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Major Insect and Mite pests of French bean in Himachal Pradesh

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ABSTRACT

French bean is mainly grown as kharif season crop in Himachal Pradesh and also grown as a rabi crop. A diverse range of insect and mite pests have been known to infest this crop. Among these, seven major pests *viz*. two spotted spider mite, pod borer, stem fly, whitefly, bean bug, aphids, leaf miner etc. have been found infesting this crop in Himachal Pradesh. This article gives a brief description, nature of damage and management strategies of these pests which will be beneficial for the readers especially students, researchers and farmers.

INTRODUCTION

French bean; *Phaseolus vulgaris* L. is an important vegetable crop in India which is grown for its green shelled beans and dry beans for seeds. It is highly nutritious and rich in vitamins, minerals and fibers. In hills, French bean is grown in months of February- March and October-November in plains. These can be eaten raw (as salads or snacks), cooked and as various delightful recipes. It is not only a nutritious and appetizing vegetable but it also plays an important role in sustainable agriculture development by fixing nitrogen which benefits the crop that is grown along with it. In India, it is grown on an area of about 261 ha with production of 2595 MT and productivity of 9.94 MT/ha (Singh et al. 2022). The production and productivity of French bean is affected by many arthropod pests (Table 1) *viz.* two spotted spider mite, pod borer, stem fly, whitefly, bean bug, aphids, leaf miner, bean gall weevil, tobacco caterpillar, mealy bug, blue butterfly, thrips, hairy caterpillar, red pumpkin beetle, leaf eating beetle, cabbage semilooper, pod sucking bug etc.

Table 1. Diversity of major and minor pests infesting French bean.

Sr. No.	Common Name	Scientific Name	Family	Order	Plant Part Damaged
1	Two spotted spider mite	*Tetranychus urticae* Koch	Tetranychidae	Acarina	Whole plant
2	Pod borer	*Helicoverpa armigera* (Hübner)	Noctuidae	Lepidoptera	Pods and leaves

3	Stem Fly	*Ophiomyia phaseoli* (Tryon)	Agromyzidae	Diptera	Stem
4	Whitefly	*Bamasia tabaci* (Gennadius)	Aleyrodidae	Hemiptera	Leaves
5	Bean bug	*Chauliops nigrescens* Distant	Lygaeidae	Hemiptera	Growing/young shoots
6	Aphids	*Aphis craccivora* (Koch)	Aphididae	Hemiptera	Growing/young shoots
7	Leafminer	*Liriomyza trifolii* (Burgess)	Agromyzidae	Diptera	Leaves
8	Bean gall weevil	*Alcidodes signatus* Boheman	Curculionidae	Coleoptera	Stem
9	Tobacco caterpillar	*Spodoptera litura* (Fabricius)	Noctuidae	Lepidoptera	Leaves
10.	Blue butterfly	*Lampides boeticus* (Linnaeus)	Lycaenidae	Lepidoptera	Young pods, buds and flowers
11.	Thrips	*Scirtothrips dorsalis* Hood	Thripidae	Thysanoptera	Leaves and flowers
12.	Hairy caterpillar	*Spilosoma obliqua* Walker	Noctuidae	Lepidoptera	Leaves
13.	Red pumpkin beetle	*Raphidpalpa foevicollis* Lucas	Chrysomelidae	Coleoptera	Leaves
14.	Leaf eating beetle	*Monolepta signata* (Olivier)	Chrysomelidae	Coleoptera	Leaves
15.	Cabbage semilooper	*Trichoplusia ni* (Hübner)	Noctuidae	Lepidoptera	Leaves
16.	Pod sucking bug	*Clavigralla* spp.	Coreidae	Hemiptera	Pods and flower buds

1. Two spotted spider mite, *Tetranychus urticae* Koch (Tetranychidae: Acarina)

Spider mites are known so because of their ability of constructing webs on leaves for oviposition and also for dispersal. These are red coloured small arthropods having 2 black distinct spots on their body.

Adult two spotted spider mite

Damage:

These have chalicerate type of mouthparts which puncture the plant cells and they suck the plant sap causing yellowing of leaves, reduced plant vigour and cause bronzing. When the greenness is lost white spots also appears on the plant surface. Plant dries up and get destroyed (DOA, 2023). They reproduce very successfully in very short time and multiply at very fast rate and cause heavy damage to the crop.

