

DISEASES OF EGGPLANT (SOLANUMMELONGENA) AND THEIR MANAGEMENT

Abstract

Eggplant (*Solanum melongena*) is a widely cultivated vegetable crop susceptible to various diseases that can cause significant yield losses. This short abstract provides an overview of the major diseases affecting eggplant and their management. Fungal diseases like Fusarium wilt, Verticillium wilt, Phytophthora blight, and Alternaria fruit rot, bacterial diseases such as bacterial wilt and bacterial spot, viral infections like Tomato mosaic virus, Cucumber mosaic virus, and Potato virus Y, and nematode infestations, particularly root-knot nematodes, are the primary challenges faced by eggplant growers. Disease management strategies involve cultural practices, biological controls, chemical interventions, and integrated pest management approaches. Implementing these measures will contribute to improved eggplant production and sustainable agricultural practices.

Keywords: Eggplant, *Solanum melongena*, Diseases, Management

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I. INTRODUCTION

One of the most typical, well-liked, and important vegetable crops growing in India and other countries throughout the world is the eggplant (*Solanum melongena* L.). With the exception of higher elevations, it may be grown year-round in practically all regions of India. The brinjal, which is widely grown in India, Bangladesh, Pakistan, China, and the Philippines, is very significant in the warm regions of the world. America, France, and Italy are other countries where people like it. India is the second-largest producer of brinjal in the world after China with 12,826,000 MT. A total of 184394.51 MT of vegetables are produced in India on an area of eggplant that is 550,000 hectares large, Horticultural Statistics at a Glance, (2018).

II. FOOD VALUE OF USES

The fruit known as brinjal is a good source of the vitamins 'B' group, calcium, phosphorus, and iron. The following figures (per 100g of fresh weight) were obtained from an analysis of the edible sections of fruits, excluding the stalk and calyx: moisture (92.7g), protein (1 kg), fat (0.3g), minerals (0.3g), fibre (1.3g), and carbohydrates (4.0g). Ca (18 mg), Mg (16 mg), P (3 mg), Fe (0.9 mg), Na (3 mg), Cu (0.17 mg), S (44 mg), 52 mg, and Na (0.4 mg) are the mineral components per 100g edible portion. Iodine (7 micro/kg) is also present, but in very minor amounts. Vitamin A (124 mg), Amine (B1) (0.4 mg), Riboflavin (B2) (0.11 mg), Niacin (0.9 mg), Vitamin C (12 mg), and Choline (52 mg/100g) in digestible amount are the vitamins that are included (Aykroid, 1963). Brinjal is known to accelerate the intrapeptic metabolism of blood cholesterol. Significant decline in blood cholesterol levels for fresh or dried food, leaf and fruit. The flesh and seeds of the fruit have the highest concentration of poly-saturated fatty acids (linoleic and lenolenic) and are responsible for the de-cholesterol to their presence (65.1%). Magnesium and potassium salts' presence aids in the de-cholesterizing process. Fruit extracts in aqueous form influence the choline esterase activity in human plasma. According to certain reports, dry fruit has goitrogenic properties.

III. DISEASES AND PESTS OF EGG PLANT

Numerous diseases that damage the egg plant's roots, leaves, stems, and fruits are present. The most common fungal, bacterial, viral and mycoplasmal, pests and nematode diseases are as follows:

1. Fungal Diseases

- **Damping off:** The causal organism of this disease viz. *Pythium* sp., *Phytophthora* sp. and *Rhizoctonia* sp. by Sarejanni (1952) in Greece which caused severe damage to brinjal plants.
- **Symptoms:** The hypocotyls, basal stem, and growing tap root are the common targets of the fungus attack, which typically begins on the germinating seed. The damaged seedlings are a light green color, and the stem's base has a brownish lesion. The lesion first encircles the stem before eventually spreading up and down. The seedlings wilt and the infected tissue rots. The fungus enters the plants' lower leaves, fruit, or neck, and the last sort of infection is the most problematic because it

causes the wilting of the entire plant. As per Gill us Niger was shown to be most efficient in a study on the impact of several antagonistic fungi against the damping off diseases of eggplant. *Meloidogyne incognita* alone did not cause pre-emergence damping off in egg plants grown in pots, but when *M. incognita* and *R. bataticola* both existed in the substrate, germination of seed was significantly reduced. Chhabra and Sharma (1981) came to this result after researching the joint impact of *M. incognita* and *R. bataticola* on pre-emergence damping down in egg plants produced in pots.

