www.hortflorajournal.com
HortFlora Research Spectrum, 4(3): 260-263 (September 2015) ISSN : 2250-2823

STUDY ON THE EFFICACY OF BIOAGENTS ON NODULATION OF COWPEA (*Vigna unguiculata* L. Walp)

Rashmi Nigam* and Joginder Singh[1]

Department of Plant Pathology, Janta Vedic College, Baraut, Baghpat

[1]*Department of Horticulture, J. V. College, Baraut, Baghpat*

**E-mail: neelu.nigam@gmail.com*

ABSTRACT : The present investigation was carried out on cowpea variety IFC-901, to study the efficacy of doses of bioagents on nodulation of cowpea (*Vigna unguiculata* L. Walp) in pot condition consecutively for three years. In terms of nodulation status, the pooled data of three year revealed that all the treatments were significantly superior in increasing the nodules/plant as compared to control. Number of nodules was higher when the treatments were given with *Trichoderma species*. *T. harzianum* recorded the best results in increasing the number of nodules against *M. phaseolina, R. solani* and *F. oxysporum* infested plants. The study revealed that 15 g dose was most effective for all bioagents.

Keywords : *Cowpea, bioagent, inoculation, nodulation.*

Cowpea (*Vigna unguiculata* L. Walp) is a warm season annual leguminous vegetable-cum-fodder crop mainly grown in northern and central India. The cowpea fodder is rich in proteins and forms an excellent mixture with maize, sorghum and bajra and teosinite for increasing the flow of milk (Coetzee, 3). Its other uses are that it can be grown as green manure, cover crop vegetable or as a pulse crop. As a drought tolerant and warm weather crop, cowpea is well adapted to the dryer region of tropics, where other legumes do not perform well. It also has the useful ability to fix atmospheric nitrogen through its root nodules, and it grows well in poor soils with more than 85 per cent sand and with less than 0.2 per cent organic matter and low level of phosphorus. In addition, it is shade tolerant, and therefore, compatible as an intercrop with fruit crops and cereals. This makes cowpea an important component of traditional inter cropping system, especially in the complex and elegant subsistence farming system.

Cowpea is susceptible to wide variety of pathogens, which attack the crop at all the stages of plant growth, and hampers the crop establishment, impairs herb quality and reduces the green fodder and seed yield. Besides this, they also cause indirect losses, like reduction in nodule formation which ultimately results reduction of nitrogen fixation. The fungi, like *Rhizoctonia solani, Macrophomina sp.* and *Fusarium sp.* are the most widespread and destructive plant pathogens causing root rot/dry root rot. These pathogens infect the crop either alone or as a complex there by resulting in rots before and after emergence of seedling and wilting of plants (Sumner, 12; Singh and Gurha, 10; Bhatnagar and Bansal, 1; Gokulapalan *et al.,* 5). Considering the limitations and environmental and health hazards due to pesticides, there has been growing awareness towards biological control of plant pathogens which could bring about a reasonably reduction to the crop damage, ensure sustainability of production, cost effectiveness and provide healthy eco-system (Cohen *et al.,* 4; Mishra *et al.* 8). Use of antagonist microorganisms has gained much interest among the growers and researchers. It has been well documented that *Trichoderma spp.* also boost the crop growth and suppress the diseases in various economically important crops (Singh and Sachan, 11). It mobilizes the immobile/locked-in phosphorus and improves the uptake of Cu, Fe, Mn and Zn in cucumber crop (Yedidia *et al.,* 14). *Trichoderma* spp. protects plant from plant pathogens by responses that are similar to systemic acquired resistance (SAR). Considering the above facts the present study was undertaken to find out the effect of different doses of bioagents on root rot pathogens and its effect on nodulation status of cowpea

MATERIALS AND METHODS

The present experiments were carried out for three consecutive crop seasons at the Central Research Farm, Indian Grassland and Fodder Research Institute, Jhansi. Fungal bioagents (*T. harzianum, T. viride, T. koningii, T. pseudokoningii, A. niger, A. flavus*) were used as seed treatment against cowpea root rot pathogens in pot condition consecutively for three year to determine the plant growth promoting activity of these isolates by seed

Received : 09-08-2015 *Accepted : 12-09-2015*

treatment. The present studies were carried out on cowpea variety IFC-901, the important vegetable-cum-forage legume which is susceptible to root rot disease. Dry powder of the antagonist was prepared by growing the antagonists on soaked and sterilized sorghum grains for 20 days.

