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Seed yield and economic response of mustard (*Brassica juncea* L.) to plant spacing and varieties under Gwalior region

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Abstract

A field experiment was conducted during the *rabi* season of 2025-26 at the Agriculture Research and Development Centre, Sakatpura, Vikrant University, Gwalior, Madhya Pradesh, to study the effect of plant spacing and varieties on yield attributes, seed yield and economics of mustard (*Brassica juncea* L.). The experiment was laid out in Factorial Randomized Block Design with three replications and nine treatment combinations consisting of three varieties, namely Shriram, Pioneer and Advanta, and three plant spacings, namely 30 × 15 cm, 40 × 15 cm and 50 × 15 cm. Results showed that yield attributes and economic returns were markedly influenced by variety and crop geometry. The maximum number of siliqua plant⁻¹ (300), seeds siliqua⁻¹ (14.0) and test weight (4.90 g) were recorded under T₈ (Pioneer - 50 × 15 cm), while the highest seed yield (1878 kg ha⁻¹) was recorded under T₃ (Pioneer - 40 × 15 cm). The same treatment recorded the highest gross return (₹ 115,965.50 ha⁻¹), net return (₹ 74,765.50 ha⁻¹) and B:C ratio (2.81). The improvement was mainly associated with optimum plant population, better reproductive development and efficient use of available resources. Therefore, Pioneer variety planted at 40 × 15 cm spacing may be considered suitable for higher productivity and profitability of mustard under Gwalior and similar agro-climatic conditions.

Keywords: Mustard, plant spacing, variety, seed yield, net return, benefit-cost ratio

Introduction

Mustard (*Brassica juncea* L.) is an important *rabi* oilseed crop of India and has a significant role in edible oil production, livestock feed and farm income. The crop is widely cultivated under different agro-climatic conditions because of its adaptability and economic importance. However, productivity often remains below potential due to improper selection of variety and non-optimum plant population.

Plant spacing determines the number of plants per unit area and directly influences resource utilization, canopy development and reproductive growth. Closer spacing increases plant population, but excessive competition for light, nutrients, moisture and space may reduce individual plant performance. On the other hand, very wide spacing improves growth per plant but may reduce yield per unit area due to lower plant population.

Varietal response is equally important because mustard varieties differ in plant architecture, branching pattern, maturity behaviour and yield potential. A variety with better genetic capacity can express its yield potential only when it is grown under suitable crop geometry. Earlier studies have also indicated that plant spacing and varietal characters influence yield attributes, seed yield and profitability of mustard (Pandey *et al.*, 2015; Meena *et al.*, 2017; Yadav *et al.*, 2018) [8, 6, 9, 10]. Keeping these points in view, the present research paper was prepared to evaluate the response of mustard yield attributes, seed yield and economics to different plant spacing and varieties under the Gwalior region of Madhya Pradesh.

Materials and Methods

The field experiment was conducted during *rabi* 2025-26 at the Agriculture Research and Development Centre, Sakatpura, Vikrant University, Gwalior, Madhya Pradesh. The experimental site represents semi-arid subtropical conditions.

The soil of the experimental field was sandy loam in texture, slightly alkaline in reaction and suitable for mustard cultivation. The experiment was laid out in Factorial Randomized Block Design with three replications. The treatments consisted of three mustard varieties (Shriram, Pioneer and Advanta) and three plant spacings (30×15 cm, 40×15 cm and 50×15 cm), making nine treatment combinations. The crop was sown by line sowing and recommended agronomic practices were followed uniformly in all treatments.

The treatment details followed in the experiment are presented in

Table 1. Yield attributes were recorded from representative plants selected from each plot. Seed and stover yield were recorded from the net plot and converted into kg ha^{-1} . Biological yield was calculated as the sum of seed and stover yield, while harvest index was calculated as seed yield divided by biological yield and multiplied by 100. Gross return, net return and B:C ratio were worked out on the basis of prevailing market prices and cost of cultivation. Data were statistically analysed as per the standard procedure of Factorial Randomized Block Design, and treatment differences were tested at the 5 per cent level of significance.

