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Effect of PGPR on Microbial Population of Maize Rhizosphere at Different Growth Stages

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ABSTRACT

The present study was conducted to know the rhizosphere microorganisms of maize as influenced by PGPR (Plant Growth Promoting Rhizomicroorgnisms) with different levels of inorganic fertilizers. Significantly the higher bacterial population at 30 (46.00×10^6 cfu/g soil), 60 (87.47×10^6 cfu/g soil), 90 (67.23×10^6 cfu/g soil) days after sowing and at harvest (57.53×10^6 cfu/g soil) stage was noticed in the treatment (T_{11}) involving application of 100 % NPK + A. chroococcum + A. awamori + P. fluorescens. Whereas the higher the higher fungi and actinomycetes population at 30 (52.03×10^4 and 10.67×10^3 cfu/g soil), 60 (67.03×10^4 and 14.83×10^3 cfu/g soil), 90 (58.67×10^4 and 28.17×10^3 cfu/g soil) days after sowing and at harvest (33.90×10^4 and 27.67×10^3 cfu/g soil) stage was noticed in the treatment involving 100 % NPK + A. chroococcum + A. awamori + G. fasciculatum.

Keywords: *A. chroococcum, A. awamori, P. fluorescens and G. fasciculatum.*

INTRODUCTION

Maize (Zea mays L.), belongs to the family Poaceae (Gramineae). Besides being an important food grain for human consumption, maize has also become a major component of livestock and poultry feed. PGPR are important in managing plant growth because of their effects on soil condition, nutrient availability, disease suppression, growth and yields (Mohammad Yazdani et al., 2009). Plant Growth Promoting Rhizobacteria (PGPR) actively colonize plant roots and increase plant growth and yield by the ability to producing phytohormons, through asymbiotic N_2 fixation, protecting plants from phytopathogenic microorganisms by production of siderophores, antibiotics, enzymes and fungicidal compounds and also help in solubilization of mineral phosphates and other nutrients (Gholami, et al., 2009). The availability of required micronutrients (viz., Zn, Fe, and Mo) can be increased by proliferation and establishment of PGPR microorganisms along with their metabolic activity in the rhizosphere soil and their utility in the early stage of plant growth.

MATERIALS AND METHODS

The study was conducted at Agricultural Research Station, Bhavikere Farm, Bhavikere, University of Agricultural Sciences, Bangalore during *Kharif* 2010.

The laboratory studies were conducted in the Department of Agricultural Microbiology, UAS, GKVK, Bangalore. The experimental site is situated between 130 42' North latitude and 750 51' East longitude and an altitude of 695 meters above mean sea level. It lies in the Southern Transitional Zone (Zone VII) of Karnataka. The soil of the experimental site was red sandy loam. The soil was neutral in reaction, medium in available nitrogen, phosphorus and potassium. The experiment was laid out in randomized complete block design (RCBD) with 12 treatment combinations and 3 replications. The cultures of PGPR microorganisms obtained from the Department of Agriculture Microbiology, UAS, GKVK, Bangalore.

Enumeration of rhizosphere microorganisms

The population of rhizosphere microorganisms in soil was determined by serial dilution plate count method. Rhizosphere soil samples were collected treatment wise at different intervals. Ten grams of soil (treatment wise) weighed and mixed in 90 ml sterilized water blank to give 10^1 dilutions. Subsequent dilutions up to 10^6 were made by transferring serially 1 ml of each dilution to 9 ml sterilized water blanks. The population of bacteria, fungi and actinomycetes were determined in respective medium. Plates were incubated at $30 \pm 10\ ^0C$ for a week and the colonies which emerged were counted.

RESULT AND DISCUSSION

Significantly, highest number of bacterial population in the rhizopshere soil at different days intervals *viz.,* 30, 60, 90 and at harvest (46.00, 87.47, 67.23 and 57.53 X 10^6 cfu / g of soil respectively) was recorded in the treatment (T_{11}) having 100 % NPK + *A. chroococcum* + *A. awamori* + *P. fluorescens*.

