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Growth and Yield of Mustard (*Brassica juncea* L.) Influenced by Different Varieties and Spacing

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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 Agricultural Research Farm, Narayan Institute of Agricultural Sciences, Gopal Narayan Singh University, Jamuhar, Sasaram, Rohtas, (Bihar) during the rabi (winter) season of 2022-2023 to access the effect of different varieties and spacing on growth and yield of mustard. Treatment consisted of three varieties RH- 404, DRMR-1165-40 and NRCM-101 and three spacing viz. 30×10 cm, 40×10 cm and 50×10 cm. Experiment was conducted under randomized block design with three replications. The result showed that growth viz. plant height, dry weight and yield attributes viz, number of siliqua/plant, length of siliqua (cm), test weight, grain yield (kg/ha) and harvest index (%) and yield were significantly affected due to different treatment combination. The maximum plant height (179.60 cm), dry weight (38.49 g/plant) at harvest, number of siliqua (395.33/plant), length of siliqua (6.54 cm), test weight (6.50 g), grain yield (2286.67 Kg/ha) and harvest index (34.80 %) was recorded in treatment combination of NRCM-101 **+** 40 cm × 10 cm.

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1. INTRODUCTION

"Indian mustard belongs to cruciferae family, genus *Brassica* and species *juncea*. Approximately 20–22% of all oilseeds produced in India are mustard, making it the second most important oilseed crop after soybeans" [1]. "In the world in 2019–20, there were 35.95 million hectares (mha), 71.49 million tons (mt), and 1990 kg/ha of rapeseed–mustard produced. It is anticipated that 36.57 million tons of oilseeds will be produced overall in 2020–21. With 11.12% of the global rapeseed-mustard production, India ranks third in the world behind China and Canada. In 2020–21, India produced 305.44 million tons of food grains, a record. Of all agricultural commodities produced worldwide, vegetable oil accounts for one of the largest percentages (40%) of output" [2]. "India is the world's biggest importer of edible oils, bringing in $10.5 billion, ahead of the United States and China" [3]. "In India, mustard is grown on approximately 6.70 million hectares, with a production of 10.21 million tons and a productivity of 1524 kilograms per hectare. Haryana has the highest productivity of mustard 2028 kg/ha". Directorate of Economics & Statistics, DAC and FW, [4]. The quantity of siliqua and other growth characteristics of mustard are determined by plant density, which is an essential cultural activity. Higher yields can be achieved by growing improved kinds of mustard with the proper row spacing. To determine the ideal spacing and variety, the current investigation was conducted.

2. MATERIALS AND METHODS

The experiment was conducted during the *Rabi* season 2022-23 at the Crop Research Farm, Department of Agronomy, NIAS, GNSU, Jamuhar, Rohtas, Bihar. The Crop Research Farm is situated at 24^0 56' N latitude, 84^0 6' E longitude from the sea level. This area is situated on the right side of the river *Sone* and by the opposite side of Sasaram city. The meteorological data including the weekly average temperature (maximum 32.5°C and minimum 5°C), relative humidity (maximum 88.97 % and minimum 68.07 %). The treatment consisted of three varieties RH- 404, DRMR-1165-40 and NRCM-101 and three spacing viz. 30 cm × 10 cm, 40 cm ×10 cm and 50 cm ×10 cm. treatment combination of RH-404 **+** 30 cm × 10 cm, RH-404 **+** 40 cm × 10 cm, RH-404 **+** 50 cm × 10 cm , DRMR-1165-40 **+** 30 cm × 10 cm, DRMR-1165-40 **+** 40 cm × 10 cm , DRMR-1165-40 **+** 50 cm × 10 cm, NRCM-101 **+** 30 cm × 10 cm, NRCM-101 **+** 40 cm × 10 cm and NRCM-101 **+** 50 cm × 10 cm. Present Experiment was conducted under randomized block design with three replications and total 27 plots made under experiment. The crop was sown on 17/11/2022 by using seed rate of mustard 6 kg/ha. The gross plot size was 4.5 m × 3.6 m (16.2 m^2). The row to row and plant to plant spacing were maintained according to the treatments. Urea, NPK (12:32:16) and muriate of potash used to supply 80 kg Nitrogen, 40 Kg Phosphorus and 40 kg/ha potassium to supply recommended dose of fertilizer for mustard crop. Fertilizer requirement were calculated on the basis of individual plot size and full dose of NPK (12:32:16), muriate of potash and half dose of urea applied as a basal dose at the time of sowing and remaining dose of urea applied as a top dressing. Height of the five randomly selected plants was measured with the help of meter scale from soil surface to the apex during the harvest and the mean values were taken. the samples were oven dried at 70 °C for 72 hours and weighed by electronic balance.

