EFFECT OF INTEGRATED WEED MANAGEMENT PRACTICES ON GROWTH, YIELD AND QUALITY OF LINSEED (*Linum usitatissimum* L.)

[1]CHHAGANIYA, H. J.; [2]PATEL, A. P.; [3]PATEL, H. N.; [4]PATEL, A. M.; [5]PATEL, A. J. AND [6]*PATEL, D. D.

DEPARTMENT OF AGRONOMY
N.M.COLLEGE OF AGRICULTURE, NAVSARI AGRICULTURAL UNIVERSITY
NAVSARI – 396 450, GUJARAT, INDIA

***EMAIL: ddpatel@nau.in**

[1]M.Sc. (Agri.) Student, N.M. College of Agriculture, NAU, Navsari, Gujarat
[2]Associate Professor, College of Agriculture, NAU, Waghai, Gujarat
[3]Assistant Research Scientist, Cotton Wilt Breeding Station, NAU, Hansot, Gujarat
[4]Assistant Research Scientist, Office of the Directorate of Research, NAU, Navsari, Gujarat
[5]Assistant Professor, Department of Agronomy, NMCA, NAU, Navsari, Gujarat
[6]Principal, Polytechnic in Agriculture, NAU, Bharuch, Gujarat

ABSTRACT

Field experiment was conducted on deep black soil of the College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari during rabi 2014-15 to study the effect of integrated weed management practices on growth, yield and quality of linseed (Linum usitatissimum L.). Interculturing (IC) + hand weeding (HW) at 20 and 40 DAS significantly increased seed yield (810 kg/ha), stover yield (2391 kg/ha), oil yield (310 kg/ha) and weed control efficiency (84.09%) and reduced the weed population and dry weight of weeds (248.85 kg/ha), which was followed by application of pendimethalin @ 750 g/ha as pre-emergence + interculturing and hand weeding at 30 DAS.

KEY WORDS: Integrated Weed Management, linseed, oil yield

INTRODUCTION

Linseed or flax is among the oldest crop plants cultivated for the purpose of oil and fiber. It belongs to the genus *Linum* and family Linaceae. The botanical name, *Linum usitatissimum* was given by Linnaeus in his book "Species Plantarum" (Linnaeus, 1857). It is an annual herbaceous plant with shallow root system. The common names flax and linseed are used in North America and Asia, respectively, for *L. usitatissimum*. Oilseed varieties and fiber varieties are specialized development of this species (Millam *et al*., 2005). 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 fiber purpose are tall growing with straight culms and have fewer secondary branches. Every part of linseed plant is utilized commercially, either directly or after processing. Seed contains 33 to 47 per cent oil. A small quantity is directly used for edible purposes. About 20 per cent of the total oil produced is used at farmer level and the rest 80 per cent oil goes to industries in various forms, such as boiled oil, borated oil, eposidized oil, aluminated oil, urethane oil, isomerized oil *etc*. The oil (>66%) is rich in linolenic acid and is a perfect drying oil. The seed of linseed content nutrient value per 100 g is carbohydrates 28.88 g, sugars 1.55 g, fat 42.16 g, protein 18.29 g and dietary fibers 27.39 g (Anonymous, 2013).

The present weed control practices are characterized by intensive use of manual labour and animal power. Both of them are in short supply and increasingly became uneconomical. Adverse soil and climatic conditions prevent timely removal of weeds through manual and mechanical

means. Linseed having less branching habit, small leaf area and show growth during initial growth period, it complete poorly with weeds and often suffers from severe weed competition. Unchecked weed growth has been reported to reduce grain yield of linseed to the tune of 34.2 per cent (Mani *et al*., 1968). Weeds the essential component of agro-ecosystems, interfere with crops and lead to enormous crop losses (Vaid *et al*., 2010).

