# Sorghum downy mildew

*Peronosclerospora sorghi*

**SUMMARY**: Sorghum downy mildew is caused by *Peronosclerospora sorghi*, a fungus-like pathogen. It is predominantly a soil-borne disease. Thick-walled oospores can survive for several years in the soil before infecting young plants. Oospores can also be carried over in seed. Systemic infections result in a distinctive striping of young leaves and stunted growth. Most plants fail to produce grain. Localized infections from wind-borne conidia are less damaging. The main control methods are clean seed and resistant varieties. Some strains of sorghum downy mildew also attack maize.

## KEY SIGNS

New leaves produced in systemically infected plants first show a loss of colour (chlorosis) before developing white stripes, widening with subsequent leaf production – this differs from much narrower streaks associated with maize dwarf mosaic virus. Leaves are narrower and more erect in diseased plants, compared to healthy plants. The white areas eventually dry up, going reddish-brown as oospores are formed. The weakened leaves eventually shred, releasing oospores. Infected plants are stunted and usually do not produce any grain.

Localized infections caused by conidia, another type of spore produced by downy mildews, result in brown, rectangular lesions on leaves. Masse of conidia produced on the underside of leaves give them a typical downy or woolly appearance.

## MANAGEMENT

**Prevention** – what to do before signs are seen

*Cultural approaches:* A combination of clean, healthy seed and resistant varieties is the best strategy for managing downy mildew.

Resistant varieties are effective in reducing disease losses but their use will depend on farmer acceptance, adaptation to local growing conditions and availability.

Seeds from areas with downy mildew have a higher risk of being contaminated. Given that the disease is well-established across Africa, it is important to buy seed from a reliable source.

Early planting of sorghum will limit the spread of the disease through reduced availability of wind-borne conidia. Experimental trials suggest that soils with a low sand content suppress oospore germination, which is also less likely at lower soil temperatures. Translating these observations into practical recommendations requires further investigation.

Another option is to alternate sorghum with crops other than maize, which may be infected by the same strains of downy mildew that infect sorghum. Crop rotation will limit build-up of oospores in the soil, the principal source of disease outbreaks in many areas.

Sorghum downy mildew also infects related weed hosts, such as Columbus grass (*Sorghum almum*). The importance of wild reservoirs is still not fully understood but may be small in comparison to persistence of oospores in the soil and aerial spread of conidia. Removing weeds and plant remains from previous crops is often helpful in reducing potential sources of disease although, as with crop rotation, this may not be practical for smallholders.

*Chemical approaches:* Seed for sowing next season should be dried to less than 20% moisture to reduce the risk of disease transmission. Seed dressing with a suitable fungicide such as metalaxyl, is also effective in reducing carry-over.

Foliar sprays with fungicides containing metalaxyl at 10 and 40 days after emergence of young sorghum plants will, in conjunction with seed treatment, eliminate the disease. Late season spraying will prevent systemic infections and limit the production of oospores. The cost and practicality of foliar sprays suggests this method is unsuited to small-scale farmers. There is little evidence that this is a common practice in Africa. There is an added danger of metalaxyl-resistance arising, as seen in the USA.

## CAUSE

Downy mildew is caused by *Peronosclerospora sorghi*. This is a fungus-like organism, or water mould, belonging to the same group of organisms as *Phytophthora* (one of which causes late blight) and known scientifically as

oomycetes. Powdery mildews are caused by true fungi, which are controlled by different types of fungicide. There are no powdery mildews of sorghum.

*P. sorghi* was originally divided into strains that infected sorghum and maize, and those that only infected maize. Molecular techniques suggest that strains infecting maize may be different species.

When oospores penetrate the roots of young plants the infection spreads to the leaves, where wind-borne spores known as conidia are produced, as well as more oospores. The oospores can be blown in the wind, though soil is a more important source of disease carry-over. Oospores and fungal fragments are also seed transmitted.

The short-lived conidia are blown on to new plants where they infect leaves. Disease spread is limited, perhaps less than 100 metres. It is rare for such infections to become systemic and their overall impact on production is small. Aerial spread is, however, still important in spreading the disease to new areas and in maintaining disease pressure.

## IMPACT

The persistence of oospores in soils and their spread in seed, together with aerial dispersal by conidia, has helped establish sorghum downy mildew across Africa and beyond. The disease was introduced to North America, where it also causes significant losses, in the early 1960s. Effective quarantine measures have prevented the disease spreading to Australia. Disease outbreaks are common and their potential impact is kept in check largely through the use of clean seed and resistant varieties. However, major losses occur regularly in Nigeria, for example, with similar impacts in other West African countries.

Sorghum downy mildew is most damaging when it infects roots and results in systemic infections. Localized infections are less severe and the effect on production is minimal. Systemic infections affect the overall growth of the plant, which is frequently barren and without any grain. Losses of up to 100 000 metric tonnes have been reported from India. In southern Nigeria losses of more than 10% have been observed, probably enhanced by the occurrence of a maize-infecting strain of the pathogen.

## DISTRIBUTION

Sorghum downy mildew is probably present in all countries in Africa where sorghum is grown. It has been recorded from Egypt, south through Sudan and Ethiopia to Kenya, Tanzania and Malawi, and beyond to Zambia, Zimbabwe and South Africa. In West Africa the disease is reported from Burkina Faso, Ghana and Nigeria.

## FURTHER READING

Crop Protection Compendium (www. cabi.org/cpc) and Plantwise Knowledge Bank (www.plantwise.org).

Fact sheets on sorghum downy mildew:http://amarillo.tamu.edu/files/2010/11/SorghumDownyMildewPart2.pdf

Frederiksen, RA (1980) Sorghum downy mildew in the United States: overview and outlook. Plant Disease 64, 903-908 (www.apsnet.org/publications/plantdisease/backissues/Documents/1980Articles/PlantDisease64n10_903.pdf)

The most recent comprehensive scientific review of sorghum downy mildew is:

Jeger MJ, Gilijamse E, Bock CH, Frinking HD, 1998. The epidemiology, variability and control of the downy mildews of pearl millet and sorghum, with particular reference to Africa. Plant Pathology 47, 544-569 (PDF can be downloaded free from http://onlinelibrary.wiley.com/doi/10.1046/j.1365-3059.1998.00285.x/abstract)

Frederiksen RA, Odvody GN (editors), 2000. Compendium of sorghum diseases. Second edition. American Phytopathological Society, Minnesota.