**Insect Pests and Diseases of Green Gram *Vigna radiata* and Their Management**

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**Abstract:**

This chapter delves into the realm of insect pests and diseases that afflict Green Gram (Vigna radiata), a crucial leguminous crop. Recognizing the nutritional importance and economic significance of Green Gram, the study highlights its vulnerability to a range of pests and diseases that impact its growth and yield. Through detailed exploration of major pests like thrips, whiteflies, and gram pod borers, as well as diseases like anthracnose and yellow mosaic, the paper offers insights into the damage symptoms, bionomics, and effective management strategies. By comprehensively addressing the challenges posed by these threats, the study contributes to the broader efforts of sustaining crop productivity and ensuring food security.

Introduction:

Pulses, which are edible, low-cost dry seeds from the *Fabaceae* (*Leguminosae*) family, are an important source of nutrition for us. Pulses are a valuable group of food crops that contribute to national food security, nutritional security, and the availability of high-quality proteins for the country's largely vegetarian population. Pulses make for 8.37 percent of all food grains consumed. It's a cheap and nutritious source of plant-based proteins, vitamins, and minerals. Pulses are a valuable addition to the diet since they are high in protein (20-25%) and can help with obesity, diabetes, and malnutrition.

*Vigna* is a well-known and frequently farmed genus, with green gram (mung bean) accounting for a significant portion of global agricultural production. Green gram [*Vigna* *radiata* (L.) Wilczek], commonly known as golden bean and mung bean, is a member of the *Leguminosae* family and the *Vigna* genus. Green gram is most significant legume crop of India from the nutritional viewpoint and suitable for enhancing the soil fertility, grown in tropical and subtropical Asia as a source of nitrogen especially for the vegetarian population (Kumari and Chakraborty, 2017).

In addition, green gram seeds have much medicinal importance to cure edema, diarrhea, headaches and eye problems (Li, 1999). Green gram is a high-protein (23-24%), carbohydrate (54-56%), mineral, and vitamin-rich food. It is fed to babies, convalescents, and the elderly because of its excellent digestibility. It has no flatulent impact in the stomach, unlike other pulses. In terms of energy, protein, and fat, the per capita contribution of pulses in India's nutrition supply is currently 117.4 Kcal, 6.9 g, and 1.0 g, respectively. An adult male and female requires 80 and 70 g per capita per day respectively, for balanced diet (Anonymous, 2004). The seeds of the crop are eaten as daal and leaves, green and dried stalk are used as fodder (Singh and Ahlawat, 2005). It is a short duration crop (60-65 days), making it fit in mixed cropping systems and crop rotation (Timsina and Connor, 2001).

Currently, green gram is cultivated in tropical and subtropical Asia mainly in India, China (Zhang *et al*., 2003) and in some parts of Australia, U.S. (Oklahoma), Africa, and Pakistan (Smýkal *et al*., 2015). Asia produces largest amount (90%) of green gram in the world where India contributes about 50% world’s production (Pandiyan *et al*., 2011). It is the third most largely grown pulse crop in India that is rich source of proteins, carbohydrates, minerals and vitamins for grain-based diets in South and Southeast Asia (Afzal *et al.,* 2008)**.** More than 70% of world’s green gram production comes from India and accounts for about 10 to 12% of total pulse production in the country(Anonymous, 2014). Green gram is grown in practically every state in India, making it the world's leading producer. It is farmed on around 4.5 million hectares, producing 2.5 million tonnes at a productivity of 548 kg/ha, accounting for 10% of the world's production of pulses. According to third advance projections from the Indian government, 2.64 million tonnes of green gram will be produced in 2020–21. The consumption of green gram was 22.5 lakh tonnes in the marketing year 2020–2021 compared to production of 21.42 lakh tonnes, with the remaining demand-supply gap being filled by imports of about 1.08 lakh tonnes and opening stockpiles of 2.10 lakh tonnes (Green gram Outlook Report, 2021).

