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Effect of Biofertilizer Seed Treatment on Growth, Yield and Economics of Toria (*Brassica Campestris* L.) under Rainfed Condition in Hill Zone of Assam

NILIM KALITA[1]*, SANJIB BHUYAN[2], SUBAL MAIBANGSA[3] and RANJIT KUMAR SAUD[4]

[1]SMS (Soil Science), Krishi Vigyan Kendra, Karbi Anglong, AAU, Assam, India.
[2]SMS (Extn. Ed.), Krishi Vigyan Kendra, Karbi Anglong, AAU, Assam, India.
[3]Head, Krishi Vigyan Kendra, Karbi Anglong, AAU, Assam, India.
[4]Associate Director of Extension Education, Assam Agricultural University, Jorhat, Assam, India.

Abstract

The study was conducted at the farmers' field of Karbi Anglong district of Assam to determine the effect of seed treatment with *Azotobacter* and Phosphorus Solubilizing Bacteria (PSB) on growth and yield of Toria (var. TS-36). The effect of biofertilizers was observed in combination with various levels of chemical fertilizers and FYM. Seed inoculation with *Azotobacter* and PSB @40g kg^{-1} seed + 75% NPK recorded maximum grain yield (11.15 qha^{-1}) due to the higher plant height (88.52 cm), branches $plant^{-1}$ (4.96), siliqua $plant^{-1}$ (164.76), root growth (2.30g $plant^{-1}$), seeds $siliqua^{-1}$(10.97) and 1000-seed weight (4.82 g). The seed treatment with biofertilizers in combination with different levels of chemical fertilizers was found to be superior over recommended dose of NPK. Economics of cultivation in terms of net return of Rs.17605 & Rs. 17205 and B: C of 2.07 & 2.11 were considerably higher in treatment of *Azotobacter* + PSB + 50% NPK + FYM and *Azotobacter* + PSB + 75% NPK + FYM In which biofertilizer seed treatment was done as compared to recommended NPK (Rs. 14160 and 1.93, respectively). Application of *Azotobacter* and PSB in combination with 75 and 50% NPK and FYM @2 t ha^{-1} were found as viable and feasible option for getting higher yield and economic return from cultivation of toria in hill zone of Assam.

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CONTACT Nilim Kalita nilimkalitakvk@gmail.com SMS (Soil Science.), Krishi Vigyan Kendra, Karbi Anglong, AAU, Assam, India.

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Introduction

India accounted for 19% of oilseeds area, and 2.7% of oilseeds production in the world, (FAOSTAT, 2013). Rapeseed and mustard is the second most important oilseed crop in India after ground nut. In terms of area, oilseeds occupy 14.1 per cent, rape seed and mustard alone occupies 3 per cent of the total cropped area in the country.[1] Rapeseed and mustard is cultivated on 6.32 million hectares in India with an annual production and productivity of 7.39 million tones and 1170 kgha^{-1} (Anonymous, 2016).[2]

Although, India occupies second place in rapeseed and mustard production after China, yet its productivity is far below compared to the world average.[3] The low productivity of rapeseed and mustard in India is due to sub-optimal application of fertilizers and cultivation under rainfed conditions.[4] There is ample opportunity to bridge this yield gap of these crops in the country through use of organic manures and biofertilizers along with chemical fertilizers.

Toria responds favorably to bio- fertilizers, viz., *Azotobacter* and phosphorus solubilizing bacteria (PSB).[5] In view of the escalating price of fertilizers and its ill effects on soil health, there is a need to focus on integrated nutrient supply system that may improve crop production with reduced cost of cultivation. Biofertilizers are reported to enhance the yield of Indian mustard6, which is mainly attributed to better N nutrition through N_2 - fixation, enhancement of nutrient availability and uptake and production of growth hormones such as indol acetic acid, gibberellins etc.[7,8,9]

In Assam, toria is cultivated in an area of 2.81 lakh ha with a production and productivity of 1.88 lakh MT and 6.67qha^{-1}, which is lower than the national average, respectively.[10] Karbi Anglong district, which falls under the Hill Zone of Assam, has a sizeable area under rapeseed-mustard cultivation with area and production 0.28 lakh ha and 0.20 lakh MT, respectively.[10] The productivity is also much low its potential yield, which may be due to non utilization of chemical fertilizers and low biological activity of the soils.[11] As the majority of the area under cultivation in the district is organic by default, there is ample opportunity of enhancing the productivity of toria through use of biofertilizers. Therefore, an on farm trial was conducted at the farmers' field of Karbi Anglong district to study the effect of biofertilizer seed treatment in toria in conjunction with organic manures and chemical fertilizers under rainfed condition.