3. RESULTS AND DISCUSSION

3.1 Growth Attributes of Mustard

3.1.1 Plant height (cm)

Plant height of mustard were significantly affected due different varieties and spacing at harvest. "However, maximum plant height (179.60 cm) was recorded in treatment combination of NRCM-101 + 40 cm × 10 cm which was statistically at par with treatment combination of RH-404 + 40 cm × 10 cm (173.17 cm).The probability in increase in plant height due to widest plant spacing might be due to the fact that the increased spacing between plants resulted in, sun-light, nutrients and soil moisture for increased photosynthesis, metabolic activities, growth and development" [5,6]. Plant height under wider intra row spacing was due to suppression of apical dominance as against closer spacing which include more vertical growth due to congestion of plant/area. The results corroborated the findings of Dhongade *et al*. [7] Gopale *et al*. [8] and Sapkal *et al*. [9]. **"**This would be increasing the metabolic process and promotes the meristematic activities caused apical growth and resulted in increased plant height" [10].

3.1.2 Dry weight (g/plant)

Dry weight of mustard was significantly affected by different varieties and spacing at harvest. However maximum dry weight of (38.49 g) was recorded in treatment combination of NRCM-101 **+** 40 cm × 10 cm, which was statistically at par with treatment combination of RH-404 **+** 40 cm × 10 cm (37.01 g), DRMR-1165-40 **+** 30 cm × 10 cm (36.77 g).

"Better growth observed under wide row spacing compared to closer spacing might be due to efficient use of light, soil moisture and nutrients under wider spacing". Pandey *et al.* [11].

"The increasement of plant dry weight might be due to relatively competition free environments, more availability of nutrients, light interception, efficient use of soil moisture and space under lower degree of inter plant competition ultimately leads to increased photosynthesis of production more dry matter/plant". Beulah and Umesha [12].

3.2 Yield Attributes of Mustard

Number of siliqua/plants of mustard was significantly influenced by different varieties and spacing (Table 1). However the maximum number of siliqua (395.33) was recorded under the treatment combination of NRCM-101 + 40 cm × 10 cm, which was statistically at par with treatment combination of RH-404 + 40 cm × 10 cm (381.87), DRMR-1165-40 + 30 cm × 10 cm (361.67), DRMR-1165-40 + 40 cm × 10 cm (312.13), NRCM-101 + 30 cm × 10 cm (272.53) and RH-404 + 30 cm × 10 cm (227.67). Increased vigor and strength reached by the plants as a result of improved photosynthetic activities with enough light availability and provision of nutrients in balanced amount of the plants during growing phases may have made a higher number of Siliqua/plant achievable. Anjana *et al*., (2020) observed the similar results. The increasement siliqua and seeds per siliqua may better translocation of nutrients and assimilates to the reproductive regions. These findings are in good lines with those achieved by Mondal *et al.* [13] Ghosh *et al*. [14] Singh *et al*. [15] and Aiken *et al*. [16].

3.2.1 Length of siliqua (cm)

Length of siliqua of mustard was significantly affected by different varieties and spacing (Table 1). However, maximum length of siliqua **(**6.54 cm) was recorded in treatment combination of NRCM-101 **+** 40 cm × 10 cm.

Production of higher yield by different varieties is the contribution of cumulative favorable effects of the mustard crop characteristics viz., branches/plants, siliqua/plants and seeds/siliqua. Helal *et al.* [17].

