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# Studies on the efficacy of fungal bioagents on dry shoot weight of cowpea (*Vigna unguiculata* (L.) Walp)

**Rashmi Nigam, Joginder Singh, Rajendra Singh and Pradeep Saxena**

**Abstract**
The efficacy of different doses of biological control agents on dry shoot weight of cowpea (*Vigna unguiculata* (L.) Walp) was studied at Indian Grassland Fodder Research Institute (IGFRI) Jhansi. A maximum increase in the dry weight of shoot was observed due to *Trichoderma harzianum* followed by *Trichoderma viride* at various doses. Both the biological agents acted more effectively at 10 to15 g dose. The study also reveals that the *Trichoderma* species namely *Trichoderma pseudokoningii* and *Trichoderma koningii* did not visualize any significant difference in their efficacies when compared from each other. *Aspergillus flavus* proved to be least effective and showed minimum dry shoot weights. Among the bioagents, *Trichoderma* spp. were superior than *Aspergillus* spp. Bavistin was also effective in increasing the dry shoot weights and was statistically *at par* with *Trichoderma harzianum*.

**Keywords:** Biological control, *Trichoderma harzianum*, *Aspergillus*, shoot weight, cowpea, root rot

## Introduction
Cowpea (*Vigna unguiculata* (L) walp is a warm season annual leguminous fodder crop mainly grown in northern and central India. Cowpea is a heat-loving, drought-tolerant crop with high protein content and lower soil fertility requirements than many other crops (Coetzee, 1995). These properties, and the presence of nodular bacteria specific to cowpea (*Bradyrhizobium* spp.), make it suitable for cultivation in the hot, marginal cropping areas of Southern Africa, as well as in the cooler, higher rainfall areas. Cowpea is susceptible to a wide range of pests and pathogens that attack the crop at all stages of growth (Anilkumar *et al.* 1994; Emechebe and Florini, 1997; Aveling and Adandonon, 2000; Aveling *et al.* 2001). These include insects, bacteria, viruses and fungi. The common diseases of cowpea occurring after its sowing are comprised of complex etiology *viz.* pre-and post-emergence damping-off, seedling rot/blight, wilt, root rot and stem rot. Allen (1957) advocated that these diseases may be resulted due to association of one or more than one pathogenic fungi of soil and of seed borne nature, while many of the root pathogens have been characterized ecologically as root rot inhabitants (Garrett, 1970). The fungi, like *Rhizoctonia solani, Macrophomina* and *Fusarium* sp. are the most widespread and destructive plant pathogens causing root rot/dry root rot in cowpea (Davis *et al.* 1991). These pathogens are restricted to inject the crop either alone or as a complex there by resulting in rots before and after emergence of seedling and wilting of plants (Sumner, 1985; Singh and Gurha, 1996; Bhatnagar and Bansal, 2003; Gokulapalan *et al.* 2006). These disease causes substantial losses to cowpea crops (Shihata and Gad El Hak, 1989; Ushamalini *et al*. 1993; Abdel-Kader and Ashour, 1999; Rauf, 2000). Biological control of plant pathogens through antagonistic microorganisms is a promising alternative to the use of chemicals. The success of biological control of plant pathogens depends mainly on the ability of the introduced micro-organisms to competitively colonize the rhizosphere of the host plant, which is influenced by the availability of nutrient from the substrate or a carrier medium through which Bio-control Agent (BCA) is applied. Keeping this in mind the present the present study was aimed to investigate the effect of different doses of bioagents on fresh shoot weight of cowpea

## Materials and Methods
The present investigations and experiments were carried out for three consecutive crop seasons at the Indian Grassland and Fodder Research Institute, Jhansi. The studies were carried out on cowpea variety IFC-901, the important forage legume which was susceptible to root rot disease.

**Source of culture**

**(a) Causal Pathogens:** Isolation of Pathogens (*Macrophomina phaseolina*, *Rhizoctonia solani* and *Fusarium oxysporum)* done in culture media from diseased plant part collected from field.

