

SYMPTOMS AND DIAGNOSIS OF THE BACTERIAL BLIGHT DISEASE OF RICE.

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THE 1963 epidemic of a leaf-drying disease of rice in Shahabad, Bihar and several other States led to considerable confusion with regard to its cause until the authors (1963, 1964a) conclusively demonstrated the bacterial nature of the disease, commonly called bacterial blight, incited by *Xanthomonas oryzae* (Uyeda and Ishiyama) Dowson. This disease is widely prevalent in the eastern countries, viz., Japan, China, Formosa, Philippines, Thailand, Indonesia, Malaya and has been recently reported from Ceylon also.

The only Indian record of occurrence of the disease, based on isolation and pathogenicity of the bacterium, prior to the epidemic of Bihar, was from Bombay by Sreenivasan *et al.* (1959). While the symptoms described by them are suggestive of the non-vascular streak disease of which the pathogen is *X. oryzae* Fang *et al.*, the bacterium isolated and worked with appears to have been *X. oryzae* by virtue of its requirement of enriched medium for growth as also its ability to infect the vascular system of the host. Goto (1964) considers *X. oryzae* Fang *et al.* to be *X. translucens* f. sp. *oryzae* Pordesimo. Based on a careful study of the properties and pathogenicity of a large number of isolates of both bacteria, Goto differentiates the blight and streak pathogens into two distinct species.

Since the disease has assumed national importance and has attracted the attention of a large number of workers, the present paper is aimed to provide a clear picture of the symptoms and methods of field diagnosis of the disease.

During August 1964 the bacterial blight disease was reproduced in a 10 weeks old rice crop of T. 90 by spraying pure cultures of a virulent strain of *X. oryzae*, originally isolated from diseased leaves of the previous year's epidemic in Bihar. The seeds were treated by the method published earlier by the authors (1964b). A sub-culture of the bacterium has been deposited in the International Collection of Phytopathogenic Bacteria, maintained by Dr. M. P. Starr, Professor of Bacteriology, University of California, Davis, California.

The symptoms of the disease become visible one week after inoculation and are characterised

by linear straw coloured stripes, rarely on one and generally on both margins of the leaves, starting from the tip downward (Fig. 1). This is



FIGS. 1-2. Fig. 1. Infected rice leaves showing various patterns and stages of blighting. Fig. 2. A piece of infected leaf showing bacterial ooze, $\times 970$.

followed by drying of the leaf tip, inward rolling and twisting (somewhat spiral) of the

infected portion of the leaf. The marginal blight extends rapidly to cover larger area of the leaf crosswise and lengthwise, usually leaving small green areas in the centre, which in course of time also get blighted. In occasional cases, the linear stripes develop on the leaf lamina or along the midrib with or without the marginal stripes. These are yellowish in the beginning but become straw coloured later. After blighting, the leaves unroll and support growth of sooty moulds. The disease extends to the leaf-sheaths and culms, killing the tiller or the whole clump. The glumes of the seeds are also infected, but the symptoms are not well defined. The disease remains aggressive throughout the monsoon season at the end of which some new tillers are produced which are either mildly infected or remain green.

Inoculations made on 3-4 weeks or older seedlings also produce the above symptoms, but seedlings younger than 2 weeks show bleaching of the leaf tips followed by rapid wilting.

When a small piece of the blighted leaf-sheath or culm is mounted in water and examined under the microscope, cloudy masses of the bacterium are seen oozing out from the vascular strands (Fig. 2). The ooze is profuse during active development of the disease. Blighted leaves stored at room temperature retain the ability to show the bacterial ooze even after 12 months. Pure cultures of the bacterium can be established by streaking dilutions of the ooze on nutrient agar. This is easier from fresh lesions than from advanced stages of blighting. In the latter, several saprophytic bacteria occur, some of which can be readily mistaken for *X. oryzae* on account of their yellow colour. The inoculum prepared from freshly infected leaves by suspending finely chopped pieces in a beaker of water is as infective as the pure culture. Thus, where facilities do not exist for isolation and purification of the bacterium, the inoculum prepared in this manner can be used for experimental purposes.

When a piece of the infected leaf was placed in a few drops of water on a clean glass plate, the water became turbid on account of the bacterial ooze within 10-15 minutes. When a six-inch piece of an infected leaf was half immersed in water in a glass tumbler, very tiny droplets of the bacterial ooze appeared on the

immersed edge of the leaf and gradually dispersed in the water. A piece of the infected culm suspended in the same manner released larger masses of the bacterium. These tests can be readily employed even by a layman for field diagnosis of the disease. Leaves killed or dried due to reasons other than bacterial infection do not respond to these tests.

Between August and October, 1964, the authors undertook a survey of some of the intensive rice-growing areas in U.P., Bihar, West Bengal, Orissa, Andhra Pradesh and Maharashtra. The disease was found to be prevalent in varying degrees of intensity in all the States, the foci of epidemic being Basti, Gorakhpur and Banaras in U.P., Shahabad in Bihar, Chinsurah in West Bengal, Sambalpur in Orissa, Rajendera Nagar in Andhra Pradesh and Karjat and Khopoli in Maharashtra. The symptoms of the disease was identical with those produced in the artificially inoculated crop at Delhi. Bits of infected leaves collected from these places showed the characteristic bacterial ooze from the vascular strands from which pure cultures of *X. oryzae* were established in all cases.

Some of the local names given by farmers to leaf-drying diseases of paddy are *Pansukh* in most parts of North India, *Dakhina* in Bihar and *Khaira* in the Terai regions of U.P. The identity of the diseases under these names is somewhat obscure. The authors wish to caution the investigators against interpreting all these as bacterial. While the bacterial blight essentially involves leaf-drying, its distinction from other causes of leaf drying is quite easy with the symptoms and the diagnostic tests described in this paper.

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