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Co-inoculation effect of *Acetobacter diazotrophicus* and phosphate solubilizing fungus on growth parameters in sorghum (*Sorghum bicolor*)

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Abstract
The objective of the conducting this study was to evaluate co-inoculation effects of *Acetobacter diazotrophicus* and phosphate solubilizing fungus on growth, nutrient uptake and yield of sorghum, which showed that dual inoculation of *Acetobacter diazotrophicus* @ 25 g kg-1 seed and phosphate solubilizing fungus @ 10 g kg-1 seed along with application of 75% of recommended dose of nitrogen, phosphorus and 100% recommended dose of potash had profound effect on growth, nutrient uptake and yield of sorghum. However, this treatment did not differ significantly from the treatments consisting of seed treatment of sorghum with *Acetobacter diazotrophicus* + phosphate solubilizing fungus along with application of 100% of recommended dose of nitrogen, phosphorus and potash; the treatment consisting of *Acetobacter diazotrophicus* + phosphate solubilizing fungus along with application of 50% recommended dose of nitrogen, phosphorus and 100% of recommended dose of potash; the treatment of phosphate solubilizing fungus with 100% recommended dose of nitrogen, phosphorus and potash and, the treatment consisting of phosphate solubilizing fungus with 100% recommended dose of nitrogen, potash and 75% recommended dose of phosphorus Thus, all these treatments were found to be equally effective in germination percentage, enhancing growth, height of plants etc. and significantly superior over rest of the treatments.

Keywords: Sorghum, *Acetobacter diazotrophicus*, phosphate solubilizing fungus

Introduction
Sorghum (*Sorghum bicolor*) belongs to the family *Poaceae*, commonly called as sorghum and also known as great millet, durra, shalu, jowar or milo. It is a grass species cultivated for its grain, which is used for food for humans, animal feed and ethanol production. Sorghum is originated in Africa and it now cultivated widely in tropical and sub-tropical regions. Sorghum is the world's fifth most important cereal crop after rice, wheat, maize and barley. Sorghum is mainly concentrated in the peninsular and central India. Inoculation of biofertilizers leads to reduction of chemical fertilizer requirement by fixation & solubilization of plant nutrients and thus, may able to maximize plant growth, yields and quality of output. (Singh *et al.* 2018) [6, 8, 11].

Acetobacter diazotrophicus is an endophytic diazotrophic bacterium that has been found in Almost 100 bacterial genera, of both the *Eubacteria* and *Archaebacteria*, are capable of fixing N2. There may exist many more bacterial species or genera which can fix nitrogen since a majority of bacterial species are not presently culturable. The search for diazotrophs in some environments has been relatively limited. Research on N2-fixing bacteria endophytically associated with sugarcane led to the description of *Acetobacter diazotrophicus*, which is the only known nitrogen- fixing species of acetic acid-producing bacteria (Salgado *et al.* 1997) [10].
Apart from nitrogen, phosphorous is one major nutrient required for healthy growth by plants.
Phosphorous is naturally present in soil but not all of its readily available for plant use as some of it is transformed into insoluble complexes with soil constitutions and therefore reducing the overall availability and efficiency of soil phosphorous. As such, in order to maintain the amount of phosphorous available in soil for plant use, large amount of phosphorous based fertilizer added to soil (Akintokun *et al.* 2007) [3]. Fungi, compared to bacteria, have major capacities to liberate phosphorous from insoluble phosphorous form.
Bioavailability of soil phosphorous is increased by using P-solubilizing fungi, particularly some *Aspergillus* and *Penicillium* species. Several studies have demonstrated the capacity of

colonized soil fungi including *Rhizoctonia sp., Rhizoctonia solani, Aspergillus niger, Aspergillus awamori, Penicillium italicum, Penicillium radicum, Sclerotium rolfsii, Pythium sp., Cladosporium sp, Fusarium oxysporum* to solubilize rock phosphate and insoluble mineral phosphates such as aluminum phosphate and tricalcium phosphate, suggesting the beneficial possibility of these fungi to enhance plant growth and productivity. Phosphorus-solubilizing fungi were shown by the formation of a clear zone around fungal colonies. (Abdel-Ghany *et al.* 2019) [4].