On average, pests kill 2.5 to 3.0 million tonnes of pulses every year. More than 250 insect species are said to affect pulses in India. Nearly a dozen of these insects cause significant crop losses. Annually, an estimated 2-2.4 million tonnes of pulses worth roughly Rs. 6,000 crores are destroyed due to the ravages of insect pest complexes. Green gramme yield loss due to pod borer complex was calculated to be 36.41 percent, with a grain yield of 513.67 kg ha-1 (Umbarkar *et al*., 2013). Host plant resistance play a crucial role in insect pest management of grain legumes and resistance to insect pest has been a major criterion in the development and release of new varieties (Soundararajan *et al*., 2013).

Various sucking insect pests attack the green gram, including white fly, green leaf hopper, flower thrips, spotted pod borer, pod bug, stink bug and gram pod borers. Various diseases attack on green gram are anthracnose, leaf spot, yellow mosaic and powdery mildew.

-: Major pests of green gram :-

Thrips*: Megalurothrips distalis* (Thripidae, Thysanoptera)

Damage symptoms:

 Due to insect attack on green gram especially during dry spells, the leaves are spotted with the characteristic silvering. Later, leaves shrivel and drop. Plants with damage do not produce pods. It serves as a disease vector as well.

Bionomics:

 Eggs are laid in the buds and calyx of developing green gram flower. The eggs are very tiny; a single egg is 0.25 mm long and 0.1 mm wide. They are white when freshly laid and turn pale yellow toward maturation. Incubation period takes an average period of 2 to 3 days. The first and second instar larvae were translucent to white in colour and turn yellow after 2 to 3 days, the yellow form lasted for 2 to 3 days and change to arrange form which lasted for 3 to 4 days before pupation. Both two larval stages are active feeding on host plant tissue, second stage larvae search for shelter to pupate, mostly in the soil. The entire pupation period took an average period of 4 to 7 days. Winged adults then emerge from the pupal stage. The entire life cycle took 12 to 14 days.



Fig: Thrips

**Management:**

Many cultural practises are used to control flower thrips. Pupae in the field can be destroyed by scouring and ploughing before planting. A well-established crop that is better able to endure infection is another benefit of early planting. This is due to the fact that thrips populations are often lower during rainy seasons and higher during dry ones. Deltamethrin, Malathion, monocrotophos, pirimphos-methyl cypermethrin, dimethoate, and lambda-cyhalothrin are appropriate insecticides. The use of numerous techniques, including frequent applications of pricey pesticides, has been suggested and has resulted in a reduction of roughly 80% of flower bud thrips populations in green gram production.

Whitefly: *Bemisia tabaci* (Aleyrodidae: Hemiptera)

**Damage symptom:**

Both nymphs and adults, which are numerous, are responsible for the harm. They sap the life out of the plant by eating its sap. An intense infection causes early defoliation, the growth of sooty mould or honey dew, and the dropping of flowers and pods.

**Bionomics:**

The life cycle of whiteflies typically consists of six stages, including the egg, four nymphal instars, and the adult stage. On both the upper and lower leaf surfaces of plants, Bemisia tabaci lays its eggs. The incubation period for eggs is typically between 5 and 9 days, and they are pear-shaped (about 0.2 mm length) and shiny white when they are laid. The first instar (crawler) leaves the egg shortly after hatching and moves a short distance before successfully probing the leaf to feed on the phloem sap before proceeding through three further nymphal instar stages.

After feeding, the whitish-yellow nymphs in the second instar stage turn yellow and take on a dome-like shape. However, the recently moulted, light yellow third instar nymphs eventually turn dark yellow and develop a flatter form after feeding. The fourth instar, commonly known as the "pupal" stage or "red-eye nymph," is characterised by enormous, yellowish-white eyes that are visible through the integument.

Through an inverted "T"-shaped opening, fully mature adults of B. tabaci emerge from the dorsal surface of the pupal case. A B. tabaci female has a broad, rounded belly, whereas a male has a pointed abdomen. From egg to adult, the B. tabaci life cycle spans from 16 to 31 days.



