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Influence of Nitrogen and Phosphorus Application on Crop Productivity and Profitability of Gobhi Sarson (*Brassica napus* L.)

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Abstract

The field experiment was conducted at Agriculture Research Farm, RIMT University, Mandi Gobindgarh (Punjab) during the *rabi* season of 2023-24 to study the "Influence of nitrogen and phosphorus application on crop productivity and profitability of Gobhi sarson (*Brassica napus* L.)". The experiment consisted of nine treatments combination with nitrogen and phosphorus levels. The experiment comprised of three level of nitrogen viz., (75 kg, 100 kg and 125 kg N/ha) and three levels of phosphorus viz., (20 kg, 30 kg and 40 kg P_2O_5/ha) were tested in Randomized Block Design (RBD) with three replications. Observation concerning growth parameters, yield attributes and seed yield of *Gobhi sarson* was recorded. The application of 125 kg/ha N + 40 kg/ha P_2O_5 treatment had the highest values for growth characteristics like plant population, plant height, number of branches/plants, chlorophyll content, yield characteristics like number of siliqua/plants, number of seed/siliqua, siliqua length (cm), test weight, grain yield, straw yield and also economically viable like net return and B:C ratio over rest of the treatments.

***Key words*:** *Brassica napus* L, Nitrogen, Phosphorus, Growth parameter, Yield attributes, Yield, Economics

After cereals in the field crop category, oilseed crops rank second in importance to the agricultural economy. India is the 4th largest oilseed producer in the world. It has 20.8% of the total area under cultivation globally, accounting for 10% of global production [1]. The country produces groundnut, soybean, Niger seed, sunflower, safflower, sesamum and mustard. Vegetable oils are mostly derived from nine oilseeds, which are mostly produced on an area of roughly 26 million ha under rainfed conditions [2]. In India, oilseed cultivated over an area of about 302.39 lakh hectares with an annual production of 413.55 lakh tonnes and an average yield of 1368 kg/ha, placing it as the fourth-largest oilseed producing nation in the world, behind the United States, China, and Brazil. In Punjab, oilseed cultivated over an area of about 0.59 lakh hectares, production of 0.93 lakh tonnes and productivity of 1566 kg/ha [3]. Under proper agronomic management, Gobhi Sarson can yield 20-25 quintals per hectare in irrigated conditions and 12-15 quintals per hectare in rainfed conditions. The introduction of high-yielding hybrid varieties and sustainable practices has significantly improved its productivity.

Gobhi Sarson (*Brassica napus* L.), commonly known as rapeseed or canola, is an important oilseed crop cultivated in India, particularly in northern states such as Punjab, Haryana, and Jammu & Kashmir. It is a high-yielding, short-duration crop that fits well into multiple cropping systems. Its productivity and profitability depend on various agronomic, environmental, and economic factors, including soil fertility, climate, input use efficiency, and market dynamics. Rapeseed also known as *gobhi sarson*, it has been cultivated in Asia, Europe and North-western Africa since ancient times as a source of oil for food, lamps, soap and later for industrial purposes. With 12% of the global output, India ranks third among rapeseed-mustard producers, behind China and Canada. Rapeseed is an important source of vegetable oil and bio fuel for the world [4].

Fertilization of rapeseed and mustard with nitrogen, phosphate, and potassium is essential for the growth and development of rapeseed mustard crops [5]. Nitrogen (N) showed an important role in seed protein and physiological functions of the plant and supports the plant with rapid growth, increasing seed and fruit production and enhancing quality of leaf and oil seed yield. Nitrogen has also significant effect on siliqua/plant and other growth factors and yield of gobhi sarson. Phosphorus application in general had beneficial effect on improving plant vigour, resistance of plant against insect-pest and diseases and in increasing the vegetative growth and seed yield of rapeseed and mustard [6]. Phosphorus plays a great role in enhancing and sustaining crop productivity worldwide. Phosphorus promotes flowering, setting of siliqua and also increase the size of siliqua and yield in mustard [7]. It also promotes root development and enlargement, affect seed germination, cell wall division, flowering, fruiting, synthesis of fat, starch and in fact most biochemical activities like amino acid synthesis. Phosphorus also increases the efficiency of other nutrients [8]. Therefore, it is very important to identify the proper nutrient dose as well as their effective combination with appropriate proportion. Keeping this in view, present investigation was carried out to find out best nitrogen and

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phosphorus levels application as well as management for maximization of gobhi sarson production.

