ROLE OF BIOFERTILIZERS IN AGROFORESTRY WITH SPECIAL REFERENCE TO SOME LEGUMES

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1. INTRODUCATION

In developing country like India, use of chemical fertilizers is economically not feasible in agro forestry. The high price tag of these conventional fertilizers deters its possible use in tree plantation.

Environmental and health hazards associated with chemical fertilizer further make their possible use difficult. On the other hand success in agroforestry requires various inputs leading to proper establishment and growth of tree species. Selection of low demanding and fast growing tree species, fertilization, disease and pest management and proper protection of plants are some vital factors. Agro forest ecosystem after a few years becomes self sustainable because it follows a “feedback regulating system”. The nutrient budget in such ecosystem is polycyclic in nature. Weathering of litter and biological cycle are some important processes of nutrient management. The contribution of nutrient from plant to soil varies from species to species and this is an important factor for selecting species for agro forestry. *Acacia auriculaeformis*, *Acacia nilotiea* and *Leucaena leucocephala* are three legumes suitable for agro forestry because their litter contains more than 2% nitrogen (Puri 1959). These three species were reported to be highly favorable for Jharkhand because they can easily be grown at an elevation of 0 – 500 m receiving rainfall 200 – 1400 mm annually (Mishra 2004). The three species can easily withstand 4-6 months of dry season. It is however equally important to screen some suitable biofertilizers for these species. The present study was therefore aimed to study effect of *Rhizobium* and Mycorrhizal inoculation on growth of these three legumes.

2. MATERIALS AND METHODS :

Collection, isolation, purification and authentication of rhizobium culture were done by methods recommended by Vincent (1970). Multiplication of rhizobial culture was done by “yiest extract manitol” technique developed by Tilak (1990). VAM inoculation was procured by sieving and decanting method proposed by Gerdemann and Nicolson (1963). The mother culture of *Glomus faseiculatum, Glomus mosseal* and *Gigaspora gilmorei* was multiplied on upper layer of sterilized sand, soil and farm manura in 1:2:1 proportion. The most viable and efficient isolates of *Rhizobium* and mycorrhizal culture was applied at the time of sowing of three legumes to be tested, at rate of 2 gms per plant. Charcoal based carrier and root based cultures were used for treatment. Satndard doze of N(40 kg/ha) P(40 kg/ha) and K (30 kg/ha) was uniformly applied to all test plots. One test plot was provided *Rhizobium c*ulture while the other was provided mycorrhizal culture. The third set of experiment was performed with combined inoculation of *Rhizobum* as well as mycorrhizae. One control set, without any artificial applications was maintained for comparison. Five replicates of each treatment were maintained for obtaining average reading. Observations were recorded after six months and shoot length, root length, above ground biomass, below ground biomass, nodules per plant and percentage of mycorrhizae were noted down. Data obtained were statistically analyzed.

3. RESULT AND DISCUSSION:

Impact of *Rhizobium* and VAM inoculation on growth parameters of *Acacia auriculiformis* is given in Table – 1. Maximum root length and shoot length was recorded in combination of *Rhizobium* and VAM inoculation and the value was 35.5 cm and 58.6 cm respectively. The root length and shoot length in *Rhizobium i*noculated test plot was 28.0 cm and 54.6 cm respectively. In VAM inoculated test plot, the two parameters of *Acacia auriculiformis* was 29.5 cm and 55.8 cm respectively. The values in all three inoculation cases were significantly higher as compared to control condition, where root length and shoot length were 24.5 cm. and 52.5 cm respectively. The below ground biomass and above ground biomass in control set was 2.80 gm/plant and 3.52 gms/plant respectively. Significantly higher biomass, both below ground and above ground, in inoculation conditions was recorded. Highest biomass was found in combined inoculation of *Rhizobium* and VAM and the value was 4.46 gm/plant and 4.77 gm/plant. *Rhizobium* inoculation helped increase below ground biomass (3.24 gms/plant) but VAM inoculation was not effective in this respect. Above ground biomass increased in both *Rhizobium* as well as VAM inoculation and the value recorded was 4.35 gms/plant and 4.78 gm/plant respectively. The increase in growth parameters can be attributed to increase in number of nodules per plant and percentage colonization of mycorrhizae observed in inoculation conditions.

