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Effect of different sowing dates and varieties on growth, development and yield-contributing characters of linseed (*Linum usitatissimum* L.)

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ABSTRACT

A field experiment was conducted during the Rabi season of 2024–25 at the Agricultural Research Farm of R.B.S. College, Bichpuri, Agra. The experiment was laid out in a Split Plot Design with three replications, comprising three dates of sowing 25th October, 05th November and 15th November in the main plots and three varieties Shubhra, SLS-67 and LCK-1101 in the sub-plots, resulting in nine treatment combinations. Results revealed that the date of sowing and variety had a non-significant effect on germination count, but sowing on 25th October significantly improved crop stand, plant height, number of primary and secondary branches per plant and dry matter accumulation per plant at all the growth stages compared with sowing on 5th November and 15th November. Sowing on 25th October significantly improved yield-contributing characters, recorded the highest number of capsules per plant (51.97), capsules weight (2.59 g), seeds per capsule (8.48), test weight (8.12 g) and shelling percentage (50.41%), being lowest under 15th November sowing. Among the varieties, variety Shubhra recorded significantly better crop stand, plant height, branching and dry matter accumulation than varieties SLS-67 and LCK-1101, and also produced the highest number of capsules per plant (53.63), capsules weight (2.56 g), seeds per capsule (8.43), test weight (8.58 g) and shelling percentage (49.17%).

Keywords: Date of sowing, Development, Growth, Linseed, Variety and Yield-Contributing

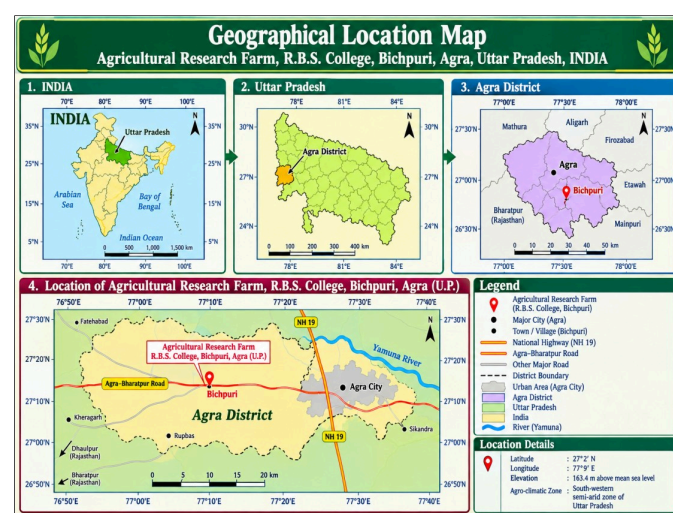
Introduction

Linseed (*Linum usitatissimum* L.), commonly known as alsi or flax, belongs to the family Linaceae and is one of the important rabi oilseed crops of India, grown primarily for its seed, which is used for extracting oil. The oil content of the seed varies from 33 to 47 per cent and is extensively used in the manufacture of paints, varnishes, oil-cloth, waterproof fabrics and linoleum, while the oil-cake serves as a nutritious cattle feed and manure (Shaikh *et al.*, 2015) [1]. Linseed is also among the richest plant-based sources of omega-3 fatty acid (alpha-linolenic acid), besides being a good source of fibre, protein and minerals (Prakash *et al.*, 2015) [2]. India ranks among the leading linseed growing countries of the world, occupying an area of about 1.75 lakh hectares with a production of 1.13 lakh tonnes and a productivity of only 392 kg ha⁻¹, which is much lower than the potential of improved varieties (Annual Report, 2024–25; USDA, 2025) [3, 4]. Uttar Pradesh alone accounts for about 26 per cent of the total linseed area of the country.

Growth and development of a crop, reflected through germination, plant height, branching pattern, leaf area index and dry matter accumulation, form the physiological foundation on which yield is subsequently built (Kumar *et al.*, 2026) [5]. Selection of suitable variety plays a vital role in crop production. Thus, the value of stable and high yielding variety has been universally recognized as an important factor for boosting crop production. With the improvement of crop productivity through the adoption of high yielding varieties use has become more and more important to increase crops yield and quality. (Sharma *et al.*, 2026) [6]. With the release of several high yielding linseed varieties by ICAR institutes and State Agricultural Universities, it has become necessary to identify the most suitable sowing window for each variety, so that better crop stand and vigorous growth can be ensured. The sowing date is one of the most important factors affecting seed production and quality. The optimum sowing date depends on rainfall and temperature to maintain high seed yields. (Summan *et al.*, 2025) [7]. Sowing date determines the extent to which the crop is exposed to prevailing temperature, photoperiod and moisture regimes during its different phenophases; both early and delayed sowing may expose the crop to frost or terminal heat stress and thereby adversely affect vegetative growth and phenological development.

