Journal of Crop and Weed, 15(1): 164-169 (2019)

Effect of herbicides on weed dynamics, phytotoxicity and seed yield of linseed (*Linum usitatissimum* L.)

C. S. PUHUP AND S. K. DWIVEDI

Department of Agronomy, College of Agriculture
Indira Gandhi Krishi Vishwavidyalaya, Raipur-492012, Chhattisgarh

Received : 10-09-2018 ; Revised : 29-01-2019 ; Accepted : 15-02-2019

ABSTRACT

A field experiment was conducted during rabi season of 2016-17 and 2017-18 at Research cum Instructional Farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh. The treatment was comprised i.e. metribuzin + oxyflurofen @ 250 g a.i.+ 125 g a.i. ha^{-1} as pre-emergence (T_1), oxyflurofen @125 g a.i.ha^{-1} as pre-emergence (T_2), oxadiargyl @ 80 g a.i. ha^{-1} as pre-emergence (T_3), imazethapyr 10 EC @ 75 g a.i. ha^{-1} as post-emergence (T_4), metsulfuron-methyl @ 4 g a.i. ha^{-1} as post-emergence (T_5), isoproturon @ 1 kg a.i. ha^{-1} as post-emergence (T_6), isoproturon + metsulfuron-methyl @ 1 kg a.i. + 4 g a.i. ha^{-1} as post-emergence (T_7), pendimethalin + fb metsulfuron-methyl @ 1 kg a.i.+ fb 4 g a.i. ha^{-1} as pre + post-emergence (T_8), hand weeding twice 21 and 45 DAS (T_9) and weedy check (T_{10}). The experiment was laid out in RBD and thrice replicated with the variety of 'RLC-92'. The lowest weed density of total weeds and dry matter of weeds were observed with hand weeding treatment, however among herbicide treatment, application of isoproturon + metsulfuron-methyl @ 1 kg a.i.+ 4 g a.i. ha^{-1} as post-emergence (T_7) was found lowest density of total weeds and dry matter at 60, 90 DAS and at harvest stages. The treatments of imazethapyr 10 EC @ 75 g ha^{-1} as post-emergence (T_4) and pendimethalin + fb metsulfuron-methyl @ 1 kg a.i.+ fb 4 g a.i. ha^{-1} as pre + post-emergence (T_8) was found phytotoxic on linseed. The seed yield of linseed was recorded highest with hand weeding treatment (1940 kg ha^{-1}) however, application of isoproturon + metsulfuron-methyl @ 1 kg + 4 g ha^{-1} as post-emergence (T_7), metsulfuron-methyl @ 4 g a.i. ha^{-1} as post-emergence (T_5), pendimethalin + fb metsulfuron-methyl @ 1 kg a.i. + fb 4 g a.i. ha^{-1} as pre + post-emergence (T_8) and isoproturon @ 1 kg a.i. ha^{-1} as post-emergence (T_6) were found statistically at par. In case of economical analysis, the application of metsulfuron-methyl @ 4 g a.i. ha^{-1} as post-emergence (T_5) was found highest value (3.91). Hence, sole application of metsulfuron-methyl @ 4 g a.i. ha^{-1} as post-emergence (T_5) was most effective herbicide against broad leaf of weed flora i.e. Medicago dendiculata.

***Keywords*:** Herbicides, linseed seed yield and weed dynamics

Linseed (*Linum usitatissimum* L.) is an important oilseed crop of central india, is one of the oldest crops, grown in almost all countries of world for oil, fibre and seed purpose. The Chhattisgarh accounts for nearly cultivated area 29.90 thousand hectare with a production of 10.30 thousand tones and productivity of 344 kg ha^{-1} (Anon., 2016-17). 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). 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, non availability of herbicide etc. (Patial *et al*., 2014). Linseed is having medicinal value due to presence of high content of omega 3, which is having tremendous medicinal values; hence farmers are interested to grow linseed for higher productivity with improved package and practices. The weed management is one of the important constants for higher productivity. Weeds can be controlled by different methods such as manual, mechanical and chemical methods. Generally, for the weed management, farmers do manual weeding, but manual weed management is always laborious, expensive, time consuming, uneconomical and needs to be often repeated at different intervals, as compared to chemical weed management. Weed management with herbicides is an effective, quick in action, and time saving (Ahmed *et al.*, 2005). Hence experiment has been conducted for evaluating herbicides for harnessing optimum yield of linseed by controlling of weeds.

