

Chapter 19.

Spinach Production in Florida

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BOTANY

Nomenclature

Family - Chenopodiaceae

Spinach - *Spinacia oleracea*

Origin

Spinach is believed to be native to the Middle East in the general area of Iran (Fig. 19-1).

Related Species

Beet and Swiss chard are the only other vegetables of significance in the Chenopodiaceae family. The most important economic plant in this family is the sugar beet.

VARIETIES

Spinach varieties grown in Florida include:

Smooth leaf

A&C #30 (H)¹

Space (H)

Semi-savoy leaf

Chinook II (H)

Gladiator (H)

Melody (H)

Skookum (H)

Tyee (H)

Savoy leaf

Ambassador (H)

Hybrid 612 (H)

¹H = hybrid.

SEEDING AND PLANTING

Planting dates and seeding information are given in Table 1.

FERTILIZER AND LIME

For mineral soils, broadcast all P₂O₅, micronutrients, and 25 to 50% of N and K₂O. Topdress remaining N and K₂O about 2 to 3 weeks after seeding (see Table 2).

For organic soils, broadcast all fertilizer before seeding. Up to 30 lbs/A of N might be needed in cool, winter weather or after leaching rain.

PLANT TISSUE ANALYSIS

Plant tissue analysis information for spinach is given in Table 3. The analysis was done 30 days after seeding, using the most recently matured leaf.

IRRIGATION

Initial water requirements of spinach (see Chapter 3, *Principles and Practices for Irrigation Management of Vegetables*, Table 4 to 6) will be low (20% to 40% of ETo, see Chapter 3, *Principles and Practices for Irrigation Management of Vegetables*, Table 3) until rapid leaf growth occurs. Water requirements rapidly increase to 95% of ETo and remain at or only slightly below that level through harvest.

WEED MANAGEMENT

Herbicides labeled for weed control in spinach are listed in Table 4.

DISEASE MANAGEMENT

Information on managing diseases of spinach are listed in Table 5.

INSECT MANAGEMENT

Table 6 outlines the insecticides approved for use on insects attacking spinach.

Table 1. Seeding and planting information for spinach.

Planting dates	
North Florida	Sept - Mar
Central Florida	Sept - Mar
South Florida	Oct - Feb
Seeding information	
Distance between rows (in)	12 - 36
Distance between plants (in)	2 - 6
Seeding depth (in)	0.5
Seed per acre (lb)	10 - 15
Days to maturity from seed	45 - 60
Plant population ¹ (acre)	261,136
¹ Population based on closest between and within row spacing.	

Table 2. Soil test and fertilizer recommendations for mineral soils for spinach.¹

Target pH	N lb/A	<u>P₂O₅</u>					<u>K₂O</u>				
		VL	L	M	H	VH	VL	L	M	H	VH
		(lb/A/crop season)									
6.5	90	120	100	80	0	0	120	100	80	0	0

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

¹ Seeds and transplants may benefit from applications of a starter solution at a rate no greater than 10 to 15 lbs/acre for N and P₂O₅, and applied through the plant hole or near the seeds.

Table 3. Plant tissue analysis for spinach 30 days after seeding. Dry wt. basis.

Status	N	P	K	Ca	Mg	S	Fe	Mn	Zn	B	Cu	Mo
	Percent						Parts per million					
Deficient	<3.0	0.3	3.0	0.6	1.0	0.3	50	50	50	20	5	0.1
Adequate range	3.0-4.5	0.3-0.5	3.0-4.0	0.6-1.0	1.0-1.6	0.3-0.6	50-150	50-100	50-80	20-40	5-10	0.1-1.0
High	>4.5	0.5	4.0	1.0	1.6	0.6	150	100	80	40	10	1.0

Table 4. Chemical weed controls: spinach.

Herbicide	Labeled crops	Time of application to crop	Rate (lbs. AI./Acre)	
			Mineral	Muck
Carfentrazone (Aim)	Spinach	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 burn-down of emerged broadleaf weeds. May be tank mixed with other registered herbicides. May be applied at up to 2 oz (0.031 lb ai). Use a quality spray adjuvant such as crop oil concentrate (coc) or non-ionic surfactant at recommended rates.				
Clethodim (Select 2 EC) (Arrow) (Select Max)	Spinach	Postemergence	0.09-0.25	
Remarks: Postemergence control of actively growing annual grasses. Apply at 6-16 fl oz/acre (Select, Arrow) or 9-16 fl oz/acre (Select Max). Higher rates are listed for perennial grasses. Use a crop oil concentrate for Select and Arrow, but a non-ionic surfactant may be used for Select Max. Do not apply within 14 days of harvest.				
Glyphosate (Roundup, Touchdown Durango, Glyphomax)	Spinach	Prior to crop emergence or pretransplanting	0.5 - 1.0	0.5 - 1.0
Remarks: Apply as directed for "Cropping Systems" under conditions described on label. Does not provide residual weed control.				
Pelargonic Acid (Scythe)	Spinach	Preplant 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.				
Sethoxydim (Poast)	Spinach	Postemergence	0.188 - 0.28	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 30 days of harvest for head lettuce and 15 days of harvest for leaf lettuce and spinach. 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.) to seedling grasses and up to 0.28 lb. ai. (1.5 pts.) to perennial grasses emerging from rhizomes, etc. Consult label for grass species and growth stage for best control.				