MATERIALS AND METHODS Fig. 1. Geographical location map

The field experiment was conducted during the *Rabi* season of 2024–25 at the Agricultural Research Farm of Raja Balwant Singh (R.B.S.) College, Bichpuri, Agra (U.P.), situated about 11 km west of Agra city on the Agra–Bharatpur road. The soil of the experimental field was sandy loam in texture, slightly alkaline in reaction (pH 8.54), low in available nitrogen ($176.45 \text{ kg ha}^{-1}$), medium in available phosphorus ($26.07 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$) and rich in available potassium ($277.64 \text{ kg K}_2\text{O ha}^{-1}$). The experiment was laid out in a Split Plot Design with three replications, comprising three dates of sowing, viz., 25th October (D₁), 5th November (D₂) and 15th November (D₃), in the main plots, and three varieties, viz., Shubhra (V₁), SLS-67 (V₂) and LCK-1101 (V₃), in the sub-plots, giving a total of nine treatment combinations. The crop was sown with a seed rate of 30 kg ha^{-1} at a row spacing of 30 cm. A recommended dose of 60 kg N, 40 kg P₂O₅ and 30 kg K₂O ha⁻¹ was applied as basal dose through urea, single super phosphate and muriate of potash, respectively. All the recommended package of practices was followed uniformly for raising a good crop. The data recorded on various growths, development and yield contributing characters were statistically analysed by the analysis of variance technique applicable to a split plot design, as suggested by Panse and Sukhatme (1967) [8], and the treatment means were compared at 5 per cent level of significance.



Results and discussion

Dates of sowing

Data presented in Table 1 reveal that the germination count recorded at 15 days after sowing (DAS) was numerically highest (35.14) with the 25th October sowing (D₁), followed by (34.30) 5th November

sowing (D₂) and (34.16) 15th November sowing (D₃). A significant reduction in plant height at harvest was observed with delay in sowing. The maximum plant height (82.92 cm) was recorded with the earliest sowing 25th October (D₁), significantly superior to (80.38 cm) 5th November sowing (D₂) and (76.07 cm) 15th November sowing (D₃), the latter recorded the minimum plant height. These findings are in close agreement with Maurya *et al.*, (2017) [9] and Emam (2019) [10].

The number of primary branches per plant followed a similar declining trend with delay in sowing. Crop sown on 25th October (D₁) produced significantly more primary branches (5.99) than (D₂) 5th November sowing (5.23) and (D₃) 15th November sowing (3.05). Similar reductions in branching under late sowing have been reported by Kumhare *et al.*, (2022) [11] in linseed varieties. A significant and progressive decrease in secondary branches was also noted with delay in sowing, from 24.43 in 25th October (D₁) to 22.40 in 5th November sowing (D₂) and 18.46 in 15th November sowing (D₃). Since secondary branches arise from primary branches, the reduction in primary branch number under late sowing directly constrained the potential for secondary branch formation. This pattern is consistent with the findings of Maurya *et al.*, (2017) [9] and Kumhare *et al.*, (2022) [11] on delayed sowing of linseed. Dry matter accumulation per plant at harvest was significantly influenced by date of sowing, being highest in 25th October (D₁) (57.39 g plant⁻¹), followed by 5th November sowing (D₂) (53.87 g plant⁻¹) and 15th November sowing (D₃) (49.54 g plant⁻¹). The superiority of early sowing in dry matter accumulation can be explained by the cumulative effect of greater plant height and branch number, which together enhanced light interception and photosynthetic efficiency over longer growth duration. This corroborates the observations of Chauhan *et al.*, (2008) [12] and Emam (2019) [10].

Effect of varieties

The germination count at 15 DAS did not differ significantly among the three varieties, although SLS-67 (V₂) recorded the numerically highest (37.23), followed by varieties (V₃) LCK-1101 (36.25) and (V₁) Shubhra (35.94). The non-significant variation suggests that germination behaviour is governed more by inherent seed vigour and prevailing environmental conditions than by varietal differences, a trend also observed by Singh *et al.* (2011) [13] and Mohapatra *et al.*, (2023) [14] among linseed varieties. Plant height at harvest differed significantly among the varieties, with Shubhra (V₁) recording the maximum height (83.73 cm), followed by varieties LCK-1101 (V₃, 81.97 cm) and SLS-67 (V₂, 80.63 cm). The significant variation in plant height among varieties can be attributed to their differing genetic makeup governing inherent growth potential and internodal elongation, similar to varietal differences reported by Chauhan *et al.*, (2008) [12] in linseed.