Different bioagents were tested under pot condition. Fifteen cm diameter earthen pots were filled with 1 kg autoclaved soil manure mixture of 3:1 ratio. These pots were inoculated with the test pathogens separately (*M. phaseolina, R. solani and F. oxysporum*). Different doses of inoculum *viz.* 2, 5, 10 and 15 g were prepared for the treatment of cowpea seed. Treated seeds of cowpea (*Vigna unguiculata* L. Walp) were sown. The pots were arranged in Complete Randomised Block Design (CRBD). There were 3 replicates of each treatment including the treated control as well as untreated control. Observations in respect of number of nodules were recorded and the data were analyzed by the standard statistical methods.

RESULTS AND DISCUSSION

The effect of bioagents on the nodulation of cowpea as depicted in Table 1, 2, 3 and Fig. 1 revealed that all the treatments were significantly superior in increasing the nodulation status of cowpea roots as compared to untreated ones. Average values indicated that the number of nodules were many fold higher when the treatments were given with *Trichoderma species*, which provide greater enhancement in nodulation over the others, indicating that nodulation is an important factor associated with greater resistance to pathogens.

Among the *Trichoderma species*, *T. harzianum* recorded higher nodulation i.e. 36.5, 39.2 and 38.4 nodules/plant in case of *M. phaseolina, R. solani* and *F. oxysporum* infected plants and thus showed 615.1, 553.7 and 563.6 per cent increment over untreated control. This was followed by the seed treatments with *T. viride, T. pseudokoningii* and *T. koningii,* respectively. All these three species offered somewhat similar results in terms of nodulation.

Aspergillus sp. i.e. A. flavus and *A. niger* could not yielded better results when compared with the *Trichoderma sp.,* although they also increased the nodulation by 168.0 per cent against *M. phaseolina,* 151.8 per cent against *R. solani* and 140.7 per cent against *F. oxysporum* infected cowpea plants. Findings also revealed that 15 g/kg seed dose was more

Table 1: Effect of bioagents on root nodules of cowpea infested with *M. phaseolina*.**

Treatments	Number of nodules /plant *				Average	Increase over control (%)
	Dose (g/kg)					
	2g	5g	10g	15g		
A. flavus	12.0	13.2	14.2	15.3	13.7	168.1
A. niger	16.2	17.3	18.7	19.4	17.9	250.7
T. koningii	20.0	20.8	21.6	22.3	21.2	314.4
T. pseudokoningii	23.0	24.1	25.1	26.2	24.6	381.7
T. viride	27.6	28.7	29.9	26.7	28.2	451.9
T. harzianum	32.2	37.3	36.4	40.1	36.5	615.1
Bavistin (Treated check) @ 2g/kg	35.1	35.1	35.1	35.1	35.1	587.4
Control (untreated check)	5.1	5.1	5.1	5.1	5.1	-
CD (P=0.05)	Treatment: 1.24		Doses: 1.75		Interaction: 0.62	

* Each value is mean of three replicate. **Pooled data of three year.

Table 2: Effect of bioagents on root nodules of cowpea infested with *R. solani*.**

Treatments	Number of nodules /plant *				Average	Increase over control (%)
	Dose (g/kg)					
	2g	5g	10g	15g		
A. flavus	13.1	14.2	16.0	17.1	15.1	151.8
A. niger	17.6	19.3	20.6	21.7	19.8	229.6
T. koningii	22.0	23.3	24.6	26.1	24.0	300.0
T.. pseudokoningii	27.3	29.1	29.9	30.8	29.3	388.0
T. viride	31.7	32.6	33.6	35.1	33.2	453.7
T. harzianum	36.6	37.9	39.7	42.8	39.2	553.7
Bavistin(Treated check) @ 2g/kg	36.8	36.8	36.8	37.0	36.8	513.9
Control (untreated check)	6.0	6.0	6.0	6.0	6.0	-
CD (P=0.05)	Treatment: 0.95		Dose: 1.34		Interaction: 0.47	

* Each value is mean of three replicate. **Pooled data of three year.

