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Chapter 24.
Guidelines for Chinese Leafy and Root Crop Vegetables in South Florida

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Over 4,500 acres of Chinese vegetables are being grown in Florida. Production occurs on sand, marl, and muck soils. Approximately 3,100 harvested acres are grown in Palm Beach County (2,800 acres on sand soil and 300 on muck) with the remaining production coming from Miami-Dade, Hillsborough, Manatee, Orange, Seminole, and Bradford counties. Most growers can average two or more harvested crops per acre per year. Sub-surface seepage irrigation is used in Palm Beach County and Central Florida and overhead irrigation is used in the Homestead area. Total production has remained fairly steady for the last 10 years with most of the vegetables being marketed in areas with large Asian populations, such as New York, Boston, Chicago, Washington DC, Atlanta, Houston, Toronto, Montreal, and Vancouver.

In Central and South Florida, planting begins in early to mid-September and continues until late April (for short season crops). Harvesting begins in late October and continues to late May. There may be little or no production in North Florida in mid-winter. Early and late season demand for these crops partially depends on the supply coming from New Jersey and other Northeast production areas. Mexico supplies part of the market from late fall to early spring and California has supplies year round. These crucifers grow best during cooler weather: generally November to April in South Florida and fall and spring in North Florida. Crops grown during warmer weather and when heavy rains are common are more subject to disease and insect pests as well as to several physiological disorders.

GENERAL PRODUCTION PRACTICES

In Southeast Florida sandland production, Chinese leafy vegetables are typically grown on 44-inch wide raised beds on six-foot centers. The beds are pressed and the soil surface is often roughened with a cage cultivator before planting. Cross ditches are made to increase surface drainage. Where broadcast fertilizer is needed, it may be applied before bedding or at bedding. On previously cropped land testing high in P and minor elements, no broadcast fertilizer is used, but the first sidedress application of N and K is applied very soon after planting.

Crops are direct seeded in three to four rows per bed (Table 1). Four rows are used for smaller sized crops such as Chinese broccoli, baby bok choy, Shanghai bok choy, and u-choy where rows are 11 inches apart. Three rows per bed are used for larger sized crops such as napa, bok choy, and Chinese mustard where rows are 14 inches apart. Occasionally growers may grow napa in two rows to the bed if very large heads are desired. Chinese radishes may be grown three rows per bed in the fall and spring and four rows per bed during the winter. Closely spaced crops such as broccoli and u-choy are precision seeded to stand and usually not thinned. Slightly larger crops, such as baby bok choy and Shanghai bok choy, may be precision seeded to stand or hill planted and thinned to stand. The largest sized crops (napa, bok choy, and Chinese mustard) are hill planted and thinned to stand. Stanhay belt seeders are used successfully. Napa and bok choy transplants have been used successfully where fields are extremely weedy or where growing seasons are short.

On muck soils, where crops have been mostly limited to chihili with small acreages of napa and bok choy, lettuce beds on three-foot centers have been used. Crops are planted two rows per bed in rows 12 to 14 inches apart.

Usually two to four sidedress applications of fertilizer are made depending on rainfall and length of crop season. Recommended amounts are 30 to 40 lb/A N and K per application. Dry fertilizer is usually used early while it can be incorporated by cultivation. Rolling cage cultivators are used for weed control and fertilizer incorporation. Liquid fertilizer may be knifed in after the crop begins to close over the row. Sweeps are usually used on cultivation equipment and/or fertilization equipment to reform and firm soil up against the sides of the beds. Details on chemical pest control are presented in Table 2.

Weeds in the row are pulled by hand when crops are thinned and hand weeding may be done a second time depending on weed pressure.

Most of the leafy crops are cut by hand, field packed in either wirebound wooden crates or corrugated cardboard and vacuum cooled. Some baby bok choy may be cut and hauled in bulk to a packing area where it is trimmed and

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place packed to enhance appearance. Chinese radish may be trimmed and washed in the field or be transported to the packinghouse for washing and packing. Chinese radishes may only be room cooled prior to shipment.

