigations may cause injury. For furrow irrigation where no rainfall is received, a shallow cultivation may be used to activate the herbicides. Do not apply before transplanting. Do not apply under row covers, hot caps or polyethylene mulches. May be applied as a post-directed spray to row middles after crop emergence or transplanting. Do not apply over plants. The premix controls a large number of grasses and broadleaf weeds.				
Flumioxazin (Chateau)	Melon group, Muskemelon, watermelon	Directed Row Middles	0.125	---
Remarks: Chateau may be applied up to 4oz product/application to row middles of raised plastic-mulched beds that are at least 4 inches higher than the treated row middle and the mulched bed must be a minimum of a 24-inch bed width. Do not apply after crops are transplanted/seeded. All applications must be made with a shielded or hooded equipment. For control of emerged weeds, a burn down herbicide may be tank-mixed. Label is a Third-Party registration (TPR,Inc). Use without a signed authorization and waiver of liability is a misuse of the product.				
Glyphosate (Roundup, Durango) Touchdown, Glyphomax)	Cucurbits	Chemical fallow Preplant, pre mergence, Pre transplant	0.3-1.0	---
Remarks: Roundup, Glyphomax and Touchdown have several formulations. Check the label of each for specific labeling directions.				
Halosulfuron (Sandea)	Cucumber, Cantaloupe, Honeydew and Crenshaw melons.	Preemergence Postemergence	0.024	---
Remarks: Apply uniformly at ½ oz. product with ground equipment in a minimum of 15 gallons of water per acre. For postemergence applications, apply after the crop has reached the 2 true leaf stage, but before flowering. Use a non ionic surfactant for postemergence applications. May be used for row middle treatments at up to 1 oz. product. Controls actively growing nutsedge species best POST. Do not apply within 30 days of harvest for cucumber and 57 days for the melon subgroup.				
Halsulfuron (Sandea)	Cucurbit vegetables including watermelon, squash, pumpkins Cucumbers, and melons	Row middles	0.024-0.048	
Remarks: May be applied between rows of direct seeded or transplanted crop for the control of nutsedges and listed broadleaf weeds. Apply at 0.5 to 1 oz. product per acre treated. Add a non-ionic surfactant.				
Halosulfuron (Sandea)	Watermelon	Preemergence Pre transplant	0.024 - 0.036	
Remarks: Sandea may be applied preemergence to seeded watermelon on bare ground culture or pre-seeding to mulch-cultured melons. Pre transplant applications may be made also to bare ground or mulched production. Transplanting should be no sooner than 7 days after application. Applications may be ½ to ¾ oz product per acre. Use lighter rates on sandy soils with low organic matter.				

Table 6. Continued.

Herbicide	Labeled crops	Time of application to crop	Rate (lbs. AI./Acre) Mineral	Muck
Halosulfuron (Sandea)	Pumpkins Winter Squash	Preemergence Pre transplant Post transplant	0.024 - 0.036	
Remarks: Sandea may be applied after seeding but before soil cracking or pre transplant. Transplanting should not be made sooner than 7 days after application. May be applied post over-the-top when plants reach the 4-5 true leaf stage, but before first female flowers appear. Applications may be ½ to ¾ oz product per acre.				
Naptalam (Alanap-L)	Cantaloupes, Muskmelons, Cucumbers, Watermelons	Preemergence Preplant (Irrigated Melons)	3.0-4.0	---
Remarks: Apply within 48 hours of seeding. Apply preemergence to weeds and incorporate with overhead irrigation. Label states control of germinating annuals such as lambsquarter, ragweed, purslane, cocklebur, white mustard, shepherdspurse, redroot pigweed, hairy galingosa and carpetweed.				
Naptalam (Alanap-L)	Cantaloupes, Cucumbers, Watermelons	Postemergence Posttransplant	3.0-4.0	---
Remarks: Apply 1 month after planting when vines are starting to run but before weeds have emerged or immediately after transplanting. Do not use when plants are under stress due to weather conditions. Do not tank mix with crop oil or adjuvants. Phytotoxicity may occur.				
Paraquat (Gramoxone Inteon) (Firestorm)	Watermelon, Squash, Pumpkin, Cantaloupe, Muskmelon, Cucumber	Preplant or Preemergence	0.63 - 0.94	---
Remarks: Controls emerged weeds only. Apply prior, during or after planting, but before crop emerges. Use a non-ionic spreader.				
Paraquat (Gramoxone Inteon)	Melons	Postemergence directed spray	0.47-0.93	---
Remarks: Controls emerged weeds only. Apply 1.5 to 3.0 pts. per sprayed acre with ground equipment directing spray between the rows and use shields to prevent spray contact with the crop plants. Add a non-ionic surfactant at 8 fl. oz. per 100 gals. of spray mix. Do not apply more than 3 times per season. A Special Local Needs (24c) label for Florida.				
Pelargonic Acid (Scythe)	Cucurbits (melons; cucumber, gourd, pumpkin, squash, muskmelon and watermelon)	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 activity. May be tank mixed with soil residual compounds. Consult the label for rates and other information.				
S-Metolachlor (Dual Magnum)	Pumpkin	Inter-row Inter-hill	0.95 - 1.26	
Remarks: Apply before weeds emerge at 1.0 to 1.33 pint/A as an inter-row or inter hilll application in pumpkin. Leave 1 foot of untreated area over the row, or 6 inches to each side of the planted hill and/or emerged pumpkin foliage (inter-row or inter-hill means not directly over th planted seed or young pumpkin plants). Do not apply closer than 30 days before harvest.				
Sethoxydim (Poast)	Cucurbits: all	Postemergence	0.188-0.28	---
Remarks: Controls actively growing grass weeds. A total of 3 pts. product per acre may be applied in one season. Do not apply within 14 days of harvest. Apply in 5 to 20 gals. 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.				
Terbacil (Sinbar)	Watermelon	Preemergence Pretansplant Row Middles	0.1 - 0.2	---
Remarks: For watermelon only. Apply 2 to 4 oz product (0.1 - 0.2 lb ai) to seeded or transplanted watermelon preemergence after planting to seeded and pretransplanting to transplanted watermelon. May be applied under much and to row middles. Controls many annual broadleaf weeds.				

Table 7. Foliar fungicides for the 5 cucurbit crops: Cantaloupe (Muskmelon), Pumpkin, Squash, Watermelon and Cucumber.

