

Growth, Yield, Quality Parameters and Nutrient Uptake of Linseed (*Linum usitatissimum* L.) Cultivars as Influenced by Varying Planting Dates

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Abstract A field experiment was conducted at Varanasi during two consecutive winter seasons of 2012-2013 and 2013-2014 respectively to study the influence of varying planting dates and cultivars on yield attributes, yield and quality parameters on linseed. The experiment was laid out in split plot design with three replications and main plot comprised of a combination of five dates of sowing viz. D₁ (15 October), D₂ (30 October), D₃ (15 November), D₄ (30 November) and D₅ (15 December). Four linseed varieties were assigned to sub plots viz. V₁ (Neelam), V₂ (Shekhar), V₃ (T-397) and V₄ (Garima) were assigned to sub plots. The results revealed that higher growth attributes, yield attributes, yield and quality were recorded with sowing on D₁ (15 October) and D₂ (30 October) and with variety V₂ (Shekhar) and was significantly superior to other dates of planting. Significant reduction in all the parameters were recorded

with sowing beyond D₃ (15 November) with variety V₃ (T-397).

Keywords Linseed, Yield, Nutrient uptake.

Introduction

Linseed (*Linum usitatissimum* L.) is a member of the genus *Linum* of family Linaceae. It is the sixth largest oilseed crop in the world and an important *rabi* oilseed crop and a prominent source of oil and fiber. India ranks first in terms of area under linseed cultivation and third in production in the world. Madhya Pradesh, Chhattisgarh, Maharashtra, Uttar Pradesh, Orissa and Bihar are the major linseed producing states. It is the best source of omega-3 fatty acid and it is essential as it cannot be synthesized by the body, but must be supplemented directly from foods. Since, there is a shift in global climate due to several reasons and different genotypes may respond differently to changing climate and exhibit marked variation in the growth, development and yield of a particular cultivar. So, with an idea to obtain higher crop yield and to evolve suitable agro-technique like optimum date of sowing and to utilize optimum solar energy the following research was planned.

Materials and Methods

A field experiment was conducted during two consecutive *rabi* seasons of 2012-2013 and 2013-2014 at

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Table 1. Growth, yield attributes and yield of linseed as influenced by varying planting dates and cultivars during both the years.

Treat- ments	Plant height		Branches/plant		Dry matter accumulation/plant		Capsules/plant	
	2012	2013	2012	2013	2012	2013	2012	2013
Planting dates								
15 Oct	56.21	56.54	4.94	5.57	9.90	10.12	62.50	63.92
30 Oct	52.43	55.13	4.84	5.31	9.88	9.83	60.17	60.42
15 Nov	51.23	52.71	4.44	5.12	9.40	9.38	58.75	59.17
30 Nov	50.39	51.13	4.12	4.31	9.12	9.32	42.92	43.33
15 Dec	47.58	49.90	3.83	4.02	8.12	8.32	39.75	40.58
SEm±	1.21	1.12	0.13	0.08	0.13	0.20	1.09	0.77
CD (<i>p</i> = 0.05)	3.96	3.66	0.42	0.26	0.42	0.67	3.55	2.53
Cultivars								
Neelam	50.25	51.47	4.38	4.58	9.18	9.28	53.47	54.27
Shekhar	50.89	51.82	5.20	5.37	9.52	9.65	54.20	55.00
T-397	50.63	52.53	4.42	4.60	9.05	9.15	51.27	51.47
Garima	54.52	56.51	4.53	4.75	9.39	9.50	52.33	53.20
SEm±	0.79	0.85	0.10	0.03	0.11	0.12	0.63	0.55
CD (<i>p</i> = 0.05)	2.28	2.47	0.30	0.09	0.32	0.37	1.83	1.61

Table 1. Continued.

Treat- ments	Seeds/capsule		Test weight (g)		Seed yield (q/ha)		Straw yield (q/ha)	
	2012	2013	2012	2013	2012	2013	2012	2013
Planting dates								
15 Oct	8.00	8.29	7.94	8.19	12.67	14.62	33.13	34.27
30 Oct	7.75	7.97	7.61	7.73	12.20	13.11	31.30	32.62
15 Nov	7.58	7.84	7.39	7.53	11.49	12.26	32.75	34.03
30 Nov	7.51	7.81	7.05	7.17	10.84	11.95	30.63	32.80
15 Dec	7.35	7.63	6.93	7.03	9.41	9.87	27.70	29.32
SEm±	0.10	0.11	0.09	0.12	0.21	0.24	0.48	0.52
CD (<i>p</i> = 0.05)	0.33	0.39	0.31	0.41	0.71	0.80	1.56	1.72
Cultivars								
Neelam	7.72	7.98	7.41	7.55	11.73	12.56	32.46	33.65
Shekhar	7.83	8.10	7.90	8.06	12.24	12.92	31.24	32.88
T-397	7.40	7.65	6.93	7.06	9.81	11.54	29.86	31.82
Garima	7.61	7.91	7.28	7.44	11.52	12.3	30.85	32.07
SEm±	0.08	0.10	0.06	0.09	0.19	0.20	0.41	0.46
CD (<i>p</i> = 0.05)	0.23	0.29	0.17	0.26	0.55	0.60	1.19	1.34

