UNIVERSITY OF FLORIDA
Cooperative Extension Service
Institute of Food and Agricultural Sciences

SP-214

Tomato Production Guide for Florida: Fertilization[1]

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Prior to each cropping season, soil tests should be conducted to determine fertilizer needs. Obtain an IFAS soil sample kit from the local Agricultural Extension Agent for this purpose. Commercial soil-testing laboratories also are available, but be sure the lab employs laboratory procedures calibrated for Florida soils and can provide sound recommendations. Routine soil-testing will help reduce over fertilization which reduces farming efficiency and increases the risk of groundwater pollution.

The crop nutrient requirements of nitrogen (N), phosphorus (P), and potassium (K) (designated in fertilizers as N-P_2O_5-K_2O) in Table 1 represent the optimum amounts of three nutrients needed for maximum production. A portion of this required nutrition will be supplied by the native soil and previous crop residue. The remainder of the nutrient requirements will be supplied by fertilizer, and this amount must be determined by soil testing. Therefore, nutrient amount in these tables are applied as fertilizers only to soils testing very low in the specific plant nutrients. Automatic use of the amounts of nutrients in the tables without a soil test may result in wasted fertilizer, crop damage from salt injury, reduced yields and quality, and a risk to the environment if fertilizer leaches to the water table.

Growers should resist the urge to overfertilize because excessive fertilization can have negative effects on yield, earliness, and fruit quality. For example, excessive N leads to vigorous plants that grow vegetatively at the expense of early fruit set and total yields. High N also increases the severity of graywall and reduces fruit firmness. Growers can use petiole sap analysis to determine plant N status and make adjustments in the N program if injecting N through the drip system.

If the Mehlich-1 soil test is high in P, then there is enough P in the soil already to satisfy the current season’s needs. Some tomato growers still apply about 100 lb P_2O_5 per acre to soils testing high in P. This P fertilization is not needed; a fact that has been successfully tested in commercial fields.

Liming

The optimum pH range for tomatoes is between 6.0 and 6.5. Fusarium wilt problems are reduced by liming within this range, but it is not advisable to raise the pH much higher than 6.5 because of reduced micronutrient availability.

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Table 1. Fertilization recommendations for mulched tomatoes on irrigated soils testing very low in phosphorus and potassium.

		Nutrient requirements	Supplemental applications[1]	
Soil	Number of expected harvests	lb/A[2] $N\text{-}P_2O_5\text{-}K_2O$	lb/A	Number of applications
Mineral	2-3	175-150-225	30-0-20	0-2
Rockdale	2-3	150-200-200	30-0-20	0-2

[1]Sidedressing to replenish nitrogen and potassium can be accomplished by the use of a liquid fertilizer injection wheel.
[2]Approximately 7200 linear bed feet of crop per acre (43,560 square feet).

Calcium and magnesium levels should be corrected according to the soil test. If both elements are low, broadcast and incorporate dolomitic limestone. Where calcium alone is deficient, lime with "hi-cal" limestone. Adequate calcium is important for reducing the severity of blossom-end rot. A Mehlich-1 calcium index of 300 to 350 ppm indicates adequate soil calcium. Growers should avoid routine gypsum and lime applications since they can lead to increased soluble salt levels in the soil or to excessively high pH in the case of lime. On limestone soils, add 30-40 pounds per acre of magnesium in the basic fertilizer mix. It is best to apply lime several months prior to planting. However, if time is short, it is better to apply lime any time before planting than not to apply it at all. Where the pH does not need modification, but magnesium is low, apply magnesium sulfate or potassium-magnesium sulfate with the fertilizer.

Fertilizer Application

Full-bed Mulch with Subsurface (Seep) Irrigation. Under this system, the crop may be supplied with all of its soil requirements before the mulch is applied. It is difficult to correct a deficiency after mulch application, although the liquid fertilizer injection wheel facilitates sidedressing through the mulch. The injection wheel will also be useful for replacing fertilizer under the used plastic mulch for double-cropping systems.

Micronutrients

For virgin, sandy soils, or sandy soils where a proven need exists, a general guide for fertilization is the addition of micronutrients (in pounds per acre) manganese - 3, copper - 2, iron - 5, zinc - 2, boron - 2, and molybdenum - .02. Micronutrients may be supplied from oxides or sulfates. Growers using manganese - , zinc - , and copper -containing fungicides need to consider these sources when calculating fertilizer micronutrient needs. More information on micronutrient use is available from Florida Cooperative Extension Service Circular 225D, Commercial Vegetable Fertilization Guide.

