

Rabi fodder crops: Major diseases, insects and their management

Ashlesha Singla¹, Sandip Landge², Mahesha H.S.³, Subhash Chand^{4*} and V.K. Yadav⁴

¹Punjab Agricultural University, Ludhiana, Punjab 141 004

²Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra 413 722

³ICAR-National Institute for Research on Commercial Agriculture, Rajahmundry, Andhra Pradesh 533 105

⁴ICAR-Indian Grassland and Fodder Research Institute, Jhansi, Uttar Pradesh 284 003

Cultivated rabi fodder crops such as oat, berseem, and lucerne play a crucial role in sustaining livestock productivity during the winter season by providing high-quality green fodder rich in crude protein and essential nutrients. However, their productivity and fodder quality are severely affected by a range of diseases and insect-pests, which can cause yield losses ranging from 20–50%, depending on the crop, pest or pathogen severity and prevailing environmental conditions. Besides reducing biomass yield, these biotic stresses adversely affect the nutritional quality and palatability of fodder, resulting in substantial economic losses to livestock farmers. Among the major diseases, stem rot, leaf blights, powdery mildew, downy mildew and rust are the most prevalent, while aphids and leaf-eating caterpillars are the principal insect-pests. This article summarised key diseases and insect-pests of major rabi fodder crops along with their symptoms and management practices.

Keywords: Oat, Berseem, Lucerne, Pest management

PRESENTLY, India ranks 1st in milk production, contributing 25% to the global milk production (BAHS, 2024). However, the milk productivity is quite low in the world. Lack of balanced ration is one of the main reasons for this low productivity. Therefore, it is necessary to devise suitable strategies to increase the production and productivity of fodder crops. Fodder *rabi* crops such as oat, berseem, and lucerne are rich in crude protein content, high in other essential nutrients with good palatability making them an essential part of ruminant ration. Despite their importance, diseases and insects adversely affect fodder quality as well as production in these crops. These biotic factors contribute 20–50% in fodder yield losses, deteriorate, nutritional quality and lowering profitability for dairy farmers. Therefore, an accurate

diagnosis of causal organism is of utmost importance for reducing losses and for the application of timely and sustainable management strategies.

Fodder oat (*Avena sativa*)

Oat is an important *rabi* cereal crop cultivated in temperate and sub-tropical regions in India. Oat is nutritionally rich, particularly in fat, protein, vitamin B1, phosphorus, and iron. It thrives well in moist and cool climate and may be sensitive to dry and hot conditions during maturation. Among pests, severe outbreaks of foliar diseases have been reported to cause yield losses ranging from 30–40%.

Leaf blotch/blight: The leaf blotch symptoms appear initially as small, light brown to greyish-brown, oval to elongated spots on leaves. Lesions are usually confined between the veins, giving a blotched or

striped appearance. Spots gradually enlarge and turn dark brown to grey with well-defined margins. Multiple lesions coalesce to form large, irregular blotches covering major portions of the leaf blade. Affected areas become necrotic and dry, often leading to partial or complete blighting of leaves. In advanced stages, leaves show premature yellowing and drying from the tip downwards. Severe infection results in reduced photosynthetic activity, poor plant growth, and significant reduction in green fodder yield.

Management:

- Sow resistant varieties such as OS-6, UPO-94, JO-03-91, JO-03-93 and OS-377.
- Seed treatment with carbendazim 50% WP @ 2 g/kg seed followed by foliar application of propiconazole 25% EC @ 1 mL/L at 21 days after sowing.

Powdery mildew: The symptoms first appear as small, white, fluffy or powdery patches on the upper surface of leaves. Powdery growth consists of superficial fungal mycelium and spores. The mycelium darkens to yellowish grey with age. Yellowing and chlorotic patches develop beneath the infected areas on the leaf surface. Late in the season, black spherical fruiting structures (cleistothecia) develop in the mycelial mats. Severe infection reduces photosynthetic efficiency, leading to stunted plant growth and decreased fodder yield.

Management:

- Sow resistant varieties such as OS-6, JO-03-91 and JO-03-93.
- Two foliar sprays of hexaconazole 5% EC @ 0.05% or propiconazole 25% EC @ 0.05% at 15 days interval after onset of disease.