Weeds infestation imposes serious constraints in realizing higher yields. Hand weeding and interculturing between the rows are the conventional methods of weed control. These methods are troublesome due to labour problem in weeding peak and unavailability of suitable intercultural implements. Under such circumstances suitable integrated weed-management practices remains the only choice for the farmers. Broad-leaf and grassy weeds are commonly associated with this crop which is itself of similar nature. Therefore, for effective control of these weeds with the use of selective herbicide is difficult and need the integration of intercultural and hand weeding operations also (Angiras *et al*., 1991).

MATERIALS AND METHODS

A field experiment was conducted during *rabi* season of 2014-15 at the College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari. The experiment was conducted in randomized block design with twelve treatments *i.e.* T_1: Pendimethalin @ 750 g/ha as pre-emergence, T_2: Oxyfluorfen @ 60 g/ha as pre-emergence, T_3: Isoproturon @ 750 g/ha as post-emergence at 15-20 DAS, T_4 : Quizalofop ethyl @ 75 g/ha as post-emergence at 15-20 DAS, T_5: T_1 fb IC and HW at 30 DAS, T_6: T_2 fb IC and HW at 30 DAS, T_7: T_3 fb IC and HW at 30 DAS, T_8: T_4 *fb* IC and HW at 30 DAS, T_9:T_1 + T_4, T_{10}:1 HW at 20 DAS, T_{11}: Weed free (IC *fb* HW at 20 and 40 DAS) and T_{12}:Weedy check with three replications. The experimental soil was deep black having 235 kg/ha available N, 38 kg/ha available P_20_5 and 463 kg/ha available K_20 with 7.6 pH. Linseed local variety was grown on November 20, 2014 at 30 x 10 cm spacing. Observation regarding growth i.e. plant height and number of branches per plant were recorded at harvest. Weed study i.e. weed count (Number per m^2) were recorded at 25 and 50 DAS, and also at harvest along with weed control efficiency (%) and weed index (%). Dry weight of weeds (kg/ha), seed yield (kg/ha) and stover yield (kg/ha) were recorded at harvest, while observation regarding seed yield, stover yield, oil content (%) and oil yield (kg/ha) were recorded at harvest. The data were analyzed statistically by adopting the standard procedures described by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Weeds flora

Weed flora identified in experiment plot were monocot, dicot and sedges weeds. In monocot weeds, *Cynodon dactylon, Digitaria sanguinalist, Bracharia spp., Sorghum halepense and Echinochloa crusgallis* and in dicot weeds, *Alternanthera sessillis, Physalis minima, Euphorbia hirta, Vernonia cinerea, Amaranthus viridis and Digera arvensis* were observed, while under sedges weed, *Cyperus rotundus* was observed.

Effect of weed management practices on weed count and dry weight of weed

A perusal of data presented in Tables 1 indicated that the treatment weed free *i.e.*, interculturing followed by hand weeding at 20 and 40 DAS (T_{11}) recorded significantly the lowest number of monocot, dicot and sedges weeds at 25 DAS, 50 DAS and at harvest, but remained at par with treatments T_{10} (1 HW at 20 DAS), T_5 (T_1 *fb* IC and HW at 30 DAS) and pendimethalin @ 750 g/ha as pre-emergence at 25 DAS (T_1). The treatment having one hand weeding at 20 DAS (T_{10}) recorded significantly the lowest number of monocot, dicot and sedges weeds next to T_{11} (1.46, 1.33 and 1.46 per cent m^2). It

clearly indicated that interculturing followed by 1 HW significantly reduced the weed population during initial period of crop growth. At 50 DAS and at harvest, besides treatment T_{11} (IC *fb* HW at 20 and 40 DAS), T_5, T_8 and T_6 recorded significantly the lower number of monocot, dicot and sedge weeds as compared to the treatment weedy check (T_{12}). The removal of weed at regular interval through hand weeding at 20 and 40 DAS accounted for less count of monocot, dicot and sedge weeds under treatment T_{11}. At harvest, treatment T_5, T_8 and T_6 were found at par with treatment weed free *i.e.* interculturing followed by hand weeding at 20 and 40 DAS (T_{11}) for monocot, dicot and sedge weeds. Tomar *et al*. (1990) reported significant reduction in grassy and broad leaved weeds which causes 37.9 per cent reduction in yield of linseed. The lowest dry weight of weeds (248.85 kg/ha) was recorded at harvest under the treatment T_{11} weed free (interculturing followed by hand weeding at 20 and 40 DAS).