**Management:**

Predators include lacewings, bigeyed bugs, and minute pirate bugs. Several small lady beetles including *Clitostethus arcuatus* (on ash whitefly) and scale predators, such as *Scymnus* or *Chilocoru*s species, and the Asian multicolored lady beetle, *Harmonia axyridis*, feed on whiteflies. Insecticides imidachlorpid and diafenthurion are appropriate for control whiteflies.

Green leafhopper: *Empoasca kerri* (Cicadellidae: Hemiptera)

**Damage symptoms:**

By sucking plant sap, the nymphs and adults consume fragile leaves and other plant parts. When attacked severely, leaves become dry and brittle. Hopper burn symptoms, such as leaf cupping, emerge. Poor growth may come from the plant losing its vigor.

**Bionomics:**

The gravid female, who is green with a black spot and a black patch on her wings, places 200–300 eggs in groups of 8–16 in the midrib of the leaf blade. Nymphs go through five instars during their 6-7 day egg stage and mature in 25 days. Twenty to thirty days for adults. The population typically starts to rise in August, peaks in September and October, and then starts to fall in November.



**Management:**

Use resistant varieties. Nursery should not be raised near the lamp posts. Apply neem cake @ 12.5 kg/800 m2 nursery as basal dose. Apply carbofuran 3 G @ 3.5 kg or phorate 10 G @ 1.0 kg or quinalphos 25 EC 80 ml. maintain the water level at 2.5 cm for 3 days after granular application. Spray any of the following insecticide in 500 L water/ha Imidacloprid 17.8 SL 100 -125 ml, Acephate 75 SP 666-1000 g, Buprofezin 25 SC 800 ml and Quinalphos 25 EC 1000 ml.

**Gram pod borer: *Helicoverpa Armigera* (Noctuidae,Lepidoptera)**

**Damage symptoms:**

Defoliation in early stages Larva’s head alone thrust inside the pods and the rest of the body hanging out. Pods with round holes.

**Bionomics:**

The eggs are spherical and 0.4 to 0.6 millimetres (1⁄64 to 3⁄128 in) in diameter, and have a ribbed surface. They are white, later becoming greenish. The larvae take 13 to 22 days to develop, reaching up to 40 millimetres (1+1⁄2 in) long in the sixth instar. Their coloring is variable, but mostly greenish and yellow to red-brown. The head is yellow with several spots. Three dark stripes extend along the dorsal side and one yellow light stripe is situated under the spiracles on the lateral side. The ventral parts of the larvae are pale. They are rather aggressive, occasionally carnivorous and may even cannibalize each other. If disturbed, they fall from the plant and curl up on the ground. The pupae develop inside a silken cocoon over 10 to 15 days in soil at a depth of 4–10 centimeters (1+1⁄2–4 in), or in cotton bolls or maize ears.

**Management:**

Pheromone traps for *Helicoverpa armigera* 12/ha. use Bird perches 50/ha. ApplyHa NPV 1.5 x1012 POB/ha with teepol (1 ml/lit.).Apply any one of the following (Spray fluid 625 ml/ha) Dichlorvos 76 WSC 625 ml/ha, Neem seed kernel extract 5% (31.0 kg/ha) twice followed by Triazophos 40 EC 780 ml/ha and Neem oil 12.5 lit./ha

Pod bug: *Riptortus pedestris, Clavigralla gibbosa* (Coreidae: Hemiptera)

**Damage symptoms:**

The unripe seeds' juice is sucked from the green pods by the nymphs and adults. When there is a significant infestation, the delicate areas shrivel and then dry out. On the pods, the bugs may be seen grouped together.