Table 5. Disease management for spinach.

Chemical (a.i.)	Fungicide Group	Maximum Rate/Acre/		Min. Days to Harvest	Pertinent Diseases	Remarks
		Application	Season			
Ridomil Gold 4 EC (Mefenoxam)	4	2 pt/trtd acre			Pythium seedling blight	Apply at seeding in a 7-12" band on soil over seed furrow
Actigard (Acibenzolar-s-methyl)	21	0.75 oz	2.25 oz	7	Downy mildew	Apply preventatively. Do not make more than 3 consecutive applications.
Aliette 80 WDG (Fosetyl-Al)	33	5 lb	35 lb	3	Downy mildew	Limit is 7 appl/crop. Do not tank mix with copper fungicides
Amistar (Azoxystrobin)	11	5 oz	20 oz	0	Various, see label	Limit is 4 appl/crop & alternate chemistry
Cabrio 20 EG (Pyraclostrobin)	11	16 oz	64 oz	0	Various, see label	Limit is 4 appl/crop & alternate chemistry
Armicarb 100, Kaligreen, Milstop, (Potassium bicarbonate)		See labels	See labels	See labels	Powdery mildew	Do not mix with highly acidic pesticides. Use within 12 hrs of mixing
Various copper compounds (see individual labels), including Badge SC, Basic Copper 53, Blueshield, COCS WDG, Champ DP, Champion WP, Copper Count N, Cuprofix Ultra, Kentan, Kocide, Nordox, Nu Cop	M1	See labels	See labels	1	Downy mildew White rust Anthracnose Cercospora leaf spot	Flecking on leaves may occur. Do not tank-mix with phosphonic fungicides
Various Potassium phosphite compounds (see individual labels), including Fosphite, Fungi-phite, Prophyt, Phostral,		See labels	See labels	0	Downy mildew Pythium	
Various sulfur compounds (see individual labels), including Dusting Sulfur-IAP, Micro Sulf, Micronized Gold, Microthiol disperss	M2	See labels	See labels		Powdery mildew	Do not apply during periods of warm weather
Oxidate (Hydrogen dioxide)		2 gal				
Quadris 2.08 FL (Azoxystrobin)	11	15.4 fl oz	2.88 qt	0	Downy mildew, Stemphyllium leaf spot Various, see label	For restrictions and use patterns, see celery for foliar diseases and onions for soilborne diseases
Rhapsody (Bacillus subtilis strain QST 713)		6 qt		0	Downy mildew Powdery mildew	
Cabrio 20 EG (Pyraclostrobin)		16 oz	64 oz	0	Various, see label	Limit is 4 appl/crop & alternate chemistry