Weed control efficiency and weed index

A perusal of data presented in Tables 1 indicated that weed free treatment *i.e.* interculturing followed by hand weeding at 20 and 40 DAS (T_{11}) recorded the highest weed control efficiency (84.09 %), which was followed by treatment pendimethalin @ 750 g/ha as PE *fb* IC and HW at 30 DAS (T_5) and quizalofop ethyl @ 75 g/ha as PoE at 15-20 DAS *fb* IC and HW at 30 DAS (T_8) having weed control efficiency of 81.60 and 80.90 per cent at harvest, respectively. While, weed index was recorded in the manner of $T_{11} < T_5 < T_8 < T_6 < T_7 < T_9 < T_1 < T_4 < T_2 < T_{10} < T_3 < T_{12}$. Frisen and freer (1991) reported that only pre emergence herbicides application was less effective and allow weed competition in later stages, therefore along with cultural practices (hoeing or weeding) or post emergence herbicides gave maximum weed control efficiency. Bali *et al.* (2016) reported that weed free plots recorded highest weed control efficiency followed by hand weeding (15 & 35 DAS).

Effect of weed management practices on growth attributes of linseed

The highest plant height at harvest (63.06 cm) and number of branches per plant (8.43) were observed under the treatment weed free *i.e.* IC followed by HW at 20 and 40 DAS (T_{11}) and was statistically at par with T_5, T_8 and T_6 (Table 2). It is established fact that weed compete for light, space, nutrient and water with the crop and hamper overall growth of the same. If weeds are removed by weed control methods, the trend was reversed and crop gain height as well as more number of branches per plant. Mechanical weeding improved the soil aeration and increased nutrient availability to the crop through active mineralization and decomposition. It was also accordance with Seema *et al*. (2014).

Effect of weed management practices on yield

A perusal of data presented in Tables 2 indicated that seed yield (810 kg/ha) and stover yield (2391 kg/ha) were found significantly higher under treatment weed free i.e. interculturing followed by hand weeding at 20 and 40 DAS (T_{11}), which was remained at par with treatments T_5 (Pendimethalin @ 750 g/ha as PE *fb* IC and HW at 30DAS), T_8 (Quizalofop ethyl @ 75 g/ha as PoE at 15-20 DAS *fb* IC and HW at 30DAS), T_6 (Oxyfluorfen @ 60 g/ha as PE *fb* IC and HW at 30 AS) and T_7 (Isoproturon @ 750 g/ha as PoE at 15-20 DAS *fb* IC and HW at 30 DAS). Vedharethinam *et al*. (2004) reported the similar results in sunflower, and Jain and Jain (2016) in linseed. All weed control methods established their superiority over weedy check in respect of seed yield and stover yield by virtue of reduced weed competition. Angiras *et al*. (1991) also reported that herbicidal treatments produced significantly higher seed yield over un-weeded check in linseed. Mishra *et al.* (2003) also recorded higher yield in

hand weeding treatment than chemical weed management in linseed.

Effect of weed management practices on quality of linseed

The highest oil yield (310 kg/ha) was recorded with the treatment T_{11} *i.e.* weed free (IC *fb* HW at 20 and 40 DAS). The higher oil yield received under this treatment was due to the higher seed yield recorded under this treatment which directly responsible for higher oil yields (Table 2). The oil content in seed was not differed significantly due to various treatments. This might be due to oil content is mainly a genetic character which cannot be manipulated by agronomic practices.

