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Shyamu Singh
 School of Agriculture
 Science Vikrant University,
 Chitora Road, Gwalior,
 Madhya Pradesh, India

Chandan Singh
 School of Agriculture
 Science Vikrant University,
 Chitora Road, Gwalior,
 Madhya Pradesh, India

Mandvi Srivastava
 School of Agriculture
 Science Vikrant University,
 Chitora Road, Gwalior,
 Madhya Pradesh, India

Hirdesh Kumar
 School of Agriculture
 Science Vikrant University,
 Chitora Road, Gwalior,
 Madhya Pradesh, India

Corresponding Author:
Shyamu Singh
 School of Agriculture
 Science Vikrant University,
 Chitora Road, Gwalior,
 Madhya Pradesh, India

Effect of sowing dates on growth and yield of mustard (*Brassica juncea* L.)

Shyamu Singh, Chandan Singh, Mandvi Srivastava and Hirdesh Kumar

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Abstract

An experiment was conducted to study the entitled “Effect of sowing dates on growth and yield of mustard (*Brassica juncea* L.)” was conducted during the Rabi season of 2024-25 at Agriculture Research and Farm Development Centre, Sakatpura, School of Agriculture Science, Vikrant University, Gwalior, Madhya Pradesh, to study the influence of different sowing dates on growth and productivity. The experiment consisted of 08 treatment combinations with date of sowing and mustard variety, var. Rachna. The experiment included eight sowing dates (7th October-25th November) in a randomized block design with three replications. Results revealed that germination was unaffected by sowing dates, but plant height, branches per plant, leaf area index, and dry matter accumulation were significantly influenced. The maximum growth parameters were observed under 11th November sowing, closely followed by 4th November, while delayed sowing (25th November) recorded poor vegetative growth and reduced biomass. Crop duration was longer under timely sowing, whereas early October and late November sowings resulted in shorter growth cycles. The study highlights that optimum sowing during early November ensures favorable growth conditions and higher productivity.

Keywords: Mustard, sowing dates, growth attributes, plant height, dry matter, leaf area index

Introduction

Mustard (*Brassica juncea* L.), commonly known as Indian mustard or rai, is one of the most important oilseed crops grown during the Rabi season in India. It holds a significant place in the agricultural economy due to its multifaceted uses. The crop is primarily cultivated for its seeds, which contain 38-42% oil, making it an excellent source of edible oil. Mustard oil is widely consumed in Indian households, particularly in northern and eastern states, for cooking and pickling purposes. In addition to oil, by-products such as oilcake are used as protein-rich cattle feed, while the green plants serve as nutritious fodder for livestock. Beyond its economic value, mustard contributes substantially to crop diversification, sustainability, and food security. Its short duration, adaptability to diverse climatic conditions, and drought tolerance make it an ideal crop for both irrigated and rainfed farming systems. India ranks among the leading producers of mustard in the world. According to the Ministry of Agriculture & Farmers Welfare (2023), the crop is cultivated on about 6.5-7.0 million hectares, producing 9.5-10.0 million tonnes, with an average productivity of 1300-1400 kg/ha. Rajasthan, Uttar Pradesh, Madhya Pradesh, Haryana, and Gujarat are the dominant mustard-growing states. Rajasthan alone contributes more than 40% of the total national production. Madhya Pradesh, with approximately 8.0 lakh hectares under mustard, records productivity levels ranging from 1200 to 1300 kg/ha. Within Madhya Pradesh, the Gwalior region, located in the Gird agro-climatic zone, is a major mustard belt where the crop is generally grown under conserved soil moisture conditions or with limited irrigation facilities. Among the various factors that determine mustard productivity, sowing time is regarded as one of the most critical non-monetary inputs. The choice of sowing time directly influences crop duration, growth pattern, and exposure to temperature at sensitive growth stages, and ultimately yield and oil quality. Early sowing often results in prolonged vegetative growth, delayed flowering, and higher susceptibility to frost injury during the reproductive stage. On the other hand, delayed sowing shortens the crop duration and exposes it to terminal heat stress, which adversely affects flowering, seed setting, and seed filling.

Consequently, reduced seed size, lower oil content, and poor yields are common in late-sown crops. Therefore, optimum sowing time is essential to synchronize the crop's critical growth stages with favorable environmental conditions, ensuring higher productivity and quality oilseed production (Verma *et al.*, 2018; Kumar *et al.*, 2020) ^[21, 11]. Despite the importance of sowing time, region-specific studies on mustard in Madhya Pradesh, particularly in the Gwalior region, are relatively limited. Considering that climatic conditions, soil types, and irrigation availability vary significantly across regions, research findings from one location cannot always be generalized. Hence, localized experiments are necessary to develop precise recommendations for farmers.

