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The Sustainable Way of Managing Insects and Diseases in Fenugreek

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Abstract: **Fenugreek (*Trigonella foenum-graecum* L.), is a significant leafy vegetable and a necessary spice. It is an old medicinal herb that comes from Northern Africa and India. Fenugreek has several uses in Chinese and Ayurvedic medicine, including as promoting labour, facilitating digestion, and serving a general tonic that can help boost your metabolism and support your overall well-being. Preliminary research on humans and animals suggests that oral fenugreek seed powder may have Antihyperlipidemic and hypoglycemic benefits. According to a study, fenugreek crops were Infested by a high number of insects pest and Diseases. Five insect pests and Five Diseases of fenugreek were studied in this article. They are listed below Major Pests that cause the greatest yield loss in Fenugreek are Aphids (*Aphis craccivora*), Serpentine leaf miner (*Liriomyza trifolii*), Mites (*Tetranychus cucurbitae*), Thrips (*Scirtothrips dorsalis*), Spotted pod borer (*Maruca testulalis*). while diseases include Cercospora leaf spot (*Cercospora traversiana*) and Collar rot (*Rhizoctonia solani*), Fusarium wilt (*Fusarium oxysporum*), Spring black stem and leaf spot (Phoma pinodella) and powdery mildew (Erysipe polygoni and Laevillea taurica).**

Keywords: **Fenugreek, leafy vegetable, Insect, Management, Sustainable.**

1. INTRODUCTION

Fenugreek (*Trigonella foenum-graecum*), an annual herb, is a member of the Fabaceae family. The two primary cultivated species of the genus Trigonella are corniculata, also known as the Kasuri type of fenugreek, and Phonum-graecum, known as common fenugreek. Known for its small, deeply wrinkled seeds, fenugreek has many uses as a vegetable and flavoring (**Pradeep Kumar Chandra et al., 2023**). Fenugreek grown for its leaves and seeds and used medicinally for centuries. It has an upright growth habit, a strong, sweet aroma, and small, three-lobed leaves. It bears pale flowers followed by pods containing brown seeds. Fenugreek is a cool-season crop, and probably originated in the western Mediterranean. It is used as a herb, spice, and vegetable, and its sweet odor is due to sotolon. Fenugreek, an essential ingredient in Indian cuisine, is rich in protein, minerals and vitamins A and C **(Arya P S. 2000)**. In all the major producing regions of the country crop production has been significantly reduced due to pest infestation, which is a major hindrance in achieving the potential yield. Approximately 30 different pests have been identified that affect fenugreek **(Kakani R. K. and Anwer M. M. 2012; Manjula K. N. et al., 2015; Mittal V. P. and Butani P. G. 1994).** The most damaging pests of fenugreek are sucking insects, which multiply on the crop during the growing season but become more concentrated During flowering and fruiting, fenugreek plants suffer significant yield losses in major spice-producing regions of India **(Bindhani G. et al., 2021).**

2. MATERIALS & METHODS

Insect pests in Fenugreek

1. Aphids

Causal organism: *Aphis craccivora*

Symptoms of damage:

Infestations of soil-dwelling aphids (in both adult and nymph stages) pose a significant threat to fenugreek. By extracting sap from various parts of plant (leaves, shoots, buds, and flowers), they weaken the plant. Their sugary excrement, known as honeydew, facilitates the growth of sooty mold, which can become so severe that it makes the fenugreek unusable.

Moreover, these aphids can spread diseases like common bean mosaic virus. The black bean aphid is a widespread and damaging pest of fenugreek.

Management

For localized aphid infestations on just a few leaves or shoots, pruning can be an effective control method. It's important to inspect plants for aphids before planting. When possible, choosing aphid-tolerant varieties can help. To deter aphids, consider using reflective mulches like silver plastic. A strong stream of water can dislodge aphids from the leaves of healthy plants. Generally, low to moderate aphid numbers are tolerable, and pesticides should only be used for severe infestations. Insecticidal soap or oils like canola or neem are usually the preferred treatments. Always consult product labels for specific application instructions before use.