- **Control:** If the soil is sterile previously sowing and the seeds are cerersan-treated before sowing, the disease may be managed. The disease has also been successfully managed by treating seeds in hot water (15.170C for 30 minutes) (Nath, 1976; Choudhary, 1976 a). When there is an infestation, it is advised not to use any plants from infected seed beds, to treat the seed bed with two applications of 0.05% copper sulphate prior to sowing, to remove infected plants from the field as soon as symptoms appear, to disinfect irrigation water by placing a copper sulphate bag in the main channel (two disinfections at an interval of 8–10 days are typically sufficient), and to avoid growing solonaceous crops in infected fields.
- **Phomopsis Blight:** This disease was caused by *Phomopsisvexans*. In Gujarat, the disease was initially discovered in 1914. Since then, it has been found in many other places of India.
 - **Symptoms:** According to Rangaswami (1979), it caused seedling blight, development of spot, and fruit rot. This is a serious disease of brinjal. In seedling infection it causes damping off symptoms. According to Panwaret al. (1970), the seeds from infected fruits have poor germination rates and the fungus can survive in soil detritus for up to 14 months.
 - **Control:** The following measures suggested by various workers, these are
 - a. Hot water treatment of seeds at 50⁰ C for 30 minutes.
 - b. Seed treatment by 0.1% mercuric chloride or with other oregano mercurial fungicides.
 - c. Spraying at regular intervals in the nursery and in the main field with 1% Bordeaux mixture.
 - d. A suitable crop rotation may also help in reducing the incidence of the disease
 - e. Use of seeds obtained from disease free plants.

According to French researchers Jacqua and Gerion (1988), *Phomopsisvexans* in brinjal could be managed by spraying mixes of Captafol + Carbendazing (ceretal), Maneb plus Thiopohanate - methyl (Pettar), and chlorothalonil (as Daconil) every 10–12 days.

In their study of 300 entries, Kaldaet al. (1976) examined the resistance of *Phomopsisvexans* against *Solanum* sp., brinjal cultivars, and inter-specific F1 hybrids. Highly resistant species included *Solanumxanthocarpum*, *S. indicum*, *S. gilo*, *S. Khasianum*, *S. nigram*, and *S. sisymbriifolium*. Lines 11a and 264 of *S. melongena* were resistant. The responses from the F1 hybrids were inconsistent. Further research revealed that *Phomopsis*

blight resistance was polygenic and recessive. In the majority of the crossings, dominance gene effects were more prominent than additive effects (Kalda et al. 1977; Simon et al. 2021). Florida Market and Florida Beauty are two cultivars via hybridization Dacker (1951) introduced that are resistant to this disease.

- **Leaf Spot:** *Alternaria melongenae*, *Alternaria solani*, *Cercospora solani-melongenae*, and *Cercospora solani* are the four different types of leaf spots that *Alternaria* sp. and *Cercospora* sp. can cause (Rangaswami, 1979).
- **Symptoms:** With concentric rings, both species produce the distinctive leaf markings. Most of the spots are asymmetrical, 4 to 8 mm in diameter, and may spread to cover a significant portion of the leaf blade. When *Alternaria melongenae* infects the fruits and causes deep-seated, obtrusive patches, the leaves may drop off as a result. The typical *Cercospora* leaf spots are angular to irregular chlorotic lesions that eventually develop greenish brown with copious sporulation at the spot's centre. Fruit output is reduced as a result of severely infected leaves dropping off early.
- **Control:** The illness may be mostly managed by keeping the land clean and by burning any infected leaves. This can be controlled by spraying Dithane Z-78, Fytolan and Blitox etc.

The moderately resistant cultivars to *Cercospora* are Majarigota, Blank Round, Juhagadh sel. II (1 mg), P-8, Pusa Purple cluster and H-4.

- **Wilt:** A number of pathogens associated with this disease include *Verticillium dahliae*, *Fusarium solani*, *Sclerotium rolfsii* and *Marcophominaphaseolina*.
- **Verticillium wilt:** Patel et al. (1949) were the ones who initially reported it from Poona in India. Since that time, the illness has spread to nearly all of the country's regions that grow brinjal (Rangaswami, 1979).

