Effect of Zinc Solubilizing Microorganisms on Yield and Economics of Groundnut Grown on Vertisol

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Abstract—*The experiment was conducted on zinc deficient soil at farmer's field in Parbhani, Maharashtra during summer season of 2014-15 to assess the ability of zinc solubilizing microorganisms on yield and economics of Groundnut. The treatments comprised of seven strains of zinc solubilizers viz. Burkholderia cepacia, Burkholderia cenocepacia, Pseudomonas fluorescens, Pseudomonas striata, Trichoderma viride, Trichoderma harzianum and Bacillus megaterium along with recommended dose of fertilizers which were replicated three times in randomized block design. The result revealed that kernel and haulm yield of groundnut and net returns was increased with inoculation of zinc solubilizing microorganisms along with recommended dose of fertilizers over uninoculated control. Among all the zinc solubilizers, RDF + Rhizobium + Pseudomonas striata recorded significantly highest yield and net returns.*

Keywords*: Groundnut, GMR, NMR, zinc solubilizing microorganism,*

1. INTRODUCTION

Oil seed crops have been the backbone of agricultural economy of India and the world. Groundnut (*Arachis hypogaea* L.) is an important oil seed crop and food grain legume.

Groundnut has indeterminate growth habit; hence growth and development of reproductive and vegetative organs overlap. This causes low fruiting efficiency due to inter organ competition for photo-assimilates and other metabolites. Consequently there is improper partitioning of assimilates to the developing pods and seeds. Most prominent constraint in the low yield is extended duration of flowering and variable pod sizes. Parmar and Schmidt (1989) have demonstrated the translocation of photosynthates within groundnut plant is not random but has a definite pattern, and this pattern is changed during different phases of plant growth. In view of the vagaries of rainfall and soil fertility problems, groundnut crop needs efficient nutrient management practices with an integrated approach of exploring all possible nutrient resources, not only to augment the nutrient supply but also to improve the physical, chemical and biological properties of soil, so as to overcome the limitations of groundnut cultivation.

At several places normal yield of crops could not be achieved despite judicious use of NPK fertilizers due to deficiency of micronutrients in soil in general that of Zn in particular. Numerous microorganisms especially those associated with roots, have the ability to increase plant growth and productivity. In soil, both macro and micronutrients undergo a complex dynamic equilibrium of solubilization and insolubilization that is greatly influenced by the soil pH and microflora and that ultimately affects their accessibility to plant roots for absorption (Altomare *et al*., 1999). Keeping these points in consideration, field trial was conducted to enhance the yield and economics of groundnut using Zn solubilizing microbial cultures on Vertisol.

2. MATERIALS AND METHOD

The experiment was conducted on farmer's field in Kehal village, Tq. Jintoor, Dist. Parbhani on Vertisol during summer season of 2014-15 on Groundnut. The soil was clayey in texture, moderately alkaline in reaction, medium in available nitrogen, phosphorus and sufficient in available potassium, iron, sulphur and low in zinc. As among the micronutrient status Cu, Fe and Mn were above the critical limits but Zn content in experimental soil was found to be deficient. The treatments comprising inoculation with liquid inoculants of *Bradyrhizobium* and *Bacillus megaterium* (PSB) for Groundnut seed in alone and in combinations. Total eight treatments of bioinoculants were replicated three times in RBD. The experiment consists of 8 treatments of laboratory tested P and Zn solubilizers RDF+ *Rhizobium*; RDF + *Rhizobium* + *Bacillus megaterium*; RDF + *Rhizobium* + *Burkholderia cepacia*; RDF + *Rhizobium* + *Burkholderia* *cenocepacia*; RDF + *Rhizobium +Pseudomonas fluorescens;* RDF + *Rhizobium+ Pseudomonas striata;* RDF + *Rhizobium + Trichoderma viride;* RDF + *Rhizobium + Trichoderma* harzianum. Seed treatment was done before sowing with liquid bioinoculants each @ 50 ml 10 kg^{-1} seed. The crop was raised following recommended agronomic practices. The recommended dose of chemical fertilizers was applied @ 30:60:30 NPK kg ha^{-1} at the time of sowing. Intercultural operations like thinning, weeding, spraying of insecticides, fertilizer application and schedule of irrigation for groundnut crop was carefully followed. The crop variety used was TAG 37A. The data obtained was statistically analyzed and appropriately interpreted as per the methods described in "Statistical Methods for Agricultural Workers" by Panse and Sukhatme, (1985).