Table 1. Germination count, Plant height (cm), Number of primary branches plant⁻¹, Number of secondary branches plant⁻¹ and Dry matter accumulation per plant at harvest stages of crop growth as influenced by dates of sowing and varieties.

Treatments	Germination count (15 DAS)	Plant height (cm)	Number of primary branches plant ⁻¹	Number of secondary branches plant ⁻¹	Dry matter accumulation (g plant ⁻¹)
Date of sowing					
25 th October (D ₁)	35.14	82.92	5.99	24.43	57.39
5 th November (D ₂)	34.30	80.38	5.23	22.40	53.87
15 th November (D ₃)	34.16	76.07	3.05	18.46	49.54
SEm ±	0.82	0.97	0.87	1.18	1.33
CD (p = 0.05)	NS	2.67	1.53	3.11	3.78
Effect of varieties					
Shubhra (V ₁)	35.94	83.73	5.89	22.12	58.11

(continued on next page)

SLS-67 (V ₂)	37.23	80.63	4.06	17.54	56.93
LCK-1101 (V ₃)	36.25	81.97	4.79	20.43	48.32
SEm ±	0.47	0.93	1.20	0.56	0.68
CD (p = 0.05)	NS	2.58	1.76	3.64	3.98

Significant varietal differences were recorded for primary branch number, with Shubhra (V₁) producing the highest number of primary branches (5.89), followed by LCK-1101 (V₃, 4.79) and SLS-67 (V₂, 4.06). This indicates that variety Shubhra (V₁) possesses a stronger inherent capacity for axillary bud break and lateral branch initiation, consistent with the varietal branching differences reported by Singh *et al.* (2011) [13] and Bastia and Mohanty (2001). A similar result was observed for secondary branches, with Shubhra (V₁) recorded the highest number (22.12), SLS-67 (V₂) recording 17.54, and LCK-1101 (V₃) an intermediate (20.43). Since secondary branches originate from primary branches, the higher primary branching in (V₁) Shubhra directly translated into greater secondary branch production, reflecting the cascading effect of genetic branching potential, in line with Choudhry *et al.*, (2009) [15] and Meena *et al.*, (2012) [16]. Dry matter accumulation per plant at harvest was significantly the highest in Shubhra (V₁, 58.11 g plant⁻¹), followed closely by SLS-67 (V₂, 56.93 g plant⁻¹), while LCK-1101 (V₃) recorded significantly the lowest accumulation (48.32 g plant⁻¹). This may be due to Shubhra's superior photosynthetic efficiency and assimilate partitioning, a pattern also reported by Singh *et al.* (2011) [13] and Dubey *et al.*, (2005) [17] for high-performing linseed varieties.

Yield contributing characters

Effect of dates of sowing

The maximum number of capsules (51.97) was recorded on 25th October sowing (D₁), significantly higher than 5th November sowing (D₂) 49.96 and 15th November sowing (D₃) 46.20. The decline under delayed sowing may be attributed to the shortened reproductive phase

and exposure to higher temperatures during flowering, adversely affecting pollination and fruit-set. Similar reductions in capsules number under delayed sowing of linseed have been reported by Maurya *et al.*, (2017) [9] and Sharma *et al.*, (2025) [18]. Capsules weight declined significantly from 2.59 g 25th October sowing (D₁) to 2.38 g 5th November sowing (D₂) and 2.11 g 15th November sowing (D₃), reflecting the compounding effect of fewer capsules and poorer seed filling under sub-optimal temperature during the reproductive stage. These results agree with Singh *et al.*, (2023), Kumhare *et al.*, (2022) [11] and Chauhan *et al.*, (2008) [12], who reported reduced capsules weight in linseed under delayed sowing. Seeds per capsules were significantly higher under 25th October sowing (D₁) 8.48 compared to 5th November sowing (D₂) 7.83 and 15th November sowing (D₃) 6.96. Delayed sowing exposes the crop to rising temperatures during flowering, shortening the effective seed-filling duration. This is consistent with the findings of Emam (2019) [10], Maurya *et al.*, (2017) [9] and Singh *et al.*, (2022) [19].