**Bionomics:**

On pods near their base, the female insect lays an average of 115 eggs individually. There is a 3–4 day egg period. The nymphs are hemispherical, brownish-black, and resemble brown ants. In 16 days, the nymphal stage goes through five instars. The size of Clavigralla gibbosa is greater than that of C. horrens. On pods or leaves, it lays eggs in clusters of 3 to 15 eggs. Per female, there are 60–400 eggs produced. There is a 4-day incubation period. Five nymphal instars are present. The nymphal stage lasts from 7 to 31 days. The lifespan of an adult insect is 150 days. The dark, flat, narrow-bodied C. horrens insect has pronounced lateral spines on the prothorax and an expanded hind femur.



**Management:**

Physical shaking of the infested plants over the vessels of oil and water or oily cloth help reduce the population. Spray monocrotophos 36sl 1ml/litre of water during flowering and pod formation stage.

Lablab bugs / stink bug: *Coptosoma cribraria* (Coremelanidae: Hemiptera

**Damage symptoms:**

 On the delicate stalks, nymphs and adults assemble and drink the sap.

Wines with a lot of pests dry up and shed. Plants with a moderate infestation continue to be frail and grow slowly.

Bionomics:

On the fragile pods, oval-shaped greenish bugs lay ivory white sculptured eggs in two rows in batches of 35-50. The incubation period is around 7 days. In South India, the entire life cycle takes about 49 days.



**Management:**

Spray insecticides imidachlorpid, cypermethrin

Termites: *Odontotermes obesus* (Termitidae: Isoptera)

**Damage symptoms:**

Damage from termites begins immediately after sowing and lasts until the growth stage. Plants with damage have drooping leaves, which eventually wither and dry. These plants are simple to uproot.

**Bionomics:**

The female lays its first batch of 100-130 eggs 7-10 days after taking flight. It takes 40-42 days for these eggs to hatch. The female termite then grows to become the queen, laying up to 30,000 eggs every day. This group consists of social insects such as labourers, soldiers, kings, and queens.

**Management:**

Intercultural procedures and irrigation prior to sowing are frequent. Field sanitation, as well as the proper disposal of crop storage and undecomposed plant parts. FYM, whether composed or uncomposed, should not be employed. Two-three deep ploughing could also aid with insect management. Destroy the termite bunds in and around the field, and then kill the queen and any other forms that may exist. Chlorpyriphos seed treatment (4ml/kg seed).

Spotted Pod Borer: *Maruca testulalis* (Crambidae, Lepidoptera)

Symptoms of damage: Make holes in the buds, flowers, and pods. Infested pods and blooms are intertwined.

**Bionomics:**

Female moths lays flat scaly eggs on floral buds, flowers, leaves, leaf axils, terminal shoots and tender pods. Larvae are translucent with dark brown dots on each segment, and the larval stage ranged from 11 to 21 days, with the complete life cycle lasting from 27 to 36 days on various hosts.

**Management:**

Rotate green grams with non-legumes such as maize, cabbages and pumpkin. Install bird perches at 20 perches per acre. Collect infested pods and hand pick and destroy the borers by crushing. Spray neem oil at 40ml/20L of water (Neemroc EC). Apply *Bacillus thuringiensis var. kurstaki* (e.g. Bio T Plus). Spray Lambda-cyhalothrin 50g/L (Pentagon 5% EC at 10ml/20L water). Spray Profenofos 400g/L +Cypermethrin 40g/L (PROFILE 440 EC at 30ml/20L water). Spray cypermethrin based products e.g Debush EC at the rate of 100mls/20L of water. Repeat after 10 days if problem persists.Spray with Spinosad (tracer 480 SC) at the rate of 4ml per 20L of water

**Major Diseases of green gram**

Anthracnose - *Colletotrichum lindemuthianum*

**Disease cycle:**

The main infection is caused by the seed-borne fungus. It also exists in soil-borne plant tissues from diseased plants. Secondary spread by conidia formed on diseased plant components that are airborne. Additionally, rain splash aids in spreading

**Symptoms:**

Any stage of plant growth and all aerial components are affected by the disease. On leaves and pods, there are round, black, sunken dots with a dark center and a brilliant red or orange edge. When an infection is severe, the afflicted areas deteriorate. Soon after seed germination, infection causes seedlings to become blighted.



