

Tomato (*Lycopersicon esculentum* Mill.)

French: Tomate; Spanish: Tomate; Italian: Pomodoro; German: Tomate

Under Temperate Conditions

Annual. Harvested part: fruits.

Direct sowing is practised, mainly in crops for processing, but transplanting is more usual.

Root system mainly (70 % or more) in upper 20 cm soil layer.

Cycle length varies with sowing time and growing methods. 3 000-4 000 degree(°C)-days are required between sowing and ripening of the first fruit.

Plant density: 3-4/m².

Yields, in more typical areas: for processing, up to 40-50 t/ha; for table tomatoes, 20-60 t/ha outdoors, up to 100 t/ha or more under glass.

Can be grown on soils with a range of textures. Preferred pH 6.5-7.0. Tolerates brackishness up to conductivitys of about 2-3 mmho/cm. Fairly resistant to moderate drought but is usually irrigated.

Growth requires temperatures between 10 ° and 30 °C. In protected cultivation tomato is the most important crop in the Mediterranean area.

Nutrient demand/uptake/removal

100-150 kg N, 20-40 kg P₂O₅, 150-300 kg K₂O, 20-30 kg MgO per ha for outdoor crop yielding 40-50 t/ha; or, for greenhouse crop on natural soil yielding over 100 t/ha, about 200-600 kg N, 100-200 kg P₂O₅, 600-1000 kg K₂O per ha. The greatest rates of uptake of the three major nutrients occur during flowering and when the first fruits ripen.

Plant analysis data

Normal ranges in leaves of healthy plants: 2.8-4.9 % N, 0.4-0.7 % P₂O₅, 2.7-5.9 % K, 0.4-0.9 % Mg, 2.4-7.2 % Ca, 1.0-3.2 % S, 32-97 ppm B, 10-16 ppm Cu, 101-291 ppm Fe, 55-220 ppm Mn, 0.9-10.0 ppm Mo, 20-85 ppm Zn, all expressed on a dry matter basis.

Deficiency levels: <2 % N, <0.2 % P, <1.5 % K at vegetative stage or <2.5 % K at fruiting stage, <1 % Ca, <0.3 % Mg.

Fertilizer recommendations

FYM or other organic manures should first be applied at not less than 30 t/ha in order to increase the organic matter in the soil.

Outdoor crops yielding 40-50 t/ha should be given a basal fertilizer application, before planting, of about 50 kg N, 150-200 kg P₂O₅, 200-250 kg K₂O per ha (less K₂O if indicated by soil analysis), followed by 100-150 kg/ha N divided into two or three topdressings. Topdressing with K₂O may also be useful for table tomatoes.

For protected crops, the rates and timing of fertilizer application need to be modified to take into account the higher yield, the longer growth cycle and the increased uptake per unit yield.

Nitrate N has proved more effective than ammonium N in the poorer light conditions in winter, and for use on plantlets low in carbohydrates.

Some attempts have been made to establish predictive models on which to base fertilizer application. A simple model for N fertilizer requirement has been proposed (Feigin et al., 1986), according to the formula:

$$N_f = (N_p / E) - N_a$$

where N_f = amount of N to be applied
 N_p = uptake by the crop estimated from data in the literature
 E = nitrogen efficiency factor of 0.70 to 0.75
 N_a = soil N content (from analytical data) plus mineralizable N minus expected denitrification loss.

Tomatoes are rather sensitive to excess or deficiency of both macro- and micro- nutrients. Examples of likely deficiencies, particularly in soilless culture, other than those of N and P, are: K deficiency, affecting fruit quality; Ca deficiency, causing blossom end rot; Mg deficiency, in acid soils and in the presence of high levels of K; and deficiencies of B, Fe and Mn in calcareous soils.

Under Tropical/Subtropical Conditions

Crop data

Transplanted 35 to 50 days after seeding. Harvested 60 to 90 days after transplanting. Plant density: 12 150 to 36 900 plants/ha. Preferably grown in sandy soils for an early harvest but adapted to sandy and clay soils, pH 6 - 6.5. Adapted to 20 - 24 °C temperatures and at least a 115-day growing season. In the tropics tomatoes are normally grown in the highlands or in the cooler season.

