Int.J.Curr.Microbiol.App.Sci (2021) *10*(07): 137-142

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 10 Number 07 (2021)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2021.1007.016

Effect of Consortium of *Azotobacter*, Phosphate Solubilizing Bacteria and Potash Mobilizing Bacteria on Yield of *rabi* Sorghum

D. D. Dudhade and S. S. Gadakh*

All India Co-ordinated Sorghum Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri - 413 722, M.S., India

**Corresponding author*

Keywords

Azotobacter, PSB, Potash Mobilizing Bacteria, rabi Sorghum

Article Info

Accepted:
12 June 2021
Available Online:
10 July 2021

ABSTRACT

Experiment was carried out to study the effect of consortium of Azotobacter, PSB and Potash mobilizing bacteria on yield of *rabi* sorghum at All India Co-ordinated Sorghum Improvement Project, M.P.K.V., Rahuri. Significantly higher plant height (314.7 cm) was recorded by seed treatment with Azotobacter, PSB and KMB Consortium + 100 % RDF (T_4). Seed treatment with Azotobacter, PSB and KMB Consortium + 100 % RDF (T4) recorded higher test weight (31.9 g) than T_1-Absolute control and T_9 (KMB + 75 % N + 100 % RDP & K). Highest grain (2137 kg ha^{-1}), fodder (5243 kg ha^{-1}) and biological yields (7381 kg ha^{-1}) were recorded in seed treatment with MPKV Azotobacter, PSB and KMB consortium + 100 % RDF (T_4) whereas, lowest grain, fodder and biological yields (1270 kg ha^{-1}, 2877 kg ha^{-1} and 4147 kg ha^{-1}) were recorded in control plot. Highest grain and fodder yields in seed treatment with Azotobacter, PSB and KMB Consortium + 100 % RDF (T_4) which were 41.0 % and 45 % higher over absolute control. Higher availability of gross returns of Rs. 82,471 ha^{-1}, net returns of Rs.55, 422 ha^{-1} with B: C ratio of 3.05 was recorded in seed treatment with *Azotobacter*, PSB and KMB Consortium + 100 % RDF (T_4).

Introduction

In India, the area under sorghum is 5.79 million ha with an annual production of about 5.45 million tonnes and an average productivity of 957 kg/ha^{-1}. To meet the escalating demand for food arising from the continuous expansion of the world's population, different crop nourishment strategies are being explored by farmers. According to FAO's estimates, the demand for agricultural products will increase to 60% by 2030 (Mia and Shamsuddin, 2010). Enhancing the production while keeping the environment safe is one of the major challenges in the 21st century (Berg, 2009). Fertilizers have been used extensively to increase crop production from arable land. Increasing use of chemical fertilizers in agriculture may make a country self-sufficient in food production, but chemicals have an adverse impact both on the environment and living organisms. In addition, the chemical fertilizers are expensive, affect the soil, reduce its water-holding capacity and fertility, cause imbalance in the soil nutrients, and result in unacceptable levels of water pollution (Sprent and Sprent, 1990). On the other hand, biofertilizers are eco-friendly, cost-effective, non-toxic, and easy to apply and they help maintain soil structure and biodiversity of the agricultural land. Thus, they serve as a good substitute for chemical fertilizers (Dipali and Gangwar, 2021). The dependency on the increased dose of inorganic fertilizer for higher productivity can be reduced. Among the benefits of using bioferilizers is the reduction in cost of cultivation as compared with the use of full dose of inorganic fertilizers (Game *et al.*, 2020).

Phosphorus (P) is a macronutrient required for the proper functioning of plants. Because P plays a vital role in every aspect of plant growth and development, deficiencies can reduce plant growth and development. Though soil possesses total P in the form of organic and inorganic compounds, most of them remain inactive and thus unavailable to plants. Since many farmers cannot afford to use P fertilizers to reduce P deficits, alternative techniques to provide P are needed. Phosphate solubilizing microbes (PSMs) are a group of beneficial microorganisms capable of hydrolyzing organic and inorganic insoluble phosphorus compounds to soluble P form that can easily be assimilated by plants (Kalayu, 2019). Biofertilizers, also called microbial inoculants, are organic products containing specific microorganisms, which are derived from plant roots and root zones. They have been shown to improve the growth and yield of the plant by 10-40% (Kawalekar, 2013). These bioinoculants colonize the rhizosphere and the interior of the plant, promoting plant growth when applied to the seed, plant surface or the soil. They not only improve soil fertility and crop productivity by adding nutrients to the soil, but also protect the plant from pests and diseases. They have been shown to enhance the growth of the root system, extend its life, degrade the harmful materials, increase the survival of seedlings, and reduce the time to flowering. Biofertilizers has a low cost, low capital intensive and ecofriendly route to boost the farm productivity depending upon their activity of mobilizing different nutrients. Use of biofertilizer in crop not only fixes the biological nitrogen but also solubilizes the insoluble phosphates in soil and thus improves fertilizers-use efficiency (Gogoi, 2008). These microorganisms play an important role in increasing the availability of N, P and K. Keeping this in view, present investigation was undertaken to find out effect of consortium of Azotobacter, PSB and Potash mobilizing bacteria on yield of sorghum

