Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.5604

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **5 (4):** 1582-1587 (2017)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Effect of Herbicides on Yield and Economics of Sunflower (*Helianthus annuus* L.)

J. Narender[1*], J. Padmaja[1], A. Srinivas[1] and V. Sailaja[2]

[1]Department of Agronomy, PJTSAU, Hyderabad-500030, Telangana, India

[2]Department of soil Science, PJTSAU, Hyderabad-500030, Telangana, India

*Corresponding Author E-mail: jalarinarender@gmail.com

Received: 11.07.2017 | Revised: 23.07.2017 | Accepted: 25.07.2017

ABSTRACT

A field experiment was conducted during kharif, 2013-14 at Student Farm, College of Agriculture, Rajendranagar, Hyderabad, Acharya N. G. Ranga Agricultural University to find out the effect of different weed management practices in sunflower. Weed spectrum of the experimental field consisted of three groups of weeds like grasses, sedges and broad leaved weeds. The highest seed yield and stalk yields were recorded with weed free conditions and it was on par with practicing hand weeding twice at 20 and 40 DAS, application of oxyfluorfen @ 150 g a.i ha^{-1} as PE with one hand weeding at 25 DAS. Higher net returns (₹ 35826 ha^{-1}) were realized due to application of oxyfluorfen @ 150 g a.i ha^{-1} as PE with hand weeding at 25 DAS followed by hand weeding at 20 and 40 DAS (₹ 34434 ha^{-1}). The B: C ratio was higher (2.3) with application of oxyfluorfen @ 150 g a.i ha^{-1} as PE fb hand weeding at 25 DAS and oxyfluorfen @ 150 g a.i ha^{-1} as PE fb paraquat @ 600 g a.i ha^{-1} as PoE at 20 DAS as directed spray over rest of the treatments.

Key words: *Sunflower, Oxyfloufen, Pendimethalin, Quizalofop-p-ethyl, Fenoxaprop-p-ethyl, Paraquat, Hand weeding, Net returns.*

INTRODUCTION

Agriculture is the backbone of Indian economy as nearly 60 per cent of the total population depends directly or indirectly on agriculture. Agriculture and allied sectors are providing 52 per cent of the gainful employment in India. Much of the acreage under coarse cereals (85%), pulses (83%) and oilseeds (70%), substantial area under rice (42%) and nearly 65 per cent of the cotton area is under rainfed conditions[10]. Sunflower (*Helianthus annuus* L.), by virtue of its short duration, wider adaptability to different soil types, photo-insensitivity and availability of promising hybrids and varieties, has stabilized its area and production in India. Sunflower is the oil of preference among the consumers world-wide due to its health appeal and in India too, sunflower oil is the largest selling oil in the branded oil segment. It is also a crop of choice for farmers due to its wider adaptability, high yield potential, shorter duration and profitability.

Cite this article: Narender, J., Padmaja, J., Srinivas, A., and Sailaja, V., Effect of Herbicides on Yield and Economics of Sunflower (*Helianthus annuus* L.) *Int. J. Pure App. Biosci.* **5(4):** 1582-1587 (2017). doi: http://dx.doi.org/10.18782/2320-7051.5604

Our country accounted for 3.26 per cent (1044 thousand mt) of total world production of sunflower in 2011 with average productivity of 610 kg ha^{-1}, which is very much lower than the world average of 1356 kg ha^{-1}, indicating wider scope for improving the yield potential.There are several constraints in sunflower production, amongst them weed infestation is one of the major constraints to be addressed for increasing productivity. One of the major constraints in sunflower production is weed competition. The weeds are the major threat resulting in a seed yield loss[11] upto 45 to 55%. The possibility of enhancing the productivity in sunflower has increased significantly with the discovery of several selective herbicides and also opened up new opportunities efficient weed management. Sunflower is a poor competitor with weeds on account of its slow growth in the initial stage. It has now been well established that losses from weeds are far more than due to infestation of insect pests and diseases. Weeds compete with crop plants for nutrients, soil moisture, space and sunlight causing poor growth and yield losses. Uncontrolled weed growth caused enormous loss of nutrients, which in turn reduced the yield of sunflower crop to an extent of 64 per cent[4]. Reduction in yield depends on various aspects like weed density, time and duration of weed competition, weed spectrum[1] etc.

