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Tomato
Fertilization

(Reviewed 1/07, updated 11/08)

In this Guideline:

Most agricultural soils in California contain sufficient potassium and micronutrients to produce a tomato crop. Moderate applications of nitrogen and phosphorus are all that are required to promote seedling growth and produce maximum yields in many fields, although soils in some areas may be low in other nutrients. A few may have toxic levels of certain salts.

Preplant soil testing is the primary tool for assessing nutritional needs. Depending on need, fertilizer may be applied preplant, or any time up to first red fruit. Plant tissue testing is a useful technique to confirm the adequacy of fertilization. Higher than required rates of nitrogen and phosphorus can be both detrimental to the crop and the environment through runoff into waterways. To avoid runoff of fertilizer, take measures to reduce adverse water quality problems from surface runoff.

PREPLANT ACTIVITIES

Soil testing for nutrient and salinity analysis. Preplant fertilization should be based on soil test nutrient levels. For the most accurate estimation of soil nutrient availability, collect and analyze soil from throughout the rooting zone, which for tomatoes is the top foot of soil. Collect a composite sample of a minimum of 12 soil cores from each field; if zones of different soil texture exist within the same field, take separate samples to represent each major soil type. The following table suggests appropriate soil analysis procedures, and interpretation of laboratory results.

Commonly used laboratory procedures for soil analysis and interpretation of results.

	Element (soil test procedure)				
Soil test interpretation	*Phosphorus (Bicarbonate extraction)*	*Potassium (ammonium acetate extraction)*	*Zinc (DPTA extraction)*	*Soluble salts (saturated paste)*	*Boron (saturated paste)*
Low	< 15 ppm	< 130 ppm	< 0.5 ppm	< 2 dS/m	< 1 ppm
Medium	15-25 ppm	130-250 ppm	0.5-1.0 ppm	2-4 dS/m	1-5 ppm
High	> 25 ppm	> 250 ppm	> 1.0 ppm	> 4 dS/m	> 5 ppm

Key:
< =less than
> =greater than
dS/m=mmho/cm
ppm =parts per million

For *phosphorus, potassium, and zinc* a low soil test value suggests the need to fertilize; with medium soil levels yield response to fertilizer application is possible, but not necessarily likely. At high soil levels yield response is unlikely. For phosphorus and zinc, fertilization is best done preplant, or as a starter solution at seeding or transplanting; potassium can be applied preplant, at sidedressing, or fertigated (injected into drip irrigation water) during the growing season.

For *soluble salts (salinity) and boron,* the issue is not whether enough is present, but whether soil levels are high enough to be detrimental. For both analyses, soils in the low range are desirable. As soil levels increase, the likelihood of crop damage increases; when high levels of either soluble salts or boron are present, remedial actions are justified. Those actions include leaching the soil profile, sprinkling up the crop to create a zone of lower concentration around the seedlings or transplants, and switching to a higher quality irrigation source to prevent further buildup (high soil salinity and boron is often the result of using marginal quality irrigation water).

Preplant soil testing for available nitrogen (N) is difficult to interpret. In the low rainfall areas of the San Joaquin Valley, where winter rain is seldom enough to provide significant leaching, most of the nitrate nitrogen (NO_3-N) present in soil in the fall will remain available to the succeeding tomato crop. The higher rainfall typical of the Sacramento Valley makes NO_3-N analysis of fall-collected soil samples unreliable. However, regardless of location or soil NO_3-N level, heavy preplant nitrogen fertilization is not recommended. Early season crop N requirements are modest, and the amount of nitrogen typically contained in common phosphorus fertilizers (10-34-0 or 11-52-0, for example) is sufficient to maintain the crop until sidedressing during the planting to prebloom period.

PLANTING TO PREBLOOM

Fertigation through drip irrigation (100 KB, PDF)**.** Nitrogen and potassium fertility management practices may be different in drip-irrigated fields than in furrow-irrigated fields. Given the higher yield potential of drip fields, slightly higher seasonal rates of both elements may be justified. With drip irrigation multiple applications throughout the growing season typically replace the traditional sidedress application. Concentrate fertigation during the rapid growth phase of the crop, which extends from early bloom until first red fruit. Although fertilizer can be injected in each irrigation, research has shown that fertigation more often than once per week is generally unnecessary.

