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Original Article

Role of inoculation of *Heterodera cajani* and *Rhizobium* on productivity of cowpea

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Abstract

The variability in rhizobia nodulation and *Heterodera cajani* cyst population on cowpea was studied in respect to prior or post inoculation of rhizobia. Comparatively higher reduction in nodulation was observed in root samples treated with prior inoculation of nematode to the bacterial strain. Though the results obtained from all the treatments showed reduced nodulation and increased *H. cajani* population but treatments $N_{15}R$ treatment showed maximum reduction in nodulation. The time sequence of Rhizobium strain and nematode inoculum appeared to have a correlation on the extent of damage caused to the cowpea plant and the full benefit of the rhizobia inoculation could be derived if the control of nematode is taken care initially even before applying bacterial fertilizer in the soil.
Key words: *Heterodera cajani*, Pigeon-pea cyst nematode, Rhizobia, nodulation, cyst.

Introduction

Cow pea (*Vigna unguiculata*. L) was found heavily infected by many plant parasitic nematodes (Hasan *et al*, l998). Among these nematodes pigeon pea cyst nematode, *Heterodera cajani* (Koshy, 1967) infection lead to heavy economic losses in the state of Rajasthan, India. This legume is essential both as source of protein rich animal feed and their ability to fix atmospheric nitrogen in symbiotic association with nodule forming bacteria of the genus Rhizobium. This nematode limits the maximum nitrogen production and forage production by consequently decreasing the nodulation in roots and also provide suitable site to attack by other pathogens such as virus and fungi etc. Nigh (1966) reported suppression of rhizobium nodulation on alfalfa by *M. javanica*. A drastic reduction and early disintegration of nodules in *M. javanica* and *Heterodera trifolii* infected leguminous plant(Taha and Raski, 1969). *M. javanica* and *M. incognita* besides being pathogenic to mung bean found to infect bacterial nodulation and hamper nitrogen fixation (Hussaini and Seshadri, 1975; Walia *et al*., 1989). Mishra and Gaur (1981) reported a 75% reduction in nodulation in root-knot infected mungbean. The nematode inoculation prior to treatment with rhizobia resulted in maximum reduction in number of nodules in french bean(Singh and Reddy 1981; Khan and Saxena, 1987). Mishra *et al*., (1994) reported improved growth of *Phaseolus aureus* L. plant by *Rhizobium leguminosaerum* inoculation as compared to reniform nematode infected plant. Jain and Trivedi (1995) in a study reported that nematode inoculation (*M. incognita*) either simultaneously or fifteen days prior to rhizobia inoculation suppressed the length, fresh and dry weight of chickpea. Sharma and Sharma (1998) reported an adverse affect on nodulation of chickpea plants infected with *M. incognita* and *M. javanica.*

The current knowledge regarding the effect of *H. cajani* on rhizobium nodulation on cowpea is meagre. Hence present study was, done to determine the role of time sequential application of rhizobia on cowpea and its effect on the development of *H. cajani* population on cowpea.

Materials and Methods

Pot experiments were conducted during kharif season at the Nematology Lab, Univ. of Rajasthan, Jaipur. The experiment was laid out using highly susceptible cowpea cultivar variety RC-19 with six treatments and five replications. The experiment was carried in 15 cm diameter pots containing sterilized soil. Nematode inoculum was maintained on highly susceptible cultivar of cowpea. Cyst so obtained were allowed to hatch at $29\pm1^{O}C$ in BOD. One thousand freshly hatched L_2S were inoculated through three holes made around the roots of seven days old seedlings of cow pea in each pot.

