Original Research Article

Economics Analysis of Linseed (*Linum usitatissimum*) Grown After Rice in Alfisols of Chhattisgarh Plain

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A B S T R A C T

Ph.D research on "Agro-resource management studies on growth, yield, quality and economics of linseed (*Linum usitatissimum* Linn.) grown after rice in Alfisols of Chhattisgarh plains" was conducted during *rabi* seasons of 2009-10 and 2010-11 at Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur with the specific objectives to study the interaction effect of sowing methods and fertilizer management on growth, yield, nutrient uptake, oil content and economics of linseed varieties. Two different experiments on linseed crop were undertaken during two consecutive *rabi* seasons of 2009-10 and 2010-11. The experiment was sown on 26th November, 2010 and harvested on 24th March, 2011. Based on 2 years experimentation it is concluded that treatment line sowing x RLC-92 (S_1V_1) registered significantly highest yield attributes and yield as well as maximum net return and B: C ratio. Among fertilizer levels, significantly highest yield attributes and yield as well as maximum net return and B: C ratio were noted with 50% more RDF (F_2) during both the years and on mean basis.

Introduction

Linseed is grown after rice on marginal and sub-marginal lands with low or no-fertilizers, mostly under rainfed both as relay cropping "*utera*" in paddy fallow and as upland in unbunded fields.

In *utera* cultivation, most of the farmers use broadcasting method of sowing without fertilizer application, resulting in poor soil seed moisture content and seed may not get proper germination with decreases plant growth. So, there is urgent need to find out efficient method of sowing for optimum stand establishment and higher production and productivity of the crop. Keeping above facts in view and considering the benefits

and increased popularity of linseed, Ph.D research entitled "Agro-resource management studies on growth, yield, quality and economics of linseed (*Linum usitatissimum* Linn.) grown after rice in Alfisols of Chhattisgarh plains" was conducted during *rabi* seasons of 2009-10 and 2010-11 at Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur with the following specific objectives:

To study the interaction effect of sowing methods and fertilizer management on growth, yield, nutrient uptake, oil content and economics of linseed varieties.

Materials and Methods

Location and experimental site

The location of the experimental site was Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh) located at 21°4' N latitude and 81°39' E longitude with an altitude of 298 metre above mean sea level having sub tropical humid climate.

Climate conditions

The climate of Raipur region is sub humid with hot and dry summer and mild winter. It comes under the Chhattisgarh plains agro-climatic sub zone of seventh agro climatic region of India i.e. eastern plateau and hills. The average annual rainfall is about 1320 mm of which about 88 % is received during a span of four months i.e. between June to September. The rainfall is largely contributed by south-west monsoon. The maximum temperature raises up to 45°C during summer and minimum temperature falls to 5-6 °C during winter season. The relative humidity reaches maximum 93 % and minimum 41 % in August and March, respectively.

Treatment details

Two different experiments on linseed crop were undertaken during two consecutive *rabi* seasons of 2009-10 and 2010-11. The experiment treatments were divided into main plots and sub plots in split plot design with three replications. Treatments comprised of three sowing methods with two varieties viz., broadcast x RLC-92 (S_0V_1), line sowing x RLC-92 (S_1V_1), criss-cross x RLC-92 (S_2V_1), broadcast x Deepika (S_0V_2), line sowing x Deepika (S_1V_2), criss-cross x Deepika (S_2V_2) as main plot treatment and three fertilizer levels viz. RDF

(F_0), RDF + S (F_1) and 50% more of RDF (F_2) as sub plot treatment. The experiment was sown on 26th November, 2010 and harvested on 24th March, 2011.

Cost economics

Economics of linseed production was calculated on the prevailing prices of linseed as well as inputs used. The cost of cultivation of linseed crop was calculated on the basis of prevailing prices for different inputs. The production of linseed crop was converted in to gross return (ha⁻¹) on the basis of prevailing prices in the market.

Gross return (ha^{-1}) = Linseed yield (q ha^{-1}) x Price of yield (q^{-1})

Net return (ha^{-1}) = Gross return (ha^{-1}) - Cost of cultivation (ha^{-1})

$$\text{Benefit: Cost ratio} = \frac{\text{Net return (ha}^{-1})}{\text{Cost of cultivation (ha}^{-1})}$$

Results and Discussion

Economic yield (q ha^{-1})

The data on Economic yield of linseed as influenced by sowing methods x varieties and fertilizer levels are given in Table 1. The results revealed that among sowing methods x varieties significantly higher seed yield of linseed was observed under line sowing x RLC-92 (S_1V_1) as compared to other treatments, however, it was at par to criss-cross x RLC-92 (S_2V_1) and line sowing x Deepika (S_1V_2) during both the years and on mean basis. Linseed seeded under fertilizer levels showed significant variation in seed yield. The 50% more RDF (F_2) produced significantly higher seed yield (11.53, 11.34 and 11.44 q ha^{-1} in 2009-10, 2010-11 and on mean basis, respectively)

than RDF (F_0), but it was comparable to RDF + S (F_1) during both the years and on mean basis.