Materials and Methods

The investigation was carried out at farmer's field during *rabi* season (October-January) of 2015-16 and 2016-17 at five villages in Karbi Anglong district under hill zone of Assam. The experimental soils were sandy loam to clay loam with pH 5.75 to 6.10, medium in organic carbon (0.56 to 0.75%), medium in available N(244.8 to 290.32 kgha^{-1}), low in available P_2O_5 (6.10 to 12.55 kgha^{-1}) and medium in available K_2O (133.6 to 223.4 kgha^{-1}).The experiment was conducted at five farmers' field as replication with five treatment combinations. The treatment combinations were: T1- Recommended NPK, T2- Recommended NPK + FYM, T3- *Azotobacter* + PSB + 50% NPK + FYM, T4- *Azotobacter* + PSB + 75% NPK + FYM and T5- Farmers practice (control). The farmers' cultivation practice is application of only farm yard manure (FYM) @ 1-2 t ha^{-1}.

Inoculants of nitrogen fixing bacteria (*Azotobacter*) and Phosphate Solubilizing Bacteria (PSB) was mixed with the seeds and kept in shade for 20 minutes and sown immediately. The quantity of biofertilizer culture was used @ 40g kg^{-1} seed and the recommended dose of NPK @ 65:35:0 kg ha^{-1}. FYM was applied @ 2 t ha^{-1} to all the treatments except T_1 and T_5 and fertilizers as per the treatments were applied at the time of land preparation. The observations on plant height, number of branches, siliqua per plant, root weight, and 1000 seed weight were recorded. Available soil nutrients as well as nutrient content were determined following the standard procedures.[12] Final crop yield (seed & stover) were recorded and the economics of cultivation were calculated on the basis of prevailing market price of the produce.

The experimental data were pooled over two growing seasons and statistically analyzed applying the techniques of analysis of variance and by error mean square of Fisher Snedecor's 'F' test at probability level 0.05.[13,14]

Results and Discussion

Growth Parameters

The data on different parameters are presented in table 1. The highest plant height (88.52 cm), number of branches plant^{-1} (4.93), root dry weight (2.30g) was recorded in T4 (*Azotobacter* + PSB + 75 % of recommended NPK + FYM), which was significantly higher than T_1 (Recommended NPK) and T_2 (Recommended NPK + FYM). The minimum plant height (73.33cm), number of branches plant^{-1} (4.17), root dry weight plant^{-1} (1.24 g) was recorded at farmer's practice (control). The better root growth as evidenced by significantly higher root dry weight (2.46 g plant^{-1}) in treatment receiving *Azotobacter* + PSB + 75% NPK + FYM and *Azotobacter* + PSB + 50% NPK + FYM (2.33 g plant^{-1}) might have helped the plants to uptake more nutrients and water, thereby resulted better plant growth. Improved plant growth by *Azotobacter* sp. and PSB may be attributed to several mechanisms especially growth hormone production, improving the efficiency of roots, by supplying combined nitrogen and increasing phosphorus availibilty.[15] In another study reported increased plant height (116.0 cm), branches plant^{-1} (7.0) and pod plant^{-1} (173.6) under *Azotobacter* and PSB application compared to 103.3 cm, 7.0 branches plant-^{1} and 116.1 pods plant-1 in controlled plot, respectively.[16] Similar result of increase in plant height, branches plant^{-1} and number of pods plant^{-1} in Indian mustard was reported by other workers.[5,17]

Table 1: Effect of biofertilizer on plant growth and yield attributes

Treatment	Plant height (cm)	Root weight (g plant^{-1})	Branches plant^{-1}	Siliqua plant^{-1}	Seeds siliqua^{-1}	1000 seed weight (g)
T_1 - Recommended NPK only (control)	84.43	1.35	4.76	140.67	9.33	4.06
T_2 - Recommended NPK + FYM	85.36	1.80	4.78	154.53	10.18	4.55
T_3 - Azotobacter+ PSB +50% recommended NP + recommended K + FYM	88.48	2.27	4.93	158.80	10.84	4.70
T_4 - Azotobacter + PSB + 75% recommended NP + recommended K + FYM	88.52	2.30	4.96	164.76	10.97	4.82
T_5 – Farmer's practice	73.33	1.24	4.17	131.56	8.66	3.87
S.Ed±	1.144	0.104	0.116	1.860	0.265	0.088
CD (P=0.5)	2.56	0.40	NS	9.14	0.55	0.26

Yield Attributes

The results of yield attributes given in table 2 indicate significant increase in yield parameters viz. number of siliqua plant^{-1}, number of seed siliqua^{-1}, test weight (g) of seeds, seed yield and straw yield of toria due to combined use of inorganic fertilizers, FYM and biofertilizer.

