Bacterial leaf blight of rice

Xanthomonas oryzae pv. *oryzae*

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Bacterial leaf blight symptoms in the field.

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Pale yellow-whitish streaks caused by bacterial leaf blight on the leaves, showing wavy margins.

SUMMARY: Bacterial leaf blight of rice kills seedlings and destroys the leaves of older plants. The disease is extremely serious worldwide and has emerged as a major problem in irrigated crops in the Sahel. Recently, it has also been reported from East Africa. Wild hosts maintain the disease between crops and spread occurs in irrigation, floodwaters, in wind and rain, and in seed. Management requires planting resistant or tolerant varieties, good drainage of fields, removal of weeds, ploughing under of stubble and removal of volunteer seedlings.

KEY SIGNS

On seedlings, leaves show grey-green streaks starting from the tips and margins; later the streaks join together, turn yellowish-white with wavy edges, dry up and die. If the infection is systemic, i.e. throughout the entire plant, then leaves wilt, dry up and die – a symptom common on transplanted seedlings, known as 'kresek' (an Indonesian word). On older plants, the leaves show pale yellow steaks with wavy margins going from the tips towards the base, and then die.

Small milky drops of liquid (bacteria) ooze from the streaks, later drying as a crust on the leaves. Streaks also occur on the leaf sheaths and the stems of susceptible varieties. To check that bacteria are present in the leaves, cut a leaf across a young streak and place the cut end in a glass of water: if bacteria are present a cloudy liquid will stream out.

Some symptoms of bacterial leaf blight could be confused with bacterial leaf streak, caused by a different but related bacterium. The difference appears in the margins of the leaf streaks: those of bacterial leaf streak are straight, whereas those of bacterial leaf blight are wavy. Confusion could also occur between seedlings damaged by stem borers and bacterial leaf blight. To find out which one is present, squeeze the low part of the plant. If a yellowish liquid oozes from the ends of cut leaves, the cause is bacterial leaf blight. Also, infected plants cannot be pulled easily from the soil.

MANAGEMENT

Prevention – what to do before signs are seen

Cultural approaches: National biosecurity organisations need to ensure that rice seed entering the country originates from crops certified free of bacterial leaf blight and is subject to closed quarantine upon arrival, and further testing for the bacterium causing this disease.

In low-input farming systems, where resource-limited farmers can hardly ever afford external inputs, control of bacterial leaf blight is mainly through the use of resistant/tolerant varieties in combination with sound management practices, such as good weed control. Resistant varieties are available in Southeast Asia: PSB Rc82 is a standard variety with resistance; Macassane has been shown to have improved bacterial leaf blight resistance and is being used in Mozambique, and two IRRI varieties – IR22 and IR 54 – are resistant and moderately resistant respectively in Tanzania. Several NERICA hybrids from AfricaRice have been tested and found to have resistance. Check whether these are available locally.

Take care when selecting seed. For farmers who are using their own seed, it is important that they always select from plants uninfected by bacterial blight symptoms.

During planting and crop growth, do not damage seedlings when taking them from the nursery. They should not be pulled from the soil, but eased out with roots intact; the leaves should not be clipped.

Be careful with fertilizer applications: too much nitrogen increases shoot and leaf production and creates conditions that promote disease development because of higher humidity. 80-100 kg N/ha is suggested, depending on local conditions.

Ensure good drainage of fields and nurseries. Even in irrigated lowland rice, most varieties are not able to withstand flooding for more than a week, and floodwater spreads the bacterial leaf blight between plants. Keep fields clean of weeds, especially species of *Leersia* which are considered to be the main weed host of bacterial leaf blight. After harvest, plough land to bury rice stubble, straw, rattoon plants and volunteer seedlings. Note that the bacteria causing this disease do not live long in the soil.

Chemical approaches: Chemical treatments, such as applications of copper compounds or antibiotics, are costly and in any case have been shown to be ineffective.

