

Major diseases of *kharif* sown annual fodder crops and their management

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Cultivated fodder crops are the primary source of energy for livestock to meet their daily requirements through forage, silage, and hay. During the kharif season, farmers primarily cultivate maize, sorghum, pearl millet, and cowpea as fodder crops, however, diseases often compromise their production and quality. In this article, important diseases of annual fodder crops and their management approaches are mentioned to minimise yield losses without compromising quality.

Keywords: Biocontrol agents, Disease management, Fodder crops, Fungicides

FODDER crops are grown and harvested all year long to provide animals with hay, silage, and fodder. In India, major annual *kharif* fodder crops include sorghum, pearl millet, maize, and cowpea. One of the biggest challenges in fodder cultivation is the prevalence of fungal, bacterial, and viral diseases that affect their production and quality. These diseases not only reduce green fodder yield but also hinder crop establishment, lower forage quality, and decrease seed yield. Principally, fodder crops are typically grown under low-input agricultural conditions, therefore, chemical disease management is not recommended, and preventive measures are primarily adopted.

The prevalence of diseases leads to reduced fodder and seed production, deterioration in nutritive quality, and ultimately, lower profitability for farmers. Globally, all fungal, bacterial, and viral diseases contribute to losses in terms of fodder yield and quality. However, disease management in fodder crops has not received adequate attention. In the era of climate change, the risk of

epidemics poses a significant threat to fodder production, exacerbating the existing deficit of both green and dry fodder. Fungal diseases pose a more substantial threat to crops than bacterial and viral diseases. These diseases must be effectively managed to enhance both the yield and quality of green and dry fodder, ensuring a sustainable and nutritious feed supply for livestock.

Maize

- Leaf and sheath blight

Sorghum

- Grey leaf spot
- Zonate leaf spot
- Anthracnose

Pearl millet

- Blast
- Downy mildew

Cowpea

- Leaf spot
- Mosaic

Major diseases of *kharif* fodder crops

Fodder maize

Maize holds special importance due to its versatility as both a food crop and animal feed across a wide range of diverse agro-climatic conditions. It can be cultivated successfully during the rainy (*Kharif*), winter (*Rabi*), and spring-summer (*Zaid*) seasons. Maize has the potential to provide energy-rich fodder for livestock throughout its growth stages and is widely used in dairy farming due to its high palatability. However, the crop is susceptible to various diseases, with leaf blights being a major concern in fodder maize.

Northern leaf blight: The disease is caused by *Exserohilum turcicum*. Long, elliptical lesions that are greyish-green and range 2.5–25 cm in length and as much as 4 cm in breadth are indicative of the disease. At first, the leaves have tiny, round to oval, yellowish dots on them. Later turn into elliptical patches with straw to greyish-brown in colour at the core, dark brown edges, and their area gradually grows larger until they are more noticeable. The spots combine to create larger ones and appear blighted.

Southern leaf blight: It is caused by *Cochliobolus heterostrophus*. Symptoms of this disease appear on the leaves as slight, tan, spindle-shaped or elliptical lesions with yellow-green or dark brown margins, or chlorotic halos. These lesions later become elongated and may coalesce to form large, irregular patches on leaves, leaf sheaths, stalks, ears, and cobs. In warm humid temperate to tropical climates with temperatures between 20°C and 30°C throughout the cropping season, leaf blights are common.



Leaf blight of maize

Management of leaf blights:

- Maintain field cleanness, follow appropriate crop rotations and tillage operations, and destroy or plough the crop residues to decrease the initial infections.



Banded leaf and sheath blight

- Use of tolerant varieties such as 'African tall' and 'Pratap Makka Chari 6' (PMC-6).
- Foliar spray of mancozeb or zineb at the rate of 2–2.5g/L of water.

Banded leaf and sheath blight: *Rhizoctonia solani* is the disease's causal agent. On the lower leaves and the sheath, the symptoms manifest as broad, discoloured patches that alternate with asymmetrical black bands. Under ideal circumstances, the symptoms spread to kernels, glumes, and silk. Usually, disease first manifests during the pre-flowering phase. The internodes rupture at the site of infection, and symptoms also show up on the stalk. Dark brown sclerotia are formed later in the season, serving as a source of survival during the off-season. Hot climate, excessive rainfall and high relative humidity greatly promote the growth and spread of disease.