Webbing by *Tetranychus urticae* on French bean plants

Management:

- Remove out already infested plant from crop field.
- Mites thrive and grow at faster rate in dry and hot climate. Hence, maintaining optimum temperature and moisture will help in restricting the growth and development of mites. Irrigation at regular intervals will be helpful (Opit et al. 2006).
- Biological agents like predatory mites, green lacewing, anthocorid bugs are efficient predators of spider mites. Releasing these in nursery and planting natural flora that encourage their population growth.
- Phytoseiid predatory mite, *Neoseiulus longispinosus* (Evans) is used against these mites. These mites can be released and can provide a control on phytophagous mites.
- *Phytosiulus persimilis* is also recommended for the control of spider mites (Abdallah et al. 2014).
- Spraying of 100ml Malathion (Cythian 50 EC) or Dicofol (Calthane/ Hilphol/ Hexacil 18.5 EC) dissolved in 100 L of water is recommended (DOA, 2023).

2. Pod borer, *Helicoverpa armigera* (Hübner) (Noctuidae: Lepidoptera)

This is stout to medium noctuid moth whose forewings contain 7-8 lines of blackspots on margins and a black comma shaped marking on underside of forewings (IIMR, 2024). Life cycle of pod borer is about 28-46 days in which larval period lasts for about 20 days. Highest incidence is in 29th standard meteorological week (SMW) which reaches its peak during 33rd SMW (Farooq et al. 2022).

Caterpillar of pod borer

Damage:

Young larvae bite or scrap the foliage of plant and later the older larvae bore into the pods leaving its remaining body hanging outside the pod. Pods with irregular big holes are seen on the affected plants. Frass produced by these caterpillars is clearly visible around the bore holes and inside the pods.

Management:

- Pest monitoring is an useful practice by installing pheromone and light traps to check the occurrence and abundance of this pest in field. Also, ETL of 1 larva/ plant is employed in case of pod borer.
- Collect and destroy the already infested pods and plants and clean the debris regularly to remove hibernating larvae.
- Judicious water management and nitrogenous fertilizers to avoid excessive vegetative growth and discouraging larval growth.
- Avoid monocropping and practice intercropping with non-leguminous crops.
- As it is a noctuid moth and are active during night hence installing light traps after dusk hours helps in trapping adult moths (Sushil et al. 2016).
- Release of parasitoids like *Ichneumon* sp., *Telenomus* sp., *Trichogramma* sp., *Chelonus* sp., *Bracon* sp., *Carcelia* sp., *Tetrastichus* sp., *Campoletis* sp. etc.
- Predators: Lacewing, earwig, spider, dragonfly, pentatomid bug (*Eocanthecona furcellata*), ladybird beetle, ground beetle, robber fly, reduviid bug, big-eyed bug (*Geocoris* sp.), praying mantis, red ant, black drongo (King crow), common mynah, wasp, etc. are potential biocontrol agents against control of this pest.
- Use of parasitoid like *Trichogramma pretiosum* 4-5 times from initiation of flowering @ 40,000/acre as an innundative release (Satygopal et al. 2014).
- *Steinernema feltiae* is an entomopathogenic nematodes (EPNs) which is used against @ 1 billion infective juveniles/acre.
- Follow ecological engineering like raise short flowering plants towards main crop and taller plants towards border to attract natural enemies and to avoid pest population establishment, reduce tillage intensity, avoid using broad spectrum chemicals etc
- Biopesticides like *Bacillus thuringiensis* var. *kurstaki* 2.5% AS (Spicbio-BTK AS) 0.75 kg in 500-750 L/ha.
- Spray Chlorpyrifos 20 % EC @3000 ml in 500-1000L/ha (CIBRC)

3. Stem Fly, *Ophiomyia phaseoli* (Tryon) (Diptera: Agromyzidae)

It is a fly, metallic black in colour and its wings are hyaline which have a distinct notch in the coastal areas. Eggs are oval milky to translucent white in colour laid near the petioles (Satygopal et al. 2014).

Damage:

After hatching from eggs, the emerged maggots start mining through petioles and reach at the stem junction and starts feeding inside the stem.The pupation takes place inside the stem. Initially, maggots are white but later turn yellowish brown in colour. Infestation occurs at seedling stage and affect plants throughout the vegetative stage. Infested plant bears few pods and crop yield reduced. Infested stems are red in colour from from inside. Under heavy infestation (3 or more than 3 maggots per plant), plant shows wilting and death of plant may occur if infestation is at basal part of the plant (Yadav et al. 2019, Sushil et al. 2016).

