International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(5): 165-167

Received: 10-07-2019
Accepted: 12-09-2019

Dhananjai Singh
Associate Professor, Department of Agronomy, C.S. Azad University of Agriculture & Technology, Kanpur, Kanpur, Uttar Pradesh, India

Pradeep Kumar
M.Sc. (Ag) Student, Department of Agronomy, C.S. Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

VK Verma
Associate Professor, Department of Agronomy, C.S. Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

Ram Pyare
Professor, Department of Agronomy, C.S. Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

CB Verma
Assistant Professor, Department of Crop Physiology C.S. Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

Correspondence
Dhananjai Singh
Associate Professor, Department of Agronomy, C.S. Azad University of Agriculture & Technology, Kanpur, Kanpur, Uttar Pradesh, India

Effect of weed management practices on weed density and yield of linseed (*Linum usitatissimum* L.)

Dhananjai Singh, Pradeep Kumar, VK Verma, Ram Pyare and CB Verma

Abstract
An experiment was conducted during *Rabi* 2018-19 at Oilseed Research Farm, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur to study the effect of pre and post emergence herbicides on weed density, weed biomass, seed yield and economics of linseed. The treatments comprised individual application of oxyflurofen @ 125 g ha^{-1}, oxadiargyl @ 80 g ha^{-1}, imazethapyr 10 SL @ 75 g^{-1}, and metsulfuron methyl @ 4 g ha^{-1}, and mixture of metribuzin @ 25 g ha^{-1} + oxyflurofen @ 125 g ha^{-1}, pendimethalin 30 EC @ 1.0 kg ha^{-1} + metsulfuron methyl @ 4 g ha^{-1}, and clodinofop @ 60 g ha^{-1} + metsulfuron methyl @ 4 g ha^{-1} compared with hand weeding twice and weedy check. The experimental field was infested mainly with *Cynodan dactylon*, *Cyperus rotundus*, *Chenopodium album* and *Anagalis arvensis*. The post emergence application of clodinofop @ 60 g ha^{-1} + metsulfuson methyl @4 gha^{-1} observed highest weed control efficiency (64.95%) and lowest weed completion index (11.80%). Results revealed that weedy check reduced the seed yield of linseed by 51.22 per cent over hand weeding twice at 20 and 45 days after sowing (DAS). Results exhibited that post emergence application of clodinofop @ 60 g ha^{-1} + metsulfuron methyl @ 4 g ha^{-1} registered significantly at par seed yield of 1800 kg ha^{-1}, net monetary return of Rs. 51936 ha^{-1} and benefit cost ratio of 2.78 compared with hand weeding twice at 20 and 25 DAS could be an alternative for weed management in irrigated linseed, which recorded seed yield (1847.00 kg ha^{-1}) net return of (Rs. 49923.00 ha^{-1}) with benefit cost ratio (2.47).

Keywords: Economics, linseed, weed control efficiency, weed competition index

Introduction
India is the third largest linseed growing country in the world (10.8%) after Canada and Kazakhistan but production wise it ranks fifth (523 kg ha^{-1}) in the world after Canada (1405 kg ha^{-1}), USA (1323 kg ha^{-1}), China (1248 kg ha^{-1}) and Kazakhistan. Linseed is a major *rabi* oilseed crop of the country next to rapeseed and mustard. At present linseed is cultivated in about 3.30 million ha and contributed 1.73 million tonnes to the annual oilseed production of the country. Linseed has many industrial, medicinal properties and used for value added product. It is generally grown under rainfed condition, however, its cultivation is widely extended in irrigated areas because of higher yield potential. The productivity of linseed at national level is 523 kg ha^{-1} (Annonymous 2017) [1] while at experimental level it is 1800-2000 kg ha^{-1}. This gap in yield is due to poor management of inputs. Owing to poor initial growth and small sized leaves, the crop of linseed is highly infested with weeds causing 30-40% loss in seed yield (Mahere *et al.*, 2000) [3]. Though, hand weeding is most common but it involves more cost which reduces profit gain. Therefore, the use of herbicides may be a suitable alternative for managing the weeds for higher returns. There is need to find out a suitable herbicide and their dose for linseed grown under irrigated conditions in order to harness yield potential of higher yielding cultivar. Keeping above facts in view, the present investigation was carried out to evaluate the efficacy of pre and post emergence herbicides on weed density, biomass and seed yield as well as economics of linseed under irrigated condition of Central Plain Zone of Uttar Pradesh.