**(b) Bioagents:** Antagonistic fungi isolated from rhizosphere of cowpea field which was collected from bundle khand region and further isolation carried out by serial dilution. *Trichoderma* species *viz, T. harzianum, T. koningii, T. pesudokonigii* and *T. viride* were isolated on *Trichoderma* specific media (TSM) from the root zone of cowpea grown at the Indian Grassland and Fodder Research Institute, Jhansi.

**Effect of bioagents on dry shoot weight of cowpea**

Fungal antagonists were further used as seed treatment against cowpea root rot pathogens in pot condition consecutively for three year to determine the plant growth promoting activity in terms of dry weight, of these isolates by seed treatment. 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. These pots were pre inoculated with the test pathogens separately (*Macrophomina phaseolina, Rhizoctonia solani and Fusarium oxysporum)*. Different doses of inoculum *viz.* 2 g, 5 g, 10 g and 15 g were prepared and treated with the seed of cowpea. Treated seed of cowpea (*Vigna unguiculata* L. walp) were sown. The pots were arranged in complete randomized block design and irrigated daily. There were 3 replicates of each treatment including the treated control as well as untreated control. After 50% flowering of the plant, the plants were uprooted and plant growth parameters, such as dry shoot weight were calculated. The plants were dried in an oven at 60 $^0$C to determine the dry weight of shoot. Observations in respect of dry weight of shoot were recorded. The data were analyzed by the standard statistical methods.

**Results and Discussions**

**Effect of bioagents on dry shoot weight of cowpea inoculated with *Macrophomina phaseolina.***

The data presented in Table 1 reveal that the efficacy of all the test bioagents in terms of dry shoot weight of plant significantly varied with the doses. The maximum dry shoot weights were recorded in 15 g/kg seed treatment and minimum in 2 g/kg seed treatment of bioagents. Of all the fungal bioagents, seed treatment with *T. harzianum* offered maximum increase in dry shoot weight (202.2%) followed by *T. viride* (176.4%), *T. pseudokoningii* (148.0%), *T. koningii (122.3%)* and *A. niger* (93.9%), respectively over the untreated control. *A. flavus* was the least effective bioagent and showed minimum increase in dry shoot weight (62.8%). Bavistin @ 2g/kg seed treatment increased dry shoot weight by 194.6 per cent and it was next best treatment after *T. harzianum*.

**Effect of bioagents on dry shoot weight of cowpea inoculated with *Rhizoctonia solani.***

It is evident from the Table 2 that all the promising bioagents exhibited significant effect with respect to increase in dry shoot weight of the plant at different doses. However, increase in dry shoot weight varies from 50.0 to 179.6 per cent over untreated control. *T. harzianum* was found to be statistically at par in its efficacy at all the doses and resulted in 179.6 per cent increased in dry shoot weight. Maximum increase in dry shoot weight by all the treatments was recorded with 15 g/kg seed dose. The remaining bioagents also showed promising results with respect to enhancement in dry shoot weight of cowpea plant infected with *R. solani*. Among the bioagents evaluated, *A. flavus* was least effective as reported in earlier studies.

**Effect of bioagents on dry shoot weight of cowpea inoculated with *Fusarium oxysporum*.**

Average value of three year data (Table 3) clearly indicate about the significant effect of different treatments as well as their doses against *F. oxysporum* infected cowpea plant. Among different bioagents, *T. harzianum* proved to be most effective in increasing the dry shoot weight (166.3%) followed by *T. harzianum* (141.9%), *T. pseudokoningii* (121.3%) *and T. koningii* (98.1%), respectively. Among the *Aspergillus* spp., *A. Niger* was more effective than *A. flavus* and increased the dry shoot weights by 71.3 and 42.5 per cent of *A. flavus* over untreated control. The findings obtained in the present study were in accordance with the finding of the earlier workers (Harman and Kupicek, 1998; Zareen, 2001; Bhatnagar and Bansal, 2003; Evans *et al*. 2003; Harman *et al*. 2004; Patibanda and Sen, 2007).

