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GROWTH RESPONSES OF COTTON PLANT TO INFECTION BY *Xanthomonas campestris* pv. *malvacearum*

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Xanthomonas campestris pv. *malvacearum* (Smith) Dye inoculated on single or both cotyledonary leaves of cotton cultivar B-557 produced water soaking and necrosis of the inoculated leaves and subsequent secondary leaves of the same plant, thus indicating the systemic nature of the disease. Plant height, stem dry weight, area and dry weight of leaves and total dry weight of inoculated plants were reduced significantly than noninoculated plants. Leaf expansion was affected more than dry matter accumulation in most of the treatments.

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is an important cash crop of Pakistan but its average yield is only 1350 kg/ha. One of the important factors contributing towards its low yield is the attack of insect pests and diseases, which affect both the quality as well as quantity of the produce. Amongst various diseases, bacterial blight caused by *Xanthomonas campestris* pv. *malvacearum* recorded near Multan in 1965 is responsible for heavy losses to cotton crop (Evans, 1976). According to Hussain and Ali (1975) this disease can reduce the yield of the crop upto 50 per cent under favourable conditions of the disease development. The effect of the pathogen on different growth parameters of the host was still unknown which was studied and is presented here.

MATERIALS AND METHODS

Acid delinted seeds of cotton cultivar B-557 were sown in 20 cm diameter clay pots 10 seeds in each pot. When the cotton seedlings attained the height of about 10 cm, crop was thinned to two plants per pot. A highly pathogenic culture of *X. campestris* pv. *malvacearum* was isolated from the infected cotton plant and was identified by morphlogical, biochemical characters and usual pathogenicity tests. For inoculation aquous suspension of the bacterium containing approx. 10^8 cells/ml was prepared from 48 hours old culture grown

on nutrient agar at 30°C. When the primary or the secondary leaves attained 25 per cent of their normal size, the suspension was sprayed on their abaxial surface by a spraying pump at a pressure of 1.1 kg/cm^2. The plants were kept in greenhouse until symptoms of disease developed. There were six replicate plants of each of the following treatments :

T_0 = Uninoculated control
T_1 = One cotyledonary leaf inoculated
T_2 = Both cotyledonary leaves inoculated
T_3 = Both cotyledonary and subsequent secondary leaves inoculated.
T_4 = Only secondary leaves inoculated

Sixty days after inoculation the plants were gently removed from the soil and dissected into component parts i.e. leaves, stem and roots. Immediately after removing from the soil leaf area was measured by an electric leaf scanner. The plant parts were dried in an oven at 70°C for three days and their dry weight recorded.

RESULTS AND DISCUSSION

Inoculation of cotton leaves produced the symptoms of water-soaking and ultimately necrosis at the infection site. The pattern of symptom development on the inoculated secondary leaves (T_4) was similar to that of the inoculated cotyledonary leaves (T_1 and T_2). Inoculation of cotyledonary leaves (T_1 and T_2) resulted into symptom development (necrosis) of the subsequent secondary leaves, thus indicating the systemic nature of the disease. When all the leaves of the plant were inoculated (T_3) stem showed spliting with black elongated lesions. The reduction in leaf area and leaf dry weight took place in all the treatments (Table 1). Thus for plants in which single cotyledonary leaf was inoculated (T_1), reduction in total leaf area and total leaf dry weight was 57.9 and 36.6 percent respectively. Decrease in total leaf area and leaf dry weight for plants in which both cotyledonary leaves were inoculated (T_2) was 75.7 and 69.4 per cent respectively. For plants where all leaves were inoculated (T_3), the reduction in total leaf area and leaf dry weight was 80.5 and 72.9 percent respectively. The effect of inoculation of only secondary leaves (T_4) of cotton plant, though statistically significant was not much and there occured only 16.9 and 20.2 percent reduction in total leaf area and total dry leaf weight

respectivaly. Of the two parameters i.e. leaf area and dry leaf weight, the former was affected more in T_1, T_2 and T_3. Thus it is evident that cotyledonary leaves infection is of great importance in the subsequent development of cotton plants. Inoculation of cotyledonary leaves, on account of their succulence and parenchymatous nature, probably provided comparatively favourable conditions for the rapid multiplication of the bacterium which when moved systemically through the xylem vessels blocked the vessels (Bhagwat and Bhide, 1962; Verma and Singh, 1970; Wickens, 1956), thus interferring with the water and nutrients uptake. This interferrence coupled with necrosis of the subsequent secondary leaves affected the phothsynthesis which in turn affected leaf expansion and leaf dry weight. Since the leaf area was affected more, it resulted in an increased leaf area : weight ratio for the treatments (T_1, T_2, T_3) in which cotyledonary leaves were inoculated (Table 1). Such effects have also been reported for *Pseudomonas phaseolicola* infection and for *Xanthomonas phaseoli* infection on dwarf beans (Hale *et al.*, 1972; Bhatti and Whitbread, 1981).