MATERIALS AND METHODS

Experiment was conducted in the Research cum Instructional Farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur, (C.G.) during *rabi* season of 2016-17 and 2017-18. The experiment was laid out in Randomized Block Design with ten treatments and three replications. The treatment details were metribuzin + oxyflurofen @ 250 g *a.i.*+ 125 g *a.i.* ha^{-1} as pre-emergence (T_1), oxyflurofen @125 g *a.i.* ha^{-1} as pre-emergence (T_2), oxadiargyl @ 80 g *a.i.* ha^{-1} as pre-emergence (T_3), imazethapyr 10 EC @ 75 g *a.i.* ha^{-1} as post-emergence (T_4), metsulfuron-methyl @ 4 g *a.i.* ha^{-1} as post-emergence (T_5), isoproturon @ 1 kg *a.i.* ha^{-1} as post-emergence (T_6), isoproturon + metsulfuron-

Email: apuhup@gmail.com

methyl @ 1 kg *a.i.* + 4 g *a.i.* ha^{-1} as post-emergence (T_7), pendimethalin + *fb* metsulfuron-methyl @ 1 kg *a.i.* + *fb* 4 g *a.i.* ha^{-1} as pre + post-emergence (T_8), hand weeding twice 21 and 45 DAS (T_9) and weedy check (T_{10}). The RLC-92 variety of linseed was sown on 19 November 2016 and 15 November 2017 for 1styear and 2nd year of experimentation at 30 cm row to row spacing and gap filling was done on 10 DAS. Observations regarding growth study *i.e.* dry matter accumulation of plant were carried out at 90 DAS and at harvest and weed study *i.e.* total weed count and weed dry matter (g plant^{-1}) at 30, 60, 90 DAS and at harvest were determined, while, yield attributing characters *i.e*, number of capsules plant^{-1}, number of seeds capsules^{-1}, 1000 seed weight (g) and seed yield were noted. Phytotoxicity study at different interval was also observed. Weed index and economics were computed as per standard method. Transformation $\left(\sqrt{x+0.5}\right)$ of weed data and statistical analysis was fallowed as per Gomez and Gomez 1984.

RESULTS AND DISCUSSION

The dominant 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 also observed.

Effect of herbicides on weed density, dry matter and phytotoxicity effects on crop

The weed density of *Medicago denticulata, Convolvulus arvensis, Parthenium hysterophorus* and others weeds were recorded at 30, 60, 90 DAS and at harvest (Table 1). The total weed density and dry matter of weeds at 30, 60, 90 DAS and at harvest were significantly influenced by different weed management treatments during all the stages of observations. At 30, 60, 90 DAS and at harvest, the minimum total weed density (no.) 1.82, 1.63, 3.11, 2.27 and dry matter (g m^{-2}) 0.94, 1.92, 2.51, 2.25, respectively were observed under the treatment of hand weeding twice (T_9), which was significantly superior over other treatments, while, among the herbicides application, it was lower with isoproturon + metsulfuron-methyl @ 1 kg *a.i.*+ 4 g *a.i.* ha^{-1} as post-emergence (T_7) and metsulfuron-methyl @ 4 g *a.i.* ha^{-1} as post-emergence (T_5), as compared to rest of the herbicides treatments except 30 DAS. The total weed density (no.) 9.41, 9.18, 8.76 9.18 and dry matter of weeds (g m^{-2}) 3.79, 7.83, 9.12, 8.24 at 30, 60, 90 DAS and at harvest, respectively were found higher with the treatment of weedy check (T_{10}). Kumara *et al*. (2007) concluded that the more crop-weed competition was observed in weedy check plot hence higher nutrient uptake and dry matter accumulation by weed was obtained in the same treatment.