IRRIGATION

Little direct information is available on water use of Chinese vegetables grown under Florida conditions. Thus, irrigation requirements may be estimated based on the requirements of similar types of vegetables listed in Tables 4 to 6 of Chapter 3, *Principles and Practices for Irrigation Management of Vegetables*. This table provides crop water use coefficients for the major vegetable crops gown in Florida. Crop water use can be estimated by multiplying these coefficients times the values of reference evapotranspiration, ETo, listed in Table 3 of Chapter 3, *Principles and Practices for Irrigation Management of Vegetables*.

For optimum production, irrigation should be scheduled to maintain adequate soil moisture throughout the growing season. For drip and sprinkler irrigation, small, frequent applications should be scheduled to avoid water and nutrient losses below the plant root zone. For seepage irrigation, the field water table should be maintained sufficiently high that soil moisture is adequate but not excessively wet in the plant root zone throughout the growing season. Overhead irrigation is often used in the dry spring season to assist crop emergence. Generally, a-choy tolerates wetter soil conditions than other crops.

SPECIFIC CROP DETAILS

Napa (tight-heading Chinese cabbage). Suggested varieties: China Pride and China Express. 60-85 days seeding to maturity. Average seasonal yield 300-500+ 1 3/4 bu. crates/A (50 lb/crate, 12-18 heads per crate). Once over harvest may be possible if crop is uniform. Typical average price, $5-8.50/crate.

Possible Problems: Beet and fall armyworm especially in the fall, sporadic aphid infestations in winter and early spring, diamond-back moth (DBM) in spring, and bacterial soft rot with excess soil moisture or flooding. Physiological: Black spot (pepper spot), blackheart, tipburn, and occasional premature bolting.

Chihili (semi-loose headed Chinese cabbage), mostly grown on muck soil. Suggested varieties: Michihili, Monument, Jade Pagoda. 55-70 days seeding to maturity. Average seasonal yield 600-800+ crates/A (45 lb/crate, 20-24 heads per crate). Typical average price, $4-7/crate.

Possible Problems: Beet and fall armyworm especially in the fall, sporadic aphid infestations in winter and early spring, DBM in spring, and bacterial soft rot with excess soil moisture or flooding. Physiological: Black spot (pepper spot), blackheart, and tipburn and occasional premature bolting.

Bok choy. Suggested variety: Joi Choy. 55-70 days seeding to maturity. Average seasonal yield 300-500+1 3/4 crates/A (50 lb/crate, 14-22 heads per crate). Typical average price, $6-9/crate. Cut and laid on bed for a short time before packing so petioles will wilt and not be broken when packed.

Possible Problems: Beet and fall armyworm especially in the fall, sporadic aphid infestations in winter and early spring, DBM in spring, and bacterial soft rot with excess soil moisture or flooding. Physiological: occasional black spot (pepper spot) and premature bolting.

Baby bok choy and **Shanghai bok choy**. 45-55 days seeding to maturity. Average seasonal yield 250-400+ 1 3/4 bu crates/A (45 lb/crate, 30-50 heads per crate). One to two harvests. Typical average price, $8-12/crate.

Possible Problems: Beet and fall armyworm especially in the fall, sporadic aphid infestations in winter, DBM in spring, bacterial soft rot with excessive soil moisture or flooding. Pest infestations are usually not as severe as on napa and bok choy. Physiological: premature bolting.

U-choy (flowering bok choy). 30-45 days seeding to maturity. Average seasonal yield 120-260 1 3/4 bu crates/A (40 lb/crate, loose packed). Two to three harvests. Matures quickly, must cut before plants reach full flower. Harvest is labor intensive. Typical average price, $14-22/crate. Will

Table 1. Typical plant spacings and theoretical plant populations for several of the Chinese vegetables grown on sand.