Materials and Method

A field experiment was conducted to study the effect of *Acetobacter diazotrophicus* and phosphate solubilizing fungus on growth, yield and nutrient content in sorghum (*Sorghum bicolor*) during *kharif*, 2019 at the Agronomy Farm of Rajarshee Chhatrapati Shahu Maharaj College of Agriculture, Kolhapur.

Details of the field experiment

1. Experimental Location: RCSM College of Agriculture, Kolhapur
2. Season: *Kharif*, 2019
3. Crop: Sorghum (*Sorghum bicolor*)
4. Variety: SSV-84 (Phule Vasundhara)
5. Fertilizer dose: 100:50:50 Kg ha^{-1} N, P2O5, K2O
6. Manure: 20 Cartloads of FYM/ha
7. Design: Randomized Block Design (RBD)
8. No. of treatments: 9
9. No. of replications: 3
10. Plot Size: a) Gross: 5.40 m × 4.00 m b) Net 3.60 m × 3.80 m
11. Spacing: 45 cm × 15 cm

Treatment details

- T1 = *Acetobacter diazotrophicus*
- T2 = Phosphate solubilizing fungus
- T3 = *Acetobacter diazotrophicus* + PSF + 100% NPK
- T4 = *Acetobacter diazotrophicus* + PSF + 75% NP + 100% K2O T5 = *Acetobacter diazotrophicus* + PSF + 50% NP + 100% K2O T6 = PSF + 100% NPK (RDF)
- T7 = PSF + 100% NK+ 75% P T8 = PSF + 100% NK + 50% P
- T9 = RDF (Control)

Observations recorded

Plant growth parameters

1. Germination percentage,
2. Height of the plant at 30,45,60 and at harvest
3. Number of tillers after 30 days of sowing
4. Fodder yield

Statistical analysis

The experimental data were subjected to statistical analysis by following the standard methods for analysis of variance. The standard error for the treatment means and critical difference at 5 per cent level of significance were worked out (Panse and Sukhatme, 1985) [9] for drawing precise conclusions.

Results and Discussion

A field experiment was conducted at the Instructional Farm of Rajarshee Chhatrapati Shahu Maharaj College of Agriculture, Kolhapur during *kharif*, 2019-2020, to study the effect of *Acetobacter diazotrophicus* and phosphate solubilizing fungus, singly and in combination, on growth parameters of sorghum.

Table 1: Effect of *Acetobacter diazotrophicus* and phosphate solubilizing fungus on growth parameters of sorghum

Treatments	Germination %	30 DAS	Height (cm) 45 DAS	60 DAS	At harvest	No. of tillers/plant	Fodder yield (t/ha)
T1 = *Acetobacter diazotrophicus*	76.33	17.13	27.13	63.27	203.27	4.27	109.33
T2 = Phosphate solubilizing fungus	76.23	17.07	27.27	63.00	201.67	4.20	108.22
T3 = *Acetobacter diazotrophicus* + PSF + 100% NPK	86.40	21.13	29.67	70.73	214.47	7.17	122.05
T4 = *Acetobacter diazotrophicus* + PSF + 75% NP + 100% K	86.57	21.40	31.40	74.23	215.90	7.40	123.11
T5 = *Acetobacter Diazotrophicus* + PSF + 50% NP + 100% K	85.43	19.00	29.33	70.33	213.73	6.73	121.00
T6 = PSF + 100% NPK (RDF)	82.67	18.47	27.53	64.27	210.63	5.97	120.41
T7 = PSF + 100% NK + 75% P	82.27	18.27	27.47	64.00	206.47	5.87	120.17
T8 = PSF + 100% NK + 50% P	81.33	18.13	27.40	64.23	205.30	5.60	118.88
T9 = RDF (Control)	78.00	17.40	27.17	63.93	205.07	5.57	118.47
S. E±	1.40	0.95	0.86	2.16	3.00	0.39	0.85
C.D. at 5%	4.21	2.88	2.59	6.50	9.00	1.20	2.56