The treatments of imazethapyr 10 EC @ 75 g *a.i.* ha^{-1} as post-emergence (T_4) and pendimethalin *fb* metsulfuron-methyl @ 1 kg *a.i.* ha^{-1} *fb* 4 g *a.i.* ha^{-1} as pre and post-emergence (T_8) was found phytotoxic on linseed, light yellow discoloration and temporary epinasty was observed at 7 and 10 days after application of these herbicides, but crop was normal by 15 days after herbicides application. Manjunath and Hosmath (2016) reported that post-emergence application of imazethapyr @ 100 g *a.i.* ha^{-1} showed phytotoxic effect on plant.

Effect of herbicides on dry matter accumulation of linseed

Dry matter accumulation was observed at 90 DAS and at harvest, the significantly higher dry matter accumulation (4.32 and 5.66 g plant^{-1}) was registered under hand weeding twice at 21 and 45 DAS (T9), which was found at par with the application of isoproturon + metsulfuron-methyl @ 1 kg *a.i.* + 4 g *a.i.* ha^{-1} as post-emergence (T_7), metsulfuron-methyl @ 4g *a.i.* ha^{-1} as post emergence (T_5), pendimethalin *fb* metsulfuron-methyl @ 1 kg *a.i.* ha^{-1} *fb* 4g *a.i.* ha^{-1} as pre + post-emergence (T_8) and isoproturon @ 1kg ha^{-1} as post-emergence (T_6), while at 90 DAS application of metribuzin + oxyflurofen @ 250 g *a.i.* + 125 g *a.i.* ha^{-1} as pre-emergence (T_1) was also found at par. The lowest dry matter accumulation (3.46, 4.73 g plant^{-1}) at both stages was observed with the treatment of weedy check (T_{10}).

Effect of herbicides on yield attributes and yield

Seed yield of oilseed is highly dependent upon the number of capsules plant^{-1} produced by each plant. Different weed management practices significantly affected the number of capsules plant^{-1} (Table 2). With regards to weed management practices, hand weeding twice at 21 and 45 DAS (T_9) proved to be best in enhancing number of capsules plant^{-1} (66.42) which was found comparable to at par with the treatment of isoproturon + metsulfuron-methyl @ 1 kg *a.i.* + 4 g *a.i.* ha^{-1} as post-emergence (T_7), metsulfuron-methyl @ 4 g *a.i.* ha^{-1} as post-emergence (T_5) and pendimethalin *fb* metsulfuron-methyl @ 1 kg *a.i.* ha^{-1} *fb* 4 g *a.i.* ha^{-1} as pre and post-emergence (T_8), respectively and lowest number of capsules (53.98) was noted under weedy check (T_{10}). Kumar *et al*. (2012) also reported that the yield contributing characters increased with herbicide combinations and sequential application in mustard. The highest number of seed capsule^{-1} (8.73) and lowest number of seed capsules^{-1} (7.89) of linseed was also found significant difference and almost similar pattern was observed. Test weight of linseed was found non significant.

Table 1: Effect of herbicides on total weed density, dry matter of weeds and herbicidal phytotoxicity effects of linseed (pooled)