Materials and Methods

A field experiment was carried out during *rabi* season of the year 2019-20 at Sorghum Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri. The soil was clay loam, medium in organic carbon (0.58 %), low in available nitrogen (248 kg ha^{-1}), low in available phosphorus (11.62 kg ha^{-1}) and very high in potassium (314 kg ha^{-1}). The treatments consisted of nine treatments as follows,

T_1 : Absolute Control

T_2 : 100% RDF

T_3 : MPKV *Azotobacter*, PSB and KMB Consortium

T_4 : MPKV *Azotobacter*, PSB and KMB Consortium + 100 % RDF

T_5 : 75 % RDF

T_6 : MPKV *Azotobacter*, PSB and KMB Consortium + 75 % RDF

T_7 : MPKV *Azotobacter* + 75 %N + 100 % RDF & K

T_8 : PSB + 75 %N + 100 % RDF & K

T_9 : KMB + 75 %N + 100 % RDF & K

These treatments were evaluated in Randomized Block Design. Sorghum variety Phule Suchitra was sown at 45 x 15 cm row spacing using a seed rate of 12 kg ha^{-1}. Application of fertilizers 60 kg N, 40 kg P_2O_5 and 0 kg K_2O $ha^{-1.}$ Half dose of N and full dose of P and K applied basal at the time of sowing and remaining half dose of N at 30 days after sowing. Seeds were uniformly coated with Azotobacter, PSB and KMB Consortium using 500 g ha^{-1}.

The crops were harvested at maturity. The results were analyzed using standard statistical procedure given by Panse and Sukhatme (2000).

Results and Discussion

The application of biofertilizers significantly increased the yield of sorghum (Table 1). Initial and final plant population sqm^{-2} were found to be non-significant.

Number of days to 50% flowering significantly differed with the use of bio-fertilizers in *rabi* sorghum. Seed treatment with MPKV *Azotobactor*, PSB and KMB Consortium + 100 % RDF (T_4) recorded significantly more days to 50 % flowering (80) over T_3 (77), T_1 (75), T_8 (75) & T_9 (73).

Significantly higher plant height (314.7 cm) was recorded by seed treatment with MPKV Azotobactor, PSB and KMB Consortium + 100 % RDF (T_4) and on par with T_2 : 100% RDF (286.3 cm) and T_6 - MPKV *Azotobactor*, PSB and KMB Consortium + 75 % RDF (289.7 cm).

Lowest plant height was recorded in absolute control (251.3 cm) plots followed by seed treatment with T_9 - KMB + 75 % N + 100 % RDP& K (239.7 cm).

Seed treatment with MPKV *Azotobactor*, PSB and KMB Consortium + 100 % RDF (T_4) recorded higher taste weight (31.9 g) than T_1- Absolute control and T_9- KMB + 75 % N + 100 % RDP & K). Similar results were obtained by Game *et al.*, (2020) in wheat.

The grain, fodder and biological yields were significantly affected due to use of different bio-fertilizers formulations. Significantly highest grain (2137 kg ha^{-1}), fodder (5243 kg ha^{-1}) and biological yields (7381 kg ha^{-1}) were recorded in seed treatment with *Azotobactor*, PSB and KMB Consortium + 100 % RDF (T_4) whereas, lowest grain, fodder and biological yields (1270 kg ha^{-1}, 2877 kg $ha^{-1}$and 4147 kg ha^{-1}) were recorded in control plot.

Highest grain and fodder yields in seed treatment with Azotobactor, PSB and KMB Consortium + 100 % RDF (T_4) which were 41.0% and 45% higher over absolute control.