The data presented in Table No. 1 in regard to germination percentage, plant height, no. of tillers fodder yield as influenced by use of *Acetobacter diazotrophicus* and phosphate solubilizing fungus in jowar explicitly revealed that, the treatments (T3, T4, T5, T6 and T7) had significantly profound effect on sorghum seeds. The present results of increase in sorghum germination due to inoculation of *Acetobacter diazotrophicus* and phosphate solubilizing fungus are in agreement with those of Hassan *et al*. (2013) [4] who stated that application of fungal microbes showed higher effects on germination rates, which improve the germination and growth of plants and stimulate microbial activity in field. Phosphate solubilizing fungi have highly competitive and wide metabolic capability and exert plant growth-promoting activity. It has been shown that these fungi rapidly colonize plant roots and cause at the plant level significant shoot increases. The result obtained in present investigation are in agreement with Mittal *et al*. (2008) [8] reported that, the dual inoculation of phosphate solubilizing fungi significantly increases plant height. Kushwaha *et al*. (2018) [6] reported that application of nitrogen, phosphorus and biofertilizers improves the shoot length, no. of tillers, grain and fodder yield of sorghum. Kaur *et al.* (2018) [5, 8] reported that application of microbial fertilizers along with nutrient fertilizers increases in plant height, leaves per plant, tillers per plant, leaf/root ratio, green fodder yield and dry fodder yield of sorghum. Adriano-Anaya *et al*. (2005) [2] reported that Two strains of *Gluconacetobacter diazotrophicus*, and the arbuscular mycorrhizal fungus Glomus increased both the shoot and root dry weight of sorghum 45 days after inoculation.

References

1. Abdel-Ghany MT, Mohamed ZH, Al Abboud MA, Helmy EA, Al-Rajhi AH, Shater AR. Solubilization of inorganic phosphate by rhizospheric fungi isolated from soil cultivated with *Sorghum bicolor* L. Bioresourses 2019;14(3):5521-5532.
2. Adriano-Anaya ML, Salvador-Figueroa M, Ocampo JA, Garcia-Romera I. Hydrolytic enzyme activities in maize (*Zea mays*) and sorghum (*Sorghum bicolor)* roots inoculated with *Glucanoacetobacter diazotrophicus* and *Glomus intraradices*. Soil biology and biochemistry 2005;38:879-886.
3. Akintokun AK, Akande GA, Akintokun PO, Popoola AO, Babalola TO. Solubilization of insoluble phosphate by organic acid-producing fungi isolated from Nigerian soil. International journal of soil science 2007;2:301-307.
4. Hassan MM, Hussien Daffalla M, Hanan Ibrahim Modwi, Magdoleen Osman G, Inas Ishag Ahmed, Migdam Abdel Gani E, Abdel El Gabar Babiker E. Effects of Fungal Strains on Seeds Germination of Millet and Striga Hermonthica. Universal Journal of Agricultural Research 2013;2(2):83-88.
5. Kaur A, Padnove G, Oberoi HK. Appraisal of microbial inoculant on growth, yield and quality attributes of forage sorghum. Forage Res 2018;44(3):179-184.
6. Kushwaha M, Singh M, Pandey AK, Kar S. Role of nitrogen, phosphorus and biofertilizers in improving performance of fodder sorghum. Journal of hill agriculture 2018, P976- 7606.
7. Mehana TA, Wahid OA. Associative effect of phosphate dissolving fungi, Rhizobium and phosphate fertilizer on some soil properties, yield components and the phosphorus and nitrogen concentration and uptake by Vicia faba L. under field conditions. Pakistan J Biol. Sci 2002;5:1226-1231.
8. Mittal V, Singh O, Nayyar H, Kaur J, Tewari R. Stimulatory effect of phosphate solubilizing fungal strains (*Aspergillus awamori* and *Penicillium citrinum* on the yield of chickpea (*Cicer arietinum L.* cv. GPF2). Soil Biol Biochem 2008;40:718-727
9. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research Publication 1985, P87-89.
10. Salgado TJ, Fuentes-Ramirez LE, Tapia-Hernandez A, Mascaraua-Esparza MA, Martinez-Romero E, Caballero-Mellado J. *Coffee arabica* L., a new host plant for *Acetobacter diazotrophicus*, and isolation of other nitrogen-fixing acetobacteria. Applied and environmental microbiology 1997, P3676-3683.
11. Singh D, Raghuvanshi K, Chaurasiya A, Dutta SK, Dubey SK. Enhancing the nutrient uptake and quality of pearl millet (*Pennisetum glaucum* L.) through use of biofertilizers. International journal of current microbiology and applied sciences 2018, P2319-7706.