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Effect of weed management practices on growth on weeds, yield and economics of linseed (*Linum usitatissimum* L.)

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Abstract
A field experiment was conducted during *rabi* season of 2016-17 at Research cum Instructional Farm of IGKV, Raipur, Chhattisgarh to study the effect of weed management practices on growth Weeds, yield and economics on linseed (*Linum usitatissimum* L). Experiment was laid out in Randomized Block Design with three replications. The treatments comprised of ten weed management practices *viz*, metribuzin + oxyflurofen @ 250 g + 125 g ha^{-1} as pre-emergence 1 DAS (T_1), oxyflurofen @ 125 g ha^{-1} as pre-emergence at 1 DAS (T_2), oxadiargyl @ 80 g ha^{-1} as pre-emergence at 1 DAS (T_3), imazethapyr 10 EC @ 75 g ha^{-1} as post-emergence at 22 DAS (T_4), metsulfuron-methyl @ 4 g ha^{-1} as post-emergence at 22 DAS (T_5), isoproturon @ 1 kg ha^{-1} as post-emergence at 22 DAS (T_6), isoproturon + metsulfuron-methyl @ 1 kg + 4 g ha^{-1} as post-emergence at 22 DAS (T_7), pendimethalin + *fb* metsulfuron-methyl @ 1 kg + *fb* 4 g ha^{-1} as pre + post-emergence at 1 and 22 DAS (T_8), and hand weeding twice at 21 and 45 DAS (T_9), weedy check (T_{10}). Hand weeding twice 21 and 45 DAS (T_9) followed by isoproturon + metsulfuron-methyl @ 1 kg + 4 g ha^{-1} as post-emergence (T_7), metsulfuron-methyl @ 4 g ha^{-1} as post-emergence (T_5), were most appropriate for reducing weed density, weed dry matter production, lowest weed growth rate. Whereas weed index recorded minimum in hand weeding twice at 21 and 45 DAS (T_9). The economic returns in terms B: C ratio was maximum under metsulfuron-methyl @ 4 g ha^{-1} as post-mergence (T_5).

Keywords: B:C ratio, herbicide, post-emergence, randomized block design

Introduction
Among the oilseeds, linseed or flax (*Linum usitatissimum* L.) is one of the oldest crops, grown in almost all countries of world for oil, fibre and seed purpose. Linseed is unique among oilseeds for its technical grade vegetable oil producing ability and fibre (good quality having high strength and durability) production. Linseed contains 35-45 percent oil with high content of omega-3 fatty acid, alpha lenolenic acid (ALA). Omega-3 fatty acid lowers levels of triglycerides in the blood, thereby reducing heart disease and also promise in the battle against rheumatoid arthritis. Linolenic acid omega-3 and omega-6 linoleic acid, essential fatty acids are also found in linseed. Linseed oil contains three times as much omega-3 fatty acid than omega-6 fatty acid (Singh *et al*., 2013) [9]. Its seed has 36 percent protein out of which 85 percent is digestible. Chhattisgarh is one of the important linseed growing states of India, which accounts for nearly cultivated over 3.0 thousand hectare area with a production of 12.3 thousand tonnes and productivity of 397 kg ha^{-1} (Anonymous, 2014-15b) [1]. It occupies 9 per cent of area under oilseeds and 6.29 per cent contribution to the total oilseed production of the country. Pre-mixed application of as pre-emergence, early post-emergence and post emergence herbicides was found effective elsewhere for weed control in linseed and other oilseed crops (Siddesh *et al*., 2016) [8].

Materials and Methods
Experiment was conducted on the Research cum Instructional Farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur, (C.G.) during *rabi* season of 2016-17. The experiment was conducted in Randomized Block Design with ten treatments replication three times, In the experiment 60:30:30 N, P_2O_5 and K_2O kg ha^{-1} nutrient was applied as recommended dose of along with 5t ha^{-1} FYM was incorporated at the time of final field preparation.

Table 1: Treatment details of the experiment

S. No	Treatment	Dose (*a.i.* ha^{-1})	Time of application	Application (DAS)
T_1	Metribuzin + oxyflurofen	250 g + 125 g	Pre- mergence	1 DAS
T_2	Oxyflurofen	125 g	Pre-emergence	1 DAS
T_3	Oxadiargyl	80 g	Pre-emergence	1 DAS
T_4	Imazethapyr 10 EC	75 g	Post-emergence	22 DAS
T_5	Metsulfuron- methyl	4 g	Post-emergence	22 DAS
T_6	Isoproturon	1 kg	Post-emergence	22 DAS
T_7	Isoproturon + metsulfuron- methyl	1 kg + 4 g	Post-emergence	22 DAS
T_8	Pendimethalin + *fb* metsulfuron- methyl	1 kg + 4 g	Pre + post -emergence	1 + 22 DAS
T_9	Hand weeding twice	-	-	21 and 45 DAS
T_{10}	Weedy check	-	-	-

DAS* = Days after sowing

Result and Discussion

Weed flora identified in experimental plot were broad leaved weeds. In broad leaved weeds *Medicago denticulate, Convolvulus arvensis, Parthenium hysterophorus* and others weeds *spp.etc*, were observed.