Properly diagnosed micronutrient deficiencies can often be corrected by foliar applications of the specific nutrient. For most micronutrients, a very fine line exists between sufficiency and toxicity. Foliar application of major nutrients (N, P, or K) has not been shown to be beneficial where proper soil fertility is present. For more information on foliar micronutrient fertilization of tomatoes, consult the Commercial Vegetable Fertilization Guide, Circular 225D.

A general sequence of operations for full-bed plastic mulch and subsurface irrigation is:

1) **Land preparation.** Include development of irrigation and drainage systems and liming of the soil.

2) **Application of "starter" fertilizer or "in-bed" mix.** This operation should comprise only 10 to 15 percent of the total nitrogen and potassium seasonal requirement and all of the phosphorus and micronutrients. Starter fertilizer can be broadcast over the bed area prior to bedding and then incorporated. During bedding, the fertilizer will be gathered into the bed.

3) **Formation of beds.** Incorporate herbicide and application of mole cricket bait.

4) **Application of remaining fertilizer.** The remaining 85 to 90 percent of the nitrogen and potassium is placed in narrow bands nine to 10 inches to each side of the plant row in furrows two to three inches deep. Placing the fertilizer in the grooves allows it to be in contact with moist soil. Bed presses are modified to provide the groove. Only water-soluble nutrient sources

should be used for the banded fertilizer. For example, nutrient sources such as potassium nitrate, potassium sulfate, ammonium nitrate, ammonium sulfate, potassium chloride, and calcium nitrate among others can be used in the bands.

5) **Fumigation, pressing of beds, and mulching.** This operation should be combined in one operation, if possible. Be sure that the mulching machine seals the edges of the mulch adequately with soil to prevent fumigant escape.

There is equipment that will perform most of the operations in steps four and five above in a single pass over the field.

Water management with the seep irrigation system is critical to successful crops. Maintain the water level at 18 to 24 inches below bed surface. Do not fluctuate the water table since this leads to increased leaching losses of plant nutrients.

Mulched Culture with Overhead Irrigation. For the sandy soils, maximum production has been attained by broadcasting 100 percent of the fertilizer in a swath three to four feet wide and incorporating prior to bedding and mulching. Where soluble salt injury has been a problem, a combination of broadcast and banding should be used. Incorporate 30 percent to 40 percent of the N and K and 100 percent of the P and micronutrients into the bed by rototilling. The remaining N and K is applied in bands six to eight inches to the sides of the seed or transplant and two to four inches deep to place it in contact with moist soil. Perforation of plastic mulch is needed on soils such as Rockdale and coarse sands where lateral movement of water through the soil is negligible.

Mulched Production with Drip Irrigation. Where drip irrigation is used, drip tape or tubes should be laid ½ to one inch below the bed soil surface prior to mulching. This placement helps protect tubes from mice and cricket damage and minimizes movement of the tape on the bed surface during the season. The drip system is an excellent tool with which to fertilize the crop. Where drip irrigation is used, before planting apply all phosphorus and micronutrients, and 20 to 40 percent of total N and K prior to mulching. Use the lower percentage (20 percent) on seep-irrigated tomatoes where seepage irrigation will be used early in the season to establish the plants before irrigation is taken over by the drip system. Apply the remaining N and K through the drip system in increments as the crop develops. Start soon after planting with weekly amounts representing two percent to four percent of the total crop N and K requirements. Then increase the amount applied as the crop develops so that, at early fruiting, approximately 10 to 12 percent of the total N and K are applied weekly (Table 2).

Table 2. Injection schedules for N and K for drip-irrigated tomatoes.

Crop development		Injection rate (lb/acre/day)[z]	
Stage	Weeks[y]	N	K_2O
1	2	1.0	1.5
2	2	1.5	2.0
3	7	2.5	3.0
4	1	1.5	2.0
5	1	1.0	1.5

[z]Total seasonal amounts of nutrients are 175 N and 225 K_2O (lb/acre), including any in-bed starter fertilizer. Extended-season applications can proceed at 1.0 to 1.5 lb N or K_2O per acre per day.

[y]Number of weeks in length of a particular crop stage.