The stem and roots contain the most recognizable signs of *Verticillium* sp. infection. The infected plants develop in a stunted manner and typically don't slow down and produce fruit. After flowering or fruit setting, if an infection occurs, the flowers and fruits wilt, become flaccid, and eventually fall off. The afflicted stem's lengthwise cut reveals a black tint inside the vascular tissue. The lower leaves show the earliest signs of the disease. The damaged leaves wilt after first turning yellow and then brown between the veins. Wilting spreads from one margin to the next, eventually causing the leaves to drop off and droop completely. Primary inoculum and soil-borne pathogens typically originate in the soil.

- **Control:** Using plastic mulch to raise the soil's temperature before planting, according to Katan et al. (1975). Reported that mulching controlled weeds, enhanced plant development, decreased wilt (*Verticillium dahliae*) incidence by 60-90% and increased crop yield by 300%.

- a. Fumigation of the soil also works well to control this illness. By fumigating the soil with chloropicrin, Rosa (1954) was able to significantly enhance the production per plant, the weight of each individual fruit, and the wilt rate.
 - b. Because Fusarium wilt is caused by a soil-born pathogen, soil treatment with various chemicals has been found to be particularly efficient. Verticilliums and Fusarium wilt development were inhibited by seed soaking in 0.05% hydroquinone, 0.5% methylene blue, 0.01% orthonitrophenol, or 0.01% orthonitrophenol (Machuzhenko, 1972).
 - c. Use of resistant cultivars, however, controls the disease permanently. Diki and Mekiyudoua (1975) reported that brinjal cv. Black beauty (USA), Pusa purple Long (India) and K-2282 (USSR) are less affected by Verticillium species.
- **Bacterial wilt:** Caused by *Pseudomonas solanacearum*. The disease's signature signs include yellowing, stunting, and wilting of the foliage, which are followed by the complete collapse of the plant.
 - **Control/ Management:** Sohiet al. (1981) assert that effective crop rotations lessen disease infestation. A two-year study with the brinjal cv. Pusa Purple The following rotations were discovered to lessen the disease incidence in plants that were previously vulnerable to *Pseudomonas solanacearum*: Okra-okra-radish-maize-vigna-sp-maize resistant cv. Pusa Purple cluster)-Pharsalus vulgaris. The most resistant cultivars to bacterial wilt were Dingras multiple purple, Sinampira, and Pusa Purple cluster, whereas Black Beauty was susceptible, PusaKranti was only moderately resistant, and Improved Muktakashi was resistant.

2. Viral and Mycoplasmal diseases

- **Little Leaf:** This disease was first reported in India by Thomas and Krishnawamy (1939). *Mycoplasma* is the causal organism of the disease.
 - **Symptoms:** The damaged plant, known as little leaf, is typically smaller in size but has more branches, roots, and leaves than an unaffected plant would have. The leaves are also deformed into little chlorotic forms. Petioles become noticeably shorter; numerous buds emerge in the leaf axils; internodes become shorter and give the plant a bushy appearance; and flower parts become malformed, making them infertile. Infected plants don't produce any fruit, and the fruit they do produce is quite tough.

The leafhoppers *Cestius hishimonus phycitis* and *Amrasca biguttata biguttata* are the carriers of the mycoplasma.

According to Mitra et al. (1979) certain metabolic changes take place due to the infection. The respiration rate of plants of cultivars like Pusa Purple Long, Pusa Purple Round, Pusa Anmole, Pusa Kranti infected with little leaf disease was higher than that of healthy plants, and peroxidase and polyphenol oxidase activity was reduced in all cultivars.

Leaf N, Ca and Mg contents in cv.Pusa Purple Long were lower in diseased than the healthy plants and their P and K contents were higher (SivapraKasamet al. 1976).

Chakraborty and chaudhary (1974) observed that the disease increased dry matter content and decreased the moisture and total nitrogen content in the susceptible cv. Pusa Purple Long and vice versa in case of resistant species *Solanumintegrifolium*.

It may be possible to stop the spread of the disease by removing the infected plant at the earliest stage of infestation and spraying with Ekatox or Folidol till fruit set (Choudhry 1976 and Nath 1976).

According to Gupta and Chakravarty (1975) cvs.Pusa Purple luster and Kartain and resistant to the disease under field conditions, Chakraborty and Choudhary (1975) obtained only 3 lines, namely, sel. 212-1, sel. 252-1-1 and sel. 252-2-1 which were free from little leaf among 164 cultivars tested. The cultivars Pusa Purple Cluster, Pusa Purple Round and Round Local more tolerant than others Keshwal and Khare (1986).

