Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(1): 388-392
Received: 12-11-2018
Accepted: 15-12-2018

Ganvit JB
Department of Agronomy, N. M. College of Agriculture, Navsari Agriculture University, Navsari, Gujarat, India

Seema Sharma
Department of Agronomy, N. M. College of Agriculture, Navsari Agriculture University, Navsari, Gujarat, India

Vaishali H Surve
Department of Agronomy, N. M. College of Agriculture, Navsari Agriculture University, Navsari, Gujarat, India

Ganvit VC
Department of Agronomy, N. M. College of Agriculture, Navsari Agriculture University, Navsari, Gujarat, India

Correspondence
Ganvit JB
Department of Agronomy, N. M. College of Agriculture, Navsari Agriculture University, Navsari, Gujarat, India

Effect of sowing dates and crop spacing on growth, yield and quality of linseed under south Gujarat condition

Ganvit JB, Seema Sharma, Vaishali H Surve and Ganvit VC

Abstract
A field experiment was conducted during the *rabi* season of 2016-17 at College Farm, Navsari Agriculture University, Navsari, Gujarat to study the Effect of sowing dates and crop spacing on growth, yield and quality of linseed. The treatments comprised of 4 sowing dates, Viz. D_1: 3rd week of October, D_2: 4th week of October, D_3: 1st week of November and D_4: 2nd week of November in main plots and 3 spacing (S_1: 20 cm x 5 cm, S_2: 30 cm x 5 cm and S_3: 40 cm x 5 cm) in sub-plots, replicated four times in a split plot design. Sowing dates as well as spacing significantly affected growth characters, yield attributes, yield, oil yield and Economics. The results of the experiment showed significantly higher plant height (59.62 cm), number of branches/plant (9.78), number of seeds/capsule (6.62), test weight (6.61 g), seed yield (1272 kg/ha), stover yield (2908 kg/ha), oil yield (476 kg/ha) and accrued highest net realization (₹ 73,252/ha) with BCR (4.47) were recorded in sowing on 1st week of November (D_3). Sowing of linseed with narrow spacing S_1 (20 cm x 5 cm) was recorded significantly higher plant height (59.62 cm), seed yield (1262 kg/ha), stover yield (2976 kg/ha), oil yield (471 kg/ha) and also reported maximum net realization (₹ 72,565/ha) with BCR (4.43).

Keywords: Sowing dates, growth, spacing, linseed, yield, quality, economics

Introduction
Linseed (*Linum usitatissimum* L.), also known as flax is a member of genus *Linum* in the family Linaceae. It is commonly known as *Alashi* or *Alsi*. Every part of the linseed plant is utilized commercially, either directly or after processing. On a very small scale seed is directly used for edible purposes. It contains 33 to 47% of oil. About 20% of the total oil produced is used at farmer's level and the rest 80% oil goes to industries in various forms such as boiled oil, borated oil, eposidized oil, aluminates oil, urethane oil, isomerizes oil *etc*. The oil is rich in linolenic acid (>66%) and it is a perfect drying oil. Linseed seeds contain high levels of dietary fiber as well as lignin, an abundance of micronutrient and omega-3 fatty acids. It is good in taste and contains 36% protein, 85% of which is digestible. It is also used as organic manure and contains about 5% N, 1.4% P_2O_5 and 1.8% K_2O.

India is an important linseed growing country in the world and it contributes 7 per cent to the world linseed pool. At present, linseed is cultivated in about 2.63 lakh hectares with contribution of 1.26 lakh tones to the annual oilseed production of the country. The average productivity of linseed is 477 kg/ha (2015-16). Major linseed growing states in India are Madhya Pradesh, Uttar Pradesh, Chhatisgarh, Bihar, Rajasthan, Orissa and Karnataka. Madhya Pradesh has largest growing area (1.16 lakh ha) and production (0.55 lakh tones) with 474 kg/ha productivity (Anonymous 2015-16) [2].

Optimum sowing time is one of the most important agronomic factor and non-monetary input but has noticeable impact on productivity of crop. Planting dates significantly affect growth character, yield and its components as well as oil yield in flax (Al-Doori, 2012) [1]. Sowing dates have been shown to provide differential growth conditions such as temperature, precipitation and growth periods. The appropriate sowing date is very important since it ensures good seed germination, as well as timely appearance of seedling and optimum development of root system.

Spacing plays an important role in increasing production per unit area. It is well known fact that spacing plays an important role in production of field crops. Spacing is dependent upon the expected growth of a particular crop and variety in a given agro-climatic condition. Therefore, optimum plant spacing is one of the most important factors in increasing the yield per hectare.