Additional nutrients can be supplied through drip irrigation if deficiencies occur during the growing season. Be careful not to apply excessive amounts of water with the fertilizer because severe leaching can occur.

Sources of N - P_2O_5 - K_2O

Most sources of N can be used for tomato including ammonium nitrate, potassium nitrate urea, ammonium sulfate, calcium nitrate, among others. With seepage or overhead irrigated tomato, slow release N sources such as isobutylidene or sulfur-coated urea can be used for a portion of the N.

Normal superphosphate and triple superphosphate are highly recommended for P needs. Both contribute calcium and normal superphosphate contributes sulfur.

All sources of K can be used, including potassium sulfate, sodium-potassium nitrate, potassium nitrate, potassium-magnesium sulfate, and potassium chloride. When soil-test predicted rates of K are used, there should be little concern about the K source or its soluble salt index.

Plant Tissue Testing

Analysis of leaves for mineral element concentration can help growers evaluate the fertilization program (Table 3). To be successful in tissue testing, growers need to know how to collect good samples, identify a competent lab to do the analysis, and know where to obtain accurate interpretation of the results.

The most detailed and accurate method of tissue analysis is to analyze dried whole leaves in a tissue testing laboratory, which can determine the concentrations of all mineral elements.

An alternate technique, usable on the farm, to test for nitrogen and potassium, is petiole sap testing (Table 4). With sap testing, growers can quickly test the plants for N or K status, and if the grower is injecting N and K through the drip system, then adjustments can be made in the fertilization program quickly.

Table 3. Sufficiency ranges for whole-leaf tissue testing of tomato at various stages in the season.

Plant part	Time of sampling	Status	% N	% P	% K	% Ca	% Mg	% S	ppm Fe	ppm Mn	ppm Zn	ppm B	ppm Cu	ppm Mo
MRM[z] leaf	5-leaf stage	Deficient	<3.0	0.3	3.0	1.0	0.3	0.3	40	30	25	20	5	0.2
		Adequate range	3.0 5.0	0.3 0.6	3.0 5.0	1.0 2.0	0.3 0.5	0.3 0.8	40 100	30 100	25 40	20 40	5 15	0.2 0.6
		High	>5.0	0.6	5.0	2.0	0.5	0.8	100	100	40	40	15	0.6
MRM leaf	First flower	Deficient	<2.8	0.2	2.5	1.0	0.3	0.3	40	30	25	20	5	0.2
		Adequate range	2.8 4.0	0.2 0.4	2.5 4.0	1.0 2.0	0.3 0.5	0.3 0.8	40 100	30 100	25 40	20 40	5 15	0.2 0.6
		High	>4.0	0.4	4.0	2.0	0.5	0.8	100	100	40	40	15	0.6
		Toxic (>)	-	-	-	-	-	-	-	1500	300	250	-	-
MRM leaf	Early fruit set	Deficient	<2.5	0.2	2.5	1.0	0.25	0.3	40	30	20	20	5	0.2
		Adequate range	2.5 4.0	0.2 0.4	2.5 4.0	1.0 2.0	0.25 0.5	0.3 0.6	40 100	30 100	20 40	20 40	5 10	0.2 0.6
		High	>4.0	0.4	4.0	2.0	0.5	0.6	100	100	40	40	10	0.6
		Toxic (>)	-	-	-	-	-	-	-	-	-	250	-	-
MRM leaf	First ripe fruit	Deficient	<2.0	0.2	2.0	1.0	0.25	0.3	40	30	20	20	5	0.2
		Adequate range	2.0 3.5	0.2 0.4	2.0 4.0	1.0 2.0	0.25 0.5	0.3 0.6	40 100	30 100	20 40	20 40	5 10	0.2 0.6
		High	>3.5	0.4	4.0	2.0	0.5	0.6	100	100	40	40	10	0.6

[z]MRM, Most-recently-matured leaf.

Table 4. Guidelines for tomato plant leaf petiole fresh sap nitrate - N and potassium testing.

Crop development stage	Fresh petiole sap concentration (ppm)	
	NO_3-N	K
First buds	1000-1200	3500-4000
First open flowers	600-800	3500-4000
Fruits one-inch diameter	400-600	3000-3500
Fruits two-inch diameter	400-600	3000-3500
First harvest	300-400	2500-3000
Second harvest	200-400	2000-2500