Materials and Methods
An experiment was conducted during *Rabi* season of 2018-19 at the Oilseed Research Farm, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur situated at central part of Uttar Pradesh in Randomized Block Design with three replications. The experiment consisted of 10 treatments viz. hand weeding twice at 20 & 25 DAS, oxyfluorfen @ 1.25

g ha^{-1}, oxidiargyl @ 80 g ha^{-1}, imazethapyr 10 sl @ 75 g ha^{-1}, metsulfuron methyl @ 4 g $ha^{-1,}$ clodinofop @ 60 g ha^{-1}, metribuzin @ 250 g ha^{-1} + oxyfluorfen @ 1.25 g ha^{-1}, pendimethalin 30 EC @ 1.0 kg ha^{-1} + metsulfuron methyl @ 4 g ha^{-1}, clodinofop @ 60 g ha^{-1} + metsulfuron methyl @ 4 g ha^{-1} and weedy check (Table-1). The soil of experimental site was sandy loam in texture, low in organic carbon (0.35%) and available nitrogen (179 kg ha^{-1}) and medium in available phosphorus (22.5 kg ha^{-1}) and potassium (160 kg ha^{-1}). The experimental site was infested with *Cynodan dactylon, Chenopodium album, Cyperus rotendus* and *Anagalis arvensis*. Linseed variety 'Shekhar' was sown in lines 25 cm apart using seed rate of 25 kg ha^{-1} and fertilized @ 80 kg N, 40 kg P_2O_5 and 20 Kg K_2O ha^{-1} through urea, di-ammonium phosphate and muriate of potash, respectively. The crop was irrigated twice besides pre sowing irrigation. All the herbicides were sprayed with knop sack sprayer. Weed control efficiency and weed completion index were calculated as per following formulae.

Table 1: Effect of herbicides on weed density, weed dry weight, weed control efficiency and weed completion index in irrigated linseed

Treatments	Weed density (m^{-2}) at harvest					Fresh weight of weeds (g m^{-2})	Dry weight of weeds (g m^{-2})	Weed control efficiency (%)	Weed competition index (%)
	Cynodan dactylon	*Chendpodium album*	*Cyperus rotundus*	*Anagalis arvensis*	Total weed Count. (m^{-2})				
1. Hand weeding twice at 20 and 45 DAS	2.25 (6)	1.22 (1)	1.58 (2)	1.58 (2)	3.39 (11)	16	9	90.72	-
2. Oxyfluorfen @ 125 g ha^{-1} pre-emergences	6.36 (40)	2.55 (6)	4.53 (20)	2.12 (4)	8.40 (70)	165	48	50.51	30.47
3. Oxadiargyl @ 80 g ha^{-1} (Pre-emergence)	6.36 (40)	2.55 (6)	4.74 (22)	1.87 (3)	8.46 (71)	166	55	43.31	43.30
4. Imazethapyr 10 SL @ 75 g ha^{-1} at 2-3 leaf stage of weeds	5.96 (35)	1.58 (2)	4.06 (16)	1.87 (3)	7.52 (56)	140	45	53.61	26.95
5. Metsulfuron methyl @ 4 g ha^{-1} at 2-3 leaf stage of weeds	5.61 (31)	1.87 (3)	4.30 (18)	1.58 (2)	7.38 (54)	135	42	56.70	24.89
6. Clodinofop @ 60 g ha^{-1} at 2-3 leaf stage of weeds	6.60 (43)	2.35 (5)	4.95 (24)	1.58 (2)	8.63 (74)	170	50	48.45	38.51
7. Metribuzin @ 250 g ha^{-1} + Oxyfluorfen @ 125 g ha^{-1} (Pre-emergence)	6.12 (37)	2.12 (4)	5.61 (31)	1.87 (3)	8.67 (75)	180	65	32.99	42.67
8. Pendimethalin 30 EC @ 1.0 kg ha^{-1} (Pre-em.) + Metsulfuron methyl @ 4 g ha^{-1} at 25 DAS	5.15 (26)	1.87 (3)	4.06 (16)	1.22 (1)	6.82 (46)	110	35	63.92	19.21
9. Clodinofop @ 60 g ha^{-1} + Metsulfuron methyl @ 4 g ha^{-1} at 2-3 leaf stage of weeds	4.42 (19)	1.2 (1)	4.85 (23)	1.58 (2)	6.75 (45)	95	34	64.95	11.80
10. Weedy check	7.78 (60)	2.55 (6)	6.75 (45)	2.12 (4)	10.75 (115)	235	97	-	51.25
SE (d) ±	0.45	0.19	0.29	0.27	0.20	4.16	2.53	2.59	
C.D. at 5%	0.95	0.41	0.62	0.56	0.42	8.82	5.36	3.19	

$$\text{Weed Control Efficiency (WCE\%)} = \frac{WD_c - WD_t}{WD_c} \times 100$$

Where,
WD_c = Weed density in control plot;
WD_t – Weed density in treated plot

$$\text{Weed competition Index (\%)} = \frac{Y_{WF} - Y_{TT}}{Y_{WF}} \times 100$$

Where,
Y_{WF} – Crop yield in weed free plot; Y_{TT} – Crop yield in treatment plot