Materials and Methods

The present field experiment entitled "Effect of Different Sowing Dates on Growth and Yield of Mustard (*Brassica juncea* L.)" was conducted during the Rabi season of 2024-25 at the Research Farm, Faculty of Agriculture, Vikrant University, Gwalior, Madhya Pradesh, situated at 26.21° N latitude, 78.18° E longitude and 211 m above mean sea level, falling in the Gird agro-climatic zone. The climate of the region is subtropical with hot summers, humid monsoons, and cold winters, receiving nearly 900 mm annual rainfall of which 80-90% occurs during the monsoon months, with negligible showers during the crop season, necessitating supplemental irrigation. The experimental soil was sandy loam, slightly alkaline (pH 7.92), low in organic carbon (0.40%) and available nitrogen (192.50 kg ha⁻¹), medium in phosphorus (15.4 kg ha⁻¹), and high in potassium (248.0 kg ha⁻¹).

The experiment was laid out in a Randomized Block Design (RBD) with three replications and eight sowing date treatments, viz. 7th October, 14th October, 21st October, 28th October, 4th November, 11th November, 18th November, and 25th November. Each treatment was allocated randomly within replications to minimize variability, and the gross and net plot sizes were 5.0 m × 4.5 m and 4.0 m × 3.6 m, respectively. The mustard variety 'Pusa Bold', a high-yielding, medium-duration cultivar with bold seeds and 40-42% oil content, was used. A seed rate of 5 kg ha⁻¹ was sown manually in rows spaced at 45 cm × 15 cm using the pora method, followed by light planking for seed coverage at 2-3 cm depth, and the seeds were treated with Carbendazim (2 g/kg) to prevent seed-borne diseases. The recommended fertilizer dose of 60:40:20 kg N: P₂O₅: K₂O ha⁻¹ was applied, with full phosphorus and potassium as basal and nitrogen split into two equal doses, half as basal and half top-dressed at pre-flowering. One hand weeding was carried out at 25-30 DAS to minimize weed competition, and plant protection measures included spraying Dimethoate 30 EC @ 0.03% against aphids and Mancozeb 75 WP @ 0.25% against white rust and *Alternaria* blight as per incidence. Irrigation was provided at critical stages: pre-flowering, pod formation, and grain filling, depending on soil moisture availability. Harvesting was performed manually when 90-95% siliques turned brown, followed by sun drying and threshing, and seed and stover yields were recorded separately. Growth attributes were recorded at 30, 60, 90 DAS and at harvest from five randomly selected plants per plot, which included plant population (plants m⁻², recorded using a 0.25 m² quadrat),

