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Effect of microbial inoculants (VAM and PSB) on soil physico-chemical properties

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ABSTRACT

The aim of this study is to determine the effects of microbial inoculants, (microbial fertilizers) on soil physico-chemical properties Supplementation of biofertilizers such as Vesicle Arbuscular Mycorrhizal (VAM). Fungi, and phosphate solubilizing bacteria (PSB). Supplementation of bioinoculents to soil improved the physical properties such as colour, and chemical characteristics, organic carbon, nitrogen, phosphorous, potassium, and lowered the electrical conductivity (EC).. With increasing the soil incubation time also these parameters are improved in soil treated with microbial inoculants than control. Improved physical and chemical parameters in test soil in this study is an indication of improvement of soil fertility due improved microbial and their biochemical and metabolic activities

KEYWORDS

Microbial inoculants;
VAM;
PSB;
Physico-chemical properties of soil.

INTRODUCTION

The rhizosphere is a heterogeneous, continuous and natural habitat in which different types of interactions occur between soil microbes and plants. The beneficial plant microbe interaction in the rhizosphere is the primary determinants of plant health and soil fertility. Concentrated efforts are being made worldwide to develop nutrient use-efficient crop cultivars responsive to bio-fertilizers to increase crop yield and also to maintain soil good health. The current emphasis is on sustainable agriculture, which uses less of chemical inputs like fertilizers and pesticides having adverse effect on soil health, fertility and environment. Thus, use of microbial inoculants play an important role in sustainable agriculture. Arbuscular Mycorrhizal (AM) fungi are found in most of the soils around the world, and they form association with 80% of all terrestrial plant roots[1]. The VAM fungi improve plant growth through mineralization of nutrients. Nutrient absorption is due to external hyphae of the fungus proliferating beyond the nutrient depletion zone and reaching the source of nutrients. Mycorrhizal fungi appear to be extremely advantageous to crops grown in soils with low fertility. The improved plant growth is also attributed to the production of growth promoting substances, tolerance to drought, salinity and transplantation shock, resistance to soil-borne plant pathogens and synergetic interactions

with other beneficial rhizosphere microorganisms[2].

There are several microorganisms which can solubilize the unavailable phosphorous. The bacteria species, *Bacillus megatherium*, *Bacillus polymyxa* and *Pseudomonas straita* are an important phosphate solubilizing microorganisms and this group of bacterial strains are called as "plant growth promoting rhizobacteria" or PGPR. They solubilize the bound phosphorous through secretion of organic acids and phosphatase enzyme to make it available to the plant, resulting in the improved plant growth and yield. They may also release soluble inorganic phosphate into soil through decomposition of phosphate rich organic compounds[3]. Inoculation of plants with microbial symbionts, mycorrhizal fungi and bacteria, helps plant establishment and improvement of physico-chemical and biological properties of the soil. In view of the importance of microbial inoculants, the present work was carried out to investigate the influence of microbial inoculants (bioferilizers), VAM and PSB on soil physical and chemical properties.

MATERIALS AND METHODS

The soil samples were collected from area of S.V. University Botanical Garden, Tirupati, These soil samples treated with individual VAM and PSB and combination with PSB+VAM in separate pots the control was contained without treatment of bioinoculents. The soil in the pots were incubated and at different time intervals 30,60 and 90 days intervals. The soil soil sample was taken in each intervals and air dried under shade and grounded with wooden pestle to break the clumps, and the samples are passed through 2 mm sieve. The physico-chemical properties of both control and test soil were analyzed at different time intervals by standard protocol procedure[4].

RESULTS AND DISCUSSION

The physical and chemical properties of soil treated both VAM, PSB control samples were analyzed by standard protocols and the results listed in TABLE 1. In microbial inoculated soil the physical parameters were improved with increasing the soil incubation period than without treatment. For instance the soil pH and color altered in test soil than control. The pH of microbial inoculated soil was 7.22 where as in control 6.8, Slight increase in pH in test soil may be microbial action or releasing enzymes and secondary metabolites to the soil.