Materials and Methods

The present study was conducted on plot No. D-16 of the College Farm, N.M. College of Agriculture, Navsari Agricultural University, Navsari during *rabi* season of 2016-17. The soil of experimental plot was clayey in texture, low in organic carbon (0.44%) and available nitrogen (206.50 kg/ha), medium in available phosphorus (38.20 kg/ha) and high in available potassium (323.18 kg/ha). The soil was found slightly alkaline (pH 7.8) with normal electric conductivity.

The experiment was laid out in split plot design with four levels of sowing dates, i.e. D_1: 3rd week of October, D_2: 4th week of October, D_3: 1st week of November and D_4: 2nd week of November in the main plots and three levels of spacing, viz. S_1: 20 cm x 5 cm, S_2: 30 cm x 5 cm and S_3: 40 cm x 5 cm in the sub plots, replicated four times. Required quality of seed as per treatment was calculated for experimental area. The seeds were drilled 3-4 cm deep in previously opened furrows as per treatments and covered properly with soil. Five plants were selected randomly from each net plot and tagged for recording growth and yield attributing parameters. Oil content of seed was determined by soxhlet apparatus as per the method suggested by Tiwari *et al.*, 2011 [16]. The statistical analysis of data recorded for different characters during the course of investigation was carried out through the procedure appropriate to the Split plot design as described by Cochran and Cox, 1967 [4]. The economics was calculated on the basis of different inputs and output.

Result and Discussion

Effect of sowing dates

Effect on growth parameters

Plant height

The significantly taller plant (59.62 cm) was observed under the treatment D_3 (1st week of November). This is probably due to timely sowing which might have enjoyed favourable climatic conditions in terms of temperature and other parameters during crop growth and also on account of better availability of mineral nitrogen to the plants due to favourable soil temperature which have resulted in better utilization of carbohydrates to form more protoplasm resulting in more cell division and enlargement. These results lend support to those reported by Al-Doori (2012) [1] at Mosul and Ganga *et al.* (2015) [6] at Varanasi (Table 1).

Number of branches/plant

Significantly higher number of branches/plant (9.78) recorded under treatment D_3 (1st week of November). This might be due to favourable weather during entire crop period coupled with nutrient absorption at appropriate time. These results also corroborate with the findings of Kalita *et al*. (2005) [8] at Assam and Ganga *et al.* (2015) [6] at Varanasi (Table 1).

Effect on yield and attributes and yield

Number of capsules/plant

Significantly highest number of capsules/plant (53.85) was recorded under treatment D_3 (1st week of November). This was possibly due to timely planting and crop exposure to favourable weather during the whole growth period and thus different phases of crop were completed at appropriate timings, which ultimately resulted in production of more number of branches/plant providing more sites for reproductive structures *viz*., number of capsules/plant. This also confirms the results of Ganga *et al.* (2015) [6] at Varanasi and Maurya *et al*. (2017) [13] at Varanasi (Table 1).

Number of seeds/capsule

Treatment D_3 (1st week of November) produced significantly higher number of seeds/capsule (6.62). This was might be because of favourable environment particularly that of temperature that prevailed during the time of sowing and at vegetative and reproductive stages. The results obtained by Raundal *et al.* (2015) [14] at Pune and Maurya *et al*. (2017) [13] at Varanasi also confirm the findings of present investigation (Table 1).

1000 seed weight

Treatment D_3 (1st week of November) recorded significantly higher 1000 seed weight (6.61). This due to timely sown crop got an advantage because after having completed its vegetative growth satisfactorily it came in the reproductive stage when the temperature was quite favourable. The results lend support to those reported by; El-Mohsen *et al.* (2013) [5] at Egypt and Maurya *et al*. (2017) [13] at Varanasi (Table 1).

Seed yield

The treatment D_3 recorded significantly higher seed yield (1272 kg/ha) of linseed by 6.35 and 11.19 per cent over D_2 and D_1, respectively. Higher seed yield might be the result of cumulative effect of improvement in growth and yield attributes such as number of branches/plant, number of capsules/plant, number of seeds/capsule as well as 1000 seed weight. The timely sown crop received favourable weather conditions for longer duration and recorded better growth and yield attributes and resulted in greater productivity. Superiority of timely planting might be due to prevalence of favourable climatic factors such as temperature and light energy, which provide the plant full chance to develop well canopy and biomass and its increased capacity to absorb enough water and nutrients, and consequently possessed more effective productive organs. The results lend support to those reported by El-Mohsen *et al.* (2013) [5] at Egypt; Ganga *et al.* (2015) [6] at Varanasi and Maurya *et al*. (2017) [13] at Varanasi (Table 1).

