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Response of Phosphobacterial and Mycorrhizal Inoculation in Wheat

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Abstract: A pot study was conducted to assess the significance of phosphobacterial and mycorrhizal inoculation in wheat. The results showed that phosphobacterial counts before sowing and after harvesting of wheat were significantly improved as compared to their respective control treatments. Highest phosphobacterial estimates of 86.25 x 10^8 g^{-1} soil recorded in P fertilizer treatment were statistically identical to 80.25 x 10^8 g^{-1} soil obtained with phosphobacterial inoculation. Moreover, yield and yield attributes in wheat were also affected significantly by phosphobacterial inoculation. The grain yield of 15.20 g/pot recorded with 100 kg ha^{-1} of applied P was statistically similar to 13.97 g /pot obtained from phosphobacterial treatment.

Key words: Phosphobacteria, mycorrhiza, phosphorus, *Triticum aestivum* L.

Introduction

Phosphate solubilizing microorganisms and mycorrhizal fungi plays a key role in the plant metabolism and crop productivity. They have been reported to increase the availability and uptake of native soil P in different crops by converting insoluble phosphates in the soil to soluble forms by producing various organic acids (Guar and Ostwal, 1972; Banik and Dey, 1982; Subba Rao, 1982; Kucey, 1987; Raced, 1994). Moreover, substantial increase in crop growth and yield by phosphobacterial and mycorrhizal inoculation has also been reported by Guar *et al.* (1980), Menge and Johnson (1987) and Young *et al.* (1988). However, the presence of phosphobacteria in sufficient quantities is always necessary in the soil for higher inoculation affectivity on the crop plants (Subba Rao, 1982).

Owing to limited informations available on the subject, therefore, a pot study was conducted to evaluate the impact of phosphobacterial and mycorrhizal inoculation with respect to yield and yield contributing attributes in wheat.

Materials and Methods

Studies were conducted during Rabi season 1999-2000 under green house conditions at Nuclear Institute of Agriculture, Tandojam. Soil used for the purpose was silty clay in texture, low in organic matter (0.89%), Kjeldahl N (0.043%) and Olsen's P (8.1 mg kg^{-1}). Inoculum of phosphate solubilizing bacteria was prepared by using tricalcium phosphate media as modified by Subba Rao (1982). Mycorrhizal species were extracted by wet sieving and decanting method as described by Gerdemann and Nicolson (1963). The experimental treatments comprising of control (P_0), 100 kg P ha^{-1}, phosphobacteria, mycorrhiza and phosphobacteria + mycorrhiza were arranged according to Complete Randomized Design (CRD) having four replications. Each pot containing 5 kg soil was sown to seven wheat seeds. The seeds sown to phosphobacterial and mycorrhizal treatments were treated with their respective inoculum at the bacterial concentration of 5x 10^8 ml^{-1} solution. After germination, 50 ml suspension each of phosphobacteria and mycorrhiza was also imposed in addition to seed treatment for maintaining and regularizing the availability of soil P for plant growth. Soil samples obtained from each pot before sowing, but seven days after inoculation and after harvesting of wheat were assessed for phosphobacterial population using standard method.

The data recorded at maturity on yield and yield attributes were subjected to statistical analysis according to methods described by Steel and Torrie (1986). The differences among treatments means were compared by employing Duncan's multiple range test (Duncan, 1970).

Results and Discussion

Quantitative estimates: The microbiological analysis of the soil samples showed that before sowing of wheat, but seven days after inoculation, phosphobacterial estimates varied from 51.75 x 10^8 to 63.25 x 10^8 g^{-1} soil against microbial counts of 48.75 x 10^8 g^{-1} soil recorded in the control treatment (Table 1). However, phosphobacterial population in P fertilizer treatment was significantly highest showing counts of 74.75 x 10^8 g^{-1} soil. After harvesting of wheat, microbial counts of 80.25 x 10^8 g^{-1} soil recorded in phosphobacterial treatment were statistically identical to 86.25 x 10^8 g^{-1} soil obtained from the treatment receiving 100 kg ha^{-1} of fertilizer phosphorus. Significant variations however, were observed between phosphobacterial + mycorrhizal treatment and single mycorrhizal inoculation by producing bacterial counts of 74.0 and 65.75 x 10^8 g^{-1} soil, respectively. Higher number of phosphobacteria recorded after harvesting of wheat may be ascribed to synergistic interactions between native rhizobacterial activities and the added phosphobacterial plus mycorrhizal species. The results are in close conformity with those reported by Barea *et al.* (1975) and Reid (1990).

