



DEPARTMENT OF AGRICULTURE  
BUREAU OF PLANT INDUSTRY

# TOMATO

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## PRODUCTION GUIDE



**Tomato**  
*Solanum lycopersicum*



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## The TOMATO Plant

Tomato belongs to Family *Solanaceae* originated in Tropical America. It is an annual herbaceous plant, stems are soft, brittle and hairy when young, hard and woody when old. The 5-16 inches long leaves are alternately arranged. Flowers are borne in clusters and the fruit has two to many celled-berries. The seeds are kidney-shaped covered with short hairs.

Tomato is a common ingredient vegetable to many dishes (fresh market tomatoes) and can also be processed into ketchups, sauces and seasoning (processing tomatoes). The fruit is rich in Vitamin C, Beta-carotene and lycopene. The stem can be used in paper manufacture. An antibiotic *tomatin* can be extracted from the seeds. The dried tomato pulp mixed with pectin is used in the treatment of diarrhea and dysentery.

Tomato requires a relatively cool, dry climate for high yield and premium quality and is adapted to a wide range of climatic conditions. The optimum temperature requirement is 21-24° C.

Tomatoes can be grown in varied soil types such as sandy loam to clay-loam with rich organic matter but should not be planted in areas with long period of flooding. The ideal soil pH is 6.0-6.5. It can be harvested in 90-100 days after transplanting during the cool season and 60-90 days after transplanting during hot season

In the Philippines, a total of 204,272 metric tons was produced in 2010 with a total land area of 17,663 hectares (BAS, 2010).



## VARIETIES

1. BPI-TmP1 (Mapula) (Figure 1) : A processing type from AVRDC (CL-2784-1-1-4), officially released as seedboard variety in 1986. Fruits are round, relatively soft, intense red color, resistant to cracking with high Total soluble solids (TSS) content and yields 36 t/ha.
2. PSB – Tm9 (Figure 2) : A fresh market determinate tomato from AVRDC, commercially released in 1999. The semi-globe fruits weigh 30 gms with potential yield of 25 t/ha. The variety is moderately resistant to bacterial wilt and tomato mosaic virus.



Figure 1. BPI-TmP1

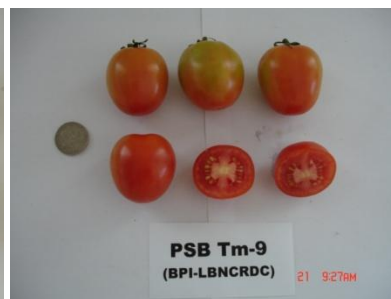


Figure 2. PSB-Tm9

Table 2. Onion varieties listed in the PSIA Seed Catalogue.

OWNER	VARIETY	MATURITY (DAT)	FRUIT TYPE			SEASON	FEATURES
			Shape	Color	Weight (g)		
Harveson	Anant F1 (nunhems)	45-50	Round	12-13	Medium firm	All year round	Sweet taste, with a brix value of 7.5
Allied Botanical	Anath (FA-189) (hazera)		Round	130-200	Very firm	All year round	Noted for extended shelf life. Resistance to fusarium wilt, verticillium wilt and tobacco mosaic virus
Allied Botanical	Apollo Select (condor)	55	Plum	50-70	Firm	All year round	Very vigorous semi-determinate with good foliage cover. Resistant to bacterial wilt
	Apollo white OP	75	Oblong	85-150	Good	Year round	Fresh market, very high yield
Harveson	Astona F1 (nunhems)	90	Round	170-200	Very firm	All year round under green house condition	Strong tolerance to blotchy
Allied Botanical	Hybrid rising Sun (condor)	63	High round	70	Firm	All year round	Very vigorous, resistant to bacterial wilt
Harveson	Jakarta F1 (nunhems)	90	Round	200	Very firm	All year round under greenhouse condition	Strong against cracking and blotchy
Allied Botanical	Jet star F1 (ferry morse)	66	Slightly flattened	150-200	Firm	All year round	Can be grown in lowland and highland under open field or tunnel culture. Resistant to fusarium wilt. Verticillium wilt and bacterial wilt.
	Maxima F1	55-66	Flat round	150-200	Moderate	Regular	Green shoulder, strong plants, good for extended season in mid to highland
Harveson	Menhir F1 (nunhems)	75	Flattened Round	160-190	Very firm	All year round under greenhouse condition	It has a long shelf life and highly tolerant to all types of cracking
Harveson	NP 7704 F1 (nunhems)	75-80	Oblong	80-90	Very firm	All year round	Good foliage cover
Allied Botanical	Sweet million F1 (sakata)	Early	Round	15-20	Firm	All year round	Very sweet and has outstanding eating quality. Tolerant to cracking and has excellent keeping quality. Cherry type tomato
Harveson	s-7610 F1 (nunhems)	60-65	Deep oblate	70-80	firm	Post rainy season	Early maturity, resistance to verticillium, fusarium 1 & 2 and high level of partial resistance to bacterial wilt