Effect of weed management practices on total weed count of weeds

The total weed count was significantly influenced by different weed Management practices at 90 DAS and at harvest and data are presented in Table 2: Significantly higher total count of weed species namely *Medicago denticulata, Convolvulus arvensis, Parthenium hysterophorus,* and others were observed under weedy check (T_{10}) as compared to rest of the treatments at 90 DAS and at harvest significantly lower total count of weed species was observed under the treatment of hand weeding twice at 21 and 45 DAS (T_9), however, at 90 DAS treatment metsulfuron-methyl @ 4 g ha^{-1} as post-emergence (T_5) were found at par. These results are corrobaorative with the findings of kumara *et al*. (2007) [4]. Who reported that the highest weed density and dry weight of weeds was recorded in weedy check.

Effect of weed management practices on total dry matter accumulation of weeds

The total weed dry matter was significantly influenced by different weed Management practices at 90 DAS and at harvest and data are presented in Table 2 Significantly higher total dry matter of weed species namely *Medicago denticulata, Convolvulus arvensis, Parthenium hysterophorus,* and others were observed under weedy check (T_{10}) as compared to rest of the treatments at 90 DAS and at harvest significantly lower total dry matter of weed species was observed under the treatment of hand weeding twice at 21 and 45 DAS (T_9), however, at 90 DAS treatment metsulfuron-methyl @ 4 g ha^{-1} as post-emergence (T_5) were found at par. These results are corrobaorative with the findings of Malligawad *et al.* (2000), Madhu *et al.* (2006) [5]. Who reported that the highest weed density and dry weight of weeds was recorded in weedy check

Effect of weed management practices on yield and B:C ratio

Data related to seed yield as affected by various weed management practices on linseed are presented in Table 2 and reveals that amongst weed management practices, hand weeding twice at 21 and 45 DAS (T_9) registered significantly higher grain yield (1895 kg ha^{-1}). However, it was statistically at par with the treatment of metsulfuron-methyl @ 4 g ha^{-1} as post-emergence (T_5), isoproturon @ 1 kg ha^{-1} as post-emergence (T_6), isoproturon + metsulfuron-methyl @ 1 kg + 4 g ha^{-1} as post-emergence (T_7) and pendimethalin + *fb* metsulfuron-methyl @ 1 kg + *fb* 4 g ha^{-1} as pre + post-emergence (T_8). Similar finding were also reported by Dange *et al.* **(**2007) [2]. The minimum seed yield was recorded under weedy check (T_{10}) due to unhindered growth of weeds. Similar results also reported by Jain and Agarwal (1998) [3] and Mishra *et al.* (2003) [7].

The highest benefit: cost ratio (4.28) was recorded under the treatment of metsulfuron-methyl @ 4 gha^{-1} as post-emergence (T_5), followed by isoproturon + metsulfuron-methyl @ 1 kg + 4 g ha^{-1} as post-emergence (T_7) and pendimethalin + *fb* metsulfuron-methyl @ 1 kg + *fb* 4 g ha^{-1} as pre + post-emergence (T_8). However, minimum gross return, net return and benefit: cost ratio was obtained under weedy check (T_{10}). The higher B:C ratio under above treatments might be due to higher seed yield coupled with lower cost of chemical treatment. Mishra *et al*. (2003) [7] reported te similar findings.

Conclusion

Hand weeding twice at 21 and 45 DAS (T_9) has registered higher growth, yield attributes under *Vertisols* condition of Chhattisgarh plains as compared to other weed management practices. Economics in terms of benefit cost ratio was recorded highest under metsulfuron-methyl @ 4 g ha^{-1} as post-emergence (T_5).

Table 2: Effect of weed management practices on total weed count, total dry matter accumulation of weeds, seed yield and B:C ratio

Weed management practices	Doses (*a.i.* / ha)	Time of application (DAS)	Total weed count		Total weed dry matter		Seed yield (Kg/ha)	B:C ratio
			90 DAS	At harvest	90 DAS	At harvest		
T_1-Metribuzin+ oxyflurofen	250 g + 125 g	1	6.28 (39.00)	6.12 (37.00)	6.31 (39.38)	5.91 (34.38)	1676	3.80
T_2-Oxyflurofen	125 g	1	9.03 (81.33)	8.88 (78.67)	8.07 (64.74)	7.64 (58.04)	1595	3.70
T_3-Oxadiargyl	80 g	1	11.11 (123.00)	10.98 (120.33)	8.72 (75.62)	8.33 (68.97)	1548	3.55
T_4-Imazethapyr 10 EC	75 g	22	11.53 (132.67)	11.38 (129.33)	9.00 (80.60)	8.62 (73.98)	1394	3.22
T_5-Metsulfuron- methyl	4 g	22	3.38 (11.00)	3.13 (9.33)	4.23 (17.46)	3.76 (13.68)	1817	4.28
T_6-Isoproturon	1 kg	22	4.98 (24.33)	4.74 (22.00)	5.41 (28.91)	5.25 (27.12)	1774	3.96
T_7-Isoproturon+metsulfuron – methyl	1 kg + 4 g	22	3.24 (10.00)	2.91 (8.00)	3.98 (15.33)	3.59 (12.43)	1874	4.13
T_8-Pendimethalin+ *fb* metsulfuron-methyl	1 kg+ *fb* 4 g	1 + 22	4.01 (15.67)	3.80 (14.00)	5.01 (24.68)	4.78 (22.52)	1788	3.99
T_9-Hand weeding twice	-	21 & 45	2.55 (6.00)	2.34 (5.00)	2.91 (7.99)	2.55 (6.01)	1895	3.78

T_{10}-Weedy check	-	-	11.89 (141.00)	11.77 (138.00)	9.56 (91.01)	9.15 (83.25)	1289	3.12
SE m±			0.23	0.21	0.21	0.20	62.06	
CD (P=0.05)			0.67	0.62	0.62	0.59	184.39	

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