Management:

- Crop whose sowing is done in 2nd week of October escapes the damage of this pest.
- Collect and destroy already affected plant from field.
- Maintaining sanitation in and around the field by cleaning debris and removing weeds is a good approach to prevent damage.
- Optimum use of nitrogenous fertilizers is recommended for avoiding more vegetative growth that service pest population growth.
- As French bean is susceptible for this pest mainly at seedling stage hence, monitoring of seedlings for pest symptoms like oviposition marks on leaves, black flies with clean wings should be done. Swollen and ruptured stem at plant base also show the incidence of bean fly (Yadav et al. 2019).
- Spray Quinalphos 25 % EC (250 a.i.) @ 1000 ml dissolved in 500 – 1000 L of water per hectare.
- Use Quinalphos 01.50 % DP (30 a.i.) @ 20000 gm per hectare (CIBRC).

4. Whitefly, *Bamasia tabaci* (Gennadius) (Aleyrodidae: Hemiptera)

These are very minute (1.0-1.5mm) soft bodied moth like flies, yellow coloured on which white waxy powder is seen. The life cycle of whitefly is about 18- 35 days. The occurrence of whitefly starts 25 days after sowing up to harvesting (Sushil et al. 2016).

Eggs and adults of whitefly

Damage:

Nymphs and adults damage the crop by sucking the sap due to which affected plants show reduced vigour. It also secretes honeydew which promotes growth of sooty mould (black fungus) and cover the leaf surface due to which photosynthesis is hindered. It also transmits viral diseases into the host. Whitefly lay its eggs on undersurface of leaves. After hatching, mobile first instar, known as crawlers move and find a suitable place for feeding. They tuck their mouthparts there and feed at one place throughout their next immature stages Ih are known as nymphs (Borgan and Heinz. 2006).

Management:

- In management of whiteflies, cultural practices like adjustment of irrigation and fertilizer application have shown decrease in the infestation of whiteflies. Drip and sprinkler irrigation are ideal for management of these whiteflies.
- Also, adjustment of crop growing season can escape the damage of whiteflies when their population is at peak.
- Mulching is a great practice for reducing the infestation of whiteflies. Organic mulches like compost, wheat straw, bark, wood straw and synthetic mulches like silver or aluminium coated plastic lower down whiteflies incidence. The sunlight reflected by silver coating of mulches repel whiteflies incursion (Borgan and Heinz. 2006).
- Intercropping, trap cropping, physical protection of crops with the help of row covers, construction of tunnels, screen buildings, field separation, and the use of virus-free seed etc methods are also employed for managing whitefly incidence.

- Traditional approaches like using fermented curd water, cow dung/urine, ash etc. and botanical extracts like marigold and chilli, crushed roots of turmeric etc. are also used (Abubakar et al. 2022).
- Biopesticides like Azadirachtin 0.03% WSP (300 PPM) Neem Oil Based 2500-5000 ml in 500-1000 L of water per hectare and Azadirachtin 5.00% w/w Min. Neem Extract Concentrates 200g in 400L of water per hectare (CIBRC).

5. Black Bean Bug; *Chauliops nigrescens* Distant (Lygaeidae: Hemiptera)

The eggs are cylindrical and dark brown in appearance with fine reticulate markings on its surface. The immature forms i.e. nymphs are light orange in colour whereas the mature instars (fourth and fifth nymphal instars) are dull red and dark brownish in colour. The adults are black in colour and are about 0.5 cm in length. Hind wings are membranous. The hardened basal portion is composed of two regions separated by a concave vein Cu_2.

Damage:

Both nymphs and adults suck the sap usually from the lower surface of the leaves. As a result of sap sucking, the chlorophyll content gets reduced which ultimately affect the quality and yield of the crop. Severely attacked leaves show several minute, yellowish specks and small, black pustules of excreta. The damaged leaves gradually wither and fall off. The adults appear in the month of June (with the onset of monsoon) and remain on the crop until final harvest.

Adult of Black Bean Bug

Management:

- Removal of alternate hosts (chickpeas, lentils and faba beans) and weeds in and around field.
- Avoidance of dense sowing is preferred.
- Ecological engineering is followed for conservation of natural enemies.
- Augmentative release of natural enemies.
- Treatment with Chlorpyrifos 20 % EC 600 (a.i (gm)) 3000 gm diluted in 500 –1000L of water (CIBRC).

