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SOME FACTORS AFFECTING INFECTION OF COTTON SEEDLINGS BY *MACROPHOMINA PHASEOLI*

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Abstract

Deficiency or excess of nitrogen and potassium over a wide range had no influence on the susceptibility of cotton seedlings to wilting due to *Macrophomina phaseoli*, whereas water stress proved to be a principal factor in predisposing both cotton and jute plants to this disease. There was about two fold increase in the protein content of the roots of cotton seedlings inoculated/water stressed as compared to uninoculated/regularly watered plants. The significance of these findings is discussed and future line of research is suggested.

Introduction

The fungus *Macrophomina phaseoli* (Maubl.) Ashby (- *Rhizoctonia bataticola* (Taub.) Butl.) and the root rot of cotton has been the subject of good deal of investigation and controversy with regards to the nature of the disease and the mode of infection. On the basis of inoculation experiments, the root rot disease of cotton was attributed to *Rhizoctonia solani* and *R. bataticola* (Vasudeva, 1935). A combination of these fungi was found to be more virulent than inoculation with each of them alone (Vasudeva, 1936). Maximum infection was caused at 15-20% soil moisture (Vasudeva, 1937). *Macrophomina phaseoli* affected cotton seedlings over a temperature range of 25-39°C. There was no appreciable difference in the texture and chemical composition of healthy and root rot infested soils but a high amount of acid soluble Ca and higher Ca and Mg ratio was found in the root rot infested soil. Similarly pH of the soil did not affect incidence of root rot (Vasudeva & Ashraf, 1939). In contrast to these results, Sattar (1952) having been unable to produce infection on cotton concluded that *M. phaseoli* would not probably be able to attack cotton unless certain soil factors like hard pan, bad dgainage and high concentration of salts were present. Khan (1956, 1959) found that most of the isolates of *R. bataticola* were unable to cause root rot of cotton in pots and in field. Deep cultivation, wet cultivation, artificial hard pan, frequency of irrigation etc., also did not consistently reduce root rot disease from root rot infested patches. Experiments were therefore carried out to study the effect of certain predisposing factors on the development of *Macrophomina* infection on cotton. This is described below:

Materials and Methods

An isolate of *M. phaseoli* (no. 54) present in the culture collection of the Botany Department, Karachi University was used in the experiments. This was the same isolate used by Ghaffar et al (1969) in their investigations. The fungus was grown in Czapek

Dox solution, pH 5.3, in Erlenmeyer flasks at 25°C as still cultures. Three days old fungal mat was washed in sterilized water and macerated in a blender for inoculation of cotton seedlings. Acid delinted cotton seeds, var. M 100 were germinated in sterilized sand and two days old seedlings were used for transplanting.

Experimental

1. *Effect of excess or deficiency of mineral nutrients in sand culture*:

Two days old cotton seedlings dipped for five seconds in a mycelial suspension of *M. phaseoli* were transplanted into 3½" plastic pots containing washed and sterilized gravel. A comparable set of uninoculated seedlings were also used. There were 5 seedlings in each pot with six replicates of each treatment. These were maintained at 50% w.h.c. (Keen & Roczkowski, 1921) using different molar solutions of K^+ and N^{---} series. In one series of experiments the effect of nitrogen was examined for which $Ca(No_3)_2 . 4H_20_2$ was used as sole source of nitrogen with intermediary variables prepared from 1 M stoock solutions ranging from 2 Molar to 0.5 Molar. In the second series, the effect

Table 1. Predisposition of cotton seedlings to root rot (*M. phaseoli*) infection under conditions of excess or deficiency of K^+ and N^{---} in sand culture.

Excess or deficiency of K^+/N^{---}	Inoculated		Uninoculated	
	Wilting %	*M. phaseoli* infection %	Wilting %	*M. phaseoli* infection %
$Ca(No_3)_2$ 2M Variables	75.0	100	0	0
3.5ml	42.1	100	0	0
2.5ml	53.5	100	0	0
1.0ml	83.3	100	0	0
0.5ml	51.7	100	0	0
0.0ml	60.7	100	0	0
KNO_3 2M Variables	53.5	100	0	0
3.5ml	50.0	100	0	0
2.5ml	38.4	100	0	0
1.0ml	65.5	100	0	0
0.5ml	53.5	100	0	0
K^+ and N^{---} absent	60.0	100	0	0
Complete nutrient	75.8	100	0	0

of both K^+ and N^- was tested using different dosages of KNo3. Complete nutrient solution containing $Ca(NO_3)_2$. $4H_20$; KN03, MgSo4; KH_2Po_4 in distilled water and distilled water alone were used as control. From the data presented in Table 1 it would appear that none of the seedlings wilted in the uninoculated series. In the inoculated series all the seedlings were however infected with *M. phaseoli* and the wilting percentage varied. Confirmation of *M. phaseoli* infection was obtained after isolations made from root pieces on Czapek Dox agar. Deficiency or excess of K^+ and N^- over a wide range apparently do not predispose the cotton seedlings to wilting under pot culture conditions.

2. *Effect of water stress on the production of wilt and the protein content of cotton seedlings*:

Experiments were conducted to determine the effect of water stress on the development of wilting due to *Macrophomina* infection. The results obtained in this department corroborate the earlier findings of Ghaffar & Erwin (1969) in which they showed that the severity of wilting was greater in cotton plants subjected to soil water stress than in those provided with sufficient soil water. The same experiment with jute also gave similar results. It was considered interesting to find the protein content of plants inoculated and uninoculated with *M. phaseoli*. One week old seedlings were used in this experiment and determination of protein was done following the technique of Lowry et al. (1951). From the data presented in Table 2 it would appear that total protein content of inoculated plants subjected to water stress was higher as compared to regularly watered series.

Table 2. Protein content (mg) in roots of cotton seedlings subjected to water stress after inoculation with *M. phaseoli*.

Water stressed		Regularly watered	
Inoculated	Uninoculated	Inoculated	Uninoculated
48.6	34.1	26.0	18.4

Data based on 4 replicates.

Conclusion

The deficiency or excess of N^- and K^+ over a wide range apparently did not predispose cotton plants to wilting due to *Macrophomina* infection. It may be mentioned that Alshukry (1969) found that plants grown in soil rich in superphosphate and potassium sulphate became less susceptible to *Fusarium* attack. Similarly calcium deficiency predisposed cotton plants to wilting by *Fusarium* and *Verticillium* sp. and in high calcium content the plants were resistant to infection. It would therefore be worthwhile to examine this phenomenon in greater detail in root rot infested patches of the country.

Cotton and jute plants subjected to water stress were predisposed to wilting by *Macrophomina* infection as compared to regularly watered series. Protein content of the roots of inoculated cotton seedlings was higher than that of the uninoculated plants. The protein content, in roots of cotton seedlings subjected to water stress, was twice as high as compared to regularly watered plants. Conditions of water stress would be of common occurrence in the hot summer months prevailing during the growing season of cotton crop in Pakistan. What substances are exuded by cotton and jute plants as a result of abnormal host metabolism during desication is not known. It may here be mentioned that the activity of micro-organisms in the rhizosphere is directly corelated with exudation of vitamins and amino-acids. Studies of the rhizosphere microflora of cotton under water stress conditions with special reference to the actual mechanism of root infection by *M. phaseoli* would therefore be of considerable interest.

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