Test weight was maximum under 25th October sowing (D₁) 8.12 g, declining progressively to (7.65 g) 5th November sowing (D₂) and 6.87 g 15th November sowing (D₃). Higher test weight under timely sowing reflects efficient translocation of photosynthates during a longer effective seed-filling period, in line with Kumhare *et al.*, (2022) [11], Sharma *et al.*, (2025) [18] and Singh *et al.*, (2026) [6]. Shelling percentage was significantly highest under 25th October sowing (D₁) 50.41%, declining to 49.45% 5th November sowing (D₂) and 43.90% 15th November sowing (D₃), a trend also reported by Chauhan *et al.*, (2008) [12] and Emam (2019) [10] for delayed sowing of linseed.

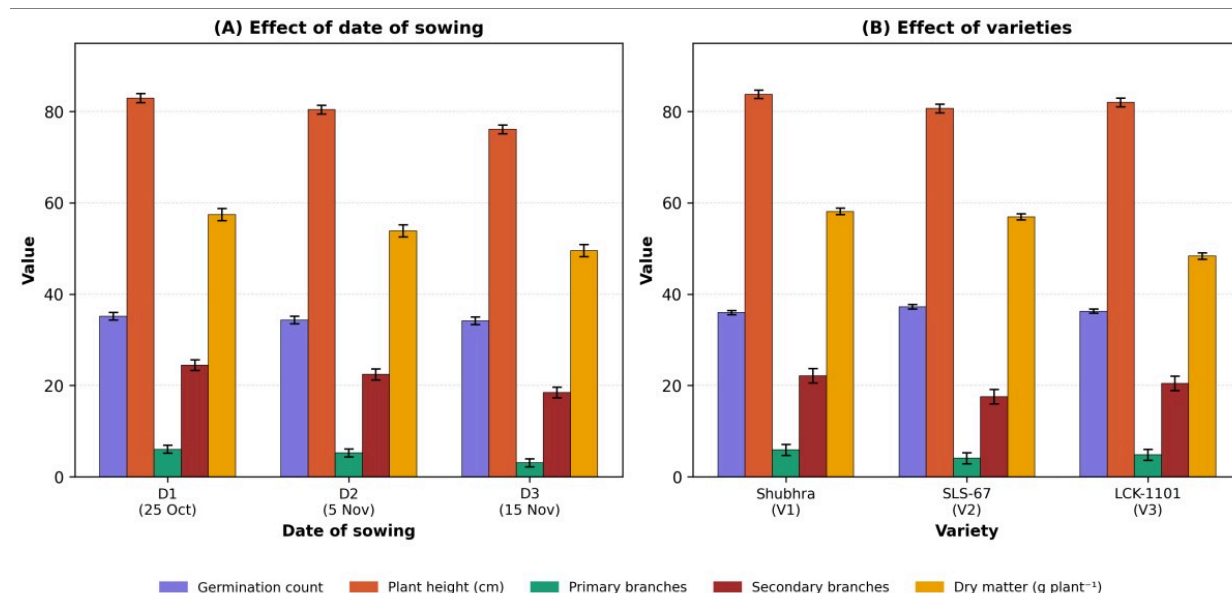


Figure 2. Effect of date of sowing and varieties on growth parameters

Table 2. Yield contributing characters as influenced by dates of sowing and varieties.

Treatments		No. of capsules plant ⁻¹	Weight of capsules plant ⁻¹ (g)	No. of seeds capsule ⁻¹	Test weight (g)	Shelling %
Date of sowing						
25 th October	D ₁	51.97	2.59	8.48	8.12	50.41
05 th November	D ₂	49.96	2.38	7.83	7.65	49.45

(continued on next page)

15 th November	D ₃	46.20	2.11	6.96	6.87	43.90
SEm ±		0.75	0.08	0.41	0.48	0.64
CD (<i>p</i> = 0.05)		2.11	0.23	0.97	1.29	1.89
Effect of varieties						
Shubhra	V ₁	53.63	2.56	8.43	8.58	49.17
SLS-67	V ₂	50.89	2.29	7.66	7.75	46.12
LCK-1101	V ₃	47.63	2.04	6.66	6.87	45.11
SEm ±		1.15	0.12	0.38	0.47	0.74
CD (<i>p</i> = 0.05)		2.92	0.31	0.86	1.40	2.18

