AVRDC

AVRDC Training Guide

Suggested Cultural Practices for Eggplant

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Introduction

Eggplant, *Solanum melongena* L., is a popular vegetable crop grown in the subtropics and tropics. It is called brinjal in India and aubergine in Europe. The name *eggplant* derives from the shape of the fruit of some varieties, which look like chicken eggs (top right photo of Fig. 1).

Climate & Soil Requirements

Climate

A long growing season of about 120 days is required for successful production. Eggplant is a warm-weather plant that grows best under temperatures of 21 ° to 29 °C. It cannot tolerate frost, and the growth of young plants will be retarded when night temperatures are below 16°C. Cool temperatures and cloudiness can reduce fruit set.

Eggplant can tolerate drought and excessive rainfall, but struggles to grow when temperatures exceed 30°C. When temperatures and humidities are high, eggplant becomes more vegetative.

Soil

Eggplant prefers a soil that is deep, fertile, well-drained, high in organic matter, and has a pH of 5.5 to 6.8. A sandy loam soil is ideal when an early yield is desired. Heavy clay and saturated soils should be avoided due to the build-up of root-rotting diseases.

Fig. 1. Eggplant comes in many shapes and colors.

Eggplant should not follow other Solanaceous crops (tomato, pepper, potato) since these crops share many of the same disease and insect pests. The incidence of bacterial wilt and nematodes can be reduced if eggplant is planted after paddy rice.

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Selecting a variety

The fruits of eggplant come in a wide array of shapes and colors (Fig. 1). Select a variety that is most suitable to your market. Other desirable characteristics for varieties include high productivity, resistance to diseases, early maturity, strong growth habit, and tolerance to heat.

Seed treatment

No treatment is needed if you are sowing fresh, vigorous seed in sterilized soil. Otherwise, soak seeds in warm water (50 °C) for 30 minutes, rinse them in cold water, and dry them before sowing. Seeds may be further treated with Thiram to prevent seedling rot.

The optimum temperature for germination is at 24 to 29 °C. At this temperature, seedlings should emerge in six to eight days. Use fresh seed; seeds older than two years will be less vigorous.

Seedling production

Transplants are usually used to establish a uniform and complete stand of plants. Transplants grown in cells or containers are ideal because they allow field planting without disturbing the root system. Plug trays or containers are filled with a sowing medium such as peat moss, commercial potting soil, or a potting mix prepared from a combination of soil, compost, rice hulls, vermiculite, peat moss and sand. Sterilize the soil mixture by autoclaving or baking at 150 °C for 2 hours.

Plug seedlings are raised under greenhouse conditions (Fig. 2). Fertilize seeds weekly after two weeks, preferably with a water-soluble fertilizer solution. Plug seedlings will be ready to set in the field four to five weeks after sowing.

Seeds may also be sown in seedling beds (Fig. 3). The seedbeds should be fertile and well drained. The bed area can be incorporated with fertilizers at 40 g/m^2 ammonium sulfate, 50 g/m^2 superphosphate, 30 g/m^2 potassium chloride, and 2 kg/m^2 of compost. Prepare seedbeds which are 15 cm high and 0.8 m wide, and sow the seed in rows of 6 cm apart and 0.5 cm deep. Apply a thin layer of compost on the bed before mulching with rice straw and cover them with a mesh screen net. Thin seedlings at the first true leaf stage. They will be ready for transplanting in five to six weeks after sowing.

Figs. 2 and 3. Seedlings grown in cell trays in a greenhouse (left) and in beds (right).

Transplanting

The ideal transplant is a seedling with three to four true leaves, stocky and disease-free, and without flower buds (Fig. 4).

Fig. 4. Ideal transplants.

Begin hardening plants six to nine days before transplanting to reduce transplanting shock. Slightly withhold water. Expose seedlings to stronger sunlight by removing the netting.

Thoroughly water seedlings 12 to14 hours before transplanting to the field. Transplanting should be done in the late afternoon or on a cloudy day in order to minimize transplanting shock.