The data on Economic yield of linseed reveal that significantly highest seed yield of 11.71 q ha^{-1} on mean basis was noted under line sowing x RLC -92 (S_1V_1) followed by criss-cross x RLC -92 (S_2V_1) and line sowing x Deepika (S_1V_2). Increase in seed yield was also contributed due to corresponding increase in growth parameters viz., plant height, number of branches plant^{-1}, leaf area index and dry matter accumulation and yield components viz. number of seeds capsule^{-1}, number of capsules plant^{-1} and 1000-seed weight.

It is well known fact that nitrogen, phosphorus and potassium play a major role in photosynthesis, development of capsules plant^{-1}, 1000-seed weight consequently helping in increased yield. This observation is in close conformity with the findings of Sharma and Thakur (1989), Sood and Kumar (1993), Dhiman *et al.,* (1997), Singh *et al.,* (1997) and Khare *et al.,* (1999).

The treatment line sowing produced higher yield followed by broadcast. Higher seed yield may be because of proper placement of seed and fertilizer through seed-cum-fertilizer drill and availability of nutrient for longer period. Whereas, in broadcast some of the applied nitrogen might have been lost due to volatilization from surface application as the soil reaction was conducive for such a loss. Similar results were reported by Bhatia *et al.,* (1989).

The higher yield of linseed under 50% more RDF treatment can be ascribed due to higher value for growth parameters like plant height, dry biomass of plant, number of branches plant^{-1}, LAI and CGR during both the years. The above findings clearly

suggest that higher nutrient doses enhanced the growth parameters, which ultimately increase seed yield. The higher yield obtained was also due to higher yield attributes *viz*., number of seeds capsule^{-1}, number of capsules plant^{-1} and 1000-seed weight. The similar findings were also obtained by Mahmud *et al.,* (1997) and Ramamoorthy *et al.,* (1997).

Stalk yield (q ha^{-1})

The data presented in Table-1 reveals that among sowing methods x varieties, the stalk yield of linseed was significantly higher under line sowing x RLC-92 (S_2V_1) as compared to other treatments, however, it was at par to criss-cross x RLC-92 (S_2V_1), broadcast x RLC-92 (S_0V_1) and broadcast x Deepika (S_0V_2) during 2009-10 and on mean basis. During 2010-11, treatment criss-cross x RLC-92 (S_2V_1) registered significantly higher stalk yield of linseed as compared to other treatments, but it was comparable to line sowing x RLC-92 (S_1V_1) and broadcast x Deepika (S_0V_2).

Linseed seeded under fertilizer levels showed significant variation in stalk yield. The 50% more RDF (F_2) produced significantly higher stalk yield (25.11, 23.19 and 24.15 q ha^{-1} during 2009-10, 2010-11 and on mean basis, respectively) than RDF (F_0), however, it was comparable to RDF + S (F_1) treatment during both the years and on mean basis. Similar findings have been also reported by Subbain and Ramaih (1981).