Table 1: Treatment combinations used in the experiment

Treatment	Treatment combination
T ₁	Shriram - 30×15 cm
T ₂	Pioneer - 30×15 cm
T ₃	Advanta - 30×15 cm
T ₄	Shriram - 40×15 cm
T ₅	Pioneer - 40×15 cm
T ₆	Advanta - 40×15 cm
T ₇	Shriram - 50×15 cm
T ₈	Pioneer - 50×15 cm
T ₉	Advanta - 50×15 cm

Results and Discussion

Yield attributes

Yield attributes were clearly influenced by plant spacing and varieties (Table 2). The maximum number of siliquea plant⁻¹ (300), seeds siliquea⁻¹ (14.0) and test weight (4.90 g) were recorded under T₈ (Pioneer - 50×15 cm). This treatment was closely followed by T₉ (Advanta - 50×15 cm) and T₅ (Pioneer - 40×15 cm). The lowest values for siliquea plant⁻¹, seeds siliquea⁻¹ and test weight were recorded under T₁ (Shriram - 30×15 cm).

The improvement in reproductive characters under wider spacing may be due to reduced inter-plant competition and better availability of light, nutrients and moisture. Pioneer showed better reproductive performance than Shriram and Advanta due to its superior genetic potential and efficient partitioning of assimilates towards siliquea and seed development. Similar improvement in mustard yield attributes under suitable crop geometry was also reported by Chauhan *et al.* (2016) [2], Meena *et al.* (2017) [6] and Kumar and Yadav (2020) [4].

Table 2: Effect of plant spacing and varieties on yield attributes of mustard

Treatment	Siliquea plant ⁻¹	Seeds siliquea ⁻¹	Test weight (g)	Seed yield (kg ha^{-1})
T ₁ - Shriram - 30×15 cm	195	11.4	4.35	1456
T ₂ - Pioneer - 30×15 cm	215	12.1	4.55	1608
T ₃ - Advanta - 30×15 cm	205	11.8	4.48	1555
T ₄ - Shriram - 40×15 cm	235	12.7	4.55	1726
T ₅ - Pioneer - 40×15 cm	265	13.5	4.78	1878
T ₆ - Advanta - 40×15 cm	250	13.1	4.70	1826
T ₇ - Shriram - 50×15 cm	275	13.4	4.70	1626
T ₈ - Pioneer - 50×15 cm	300	14.0	4.90	1778
T ₉ - Advanta - 50×15 cm	292	13.8	4.82	1726
SEm±	8.50	0.38	0.13	72.8
CD (P = 0.05)	25.4	1.14	0.39	218
CV (%)	9.6	8.5	8.8	9.2

Yield

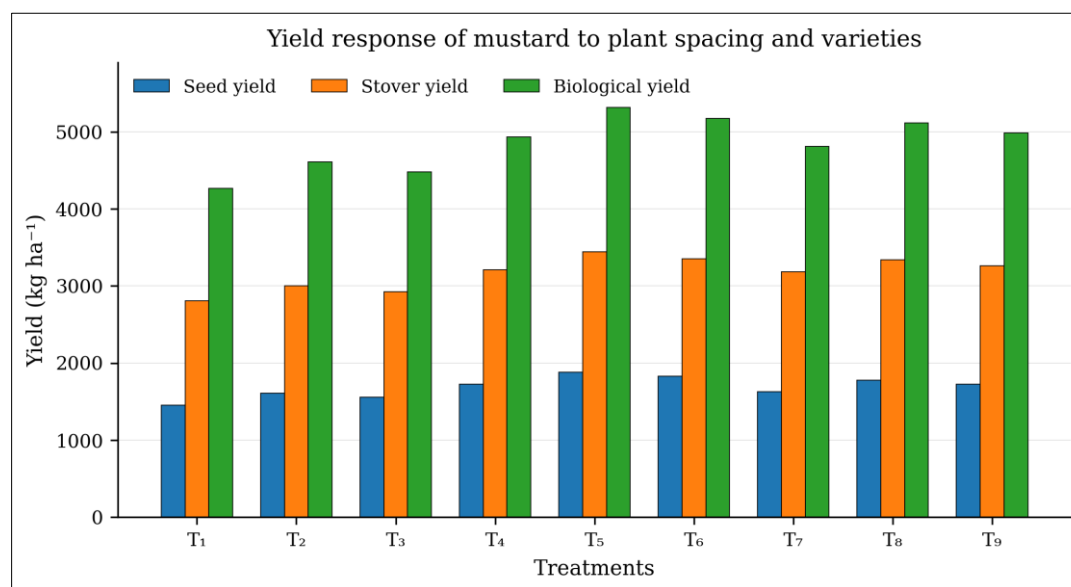
Seed yield showed a clear response to the combined effect of variety and plant spacing (Table 3 and Fig. 1). Seed yield ranged from 1456 to 1878 kg ha^{-1} . The maximum seed yield was recorded under T₅ (Pioneer - 40×15 cm), followed by T₆ (Advanta - 40×15 cm) and T₈ (Pioneer - 50×15 cm), whereas the lowest seed yield was recorded under T₁ (Shriram - 30×15 cm).