Table 6. Selected insecticides approved for use on insects attacking spinach.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code ¹	Notes
Actara (thiamethoxam)	1.5-5.5 oz	12	7	aphids, flea beetles, leafhoppers, whiteflies	4A	Do not use if other 4A insecticides have been or will be used.
Admire Pro (imidacloprid)	4.4-10.5 fl oz	12	21	aphids, leafhoppers, thrips (foliage feeders), whiteflies	4A	Limited to 0.38 lb ai per acre per season.
Agree WG (<i>Bacillus thuringiensis</i> subspecies <i>aizawai</i>)	0.5-2.0 lb	4	0	lepidopteran larvae (caterpillar pests)	11	Apply when larvae are small for best control. OMRI-listed ² .
*Agri-mek 0.15 EC (abamectin)	8-16 fl oz	12	7	<i>Liriomyza</i> leafminers, spider mites	6	No more than 2 sequential applications. Maximum of 48 oz per acre per season.
*Ambush 25W (permethrin)	6.4-12.8 oz	12	1	aphids, beet armyworm, cabbage looper, corn earworm, cutworms, fall armyworm, leafhoppers, vegetable leafminer	3	Do not apply more than 2 lb ai/acre per season.
Assail 70WP (acetamiprid)	0.8-1.7 oz	12	7	aphids, whiteflies	4A	Begin applications for whiteflies when first adults are noticed. Do not apply more than 5 times per season or apply more often than every 7 days.
Assail 30 SG	2.0-4.0 oz					
Aza-Direct (azadirachtin)	1-2 pts, to 3.5 pts if needed	4	0	aphids, beetles, caterpillars, leafhoppers, leafminers, mites, stink bugs, thrips, weevils, whiteflies	un	Antifeedant, repellent, insect growth regulator. OMRI-listed ² .
Azatin XL (azadirachtin)	5-21 fl oz	4	0	aphids, beetles, caterpillars, leafhoppers, leafminers, thrips, weevils, whiteflies	un	Antifeedant, repellent, insect growth regulator.
*Baythroid XL (beta-cyfluthrin)	0.8-3.2 fl oz	12	0	beet armyworm (1 st and 2 nd instars), cabbage looper, corn earworm, cutworms, flea beetles, grasshoppers, potato leafhopper, saltmarsh caterpillar, thrips, vegetable weevil, yellowstriped armyworm	3	Maximum of 12.8 fl oz per acre per season.
Beleaf 50 SG (flonicamid)	2.0-2.8 oz	12	0	aphids, plant bugs	9C	Do not apply more than 8.4 oz/acre per season. Begin applications before pests reach damaging levels.
Biobit HP (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5-2.0 lb	4	0	caterpillars (will not control large armyworms)	11	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed ² .
BotaniGard 22 WP, ES (<i>Beauveria bassiana</i>)	WP: 0.5-2 lb/100 gal ES: 0.5-2 qts/100 gal	4	0	aphids, thrips, whiteflies	--	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
Confirm 2F (tebufenozide)	6-8 fl oz	4	7	armyworms, cabbage looper, garden webworm	18	Do not exceed 56 ounces of product per acre per season.
Coragen (rynaxypyr)	3.5-7.5 fl oz	4	1	beet armyworm, cabbage looper, corn earworm, leafminers, suppression of whitefly nymphs	28	May be applied by drip chemigation.

Table 6. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code ¹	Notes
Crymax WDG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5-2.0 lb	4	0	caterpillars	11	Use high rate for armyworms. Treat when larvae are young.
Deliver (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.25-1.5 lb	4	0	caterpillars	11	Use higher rates for armyworms. OMRI-listed ² .
Diazinon AG500 50W (diazinon)	2-4 qts 4-8 lb	72	at planting	cutworms, wireworms	1B	Do not make more than one soil application per year.
DiPel DF (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5-2.0 lb	4	0	caterpillars	11	Treat when larvae are young. Good coverage is essential.
Durivo (thiamethoxam, chlorantraniliprole)	10-13 oz	12	30	aphids, beet armyworm, cabbage looper, corn earworm, fall armyworm, flea beetles, imported cabbageworm, leafhoppers, whiteflies	4A, 28	Apply via drip chemigation only.
Entrust (spinosad)	0.5-3 oz	4	1	armyworms, cabbage looper, leafminers, thrips	5	Use no more than 9 oz per acre per crop. OMRI-listed ² .
Extinguish (S)-methoprene)	1.0-1.5 lb	4	0	fire ants	7A	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
Fulfill (pymetrozine)	2.75 oz	12	7	aphids, suppression of whiteflies	9B	Apply when aphids first appear, before populations build to damaging levels. Two applications may be needed to control persistent aphid populations.
Intrepid 2F (methoxyfenozide)	4-16 fl oz	4	1	armyworms, cabbage looper, webworms	18	Do not apply more than 64 fl oz acre per season.
Javelin WG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.12-1.5 lb	4	0	most caterpillars, but not <i>Spodoptera</i> species (armyworms)	11	Treat when larvae are young. Thorough coverage is essential. OMRI-listed ² .
*Lannate LV; *SP (methomyl)	LV: 1.5-3.0 pts SP: 0.5-1.0 lb	48	7	beet armyworm, cabbage looper, fall armyworm, imported cabbageworm, variegated cutworm	1A	Do not use more than 4 lb of SP, or 12 pt of LV per acre/season. Do not apply to seedlings less than 3" diameter.
*Larvin 3.2 (thiodicarb)	16-30 fl oz	48	14	armyworms, beet armyworm, cabbage looper, corn earworm, fall armyworm, southern armyworm	1A	Do not exceed 60 fl oz per acre per season.
Lepinox WDG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	1.0-2.0 lb	12	0	for most caterpillars, including beet armyworm (see label)	11B2	Treat when larvae are small. Thorough coverage is essential.
Malathion 8 F (malathion)	1.5 pt	12	7	aphids	1B	

