Biological Forum – An International Journal **14(2): 1446-1450(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Productivity and Profitability of Toria (*Brassica campestris* L. var. *toria*) as Influenced by Integrated Nutrient Management in Trans-Gangetic plains of Punjab

Sandal Choudhary*, Barkha, Sayan Sau and Kangujam Bokado
Department of Agronomy, School of Agriculture,
Lovely Professional University, Phagwara (Punjab), India.

(Corresponding author: Sandal Choudhary)*
(Received 21 April 2022, Accepted 14 June, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Considering the current scenario of rising population but stagnant cultivable area, there is a need to enhance crop productivity. Usually, over-application of chemical fertilizers in high-yielding cultivars are used to achieve this objective which is not only reducing agricultural net profit but also deteriorating the soil and human health. Thus, present study was undertaken to evaluate alternatives like INM approach in order to overcome this challenge. The experiment was conducted in randomized block design with three replications and eight treatments comprising different doses of RDF with biocompost in combination with SOB and PSB on during the *Rabi* season of 2021-22 at Agriculture farm, School of Agriculture, Lovely Professional University, Phagwara. The maximum plant height was recorded under the application of 75% RDF +5 t/ha biocompost + SOB @ 10 ml/kg seed (T_5) at 30, 60 and 90 DAS interval which was 61.13, 117.53, and 133.89 cm, respectively. At 30, 60 and 90 DAS, number of leaves per plant were found to be highest (6.79, 37.50, 12.09 respectively) under T_3 *i.e.,* application of 75% RDF + 5 t/ha biocompost, while 75% RDF + 5 t/ha biocompost + PSB @ 10 ml/kg seed (T_4) resulted in higher number of branches per plant (2.51, 6.17, 9.85) at different stages of growth in 30, 60 and 90 DAS, respectively. Yield attributes, cost of cultivation, gross returns, net returns and B:C ratio significantly increased with the application of 75 % RDF + 5 t/ha biocompost + SOB @ 10 ml/kg seed (T_5). The results achieved can pave a better path for attaining the goal of higher productivity, profitability as well as sustainability.

Keywords: Integrated nutrient management, Biocompost, Agricultural productivity.

INTRODUCTION

Rapeseed-mustard is India's leading edible oilseed crop group and an important source of income, particularly for small and marginal farmers in rainfed areas. After groundnut, it is India's 2nd largest edible oilseed, contributing to about 27.8 percent of the country's oilseed sector. Rapeseed-mustard is one of the oilseed crops grown in 26 states in the country's northern and eastern regions, with 30% of the land being rainfed. The major rapeseed-mustard producing states in India which are cultivating are Rajasthan (47.26 %), Haryana (11.73 %), Madhya Pradesh (10.82 %), Uttar Pradesh (9.73 %), and West Bengal (6.69 %). India is the world's biggest producer, with 6.32 million hectares of land under cultivation of Brassica, accounting for about 7.39 million tonnes to worldwide production (Mahanta *et al.,* 2019).

Toria (*Brassica campestris* L. *var. toria*) is considered an important oilseed crop mainly grown during the *Rabi* season. It is a short duration irrigated crop with a growingseason of 90-92 days. Due to its shorter duration and adaptability to a wide range of agro-climatic regions and variety of soils, it is considered to have significant potential as an important oilseed crop (Mahanta *et al.,* 2019). *Rabi* season can be better utilized by growing toria in double cropping, which can ultimately lead to increasing farmer's income. But growing population, as well as a reduction in available land and other productive units, are putting tremendous strain on current agriculture and natural resources in order to meet rising food demand. The farmers are using excessive agrochemicals to increase the productivity in order to meet the rising demands but the application of chemicals in excessive amount is resulting in deterioration of soil health and loss of soil fertility. INM is the most efficient way for maximizing resources available and producing crops at a minimum cost. Problems such as increase in the price of inorganic fertilizer and soil deterioration can also be addressed by the effective and combined application of sufficient nutrients by inorganic and organic fertilizers (Sindhi *et al.,* 2018). The significance of INM (integrated nutrient management) was not recognized earlier due to subsistence farming because crop nutrient removal was so minimal (Sharma *et al.,* 2022). INM improves the

physical, chemical and biological characteristics of the soil while also facilitating the flow of all important nutrients required by plants (Priyanka *et al.,* 2020).Organic manures such as compost, FYM, vermicompost, slurry, biogas, biocompost, poultry manure, bioagents, pressmud, oilcakes, phosphocompost and balanced fertilizer nutrient use along with biofertilizers such as *Azotobacter*, *Rhizobium*, PSB, SOB etc. are essential components of integrated nutrient management because they provide a low-cost, renewable source of plant nutrients that can be exploited to replace chemical fertilizers in sustainable agriculture. The use of INM in toria can effectively lower the doses of fertilization, as demonstrated by the observations of Mondal *et al.,* 2015.