Rust: The symptoms first appear on leaves as small, orange to reddish-brown pustules (uredinia) that appear mainly on leaves, leaf sheaths, and sometimes on stems. As the disease progresses, pustules rupture the epidermis, releasing rusty powdery spores and causing leaf tissue damage. Severe infection leads to premature drying of leaves, reduced fodder quality, and lower green biomass yield.

Management:

- Spray of propiconazole 25% EC @ 0.05% at 15 days interval at disease onset.

Oat aphid: Oat aphids are small, soft pear-shaped bodied insects (ranging from olive-green to greenish-black). They colonise the lower stems and leaves.

Nature of damage: The nymphs

and adults of aphid pierce and suck sap from leaves, stems and less frequently the developing tillers of oat. This leads to stunted growth, leaf distortion, and reduced yield and quality. Aphids inject toxic substances during feeding on plants that destroy plant tissue. High aphid populations also produce sticky honeydew promoting sooty mold growth that hinders photosynthesis and plant health.

Management:

- Maintain optimum plant spacing and avoid excessive nitrogen fertilisation.
- Conserve and encourage natural enemies i.e. *Coccinella septempunctata* (ladybird beetle), *Menochilus sexmaculatus*, *Chrysoperla zastrowi sillemi* (green lacewing), *Syrphus* spp. (hoverfly larvae).
- Spraying of *Lecanicillium lecanii* 1.15% WP or *Metarhizium anisopliae* 1.15% WP @ 5 g/L of water as soon as the incidence of pest is noticed.
- Spray of azadirachtin (1,500 ppm) @ 3 mL/L of water immediately after infestation, or spray twice imidacloprid 17.8% SL @ 0.3 mL/L of water at 15 days interval. Apply these fungal biopesticides during periods of high relative humidity (>70%) and moderate temperatures for better efficacy.

Berseem (*Trifolium alexandrinum*)

Berseem is an important leguminous *rabi* fodder crop and has since become a cornerstone of forage crops, covering approximately 2 mha across states like Punjab, Haryana, Delhi, Uttar Pradesh,

Madhya Pradesh, Bihar, Rajasthan and Gujarat. Its prominence is attributed to its multi-cut nature (4–6 cuts), long duration of green fodder availability (November to April), high green fodder yield, superior forage quality, high digestibility (up to 65%), and exceptional palatability. The diseases and insects cause yield losses up to 25–45% in terms of quantity and quality of fodder under favourable environmental conditions.

Stem rot: It initially appears as water-soaked, soft lesions on the stem near the collar region, especially under cool and humid conditions. The leaves turn olive-greyish-brown before they wither and become covered with mycelium. As the disease progresses, the infected stem tissues become pale brown, soft, and rotten, resulting in weakening of the stem. A characteristic white, cottony fungal growth develops on the affected stem, leaf bases, and nearby soil surface. Infected and dead plants are covered by greyish mycelia, with black sclerotia forming in dead plant tissue at soil level, or in the soil close to dead plants. Due to rotting of the stem and crown, affected plants show sudden wilting, yellowing, lodging, and eventual death, usually occurring in patches across the field, leading to significant reduction in fodder yield and quality.

Management:

- Follow 3–4 years crop rotation with non-host crops and deep ploughing during summer.
- Foliar application of carbendazim 50% WP @ 1 kg/ha after first and second fodder harvestings.

Leaf blight: Initially, small, water-soaked or light brown spots on older leaves, usually starting from the lower canopy, later turned brown with a distinctive 'V' shape. When severe, whole plants had a 'burnt' appearance and there is no seed formation. Severely affected leaves turn dark brown to black, become brittle, and dry prematurely.

Management:

- Destruction of crop debris before sowing and after harvesting of the crop.
- Seed treatment with *Trichoderma*



Leaf blight of oat



Powdery mildew of oat



Oat aphid

harzianum (5 g/kg seed) or carbendazim (2 g/kg seed).

- Spray of *T. harzianum* @ 10 g/L water at the appearance of disease symptoms or spray of mancozeb 1 kg/ha.