Inoculation of cotton plant by *X. campestris* pv. *malvacearum* also greatly affected the plant height, dry stem and root weights as well as the total dry weight of the plant (including the leaves). The effects of inoculation (i. e. percent reduction in the parameters) were dependent and proportional to treatment inculation. Thus in T_3 where all the leaves were inoculated, the reduction in plant height, and stem weight, dry root weight, and total dry weight was maximum i. e. 45.8, 72.2 61.6 and 65.6 respectively. This was followed by T_2 where both the cotyledonary leaves were inoculated and in response to this inoculation there was 36.5, 58.6, 56.3 and 55.2 percent reduction in plant height, dry stem weight, dry root weight and total dry weight of the plant respectively. T_2 was followed by T_1 where only single cotyledonary leaf was inoculated and here the magaitude of reduction in plant height, dry stem weight, dry root weight and total dry weight of the plant was 24 2, 37.1, 39.7 and 34 4 per cent, respectively (Table 2). Similar results of significant reduction in plant height and dry stem weight have been reported by Bhatti and Whitbread (1981) in the case of bean plant infected with *X. phaseoli* and by Ahmad (1976) in the case of potato plant infected with *Pseudomonas solanacearum*. In treatment where only secondary leaves were inculated (T_4) only plant height and dry root weight were found to be slightly affected and there was 3.2 and 19.2 percent reduction, respectively. There was no significant effect on dry stem weight and total dry weight of the plant.

Table 1. *Effect of inoculation of cotton plant by Xanthomonas campestris pv malvacearum on mean total area, dry weight area: weight ratio of the leaves of cotton plant*

Treatments	Leaf area (cm^2)	Percent reduction in leaf area over uninoculated control	Leaf dry weight (mg)	Percent reduction in leaf dry weight over uninoculated control	Leaf area-weight ratio (mg/cm^2)
T_1 = Single cotyledonary leaf inoculated	102.2[c]*	57 9	449.3[b]	36.3	4.6[a]
T_2 = Both cotyledonary leaves inoculated	61.2[d]	75.7	287.3[c]	59.4	4.9[a]
T_3 = All leaves inoculated	49.4[d]	80.5	192.0[c]	72.9	4.1[a]
T_4 = Only secondary leaves inoculated	207 6[b]	16.9	564.7[b]	20.2	2 8[b]
T_0 = No leaf inoculated (uninoculated control)	249.8[a]	—	708.0[a]	—	2.9[b]

*Mean values sharing the same letter in the same column do not differ significantly at 1% level of significance (DMR Test).

Table 2. *Effect of inoculation by Xanthomonas campestris pv. malvacearum on the height and weight of cotton plant*

Treatments	Plant height (cm)	Per cent reduction in plant height over uninoculated control	Dry stem weight (mg)	Per cent reduction in dry stem weight over uninoculated control	Dry root weight (mg)	Per cent reduction in dry root weight over uninoculated control	Total dry weight of the plant (g)	Per cent reduction in total dry weight of the plant over uninoculated control
T_1 = Single cotyledonary leaf inoculated	38.2[c]*	24.2	41.3[b]	37.1	60.7[c]	39.7	1.45[b]	34.4
T_2 = Both cotyledonary leaves inoculated	32.0[d]	36.5	27.2[c]	58.6	44.0[d]	56.3	0.99[c]	55.2
T_3 = All leaves inoculated	27.6[e]	45.2	18.3[d]	72.2	38.1[d]	61.6	0.76[d]	65.6
T_4 = Only secondary leaves inoculated	48.8[b]	3.2	61.6[a]	6.1	81.3[b]	19.2	2.18[a]	1.4
T_0 = No leaf inoculated (uninoculated control)	50.4[a]	—	65.7[a]	—	100.7[a]	—	2.21[a]	—

*Mean values sharing the same letter in the same column do not differ significantly at 1% level of significance (DMR Test)

REFERENCES

Ahmad, W. 1976. Effect of *Pseudomonas solanacearum* on the growth of potato. Some studies on brown rot of potato. M. Sc. Thesis, Univ. of Agri., Faisalabad.

Bhagwat, N. Y., and V. P. Bhide. 1962. Vascular infection of some cottons by *Xanthomonas malvacearum*. Indian Cott. Grow. Rev., 16 : 80-82.

Bhatti, M. A. R., and R. Whitbread. 1981. Growth responses of dwarf bean to infection by *Xanthomonas phaseoli*. Pak. J. Agri. Res. 2 : 97-107,

Evans, G. 1978. Cotton disease research in Pakistan. A consultant report of F. A. O. Rome, Page 44.

Hale, G.N., R.Whitbread, B.Jansen, and G.Marshall. 1972. Growth responses of dwarf bean to infection by *Pseudomonas phaseolicola* (Burk.) Dows. Ann. Bot., 36 : 136-43.

Hussain, T. and M. Ali. 1973. A review of cotton diseases of Pakistan. The Pak. Cott., 19 (2) : 71-86.

Verma, J. P., and R. P. Singh. 1970. Quantitative estimation of the degree of susceptibility of certain popular varieties of cotton to black arm diseases. Sci. Cult. Cott. Gr. Rev. 36 : 566-67

Wickens, G. M. 1956. Vascular infection to cotton by *Xanthomonas malvacearum* (E. F. Sm.) Dows. Ann. Appl. Biol., 44 (1) : 129-137,