



Good Agricultural Practice for Brinjal Cultivation in West Bengal and their Pest Management at Present Climatic Situation

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Abstract

In tropical and sub-tropical areas, aubergine, also known as brinjal, is a significant solanaceous vegetable crop. It is a member of the Solanaceae family of nightshades, which also includes tomatoes, peppers, and potatoes. Approximately 94% of the world's brinjal growing regions and 92% of global production are in Asia. It is an adaptable crop that is grown year-round in a variety of agroclimatic zones. Eggplant or brinjal is mostly a warm-season crop that yields best when grown between 21^o-27^o C. Brinjal is one of the most important vegetables in West Bengal. West Bengal ranks first in vegetable production. Nutrients such dietary fibre, folate, ascorbic acid, vitamin-K, niacin, vitamin-B6, pantothenic acid, potassium, iron, magnesium, manganese, phosphorus, and copper are all significantly lacking in eggplant. The cultivation of brinjal is severely limited in tropical and sub-tropical regions by the presence of several illnesses and insect-pests out of them brinjal shoot and fruit borer, white fly, jassids, *epilachna* beetle etc. Good agricultural practices and integrated pest management of the important insect-pests are necessary to obtain good yields of brinjal.

Keywords: Eggplant, Solanaceae, Cultivation practice, Insect pests, IPM

Introduction:

Aubergine, or eggplant or brinjal (*Solanum melongena* L), is a vital vegetable that is grown all over the world. In tropical and sub-tropical areas, aubergine, also known as brinjal, is a significant solanaceous vegetable crop. It is a member of the Solanaceae family of nightshades, which also includes tomatoes, peppers, potatoes, and peppers. 48.4 million metric tonnes are produced annually from more than 1,85,3023 hectares of cultivation globally (FAO, 2014). Egypt (1.2 million tonnes), Turkey (0.82 million tonnes), Iran (0.75 million tonnes), India (13.4 million tonnes; 27% of the world's total), and China (2804 million tonnes; 57% of the world's total) are the top five eggplant-producing nations. Approximately 92% of global output of this vegetable comes from Asia (FAO, 2007).

It is a crop that may be grown year-round and is adaptable to many agroclimatic zones. Despite being a perennial plant, it is grown as an annual crop for commercial purposes. India grows a variety of varieties, and the size, shape, and colour of the fruit determine according to the consumers' choice. Curries are made from immature fruits, and the green eggplant is utilised in many different recipes. Vitamins and minerals such as calcium, iron, and phosphorus are found abundance in fruits. Each variety of aubergine has a different nutritional value. Dietary fibre, folate, ascorbic acid, vitamin-K, niacin, vitamin-B6, pantothenic acid, potassium, iron, magnesium, manganese, phosphorus, and copper are among the nutrients found in eggplant (USDA, 2009). Due to the increased concentrations of polyunsaturated fatty acids (linoleic and lenolenic) found in the flesh and seeds of the fruit (65.1%), aubergine is also prized for its therapeutic qualities and has the ability to lower cholesterol. Fruits include potassium and magnesium salts, which also have a de-cholesterolizing effect. Brinjal has been used in traditional medicine to treat intestinal worms, cholelithiasis, leucorrhea, rheumatism, liver disorders, and coughs brought on by allergies. Patients with diabetes can benefit from eggplant's well-known ayurvedic therapeutic qualities. It has been suggested as a great treatment for those with liver conditions (Shukla and Naik, 1993).

The cultivation of brinjal is severely limited in tropical and sub-tropical regions by the presence of several illnesses and insect and mite pests. Although brinjal is grown commercially in northeastern India, damage from insect and mite pests limits its ability to be produced successfully (Ghosh et al. 1999; Ghosh et al. 2000; Ghosh and Senapati 2001; Chaudhury et al. 2001). The main pests are brinjal shoot and fruit borer, *hadda/epilachna* beetle, whiteflies, jassids, thrips, red spider mite. According to Ghosh and Senapati (2009), brinjal shoot and fruit borer infestations were found to be quite prevalent in the Sub-Himalayan region of India during the summer and rainy season, especially from May to August, and they damaged between 50 and 80 percent of the fruits. Therefore, the proper management practices are most essential to obtain very good crop yield.