This might be due to the establishment and increased mass multiplication of inoculated bacteria and also their synergistic interaction with soil bacteria, similar results of increased bacterial population in the inoculated treatments have been reported by Muhammad et al. (2007). Ninety days after sowing the bacterial population gradually decreased in most of the treatments under study, this might be due to the decrease in the quantity and quality of root exudates by the ageing of plants. The present results are in accordance with the results obtained by Baig et al. (2002).

An increase fungal population (52.03 x 10^4 cfu /gm soil) at 30 DAS was recorded in the treatment which received *A. chroococcum* + *A. awamori* + *Glomus fasciculatum* with 100 per cent RDF. At 60, 90 and 120 DAS also the same treatments showed the higher fungal population (67.03, 58.67 and 33.9 x 10^4 cfu /gm soil respectively) compared to control. This might be due to the multiplication and establishment of inoculated fungus along with soil fungi due to the availability of organic matter root exudates and other nutrients. Ninety DAS and at harvest a gradual decrease in the fungal population in most of the treatments under study was observed. This might be due to the decrease in the soil organic matter, root exudates and various other soil nutrients. Similar results are obtained by Baig et al. (2002).

At 30 DAS, treatment having *A. chroococcum* + *A. awamori* + *Glomus fasciculatum* + 100 per cent RDF (T12) showed maximum actinomycetes population (10.67 x 10^3 cfu /gm soil). At 60, 90 and 120 DAS also the same treatment showed the higher actinomycetes population (14.83, 28.17 and 27.67 x 10^3 cfu /gm soil respectively) compared to uninoculated control. The increase in the population at different growth stages might be due to the bacterial interaction, availability of organic matter, root exudates and other nutrients. Similar result was obtained by the Muhammad et al. (2007).

Table 1: Effect of inoculation of PGPR microorganisms with different levels of inorganic fertilizers on population density of bacteria (CFU X 10^6/g soil) in maize rhizosphere at different growth stages under field condition

Treatments	Population of bacteria (CFU X 10^6 /g soil)			
	30 DAS	60 DAS	90 DAS	120DAS (harvest)
T_1-100%RDF	34.17	59.60	54.47	39.00
T_2-75%RDF	33.00	57.20	52.17	37.23
T_3 -Recommended NPK+ *Azotobacter chroococcum*	43.03	79.10	62.43	52.00
T_4 -Recommended NPK+ *Aspergillus awamori*	35.7	59.27	55.23	44.60
T_5 - Recommended NPK + *Pseudomonas fluorescens*	42.47	78.40	61.73	51.33
T_6 - Recommended NPK+ *Glomus fasciculatum*	34.70	57.33	55.40	46.67
T_7 - 75% NP + 100% K + *A.chroococcum* + *A.awamori*	40.93	79.93	61.67	51.67
T_8 - 75% NP + 100% K + *A.chroococcum* + *A.awamori* + *P.fluorescens*	44.10	84.70	65.00	57.33
T_9 - 75% NP + 100% K + *A.chroococcum* + *A.awamori* + *G.fasciculatum*	41.67	78.97	62.30	52.57
T_{10} -100% NPK + *A.chroococcum* + *A.awamori*	41.07	80.27	61.00	53.53
T_{11} -100% NPK + *A.chroococcum* + *A.awamori* + *P.fluorescens*	46.00	87.47	67.23	57.53
T_{12}-100% NPK + *A.chroococcum* + *A.awamori* + *G.fasciculatum*	40.33	80.33	62.00	53.63
SEm $\pm$	0.99	1.34	1.35	1.14
C.D at 5 %	2.93	3.99	4.00	3.39

Table 2: Effect of inoculation of PGPR microorganisms with different levels of inorganic fertilizers on population density of fungi in maize rhizosphere at different growth stages under field condition