MATERIALS AND METHODS

A field experiment was conducted during *kharif*, 2013-14 at Student Farm, College of Agriculture, Rajendranagar, Hyderabad, Acharya N. G. Ranga Agricultural University to study the effect of different weed management practices in sunflower. The experiment was laid out in randomized block design with three replications and thirteen treatments *viz.*, pendimethalin @ 580 g *a.i* ha^{-1} as PE, oxyflourfen @ 150 g *a.i* ha^{-1} as PE, pendimethalin @ 580 g *a.i* ha^{-1} as PE + HW at 25 DAS, oxyflourfen @ 150 g *a.i* ha^{-1} as PE + HW at 25 DAS, pendimethalin @ 580 g *a.i* ha^{-1} as PE + quizalofop-p-ethyl @ 50 g *a.i* ha^{-1} as PoE at 15-20 DAS, oxyflourfen @ 150 g *a.i* ha^{-1} as PE + quizalofop-p-ethyl @ 50 g *a.i* ha^{-1} as PoE at 15-20 DAS, pendimethalin @ 580 g *a.i* ha^{-1} as PE + fenoxaprop-p-ethyl @ 56.25 g *a.i* ha^{-1} as PoE at 15-20 DAS, oxyflourfen @ 150 g *a.i* ha^{-1} as PE + fenoxaprop-p-ethyl @ 56.25 g *a.i* ha^{-1} as PoE at 15-20 DAS, pendimethalin @ 580 g *a.i* ha^{-1} as PE + paraquat @ 600 g *a.i* ha^{-1} as PoE at 15-20 DAS (directed spray), oxyflourfen @ 150 g *a.i* ha^{-1} as PE + paraquat @ 600 g *a.i* ha^{-1} as PoE at 15-20 DAS (directed spray), hand weeding at 20 and 40 DAS, weed free (HW from 15 DAS to harvest at 15 days interval) and control (weedy check). A uniform dose of 60-40-30 kg N-P_2O_5- K_2O ha^{-1} in the form of urea (46 % N), single super phosphate (16 % P_2O_5) and muriate of potash (60 % K_2O) respectively were applied. Entire quantity of P and K was applied as basal, whereas N was applied in two splits, one half at the time of sowing as band placement, 5 cm away from seed row at a depth of about 5 cm, maintaining 60 cm row spacing and between the plants 30 cm. The sunflower cultivar DRSH-1 was shown on 5 July, 2013 adopting the recommended seed rate of 5 kg ha^{-1} and harvested on 10th October, 2013. Standard procedures were adopted for recording the data on various growth and yield parameters. Plants enclosed in an area of 0.25m^2 from the destructive sampling area were removed at 30, 60 DAS and at harvest the plant samples so collected were sun dried and later oven dried at 60°C till a constant weight is obtained. The data was computed and expressed in kg/ha. Five heads were taken randomly to determine the number of seeds/head. Average number of seeds per head was calculated. 1000 seeds were taken from each plot and were weighed. Plants were threshed manually; seed yield of each plot was recorded and converted into kilograms/hectare.

Harvest index of sunflower was calculated as ration of seed yield to biological in %. The economics of different weed management treatments were calculated by taking into the input costs and output prices at the time of harvest.

