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Effect of Nitrogen Management and Biofertilizer on Productivity and Profitability of Rapeseed

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Authors' contributions

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

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ABSTRACT

A field experiment was conducted at the experimental farm, Department of Agronomy, Faculty of Agriculture and Veterinary Sciences, Mewar University Gangrar, Chittorgarh (Rajasthan) during Rabi season of 2023-24 to effect of nitrogen and bio-fertilizer on growth and yield characters of Rapeseed variety "T-9" was used in this study. The required quantities of fertilizers were applied as per treatments. The experiment was laid out in randomized block design with three replications consisting of nine treatments combinations *i.e.* T_1-Azotobacter + 60 kg ha^{-1} N through inorganic Fertilizer (RDF), T_2-Azotobacter + 45kg ha^{-1} N through inorganic Fertilizer + 15kg ha^{-1} N through poultry Manure (PM), T_3-Azotobacter + 30kg ha^{-1} N through inorganic Fertilizer + 30kg ha^{-1} N

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through poultry Manure (PM), T_4-PSB + 60kg ha^{-1} N through inorganic Fertilizer (RDF), T_5-PSB + 45kg ha^{-1} N through inorganic Fertilizer + 15kg ha^{-1} N through poultry Manure (PM), T_6-PSB + 30kg ha^{-1} N through inorganic Fertilizer + 30kg ha^{-1} N through poultry Manure (PM), T_7-Azotobacter + PSB + 60kg ha^{-1} N through inorganic Fertilizer (RDF), T_8-Azotobacter + PSB + 45kg ha^{-1} N through inorganic Fertilizer +15kg ha^{-1} N through poultry Manure (PM) and T_9-Azotobacter + PSB + 30kg ha^{-1} N through inorganic Fertilizer + 30kg ha^{-1} N through poultry Manure (PM). The increased yield parameter such as a number of per siliqua, seed yield, stover yield harvest index was recorded with T_9 (Azotobacter + PSB + 30 kg ha^{-1} N through inorganic Fertilizer + 30 kg ha^{-1} N through poultry manure).

Keywords: Nitrogen; poultry manure; profitability; biofertilizer; rapeseed.

1. INTRODUCTION

"Indian mustard (*Brassica juncea* L.) commonly known as raya, rai or laha is an important oil seed crop, among the Brassica group of oilseeds in India. Compared to other members of the cruciferae family, it has a larger potential for output per unit area. India's principal crop for Rabi oil seeds is rapeseed. They hold a significant position, ranking second in production and area behind ground nuts. The percentages of oil and protein in Toria seeds are 40–48% and 20–40%, respectively. To make pickles and to add taste to curries and vegetables, toria seeds and oil are used as a condiment. Young plants' leaves are consumed as green vegetables" [1].

In India's oil seed economy, rapeseed-mustard is a significant category of oilseed crops that holds a leading position. It comes in second place to soybean in terms of contribution to oilseed acreage and output in India in 2021–2022, with 22.4% and 22.6%, respectively. By the end of the 12th five-year plan in 2017, an estimated 1.32 billion people live in India, meaning that 21.12 million tonnes (mt) of edible oil will be needed, based on a daily consumption estimate of 16 kg per person.

Mustard is rich in minerals like calcium, manganese, copper, iron, selenium, zinc, vitamin A, B, C and proteins. 100g mustard seed contains 508 kcal energy, 28.09g carbohydrates, 26.08g proteins, 36.24g total fat and 12.2g dietary fibre.

In the rhizosphere of non-legumes, Azotobacter is a non-symbiotic nitrogen-fixing agro-microbe that can fix significant amounts of atmospheric nitrogen. In addition to fixating nitrogen.

To provide nitrogen to most non-leguminous annual and perennial crops, such as rice, cotton, and sugarcane, Azotobacter can be utilized as a biofertilizer. pH 6.5-8.0 temperate zone soils are ideal for azotobacter activity. In the soil, it fixes nitrogen at a rate of 5-20 kg N ha^{-1} year. Azotobacter application techniques include soil application, seed treatment, and seedling dipping. Ten kg of seed were treated with 200 g of Azotobacter.

