

Diseases of Small Millets

1. Blast: Reported for the first time from Tanjore delta of Tamil Nadu, India by Mc Rae (1920) is a major production constraint causing heavy yield losses.

Symptoms: Characterized by typical spindle shaped spots on leaf lamina (Fig. 1a). Under highly congenial conditions such spots enlarge, coalesce and leaf blades especially from the tip towards base give a blasted appearance. Two to four inches of the neck almost immediately below the ear turns initially brown and later to black (Fig. 1b). An olive grey growth of the fungus may be seen on this area. The pathogen also attacks fingers (Fig. 1c).

Causal fungus: *Pyricularia grisea*

Minimum temperature of 15-25° C and relative humidity of more than 85 % with intermittent rainfall are congenial climatic conditions for disease development

Management: Seed treatment with *Trichoderma harzianum* and two sprays of *Pseudomonas fluorescens* at 0.3% at the time of flowering followed by second spray 10 days later. Use of blast resistant varieties like GPU-28, GPU-26, and GPU-48 coupled with carbendazim as seed treatment at 2g/kg. Two sprays of Saaf (0.2%) or carbendazim 0.05% or tricyclazole 0.05% with first spray at 50 per cent flowering followed by the second 10 days after were also found effective.

Same fungus attacks little and barnyard millets inflicting leaf blast, whereas *Pyricularia setariae*. Causes blast of foxtail millet with only foliage symptoms.

2. Cercospora Leaf Spot: This is one of the important foliar diseases occurring in Himalayan foothills and mid hills of Nepal. The crop is susceptible to the disease during all stages of its growth, from seedling to grain formation stage.

Symptoms: Initial symptoms that mostly start on older leaves appear as reddish-brown specks with yellow halo. At this stage, the lesions are easily confused with those of *Helminthosporium* leaf spot. Later, several such specks coalesce to form large lesions with a yellow hollow (Fig. 2). In some cases, the lesions enlarge to assume eye shaped spot measuring up to 15 x 3mm and such lesions are similar to those of blast. Such leaves give burnt appearance.

Causal fungus: *Cercospora eleusinis*

Fungus prefers to grow in hilly terrains where mean daily temperature does not exceed 20°C and rainfall is generally high. The disease occurs most severely in the month of June in the early sown crop.

Control measures: Field sanitation and spraying of carbendazim @ 0.05% at 15 days intervals has been reported to reduce infection to some extent.

3. Green Ear Disease or Downy Mildew or Crazy Top: This disease of ragi was reported for the first time in India by Venkatarayan (1946) from old Mysore state. Disease occurs in a sporadic manner and may lead to total crop failure owing to malformation of the affected ears.

Symptoms: Affected plants are generally stunted with shortened internodes and profuse tillering. The plant assumes a bunchy and bushy appearance. Often, pale yellow translucent spots are seen on leaves of affected plants. The green ear manifests itself at the time of grain formation and completely converts the ear heads into green narrow leafy structures causing complete sterility. The whole ear gives a bush-like appearance displaying typical 'green ear' symptom (Fig. 3).

Causal fungus: *Sclerophthora macrospora*.

The disease is favored by heavy dew and low temperature during the period of crop development in *kharif*. A temperature range of 20-25⁰C that occur during night and early morning favors very good spore germination and disease development.

Control measures: Seed treatment with Apron 35 SD @ 2.5 – 3.0 g/kg. Providing good drainage in the low lands, proper crop rotation methods, roguing of infected plants and elimination of wild grasses and related wild hosts will reduce the disease incidence.

Sclerospora graminicola in foxtail millet can cause loss up to 50 per cent in certain years. Whitish bloom of sporangiophores and sporangia develop on the surface of the affected leaves under humid conditions (Figure 3a). Floral parts are proliferated into green leafy structures (Figure 3b), hence the name "green ear". Leaf shredding is very common (Figure 3c and 3d).

4. Brown Spot (Seedling Blight or Leaf Blight): This disease was first noticed by Butler (1918) to cause foot rot, seedling blight or leaf blight of ragi in different parts of India. The disease assumes severe proportion when the crop suffers from prolonged drought or nutrient deficiency.