Higher organic carbon content was observed in microbial inoculated soil than control, Similarly soil treated with microbial inoculants improved the soil organic carbon content[5,6]. In this study organic content test improved from 0.59-0.83 percentage. The soil in control pots was light brown in colour and in treatments the colour was intensity increased. Higher organic content in test soil gives darken and higher water holding capacity[7]. Extra radical hyphae, fungal spore and bacterial population in treated plants attributes to the

TABLE : Physico- properties of the soil treated with/without VAM and PSB

Treatments	pH			Organic carbon (%)			Electrical conductivity (µ mho.cm-1)		
	Days after treatment								
	30	60	90	30	60	90	30	60	90
$T_{1(Control)}$	6.80	6.83	6.90	0.59	0.63	0.69	0.05	0.07	0.09
	(0.00)	(0.00)	(0.06)	(0.01)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)
$T_{2(VAM)}$	7.00	7.15	7.22	0.65	0.70	0.78	0.04	0.05	0.07
	(0.00)	(0.06)	(0.06)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
$T_{3(PSB)}$	7.00	7.10	7.20	0.59	0.63	0.74	0.04	0.04	0.04
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
$T_{4(VAM+PSB)}$	7.10	7.15	7.22	0.67	0.75	0.83	0.04	0.06	0.09
	(0.00)	(0.06)	(0.06)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
LSD	0.00	0.08	0.09	0.01	0.02	0.01	0.00	0.00	0.00
SE	0.03	0.03	0.06	0.01	0.02	0.02	0.00	0.00	0.00

Values within the brackets indicate standard deviation; Each value represents mean of six replications.

FULL PAPER

increased organic carbon content in soil. There was a slight decrease in the electrical conductivity of test soil than control. This might be due to the direct uptake, translocation and transfer of ions by mycorrhizal hyphae to the host plant[8]. The lowered electrical conductivity of mycorrhizal soil demonstrates that VAM fungi have a profound effect on the ionic balance[8,9].

The Nitrogen, phosphorous, potassium content of test and control soils were analyzed and results shown in figures 1,2,3. With increasing the soil incubation periods, the total nitrogen content was increased which ranges from 166.00 to 230.33Kg/ha. Similar studies were reported earlier[10-12]. Similarly, the soil type, form of nitrogen and total nitrogen content in to the host influence the nitrogen content in soil[13]. The mycorrhizal fungi may contribute to an increased nitrogen status in the mycorrhizosphere by decomposing organic nitrogen compounds. This activity might be accelerated in presence of phosphate solubilizing bacteria which could be the reason for more soil N content in dual inoculated plants.

The influence of microbial cultures on soil phosphorous content studied and results shown in Figure 2. Highest amount of Phosphorus content was observed in dual culture (VAM,PSB) inoculated soil (52.67Kg/ha) than either VAM (42.0Kg/ha) or PSB(40.67Kg/ha) alone than control (26.0Kg/ha) (Figure 2). With increasing the soil incubation period the soil phosphorous content also slightly increased in inoculated soils(Figure 2) The Increased phosphorus content id due to P_2O_5 availability and increased phosphatase activity in the soil. The decomposition of phosphate rich organic compounds release soluble inorganic P into the soil[11,12,14].

