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Performance of linseed (*Linum usitatissimum* L.) as influenced by seed rate and crop geometry

Gajala Ambari and RS Sidar

Abstract
A field experiment entitled "Performance of Linseed (*Linum usitatissimum* L.) as influenced by seed rate and crop geometry" was conducted at RMD College of Agricultre and research Station, Ambikapur (C.G.) during the *rabi* season of 2020-21. The soil of the experiment field was sandy loam in texture with slightly acidic in nature, low in available nitrogen and medium in phosphorus and potassium content. The experimental field was layout in Factorial Randomized Block Design with six treatment combination consisting three levels of seed rate i.e., 20, 30 and 40 kg ha^{-1} and two level of crop geometry (row to row spacing) i.e., 30 and 45 cm and three replication. Among the different seed rates S_3 (40 kg ha^{-1}) recorded maximum plant height (69.23 cm), seed yield (12.79 q ha^{-1}) and stover yield (28.09 q ha^{-1}), biological yield (40.57 q ha^{-1}), gross returns (Rs. 66758 ha^{-1}) and net returns (Rs. 38593 ha^{-1}) over remaining seed rates. Sowing the linseed crop with row spacing of 30 cm between two row recorded significantly higher in all growth parameters, yield attributes characters, yield and economics over 45 cm between two row. Hence, seed rate of 40 kg ha^{-1} and row spacing of 30 cm between two row is recommended.

Keywords: Seed rate, crop geometry, linseed, growth and yield attributes and yield

Introduction
Flaxseed is one of the oldest crops, having been cultivated since the beginning of civilization. Flax is a self-pollinated crop widely adapted to temperate climate of the world. The Latin name for flax is *Linum usitatissimum* L. (2n=30, X=15) belongs to Linaceae family. The generic name ''*Linum*'' comes from Celtic word *lin* means thread and the species name "*usitatissimum*" given by Carl Linnaeus, means very useful. So it directly refers to its multiple applications and their importance in ancient times. The genus *Linum* is composed of approximately 230 species but cultivated linseed or flax is the only species of economic importance in the genus (Rowland *et al*., 1995; Tadesse *et al*., 2010) [22, 25] and is one of the oldest plants cultivated for fibre and oil. Linseed oil has been used for centuries as a drying oil whose oil content varies from 33-45% (Gill, 1987) [16].

Linseed is one of the most important crop of the world cultivated in over an area of 22.70 lakh ha with a production of 22.39 lakh tone and productivity of 986 kg ha^{-1}. In India, it occupies an area of 3.38 lakh ha with a production of 1.47 lakh tone and a productivity of 435 kg ha^{-1}. India ranks third in area after Canada and Kazakhstan. India contributes about 14.88% and 6.57% of world's area and production respectively. In India, linseed is grown mostly under rainfed (63%), Utera (25%), irrigated (17%) and in input starved condition in major linseed producing states i.e. Madhya Pradesh, Chhattisgarh, Maharashtra, Jharkhand, Uttar Pradesh and Odisha (Srivastava, 2009) [24]. At present Chhattisgarh cultivated over 28 thousand hectare area with a production of 12.58 thousand tones and productivity of 446 kg/ha (Economics Survey of India, Economic Division, Ministry of Finance, Govt. of India, 2017-18). In Surguja district, linseed is cultivated over 3.016 thousand ha area with a production of 1.508 thousand tones and productivity of 500 kg/ha (State Chhattisgarh, Agriculture Contingency Plan for District Surguja, 2017-18).

The seed rate has profound influence on cultivation of field crops including oilseeds also. To obtain the maximum yield, optimum plant population is the prerequisite that can be maintained only by sowing of appropriate seed rates. This is an important constituent for determining the extent of growth, development and finally yields of the crop (Kumar *et al.*, 2016) [19]. In case of crop geometry the proper row spacing is an important another aspect for better growth and enhancing production potential of a crop by optimization the utilization of moisture, nutrients and interception of light, carbon dioxide among others. These sowing processes can be lead to intraspecific and inter specific compition for natural resources and effect on growth,

development and consequently the production of crop (Zanine and Santos, 2004) [27].

Materials and Method

The experiment was carried out during *Rabi* season 2020-21conducted at Raj Mohini Devi College of Agriculture and Research Station, Ambikapur (C.G.), which is situated at 23.15º North latitude and 83.15º East longitude and at an altitude of 623 meters above from mean sea level (MSL). The general climate condition of Surguja (Chhattisgarh) is Eastern Plateau and Hilly region with average annual rainfall is about 1356 mm, of which about 82% is, received a short span of four month i.e. between June to September. The experiment was conducted Factorial RBD with total six treatment combinations consisting of three levels of seed rate and two levels of row spacing. 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. The statistical analysis of data recorded for different characters during the course of investigation was carried out through the procedure appropriate to the Factorial Randomized Block Design as described by Panse and Sukhatme, 1967.