Farmers know the advantages of using poultry manure and how it releases nutrients that promote healthy plant growth. For this reason, several farmers in and around these villages frequently utilize poultry manure in their crop cultivation [2]. To make an effective use of the manure, there doesn't seem to be much usage of poultry manure in the country, and nothing is known about how the manure affects crops. To reach farmers, more information on this manure is required. Therefore, the goal of the study is to ascertain how application rates of chicken manure affect the growth and productivity of mustard.

2. MATERIALS AND METHODS

A field experiment was conducted during the Rabi season of 2022-23 at the experimental farm, Department of Agronomy, Faculty of Agriculture and Veterinary Sciences, Mewar University Gangrar, Chittorgarh (Rajasthan). Soil of the experimental field was sandy loam in texture, saline in reaction with a pH value of 7.6, poor in organic carbon (0.16%), deficient in available zinc (0.48 ppm) and iron (1.2 ppm) low in available nitrogen (176 kg/ha) and phosphorus (20.2 kg/ha) but medium in available potassium (320 kg/ha). The experiment was laid out in randomized block design with three replications consisting of nine treatments mentioned in the abstract. The required quantities of fertilizers were applied as per treatments. The doses of NPK were applied in the form of urea, diammonium phosphate, murate of potash respectively.

3. RESULTS AND DISCUSSION

The purpose of this study was to determine the extent of performance for yield traits. These yield attributes are included in the present study such as number of per siliqua, seed yield, stover yield harvest index and economics of lentil.

3.1 Yield Attributes and Yield

The data in Table 1 and Fig. 1, which were impacted by the quantity of siliqua^{-1} seeds, demonstrate unequivocally that the number of siliqua^{-1} seeds with plant age and peaked at 75 DAS. A notable variation was noted based on the quantity of seeds siliqua^{-1} at various phases. With the maximum number of seeds per unit (20.40), T_9 (Azotobacter + PSB + 30 kg ha^{-1} N through inorganic fertilizer + 30 kg ha^{-1} N through poultry manure) was found to be present. The lowest number of seeds siliqua^{-1} (15.87). This result is also supported by Meena et al. [3], Rundala et al. [4], Gudadhe et al. [5] and Khambalkar et al. [6].

The data on seed yield (kg ha^{-1}) as it related to the data shown in Table 1 and Fig. 1 makes it abundantly evident that the seed yield (kg ha^{-1}) with plant age peaked at 75 DAS. Considerable variation was noted in the quantity of seed output (kg ha^{-1}) at various phases. T_9 had the significantly largest seed yield (kg ha^{-1}) (1500 kg ha^{-1}) (Azotobacter + PSB + 30 kg ha^{-1} N through inorganic fertilizer + 30 kg ha^{-1} N through poultry manure). The T_1 treatment (Azotobacter + 60 kg ha^{-1} N through inorganic fertilizer) (control) had the lowest seed production (kg ha^{-1}) (926 kg ha^{-1} g). These findings also confirmed by Tomar et al. [7], Rana, et al. [8], Singh and Paln [9] and Hadiyal et al. [10].

It is evident from the data on straw yield (kg ha^{-1}) as it related to the data in Table 1 and Fig. 1 that the straw yield (kg ha^{-1}) with plant age and peaked at 75 DAS. At various stages, a notable variation in the quantity of straw yield (kg ha^{-1}) was noted. The crop with the significant highest straw yield (kg ha^{-1}) was T_9 (Azotobacter + PSB + 30 kg ha^{-1} N through inorganic fertilizer + 30 kg ha^{-1} N through poultry manure) (3790 kg ha^{-1}. The lowest straw yield (kg ha^{-1}) of 2886 kg ha^{-1}. Similar results also confirmed by Meena et al. [3], Singh and Sinsinwar [11] and Singh et al. [12].

Table 1. Effect of nitrogen management and biofertilizers on oil content of Rapeseed

Treatments	Number of seeds per siliqua	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index (%)
T_1	15.87	926.67	2886.67	24.29
T_2	16.40	1126.67	3130.00	26.39
T_3	16.07	1116.67	3123.33	26.31
T_4	16.51	1056.67	3046.67	25.76
T_5	15.93	1053.33	2946.67	26.33
T_6	17.20	1086.67	2900.00	27.27
T_7	19.07	1326.67	3506.67	27.42
T_8	17.87	1173.33	3326.67	26.08
T_9	20.40	1500.00	3790.00	28.36
S. Ed. (±)	0.973	73.678	101.735	0.963
C.D. (P = 0.05)	2.009	152.071	209.981	1.988