Results and Discussion

Weed infestation

The experimental plots during the course of investigation were mainly infested wtih *Cynodan dactylon, Cyperus rotundus, Chenopodium album* and *Anagalis arvensis* (Table-1). Among different weed species the dominance of *Cynodan dactylon* (60 m^{-2}) and *Cyperus rotundus* (45 m^{-2}) was observed. Mishra *et al.* (2003) [4] also reported similar findings. Post emergence application of clodinofop @ 60 g ha^{-1} + met sulfuron methyl @ 4 g ha^{-1} observed least weed density (45 m^{-2}), weed dry weight (34 g m^{-2}), compared with all remaining herbicides and was comparable to pendimethalin 30 EC @ 1.0 kg ha^{-1} (pre-emergence) + metsulfuron methyl 4 g ha^{-1} at 25 DAS, in respect of weed density (46 m^{-2}), and dry weight of weed (35g m^{-2}). Clodinofop @ 60 g ha^{-1} + metsulfuron methyl @ 4 g ha^{-1} and pendimethalin 30 EC @ 1.0 g ha^{-1} + met sulforuon methyl @ 4 g ha^{-1} also observed comparable weed control efficiency. It is also clear from the table-1 that clodinofop @ 60 g ha^{-1} and pendimethalin 30 EC @ 1.0 kg ha^{-1} in combination with metsulfuron methyl @ 4 g ha^{-1} proved superiority for management of weed over other herbicidal treatments. It may be due to adverse effect of clodinofop on enzyme activities of grassy weeds because acetyl coenzyme acarboxylase in grasses are sensitive to this herbicide whereas the acetyl coenzyme carboxylase of dicot plants are not sensitive. Metsulfuron methyl found more sensitive to dicot plants. Hand weeding twice at 20 and 45 DAS managed the weeds more effectively than herbicides and recorded least weed density (11 m^{-2}) and weed dry weight (9 g m^{-2}) at harvest. Husain *et al.* (2015) [5] also observed lower weed count and dry weight of weed in hand weeding twice treatment compared to chemical weed control and weedy check in linseed.

It is clear from the data that weed competition index (crop yield loss) in comparison to hand weeding twice was recorded maximum with weedy check (51.25%) and minimum with clodinofop @ 60 g ha^{-1} + metsulfuron methyl @ 4 g ha^{-1} (11.80%) due to variation in growth and yield attributes of linseed as well as weedy density and dry matter of weeds.

Among the herbicides oxydiargyl @ 80 g ha^{-1} recorded weed competition index of 43.31% because this herbicide showed phyto-toxicity on linseed. The superiority of clodinofop 60 g ha^{-1} + metsulfuron @ 4 g ha^{-1} in respect of growth and yield attributes was attributed to lower crop weed competition, which provided better growing condition thereby influencing the metabolism of carbohydrates positively leading to increased translocation and partioning of photosynthetes towards growth and yield attributing characters and resulted in higher seed yield of linseed. On contrary, it was true in the case of weedy check treatment.

Growth and yield attributes

The growth and yield attributes viz., plant height, branches plant^{-1}, capsule plant^{-1}, seed plant^{-1} and test weight shown significant improvement with clodinofop @ 60 g ha^{-1} + metsulfuron methyl @ 4 g ha^{-1}, hand weeding and other herbicidal treatment compared to weedy check (Table - 2). The treatment clodinofop @ 60 g ha^{-1} + metsulphuron methyl @ 4 g ha^{-1} 4 g ha^{-1} also recorded at par plant height (56.00 cm) branches plant^{-1} (25.95) seeds capsule^{-1} (9.20) and test weight in comparison to hand weeding twice at 25 and 50 DAS. The maximum plant height (56.70 cm), branches plant^{-1} (26.00) capsule plant^{-1}(64), seeds capsule^{-1} (9.3) and test weight (8.25 g) where recorded under hand weeding twice at 20 and 45 DAS. Minimum plant height (42.30 cm), branches plant^{-1} (12.00), capsule plant^{-1} (36.00), seeds capsule^{-1}(7.3) and test weight (7.91 g) were recorded under weedy check. Husain *et al.* (2003) [2], Mishra *et al.* (2003) [4] and Husain *et al.* (2015) [5] also reported similar results. Higher growth and yield attributes of linseed in clodinofop @ 60 g ha^{-1} + metsulfuron methyl @ 4 g ha^{-1} treatment may be due to lowest weed density and weed dry weight observed with this treatment.

