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EFFECT OF ORGANIC AND INORGANIC NUTRIENT COMBINATIONS ON THE GROWTH AND YIELD OF GOBHI SARSON (*BRASSICA NAPUS* L.)

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ABSTRACT

A field experiment entitled "Effect of Organic and Inorganic Nutrient Combinations on the Growth and Yield of Gobhi sarson (*Brassica napus* L.)" was conducted at the Student's Research Farm, Department of Agronomy, Guru Kashi University, Talwandi Sabo, Bathinda during the *Rabi* season of 2024-25. The experiment was conducted in Randomized Block Design (RBD) and consisted of eleven treatments, T_1 Control, T_2 (100% RDN), T_3 (75% RDN+ 5 t FYM ha^{-1}), T_4 (75% RDN + 5 t FYM ha^{-1}+ *Azotobacter* 20 mL ha^{-1}), T_5 (75% RDN + *Azotobacter* 20 mL ha^{-1}), T_6 (50% RDN + 10 t FYM ha^{-1}), T_7 (50% RDN + 10 t FYM ha^{-1} + *Azotobacter* 20 mL ha^{-1}), T_8 (50% RDN + *Azotobacter* 20 mL ha^{-1}), T_9 (100% RDN + 2.5 t FYM ha^{-1}), T_{10} (100% RDN + 2.5 t FYM ha^{-1} + *Azotobacter* 20 mL ha^{-1}) and T_{11} (100% RDN + *Azotobacter* 20 mL ha^{-1}) with three replications. Results of the treatment revealed that traits of the plant such as plant height, number of branches, number of siliquae per plant, number of seeds per silique and 1000 seed weight were maximum in T4 (75% RDN+ 5 t FYM ha^{-1} + *Azotobacter* 20 mL ha^{-1}). Grain and stover yield of 25.40 q ha^{-1} and 59.79 q ha^{-1} respectively with HI (29.91%) of mustard was significantly influenced by fertilizer application. The T4 was statistically at par with T10 (100% RDN + 2.5 t FYM ha^{-1}+ *Azotobacter* 20 mL ha^{-1}). Treatment 1 (Control) exhibited the worst performance due to improper nutrient supply optimum for growth and yield. Results of this field experiment indicates that the use of organic and inorganic combinations are helpful in increasing the productivity.

***Keywords*:** Biofertilizers, *Azotobacter*, FYM, *Brassica napus*, Siliquae

Introduction

Gobhi sarson (*Brassica napus* L.) which is also known as Winter rape is an annual herbaceous crop which is most typically grown for its leaves and its seed. It belongs to the category of Rapeseed-Mustard. It belongs to the Brassicaceae family. It is accepted that the origin of Gobhi sarson is in the Mediterranean Europe region (OECD, 2012; Rakow, 2004). The average height of the crop is around 1.5 metres tall when it is fully mature. It possesses hairless leaves which are alternately arranged along the main axis and it is commonly used as a leafy vegetable to prepare dishes such as *saag* in India, popularly in the state of Punjab. The plant produces yellow-coloured sepals which are 1.5 mm in breadth and 6 mm in length and usually flowers during February - March when timely sown during *Rabi* season (OECD, 2012). The seeds of the crop have high nutrition values with oil content of 38 - 46% depending upon the varieties and also a protein content of around 28 - 36% making it suitable for wide use for cooking, industrial applications and also as a source of animal feed after oil extraction. Rapeseed is an important source of both vegetable oil and bio fuel for the world (Zheng *et al.*,2022) and is one of the most important and significant oilseed crops in the world among major oilseeds (Liu *et al.*,2022) .

Generally, farmers rely upon inorganic fertilizers since they quickly supply essential nutrients like nitrogen, phosphorus and potassium (Sharma *et al.*, 2021). But, overusing these fertilizers leads to soil health problems and increases in the cost of production (Meitei and Bajpay, 2019). In order to overcome these challenges, the combined usage of organic fertilizers such as farmyard manure along with chemical fertilizers and also with the use of biofertilizers such as *Azotobacter*, *Azospirillum*, PSB + KMB etc. has been studied to enhance soil fertility and crop performance.

The integrated nutrient management practice offers many advantages which includes improving the physical and biological properties of the soil, which leads to better nutrient availability and crop growth (Deekshith *et al*., 2023). Various researches has shown that the combined usage of organic manures with chemical fertilizers improves plant height, leaf area, dry matter production and yield components like siliquae and seed number per siliquae (Meitei and Bajpay, 2019; Sharma *et al*., 2021). Such practice can also lower costs of farming by reducing the dependence on chemical fertilizers while maintaining yields (Bains and Kumari, 2021). So, the use of integrated nutrient management results in greater nutrient use efficiency. It gives significant increase in both the productivity and production of rapeseed and mustard crops (Shekhawat *et al*., 2012; Kumar, 2012).