RESULTS AND DISCUSSION

The observations on number of seeds head^{-1} and 1000 seed weight (g) are presented in Table 1, The data on number of seeds head^{-1} reveal significantly higher seeds head^{-1} were under weed free (792) treatment over all other treatments but it was on par with hand weeding twice at 20 and 40 DAS, application of oxyfluorfen @ 150 g *a.i* ha^{-1} as PE with one hand weeding at 25 DAS, pendimethalin @ 580 g *a.i* ha^{-1} as PE with one hand weeding at 25 DAS and oxyfluorfen @ 150 g *a.i* ha^{-1} as PE *fb* paraquat @ 600 g *a.i* ha^{-1} as PoE at 20 DAS (directed spray) while the lowest number of seeds head^{-1} (430) was recorded with weedy check. In Table 1, the data furnished 1000 seed weight (g) revealed that the seed weight was differed significantly by different weed control treatments. Higher seed weight recorded in weed free treatment and hand weeding twice at 20 and 40 DAS and it was on par with oxyfluorfen @ 150 g *a.i* ha^{-1} *fb* hand weeding at 25 DAS and pendimethalin @ 580 g *a.i* ha^{-1} *fb* hand weeding at 25 DAS while lower test weight recorded with weedy check. Similar results were obtained by Sridhar[9] , Singh and Singh[7] and Reddy *et al*[6].The highest seed yield of 1840 kg ha^{-1} was recorded in weed free conditions was significantly superior to all other treatments and remained on par with practicing hand weeding twice at 20 and 40 DAS (1757 kg ha^{-1}), application of oxyfluorfen @ 150 g *a.i* ha^{-1} as PE with one hand weeding at 25 DAS (1697 kg ha^{-1}). Maximum seed yield with herbicide followed by one hand weeding, similar results observed by Sridhar[9], Siva Sankar and Subramanyam[8] and Nagamani *et al*[5]. Next best treatment pendimethalin @ 580 g *a.i* ha^{-1} with hand weeding at 25 DAS produced 1555 kg ha^{-1} it was on par with oxyfluorfen @ 150 g *a.i* ha^{-1} *fb* paraquat @ 600 g *a.i* ha^{-1} as PoE (directed spray) at 20 DAS (1493 kg ha^{-1}) and pendimethalin @ 580 g *a.i* ha^{-1} *fb* paraquat @ 600 g *a.i* ha^{-1} as PoE (directed spray) at 20 DAS (1490 kg ha^{-1}) while the lower seed yield (625 kg ha^{-1}) was recorded with weedy check. Significantly higher stalk yield (3328 kg ha^{-1}) was recorded in weed free treatment over all other treatments but it was on par with hand weeding twice at 20 and 40 DAS and application of oxyfluorfen @ 150 g *a.i* ha^{-1} as PE with one hand weeding at 25 DAS treatments. Next best treatment was application of pendimethalin @ 580 g *a.i* ha^{-1} with hand weeding at 25 DAS recorded 3014 kg ha^{-1} of stalk yield and it was on par with oxyfluorfen @ 150 g *a.i* ha^{-1} *fb* paraquat @ 600 g *a.i* ha^{-1} as PoE at 20 DAS (directed spray) and pendimethalin @ 580 g *a.i* ha^{-1} *fb* paraquat @ 600 g *a.i* ha^{-1} as PoE at 20 DAS (directed spray) while the lower stalk yield (1939 kg ha^{-1}) was recorded with weedy check. The late hand weeding increased the aeration and enhanced root growth of crop. This might have augmented the absorption of nutrient and moisture from the soil resulting in higher yield. It might be due to control of weeds from the initial growth of sunflower, as appeared from drastic reduction in density and dry matter of weeds in weed free condition, which helped in better growth of the crop resulting in significant seed yield of sunflower, The factors that contributed to higher crop dry matter production might have resulted in higher stalk yields in the treatments where weeds were controlled efficiently. These results corroborate those of Kumar *et al*[3], Siva Sankar and Subramanyam[8] and Nagamani *et al*[5]. The harvest index did not vary significantly with different integrated weed control treatments.

Table 1: Effect of different integrated weed control treatments on number of seeds head^{-1} and 1000 seed weight (g) of sunflower during *kharif*, 2013

