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Short communication

Effect of herbicides on weed growth parameter and stover yield of linseed (*Linum usitatissimum* L.)

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Abstract
A field experiment was conducted at Research cum Instructional Farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh during *Rabi* season of 2016-17 an entitled effect of herbicides on weed growth parameter and stover yield of linseed (*Linum usitatissimum* L.). The experiment was laid out in randomized block design (RBD) with ten treatments. Results revealed that different herbicides significantly affected on maximum number of secondary branches plant^{-1} at 60, 90 DAS, at harvest, highest leaf area index at 30, 60, 90 DAS and stover yield were recorded under the hand weeding twice 21 and 45 DAS, which was statistically at par with metsulfuron-methyl (4 g ha^{-1}) PoE, isoproturon (1 kg ha^{-1}) PoE, isoproturon + metsulfuron-methyl (1 kg + 4 g ha^{-1}) PoE and pendimethalin (1 kg ha^{-1}) PE *fb* metsulfuron-methyl (4 g ha^{-1}) PoE. The lowest number of secondary branches, leaf area index and stover yield were observed under treatment of weedy check.

Keywords: Herbicide, growth parameter, LAI, and stover yield

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. It occupies 9 per cent of area under oilseeds and 6.29 per cent contribution to the total oilseed production of the country. The important linseed growing districts of Chhattisgarh are Rajnandgaon, Durg, Bilaspur, Kabirdham, Raipur, Dhamtari, Surguja, Kanker and Raigarh. It is mostly grown on marginal and sub marginal soils under rainfed conditions. Maximum area of this crop is grown as *utera* during *Rabi* season (Agrawal *et al*., 2014) [1]. Being an important oilseed crop, its average productivity in India as well as in Chhattisgarh is very low in comparison to other country of the world, because of various factors like narrow genetic base, raising of crop by the resource poor farmers in marginal and sub-marginal areas, non-availability of high yielding varieties having resistance to biotic and abiotic stresses etc. (Patial *et al*., 2014) [6]. Weeds are one of the major constraints in linseed production and yield losses due to weed infestation in linseed were 36% (Singh *et al.* 1992) [9]. Hence, the present study was aimed to find out the efficacy of pre and post emergence herbicides for weed management in linseed.

A field experiment was conducted during 2016-17 at the research cum instructional farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). The experiment was carried out in randomized block design with three replications. The treatment details are metribuzin + oxyflurofen (250 g + 125 g ha^{-1}) PE, oxyflurofen (25 g ha^{-1}) PE, oxadiargyl (80 g ha^{-1}) PE, imazethapyr (75 g ha^{-1}) PoE, metsulfuron-methyl (4 g ha^{-1}) PoE, isoproturon (1 kg ha^{-1}) PoE, isoproturon + metsulfuron-methyl (1 kg + 4 g ha^{-1}) POE, pendimethalin (1 kg ha^{-1}) PE *fb* metsulfuron-methyl (4 g ha^{-1}) PoE, hand weeding twice 21 and 45 days after seeding (DAS) and weedy check. The linseed variety "*RLC-92*" was sown with seed rate of 30 kg ha^{-1} in rows 30 cm apart with fertilizer dose of 60:30:30 kg ha^{-1}. Pre-emergence herbicides were applied on next day of sowing and post-emergence herbicides were applied at 20-40 DAS of weeds. The observations was taken regarding number of secondary branches plant^{-1} at 60, 90 DAS and at harvest, Leaf Area index at 30, 60 and 90 DAS and Stover yield (kg ha^{-1}) of linseed.

Number of secondary branches

Number of secondary branches of linseed was observed at 30, 60, 90 DAS and at harvest and data are presented in Table 1. In general number of branches plant^{-1} was increased up to 90 DAS in all the treatments. Results revealed that different herbicides significantly affected the number of secondary branches plant^{-1} at different time interval of observations. At 60, 90 DAS and at harvest, significantly maximum number of secondary branches plant^{-1} was recorded under the hand weeding twice 21 and 45 DAS, which was at par with metsulfuron-methyl (4 g ha^{-1}) PoE, isoproturon (1 kg ha^{-1}) PoE, isoproturon + metsulfuron-methyl (1 kg + 4 g ha^{-1}) PoE, pendimethalin (1 kg ha^{-1}) PE *fb* metsulfuron-methyl (4 g ha^{-1}) PoE, the lowest number of secondary branches was observed under treatment of weedy check. More total number of branches under this treatment might be due to less weed density, providing adequate space for horizontal spread of crop leading to higher dry matter accumulation plant^{-1}. These results are in tune with Singh and Tripathi (2004) [10]. These effects were primarily due to reduced weed competition as a result of application of herbicide followed by interculture that provided a long term control of weeds with respect to crop growth period. These findings are in consonance with those of Jalali *et al*. (2012) [3] and Nejad *et al*. (2015) [4].