## CULTURE AND MANAGEMENT

- A. Seedling Production.** Fill the flats with equal amounts of garden soil, compost or hog manure and burnt rice hull. Draw a shallow line, 5 cm apart. Sow the seeds along the lines and cover thinly with soil mixture or use seedling trays for better seedling growth. Pricking and thinning can be done one week after sowing. Drench foliar fertilizer if necessary and harden the seedlings one week before transplanting.



- B. Land Preparation.** Select a well drained sandy, or sandy loam soils with pH of 6.0 to 7.0. Plow and harrow the soil twice. Set furrow distance at 0.75 to 1 meter for determinate and semi-determinate varieties and 1.5 m for indeterminate varieties.



- C. Transplanting and Fertilizer Application.** Transplant the seedlings 3 to 4 weeks after sowing, compost or hog manure maybe applied directly to the hole where seedlings will be planted at the rate of 2-5 t/ha or 1-2 kg/5 meter row at planting time. Basal fertilizer is also applied at planting time at the rate of 10 g/hill of complete fertilizer (14-14-14). Second application of fertilizer will be 2 weeks after transplanting using 2:1 parts of Urea (46-0-0) and Muriate of Potash (0-0-60) at the rate of 1.5 tablespoon (15 grams) per hill, about 6-8 cm away from the base. The third and last application will be 4 weeks after transplanting using the same rate as the second application.



- D. Weeding and Cultivation.** Off-barring is done before the first sidedressing and hilling-up after fertilizer application. Hand weeding should be done within the first month (before sidedressing) from transplanting by removing the weeds near the base of the plants.



- E. Trellising.** Trellising is recommended in growing semi-determinate and indeterminate varieties. Use bamboo or “Ipil-ipil” poles as post, A-type trellis can be used to train the vines using plastic straw.



Figure 3. A-type trellis

## PEST MANAGEMENT

### Major Pests of Tomato

- **Tomato Fruitworm** (*Helicoverpa zea*)

**Damage symptoms:** A small darkened partially healed hole at the base of the fruit pedicel is evident. The inside of the fruit has a watery cavity that contains frass and decay.

Tomatoes ripen early but are not usually marketable.

**Control:** Monitor the pest by selecting a leaf from 30 random tomato plants. Choose leaves located below the highest open flower. Healthy eggs are white with a reddish ring. If more than five healthy eggs appear, begin treatments. Pesticide treatments are also required when



large numbers of small caterpillars are found feeding on leaves. Parasitic wasps, especially *Trichogramma* spp., are important natural enemies, release egg parasitoid *Trichogramma chilonis* 2 WAT at 1 card per 10 sq.m at weekly interval. Fruitworm eggs turn black when parasitized. In severe cases spray





commercially available biological insecticides. Avoid planting tomato near corn or cotton to prevent heavy pest infestations

- **White Flies (*Trialeurodes vaporariorum*)**

**Damage Symptoms:** Leaves have numerous chlorotic spots or areas. These spots grow together forming different sized yellow areas. In severe cases, only the veins remain green. Some leaves appear completely brown and dried. Wilting and leaf drop may occur. A sticky, black mold may be found on leaves and stems.

**Control:** Whiteflies are most damaging when they spread viruses, especially Tomato Yellows Leaf Curl Virus. Protect seedlings from infection by growing them under 60-mesh screening. The traditional 32-mesh screen is not fine enough to prevent whitefly infection.

- **Beet Army Worm**

**Damage Symptoms:** Feeding scars on the fruit surface are shallow and dry. The inside of the fruit is often hollowed out. This cavity is usually dry and may have frass and decay.

**Control:** The use of alternative, biological control measures are very useful. Parasitic wasps and nuclear polyhedrosis viruses (NPVs) that target armyworm are commercially available. Strains of *Bacillus thuringiensis* (Bt) are useful for killing armyworm larvae. Pheromones for armyworm are commercially available. They are useful for monitoring, and especially to determine the entry of the pest into the field. Pheromones by themselves will not control beet armyworm. They need to be accompanied by chemical or biological control measures.