Table 3: Effect of bioagents on root nodules of cowpea infested with *F. oxysporum*.**

Treatments	Number of nodules /plant * Dose (g/kg)				Average	Increase over control (%)
	2g	5g	10g	15g		
A. flavus	12.4	13.3	14.4	15.4	13.9	140.7
A. niger	15.9	16.9	17.8	18.8	17.3	200.0
T. koningii	19.7	21.0	22.4	23.4	21.6	274.4
T. pseudokoningii	24.1	25.1	26.2	27.3	25.7	344.5
T. viride	28.2	29.7	31.6	33.2	30.7	430.6
T. harzianum	34.9	37.4	39.2	41.9	38.4	563.7
Bavistin(Treated check)@ 2g/kg	36.3	36.3	36.3	36.3	36.3	528.4
Control (untreated check)	5.8	5.8	5.8	5.8	5.8	-
CD P=0.05) Treatment: 0.98 Dose: 1.39 Interaction : 0.49						

* Each value is mean of three replicate. **Pooled data of three year.

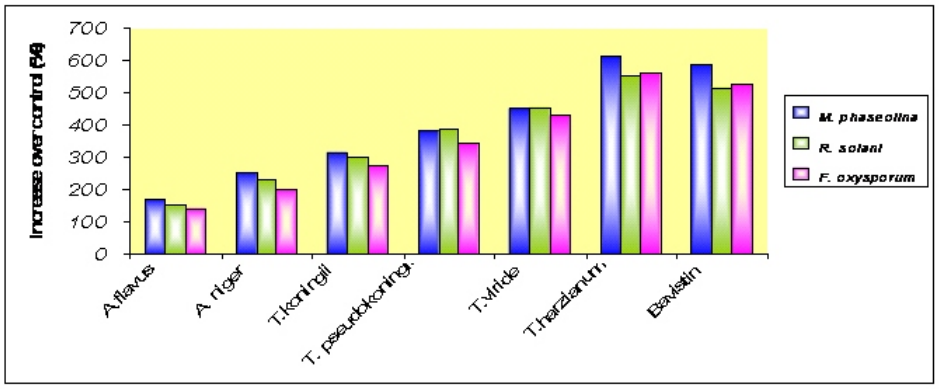

Fig.1: Effect of bioagents on increase in the number of root nodules of cowpea.

effective than other doses for most of the bioagents. However, *A. flavus* and *A. niger* could not give better results even at higher dose *i.e.,* 15 g/kg seed dose whereas, only 2 g/kg seed dose of *T. viride* and *T. harzianum* was sufficient to increase the nodulation in *M. phaseolina* infected cowpea plants. The similar results were also obtained against *R. solani* and *F. oxysporum* infected plants. The antagonists increase the nodulation of cowpea plants by protecting nodules from infestation of rot pathogens, which damage/ disintegrate the nodules. Similar results were also obtained by Mukhopadhyay *et al.* (9), Harman *et al.* (7) and Singh and Sachan (11). *Trichoderma spp.* stimulates growth and flowering of several plant species (Chang *et al.,* 2; Windham *et al.,* 13; Hanson and Howell, 6). *Trichoderma* strains have been developed for promoting activities of non-pathogenic bacteria and mycorrhizal fungi, while others act as plant-growth promoters by increasing plant size, foliar surface area and weight. Recently more important role of *Trichoderma* spp. has been noticed. They induce localized and systemic resistance in susceptible plants. The dual roles of antagonistic activity against plant pathogens and promotion of soil fertility make *Trichoderma* strains appealing alternatives to hazardous fumigants and fungicides. Therefore, it is concluded from the study that *Trichoderma* spp. *(T. harzianum, T. viride, T. pseudokoningii*) was effective in increasing the root nodule of cowpea. Hence, *Trichoderma* spp. can be exploited for the management of root rot disease of cowpea in place of bavistin (Systemic fungicide) without disturbing the ecological balance.

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Citation : Nigam R. and Singh J. (2015). Study on the efficacy of bioagents on nodulation of cowpea (*Vigna uniguiculata* L. Walp). *HortFlora Res. Spectrum*, **4**(3) : 260-263