6. Aphid, *Aphis craccivora* (Koch) (Aphididae: Hemiptera)

These are relatively small (1-4 mm long) insects. Adults have shiny black or dark brown in colour. These are soft bodied insects. Immature stages, nymphs look alike adults but relatively small. They become adults in 7-10 days (Sushil et al. 2016).

Alates of *Aphis craccivora*

Damage:

Damage is caused by both nymphs and adults. They suck the cell sap from buds, leaves, florets and shoots. The damaged leaves drooped gradually drooped and fall off from plant (Sharma and Sharma. 1998). They reduce plant vigour by sucking contents from plants also excreting honey dew which can produce sooty mould on host which hinders photosynthesis and plant can die.

These aphids are also vectors of viral disease like BCMV (Bean Common Mosaic Virus): whose symptoms includes mosaic, leaf rolling or blistering, light or dark patches on the leaves etc which ultimately retard the growth of plants (Satygopal et al. 2014).

Management:

- For managing aphids in fields, collecting and destroying already infested plants, destruction of debris, removing alternate hosts around the field, deep summer ploughing etc methods can be used.
- Planting mustard as a tall border crop also decrease infestation of aphids.
- Silver coloured plastic when used as mulches they reflect light and prevent aphids from establishing their colonies.
- Strong, sturdy plants can also be sprayed with a jet of water to knock aphids from leaves.
- Parasitoids like *Aphidius colemani, Aphelinus* sp. etc. and Predators like Red ant, robber flies, big-eyed bug (*Geocoris* sp), earwig, ground beetle, cecidomyiid fly, dragonfly, preying mantid, lacewing, ladybird beetle, spider, syrphid fly etc. are effective biocontrol agents for this pest (Satygopal et al. 2014).
- Installing yellow/blue traps/sticky traps 15 cm above plant canopy @ 10-20 traps per acre for monitoring and mass trapping (Sushil et al. 2016).
- **Prevention of BCMV**: the high frequency of this virus is due to infected seeds. Hence, planting healthy seeds is an important practice. Grow crop at enough distance away from other legumes, clovers and *Gladiolus* sp., use varities which are resistant to this virus (Expósito et al. 2024).

7. Leaf miner, *Liriomyza trifolii* (Burgess) (Agromyzidae: Diptera)

These are flies with greyish black thorax and abdomen while ventral body and legs of the flies mostly yellow in colour. Wings are generally transparent. It lays oval eggs on the upper surface of leaf. There are three larval instars which are colourless in immature forms and turn yellowish in final instars. Early instars feed on leaves on which the eggs were laid and the final instars cut the mines before formation of puparium, comes out from the mine, fall off from the mine, fall off from the leaf and dugout the soil to a few cm for the formation of pupa (Kasar and Jha. 2021).

Damage and Pupa of leaf miner on leaves of French bean

Damage:

Both larvae and adults damage the plants. Most of the damage is done by larval instars as they feed on leaves by making tunnels. This hinders the photosynthetic activity and in severe infestation, drying and premature leaf fall also affect the crop. Foliage punctures are made by adult females which give flecked appearance on leaves. This facilitates various fungi and bacteria to enter the host cause infection.

Management:

- Deep ploughing for exposing pupae, soil solarisation, field sanitation, crop rotation with non-leguminous crops especially cereals.
- Provide irrigation during stress conditions to plant. Avoid water stagnation around the plants.
- Pea and marigold as a trap crop is used for managing leaf miner population.
- Parasitoids like *Diglyphus* sp., *Opius* sp., *Halticoptera circulus*, *Neochrysocharis formosa, Chrysocharis* sp., *Gronotoma micromorpha* etc. and predators like lacewings are used against leaf miners.
- Using varieties which are resistant and tolerant recommended by State Agricultural University of that region should be preferred for growing.
- Installing yellow sticky traps @ 4-5 traps/acre helps in managing their population (Satygopal et al. 2014).

- *Bacillus thuringiensis* var*. kurstaki* 2.5% AS (Spicbio-BTK AS) @ 0.75kg dissolved in 500-750ml of water is used per hectare and *Bacillus thuringiensis* var*. kurstaki*, serotype H-39, 3B, Strain Z-52 of 0.75a.i. (g) 500-750 g/ml/ha (CIBRC).

		
1. Predatory mite	**2. Ladybird beetle**	**3. Syrphid fly**
		
4. Lacewing	**5. Anthocorid bug**	**6. Tricho cards**

Natural Enemies of insect and mite pests of French bean

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