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RESEARCH ARTICLES

EFFECT OF AM FUNGUS, RHIZOBIUM AND ROCK PHOSPHATE APPLICATION ON GROWTH BIOMASS YIELD IN *MIRABILIS JALAPA* LINN

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ABSTRACT

The interaction with AM Fungi, *Rhizobium* and Rock phosphate application has been studied on very good number of plants. Studies were undertaken on *Mirabilis jalapa* Linn. (Four 'O' clock plant) with inoculation of *Rhizophagus fasciculatus* (AM fungus) and *Rhizobium leguminasarum* with four levels of rock phosphate in which 30mg/kg soil with mycorrhiza and rhizobium influenced significantly an increased plant height, root length, biomass yield with nitrogen and phosphorus uptake in both shoot and root. However, the spore number was higher among the only mycorrhiza inoculated plants compared to the control or noninoculated plants. Use of rock phosphate application with bioinoculants to *Mirabilis jalapa* Linn. have been discussed. There was an increase root shoot ratio in controlled plants over the bioinoculated plants with rock phosphate application.

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INTRODUCTION

Soil beneficial microorganisms for the benefit of agriculture/horticulture and forestry ecosystem function is gaining worldwide importance. They are key elements for plant establishment under nutrient imbalance conditions. They can help in improve plant growth, nutrition and competitiveness and plant responses to external stress factors by and array of mechanisms (Mosse *et al*., 1981; Bori *et al*., 2008). In recent days various studies have demonstrated a positive influence of biofertilization on plant growth development and yield (Lovelock and Ewel, 2005; Lakshman, 1999, 2009). Many bacterial strains have been reported to be able to promote arbuscular mycorrhizal (AM) fungal symbiosis. There is much scope for further experimental analysis of the underlying mechanisms of bacteria-AM fungal interactions with plant roots (Lakshman, 2003). The role arbuscular mycorrhizal (AMF) fungi in improving the quality and survival of forest nursery seedlings and their growth after planting has been well recognized (Trappe,1977). Plant roots increase the efficiency of absorption of nutrients and thus enhance the growth of plants and trees (Bagyaraj, 2006). The existence of host preference has been suggested by Singh, 1994). This preferential association between certain plants and fungal species can be evaluated with respect to combined inoculation with two organisms provide the greatest plant growth stimulations and the higher root colonization or maximum sporulation (Michelson and Rosendahl, 1994). Combined inoculation of *Rhizobium* species with additional rock phosphate was found to more superior than uninoculated control plant (Koide and Schreiner, 1992; Tilak, 1993). Keeping in view the importance of nitrogen fixer (*Rhizobium*) arbuscular mycorrhizal (AM) fungi and phosphate, the present study carried out to evaluate the influence of *Rhizobium,* AM fungal and P fertilization and growth and nutrient dynamics of seedlings on *Mirabilis jalapa* Linn.

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MATERIALS AND METHODS

The experiments were carried out in randomized block design with three replication at green house, Department of Botany, Karnatak University, Dharwad- 580003. India. During 2013-2014. Earthern pots measuring 20cm × 25cm (breath x height) with 4 kg of garden soil and sand in (3:1) ratio was sterilized in 5% methyl bromide for one hour and stored at room temperature for one week. A promising indigenous AM fungal strain *Rhizophagus fasciculatus* was maintained in a host plant *Panicum maxium* L. in pot culture was used as inoculum. 15gm of inoculum containing spores 20/25 gm soil and highly infected root bits + hyphae + propagules (mixed inoculum). This inoculum was placed 2cm below the soils of experimental pots was used. Jagary based *Rhizobium legumnosarum* culture was obtained from University of Agricultural Sciences, Dharwad-580005, India. *Rhizobium* inoculum was uniformly pasted on each *Mirabilis* seed to obtain 10^8 cells/mg of final product having 30% moisture content before sowing. For control treatment the sieved soil suspension was added to maintain the rhizosphere of soil without inoculum. Pots were watered on alternate day. 15ml of Hoagland (-p) solution was added once in a week. Tricalcium phosphate crystals 5mg/kg soil, 10mg/kg soil, 15mg/kg soil and 30mg/kg soil was dissolved in distilled water and poured to the rhizosphere zone of each experimental pots. Plants were harvested after every 60 days and 120 days. Dry weight of shoots and roots was weighted after drying at 70°C for 24 hrs.

Total P content of shoots of the plants were determined following the method of (Jackson, 1973). N content of plants and root nodules were analyzed following the procedure of (Bermner, 1960). The percentage of mycorrhizal colonization was calculated after clearing the roots in 10% KOH and stained with 0.05% trypan blue lactophenol (Phillips and Hayman, 1970). A spore count in 50gm soil was determined by wet-sieving and decanting technique of Gerdeman and Nicolson, 1963. *Mirabilis jalapa* L. (four O clock plant), a perennial herbaceous bushy plant, distributed throughout India. Its leaves are used to resolved boils, buboes and abscesses. Leaf juice is a useful as healing agent for wounds. The root is a furgative, it is given in dropsy roots fried in butter and used as a tonic. A poaltice of the roots is applied over carbuncles, contusions and wounds. No research work was done by using biofertilizer on this plant. Therefore, the present study evaluate the efficacy of AM fungus, *Rhizobium* for the improvement of plant growth biomass yield and P content in shoots of *M. jalapa* has been carried out.