Symptoms: Appearance of brown to dark brown spots on the leaf lamina (Fig. 4a). Symptoms can also be seen on leaf sheath, especially in older plants (Fig. 4b), where in the woolly growth of the fungus can be seen in the centre of the lesion, especially under high humidity conditions. When infection occurs on neck and fingers often under high humid conditions, neck may break and hang on to the plant. The severe infection causes chaffiness and discoloration of the seed.

Causal fungus: *Drechslera nodulosum*

Optimum temperature for infection is 30-32⁰C. High humidity and intermittent rains during emergence of ear and before grain formation cause heavy ear infection and yield reduction.

Control: Pre sowing seed treatment with systemic fungicides. Need based spraying of Mancozeb (0.2%) reduce the disease.

In barnyard millet *Drechslera frumentacea*, in proso millet *Bipolaris panici-miliacei*, in little millet *Alternaria sp.* and in kodo millet *Alternaria tenuissima* cause similar leaf spot and leaf blight.

5. SMUT: Reported for the first time by Kulkarni (1922) from Malkapur in 1918 from the then princely state of Kolhapur.

Symptoms: The affected ovaries are transformed into velvety greenish gall-like bodies which are several times bigger in size than the normal healthy grains (Fig. 5). These infected grains gradually turn pinkish green and finally to dirty black on drying.

Causal fungus: *Melanopsichium eleusinis*.

Control: Seed treatment with Carbendazim @ 2g/kg⁻¹ of seed. Two sprays, the first with Difolatan at panicle initiation followed by second spray with mancozeb at flowering can reduce disease incidence.

In foxtail millet smut is common in India, China, Europe and Manchuria and has been reported from Karnataka, Andhra Pradesh, Uttarakhand, Tamil Nadu and Maharashtra.

The fungus *Ustilago crameria* affects most of the grains in an ear; sometimes terminal portion of the spike may escape (Fig. 5a). The sori are seen in the flowers and basal parts of palea. The sori are pale greyish in colour and measure 2-4 mm in diameter. When the crop matures, the sori rupture and produce dark powdery mass of spores.

In barnyard millet both head smut (*Ustilago trichophora*) and grain smut are common. Head smut infected inflorescence is deformed and destroyed. In addition, the smut also produces gall-like swellings on the stem, the nodes of young shoots and in the axils of the older leaves (Fig. 5b). Grain smut affected seeds enlarge two to three times of their normal size and their surface becomes hairy (Fig. 5c). The disease appears at the time of grain formation when the temperature ranges from 20 to 25°C.

Control: Seed treatment with Carbendazim or Thiram @ 2 g/kg seed before sowing. Use of resistant varieties like PRJ 1

Head smut infected kodo plants are stunted and almost all the panicles in the infected plants are converted into a long sorus ranging from 2.1 to 14.6 cm long and 0.1 to 0.6 cm broad (Fig. 5d). In early stage, the entire sorus remains surrounded by a creamy membrane. Sometimes, the sorus remains enclosed in the boot leaf and does not emerge fully. At maturity, the membrane of the sorus bursts and exposes the black mass of spores. *Sorosporium paspali-thunbergii* is the cause and the disease is seed and soil borne, seed treatment with chemicals such as Carboxin, Carbendazim, Mancozeb, Chlorothalonil and Thiram is useful.

Grain smut of kutki is caused by *Macalpinomyces sharmae* and up to 50 per cent plants/grains are affected by the pathogen (Sharma and Khare, 1987).

The affected ovary is converted into smut sorus, but does not increase in size than the normal grain (Fig. 5e). The glumes are pushed apart by the transformed spore balls (sori).

The disease can be controlled by adopting resistant cultivars (DPI 2394, PLM 202, OLM 203, DPI 2386 and CO 2), cultural practices like delayed sowing and seed treatment with Carboxin or Carbendazim @ 2 g per kg seed chemicals.

6. Foot Rot: First reported by Coleman (1920) from the then princely state of Mysore.

Symptoms: The basal portion of affected plant immediately above the ground initially appears water soaked. Later on it turns brown and subsequently dark brown with a concomitant shrinking of the stem in the affected region profuse white cottony mycelial

growth occurs in the infected area (Fig. 6a). Soon small roundish white velvety grain like structures starts appearing in the fungal matrix. They grow, become mustard seed like, turn brown and these are the sclerotial bodies (Fig. 6b).

Causal fungus: *Sclerotium rolfsii* (Sacc.)

Growing of resistant varieties and soil application of value added *Trichoderma viridae* at intercultivation or transplanting are good management practices.