Disease	Chemical	Fungicide Group	Max. Rate/A/ Application	Max. Rate /A/Season	Min. Days to Harvest	Remarks
Downy Mildew	Acrobat 50WP (Dimethomorph)	40	6.4 oz	32 oz	When spray is dry	Limit is 5 appl/crop. Tank mix with another fungicide. Labeled for all cucurbits.
	Aliette 80WDG, Linebacker WDG (Fosetyl-Al)	33	5 lb	35 lb	12 hr	Limit is 7 appl/crop. Do not tank mix with copper fungicides. Labeled for all cucurbits.
	Amistar 80DF, Quadris 2.09FL (Azoxystrobin)	11	5 oz or 3.2 pts	1.88 lb	1	Limit is 4 appl/crop for all QoI fungicides. Do not make more than 2 consecutive appl. Labeled for all cucurbits.
	Cabrio 20EG (Pyraclostrobin)	11	16 fl oz	64 fl oz	0	4 appl maximum. Same as Amistar. Max rate for downy mildew is 12 oz. Labeled for all cucurbits.
	Curzate 60DF (Cymoxanil)	27	3.2 oz	See remarks	3	Use only with labeled rate of protectant fungicide. No more than 9 appl/12 months. Labeled for all cucurbits.
	Applause 720, Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Echo 720, Echo 90DF, Echo ZN, Equus DF, Equus 720 SST, Initiate 720 (Chlorothalonil)	M5	See label	See label	0	Recommended maximum rate is less for certain diseases including downy mildew. Follow label recommendations on watermelon after fruit set. Labeled for all cucurbits.
	Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Manzate 75DF, Manzate Flowable 4F, Manzate Pro-Stick, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP (Mancozeb)	M3	See label	See label	5	Do not apply within 5 days of harvest. Do not apply more than 19.2 lb a.i. per A/crop. Labeled for all cucurbits.
	Manex 4F (Maneb)	M3	1.6 qt	12.8 qt	5	Do not apply within five days of harvest. Labeled for all cucurbits.
	Maneb 80WP (Maneb)	M3	2 lb	16 lb	5	Do not apply within five days of harvest. Labeled for all cucurbits.
	Maneb 75DF (Maneb)	M3	2 lb	17.1 lb	5	Do not apply within five days of harvest. Labeled for all cucurbits.
	Fixed copper	M1	See label		-	Repeated use may cause leaf yellowing. Labeled for all cucurbits.
	Flint 50WP (Trifloxystrobin)	11	2 oz	8 oz	0	Limit 4 appl/crop and alternate chemistry. Max rate is higher for downy mildew suppression (4 oz). Same as Amistar. Labeled for all cucurbits.

Table 7. Continued.

Disease	Chemical	Fungicide Group	Max. Rate/A/ Application	Max. Rate /A/Season	Min. Days to Harvest	Remarks
	Oxidate (Hydrogen dioxide)		Various dilution rates	See label	0	See label for specific instructions for use with cucurbits. Do not apply under conditions of high heat or drought. Labeled for all cucurbits.
	Forum (Dimethomorph)	40	6 oz	30 oz	When spray is dry	Limit is 5 appl/crop. Labeled for all cucurbits. Cucurbits may be harvested on the day of the last application after sprays have dried.
	Gavel 75DF (Mancozeb & Zoxamide)	M3 & 22	2 lb	16 lb	5	Limit is 8 appl/crop. Labeled for all cucurbits.
	Heritage (Azoxystrobin)	11	8.0 oz	3.0 lb	1	Do not make more than 2 consecutive appls. Do not make more than 6 appl/crop. Same as Amistar. Labeled for all cucurbits.
	Fosphite, Fungi-Phite, Prophyt, Topaz (Potassium phosphate)		See label	See label	0	Check label for required min gal/A. Restrictions are for use following copper application, plant and environmental conditions that restrict use, and compatibility with other materials. Labeled for all cucurbits.
	ManKocide 61DF (Copper hydroxide & Mancozeb)	M1 & M3	2.66 lb	128 lb	5	Labeled for all cucurbits. Do not apply within five days of harvest.
	Presidio (Fluopicolide)	43	4 fl oz	12 fl oz	2	Max rate is 4 fl oz/A per season. Apply no more than 2 sequential appls before alternating to a fungicide of a different chemistry. Labeled for all cucurbits.
	Previcur Flex (Propamocarb hydrochloride)	U	1.2 qt	6 pt	2	Use a tank mix partner. See label for directions using a contact fungicide and Pythium suppression. Labeled for all cucurbits.
	Pristine 38WG (Boscalid & Pyraclostrobin)	7 & 11	18.5 oz	74 oz	0	Limit is 4 appl/crop and alternate chemistry. Same as Amistar. Labeled for all cucurbits.
	PREVAM (Sodium tetraborohydrate decahydrate)		50 fl oz/100 gal			See label for specific information.
	Quadris 2.08FL (Azoxystrobin)	11	15.4 fl oz	2.88 qt	1	Limit is 4 appl/crop and alternate chemistry. Labeled for all cucurbits.
	Quadris Opti (Azoxystrobin & Chlorothalonil)	11 & M5	3.2 pt	1.0 lb ai 15.75 lb ai	1	Limit is 4 appl/crop for all QoI fungicides. Do not make more than 2 consecutive appls.
	Revus (Mandipropamid)	40	8 oz	32 fl oz	0	Max of 4 appls during one crop cycle. Apply no more than 2 sequential applications before alternating to a fungicide of a different chemistry. An adjuvant is recommended for best control. Do not use in transplant production. 30 day plant back restriction, unless plant appears on label. Labeled for all cucurbits.
	Ranman (Cyazofamid)	21	2.75 fl oz	16.5 fl oz	0	Limit is 6 appl/crop. Follow resistance management guidelines on label. Labeled for all cucurbits.

Table 7. Continued.

Disease	Chemical	Fungicide Group	Max. Rate/A/ Application	Max. Rate /A/Season	Min. Days to Harvest	Remarks
	Reason (Fenamidone)	11	5.5 fl oz	22 fl oz	14	Limit is 4 appl/crop and alternate chemistry. Labeled for all cucurbits.
	Ridomil Gold Bravo 76.4W (Chlorothalonil & Mefenoxam)	M5 & 4	3 lb	12 lb	7	Limit is 4 appl/crop. Follow resistance management guidelines on label. Labeled for all cucurbits.
	Ridomil MZ 68WP (Mancozeb & Mefenoxam)	M3 & 4	2.5 lb	10 lb	5	Limit is 4 appl/crop. Follow resistance management guidelines on label.
	Ridomil/Copper 70W (Copper hydroxide & Mefenoxam)	M1 & 4	2 lb	8 lb	5	Limit is 4 appl/crop. Follow resistance management guidelines on label.
	Rhapsody (*Bacillus subtilis* strain QST 713)		6 qt/100 gal		0	Do not use product alone. Apply with registered fungicide. Labeled for all cucurbits.
	Serenade ASO (*Bacillus subtilis* strain QST 713)		6 qt		0	Labeled for all cucurbits. For improved performance tank mix or rotate with other registered fungicides.
	Serenade Max (*Bacillus subtilis* strain QST 713)		3 lb		0	Labeled for all cucurbits. For improved performance tank mix or rotate with other registered fungicides.
	Sonata (*Bacillus pumilus strain* QST 2808)		4 qt		0	Labeled for all cucurbits. For improved performance tank mix or rotate with other registered fungicides.
	Sporan EC (clove, rosemary, thyme oil)		4 pt		0	Labeled for all cucurbits.
	Tanos 50DF (Cymoxanil & Famoxadone)	27 & 11	8 oz		3	Limit is 4 appl./crop. with a contact fungicide. Limit is 72 oz/A/max/ year. Labeled for all cucurbits.
Powdery Mildew	Amistar 80DF, Quadris 2.09FL (Azoxystrobin)	11	5 oz or 3.2 pts	1.88 lb	1	Limit is 4 appl/crop for all QoI fungicides. Do not make more than 2 consecutive appl. Labeled for all cucurbits.
	Cabrio 20EG (Pyraclostrobin)	11	16 fl oz	64 fl oz	0	4 appl maximum. Max rate for downy mildew is 12 oz. Labeled for all cucurbits.
	Applause 720, Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Echo 720, Echo 90DF, Echo ZN, Equus DF, Equus 720 SST, Initiate 720 (Chlorothalonil)	M5	See label	See label	0	Recommended maximum rate is less for certain diseases including downy mildew. Follow label recommendations on watermelon after fruit set. Labeled for all cucurbits.
	Fixed copper	M1	See label			Repeated use may cause leaf yellowing