Brinjal is cultivated in different countries of the World viz., Egypt, Italy, France, United states, China, Philippines, Pakistan, India etc. With the exception of higher elevations, it is one of the most widely cultivated, well-liked, and important vegetable crops in India. It is a crop that may be grown year-round and is adaptable to many agroclimatic zones. Despite being a perennial plant, it is grown as an annual crop for commercial purposes. The colour, size, and form of the fruit still influence consumer preference even though a sizable number of varieties are grown in India. The fruit shapes and colours of the *S. melongena* L. types vary greatly, from oval or egg-shaped to long club-shaped, and from yellow, white, green, and purple-tinged to black (DBT, 2014). This work has been done for the farming community of West Bengal to inform the scientific methods of cultivation practices of eggplant and integrated management of brinjal cultivation in present climatic situation.

Origin and distribution:

Crops are grown in South and Southeast Asia, Southern Europe, China, and Japan. India is the world's second largest producer of brinjal after China, producing 83.47 lakh tonnes from an area of 5.02 lakh ha. Brinjal cultivation is most common in Orissa, West Bengal, and Bihar, but it is also grown in nearly every state. Taxonomy The genus *Solanum* contains roughly 2000 species, including both tuber-bearing and non-tuber-bearing forms. Important edible species in non-tuber bearing forms include *S. melongena*, *S. torvum*, *S. nigrum*, *S. macrocarpom*, *S. ferox*, and *S. aethiopicum*.

Good agricultural practices for brinjal cultivation:

(A) Varieties:

A vast variety of cultivars and improved varieties with different fruit sizes, shapes, and colours are grown in India. The success of brinjal cultivation depends on the careful selection of varieties, as consumer preferences vary by region and district. Some locations grow a wide variety of native cultivars, such as *Banaras Giant*, *Wayanad Giant*, *Mukthakeshi* and *Manjiri Gota*. Some native cultivars have bitter fruits because they contain glycol-alkaloids like solanin. Most cultivars have glycol-alkaloid concentrations between 0.37 and 4.83mg 100⁻¹g. Types with upright growth patterns, high yields, soft flesh, low seediness, low solanin content, and glossy skin are usually preferred in commercial production due to their resistance to pests and diseases. The following is a list of the main characteristics of improved brinjal cultivars developed in India (Table 1, 2, 3 and 4):

Table 1. Brinjal varieties released from IIHR, Bangalore

Variety	Special features	Average yield
<i>Arka Sheel</i>	Medium– length purple fruits with a rich sheen.	38t ha ⁻¹
<i>Arka Nidhi</i>	Medium–long, glossy, blue – black fruits that are resistant to bacterial wilt.	48t ha ⁻¹
<i>Arka Neelkanth</i>	Clusters of two short purple fruits that are resistant to bacterial wilt.	43t ha ⁻¹
<i>Arka Shirish</i>	Green fruits that are extra lengthy.	45-47t ha ⁻¹
<i>Arka Kusumakar</i>	Clusters of five to seven little green fruits are produced.	45 tha ⁻¹
<i>Arka Keshav</i>	Fruits are tall, crimson, purple and glossy and they are resistant to bacterial wilt.	45t ha ⁻¹
<i>Arka Navneeth</i>	Deep purple colour, oval to oblong fruits.	65-75t ha ⁻¹

Table 2. Brinjal varieties released from IARI, NEW Delhi

Variety	Special features	Average yield
<i>Pusa Kranti</i>	Dark purple, oblong fruits that are 15-20 cm long.	14-16t ha ⁻¹
<i>Pusa purple long</i>	Long, glossy purple fruits.	27.5t ha ⁻¹
<i>Pusa purple round</i>	The fruits are purple and spherical.	45 t ha ⁻¹

