

## HISTOPATHOLOGICAL STUDIES ON BACTERIAL LEAF STREAK DISEASE OF RICE

Rice is the most important cereal crop in West Bengal. In order to increase the production of rice, high yielding dwarf varieties are cultivated in three seasons (*Aus*, *Aman* and *Boro*) under high nitrogenous fertilization which results in a changed situation relating to diseases of rice. Amongst the disease problems of the crop in the state two bacterial diseases namely bacterial leaf blight and bacterial leaf streak incited by *Xanthomonas oryzae* (Uyeda and Ishiyama) Dowson and *Xanthomonas translucens* f.sp. *oryzicola* (Prodesimo) Bradburry respectively have emerged as serious ones affecting yield. It is now evident that use of resistant varieties provides best methods of control of both the diseases and steps are being taken to find out the same. Breeding and selection of resistant varieties require an intimate understanding of mechanism of invasion and pathogenesis, host parasitic interaction and course of pathogenic reaction. Mode of infection and histopathology have been studied in the bacterial leaf blight disease (Tabei and Muko, 1968; Tabei 1967, 1968; Devadath and Premalathadath, 1970) but in case of bacterial leaf streak it has received scanty attention (Shekhawat and Srivastava, 1972; Devadath and Premalathadath, 1970) particularly in case of natural infection.

Present investigation has been under taken to determine the tissue invaded by the pathogen of the bacterial leaf streak disease under natural conditions and the resultant effect on the cell component.

To study the tissue invaded by the bacterium, diseased leaves of rice varieties *Java* and *Pankaj* at different stages of infection have been collected from the naturally infected field in the months of July to August. Infected portion of the leaves have been cut into 1—2 cm pieces. Some of the pieces have been fixed in FAA (Formalin—acetic acid—alcohol) and others have been fixed in FAA saturated with mercuric chloride for 48 hours, washed in FAA to remove the excess mercuric chloride and preserved in FAA. Free hand sections were used throughout the investigation. Sections of the diseased tissue have been stained with 0.1% acid fuchsin in lactophenol for 5 to 10 minutes (Shekhawat, 1972) to determine the tissue invaded by the bacterium and presence of the bacterial mass within the tissues.

Fresh naturally infected leaves have been used to study the effects of bacterial leaf streak disease development on pectin, cellulose, lignin and protein component of the leaf-tissues and production of gummy substances according to the method described by Shekhawat (1972). Enzyme activity of the bacterium *in vitro* has been determined by viscosimetric method (Uritani and Stahmann, 1961).

Results obtained from the present investigation has been summarised and presented in Table 1. A perusal of the observations presented in Table 1 shows that *Xanthomonas translucens* f.sp. *oryzicola*, the incitant of the bacterial leaf streak disease has been found to invade armed parenchyma tissue only and parasitism is not found to extend to the sheath tissue, sclerenchyma, xylem and phloem, epidermal and motor cells. Bacterial mass has been detected in the intercellular space and armed parenchyma cell and the veins or vascular bundles consisting primarily of xylem tissue acted as barrier for the lateral spread of the lesions, confining it to interveinal parenchyma. Hence the width of the lesion is determined by the distance between two adjacent veins, the lesion being broader in broad leaf varieties. Shrinkage of the motor cells as occasionally noticed has been probably due to the death of the surrounding parenchyma cells. The bacterial mass has accumulated in the parenchyma between two adjoining veins,

Table 1. *Tissue invaded in bacterial leaf streak disease and the consequent effect on different cell components of rice.*

	Epidermal cell	Motor cell	Armed parenchyma	Sclerenchyma	Xylem vessel	Vessel parenchyma	Phloem	Sheath tissue
Tissue invaded	No	No	Yes	No	No	No	No	No
Secondary anatomical effect	No	Shrinkage in some cases	No	No	No	No	No	No
Pectin degradation	No	in a few cases	Yes	No	No	No	No	in a few cases
Cellulose degradation	No	occasional	Yes	No	No	No	No	No
Lignin degradation	No	No	No	No	No	No	No	No
Gum deposition	No	No	No	No	No	No	No	No
Protein degradation	No	No	Yes	No	No	No	No	No

extrudes through stomata. Bacterial exudates have been found to be deposited on the leaf surface as large diffused masses of irregular shape, compact beds in rows or cirrhi. Devadath and Premalathadath (1970) and Shekhawat and Srivastava (1972) have reported that the bacterium invades not only the armed

parenchyma cells but also epidermal as well as motor cells. In the present study, however, repeated observation at varying stages of infection, invasion of epidermal and motor cells by the bacterium could not be detected nor any change in motor cells has been noticed excepting shrinkage in a few cases. Previous workers have recorded their observation on artificially inoculated leaves whereas in the present case studies have been made exclusively on the naturally infected leaves. Whether artificial conditions of inoculation create more favourable conditions so as to enable the pathogen to invade the cells which they normally do not is to be ascertained.

Present studies have demonstrated degradation of pectin and cellulose in armed parenchyma cells. Breakdown of pectin has been noticed in a few cases in motor cells and sheath tissue which has shown that these tissues though not directly invaded by the pathogen but might be affected by the enzymes secreted by the pathogen which diffuse to these cells. Shekhawat and Srivastava (1972) have not however, noticed any change in pectin and cellulose component of armed parenchyma cell. But they have demonstrated presence of bacteria in the motor and armed parenchyma cells. Their observations could not explain the entry of the bacteria in the cell when the cell wall remained undamaged. Mohan and Novcky (1972) have reported that *X. translucens* f.sp. *oryzicola* do not produce any pectic or cellulolytic enzyme in culture medium whereas Goto and Okabe (1958) have demonstrated production of cellulolytic enzyme by this bacterium. In the present investigation, the bacterium has been found to produce pectic and cellulolytic enzyme in culture. Those findings together with histopathological studies, have point out involvement of these two enzymes in pathogenesis of bacterial leaf streak disease.

Lignin has not been found to be affected and presence of any gummy substances has not been detected.

The study on the staining of proteins or its fractions in diseased tissues has shown constant increase in amino acid groups in the diseased tissue. This could be attributed to breakdown of protein due to the activity of proteolytic enzyme of the pathogen in leaf tissues. This finding confirms the earlier ones of Shekhawat and Srivastava (1972).

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