The higher seed yield under T₅ may be attributed to an optimum

balance between plant population and individual plant productivity. Although wider spacing improved yield attributes per plant, 40×15 cm spacing maintained better plant density and therefore resulted in higher seed yield per hectare. The increase in stover and biological yield under T₅ also indicated better vegetative growth and dry matter accumulation. These findings are in close agreement with the results of Pandey *et al.* (2015) [8], Sharma *et al.* (2018) [9] and Jat *et al.* (2019) [3].

Table 3: Effect of plant spacing and varieties on yield of mustard

Treatment	Seed yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)	Biological yield (kg ha ⁻¹)	Harvest index (%)
T ₁ - Shriram - 30 × 15 cm	1456	2810	4266	34.1
T ₂ - Pioneer - 30 × 15 cm	1608	3005	4613	34.9
T ₃ - Advanta - 30 × 15 cm	1555	2925	4480	34.7
T ₄ - Shriram - 40 × 15 cm	1726	3210	4936	35.0
T ₅ - Pioneer - 40 × 15 cm	1878	3440	5318	35.3
T ₆ - Advanta - 40 × 15 cm	1826	3350	5176	35.3
T ₇ - Shriram - 50 × 15 cm	1626	3185	4811	33.8
T ₈ - Pioneer - 50 × 15 cm	1778	3340	5118	34.7
T ₉ - Advanta - 50 × 15 cm	1726	3260	4986	34.6
SEm±	72.8	112	165	0.85
CD (P = 0.05)	218	335	492	NS
CV (%)	9.2	9.8	10.1	4.8

**Fig 1:** Yield response of mustard to plant spacing and varieties

Economics

Economics of mustard cultivation varied among the treatments due to differences in input cost as well as seed yield (Table 4 and Fig. 2). Cost of cultivation ranged from ₹ 38,500 ha⁻¹ under T₁ to ₹ 42,700 ha⁻¹ under T₈. Although treatments with wider spacing involved comparatively higher cost of cultivation, economic return was mainly governed by seed yield and gross return.

The highest gross return (₹ 115,965.50 ha⁻¹), net return (₹ 74,765.50 ha⁻¹) and B:C ratio (2.81) were recorded under T₅ (Pioneer - 40 × 15 cm). This was followed by T₆ with gross return of ₹ 112,732.67 ha⁻¹, net return of ₹ 71,732.67 ha⁻¹ and B:C ratio

of 2.75. The lowest gross return, net return and B:C ratio were recorded under T₁. The higher profitability under T₅ was mainly due to greater seed yield, which compensated for the cost of cultivation and provided higher return per unit investment.

Compared with T₁, T₅ increased seed yield and net return substantially. Therefore, the combination of Pioneer variety with 40 × 15 cm spacing may be considered economically viable for mustard cultivation under similar agro-climatic conditions. Similar improvement in mustard profitability under optimum crop geometry was reported by Lakra *et al.* (2018) [5], Jat *et al.* (2019) [3] and Mehta *et al.* (2022) [7].