**Table 1:** Effect of bioagents on dry shoot weight of cowpea inoculated with M. *phaseolina***

| Treatments | Average shoot weight* (gms) DOSES (g/kg) | | | | Average | Increase over control (%) |
|---|---|---|---|---|---|---|
| | 2g | 5g | 10g | 15g | | |
| *A. flavus* | 5.4 | 6.0 | 6.2 | 6.5 | 6.03 | 62.8 |
| *A. niger* | 6.7 | 7.0 | 7.3 | 7.7 | 7.18 | 93.9 |
| *T. koningii* | 7.9 | 8.1 | 8.3 | 8.6 | 8.23 | 122.3 |
| *T. pseudokoningii* | 8.8 | 9.0 | 9.3 | 9.6 | 9.18 | 148.0 |
| *T. viride* | 9.9 | 10.1 | 10.3 | 10.6 | 10.23 | 176.4 |
| *T. harzianum* | 10.8 | 11.1 | 11.3 | 11.5 | 11.18 | 202.0 |
| Bavistin (Treated check) @ 2g/kg | 10.9 | 10.9 | 10.9 | 10.9 | 10.90 | 194.6 |
| Control (untreated check) | 3.7 | 3.7 | 3.7 | 3.7 | 3.70 | - |
| CD 5% Treatment 0.18<br>Doses 0.25<br>Interaction 0.09 | | | | | | |

* Each value is mean of three replicate.

**Table 2:** Effect of bioagents on dry shoot weight of cowpea inoculated with *R. solani***

| Treatments | Average Shoot Weight* (gms) DOSES (g/kg) | | | | Average | Increase over control (%) |
|---|---|---|---|---|---|---|
| | 2g | 5g | 10g | 15g | | |
| *A. flavus* | 5.3 | 5.5 | 5.9 | 6.1 | 5.7 | 50.0 |
| *A. niger* | 6.3 | 6.5 | 6.7 | 6.9 | 6.6 | 73.7 |
| *T. koningii* | 7.1 | 7.4 | 7.6 | 7.9 | 7.5 | 97.4 |
| *T. pseudokoningii* | 8.1 | 8.4 | 8.7 | 9.0 | 8.6 | 125.0 |
| *T. viride* | 9.2 | 9.4 | 9.7 | 9.9 | 9.6 | 151.0 |
| *T. harzianum* | 10.2 | 10.5 | 10.8 | 11.0 | 10.6 | 179.6 |
| Bavistin (Treated check) @ 2g/kg | 10.7 | 10.7 | 10.7 | 10.7 | 10.7 | 181.6 |
| Control (untreated check) | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | - |
| CD 5% Treatment 0.16<br>Doses 0.22<br>Interaction 0.08 | | | | | | |

* Each value is mean of three replicate.

**Table 3:** Effect of bioagents on dry shoot weight of cowpea inoculated with *F. oxysporum***

| Treatments | Average shoot weight* (gms) DOSES(g/kg) | | | | Average | Increase over control (%) |
|---|---|---|---|---|---|---|
| | 2g | 5g | 10g | 15g | | |
| *A. flavus* | 5.4 | 5.6 | 5.8 | 6 | 5.7 | 42.5 |
| *A. niger* | 6.4 | 6.7 | 7.0 | 7.3 | 6.9 | 71.3 |
| *T. koningii* | 7.6 | 7.8 | 8.0 | 8.3 | 7.9 | 98.1 |
| *T. pseudokoningii* | 8.5 | 8.7 | 9.0 | 9.2 | 8.9 | 121.3 |
| *T. viride* | 9.4 | 9.6 | 9.7 | 10.0 | 9.7 | 141.9 |
| *T. harzianum* | 10.2 | 10.5 | 10.8 | 11.1 | 10.7 | 166.3 |
| Bavistin (Treated check) @ 2g/kg | 10.5 | 10.5 | 10.5 | 10.6 | 10.5 | 162.5 |
| Control (untreated check) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | - |
| CD 5% Treatment 0.15<br>Doses 0.22<br>Interaction 0.08 | | | | | | |

* Each value is mean of three replicate.

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