Materials and Methods

The field experiment was carried out during the *Rabi* season of 2024 and 2025 at the Student's Research Farm of the Department of Agronomy, Guru Kashi University, Bathinda, Punjab, India. The soil of the experimental field was sandy loam having a pH of 7.5, electrical conductivity 0.28 dS m^{-1}, organic carbon content 0.41%, available N 234.1 kg ha^{-1}, available P_2O_5 17.9 kg ha^{-1} and available K_2O 229.7 kg ha^{-1}. The experiment consisted of 11 treatments which were laid out in the field in Randomized Block Design (RBD) pattern with three replications. The variety selected for the experiment is GSC 7 with a seed rate of 4 kg ha^{-1}. A row to row spacing of 45 cm and a plant to plant spacing of 20 cm was applied. Nitrogen fertilizer via urea was applied in 3 split doses, with 50 percent of dose as basal application and remaining 2 doses as equal 25 percent split doses at 30 and 60 days after sowing (DAS). For the treatments requiring biofertilizers, seed treatment with 20 mL of *Azotobacter* inoculant mixed with 50 grams of jaggery along with 1 kg of seed in 300 mL of lukewarm water was done. The details of the treatments are presented in Table 1.

Table 1: List of treatments

Treatment no.	Treatments
T_1	Control
T_2	100% RDN
T_3	75% RDN+ 5 t FYM ha^{-1}
T_4	75% RDN + 5 t FYM ha^{-1} +*Azotobacter* 20 mL ha^{-1}
T_5	75% RDN + *Azotobacter* 20 mL ha^{-1}
T_6	50% RDN + 10 t FYM ha^{-1}
T_7	50% RDN + 10 t FYM ha^{-1} + *Azotobacter* 20 mL ha^{-1}
T_8	50% RDN + *Azotobacter* 20 mL ha^{-1}
T_9	100% RDN + 2.5 t FYM ha^{-1}
T_{10}	100% RDN + 2.5 t FYM ha^{-1} + *Azotobacter* 20 mL ha^{-1}
T_{11}	100% RDN + *Azotobacter* 20 mL ha^{-1}

Statistical Analysis

The recorded data was statistically analysed in a Randomized Block Design according to analysis of variance for judging of the effect of different treatments on the various attributes of Gobhi sarson as described by Panse and Sukhatme (1984). The significance of the differences of treatments were being tested using OPSTAT software (Sheoran *et al*.,1998) at 5 percent level of significance.

Results and Discussion

Growth parameters

The data regarding the effects of various organic and inorganic nutrient combinations on the growth parameters of Gobhi sarson are presented in Table 2. The plant height was recorded highest in T_4 plots which maintained the lead with 164.66 cm followed by T_3 (161.98 cm) and T_{10} (161.16 cm) which are statistically at par with each other. This shows that partial substitution of chemical fertilizers with FYM and *Azotobacter* supports growth throughout the life cycle of the plant. The results are in line with the findings of Basu *et al.* (2021).

T_4 exhibited the significantly highest number of branches at 8.30 followed by T_{10} (8.04) and T_{11} which were statistically at par with each other. This can be explained by the improved soil microbial activity and nitrogen fixation promoted by *Azotobacter* and FYM inputs. The outcomes are in line with reports of Das *et al.* (2021).

Dry Matter Accumulation DMA was also significantly highest in T_4 at 176.51 g plant^{-1}. This could be due to the nutrient balance and improved biological soil activity which are in line with the findings of Yadav *et al.* (2020).

In terms of Leaf Area Index (LAI), T_4 and T_{10} stood out as the most effective with T_4 recording the highest LAI at 3.45 which was at par with T_{10} (3.34). These findings are consistent with earlier reports by Choudhary *et al.* (2011) who saw improved vegetative growth and leaf area under integrated nutrient management practices in mustard and related *Brassica* species.

Yield attributes:

The data regarding the effects of various organic and inorganic nutrient combinations on the yield attributes of Gobhi sarson are presented in Table 3. The significantly highest number of siliquae per plant was observed in T_4 at 296.66 followed by T_{10} and T_3 at 289.35 and 282.46 respectively which are statistically at par with each other. This is due to the synergy among these different organic and inorganic nutrient sources which improved soil structure, microbial activity and nutrient availability at critical reproductive stages as earlier reported by Yadav *et al.* (2016) and Meena *et al.* (2017).

T_4 recorded the significantly highest number of seeds per siliquae with an average of 20.78 seeds per siliquae followed by T_{10} at 20.73 being statistically at par with each other. These outcomes align with earlier findings in *Brassica* species where integrated nutrient management was shown to improve seed setting and yield components as reported by Singh and Meena (2014).