Fertilizer application at planting in furrow-irrigated fields. Fertilizer application at planting (whether a banded application of a standard fertilizer, a 'starter' solution applied over direct seeding or a transplant drench) can be an effective practice, particularly for phosphorus (P). Standard, high analysis phosphorus fertilizers (10-34-0, 11-52-0, etc.) can be toxic to seedlings or transplants because of the concentrated salts they contain. Banding such fertilizers several inches below and to the side of the developing plants is the only safe method of applying a high phosphorus rate. Many growers use standard phosphorus fertilizers in transplant drenches; as a general rule, limiting the amount of P fertilizer to no more than 2 gallons per 100 gallons of transplant solution will minimize the potential toxicity of that solution. There are specialty 'starter' fertilizers made specifically to apply with seed during direct seeding; follow the fertilizer manufacturer recommendations with such products, taking care not to exceed the specified application rates to minimize the chance of toxicity.

Sidedress fertilization. The majority of seasonal nitrogen fertilization is typically applied in a single sidedressing. Many replicated trials have demonstrated that seasonal nitrogen application of about 150 lb/acre is nearly always adequate for maximum fruit yield and quality. Factoring in nitrogen applied preplant with phosphorus fertilizers, a single sidedress application of 100–120 lb nitrogen per acre is normally sufficient to finish the crop. Use of higher seasonal nitrogen rates can be both detrimental to the environment (nitrogen-rich tailwater or drain tile effluent can stimulate algae growth in the receiving water body) and to the crop. Lush vine growth stimulated by excessive nitrogen application can require additional equipment passes to trim vines and can increase fruit rot and mold problems.

Higher seasonal nitrogen (N) rates may be justified if an unusually high level of soil leaching occurs during the season, or if a field has a very high yield potential (because fruit contains 3 to 4 lb nitrogen per ton, a 60 ton per acre yield would require greater soil N supply than a 40 ton yield). Conversely, fields with significant residual soil NO_3-N require little, if any, sidedress N application. Research has shown that fields with soil NO_3-N greater than 15 ppm in the top foot of soil before sidedressing generally require no more than 50 lb nitrogen per acre at sidedressing; this level of residual NO_3-N is quite common in commercial tomato fields in the San Joaquin Valley.

A sidedress potassium (K) application can be an effective practice in fields with limited potassium supply. Because many California soils tend to fix applied potassium over time (making it only marginally available to the crop), a banded sidedress potassium application may be more effective than preplant application.

Sidedressing can be done any time from prebloom through early bloom. For drip-irrigated fields, fertilizer is typically applied through the irrigation system from early bloom until first red fruit.

BLOOM TO EARLY FRUIT SET

Nutrient monitoring. Plant tissue testing can be done to help identify any growth-limiting nutrient deficiency. Whole leaf total N/P/K analysis evaluates overall nutrient status, while petiole analysis provides a measure of unassimilated nutrients (NO_3-N, PO_4-P, and K) taken up but not yet incorporated into plant structures. Tissue analysis is most useful from early flowering through full bloom. Nutrient deficiency is rare before flowering (with the possible exception of P); after full bloom tissue nutrient concentration, particularly for potassium, is heavily influenced by fruit load; low tissue values may not reflect nutrient deficiency as much as nutrient export to the fruit.

The table below lists nutrient sufficiency guidelines for processing tomato. The whole leaf values were developed from a large-scale field survey of more than 100 fields and are broadly representative of the industry. Conversely, the petiole guidelines were developed from more limited data, much of it from trials in conventionally irrigated fields; these values should be considered provisional until additional information from drip-irrigated fields becomes available.

Whole leaf and petiole nutrient sufficiency guidelines.

		Sufficiency range by growth stage	
Plant part	**Nutrient**	*First flower*	*Full bloom*
Whole leaf	% N	4.6–5.2	3.5–4.5
	% P	0.32–0.49	0.25–0.41
	% K	2.2–3.5	1.6–3.1
Petiole	NO_3-N (ppm)	8,000–12,000	4,000–8,000
	PO_4-P (ppm)	2,500–3,500	2,000–3,000
	% K	4.5–6.0	3.0–5.0

Key:
N = nitrogen
P = phosphorus
K = potassium
ppm = parts per million

If tissue analysis suggests that the crop is nutrient-deficient, supplemental fertilization can be applied in several ways. If the vines have not covered the bed top, an additional sidedressing can be applied, taking care to place the fertilizer at the edge of the bed to minimize root damage. Soluble nutrients can be also be applied by dissolving them in furrow irrigation water; the drawback of this approach is that the uniformity of application is limited to the distribution uniformity of the irrigation. Foliar fertilization is another option, but the amount of fertilizer that can be safely applied is severely limited by the potential for phytotoxicity.

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