

RELATION BETWEEN THE AGE OF RICE PLANT AND ITS SUSCEPTIBILITY TO HELMINTHOSPORIUM AND BLAST DISEASES

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INTRODUCTION

It has been reported that there were differences in the susceptibility of seedlings and mature plants of rice to *Helminthosporium* disease (*Annual Report, C.R.R.I.*, 1946-48). Such variations in the reaction of seedlings and mature plants have been noticed in the case of other plant diseases also (Lowther, 1951; Peturson, 1944; Tapke, 1953; and Tisdale *et al.*, 1926). Sherf *et al.* (1947) inoculated rice plants of different ages, from 15 to 85 days, with *Helminthosporium oryzae* and observed that 15 days old plants had less infection than the older age groups tested. Between the latter groups there was no difference in infection. Suzuki (1940) noted that *Piricularia oryzae* could infect the leaves of 25 days old seedlings but 3 months old plants remained unattacked. Anderson *et al.* (1947) reported that only plants in the seedling and tillering stages were susceptible to leaf infection due to Blast and that the resistance to leaf infection increased as the plants became older. This observation was confirmed by Hashioka (1950).

An understanding of the exact nature of relation between the age of the host and its susceptibility to a disease is of practical importance in carrying out varietal susceptibility tests under artificial conditions. It is necessary to know whether the reaction of the host, at the age in which it is tested, would serve as an index of its reaction throughout its life-history. Plants susceptible at seedling stage may become resistant as they become older and conversely, plants resistant at seedling stage may become more susceptible with increasing age.

The relation between the age of rice plant and its susceptibility to *Helminthosporium* and Blast diseases was studied in the present investigation. Both the pathogens, *Helminthosporium oryzae* Breda de Haan [*Cochliobolus miyabeanus* (Ito et Kurib.) Drech. ex Dastur] and *Piricularia oryzae* Cav. infect the leaves, leaf-sheaths, nodes, neck of the peduncle and grains

of rice plants. The studies in the present investigation were confined to foliar infection only.

MATERIALS AND METHODS

Two different methods were adopted with respect to the two diseases. As *Helminthosporium* disease is sporadic in occurrence under natural conditions, artificial infection tests were carried out with plants raised in pots. On the other hand as Blast is of more general occurrence, reaction to this disease was studied under conditions of natural infection in field experiments.

Age of plants and susceptibility to Helminthosporium disease

Artificial infection tests were carried out for 2 seasons, 1949 and 1950 on three different dates in each year. By appropriate adjustment of the planting dates, plants of different ages were made available for inoculation on each date. Two susceptible varieties, Benibhog and T. 1145 were studied in 1949 and in 1950 a resistant variety T. 141 was also included. The intensity of infection was scored 7-10 days after each inoculation. The dates of inoculation, ages of plants infected and the intensities of infection are presented in Table I.

It may be seen from the data that:—

(i) In all the 3 varieties tested, the susceptibility of the plants increased with their age, *i.e.*, on any date of inoculation, the youngest plants showed the least infection, the infection increased progressively in plants of higher age groups and the oldest plants had the maximum infection.

(ii) Comparing different dates of inoculation, the September inoculation produced the highest amount of infection in plants of all ages and this was well marked in 45-50 and 92-95 days old plants in all the 3 varieties in 1950.

(iii) The relative susceptibility of the 3 varieties remained unaltered as compared between plants of the same ages, *i.e.*, when plants of the same age were compared on any date of inoculation, T. 141, which is a resistant variety, showed comparatively less infection than the susceptible varieties, T. 1145 and Benibhog.

Age of plants and susceptibility to Blast disease

The effect of the age of rice plants on their susceptibility to Blast disease was studied in field experiments during the year 1950 and 1951. In the first year the experiment was conducted with a moderately susceptible variety T. 1145 and in 1951 with a very susceptible variety Co. 13.