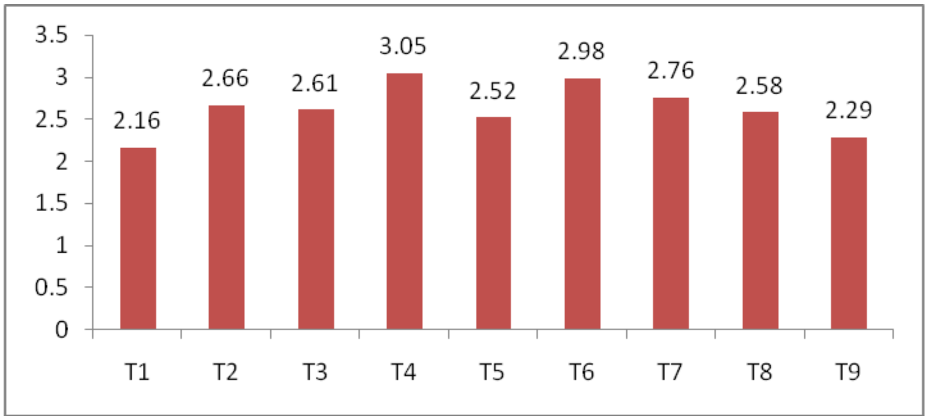
Game *et al.*, (2020) observed that seed treatment with MPKV consortium increased 2.64 q ha^{-1} yield over absolute control plot in wheat.

Similar findings had earlier been reported by Dadheech and Somani (2007) and Jat *et al.*, (2013) in sorghum. The two PSB strains in the co-inoculation acted synergistically with each other and strengthened the beneficial effects on plant growth performance (Wu *et al.*, 2019).

Table.1 Effect of consortium of Azotobacter, PSB and Potash Mobilizing Bacteria on growth yield and economics of *rabi Sorghum.*

TREATMENTS	Initial plant stand sqm^{-2}	Final plant stand sqm^{-2}	Days to 50 % flowering	Plant height at harvest (cm)	Test weight (g)	Grain yield (kg ha^{-1})	Fodder Yield (kg ha^{-1})	Total biomass (kg ha^{-1})	Harvest Index	Gross return (Rs. ha^{-1})	Cost of culti. (Rs. ha^{-1})	Net return (Rs. ha^{-1})
T_1 : Absolute Control	13.9	12.9	75.0	251.3	30.2	1270	2877	4147	30.6	48171	22256	25915
T_2 : 100% RDF	13.9	13.0	79.0	286.3	31.4	1872	4452	6324	29.6	71742	27009	44733
T_3 : *Azotobacter*, PSB and KMB Consortium	13.9	13.0	77.0	269.7	31.2	1534	3501	5035	30.5	58274	22296	35978
T_4 : *Azotobacter*, PSB and KMB Consortium + 100 % RDF	14.0	13.1	80.0	314.7	31.9	2137	5243	7381	29.0	82471	27049	55422
T_5 : 75 % RDF	14.1	13.1	78.0	273.0	31.0	1713	3943	5656	30.3	65192	25821	39371
T_6 : *Azotobactor*, PSB and KMB Consortium + 75 % RDF	14.2	13.3	78.7	289.7	31.7	2003	4816	6819	29.3	76936	25860	51076
T_7 : *Azotobactor* + 75 %N + 100 % RDP & K	14.3	13.3	78.0	279.7	30.5	1929	4540	6469	29.9	73759	26727	47032
T_8 : PSB + 75 %N + 100 % RDP & K	14.1	13.1	75.0	246.3	30.2	1824	4084	5908	30.8	69015	26727	42288
T_9 : KMB + 75 %N + 100 % RDP & K	14.1	13.1	73.0	239.7	30.1	1625	3566	5191	31.3	61231	26727	34504
SE m ±	**0.1**	**0.1**	**0.6**	**9.5**	**0.9**	**102**	**223**	**320**	**0.8**			
CD @ 5 %	**NS**	**NS**	**1.9**	**28.5**	**NS**	**305**	**668**	**958**	**NS**			
Mean	**14.1**	**13.1**	**77.1**	**272.3**	**30.9**	**1767**	**4114**	**5881**	**30.1**			
CV%	**1.71**	**1.84**	**1.41**	**6.1**	**4.9**	**10.0**	**9**	**9**	**4.8**			

Fig.1 Benefit : Cost ratio of *rabi* sorghum under different treatments.



