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Evaluation of DAPG- Producing Fluorescent Pseudomonas for Enhancing Nutrient Use Efficiency, Bio-Control of Soil Borne Diseases and Yield of Groundnut

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ABSTRACT

Groundnut (Arachis hypogaea L.) is the important food, feed, fertilizer, oil, fuel and income generating crop in Telangana state. Groundnut is the king of the oil seeds its kernels are rich in protein and vitamins A, B, etc and can be eaten raw, roasted, fried, sweetened or boiled. The main problem in limiting production of crop is rich in biotic stress and inadequate disease management. Rhizosphere microorganisms affect growth and development of higher plants. The competitive exclusion of deleterious rhizosphere organisms is directly linked to the ability to successfully colonize a root surface. In fact, all the disease-suppressive mechanisms shown by bacteria have no real value unless the bacteria establish themselves successfully in the rhizosphere. DAPG producing fluorescent Pseudomonas and Trichoderma species for enhancing nutrient use efficiency, bio-control of soil borne diseases and yield of groundnut

Key words: *DAPG, Pseudomonas, Trichoderma*

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is the important food, feed, fertilizer, oil, fuel and income generating crop in Telangana state. Groundnut is the king of the oil seeds its kernels are rich in protein and vitamins A, B, etc and can be eaten raw, roasted, fried, sweetened or boiled. The main problem in limiting production of crop is rich in biotic stress and inadequate disease management. In biological control of plant- disease, the goal of many public- and private-sector research efforts has been to identify organisms that can be applied to the seed, planting furrow, or transplant medium to suppress fungal populations. The expectation is that a specific organism will act rapidly to reduce fungal populations and/or protect the growing seedling from damage.

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This strategy is referred to as inundation biological control[2], although it can be effective, it is not the only strategy for achieving biological control also enhancing the nutrient use efficiency. Keeping this in view the present study was taken up to investigate with the following objectives to study is to evaluate effectiveness of DAPG producing fluorescent *Pseudomonas* and *Trichoderma* species for enhancing nutrient use efficiency, bio-control of soil borne diseases and yield of groundnut.

MATERIALS AND METHODS

The study was conducted on Groundnut during *Kharif* season with three consequent years of 2014 - 2016 (Pooled mean of three years) at Regional Agricultural Research Station, Polasa, Jagtial, Karimnagar (Telangana State) to evaluate effectiveness of DAPG producing fluorescent *Pseudomonas* and *Trichoderma* species for enhancing nutrient use efficiency, bio-control of soil borne diseases and yield of groundnut. Seven treatments consisting of T_1; DAPG 1, T_2; DAPG 2, T_3; FP 86, T_4; DAPG 4,T_5; FP 86 and T_6; *Trichoderma* spp and T7; Control. All the treatments were treated with seeds through jiggery slurry in Chalka type soils using groundnut cv. Kadiri - 6 adopting RBD (experimental plot) replicated thrice applied recommended dose of fertilizers (30 kg N, 60 kg P_2O_5, 40 kg K_2O and 500 kg gypsum /ha respectively with a plot size 5 X 4.5 m. Dead plants counts were made by placing the quadrate (0.5 m x 0.5 m) at four random locations of groundnut crop in different treatments in order to obtain good counts of dead plats. Nodule parameters, yield and yield attributes were analyzed statistically

RESULTS AND DISCUSSION

The pooled mean of three seasons data revealed that significantly superior dry pod yield (1990 kg ha^{-1}) recorded with seed treated with FP-86 have superior no. of pods m2 (407) and pod weight 322 g with less disease incidence of collar and stem rot at 50-65 DAS. Followed to this FP-86 and DAPG-2 recorded maximum dry pod yield respectively (1919 and 1706 kg ha^{-1}) than other seed inoculants like DAPG-4 (1385 kg ha^{-1}) and control (1052 kg ha^{-1}) with more disease incidence have less number of nodules per plant (34 and 29). The highest benefit cost ratio was obtained with seed treated with FP-86 biological strains.