3.2.2 Test weight (g)

Test weight of mustard was significantly influenced by different varieties and spacing (Table 1). However, the maximum test weight of mustard (6.50 g) was recorded under the treatment combination of NRCM-101 **+** 40 cm × 10 cm, which was statistically at par with treatment combination of RH-404 **+** 40 cm × 10 cm (6.37 g), DRMR-1165-40 **+** 30 cm × 10 cm (6.03 g).

"Higher vigour and growth attained by the plants due to sufficient absorption of nutrients might have resulted in higher test weight" [18].

3.3 Yield

3.3.1 Grain yield (kg/ha)

Grain yield of mustard were significantly affected by different varieties and spacing. However, the highest grain yield **(**2286.67 kg/ha) was recorded in treatment combination of NRCM-101 **+** 40 cm × 10 cm. which was statistically at par with treatment combination of RH-404 + 40 cm × 10 cm (2266.67 kg/ha), RH-404 + 30 cm × 10 cm (2153.33 kg/ha), DRMR-1165-40 + 30 cm × 10 cm (2260.00 kg/ha), DRMR-1165-40 + 40 cm × 10 cm (2196.67 kg/ha), NRCM-101 + 30 cm × 10 cm (2176.67 kg/ha).The increase in grain yield was mainly due to increase in the plant population per unit area due to closer spacing between plants. Although wider spacing rows the yield attributes where the plants received increased space, light, nutrients and moisture. Similar results were also reported by Sondhiya *et al.*, [5] and Tanwar *et al*., [19]. This might be attributed to the higher number of branches/plants, number of siliqua/plants, number of seeds/siliquae, test weight and over all vigorous growth of plant. The similar results were also reported by Singh *et al*. [1] The ideal distance between plants allowed them to absorb enough heat, moisture, and nutrients from the soil. This resulted in an increase in the number of siliqua/plants, seeds/siliqua, and test weight, all of which directly contributed to a rise in mustard seed output. The results were similar to Sai *et al*. [20].

Table 1. Growth and yield mustard influenced by different varieties and spacing

Treatments	Growth Attributes of mustard		Yield attributes			Yield	Harvest index (%)
	Plant height at harvest	Dry weight/ plant (g) at harvest	Number of siliqua/plants	Length of siliqua (cm)	Test weight (g)	Grain yield (kg/ha)	
RH-404 + 30 cm × 10 cm	163.69	33.52	227.67	5.21	5.20	2153.33	32.63
RH-404 + 40 cm × 10 cm	173.17	37.01	381.87	5.48	6.37	2266.67	34.50
RH-404 + 50 cm × 10 cm	160.07	32.30	194.27	5.07	5.10	2146.67	32.30
DRMR-1165-40 + 30 cm × 10 cm	169.53	36.77	361.67	5.41	6.03	2260.00	33.90
DRMR-1165-40 + 40 cm × 10 cm	167.03	35.48	312.13	5.29	5.90	2196.67	33.47
DRMR-1165-40 + 50 cm × 10 cm	159.59	35.07	175.40	5.01	4.98	2143.33	32.20
NRCM-101 + 30 cm × 10 cm	164.73	34.53	272.53	5.27	5.87	2176.67	33.23
NRCM-101 + 40 cm × 10 cm	179.60	38.49	395.33	6.54	6.50	2286.67	34.80
NRCM-101 + 50 cm × 10 cm	152.17	31.92	167.60	5.00	4.77	1853.33	30.57
SEM±	2.93	0.74	62.84	0.33	0.48	45.55	0.92
CD	8.77	2.23	188.42	1.01	1.46	137.73	2.78

3.3.2 Harvest index (%)

Harvest index of mustard was significantly influenced by different varieties and spacing Table no. 1. However, the maximum harvest index percentage (34.80) was recorded under the treatment combination of NRCM-101 **+** 40 cm × 10 cm. which was statistically at par with treatment combination of all treatment combination except NRCM-101 + 50 cm × 10 cm (30.57). Due to greater transportation of assimilates to the economic sink as compared to biological sinks. This is in conformity with the findings of Somondal et al*.* [21-24].

4. CONCLUSION

Considering the findings of present investigation, it can be concluded that treatment combination of NRCM-101 + 40 cm × 10 cm found superior in respect to growth attributes, yield attributes and yield over the other treatment combination.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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