Result and Discussion

Effect of seed rate

The variable performance of linseed was recorded with different seed rate on growth parameters (Table 1), yields attributes (Table 2) and yield (Table 3) as well as economics (Table 5). Seed rate of 20 kg ha^{-1} (S_1) recorded significantly higher number of primary and secondary branches plant^{-1} (3.89 and 15.24, respectively), dry matter accumulation plant^{-1} (15.53 g), number of capsules plant^{-1} (43.38), weight of capsules plant^{-1} (14.68 g) and seed yield plant^{-1} (2.17 g) while, significantly higher plant height (69.23 cm), seed yield (12.79 q ha^{-1}), stover yield (28.09 q ha^{-1}), biological yield (40.57 q ha^{-1}), gross return (Rs. 66758 ha^{-1} and net return (Rs. 38593 ha^{-1}) were recorded under the treatment S_3 (40 kg ha^{-1}). In case of plant height, seed yield and stover yield treatment S_3 (40 kg ha^{-1}) did not differ significantly with treatment S_2 (30 kg ha^{-1}). As a result of seed rate of 40 kg ha^{-1} the individual plant could have utilized more moisture, nutrient and solar radiation and hence there growth and development was better leading to higher dry matter accumulation and finally yield. The results are in agreement with those reported by Badiyala *et al.,* 2004 [9] and Kumar *et al.,* 2016 [19].

Effect of row spacing

Different row spacing showed remarkable influence on growth parameters (Table 1), yield parameters (Table 2) and yield (Table 3) as well as economics (Table 5) of linseed crop. Treatment R_1 (30 cm between two row) registered significantly higher in growth parameters, yield attributes and yield and economics over R_2 (45 cm between two row). This might be due to sufficient availability of sunlight and nutrient which increased per plant growth and development. While under narrow row spacing having greater plant density lowered down the expression of all growth and yield parameters. The present result is in close conformation with Khan *et al.,* 2005 [18]; Saoji et al., 2007 [23] and Ashraf *et al.,* 2013 [8].

Interaction effect

The interaction effect was found to be significant in respect to seed yield (q ha^{-1}) (Table 4), gross return and net return (Rs. ha^{-1}) (Table 6). The values for seed yield and both economics traits were found to be maximum under the treatments S_3R_1 i.e. 40 kg seed rate ha^{-1} and 30 cm row spacing recorded significantly higher seed yield (14.26 q ha^{-1}), gross yield (Rs. 74335 ha^{-1}) and net return (Rs. 45370 ha^{-1}) over the remaining combinations except S_2R_1 which were fount statistically at par.. So result reveled that sowing of linseed crop with a seed rate of 40 kg ha^{-1} and row spacing of 30 cm between two rows is recommended. These results are in conformity with those reported by Gohil *et al.,* 2016 [17].

Conclusion

From thesis results it may be concluded that maximum and profitable yield of linseed can be secured by sowing the crop at narrow row spacing 30 cm and using the seed rate of 30 to 40 kg ha^{-1} under prevailing agro climatic conditions.

Table 1: Growth parameters of linseed as influenced by seed rate and crop geometry

Treatments		Plant height (cm) at harvest	No of branches at Harvest		Dry matter accumulation (g plant^{-1}) at harvest
			Primary	Secondary	
(A) Seed rate (kg ha^{-1}) (3)					
S_1	20 kg ha^{-1}	62.98	3.89	15.24	15.53
S_2	30 kg ha^{-1}	65.97	3.59	14.47	14.23
S_3	40 kg ha^{-1}	69.23	3.28	13.90	13.81
SEm±		0.95	0.11	0.29	0.35
CD (P=0.05)		3.01	0.35	0.90	1.12
(B) Crop geometry (Row to row spacing, cm) (2)					
R_1	30 cm	69.54	3.91	15.86	15.67
R_2	45 cm	62.58	3.26	13.86	13.38
SEm±		0.78	0.09	0.23	0.29
CD (P=0.05)		2.46	0.29	0.74	0.91
Interaction S X R					
Sem±		1.35	0.16	0.41	0.50
C.D. (P=0.05)		NS	NS	NS	NS

Table 2: Growth parameters of linseed as influenced by seed rate and crop geometry

