



Pearl millet downy mildew

Sclerospora graminicola



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Deformed flower head of pearl millet caused by internal infection by downy mildew.

SUMMARY: Downy mildew of pearl millet is caused by an oomycete or water mould, *Sclerospora graminicola*. It is a serious disease in India and Africa with losses of at least 30% reported on susceptible varieties. Infection comes from the seed or from the soil. Leaves become yellow, flowers become leaf-like and plants are stunted. Two types of spores form: sporangia on the leaves, which spread the mildew to plants nearby, and oospores, thick walled spores, on all plant parts. These survive in the soil and are spread long distances in soil blown by the wind. Management is dependent on hybrids bred for resistance, and treatment of the seeds with fungicides, most commonly metalaxyl.

KEY SIGNS

Symptoms can occur on the first leaf that forms. Generally, however, they are first seen on the second leaf and then on all those that develop afterwards. The base of the leaves turn yellow and, as new leaves develop, the yellow area becomes larger. In some cases there is a 'half-leaf' symptom of yellow at the base and green above. Severe infection can cause death of the plants; most often the plants are stunted and either lack flowers, or parts of the flower head become leaf-like. This symptom is known as 'green ear', a distinctive feature of this disease.

If humidity is high (>95%), with moderate temperatures (20-25°C), spores (called sporangia) form on the yellow areas, particularly on the lower surface, giving the leaves a 'downy' appearance. The resistant spores (the oospores) develop when separate downy mildew infections grow together and form a sexual stage.

MANAGEMENT

Prevention – what to do before signs are seen

Cultural approaches: The use of resistant varieties developed by ICRISAT¹ and seed treatment are the two main ways of managing this disease.

The first releases were open-pollinated varieties and have been adopted by farmers in nine countries in West Africa. Examples are: SOSAT-C88, GB 8735 and ICMV-IS 89305. In eastern and southern Africa, ICMV 88908 (Okashana 1 and 2) has been released and adopted; for instance, it is used in over 50% of the production area in Namibia. Check whether tolerant varieties are available locally.

Chemical approaches: Seed from all sources, purchased or saved by farmers, should be treated with the fungicide metalaxyl (2g active ingredient/kg). Seed companies usually do this before seed is sold. Metalaxyl will eliminate seed-borne downy mildew infections for approximately 30 days after sowing. Farmers who save their own seed should dust with metalaxyl, or alternatively with captan, another fungicide – always following the manufacturers' instructions on the pack.

¹International Crops Research Institute for the Semi-Arid Tropics

Commercial producers growing pearl millet for seed should spray with metalaxyl, or metalaxyl plus mancozeb, at 25-30 days. The cost of this treatment is likely to be too high for smallholders. Strobilurin fungicides are also effective against this disease.

Control – what to do after signs are seen

Cultural approaches: During crop growth, especially during the first month after sowing, crops should be monitored carefully. Any plants with symptoms should be removed promptly and burnt.

CAUSE

Pearl millet downy mildew is one of the most economically damaging diseases of this crop. The mildew is not a fungus, although there are many similarities in appearance, life cycle, and symptoms. It is a water mould, also known as an oomycete, closely related to brown algae. Downy mildew of pearl millet is caused by the oomycete, *Sclerospora graminicola*.

The presence of spores (sporangia), which produce smaller internal swimming spores with two whip-like threads, and the presence of cellulose not chitin in their cell walls, sets them apart from fungi. There are different races (strains) of the oomycete. In India, the range of pearl millet varieties infected by downy mildew differs, as does severity of infection. Also, differences exist between African and Indian populations of pearl millet downy mildew.

A prominent feature of the disease is that the primary sources of infection are seed and soil. Seed becomes infected internally through the flowers (the stigma) and resistant spores (called oospores) develop on the seed coat. The soil contains oospores produced from infected plants of previous crops. Seedlings are infected from these sources.

There are reports of up to 8% infection in pearl millet seed.

Survival of the downy mildew occurs as growth inside the seed and as oospores. Oospores can survive from a few months up to 10 years, depending on variety, environment and interaction with other microorganisms. The number of oospores present in soil is related to number of plants with disease at three months. By contrast, alternative hosts are not considered important in the spread or survival of this mildew, although it has been recorded on *Setaria italica* (foxtail millet) and wild grasses.

IMPACT

Yield losses in pearl millet attributed to downy mildew vary with location, variety and season. On susceptible varieties, a disease incidence of 60% equates to about a 30% loss in yield compared to a healthy crop. There are examples from India of severe effects on yield of certain varieties from epidemics of this downy mildew and there is a report of 60% loss from Mozambique. Incidence is much less in West Africa where it is between 0 and 50%, with the exception of Nigeria where grain yield losses range from 50-70%. Losses have also been reported from China. However, the use of resistant varieties and seed dressing with metalaxyl have significantly reduced the incidence of downy mildew. In Mali, for instance, these technologies have helped increase millet yield and, consequently, farmers' incomes.

DISTRIBUTION

The downy mildew is reported in more than 50 countries in the temperate and tropical areas of Africa, Asia, North and South America, Europe and Oceania. In Africa it is found in all pearl millet growing countries, including Benin, Burkina Faso, Cameroon, Chad, Egypt, Ghana, Ivory Coast, Kenya, Malawi, Mali, Mozambique, Niger, Nigeria, Senegal, Sierra Leone, South Africa, Sudan, Tanzania, Togo, Uganda, Zambia and Zimbabwe.

FURTHER READING

Downy mildew of pearl millet (*Sclerospora graminicola*). Plantwise Knowledge Bank. <http://www.plantwise.org/KnowledgeBank/Datasheet.aspx?dsid=49159>.

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