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SURVIVAL OF *XANTHOMONAS ORYZAE* PV. *ORYZAE* (ISHIYAMA, 1922), SWINGS *ET AL.*, 1990

Bacterial blight caused by *Xanthomonas oryzae* pv. *oryzae* (Ishiyama, 1922), Swings *et al.*, 1990 is one of the most important diseases of rice in South East Asia. In Kerala, this disease is prevalent in two of the major rice growing tracts viz., Palakkad and Kuttanad. In Kuttanad, this disease occurs in a mild form during punja season (November - December to February - March) and in a severe form during the additional crop season (June - July to September - October). The present investigation was taken up to study the mode of survival of the pathogen in infected seed and stubbles and their role in the recurrence of bacterial blight disease in Kuttanad mainly during the additional crop season.

Infected seeds were collected from paddy fields of Champakulam, Edathua, Kainakary, Kavalam, Muttar, Nedumudi, Pulinkunnu, Ramankari, Thakazhi and Veliyanadu Krishibhavan areas of Kuttanad Taluk. About 500 g infected Mattatriveni rice seeds were collected from each of these locations during the additional crop season of 1993. They were stored at room temperature in brown paper covers for seven weeks. These samples were tested for the presence of *Xanthomonas oryzae* pv. *oryzae* under *in vitro* conditions by sowing 100 seeds from each lot in earthen pots at weekly intervals up to a total period of seven weeks. The emerging seedlings were closely observed for the appearance of typical symptoms of bacterial blight till the harvest stage. Data on the percentage of infected seedlings were recorded separately for each location. The data were analyzed by analysis of variance described by Snedecor and Cochran (1967) and the trend was described by adopting a statistical model viz., modified exponential form $Y = k + ab^x$ where Y denotes per cent survival, 'k' asymptote, 'a' constant, 'b' rate of change and 'x' weeks codified as 0, 1, 2, 3, etc. (Yamanae, 1969).

Five hundred grams of stubbles were collected from four locations viz., Champakulam, Nedumudi, Pulinkunnu and Ramankari and stored at room temperature. The survival of *Xanthomonas oryzae* pv. *oryzae* was monitored by inoculating the leaves of T(N)1 rice variety at maximum tillering stage by using an aqueous suspension containing chopped stubbles. The clip inoculation was done periodically at seven days interval for a total period of 63 days. Three replications were maintained for each location. Observations were made on the occurrence of typical symptoms of bacterial blight such as yellowing and marginal blighting of leaves after seven days of inoculation. The final data were recorded as positive or negative for the development of symptoms of bacterial blight.

In addition to this, infected stubbles under field condition were studied. For this, bacterial blight infected stubbles were maintained under natural field conditions both under dry and wet land conditions at four different locations viz., Champakulam, Nedumudi, Pulinkunnu and Ramankari. The survival of the pathogen was monitored by inoculating the leaves of T(N)1 rice variety at the maximum tillering stage by using an aqueous suspension containing chopped stubbles at weekly intervals up to a maximum period of 28 days. Three replications were maintained for each location. Observations were made as in the previous experiment.

There was significant reduction in the extent of survival of the pathogen in infected seed with the increase in the period of storage at room temperature. Seedlings showing the typical symptoms of bacterial blight were maintained for most of the locations up to six weeks. However, in some locations such as Muttar and Thakazhi the pathogen was found to survive only up to a maximum period of three weeks. The above observation was confirmed by bivariate regression technique (Table 1 and Fig. 1).

A decreasing trend in the survival of bacterial blight pathogen was observed with respect to the period of storage of infected seed material. This trend was described in a modified exponential form given by $Y = -10.3215 + 53.8515 \times 0.7019^x$

With infected stubbles stored at room temperature the disease incidence on plants was

Table 1. Survival *of Xanthomonas oryzae* pv. *oryzae* in infected seed (percentage of seedling showing disease symptoms)

Locality	Storage period after harvest (in weeks)						
	1	2	3	4	5	6	7
Champakulam	60	36	22	12	7	2	0
Edathua	31	25	12	8	0	1	0
Kainakary	49	37	28	10	7	1	0
Kavalam	49	35	20	8	3	1	0
Muttar	28	10	5	0	0	0	0
Nedumudi	56	50	20	17	9	2	0
Pulinkunnu	42	34	18	10	4	1	0
Ramankari	58	37	20	10	5	2	0
Thakazhi	18	12	5	0	0	0	0
Veliyanadu	48	40	20	11	5	0	0
Mean(y)	43.53	30.73	16.21	6.89	2.75	0.68	0
	(41.26)	(33.65)	(23.73)	(15.21)	(9.55)	(4.73)	