Table 6. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code ¹	Notes
Movento (spirotetramat)	4.0-5.0 fl oz	24	3	aphids, whiteflies	23	Do not apply more than 10 fl oz/acre/crop.
M-Pede 49% EC Soap, insecticidal	1-2% V/V	12	0	aphids, leafhoppers, mites, plant bugs, whiteflies	--	OMRI-listed ² .
*Mustang Max EC (zeta-cypermethrin)	2.24-4.0 oz	12	1	aphids, armyworms, corn earworm, crickets, cucumber beetles, cutworms, flea beetles, ground beetles, leafhoppers, loopers, <i>Lygus</i> bugs, saltmarsh caterpillar, stink bugs, tobacco budworm, whiteflies, wire-worm adults	3	A maximum of 0.15 lb ai/acre per season may be applied. Do not make applications less than 7 days apart.
Neemix 4.5 (azadirachtin)	4-16 fl oz	12	0	aphids, armyworms, leafhoppers, leafminers, loopers, whiteflies	un	IGR and feeding repellent. OMRI-listed ² .
Oberon 2SC (spiromesifen)	7.0-8.5 fl oz	12	7	whiteflies	23	Maximum amount per crop: 25.5 fl oz/acre. No more than three applications.
Platinum 75SG (thiamethoxam)	5.0-11 fl oz 1.66-3.67 oz	12	30	aphids, flea beetles, leafhoppers, leafminers (suppression), whiteflies	4A	Maximum = 11 oz/acre or 3.67 oz/acre (75SG) per season. Do not use in conjunction with other 4A insecticides.
*Pounce 25 W (permethrin)	6.4-12.8 oz	12	1	aphids, armyworms, beet armyworm, cabbage looper, corn earworm, cutworms, fall armyworm, leafhoppers, loopers, southern armyworm, tobacco budworm, vegetable leafminer	3	Do not apply more than 0.6 lb ai/acre per season.
*Proclaim (emamectin benzoate)	2.4-4.8 oz	12	7	beet armyworm, corn earworm, fall armyworm, loopers, tobacco budworm, suppression of leafminers	6	Do not apply more than 28.8 oz/A per season.
Provado 1.6 F (imidacloprid)	3.8 oz	12	7	aphids, flea beetles, leafhoppers, whiteflies	4A	Maximum of 19.0 fl oz per acre per season. Do not use with other 4A insecticides.
Pyrellin EC (pyrethrin + rotenone)	1-2 pt	12	0	aphids, cabbage looper, <i>Lygus</i> bug, mites, plant bugs, whiteflies	3, 21	
Radiant (spinetoram)	5-10 fl oz	4	1	armyworms (not yellow-striped), cabbage looper, corn earworm, <i>Liriomyza</i> leafminer, thrips	5	Maximum of 6 applications, no more than 2 consecutive applications before rotating to another MOA..
Sevin 80S; XLR; 4F (carbaryl)	80S: 0.63-2.5 lb XLR; 4F: 0.5-2.0 qt	12	14	armyworms, aster leafhopper, corn earworm, fall armyworm, flea beetles, leafhoppers, <i>Lygus</i> bug, spittlebugs, stink bug, tarnished plant bug	1A	Do not apply more than a total of 7.5 lb or 6 qt per acre per crop.
SpinTor 2 SC (spinosad)	1.5-10 fl oz	4	1	armyworms, cabbage looper, leafminers (<i>Liriomyza</i> spp.)	5	Do not apply more than 29 fl oz per acre per season.
Synapse WG (flubendiamide)	2.0-3.0 oz	12	1	armyworms, loopers	28	Do not apply more than 9.0 oz/acre per season.

Table 6. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code ¹	Notes
*Telone C-35 (dichloropropene + chlorpicrin)	See label	5 days - See label	preplant	symphylans, wireworms	--	See supplemental label for use restrictions in south and central Florida.
*Telone II (dichloropropene)						
Trigard (cyromazine)	2.66 oz	12	7	leafminers	17	No more than 5 applications per crop.
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: 1-3 oz soil: 5-6 oz	12	foliar: 7 soil: 21	leafhoppers, leafminers, white- flies	4A	Use only one application method (soil or foliar, not both). Do not apply more than 6 oz/acre (foliar) or 12 oz/acre (soil) per season.
Xentari DF (<i>Bacillus thur-</i> <i>ingiensis</i> subspecies <i>aizawai</i>)	0.5-2 lb	4	0	caterpillars	11	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.

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

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

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

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

*** Restricted Use Only.**