CONCLUSION

Based on the results from the experimentation, it seems quite logical to conclude that interculturing (IC) + hand weeding (HW) at 20 and 40 DAS significantly increased seed yield (810 kg/ha), stover yield (2391 kg/ha), oil yield (310 kg/ha) and weed control efficiency (84.09%) and reduced the weed population and dry weight of weeds (248.85 kg/ha), which was followed by application of pendimethalin @ 750 g/ha as pre-emergence + interculturing and hand weeding at 30 DAS.

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Table 1: Effect of weed management practices on monocot, dicot and sedges weed density at 25, 50 DAS and at harvest

Treatments		Monocot Weed (per m^2)			Dicot Weed (per m^2)			Sedge Weed (per m^2)			Dry Weight of Weeds at Harvest (kg/ha)	Weed Control Efficiency (%)	Weed Index (%)
		25 DAS	50 DAS	At Harvest	25 DAS	50 DAS	At Harvest	25 DAS	50 DAS	At Harvest			
T_1	Pendimethalin @ 750 g/ha as PE	1.68 (2.33)	3.67 (13)	5.46 (29.33)	1.68 (2.33)	4.84 (23)	6.16 (37.66)	1.53 (1.88)	6.16 (37.66)	7.15 (51)	883.85	43.51	17.47
T_2	Oxyfluorfen @ 60 g/ha as PE	2.11 (4)	3.85 (14.33)	5.72 (32.33)	2.20 (4.33)	5.23 (27)	6.40 (40.66)	2.34 (5)	6.27 (39)	7.48 (56.66)	976.72	37.58	20.65
T_3	Isoproturon @ 750 g/ha as PoE at 15-20 DAS	3.89 (14.66)	4.40 (19)	6.25 (38.66)	4.12 (16.66)	5.51 (30)	6.96 (48.33)	4.44 (19.33)	6.48 (41.66)	7.83 (61)	1034.85	33.86	22.01
T_4	Quizalofop ethyl @ 75 g/ha as PoE at 15-20 DAS	3.84 (14.33)	3.62 (12.66)	5.60 (31)	4.00 (15.66)	4.25 (17.66)	6.21 (38.33)	3.92 (15)	5.86 (34)	7.31 (53.33)	857.52	45.20	18.84
T_5	Pendimethalin @ 750 g/ha as PE *fb* IC and HW at 30DAS	1.56 (2.66)	2.03 (3.66)	3.43 (11.33)	1.52 (2)	1.95 (3.33)	3.26 (10.33)	1.52 (1.81)	3.07 (9)	5.17 (26.33)	286.85	81.66	1.03
T_6	Oxyfluorfen @ 60 g/ha as PE *fb* IC and HW at 30 AS	1.95 (3.33)	2.19 (4.33)	3.62 (12.66)	2.48 (5.66)	2.10 (4)	3.37 (11)	2.96 (8.33)	3.23 (10)	5.32 (28)	360.52	76.96	11.11
T_7	Isoproturon @ 750 g/ha as PoE at 15-20 DAS *fb* IC and HW at 30 DAS	4.02 (15.66)	2.79 (7.33)	4.33 (17)	4.18 (17)	2.60 (6.33)	4.54 (20)	3.58 (12.33)	4.12 (16.66)	6.16 (37.66)	578.99	63.00	12.22
T_8	Quizalofop ethyl @ 75 g/ha as PoE at 15-20 DAS *fb* IC and HW at 30DAS	3.76 (13.33)	2.11 (4)	3.57 (12.33)	4.04 (16)	2.03 (3.33)	3.32 (10.66)	3.48 (11.66)	3.17 (9.66)	5.22 (27)	298.85	80.90	1.44
T_9	Pendimethalin @ 750 g/ha as PE + Quizalofop ethyl @ 75 g/ha as PoE at 15-20 DAS	1.54 (2.33)	2.91 (8)	5.78 (33.33)	1.77 (2.66)	2.73 (6)	4.65 (21.33)	1.53 (1.90)	5.66 (31.66)	7.27 (52..66)	696.52	55.48	15.02
T_{10}	1 HW at 20 DAS	1.46 (1.66)	5.46 (29.33)	7.32 (53.33)	1.34 (1.33)	4.87 (23.33)	7.24 (52.33)	1.46 (1.66)	7.98 (63.33)	8.47 (71.66)	1240.19	20.74	21.60
T_{11}	Weed free (IC *fb* HW at 20 and 40 DAS)	1.34 (1.33)	1.85 (3)	3.38 (11)	1.22 (1)	1.76 (2.66)	2.90 (8)	1.34 (1.33)	2.85 (7.66)	4.80 (22.66)	248.85	84.09	0.00
T_{12}	Weedy check	5.27 (27.33)	6.94 (47.66)	8.96 (80)	5.11 (25.66)	7.63 (58)	8.54 (72.66)	6.31 (39.33)	9.23 (80)	10.41 (108.33)	1564.85	0.00	58.80
S.Em ±		0.13	0.19	0.31	0.20	0.28	0.40	0.16	0.31	0.44	46.65	-	-
CD (P=0.05)		0.39	0.55	0.91	0.59	0.82	1.17	0.48	0.92	1.30	136.83	-	-
C.V. %		8.56	9.45	10.21	12.44	12.85	13.10	9.96	10.18	11.23	10.74	-	-