Table 7. Continued.

Disease	Chemical	Fungicide Group	Max. Rate/A/ Application	Max. Rate /A/Season	Min. Days to Harvest	Remarks
	Heritage (Azoxystrobin)	11	8.0 oz	3.0 lb	1	Do not make more than 2 consecutive appls. Do not make more than 6 appl/crop. Labeled for all cucurbits.
	JMS Stylet Oil		3 qt		4 hr	See label for specific appl. Techniques required (ie: use of 400 psi). Labeled for all cucurbits.
	Flint 50WP (Trifloxystrobin)	11	2 oz	8 oz	0	Limit 4 appl/crop and alternate chemistry. Max rate is higher for downy mildew suppression (4 oz). Labeled for all cucurbits. Efficacy is greatly improved when applied before infection.
	Nova 40W/Rally (Myclobutanil)	3	5 oz	1.5 lb	0	Note that a 30 day plant back restriction exists. Labeled for all cucurbits. Follow resistance management guidelines on label.
	Oxidate (Hydrogen dioxide)		Various dilution rates	See label	0	See label for specific instructions for use with cucurbits. Do not apply under conditions of high heat or drought. Labeled for all cucurbits.
	Procure 50WS and 480SC (Triflumizole)	3	8 oz	40 oz	0	Labeled for all cucurbits. Follow resistance management guidelines on label.
	PREVAM (Sodium tetraborohydrate decahydrate)		50 fl oz/100 gal			See label for specific information.
	Pristine 38WG (Boscalid & Pyraclostrobin)	7 & 11	18.5 oz	74 oz	0	Limit is 4 appl/crop and alternate chemistry. Labeled for all cucurbits. Follow resistance management guidelines on label.
	Quadris 2.08FL (Azoxystrobin)	11	15.4 fl oz	2.88 qt	1	Limit is 4 appl/crop and alternate chemistry. Labeled for all cucurbits. Follow resistance management guidelines on label.
	Quadris Opti (Azoxystrobin & Chlorothalonil)	11 & M5	3.2 pt	1.0 lb ai 15.75 lb ai	1	Limit is 4 appl/crop for all QoI fungicides. Do not make more than 2 consecutive appls.
	Quintec (Quinoxyfen)	13	6 fl oz	24 fl oz	3	Do not make more than 4 appls. Do not make more than 2 consecutive appls. For use on cantaloupe, watermelon and other melons only.
	Kumulus DF, Micro Sulf, Micronized Gold, Microthiol Disperss, Sulfur 90W, Thiolux Jet, Wettable Sulfur (Sulfur)	M2	See label	See label		See label. Do not use in warm weather (>90°F). Labeled for all cucurbits.
	Rhapsody (*Bacillus subtilis* strain QST 713)		6 qt/100 gal		0	Do not use product alone. Apply with registered fungicide. Labeled for all cucurbits.
	Sovran (Kresoxim methyl)	11	4.8	19.2	0	Follow resistance management guidelines for QoI fungicides as per the label. Labeled for all cucurbits.
	Sporan EC (clove, rosemary, thyme oil)		4 pt		0	Labeled for all cucurbits. See label for specific application techniques required.

Table 7. Continued.

Disease	Chemical	Fungicide Group	Max. Rate/A/ Application	Max. Rate /A/Season	Min. Days to Harvest	Remarks
	sulfur	M2	See label		0	Do not use when temperatures are >90^{0}F or on sulfur-sensitive varieties. Labeled for all cucurbits.
	Thiophanate methyl 85WDG (Thiophanate methyl)	1	0.4	2.5	1	Spray at first appearance and then at 7- to 10-day intervals. Follow resistance management guidelines on label. Labeled for all cucurbits.
	Topsin M WSB (Thiophanate methyl)	1	0.5 lb	3 lb	1	Spray at first appearance and then at 7- to 10-day intervals. Follow resistance management guidelines on label. Labeled for all cucurbits.
	Topsin 4.5 FL (Thiophanate methyl)	1	10 oz	60 oz	1	Spray at first appearance and then at 7- to 10-day intervals. Follow resistance management guidelines on label. Labeled for all cucurbits.
	Topsin M70WP (Thiophanate methyl)	1	0.5 lb	3 lb	1	Spray at first appearance and then at 7- to 10-day intervals. Follow resistance management guidelines on label. Labeled for all cucurbits.
	Trilogy (Neem oil)		See label		0	Labeled for all cucurbits. See label for specific application instructions.
Gummy Stem Blight	Amistar 80DF, Quadris 2.09FL (Azoxystrobin)	11	5 oz or 3.2 pts	1.88 lb	1	Limit is 4 appl/crop for all QoI fungicides. Labeled for all cucurbits. Follow resistance management guidelines on label. Do not make more than 2 consecutive appl.
	Cabrio 20EG (Pyraclostrobin)	11	16 fl oz	64 fl oz	0	4 appl maximum. Labeled for all cucurbits. Follow resistance management guidelines on label. Max rate for downy mildew is 12 oz.
	Applause 720, Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Echo 720, Echo 90DF, Echo ZN, Equus DF, Equus 720 SST, Initiate 720 (Chlorothalonil)	M5	See label	See label	0	Recommended maximum rate is less for certain diseases including downy mildew. Follow label recommendations on watermelon after fruit set.
	Copper	M1	See label		-	Repeated use may cause leaf yellowing
	Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Manzate 75DF, Manzate Flowable 4F, Manzate Pro-Stick, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP (Mancozeb)	M3	See label	See label		Do not apply within 5 days of harvest. Do not apply more than 19.2 lb a.i. per A/crop. Labeled for all cucurbits.

Table 7. Continued.

