

are selectively lethal to this parasite.

PEARL MILLET or BAJRA

Pennisetum typhoides (Burm. f.) Stapf. & Hubb.

Bajra is one of the common millets that serve as the poor man's food grain in India, Pakistan and some parts of Africa. In India it covers an area of about 12 million hectares, distributed almost over the entire country. It comes up well in any kind of soil and for this reason poor soils not fit for growing rice, wheat and sorghum usually are selected for this crop. It is grown extensively in Tamil Nadu, Gujarat, Rajasthan, Madhya Pradesh and Uttar Pradesh.

Although about twenty diseases of this crop are known, only a few of them are important.

DOWNY MILDEW or GREEN EAR

Downy mildew is the most common disease in all areas where bajra is grown. It occurs in many parts of Africa, as well as in India, where it was first reported by Butler in 1907. Since then downy mildew has become more widespread and more virulent, causing considerable damage to the grain yield. Ill-drained soil in low lying fields is said to favour the disease. A similar disease is caused by the same fungus on *Setaria italica*.

Symptoms. The infected plants tiller excessively, and are dwarfed, because of shortened internodes. The foliage becomes pale and chlorotic, and broad streaks, extending from the base to the tip of the leaf, are promi-

ment. Often, the lateral tillers are short, pale yellow and very much reduced in height. As the disease advances, the streaks turn brown and the leaf becomes shredded lengthwise. On close examination, downy fungal growth can be seen on the lower surface of the leaf, and even on the upper surface in severe cases. This surface growth is more profuse during rainy and humid seasons.

In many affected plants ears fail to form, or if formed, they are malformed into green leafy structures; hence the name 'green-ear' disease. Mostly the entire ear is transformed into leafy structures, but at times a part of the ear alone is affected, the other part producing normal grains. The infection converts the various floral parts, including glumes, palea, stamens and pistil, into green, linear, leafy structures of variable length. As the disease advances, the green leafy structures become brown and dry. The incidence of the disease in an infested field may range from a few to 25 per cent of the plants. Recently the disease appears to be on the increase.

Causal Organism: *Sclerospora graminicola* (Sacc.) Schroet.

(Class: Phycomycetes; Order: Peronosporales; Family: Peronosporaceae)

The downy mildew fungus develops systemically in the host plant. Non-septate hyphae are intercellular in the parenchymatous tissue, sending branched haustoria into the host cells. The short, stout, hyaline sporangio-phores arise through the stomata and branch irregularly to produce sterigmata bearing the sporangia. The sporangia are hyaline, thin walled and elliptical, bear prominent papilla, and measure $19-31 \times 12-21 \mu$. They germinate in water, releasing 3 to 12 zoospores.

Examination of shredded host tissues reveals the oospore stage. The brown oospores are formed in rows in the inter-veinal area and are covered by an irregular, brown oogonial wall. The oospores measure $34-52 \mu$ in diameter, each surrounded by a round, smooth, thick and yellowish-brown wall (Fig. 83). Oospore germination in the laboratory has been

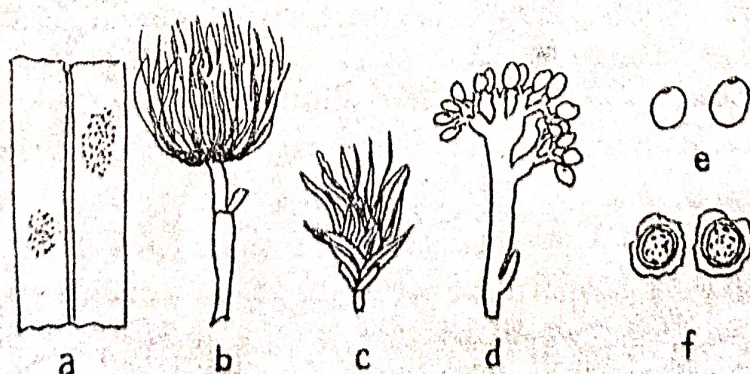


Fig. 83. Characters of downy mildew on bajra caused by *Sclerospora graminicola*: a: downy mildew symptoms on the leaf blade, b: malformed earhead, c: spikelets and floral parts transformed into leafy structures, d: sporangio-phores with sporangia, e: sporangia, f: oospores

observed in a few cases. The germination process breaks open the oospore wall, after which one or more germ tubes are produced.

✓ **Disease Cycle.** The oospores remain viable in soil for five years or longer, giving rise to the primary infection of the host seedlings, which takes place by direct penetration of root hairs and the coleoptile by the germ tubes. Secondary spread stems from sporangia, which are most active during the rainy season. The germ tubes of zoospores enter the leaf stomata to initiate infection. Since the downy mildew is an obligate pathogen, not much information is available on its nutritional requirements. More recently the host-pathogen relationship has been examined through tissue culture studies, and there are several pathogenic races. The bajra and *Setaria italica* races do not infect their hosts reciprocally, but both readily infect teosinte.

Control. Since the pathogen is mostly soil-borne, it is difficult to control the disease. As the fungus is persistent in soil up to about five years or more, crop rotation has little or no value in avoiding the disease. Systematic collection of the diseased plants, especially before the oospores are formed, and burning them would help to reduce the population of oospores reaching the soil. A search for resistant parent material for breeding resistant varieties is necessary. The variety HB-1 is highly resistant to the disease while most of the local ones are susceptible.

RUST

Rust is one of the most serious diseases of bajra, occurring everywhere the crop is grown. In India it is present in all the bajra tracts, causing considerable damage to some varieties, from the seedling stage to maturity.

Symptoms. The minute, round uredosori occur in groups on both