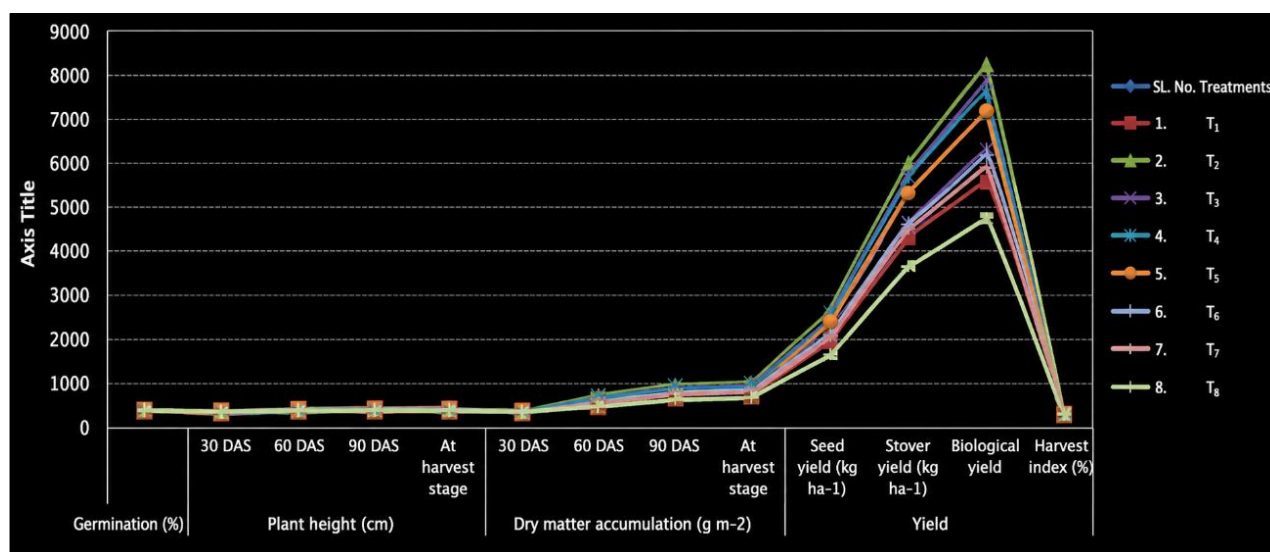
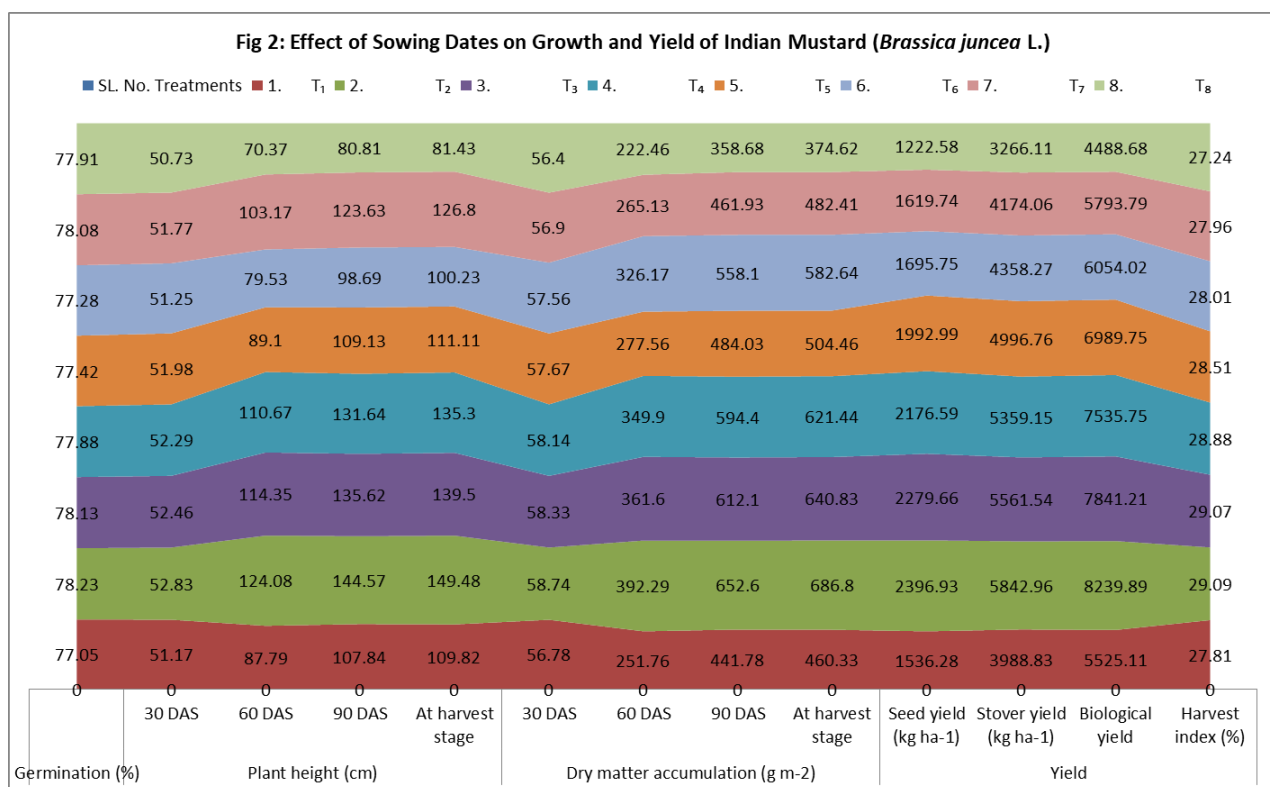
plant height (cm, measured from base to apex), number of primary and secondary branches per plant, leaf area index (calculated as per Watson, 1947) ^[22], and dry matter accumulation (g m⁻², obtained from oven-dried plant samples at 65±2 °C until constant weight). The data were subjected to statistical analysis through Analysis of Variance (ANOVA) appropriate to the RBD design following Panse and Sukhatme (1967) ^[16]. Treatment means were compared at 5% level of significance using the Critical Difference (CD) test, while the F-test was applied to determine treatment effects. Graphical representations were prepared to illustrate trends in growth attributes, and interpretations were based on pooled mean values.