Table 2: Effect of herbicides on growth, yield attributes, seed yield and economics of irrigated linseed

Treatments	Plant height at harvest (cm)	Number of branches plant^{-1} at harvest	Number of capsule plant^{-1}	Number of seeds capsule^{-1}	Test weight (g)	Seed yield (kg ha^{-1})	Net monetary return (Rs. ha^{-1})	B:C Ratio
1. Hand weeding twice at 20 and 45 DAS	56.70	26.00	64	9.3	8.25	1847.00	49323.00	2.47
2. Oxyfluorfen @ 125 g ha^{-1} pre-emergences	52.00	16.67	43	8.7	7.98	1419.00	36676.00	2.35
3. Oxadiargyl @ 80 g ha^{-1} (Pre-emergence)	48.30	17.08	40	8.3	8.18	1157.00	24886.00	1.92
4. Imazethapyr 10 SL @ 75 g ha^{-1} at 2-3 leaf stage of weeds	53.30	18.00	46	8.3	8.20	1491.00	40107.00	2.49
5. Metsulfuron methyl @ 4 g ha^{-1} at 2-3 leaf stage of weeds	55.00	18.60	44	8.7	8.19	1533.00	42071.00	2.56
6. Clodinofop @ 60 g ha^{-1} at 2-3 leaf stage of weeds	47.00	19.25	42	7.7	8.15	1255.00	27531.00	1.95
7. Metribuzin @ 250 g ha^{-1} + Oxyfluorfen @ 125 g ha^{-1} (Pre-emergence)	43.70	16.50	40	8.0	8.07	1170.00	24970.00	1.90
8. Pendimethalin 30 EC @ 1.0 kg ha^{-1} (Pre-em.) + Metsulfuron methyl @ 4 g ha^{-1} at 25 DAS	55.70	24.33	55	8.9	8.17	1649.00	44080.00	2.60
9. Clodinofop @ 60 g ha^{-1} + Metsulfuron methyl @ 4 g ha^{-1} at 2-3 leaf stage of weeds	56.00	25.95	61	9.2	8.24	1800.00	51936.00	2.78
10. Weedy check	42.30	12.00	36	7.3	7.91	995.00	21125.00	1.89
SE (d) ±	3.63	0.71	0.89	0.56	0.32	48.32		
C.D. at 5%	7.69	1.50	1.89	1.19	N.S.	95.26		

Seed yield and economics

The results depicted in Table-2 clearly revealed that seed yield of linseed shown positive response to different treatments. The herbicidal treatment clodinofop @ 60 ha^{-1} + metsulfuron methyl @ 4 g ha^{-1} regarded significantly at par seed yield (1800 kg ha^{-1}) of linseed to the treatment hand weeding twice at 20 and 45 DAS (1847 kg ha^{-1}). This may be due to lower weed density and weed biomass registered with this treatments as well as higher growth and yield attributes of linseed. Clodinofop @ 60 g ha^{-1} and oxidiargyl @ 80 g ha^{-1} could not exhibit significantly positive effect on seed yield of linseed in comparison to clodinofop @ 60 g ha^{-1} + metsulfuron methyl kg ha^{-1} and pendimethalin 30 EC 1.0 kg ha-1 + metsulforon methyl @ kg ha^{-1}. The lowest seed yield (995 kg ha^{-1}) was observed weedy check.

Though, hand weeding twice at 20 and 45 DAS recorded the highest seed yield (1847 kg ha^{-1}) but maximum net monetary return (Rs. 51936.00 ha^{-1}) and benefit cost ratio (2.78) was obtained with clodinofop @ 60 g ha^{-1} + metsulfuron methyl @ 4 g ha^{-1} because treatment cost of hand weeding twice (Rs. 34792.00 ha^{-1}) was 19.70% higher than the treatment cost of clodinofop @ 60 g ha^{-1} + met sulfuron methyl 4 g ha^{-1} (Rs. 29034 ha^{-1}).

Conclusion

It can be concluded that clodinofop @ 60 g ha^{-1} + met sulfuron methyl @ 4 g ha^{-1} in irrigated linseed reduced weed density and weed biomass, improved growth and yield attributes of linseed resulting in higher seed yield, net monetary return and benefit cost ratio. For effective weed management in linseed it could be an alternative of hand weeding twice.

References

1. Anonymous. Directorate of Economics and statistics, Department of Agriculture and Cooperation, Govt. of India, 2017.
2. Husain K, Tiwari AN, Singh NK. Bio-efficacy of Isoproturon and 2, 4-D in linseed grown under irrigated conditions of Uttar Pradesh. Indian Journal of Weed Science. 2003; 35:153.
3. Maheree J, Yadav PK, Sharma RS. Chemical weed control in linseed with special reference to cuscute. Indian Journal of weed science. 2000; 32:216-217.
4. Mishra JS, Singh VP, Yadav NT. Bio efficacy and economics of herbicidal and weed control in irrigated linseed (*Linum usitafissitrum* L.), Indian Journal of weed science. 2003; 35:154-155.
5. Husain K, Dubey SD, Verma RC, Tripathi AK, Pandey RK. Current Advances in Agriculture Sciences. 2015; 7(2):120-124.