Weed management practices	Density of total weeds (Number m^{-2})				Dry matter of total weeds species ($g\ m^{-2}$)				Herbicidal phytotoxicity effects on linseed (DAA)*			
									Yellowing		Epinasty	
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest	7	10	7	10
T_1: Metribuzin + oxyflurofen @ 250 g *a.i.* + 125 g *a.i.* ha^{-1} at 1 DAS	4.74 (22.07)**	5.18 (26.33)	5.24 (27.00)	5.23 (26.83)	2.21 (4.38)	5.30 (27.66)	5.87 (34.01)	5.52 (29.99)	0	0	0	0
T_2: Oxyflurofen @125 g *a.i.* ha^{-1} at 1 DAS	5.30 (27.67)	6.6 (43.50)	6.88 (47.00)	6.97 (48.17)	2.41 (5.34)	6.32 (39.46)	7.68 (58.65)	6.56 (42.53)	0	0	0	0
T_3: Oxadiargyl @ 80 g *a.i.* ha^{-1} at 1 DAS	5.74 (32.50)	7.31 (53.00)	8.36 (69.50)	8.45 (71.00)	2.62 (6.47)	6.80 (45.84)	8.36 (69.41)	7.19 (51.24)	0	0	0	0
T_4: Imazethapyr 10 EC @ 75 g *a.i.* ha^{-1} at 22 DAS	8.34 (69.17)	8.65 (74.33)	8.62 (73.83)	8.79 (76.83)	3.36 (10.83)	7.32 (53.19)	8.62 (73.97)	7.39 (54.18)	2	3	0	0
T_5: Metsulfuron – methyl @ 4 g *a.i.* ha^{-1} at 22 DAS	8.02 (63.87)	3.11 (9.17)	3.65 (12.83)	3.08 (9.00)	3.26 (10.18)	3.75 (13.64)	3.87 (14.52)	3.71 (13.27)	0	0	0	0
T_6: Isoproturon@ 1 kg *a.i.* ha^{-1} at 22 DAS	6.59 (43.00)	4.26 (17.67)	4.28 (17.83)	4.34 (18.33)	2.94 (8.12)	4.68 (21.47)	5.01 (24.69)	5.08 (25.30)	0	0	0	0
T_7: Isoproturon + metsulfuron–methyl @ 1 kg *a.i.* ha^{-1} + 4 g *a.i.* ha^{-1} at 22 DAS	7.58 (57.00)	2.69 (6.83)	3.28 (10.50)	2.86 (7.67)	3.13 (9.34)	3.09 (9.37)	3.62 (12.60)	3.49 (11.72)	0	0	0	0
T_8: Pendimethalin @ 1 kg *a.i.* ha^{-1} at 1 DAS *fb* metsulfuron-methyl @ 4 g *a.i.* ha^{-1} at 22 DAS	4.26 (17.73)	3.75 (13.67)	3.91 (14.83)	3.69 (13.17)	2.01 (3.56)	4.15 (16.81)	4.62 (20.96)	4.51 (20.06)	0	0	3	1
T_9: Hand weeding twice at 21 and 45 DAS	1.82 (2.83)	1.63 (2.17)	3.11 (9.17)	2.27 (4.67)	0.94 (0.38)	1.92 (3.22)	2.51 (5.81)	2.25 (4.61)	0	0	0	0
T_{10}: Weedy check	9.41 (88.00)	9.18 (83.83)	8.76 (76.33)	9.18 (83.83)	3.79 (13.99)	7.83 (60.82)	9.12 (82.77)	8.24 (67.75)	0	0	0	0
SEm (±)	**0.15**	**0.17**	**0.18**	**0.13**	**0.13**	**0.19**	**0.19**	**0.20**	–	–	–	–
LSD (0.05)	**0.43**	**0.50**	**0.54**	**0.40**	**0.39**	**0.58**	**0.58**	**0.58**	–	–	–	–

*Note: *DAA : date after application **actual value in parantheses*

Table 2: Effect of herbicides on growth parameter, yield attributes, yield, B:C ratio and weed index of linseed (pooled)

Weed management practices	Dry matter accumulation (g plant^{-1})		Number of capsules plant^{-1}	Number of seeds capcules^{-1}	1000-seed weight (g)	Seed yield (kg ha^{-1})	B:C ratio	Weed index
	90 DAS	At harvest						
T_1:Metribuzin + oxyflurofen @ 250 g *a.i.* + 125 g *a.i.* ha^{-1} at 1 DAS	3.95	5.25	59.86	7.84	7.00	1709	3.37	12.25
T_2 :Oxyflurofen @125 g *a.i.* ha^{-1} at 1 DAS	3.84	5.12	58.86	7.69	6.92	1647	3.31	15.55
T_3 :Oxadiargyl @ 80 g *a.i.* ha^{-1} at 1 DAS	3.72	5.03	57.86	7.60	6.98	1613	3.20	17.32
T_4: Imazethapyr 10 EC @ 75 g *a.i.* ha^{-1} at 22 DAS	3.47	4.79	56.85	7.69	7.00	1488	2.94	23.97
T_5:Metsulfuron – methyl @ 4 g *a.i.* ha^{-1} at 22 DAS	4.07	5.45	64.48	8.59	7.18	1871	3.91	3.67
T_6 :Isoproturon@ 1 kg *a.i.* ha^{-1} at 22 DAS	4.01	5.31	62.16	8.03	7.04	1813	3.55	6.74
T_7:Isoproturon + metsulfuron–methyl @ 1 kg *a.i.* ha^{-1} + 4 g *a.i.* ha^{-1} at 22 DAS	4.09	5.58	65.04	8.37	7.25	1921	3.73	1.01
T_8:Pendimethalin @ 1 kg *a.i.* ha^{-1} at 1 DAS *fb* metsulfuron-methyl @ 4 g *a.i.* ha^{-1} at 22 DAS	4.04	5.34	63.03	8.27	7.15	1826	3.58	6.01
T_9:Hand weeding twice at 21 and 45 DAS	4.32	5.66	66.42	8.73	7.25	1940	3.37	0.00
T_{10}:Weedy check	3.46	4.73	53.98	7.69	6.96	1370	2.82	30.20
SEm (±)	**0.13**	**0.14**	**1.42**	**0.24**	**0.09**	**41.41**	-	-
LSD (0.05)	**0.39**	**0.42**	**4.23**	**0.71**	**NS**	**123.04**	-	-

