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Effect of integrated nutrient management on growth and yield of linseed in Chhattisgarh plain

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Abstract
An experiment entitled "Effect of integrated nutrient management on growth and yield of linseed in Chhattisgarh plain" was conducted at Research Farm of Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur, Chhattisgarh during *Rabi* season of 2019-20. The linseed variety Chhattisgarh Alsi-1 (RLC-133) was used to grown on 9th November 2019 using experimental design of randomized block design" (RBD) with three replication and nine treatments *viz*., T_1:- 100% RDF, T_2:- 75% RDF + 25% Nutrients through FYM, T_3:- 50% RDF + 50% Nutrients through FYM, T_4:- 100% RDF+20 kg sulphur ha^{-1}, T_5:- 75% RDF + 25% Nutrients through FYM + 20 kg sulphur ha^{-1}, T_6:- 50% RDF + 50% Nutrients through FYM+ 20 kg sulphur ha^{-1}, T_7:- 100% RDF + 30 kg sulphur ha^{-1}, T_8:- 75% RDF + 25% Nutrients through FYM + 30 kg sulphur ha^{-1}, T_9:- 50% RDF + 50% Nutrients through FYM + 30 kg sulphur ha^{-1}. The result of experiment reveals that pre harvest observation *viz*., plant height (cm), number of branches $plant^{-1}$ and post harvest observation *viz*., dry matter $plant^{-1}$, number of capsule $plant^{-1}$, seed yield (q ha^{-1}), stover yield (q ha^{-1}), harvest index (%) were observed significantly higher under treatment T_7 (100% RDF + 30,kg sulphur ha^{-1}) in linseed crop cultivated in Chhattisgarh plain. The treatment (T_3), 50% RDF+ 50 nutrients through FYM showed significantly lower values for all the above parameters.

Keywords: Linseed, integrated nutrient management, sulphur, FYM, and seed yield

Introduction

Linseed (*Linum usitatissimum* L., 2n= 30, X = 15) belong to the family Linaceae and the genus *Linum*. The genus *Linum* is composed of approximately of around 230 species but cultivated linseed / flax is the only species of economic importance in the genus (Rowland *et al*., 1995) [1]. Aside from cultivated *Linum usitatissimum*, five uncultivated species in India have been reported. They are *L. strictum*, *L. perence*, *L. grandiflorum*, *L. mysorence*, and *L. angustifolium*.

It is the second most important *rabi* oilseed crop which stands next to rapeseed-mustard in area of cultivation and seed production in India. The linseed is produced approximately 2.5 million tons in the world (FAO 2017) and in India, it occupies an area of 0.330 million hectare with a production of 0.172 million tonnes and productivity is 523kg ha^{-1}. India ranks third in area after Canada and Kazakhstan. (Agricultural Statistics Division, Department of Agriculture, Cooperation and Farmers Welfare., 2017) [1].

"Linseed is mainly an industrial oilseed crop and its all part is capable with commercial and medicinal importance. Cultivation of linseed crop is existing in wide range of tropical, sub-tropical and temperate regions because linseed is tolerance to biotic and abiotic stresses and it is a very important characteristic of this crop. Linseed is an important crop grown both for its seed as well as fiber which is used for manufacture of linen. The seed contains a good percentage of oil varying from 33% to 47% indifferent accessions of linseed crop. Linseed sprouts are edible, with slightly spicy flavour." Linseed is an erect annual herbaceous plant 30-120 cm, in height with slender glabrous, greyish green stem. The linseed types are grown for fibre removal from the stems. The flax types are relatively taller (90-120 cm) in height with straight culms, less number of secondary branches towards the top of the stem (Gill, 1987) [2].

Linseed oil is versatile drying oil as it undergoes polymerization due to the presence of di and tri-unsaturated fatty acids. So it is changed into a solid form when expose to oxygen in air.

The polymer forming properties create simple linseed oil to use by its own or blend with other oils, solvents and resins etc. Raw linseed oil dries in a slow rate. It has affinity of yellowing with poor colour retention. In order to improve the drying and colour retention properties of linseed oil, some processes have been developed by heat modification (heating raw linseed oil at different high temperature range). The linseed oil is not edible because it contains high linolenic acid, a poly-unsaturated fatty acid, which makes the oil highly susceptible to oxidation as a result of which it's drying properties increase and gives a pungent flavour and rancidity. Further, the laxative property of the mucilage in seed coat of the seed make the oil inappropriate for edible use.

