INFLUENCE OF NUTRITION ON THE DEVELOPMENT OF HELMINTHOSPORIUM BLIGHT OF RICE

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The influence of nutrition on the development of blight of rice was studied in pot and field experiments. In pot experiment, the incidence of blight increased with an increase or decrease in the concentration of nutrients in Hoagland's solution. Seedling mortality increased in unbalanced Hoagland's solution containing low concentrations of nitrogen potassium and phosphorus.

Application of ammonium sulphate (50 lbs N), superphosphate (50 lbs P_2O_5), and potassium sulphate (50 lbs K_2O) alone and in combination to rice in the field failed to increase the germination of seed and the number of ears, and did not reduce the seedling mortality. However, fertilizers significantly increased the number of tillers and yield of the grain from the seed infested with *H. oryzae*. None of the fertilizers appeared to be significantly better than the other.

INTRODUCTION

Blight of rice caused by *Helminthosporium oryzae* is world wide in distribution and is prevalent more or less every year in the rice growing areas of Pakistan. The disease causes reduction in stand, reduces yield and lowers quality (Dickson, 1956). However, the intensity of blight and the losses caused vary with season, locality and variety cultivated. The disease assumed serious proportions in the former Bengal (areas now constituting East Pakistan) in 1942-43, when it became one of the major causes of the notorious famine of Bengal resulting from a serious reduction in yield of the rice crop (Woodhead *et al.*, 1945).

Blight of rice has been investigated in many countries of the world, and salient features of these investigations have been reviewed by Padwick (1950). However, meagre information is available on the relation of nutrients to the development of the disease. The possible relationship of the supply and form of nitrogen to the development of blight was suggested by Mallanaire (1949) and Muller (1950). The number and size of lesions of blight on the leaves of a susceptible variety grown in sand culture decreased with increasing levels of ammonium sulphate, varying from 0-12 mg per litre (Hashioka and Makino, 1956). Chattopadhay and Dickson (1960) studied the effect of nitrogen on the development of blight in rice seedlings and pointed out the undesirable

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consequences of injudicious application of nitrogenous fertilizers, particularly in areas where blight was prevalent. However, the development of blight in relation to the nutrients has not been investigated.

Cultural and pathogenic variation in *H. oryzae* and control of blight through seed dressing and spray fungicides has been studied in Pakistan (Nizamuddin, 1954; Nawaz and Kausar, 1962; 1967). As liberal application of fertilizers are being made in an attempt to increase production of rice, it is desirable to investigate the influence of nutrients to the development of blight. The present paper reports a study of the influence of nitrogen, phosphorus, and potash on the development of blight of rice on Jhona 349.

MATERIALS AND METHODS

The influence of nutrients on the development of blight of rice was studied in Hoagland's sand culture solution in crocks and in a field experiment.

Sand used for the pot experiment was infested with *H. oryzae* after thoroughly washing with distilled water and disinfesting with formaline solution. The experiment was carried out in triplicated randomised blocks. Ten seeds infested with *H. oryzae* were planted in each of the 24 crocks. Paddy seeds disinfested with mercuric chloride solution were also planted in another 24 crocks filled with disinfested sand at the same rate in each crock and served as untreated check.

Sand in eight series of three crocks each infested with *H. oryzae* and in another three crocks disinfested with mercuric chloride was kept moderately saturated with any of the following nutrient solutions: 0.25, 0.5, normal, 2 times and 4 times the normal Hoagland's solution, and normal Hoagland's solution with low nitrogen, low potassium, and low phosphorus by carboy method.

The basal nutrient solution (IN) was Hoagland's solution (Hoagland and Arnon, 1938). The concentration and balance of salts of the nutrient solution was varied according to the method employed by Walker and Gallegly (1949) and Walker and Hooker (1945). The salt concentration of the basal solution was reduced to one half (0.5N) and one fourth (0.25N) and was increased two times and four times that of the normal solution. In the unbalanced solutions, basal nutrient solution (IN) was also used as the base. Low nitrogen, low phosphorus and low potassium solutions were prepared by decreasing the amounts of the respective ions to that found in the 0.25N solution.

The influence of nutrition on the development of blight of rice was studied in the field, with 349 Jhona infested with *H. oryzae*, in a split plot design

with four replications. The fertilizers formed the large main plots, whereas infested and disinfested seeds of the variety formed sub-plots within the main plots of fertilizers. Each experimental plot consisted of six rows of Jhona 349, 18 feet long, sown one foot apart, and measured 18 feet by 6 feet.

The fertilizers used in the test were ammonium sulphate (50 lbs. N), superphosphate (50 lbs P_2O_5), potassium sulphate (50 lbs K_2O) alone and in combination. The plots without fertilizer application served as check. The seed rate was kept uniform at the rate of 600 seeds per plot. The data on germination, seedling mortality, tillering, earing, disease development and yield of grains were subjected to the analysis of variance.

