Asian Research Journal of Agriculture

Volume 17, Issue 3, Page 168-174, 2024; Article no.ARJA.121585
ISSN: 2456-561X

Impact of Crop Configuration and Microbial Liquid Fertilizers on Growth and Yield of Oilseed *Brassica*

Abhishek Nanda [a*], Anil Shukla [a], Rajeew Kumar [a], M. S. Negi [a], Pavan Shukla [b] and Mahendra Choudhary [a]

[a] Department of Agronomy, GBPUAT, Pantnagar, 263145, India.
[b] Department of Horticulture, BAU, Saharsa, 852201, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/arja/2024/v17i3485

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/121585

Original Research Article

Received: 05/06/2024
Accepted: 08/08/2024
Published: 10/08/2024

ABSTRACT

Oilseeds are essential to the Indian economy. Rapeseed-mustard is one of the important edible oilseed crops in north India. Liquid fertilizers made from agricultural residues and waste are becoming increasingly popular due to their simple production process through fermentation Exploration of sustainable agricultural practices has led to the investigation of unconventional fertilizers for improving the stagnant oil seed yield. With this prior information, field experiments conducted at the Norman E. Borlaug Crop Research Centre of G.B. Pant University of Agriculture and Technology, Pantnagar study the effect of crop configuration and microbial liquid fertilizers on growth and yield of oilseed *Brassica* during 2022-23 and 2023-24. The experiment was laid out in split plot design with three replications. The experiment was consisting of one main factor i.e. crop configuration and a sub factor i.e. different types of microbial liquid fertilizers. Main plot consists of P_1- *Brassica juncea* in 22.5cm apart rows with alternate row extraction 30 DAS, P_2- *Brassica juncea*

---

*Corresponding author: E-mail: abhishekagro21@gmail.com;

Cite as: *Nanda, Abhishek, Anil Shukla, Rajeew Kumar, M. S. Negi, Pavan Shukla, and Mahendra Choudhary. 2024. "Impact of Crop Configuration and Microbial Liquid Fertilizers on Growth and Yield of Oilseed Brassica". Asian Research Journal of Agriculture 17 (3):168-74. https://doi.org/10.9734/arja/2024/v17i3485.*

in 22.5cm apart rows with 50:50 alternate row extraction 20 and 40 DAS, P_3- *Brassica napus* and *Brassica rugosa* in 22.5cm apart rows extracting *Brassica rugosa* 30 DAS, P_4 - *Brassica napus* and *Brassica rugosa* in 22.5cm apart rows extracting *Brassica rugosa* 50:50, 20 and 40 DAS. Sub plot consist of L_1 (liquid fertilizer 1), L_2 (liquid fertilizer 2), L_3 (liquid fertilizer 3), C (Control). Crop configuration and microbial liquid fertilizers significantly influenced growth and yield parameters. Plant height, dry matter production, leaf area index (LAI), no. of siliquae per plant and seed yield were significantly higher in plant configuration involving *Brassica napus* and *Brassica rugosa* in 22.5cm apart rows extracting *Brassica rugosa* 30 DAS and liquid fertilizer 3 in compare to others. Optimal crop configuration like P_3 with tailored fertilizer, L_3 improved the growth and yield of *Brassica* species in compare to others.

Keywords: Brassica; crop configuration; microbial liquid fertilizers.

ABBREVIATIONS

LAI	*: Leaf Area Index*
HI	*: Harvest Index*

1. INTRODUCTION

Edible oils from plants are vital for human nutrition and are key components in many industrial products. India stands out as one of the top global producers of oilseeds, which are crucial to its economy. Among these, rapeseed-mustard is especially important, ranking just behind groundnut and soybean as a primary edible oilseed crop. Despite being the fourth-largest producer of vegetable oil globally, following China, Brazil, and the United States, India still imports a substantial amount of oilseeds to meet domestic demand. Rapeseed-mustard, part of the Brassicaceae family, is a crucial source of edible oils in India. Ranking fourth globally in both area and production, India follows the European Union, Canada, and China in cultivating this crop. Rapeseed-mustard thrives as a winter crop in cooler temperatures with adequate soil moisture during growth and dry conditions for harvest [1].