Material and Methods

Study area: The experiment was conducted during *Rabi* season of 2019-20 at Research Farm of Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur, Chhattisgarh. The Research Farm is situated at 22º09 N' latitude and 82º15 E' longitude and at an altitude of 298 meter above mean sea level. The region falls under the Eastern plateau and hill region (Agro-climate zone-7) of India. Chhattisgarh state is classified into three agro-climate zones, of which Bilaspur falls under the Chhattisgarh plains zone of the state. Agro-climatically, the experimental site falls into a dry, moist, sub-humid area. The average precipitation at the experimental site is 1503 mm (based on an 80-year average) per year, most of which 80 per cent is obtained from June to September during the monsoon season.

Objectives of experiment

1. To find out the effect of integrated nutrient application on growth and yield of linseed.
2. To find out the effect of sulphur on growth and yield of linseed.
3. To study the economics of treatment.

Treatment details: T_1:- 100% RDF, T_2:- 75% RDF + 25% N through FYM, T_3:- 50% RDF + 50% N through FYM, T_4:- 100% RDF+20 kg sulphur ha^{-1}, T_5:- 75% RDF + 25% N through FYM + 20kg sulphur ha^{-1}, T_6:- 50% RDF + 50% N through FYM+ 20 kg sulphur ha^{-1}, T_7:- 100% RDF + 30 kg sulphur ha^{-1}, T_8:- 75% RDF + 25% N through FYM + 30 kg sulphur ha^{-1}, T_9:- 50% RDF + 50% N through FYM + 30 kg sulphur ha^{-1}.

Manure and fertilizer application: Manure and fertilizers applied after the proper field and seed bed preparation as per the treatment details in the different plots. Complete dose of P_2O_5, K_2O, sulphur and half dose of N_2 applied on the field at the time of sowing, remaining N_2 was applied in two equal split at 30 and 60 DAS.

Sowing of seeds: Sowing of the linseed crop was completed in November 9, 2019 and were harvested February 3, 2020 as per the treatments requirements. All the recommended agronomic management practices were followed except for the treatments.

Irrigation: The primary irrigation was applied just after the sowing to facilitate germination and required irrigation were given during critical crop growth stages. Another two irrigation were applied to the crop during critical stages using border strip method of irrigation.

Weeding: Weeds were managed in the experimental field with the use of pre emergence herbicide *i.e*. Pendimethalin 30% EC @ 3.3 liter. ha^{-1} at 3 DAS followed by one hand weeding was done at 32 DAS to keep experimental plot weed free.

Plant protection: Plant protection measures were adopted as and when needed during crop growth period. Carbendazim 12% and mecozeb 63% WP were applied at 65 DAS to reduce wilting of linseed and also one irrigation was given on linseed field to control of termites.

Results and Discussion

Among various nutrient management practices plant population was not significantly influenced by various treatments. The results showed that the highest plant height (18.06, 56.20, 74.20 and 75.27 cm) were found with application of 100% RDF + 30 kg sulphur ha^{-1} (T_7) followed by T_4 i.e. (17.40, 55.60, 72.87 and 73.27 cm) at 30, 60, 90 DAS and at harvest. Maximum number of branches received under treatment T_7, (3.20 and 4.27) by the application of 100% RDF + 30 kg sulphur ha^{-1} followed by treatment T_4 i.e. 3.10 and 4.07 at 60 DAS and at harvest. Among various treatments dry matter (g $plant^{-1}$), treatment T_7 (100% RDF+ 30 kg sulphur ha^{-1}) recorded significantly higher dry matter production (5.27 $plant^{-1}$) followed by treatment T_4, (4.75). In case of number of capsule $plant^{-1}$, treatment T_7 (100% RDF+ 30 kg sulphur ha^{-1}) recorded significantly higher number of capsules $plant^{-1}$ (56.30), followed by treatments T_4, T_1, and T_8. Number of seeds $capsule^{-1}$ was not influenced significantly by various treatments. Among various nutrients management practices seed yield (11.90 q ha^{-1}), stover yield (26.52 q ha^{-1}), and harvest index (30.97%) were found significant over other treatments due to application of 100% RDF+ 30 kg sulphur ha^{-1} (T_7), followed by treatments T_4, T_1, and T_8. Data shown on table number 1 revealed that the growth and yield attributes of linseed were significantly influenced various nutrient management practices. Such results were confirmed by Rasool *et al*, (2013) [10] and Yadav *et al* (2009) [13].

Harvesting: Harvesting was done manually when the seed became hard and leaves turned to yellow in colour. Before the harvesting five randomly tagged plants were taken out from each of the plot separately for post-harvest studies and border row from each plot were removed. The plants were left in plot for 3 days to sun dry and thereafter bundles were made and bundle weight $plot^{-1}$ was recorded.