Crop	Rows/44-inch Wide Bed (6 ft. centers)	Between rows (inches)	In-row Spacing (inches)	Plants Per Acre
napa	2 or 3	14 or 24	14-18	9,680-18,671
bok choy	3	14	14-18	14,520-18,671
Chinese mustard	3	14	12-18	14,520-29,040
Chinese radish	3 or 4		6-9	29,040-58,080
choy-sum	4	11	8-12	29,040-43,560
Shanghai bok choy	4	11	8-12	29,040-43,560
baby bok choy	4	11	6-10	34,848-58,080
u-choy	4	11	2-4	87,120-174,240
Chinese broccoli	4	11	3-5	69,696-116,160

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tolerate moist soil conditions better than other Chinese leafy crops.

Possible Problems: Beet and fall armyworm especially in the fall, sporadic aphid infestations in winter and early spring, and DBM in spring. Pest infestations are usually not as severe as on napa and bok choy.

Choy-sum (heading bok choy). 60-70 days seeding to maturity. Average seasonal yield 250-400 1 3/4 bu crates/A (40 lb/crate, 60-90 heads per crate). Two to three harvests. Typical average price, $11-14/crate.

Possible Problems: Beet and fall armyworm especially in the fall, sporadic aphid infestations in winter and early spring, DBM in spring, and bacterial soft rot with excessive soil moisture or flooding. Pest infestations are usually not as severe as on napa and bok choy.

Chinese broccoli (gai lon or flowering kale). Suggested variety: Green Lance. Different types by stem length and color from light to medium green. 55-70 days seeding to maturity. Average seasonal yield 130-270 1 3/4 bu crates/A (40 lb/crate, loose packed). Two to three harvests. Cut before beads flower. Typical average price, $14-18/crate.

Possible Problems: Beet and fall armyworm especially in the fall, sporadic aphid infestations in winter and early spring, DBM in spring. Susceptible to downy mildew. Silverleaf whitefly infestations common but don't usually cause a serious problem.

Chinese mustard. 50-70 days seeding to maturity. Average seasonal yield 220-400 1 3/4 bu crates/A (50 lb/crate, 16-24 heads per crate). One to two harvests. Typical average price, $7.50-9/crate.

Possible Problems: Beet and fall armyworm especially in the fall, sporadic aphid infestations in winter and early spring, DBM in spring, and bacterial soft rot with excessive soil moisture or flooding. When leafminers are a problem, they are usually more severe on Chinese mustard than other Chinese leafy crops. Physiological: premature bolting.

Oriental radish (Chinese, Korean, and Japanese daikon). 55-75 days seeding to maturity. Average seasonal yield 200-325 1 1/9 bu crates/A (50 lb/crate, 20-30 radishes per crate). Two to three harvests. Pulled and dipped in water. Top cut off before field packing. Typical average price, $5.50-6.75/crate.

Possible Problems: Beet and fall armyworm especially in the fall, sporadic aphid infestations in winter and early spring, and DBM in spring. Since the tops are not sold, these pests problems are usually not as severe a problem as on leafy crops.

General Pest Control Strategies

Armyworms and DBM: Use soft pesticides such as Bt, SpinTor, Entrust, Proclaim and neem where possible to avoid intensifying leafminer pressure. Rotate between aizawai and kurstaki strains of Bt. Under severe pressure applications may need to be made twice/wk. Avoid using permethrin when DBM are present because DBM populations may be increased.

Aphids: Use soil applications of Admire at seeding or foliar applied Provado when aphids appear.

Leafminers: Can usually be controlled with two applications of Trigard. Severe outbreaks can generally be avoided by limiting the use of harsh pesticides.

Downy mildew: Use Manex under moderate pressure and Aliette or Ridomil Gold Bravo (Chinese broccoli and napa only) under heavier pressure.

Alternaria: Use Manex under moderate pressure and Bravo/Equus (for Chinese broccoli and napa only) under heavier pressure. Rovral (for Chinese mustard only) is also recommended for heavy pressure.

Reference

Vavrina, Charles S. (ed.) 1992. Production Guide for Florida Chinese Leafy Vegetables. Fla. Coop. Ext. Serv. Circ. SP-100.