2. Serpentine leaf miner

Causal organism: *Liriomyza trifolii*

Symptoms of Damage:

An insect is causing a distinctive type of leaf damage, appearing as serpentine trails or "snake holes." This happens because the insect bores through the leaf's outer layers and scrapes away the chlorophyll. When this damage is extensive, it hinders the plant's ability to produce food through photosynthesis and can ultimately kill the plant or cause it to lose its leaves (defoliation).

Management

The management of leaf miner infestations includes the removal and disposal of affected foliage. Sticky yellow traps are recommended for the attraction and elimination of adult flies. Early detection of leaf miner activity can be facilitated through the use of sticky traps. For the control of serpentine leaf miner, applications of dimethoate at 0.03% or emamectin benzoate at 10 g/ha are effective. Furthermore, the application of neem oil at a 2% concentration provides a beneficial control measure.

3. Mites

Causal organism*: Tetranychus cucurbitae*

Symptoms of damage:

In case of mite infection, webs will be noticeable on the leaves. To spread to new areas when their population is high, mites spin silken threads into spherical masses that are carried by the wind. The feeding action of spider mites, using their piercing mouthparts to suck out cell contents, damages the leaves by reducing chlorophyll. This damage manifests as white or yellow spots.

Management

Planting crops on time helps prevent pest outbreaks. Utilizing the right amount of nitrogen fertilizer and appropriate planting geometry are important. Neem oil or neem seed extract (NSKE) can Powerfully control early pest population growth. Powdered *Verticillium lecanii* is another viable option. For large pest populations, synthetic insecticides like imidacloprid, dimethoate, metacytox, or emamectin benzoate can be used.

4. Thrips

Causal organism: *Scirtothrips dorsalis*

Symptoms of damage:

Thrips infestation leads to leaf curling, breakdown, and leaf drop, as well as brittle buds that fall off. Damaged fruits show light brown spots. Early signs include stunted growth, fewer flowers, and poor fruit development. Adult thrips are small (around 1.2 mm) with dark wings and partial abdominal stripes. Their creamy white, kidney-shaped eggs are laid, and both larvae and adults are found mainly near the leaf midrib or margins. Pepper thrips can also cause feeding scars, distorted and brittle leaves, and leaf death.

Management

Effective thrips management involves monitoring populations with blue or yellow sticky traps. Chemical control options include insecticides containing spinosad, imidacloprid, acephate, bifenthrin, or pyrethrin, with at least two applications recommended at a seven to ten-day interval. Physical barriers like cages, hot caps, or fine mesh netting can protect vulnerable young plants from thrips. These coverings should be removed as the plants grow larger or when temperatures rise to ensure adequate space for development.

5. Spotted pod borer

Causal organism: *Maruca testulalis*

Symptoms of Damage:

Fenugreek pod borer larvae can tunnel into stems by joining young leaves, an uncommon damage in other legumes. These entry holes can also cause water to enter and stain the remaining seeds. Bean pod borer larvae, on the other hand, feed directly on the seeds inside damaged pods, often consuming them completely.

Management

Adult pod borer populations can be monitored using pheromone or light traps. Effective biological control strategies involve the weekly release of 50,000 *Trichogramma achilonis* eggs, application of *Beauveria bassiana* at a concentration of 10¹⁰ spores/ml, or the use of HANPV at 250 LE/ha. For managing low pest numbers, sprays of 5% NSKE or 2% neem oil are suitable. In cases of high infestation levels, a chemical control option is a 0.05% quinolphos spray.

Major diseases on Fenugreek

1. Cercospora leaf spot

Causal organism: *Cercospora traversiana*.