Leaf area index

Leaf area index (LAI) was computed at 30, 60, 90 DAS and at harvest and data are presented in Table 1. The maximum leaf area index was observed under hand weeding twice at 21 and 45 DAS, but it was found comparable with metsulfuron-methyl (4 g ha^{-1}) PoE, isoproturon (1 kg ha^{-1}) PoE, isoproturon + metsulfuron-methyl (1 kg + 4 g ha^{-1}) PoE, pendimethalin (1 kg ha^{-1}) PE *fb* metsulfuron-methyl (4 g ha^{-1}) PoE. Minimum leaf area index was recorded under weedy check.

The increase in LAI under above mentioned treatments might be due to production of higher number of leaves, which increased total photosynthetic surfaces with increase in leaf area and secondly due to increased availability of nitrogen, which resulted in larger leaves. In addition water availability enhances cell development and cell growth and this probably resulted in higher leaf area index and higher plant height. This has been supported by findings of Miri and Gadhiri (2006) [5] and Sadeghi and Sasanfer (2013) [8]. Rathore and Gautham (2003) [7] also found that pre emergence application of herbicides might have prevented the weed emergence at initial stages upto 30 DAS followed by hand weeding found to be good enough to take care of late emerging weeds.

Stover yield

The data on stover yield as affected by various weed management practices on linseed have been presented under Table 1. From the data it can be stated that stover yield was significantly affected by various weed management practices. The results indicated that significantly higher stover yield was obtained under hand weeding twice at 21 and 45 DAS, which was statistically at par with the treatment of metsulfuron-methyl (4 g ha^{-1}) PoE, isoproturon (1 kg ha^{-1}) PoE, isoproturon + metsulfuron-methyl (1 kg + 4 g ha^{-1}) PoE, pendimethalin (1 kg ha^{-1}) PE *fb* metsulfuron-methyl (4 g ha^{-1}) PoE. The lowest stover yield was recorded under weedy check. Davies (1986) [2] found that alone early application metsulfuron-methyl tended to delay crop maturation and gave better weed control, but generally gave poorer stover yield of linseed.

Table 1: Effect of weed management practices on number of secondary branches, leaf area index and Stover yield of linseed

Weed management practices	Number of secondary branches plant^{-1}			Leaf Area index			Stover Yield (kg ha^{-1})
	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	
Metribuzin + oxyflurofen (250 g + 125 g ha^{-1}) 1 DAS	10.61	14.92	16.17	0.257	0.475	0.417	4034
Oxyflurofen (125 g ha^{-1}) 1 DAS	10.52	14.78	15.97	0.251	0.474	0.413	3891
Oxadiargyl (80 g ha^{-1}) 1 DAS	10.47	14.78	15.86	0.250	0.465	0.404	3726
Imazethapyr (75 g ha^{-1}) 22 DAS	10.10	14.10	15.37	0.247	0.456	0.392	3390
Metsulfuron-methyl (4 g ha^{-1}) 22 DAS	11.39	16.17	17.96	0.268	0.514	0.434	4429
Isoproturon (1 kg ha^{-1}) 22 DAS	11.06	15.43	17.22	0.264	0.492	0.430	4339
Isoproturon+ metsulfuron-methyl (1 kg + 4 g ha^{-1}) 22 DAS	11.57	16.33	18.12	0.275	0.521	0.443	4625
Pendimethalin (1 kg ha^{-1}) 1 DAS *fb* metsulfuron-methyl (4 g ha^{-1}) 22 DAS	11.32	15.89	17.68	0.265	0.507	0.427	4349
Hand weeding twice 21 and 45 DAS	12.14	16.89	18.25	0.280	0.530	0.457	4661
Weedy check	9.28	12.94	14.10	0.241	0.439	0.376	3144
SE m±	0.45	0.66	0.71	0.008	0.015	0.013	143.64
CD (P=0.05)	1.33	1.95	2.12	0.022	0.043	0.039	426.77

***** DAS=Date after sowing

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