TABLE I
Intensity of Infection Developed on Plants of Different Ages at Different Parts of the Season

Age of plants in days	Date of inoculation	T. 1145			Benlbhogh			T. 141		
		Average infection	Average size of spot in mm.	Average infection	Average size of spot in mm.	Average infection	Average size of spot in mm.	Average infection	Average size of spot in mm.	
		No. of spots	Average No. of spots	Average infection	Average No. of spots	Average infection	Average No. of spots	Average infection	Average No. of spots	
19-22 days ..	30-7-1949	2.1	0.6×0.5	1949	3	3.2×1.0				
	9-9-1949	4.5	2.0×1.0		5	1.8×1.0				
	3-11-1949 (Natural infection)	2.5	..		..	..
40-57 days ..	30-7-1949	5.0	2.4×0.7		10	3.8×1.6				
	9-9-1949	4.0	2.6×1.0		5	1.8×1.3				
	3-11-1949 (Natural infection)	2.0	..		7	2.0×1.4				
94-96 days ..	3-11-1949 (Natural infection)	7.0	3.5×1.3	7.0	20	3.0×1.7				
				1950						
19-26 days ..	6-8-1950	2.8	1.8×0.7		1	1.6×0.6		2.4	0.5×0.4	
	20-9-1950	2.9	Minute		1	Minute		3.8	Minute	
	25-10-1950	2.6	Minute		5	1.6×1.6		2.0	1.0×2.0	
45-50 days ..	6-8-1950	3.0	1.9×0.8		4	2.2×1.0		2.0	0.3×0.3	
	20-9-1950	4.3	2.0×0.9		21	3.4×1.1		4.3	0.5×0.4	
	25-10-1950	2.8	1.5×1.0		..	..		2.0	0.3×0.3
92-95 days ..	20-9-1950	7.0	3.1×1.0		64	5.2×2.4		4.7	1.0×0.4	
	25-10-1950	4.2	3.5×1.0		9	4.0×1.5		3.0	3.0×1.5	
127 days ..	25-10-1950	5.7	4.7×2.1		..	..		4.9	2.9×1.3

Experiment I.—In the experiment during 1950, the variety, T. 1145, was planted in two series, one with a basal dressing of green manure and the other with a top dressing of ammonium sulphate at the rate of 20 lb. of nitrogen per acre in addition to green manuring. In each series, there were 10 treatments representing 5 planting dates beginning from 20th July upto 29th August, with an interval of 10 days between 2 plantings. On each planting date, 30 and 40 days old seedlings were transplanted. These 10 treatments were randomised in 4 replications with individual plot size of 30 ft. × 5½ ft.

Though Blast can be noticed in the field under Cuttack conditions from July-November, the disease attains a peak period between the middle of September to middle of October. Observations on the foliar infection were taken on 29th September 1950 in the above experiment. On that date plants of 5 post-planting age groups, *i.e.*, 71, 61, 51, 41 and 31 days were available, half of the plants in each age group having been raised from 30 days and another half from 40 days old seedlings at the time of transplanting. The intensity of infection was quite uniform in plants within a plot. The incidence in a plot was estimated on the basis of a standardized scale. The mean infection data for plants of different age groups both under fertilized (green manure + ammonium sulphate) and unfertilized (green manure only) series are presented in Table II.

TABLE II
Showing Mean Leaf Infection Value per Plot in Variety T. 1145 Observed on 29-9-1950 on Plants of Different Ages

Manurial treatments	Age of seedlings at transplanting	Post planting ages in days				
		71	61	51	41	31
Green manure with Ammonium sulphate	30 days	1.50	2.25	3.88	11.38	16.12
	40 days	1.12	3.25	5.88	9.12	10.12
Green manure alone	30 days	1.00	1.25	1.75	5.25	7.12
	40 days	1.00	1.38	1.75	5.25	5.00

It may be seen from the data presented in Table II that the crop was progressively resistant to foliar infection due to Blast with increase in age and the extent of increase in infection from any one age to the next was highest between 51-41 days old plants. There was no effect of the 10 days difference in the ages of seedlings at the time of transplanting on the extent of infection. Only the post-planting age apparently determined the

susceptibility of the crop to the disease. The crop which had received additional manure as ammonium sulphate over the common basal dose of green manure had more infection than the one which did not receive ammonium sulphate.

