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Production Potential and Economics of Linseed (*Linum usitatissimum* L.) as Influenced by Fertility Levels and Seed Rates in Dryland Conditions

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Abstract

A field experiment was carried out during *rabi* season of 2006 and 2007 to assess the production potential and economics of linseed under different fertility levels and seed rates in dry land ecosystem of eastern Uttar Pradesh. The results revealed that increase in fertility level from 0 to 60 : 30 : 30 : 30 kg N : P : K : S/ha significantly increased all the yield attributes viz. capsules / grains, seeds/ capsule and 1,000-grain weight. The increae in yield attributes with N, P, K and S fertilizer level resulted finally in increase seed and straw yield. However, increasing seed rate decreases all the yield attributes characters and increasing seed rate significantly increased gain yield from 22—30 kg / ha. But further increasing seed rate significantly decreased grain yield. However, increase in fertility levels and seed rate significantly increased gross return but net return was maximum with the fertilization i. e. N : P : K : S (kg/ha) 40 : 20 : 20 : 20 fertility level and seed rate of 30 kg /ha, respectively.
Key words : Linseed, Capsules, 1000-grain weight, Yield attributes, Grain and stover yield.

Linseed (*Linum usitatissimum* L.) is considered the most important industrial oil seed crop of India and stands next to rapeseed-mustard in *rabi* oil seed in terms of area and production. It is grown either for oil extracted from seed or fiber from stem. Seed oil content of linseed varies from 37—43%. Every part of the linseed plant utilized commercially either directly or after processing. Most of the oil is used in the industry for manufacturing of paints, varnishes, ink, soaps and small fraction of it is used for edible purposes. In India linseed is cultivated in about an area of 0.53 m ha and production is 0.212 mt with the 403 kg/ha productivity (1). Madhya Pradesh, Chhattisgarh, Maharashtra, Uttar Pradesh, Orissa and Bihar are the major linseed producing states of India during the last four decades. To sustain the linseed production there is a need to develop appropriate agronomic practices to obtain higher crop yield. In dry land area fertilization especially nitrogen, phosphorus, potassium and sulfur and seed rates are the key factors that determine the crop yield and quality (2). Keeping these reason in view, the present investigation was carried out during the *rabi* season of 2006 and 2007 at the research farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi i. e. eastern parts of Uttar Pradesh.

Methods

A field experiment was carried out during the *rabi* season of 2006 and 2007 at the research farm, Institute of agricultural sciences, Banaras Hindu University, Varanasi under the dry land ecosystem of eastern parts of Uttar Pradesh. The soil of the experimental site is inceptisol (type ustochempts), having sandy clay loam in texture with low nitrogen, medium in phosphorus and high in potassium availability and slightly alkaline in reaction (pH 8.2). The experimental units comprized four different fertility levels (kg/ha) N : P: K : S i.e. no fertilizer/control (F_0), 20:10:10: 10 (F_1), 40 :20 :20 : 20 (F_2) and 60 : 30 : 30 : 30 (F_3) and three seed rates i. e. and 20 (S_1), 30 (S_2) and 40 (S_3) kg/ha were replicated thrice in randomized block design. A basal application of N, P and K were applied at the time of

Table 1. Effect of fertility levels and seed rates on yield attributes, yield and economics of linseed (pooled data of two years).

Treatments	Capsule/ plant	Seeds/ capsule	1000-seed weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C ratio
Fertility Levels (N:P:K:S kg/ha)								
Control	25.111	8.889	7.203	5.809	5.809	10695	4067	1.613
20:10:10:10	34.444	9.000	7.309	8.077	8.077	14870	7499	2.017
40:20:20:20	40.778	9.000	7.363	8.716	8.716	16046	7752	1.934
60:30:30:30	45.111	9.222	7.369	8.890	8.890	16367	7051	1.756
CD (P=0.05)	0.710	0.189	0.024	0.007	0.007	–	–	–
Seed Rates (kg/ha)								
20	44.250	9.167	7.415	7.446	18.614	13682	6200	1.828
30	36.667	9.000	7.318	8.108	21.083	14927	7025	1.889
40	28.167	8.917	7.201	8.064	21.757	14873	6551	1.787
CD (P =0.05)	0.615	0.163	0.021	0.004	0.015	–	–	–