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Specific rhizobium Strain (DC-13) for cowpea was used for the experiment.
Various treatments given were:-

1. Nematode alone (N).
2. Rhizobiam alone(R).
3. Nematode and Rhizobium inoculated simultaneously (N+R).
4. Rhizobium inoculated fifteen days after nematode inoculation ($N_{15}\rightarrow R$).
5. Nematode inoculated fifteen days after Rhizobium inoculation ($R_{15}\rightarrow N$).
6. Control (without Rhizobium and Nematode inoculation),

Observation was recorded after sixty days and incidence of disease was recorded on the basis of fresh and dry weight of shoot-root, number of cysts/root system, and number of eggs/cyst. The effect on nodulation was made by counting the number of nodules in plants. Data's were analyzed statistically.

Results and Discussion

The data's from present investigation (Table-1) revealed that irrespective of time sequence infection of *Heterodera cajani* in any of these treatments caused significant reduction in fresh and dry weight of root, shoot and number of nodules as compared to *Rhizobium* alone or control treated plants.

The infestation of nematode significantly reduced the number of nodules in all treatments (Table-1) except in *Rhizobium* alone treated plants here the number of nodules was more as compared to uninoculated control plants (Table-1). This decrease in nodulation has been in confirmity with the studies made by Bhagwat and Thomas, (1982), Nigh, (1966), and Balasubramanian, (1970) on various leguminous plants.

Nematode infestation significantly reduced the number of nodules in all treatments where nematode inoculation preceded the Rhizobium inoculation and root of plants inoculated with both the organisms simultaneously. This decrease in root nodulation might be due to antagonistic competition between nematode larvae and bacteria (Epps and Chambers, 1962; Ichinohe, 1961), and physiological changes (Balasubramanian, 1970; Hussaini and Seshadri, l975). Masefield, (1953) suggested that nematode galls on root affect nodulation by causing deficiency of nutrients in host root which is needed by Rhizobia. Koshy and Swarup, (1979) were of the opinion that the infection of nematode in root might cause accumulation of ammonia in roots leading to inactivation of enzyme nitrogenase and consequently resulting in reduced nitrogen fixation.

Table -1: Effect of inoculation time sequence of *Heterodera* and *Rhizobium* on cowpea

Treatment	Fresh wt. (g)		Dry Wt. (g)		Number of nodules	Number of cyst	Number of eggs/cyst	No. of cysts/pot
	Shoot	Root	Shoot	Root				
1. $N_{15}\rightarrow R$	17.36	4.52	4.01	0.45	23	531 (22.06)	142.3 (11.9)	2400
2. $R_{15}\rightarrow N$	23.09	5.44	6.07	1.79	37	481 (21.95)	111.5 (10.6)	1660
3. R + N	19.43	4.71	4.53	0.54	25.6	504 (23.46)	130 (11.4)	1980
4. 'C'	34.4	7.42	6.00	1.86	33.3	0 (1)	0 (1)	0
5. 'N'	16.92	4.43	3.75	0.41	19	682 (26.13)	146 (12.11)	2800
6. 'R'	35.4	7.62	6.13	1.90	40.6	0 (1)	0 (1)	0
SEM ±	0.1527	0.66	1.00	0.22	1.68	2.05 (0.27)	1.43 (0.06)	-
CD at 5%	0.33	1.45	2.18	0.47	3.67	4.47 (0.60)	3.13 (0.18)	-
CD at 1%	0.4666	2.04	3.06	0.67	5.14	6.27 (0.84)	4.39 (0.20)	-

(Figures in parenthesis are $\sqrt{n+1}$ transformed values); (Observations are means of five replicates)

N=Nematode, R =Rhizobium, C=Control

A reduction in number of cysts was observed in plants inoculated with N+R treatments and $R_{15\rightarrow N}$ treatments which were favored with earlier report by Bopaiah *et al.*, (1976), Singh and Reddy,(1981) and Sharma, (l 974). Barker *et al.*, (1972) reported the adverse effect of rhizobia on the cyst formation of *H. glycines* on soybeans. The time sequence of strain and nematode inoculum appeared to have a correlation on the extent of damage caused to the

cowpea plant and the full benefit of the rhizobia inoculation could be derived if the control of nematode is taken care initially even before applying bacterial fertilizer in the soil.

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