The available nitrogen in soil after harvest was found to be most in the control plot (331 kg ha^{-1}) than the remaining treatment plots .In the remaining treatment plots, the soil available nitrogen ranged from 113 kg ha^{-1} to 186 kg ha^{-1}. The reason for more available of soil nitrogen in control is mainly due to the absence of *pseudomonas species*. The addition of *pseudomonas* in the treatments plots has enhanced the uptake of nitrogen to the plants and increased the intake of nitrogen by the plants which reserved in the less availability of soil nitrogen after harvest due to the absence of pseudomonas species in the soil ,it has caused to accumulate amount more amount of available soil nitrogen whose the enhanced activity by *pseudomonas* was absent, the uptake of nitrogen by the plants is very less as a result of less uptake of nitrogen by the plants, the more amount of soil nitrogen is present is present after harvest in the control plots.

The dead plant count at 55-60 DAS is more in the control plot (2.74/m) than the treated plots. In the remaining treated plots, the dead plants count ranged from 2.04 to 2.63 among the treated plots, the dead plant count is less in the treatment (T7). The reason for less dead plant count in the T_7 plot is due to the presence of *Trichoderma* sps which reduced or controlled the reduced the death of the plants among all the treatments, the highest dead plant count observed in the control treatment (T1) when is due to absence of species like *Trichoderma* and *Pseudomonas* where the incidence of diseases like root rot, stem rot and collar rot has occurred more and was not controlled or revealed by any species. As a result of more occurrence of collar rot disease absence of control agents like *Trichoderma, Pseudomonas* sps. The method used for *S. rolfsii* inoculation resulted in complete mortality in untreated control. Seed treatment

and soil amendment with *P. fluorescens*[3] , *T. harzianum* and *T. virens*[8] effectively protected the groundnut seedlings from stem rot infection. *Pseudomonas* spp. produces broad-spectrum and diffusible antibiotics. Phenazines, DAPG, pyoluteorin, pyrrolnitrin, lipopeptides and HCN have been well characterized for their distribution, production, antifungal activity and *in vivo* disease control[5]. *Pseudomonas* spp. applied as seed treatment were also effective in control of *S. rolfsii* in other crops. Seed treatment with *P. fluorescens* controlled *S. rolfsii* infection in betel vine[7] and chickpea[6]. The plant stand has reduced and there was increase in the number of dead plants in the control plot than the remaining treated plots.

Table: biometrics and soil available N and P as influenced by different biological strains in groundnut

Treatment	Final Plant Stand /ha^{-1}	Root length (cm)	Shoot length (cm)	No. Pods /plant	Shelling %	Pod yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Soil avialbale N after harvest kg /ha	Soil avialbal e P after harvest kg /ha	B:C	Dead plant count at 55-60 crop/m2
T_1; Control	330000	15.90	46.17	11.5	51	931	1876	331	91	1.37	2.74
T_2; DAPG 1	330000	12.83	60.40	14.3	52	1371	2113	113	90	1.84	2.36
T_3; DAPG 2	330000	13.10	58.96	15.0	55	1538	2346	124	79	1.90	2.38
T_4; DAPG 4	290000	13.30	55.26	15.8	58	1356	2573	186	70	1.64	2.63
T_5; FP 86	330000	12.50	52.86	15.3	61	1957	2852	124	66	2.31	2.07
T_6; FP 98	320000	12.80	57.53	16.5	68	2069	3098	145	72	1.97	2.44
T_7; *Trichoderma* spp.	320000	13.40	50.03	16.9	64	1601	2911	165	63	1.82	2.04
S.Em. ±	3215	1.207	2.047	0.13	5.95	74.7	58.4	41.34	5.1	0.12	0.145
LSD (P=0.05)	NS	NS	6.37	0.36	NS	231.7	176	128.79	15.8	0.36	0.452
CV (%)	16.7	15.61	6.51	15	32.618	11	11.84	42.2	11.6	10.8	10.7

CONCLUSIONS

Rhizosphere microorganisms affect growth and development of higher plants. The competitive exclusion of deleterious rhizosphere organisms is directly linked to the ability to successfully colonize a root surface. In fact, all the disease-suppressive mechanisms shown by bacteria have no real value unless the bacteria establish themselves successfully in the rhizosphere. Seed treatment adopted through different biological control agents was found superior in enhancing yield *Pseudomonas* sp. were earlier observed to effectively colonize the groundnut rhizosphere and enhance root length, shoot length, biomass, nitrogen and phosphorous uptake, and yield in field[1]. *Pseudomonas* sp. GRC2 increased the seed germination, early seedling growth, fresh nodule weight and grain yield (Gupta *et al.,* 2002)[4]. Yield and nitrogen use efficiency in groundnut with lesser disease incidence also possible to increase the production and productivity of groundnut yield.

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