S. No	Treatments	Number of seed head^{-1}	1000 seed weight (g)	Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})
T_1	Pendimethalin 38.7% CS @ 580 g *a.i* ha^{-1} as PE	523	49	914	2394
T_2	Oxyflourfen 23.5% EC @ 150 g *a.i* ha^{-1} as PE	563	49	1021	2433
T_3	Pendimethalin 38.7% CS @ 580 g *a.i* ha-1 as PE + HW at 25 DAS	735	52	1555	3014
T_4	Oxyflourfen 23.5% EC @ 150 g *a.i* ha^{-1} as PE + HW at 25 DAS	742	52	1697	3104
T_5	Pendimethalin 38.7% CS @ 580 g *a.i* ha^{-1} as PE + Quizalofop-p-ethyl 5% EC @ 50 g *a.i* ha^{-1} as PoE at15-20 DAS	705	50	1281	2772
T_6	Oxyflourfen 23.5% EC @ 150 g *a.i* ha^{-1} as PE + Quizalofop-p-ethyl 5% EC @ 50 g *a.i* ha^{-1} as PoE at15-20 DAS	715	50	1340	2812
T_7	Pendimethalin 38.7% CS @ 580 g *a.i* ha^{-1} as PE + Fenoxaprop-p-ethyl 9.3% EC @ 56.25 g *a.i* ha^{-1} as PoE at 15-20 DAS	652	50	1243	2500
T_8	Oxyflourfen 23.5% EC @ 150 g *a.i* ha^{-1} as PE + Fenoxaprop-p-ethyl 9.3% EC @ 56.25 g *a.i* ha^{-1} as PoE at 15-20 DAS	697	50	1264	2689
T_9	Pendimethalin 38.7% CS @ 580 g *a.i* ha^{-1} as PE + Paraquat 24% SL @ 600 g *a.i* ha^{-1} as PoE at 15-20 DAS	721	51	1490	2828
T_{10}	Oxyflourfen 23.5% EC @ 150 g *a.i* ha^{-1} as PE + Paraquat 24% SL @ 600 g *a.i* ha^{-1} as PoE at 15-20 DAS	725	51	1493	2911
T_{11}	Hand Weeding at 20 and 40 DAS	773	52	1757	3189
T_{12}	Weed free (HW from 15 DAS to till harvest at 15 days interval)	792	53	1840	3328
T_{13}	Control (weedy check)	430	48	625	1939
	SEm±	23	0.38	53	93
	CD(P=0.05)	68	1.10	154	273

The data pertaining to gross returns, net returns and benefit cost ratio are presented in Table 2. Higher gross returns (₹ 68092 ha^{-1}) were realized with weed free (allotted less number of labours at later stages of the crop due to less weed intensity) and hand weeding at 20 and 40 DAS (₹ 65009 ha^{-1}) over rest of the treatments. Among the integrated weed management practices, application of oxyfluorfen @ 150 g *a.i* ha^{-1} as PE with hand weeding at 25 DAS also recorded significantly higher gross returns (₹ 62789 ha^{-1}) followed by pendimethalin @ 150 g *a.i* ha^{-1} as PE supplemented with one hand weeding at 25 DAS (₹ 57535 ha^{-1}) over other treatments. This can be attributed to better control of weeds in these treatments due to either hand weeding or application of herbicides resulting in increased seed yield and thereby increasing the gross returns. In contrast, gross returns were the lowest (₹ 23125 ha^{-1}) in weedy check compared to rest of the treatments. This can be attributed to the lower seed yield because of more weed competition. Higher net returns (₹ 35826 ha^{-1}) were realized due to application of oxyfluorfen @ 150 g *a.i* ha^{-1} as PE with hand weeding at 25 DAS followed by hand weeding at 20 and 40 DAS (₹ 34434 ha^{-1}), oxyfluorfen

@ 150 g *a.i* ha^{-1} as PE *fb* paraquat 600 g *a.i* ha^{-1} at 20 DAS (₹ 31542 ha^{-1}) compared to other treatments while weedy check recorded lower net returns (₹ 2550 ha^{-1}) among all the treatments.The B: C ratio was higher (2.3) with application of oxyfluorfen @ 150 g *a.i* ha^{-1} as PE *fb* hand weeding at 25 DAS and oxyfluorfen @ 150 g *a.i* ha^{-1} as PE *fb* paraquat @ 600 g *a.i* ha^{-1} as PoE at 20 DAS as directed spray over rest of the treatments. Hand weeding at 20 and 40 DAS also recorded a comparable benefit cost ratio of 2.1 whereas weedy check recorded a lower B: C ratio (1.1) among all the treatments.

Table-2: Economics of different integrated weed control treatments in sunflower during *kharif*, 2013