Impact of *Rhizobium* and VAM inoculation on *Acacia nilotiea* is recorded in Table – 2. The root length and shoot length in control condition was found to be 18.5 cm and 45.0 cm respectively. The corresponding values in *Rhizobium* inoculation was recorded, 22.5 cm and 52.5 cm respectively and in case of VAM inoculation, 24.3 cm 53.6 cms respectively. Maximum increase in root length and shoot length was recorded in combined inoculation. The root grew 28.0 cm while the shoot grew to 55.0 cm. Below ground biomass in *Rhizobium i*noculation and *Rhizobium* + VAM inoculation were remarkably higher (2.75 gm/plant and 2.85 gm/plant respectively) as compared to control set (2.20 gms/plant). The above ground biomass was higher in VAM and *Rhizobium* + VAM combination (3.80 gms/plant and 3.95 gms/plant respectively) as compared to control (3.15 gms/plant). The increase in growth parameters correspond to number of root nodules per plant and percentage colony of VAM.

Impact on growth parameters of *Leucaena leucocephala* in conditions of *Rhizobium* and VAM inoculation is given in Table – 3. The root length and the shoot length was only 15.5 cm and 35.5 cms in control case which increased to 18.0 cms and 42.5 cm in case of *Rhizobium* inoculation. These values increased to 20.5 cms and 43.5 cms respectively in VAM incculated test plot. In case of *Rhizobium* + VAM inoculation, the root length was 22.0 cms and shoot length was 46.5 cms. The below ground biomass was 1.95 gms per plant which increased to 2.20 gms per plant, 2.00 gms per plant and 2.95 gms per plant in case of *Rhizobium*, VAM and *Rhizobium* + VAM inoculations. The increase directly corresponded to number of root nodules per plant.The above ground biomass was 2.55 gms per plant in control condition. This value increased to 2.80 gms per plant, 3.15 gms per plant and 3.25 gms per plant respectively in cases of *Rizobium*, VAM and *Rhizobium* + VAM inoculations. The positive changes in above ground biomass were in accordance with percentage mycorrhizal colony.

The results clearly indicate that inoculation of *Rhizobium*, VAM and *Rhizobium* + VAM significantly improve growth parameters as well as the biomass. Best effect of these inoculations was observed in *Acacia nilotica*. Increase in other two species was also noteworthy and significant. Almost similar results were reported by Sharma et. al. (1990) in case of Acacia catechu. Mishra (1995) has also reported good performance of *Leucaena leucocephala* after suitable inoculations on mine spoil. Better growth in case of dual inoculation has also been reported in other legumes by Kaushal (1996), Kaushik and kaushik(1995) and Verma et al (1994). This increase can be attributed to better uptake of various nutrients from soil as suggested by Sharma et al (1990). On the basis of present investigations and results obtained use of biofertilizers are highly recommended in agro forestry ecosystem. This is an ecofriendly and cost effective alternative to synthetic fertilizers.

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Table – 1

Impact of *Rhizobium* and VAM inoculation on growth of *A. aurieulacformis*

Treatment	Root Length (cm)	Shoot Length (cm)	Biomass Root g/plant	Biomass shoot I/plant	Nodulation No/plant	Mycorrhizal colonization%
Control	24.5	52.5	2.80	3.52	0.0	4.00
Rhizobium	28.0	54.6	3.24	4.35	49.0	22.4
VAM	29.5	55.8	2.85	4.78	0.0	69.4
Rhizobium+VAM	35.5	58.6	4.46	4.77	76.0	155.0
CD-0.05	1.01	1.98	0.86	0.76	26	36

TABLE - 2

Impact of *Rhizobium* and VAM inoculation on growth of *A. nilotica*

Treatment	Root length (cm)	Shoot length (cm)	Biomass Root(g/plant)	Biomass shoot(g/plant)	Nodule	Myco colony %
Control	18.5	45.0	2.20	3.15	00	2.6
Rhizobium	22.5	52.5	2.75	3.40	38	13.5
VAM	24.3	53.6	2.60	3.80	00	52.8
Rhizobium+VAM	28.0	55.0	2.85	3.95	46	59.5
CD-0.05	1.31	1.52	0.94	0.85	25.0	18.5

TABLE – 3

Impact of *Rhizobium* and VAM inoculation on Growth *L. leucoeophala*

Treatment	Root Length(cm)	Shoot Length (cm)	Biomass Root (g/plant)	Biomass Shoot (g/plant)	Nodule no/plant	Myco colony %
Control	15.5	35.5	1.95	2.55	00	3.6
Rhizobium	18.0	42.5	2.20	2.80	26	12.9
VAM	20.5	43.5	2.00	3.15	00	48.9
Rhizobium+VAM	22.0	46.5	2.95	3.25	40	52.5
CD-0.05	0.95	1.10	0.73	0.83	26.0	15.9