MATERIALS AND METHODS

A field experiment was laid out during *rabi* season 2023-2024 at the Agriculture Research Farm, RIMT University, Mandi Gobindgarh, Punjab. The experiment site (Mandi Gobindgarh) is situated in Punjab at 30.6642° N Latitude and 76.2914° E longitude at an altitude of 268 meters. The soil of the experiment field was sandy loam in texture with pH 8.4. It was moderately fertile, being moderate in available organic carbon (0.38%), and low available nitrogen (143.6 kg/ha), and low available phosphorus (17.3 kg/ha), and high in available potassium (168 kg/ha).

The experiment was laid out in factorial randomized block design with nine treatments and three replications. The treatment comprised of T_1-75 kg/ha N + 20 kg/ha P_2O_5, T_2-75 kg/ha N + 30 kg/ha P_2O_5, T_3-75 kg/ha N + 40 kg/ha P_2O_5, T_4-100 kg/ha N + 20 kg/ha P_2O_5, T_5-100 kg/ha N + 30 kg/ha P_2O_5, T_6-100 kg/ha N + 40 kg/ha P_2O_5, T_7- 125 kg/ha N + 20 kg/ha P_2O_5, T_8-125 kg/ha N + 30 kg/ha P_2O_5, and T_9-125 kg/ha N + 40 kg/ha P_2O_5. The cultivar ADV- 405 was sown with seed rate of 3.75 kg/ha at a row to row spacing was 45 cm, plant to plant was 10 cm and the net plot size was 3.6 X 4 m^2. The fertilizer application like nitrogen and phosphorus was applied as per the treatment. Standard practices were followed to record biometric observations like growth and yield. Five plants were selected randomly from each plot for taking the observations. The data were recorded on growth attributes *viz*., plant population, plant height, number of branches/plants, chlorophyll content, yield attributes viz., siliqua/plant, seeds/siliqua, siliqua length, test weight, yield (grain and straw), harvest index, net return and benefit -cost ratio.

RESULTS AND DISCUSSION

A. *Growth parameters*

At harvest stage, the application of 125 kg/ha N_2 + 40 kg/ha P_2O_5 significantly better performance (Table 1) with respect to variation in plant population (m^2). The growth attributes is a crucial physical characteristic linked to vegetative development. Application of 125 kg/ha N + 40 kg/ha P_2O_5 were observed significantly taller plant height (cm), higher number of branches/plant at harvest stage and maximum chlorophyll content (mg/plant) at 125 days after sowing throughout the crop duration than all other treatments. However, the minimum growth attributes were recorded in treatment combination with 75 kg/ha N + 20 kg/ha P_2O_5 than all amongst treatments. This might be sowing be better availability of nutrients (nitrogen and phosphorus) during the crop stages. This may be because of the fact that phosphorus encourages the cell division and cell elongation in the meristematic region of plant, besides helping in nitrogen fixation, thereby resulted in improved growth and development of the plant. Growth is one of the most prominent characteristics of crop plants the result is in close conformity with the finding with references [9].

Table 1 Effect of nitrogen and phosphorus levels on plant population, plant height, number of branches/plant and chlorophyll content in gobhi sarson

Treatments combination	plant population (m^{-2})	Plant height at harvest (cm)	Number of branches / plant at harvest	Chlorophyll content at 125 DAS (mg/plant)
T_1: 75 kg N/ha + 20 kgP_2O_5/ha	15.47	140.27	7.67	47.27
T_2: 75 kg N/ha + 30 kgP_2O_5/ha	16.47	142.50	8.63	48.30
T_3: 75 kg N/ha + 40 kgP_2O_5/ha	16.53	143.20	9.67	49.46
T_4: 100 kg N/ha + 20 kgP_2O_5/ha	17.40	143.60	9.50	49.66
T_5: 100 kg N/ha + 30 kgP_2O_5/ha	17.37	145.00	10.73	50.43
T_6: 100 kg N/ha + 40 kgP_2O_5/ha	18.47	147.70	11.60	50.47
T_7: 125 kg N/ha + 20 kgP_2O_5/ha	19.53	150.50	11.73	51.27
T_8: 125 kg N/ha + 30 kgP_2O_5/ha	20.43	151.30	12.57	52.43
T_9: 125 kg N/ha + 40 kgP_2O_5/ha	21.60	153.50	12.53	53.56
SE m±	0.19	0.60	0.13	0.19
CD at 5%	0.57	0.11	0.41	0.59

Table 2 Effect of nitrogen and phosphorus levels on number of siliqua/plant, number seeds/siliqua, siliqua length and test weight in gobhi sarson