WEED CONTROL

The term "**Brassica leafy vegetables**" is a crop group established by EPA to allow tolerances to be established for the whole crop group. Bensulide (Prefar), CDPA (Dacthal), sethoxydim (Poast), cleethodim (Select) and carfentrazone (Aim) are all labeled on the total brassica leafy vegetable group. This includes the head and stem brassica subgroup, including broccoli, Chinese broccoli, Brussels sprouts, cabbage, Chinese cabbage (napa), Chinese mustard cabbage, cauliflower, cavalo broccoli, and kohlrabi. It also includes the leafy brassica greens subgroup, including broccoli raab, Chinese cabbage (bok choy and chihilli), collards, kale, mizuna greens, mustard spinach, rape greens, and turnip greens. If the total crop group is not stated, then the product may only be used for those commodities listed on the label.

If a label states directions for cabbage, then it may only be used on cabbage; if it states cabbage and tight-headed Chinese cabbage, it may also be applied to the napa types of Chinese cabbage. The chihilli types are classified as loose headed as is bok choy.

Check the labels in Chapter 25, Cole Crop Production for labels on the various crops.

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Table 2. Preharvest intervals for pesticides labeled for Chinese vegetables. (Check labels for specific recommendations and restrictions)

	Napa	Bok choy	Chinese mustard	Chinese broccoli	Chinese radish	Kohlrabi	Comments
Insecticides							
Ammo 2.5 EC	1	1	1	1		1	
Asana XL	3			3			
Assail 30SG, 70WP	7	7	7	7		7	
Avaunt	3		3	3		3	
Azadirachtin *	0	0	0	0	0	0	
B.T. [1]	0	0	0	0	0	0	
Annex, Capture, Discipline, Empower 2 EC	7		7	7		7	
Chloropyrifos 4E, 15G	x	x				x	band at planting
Chlorpyrifos 50W						21	
Confirm 2 F	7	7	7	7		7	
Diazinon	10	10	10	10	10		
Dimethoate 267	7	7				7	
Di-syston 8, 15G	42						limited to one application
Guthion	21						
Imidacloprid *	21	21	21	21		21	soil application
Imidacloprid *	7	7	7	7		7	foliar application
Intrepid 2F	1	1	1	1		1	
Lannate LV	10	10					
Malathion	7	7	7	7		7	check label to be sure it is on it
Metasystox - R	7						
Mustang, Mustang Max	1	1	1	1		1	
Neemix	0	0	0			0	
Permethrin *	1		1	1		1	
Proclaim	7		7	7		7	
Sevin	14	1	14			3	
Spintor/Entrust	1	1	1	1		1	
Trigard	7	7	7				
Triology	0	0	0	0	0	0	
Venom 20 SG	1	1	1	1		1	
Warrior w/Zeon	1		1	1		1	
Fungicides							
Aliette	3	3	3	3		3	
Amicarb 100						0	
Bravo/Equus	7			7			
Cabrio EG					0		
Endura	0		0	0		0	
Manex/Maneb	7	10				7	
M-Pede	0	0		0		0	
Phostrol	0	0	0	0		0	
Quadris					0		
Ridomil Gold	x	x	x	x	x	x	preplant or at planting

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Table 2. Continued.

	Napa	Bok choy	Chinese mustard	Chinese broccoli	Chinese radish	Kohlrabi	Comments
Fungicides continued.							
Ridomil Gold Bravo	7			7			
Rovral/Iprodione			10				
PCNB/Terrachlor	X	X		X			incorporate into soil before planting
Switch 62.5WG	7	7		7		7	
Ultra Flourish	x	x	x	x	x	x	preplant or at planting
Herbicides							
See Chapter 25 Table 9 for herbicide information.							

[1] *Bacillus thuringiensis* insecticides include Agree, Crymax, Deliver, Dipel, Javelin, XenTari, etc.

* Are many brands and formulations available, consult label for specifics.