- **Bacterial Wilt**

**Symptoms:** Wilting first appears on the youngest leaves of plants during hot daytime temperatures. The infected plants may recover, temporarily, in the evening, when temperatures are cooler. A few days later, a sudden and permanent wilt occurs. The roots and lower portion of the stem have a browning of their vascular system. The invaded roots may rot due to infection from secondary bacteria. Diseased stems that are cut and placed in a small container of water will show yellowish or grayish bacterial ooze coming from the cut end. When conditions are less favorable for disease development (for example, cool and dry), the infected plants may only show signs of stunting, and adventitious roots may develop on the main stems. The lower leaves will turn yellow before wilting symptoms occur. Symptoms of this disease are distinguished from those of bacterial canker, which causes leaf chlorosis, stem cankers, and “bird’s eye” spots on fruits. Bacterial wilt symptoms are distinguished from those of Fusarium wilt because of the rapidity of the wilt, under favorable conditions, for the former, and the drier, firmer stem rot of the latter.

**Control:** Avoid contaminated land. Suitable rotations can only be determined through local experience because of the diversity of *R. solanacearum* strains and races, and the many agro-climatic zones where reports occur. Rotations of several years duration with maize, cotton, soybeans, grasses, and rice are used in various areas. Eradicate weed hosts. Remove wilted plants, root debris and volunteer hosts, and burn them to reduce spread of the disease from plant to plant. Disinfest tools when used in an infested field. Wash with water or bleach or sterilize by flame. Wash the soles of shoes after working in an infested area. Work in the infested portion of a field after working in the noninfested areas. For transplant production, use disease-free transplants, pasteurized soil medium, or fumigated plant beds. Use proper sanitation measures for transplant production, and avoid damage to roots during transplanting. Grafting susceptible tomato varieties onto the rootstock of resistant eggplant lines is widely practiced in developed countries of



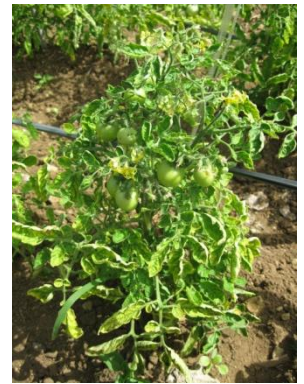
Asia. There are tomato varieties with some tolerance to bacterial wilt. Variations in race and strain of *R. solanacearum* make it difficult to utilize these varieties in some regions. Consult with your local extension agent to determine if these are available and suitable for your region. Control root-knot nematodes (*meloidogyne incognita*) and root-feeding insects since they may help the disease to establish and spread.

- **Tomato Yellow Leaf Curl Virus**

**Symptoms:** Plants are severely stunted with shoots becoming erect. Leaflets are reduced in size and pucker. Leaflets curl upwards, become distorted, and have prominent yellowing along margins and/or interveinal regions. Flowers wither. Plants will set very few fruit after infection occurs; therefore any plants infected before flowering stage will produce extremely low yields. The appearance of the fruit is unaffected.

**Control:** Grow seedlings in an insect-proof nethouse (50-mesh size or finer) or in a greenhouse, and maintain good control of whiteflies in these structures in order to prevent early infection of seedlings by whitefly feeding. If noninsect-proof nets are used with transplants, then they should be sprayed with insecticides to control entry of whitefly into the structures.

Other methods include a 1% soap solution carefully applied to the leaf undersurface to control the adult vector. Care should be taken to avoid development of phytotoxicity if spraying occurs during very high temperatures. Oil sprays may also be effective in reducing levels of infestation. Neem tree seed extracts control young nymphs, inhibit the growth and development of older adults, and reduce egg-laying by adults.



- **Southern Blight**

**Symptoms:** Young infected plants wilt suddenly and permanently. On older plants, symptoms first appear as a dark brown lesion on the stem near the soil surface. The lesion girdles the stem, causing leaf yellowing and wilting. White mats of fungal growth are produced on the stem and nearby in the soil on any organic debris. Wilting in infected plants may be more evident when soils begin to dry out. After a few days, mustard seed-sized (0.5 mm diameter), round, tan to dark brown overwintering structures known as sclerotia appear on the white fungal growth. The abundant sclerotia that form on the outside of the stem tissue are a good diagnostic feature. They are round, soft, and smaller in diameter, and lighter in color than those caused by another fungus, *Sclerotinia sclerotiorum*, which also causes a disease in tomato. The sclerotia of the latter are found inside tomato stem tissue.