<i>Pusa purple cluster</i>	Tolerant to bacterial wilt and bear rich purple fruits that are 10-20 cm long.	40-45t ha ⁻¹
<i>Pusa Ankur</i>	Oval, spherical, violet-purple fruits are produced.	35t ha ⁻¹
<i>Pusa Bindu</i>	Small, oval- shaped, violet- purple fruits are a feature of this early cultivar.	30t ha ⁻¹
<i>Pusa Uttam</i>	Fruits are round and dark purple in this early variety.	20-30t ha ⁻¹
<i>Pusa Bairav</i>	Resistant to phomopsis blight.	30t ha ⁻¹
<i>Pusa Utkar</i>	Dark purple fruits are an early variety.	35t ha ⁻¹

Table 3. Brinjal varieties released by State Agricultural Universities

Developing State Agricultural University	Variety	Special features	Average yield
Kerala Agricultural University, Thrissur	<i>Surya</i>	Tiny, oval, purple fruits that are resistant to bacterial wilt.	18t ha ⁻¹
	<i>Swetha</i>	Small, elongated, white fruits that are resistant to bacterial wilt.	35t ha ⁻¹
	<i>Haritha</i>	Long, light green, elongated fruits that last a long time and resistant to bacterial wilt.	20-30t ha ⁻¹
Tamil Nadu Agricultural University, Coimbatore	<i>CO 1</i>	Pale green, oblong fruits.	20-25t ha ⁻¹
	<i>CO 2</i>	Oblong fruits with pale backgrounds and dark purple stripes.	20-25t ha ⁻¹
Annamalai University, Tamil Nadu	<i>Annamalai</i>	Oblong, purple fruits with minimal thrones on the calyx, resistant to aphid resistant.	20-22t ha ⁻¹
GBPUA & T, Pantnagar	<i>Pant Rituraj</i>	Big spherical purple fruits.	40t ha ⁻¹
	<i>Pant Samrat</i>	Less prone to fruit and shoot borer and jassid infection, and resistant to bacterial wilt and phomopsis blight.	27.25t ha ⁻¹
Haryana Agricultural University	<i>Hisar Pragati</i>	The rectangular dark purple fruits are tolerant of little leaves and are dark and vivid purple in colour.	7.20t ha ⁻¹
	<i>Hisar Shyamal</i>	Fruits are round, black and brilliant purple.	-
	<i>Hisar Jamuni</i>	Dark purple, oblong fruits.	29.93t ha ⁻¹
Punjab Agricultural University, Ludhiana	<i>Jamuni GOI</i>	Fruits are long, plump, and shiny purple.	20-30t ha ⁻¹
	<i>Punjab Barsati</i>	Fruits are medium in length, shiny purple, and resistant to fruit borer.	25-30t ha ⁻¹
	<i>Punjab Neelam</i>	Long, purple fruits.	14t ha ⁻¹
	<i>Punjab Sadabahar</i>	Long, purple, black fruits.	25-30t ha ⁻¹
CSAUA&T, Kanpur	<i>KS 331</i>	Long, purple fruits weighing 218 g.	-

	<i>Azad Kranti</i>	Long, medium sized purple fruits that taper to the distal end.	37t ha ⁻¹
MPKV, Akola	<i>Aruna</i>	Round to oval fruits with a light purple rind.	34-36t ha ⁻¹
JNKV, Jabalpur	<i>JB 15</i>	Long, violet purple fruits weighing 270 g.	-
OUA & T, Bhubaneswar	<i>Utkal Tarini</i>	Medium sized, rectangular, deep purple fruits are resistant to bacterial wilt.	-
	<i>Utkal Madhurai</i>	Medium, length green fruits with a white stripe at the distal end that are resistant to bacterial wilt.	-
RAU, Sabour	<i>Green long</i>	Long green fruits weighing 135 g.	35-47t ha ⁻¹
MPKV, Maharashtra	<i>Vaishali</i>	Oval, purple fruits with white streaks.	-
	<i>Pragati</i>	Fruits are oval, purple peduncles with white bands and spines.	35t ha ⁻¹