Plant density significantly impacts seed yield and other important agronomic traits. In oilseed rape, row spacing and plant density vary worldwide, depending on the environment, production system, and cultivar [2]. Various nutrients and micronutrients are essential for the growth of oilseed crops, particularly those in the Brassicaceae family [3]. Modern agriculture has relied heavily on fertilizers, boosting grain yields worldwide over the past six decades. However, prolonged use of chemical fertilizers has also resulted in declining crop yields and soil fertility in intensive farming systems [4]. This has led to the adoption of integrated plant nutrient management, emphasizing the need for sustainable and eco-friendly alternatives like manures and green manures to meet crop nutrient requirements without harming the environment [5]. Using renewable sources and inputs is a key concept in sustainable agriculture, aiming for maximum crop productivity with minimal environmental impact. Therefore, achieving higher yields with reduced environmental risks necessitates new cultivation techniques that incorporate organic and liquid fertilizers [6].

2. MATERIALS AND METHODS

A field experiments was conducted at the Norman E. Borlaug Crop Research Centre of G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, which is located at the foothills of Himalayas during *Rabi* season of 2022-23 and 2023-24. The experiment was laid out in split plot design with three replications. The experiment was consisting of one main factor i.e. crop configuration and sub factor i.e. different types of microbial liquid fertilizers. A total 16 treatments formed with combinations of four Main plot i.e. P_1- *Brassica juncea* in 22.5cm apart rows with alternate row extraction 30 DAS, P_2- *Brassica juncea* in 22.5cm apart rows with 50:50 alternate row extraction 20 DAS and 40 DAS, P_3- *Brassica napus* and *Brassica rugosa* in 22.5cm apart rows extracting *Brassica rugosa* 30 DAS, P_4- *Brassica napus* and *Brassica rugosa* in 22.5cm apart rows extracting *Brassica rugosa* 50:50, 20 and 40 DAS and four Sub plot consist of L_1 (liquid fertilizer 1), L_2 (liquid fertilizer 2), L_3 (liquid fertilizer 3), C (Control).

The crop was provided with spacing of 22.5cm, with the alternate rows were removed as per the treatments with final spacing becoming 45cm, and 6.3 m × 5 m = 31.5 m^2 plot size. Microbial liquid fertilizers were prepared with organic and inorganic substances like locally available weeds and fresh cow dung and named as liquid fertilizer 1, 2 and 3 as these are under initial stage of product development. They were applied at the time of sowing as soil drenching while in control plot, only water was applied. The data were analyzed with computer-based program and the treatment comparisons were made at 5 per cent level of significance [7].

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

At harvest, *B. napus* plant grew much taller than that of *B. juncea* and the difference was significant. This could be attributed to the growth habit and the crop duration of the two species, where *B. juncea* quickly attains growth and matures, in general, by 125 -130 days, *B. napus* grows slow initially and picks up later maturing about a month later than *B. juncea.* As far as the crop configurations are concerned, extraction for leaf vegetable 30 DAS resulted in taller plants as compared to the plots where extraction was made 50:50 at 20 and 40 DAS. This indicates that while *B. juncea* configurations are beneficial in the early stages, *B. napus* configurations support better final growth, possibly due to differences in growth dynamics and nutrient requirements of the species. Similar observations were made by Thomas et al. [8], who noted species-specific growth responses in *Brassic*a under different agronomic practices. The single extraction at 30 DAS provided more space for growth and development of seed crop at relatively an early stage producing taller plants. This suggests that reducing intra-species competition early on can significantly benefit plant height, as also noted by Verma et al. [9], who reported enhanced growth parameters with optimal crop spacing and configuration. However, the difference during the two modules of extraction was not significant in case of *B. juncea* as well as *B. napus* during both the years of experimentation. The microbial liquid fertilizers influenced the plant height of *Brassica* species significantly. Application of the liquid fertilizer 3 produced the tallest plant at all the stages of growth during both the years of study which was significantly superior over that of the other liquid fertilizers [10]. The liquid fertilizer 2, however, remained statistically at par during 2022-23 only. The higher presence of essential nutrients in liquid fertilizer 3, including macronutrients and micronutrients with microbial populations, likely contributed to the enhanced plant height. The nitrogen and zinc helped in biosynthesis of plant growth hormones *viz*., auxin, tryptophan and cytokinin which induces acidification of apo plasm, cell extension and cell division; and increases the length of nodes and internodes. Similar findings have been reported by Sutar et al. [11].