Collar rot: It is a soil borne disease and symptoms include dark-coloured water-soaked lesions at the base of stems, stem thinning (resembles wire stem), and eventually wilting of the whole plant. A white mycelial mat was observed on the stem and collar region, and light brown to tan coloured sclerotial bodies formed as the disease progressed.

Management:

- Seed treatment with carbendazim + mancozeb @ 5 g/kg of seeds.
- Application of *T. harzianum* enriched FYM @ 5 t/ha.

Aphids: These small insects suck sap from the plants, leading to stunted growth and potentially transmitting viruses.

Management:

- Avoid excessive application of nitrogen fertilisers which favours aphid multiplication.
- Maintain optimum irrigation and balanced nutrition to improve plant vigour.
- Remove weed hosts that serve as reservoirs for aphids.
- Conserve natural enemies such as *C. septempunctata* (ladybird beetle), *M. sexmaculatus*, *Chrysoperla zastrowi sillemi* (green lacewing).
- Spray azadirachtin 1,500 ppm @ 3–5 mL/L of water or *L. lecanii* and *M. anisopliae* @ 5 g/L of water under humid conditions.

Leaf miner: These larvae tunnel within the leaves, creating mines and reducing photosynthetic area.



Stem rot of berseem

Management:

- Destroy crop residues after harvest, remove alternate host weeds.
- Release *Trichogramma chilonis* @ 50,000 adults/ha weekly during moth activity and conserve parasitoids such as *Chelonus* spp. and *Bracon* spp.
- Spray *Bacillus thuringiensis* (Bt) formulations against young larvae. Spray azadirachtin 1,500 ppm @ 3–5 mL/L of water.

Thrips: *Thrips tabaci* are tiny insects that damage plants by rasping and sucking sap, leading to distorted growth and silvery streaks on leaves.

Management:

- Remove weeds around the field and avoid moisture stress through proper irrigation.
- Release *Chrysoperla zastrowi sillemi* larvae, conserve predatory bugs (*Orius* spp.), or spray *Beauveria bassiana* @ 5 g/L of water.
- Spray azadirachtin 1,500 ppm @ 5 mL/L, or *L. lecanii* and *M. anisopliae* @ 5 g/L of water under humid conditions.

Whitefly: *Bemisia tabaci* are small, white-winged insects that suck sap and can transmit viruses.

Management:

- Remove alternate host weeds, avoid excess nitrogen fertilisation and maintain field sanitation.
- Install yellow sticky traps (15–20 traps/ha).
- Conserve predators like *Encarsia formosa*, *Eretmocerus* spp., ladybird beetles, lacewings.
- Spray *L. lecanii* or *B. bassiana* @ 5 g/L of water under humid conditions.

Cutworms: Larvae of various moth species such as *Agrotis ipsilon* cut down seedlings at the soil level.

Management:

- Deep summer ploughing to expose pupae, avoid continuous cropping.
- Install light traps for adult moth monitoring.
- Spray *M. anisopliae*/*B. bassiana* @ 5 g/L of water, or release *T. chilonis* against eggs.

Gram pod borer: It attacks berseem pods and developing seeds.

Management:

- Deep ploughing after harvest, crop rotation with non-host crops and remove alternate host plants.
- Install pheromone traps (5 traps/ha) for monitoring, collect and destroy eggs and larvae.
- Release *T. chilonis* @ 50,000 adults/ha weekly, spray HaNPV [*Helicoverpa armigera* nucleopolyhedrovirus (NPV)] @ 250 LE/ha and Bt formulation @ 1 mL/L of water.
- Spray azadirachtin 1,500 ppm @ 5 mL/L of water or spray *M. anisopliae*/*B. bassiana* @ 5 g/L of water

Tobacco caterpillar: *Spodoptera litura* feeds on leaves and other plant parts, causing defoliation.

Management:

- Deep ploughing, destroy egg masses and crop residues, maintain field sanitation.
- Install pheromone traps (5 traps/ha), collect egg masses and young larvae manually.
- Spray *Spodoptera litura* NPV (SINPV) @ 250 LE/ha, or spray *Bacillus thuringiensis* @ 1 mL/L of water formulation. Spray *M. anisopliae*/*B. bassiana* @ 5 g/L of water.