**Management:**

• Hot water treatment at 54o for 10 minutes. • Plant disease-free seed. • Maintain crop rotation; • Remove and destroy diseased plant detritus from the soil. • Apply Carbendazim to the seeds at a rate of 2 g/kg. • Spray Carbendazim 500g or Mancozeb 2kg/ha as soon as disease appears, and repeat after 15 days.

**Cercospora canescens causes leaf spot.**

 **Symptoms:** Small brown specks with a reddish border develop into circular patches 4mm in diameter with an ashy-grey centre. This tissue deteriorates with age, becomes fragile, and frequently falls out, leaving a jagged hole.

The fungus lives on sick plant detritus as well as seeds. Secondary spread occurs via airborne conidia.

**Disease cycle:**

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• Plant resistant varieties for management. • Plant moong among tall-growing grains and millets. • Practise clean cultivation. • Plant disease-free seed. • Keep crop population density low and row spacing wide. • Cassava, garlic, and zinger crude extracts are used to effectively control the sickness. • Mulching minimises disease incidence and thereby increases yield. • Apply Mancozeb at a rate of 2kg/ha or Carbendazim at a rate of 500 g/ha.

Yellow mosaic disease - Mungbean yellow mosaic virus (MYMV)

**Symptoms:**

Young leaves first develop little yellow spots or patches on their green lamina. It quickly transforms into a distinctive golden yellow mosaic or brilliant yellow mosaic symptom. As the yellow tinge gradually becomes worse, the leaves eventually turn entirely yellow. Plants that are infected develop slower and produce fewer flowers and pods. The pods are deformed and tiny. Before the plant can set seed, an early illness kills it.

Disease cycle:

*Bemisia tabaci*, a whitefly, can transmit the disease in favourable circumstances. Virulence whiteflies that feed on plants carry disease. Crops planted in the summer are quite vulnerable. As a reservoir for inoculum, weed hosts including *Croton sparsiflorus, Acalypha indica, Eclipta alba*, and other legume hosts are used.

Management:

Remove sick plants up to 40 days after planting. • Remove the weed hosts on a regular basis. • Raise the seed rate to 25 kg/ha. • Plant resistant green gramme varieties such as Pant Moong-3, Pusa Vishal, Basanti, ML-5, ML337, PDM-54, and Samrat during the rabi season. • Plant two rows of maize (60 x 30 cm), sorghum (45 x 15 cm), or cumbu (45 x 15 cm) for every 15 rows of black gramme or green gramme. • Apply Thiomethoxam-70WS or Imidacloprid-70WS to the seeds at a rate of 4g/kg. • In 500 litres of water, spray Thiamethoxam-25WG @ 100g or Imidacloprid 17.8% SL @ 100 ml.

Powdery mildew *- Erysiphe polygoni*

**Symptoms:**

One of the common illnesses of various legumes in green gramme is powdery mildew. On leaves and other green objects, white powdery spots first develop before they turn dull in hue. These rounds, progressively larger patches cover the lower surface as well. When the infection is severe, white powdery growth fully covers both sides of the leaves. Parts that are severely damaged become deformed and withered. When there are serious infections, the leaf becomes yellow and early defoliation results. The disease also causes the afflicted plants to mature prematurely, which causes significant output losses.

**Disease Cycle:**

The fungus is an obligate parasite and survives as cleistothecia in the infected plant debris. PAscospores from perennating cleistothecia are typically the source of first infection. The secondary spread is accomplished via airborne conidia. The propagation of the disease is further aided by rain splashes.

**Management:**

• Use resistant varieties • The seeds must be sown early in the month of June to avoid early incidence of the disease on the crop. • Spray Carbendazim 500g or Wettable Sulphur 1.5 kg or Tridemorph 500 ml/ha at disease onset and repeat 15 days later.

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