The use of bio-fertilizers may lead to higher availability of gross returns of Rs. 82,471 ha^{-1}, net returns of Rs.55,422 $ha^{-1}$with B:C ratio of 3.05 was recorded in seed treatment with MPKV *Azotobactor*, PSB and KMB Consortium + 100 % RDF (T_4) followed by T_6- *Azotobactor*, PSB and KMB Consortium + 75 % RDF (gross returns of Rs. 76,936 ha^{-1}, net returns of Rs.51,076 ha^{-1} with B:C ratio of 2.98 (Fig. 1).

From present investigation, it can be concluded that seed treatment with MPKV *Azotobactor*, PSB and KMB Consortium + 100 % RDF is ideal for obtaining higher grain yield (2137 kg ha^{-1}), net returns (Rs. 55,422 ha^{-1}) and B:C ratio (3.05) in *rabi* sorghum. Biofertilizer inoculants like Azotobacter, Phosphate Solubilising Bacteria and Potash Mobilizing Bacteria alone and in combinations with inorganic fertilizers can be used as a supplement to inorganic fertilizer and Farmyard manure to increase the yield to the maximum.

References

Berg, G. 2009. Plant–microbe interactions promoting plant growth and health: Perspectives for controlled use of microorganisms in agriculture. Appl. Microbiol. Biotechnol. 84: 11-18.

Dadheech, S. K. and Somani, L. L. 2007. Effect of integrated nutrient management in a soybean-wheat crop sequence on the yield, micronutrient uptake and post-harvest availability of micronutrients on typics to chrepts soil. Acta Agronomica Hungarica. 55(2): 205-216.

Deepali, G. K. and Gangwar, K. 2021. Biofertilizers: An Ecofriendly Way to Replace Chemical Fertilizers. 2010. Available online: https: //www.krishisewa.com/articles/organic-agriculture/237-biofertilizer-substitute-chemical.html (accessed on 7 February 2021).

Game, B. C., Ilhe, B.M., Pawar, V.S. and Khandagale, P.P. 2020. Effect of Azotobacter, Phosphate Solubilising Bacteria and Potash Mobilising Bacteria Inoculants on Productivity of Wheat (*Triticum aestivum* L.). Int. J. Curr. Microbiol. App. Sci. 9(3): 2800-2807.

Gogoi, B. 2008. Soil properties and nutrient availability as affected by INM after rainfed cropping sequence'. M.Sc. Thesis, Assam Agricultural University, Assam.

Jat, M. K., Purohit, H. S., Singh, B., Garhwal, R. S. and Choudhary Mukesh. 2013. Effect of integrated nutrient management on yield and nutrient uptake in sorghum (*Sorghum bicolor*). Indian Journal of Agronomy. 58(4): 543-547.

Kalayu, Girmay 2019. Phosphate Solubilizing Microorganisms: Promising Approach as Biofertilizers. Int. Journal of Agronomy 4917256, https://doi.org/10.1155/2019/4917256

Kawalekar, J. S. 2013. Role of biofertilizers and biopesticides for sustainable agriculture. J. Bio. Innov. 2: 73-78.

Mia, M. B. and Shamsuddin, Z. 2010. Rhizobium as a crop enhancer and biofertilizer for increased cereal production. Afr. J. Biotechnol. 9: 6001- 6009.

Panse, V. G and Sukhatme, P. V. 2000. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi.

Sprent, J. I. and Sprent, P. 1990. Nitrogen fixing organisms: Pure and applied aspects. Nitrogen Fixing Org. 19: 288.

Wu Fei, Jianrong Li, Yanliu Chen, Linping Zhang, Yang Zhang, Shu Wang, Xin Shi, Lei Li and Junsheng Liang. 2019. Effects of phosphate solubilizing bacteria on the growth, photosynthesis, and nutrient uptake of *Camellia oleifera* Abel. Forests. 10: 348.

How to cite this article:

Dudhade, D. D. and Gadakh, S. S. 2021. Effect of Consortium of *Azotobacter*, Phosphate Solubilizing Bacteria and Potash Mobilizing Bacteria on Yield of *rabi* Sorghum. *Int.J.Curr.Microbiol.App.Sci.* 10(07): 137-142. doi: https://doi.org/10.20546/ijcmas.2021.1007.016