Transplant seedlings by digging a hole deep enough to bury a plant so that its first true leaf is just above the soil surface. Press the soil firmly around the root. Irrigate furrows immediately after transplanting.

Transplanting can be done manually or by machine (Fig. 5). If transplanting is done by machine, the plug seedling trays must be compatible with the transplanter. The field should be irrigated immediately after transplanting to establish a good root-to-soil contact.

Fig. 5. Transplanting machine.

Raised beds are recommended in eggplant production (Figs. 6 and 7). Recommended plant spacing varies depending on variety, soil type, and cropping system. AVRDC uses 1.5-m-wide beds (furrow to furrow) that are 20–25 cm high. A single row of plants is planted in the middle of the bed. Plants are spaced 50 cm apart for a plant population density of 13,333 plants/ha.

Figs. 6 and 7. Raised beds are formed and plastic mulch is overlaid.

Mulching

Mulching is recommended to reduce weeds, prevent soil compaction, and conserve soil moisture. Plastic mulch must be laid before transplanting (Fig. 7), and holes are made through which the plants can be transplanted (Fig. 8). Organic mulch is usually laid after transplanting (Fig. 9). Plastic mulching is outstanding for preventing weeds, while organic mulching cools soil temperatures. For that reason, the combination of these mulches is often used during the hot season.

Figs. 8 and 9. Eggplant grown using plastic and organic mulches.

Fertilization

Adequate application of manures and fertilizers is very important for successful crop production. Being a long duration crop, eggplant requires a large quantity of fertilizers. Fertilizer rates depend on the soil's fertility, organic matter content, and texture. A soil test is strongly recommended. In the sandy loam soils at AVRDC, typical fertilizer rates are 170 kg/ha of N, 70 kg/ha of P_2O_5, and 180 kg/ha of K_2O.

Table 1 shows how fertilizer amounts should be distributed during the growing season. Using nitrogen (N) as an example, 30% of the total N should be applied before transplanting (basal), 15% applied in each sidedressing (three and six weeks after transplanting), and 40% applied during the harvest (typically in four applications each spaced two weeks apart).

Organic fertilizers improve the overall structure and condition of the soil. Compost (10 t/ha) or chicken manure (3 t/ha) are commonly used. Organic fertilizer is applied before transplanting.

Table 1. Percent distribution of chemical fertilizer during the growing season.

Nutrient	Basal	3 wks	6 wks	During harvest	Total
N	30	15	15	40	100
P	50	0	50	0	100
K	30	15	15	40	100

Irrigation

Irrigation is essential for eggplant cultivation wherever little or no rain is available during the growing season. Irrigation is most critical during the time of flowering and fruit set. A lack of water during this period could lead to the development of blossom-end rot and malformed fruit. Reduction of fruit size and yield are also caused by moisture stress.

Wilting during the late morning is a good indication that the crop needs irrigation. Eggplant is a medium-rooted crop with a root zone depth of 90 cm in well-drained soil. Irrigate soil to at least 45 cm deep.

The method of irrigation depends on soil texture, topography, and water supply. Generally, furrow (surface) irrigation and drip irrigation systems are used. In addition, mulching with black plastic will maintain more uniform soil moisture between irrigations.

Weed control

Eggplant is slow to become established and cannot compete with aggressive weeds. Weeds also harbor damaging insects and diseases.

Weeds are controlled either by physical methods or chemical control. Physical methods, such as hand weeding, cultivation, and mulching are quite common in small vegetable farms. Only shallow cultivation is necessary. Mulching with black plastic mulch effectively controls weeds and reduces labor needs. Natural organic mulches, such as rice straw, will conserve moisture and add organic matter to the soil.

Chemical weed control is especially popular in places where labor is expensive. Suitable herbicides include Lasso, Enide 50WP, and Sencor 70WP. The best chemical, rate, and method of application will vary depending on the weed species present, soil type, and temperature at time of application. Follow all instructions on the label of the herbicide.

Staking and pruning

One month after transplanting, a bamboo stake (100–120 cm) is placed nearby each plant to support the plant from fruit load (Fig. 10).