**Control:** Crop rotation has a strong influence on survival of the fungus. Grow tomato after non-host crops such as maize, sorghum, small grains, or cotton. Allow ample time for breakdown of green manure before planting the tomato crop. Bury crop debris to a depth of 24 cm. Eradicate weeds, avoid dense planting, and choose fields that are well drained, rich in humus, and not too acidic. Plastic mulch may shield the branches and fruit from sclerotia. Disease levels have been reduced by application of ammonium nitrate either before planting or as three sidedressings at monthly intervals while the crop is growing. Efforts are being made to develop solarization and biological control practices

### Other Physiological Disorders

- **Blossom-end Rot**

**Symptoms:** This is a non-infectious disease that is associated with environmental conditions and caused by calcium imbalance. It can occur at any growth stage



but often is found on the first fruit clusters. At the earliest stage, light brown patches appear at the blossom end on young fruits that are a third or more developed. These patches darken and an area of sunken black leathery tissue forms that is dry and firm. An area up to half the fruit may be affected. The dead tissue may be invaded by secondary organisms, which causes a soft fruit rot. Internal blackening can be found when the fruit is cut open.

**Control:** Ensure steady plant growth and a constant moisture level in the soil through careful irrigation. Enrich the soil with organic matter as this will help the soil to retain moisture during dry periods. Use mulches that conserve soil moisture to avoid fluctuating moisture levels in the soil especially during the flowering and fruiting stages. Provide balanced fertilization and avoid root damage of young plants. Keep cultivation shallow to avoid destroying feeder roots. Test the soil for calcium levels; if found deficient, apply dolomitic or high-calcium limestone 2–4 months before planting. Apply foliar sprays of calcium chloride or calcium nitrate prior to onset of symptoms when fruit are about 2.5 cm in diameter. If available, use varieties that are less susceptible to the disorder.



- **Sun Scald**

**Symptoms:** White, shiny, blistered tissue develops on portion of fruit suddenly exposed to sun. The lesion often becomes sunken and wrinkled. Mature green and breaker tomatoes are most susceptible.

**Control:** Be careful when pruning or harvesting so as to minimize exposure of fruits to direct sunlight. Use trellising methods that protect fruit from sunlight. Fungicide spray programs will protect foliage from disease infection. Use cultivars that provide good foliage cover.

- **Cat facing**

**Symptoms:** This is a physiological disorder that occurs most often on the first-formed fruits. It is more prevalent on large-fruited, fresh-market tomatoes. Tomato fruit are misshapen with large scars and cavities in the blossom end. Streaks and bands of scaly dark greenish and tan scar tissue occur between the swellings. The fruit may be kidney-shaped or distorted into other shapes.

**Control:** Maintain temperatures above 16°C for production of field transplants. Avoid high levels of soil nitrogen and excessive pruning. Avoid growing large-fruited tomato varieties if the disorder persists. Avoid periods where water is lacking.



## HARVESTING

Fresh market tomatoes are harvested at green ripe stage. Processing tomatoes are harvested at red ripe stage to assure good color of processed products.



Green ripe (fresh market type)



Red ripe (for processing)

Figure 3. Fresh market tomatoes

## POST HARVEST HANDLING

1. **Fresh Yield.** Green ripe tomatoes should be placed in well-ventilated containers such as wooden crates in transporting to packing house. Sorting of fruits will be done in the packing house according to sizes such as big, medium or small and the different size fruits will be placed in different containers.
2. **Seed Processing.** For seed processing; cut fruits in half and squeeze out the seed with the juice into a container. Allow mixture to ferment 1-2 days for easier removal of mucilaginous seed coat. Dip a fine-mesh strainer and rub seeds gently into the strainer to remove the coating. Put the seeds in a pail of water to allow immature seeds to float. Discard water together with the floating seeds, leaving the good seeds that settled at the bottom of the pail. Repeat the procedure until no floaters can be found. Put seeds in a net bag and air dry them for 2 to 3 days before sun drying for 4 to 5 days. Increase the sun drying time as the seeds dry. For over drying, dry seed initially to no more than 30°C as the seeds dry. For dry-sealed packaging, dry the seeds to 8% moisture content.



