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Diseases of Kodo Millet and their Management

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INTRODUCTION

Kodo millet (*Paspalum scrobiculatum* L.) is an indigenous cultivated cereal of India generally grown by tribal and resource poor farmers in the lands of poor fertility status with no or low cash inputs. Globally, the crop is cultivated primarily in India followed by Indonesia, Philippines, Thailand, Vietnam, Bangladesh, Myanmar and Western Africa. In India, kodo millet is largely grown in the states of Madhya Pradesh followed by Chhattisgarh ,Tamil Nadu, Telangana, Maharashtra, Gujrat , Karnataka and UP. Being a C_4 plant, crop has higher efficiency in absorbing and utilizing CO_2. It can be stored for a long period without fear of store grain pests, hence known as *Famine reserves*. The grains are gluten free, non-acid forming and have unique nutritional properties. The crop has rich medicinal values and provides protein, fiber, carbohydrate and minerals required for the body growth. The grains have antibacterial, anti-oxidant, anti-allergic properties and low glycemic index, hence ideal for diabetic patients. A number of fungal pathogens namely *Sporisorium paspali thunbergii* ,*Rhizoctonia solani* , *Alternaria tenuissima* , *Puccinia substriata* ,*Claviceps paspali* ,*Ephelis oryzae* , *Phyllachora winkleri* ,*Helminthosporium holmi* ,*H. turcicum* ,*Macrophomina phaseolina*, bacterial pathogen *Xanthomonas oryzae* ,nematodes *Meloidogyne incognita*, *Rotylenchulus reniformis*, *Tylenchorhynchus vulgaris* , viruses *Saccharam virus I* ,*Zea virus II* and partial root parasite *Striga* spp are reported to cause diseases. Following are major diseases of kodo millet which causes significant loss in grain yield under favourable conditions..

1. Head smut

Head smut caused by *Sporisorium paspali thunbergii* is an externally seed borne disease that can cause 13.1 to 33.0% loss in grain yield. Reduction in yield contributing parameters viz. in plant height (1.8 to 13.0%), tillers/plant (7.1 to 55.6%) , panicles/plant, flag leaf area (11.5 to 41.9%) and yield per plant (92.4 to 100%) was also reported. Characteristic symptoms of the disease appears as the crop approaches to flowering. Infected plants are stunted and almost all the panicle in the infected plant are converted into a long sorus ranging from 2.1 to 14.6 cm long and 0.1 to 0.6 cm broad. 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.

Fig. 1. Head smut of kodo millet

The sori destroy the whole inflorescence except the fibro-vascular bundles and rachis. At maturity, the membrane of the sorus bursts and exposes the black mass of spores. Necrotic streaks on the boot leaf covering infected panicle were also observed in few varieties.

Management

- Collection and destruction of smutted plants reduces the primary inoculum of the disease.
- Shallow sowing results in early emergence of seedling and less incidence of head smut
- The balance application of nitrogenous and phosphatic fertilizer minimizes the incidence of head smut in kodo millet.
- Seed treatment with Carbendazim, Carboxin, Raxil, Chlorothalonil @ 2 g per kg seed is recommended to control the disease.
- Use of resistant varieties viz. TNAU 86, JK 13 , JK 41, JK 65, JK 98, JK 106, JK 137 and JK 9-1 .

2. Banded blight

It is an emerging fungal disease of kodo millet caused by *Rhizoctonia solani*. The fungus can attack the crop at all the stages of crop growth and cause 23.5 – 37.8% loss in grain yield. The characteristic symptoms of the disease are formation of large irregular lesions that have straw coloured centre and a wide reddish brown margin. The lesions are usually observed on the leaf sheath. Although, leaf blades may also be affected. The initial lesions are small, ellipsoid or oval, greenish gray and usually develop near the water line in low land fields. Under favourable conditions, the lesions enlarge, coalesce forming bigger lesions with irregular outline. Finally, brown colour bands develop across the leaves and

sheath giving a characteristic banded appearance. A temperature range of 23-30^{0}C and more than 80% relative humidity favours the disease development.