MATERIALS AND METHOD

The experiment was conducted in randomized block design with 3 replication and 8 treatments in the sandy loam soil with pH 8.5 from September to January in the *Rabi* season of 2021-22 at the Agriculture farm, School of Agriculture, Lovely Professional University, Jalandhar. The eight treatments were T_1 – Absolute Control, T_2 - 100 % RDF (60:20:0 NPK kg/ha), T_3 - 75% RDF + 5 t/ha biocompost, T_4 - 75% RDF + 5 t/ha biocompost + PSB @ 10 ml/kg seed, T_5 - 75% RDF + 5 t/ha biocompost + SOB @ 10 ml/kg seed, T_6 - 50% RDF + 5 t/ha biocompost, T_7 - 50% RDF + 5 t/ha biocompost + PSB @ 10 ml/kg seed, T_8 - 50% RDF + 5 t/ha biocompost + SOB @ 10 ml/kg seed. Urea and single super phosphate were used to supply the inorganic fertilizers. Toria seeds of variety 'TL-17' was sown in September, 2021 in rows 30cm apart. Plant to plant spacing was kept 15 cm by thinning 15 days after sowing. According to the treatments, biocompost was applied in the specific plots 15 days before sowing. At the time of sowing, the full amount of phosphorus and half of the nitrogen (as per treatments) were administered. Remaining half dose of nitrogen was applied 30 DAS post irrigation.

RESULT AND DISCUSSION

Plant stand. There was no significant effect of treatments on plant population as different INM treatments under study were unlikely to enhance or reduce plant population at the early stage of 15 DAS. In the experimental plots, plant stand was found to be equally distributed and adequate (Table 1).

Growth attributes. Growth parameters *viz.* plant height, number of leaves and number of branches per plant increased with the varying treatments at different stages (Table 1).

Table 1: Effect of different treatments plant stand and growth attributes of toria.

Treatment	Plant stand (m^{-2})	Plant height(cm)			No. of leaves per plant			No. of branches perplant		
		30DAS	60DAS	90DAS	30DAS	60DAS	90DAS	30DAS	60DAS	90DAS
T_1: Absolute Control	25.67	41.97	79.62	97.08	4.21	28.17	6.57	1.33	4.07	5.71
T_2: 100 % RDF	27.00	47.67	88.94	106.71	4.80	29.77	7.23	1.53	4.27	6.99
T_3: 75% RDF + 5 t/ha biocompost	29.67	57.11	108.57	127.88	6.79	37.50	12.09	2.27	5.80	9.13
T_4: 75% RDF + 5 t/ha Bio compost + PSB @10ml/kg seed	29.00	58.80	111.57	129.96	6.50	36.00	10.58	2.51	6.17	9.85
T_5: 75% RDF + 5 t/ha biocompost + SOB @10ml/kg seed	29.33	61.13	117.53	133.89	6.67	36.93	11.74	2.40	6.07	9.69
T_6: 50% RDF + 5 t/ha biocompost	28.00	50.31	94.94	114.61	5.26	31.67	8.13	1.87	5.13	8.21
T_7: 50% RDF + 5 t/ha Bio compost + PSB @10ml/kg seed	27.67	51.80	98.66	116.64	5.87	32.83	8.95	1.93	5.00	7.78
T_8: 50% RDF + 5 t/ha biocompost + SOB @10ml/kg seed	28.33	53.62	102.17	120.69	5.48	32.17	9.17	2.13	5.17	8.36
SEm ±	1.84	3.07	6.04	6.30	0.32	1.53	0.57	0.12	0.27	0.49
CD (P=0.05)	NS	9.31	18.31	19.10	0.96	4.64	1.74	0.37	0.83	1.48
CV (%)	11.33	10.07	10.43	9.21	9.64	8.00	10.70	10.51	9.07	10.30

RDF – Recommended dose of fertilizer; PSB – Phosphate solubilizing bacteria; SOB – Sulphuroxidizing bacteria