CD(0.05) for treatments = 2.936; Figures in parentheses are transformed percentages in degrees

Table 2. Survival of *Xanthomonas oryzae* pv. *oryzae* in infected stubbles collected and stored at room temperature

Sl. No.	Locations	Disease incidence in T(N)1								
		Storage period of infected stubbles (days)								
		7	14	21	28	35	42	49	56	63
1	Champakulam	+	+	+	+	+	+	+	+	–
2	Nedumudi	+	+	+	+	+	+	+	+	–
3	Pulinkunnu	+	+	+	+	+	+	+	–	–
4	Ramankari	+	+	+	+	+	+	+	+	–

\+ Pathogen present; - Pathogen absent

uniform up to 35 days of storage irrespective of the locations from where they were collected (Table 2). However, thereafter the disease incidence was at random up to 56 days. This showed that the pathogen was capable of surviving in infected stubbles for a maximum period of 56 days.

Xanthomonas oryzae pv. *oryzae* was found to survive in infected stubbles remaining in field under dry land condition for 28 days after harvest of the infected crop. However, under submerged conditions, the pathogen survived only for 14 days.

The extent of survival of *X. oryzae* pv. *oryzae* in infected seed and stubbles was studied by different workers. Murthy and Devadath (1984) reported that the pathogen survived in seeds for 170-180 days in 54 per cent of seeds in July-November season and in 45 per cent of the seeds during rabi season. Trimurthy *et al.* (1982) reported that the pathogen survived in diseased stubble on the soil surface for 190 days and in stubbles buried in soil for 110 days. They suggested that in double cropped areas, infected stubble was a source of inoculum for the next crop. This sort of variation in the survival period may be due to lack of uniformity in disease intensity at different locations, varieties cultivated and also due to differences in the time interval after harvest for the collection of samples and the method adopted for the subsequent storage of such sample. It was found during this investigation that the pathogen could survive for a maximum period of 42 days in seed and 56 days in stubbles when stored at room temperature (Table 1 and 2). When the infected stubbles were left in the open field itself, the extent of survival of the pathogen was greatly reduced to a maximum period of 28 days. This could be due to the detrimental effect of relatively high temperature and UV radiation occurring under field conditions. At the same time, the pathogen could survive only for 14 days under flooded condition in the field due to the anaerobic conditions in the soil. This type of

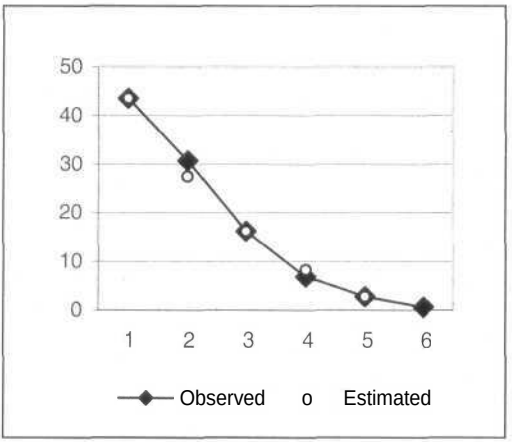

Fig 1. Trend in the survival of *Xanthomonas oryzae* pv. *oryzae* in seed (Y axis: Seedling infection %; X axis: Storage interval in weeks)

survival in infected plant materials definitely will play a critical role in the recurrence of bacterial blight in Kuttanad, if the infected seed materials were used for raising next crop especially in an area with an immediate past history of bacterial blight incidence. It was observed that many farmers were in the habit of using seeds from a previous crop without knowing whether such seeds were actually infected with the pathogen or not. If such seeds were used before the end of the observed period of viability of the pathogen in the seed material, it could serve as a potential source of inoculum for a subsequent crop susceptible to bacterial blight disease. Singh *et al.* (1980) observed that the bacterium could survive for about ten months at room temperature and the seeds retained enough infection to cause an epidemic under favourable conditions. The results of the present study also reveal the possibility of seed transmission of the disease. In a continuous cropping pattern of Kuttanad, the interval between two successive seasons was only around 30 days; infected seed could serve as a ready source of primary inoculum for the recurrence of bacterial blight in the region. It was found that due to various reasons in Kuttanad there was a sort of continuity in cultivation between two cropping seasons. As a result, very often the fields were not fully cleared of infected stubbles thereby providing another source of inoculum for infection to a subsequent crop that is susceptible to bacterial blight disease. By taking into consideration the fact that the pathogen could survive for a maximum period of 28 days under open field condition, it is essential to keep the field after harvest either exposed to sunlight or under flood fallowing for a minimum period of at least one month to ensure the complete destruction of the pathogen.

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