The dry matter accumulation of *Brassica* species, in general, increased with advancement of crop age. *B. napus* plants produced more dry matter accumulation than that of *B. juncea* and the difference was significant. The liquid fertilizers influenced the dry matter accumulation of *Brassica* species significantly. With application of the liquid fertilizer 3, more dry matter was accumulated at all the stages of growth during both the years of study which was significantly superior over that of the other liquid fertilizers. Higher dry matter accumulation in the liquid fertilizer 3 might be due to better nutrient content which enhances the dry matter accumulation by increasing photosynthetic activity in plants. The increase in root growth might absorbed more amount of nutrients from the soil and increased the dry matter accumulation in plant. Similar trends were observed by Kumar et al. [12], who noted positive effects of strategic nutrient management on dry matter accumulation in *Brassica* species.

Leaf area index (LAI) is an important parameter of growth analysis because it is a measure of the number of leaves per unit area which in turn into directly related to growth and development of plant. The LAI of *Brassica species* in general, increased with advancement of crop age. The plants of *B. napus* shown higher LAI than that of *B. juncea* and the difference was significantly at the harvesting stage. This could be attributed to the growth habit and bigger leaf size of *B. napus* in compare to *B. juncea.* As per as the configurations are concerned, extraction for leaf vegetable 30 DAS shown significantly higher LAI as compare to the plots where extraction was made 50:50 at 20 and 40 DAS during later stages while during initial days the difference was not significant. The microbial liquid fertilizers influence the Leaf area index (LAI) of *Brassica* species significantly. With the application of liquid fertilizer 3, shown higher LAI at all stages of growth during both the years of study. The interaction between crop configuration and microbial liquid fertilizers was not found significant.

3.2 Yield Parameters

Extraction of *B. rugosa* for leaf vegetable in *B. napus* plots 30 DAS had the highest number of siliquae per plant in both years significantly superior over to that of other crop configurations. The 50:50 row extraction of *B. rugosa* 20 and 40

Table 1. Effect of crop configuration and microbial liquid fertilizers on growth parameters of oilseed *Brassica*

Treatments	**Plant height (cm)**		**Dry matter accumulation (g)**		**LAI**	
	2022-23	**2023-24**	**2022-23**	**2023-24**	**2022-23**	**2023-24**
Crop configuration (P)						
P_1 (*B. juncea*; alternate row extraction 30 DAS)	181.3	192.5	49.53	50.61	3.19	3.28
P_2 *(B. juncea*; 50:50 alternate row extraction 20 and 40 DAS)	172.6	181.2	45.78	46.56	3.03	3.10
P_3(*B. napus;* with *B. rugosa* row extraction 30 DAS)	205.8	216.3	54.12	56.17	4.39	4.39
P_4 (*B. napus;* with *B. rugosa* 50:50 row extraction 20 and 40 DAS)	201.8	210.4	50.28	52.28	4.22	4.21
SEm±	2.4	3.9	0.57	0.85	0.05	0.06
CD (P=0.05)	8.4	11.4	1.99	2.94	0.14	0.17
Microbial liquid fertilizer (L)						
L_1 (Liquid fertilizer 1)	186.8	195.8	49.07	50.18	3.72	3.73
L_2 (Liquid fertilizer 2)	193.3	203.1	50.52	52.26	3.75	3.77
L_3 (Liquid fertilizer 3)	201.1	211.3	52.78	54.46	3.89	3.92
C (Control)	179.9	190.1	47.21	48.52	3.64	3.61
SEm±	2.4	2.5	0.66	0.82	0.04	0.05
CD (P=0.05)	7.0	7.4	1.93	2.34	0.11	0.13
Interaction (PXL)	NS	NS	NS	NS	NS	NS

Table 2. Effect of crop configuration and microbial liquid fertilizers on yield parameters of oilseed *Brassica*

