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Cowpea rhizobium activity lowers aerial blight (*Macrophomina phaseolina*) disease intensity on mung bean

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Effects of simultaneous infection of mung bean with its root rot and aerial blight pathogen *Macrophomina phaseolina* in the aerial parts and the symbiont i.e. *Rhizobium* sp. in the roots, on nodulation, aerial blight intensity and grain yield were studied. Field trials were conducted in two consecutive years. As expected the crop grown from *Rhizobium* inoculated seeds gave a significantly higher yield. The extent of this increase was relatively lower in plants inoculated with both the pathogen and the symbiont in different combinations but higher than those inoculated only with the pathogen. The results that the percent disease intensity was more on plants inoculated with the pathogen alone than those inoculated with the pathogen and the symbiont indicated that *Rhizobium* might have played a role indirectly by influencing the host metabolism to restrain the pathogen.

Key words : *Rhizobium*, *Macrophomina phaseolina*, Mung bean

Macrophomina phaseolina (Tassi) Goid, occurs in the collar and stem region of the many plants generally. The organism also infects aerial plant part causing leaf blight in mung bean (Grewal, 1978). Leguminous crop plants grow in nature in symbiotic relationship with a group of nitrogen fixing bacteria belonging to the genus *Rhizobium*. The crops are benefited with the nitrogen fixed by the bacteria. The legumes also suffer from diseases caused by some pathogens resulting in yield reduction. The interactions between a pathogen and a legume host (Hoffmaster *et al.* 1943) or a symbiont with a legume host (Singh, 1977 ; Kushwaha and Srivastava, 1978) have been studied separately. The present study was aimed to understand the effects of the pathogen, *Macrophomina phaseolina* and the symbiont i.e. Jca-1 strain of cowpea *Rhizobium* on mung bean particularly when the pathogen was allowed to infect aerial plant parts and the symbiont the root region. The objective was to determine whether such microorganisms interact

individnally through their common host channel and if so how and to what extent ?

MATERIALS AND METHODS

For the present programme of work mung bean i.e. *Vigna radiata* (Wilczek) was chosen for testing particularly the indirect effects of a pathogen on the *Rhizobium* or vice versa through their host when the pathogen was allowed to infect aerial plant parts. Field trials were conducted in two consecutive years with nine different treatments consisting of different combinations of pathogen and uninoculated control. The treatments were replicated four times in a randomised block design with microplotes of 2^2 net plot size. The soil of the experimental plot was sandy loam, with good drainage and moderate fertility level having pH 6.7, total nitrogen 0.59%, available phosphorus 0.0014%, and exchangeable potash 0 0116%. *Rhizobium* cells were grown in yeast mannitol agar (YMA) and YM broth medium (Vincent, 1970). The pathogen was grown in potato dextrose agar (PDA). Three day otd YM-broth culture of the symbiont and 15- day old culture of the pathogen were used for inoculation of the plants. Host plants were inoculated at their roots by the *Rhizobium* sp. and at foliage by *M. phaseolina*.

Seeds of variety B-1 of mung plants were inoculated with the corresponding symbiont namely Jca-1 strain of cowpea group by (i) seed inoculation charcoal based *Rhizobium* strain mixed with the soaked seeds before sowing, and (ii) inoculation at 30 days age of the plants (60 plants per replication) by drenching at a strength of 33.33×10^6 cells/ml in 1st year and 35.66×10^6 cells/ml in 2nd year. A sclerotial suspension of the pathogen from a 15 day old PDA-culture was sprayed on the foliage of the mung plants on 30 and 45 days after sowing at the rate of 250 ml/2^2m plot with suspensionns containing 1.6×10^6 sclerotia/ml in 1st year and 1.2×10^6 sclerotia/ml in 2nd year. Observations were made at 60 days after sowing by taking 10 plants at random/replication in terms of (i) nodulation, (ii) disease intensity and later the (iii) grain yield. Nodulation was measured by counting the number of effective nodules and by measuring volume of nodules by water displacement method. Percent intensity of the disease was measured by calculating the number of plants killed/total number of plants observed. Yield of grains was measured in weight of grains produced per plot and computed to yield in q/ha.

RESULTS

Effects on nodulation

Results presented in Table 1 showed that nodulation of the plant i.e. both

number and volume of nodules inoculated with the pathogen ot 30 and 45 days after sowing was lower compared to the uninoculated control plants in both the years. Nodulations of the plants increased significantly in both the years in cases of seeds inoculated with the symbiont. In plants inoculated with the symbiont on 30 days after sowing nodulation were also found to have increased though not to the extent of seed inoculated plants. In cases of plants inoculated simultaneously with *Rhizobinm* and *Macrophomina* in different combinations, nodulations were found to have reduced compared to uninoculated control plants except the combination of such mixed inoculation resulting increased nodulation in the 2nd year.