Pruning is recommended to produce bright-colored, high quality fruit. Maintain three branches per plant: two branches from the primary division of the main stalk and one branch below this division. All the other lateral branches are removed periodically. Remove older leaves from the lower portions of plants to allow for more air circulation and lighting within the canopy (Fig. 11).

Fig. 10. Staked plants.

Fig. 11. Staked and pruned crop.

Common Diseases

Phomopsis blight (*Phomopsis vexans*)

This is a very serious and widespread disease. The fungus attacks the stems of young plants at the soil line, often girdling the stem and causing the plants to wilt. The fungus can attack the stems of older plants, causing sunken, oval, dark-brown cankers (Fig. 13). Leaf infection first appears as round, brown spots; the centers of the spots later turn gray. Fruit spots are pale and sunken. The spots frequently originate on the calyx and expand into the fruit pedicel and then into the fruit (Fig. 14). Fruit decay is soft and spongy and may penetrate rapidly throughout the fruit.

To control this disease, use pathogen-free seeds, adopt a crop rotation cycle of three to four years, use resistant varieties such as *Florida Market* and *Florida Beauty*, and spray regularly with a protective fungicide such as maneb or zineb. Mulching and furrow irrigation will reduce infection caused by water and soil splashing.

Figs. 13 and 14. Stem and fruit lesions.

Verticillium wilt (*Verticillium dahliae; V. alboatrum*)

Leaves turn yellow along the margins (Fig.15), later turning brown and wilting (Fig. 16). A lengthwise cut of the infected stem shows dark-brown discoloration in the vascular tissue (Fig. 17). Infected plants are stunted and rarely produce fruit. If infection takes place after fruit setting, the flowers and fruits become deformed, wither, and finally drop off. Roots and the base of the stem may later decay. The pathogen is soil-borne.

Fig. 15. Infected plant.

Soil sterilization and crop rotation with non-Solanaceous crops are recommended. Grafting eggplants on suitable rootstocks also minimizes the disease infestation. Use resistant varieties.

Figs. 16 and 17. Wilting plant and vascular discoloration.

Damping off

(*Pythium* spp., *Phytophthora* spp., *Rhizoctonia* spp.)

These soil-borne fungi attack the germinating seed, spreading to the hypocotyl, basal stem, and developing tap root. The affected seedlings are pale green and a brownish lesion is found at the base of the stem (Fig. 18). The seedling collapses. Soil sterilization and seed treatment with fungicides or hot water are recommended.

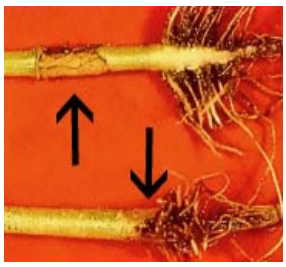


Fig. 18. Stem lesions (on pepper).

Bacterial wilt (*Ralstonia solanacearum;* formerly as *Pseudomonas solanacearum*)

This is very destructive, especially in the hot, wet season. Plants wilt and die suddenly. When newly infected stems are cut crosswise and placed in water, a dingy grayish or yellowish ooze appears (Fig. 19). The pathogen is soil-borne with a wide host range.

To control, sow resistant varieties, rotate with non-Solanaceous crops, use raised beds for improved drainage, and graft plants onto resistant rootstocks.

Fig. 19. Bacteria oozing from cut stem.

Southern blight (*Sclerotium rolfsii*)

Infected plants will suddenly wilt. White fungus develops on the stem at the soil line (Fig. 20). Allow ample time for breakdown of green manure before planting crop. Deep plow to bury the fungus. Soil fungicides such as Terrachlor F (PCNB) offer some protection. Use raised beds for good soil drainage and keep the bed surface dry. Efforts are being made to use solarization and biological control. Grow eggplant after paddy rice or corn.

Fig. 20. Fungus at base of stem.

Leaf spot (*Alternaria cucumerina*, *Cercospora capsici*)

Alternaria produces leaf spots with concentric rings. The spots are mostly irregular, 4-8 mm in diameter and may enlarge and cover a large area of the leaf blade. The leaves may drop off due to severe infection. *Cercospora* produces chlorotic lesions, angular to irregular in shape, later turning grayish brown with profuse sporulation at the center of the spot. Severely infected leaves drop off prematurely resulting in the reduction of yield.