Exploitation of Heterosis:

Brinjal's hardiness, enormous flowers, and plenty of seeds in a single fruit make it a popular candidate for heterosis breeding. This makes it possible for a single pollination to produce a large number of F₁ seeds. Due to regional variations in market acceptance, many high-yielding F₁ hybrids should be developed. Hand pollination and emasculation are still used in the production of brinjal hybrid seeds. As explained below, ICAR institutes and State Agricultural Universities have produced a large number of heterotic hybrids:

Table 4. Hybrid brinjal varieties released from different institutions

Developing Institution	Hybrid variety	Parentage	Special features	Average yield
IARI, NEW Delhi	<i>Pusa Anmol</i>	<i>Pusa Long Hyderabad</i> × <i>Purple</i>	It produces 80% greater than <i>Pusa purple long</i> .	62t ha ⁻¹
	<i>Pusa hybrid 5</i>	-	Long, glossy, dark purple fruits.	51.6t ha ⁻¹
	<i>Pusa hybrid 6</i>	-	An early variety, round, purple, glossy fruits.	45t ha ⁻¹
IIHR, Bangalore	<i>Arka Navneeth</i>	IIHR-221 × <i>Supreme</i>	Large, round to slightly oval, dark purple fruits.	65-75t ha ⁻¹
	<i>Arka Anand</i>	IIHR-3 × <i>SM 6-6</i>	Green, lengthy, medium-sized (50-55g) fruits that are resistant to bacterial wilt.	65t ha ⁻¹
Tamil Nadu Agricultural University, Coimbatore	<i>COBH 1</i>	<i>EP 45</i> × <i>CO 2</i>	Fruits are purple in colour.	56.40t ha ⁻¹

Haryana Agricultural University, Hisar	<i>Hisar Shyamal</i>	<i>Aushey</i> × <i>BR 112</i>	Round, brilliant purple colour fruits are resistant to bacterial wilt and tolerant of small leaves.	-
Kerala Agricultural University, Thrissur	<i>Neelima</i>	<i>Surya</i> × <i>SM 116</i>	Round to oval purple fruits that are resistant to bacterial wilt.	62t ha ⁻¹
GBPUA& T, Pantnagar	<i>Pant Brinjal Hybrid 1</i>	<i>PB 121</i> × <i>PB 225</i>	Clusters of lengthy fruit are produced. Resistant to bacterial wilt.	-

Field Preparation:

Proper drainage is crucial for aubergine farming. Plough the soil at least five times to achieve a fine tilth. To increase yield, incorporate bulk organic manure, such as rotten cow dung or compost (Farm Yard Manure or FYM), with soil after final ploughing or before seeding. Bulky organic manure, such as rotten cow dung or compost, can be mixed into the soil. The soil should be sterilised both chemically and physically, using steam and solar energy.

Sowing, nursery and transplanting:

Sowing time and season are primarily determined by agroclimatic conditions and agriculture regions. Although brinjal can be produced all year in South India, the peak sowing season occurs from July to August. Around the hills, seeds appear around March or April. To avoid waterlogging, brinjal seeds are planted in raised nursery beds. Raised beds typically measures 7.2 × 1.2 m (length × breadth) and range in height from 10 to 15 cm. A 70 cm spacing between two beds allows for more efficient cultivation. Manures like FYM can be mixed into each bed to promote growth, and a tiny amount of superphosphate may also be used. To prevent fungal illness, soak the beds with carbendazim @ 15-20g 10 l⁻¹ in water. The seed rate varies according to the type of seeds and seed bed. Pure line types require approximately 500-750g ha⁻¹, while hybrids require 250g ha⁻¹. It is standard practice to adequately treat the seeds before sowing them to avoid future contamination and infection. The various ways in which the seeds can cure are listed below:

1. To prevent fungal diseases, treat seeds with 4g kg⁻¹ of *Trichoderma viride* or 2g kg⁻¹ of thiram.
2. Seed treatment with *Azospirillum* (40g 400g⁻¹) enhances nitrogen fixation.
3. Breaking dormancy is crucial for optimal germination. The dormancy of seeds is normally broken by storing the seeds for 12 months at an ambient temperature.