Table 2. Effect of nitrogen management and biofertilizers on economics of Rapeseed

Treatments	Cost of Cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C ratio
T_1	32985.80	45096	12111	1.36
T_2	33729.5	52560	18831	1.55
T_3	34471.8	52218	17747	1.51
T_4	32977.80	49956	16979	1.51
T_5	33721.50	49266	15545	1.46
T_6	34463.5	49980	15517	1.45
T_7	32989.80	60816	27827	1.84
T_8	33733.50	55146	21413	1.63
T_9	34475.80	67740	33265	1.96

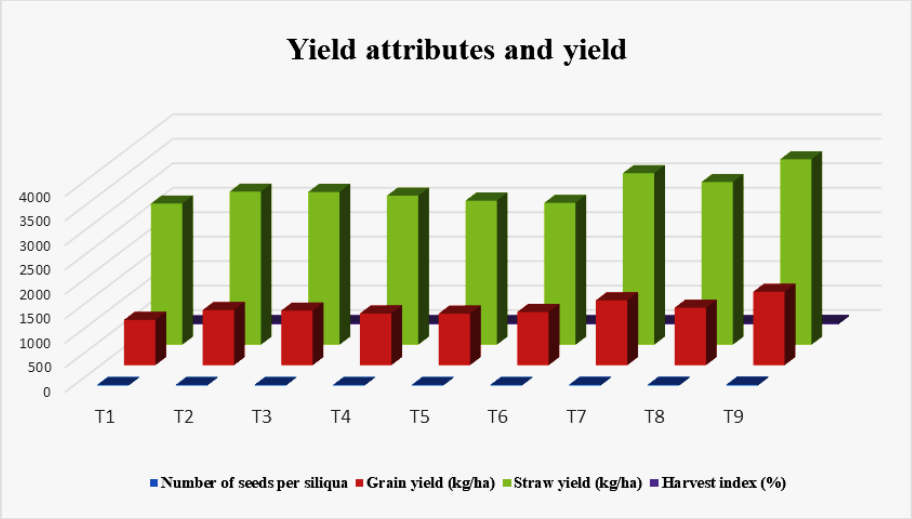

Fig. 1. Effect of nitrogen management and biofertilizers on oil content of Rapeseed

The data on harvest index (%) as it related to the data shown in Table 1 and Fig. 1 amply demonstrates that the harvest index (%) rose as plant age increased and peaked at 75 DAS. Due to the harvest index (%) at various stages, a substantial variance was seen. The crop with the significant greatest harvest index (28.36%) was T_9 (Azotobacter + PSB + 30 kg ha^{-1} N through inorganic fertilizer + 30 kg ha^{-1} N through poultry manure). The lowest harvest index (24.29%). Similar conclude by Singh et al. [13] and Keivanrad et al. [14].

3.2 Economics Variability

Cost of cultivation fixed cost (for all treatments) is included in this chapter. Cultivation expenses for every therapy. For any treatment combination, the total cost of cultivation consists of the gross return and grain and straw yield (q ha^{-1}). Following the post-harvest observation, the economic viability of each treatment was calculated to determine the cost of cultivation, gross profit, return, net profit, and benefit-cost ratio for the toria crop. The benefit-cost ratio and treatment economics statistics have been calculated and are shown in Table 2, correspondingly [15].

Notes about economics are provided in Table 2. When compared to other treatment combinations, treatment T_9 (Azotobacter + PSB + 30 kg ha^{-1} N through inorganic fertilizer + 30 kg ha^{-1} N through poultry manure) had the highest gross return (67740 Rs/ha), net return (33265 Rs/ha), and benefit-cost ratio (1.96). The economic analysis demonstrates mustard cultivation's great promise. Similar results were also confirmed by Gudadhe et al. [5] and Rundala et al. [16].

4. CONCLUSION

Based on the results obtained, it was concluded that Rapeseed (*Brassica campestris* var. toria)" crop inoculated with T_9 (Azotobacter + PSB + 30 kg ha^{-1} N through inorganic Fertilizer + 30 kg ha^{-1} N through poultry manure) gave significantly higher seed yields. However, the treatment combination (Azotobacter + PSB + 30 kg ha^{-1} N through inorganic Fertilizer + 30 kg ha^{-1} N through poultry manure) best superior treatment combination for higher productivity and profitability among all treatments.

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.

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