Symptoms of Damage:

Cercospora leaf spots start as distinctive, round, and sunken areas on the leaves, characterized by their white color and a delicate (1-2 mm) yellowish border. As the infection establishes itself, these lesions expand rapidly, leading to the death of the leaf tissue. Mature leaves typically exhibit these clearly visible lesions, most of which are framed by a noticeable yellowish ring. The spots also undergo a significant increase in size and develop a white, downy or velvety surface due to the production of fungal spores. **(Agrios, 1997)** on pods, disease symptoms include discolored infected areas as well as severely the affected parts of the plant may dry up and shrink (**Zimmer, 1984**).

Management

The pathogen is transmitted by infective seeds, in some areas pre-planting is an effective control measure **(Acharya S. N. et al., 2010)** Choosing seeds treated with beneficial substances may help control *Cercospora traversiana* **(Cook, 1978).** Rotating crops to those not susceptible to this fungus can also be useful. The key to preventing its spread is identifying the pathogen and stopping it from self-seeding. Effective chemical controls that have been proposed include benomyl, chloroethanol, mancozeb, and maneb. (**Agrios, 1997).**

2. Collar rot

Causal organism: *Rhizoctonia solani*

Symptoms of Damage:

This disease severely impacts fenugreek production, leading to the collapse and death of emerging shoots, as well as damping-off in young seedlings and foot rot in established plants. Although capable of infecting aerial parts like green leaves and seeds, the disease predominantly attacks the root system. A characteristic symptom is the persistent dampness found in the affected tissues of the plant (**Petropoulos, 2002).**

Management

A key recommendation for managing this disease in fenugreek is to prioritize the use of varieties that are known to be resistant (**Prasad and Hiremath, 1985).** Effective control of this infection can be achieved by treating seeds and drenching the soil with beneficial microorganisms such as *Rhizobium meliloti*, *Trichoderma banatum*, *Trichoderma harzianum*, and *Trichoderma pseudoconongii* (**Haque and Ghaffar 1992**) Bacillus subtilis, a Gram-positive bacterium, can also be used successfully for biological management of R. solani (**Tschen and Kou 1985).** Soil saturation with Captan can control fungi, while Carbendazim is effective as a fungicide for seeds and dry soil (**Prasad and Herimath 1985).**

3. Fusarium wilt

Causal organism: *Fusarium oxysporum*

Symptoms of Damage

Fusarium oxysporum infection leads to Fusarium wilt, which initially shows as a faint clearing of the outer veins in young leaves, followed by downward curling of mature leaves. Seedlings are highly susceptible, wilting and dying shortly after symptom onset. In older plants, characteristic vein clearing and leaf curling are accompanied by stunted growth, wilting and yellowing of the lower leaves leading to rapid leaf loss and plant death. Death of minor leaf tissue is also a symptom. **(Agrios, 1997).** A clear symptom of Fusarium wilt infection is the browning of vascular tissue. In addition, issues affecting mature plants become more apparent during the period between fruit ripening and blooming **(Acharya S. N. et al., 2010).**

Management

The use of resistant varieties, crop rotation with non-fungal hosts, soil disinfection, and seed treatment with thiram or captan are some effective ways to control *F. oxysporum* (**Singh, 2001).** As pods enter their third stage of development, the disease becomes evident through dark brown to black spots on their surface, which coalesce into a dark olive, velvety layer. These initial, horizontally spreading infections expand to cover the entire pod, evolving into more rounded or oblong lesions. Although uncommon, these spots may sometimes be observed more on the stem, but minimum on the leaves. Critically, the fungal mycelium remains superficial, not penetrating the pod's outer skin and thus not directly infecting the seeds. Seed contamination primarily occurs during the threshing process **(Petropoulos 2002).**

4. Spring black stem and leaf spot

Causal organism: *phoma pinodella*

Symptoms of Damage:

Symptoms of the disease on growing plants include many irregularly shaped, dark brownish to blackish spots on the leaves, stems, and petioles, often with a surrounding pale-yellow halo. In some instances, long, black marks may appear on the roots. Infected plants typically exhibit a slight yellowing and their development is hindered. With severe infection, clearly defined lesions form on the roots, resulting in widespread wilting and the yellowing of the majority of the leaves **(Bretag and Cunnington, 2005).**