The seeds are sown 2-3 cm thick, covered with dirt, and lightly watered. The beds are covered with grass or straw, which helps to maintain an optimum temperature and moisture level. After germination, the straw, weeds, weed seeds or any grass should be removed properly. The seedlings are toughened at the nursery for the last week before being transplanted for planting in 4 to 6 weeks.

When they can attain a height of 12-15 cm, it should be carefully uprooted with minimal root damage and transplanted in a well-prepared field. Transplanting should ideally be done in the night time. To prevent small leaf disease and avoid jassid infestation, dip the roots in 0.02% dimethoate or any other systemic insecticide 6 hours before transplantation. Brinjal is a cross-pollinated species, hence it requires adequate spacing. The spacing is mostly determined by the kind and season of planting. For spreading type, spacing might range from 75 x 60 cm to 75 × 75 cm. non-spreading and bushy varieties should have a space of 50 to 60 cm between rows and plants.

Cropping pattern:

Eggplant is very prone to insect infestations, which can be minimised by growing it alongside other crops. Crops should be cross-pollinated and hybridised between species to pass on resistant traits from wild cultivars to commercial varieties. It can also be intercropped with many other crops, such as marigold, cabbage, maize, and soya, to increase yield and harvest. Rotating with french beans reduces the risk of bacterial wilt disease. Crop rotation with wheat and sorghum helps to protect the aubergine crop against root knot nematodes.

Water management:

Irrigation can promote crop growth, flowering, fruit setting, and development. In the plains, crops can be irrigated every 3 or 4 days during the summer and every 7 to 12 days during the winter. The early period necessitates extensive irrigation. Excessive irrigation during seedling stage can lead to damping-off disease. During the vegetative phase, stagnant water generates soil-borne illnesses that impede growth. Drip irrigation method may be widely used since it maximises irrigation potential by optimising available irrigation water. Drip irrigation involves watering crops and fields every almost two days. Drip irrigation involves watering crops and fields every almost two days. Drip irrigation is perfect for brinjal growing since it efficiently meets its water requirements. During the first 70 days, the crop needs proper moisture levels. Drip irrigation has numerous benefits, including water conservation, increased fertiliser efficiency, and improved quality.

Manures and fertilizers:

Brinjal is a long-term crop with a great output potential. Low fertility conditions have a negative impact on flower and fruit yield. Depending on availability, 25 tonnes of FYM per hectare can be incorporated into soil during final ploughing. For high productivity, a strip of wet cow dung manure may be applied at 10-12 cm distant from the plant, followed by earthing up at biweekly intervals during the rainy season. Apply 25t ha⁻¹ of FYM during earthing up, apply nitrogen @ 50 kg ha⁻¹ at 30 days after transplanting, along with phosphorus @ 50 kg ha⁻¹ and potash @ 30 kg ha⁻¹ as the basal dose. During planting, spreading of 2 kg each of *Azospirillum* and *Phosphobacteria* ha⁻¹ should be done on the main field. To boost the production, spray 2 ppm (1.0 ml in 500 l) triacontanol

@ 35mg l⁻¹ of water along with either sodium borate or borax at 15 days after transplanting and during full bloom.

Weed management:

Weeds compete with the main crop for nutrients, space, and light. Weed control is vital for increased productivity. It is critical to monitor weed growth to guarantee optimum soil aeration and plant root development. Weeds can be removed using manual methods such as hand weeding and hoeing. Another highly efficient method is black polythene mulching, which blocks light and suppresses weed germination. Aside from that, some chemicals such as herbicides/weedicides can be used to eliminate or inhibit their growth.