The different sowing methods x varieties influenced the stalk yield and maximum stalk yield was obtained under line sowing x RLC-92 (S_1V_1) in 2009-10 and on mean basis and under criss-cross sowing x RLC-92 (S_2V_1) during 2010-11 as compared to other sowing methods x varieties.
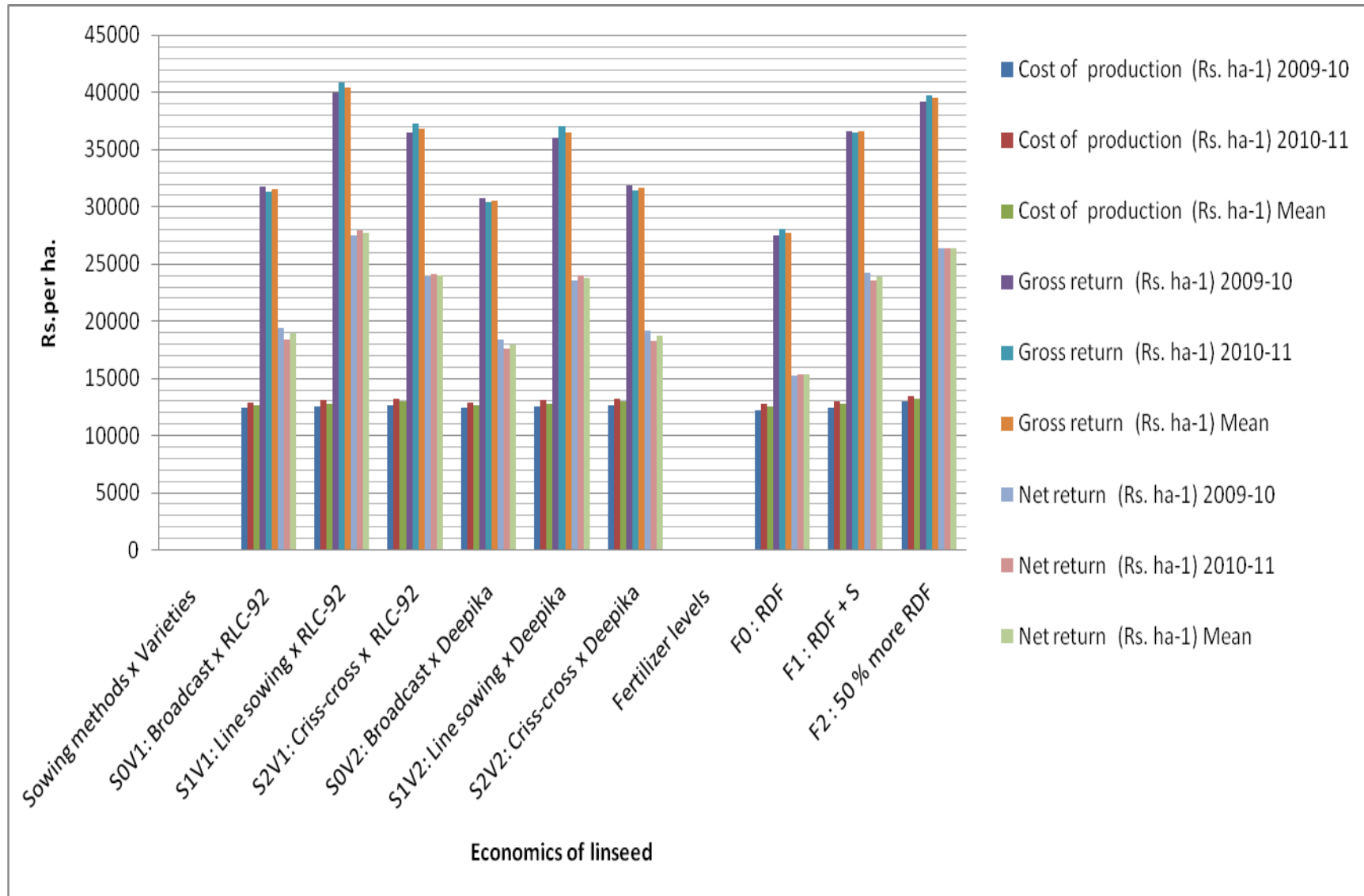
Table.1 Economic yield, stalk yield and biological yield of linseed as influenced by sowing methods x varieties and fertilizer levels

Treatment	Economic yield (q ha^{-1})			Stalk yield (q ha^{-1})			Biological yield (q ha^{-1})		
	2009-10	2010-11	Mean	2009-10	2010-11	Mean	2009-10	2010-11	Mean
S_0V_1: Broadcast x RLC-92	9.33	8.92	9.13	23.72	21.61	22.67	32.01	31.40	31.71
S_1V_1: Line sowing x RLC-92	11.76	11.67	11.71	23.94	21.94	22.94	35.47	33.28	34.38
S_2V_1: Criss-cross x RLC-92	10.73	10.63	10.68	22.92	22.92	22.92	34.55	32.65	33.60
S_0V_2: Broadcast x Deepika	9.02	8.68	8.85	22.68	22.48	22.58	32.96	30.62	31.79
S_1V_2: Line sowing x Deepika	10.60	10.56	10.58	21.47	21.47	21.47	32.07	32.03	32.05
S_2V_2: Criss-cross x Deepika	9.36	8.97	9.16	21.80	21.86	21.83	32.16	31.83	31.99
SEm±	**0.47**	**0.42**	**0.44**	**0.46**	**0.33**	**0.36**	**0.61**	**0.52**	**0.41**
CD (P=0.05)	**1.48**	**1.33**	**1.39**	**1.46**	**1.04**	**1.13**	**1.92**	**1.64**	**1.30**
F_0 : RDF	8.06	8.00	8.03	20.90	18.82	19.97	28.12	27.93	28.02
F_1 : RDF + S	10.76	10.42	10.59	24.26	22.14	23.09	34.68	34.12	34.40
F_2 : 50 % more RDF	11.53	11.34	11.44	25.11	23.19	24.15	35.31	35.36	35.34
SEm±	**0.27**	**0.33**	**0.31**	**0.32**	**0.36**	**0.40**	**0.47**	**0.55**	**0.38**
CD (P=0.05)	**0.80**	**0.98**	**0.91**	**0.93**	**1.06**	**1.17**	**1.38**	**1.63**	**1.13**