Note: Transformation √X+0.5 (Figures in parenthesis are original values)

Table 2: Effect of weed management on growth parameters, yield and quality of linseed

Treatments		Plant Height (cm) at Harvest	Number of Branches per Plant at Harvest	Seed Yield (kg/ha)	Stover Yield (kg/ha)	Oil Content (%)	Oil Yield (kg/ha)
T_1	Pendimethalin @ 750 g/ha as PE	55.59	6.66	668	2056	37.00	248
T_2	Oxyfluorfen @ 60 g/ha as PE	55.15	6.56	642	2039	37.00	238
T_3	Isoproturon @ 750 g/ha as PoE at 15-20 DAS	52.54	6.33	631	2024	36.93	234
T_4	Quizalofop ethyl @ 75 g/ha as PoE at 15-20 DAS	53.65	6.59	657	2053	36.90	243
T_5	Pendimethalin @ 750 g/ha as PE *fb* IC and HW at 30DAS	61.59	7.89	801	2358	38.03	305
T_6	Oxyfluorfen @ 60 g/ha as PE *fb* IC and HW at 30 AS	60.90	7.65	720	2220	37.73	272
T_7	Isoproturon @ 750 g/ha as PoE at 15-20 DAS *fb* IC and HW at 30 DAS	55.98	6.86	711	2206	37.33	265
T_8	Quizalofop ethyl @ 75 g/ha as PoE at 15-20 DAS *fb* IC and HW at 30DAS	61.19	7.53	798	2351	37.00	296
T_9	Pendimethalin @ 750 g/ha as PE + Quizalofop ethyl @ 75 g/ha as PoE at 15-20 DAS	55.78	6.84	688	2061	37.50	258
T_{10}	1 HW at 20 DAS	51.41	5.50	635	2045	36.33	230
T_{11}	Weed free (IC *fb* HW at 20 and 40 DAS)	63.06	8.43	810	2391	38.40	310
T_{12}	Weedy check	49.65	5.00	510	1982	35.60	183
S.Em ±		2.36	0.52	34	112	2.17	16.81
CD (P=0.05)		6.95	1.55	99	328	**NS**	49.32
C.V. %		7.28	13.45	8.5	9.0	10.14	11.32

[MS received : June 12, 2017] ***[MS accepted : June 22, 2017]***