sowing and S was thoroughly mixed in the form of elemental sulfur 15 days before sowing at about 10 cm depth (as per treatment). A promising crop variety of linseed cv Garima was sown manually in furrow with maintaining the optimum plant spacing 30 × 10 cm. However, all the other intercultural operation was done for weed management and crop requirement at the one month stage of the crop growth. Dithane M-45 at 2 kg/ha and rogor 30 EC at 1 liter ha were applied at the pod formation stage of crop to protect from rust and wilt attacks severity. The crop was harvested when the stem turned yellow and capsules began to dry. After complete sun drying, threshing was done and stover yield was calculated by subtracting seed yield from bundle weight. The economics of the various treatments was worked out on the basis of average seed yield. The existing costs of input and price of the product were taken into consideration for calculating the economics i. e expressed net return and B : C ratio. The data related to each of the characters were analyzed by applying the standard statistical procedures.

Results and Discussion

Effect of Fertility Levels

At higher levels of NPKS application, vigorous plant growth might have produced more photosynthates (Table 1). Efficient partitioning of accumulated photosynthates, which resulted, enhanced yield attributes that ultimately increased the seed yield. Marschner (3) advocated that application of NPKS might exert flower initiation and seeds/capsules in by increasing the rate of photosynthesis and transport of source to sink sites. Therefore supply of NPKS must be adequate at reproductive phase in order to obtain maximum yield. Lack of NPKS at flower initiation stage reduces potential seed number and test weight, which are determined at this stage. Reduced test weight and seeds/capsules were recorded at lower rates of NPKS applications (Table 1). Increase in capsule/plant and seed/capsule with increasing levels of fertility resulted to enhance cell division, cell elongation and tissue differentiation (4). The increase in yield attributing characters of linseed with the application of NPKS has been reported by Khare et al. (5). The favorable effect of NPKS application on yield attributing characters viz., capsules/plant, seeds/capsule, 1000-seed weight and seed yield /plant was finally reflected to seed yield. As such, seed yield /ha increased significantly upto 60 kg N, 30 kg P, 30kg K and 30 kg S. These results corroborate the earlier findings (5—7). However, the higher stover yield was recorded at higher rates of NPKS application. This could be attributed to the increased plant height, branching and dry matter accumulation with increasing levels of NPKS application. This indicates that both seed and stover utilized the applied NPKS at almost the same level of efficiency. Similar, results have been reported by Jaggi et al. (8). Marked variation in gross return, net return and B:C ratio was observed due to fertility levels and seed rate. However, increasing the levels of fertility from F_1 to F_3 (60 kg, 30 kg P, 30 kg K, 30 kg S)/ha correspondingly enhanced the gross return. However, due to increased cost of fertilizer application and comparatively less grain yield beyond F_1 (20 kg N, 10 kg P, 10 kg K and 10 kg S/ha) decrease B : C ratio but net return significantly increases up to F_2 (40 kg N, 20 kg P, 20 kg K, 20 kg S) and this dose was most optimum from the net return point of view.

Effect of Seed Rates

The data reveals that increased production of primary and secondary branches/plant at lower seed rates led to the production of higher number of capsules/plant (Table 1). The lowest plant density at 20 kg seed rate also significantly bolder seeds than 30 and 40 kg seed/ha. Further seeds/capsule though declined with increasing seed rate from 20 to 40 kg/ha. Accordingly, the seed yield /plant followed the trend of capsules/ plant and test weight. However, the seed yield (q/ha), which is the function of seed yield/plant and plant population was found to increase significantly between 20 and 30 kg seed rate but decline thereafter. Whereas due to increasing plant density and biomass production the stover yield increased corresponding with increasing seed rate but the difference between 30 and 40 kg seed rate was not significant. These results are in conformity with the finding of Dubey and Singh (9) and Jain et al. (10). The seed rates, the gross return net return and B:C ratio were increased from 20 to 30 kg seed rate. However, the profitability was found to decline when the seed rate was increased to 40 kg/ha. Hence, the fertilization application of 40 kg N, 20 kg P, 20 kg K and 20 kg S with the seed rate 30 kg/ha used to obtained the optimum economic yield of linseed under dryland conditions of eastern Uttar Pradesh.

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