



Rust of pearl millet

Puccinia substriata



Photo: Vivek Gupta

Reddish-brown (rust coloured) spots, with yellow halos, producing masses of spores which spread between pearl millet plants.

SUMMARY: Rust of pearl millet is caused by the fungus *Puccinia substriata*. It causes losses in grain yield, especially if infection is early, and also reduces the quality of fodder for livestock. The disease is present in USA, Asia and is widespread in semi-arid tropical and sub-tropical Africa. Several asexual spore stages of the rust occur on pearl millet and wild grasses, with the sexual stage on eggplant (aubergine). Spores carried on the wind spread the rust, and survival is in the soil, on debris, volunteer pearl millet and alternative hosts. Management relies on crop rotation, weeding to remove volunteer plants and weeds, tolerant varieties and destruction of crop remains after harvest. Fungicides are not economically viable unless crops are grown for commercial purposes.

KEY SIGNS

On pearl millet, small green to yellow slightly raised spots develop over the leaf surface, with more on the topside than the underside. As the spots grow larger, up to 2 mm, and rise further from the surface of the leaf, they develop into reddish-orange pustules, round to elliptical, with yellow halos. Masses of spores (urediniospores) form in the pustules and spread the rust within and between crops. Later, as the pustules age they become darker as another spore type (teliospores) appears; the leaves start to die from the tips towards the base. If the disease is severe, spots occur on the stems and the plants fall over (lodge). Note: the teliospores have thick walls and this helps them survive in the soil.

MANAGEMENT

Prevention – what to do before signs are seen

Cultural approaches: Before planting, check if resistant varieties are available locally. ICRISAT¹ began breeding varieties for resistance against this rust in the 1970s. High yielding, early maturing hybrids for most rainfed areas (600-800 mm) are available for sub-Saharan Africa, building on Indian successes. Open-pollinated varieties are also being developed. Consult seed suppliers for varietal characteristics. Note, the resistance of many hybrids is based on single genes; there is always a possibility that the rust will overcome the resistance. Varieties with tolerance (durable resistance) do not appear to be available for this rust, although they have been made available in the USA.

Plant early, as soon as weather conditions allow; this will minimize yield and grain quality losses as the crop will have matured before maximum disease development. Do not plant pearl millet continuously on the same land, but rotate with other crops such as sorghum and legumes.

During crop growth, remove weeds, grasses in particular; do not plant near eggplant or its weed relatives, e.g. *Solanum torvum* (turkey berry). After harvest, collect and bury crop residues.

Chemical approaches: Fungicides are not recommended for smallholders, as they are not likely to be economical. If pearl millet crops are grown commercially use copper compounds, chlorothalonil, sulphur or mancozeb.

¹International Crops Research Institute for the Semi-Arid Tropics

CAUSE

The rust is caused by *Puccinia substriata*, but in recent years it has been given a number of different names, for instance, *P. penniseti*, *P. substriata* var. *Penicillariae* and *P. substriata* var. *substriata*. Other reports using DNA comparisons regard *P. substriata* var. *penicillariae* the same as *P. substriata* var. *indica*.

Infection of *Solanum* hosts has been reported from Brazil, India and the USA. When the rust was first found on eggplant (*Solanum melongena*) in 1915, it was given the name *Aecidium tubulosum*. It was only later that it was recognised as being the pearl millet rust, *P. substriata*. The rust also occurs on *S. aethiopicum* (Ethiopian eggplant) and *S. torvum* (turkey berry). Likewise, several grasses are hosts, e.g. species of *Digitaria*, *Echinochloa*, *Paspalum*, *Pennisetum* and *Setaria*. Several different races of the fungus have been reported from the USA.

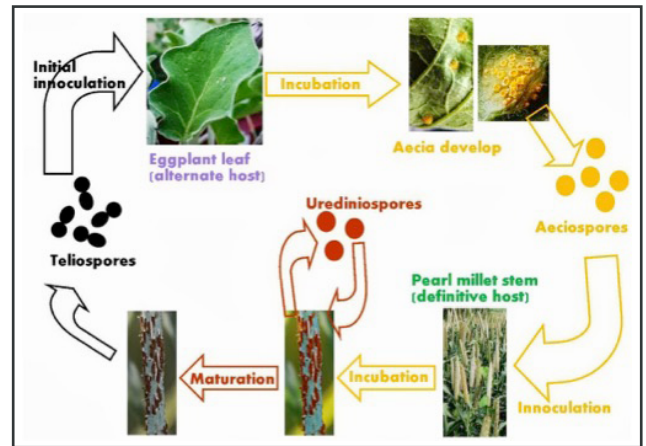


Figure 1: Image by kind permission of Roots 'n' shoots <http://rsandss.blogspot.com/>

The rust fungus that causes this disease has a complex life cycle with many different stages on two quite different hosts. Most stages occur on pearl millet and related grasses, and some on eggplant and its wild relatives. The disease reproduces sexually on eggplant. The life cycle is shown in Figure 1, above.

The life cycle of *P. substriata* has not been studied in detail, but it is likely that the teliospores germinate, producing basidiospores which infect eggplant, or wild *Solanum* species. Here, mating occurs between different strains, the result of which is another type of pustule which is yellow at first becoming reddish-brown, up to 15 mm across. The spores (aeciospores) that develop in these cup-shaped protruding structures on the underside of the leaf infect pearl millet. This completes the life cycle.

Long distance spread is on the wind. Because some stages have thick dark walls, they can travel long distances, high in the atmosphere.

Survival between crops of pearl millet occurs in a number of ways: as dormant spores (teliospores) in the soil; as spores on infected crop debris; or as infections on volunteer (self-seeded plants) pearl millet, on wild grasses, and on *Solanum* species, many of which are perennial weeds.

The disease is favoured by cool nights (15-20°C) and warm days (25-34°C) as this promotes abundant dew on the foliage, thus assisting the urediniospores to germinate and infect.

IMPACT

Severe losses occur if infection takes place before flowering. Epidemics of the disease were first recorded from the USA and since then they have occurred frequently around the world with losses of over 75% in grain production and fodder quality. In India, for instance, the disease has become widespread due to large-scale seed production schemes and overlapping crops. Trials in the southeast USA in 1993 and 1994 with a susceptible variety showed that grain losses began when rust severity scores reached 50% at harvest: scores above 50% resulted in major losses. Recently, there have been reports of serious outbreaks in Brazil after cultivation became more widespread for cattle feed using minimum tillage (no ploughing) systems. The disease was so serious that it prevented the increased expansion of the crop.

DISTRIBUTION

The rust occurs in North, South and Central America, the Caribbean, Asia and Africa. In Africa it occurs in Burkina Faso, Chad, Congo, Ethiopia, Ghana, Guinea, Ivory Coast, Kenya, Malawi, Mozambique, Niger, Nigeria, Senegal, Sierra Leone, South Africa, Sudan, Tanzania, Uganda, Zambia and Zimbabwe.

FURTHER READING

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