Experiment II.—During 1951 the layout of the experiment conducted with a very susceptible early variety, Co. 13 was also in two series, one of which received no fertilizer while the second was fertilized with ammonium sulphate at the rate of 20 lb. N per acre. In each series, there were 4 planting dates beginning from 19th July 1951 with an interval of 10 days between 2 plantings. The treatments were randomized in 6 replications, the individual plot size being 30 ft. \times 9½ ft. Observations on foliar infection were taken on 14th September 1951, on which date plants of 4 post-planting ages, *i.e.*, 58, 48, 38 and 28 days were available, each having been raised from 30 days old seedlings at the time of transplanting. The observations were made on randomly selected sampling units in each plot. A plot was divided into 2 equal halves. From each half 2 random samples of 3 ft. \times 3 ft. sq. were taken out and 4 corner plants from each square were observed. The intensity of infection was scored adopting the scale used in the previous experiment. The data representing the average infection value per plant are presented in Table III. The general prevalence of the disease was lower than in the previous year.

TABLE III
Showing Mean Infection Value per Plant in Variety Co. 13 Observed on 14-9-1951 on Plants of Different Ages

Manurial treatments	Post-planting age in days			
	58	48	38	28
Ammonium sulphate ..	2.45	3.77	4.78	4.81
No manure ..	1.32	2.78	4.11	3.53

It may be seen that in this experiment also the resistance of the crop increased with the increase in age of the plant. The plants which had received manure had more infection than the ones which had not received any.

DISCUSSION

The susceptibility of rice varieties of *Helminthosporium* disease increased with age, while the reverse was true in the case of Blast, within the ages studied. As has been stated earlier, this observation is of value in determining the

age at which the varietal susceptibility tests are to be conducted so as to get results of practical utility. Thus as far as the *Helminthosporium* disease is concerned, information obtained from seedling infection tests under optimum conditions of infection may be safely used for culling out the susceptible varieties, as with advancing age, these will become more and more susceptible. The varieties which come out as resistant in the seedling tests have to be tested further for their adult stage reaction, as resistance in the seedling stage may or may not be followed by the same in the adult stage.

The determination of the most susceptible stage of the host is also important for understanding serious outbreaks of the disease. Such epiphytotics develop only when the optimum conditions for infection and spread of the disease coincide with the susceptible stage of the host. It is therefore of particular significance that the two epiphytotics of the disease recorded hitherto in India, the Godavari Delta epiphytotic in 1918-19 (Sundararaman, 1922) and the Bengal epiphytotic in 1942 (Padmanabhan *et al.*, 1948) occurred when the crop was nearing maturity.

Regarding Blast disease, selections for disease resistance have to be carried out at the time of rapid growth following transplanting. At this age the plants are most susceptible. Varieties resistant at this stage, therefore, are likely to remain so at all other ages.

That even a difference of 10 days in the age of the crop results in a significant reduction of Blast incidence suggests that by suitably adjusting the planting dates, the severity of the disease and the loss caused by it could be minimised. It was stated that there is a peak period of Blast incidence in September-October period under Cuttack conditions. This peak period for Blast incidence varies from one locality to another depending upon the temperature, relative humidity, etc. A variety of short duration like Co. 13 which was used in one of the experiments may escape the severity of the disease in Cuttack by being transplanted sufficiently early so that the crop is in flower before the peak period of incidence sets in. This could of course be contemplated only under conditions of assured water-supply.

It is of interest to note that the changes that take place in rice leaf tissues as the plant attains maturity have opposite effects on the infectivity of the two pathogens, *Helminthosporium oryzae* and *Piricularia oryzae*.

SUMMARY

The susceptibility of rice plants of different ages to *Helminthosporium* disease was studied by conducting artificial infection tests on three different dates during the season. Three varieties, 2 susceptible and a resistant were

included in the study. It was found that the susceptibility increased with age of plants and the relative susceptibility of varieties, as compared between plants of the same age remained the same at any time during the season. Inoculations carried out in September produced the maximum infection.

Susceptibility to Blast disease at different ages was studied in 2 field experiments. It was found that younger plants were most susceptible and the resistance increased as the plants grew older. Only the post-planting age of the plants had an effect on their susceptibility.

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