the Agriculture Research Farm of Banaras Hindu University, Institute of Agriculture Sciences, Varanasi (UP). The soil of the experimental field was sandy clay loam in texture, low in organic carbon (0.37%),

low in available nitrogen (192.05 kg ha⁻¹), medium in phosphorus (19.87 kg ha⁻¹) and potassium (202.28 kg ha⁻¹) and having neutral reaction (pH 7.31). The experiment was laid out in split plot design with three

Table 2. Protein content, protein yield, oil content, oil yield and nutrient uptake by linseed as influenced by varying planting dates and cultivars during both the years.

Treat-ments	Protein content (%)		Protein yield (kg/ha)		Oil content (%)		Oil yield (kg/ha)	
	2012	2013	2012	2013	2012	2013	2012	2013
Planting dates								
15 Oct	21.84	22.47	275.63	328.52	40.77	41.21	517.24	603.09
30 Oct	22.32	22.94	271.70	300.04	40.28	40.68	491.67	533.41
15 Nov	23.30	23.93	267.26	293.34	38.96	39.66	447.79	486.39
30 Nov	23.70	24.13	256.07	288.46	37.08	37.60	402.03	449.13
15 Dec	23.83	24.65	224.36	243.61	36.82	37.19	346.77	367.42
SEm±	0.38	0.38	7.77	9.16	0.35	0.35	11.27	14.15
CD (<i>p</i> = 0.05)	1.26	1.26	25.36	29.87	1.16	1.17	36.77	46.16
Cultivars								
Neelam	23.00	23.58	268.04	294.97	39.38	39.92	463.76	503.87
Shekhar	21.49	22.08	262.87	285.40	38.91	39.36	478.08	511.39
T-397	23.22	24.00	227.72	276.42	38.56	38.96	379.29	451.63
Garima	24.28	24.84	277.39	306.38	38.28	38.83	443.28	484.67
SEm±	0.30	0.29	4.41	5.92	0.15	0.25	7.96	8.90
CD (<i>p</i> = 0.05)	0.89	0.84	12.74	17.10	0.43	0.73	23.01	25.71

Table 2. Continued.

Treat-ments	N content (%)		P content (%)		K content (%)		S content (%)	
	2012	2013	2012	2013	2012	2013	2012	2013
Planting dates								
15 Oct	3.49	3.59	0.859	0.880	0.749	0.776	0.258	0.283
30 Oct	3.57	3.67	0.827	0.850	0.723	0.751	0.251	0.271
15 Nov	3.72	3.82	0.814	0.836	0.712	0.743	0.239	0.256
30 Nov	3.79	3.86	0.801	0.823	0.671	0.701	0.216	0.244
15 Dec	3.81	3.94	0.788	0.809	0.639	0.666	0.214	0.230
SEm±	0.06	0.06	0.008	0.011	0.009	0.007	0.003	0.004
CD (<i>p</i> = 0.05)	0.20	0.20	0.028	0.036	0.028	0.021	0.009	0.013
Cultivars								
Neelam	3.68	3.77	0.824	0.124	0.701	0.728	0.237	0.260
Shekhar	3.43	3.53	0.790	0.116	0.691	0.718	0.227	0.247
T-397	3.71	3.84	0.811	0.121	0.693	0.723	0.238	0.254
Garima	3.88	3.97	0.846	0.131	0.709	0.742	0.241	0.266
SEm±	0.04	0.04	0.007	0.001	0.005	0.005	0.002	0.003
CD (<i>p</i> = 0.05)	0.14	0.13	0.022	0.005	0.014	0.015	0.006	0.009

replications. Main plot comprised of a combination of five dates of sowing viz. D₁ (15 October), D₂ (30 October), D₃ (15 November), D₄ (30 November) and D₅ (15 December). Four linseed varieties viz. V₁

(Neelam), V₂ (Shekhar), V₃ (T-397) and V₄ (Garima) were assigned to sub plots. All varieties were sown using a seed rate of 30 kg ha⁻¹ at a row spacing of 30 cm. A recommended dose of 60 kg N, 40 kg P and 40

kg K ha⁻¹ were applied to crop. Urea, DAP and Muriate of potash were used as source of fertilizer. Full amount of phosphorus and potassium along with half dose of nitrogen were applied as basal by side dressing, remaining half dose of nitrogen was top dressed after first irrigation. Crop was harvested at maturity when most of the bolls turned yellow in color and leaves started dropping. After threshing seed and stover yield (q ha⁻¹) were recorded. Quality attributes i.e. oil content and yield, protein content and yield in seed were analyzed. The economics of the experimental crop as influenced due to different treatments were also worked out. These studies provided a salient measure of efficacy of planting time and cultivars on linseed crop. All the observations were subjected to statistical analysis as per the standard procedure.