Fig. 2. Banded blight of kodo millet

Management

- Clean cultivation, draining out of excess water and removal of grass weeds can prevent the disease
- Seed treatment with Validamycin or Hexaconazole @ 2ml/lit. of water + one foliar spray of same fungicide is very effective against banded blight in kodo millet.
- One foliar spray of Salicylic acid or Sodium fluoride @ 200 ppm induces the resistance against banded blight of kodo millet
- Soil application of farm yard manure / vermi-compost enriched with *Trichoderma viride* + *Pseudomonas fluorescens* + *Bacillus subtilis* or only *T. viride* @ 2 kg /t of manure is very effective.
- Varieties like BK 5 , TNAU 86, JK 13 , JK 137, JK 9-1 ,ATL-1 and CKMV-2 are resistant to banded blight

3. Leaf blight

In India the disease was first reported from Kanpur (UP) during 1980 in a severe from. Later, the disease was reported from all kodo millet growing areas of the country. Two fungi *Alternaria* and *Helminthosporium* spp. are reported to cause leaf blight in kodo millet. Small discoloured water soaked scattered lesions of variable size are formed on the middle lamina which later turned to pale and straw coloured. The severely affected leaves showed a critical blighted appearance causing drying of leaves from tip to downwards. The infected plants bore small, twisted and abnormal ear heads with few shriveled and light weighted grains resulting enormous loss in grain yield.

Fig. 3. Leaf blight of kodo millet

Management

- Seed treatment with Carbendazim , Carboxin @ 2 g per kg seed and one foliar spray of Mancozeb (0.2%) controls the disease effectively.
- Foliar spray of Hexaconazole, Hexaconazol + Zineb, Tebuconazol + Trifloxystrobin and Azoxystrobin is also effective against leaf blight
- Use of resistant varieties namely JK 41, JK 48 and JK 13

4. Udbatta

In India, the disease was reported from Koraput and Kalahandi (Odisa) , Karnataka and Jabalpur (Madhya Pradesh). The disease is caused by *Ephelis* oryzae. Symptoms appear during panicle initiation stage. The grains get infected and entire panicle converts into hard, compact dirty/silver coloured cylindrical spikes resembling Agarbatti like shape, hence the disease is called *Udbatta*. White mycelium and conidia form narrow stripes on the flag leaf along the veins before panicle initiation. Grains are not formed on the affected panicle.

Fig. 4. Udbatta of kodo millet

Management

- Removal and burning of affected panicles, keeping bunds and field free from graminaceous weeds.
- Seed treatment with Carbendazim @ 2 g per kg seed

5. Partial root parasite (Witch weed)

Witch weeds (*Striga* spp.) locally known as *Agiya* has a very wide ecological range and two species of *Striga* namely *S. densiflora and S. asiatica* are found to infect kodo millet. In India, partial root parasite is

reported from Andhra Pradesh, Karnataka and Madhya Pradesh. In a field survey, average incidence of *Striga* species varied from 1.6 to 2.0 percent with 66.7 to 100.0 percent frequency of incidence was recorded in three districts of Madhya Pradesh. 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. Yield reduction ranging from 42.4 to 65.8 percent per plant due to infestation of *Striga* species was reported in kodo millet. Besides, 9.5 to 18.9 percent reduction in plant height, 4.8 to 32.8 percent in tillers per plant, 5.9 to 27.3 percent in panicles per plant, 2.8 to 11.9 percent in length of panicles and 6.6 to 13.7 percent in 1000 grain weight was also reported. The infestation of *Striga* species appears in the field after emergence of *Striga* plants from the soil. The underground portion of *Striga* plant remains 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 bears lanky panicles. If the infestation occurs in early stage, the plants may dry up before the flowering. Generally infestation is more in lighter soils, low fertile soils and water stress conditions.

Fig. 5. *Striga* infection in kodo millet

Management

- The weeding or hand pulling of *Striga* plants before flowering is the cheapest and effective method for its eradication
- Application of nitrogenous fertilizers reduces the infestation of *Striga* species
- Application of 100% RDF is best, however, application of farm yard manure / vermi-compost enriched with *Trichoderma* + *Azospirillum* @ 2 kg/tones of manure or application of farm yard manure / vermi-compost enriched with only *Trichoderma* @ 2 kg/tones of manure is also effective.
- Improved kodo millet varieties viz. JK 41, JK 155 and GPUK 3 are least affected with *Striga* species

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