Disease	Chemical	Fungicide Group	Max. Rate/A/ Application	Max. Rate /A/Season	Min. Days to Harvest	Remarks
	Manex 4F (Maneb)	M3	1.6 qt	12.8 qt	5	Do not apply within five days of harvest. Labeled for all cucurbits.
	Maneb 80WP (Maneb)	M3	2 lb	16 lb	5	Do not apply within five days of harvest. Labeled for all cucurbits.
	Maneb 75DF (Maneb)	M3	2 lb	17.1 lb	5	Do not apply within five days of harvest. Labeled for all cucurbits.
	Gavel 75DF (Mancozeb + Zoxamide)	M3 + 22			5	Begin application when plants are in 2-leaf stage, and repeat at 7-10 day intervals
	Heritage (Azoxystrobin)	11	8.0 oz	3.0 lb	1	Do not make more than 2 consecutive appls. Do not make more than 6 appl/crop. Labeled for all cucurbits.
	Oxidate (Hydrogen dioxide)		Various dilution rates	See label	0	See label for specific instructions for use with cucurbits. Do not apply under conditions of high heat or drought. Labeled for all cucurbits.
	Pristine 38WG (Boscalid & Pyraclostrobin)	7 & 11	18.5 oz	74 oz	0	Limit is 4 appl/crop and alternate chemistry. Labeled for all cucurbits.
	Quadris 2.08FL (Azoxystrobin)	11	15.4 fl oz	2.88 qt	1	Limit is 4 appl/crop and alternate chemistry. Labeled for all cucurbits.
	Quadris Opti (Azoxystrobin & Chlorothalonil)	11 & M5	3.2 pt	1.0 lb ai 15.75 lb ai	1	Limit is 4 appl/crop for all QoI fungicides. Do not make more than 2 consecutive appls.
	Ridomil Gold Bravo 76.4W (Chlorothalonil & Mefenoxam)	M5 & 4	3 lb	12 lb	7	Limit is 4 appl/crop. Follow resistance management guidelines on label.
	Reason (Fenamidone)	11	5.5 fl oz	22 fl oz	14	Limit is 4 appl/crop and alternate chemistry. Labeled for all cucurbits.
	Rhapsody (*Bacillus subtilis* strain QST 713)		6 qt/100 gal		0	Labeled for all cucurbits. For improved performance tank mix or rotate with other registered fungicides.
	Serenade ASO (*Bacillus subtilis* strain QST 713)		6 qt		0	Labeled for all cucurbits. For improved performance tank mix or rotate with other registered fungicides.
	Serenade Max (*Bacillus subtilis* strain QST 713)		3 lb		0	Labeled for all cucurbits. For improved performance tank mix or rotate with other registered fungicides.
	Sonata (*Bacillus pumilus strain* QST 2808)		4 qt		0	Labeled for all cucurbits. For improved performance tank mix or rotate with other registered fungicides.
	Sovran (Kresoxim methyl)	11	4.8	19.2	0	Follow resistance management guidelines for QoI fungicides as per the label. Labeled for all cucurbits.
	Thiophanate methyl 85WDG (Thiophanate methyl)	1	0.4	2.5	1	Follow resistance management guidelines on label. Labeled for all cucurbits.

Table 7. Continued.

Disease	Chemical	Fungicide Group	Max. Rate/A/ Application	Max. Rate /A/Season	Min. Days to Harvest	Remarks
	Topsin M WSB (Thiophanate methyl)	1	0.5 lb	3 lb	1	Follow resistance management guidelines on label. Labeled for all cucurbits.
	Topsin 4.5 FL (Thiophanate methyl)	1	10 oz	60 oz	1	Follow resistance management guidelines on label. Labeled for all cucurbits.
	Topsin M70WP (Thiophanate methyl)	1	0.5 lb	3 lb	1	Follow resistance management guidelines on label. Labeled for all cucurbits.
	Tanos 50WP (Famoxadone + Cymoxanil	11 + 27			3	Only for Alternaria and Anthracnose. Do not make >1 applic. before alternating with a fungicide of a different mode of action. Must be tank-mixed with a contact fungicide.
Anthracnose	Amistar 80DF, Quadris 2.09FL (Azoxystrobin)	11	5 oz or 3.2 pts	1.88 lb	1	Limit is 4 appl/crop for all QoI fungicides. Do not make more than 2 consecutive appl. Labeled for all cucurbits.
	Cabrio 20EG (Pyraclostrobin)	11	16 fl oz	64 fl oz	0	4 appl maximum. Max rate for downy mildew is 12 oz. Labeled for all cucurbits.
	Applause 720, Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Echo 720, Echo 90DF, Echo ZN, Equus DF, Equus 720 SST, Initiate 720 (Chlorothalonil)	M5	See label	See label	0	Recommended maximum rate is less for certain diseases including downy mildew. Follow label recommendations on watermelon after fruit set. Labeled for all cucurbits.
	Copper	M1	See label		-	Repeated use may cause leaf yellowing
	Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Manzate 75DF, Manzate Flowable 4F, Manzate Pro-Stick, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP (Mancozeb)	M3	See label	See label		Do not apply within 5 days of harvest. Do not apply more than 19.2 lb a.i. per A/crop. Labeled for all cucurbits.
	Manex 4F (Maneb)	M3	1.6 qt	12.8 qt	5	Do not apply within five days of harvest. Labeled for all cucurbits.
	Maneb 80WP (Maneb)	M3	2 lb	16 lb	5	Do not apply within five days of harvest. Labeled for all cucurbits.
	Maneb 75DF (Maneb)	M3	2 lb	17.1 lb	5	Do not apply within five days of harvest. Labeled for all cucurbits.
	Heritage (Azoxystrobin)	11	8.0 oz	3.0 lb	1	Do not make more than 2 consecutive appls. Do not make more than 6 appl/crop. Labeled for all cucurbits.

Table 7. Continued.