Results and Discussion

Growth attributes

Different growth parameters (plant height, number of primary and secondary branches/plant and dry matter accumulation / plant) exhibited a significant difference in all the characters due to variation in planting dates. It was observed that all the growth parameters decreased gradually with delay in sowing. D₁ (15 October) recorded significantly tallest plant height, number of branches plant⁻¹ and dry matter accumulation plant⁻¹ from 30 DAS to harvest stage of the crop during both the years (Table 1). Moreover, growth parameters of linseed sown on D₁ (15 October) and D₂ (30 October) remained at par with each other and was significantly higher as compared to other dates of sowing. These results are in corroboration with earlier findings [1, 2].

Variety V₂ (Shekhar) was found superior in all growth attributes than other varieties except in plant height and dry matter accumulation plant⁻¹ which was recorded highest in variety V₃ (Garima) (Table 1). The differences in growth attributes of varieties are in general, due to their genetic constitution [3, 4].

Yield attributes

Highest seed and stover yield (q ha⁻¹) were recorded

on D₁ (15 October) sown crop followed by D₂ (30 October), D₃ (15 November), D₄ (30 November) and D₅ (15 December) respectively. Variety V₂ (Shekhar) produced higher yield attributes viz. number of capsules plant⁻¹, number of seeds capsule⁻¹ and test weight and seed yield (q ha⁻¹) than other varieties during the first and second year respectively (Table 1).

While among varieties higher yield attributes and yield (q ha⁻¹) was produced by variety V₂ (Shekhar) during 2012 and 2013 respectively (Table 1). Similar results were obtained by Kushwaha et al. [5] and this can be attributed to the fact that higher seed yield of crop is the sum total of enhanced growth and yield attributing characters. Similar results were obtained by Verma et al. [3].

Quality parameters

Protein content (%) in seed increased as sowing was delayed. It was highest in D₅ (15 December) sown crop followed by D₄ (30 November), D₃ (15 November), D₂ (30 October) and D₁ (15 October) sown crops, respectively (Table 2). However, D₁ (15 October) sown crop recorded significantly higher protein yield due to significantly higher seed yield than late sown crop. The oil content was decreased as sowing was delayed from D₁ (15 October). The highest oil content was found in the crop sown on D₁ (15 October) followed by D₂ (30 October), D₃ (15 November), D₄ (30 November) and D₅ (15 December), respectively during both the years of study. A similar trend for oil yield (q ha⁻¹) was also recorded. Nitrogen content (%) was higher in D₅ (15 December) sown crop as compared to early sown crops while phosphorus and potassium content (%) decreased as sowing was delayed from D (15 October). Similar results were obtained earlier [1, 6].

Variety V₁ (Neelam) recorded highest oil content (%) in seed and it was closely followed by variety V₂ (Shekhar). However, variety V₂ (Shekhar) recorded the higher oil yield (kg ha⁻¹) due to significantly higher oil yield as compared to other varieties. Variety V₄ (Garima) recorded the highest protein content (%) in seed and protein yield and was closely followed by variety V₁ (Neelam) (Table 2). Variety V₄ (Garima) re-

corded the highest N, P and K content in seed while uptake (kg ha^{-1}) was higher in variety V_4 (Garima) for nitrogen and phosphorus while uptake of potassium was higher in V_2 (Shekhar). Variety V_2 (Shekhar) recorded the highest N, P and K uptake (kg ha^{-1}) in stover during both the years. These results are in close proximity to that of Salunke et al. [7].

Economics

The data on economics of different treatments differed significantly due to different date of planting. The crop sown on D_1 (15 October) gave the highest net return and benefit : Cost ratio followed by D_2 (30 October), D_3 (15 November), D_4 (30 November) and D_5 (15 December) sown crops, respectively during both the years of experimentation. Variety V_2 (Shekhar) gave the highest net return and B : C ratio followed by V_1 (Neelam), V_4 (Garima) and V_3 (T-397) respectively. These findings are similar to that of Yadav et al. [8].

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