CAUSE

Bacterial leaf blight is caused by *Xanthomonas oryzae pv. oryzae.* It is a vascular disease, meaning that the bacteria enters the plant and moves in the xylem, the water-conducting system of the plant. A number of strains are known from molecular studies; differences exist between those in Japan and the Philippines and, importantly, between strains in Asia and Africa.

There is another serious bacterial disease of rice, which is closely related; it is called leaf streak disease caused by *X. oryzaepv. oryzicola.* Both these diseases have re-emerged recently with the expansion of rice cultivation in West Africa. Current breeding programmes have not yet produced resistant or tolerant plants.

Bacterial leaf blight is one of the most serious diseases of rice. It is found worldwide in both temperate and tropical regions, causing epidemics in irrigated and rainfed lowlands, especially where fields have poor drainage and the potential for flooding.

Infection occurs through natural openings and wounds. Rice has natural openings at the leaf margins called hydathodes where excess water passes out of the leaf; leaves have stomata, the breathing pores. Wounds are made when seedlings are pulled from the seedbed and also when leaves are cut before transplanting. They are also made by insects; for example, leaf rollers, leaf folders and beetles. Once inside the plant, the bacteria invade the water conducting tubes, block them and cause a wilt.

Spread within the crop occurs in irrigation and floodwater, and in wind-driven rain. Over longer distances spread is probably via seed. In general, temperatures of 25-34°C and relative humidity of over 70% favour the disease.

Survival of bacterial leaf blight between crops is not well understood. It probably occurs in seed, but it seems that survival is not long in soil (about 5-6 weeks). In hot, dry conditions the bacterium dies rapidly. Similarly, survival is only for a few days in the stem (stubble) and root remains after harvest – about a month under dryland conditions and perhaps half as long when submerged. Longer survival between crops is on weeds, especially grasses, the most important of which are *Leersia* species, known as rice cutgrass.

IMPACT

Bacterial leaf blight can be devastating if it comes early. Yield losses range from 20% to more than 70% in Southeast Asia and India. In the Philippines, yield losses of susceptible varieties may reach 23% in the wet season, 7% in the dry. In Africa, it was first reported in the 1970s, but it is only more recently that it has become a serious disease, particularly of irrigated rice in the Sahel. There have been regular epidemics since 2002 in a number of countries. In Niger, for instance, a 2013 study showed losses in irrigated areas range from 19 to 63%, estimated to cost between 200,000 and more than 500,000 FCFA/ha (approximately, US$400-1000/ha). Mali, too, is recording epidemics, with yield losses of 75-80% in parts of the country from a combination of bacterial leaf blight and bacterial leaf streak. These two diseases are holding back the intensification of rice production in the country. Even if the disease comes late it can still cause a reduction in quality of the grain by making it black and brittle, even though the loss in yield is small.

DISTRIBUTION

Bacterial leaf blight occurs in Southeast Asia, India, Japan and Africa. It is also present with limited distribution in USA, Central and South America and Europe. In West Africa, it is a serious disease of irrigated rice in the savannah and Sahel. It was identified for the first time from Mali in the late 1970s; since then has been found in many other African countries (Burkina Faso, Benin, Cameroon, Mali, Niger, Nigeria, Senegal and Togo). It appeared in East Africa in 2013, and is now known in Mozambique, Rwanda, Tanzania and Uganda.

FURTHER READING

Program & Abstracts.3rd Africa Rice Congress 2013. Rice Sciences for Food Security through Smallholder and Agri-business Development in Africa. 21-24 October 2013, Yaoundé, Cameroon. (http://bit.ly/1dUmAok).

Rice leaf blight (Xanthomonas oryzae pv. oryzae). Plantwise Knowledge Bank. (http://bit.ly/1fAodt8).

Xanthomonas oryzae pv. oryzae. CABI Crop Protection Compendium. (http://bit.ly/1URtFrt).

Xanthomonas oryzae pv. oryzae. Wikipedia. (http://bit.ly/1GfYZVU).

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