Effects on disease intensity

The percent intensity of foliage blight of the plants inoculated with the pathogen on both 30 and 45 days after sowing was higher compared to the uninoculated were nil as expected. A relatively higher degree of foliage blight was observed in plants inoculated simultaneously with *Rhizobium* and *Macrophomina* in different combinations. Among the mixed inoculation *Rhizobium* at seed and *Macrophomina* at 45 days recorded highest disease intensity in the years. However, this intensity did not equal on plants inoculated with the pathogen alone.

Effects on yield of mung bean

Yield of mung plants inoculated with the pathogen at 30 days was lower by 29.90% and 7.96% in 1st and 2nd year respectively compared to the yield from the respective uninoculated control plants (Table 2). Yields of the plants inoculated with the pathogen at 45 days after sowing was also lower by 18.26% and 15.04% respectively in the 1st and 2nd year compared to the respective uninoculated control plants. Significantly higher yield was obtained from seeds inoculated with *Rhizobium*. The increases were 115.42% and 86.73% respectively in the 1st and 2nd year. Plants inoculated at 30 days after sowing with *Rhizobium* also showed higher yield over respective uninoculated control plants by 34.13% and 51.77% in the 1st and 2nd year. In cases of plants inoculated simultaneously with *Rhizobium* and *Macrophomina* in different combinations, however the yield was lower compared to the respective uninoculated control plants in both the years. Double inoculation as usual resulted in higher yields compared to plants inoculated only with the pathogen Subject to further study in one case, however, simultaneously inoculation resulted in enhancement of yield as high as 25.06% in the 1st year and 12.83% in the 2nd year over the respective uninoculated control plants.

Table 1. Effect of *Macrophomina phaseolina* inoculation on nodulation of Mung in field.

Treatments	Mean number of nodule per plant		Mean volume of nodule per plant in cc	
	1st year	2nd year	1st year	2nd year
Uninoculated control	8.75	7.50	0.015	0.01
Macrophomina at 30 days	3.75	3 25	0.003	0.002
Macrophomina at 45 days	4.13	5.25	0.003	0.008
Rhizobium at seed	20.00	18.75	0.04	0.11
Rhizobium at 30 days	12.00	11.25	0 03	0.06
Rhizobium at seed and Macrophomina at 30 days	7.50	7.00	0.005	0.01
Rhizobium at seed and Macrophomina at 45 days	7.50	9.25	0.008	0.02
Rhizobium at 30 days and Macrophomina at 30 days	6.50	5.50	0.004	0 006
Rhizobium at 30 days and Macrophomina at 45 days	5.00	4.75	0.008	0.004
C. D. at 5%	2.98	1.87	0.005	0.014

Table 2. Effect of *Macrophomina phaseolina* inoculation on disease intensity and yield of Mung in field

Treatments	Mean disease intensity(%) per plant		Mean yield in (q/ha)	
	1st year	2nd year	1st year	2nd year
Uninoculated control	Nil	Nil	2.08	2.26
Macrophomina at 30 days	33.97	29 17	1.50	2.08
Macrophomina at 45 days	33.25	25.33	1.70	1.92
Rhizobium at seed	Nil	Nil	4.47	4.22
Rhizobium at 30 days	Nil	Nil	2.79	3.43
Rhizobium at seed and Macrophomina at 30 days	22.15	21 68	2.60	2.55
Rhizobium at seed and Macrophomina at 45 days	25.45	25.06	1.89	2.18
Rhizobium at 30 days and Macrophomina at 30 days	25.17	22.22	1.86	2.04
Rhizobium at 30 days and Macrophomina at 45 days	19.67	18 32	1.78	2.11
C. D. at 5%	6.81	16.22	0.69	0.63

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DISCUSSION

The interaction of *Macrophomina phaseolina*, causing presently the aerial blight of mung bean and *Rhizobium* occurring on mung bean have been studied even though they were inoculated to two different parts of the mung plants namely, foliage and roots respectively. This pathogen, being, primarily a soil borne one has also outlived *Rhizobium* in different environments like soil and water (Bhattacharyya, 1989). The pathogen was allowed to cause disease in the foliage and *Rhizobium* in its turn, formed nodules on the roots. Increased nodulation as reported earlier (Idris and Sandhu, 1979 ; Bhatnagar *et al.*, 1981) due to *Rhizobium* inoculation has been confirmed in the present work. In this occassion also the disease caused on the foliage reduced nodulation. This reduction associated with foliage infection with *M. phaseolina*, however, appeared to be reported for the first time here. But, reduction of nodulation by a pathogen occurring on such a distant plant part has been reported earlier (Orellana *et al*, 1978) in soybean. Tu (1978) has reported that *Rhizobium* actively lessened the severity of *Phytophthora* sp.

Surprisingly, in spite of their occurring in two distant parts of the host plant, the extent of reduction of nodulation and yield due to foliage blight has been to some extent replenished by nodulation on roots. This replenishment of yield loss due to disease through indirect influence of *Rhizobia* appeared unique in nature.

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