Disease	Chemical	Fungicide Group	Max. Rate/A/ Application	Max. Rate /A/Season	Min. Days to Harvest	Remarks
	Oxidate (Hydrogen dioxide)		Various dilution rates	See label	0	See label for specific instructions for use with cucurbits. Do not apply under conditions of high heat or drought. Labeled for all cucurbits.
	Pristine 38WG (Boscalid & Pyraclostrobin)	7 & 11	18.5 oz	74 oz	0	Limit is 4 appl/crop and alternate chemistry. Labeled for all cucurbits. Follow resistance management guidelines on label.
	Quadris 2.08FL (Azoxystrobin)	11	15.4 fl oz	2.88 qt	1	Limit is 4 appl/crop. Labeled for all cucurbits.
	Quadris Opti (Azoxystrobin & Chlorothalonil)	11 & M5	3.2 pt	1.0 lb ai 15.75 lb ai	1	Limit is 4 appl/crop for all QoI fungicides. Do not make more than 2 consecutive appls.
	Tanos 50DF (Cymoxanil & Famoxadone)	27 & 11	8 oz		3	Limit is 4 appl./crop. Must tank mix with a contact fungicide. Limit is 72 oz/A/max/ year. Labeled for all cucurbits.
	Reason 500SC (Fenamidone)	11			14	Begin application when conditions favor disease and every 5-10 days. Do not apply >22 fl oz/ season. Alternate with fungicides from different groups, and make < 4 applications of group 11 fungicides/season. Labeled for all cucurbits.
	Sovran (Kresoxim methyl)	11	4.8	19.2	0	Follow resistance management guidelines for QoI fungicides as per the label. Labeled for all cucurbits.
	Gavel 75DF (Mancozeb + Zoxamide)	M3 + 22			5	Begin application when plants are in 2-leaf stage, and repeat at 7-10 day intervals
	Serenade Max (*Bacillus subtilis* strain QST 713)		3 lb		0	Labeled for all cucurbits. For improved performance tank mix or rotate with other registered fungicides.
	Sonata (*Bacillus pumilus strain* QST 2808)		4 qt		0	Labeled for all cucurbits. For improved performance tank mix or rotate with other registered fungicides.
	Rhapsody (*Bacillus subtilis* strain QST 713)		6 qt/100 gal		0	Labeled for all cucurbits. For improved performance tank mix or rotate with other registered fungicides.
	Thiophanate methyl 85WDG (Thiophanate methyl)	1	0.4	2.5	1	Follow resistance management guidelines on label. Labeled for all cucurbits.
	Topsin M WSB (Thiophanate methyl)	1	0.5 lb	3 lb	1	Follow resistance management guidelines on label. Labeled for all cucurbits.
	Topsin 4.5 FL (Thiophanate methyl)	1	10 oz	60 oz	1	Follow resistance management guidelines on label. Labeled for all cucurbits.
	Topsin M70WP (Thiophanate methyl)	1	0.5 lb	3 lb	1	Follow resistance management guidelines on label. Labeled for all cucurbits.
Alternaria leaf spot, Target Spot, Cercospora	Amistar 80DF, Quadris 2.09FL (Azoxystrobin)	11	5 oz or 3.2 pts	1.88 lb	1	Limit is 4 appl/crop for all QoI fungicides. Do not make more than 2 consecutive appl. Labeled for all cucurbits.

Table 7. Continued.

Disease	Chemical	Fungicide Group	Max. Rate/A/ Application	Max. Rate /A/Season	Min. Days to Harvest	Remarks
	Cabrio 20EG (Pyraclostrobin)	11	16 fl oz	64 fl oz	0	4 appl maximum. Same as Amistar. Max rate for downy mildew is 12 oz. Labeled for all cucurbits.
	Applause 720, Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Echo 720, Echo 90DF, Echo ZN, Equus DF, Equus 720 SST, Initiate 720 (Chlorothalonil)	M5	See label	See label	0	Recommended maximum rate is less for certain diseases including downy mildew. Follow label recommendations on watermelon after fruit set. Labeled for all cucurbits.
	Copper	M1	See label			Repeated use may cause leaf yellowing.
	Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Manzate 75DF, Manzate Flowable 4F, Manzate Pro-Stick, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP (Mancozeb)	M3	See label	See label		Do not apply within 5 days of harvest. Do not apply more than 19.2 lb a.i. per A/crop. Labeled for all cucurbits.
	Manex 4F (Maneb)	M3	1.6 qt	12.8 qt	5	Do not apply within five days of harvest. Labeled for all cucurbits.
	Maneb 80WP (Maneb)	M3	2 lb	16 lb	5	Do not apply within five days of harvest. Labeled for all cucurbits.
	Maneb 75DF (Maneb)	M3	2 lb	17.1 lb	5	Do not apply within five days of harvest. Labeled for all cucurbits.
	Gavel 75DF (Mancozeb & Zoxamide)	M3 & 22	2 lb	16 lb	5	Limit is 8 appl/crop. Labeled for all cucurbits.
	Heritage (Azoxystrobin)	11	8.0 oz	3.0 lb	1	Do not make more than 2 consecutive appls. Do not make more than 6 appl/crop. Labeled for all cucurbits.
	Oxidate (Hydrogen dioxide)		Various dilution rates	See label	0	See label for specific instructions for use with cucurbits. Do not apply under conditions of high heat or drought. Labeled for all cucurbits.
	Serenade Max (*Bacillus subtilis* strain QST 713)		3 lb		0	Labeled for all cucurbits. For improved performance tank mix or rotate with other registered fungicides.
	Sonata (*Bacillus pumilus strain* QST 2808)		4 qt		0	Labeled for all cucurbits. For improved performance tank mix or rotate with other registered fungicides.

Table 7. Continued.

Disease	Chemical	Fungicide Group	Max. Rate/A/ Application	Max. Rate /A/Season	Min. Days to Harvest	Remarks
	Rhapsody (*Bacillus subtilis* strain QST 713)		6 qt/100 gal		0	Labeled for all cucurbits. For improved performance tank mix or rotate with other registered fungicides.
	Tanos 50WP (Famoxadone + Cymoxanil	11 + 27			3	Only for Alternaria and Anthracnose. Do not make >1 applic. before alternating with a fungicide of a different mode of action. Must be tank-mixed with a contact fungicide.
	Pristine 38WG (Boscalid & Pyraclostrobin)	7 & 11	18.5 oz	74 oz	0	Limit is 4 appl/crop and alternate chemistry. Labeled for all cucurbits.
	Quadris 2.08FL (Azoxystrobin)	11	15.4 fl oz	2.88 qt	1	Limit is 4 appl/crop and alternate chemistry. Labeled for all cucurbits.
	Quadris Opti (Azoxystrobin & Chlorothalonil)	11 & M5	3.2 pt	1.0 lb ai 15.75 lb ai	1	Limit is 4 appl/crop.
	Reason (Fenamidone)	11	5.5 fl oz	22 fl oz	14	Limit is 4 appl/crop and alternate chemistry. Labeled for all cucurbits.
	Sovran (Kresoxim methyl)	11	4.8	19.2	0	Follow resistance management guidelines for QoI fungicides as per the label. Labeled for all cucurbits.
	Sporan EC (clove, rosemary, thyme oil)		4 pt		0	Labeled for all cucurbits. See label for specific application techniques required.
	Topsin M70WP (Thiophanate methyl)	1	0.5 lb	3 lb	1	Follow resistance management guidelines on label. Labeled for all cucurbits.
Phytophthora blight, Damping-off, Pythium	Acrobat 50WP (Dimethomorph)	40	6.4 oz	32 oz	When spray is dry	Limit is 5 appl/crop. Tank mix with another fungicide. Labeled for all cucurbits.
	Forum (Dimethomorph)	40	6 oz	30 oz	When spray is dry	Limit is 5 appl/crop. Apply with another fungicide that has a different mode of action. Min gal/A required. Labeled for all cucurbits.
	Fosphite, Fungi-Phite, Prophyt, Topaz (Potassium phosphate)		See label	See label	0	Check label for required min gal/A. Restrictions are for use following copper application, plant and environmental conditions that restrict use, and compatibility with other materials. Labeled for all cucurbits.
	Oxidate (Hydrogen dioxide)		Various dilution rates	See label	0	See label for specific instructions for use with cucurbits. Do not apply under conditions of high heat or drought. Labeled for all cucurbits.
	Presidio (Fluopicolide)	43	4 fl oz	12 fl oz	2	Max rate is 4 fl oz/A/appl and 12 fl oz/A per season. Apply no more than 2 sequential appls before alternating to a fungicide of a different chemistry. Labeled for all cucurbits.

