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Comparative Effect of *Rhizobium* and Vesicular Arbuscular Mycorrhiza Inoculation on Cowpea in Mine Waste Soils of Orissa

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ABSTRACT Due to heavy mining activities the yield of cowpea is decreasing drastically at the valleys of Sukinda and Kaliapani, in Orissa. To improve plant growth and yield and mine soil status, biofertilisers like *Rhizobium* and VAM fungi (*Glomus mosseae*) were selected and tested in nursery conditions. Dual inoculation of *Rhizobium* and VAM, showed much better plant growth than single strain inoculation. Dilution of mine soil with sand (25%) further improves growth and nodulation of Cowpea.

INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp) is one of the most important forage crop of Eastern Ghats region of Orissa. Now a days this region is facing serious environmental quality degradation problems due to overexploitation of mineral resources, practised by open caste mining system, resulting decrease in growth and yield of cowpea, through leaching of heavy metal toxic ions. The inoculation of soyabean seed with an efficient *Rhizobium*, has become an important farm practice in different parts of the world. The inoculation of cowpea seed with *Rhizobium* is yet to be established as a definite important practice in mine waste soil. This experiment was undertaken with a view to increase growth and nodulation of cowpea through, dual inoculation of *Rhizobium* and Vesicular Arbuscular Mycorrhizal (VAM) fungi in mine waste soils.

MATERIAL AND METHODS

The experiments were carried out during July to October 1992, in the nursery of Botany Department, Utkal University, Bhubaneswar. The chromite and Iron mine waste soils were collected from Sukinda and Daitary mine areas of Orissa, respectively. Polypots (15.2 x 25.4 cm) were filled up with pure mine waste soils and sand amended (mine soil : sand, 3:1) mine waste soils (3 kg/Polypot) of each mine soil. Seedling were raised from surface sterilised cowpea seeds, germinated in sterile petri dishes over water soaked cotton, that were used for polypot culture being inoculated with *Rhizobium* suspension (10^7 cells/ml.). The *Rhizobium* strain (VU42) isolated from the test plant was used as inoculum. For mycorrhizal inoculation, *Glomus mosseae* (Nicol and Gerd.) inoculum consists of soil (1gm. soil/polypot) along with root chops of *Sorghum* species containing spores of *Glomus mosseae* (20 spores/gm. soil, approx.) added 2 cm below the surface layer. The polypots for each mine soil with pure and sand amended condition were arranged in randomised bock design, consisting of four treatments, such as (i) Control (ii) *Rhizobium* treated (iii) VAM treated, and (iv) VAM and *Rhizobium* dual treated with adequate watering under natural condition. Thining of plants was done, keeping one plant per polypot, after seven days. Sampling of plants was done at the final stage (75 days). The dry weight of plants was taken after keeping the samples in oven at 60° for 48 hours. The nodules were separated from carefully uprooted plants, dried and the dry weight was taken like the plant dry weight.

RESULTS AND DISCUSSION

The results of growth and nodulation of cowpea are represented in table 1. Plant growth

Table 1: Comparative effect of *Rhizobium* and VAM inoculation on growth and nodulation of cowpea in chromite and Iron mine waste soil

Inoculant	*Plant dry weight in gm/plant*				*Nodule dry weight in mg/plant*			
	Chromite mine soil		*Iron mine soil*		*Chromite mine soil*		*Iron mine soil*	
	Pure	*Sand amended*	*Pure*	*Sand amended*	*Pure*	*Sand amended*	*Pure*	*Sand amended*
Control	0.2±0.01	0.3±0.05	0.428±0.01	0.566±0.01	1±0.23	2±0.94	3.33±0.27	5.66±0.27
Rhizobium	0.475±0.007	0.58±0.009	0.771±0.01	1.388±0.17	3±0.47	4±0.47	10.66±0.54	20.66±1.44
VAM	1.2±0.04	2.8±0.047	0.685±0.04	0.91±0.054	15±2.44	28±1.24	10±1.24	15.33±0.72
VAM + *Rhizobium*	3.2±0.12	4.6±0.18	0.9±0.02	1.49±0.06	30±0.94	55±4.92	22±0.94	48±0.94

±SEM

measured in terms of plant dry weight and nodulation in terms of nodule dry weight were found to be very low in pure mine soils, attributed to stress conditions like acidic pH, low nutrient content, along with presence of heavy metal toxic ions in mine soil (Mishra et al., 1990). Addition of sand does not add to the nutrient content of the mine-soil, the increase in growth may be due to decrease in heavy metal toxic impact of mine soil, coupled with the enhancement of soil porosity and aeration (Thatoi et al., 1993). Plant growth and nodulation were seen to increase, with inoculation with *Rhizobium*. The low nodulation capacity in untreated soils (both pure and sand amended) might be due to poor survival of indigenous rhizobia. Interestingly VAM inoculation shows a higher growth response, than *Rhizobium* inoculation in chromite mine soil, but it is lower in iron mine waste soil, indicating the sensitiveness of VAM to stress condition of Iron mine soil. However dual inoculation of VAM and *Rhizobium* shows the best growth and nodulation of cowpea in each of the mine-soil condition, perticularly in sand ammended mine soil conditions. Phosphorous deficiency is an important limiting factor in nitrogen fixation and legume production (Jacobson, 1985). Legumes inoculated with both rhizobia and VAM fungi benefit from 'P' uptake and generally have greater N_2 fixation, nodule mass, N,P content and yield (Rawat et al., 1991) than legumes inoculated only by *Rhizobium* (Barea and Azocon-Aguilar, 1983). The dual inoculation of VAM and *Rhizobium* has been found to be much effective in chromite mine waste soils.

Therefore, we conclude that dual inoculation of *Rhizobium* and VAM fungi has greater potential for improvement of cowpea growth and can be tried for further field inoculation study, with sand amendment to mine waste soils.

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