Green stink bug: These bugs (*Nezara viridula*) pierce plant tissues and suck sap, leading to deformed growth or reduced seed quality.

Management:

- Follow proper field preparation, deep summer ploughing and crop rotation.
- Spraying of *L. lecanii* 1.15% WP or *M. anisopliae* 1.15% WP @ 50 g/10 L of water as soon as the incidence of pest is noticed.

Lucerne (*Medicago sativa*)

Lucerne (alfalfa) is an annual as well as a perennial fodder crop, and is called the queen of fodder crops due to its high biomass, vitamins, minerals and proteins. High nutritive value, crude protein, palatability and low acid and neutral detergent fibre and lignin make this fodder popular among dairy farmers as feed for herbivorous livestock. It is a crop

of the temperate region; however, due to its better adaptability over other fodder crops in diversified soil types and climate, it can be raised in sub-tropical and tropical regions of India and cultivated for fodder, hay or bales. The quantitative losses due to diseases and insects recorded in India are about 37.7%.

Rust: The symptoms appear as small, round, powdery, reddish-brown to dark brown pustules that form, mostly on the undersides of the leaves. Pustules may also appear on the petioles and stem. Severely infected leaves may turn yellow, wither, and drop prematurely.

Management:

- Use of resistant varieties such as Chetak, Anand Lucerne-3 and RRB-07-1.
- Spraying of mancozeb (2.5 g/L) and tebuconazole (0.5 mL/L) alternately at 15 days interval is recommended for superior seed yield.

Downy mildew: Appears as yellowish spots on leaves, leading to distorted, curled leaves and a fuzzy, greyish-white growth on the underside, especially in cool, moist conditions. It primarily affects seedlings and young tissue, causing stunted growth and rosette formations at the tips of stems.

Management:

- The first fodder harvest should be cut early to remove diseased tissues, and cutting also reduces humidity in the canopy, thus reducing the risk of infection.
- Spraying of mancozeb (2.5 g/L) at the time of appearance of disease symptoms.

Leaf spot: Initial symptoms include small, circular brown to black spots on the leaflets of lower leaves before moving upward. Mature lesions usually remain isolated from each other and may have a size of 1/8 inch. A raised, light brown fungal fruiting body (apothecium) within the lesion may appear on the upper leaf surface. The infected leaves turn yellow and neem drop from the plant as the disease progresses.

Management:

- The first fodder harvest should

be cut early to remove diseased tissues, and cutting also reduces humidity in the canopy, thus reducing the risk of infection.

Little leaf/Witches broom disease: The distinctive symptoms incited by phytoplasma include stunted growth, and leaf yellowing followed by proliferation of shoots with short inter-nodal length and severe reduction in leaf size with short petioles. Later, floral parts were converted into leaf-like structures leads to sterility in the plants.

Management:

- Remove weeds from the bunds and surrounding area.
- If necessary, in seed crop, spray streptomycin @ 0.5 g/L of water.

Lucerne aphid: The spotted alfalfa aphid is small, soft-bodied insects, often pale yellow-green or blue-green, on lucerne plants, especially on stems and young growth. The pea aphid is a large green aphid with long legs, antennae with dark bands and feeds on stems. Cowpea aphids are shiny and black in colour and found in clusters on young shoots.

Nature of damage: Lucerne aphids damage crops by feeding on phloem sap, leading to reduced plant height and leaf area, yellowing, leaf distortion, reduced growth and premature leaf fall. Infestations cause stunting, shortening of internodes, and decreased yield. Aphid saliva can inject toxins and their honeydew excretion promotes sooty mould growth, which further impairs photosynthesis.

Management:

- Maintain optimum irrigation and balanced fertilisation and avoid excessive nitrogen application which favours aphid multiplication.
- Harvest the crop within 18–21 days, as cutting removes a large proportion of aphids and interrupts their life cycle.
- Seed treatment with neem seed kernel powder (NSKP) (50 g/kg) followed by foliar spray of seed kernel extract (NSKE) (5%) at 15 days interval after each cut.
- Foliar application of mixture of *L. lecani* @ 5 g/L + *M. anisopliae* @ 5 g/L or *L. lecani* @ 5 g/L.