Table 7. Continued.

Disease	Chemical	Fungicide Group	Max. Rate/A/ Application	Max. Rate /A/Season	Min. Days to Harvest	Remarks
	Revus (Mandipropamid)	40	8 oz	32 fl oz	0	Max of 4 appls during one crop cycle. Apply no more than 2 sequential applications before alternating to a fungicide of a different chemistry. An adjuvant is recommended for best control. Do not use in transplant production. 30 day plant back restriction, unless plant appears on label. Labeled for all cucurbits.
	Ranman (Cyazofamid)	21	2.75 fl oz	16.5 fl oz	0	Limit is 6 appl/crop. Follow resistance management guidelines on label. Labeled for all cucurbits.
	Previcur Flex (Propamocarb hydrochloride)	U	1.2 qt	6 pt	2	Use a tank mix partner. See label for directions using a contact fungicide and Pythium suppression. Labeled for all cucurbits.
	Soilgard 12G (*Gliocladium virens*)		See label		0	Must be incorporated or drenched into the soil. See label for specific rates and methods of application.
	Ridomil gold 4EC and Ridomil Gold SL (Mefenoxam)	4	2 pt/treated A	See label	See label	Apply at seeding in a 7-12" band on soil over seed furrow. Labeled for all cucurbits. Follow guidelines on label for resistance management.
	Ultra Flourish (Mefenoxam)	4	4 pt/treated A	See label	See label	Follow guidelines on label for resistance management. Labeled for all cucurbits.
Aphid transmitted viruses	JMS Stylet Oil		3 qt		4 hr	See label for specific appl. Techniques required (ie: use of 400 psi). Labeled for all cucurbits.
Rhizoctonia	Fosphite, Fungi-Phite, Prophyt, Topaz (Potassium phosphate)		See label	See label	0	Check label for required min gal/A. Restrictions are for use following copper application, plant and environmental conditions that restrict use, and compatibility with other materials. Labeled for all cucurbits.
	Oxidate (Hydrogen dioxide)		Various dilution rates	See label	0	See label for specific instructions for use with cucurbits. Do not apply under conditions of high heat or drought. Labeled for all cucurbits.
	Soilgard 12G (*Gliocladium virens*)		See label		0	Must be incorporated or drenched into the soil. See label for specific rates and methods of application.
	Amistar 80DF, Quadris 2.09FL (Azoxystrobin)	11	5 oz or 3.2 pts	1.88 lb	1	Limit is 4 appl/crop for all QoI fungicides. Do not make more than 2 consecutive appl. Follow guidelines on label for resistance management. Labeled for all cucurbits.
	Heritage (Azoxystrobin)	11	8.0 oz	3.0 lb	1	Do not make more than 2 consecutive appls. Do not make more than 6 appl/crop. Labeled for all cucurbits.
	Applause 720, Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Echo 720, Echo 90DF, Echo ZN, Equus DF, Equus 720 SST, Initiate 720 (Chlorothalonil)	M5	See label	See label	0	Recommended maximum rate is less for certain diseases including downy mildew. Follow label recommendations on watermelon after fruit set. Labeled for all cucurbits.

Table 7. Continued.

Disease	Chemical	Fungicide Group	Max. Rate/A/ Application	Max. Rate /A/Season	Min. Days to Harvest	Remarks
	ManKocide 61DF (Copper hydroxide & Mancozeb)	M1 & M3	2.66 lb	128 lb	5	Labeled for all cucurbits. Do not apply within five days of harvest.
	Fixed copper (M1)	See label			0	Repeated use may cause leaf yellowing.
	Rhapsody (*Bacillus subtilis* strain QST 713)		6 qt/100 gal		0	Labeled for all cucurbits. For improved performance tank mix or rotate with other registered fungicides.
Bacterial diseases: Leaf Blotch, Fruit Blotch, Angular Leaf Spot	Various copper formulations (Badge SC, Basic Copper 53, Champ DP Dry Prill, Champ Formula 2 FL, Champion WP, COC WDG, COC DF, COC WP, Copper-Count-N, Cuprofix Ultra 40 Disperss, Cuprofix MZ Disperss, Kentan DF, Kocide 101, Kocide 2000, Kocide 4.5LF, Kocide DF, Nordox, Nordox 75 WG, Nu-Cop 3L, Nu-Cop 50 WP, Nu-Cop 50 DF, Stretch, Tenn-Cop 5E)	M1	See label	See label		See label

Table 8. Selected insecticides approved for use on insects attacking cucurbit crops.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Acramite-50WS (bifenazate)	0.75-1.0 lb	12	3	twospotted spider mite	un	One application per season.
Actara (thiamethoxan)	1.5-5.5 oz	12	0	aphids, flea beetles, whiteflies	4A	Apply before pests reach damaging levels.
Admire Pro (imidacloprid)	7-10.5 oz	12	21 (soil)	aphids, cucumber beetles, leafhoppers, thrips, whiteflies	4A	Will not control thrips in flowers. Do not use with other Group 4A insecticides
Admire Pro (imidacloprid)	0.44 fl oz/10,000 plants	12	21	aphids, whiteflies	4A	**Planthouse:** One application to transplants. See label for use on mature greenhouse cucumbers.
Agree WG (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	lepidopteran larvae (caterpillar pests)	11	Apply when larvae are small for best control. OMRI-listed[2].
***Agri-Mek 0.15 EC** (abamectin)	8-16 fl oz	12	7	leafminers, spider mites	6	Minimum 7-day int. No more than 2 sequential applications.
***Ambush 25W** (permethrin)	6.4-12.8 oz	12	0	cabbage looper, cucumber beetles, cutworms, leafminers, lygus bug, melonworm, pickleworm, plant bugs, rindworms, squash bugs, squash vine borer, stink bugs	3	Do not apply more than 1.6 lb ai/acre per season.
***Asana XL (0.66 EC)** (esfenvalerate)	5.8-9.6 fl oz	12	3	cabbage looper, corn earworm, cucumber beetles (adults), cutworms (seedling spray), grasshoppers, leafhoppers, lygus bug, rindworms, squash bug, squash vine borer, stink bugs	3	Do not apply more than 0.25 lb ai/acre per season, (or 5 applications at high rate).
Assail 30SG, 70WP (acetamiprid)	2.5-5.3 oz 1.1-2.3 oz	12	0	aphids, cucumber beetles, leafhoppers, melonworm, pickleworm, squash bug, squash vine borer, whiteflies	4A	No more than 5 applications per season. Do not use if another group 4A insecticide has been used.
Avaunt (indoxacarb)	2.5-6.0 oz	12	3	beet armyworm, cabbage looper, melonworm, pickleworm	22	Do not apply more than 24 oz/acre per crop.
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, repellant, 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, repellant, insect growth regulator.
***Baythroid XL** (beta-cyfluthrin)	0.8-2.8 fl oz	12	0	armyworm, cabbage looper, corn earworm, cucumber beetles, cutworms, grasshoppers, melonworm, pickleworm, rindworms, tobacco budworm	3	Maximum amount per season: 11.2 fl oz/acre.
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.

