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Effect of Integrated Weed Management on Growth, Yield, Yield Attributes and Economics 0f Linseed (*Linum usitatissimum* L.) under South Gujarat Condition

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A B S T R A C T

Field experiment was conducted on clayey soil of the college farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari during rabi season of 2016-2017 to study the effect of integrated weed management on growth parameters, yield, yield attributes and economics of linseed (*Linum usitatissimum* L.). Production potential, higher profit and effective weed control in linseed can be achieved by maintaining weed free through hand weeding throughout crop growth period, where labours are easily available. In case of labours scarcity, application of pendimethalin 0.75 kg/ha PE fb 2,4-D 0.5 kg/ha PoE, 40 DAS was also equally effective.

Introduction

Linseed or flax is among the oldest crop plants cultivated for the purpose of oil and fibre. It belongs to the genus *Linum* and family Linaceae. The cultivars grown primarily for seed/oil purpose are relatively short in height and possess more secondary branches and seed bolls (seed capsule). The cultivars grown for fibre purpose are tall growing with straight culms and have fewer secondary branches. Seed contains 33 to 47 per cent oil. Seeds of linseed contain high levels of dietary fibers as well as lignans, an abundance of micronutrients and omega-3 fatty acids. The oil (>66%) is rich in linolenic acid and is a perfect drying oil. Oil cake contains 36 per cent protein, 85 per cent of which is digestible. It is also used for organic manure. It contains about 5 % N, 1.4 % P_2O_5 and 1.8 % K_2O. The seed of linseed content nutrient value per 100 g is carbohydrates 28.88 g, sugar 1.55 g, fat 42.16 g, protein 18.29 g and dietary fibers 27.39 g (Anonymous, 2013). Linseed is roughly 40% oil by weight, about 55% of which is alpha linolenic acid (omega-3 fatty acid) which has anti-inflammatory action in the treatment of arthritis. It has also quality in

lowering down the cholesterol level in mammals. Overall Linseed play role in the treatment of cancer, arthritis and cardiological diseases.

Among several factors affecting linseed production, weed is an important factor responsible for causing tremendous loss of yield. Weeds compete with crop plants for water, light, space and nutrients. Scientific literature shows that reduction or elimination of weed interference can increase linseed seed and oil yield. Yield losses may be less if only few weeds are present, but heavy infestations may cause complete crop failures. Hand weeding and interculturing between the rows are the conventional methods of weed control. Weeds infestation imposes serious constraints in realizing higher yields. Broad-leaf and grassy weeds are commonly associated with this crop, which is itself of similar nature. Pendimethalin is extensively used as pre-emergence herbicide for weed management in linseed field, but the efficacy of pendimethalin fluctuates according to the soil type, moisture regime, and types of weed flora and there is no recommended herbicide for linseed. Therefore, effective control of these weeds with the use of selective herbicide is difficult and need the integration of interculturing and hand weeding operations also (Angiras *et al.*, 1991).

Materials and Methods

A field experiment was conducted on plot B-12 of the College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari during *rabi* season of 2016-17. Twelve treatments comprising of weed management practices *viz*., T_1: Weed Free, T_2: One hand weeding at 20 DAS, T_3: Two hand weeding at 20 and 40 DAS, T_4: Pendimethalin 1.0 kg/ha PE, T_5: Isoproturon 1.0 kg/ha PoE, 20 DAS, T_6: 2,4-D 0.5 kg/ha, PoE, 20 DAS, T_7: Pendimethalin 0.75 kg/ha PE *fb* Isoproturon 0.75 kg/ha PoE, 40 DAS, T_8: Pendimethalin 0.75 kg/ha *fb* 2,4-D 0.5 kg/ha PoE, 40 DAS, T_9: Pendimethalin 0.75 kg/ha + One hand weeding at 40 DAS, T_{10}: Isoproturon 0.75 kg/ha PoE, 20 DAS + One hand weeding at 40 DAS, T_{11}: 2,4-D 0.5 kg/ha PoE, 20 DAS + One hand weeding at 40 DAS, T_{12}: Weedy check; were evaluated in randomized block design with three replications. The soil of the experimental field was clayey in texture, low in available nitrogen (254kg/ha) and medium in available phosphorus (32.67 kg/ha), fairly rich in available potash (430 kg/ha), slightly alkaline in reaction (pH 7.64) and having well drainage with good moisture retention capacity. The Linseed cv. local variety was sown on 23rd November, 2016 and harvested on 10th March 2017. The crop was fertilized with 60 kg N and 30 kg P_2O_5/ha.

Observation regarding to the growth parameters *i.e.* plant height (cm) at 30 DAS, 60 DAS and at harvest, number of branches per plant, days to 50% flowering and dry matter production per plant (m^2), yield and yield attributes *i.e.* test weight (g/cc), seeds and stover yield (kg/ha)were taken. The data were analyzed procedures described by Panse and Sukhatme (1985).