Data related to seed yield as affected by various weed management practices on linseed are presented in the table 2 and fig. 1 and revealed that amongst weed management practices, hand weeding twice at 21 and 45 DAS (T_9) registered significantly higher seed yield (1940 kg ha^{-1}). However, it was statistically at par with the treatment of isoproturon + metsulfuron-methyl @ 1 kg *a.i.* + 4 g *a.i.* ha^{-1} as post-emergence (T_7), metsulfuron-methyl @ 4 g ha^{-1} as post-emergence (T_5), pendimethalin *fb* metsulfuron-methyl @ 1 kg *a.i.* ha^{-1} *fb* 4 g *a.i.* ha^{-1} as pre and post-emergence (T_8) and isoproturon @ 1 kg *a.i.* ha^{-1} as post-emergence **(**T_6). Dange *et al.* **(**2007**)** and Devendra *et al.* (2016) reported that all weed control methods established their superiority over weedy check in respect of seed yield and yield attributing characters by virtue of reduced weed competition. The minimum seed yield (1370 kg ha^{-1}) was recorded under weedy check (T_{10}) treatment due to unhindered growth of weeds. Jain and Agarwal (1998) and Mishra *et al.* (2003) noticed that the presence of weed throughout the cropping season caused 45.5 per cent reduction in seed yield compared to one hand weeding. Significant yield reduction by weeds (37.9 %) in linseed crop was also observed by Tomar *et al.* (1990).