Treatments combination	Number of siliqua / plant	Number of grain / plant	Silique length (cm)	Test weight (g)
T_1: 75 kg N/ha + 20 kgP_2O_5/ha	186.43	16.53	5.47	3.87
T_2: 75 kg N/ha + 30 kgP_2O_5/ha	192.43	17.50	5.12	3.77
T_3: 75 kg N/ha + 40 kgP_2O_5/ha	195.30	18.43	5.52	3.43
T_4: 100 kg N/ha + 20 kgP_2O_5/ha	198.43	19.47	5.59	4.30
T_5: 100 kg N/ha + 30 kgP_2O_5/ha	214.57	19.50	6.43	4.40
T_6: 100 kg N/ha + 40 kgP_2O_5/ha	216.47	20.53	6.41	5.50
T_7: 125 kg N/ha + 20 kgP_2O_5/ha	217.40	21.20	7.61	5.53
T_8: 125 kg N/ha + 30 kgP_2O_5/ha	219.37	22.43	7.36	6.27
T_9: 125 kg N/ha + 40 kgP_2O_5/ha	220.60	22.57	7.14	6.73
SE m±	0.18	0.18	0.15	0.11
CD at 5%	0.55	0.53	0.45	0.59

B. *Yield parameters*

In (Table 2) contained data on yield qualities that were influenced by nitrogen and phosphorus levels. The number of siliqua/plants, number of seed/siliqua, increased significantly by 125 kg/ha N + 40 kg/ha P_2O_5 over than 75 kg/ha N + 20 kg/ha P_2O_5. The results confirm the findings with reference

[10]. The increase in the vegetative growth owing to P_2O_5 application resulted in the production of more siliqua of length and test weight. Maximum seed yield (22.70 q/ha) was recorded with application of 125 kg/ha N+ 40 kg/ha P_2O_5 maximum straw yield (73.63 q/ha) and harvest index (23.60 %) was also recorded with application of 125 kg/ha N. The result confirms the finding with references [11-12].

C. *Economics*

Economics analysis showed that the combined application of 125 kg/ha N + 40 kg/ha P_2O_5 resulted in significantly higher net return. (Rs 81,066.16) and benefit - cost ratio (2.9) than the other nitrogen and phosphorus levels treatments. The minimum net return (Rs 31,686.83) and benefits-cost ratio (1.7) was recorded under 75 kg N/ha + 20 kg P_2O_5/ha (Table 3.) This might be owing to more grain yield in 125 kg/ha N + 40 kg P_2O_5/ha levels treatment. These finding are in agreement by references [13].

Table 3 Effect of nitrogen and phosphorus on grain yield, straw yield, harvest index, net return (Rs/ha) and benefit-cost ratio in gobhi sarson

Treatments combination	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)	Net return (Rs)	B:C ratio
T_1: 75 kg N/ha + 20 kgP_2O_5/ha	13.50	64.47	17.30	31,686.83	1.7
T_2: 75 kg N/ha + 30 kgP_2O_5/ha	13.60	64.40	16.93	30,742.50	1.7
T_3: 75 kg N/ha + 40 kgP_2O_5/ha	14.60	66.87	17.77	35,609.83	1.8
T_4: 100 kg N/ha + 20 kgP_2O_5/ha	15.67	68.73	18.27	39,925.17	1.9
T_5: 100 kg N/ha + 30 kgP_2O_5/ha	16.70	69.20	19.30	47,394.50	2.1
T_6: 100 kg N/ha + 40 kgP_2O_5/ha	17.47	70.30	19.87	52,494.33	2.2
T_7: 125 kg N/ha + 20 kgP_2O_5/ha	19.53	71.13	21.47	63,304.83	2.5
T_8: 125 kg N/ha + 30 kgP_2O_5/ha	21.53	72.30	22.73	72,518.50	2.7
T_9: 125 kg N/ha + 40 kgP_2O_5/ha	22.70	73.63	23.60	81,066.16	2.9
SE m±	0.16	0.23	0.12	744.94	0.04
CD at 5%	0.47	0.72	0.38	2252.55	0.11

CONCLUSION

From the overall findings, it could be inferred that based on the one-year study on gobhi sarson (*Brassica napus* L.), effect of nitrogen and phosphorus was significantly better with treatment combination 125 kg/ha N + 40 kg/ha P_2O_5, in term of growth attributes viz., plant population, plant height, number of branches/plants, chlorophyll content and yield attributes viz., siliqua/plant, seeds/siliqua, siliqua length, test weight, biological yield and harvest index. And also performed economically well as compared to other treatments.

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