The maximum plant height recorded under the application of 75% RDF in combination with 5 t/ha biocompost + SOB @ 10 ml/kg seed (T_5) was 61.13, 117.53, 133.89 cm which remained at par with 75% RDF + 5 t/ha biocompost + PSB @ 10 ml/kg seed (T_4), 75% RDF + 5 t/ha Biocompost (T_3) and 50% RDF + 5 t/ha Biocompost + SOB @ 10 ml/kg seed (T_8) at 30, 60, 90 DAS. At 30, 60 and 90 DAS, number of leaves were found to be highest (6.79, 37.50, 12.09) under T_3 with application of 75% RDF + 5 t/ha biocompost followed by T_5 and T_4 which had 75% RDF + 5 t/ha biocompost + SOB @ 10 ml/kg seed, 75% RDF + 5 t/ha

biocompost + PSB @ 10 ml/kg seed respectively. Application of 75% RDF + 5 t/ha biocompost + PSB @ 10 ml/kg seed (T_4) resulted in higher number of branches (2.51, 6.17, 9.85) followed by T_5 75% RDF + 5 t/ha biocompost + SOB @ 10 ml/kg seed and T_3 75% RDF + 5 t/ha biocompost at 30, 60 and 90 DAS, respectively. This could be attributed to the use of organic manures such as biocompostin conjunction with inorganic fertilizers, which boosts nutrient availability over a longer period of crop duration due to the gradual release which helps in promoting plant height. Similar findings were reported by Choudhary *et al.* (2018). As biocompost improves soil's biological and physical properties, including the supply of nearly all essential nutrients for optimal plant growth and development, it may have facilitated creation of new tissues and leaves. Increased sulphur supply from SOB treatment improved growth parameters such as number of branches per plant due to better tissue differentiation. Sharma *et al.* (2017); Sahoo *et al.* (2018) reported similar results**.**

Yield attributes. Data illustrated in Table 2 clearly suggests that yield attributes under study *viz.*, number of siliquae per plant (238.50), length of siliqua (6.83), number of seeds per siliqua (13.68), test weight (4.18), seed yield (1801.40) and stover yield (3298.57) except harvest index, significantly increased with the application of 75 % RDF + 5 t/ha biocompost + SOB @ 10 ml/kg seed (T_5). Application of 75% RDF + 5 t/ha Biocompost + PSB @ 10 ml/kg seed (T_4) and 75% RDF + 5 t/ha Biocompost (T_3) also remained statistically at par with T_5. Harvest index (36.77) was found to be maximum with the application of 75% RDF + 5 t/ha biocompost + PSB @ 10ml/kg seed (T_4).Increased availability and supply of essential soil nutrients to the crop from its own nutrient pool and a higher amount of nutrients in the soil resulted in improved yield attributes. Increased plant nutrient absorption results in even higher assimilationrate in the fruiting part, *i.e.,* siliqua, which increases the contributing characters development. Higher sulphur availability may have accelerated the process of tissue differentiation from somatic to reproductive, meristematic activity and floral primordial development, resulting in significantly higher number of branches, flowers and siliqua, thus ultimately a higher seed and stover yield in the crop. Similar results are confirmed by Solanki *et al.* (2015); Kansotia *et al.* (2013); Singh *et al.* (2014).

Table 2: Effect of different treatments on yield attributes and yield of toria.

Treatment	No. of siliqua per plant	No. ofseeds per siliqua	Length of siliqua (cm)	Test weight(g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest Index (%)
T_1: Absolute Control	164.51	7.53	4.81	3.28	853.33	2083.33	29.09
T_2: 100 % RDF	179.30	10.06	5.50	3.62	1144.33	2403.10	32.26
T_3: 75% RDF + 5 t/ha biocompost	221.64	12.92	6.50	3.92	1663.31	2927.29	36.42
T_4: 75% RDF + 5 t/ha biocompost + PSB @10ml/kg seed	227.17	13.11	6.53	4.04	1749.67	3011.10	36.77
T_5: 75% RDF + 5 t/ha biocompost + SOB @10ml/kg seed	238.50	13.68	6.83	4.18	1801.40	3298.57	35.26
T_6: 50% RDF + 5 t/ha biocompost	205.64	11.17	5.74	3.77	1337.08	2674.17	33.33
T_7: 50% RDF + 5 t/ha biocompost + PSB @10ml/kg seed	209.03	11.14	5.71	3.79	1467.01	2707.28	35.14
T_8: 50% RDF + 5 t/ha biocompost + SOB @10ml/kg seed	213.23	11.57	5.77	3.89	1532.87	2781.13	35.49
SEm ±	9.71	0.69	0.34	0.09	88.39	170.11	1.64
CD (P=0.05)	29.44	2.09	1.04	0.27	268.10	515.97	NS
CV (%)	8.11	10.49	10.03	4.03	10.60	10.77	8.31

RDF – Recommended dose of fertilizer; PSB – Phosphate solubilizing bacteria; SOB – Sulphuroxidizing bacteria

Results revealed that the seed yield increased significantly by 34.10%, 94.91%, 105.40%, 111.10%, 56.68%, 71.91% and 79.63% over absolute control (T_1) under T_2, T_3, T_4, T_5, T_6, T_7 and T_8, respectively (Fig. 1). All growth and yield parameters of toria increased which could be due to integrated application of organic manures, fertilizers, sulphur, biocompost and phosphorus resulting in increased cell division and enlargement, which also increases photosynthesis, reduces respiration/transpiration and enhances water/nutrients uptake andtranslocation.