3. **Mosaic:** Caused by virus. The main symptom of this disease is the infected plants are stunted in growth and show mosaic symptoms of leaves.

Sharma (1969) isolated 5 distinct viruses from brinjal plants infected by a wide spread sap-transmissible mosaic disease from Poona, Maharashtra. The isolated are isolate LL (a distinct strain of TMV) called as brinjalmild mosaic, isolate 4 (a distinct strain of CMV) known as common brinjal mosaic, isolate SS known as brinjal severe mosaic, isolate 6 known as brinjalring mosaic and isolate 17 known as brinjal crinkle mosaic, with the exception of *Solanumindicum* IW 599, which was resistant to isolates SS and H, the 12 *Solanum* species tested were susceptible to the above 5 viruses.

The mosaic illness, which was initially identified in Punjab, is sap-transmissible, claim Mayee et al. (1973). For cultivars with long fruit, the incidence of infection ranged from zero in Pusa Purple Cluster to 27.12% in Pusa Kranti, while for cultivars with round fruit, it ranged from 3.83% in T3 to 10.72% in Pusa Purple Round.

Aphid species do not transmit the virus, but there is some seed transmission. Naqvi and Mahmood (1976) discovered that inoculating immature Pusa Purple Long cultivar plants with brinjal mosaic virus dramatically decreased shoot and root growth as well as water intake by 17 and 33% at 10 and 30 days post inoculation, respectively, in contrast to non-included plants.

Uses of resistant or lenient cultivars are the only control measure to be adopted. From screening tests, Patil and Mali (1977) found 6 cultivars were susceptible and only one; Pusa Cluster was tolerant to brinjal mosaic virus.

4. Pests

- **Shoot and Fruit Borer (*Leucinodes orborialis*):** Short and fruit borer alone is as serious menace and has been reported causing as loss up to 70% in yield. It is a tiny, pinkish-pink pest larva that initially bores into the terminal shoots of plants, causing the shoots to wither and dry out. Later, it also bores holes into the immature fruit and

feeds inside, rendering the fruits unfit for human eating. In extreme circumstances, it also contributed to fruit rot.

- **Control: Agnihotriet al. (1990)** found that among the synthetic parathyroid insecticides, Cypermethrin(0.01%) and Deltamethrin (0.00125%) remained the most active in controlling *Leucinodesorbonalis* in two cultivars PusaKranti and Pusa Purple Long. Several accessions of Salanummelongena have been screened against this insect pest and Pusa Purple Long Singh and sikka, (1955), Gill and Chadha, (1979) H-128 and H-129 (Srinivasan and Basheer, 1961): AusheyLal and Ahmed, 1965, Dhankaret al. 1977).

Thorn Pandy, Black Pandy, H-165 and H- 407 (Paddaet al. 1971), SM 202, Sel. 519, Sel. 520, Sel. 521 and Solan- 11 (Lalet al. 1976), PP C-2 (Dhankharet al. 1977), Mawale and Sohone(1977), Long Purple (Frempong and Bualin, 1977); PCC- 17-4 and PVR- 195 (Singh, 1981) have been reported to be lenient or resistant Singh and Sidhu (1988) reported that cultivars PBR 129-5 and SM 17-4 are resistant to *Leucinodesorbonalis*.

Subbaratnam and Butani (1981) reported that cultivars H-4 PusaKranti and A-61 were moderately tolerant to short and fruit borer, while AkaraKusumarkar is tolerant this insect pest. Out of 13 cultivars screened against this insect pest, it has been reported that cultivars H-4, Pusa Purple Long, PusaKranti and SM-41 exhibited tolerance to fruit as well as shoot infestation Raut and Sonone (1980).

Cotton Aphid-Aphis gossypii, Myzus persicas) It is a polyphagous species that has infected numerous plants all throughout India. On fragile shoots and the underside of tender leaves, the tiny, velvety, yellowish green or greenish brown aphid lives in colonies of hundreds. Nymphs and adults both consume the leaf sap. When a severe attack occurs, the damaged leaves curl, gradually deteriorate, and eventually dry up. The pest can be controlled by spraying with 0.05% DDUP (Dichlorvos) or 0.1% Malathion.