The maximum number of siliqua plant^{-1} (164.76), maximum number of seeds siliqua^{-1} (10.17) and highest 1000-seed weight (4.92) were recorded in treatment of *Azotobacter* and PSB + 75 % NPK, which was at par with *Azotobacter* + PSB + 50% NPK followed by recommended NPK + FYM and recommended NPK. The farmer's practice recorded the lowest values in all the yield attributing characters. There was also reported increase in seed yield of Indian mustard due to combined application of Azotobcter and PSB by 22.4, 7.8 and 3.6 % over control, PSB and *Azotobacter*, respectively.[16] Among the different treatments studied, highest net return (Rs.17605 ha^{-1}) was recorded with T_4 followed by T_3 (Rs 17205 ha^{-1}) and the minimum net return was recorded from farmer's practice. The maximum B: C (2.11) was recorded in T_3, which was closely followed by T_4 (2.07). However, the B: C in farmers

practice was found to be higher than recommended NPK and recommended NPK + FYM. Similar results of yield enhancement in experimental farm as well as at real farming situation in different crops through technology dissemination has been reported by several researchers.[18,19,20,21,22,23,24,25]

Table 2: Effect of biofertilizer on yield and economic return of toria cultivation

Treatment	Seed Yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Gross cost (Rs ha^{-1})	Gross return (Rs ha^{-1})	Net return (Rs ha^{-1})	B:C ratio
T^1 - Recommended NPK only (control)	978	1695	15180	29340	14160	1.93
T_2 - Recommended NPK + FYM	1056	1847	17355	31680	14325	1.83
T_3 - Azotobacter+ PSB +50% NPK + FYM	1088	1947	15435	32640	17205	2.11
T_4 - Azotobacter + PSB + 75% NPK + FYM	1135	2018	16445	34050	17605	2.07
T_5 – Farmer's practice	782	1265	11640	23460	11820	2.02
S.Ed±	10.732	40.880	-	-	-	-
CD $_{(P=0.5)}$	42.0	134.0	-	-	-	-

Conclusion

Considering the above results of the experiment, it is concluded that seed treatment with bio-fertilizer in toria is beneficial for higher crop production, maintenance of soil health and 25 to 50 per cent saving of chemical fertilizer. Application of *Azotobacter* and PSB in combination with 75 and 50% NPK and FYM @ 2 t ha^{-1} may be viable and feasible option for getting higher yield and economic return from cultivation of toria in hill zone of Assam.

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Conflict of Interest

The authors do not have any conflict of interest.

References

1. Shekhawat, K.; Rathore, S.S.; Premi, O.P.; Kandpal, B. K. and Chauhan, J.S. Advances in agronomic management of Indian mustard (*Brassica juncea* (L.) *Czernj. Cosson*): *Intl. J. Agronomy*; 2012: 14
2. Anonymous. Agricultural Statistics at a glance, Deptt. of Agricultural Cooperation & Farmers Welfare, Govt. of India; 2016
3. Hegde, D.M. Becoming self-reliant. *The Hindu Survey of Indian Agricultur*; 2004; 45-47.
4. Majumder S., Halder T. K and Saha, D. Integrated nutrient management of rapeseed (*Brassica campestris* L. var. *yellow sarson*) grown in a typic haplaquept soil. *J. Appl. & Nat. Sci.*; 2017;9 (2): 1151 – 1156.
5. Vyas, S.P. Efficacy of biofertilizer on Brassica genotypes in arid Gujarat. *Fertilizer News*;2003; 48:49-51.