Economics. Total cost of cultivation, gross returns, net returns and B: C ratio for this experimental study as influenced by different treatments is presented in Table 3. It is evident that 75 % RDF +5 t/ha biocompost + SOB @ 10ml/kg seed (T_5) had the best gross returns (108060 ₹ ha^{-1}), net returns (79175.88 ₹ ha^{-1}) and BC ratio (2.74), followed by the application of 75 % RDF + 5 t/ha biocompost + PSB @ 10ml/kg seed (T_4).These findings are in confirmation with Ramesh *et al.* (2009); Rao (2003).

Table 3: Effect of different treatment on economics of toria.

Treatment	Fixed Cost (₹/ha)	Variable Cost (₹/ha)	Cost of Cultivation (₹/ha)	Gross returns (₹/ha)	Net Returns (₹/ha)	B:C
T_1: Absolute Control	17580	0	17580	51180	33600	1.91
T_2: 100 % RDF	17580	1717.5	19297.5	68640	49342.5	2.56
T_3: 75% RDF + 5 t/ha biocompost	17580	11288.12	28868.12	99780	70911.88	2.46
T_4: 75% RDF + 5 t/ha biocompost +PSB @ 10ml/kg seed	17580	11296.12	28876.12	104940	76063.88	2.63
T_5: 75% RDF + 5 t/ha biocompost +SOB @ 10ml/kg seed	17580	11304.12	28884.12	108060	79175.88	2.74
T_6: 50% RDF + 5 t/ha biocompost	17580	11858.75	29438.75	80220	50781.25	1.72
T_7: 50% RDF + 5 t/ha biocompost +PSB @ 10ml/kg seed	17580	11866.75	29446.75	88020	58573.25	1.99
T_8: 50% RDF + 5 t/ha biocompost +SOB @ 10ml/kg seed	17580	11874.75	29454.75	91920	62465.25	2.12

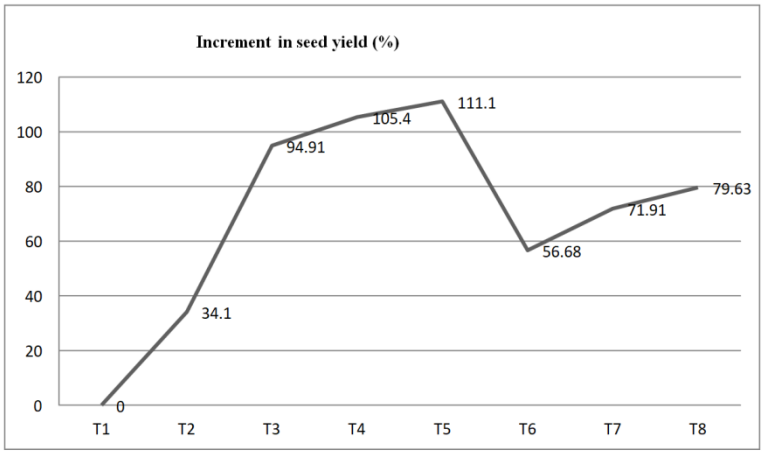

Fig. 1. Increment in seed yield (%) under various treatments over absolute control.

CONCLUSION

As evident from the results, application of 75% RDF + 5 t/ha biocompost in conjugation with either SOB or PSB produced better growth and yield attributes, yield and economic returns in toria. Therefore, it can be concluded that for achieving better crop productivity and profitability in toria, it is better to go with integrated nutrient management practices over sole use of chemical fertilizers. This will also aid in maintaining environmental quality as well as in achieving agricultural sustainability.

FUTURE SCOPE

The results of the current investigation would serve as a baseline for further research studies on integrated nutrient management as a successful alternative for excessive chemical use issue in states like Punjab to increase the productivity and profitability without posing threats to human and environmental health. In addition to inorganic fertilizers, other organic nutrient sources that were not investigated in this experiment such as FYM, vermicompost, green manures, green leaf manuring, oil cakes etc. should be studied and then conclusive suggestions can be made to local farmers to increase their profit and minimize chemical application in soil of Punjab.