Table 1: Effect of various nutrient management practices on growth and yield of linseed at harvest

Treatment details	Plant height (cm)	Number of branches $plant^{-1}$	Dry matter $plant^{-1}$	Number of capsule $plant^{-1}$	Test weight	Seed yield (q ha^{-1})	Stover yield (q ha^{-1})	Harvest index
T_1:- 100% RDF	74.47	3.93	4.67	53.53	7.12	10.02	25.83	27.94
T_2:- 75% RDF + 25% N through FYM	69.40	3.80	4.48	51.33	6.52	8.58	23.14	27.04
T_3:- 50% RDF + 50% N through FYM,	66.53	3.57	4.38	50.20	6.45	8.36	22.61	26.98

T_4:- 100% RDF+20 kg sulphur ha^{-1}	73.27	4.07	4.75	54.13	7.14	11.13	26.23	29.79
T_5:- 75% RDF + 25% N through FYM + 20kg sulphur ha^{-1}	72.67	3.97	4.58	51.47	7.01	9.59	23.26	29.21
T_6:- 50% RDF + 50% N through FYM+ 20 kg sulphur ha^{-1}	71.60	3.83	4.62	50.93	6.56	8.99	22.66	28.40
T_7:- 100% RDF + 30 kg sulphur ha^{-1}	75.27	4.27	5.27	56.30	7.24	11.90	26.52	30.97
T_8:- 75% RDF + 25% N through FYM + 30 kg sulphur ha^{-1}	72.40	4.00	4.93	52.80	6.61	9.89	22.75	30.30
T_9:- 50% RDF + 50% N through FYM + 30 kg sulphur ha^{-1}	70.73	3.83	4.80	52.13	6.58	9.11	23.85	27.63
S.Em±	0.889	0.091	0.100	0.438	0.166	0.499	1.172	1.734
C.D. at 5%	2.66	0.27	0.30	1.31	0.50	1.49	3.51	3.20

Economics of linseed

The data on cost of cultivation (Rs. ha^{-1}), gross return (Rs. ha^{-1}), net return (Rs. ha^{-1}) and benefit cost ratio (B:C) revealed that the application of 100% RDF+30 kg S ha^{-1} (T_7) gave highest gross returns (Rs. 55012 ha^{-1}) and it was followed by T_4 i.e. application of 100% RDF + 20 kg S ha^{-1} (Rs. 51595 ha^{-1}), whereas minimum gross return of (Rs. 39035 ha^{-1}) was recorded with application of 50% RDF+ 50% nutrients through FYM (T_3). Net return was (Rs. 34164 ha^{-1}) recorded highest with the application of 100% RDF+ 30 kg S ha^{-1} (T_7) followed by the application of 100% RDF+ 20 kg S ha $^{-1}$ (T_4) gave (Rs.30936 ha^{-1}), whereas minimum net return of (Rs. 16258 ha^{-1}) was recorded with application of 50% RDF+ 50% nutrients through FYM (T_3). Benefit cost ratio (2.63) recorded highest with the application of 100% RDF+ 30 kg S ha^{-1} (T_7) followed by the T_4 i.e. application of 100% RDF + 20 kg S ha^{-1} (1:2.49). It is because of the no extra cost of FYM and labour imposed on it. Lowest benefit cost ratio (B:C) of 1.71 recorded by the application of 50% RDF+ 50% nutrients through FYM (T_3).

Table 2: Effect of various nutrient management practices on economics oflinseed

Treatment	Cost of cultivation (Rs. ha-^{1})	Gross return (Rs. ha-^{1})	Net return (Rs. ha-^{1})	Benefit cost ratio (B:C)
T1	20659	44671	24012	2.16
T2	21724	40066	18342	1.84
T3	22787	39045	16258	1.71
T4	20659	51595	30936	2.49
T5	21804	44552	22748	2.04
T6	23009	41822	18813	1.81
T7	20848	55012	34164	2.63
T8	22054	47791	25737	2.16
T9	23258	42469	19211	1.82

Conclusion

It was revealed from the results that pre harvest observation *viz*., plant height (cm), number of branches plant^{-1} and post harvest observation *viz*., dry matter plant^{-1}, number of capsule plant^{-1}, test weight (g), seed yield (q ha^{-1}), stover yield (q ha^{-1}), harvest index (%) were observed significantly higher under treatment T_7 (100% RDF + 30 kg sulphur ha^{1}) in linseed crop cultivated in Chhattisgarh plain. Treatment (T_3), 50% RDF+ 50 nutrients through FYM showed significantly lower values for all the above parameters. The highest cost of cultivation recorded under treatment (T_9) by application of 50% RDF+ 50% nutrients through FYM+ 30 kg sulphur ha^{-1} (Rs. 23258 ha^{-1}). The highest net return was recorded by application of 100% RDF+ 30 kg sulphur (Rs. 34164 ha^{-1}). The highest benefit cost ration (B:C) was recorded under treatment T_7 (2.63).

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