6. Suneja, S. and Lakshminaraya, K. Isolation of siderophore negative mutants of *Azotobacter chroococcum* and studied on the role of siderophores in mustard yield. *Ind. J. Plant Physiol.*; 2001; 6: 190-193
7. Antoun, H., C.J. Beachamp, N. Goussard, R. Chabot and Lalande, R. Potential of *Rhizobium* and *Bradyrhizobium* species as plant growth promoting rhizobacteria on non-legumes: Effects on radishes (*Rhaphanus sativus* L.). Plant Soil; 1998; 204: 56-67
8. Arshad, M. and W.T. Frankenberger Jr. Plant growth-regulating substances in the rhizosphere: Microbial production and functions. *Adv. Agron.*; 1997; 62: 45-151.
9. Wani, S.P., Chandrapalaiah, S., Zambrem, M.A. and Lee, K.K. Association between nitrogen-fixation bacteria and pearl millet plants, responses mechanisms and resistance. *Plant Soil*; 1998;110: 284-302
10. Anonymous. *Statistical handbook Assam*, Directorate of Economics and Statistics, Government of Assam; 2015
11. Das, K.K. and Shrm, A. Effects on Input Use on Rapeseed and Mustard Production in Nagaon District of Assam, *India Int.J.Curr. Microbiol.App.Sci*; 2018; 7(5): 629-634
12. Jackson, M. L. *Soil Chemical Analysis*, Prentice Hall of India Private Limited, New Delhi, 1973.
13. Gomez, K.A. and Gomez A.A. Statistical procedures for agricultural research, 2nd edn. Wiley India Pvt Ltd, India:2010.
14. Cochran W.G., Cox G.M. *Experimental Designs*, Asia Publishing House. Kolkata;1977; 142-181
15. Vessey,J.K. Plant growth promoting rhizobacteria as biofertilizers. *Plant Soil*; 2003; 255:571-586.
16. Vyas, S.P. Interactive Effects of Nitrogen and Bio-fertilizers on Indian Mustard *Annals of Arid Zone*; 2005;44(2): 47-50.
17. Pati, P. ; Baliarsingh, A. ; Dash, D. K. ; Naik, P..Response of biofertilizer application in toria (*Brassica rapa var toria*). *Environment and Ecology*; 2016;.34(4B):2059-2062
18. De, B., Das B., Das B. and Sinha A. C. Effect of integrated nutrient management on yield, nutrient uptake and economics of rapeseed (*Brassica campestris* var. yellow sarson) in *terai* region of West Bengal. *Journal of Crop and Weed*; 2014;10(1):69-72.
19. Esmaeil Yasari, M.A. Esmaeili Azadgoleh, Saedeh Mozafari and Mahsa Rafati Alashti, 2009. Enhancement of Growth and Nutrient Uptake of Rapeseed (*Brassica napus* L.) by Applying Mineral Nutrients and Biofertilizers. *Pakistan Journal of Biological Sciences*; 2009; 12: 127-133.
20. Gudadhe, N. N., Mankar, P.S., Khawale, V.S. and Donoarkar, K.P. Effect of biofertilizers on growth and yield of mustard (*Brassica juncea* L.) *J. Soils and Crops*;2005; 15(1):160-162
21. Rundala, S. R., Kumawat, B. L., Choudhary, G. L., Prajapat, K.and K. Sita. Performance of Indian mustard (*Brassica juncea*) under integrated nutrient management. *Crop Research*; 2013;46(1/3):115-118.
22. Saini, L. B., George, P.J. and Bhadana, S. S. Effect of Nitrogen Management and Biofertilizers on Growth and Yield of Rapeseed (*Brassica campestris* var. toria) *Int. J. Curr. Microbiol. App. Sci*; 2017;6(8): 2652-2658
23. Singh, S. P. and Pal, M. S. (2011) Effect of integrated nutrient management on productivity, quality, nutrient uptake and economics of mustard *(Brassica juncea). Indian Journal of Agronomy*;2011; 56(4):381-387
24. Tripathi M. K., Chaturvedi, S. Shukla, D. K. and Saini, S. K. Influence of integrated nutrient management on growth, yield and quality of Indian mustard (*Brassica juncea* L.) in tarai region of northern India. *Journal of Crop and Weed*; 2011; 7(2):104-107.
25. Umesha, S., Srikantaiah, M., Prasanna, K. S., Sreeramulu, K.R., Divya, M. and Lakshmipathi, R.N. Comparative Effect of Organics and Biofertilizers on Growth and Yield of Maize *(Zea mays. L) Curr. Agri. Res. Jour.*; 2014;2(1): 55-62.