3. RESULTS AND DISCUSSION

Yield of Groundnut

The results narrated in Table 1 indicated significant impact of Zn solubilizing microorganisms on dry pod and dry haulm yield of groundnut. Significantly highest dry pod yield and dry haulm yield of groundnut was noted in RDF + *Rhizobium +Pseudomonas striata* but treatment RDF+ *Rhizobium + Pseudomonas fluorescens*, RDF+ *Rhizobium + Trichoderma viride*, RDF+ *Rhizobium + Trichoderma harzianum* and RDF+ *Rhizobium + Burkholderia cenocepacia* were found statistically at par. Lowest biological yields were obtained in treatment T_1. These results are also corroborate with reports of Datta *et al.* (2014) as they revealed that pod and haulm yield of groundnut was significantly influenced by different nutrient management, *Rhizobium* inoculation of groundnut seed along with soil application of 50 kg $P_2 O_5$ ha^{-1} and 50 kg K_2O ha $^{-1}$ This may be owing to the fact that seed inoculation with biofertilizer, soil phosphorus and potassium significantly increased the yield component and yield of groundnut. Thereafter, Gupta (2006) noted that the seed inoculation with *Rhizobium + PSB + Azotobacter* increased grain yield in chickpea. However, Sable *et al*. (1998) also reported significant increase in grain yield with inoculation with *Rhizobium* + RDF.

Economics of groundnut

The data presented in the Table 2 revealed that gross monetary returns and net monetary return of groundnut was obtained significantly highest in treatment RDF + *Rhizobium + Pseudomonas striata* followed by treatments RDF + *Rhizobium +Pseudomonas fluorescens* and RDF + *Rhizobium + Trichoderma harzianum*. The treatment RDF + *Rhizobium +Pseudomonas fluorescens*, RDF + *Rhizobium + Trichoderma viride* and RDF + *Rhizobium + Trichoderma harzianum* were found to be at par with each other. Regarding, benefit cost ratio of groundnut, the highest B:C ratio was computed in treatment RDF+ *Rhizobium + Pseudomonas striata* and T_5, T_7 and T_8 these treatments were found to be at par with each other. These results are concurred with Subrahmaniyan *et al.*, (1998) reported that highest benefit :cost ratio (B:C) was recorded in plot inoculated with *Rhizobium* culture and *Rhizobium* culture + 50 kg P_2O_5+ 50 kg K_2O ha^{-1} compared to all other treatment. These results are also in close conformity with reports of Subrahmaniyan *et al*., (2000) and Mohapatra *et al*., (2010). Further, Naik *et al.*, (2012) reported that organic manure to safflower had significant influence on the economics of safflower production and also application of 150% NPK recorded significantly higher gross returns, net returns, cost of cultivation and B:C ratio over 100% NPK, but was on par with 125% NPK in black clay loam soil.

4. CONCLUSION

The inoculation of zinc solubilizing microorganisms along with NPK increased yield of groundnut. Results indicated that significantly highest kernel and haulm yield of groundnut was noted in inoculated plots with liquid form of *Rhizobium* and *Pseudomonas striata* over other treatments. The significant improvement in economics (GMR, NMR and B:C) of groundnut crop was also noted with inoculation of *Rhizobium* and *Pseudomonas striata* along with recommended dose of fertilizers.

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Table 1. Effect of zinc solubilizing micro-organism on dry pod and dry haulm yield of Groundnut

Sr. No.	Treatment	Dry Pod yield (q ha^{-1})	Dry Haulm yield (q ha^{-1})
T_1	RDF+*Rhizobium*	23.50	30.73
T_2	T1+*Bacillus megaterium*	24.96	32.19
T_3	T1+*Burkholderia cepacia*	25.63	32.86
T_4	T1+*Burkholderia cenocepacia*	26.67	33.90
T_5	T1+*Pseudomonas fluorescens*	28.43	35.66
T_6	T1+*Pseudomonas striata*	29.10	36.33
T_7	T1+*Trichoderma viride*	28.60	35.83
T_8	T1+*Trichoderma harzianum*	27.83	35.06
	S.E.±	0.62	0.62
	C.D. at 5 %	1.88	2.61
	C.V. %	4.01	3.15

Table. 2 Effect of zinc solubilizing microorganisms on economics of groundnut

Sr. No.	Treatment	Cost of cultivation (Rs ha^{-1})	Gross monetary return (Rs ha^{-1})	Net monetary return (Rs ha^{-1})	B: C
T_1	RDF+*Rhizobium*	30159	84600.00	54441.00	2.81
T_2	T1+*Bacillus megaterium*	30359	89856.00	59497.00	2.96
T_3	T1+*Burkholderia cepacia*	30359	92268.00	61909.00	3.04
T_4	T1+*Burkholderia cenocepacia*	30359	96012.00	65653.00	3.16
T_5	T1+*Pseudomonas fluorescens*	30359	102360.00	72001.00	3.37
T_6	T1+*Pseudomonas striata*	30359	104760.00	74401.00	3.45
T_7	T1+*Trichoderma viride*	30359	102960.00	72601.00	3.39
T_8	T1+*Trichoderma harzianum*	30359	100188.00	69829.00	3.30
	S.E. ±		2236.2	2236.2	0.07
	C.D. at 5 %	-	6783.5	6783.5	0.22
	C.V. %	-	4.01	5.84	4.01