Treatments	No. of capsules plant^{-1}	Weight of capsules plant^{-1} (g)	No. of seed capsule^{-1}	Seed yield plant^{-1} (g)	1000 seed weight (g)
(A) Seed rate (kg ha^{-1})					
S_1 20 kg ha^{-1}	43.38	14.68	8.38	2.17	6.26
S_2 30 kg ha^{-1}	41.81	13.99	8.22	2.05	6.21
S_3 40 kg ha^{-1}	39.47	12.41	8.12	1.97	6.11
SEm±	0.53	0.24	0.14	0.05	0.14
CD (P=0.05)	1.66	0.75	NS	0.15	NS
(B) Crop geometry (Row to row spacing, cm)					
R_1 30 cm	43.24	14.86	8.41	2.15	6.14
R_2 45 cm	39.87	12.53	8.07	1.98	6.25
SEm±	0.43	0.19	0.11	0.04	0.11
CD (P=0.05)	1.36	0.61	NS	0.12	NS
Interaction S X R					
SEm±	0.75	0.34	0.19	0.07	0.19
CD (P=0.05)	NS	NS	NS	NS	NS

Table 3: Yields and harvest index of linseed as influenced by seed rate and crop geometry

Treatments	Biological yield (q ha^{-1})	Seed yield (q ha^{-1})	Stover yield (q ha^{-1})	Harvest Index (%)
(A) Seed rate (kg ha^{-1}) (3)				
S_1 20 kg ha^{-1}	36.51	11.72	24.79	32.07
S_2 30 kg ha^{-1}	38.82	12.41	26.41	31.88
S_3 40 kg ha^{-1}	40.57	12.79	28.09	31.31
SEm±	0.57	0.14	0.56	0.49
CD (P=0.05)	1.79	0.45	1.76	NS
(B) Crop geometry (Row to row spacing, cm) (2)				
R_1 30 cm	41.77	13.57	28.41	32.33
R_2 45 cm	35.49	11.05	24.45	31.17
SEm±	0.46	0.12	0.46	0.40
CD (P=0.05)	1.46	0.37	1.43	NS
Interaction S X R				
SEm±	0.80	0.20	0.79	0.69
CD (P=0.05)	NS	0.64	NS	NS

Table 4: Interaction effect on seed yield of linseed as influenced by seed rate and crop geometry

Treatments	Seed rate (kg ha^{-1})		
Row spacing (cm)	S_1 : 20 kg ha^{-1}	S_2 : 30 kg ha^{-1}	S_3 : 40 kg ha^{-1}
R_1 : 30 cm	12.65	13.79	14.26
R_2 : 45 cm	10.80	11.03	11.32
Interaction S X R			
SEm±	0.20		
CD (P=0.05)	0.64		

Table 5: Economics of linseed as influenced by seed rate and crop geometry

Treatments	Gross Return (Rs. ha^{-1})	Cost of cultivation (Rs. ha^{-1})	Net Return (Rs. ha^{-1})	Benefit: Cost Ratio
(A) Seed rate (kg ha^{-1})				
S_1 20 kg / ha	61095	26765	34330	1.28
S_2 30 kg / ha	64690	27465	37225	1.35
S_3 40 kg / ha	66758	28165	38593	1.36
SEm±	729.11	-	729.11	0.03
CD (P=0.05)	2297.49	-	2297.49	0.09
(B) Crop geometry (Row to row spacing, cm) (2)				
R_1 30 cm	70674	28265	42409	1.50
R_2 45 cm	57689	26665	31024	1.17
SEm±	595.32	-	595.32	0.02
CD (P=0.05)	1875.89	-	1875.89	0.07
Interaction S X R				
SEm±	1031.12	-	1031.12	0.04
CD (P=0.05)	3249.14	-	3249.14	0.12

Table 6: Interaction effect on gross return (Rs. ha^{-1}) and net return (Rs. ha^{-1}) of linseed as influenced by seed rate and crop geometry

Gross return (Rs. ha^{-1})			
Treatments	**Seed rate (kg ha^{-1})**		
Row spacing (cm)	S_1: 20 kg ha^{-1}	S_2: 30 kg ha^{-1}	S_3: 40 kg ha^{-1}
R_1: 30 cm	65895	71791	74335

R_2: 45 cm	56295	57590	59182
SEm±	1031.12		
CD (P=0.05)	3249.14		
Net return (Rs. ha^{-1})			
Treatments	**Seed rate (kg ha^{-1})**		
Row spacing (cm)	20 kg ha^{-1}	30 kg ha^{-1}	40 kg ha^{-1}
R_1: 30 cm	38330	43526	45370
R_2: 45 cm	30330	30925	31817
SEm±	1031.12		
CD (P=0.05)	3249.14		

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