Management

By utilizing chemical seed treatments, crop rotation, and eliminating diseased plant parts, primary disease infections can be significantly reduced. Importantly, the majority of disease studies reveal that successful containment of the fungus at this initial infection stage prevents its progression to advanced disease development **(Bretag *et al*., 2006).**

5. Powdery mildew

Causal organism: *Erysipe polygoni and Laevillea taurica*

Symptoms of Damage:

The presence of a strong odor and the development of white to gray powder like patches or circular to elliptical blemishes on the upper side and lower side leaf surfaces (seldom on flowers) are characteristic of infected plants. These fungal markings may start as isolated specks but merge into larger areas as the infection takes hold. The disease often begins on the lower foliage and can swiftly spread, coating the entire plant with the fungus. The upper leaf surface typically supports

a greater abundance of fungal structures and spores compared to the underside. Severely impacted leaves become distorted, drying out and exhibiting irregular sizes, consequently slowing the plant's overall development **(Basu *et al*., 2006a).**

Management

The best approach to manage this disease is to use resistant plant varieties as a preventative measure. If control is needed, effective options include Tilt 250E (containing propiconazole) or a combination of milgo-ethrinol (at a concentration of 28% using 2.5 ml per liter of water) with either captan (at a 50% concentration using 2.0 grams per liter of water) or benomyl (at a 50% concentration using 2.0 grams per liter of water) **(Basu *et al*., 2006a).** Another viable method for managing the disease involves the application of a dinocap spray, utilizing 8 to 10 ounces of active ingredient per acre in a 100-gallon solution **(Petropoulos 1973).**

Table 1. Important pest of Fenugreek

Sr. No.	Name of pest	Causal Organism	Site of Damage
1.	Aphids	*Aphis craccivora*	Yong stem, Leaf, Fruit
2.	Serpentine leaf miner	*Liriomyza trifolii*	Leaf
3.	Mite	*Tetranychus cucurbitae*	Leaf
4.	Thrips	*Scirtothrips dorsalis*	Leaf, Fruit
5.	Spotted pod borer	*Maruca testulalis*	Leaf, Seed

Table 2. Important Diseases of Fenugreek

Sr. No.	Name of Disease	Causal Organism	Site of Damage
1.	Cercospora leaf spot	*Cercospora traversiana*.	Leaf
2.	Collar rot	*Rhizoctonia solani*	leaves and seeds,
3.	Fusarium wilt	*Fusarium oxysporum*	Leaf, Tissue
4.	Spring black stem and leaf spot	*phoma pinodella*	Leaf, stems and petioles
5.	Powdery mildew	*Erysiphe polygoni and Leveillula taurica*.	Leaf

3. CONCLUSION

Insect Pests are one of the most important obstacles to increasing agricultural crop production. Vegetable crops are commonly targeted by insect attacks. Damage to seeds, roots, leaves, and stems can all affect plant vigor, plant depth, and crop loss. Fenugreek, like many crops, is susceptible to a range of insect pests. Fenugreek plants are attacked by many pests & Diseases During the investigation five insect pests & five Diseases of Fenugreek were identified, They are listed below. Aphids (*Aphis craccivora),* Serpentine leaf miner (*Liriomyza trifolii*), Mites (*Tetranychus cucurbitae*), Thrips (*Scirtothrips dorsalis*), Spotted pod borer (*Maruca testulalis*) Among them Aphids, leaf miners, pod borers, and thrips being the most destructive pests of fenugreek, while diseases include Cercospora leaf spot (*Cercospora traversiana*) and Collar rot (*Rhizoctonia solani*), Fusarium wilt (*Fusarium oxysporum*), Spring black stem and leaf spot (Phoma pinodella) and powdery mildew (Erysipe polygoni and Laevillea taurica) Among them powdery mildew and Cercospora leaf spot being the most devastating disease in fenugreek.

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