EXPERIMENTAL RESULTS

Experiment in Crocks

Seed emergence and seedling mortality as influenced by different nutrient solution are summarised in Table 1. Different concentrations of the Hoagland's solution did not influence the germination of seeds infested with *H. oryzae*. However, the germination of seeds infested with *H. oryzae* was lower than those of uninfested seeds.

TABLE 1. *Effect of different levels of Hoagland's solution on the germination and seedling mortality of Jhona 349 seeds uninfested and infested and with Helminthosporium oryzae in pots.*

Different concentrations of Hoagland's solution	Germination (per cent)		Seedling mortality (per cent)	
	Uninfested	Infested	Uninfested	Infested
0.25 Hoagland's solution ..	83.3	70.0	0	47.6
0.5 Hoagland's solution ..	90.0	70.0	0	33.3
Normal Hoagland's solution ..	90.0	73.3	0	22.7
2N Hoagland's solution ..	90.0	73.3	0	22.7
4N Hoagland's solution ..	90.0	73.3	0	38.0
Normal with low nitrogen ..	86.6	66.6	0	45.0
Normal with phosphorus ..	90.0	70.0	0	42.8
Normal with low potassium ..	90.0	70.0	0	42.8

TABLE 2. *F value for emergence mortality, tillering, earing, disease development and yield of grains from seeds free from and infested with H. oryzae in plots fertilized with fertilizers.*

Variation due to	Degree of	F values					
		Germination	Mortality	Tillering	Earning	Disease Development	Yield
Blocks	3						
Fertilizers (F)	4	.43	.29	4.27*	.28	1.07	7.10**
Error I	12						
Infestation (I)	1	12.43**	10.04**	22.33**	6.58*	23.48**	12.32**
F x I	4	.05	.12	.11	.11	1.20	.03
Error II	15						
Total	39						

* Significant at 5 per cent level ** Significant at 1 per cent level

TABLE 3. *The effect of fertilizers on the emergence of rice seeds, seedling mortality, tillering, earing, disease development and yield of grains from the seeds infested with Helminthosporium oryzae.*

Fertilizers	Emergence of seeds (in numbers)	Seedling mortality (in numbers)	Number of tillers produced	Number of ears produced	Desease development (in numbers)	Yield of grain in maunds per acre
Ammonium sulphate	340	48.7	1405	1873	14.2	58.3
Supper phosphate	345	50.0	1187	1757	13.2	54.7
Potassium sulphate	331	40.7	1267	1860	10.7	56.1
Complete fertilizer	332	37.2	1304	1870	14.0	57.1
Check	339	42.2	1106	1697	12.2	48.2
Least significant difference for infestation						
at 5 per cent level	9.8	7.2	113.0	138.7	.8	.34
at 1 per cent level	13.5	10.0	156.3	191.8	1.2	.47

In the unbalanced nutrient solution containing low levels of nitrogen, phosphorus and potassium, the seedling mortality was higher than in the normal Hoagland's solution. The plants were also less vigorous in unbalanced solutions. The rate of mortality in seedlings from infested seeds generally increased with an increase or decrease in the concentration of the Hoagland's solution.

Field Experiment.

F value for infestation in respect of germination of the seed, seedling mortality, tillering, earning, blight development on leaves and yield of grain were highly significant. However, F values for the fertilizer treatments and for the interaction between infestation and fertilizers in respect of these characters were non-significant, except that the F value in respect of fertilizer treatments was significant for tillering and yield (Table 2). This shows that application of fertilizers had no effect on the germination of the seed, seedling mortality, ear formation and disease development. Besides, the response of different fertilizers was similar on disinfested seed and seed infested with *H. oryzae* in respect of the character studied. However, the germination, tillering, earing and yield from infested seeds was significantly lower than from uninfested seeds, whereas mortality of seedlings and development of blight on leaves was higher on plants from infested seed (Table 3).

The application of fertilizers significantly increased the number of tillers and yield of grain. However, the differences in the number of tillers and yield of grain produced by the application of different fertilizers were non-significant. The effectiveness of fertilizers was in order of ammonium sulphates, complete fertilizers, potassium sulphate and supper phosphate.

DISCUSSION

The results of pot experiments indicate a response of the nutrient concentration to the development of blight of rice, whereas those of the field experiment show that the application of 50 lbs. nitrogen as ammonium sulphate, 50 lbs. P_2O_5 as superphosphate amd 50 lbs. K_2O as potassium sulphate alone or in combination had no significant effect on the incidence of blight. The fertilizers used were generally effective in enhancing tillering and yield of grain, but the differences among the effectiveness of different fertilizers in this respect were more significant. The results of pot experiments are in conformity of those of Chattopadhyay and Dickson (1960), who studied the relation of nitrogen to the development of paddy blight. Thus, the application of recommended rates of nitrogenous, phosphatic or potassic fertilizers are not likely to influence the incidence of blight. The application of nitrogenous, phosphatic or potassic fertilizers at their recommended rates can, therefore, be taken up

without any deleterious effect in so far as the development of blight of rice is concerned.

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