Management of banded leaf and sheath blight:

- Follow crop rotation practices with non-hosts, as the pathogen has a broad host range.
- Remove and burn the infected plant portions and to strip basal two to three leaves of their sheath.
- Treat the seeds with the biocontrol agent *Pseudomonas fluorescens* at a rate of 5–10 g/kg seed or as a soil application at a rate of 10g/L of water.

Fodder sorghum

A common cereal and fodder crop grown in a variety of climates and production systems is sorghum. It is an annual crop that is cultivated in temperate and sub-tropical climates. It can withstand high temperatures and low rainfall regimes, therefore, farmers are adopting it more as a major fodder crop in dry regions of the country. The diseases not only deteriorate the quality and nutritional value of both fodder and grain but also reduce the total farm income adversely affecting fodder selling and livestock productivity. Under high temperature and humidity, yield

losses may reach up to 50% due to foliar diseases.

Grey leaf spot: This disease is caused by fungal plant pathogen, *Cercospora sorghi*. The leaf spots appear on leaves as narrow rectangular spots delimited by veins. These lesions elongate longitudinally to form blotches. Spots are grey to tan coloured. Disease causes more damage to the crop under high humidity, hot temperature, and recurrent rainfall conditions.



Grey leaf spot in sorghum

Anthracnose: *Colletotrichum sublineolum* is fungal pathogen that causes sorghum anthracnose. Initially, symptoms appear as small, circular to elliptical spots with light, straw-coloured centres and dark, red or black margins. Spots on the leaves may coalesce to give the blighted appearance. Symptoms also appear on the midrib, sheath or stalk. Red lesions develop inside infected stalks, which gives a ladder-like appearance. Infections in the fields could be caused by contaminated seeds.

Zonate leaf spot: The causal organism is *Gloeocercospora sorghi*. The disease appears as the occurrence of circular, purplish to brown zones alternating with straw-coloured zones, resembling a bull's eye. The spots are always seen along the margins of sorghum leaves in a semicircular pattern. The best conditions for the onset of symptoms are moderate to high temperatures and times of high relative humidity.



Zonate leaf spot in maize

Management of leaf spots and anthracnose:

- Use healthy, disease-free seed, change the planting dates, maintain good field hygiene, remove crop leftovers and alternate hosts (wild sorghum), control weeds and remove sick plant debris.
- At various phases of sorghum growth, use of *Trichoderma* isolates reduces the incidence and severity of foliar infections as well as seedling mortality.
- Seed treatment with *T. viride* @ 5 g/kg, followed by one spray each with neem bio-pesticide @ 3% and propiconazole @ 1 mL/L at 10-day intervals starting from disease onset.

Fodder pearl millet

Pearl millet is a major cereal and fodder crop cultivated globally, particularly in arid, sub-tropical, and low-rainfall regions. It thrives under harsh conditions due to its tolerance to salinity and drought, which often limit the production of other major cereals. As a key fodder crop of the rainy season, following sorghum and maize, pearl millet is valued for its high biomass, crude protein content, and excellent palatability. However, its growth and development are significantly hindered by leaf blast and downy mildew diseases, which recur

annually across all pearl millet-growing regions.

Leaf blast: The disease is caused by *Pyricularia grisea*. Elliptical or eye-shaped, brown-coloured lesions appear on the leaves with grey centres and are surrounded by a chlorotic halo. Later, lesions become necrotic, leading to the premature drying of young leaves. Infection and disease are more likely to develop when moderate temperatures (25–30°C) and high humidity (>90%) are prevalent. Under humid climatic conditions, the disease worsens, particularly in dense plant stands.



Leaf blast in pearl millet

Management of leaf blast:

- Use seeds harvested from disease-free plants for sowing.
- Avoid burning crop straw and stubble, and refrain from using excess nitrogen-based fertilisers and early sowing of the crop.
- Foliar spray of tebuconazole + trifloxystrobin @ 0.4 g/L or tricyclazole @ 0.3 g/L at 15-day intervals starting from disease onset.