Results and Discussion

The germination percentage data represent the mean germination percentage of mustard as influenced by different sowing dates. Statistical analysis revealed that sowing dates had a non-significant effect on germination. Germination percentage ranged from 77.05% (7th October sowing) to 78.23% (11th November sowing). The maximum germination was observed under T₂ (78.23%), followed by T₃ (78.13) and T₇ (78.08), while the lowest was recorded under T₁ (77.05%). Despite minor numerical differences, the values were statistically at par, indicating that sowing time did not markedly affect germination. The uniformity in establishment across sowing windows may be attributed to favorable initial soil moisture and good seed quality. These results are in close agreement with Meena *et al.* (2017) ^[12], who reported that seed vigor and soil conditions play a greater role than sowing date in influencing germination. Similar findings were also observed by Singh *et al.* (2020) ^[19]. Plant height of mustard increased steadily with crop age and was significantly influenced by sowing dates. At harvest, the tallest plants were obtained under T₂ (149.48), followed by T₃ (139.50) and T₄ (135.30), while the shortest plants were recorded with T₈ (81.43). Early sowing in October also produced comparatively shorter plants. The results clearly indicate that timely sowing during the first fortnight of November provides optimum photo-thermal conditions for vegetative growth, favoring cell elongation and internodal development. Conversely, delayed sowing exposed the crop to terminal heat stress, while very early sowing experienced suboptimal conditions, both leading to reduced plant stature. These findings corroborate those of Rathore *et al.* (2021) ^[17], who emphasized the role of sowing window in optimizing growth, and Kumar *et al.* (2018) ^[21], who reported restricted vegetative development in late-sown mustard due to unfavorable temperatures and shorter photoperiods. Dry matter accumulation in mustard increased progressively with crop age and was significantly influenced by sowing dates. At harvest, the maximum dry matter was recorded under T₂ (686.80), followed by T₃ (640.83) and T₇ (621.44). The lowest value (374.62) was observed in 25th November sowing. Early growth stages showed smaller differences, but variations became more pronounced at 60 DAS and later, reflecting the cumulative effect of favorable growing conditions. The higher dry matter in timely sown crops can be attributed to prolonged vegetative duration, higher LAI, and efficient utilization of light and nutrients, whereas delayed sowing curtailed biomass production due to shorter growth period and terminal heat stress.

Table 1: Effect of sowing dates on growth and yield of Indian mustard (*Brassica juncea* L.)

SL. No.	Treatments	Germination (%)	Plant height (cm)				Dry matter accumulation (g m ⁻²)				Yield			
			30 DAS	60 DAS	90 DAS	At harvest stage	30 DAS	60 DAS	90 DAS	At harvest stage	Seed yield (kg/ha.)	Stover yield (kg/ha.)	Biological yield (kg/ha.)	Harvest index (%)
1.	T ₁	77.05	51.17	87.79	107.84	109.82	56.78	251.76	441.78	460.33	1536.28	3988.83	5525.11	27.81
2.	T ₂	78.23	52.83	124.08	144.57	149.48	58.74	392.29	652.60	686.80	2396.93	5842.96	8239.89	29.09
3.	T ₃	78.13	52.46	114.35	135.62	139.50	58.33	361.60	612.10	640.83	2279.66	5561.54	7841.21	29.07
4.	T ₄	77.88	52.29	110.67	131.64	135.30	58.14	349.90	594.40	621.44	2176.59	5359.15	7535.75	28.88
5.	T ₅	77.42	51.98	89.10	109.13	111.11	57.67	277.56	484.03	504.46	1992.99	4996.76	6989.75	28.51
6.	T ₆	77.28	51.25	79.53	98.69	100.23	57.56	326.17	558.10	582.64	1695.75	4358.27	6054.02	28.01
7.	T ₇	78.08	51.77	103.17	123.63	126.80	56.90	265.13	461.93	482.41	1619.74	4174.06	5793.79	27.96
8.	T ₈	77.91	50.73	70.37	80.81	81.43	56.40	222.46	358.68	374.62	1222.58	3266.11	4488.68	27.24
9.	S.E(m) ±	1.29	0.73	2.33	4.04	3.04	1.23	8.01	19.10	13.93	37.05	90.00	127.05	0.85
10.	CD (p = 0.05)	3.92	2.19	6.94	11.99	9.02	3.69	23.80	56.73	41.37	110.09	267.40	377.49	2.53
11.	CV (%)	3.60	3.86	4.21	6.06	4.45	4.04	4.57	6.38	4.45	5.25	6.06	4.45	6.50

**Fig 1:** Effect of sowing dates on growth and yield of Indian mustard (*Brassica juncea* L.)**Fig 2:** Effect of sowing dates on growth and yield of Indian mustard (*Brassica juncea* L.)