5. Nematodes

- **Root knot Nematode (Meloidogyne incognita)**-In India, these are the most prevalent plant parasitic nematodes, and their infestation can be easily identified by the distinctive root-galls they produce. Brinjal has a high nematode susceptibility. The nematode infestation causes the plants to become stunted, the leaves to display symptoms of chlorosis, and the fruiting process is negatively impacted Pant et al. (2023). Increased root total soluble phenols, free amino acid, total proteins and O-dihydroxy phenols and unchanged total carbohydrates were noticed due to the inoculation with *Meloidogyne incognita* in brinjal plants (Alamet al. 1976).
- **Control:** In order to reduce the population, it is important to rotate crops that are resistant to root knot nematodes, such as marigolds (Chaudhary, 1976).

The root-knot index of *Meloidogyne incognita*, *M. javanica* and *M. incognita*, var. *acrita* was reduced by Aldicarb or Tagetespartula or Sesamum oriental inter planting.

According to Chahal and Chahal (1988), *Azobobacterchroococeum* prevented *Meloidogyne incognita* larvae from penetrating the roots of brinjal to avoid galls.

The combined infection of *M. incognita* and *Fusariumsolani* in brinjal was best controlled by carbofuran at 2 kg ai/ha+ Bavistia at 2000 ppm Deolet al.(1989).

Verma and Choudhary (1974) reported that sel. 96-2, sel. 419, Pod Baigan and the species *Solanumsisymbriifolium* and *S. elaeagnifolium* are highly tolerant to *Meloidogyne* spp. under field and laboratory condition. According to Yadav et al. (1975) Vijaya and Black Beauty cultivars are tolerant to *M. incognita*.

According to Mandwana et al. (1980) Black Beauty, Y-2 (U.P.) Vijaya and Banaras Giant cultivars showed relatively low number of nematode egg/ root- system.

For the experiment trial, different bio-control agents including *Trichodermaharzianum*, *Paecilomyceslilacinus*, and *Trichoderma viride* were used. The findings indicated that *T. viride*, *P. lilacinus*, and *T. harzianum* recorded the highest plant growth characteristics and fruit yields, respectively. According to Pant and Singh (2016), Pant (2014), and *T. viride*, *P. lilacinus*, and *T. harzianum* treatments, the most root galls were seen.

In the year 2013, 22 tomato and brinjal growing fields in the Bahadur block near Allahabad were surveyed. *Meloidogyne* sp., *Rotylenchusreniformis*, *Pratylenchus* sp., and *Trylenchus* sp. were among the five genera of plant parasitic nematodes discovered in the Bahadur block area of Allahabad. In the case of brinjal, root knot nematode infection levels were found to be greater in Mahehpur, Neevee, and Katihar. Nineteen villages had disease intensity in both crops that was less than 25%. *Meloidogyne* sp., *Rotylenchusreniformis*, and *Pratylenchus* sp. were discovered to be the predominant rhizospheric plant parasitic nematodes (Pant and Pandey, 2013; Maurya et al. 2018).

Vijay Lakshmi et al. (1979) tested 50 native plant products against the second stage juvenile of *M. incognita* in a lab setting to determine their nematicidal value. *Datura* (Datura metal) leaves appeared to be the most promising of all the experimental materials since a 10% concentration yielded a 100% mortality rate after a 48-hour exposure.

The other potential plant products of nematicidal value were Babadinga (*Embelaribes*) seeds, Bhang (*Conhabinus sativa*) leaves, Bhilawa (*Semecarpusanacardium*) fruit, Ajwain seeds, bhangra (*Eclipta alba*) leaves, Neem (*Azadirachta indica*) seed, Kala Jeera (*Uerhonia cinerea*) seeds, Sarpghandha (*Ranwofiaserpentina*) roots and Tulsi (*Ocimum sanctum*) leaves. Srivastava et al. (1971) reported neem cake @ 464 kg per acre as most effective against *Meloidogyne javanica* on tomato and brinjal.

Nematode pathogens are a crucial part of IPM and can be controlled by carefully planning nematode suppressive crop sequences, deep summer ploughing, organic

manuring, clean cultivation, adjusting sowing time, water and irrigation management, and prudent nematicide use. For these significant plant parasitic nematodes to be controlled and reduced in number, effective management techniques must be implemented (Maurya et al. 2020; Maurya et al. 2020).

In conclusion, eggplant is vulnerable to various diseases affected by fungi, bacteria, viruses, and nematodes. Accurate nematode identification is essential for developing appropriate management strategies for these diseases, including the use of resistant cultivars, crop rotation, sanitation, and chemical and biological controls. Integrated pest management (IPM) strategies that combine different management techniques are recommended for sustainable eggplant production.

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