Table 8. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Biobit HP (*Bacillus thuringiensis* subspecies *kurstaki*)	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[2].
BotaniGard 22 WP, ES (*Beauveria bassiana*)	**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.
***Brigade 2 EC** (bifenthrin)	2.6-6.4 fl oz	12	3	aphids, armyworms, cabbage looper, corn earworm, cucumber beetles, cutworms, grasshoppers, leafhoppers, melonworm, mites, pickleworm, plant bugs, rindworms, squash bug, squash vine borer, stink bugs, tobacco budworm	3	Do not apply more than 19.2 ounces of product per acre per season. Do not make more than 2 applications after bloom.
Coragen (rynaxypyr)	2.0-7.0 fl oz	4	1	beet armyworm, cabbage looper, melonworm, pickleworm, suppression of leafminers and whitefly nymphs	28	May be applied through drip (chemigation).
Courier 40SC (buprofezin)	9-13.6 fl oz	12	7	whitefly nymphs	16	Insect growth regulator. Do not make more than 2 applications per season per crop. See label for crop rotational restrictions.
Crymax WDG (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	caterpillars	11	Use high rate for armyworms. Treat when larvae are young.
***Danitol 2.4 EC** (fenpropathrin)	10.67-16 fl oz	24	7	banded cucumber beetle, cabbage looper, fall armyworm, green stink bug, plant bug, striped cucumber beetle, twospotted spider mite, yellow-striped armyworm **NOTE:** mix with endosulfan for aphid, thrips, and whitefly control.	3	Do not exceed 42.67 fl oz per acre per season.
Deliver (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-1.5 lb	4	0	caterpillars	11	Use higher rates for armyworms. OMRI-listed[2].
***Diazinon 4 E, *50 W, *AG500** (diazinon)	**foliar - AG500, 4E:** 0.5-1.5 pt **50W:** 0.5-1.5 lb	72	3	aphids, cucumber beetles, leafhoppers, leafminers, mites, thrips	1B	Will not control organophosphate- resistant leafminers. Do not apply more than once (foliar or s oil) melons only. Not for squash or cucumbers.
	preplant - AG500, 4E: 2-4 qts **50W:** 4-8 lb		preplant	cutworms, wireworms		

Table 8. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
***Dibrom 8E** (naled)	1 pt	48	1	aphids, armyworms, cucumber beetles, loopers, thrips	1B	Summer squash and netted varieties of cantaloupe only. Do not use if temperature is >90°F.
Dimethoate 4 EC, 2.67 EC (dimethoate)	**4EC:** 0.5-2 pt **2.67:** 0.75-1.5 pt	48	3	aphids, leafhoppers, leafminers, maggots	1B	Highly toxic to bees. Not for squash or cucumber.
DiPel DF (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	caterpillars	11	Treat when larvae are young. Good coverage is essential. OMRI-listed[2].
Durivo (thiamethoxam, chlorantraniliprole)	10-13 fl oz	12	30	aphids, flea beetles, leafhoppers, melonworm, pickleworm, thrips, whiteflies	4A, 28	Apply via drip chemigation only.
Entrust (spinosad)	1.25-2.5 oz	4	3	armyworms, cabbage looper, leafminers, loopers, melonworm, pickleworm, rindworms, thrips	5	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	0	green peach aphid, melon aphid, suppression of whiteflies	9B	Minimum of 7 days between applications. Maximum 5.5 oz/acre/season.
Intrepid 2F (methoxyfenopzide)	4-10 oz	4	3	beet armyworm, cabbage looper, melonworm, pickleworm, rindworm, southern armyworm, true armyworm, yellowstriped armyworm	18	Do not make more than 4 applications per season.
Javelin WG (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12-1.50 lb	4	0	most caterpillars, but not *Spodoptera* species (armyworms)	11	Treat when larvae are young. Thorough coverage is essential. OMRI-listed[2].
Knack IGR (pyriproxyfen)	8-10 fl oz	12	7	whiteflies (immatures)	7C	Do not apply more than twice per season. Do not apply less than 8 oz per acre per application.
Kryocide (cyrolite)	8-16 lb (8-12 for cucumber)	12	14 7 - summer squash only	cabbage looper, *Diabrotica* beetles (cucumber beetles), flea beetles, melonworm, pickleworm	un	Do not exceed 64 lb/acre per season, 48 for cucumber.
***Lannate LV** (methomyl)	LV: 1.5-3.0 pt	48	1=1.5 pts 3=1.5+ pts	beet armyworm, cucumber beetles, fall armyworm, flea beetles, granulate cutworms, loopers, melon aphid, melonworm, pickleworm, tobacco budworm, variegated cutworm, yellowstriped armyworm	1A	Not for use on winter squashes such as butternut or acorn - only for summer squash, cucumbers, and melons.