Proper field sanitation can control these diseases. If the general control measures suggested for Phomopsis blight are followed, these leaf spots will also be reduced.

Little leaf

Little leaf disease is a serious disease throughout India. The infected plant is stunted yet has more branches, leaves and roots than a healthy plant. The leaves are malformed into tiny yellowish structures. Many lateral shoots develop in the leaf axils. The shortened internodes give the plant a bushy appearance. The mycoplasma is transmitted by leaf hopper *Hishimonus phycitis* and by grafting.

To control, eradicate all Solanaceous weeds, use insecticides to kill leaf hopper, remove diseased plants immediately, and use resistant cultivars such as *Pusa Purple Cluster* and *Kartain*.

Virus

Cucumber mosaic virus (CMV), potato virus Y (PVY), potato virus X (PVX), and tobacco ringspot virus (TRSV) infect eggplant. Plants infected with these viruses are generally stunted and show mosaic symptoms on leaves. Control by using resistant cultivars, rotating crops, removing infected plants, sowing disease-free seed, and controlling vectors such as aphids.

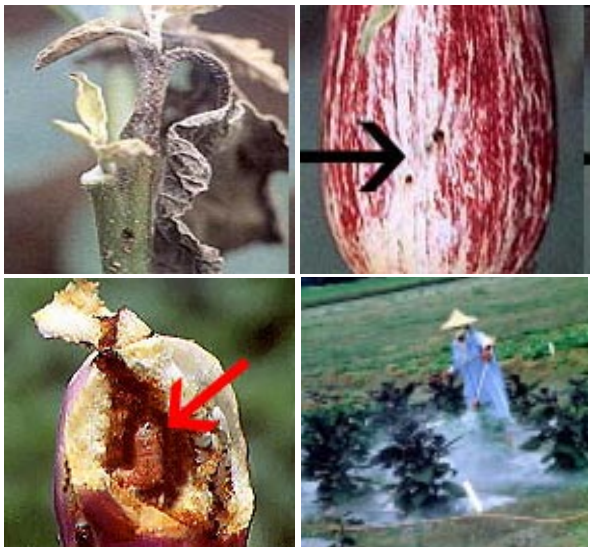
Common Insect Pests

Eggplant fruit and shoot borer

(*Leucinodes orbonalis*)

This is a very destructive pest in S and SE Asia. The larva attacks the terminal shoots and bores inside, resulting in the withering of the shoots (Fig. 21). It also bores into the young fruit and feeds inside which makes the fruit unmarketable (Figs. 22 and 23).

Several insecticides have been tested and found to be effective in controlling this pest, but numerous sprays are needed (Fig. 24). Check the latest recommendations in your country before selecting a chemical. Rotation of crops and the prompt destruction of damaged shoots on a community-wide basis are alternatives. Resistant cultivars are being developed.



Figs. 21-24. (Clockwise from top left) Wilted shoot, exit holes into fruit;, exposed larva inside fruit; pesticide spraying.

Thrips (mainly *Thrips palmi*)

Thrips (Fig. 25) attack eggplant mostly during the dry season. They cause browning of leaves, especially on the lower leaf surface (Fig. 26). Thrips at times also scratch fruits causing irregular discoloration.

Insecticides, such as Oxamyl, Carbosulfan, and Cyhalothrin have been proven to be effective. Spray weekly until infestation stops.


Figs. 25 and 26. Thrips feeding along midvein; damage to underside of foliage.

Cotton leafhopper or Jassids (*Amrasca biguttula biguttula, Hishimonus phycitis*)

Cotton leafhoppers feed mainly on the underside of eggplant leaves (Fig. 27). The infested leaves curl upwards along the margin. Their feeding results in small yellow patches on the foliage (Fig. 28). Certain species also transmit mycoplasma-like diseases, such as little leaf disease. Fruit setting is adversely affected by the infestation.