Yield and yield parameters: The performance of phosphobacterial and mycorrhizal inoculation with regard to yield and yield attributes in wheat has been depicted in Table 2. The results showed that plant height of 59.20 cm produced by 100 kg ha^{-1} of fertilizer P was highest and significantly different from phosphobacteria (53.40 cm), mycorrhiza (52.80 cm) and phosphobacteria + mycorrhiza (51.90 cm). Lowest plant height of 50.90 cm however, was recorded in the control (P_0) treatment. The data further revealed that number of spikelets per spike recorded were 15.8 with 100 kg P, 14.2 with phosphobacteria, 14.1 with mycorrhiza and 14.0 with phosphobacterial + mycorrhizal treatment. With the exception of pots receiving 100 kg P ha^{-1}, the differences among rest of the treatments for number of spikelets/spike were statistically non-significant. It was also observed that by producing 46.2 number of grains per spike, phosphobacterial inoculation was statistically parallel to treatments receiving 100 kg P ha^{-1} (46.9 grains), mycorrhiza (45.7 grains) and phosphobacteria + mycorrhiza (45.4 grains), but significantly higher than control treatment (30.1 grains). Moreover, grain yield of 15.2 g/pot recorded with 100 kg ha^{-1} of fertilizer P was statistically identical to 13.97 g yielded by phosphobacterial treatment, but significantly higher than 12.34 g and 12.42 g obtained from mycorrhizal treatment and phosphobacterial + mycorrhizal inoculation, respectively. Significantly lowest yield of

Table 1: Phosphobacterial estimates before sowing and after harvesting of wheat.

	Phosphobacterial population (1 x 10^8 g^{-1} soil)	
Treatments	7 days after inoculation	After harvesting
Control (P_o)	48.75d	58.25d
100 kg P ha^{-1}	74.75a	86.25a
Phosphobacteria	63.25b	80.25ab
Mycorrhiza	51.75c	65.75c
Phosphobacteria + Mycorrhiza	61.75b	74.0b

Means followed by similar letters do not differ significantly from each other at 5% level of probability.

Table 2: Effect of phosphobacterial and mycorrhizal inoculation in wheat

Treatments	Plant height (cm)	Spikelets /spike	Grains /spike	Yield/pot (g)
Control (P_0)	50.90b	13.00b	30.10b	9.09c
100 kg P ha^{-1}	59.20a	15.80a	46.90a	15.20a
Phosphobacteria	53.40b	14.20b	46.20a	13.97ab
Mycorrhiza	52.80b	14.10b	45.70a	12.34b
Phosphobacteria + Mycorrhiza	51.90b	14.00b	45.40a	12.42b

Means followed by similar letters do not differ significantly from each other at 5% level of probability.

9.09 g pot^{-1} however, was recorded in the control treatment (P_0). These findings have also been substantiated by many researchers, while investigating the inoculation effects of different species of phosphate solubilizing bacteria and vesicular-arbuscular fungus on variety of crop plants. Rovira (1963) recorded significant positive effect with the inoculation of *Bacillus* species on the yield and various yield parameters in wheat. Wanish (1990) reported that the combined inoculation of *Azospirillum* species and vesicular-arbuscular mycorrhiza showed better plant growth and nutrient uptake than control and single inoculation in pearl millet and summer wheat. Sharif (1999) conducted pot experiment to study the interactions among phosphate solubilizing bacteria, VAM fungus and associative N_2-fixing bacteria with respect to growth and nutrient uptake in pearl millet. He reported that the plants fertilized with hardly soluble rock phosphate and inoculated with *Bacillus megaterium* var. *phosphaticum* produced significantly higher shoot dry weight as compared to plants treated only with soluble monocalcium phosphate in sterilized soil. Significant yield response of wheat to phosphobacterial and mycorrhizal inoculations warranted extensive research efforts under field conditions with a view to exploit their potential in fullest for mobilizing soil and added fertilizer phosphorus.

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