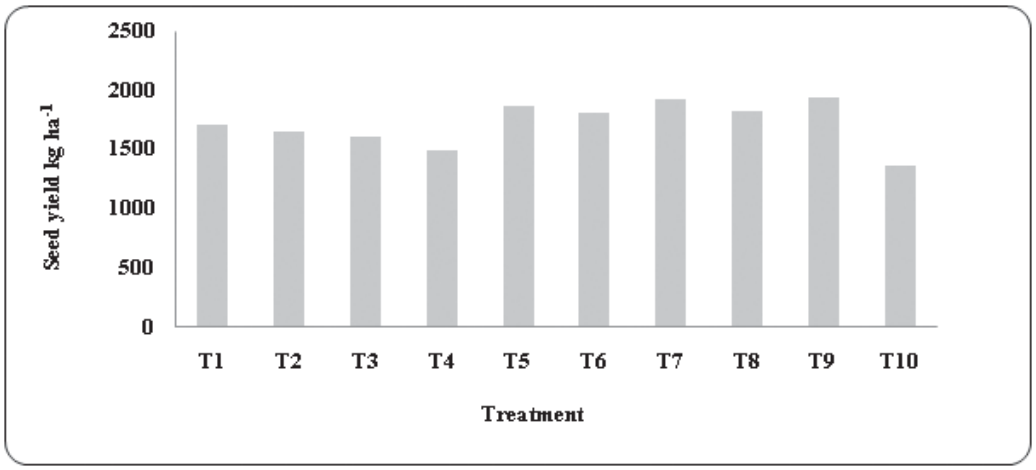

Fig. 1: Effect of herbicide on seed yield of linseed

Effect of herbicides on economics and weed index

The highest benefit: cost ratio (3.91) was recorded under the treatment of metsulfuron-methyl @ 4 g ha^{-1} as post-emergence (T_5), followed by isoproturon + metsulfuron-methyl @ 1 kg *a.i.* + 4 g *a.i.* ha^{-1} as post-emergence (T_7) and pendimethalin *fb* metsulfuron-methyl @ 1 kg *a.i.* ha^{-1} *fb* 4 g *a.i.* ha^{-1} as pre and post-emergence (T_8). However, minimum benefit: cost ratio (2.82) 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. Among the herbicides treatments application of isoproturon + metsulfuron-methyl @ 1 kg *a.i.* + 4 g *a.i.* ha^{-1} as post-emergence (T_7) was found minimum value of weed index (1.01), which was at par with metsulfuron-methyl @ 4 g ha^{-1} as post-emergence (T_5) and isoproturon @ 1 kg ha^{-1} as post-emergence **(**T_6). However, the maximum value (30.20) of weed index was found with weedy check treatment (T_{10}).

The seed yield of linseed was recorded highest with hand weeding treatment (1940 kg ha^{-1}). However in terms of economical gain *i.e.* B:C ratio, the application of metsulfuron-methyl @ 4 g *a.i.* ha^{-1} as post-emergence (22 DAS) application was found highest value *i.e.* 3.91. Hence alone application of metsulfuron-methyl was most effective and economical herbicide against broad leaf weed *i.e. Medicago dendiculata* which is most dominant weed in Chhattisgarh state during *rabi* season.

REFERENCES

Agrawal, A.P., Minz, M. and Neelofar, S. 2014. Screening of linseed genotypes against bud fly in Chhattisgarh.In National Seminar on Strategic Interventions to enhance Oilseeds production in India. Feb 19-21, pp. 152-53.

Ahmed, G. J. U., Bhuiyan, M. K. A., Riches, C. R., Mortimer, M. and Johnson, D. 2005. Farmer's participatory studies of integrated weed management system for intensified low land. *Proc. 8th Bien. Agron. Conv.*, Bangladesh Agron. Soc., Dhaka.

Anonymous, 2016-17. Ministry of Agriculture and Farmers Welfare, Govt. of India. (ON1299) & Past Issues.

Dange, R.B., Pawar, W.S., Khawale, V.S. and Choudhary, R.L. 2007. Effect of weed management practices on growth and yield of linseed (*Linum usitatissimum* L.). *J. Soils and Crops*, **17** : 411-15.

Devendra, Jain, N. and Jain, V. 2016.Weed management with pre and post-emergence herbicides in linseed. *Indian J. Weed Sci*., **48**: 93-94.

Gomez, K. A. and Gomez, A. A. 1984. Statistical procedures for Agricultural Research. A Willey Inter-science Publication, John Willey and Sons, New York, pp. 108-27.

Jain, N.K. and Agrawal, K.K.1998. Effect of irrigation levels, (based on IW/CPE ratio) fertility levels and weed control methods in linseed (*Linum usitatissimum* L.). *World Weeds*, **5**: 41-45.

Kumar, S., Kumar, A., Rana, S.S., Chander, N. and Angiras, N.N. 2012.Integrated weed management in mustard. *Indian J. Weed Sci*., **44**: 139-43.

Kumara, O., Venugopal, N., Prasad, T. V. R., Reddy, S. S. and Kumar, N.D. 2007. Effect of nitrogen levels and weed management practices on nutrient uptake by sunflower and weeds. *Karnataka J. Agric. Sci*., **20**: 123 -25.

Manjunath, N. C. and Hosmath, J. A. 2016. Effect of sequential application of herbicides on weed dynamics and yield of soybean. *J. Farm Sci*., **29**: 187-89.

Mishra, J. S., Singh, V. P. and Yaduraju, N. T. 2003. Bio-efficacy and economics of herbicidal weed control in irrigated linseed *(Linum usitatissimum* L.). *Indian J. Weed Sci*., **35**: 154-55.

Patial, R., Paul, S. and Sharma, D. 2014. Studies on Genetic Variability for Yield Improvement in Linseed, National Seminar on Strategic Interventions to enhance oilseeds production in India, Feb 19, pp. 85-88.

Tomar, S.S., Bajpai, R.P. and Bisen, C.R. 1990. Chemical weed control in linseed. *Indian J. Weed Sci*., **22**: 23-27.