Acknowledgement. The College of Agriculture at Lovely Professional University in Phagwara, India, provided the space and resources necessary for the research to be conducted, for which the authors are grateful. They appreciate the anonymous referee for making suggestions for improving the paper's presentation, as well as the organization's support and assistance for making work performance smooth.
Conflict of Interest. None.

REFERENCES

Choudhary, S., Tanvi, V. N., & Goyal, S. (2018). Response of sulphur oxidizing bacterial inoculation on growth and yield parameters of mustard (*Brassica juncea L.*). *International journal of Chemical Studies*, *6*(6): 2452-2457.

Deepa Sharma, Ishant Dutta and Prachi Choudhary (2022). Growth, Yield and Quality of Cauliflower (*Brassica oleracea* var. botrytis) as Affected by Integrated Nutrient Management under Low Hill Region of Himachal Pradesh. *Biological Forum – An International Journal, 14*(1): 508-512.

Kansotia, B., Meena, R. and Meena, V. (2013) Effect of biocompost and inorganic fertilizers on Indian mustard (*Brassica juncea* L.). *Asian Journal of Soil* Science, *8*(1): 136-139.

Mahanta, N., Kurmi, K., & Das, J. C. (2019). Conservation of Soil Moisture and Sustenance of Yield in Late Sown Toria in Sali Rice Fallows through Moisture

Conservation and INM Practices. *International Journal of Current Microbiology and Applied Sciences*, *8*(6): 556-563.

Mondal R. I., Begum, F., Aziz M. A., Sharif S. H. (2015). Crop sequences for increasing cropping intensity and productivity. *SAARC Journal of Agriculture*, *13*(1): 135–147.

Priyanka, R. P., Yadav, R., Kumar, N., & Dhillon, A. (2020). Performance of different Indian mustard (*Brassica juncea*) varieties with saline water and graded fertilizer doses under semi- arid conditions of Haryana. *Journal of Environmental* Biology, *41*: 1599-1604.

Ramesh, P., Panwar N. R., Singh A. B, Ramana S. (2009). Effect of organic nutrient management practices on the production potential nutrient uptake, soil quality, input use efficiency and economics of mustard (*Brassica juncea*). *Indian Journal of Agricultural Sciences*, *79*(1):40-44.

Rao, S. S. (2003). Nutrient balance and economics of integrated nutrient management ingroundnut (*Arachis hypogheal*)-mustard (*Brassica juncea* L.) cropping sequence. *Madras Agriculture Journal, 90*: 465, 471.

Sahoo, G. C., Santra, G. H., Biswas, P. K., & Mishra, S. (2018). Influence of doses and source of sulphur on yield, quality and economics of mustard (*Brassica camprestris var toria*) in red soil of Odisha. *Annals of Plant and Soil Research*, *20*(1): 46-51.

Sharma J. K., Jat Gajanand, Meena R. H., Purohit, H. S., & Choudhary R. S. (2017). Effect of biocompost and nutrients application on soil properties, yield, uptake and quality of Indian mustard (*Brassica juncea*). *Annals Plant Soil Research*, *19*(1): 17 -22.

Sindhi S. J., Thanki J. D. and Desai L .J. (2018). A review on integrated nutrient management (INM) approach for maize. *Journal of Pharmacognosy and Phytochemistry*, *7* (4): 3266-3269.

Singh, V., Verma, S., Srivastava, V. K., Mohd.A.K. and T. Aslam. (2014). Studies on integrated nutrient management in mustard [*Brassica juncea* (L.) Czern & Coss]. *International Journal of Agricultural Sciences, 10*(2):667-670.

Solanki R. L., Mahendra S., Sharma S. K., Purohit H. S. and Arvind,V. (2015). Effect of different levels of phosphorus, sulphur and PSB on the yield of Indian Mustard (*Brassica juncea* L.) and soil properties and available micronutrients. *Scholarly Journal of Agricultural Sciences*, *5*(9): 305-310.

Verma, R., K Singh, P., K Naresh, R., Sharath Chandra, M., Kumar Maurya, D., & Prakash Gupta, S. (2021). Effect of Integrated Nutrient Management (INM) Modules on yield, yield attributes and profitability of Indian mustard [*Brassica juncea* (L.)] in Western Uttar Pradesh. *International Journal of Environment and Climate Change*, *11*(12): 324-330.

How to cite this article: Sandal Choudhary, Barkha, Sayan Sau and Kangujam Bokado (2022). Productivity and Profitability of Toria (*Brassica campestris* L. var. *toria*) as Influenced by Integratednutrient management in Trans-Gangetic plains of Punjab. *Biological Forum – An International Journal*, *14*(2): 1446-1450.