RESULTS AND DISCUSSION

Conducted in earthern pots, which were filled with sandyloam had low phosphorus (33.87/kg). The data regarding the growth characters of seedling represented in (Table 2). The rock phosphate application with *Rhizobium* had significantly influenced on seedling height, root length, dry weight of shoot and roots, dry weight, percent root colonization and spore population in compare to control non inoculated plants. There was increased phosphorus in shoots (30 mg/kg soil). *Rhizobium* similar results were reported by (Cruz *et al*., 1988; Koide and Schreiner, 1992; Lakshman, 1996 and 2005). The number of leaves increased with an increased P level uptake (30 mg/kg soil) with *Rhizobium* inoculation. However, further increase in the levels of P had no effect even in the presence of *Rhizobium*. This may be due to the reason that when P is freely available in the soil. At the same time higher concentration may act as inhibitor for the symbiotic association (Allen, 1992; Smith and Read, 1997; Druege *et al.,* 2006). These results revealed that mycorrhiza (*R. fasciculatus*) inoculation alone influence on in the increase of mycorrhizal colonization in the roots and spore number in the rhizosphere soils. The lower

Table 1. Physico-chemical analysis of garden soil used for pot experiments

Parameters	Test value	Inference	Method employed
Texture	Sandy loam	Silt dominated solid	International pipette method (Jackson, 1973)
pH	6.8	Acidic	1:2:5 water suspension
Organic carbon (%)	0.47	Low/Medium	Walkley and Black Method, 1934
Available N (kg ha^{-1})	242.91	Low/Medium	Microkjeldhal procedure (Brener, 1960)
Available P (kg ha^{-1})	33.87	Low	Olsen *et al.* (1954)

• Each value is the mean of 12 sample.

Table 2. Effect of AMF *(R. fasciculatus)* *Rhizobium* and phosphorus level and growth character of *Mirabilis jalapa* Linn. seedlings for 120 days

Treatment	Plant height (cm)	Dry wt. of shoot (g)	Root length (cm)	Dry weight of root (g)	Root/shoot ratio (g/plant)
NM/NR	6.38	1.92	4.51	0.34	0.83
M	11.2	2.93	7.31	0.44	0.58
Rh	9.4	2.07	7.11	0.37	0.42
M+R+P 5g mg	14.3	3.88	10.25	1.76	0.44
M+R+P 10g mg	13.5	3.24	9.19	1.56	0.36
M+R+P 15g mg	19.54	5.36	11.63	1.76	0.39
M+R+P 30g mg	27.63	8.42	15.32	1.93	0.34

Table 3. Effect of AM fungus *R. fasciculatus Rhizobium* and phosphorus levels as nutrient content in shoots *Mirabilis jalapa* Linn. seedlings for 120 days

Treatment	N mg/plant in roots	per cent VMF colonization	Spore number/ 50g soil	P mg/plant
NM/NR	2.14	-	-	22.1
M	7.89	47.3	207	41.4
Rh	3.17	34.5	129	28.2
M+R+P 5g mg	5.78	46.1	159	53.5
M+R+P 10g mg	5.61	45.5	157	50.1
M+R+P 15g mg	5.91	44.2	163	56.4
M+R+P 30g mg	9.13	49.7	169	58.2

level of rock phosphate, *Rhizobium* with mycorrhizal inoculation does not influence on *Mirabilis jalapa* biomass production. Varying levels of phosphate application with *Rhizobium* plants showed different growth and yield parameters. The nutrient content increased significantly in rock phosphate amended with mycorrhizal and *Rhizobium* inoculated plants as compared to control set (Table 3). Similarly, nitrogen P uptake increased in AMF+ *Rhizobium* + rock phosphate treatments.

Therefore, these studies indicated that mycorrhizal inoculation helps in the effective utilization of rock phosphate by changing in to available form which later is taken up by the plants for better growth and development. Lower levels of phosphate were observed to be par or sometimes better than the higher levels in producing vigorous growth and yield of inoculated plants (Michelsen and Resendahl, 1990; Maya and Lakshman, 2009; Hosmani *et al*., 2011). Nitrogen uptake and phosphorus uptake in shoots increased with increase in rock phosphate plus *Rhizobium*. This may be because of the slowly dissolved available phosphorus in the soil and phosphorus being the essential element for establishment of healthy symbiosis between *Rhizobium* and *R. fasciculatus* (Lakshman, 1999). It is also thought that the plant *Rhizobium* system benefits from the presence of AM fungi because the mycorrhizae ameliorate not only P deficiency but also other nutrient deficiencies that might be limiting to *Rhizobium* (Lakshman, 2009; Chaitra and Lakshman, 2016; Kurandawad *et al*., 2014; Lakshman, 2015). In conclusion this study clearly showed that the effect of AM fungi, *Rhizobium* with rock phosphate application can boost the biomass yield and plant growth of *Mirabilis jalapa* L. at green house experiments.

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