Stover yield

Significantly higher straw yield (2908 kg/ha) was recorded under the treatment D_3 which superseded by 13.46 per cent over D_1. Higher straw yield under treatment D_3 might be due to more favorable period for vegetative growth in terms of plant height obviously resulted into more straw yield. These findings are in cognizance with the results of El-Mohsen *et al.* (2013) [5] at Egypt and Ganga *et al.* (2015) [6] at Varanasi (Table 1).

Effect on quality

Varying sowing dates failed to produce significant effect on quality of linseed in terms of oil content. However, numerically higher oil content (37.53 %) in linseed was observed under the treatment D_3 (1st week of November). Significantly higher oil yield (476 kg/ha) was recorded under the treatment D_3 (1st week of November). The higher oil yield obtained under the above treatment was the resultant of perceptibly higher seed along with the higher oil content which were directly responsible for higher oil yield. The timely sown crop experienced favourable weather conditions for longer duration recorded better growth and seed yield resulted in more oil productivity. These results lend support to those reported by Al-Doori (2012) [1] at Mousul and Ganga *et al.* (2015) [6] at Varanasi (Table 1).

Effect on economics

Among various sowing dates D_3 recorded the highest net returns of ₹ 73,252/ha with BCR of 4.47. These findings are substantiated with those reported by Gohil *et al.* (2016) [7] at Navsari and Maurya *et al*. (2017) [13] at Varanasi (Table 1).

Effect of spacing

Effect on growth parameters

Plant height

The significantly tallest plant (59.73 cm) was observed under the treatment S_1 (20 cm x 5 cm). Higher plant height might be due to unavailability of sufficient space and sunlight which forced the plants to grow vertically rather than horizontly. The present results are in close conformity with those of Kushwaha *et al*. (2006) [11] at Kanpur and Gohil *et al.* (2016) [7] at Navsari (Table 1).

Number of branches/plant

Significantly higher number of branches/plant (9.76) recorded under treatment S_3 (40 cm x 5 cm). This might be due to sufficient availability of sunlight and nutrient which increased plant growth and development. The present results are in cognizance with those of Khan *et al*. (2005) [9] at Multan and Gohil *et al.* (2016) [7] at Navsari (Table 1).

Effect on yield and attributes and yield

Number of capsules/plant

Significantly higher number of capsules/plant (50.49) was recorded under treatment S_2 (30 cm x 5 cm). This was possibly due to less competition between plants for nutrient, soil moisture, space and solar radiation etc. in wider spacing than closer spacing. This also confirms the results of Kushwaha *et al*. (2006) [7] at Kanpur and Chaudhary (2009) [3] at Kanpur and (Table 1).

Number of seeds/capsule

Treatment S_2 (30 cm x 5 cm) produced significantly higher number of seeds/capsule (6.46). This was due to plants grown wider spacing produce more branches, which stimulate the formation of a larger number of capsules and seeds on the stems. The result obtained by Saoji *et al*. (2007) [15] at Gondia (M. S.) and Gohil *et al.* (2016) [7] at Navsari also confirm the findings of present investigation (Table 1).

1000 seed weight

An appraisal of results in respect of weight of 1000 seeds (test weight) was found to be non significant due to various spacing, however, the numerically higher test weight (6.46 g) was observed in treatment S_3 (40 cm x 5 cm). These results lend support to those reported by Khan *et al*. (2005) [9] at Multan; Chaudhary (2009) [3] at Kanpur and Gohil *et al.* (2016) [7] at Navsari (Table 1).

Seed yield

The treatment S_1 (20 cm x 5 cm) recorded significantly higher seed yield (1262 kg/ha) of linseed by 9.17 percent over S_3. Higher seed yield might be more number of plants per unit area resulted in higher yield per unit area. As narrow spacing sown crop have more number of plants per unit area and reduction in yield per plant might be compensated with yield from more number of plants per unit area. But there is a optimum plant population level at which yield per plant decrease with narrow spacing is compensated with yield from more number of plants per unit area. This equilibrium plant population where yield per unit area is higher with given plant population is considered optimum crop spacing. These results lend support to those reported by Kushwaha *et al*. (2006) [12] at Kanpur; Saoji *et al*. (2007) [15] at Gondia (M. S.) and Gohil *et al.* (2016) [7] at Navsari (Table 1).