Figure 4. The cutting of tomatoes in half and squeezing out of seeds; fermentation; floating of seeds and; drying process

3. **Seed Packaging and Storage.** Use moisture resistant packaging materials such as thick polyethylene plastic, aluminum foil, tin cans, or glass jars and seal them well. Keep seeds away from moisture and high temperature. The cooler and drier the area, the longer will be the life of the seeds.



Figure 5. Using of glass jars for packaging of seeds and storage

Table 3. Tomato Estimated Average Production Costs and Returns at Year 2010 Price

CASH COSTS	62,353
Seeds/Planting Materials	910
Fertilizers	20,874
Mulching Materials	0
Pesticides	9,257
Other Material Inputs	0
Hired Labor	19,752
Land Tax	160
Rentals:	1,604
Fuel and Oil	1,407
Transport of Inputs	586
Irrigation Fee	29
Interest on Crop Loan	433
Food Expense	2,228
Repairs	4,572
Landlord's Share	0
Wages for Overseer	0
Electricity	0
Others	541
NON-CASH COSTS	2,676
Seeds/Planting Materials Paid in Kind	480
Hired Labor Paid in Kind	153
Landlord's Share Paid in Kind	875
Harvester's Share	76
Other Laborer's Share	0
Lease Rental	1,092
Others Paid in Kind	0
IMPUTED COSTS	19,466
Operator Labor	0
Family Labor	0
Operator and Family Labor	7,065
Exchange Labor	348
Depreciation	2,999
Interest on Operating Capital	8,127
Rental Value of Owned Land	927
TOTAL COSTS	84,495
GROSS RETURNS	141,324
RETURNS ABOVE CASH COST	78,971
RETURNS ABOVE CASH AND NON-CASH COSTS	76,295
NET RETURNS	56,829
NET PROFIT-COST RATIO	0.67
Cost Per Kilogram in Pesos	7.31
Yield Per Hectare in Kilograms	11,565
Farmgate Price in Pesos Per Kilogram	12.22

.. - Data not available

R - Revised estimates

P - Preliminary estimates



**Table 4. Cost and Return for Tomato Seed Production**  
**Farm Expenses**

Expenditures	Quantity and Unit	Unit Cost <sup>1</sup> (P)	Total Cost (P)
<b>A. Labor Cost</b>			
1. Land preparation (mechanized)			
Mowing		2,164	2,164
Disking		1,640	1,640
Plowing		2,617	2,617
Harrowing (2x)		2,164	4,328
Rotavation		3,001	3,001
Furrowing		1,640	1,640
2. Seedling preparation			
Sowing	1 MD	210	210
Land preparation/Potting	2 MD	210	420
Pricking	10 MD	210	2,100
Maintenance	5 MD	210	1,050
3. Transplanting/Basal fertilization	20 MD	210	4,200
4. Hilling-up		2,350	2,350
5. Field maintenance			
Irrigation (Furrow-10x)			
2 MD/Irrigation	20 MD	210	4,200
Side dressing	2 MD	210	420
Weeding (3x)		3,000	9,000
Spraying (10x)	18 MD	210	3,780
6. Roguing	2 MD	210	420
7. Harvesting/hauling	80 MD	210	16,800
8. Seed extraction/Cleaning/Drying	100 MD	210	21,000
9. Seed sorting	10 MD	210	2,100
10. Seed treatment	1 MD	210	210
		Sub-total	83,650
<b>B. Supplies and Materials</b>			
1. Seeds	0.25 kg	3,750	938
2. Fertilizers			
Complete (14-14-14)	4 bags	1,200	4,800
Urea (46-0-0)	8 bags	1,020	8,160
Muriate of potash (0-0-60)	3 bags	1,800	5,400
3. Fungicide			1,500
4. Insecticide			5,000
5. Jute sacks	30 pcs	12	360
6. Net bags	30 pcs	10	300
7. Coir dust	1 sack	30	30
8. Garden soil	1 sack	30	30
		Sub-total	26,518
		Grand Total	110,168

## II. Economics

	Low	Medium	High
Seed Yield (kg/ha)	50	80	120
Gross Income (P3,000/kg)	150,000	240,000	360,000

Cost of Production	110,168	110,168	110,168
Net income	39,832	129,832	249,832
Return on Investment (ROI, %)	36	118	227

<sup>1</sup>Based on prevailing prices of labor and supplies as of January 2010.

MD – Man-day.

Source: PCARRD Info Bulletin No. 307/2010

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