Treatments	**Number of siliquae per plant**		**Seeds per siliqua**		**Seed yield (kg/ha)**		**HI**	
	2022-23	**2023-24**	**2022-23**	**2023-24**	**2022-23**	**2023-24**	**2022-23**	**2023-24**
Crop configuration (P)								
P_1(*B. juncea*; alternate row extraction 30 DAS)	181.3	192.5	15.27	15.29	1719	1820	22.2	22.4
P_2 *(B. juncea*; 50:50 alternate row extraction 20 and 40 DAS)	172.6	181.2	14.95	14.98	1552	1651	22.3	22.5
P_3(*B. napus;* with *B. rugosa* row extraction 30 DAS)	205.8	216.3	18.92	20.71	2129	2257	22.9	23.3
P_4 (*B. napus;* with *B. rugosa* 50:50 row extraction 20 and 40 DAS)	201.8	210.4	18.56	19.46	1981	2108	22.7	22.9
SEm±	2.4	3.9	0.27	0.32	40	37	0.5	0.2
CD (P=0.05)	8.4	11.4	0.95	0.96	137	126	NS	NS
Microbial liquid fertilizer (L)								
L_1 (Liquid fertilizer 1)	186.8	195.8	16.61	17.25	1764	1871	22.4	22.6
L_2 (Liquid fertilizer 2)	193.3	203.1	17.17	17.83	1891	2008	22.7	22.8
L_3 (Liquid fertilizer 3)	201.1	211.3	17.82	18.42	2048	2180	22.8	23.1
C (Control)	179.9	190.1	16.12	16.71	1678	1778	22.0	22.2
SEm±	2.4	2.5	0.29	0.27	36	35	0.3	0.4
CD (P=0.05)	7.0	7.4	0.86	0.81	104	104	NS	NS
Interaction (PXL)	NS	NS	NS	NS	NS	NS	NS	NS

DAS in *B. napus* plots also produced significantly higher number of siliquae per plant over that of the two configurations involving *B. juncea*. The

alternate row extraction of *B. juncea* row at 30 DAS for leaf vegetable also remains significantly superior over its 50:50 alternate row extraction at 20 and 40 DAS in terms of number of siliquae per plant during both years. As a long duration species *B. napus* had long vegetative and reproductive phases than that of *B. juncea,* which made it to cope up with initial competition and improved its siliquae per plant.

Extraction of *B. rugosa* for leaf vegetable in *B. napus* plots 30 DAS shown the highest number of seeds per siliqua statistically at par with the 50:50 row extraction of *B. rugosa* 20 and 40 DAS but significantly higher than the configurations involving *B. juncea*. It aligns with findings that *B. napus* generally produces more seeds per siliqua compared to *B. juncea* [13]. Among microbial liquid fertilizers, liquid fertilizer 3 again was superior among fertilizers in compare to others, suggesting that nutrient-rich liquid fertilizers enhance seed setting and development [14]. These results demonstrate the importance of selecting appropriate crop configurations and liquid fertilizers to optimize the yield components of *Brassic*a species. The extraction of *B. rugosa* for leaf vegetable in *B. napus* plots 30 DAS configuration. Among microbial liquid fertilizers, liquid fertilizer 3 outperformed others with significantly higher number of siliquae during both the years in comparison to others, highlighting the effectiveness of the microbial fertilizers in promoting reproductive growth. The number of siliquae per plant and number of seeds per siliquae was recorded more in liquid fertilizer 3 during both years was due to production of a greater number of branches per plant which has eventually increased flowers and more siliquae and seeds. Studies have shown that liquid fertilizers can significantly improve the reproductive traits of crops [15].

Extraction of *B. rugosa* for leaf vegetable in *B. napus* plots 30 DAS produced the maximum seed yield being significantly superior over to that of other crop configurations during both the years. The 50:50 row extraction of *B. rugosa* 20 and 40 DAS in *B. napus* plots also produced significantly higher seed yield over that of the two configurations involving *B. juncea*. The higher seed yield in these treatments is the result of a greater number of branches per plant as well as a greater number of siliquae per plant and more numbers of seeds per siliqua. The increase in seed yield is largely a function of improvement in the yield attributes. The alternate row extraction of *B. juncea* row at 30 DAS for leaf vegetable also remains significantly superior over its 50:50 alternate row extraction at 20 and 40 DAS in terms of seed yield. Among the microbial liquid fertilizers, liquid fertilizer 3 produced significantly superior seed yield over that of other liquid fertilizers.

The grain yield of mustard crop depends on length of grain filing phase with amount of photosynthetic area available, sink potential to store photosynthetic assimilates and rate of assimilation from source to sink. Even as a long duration species, *B. napus* had a long vegetative and reproductive growth in compare to *B. juncea,* which made it to cope up with initial competition, culminating in higher yield attributing characters. In present study, significantly more grain yield was observed in liquid fertilizer 3, which might be due to improved nutrient content in microbial fertilizers, which helped in production of more dry matter, number of branches and yield attributes. The more chlorophyll content was also observed with similar treatments which probably enhanced photosynthetic activity and produced more assimilates as compared to other liquid fertilizers. The results are in line with finding of Dixithgouda et al. [16] and Yi et al., [17].