S. No	Treatments	Cost of cultivation (₹ ha^{-1})	Gross returns (₹ ha^{-1})	Net Returns (₹ ha^{-1})	B:C ratio
T_1	Pendimethalin 38.7% CS @ 580 g *a.i* ha^{-1} as PE	22761	33818	11057	1.5
T_2	Oxyflourfen 23.5% EC @ 150 g *a.i* ha^{-1} as PE	21975	37777	15802	1.7
T_3	Pendimethalin 38.7% CS @ 580 g *a.i* ha^{-1} as PE + HW at 25 DAS	27761	57535	29786	2.1
T_4	Oxyflourfen 23.5% EC @ 150 g *a.i* ha^{-1} as PE + HW at 25 DAS	26975	62789	35826	2.3
T_5	Pendimethalin 38.7% CS @ 580 g *a.i* ha^{-1} as PE + Quizalofop-p-ethyl 5% EC @ 50 g *a.i* ha^{-1} as PoE at 15-20 DAS	23861	47384	23524	2.0
T_6	Oxyflourfen 23.5% EC @ 150 g *a.i* ha^{-1} as PE + Quizalofop-p-ethyl 5% EC @ 50 g *a.i* ha^{-1} as PoE at 15-20 DAS	23075	49592	26517	2.1
T_7	Pendimethalin 38.7% CS @ 580 g *a.i* ha^{-1} as PE + Fenoxaprop-p-ethyl 9.3% EC @ 56.25 g *a.i* ha^{-1} as PoE at 15-20 DAS	23561	45991	22430	2.0
T_8	Oxyflourfen 23.5% EC @ 150 g *a.i* ha^{-1} as PE + Fenoxaprop-p-ethyl 9.3% EC @ 56.25 g *a.i* ha^{-1} as PoE at 15-20 DAS	22775	46768	23993	2.1
T_9	Pendimethalin 38.7% CS @ 580 g *a.i* ha^{-1} as PE + Paraquat 24% SL @ 600 g *a.i* ha^{-1} as PoE at 15-20 DAS	24386	51195	26810	2.1
T_{10}	Oxyflourfen 23.5% EC @ 150 g *a.i* ha^{-1} as PE + Paraquat 24% SL @ 600 g *a.i* ha^{-1} as PoE at 15-20 DAS	23600	55142	31542	2.3
T_{11}	Hand Weeding at 20 and 40 DAS	30575	65009	34434	2.1
T_{12}	Weed free (HW from 15 DAS to harvest at 15 days interval)	36575	68092	31517	1.9
T_{13}	Control (weedy check)	20575	23125	2550	1.1

REFERENCES

1. Carranza, P., Saavedra, M and Garcia-Torres, L. Competition between *Ridolfiasegetum* and sunflower. *Weed Res.*, **35**: 369–375 (1995).
2. FAO (Food and Agriculture Organization). FAO STAT. Crops Production. Food and Agriculture Organization of United Nations, Rome, Italy. (*http:faostat.org/site/ 291/default.aspx*) (2011).

3. Kumar, K. A., Reddy, M. D and Krishna, A. Integrated weed management in *rabi* sunflower. *J Oilseed Res.* **15(1)**: 109-114(1998).
4. Legha, P. K., Malik, R. K and Faroda, A. S. Weed management in Kharif sunflower. *Crop Res.* 5: 376-379(1992).
5. Nagamani, C., Muneendra Naidu, S. M and Subramanyam, D. Weed dynamics and Yield of Sunflower as influenced by varied planting patterns and weed management practices. *Indian J Weed Sci*. **43(1&2)**: 101-104(2011).
6. Reddy, A. M., Reddy, G. P., Reddy, D. S and Reddy, K. B. Determination of critical period of crop-weed competition in hybrid sunflower. *Indian J Weed Sci*. **40(1&2)**: 90-93(2008).
7. Singh, D. K and Singh, K. N. Weed control in sunflower (*Helianthus annuus*) under temperate conditions of Kashmir vally. *Indian J Agron.* **51(3)**: 225-227(2006).
8. Siva Sankar, K and Subramanyam, D.. Weed flora and yield of sunflower (*Helianthus annuus* L.) as influenced by pre- and post-emergence application of herbicides. *Indian J Weed Sci.* **43(1&2):** 105-109(2011).
9. Sridhar, V.. Effects of herbicides and in integration with cultural practices on weed control and yield of sunflower (*Helianthus annuus* L.). *J Oilseed Res.* **19(2)**: 239-241(2002).
10. Venkateswarlu, B and Prasad, J. V. N. S.. Carrying capacity of Indian agriculture, issues related to rainfed agriculture. *Curr Sci.* **102**: 882-888(2012).
11. Wanjari, R. H., Yaduraju, N. T., and Ahuja, K. N.. Nutrient uptake by sunflower (*Helianthus annuus* L.) and associated weeds during rainy season. *Indian J Agron*. **46**: 541-546(2001).