Lucerne aphid



Lucerne downy mildew



Lucerne defoliator

- Application of dimethoate 30 EC @ 2 mL/L of water.

Lucerne weevil: The lucerne weevil adults are roughly 5–7 mm long, greyish-brown with distinctive light-colored stripes on the thorax and elytra, a relatively short snout and a body that gradually becomes darker with age. The larvae are white, leg less, soil-dwelling grubs, up to 8–10 mm long, with a brown head and mouth parts.

Nature of damage: The pest causes damage by eating leaves and growing tips, resulting in a bleached-out appearance and stunted growth. Damage from adult weevils appears as 'skeletonised' or 'shredded' new growth in early spring, while egg-laying damage to buds forms hardened, blister-like marks. It is a significant defoliating

pest of lucerne crop in India, particularly in states like Haryana, Madhya Pradesh, Rajasthan and Uttar Pradesh.

Management:

- Crop rotation with non-host crops like small grains, maize or sorghum for a few years can disrupt the weevil's life cycle and help manage infestations.
- Destroy stubble and litter.
- Identify and conserve natural enemies of the alfalfa weevil, such as parasitoid wasps (e.g. *Bathyleptes* spp, *Microctonus aethiopoides*.) and *B. curculionis* predators (e.g. lady bird beetles, damsel bugs).
- Neem extracts, particularly the active ingredient azadirachtin,

deter weevil larvae and adults from feeding on alfalfa leaves, reducing damage.

- *B. bassiana* and *M. anisopliae* can attack weevil larvae and help control populations, especially under moist conditions.

Gram pod borer: The young larvae or caterpillars vary from nearly black to dark in colour and become lighter as they age. The colour of older caterpillars can vary from green to brown to red-pink. The underside is dirty white. The presence of a broad white to pale yellow stripe down each side is characteristic. The full-grown caterpillars are about 30–40 mm long, with hairs on the body. The rear wings are paler, each with a

characteristic dark brown to black fleck. The moth is 15–20 mm long when sitting and has a wing span of 35–40 mm. The eggs are yellow-white and become brown just before hatching. The pupae are in thin cocoons in nests about 25–75 mm below ground level. The caterpillars feed on the young leaves and hollow out the inflorescences and may also destroy the growing tip of the plant.

Management:

- Deep ploughing after harvest, crop rotation with non-host crops and remove alternate host plants.
- Installation of 'T' shaped perches for birds @ 15/ha.
- Install pheromone traps (e.g. Helilure) at 12 traps/ha to

Table 1. Favourable conditions of pest development

Pest	Scientific name/Causal organism	Favourable condition
Diseases of oats		
Leaf blotch	<i>Pyrenophora avenae</i> (<i>Drechslera avenae</i>)	15–28°C temperature along with high moisture conditions during the month of January to March
Powdery mildew	<i>Blumeria graminis</i> f. spp. <i>avenae</i>	Heavy nitrogen fertilisation, high humidity and cool temperatures
Rust	<i>Puccinia coronata</i> f.spp. <i>avenae</i>	
Insect-pests in oats		
Aphid	<i>Rhopalosiphum padi</i>	Moderate temperatures of 21–25°C with more than 70 % relative humidity and high nitrogen. Economic threshold level (ETL): 20–25 aphids/tiller
Diseases of berseem		
Stem rot	<i>Sclerotinia sclerotiorum</i>	Cold temperature (12–25°C) along with mild winds and intermittent frost especially during the month of January and February in Central and North India.
Leaf blight	<i>Curvularia trifolii</i>	Severe on younger leaves, when temperature increased (28–32°C) after the winter rain.
Collar rot	<i>Sclerotium rolfsii</i>	12–25°C temperature
Insect-pests of berseem		
Aphids	<i>Therioaphis trifolii</i>	Mild-to-warm temperatures (20–29°C) accelerates rapid nymph development and reproduction and semi-arid conditions.
Leaf miner	<i>Aproaerema modicella</i>	Warm temperatures (25–30°C), dry spells or water-stressed conditions, and the presence of dense, lush leguminous crop growth.
Diseases of lucerne		
Rust	<i>Uromyces striatus</i>	Warm and humid weather
Downy mildew	<i>Peronospora trifoliorum</i>	Cool, moist conditions, especially during the spring
Leaf spot	<i>Pseudopeziza medicaginis</i>	Cool, moist growing conditions during the fall
Little leaf	<i>Candidatus Phytoplasma Australasia</i>	
Insect-pests of lucerne		
Aphids	Cowpea aphid (<i>Aphis craccivora</i>), bluegreen aphid (<i>Acyrtosiphon kondoi</i>), spotted alfalfa aphid (<i>Therioaphis trifolii maculata</i>), pea aphid (<i>Acyrtosiphon pisum</i>)	Moderate-to-warm temperatures (20–28°C), dry weather, and high nitrogen doses in plants Peak populations typically develop during late winter and early spring
Lucerne weevil	<i>Hypera postica</i>	Warm (16–24°C), dry spring weather
Gram pod borer	<i>Helicoverpa armigera</i>	Warm temperatures between 25°C and 30°C, moderate to high relative humidity, and the presence of abundant flowering parts ETL: 2 larvae/m ²
Fall armyworm	<i>Spodoptera litura</i>	Temperatures between 30°C and 36°C, high relative humidity above 80%, and lush green canopy growth