Table 4: Effect of plant spacing and varieties on economics of mustard

Treatment	Cost of cultivation (₹ ha ⁻¹)	Gross return (₹ ha ⁻¹)	Net return (₹ ha ⁻¹)	B:C ratio
T ₁ - Shriram - 30 × 15 cm	38,500.00	89,884.67	51,384.67	2.33
T ₂ - Pioneer - 30 × 15 cm	39,200.00	99,265.84	60,065.84	2.53
T ₃ - Advanta - 30 × 15 cm	39,000.00	96,033.01	57,033.01	2.46
T ₄ - Shriram - 40 × 15 cm	40,500.00	106,584.33	66,084.33	2.63
T ₅ - Pioneer - 40 × 15 cm	41,200.00	115,965.50	74,765.50	2.81
T ₆ - Advanta - 40 × 15 cm	41,000.00	112,732.67	71,732.67	2.75
T ₇ - Shriram - 50 × 15 cm	42,000.00	100,436.00	58,436.00	2.39
T ₈ - Pioneer - 50 × 15 cm	42,700.00	109,817.17	67,117.17	2.57
T ₉ - Advanta - 50 × 15 cm	42,500.00	106,584.34	64,084.34	2.51

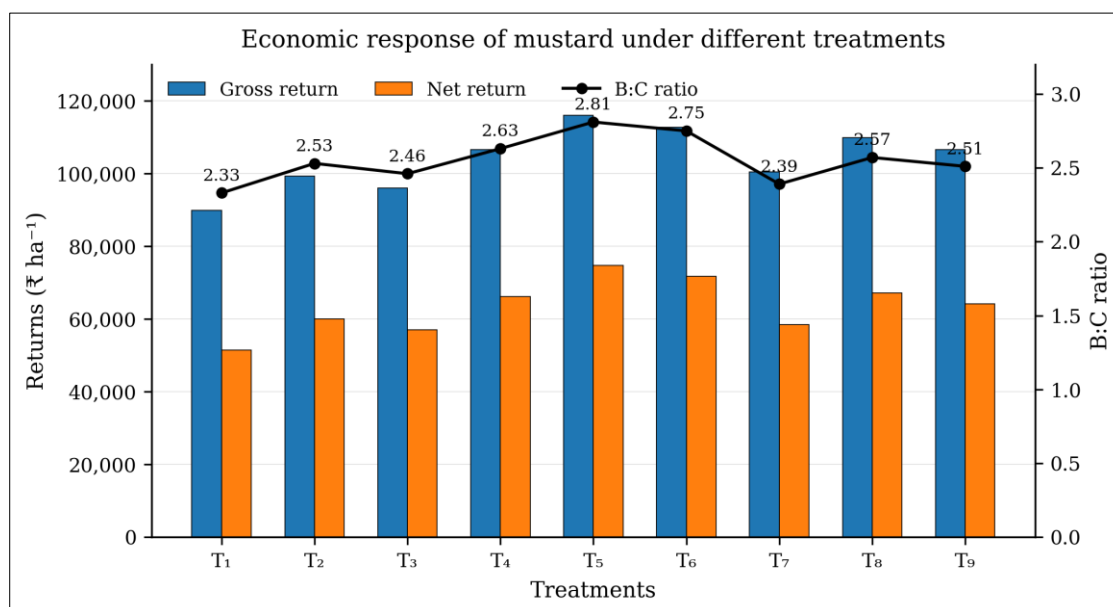


Fig 2: Economic response of mustard under different plant spacing and variety treatments

Conclusion

The results clearly indicated that plant spacing and varieties influenced yield attributes, seed yield and economic returns of mustard. Wider spacing of 50 × 15 cm improved individual plant yield attributes such as siliqua plant⁻¹, seeds siliqua⁻¹ and test weight. However, the treatment T₅ (Pioneer - 40 × 15 cm) recorded the highest seed yield, gross return, net return and B:C ratio due to optimum plant population and better yield performance per unit area. Therefore, Pioneer variety planted at 40 × 15 cm spacing may be recommended for obtaining higher productivity and profitability of mustard under Gwalior and similar agro-climatic conditions.

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