Harvesting and yield:

The brinjal plant's fruits are ready to harvest after around 60 to 150 days of transplanting. It is critical that the fruits be harvested at the appropriate moment, when they have reached the proper size and before the seeds become too huge. Harvesting can be done in intervals since fruits mature at different times. To avoid bruising and harm, the brinjal must be handled carefully during harvest. When the brinjal fruit ripens too much, it becomes bitter. The production is strongly dependent on the season and variety of brinjal. When correctly grown, brinjal can produce an average output of 20 to 30 tonnes per hectare.

Susceptibility of eggplant growth stages to pests:

The plant's growth stage is important since pest and disease attacks are dependent on specific growth stages. (DBT; 2014). Injuries to elder leaves during crop development do not affect the final output. Eggplants may compensate for various injuries by growing additional leaves, new branches, or larger-sized fruits. When plants compensate for crop harm without reducing output or quality, there is no need to use plant protection methods such as insecticides. The removal of contaminated fruits as a sanitation procedure for shoot and fruit borer may be conducted to determine whether the loss of early fruits leads to poorer production in the long run. Some pests are prevalent throughout the crop season and can harm eggplant at any stage of development. They will only have an effect on quality or yield during susceptible growth phases. Damage will also be determined by the season, aubergine variety grown, and other ecological factors such as natural enemies, weather conditions, fertilizer, and water availability.

Insect-pests of brinjal:**A. Brinjal shoot and fruit borer (*Leucinodes orbonalis*):**

In addition to attacking a variety of solanaceous plants, this lepidopteran insect targets brinjal shoots as well as green fruits. Only the caterpillars, creamy white while young but light pink when fully grown are the most responsible for causing the damage. The adult moth is white, but its abdomen and thorax dorsum have black or pale brown markings. The apical and anal borders of its

white wings, which have a pinkish or bluish tint, are ringed with tiny hairs. The patterns of larval incidence on the crop in several seasons since the pattern of larval infestation differs from season to season and from location to location (Nayak *et al.*, 2014).

Symptoms of damage:

1. When terminal shoots are attacked, the growth points are destroyed, which results in dead hearts and terminal shoot withered. The impacted developing shoots become stuck and eventually dry out.
2. They drilled holes in the brinjal fruits. The attacked fruits have excreta-filled bore holes.
3. Infected fruits contain several tunnels inside it. When the larvae feed into the brinjal fruits, they can be seen in the tunnels.
4. The fruits rot as a result of the secondary fungal infection.
5. The brinjal fruits are no longer suitable for human consumption.

Management practice:**Cultural control:**

1. Take out and destroy any affected shoots and fruits that have bores inside of them.
2. Avoid brinjal growing continuously in same field and crop rotation helps to reduce the pest infestation.
1. 3. The brinjal crop should not be ratooned.
3. Try to plant resistant cultivars such as *SM 67*, *SM 68*, *Pant Samrat*, *Pusa Purple Round* and *Pusa Purple Long*.
4. Since old plants harbour pests and spread infestations, remove and burn them before replanting.

Mechanical control:

1. To capture adult male moths in the brinjal field, install funnel type pheromone traps containing 'Leuci' lure.
2. Cover the brinjal field with mosquito nets to restrict the entry of the adult moths from outside.
3. Kill the larvae inside the affected shoots and clean and destroy affected fruits. The affected fruits should be dipped into the water containing insecticide or bury them into soil.
4. To draw in and eliminate the adult moths, set up light trap @ 1.0 no. ha⁻¹.

Biological control:

1. Release egg parasitoids *Trichogramma chilonis* @ 1.0 lakh ha⁻¹.
2. Spray *Bacillus thuringiensis* var. *Kurstaki Bt* formulations (dipel) @ 1.5 to 2.0 ml l⁻¹.