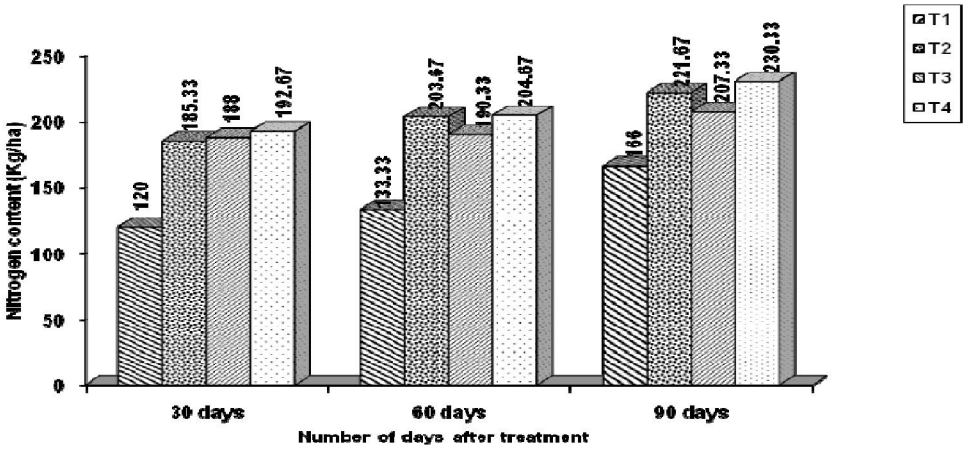

Figure 1: Effect of VAM fungi and PSB on nitrogen content of soil

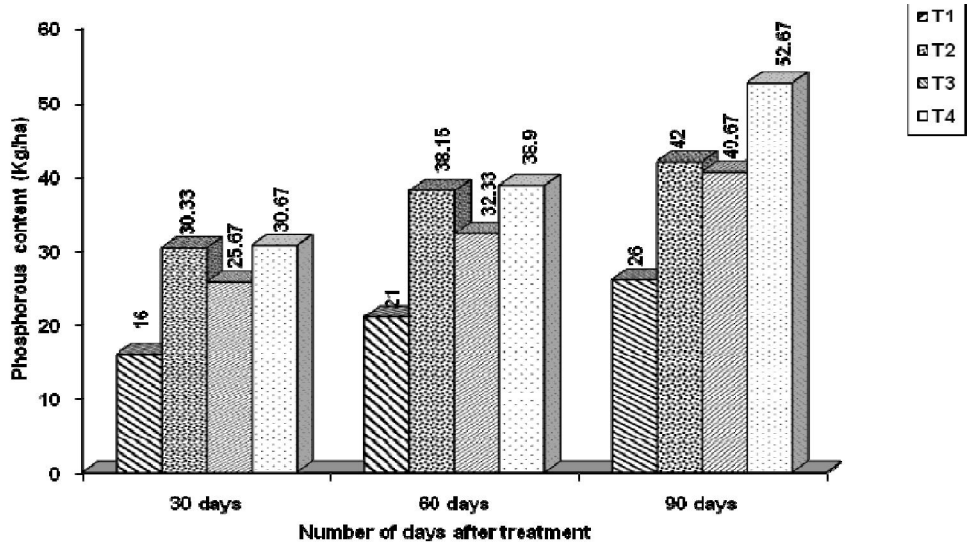

Figure 2 : Effect of VAM fungi and PSB on phosphorous content of soil

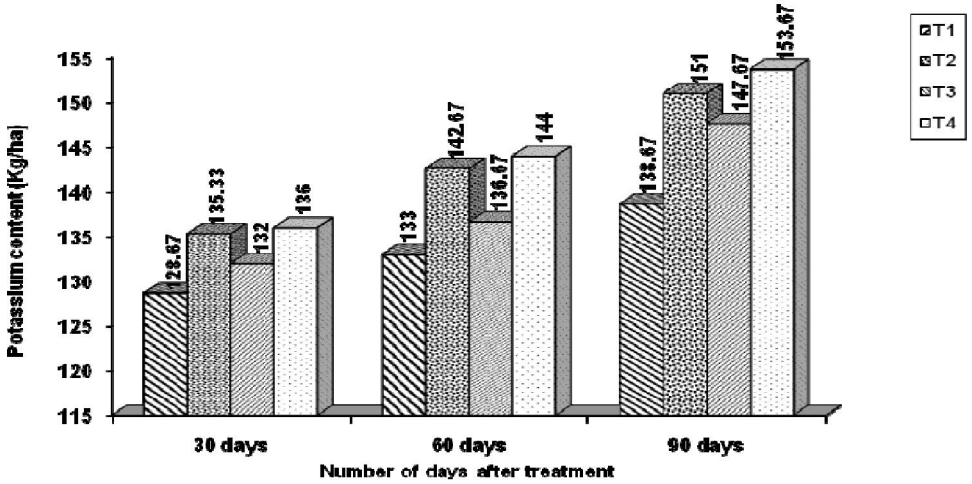

Figure 3 : Effect of VAM fungi and PSB on potassium content of soil

In the present study the potassium content of the soil was significantly increased in all the treatments when compared to control (Figure 3). With increasing the soil incubation period the potassium content also slightly improved. For instance the potassium content on 30th day interval was 128.67 in control and 135.33, 132, 136 Kg/ha in VAM, PSB, VAM+PSB test soil. Where as in 90th day it increased upto a range of 138.67 in control and 151, 147.67, 153.67 Kg/ha in test soil. The response to K^+ uptake by crops depends to an appreciable extent on the level of N nutrition. Generally, the better the crop is supplied with N, the higher the yield increase due to K^+ The release of organic acids and enzymes by the VAM and PSB might have accelerated the weathering process to release nutrients in soil[11,12,15] reported an increase in K content in the rhizosphere soil of mycorrhizal treated.

CONCLUSIONS

The present study clearly indicates that supplementation of microbial cultures both individual and combination with Vesicle Arbuscular Mycorrhizal (VAM). Fungi, and phosphate solubilising bacteria (PSB). Improved the physicochemical properties like, pH, organic carbon, phosphorous and potassium contents in soil.. With increasing the soil incubation period of soil treated with/without microbial cultures the chemical properties also enhanced. Improved physicochemical properties, major nutrients, microbial population, and their enzymes are the sensitive indicators for soil fertility and plant growth.

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