1000 seed weight of 4.17 was recorded in T_{10} and T_{11} followed by T_4 at 4.11 which are statistically at par with each other. This could be explained by improved seed quality resulting from partial substitution of inorganic fertilizers with organic sources with the support of microbial inoculants. The results are in line with earlier findings of Saha *et al.* (2018).

Among all the treatments, T_4 achieved the significantly highest grain yield of 25.40 q ha^{-1} which was at par with T_{10} with 24.87 q ha^{-1}. Similar trend was observed in terms of biological yield where T4 gave significantly higher biological yield at 85.19 q ha^{-1} followed by T_{10} at 83.93 q ha^{-1} being statistically at par with each other. This could be explained by the adequate and balanced nutrient availability leading to higher amounts of photosynthesis resulting in increased photosynthate production and their translocation from leaves to other parts of the plant. The results observed are in line with Das *et al.* (2021).

In terms of Harvest index, T_4 recorded the highest HI at 29.91% which suggests the highest efficient allocation of biomass toward seed formation. Close contenders were T_{10} and T_3 at 29.53% and 29.03% respectively which were statistically at par with each other being significantly higher than the control and other treatments.

Table 2: Effect of organic and inorganic nutrient combinations on growth parameter of Gobhi sarson

No.	Treatments	Plant height (cm)	No. of branches per plant	DMA (g plant^{-1})	Leaf Area Index (LAI)
T_1	Control	31.71	5.93	121.08	2.08
T_2	100% RDN	54.81	6.70	149.05	2.77
T_3	75% RDN+ 5 t FYM ha^{-1}	61.98	7.70	163.09	3.10
T_4	75% RDN + 5 t FYM ha^{-1} + *Azotobacter* 20 mL ha^{-1}	164.66	8.30	176.51	3.45
T_5	75% RDN + *Azotobacter* 20 mL ha^{-1}	151.76	7.73	160.24	3.00
T_6	50% RDN + 10 t FYM ha^{-1}	143.96	6.92	139.09	2.40
T_7	50% RDN + 10 t FYM ha^{-1} + *Azotobacter* 20 mL ha^{-1}	51.29	7.62	151.67	2.83
T_8	50% RDN + *Azotobacter* 20 mL ha^{-1}	38.08	6.54	134.26	2.19
T_9	100% RDN + 2.5 t FYM ha^{-1}	51.66	7.27	165.30	2.90
T_{10}	100% RDN + 2.5 t FYM ha^{-1} + *Azotobacter* 20 mL ha^{-1}	61.16	8.04	170.18	3.34
T_{11}	100% RDN+ *Azotobacter* 20 mL ha^{-1}	60.26	7.92	170.47	3.21
	CD (0.05)	7.46	0.27	4.32	0.17
	SE (m) ±	2.53	0.09	1.46	0.015
	CV (%)	7.90	5.21	9.64	9.93

Table 3: Effect of organic and inorganic nutrient combinations on yield attributes of Gobhi sarson:

No.	Treatments	No. of silique per plant	No. of seeds per silique	Test weight (g)	Grain yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest index (%)
T_1	Control	188.12	18.15	3.81	15.24	56.50	27.15
T_2	100% RDN	272.20	19.42	4.05	22.57	77.21	28.70
T_3	75% RDN+ 5 t FYM ha^{-1}	282.46	20.13	4.04	23.99	83.07	29.03
T_4	75% RDN+ 5 t FYM ha^{-1} +*Azotobacter* 20 mL ha^{-1}	296.66	20.78	4.11	25.40	85.19	29.91
T_5	75% RDN + *Azotobacter* 20 mL ha^{-1}	278.46	19.93	4.12	23.34	80.65	29.02
T_6	50% RDN+ 10 t FYM ha^{-1}	250.44	18.56	3.94	20.43	72.73	28.01
T_7	50% RDN+ 10 t FYM ha^{-1} +*Azotobacter* 20 mL ha^{-1}	260.78	19.49	3.97	21.91	77.76	28.71
T_8	50% RDN + *Azotobacter* 20 mL ha^{-1}	237.55	18.12	3.84	18.70	67.25	27.20
T_9	100% RDN + 2.5 t FYM ha^{-1}	272.09	19.38	4.08	22.82	79.19	28.66
T_{10}	100% RDN + 2.5 t FYM ha^{-1} + *Azotobacter* 20 mL ha^{-1}	289.35	20.73	4.17	24.87	83.93	29.53
T_{11}	100%RDN+*Azotobacter* 20 mL ha^{-1}	279.59	19.99	4.17	22.58	80.81	28.97
	CD (0.05)	14.18	0.78	0.106	1.06	1.76	1.30
	SE (m) ±	4.8	0.26	0.036	0.36	0.8	0.44
	CV (%)	6.14	8.34	11.73	7.86	8.14	8.67

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