Chemical control:

1. To prevent the emergence of secondary pests and the development of pesticide resistance, repeated insecticide application belonging to the same group should be avoided.

2. Lightly watering the base of the plant is required just after applying granular insecticide (carbofuran 3 G @ 30.0kg ha⁻¹, cartap hydrochloride 4G @ 20.0kg ha⁻¹, chlorantraniliprole 0.4GR @ 10kg ha⁻¹, chlorantraniliprole+thiomethoxam 5G @ 8.0kg ha⁻¹).
3. Following the spray, there should be a seven-day waiting period.
4. Spray any of the following insecticides at 15 days intervals beginning one month after planting: flubendiamide 20 WG @ 375g ha⁻¹, chlorantraniliprole @ 0.3 ml l⁻¹, chlorantraniliprole 8.8% + thiamethoxam 17.5% SC @ 0.5ml l⁻¹, azadirachtin 1.0%, neem oil @ 1.0 l ha⁻¹ with 500l water ha⁻¹ (high volume spray)

B. Hadda beetle / Epilachna beetle (*Henosepilachna vigintioctopunctata*):

This pest targets a wide variety of solanaceous vegetables, including gourds, bitter gourds, tomatoes, potatoes, and brinjal. The grubs and beetles are to responsible for the crop damage.

Damage of symptoms:

1. By eating on the upper surface of leaves, both adults and grubs inflict harm.
2. They leave behind parallel bands of uneaten tissue after eating away regular sections of the leaf tissue.
3. As a result, the leaves have the appearance of lace. They completely skeletonise plant leaves by becoming brown, drying out and falling off of leaves.

Management practices:

Use resistant variety: Insect resistance has been demonstrated by varieties such as *Shankar Vijai*, *Hissar Selection 1-4* and *Arka Shirish*.

Mechanical control: Gather and eliminate the immature grubs, adults and the infected leaves as soon as possible.

Chemical control: Apply any of the following insecticides: NSKE 5%, azadirachtin 1.0%, quinalphos 25 EC @ 1.5 litre + neem oil @ 1.0l ha⁻¹, flubendiamide 20 WG @ 375g ha⁻¹, emamectin benzoate + novaluron @ 1.5ml l⁻¹, chlorantraniliprole @ 0.3ml l⁻¹, flubendiamide 39.35 SC @ 0.3ml l⁻¹ of waters with 500 litres of water per hectare (high volume spray).

C. Whitefly (*Bemisia tabaci*):

The whiteflies attack brinjal, okra, cabbage, cauliflower, cotton, sarson, toria, melon potatoes, sesame, and other crops. The insects are slow-moving, louse-like nymphs that suck sap, grouped together on the underside of the leaves. Adults also consume leaf sap.

Symptoms of Damage:

1. As a result of continuous cell sap sucking from the plant bodies, the brinjal plant's vitality is reduced very quickly.
2. The development of a sooty mould on the insect's discharged honeydew interferes with normal photosynthesis.

3. The crop that has been attacked seems sickly dark from a distance.
4. The insects act as a vector of mycoplasmal disease 'little leaf of brinjal'.

Management practices:

This insects deposit honey dew on 50% of plants. The economic threshold level (ETL) is that when 20 nymphs or 8–10 adults per leaf or leaf stickiness will be found.

Mechanical control:

1. To prevent the attack of adult whiteflies from entering the brinjal field, cover the complete field with small mesh mosquito nets.
2. Install 24–40 blue sticky traps for an acre area.

Biological control:

1. Ladybird beetle and lacewing bug larvae may be released into the brinjal field as predators (2 larvae per 20 nuisance insects, 2 larvae per square foot, or 10000-50000 larvae per acre).
2. Whiteflies in gardens or commercial growing can be managed with *Beauveria bassiana* (fungus) (Botani Gard, Bioceros) spraying continuously.