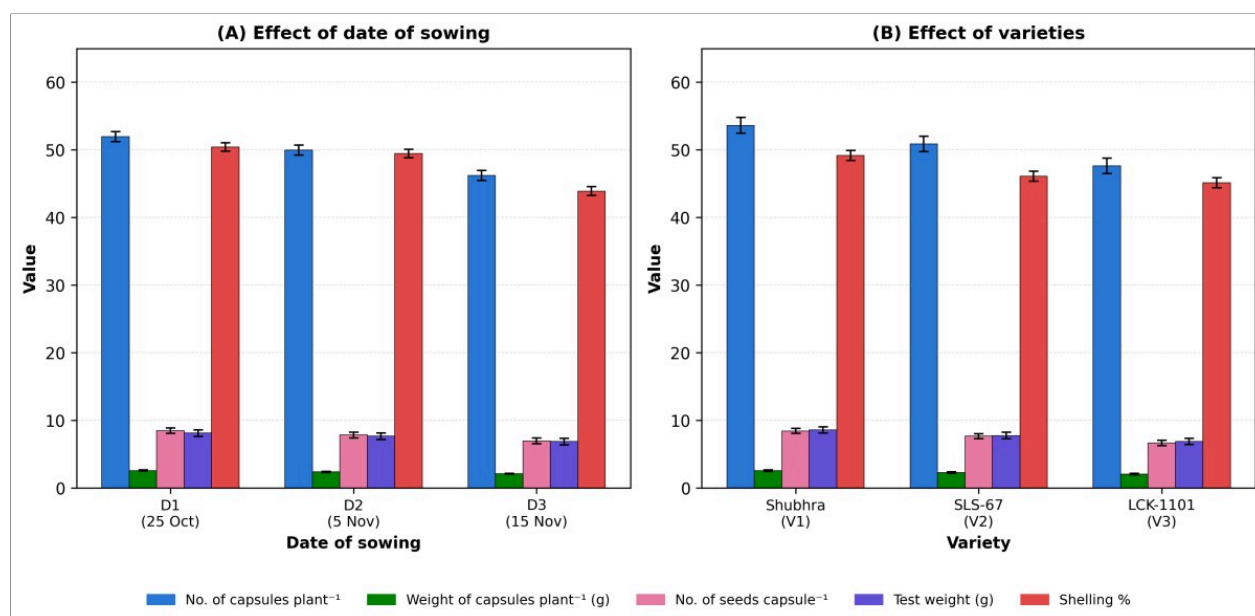


Figure 3. Effect of date of sowing and varieties on yield contributing characters

Effect of varieties

Variety Shubhra (V₁) recorded significantly the highest number of capsules (53.63), followed by varieties SLS-67 (V₂, 50.89) and LCK-1101 (V₃, 47.63). This superiority likely stems from Shubhra's greater branching, providing more reproductive sites, consistent with the varietal differences reported by (Sharma *et al.*, 2025) [18]. Capsule weight was significantly highest in variety Shubhra (V₁, 2.56 g) over varieties SLS-67 (V₂, 2.29 g) and LCK-1101 (V₃, 2.04 g), reflecting more efficient assimilate partitioning towards reproductive structures, as similarly observed by Pathak *et al.*, (2011) [20] across linseed varieties. Variety (V₁) Shubhra recorded the highest seeds per capsule (8.43), significantly superior to varieties SLS-67 (V₂, 7.66) and LCK-1101 (V₃, 6.66), attributable to genetically superior ovule number and fertilization efficiency, in agreement with Rai (2023) [21]. Test weight was significantly highest in variety Shubhra (V₁, 8.58 g) than varieties SLS-67 (V₂, 7.75 g) and LCK-1101 (V₃, 6.87 g), pointing to a more efficient source-sink translocation system, similar to varietal differences reported by Bastia and Mohanty (2001) and Maurya *et al.*, (2017) [9]. Shelling percentage was highest in variety Shubhra (V₁, 49.17%), followed by varieties SLS-67 (V₂, 46.12%) and LCK-1101 (V₃, 45.11%), consistent with its superior seed development, a pattern also noted by Shahidullah *et al.*, (2018) [22].

Conclusion

The results of the study demonstrate that agro-climatic conditions of the Agra region of Uttar Pradesh, sowing of linseed on 25th October results in significantly better crop stand, plant height, branching and dry matter accumulation, along with earlier flowering and maturity, than sowing on 5th November and 15th November. Sowing on 25th October produced significantly superior yield-contributing characters,

including a higher number of capsules per plant, capsules weight, seeds per capsule, test weight and shelling percentage, compared to the delayed sowings. Among the varieties evaluated, variety Shubhra proved consistently superior to varieties SLS-67 and LCK-1101 in growth characters as well as in yield-contributing characters such as capsule number, capsule weight, seeds per capsule, test weight and shelling percentage.

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