monitor and reduce the adult moth population.

- Monitored with light traps @1 trap/ha.
- Release *T. chilonis* @ 50,000 adults/ha weekly, spray *HaNPV* @ 250 LE/ha and *Bacillus thuringiensis* formulations @ 1 mL/L of water.
- Spray azadirachtin 1,500 ppm @ 5 mL/L of water, or *M. anisopliae* or *B. bassiana* @ 5 g/L of water.
- Spraying of *HaNPV* @ 250 LE/ha during the flowering period (crop left for seed production).

Fall army worm: *Spodoptera litura* on lucerne is golden brown, hairy egg masses, pale green to dark grey larvae with dark spots and yellow-green/white stripes and brown adults with wavy white lines on the forewings and a brown patch on the hind wing margin. The larvae are initially gregarious and feed on lucerne leaves, creating irregular damage patterns.

Management:

- Cultural practices like deep summer ploughing and trap crops (e.g. marigold).
- Biological control using natural enemies. Spraying *Bacillus thuringiensis* @ 1.0 kg/ha in 500 L of water 8 days after the second

release of *T. chilonis*.

- Installation of 'T' shaped perches for birds @ 15 traps/ha.
- Spraying of *M. anisopliae* and *B. bassiana* @ 50 mL/ 10 L of water.
- Monitoring with light traps @ 1 trap/ha.
- Install pheromone traps (e.g. Helilure) at 12 traps/ha.
- Spraying of *HaNPV* @ 250 LE/ha during the flowering period (crop left for seed production).
- Spraying of NSKE 5% at ETL or Pod formation stage.

Safe use of pesticides in fodder crops

Ensuring fodder safety following pesticide application is essential to protect livestock health and prevent the entry of pesticide residues into the food chain through milk, meat, and other animal products. Farmers should check the label and use only registered products specified for crops or weeds. Read and follow all label directions. Follow the pre-harvest interval (PHI) and the waiting period requirements on the label. The waiting period is the minimum length of time farmer must wait after applying the pesticide before it is safe to harvest the crop.

Fodder should not be fed to animals for 15 days after spraying.

The use of highly hazardous or unregistered pesticides on fodder crops should be avoided. Following these guidelines ensures safe livestock feeding, protects consumer health, and promotes sustainable fodder production.

SUMMARY

Diseases and insects pose a major constraint to green fodder production, adversely affecting the fodder quality, livestock health and milk yield. The causal agents attack economically vital plant parts at different growth stages, necessitating effective management to enhance both green fodder yield and fodder quality. Key control measures include clean cultivation, adjusting sowing dates, soil and seed treatment, proper crop management, timely removal and destruction of infected plants, use of resistant cultivars, and targeted spraying of bio-control agents. Implementing these practices can significantly reduce disease incidence and ensure the production of healthy fodder crops.

*Corresponding author email: subhashchand5415@gmail.com

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