7. RUST: This disease on finger millet as of now is negligible albeit. Severe incidence of rust was reported from Agricultural Research Station, Vizianagaram, Andhra Pradesh on various varieties.

Causal fungus: *Uromyces eragrostidis*

Symptoms: The rust symptoms appear as minute to small, dark brown, broken pustules linearly arranged on the upper surface of the top leaves (**Fig. 7**). The rust is more severe towards the top 1/3 portion of the upper leaf.

Management: Growing of resistant varieties viz., SEC 915, 314, 712 and ICMV-221

On *Setaria*, rust is prevalent in the states of Maharashtra, Uttar Pradesh, Madhya Pradesh, Tamil Nadu, Karnataka, Andhra Pradesh and Bihar. During certain years, it becomes epiphytotic and causes extensive reduction in grain yield. In 1944, it appeared in a very severe form in Andhra Pradesh and Karnataka states.

Symptoms: Numerous minute brown uredosori appear on both sides of the leaf. Rust pustules are oblong, brown, often formed in linear rows (Fig.7a). They are also produced on the leaf sheaths, culms and stems. If the infection is severe premature drying of leaves and poor grain set are observed.

8. Banded Blight: Banded blight of finger millet was first recorded in a severe form at Vellayani, Kerala from India (Lulu Das and Girija, 1989). It is an emerging problem on all the small millets.

Symptoms: The disease is characterized by oval to irregular light grey to dark brown lesions on the lower leaf and leaf sheath. Occurrence of a series of copper or brown colour bands across the leaves gives a very characteristic banded appearance. The mycelial growth along with white to brown sclerotia can be observed on and around the lesions. Later on, the leaves dry up and plants appear blighted. The symptoms produced on every part of the plant, give a very characteristic banded appearance, due to which the disease has been named as banded blight (Fig. 8).

Causal fungus: *Rhizoctonia solani*

Management: Clean cultivation, draining out of excess water and removal of grass weeds on bunds can prevent the disease. Spraying of propiconazole @ 1 mL⁻¹ water is highly effective.

9. Udbatta: This disease is very common in foxtail millet and kodo millet. Sometimes it is seen in little as well as proso millets. Affected panicles are transformed into a compact agarbatti like shape (Fig. 9), hence the name “Udbatta”.

Causal organism: *Ephelis oryzae* Syd.

10. Phanerogamic partial root parasite: Losses in grain yield due to infestation of *Striga* species depend primarily on the number of *Striga* plants attacking the crop and level of host resistance. Jain and Tripathi (2005) reported 42.4 to 65.8 per cent loss in grain yield per plant due to infestation of *Striga densiflora* in kodo millet.

Symptoms: The infestation of *Striga* species appears in the field after emergence of *Striga* plants from the soil (Fig 10). The underground portion of *Striga* plants remain attached to the roots of host plant by haustoria, from which the parasite absorb water and nutrients. The attacked plants are stunted with poor aerial growth and bear lanky panicles. If the infestation occurs in early stage, the plants may dry up before the flowering.

Causal organism: *Striga asiatica*

Control: Weeding or hand pulling of *Striga* plants before flowering is the cheapest and effective method for its eradication. Improved kodo millet varieties viz. JK 41, GPUK 1, GPUK 3 and GPUK 5 were found least affected with *Striga* species. Application of nitrogenous fertilizers also reduces the infestation of *Striga* species



Fig. 1a.Leaf blast; b.Neckblast; c.Finger blast Fig. 2 Cercospora Leaf Spot



Fig. 3aGreen Ear of ragi; b. Green ear of foxtail millets; c. Downy growth; d Leaf shredding



Fig. 4a brown spot on leaf; bSymptoms on leaf sheath; c. Leaf spot/blight of Proso millet;



d.Little millet; e. Barnyard millet; f. Kodomillet



Fig. 5a Grain smut of finger millet; b Head smut of barnyard millet; c Grain smut of foxtail millet; d Head smut of kodo millet; e Grain smut of little millet.



Fig. 6a White cottony mycelial growth due to foot rot; b. Sclerotial bodies on the infected tissue Fig. 7 Rust of foxtail millet



Fig. 8 banded blight of small millets; Fig. 9. Udbatta disease of kodo millet Fig. 10 *Striga* on kodo millet.