Target marketable yields in intensive commercial production: 27 - 37 t/ha.

Nutrient demand/uptake/removal

Nutrient uptake/removal - Macronutrients					
Yield t/ha	kg/ha				
	N	P2O5	K2O	MgO	CaO
24	177	46	319	43	129
Source: various					

Plant analysis data

Plant analysis data - Macronutrients (optimum fertility conditions)							
Plant part	Growth stage	% of dry matter					
		N	P	K	Mg	Ca	S
Young mature leaf	1/2 fruit	2.7	0.5	2.9	0.4	1.2	0.3
Source: various							

Plant analysis data - Micronutrients (optimum fertility conditions)							
Plant part	Growth stage	ppm dry matter					
		Fe	Mn	Zn	Cu	B	Mo
Young mature leaf	1/2 fruit	119	76	24	7	25	0.16
Source: various							

Fertilizer recommendations

N requirements are moderate during foliage growth until fruit set. P is very important for vigorous growth and fruit production. Near maximum yield is attained at approx. 0.2 mg P/l soil solution. Root inoculation with *Glomus intraradices* vesicular-arbuscular mycorrhizal fungi may improve growth through improved P uptake and decreased *Fusarium oxysporum* disease incidence.

K is required for fruit set and enlargement. Important growth stages for nutrient uptake include seedling establishment when maximum nutrient efficiency uptake occurs, and early fruiting when the maximum rates of K accumulation take place. Tomato should be supplied with Mg in soils deficient in this nutrient. Ca deficiencies may cause "blossom end rot" or apical necrosis.

Fertilizer applications through a drip irrigation system may improve the efficiency of N uptake.

Present fertilizer practices.

Senegal (Camberene)

In a light sandy soil in semi-arid conditions apply 20 t/ha organic matter, 70 kg/ha N, 200 kg/ha P₂O₅, and 240 kg/ha K₂O distributed in the following manner: All organic matter and one-fifth of the N, P₂O₅ and K₂O broadcast before planting, followed by four equal sidedressings of N, P₂O₅ and K₂O at 20-day intervals beginning 15 days after planting.

For intensive tomato production under irrigation in sandy soil apply 190 kg/ha N, 225 kg/ha P₂O₅, and 300 kg/ha K₂O. One-fifth of the N, P₂O₅ and K₂O is broadcast before planting, and the remainder in four equal dressings at 15-day intervals beginning 15 days after planting.

Philippines

Fertilizer requirements are 96 kg/ha N, 192 kg/ha P₂O₅, and 96 kg/ha K₂O. A basal dressing of all the P₂O₅ and one-half the N and K₂O is placed 8 cm below and slightly to the side of the seedling root crown. The remaining N and K₂O is sidedressed 1 month after transplanting. If planting in furrows, the fertilizer is applied in the furrows and covered with soil.

Pakistan (Baluchistan Province)

Fertilizer recommendations are 150 kg/ha N, 100 kg/ha P₂O₅, and 50 kg/ha K₂O. Apply all the P₂O₅ and one-half the N and K₂O before transplanting. The remainder of the N and K₂O is applied at 6 - 8 weeks after transplanting.

Venezuela (States of Lara, Aragua, Falcon, Nueva Esparta and Trujillo)

Sidedress 800 kg/ha of 12-24-12 fertilizer 15 - 20 days after planting.

Further reading

DANGLER, J.M.; LOCASIO, S.J.: Yield of trickle-irrigated tomatoes as affected by time of N and K application. *J. Amer. Soc. Hort. Sci.* 115, 585-589 (1990)

OLASANTAN, F.O.: Response of tomato and okra to nitrogen fertilizer in sole cropping and intercropping with cowpea. *J. Hort. Sci.* 66, 191-199 (1991)

WIDDERS, I.E.; LORENZ, O.A.: Potassium nutrition during tomato plant development. *J. Amer. Soc. Hort. Sci.* 107, 960-964 (1982)