Spraying with Carbosulfan or Bifenthrin once a week is recommended. Eggplant varieties *Junagadh Sel. 1*, *Aushey*, *R-34*, *H-4* and *T-3* have been reported to be resistant to cotton leafhopper.


Figs. 27 and 28. Leafhoppers; damage to leaf.

Aphids (*Aphis gossypii*)

Aphids are small, soft, and yellowish green or greenish brown in color (Fig. 29). They are found in colonies on the tender shoots and the undersurface of young leaves. They feed on leaves and stems by sucking the plant juice. Black sooty mold develops on the sugary excretions of the aphid, covering the plants and reducing photosynthesis (Figure 30). As a result, infested plants weaken. These insects occur in the cool dry season. Spraying with Bifenthrin, Pirimicarb, or Carbosulfan on a weekly basis is suggested.


Figs. 29 and 30. Aphids; sooty mold damage (on pepper).

Epilachna beetle (*Epilachna vigintioctopunctata, E. indica*)

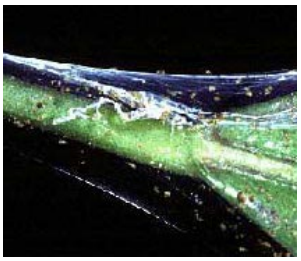
The adult beetle is brown to red, small, spherical and mottled with black spots (Fig. 31). Both adults and larvae feed voraciously on the leaves and tender parts of eggplant. They cause serious damage during their larval stage (Fig. 32) and when they appear in large numbers. As a result of their feeding, skeletonized patches develop on leaves. Later the leaves dry away. These pests can be controlled with Carbaryl or Malathion sprays.


Figs. 31 and 32. Adult and larval stages feeding on leaves.

Other Common Pests

Two-spotted spider mite (*Tetranychus urticae*)

These tiny pests (Fig. 33) feed on the underside of eggplant leaves in large colonies, creating webbing and white specks on the leaves (Fig. 34). Ultimately, the entire leaf becomes discolored and withered. The damage is more pronounced during the warm and dry season. Spraying with Bifenthrin 10WP or Cyhalothrin 2.8EC is effective in controlling the mite.



Figs. 33 and 34. Drawing of mite; mites and webbing on leaf.

Root-knot nematodes (*Meloidogyne* spp.)

Eggplant is highly susceptible to this nematode, especially on sandy soils. Infested plants become stunted, and their leaves show yellowing. Look for the characteristic root galls (Fig. 35). Crop rotation with paddy rice or resistant crops will reduce nematode populations. Fallow plowing will expose nematodes, leading to their dessication. Terbufos (10%) or DCIP 80EC is recommended for control.

Fig. 35. Root gall caused by root knot nematode (on tomato).

Publication updated in 2002.

Harvesting

Eggplant fruits are harvested once they have reached sufficient size for marketing (usually three to four weeks after flowering). Harvesting is done by hand using a sharp knife or clippers, leaving the calyx attached to the fruit. Harvest once or twice a week.

High quality eggplant is firm, heavy (in relation to size), glossy with a desirable color, and free of cuts and scars (Fig. 36). Once the color of the skin begins to dullen, the seeds darken and the flesh becomes spongy and bitter.

Fig. 36. High quality eggplant.

Yields are commonly in the range of 30 to 40 tons/ha. Six to twelve marketable fruits may be expected per plant for the large-fruited varieties, weighing 300–400 g each. The elongated varieties may produce twice as many fruits, with individual fruits weighing 100–150 g each.

Postharvest Storage

Eggplant does not have a long storage life and should be marketed immediately after harvest. Fruits are generally sorted by size and color, and packed into either baskets or cartons (Fig. 37). They are handled and packed carefully to avoid damaging the skin.

Eggplant can be stored safely for 7 to10 days at 7–10 °C and 90–95% relative humidity. It is subject to chilling injury when stored at temperatures below 7 ° C. Symptoms of chilling injury are pitting, surface bronzing, and brown[illegible] of seeds and pulp.

Fig. 37. Eggplant packed for the market.