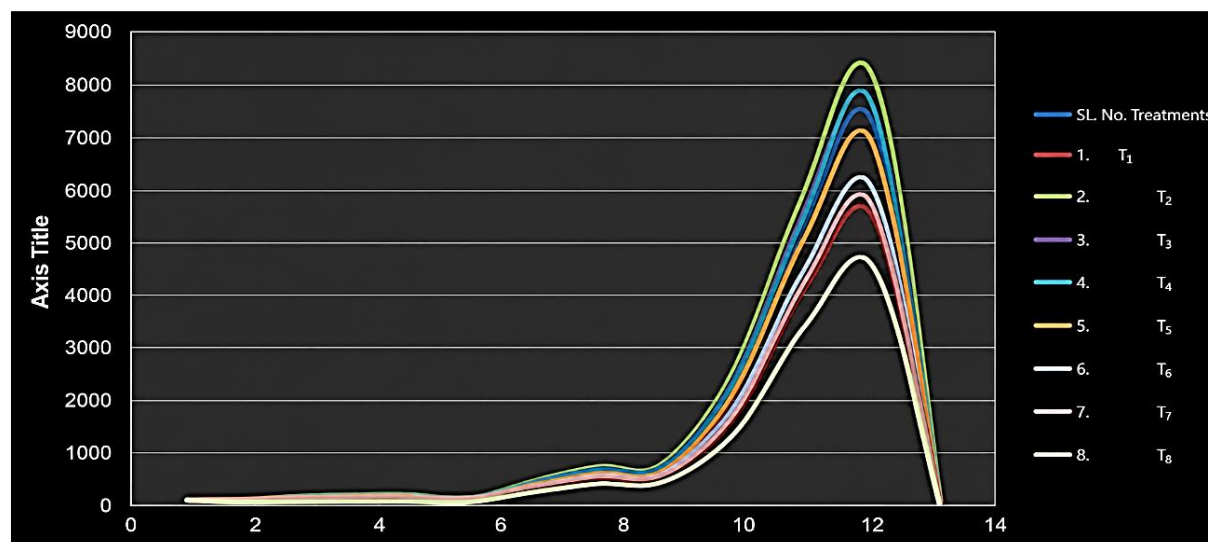


Fig 3: Effect of sowing dates on growth and yield of Indian mustard (*Brassica juncea* L.)

These findings are supported by Yadav *et al.* (2015) [23] and Meena *et al.* (2022) [22], who reported maximum dry matter production in mustard under timely sowing conditions. Seed yield of mustard was markedly influenced by sowing dates. The highest seed yield was obtained under T₂ (2396.93), followed by T₃ (2279.66) and T₄ (2176.59). The lowest yield was observed under T₈ (1222.58). The highest stover yield T₂ (5842.96) followed by T₃ (5561.54) and T₄ (5359.15). The highest biological yield was recorded in T₂ (8239.89), followed by T₃ (7841.21) and T₄ (7535.75). The highest harvest index was recorded under T₂ (29.09), followed by T₃ (29.07) and T₄ (28.88). The higher productivity in timely sowings can be attributed to favorable growth attributes such as plant height, branching, leaf area index, and dry matter accumulation, coupled with superior yield attributes like more siliquae per plant and higher seeds per siliqua. Similar trends have been reported by Thakur *et al.* (2019) [20] and Meena *et al.* (2021) [13], who found that sowing in early to mid-November ensured optimal thermal conditions, while delayed sowing reduced yield by 30-40% due to terminal heat during flowering and seed filling.

Conclusion

The study revealed that sowing dates significantly influenced growth attributes and yield of mustard, except germination percentage which remained unaffected. Timely sowing, particularly during the first fortnight of November, resulted in superior plant height, branching, leaf area index, dry matter accumulation, and favorable phenology, leading to enhanced yield attributes and productivity. Among the treatments, T₂ sowing recorded the highest seed yield (2396.93 kg ha⁻¹) and stover yield (5842.96 kg ha⁻¹), while delayed sowing on 25th November resulted in poor performance due to terminal heat stress. Thus, early November sowing is most suitable for maximizing mustard yield in the Gwalior region.

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