Effect on stover yield

Significantly higher straw yield (2976 kg/ha) was recorded under the treatment S_1 (20 cm x 5 cm). Higher straw yield might be due to healthy vegetative growth in terms of plant height obviously resulted into more straw yield. These findings are in cognizance with the results of Kushwaha *et al*. (2006) [12] at Kanpur; Chaudhary (2009) [3] at Kanpur and Gohil *et al.* (2016) [7] at Navsari (Table 1).

Effect on quality

Oil content was not influenced significantly due to spacing. The narrow spacing of S_1 (20 cm x 5 cm) recorded significantly higher oil yield (471 kg/ha). The higher oil yield achieved under this treatment was due to the higher seed yield, which is directly responsible for higher oil yield. Almost similar findings were also reported by Kumari *et al*. (2012) [10] at Pantnagar (Uttarkhand) and Gohil *et al.* (2016) [7] at Navsari (Table 1).

Effect on economics

In case of spacing highest net returns **(**₹ 72565/ha**)** was recorded under the treatment S_1 (20 cm x 5 cm) with 4.43 BCR. These findings are substantiated with those reported by Kumari *et al*. (2012) [10] at Pantnagar (Uttarkhand) and Gohil *et al.* (2016) [7] at Navsari (Table 1).

Interaction effect

Seed yield

Interaction effect between sowing dates and spacing was found to be significant in terms of seed yield (kg/ha) in linseed. However significantly higher values of seed yield (1429 kg/ha) was observed in treatment combination of D_3S_1 (1st week of November and 20 cm x 5 cm) and remained at par with D_4S_1. These results are in conformity with those reported by Saoji *et al.* (2007) [15] at Gondia (M. S.); Gohil *et al.* (2016) [7] at Navsari (Table 2).

Economics

Highest net returns (₹ 84,240/ha) and BCR of 5.14 were obtained with treatment combination of D_3S_1 (1st week of November and 20 cm x 5 cm) followed by D_4S_1 (₹ 76,448/ha) with BCR 4.67. The lowest net returns (₹ 60,571/ha) with BCR value of 3.70 were realized in D_1S_3 (1st week of October and 40 cm x 5 cm) treatment. Higher net gain/ha under 1st week of November sowing (D_3) and20 cm x 5 cm (S_1) was due to higher yield. These findings are substantiated with those reported by Ganga *et al.* (2015) [6] at Varanasi and Maurya *et al*. (2017) [13] at Varanasi (Table 2).

Table 1: Effect of sowing dates and spacing on growth parameters, yield attributes, yield, quality and economics of linseed

Treatment	Plant height (cm)	Number of branches/plant	Number of capsules/plant	Number of seeds/ Capsule	Test weight (g)	Seed Yield (kg/ha)	Stover Yield (kg/ha)	Oil content (%)	Oil yield (kg/ha)	Total cost of cultivation (₹/ha)	Net realization (₹/ha)	BCR
Sowing dates (D)												
D_1	55.86	9.16	45.55	6.08	6.13	1144	2563	36.39	416	16370	64223	3.92
D_2	56.23	9.39	46.61	6.20	6.23	1196	2798	36.90	441	16370	67910	4.15
D_3	59.62	9.78	53.85	6.62	6.61	1272	2908	37.53	476	16370	73252	4.47
D_4	57.77	9.67	47.33	6.34	6.38	1248	2817	37.20	466	16370	71553	4.37
S.Em. ±	0.67	0.14	0.87	0.11	0.11	22	73	0.55	11	-	-	-
C.D.at 5%	2.13	0.44	2.78	0.37	0.34	70	234	NS	35	-	-	-
Spacing (S)												
S_1	59.73	9.11	46.93	6.12	6.23	1262	2976	37.29	471	16370	72565	4.43
S_2	56.54	9.63	50.69	6.46	6.32	1227	2678	37.04	454	16370	70056	4.28
S_3	55.84	9.76	47.37	6.35	6.46	1156	2660	36.68	425	16370	65082	3.98
S.Em. ±	0.95	0.20	1.26	0.14	0.19	22	104	0.94	14	-	-	-
C.D.at 5%	2.78	0.57	3.68	0.42	NS	65	303	NS	42	-	-	-
Interaction (D x S)												
S.Em. ±	1.91	0.40	2.52	0.28	0.28	60	207	2.32	28	-	-	-
CD at 5%	NS	NS	NS	NS	NS	Sig.	NS	NS	NS	-	-	-

(D_1: Third week of October, D_2: Forth week of October, D_3: First week of November, D_4: Second week of November, S_1: 20 cm × 5 cm, S_2: 30 cm × 5 cm, S_3: 40 cm × 5 cm)

Table 2: Seed yield and economics of linseed influenced by interaction effect of sowing dates and spacing