Downy mildew: The fungal pathogen responsible for the disease is *Sclerospora graminicola*. Initial signs appear on the leaves as chlorosis or yellowing on upper surface of leaves, and later on, spread to other parts of the plants. White powdery masses of sporangia are visible on the lower side of leaves. On infected plants, symptoms are also seen on ear heads as ear heads are converted into green leafy structures called green ears. Plants remain dwarf or stunted. High relative humidity (85–90%) and moderate temperatures (20–30°C) promote the development of disease.



Downy mildew of pearl millet

Management of downy mildew:

- Long-term crop rotation, summer deep ploughing, roguing out diseased plants, and choosing seeds from the healthy crop.
- Seed treatment with biocontrol agent such as *Bacillus subtilis* (@ 5 g/kg seed), followed by two foliar sprays of *B. subtilis* (@ 5 g/L) at 10-day intervals starting from disease onset.

Fodder cowpea

Cowpea, a multipurpose, drought-tolerant, and warm-season legume, is grown in tropical and sub-tropical areas as green manure to improve soil fertility, produce pulses for human consumption, feed and fodder for animals. It is ideal for animal intake because it contains more than 25% crude protein, a good amount of carbohydrates, and essential minerals such as iron, zinc, potassium, and phosphorus. However, cowpea is susceptible to foliar diseases, including leaf spots and mosaics. These diseases cause significant yield losses of up to 60%.

Leaf spot: *Cercospora cruenta* and *C. canescens* are the fungal pathogens causing the leaf spot disease. At early stage, tiny, round dots appear on the leaves, with a reddish-brown border and a grey centre. The many patches combine to create uneven brown lesions. Severe leaf spotting and defoliation occurs during flowering and pod production when the environment is favourable. In extreme situations, the brown lesions may appear on the petioles,

branches, and pods. When the fungus reaches maturity, infected pods exhibit black sporulation.

Anthracnose: The fungal pathogen, *Colletotrichum lindemuthianum* causes the disease. The plant's leaves and other areas develop dark brown, and horse shoe-shaped markings. Lesions quickly unite to girdle stems, branches, peduncles, and petioles in extreme circumstances. Wet and cool weather speeds up the spread of disease.

Management of leaf spot and anthracnose:

- Use of resistant cultivars such as UPC-607, UPC-622 and UPC-628.
- Seed treatment with tebuconazole 2% @ 1 g/kg seed + neem seed kernel powder @ 50 g/kg seed followed by two foliar sprays of 0.1% propiconazole at 15-day intervals.

Cowpea mosaic: Cowpea mosaic disease is caused by cowpea mosaic virus. Young leaves first develop minimal yellow dots or patches on the upper surface. The subsequent trifoliate leaves that emerge from the developing apex have asymmetrical and alternate green and yellow patches. Newly developed leaves

may eventually turn entirely yellow as the yellow discolouration progressively worsens. Necrotic lesions are also present in infected leaves. The diseased plant shows late and stunted growth producing less number of reproductive flowers. The pods are deformed and tiny. The plant dies before the seeds set because of the early infection. The virus can live in different legume crops as well as weed hosts. The whitefly transmits the disease.



Cowpea mosaic

Management of mosaic:

- Use of resistant varieties such as UPC-607 and UPC-622.
- Two sprays of imidacloprid 17.8 SL @ 0.3 mL/L at 15-day intervals followed by two sprays of *Veticillium lecani* @ 5 g/L, at 10-day intervals to reduce the

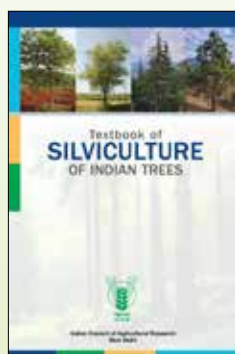
vector population.

SUMMARY

Diseases pose a significant challenge to green fodder production, affecting both the quality of fodder and milk yield. Economically important diseases include leaf blights in fodder maize; grey leaf spot, zonate leaf spot, and anthracnose in fodder sorghum; blast and downy mildew in fodder pearl millet; and leaf blight and mosaic in fodder cowpea. These diseases affect 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, judicious fertiliser application, 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.

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