Treatments	Population of fungi (CFU X 10^4 /g soil)			
	30 DAS	60 DAS	90 DAS	120 DAS (harvest)
T_1-100%RDF	26.47	41.60	32.63	22.37
T_2-75%RDF	24.97	39.97	29.97	21.03
T_3 -Recommended NPK+ *Azotobacter chroococcum*	30.50	45.50	37.30	23.50
T_4 -Recommended NPK+ *Aspergillus awamori*	48.60	53.60	51.27	32.73
T_5 - Recommended NPK + *Pseudomonas fluorescens*	29.03	44.03	33.70	23.17
T_6 - Recommended NPK+ *Glomus fasciculatum*	29.20	43.87	34.20	22.47
T_7 - 75% NP + 100% K + *A.chroococcum* + *A.awamori*	46.00	61.00	54.00	27.43
T_8 - 75% NP + 100% K + *A.chroococcum* + *A.awamori* + *P.fluorescens*	46.43	61.43	52.43	29.40
T_9 - 75% NP + 100% K + *A.chroococcum* + *A.awamori* + *G.fasciculatum*	48.53	63.53	53.20	31.60
T_{10} -100% NPK + *A.chroococcum* + *A.awamori*	41.17	56.17	50.50	27.67
T_{11} -100% NPK + *A.chroococcum* + *A.awamori* + *P.fluorescens*	48.53	63.53	53.53	30.13
T_{12}-100% NPK + *A.chroococcum* + *A.awamori* + *G.fasciculatum*	52.03	67.03	58.67	33.90
SEm $\pm$	0.87	0.85	0.98	0.62
C.D at 5 %	2.58	2.52	2.93	1.85

Table 3: Effect of inoculation of PGPR microorganisms with different levels of inorganic fertilizers on population of actinomycetes in maize rhizosphere at different growth stages

Treatments	Population of actinomycetes (CFU X 10^3/ gm soil)			
	30 DAS	60 DAS	90 DAS	120 DAS (harvest)
T_1-100%RDF	5.07	6.60	12.80	12.27
T_2-75%RDF	4.87	4.43	12.67	11.63
T_3 -Recommended NPK+ *Azotobacter chroococcum*	9.47	10.9	26.47	25.70
T_4 -Recommended NPK+ *Aspergillus awamori*	7.17	8.93	16.67	16.43
T_5 - Recommended NPK + *Pseudomonas fluorescens*	8.07	10.93	18.27	17.70
T_6 - Recommended NPK+ *Glomus fasciculatum*	6.87	9.80	14.47	14.13
T_7 - 75% NP + 100% K + *A.chroococcum* + *A.awamori*	9.03	10.10	22.80	22.13
T_8 - 75% NP + 100% K + *A.chroococcum* + *A.awamori* + *P.fluorescens*	7.84	10.90	14.90	13.90
T_9 - 75% NP + 100% K + *A.chroococcum* + *A.awamori* + *G.fasciculatum*	8.90	9.93	14.60	14.07
T_{10} -100% NPK + *A.chroococcum* + *A.awamori*	7.93	9.67	15.00	14.47
T_{11} -100% NPK + *A.chroococcum* + *A.awamori* + *P.fluorescens*	10.30	10.60	15.93	15.40
T_{12}-100% NPK + *A.chroococcum* + *A.awamori* + *G.fasciculatum*	10.67	14.83	28.17	27.67
SEm $\pm$	0.19	0.23	0.41	0.42
C.D at 5 %	0.57	0.69	1.23	1.26

CONCLUSION

It can be concluded that significantly higher number of bacterial populations was recorded with the application of 100 % NPK + *A. chroococcum* + *A. awamori* + *P. fluorescens* and fungal and actinomycetes populations

were recorded in the *A. chroococcum + A. awamori + Glomus fasciculatum +* 100 per cent RDF treatment of compare to other treatments.

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