Treatment	Seed Yield (kg/ha)	Total cost of cultivation (₹/ha)	Net realization (₹/ha)	BCR
D_1S_1	1140	16370	64029	3.91
D_1S_2	1198	16370	67998	4.15
D_1S_3	1093	16370	60571	3.70
D_2S_1	1163	16370	65680	4.01
D_2S_2	1227	16370	70035	4.28
D_2S_3	1197	16370	67955	4.15
D_3S_1	1429	16370	84240	5.14
D_3S_2	1242	16370	71144	4.35
D_3S_3	1146	16370	64439	3.94
D_4S_1	1318	16370	76448	4.67
D_4S_2	1239	16370	70892	4.33
D_4S_3	1188	16370	67379	4.12
S.Em. +	44	-	-	-
CD at 5%	129	-	-	-

Conclusion

Finally it is concluded that for obtaining potential yield and profit from linseed local variety could be obtained by sowing of linseed either during 1st week of November or 2nd week of November along with spacing 20 cm x 5 cm.

References

1. Al-Doori SM. Influence of sowing dates on growth, yield and quality of some flax (*Linum usitatissimum* L.) genotypes. College of Basic Education Researchers Journal. 2012; 12(1):733-746.
2. Anonymous. Ministry of Agriculture & Farmers welfare, Government (ON1627) & Past Issues, 2015-16. www.indiastat.in.
3. Chaudhary S. Study on row spacing for different varieties of linseed (*Linum usitatissimum* L.). International Journal of Plant Science. 2009; 4(2):373-374.
4. Cochran WG, Cox GM. Experimental Designs 2nd Ed. John Wiley and Sons Inc., New York, 1967.
5. El-Mohsen AA, Abdallah AM, Mahmoud GO. Optimizing and describing the influence of planting dates and seeding rates on flax cultivars under Middle Egypt region conditions. World Essays Journal. 2013; 1(2):28-39.
6. Ganga P, Singh RK, Singh A, Singh K. Growth, yield and nutrient uptake and quality of Linseed (*Linum usitatissimum* L.) Varieties as Affected by Varying Sowing Dates. Environment and Ecology. 2015; 33(1A):271-274.
7. Gohil JR, Kamani MD, Kumar D, Arvadiya LK. Performance of linseed (*Linum usitatissimum* Linn.) to different dates of sowing, seed rate and row spacing. Advances in Life Science. 2016; 5(5):1755-1759.
8. Kalita H, Bora PC, Debnath MC. Effect of sowing date and tillage on soil properties, nutrient uptake and yield of linseed (*Linum usitatissimum* L.) grown in winter rice (*Oryza sativa* L.) fallows. Indian Journal of Agronomy. 2005; 50(1):70-72.
9. Khan MB, Yasir TA, Aman M. Growth and yield comparison of different linseed (*Linum usitatissimum* L.) genotypes planted at different row spacing. *International* Journal of Agricultural Biology. 2005; 7(3):515-517.
10. Kumari A, Singh RP, Yeshpal. Productivity, nutrient uptake and economics of mustard hybrid (*Brassica juncea*) under different planting time and row spacing. Indian Journal of Agronomy. 2012; 57(1):61-67.
11. Kushwaha CL, Prasad K, Kushwaha SP. Effect of row spacing and nitrogen doses on yield attributes and yield of linseed (*Linum usitatissimum* L.) varieties under irrigated conditions of Bundelkhand. Plant Archives. 2006; 6(2):741-743.

12. Kushwaha CL, Prasad K, Kushwaha SP. Effect of row spacing and nitrogen doses on plant population and growth of linseed (*Linum usitatissimum* L.) varieties. Plant Archives. 2006; 6(2):729-731.
13. Maurya AC, Raghuveer M, Goswami G, Kumar S. Influences of date of sowing on yield attributes and yield of linseed (*Linum usitatissimum* L.) varieties under dryland condition. International Journal of Current Microbiology and Applied Sciences 2017; 6(7):481-487.
14. Raundal PU, Pohare VB, Shinde LD. Response of different linseed varieties under extended sowing dates. International Journal of Tropical Agriculture © Serials Publications, 2015, 33(4).
15. Saoji BV, Patil MJ, Moon MK, Nagdeote V, Khade AH. Effect of spacing and higher seed rates on yield of linseed in command area of Gondia district. Journal of Soils and Crops. 2007; 17(1):117-121.
16. Tiwari PN, Gambhit PN, Rajan TS. Rapid and non-destructive determination of oil in oilseeds. Journal of the American oil Chemists Society. 2011; 51:1049.