Table.2 Economics of linseed as influenced by sowing methods x varieties and fertilizer levels

Treatment	Cost of production (Rs. ha^{-1})			Gross return (Rs. ha^{-1})			Net return (Rs. ha^{-1})			Return Rs.$^{-1}$ invested		
	2009-10	2010-11	Mean	2009-10	2010-11	Mean	2009-10	2010-11	Mean	2009-10	2010-11	Mean
Sowing methods x Varieties												
S_0V_1: Broadcast x RLC-92	12350	12830	12590	31722	31220	31471	19372	18390	18881	1.57	1.43	1.50
S_1V_1: Line sowing x RLC-92	12488	12998	12743	39984	40845	40414	27496	27847	27671	2.20	2.14	2.17
S_2V_1: Criss-cross x RLC-92	12650	13160	12905	36482	37205	36843	23832	24045	23938	1.88	1.83	1.85
S_0V_2: Broadcast x Deepika	12350	12830	12590	30668	30380	30524	18318	17550	17934	1.48	1.37	1.42
S_1V_2: Line sowing x Deepika	12488	12998	12743	36040	36960	36500	23552	23962	23757	1.89	1.84	1.86
S_2V_2: Criss-cross x Deepika	12650	13160	12905	31824	31395	31609	19174	18235	18704	1.52	1.39	1.45
Fertilizer levels												
F_0 : RDF	12192	12692	12442	27404	28000	27702	15212	15308	15260	1.25	1.21	1.23
F_1 : RDF + S	12410	12910	12660	36584	36470	36527	24174	23560	23867	1.85	1.72	1.79
F_2 : 50 % more RDF	12885	13385	13135	39202	39690	39446	26317	26305	26311	2.04	1.97	2.00

Fig.1 Economics of linseed as influenced by sowing methods x varieties and fertilizer levels

This treatment may be attributed to better performance of plant growth parameters (plant height, primary and secondary branches) through optimum utilization of resources which had direct bearing on the production of higher dry matter. This might also because of favourable physical environment that might have increased the mineralization mobility of fertilizer resulting higher nutrient uptake and crop growth thus, leading to higher dry matter production. The results are in conformity with the findings of Kondazatowicz (1970) and Jaiswal and Singh (2001).

Biological yield (q ha^{-1})

The data presented in Table-1 reveal that among sowing methods x varieties, the biological yield was significantly higher under line sowing x RLC-92 (S_1V_1) as compared to other treatments, however, it was at par to criss-cross x RLC-92 (S_2V_1) during both the years and on mean basis. Treatment line sowing x Deepika (S_1V_2) was also found comparable during 2010-11. The biological yield was significantly affected due to fertilizer levels. Significantly higher biological yield of linseed was observed under 50% more RDF (F_2) than RDF (F_0), however, it was statistically at par to RDF + S (F_1) during both the years and on mean basis.

Economics of linseed production

Economics of linseed production in terms of gross and net return were calculated for different sowing methods x varieties and fertilizer levels and the outcome are in presented in Table-2. The data reveals that the maximum gross and net return were obtained under line sowing x RLC-92 (S_1V_1) followed by line sowing x Deepika (S_1V_2) during both the years and on mean basis. However, the return per rupee invested was maximum under line sowing x RLC-92 (S_1V_1) followed by line sowing x Deepika (S_1V_2) and criss - cross x RLC-92 (S_2V_1) during both years and on mean basis.

As regards to fertilizer levels, the maximum gross return, return and net return per rupee invested were recorded under 50% more RDF (F_2) followed by RDF + S (F_1) during both the years and on the mean basis. Trivedi (1996) also reported similar findings. Net return and benefit cost ratio were significantly higher in treatment 50 % more RDF (F_2) than RDF (F_0). Higher yields directly contribute to the return at higher fertilizer levels (Kumar, 2008). Highest gross return, net return, cost benefit ratio under drilling method of sowing as compared to broadcasting in soybean was also reported by Sharma and Thakur (1989).

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