The harvest index (HI) was relatively consistent across all the crop configurations and the liquid fertilizers. Extraction of *B. rugosa* for leaf vegetable in *B. napus* plots 30 DAS had the highest HI, indicating a more efficient conversion of biomass into seed yield. Among the fertilizers, liquid fertilizer 3 had the highest HI. The interaction between crop configuration and microbial liquid fertilizers was not found significant.

4. CONCLUSION

With altered plant configuration, *B. napus;* with *B. rugosa* row extraction 30 DAS along with tailored source of nutrients i.e. liquid fertilizer 3 made of using organic and inorganic materials can improve the growth and yield of *Brassica* species which can pave the way for sustainable agriculture with improved fertilization and even can be acted as a new source of fertilizer.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Chauhan JS, Singh KH, Singh VV, Kumar S. Hundred years of rapeseed mustard breeding in India: accomplishments and future strategies. Indian J. Agric. Sci.2011;81(12):1093-1109
2. Sonani VV, Patel PT, Patel GG. Performance of mustard under different dates of sowing in Bhal and Coastal Agro-climatic zone of Gujarat. J. Oilseeds Res. 2002;19(1):122.
3. Yadav HK, Thomas T, Khajuria V. Effect of different levels of sulphur and biofertilizer on the yield of Indian mustard (*Brassica juncea* L.) and soil properties. J. Agric. Phys. 2010;10:61-65.
4. Dadhich SK, Somani LL, Shilpkar D. Effectof integrated use of fertilizer P, FYM andbiofertilizers on soil properties and productivityof soybean-wheat crop sequence. J. Adv. Dev.Res. 2011;2:42-46.
5. Unnikrishnan G, Vijayaraghavan R. Utilization of liquid fertilizers for agro-industrial waste management and reducing challenges through nano-encapsulation-a review. Indian J. Agric. Res. 2019;53(6):641-645.
6. White B, Tubana BS, Babu T Jr. Mascagni H, Agostinho F, Datnoff LE. Effect of silicate slag application on wheat grown under two nitrogen rates. Plants. 2017;6:1–14.
7. Gomez KA, Gomez AA. Statistical procedures for agricultural research (2 ed.). John wiley and sons, New York, USA. 1984;181.
8. Thomas WJW, Edwards D Batley J. The genetic basis of yield and yield stability in major crops. Plants. 2022;11(20):2740.
9. Verma VK, Vaghela PK, Singh NB, Kumar M. Impact of organic modules on higher value crop mustard (*Brassica juncea* L.). Int. J. Res. Agron. 2024;7(3):650-658. DOI:10.33545/2618060X.2024.v7.i3i.495
10. Jayara AS, Kumar R, Shukla A, et al. Impact of Nano-Fertilizers and Modified Indigenous Minerals on Biomass Accumulation, Root Growth, and Soil Parameters in Wheat. J Soil Sci Plant Nutr; 2024.
11. Sutar R, Sujith GM, Devakumar N. Growth and yield of cowpea (*Vigna unguiculata* L. Walp) as influenced by jeevamrutha and panchagavya application. Leg. Res. 2019;42(6):824-828.
12. Kumar VK, Vaghela PK, Singh NB, Kumar M. Impact of organic modules on higher value crop mustard (*Brassica juncea* L.). Int. J. Res. Agron. 2024;7(3):650-658.
13. Rathore SS. Growth and yield of Indian mustard (*Brassica juncea*) as influenced by different levels of nitrogen and phosphorus. J. Oilseeds Brassica. 2015;6(2):317-321.
14. Di Stasio E, Rouphael Y, Colla G, Raimondi G, Giordano M, Pannico A, El-Nakhel C, De Pascale S. The influence of Ecklonia maxima seaweed extract on growth, photosynthetic activity, and mineral composition of Brassica rapa L. subsp. sylvestris under nutrient stress conditions. Eur. J. Hortic. Sci. 2017;82(6): 286-293
15. El Boukhari MEM, Barakate M, Bouhia Y, Lyamlouli K. Trends in seaweed extract-based biostimulants: manufacturing process and beneficial effect on soil-plant systems. Plants. 2020;9(3):359.
16. Dixithgouda Dhanoji MM, Meena MK, Suma TC, Khan H. Influence of foliar organic nutrition on morphological, yield and yield components of groundnut (*Arachis hypogaea* L.). Int. J. Chem. Stud. 2020;8(1):2173-2175.
17. Yi H, Xu G, Cheng H, Wang J, Wan Y, Chen H. An overview of utilization of steel slag. Procedia J. Environ. Sci.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/121585