Chemical control:

Apply any one of the following insecticides, thiacloprid 21.7% SC @ 200-240 ml acre⁻¹, flonicamid 50% WG @ 60 g acre⁻¹, buprofezin 25% SC @ 400 ml acre⁻¹, diafenthiuron 50% WP @ 240 g acre⁻¹, imidacloprid 17.8% SL @ 80-100 ml acre⁻¹, or thiamethoxam 25% WG @ 80 g acre⁻¹.

D. Jassids (*Amrasca biguttula biguttula*):

Both adults and nymphs, who are extremely nimble and move quickly both forward and sideways, are responsible for damage. At night, the winged adults are drawn to the light and will leap or fly away at the slightest disturbance.

Symptoms of damage:

1. Jassids are a type of polyphagous sucking bug that often feeds on the underside of leaves.
2. Plant damage results from sap loss and most likely from toxin injections as well.
3. The plants that are drawn to the area exhibit curling and wilting along the edges, eventually turning pale to bronze, and then experiencing premature defoliation.

Management practices:

1. Install light trap @ 1.0 no. ha⁻¹.
2. When sowing or planting, apply granular insecticides (carbofuran 3G @ 30 kg ha⁻¹) into furrows and then apply lightly water.
3. Spray when 50% of the plants exhibit second-grade injury symptoms by jassids, such as yellowing and curling at the leaf margins, or when the economic threshold level (ETL) of 1-2 nymphs per leaf is reached. Spray imidacloprid 17.8% SL @ 80-100 ml acre⁻¹, buprofezin 25% SC @ 400 ml acre⁻¹, diafenthiuron 50% WP @ 240 g acre⁻¹, thiacloprid 21.7% SC @

200-240 ml acre⁻¹ or thiamethoxam 25% WG @ 80 g acre⁻¹. Any insecticide can be sprayed twice at fortnightly intervals beginning on 10 DAS/DAP.

Importance and uses of brinjal crop:

1. Brinjal is the most common, popular and principle vegetable crop grown widely in India for its various shape, size, and colour of fruits.
2. High productivity, wide adaptation and ease in availability make the crop to find its place as the poor man's crop.
3. In India, it is cooked in vegetable and fish curry, sambar, mashed, fried, grilled and stuffed with spices and then fried.
4. Pigment, dark purple brinjal has more vitamin C than those with white skin.
5. Bitterness of fruits is due to presence of glycoalkaloids, solasodine, and purple skin colour of fruits is due to anthocyanin pigment.

Medicinal values of brinjal:

1. Fruits are effective in treating liver problems and excessive blood cholesterol.
2. Consuming fresh or dried fruits or leaves results in significant decreases in blood cholesterol levels. The presence of 65% polyunsaturated fatty acids (linoleic and lenolenic acids) in the flesh and seeds of the fruit contributes to its cholesterol-lowering effect.
3. Fruits contain magnesium and potassium, which help reduce cholesterol levels.
4. Rich in bioflavonoids, which can prevent stomach cancer. - Brinjal fruits can be pierced with a needle and fried in sesame oil for toothache relief. - White brinjal is recommended for diabetics.

Conclusion:

Brinjal is an important vegetable grown all over world. India grows a lot of varieties as an annual crop for commercial purposes. Brinjal contains rich in vitamin, iron, calcium, fibre, manganese and others micronutrients as well as it is used in traditional medicine to treat various disease. The present study shows the good agriculture practice of brinjal cultivation with a focus on pest's attack and their management at present climatic situation in West Bengal. The study identified major pests affecting brinjal cultivation in West Bengal, including the brinjal shoot and fruit borer, hadda beetle, jassids and whiteflies. To mitigate the impacts of climate change on brinjal cultivation, this study recommends adopting integrated pest management strategies, including the use of resistant varieties, crop rotation, cultural control, mechanical control, biological control methods and finally chemical management. Additionally, farmers should be trained on climatic-resilient agricultural practices, such as mulching, drip irrigation, and conservation agriculture.

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