Table 8. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
***Lannate SP** (methomyl)	SP: 0.5-1.0 lb	48	1=1/2 lb 3=1/2+ lb	See above		
Lepinox WDG (*Bacillus thuringiensis* subspecies *kurstaki*)	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.
Malathion 8 (malathion)	1.75 pt	12	1	aphids, cucumber beetles, leafminers, mites, pickleworm, squash vine borer	1B	Squash and cucumbers only.
M-Pede 49% EC (Soap, Insecticidal)	1-2%V/V	12	0	aphids, leafhoppers, mites, plant bugs, thrips, whiteflies	–	OMRI-listed[2].
***MSR Spray Concentrate** (oxydemeton-methyl)	1.5-2.0 pt	14 days	14	aphids, cucumber beetles, mites	1B	Do not apply more than 3 times per season.
Neemix 4.5 (azadirachtin)	4-16 fl oz	12	0	fall armyworm, leafminers, melonworm, pickleworm, rindworms, squash bug, squash vine borer, tobacco budworm, whiteflies	un	IGR and feeding repellant. Greenhouse and field use. OMRI-listed[2].
Oberon 2SC (spiromesifen)	7.0-8.5 fl oz	12	7	twospotted spider mite, whiteflies	23	Maximum amount per crop: 25.5 fl oz/acre. No more than 3 applications. See label for plant-back intervals.
Oil, Insecticidal SunSpray 98.8% Ulta-Fine **JMS Stylet Oil, Saf-T-Side, Others**	3-6 qts/100 gal (JMS) 1-2 gal/100 gal	4	0	aphids, leafhoppers, leafminers, mites, thrips, whiteflies, aphid-transmitted viruses (JMS)	--	Organic Stylet-Oil and Saf-T-Side are OMRI- listed[2].
Platinum (thiamethoxam) **Platinum 75SG**	5-11 fl oz 1.66-3.67 oz	12	30	aphids, flea beetles, whiteflies	4A	For most crops that are not on the label, a 120-day plant-back interval must be observed.
***Pounce 25 WP** (permethrin)	6.4-12.8 oz	12	0	aphids, cabbage looper, cucumber beetles, cutworms, leafhoppers, leafminers, melonworm, pickleworm, plant bugs, rindworms, squash bug, squash vine borer	3	Use high rate for aphids and squash bug. Do not apply more than 1.2 lb ai/acre per season (0.8 lb ai for cantaloupes).
Prokil Cryolite 96 (cyrolite)	8-16 lb	12	14 7 for summer squash	cabbage looper, *Diabrotica* beetles (cumcumber beetles), flea beetles, melonworm, pickleworm	un	Do not apply more than 80 lb/acre per season. Not for cucumbers.
Pyganic 5.0 (pyrethrins)	4.5-18 oz	12	0	insects	3	Treat when insects first appear.
Pyrellin EC (pyrethrin + rotenone)	1-2 pt	12	12 hours	aphids, leafhoppers, leafminers, loopers, lygus bug, mites, plant bugs, thrips, whiteflies	3, 21	Can be used on greenhouse vegetables.
Pyronyl Crop Spray (pyrethrin + piperonyl butoxide)	1-12 fl oz	12	12 hours	ants, aphids, armyworms, cabbage looper, corn earworm, cucumber beetles, flea beetles, leafhoppers, thrips, whiteflies	3	Can be used on greenhouse vegetables.

Table 8. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Radiant SC (spinetoram)	5-10 fl oz	4	3 1 for cucumbers	armyworms (not yellowstriped), cabbage looper, leafminers, melonworm, pickleworm, rindworms, thrips	5	No more than 6 applications or 34 fl oz per acre per crop.
Requiem (extract of *Chenopodium ambiosioides*)	2-3 qts	4	0	green peach aphid, whiteflies	un	Apply before pests reach damaging levels.
Sevin 80S, 4F, XLR (carbaryl)	**80S:** 0.63-1.25 lb **4F, XLR:** 0.5-1.0 qt	12	3	cucumber beetles, flea beetles, leafhoppers, melonworm, pickleworm, squash bug	1A	Do not apply more than 7.5 lb (80S) or 6 qt (4F, XLR) per acre per year. Do not apply when plants are wet.
SpinTor 2 SC (spinosad)	4-8 fl oz	4	3 1 for cucumber	armyworms, cabbage looper, leafminers, melonworm, pickleworm, thrips	5	Do not apply more than 3 times in a 21-day period. Rotate to a different class of product for 21 days.
Sulfur	See label	24	1	mites	--	
Synapse WG (flubendiamide)	2.0-3.0 oz	12	1	armyworms, cabbage looper, melonworm, pickleworm, rindworms	28	Do not apply more than 9 oz per acre per season.
***Telone C-35** (dichloropropene + chloropicrin)	See label	5 days	preplant	symphylans, wireworms	--	See supplemental label for use restrictions in south and central Florida.
***Telone II** (dichloropropene)						
***Thionex 3 EC** ***Thionex 50W** (endosulfan)	0.66-1.33 qt 1-2 lb	24	2	aphids, cabbage looper, cucumber beetles, melonworm, pickleworm, rindworms, squash beetle, squash bug, squash vine borer, striped flea beetle, whiteflies	2	Do not make more than 6 applications per year or exceed 3.0 lb active ingredient per acre per year.
Trigard (cyromazine)	2.66 oz	12	0	leafminers	17	Do not make more than six applications.
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[2].
Venom Insecticide (dinotefuran)	**foliar:** 1-4 oz **soil:** 5-6 oz	12	**foliar:** 1 **soil:** 21	leafhoppers, leafminers, thrips, whiteflies	4A	Do not apply more than 6 oz per acre per season (foliar) or 12 oz (soil) per acre per season. Use only one application method (soil or foliar).
***Vydate L** (oxamyl)	2-4 pt	48	1	aphids, leafminers, thrips	1A	Do not apply more than 24 pt per acre per season.
Xentari DF (*Bacillus thuringiensis* subspecies *aizawai*)	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.
Zeal (etoxazole)	2.0-3.0 oz	12	7	twospotted spider mite	10B	Melons only. Apply when populations are low. One application per season.

Table 8. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes

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

*** Restricted Use Pesticide**

Table 9. Breakeven production costs of cucumber at various yield levels in southwest Florida, 2005-2006.

		Yield (bushels/acre)				
	Cost per acre	400	500	600	700	800
Variable Costs	$1,684.29	$4.21	$3.37	$2.81	$2.41	$2.11
Fixed Costs	$801.73	$2.00	$1.60	$1.34	$1.15	$1.00
Harvest Cost/unit		$4.66	$4.66	$4.66	$4.66	$4.66
Total Cost/unit		$10.88	$9.63	$8.80	$8.21	$7.77

Table 10. Breakeven production costs of summer squash at various yield levels in the Miami-Dade County area, 2005-2006

		Yield (bushels/acre)				
	Cost per acre	300	338	375	413	450
Variable Costs	$1,535.30	$5.12	$4.54	$4.09	$3.72	$3.41
Fixed Costs	$1,197.38	$3.99	$3.54	$3.19	$2.90	$2.66
Harvest Cost/unit		$5.40	$5.40	$5.40	$5.40	$5.40
Total Cost/unit		$14.51	$13.48	$12.69	$12.02	$11.47

Table 11. Breakeven production costs of watermelon at various yield levels in the Manatee/Hillsborough areas, 2005-2006.

		Yield (cwt/acre)				
	Cost per acre	280	300	320	340	360
Variable Costs	$1,522.41	$5.44	$5.07	$4.76	$4.48	$4.23
Fixed Costs	$749.58	$2.68	$2.50	$2.34	$2.20	$2.08
Harvest Cost/unit		$2.66	$2.66	$2.66	$2.66	$2.66
Total Cost/unit		$10.77	$10.23	$9.76	$9.34	$8.97

Table 12. Breakeven production costs of watermelon at various yield levels in the southwest Florida area, 2005-2006.

		Yield (cwt/acre)				
	Cost per acre	300	320	340	360	380
Variable Costs	$2,144.04	$7.15	$6.70	$6.31	$5.96	$5.64
Fixed Costs	$1,097.18	$3.66	$3.43	$3.23	$3.05	$2.89
Harvest Cost/unit		$2.95	$2.95	$2.95	$2.95	$2.95
Total Cost/unit		$13.75	$13.08	$12.48	$11.95	$11.48