Results and Discussion

Effect of weed management on growth

A perusal of data presented in Table 1 on plant height at 30 DAS, 60 DAS and at harvest, number of branches per plant and dry matter production per plant (6.91 g/m^2) significantly influenced by weed management treatment. Significantly higher plant height (22.1, 54.3, 66.1 cm, respectively) was observed under weed free treatment (T_1). Among the integrated weed management treatment T_8 recorded significantly higher plant height (19.2, 52.0, 64.7 cm respectively), which being statistically at par with treatment T_9, T_3, T_7, and T_4 at 60 DAS and at harvest of crop.

The shortest plant height was recorded under weedy check (T_{12}). The increase in plant height at periodical growth stage under weed free condition during critical crop competition period might be due to effective control of weeds under these treatments, which improved growth of crop and checked nutrients drain by weeds. The shortest plant height might be due to severe competition by weeds for moisture and nutrients; consequently, the plant growth was affected. The weed control treatments have significant effect on number of branches per plant as compared to weedy check (T_{12}) (Table 1). Significantly higher number of branches per plant (8.21) at harvest was recorded under weed free treatment (T_1). Among the integrated weed management treatment T_8 significantly higher number of branches per plant (8.17), which was statistically at par with treatment T_3, T_9, T_7, T_4, T_{10} and T_{11} at harvest. The weed control treatments failed to exert its significant effect on days to 50 % flowering. Numerically earlier flowering was observed under weed free treatment while late in weedy check treatment. In case of dry matter production, significantly higher dry matter production (6.91 g/m^2) at harvest was recorded under weed free treatment (T_1), which was statistically at par with treatment T_8, T_3, T_9, T_7, T_4 and T_3 at harvest. The higher dry matter production per plant under T_1 might be due to more number of branches per plant (Table 1). Significant improvement in growth characters also might be due to increase water and nutrient uptake, which might have accelerated photosynthetic rate, thereby increasing the supply of carbohydrates, resulted in increased cell division, multiplication and elongation leading to increase the number of branches per plant. The lowest number of branches per plant was recorded under treatment T_{12} (weedy check) may be due to serve competition by weeds for resources, which made the crop plant inefficient to take up more moisture and nutrients, consequently photosynthesis might have been affected leading to less production of photosynthates and ultimately growth was adversely affected due to less supply of carbohydrates. Treatment T_1 (weed free) proved better than other herbicides as well as weedy check. Suppressed weed allowed more light, moisture, nutrients and space to crop plant, which resulted in better growth characters. Similar results were also reported by Giriyapla *et al.,* (2016) and Mane *et al.,* (2017).

Effect on yield and yield attributes

The entire yield attributes namely seed yield (kg/ha) and stover yield (kg/ha) showed significant response to weed management practices but test weight did not exert their significant effect (Table 2). The higher seed and stover yield (1420 and 2962 kg/ha, respectively) was recorded under the weed free treatment (T_1). The treatment T_8 in which pre-emergence application of pendimethalin 1.0 kg/ha *fb* post emergence application of 2,4-D 0.5 kg/ha at 40 DAS was at par with T_3, T_9, T_7, T_3. The magnitude of increase in grain yield under treatment T_1 was to the tune of 56.2 % over weedy check (T_{12}), while 56.10 % in T_8, 53.4 % in T_9 and 52.04 % increase in T_7 over weedy check. The per cent increase in stover yield due to weed free condition (T_1) was to the tune of 71.3 % over weedy check (T_{12}), while 70.4 % increase in T_8, 68.6 % increase in T_3, 66.7% increase in T_9 over unweeded treatment (T_{12}). The reason for the increase in seed yield was mainly due to weed free condition provided at critical crop weed competition period, which might be due to effective control of weeds under these treatments. Seed yield is primarily a function of accumulation of photosynthates resulted in growth and increase yield attributes. Therefore, it can be inferred that significant improvement in these parameters contributed towards higher grain yield.

Table.1 Effect of different weed management treatments on growth parameters of linseed under south Gujarat

Treatments		Plant height			No. of branches per plant	Days to 50% flowering	Dry matter production per plant (g/m^2)
		30 DAS	60 DAS	At harvest			
T_1	Weed free	22.1	54.3	66.1	8.21	63.3	6.91
T_2	One hand weeding at 20 DAS	14.4	44.8	52.0	5.20	69.7	4.70
T_3	Two hand weeding at 20 and 40 DAS	18.6	51.2	63.8	8.03	65.0	6.38
T_4	Pendimethalin 1.0 kg/ha PE	16.4	48.6	60.1	7.43	68.3	5.83
T_5	Isoproturon 1.0 kg/ha PoE, 20 DAS	14.8	46.1	52.7	6.85	66.3	5.21
T_6	2,4-D 0.5 kg/ha, PoE, 20 DAS	14.5	45.9	52.3	6.53	68.3	5.09
T_7	Pendimethalin 0.75 kg/ha PE *fb*Isoproturon 0.75 kg/ha PoE, 40 DAS	16.7	49.3	61.0	7.53	68.0	5.91
T_8	Pendimethalin 0.75 kg/ha *fb* 2,4-D 0.5 kg/ha PoE, 40 DAS	19.2	52.0	64.7	8.17	64.7	6.87
T_9	Pendimethalin 0.75 kg/ha + One hand weeding at 40 DAS	17.4	50.0	62.8	7.77	65.3	6.04
T_{10}	Isoproturon 0.75 kg/ha PoE, 20 DAS + One hand weeding at 40 DAS	15.6	46.6	56.7	7.23	66.3	5.66
T_{11}	2,4-D 0.5 kg/ha PoE, 20 DAS + One hand weeding at 40 DAS	15.4	46.4	55.3	7.10	67.7	5.37
T_{12}	Weedy check	12.5	40.5	50.7	4.73	70.0	4.28
	S.Em. ± C.D at 5 % C.V. %	0.71 2.22 7.49	2.17 6.75 7.83	3.07 9.55 9.14	0.42 1.31 10.32	3.61 NS 9.35	0.43 1.33 12.97

Table.2 Effect of different weed management treatments on growth parameters of linseed under south Gujarat

	Treatments	Yield(kg/ha)		Cost of cultivation (₹/ha)	Gross returns (₹/ha)	Net returns (₹/ha)	B:C Ratio
		Seed	Stover				
T_1	Weed free	1420	2962	19442	99992	80550	4.14
T_2	One hand weeding at 20 DAS	0955	1646	18018	67179	49161	2.73
T_3	Two hand weeding at 20 and 40 DAS	1321	2708	19086	93035	73949	3.87
T_4	Pendimethalin 1.0 kg/ha PE	1181	2337	17782	83114	65332	3.67
T_5	Isoproturon 1.0 kg/ha PoE, 20 DAS	0979	1958	16610	68945	52335	3.15
T_6	2,4-D 0.5 kg/ha, PoE, 20 DAS	0969	1864	16332	68203	51871	3.18
T_7	Pendimethalin 0.75 kg/ha PE *fb*Isoproturon 0.75 kg/ha PoE, 40 DAS	1297	2465	17742	91283	73541	4.15
T_8	Pendimethalin 0.75 kg/ha *fb* 2,4-D 0.5 kg/ha PoE, 40 DAS	1417	2872	17582	99741	82159	4.67
T_9	Pendimethalin 0.75 kg/ha + One hand weeding at 40 DAS	1334	2576	18450	93872	75422	4.09
T_{10}	Isoproturon 0.75 kg/ha PoE, 20 DAS + One hand weeding at 40 DAS	1045	2090	17560	73591	56031	3.19
T_{11}	2,4-D 0.5 kg/ha PoE, 20 DAS + One hand weeding at 40 DAS	1021	1997	17400	71893	54493	3.13
T_{12}	Weedy check	622	851	15882	43710	27828	1.75

Selling price: 1. Seed per kg 70 ₹ 2. Stover per kg 0.20 ₹

The yield loss study also shows that reduced weed population initially by pre-emergence herbicide followed by weed control around 25 to 30 DAS either by post emergence herbicide or hand weeding has less reduction in yield. This result indicated that appreciable increase in seed and stover yield could be the significant improvement in plant growth in terms of plant height, number of branches and dry matter production per plant under those treatments. Similar effect was also reported by Giriyapla *et al.,* (2016) and Jain and Jain (2016) in linseed.

Economics

Economics is the major consideration of farmers, while taking a decision regarding the adoption of the recently developed new technology. Hence the gross realization, net realization and benefit cost ratio were computed for different weed management treatments. Data presented in (Table 2) revealed that maximum gross returns of (₹99992/ha) was realized under the treatment T_1 (weed free), followed by treatment T_8 (₹ 99741/ha) and T_9 (₹93872/ha). The higher seed yields recorded under these treatments might be responsible for higher gross return. However, the maximum net returns (₹82159/ha) and B: C ratio (4.67) was accrued under the treatment T_8 followed by T_1. The lowest gross return, net return and B: C was accrued under the treatment T_{12} (₹43710/ha, ₹27828/ha and 1.75 respectively). So higher gross returns along with the lowest cost under T_1, T_8, T_9 treatments might be responsible for higher net return and B: C ratio. These findings are in close vicinity with those reported by Kumar and Nagaich (2013) and Giriyapla *et al.*, (2016) in linseed.

Based on results of the field experiment, it seems quite logical to conclude that production potential, higher profit and effective weed control in linseed can be achieved by maintaining weed free through hand weeding throughout crop growth period, where labours are easily available. In case of labours scarcity, application of pendimethalin 0.75 kg/ha PE *fb* 2,4-D 0.5 kg/ha PoE, 40 DAS was also equally effective.

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