The Andhra Agric. J 59(2): 177-180, 2012

Effect of Sequential Application of Herbicides on Growth and Yield of Sunflower *(Helianthus annuus* L.)

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ABSTRACT

Field experiment was conducted to study the effect of sequential application of pre- (pendimethalin @ 1 kg *a.i* ha^{-1}, oxadiargyl @ 250 g *a.i* ha^{-1}) and post-emergence (fenoxaprop-p-ethyl @ 60 g *a.i* ha^{-1}, propaquizafop @ 60 g *a.i* ha^{-1}, quizalofop-p-ethyl @ 50 g *a.i* ha^{-1}) herbicides in sunflower on sandy loam soils of Southern Agro-Climatic Zone of Andhra Pradesh. The study revealed that pre-emergence application of pendimethalin @ 1 kg *a.i* ha^{-1} + propaquizafop @ 60 g *a.i* ha^{-1} applied at 20 DAS resulted in significantly higher seed yield and lesser density and dry weight of weeds with higher weed control efficiency compared to rest of the weed management practices. The next best treatment was the two hand weedings at 20 and 40 DAS produced higher seed yield and lesser weed density and dry weight. The reduction in seed yield of sunflower due to unchecked weed growth was 50.03 per cent compared to the best weed management practice *i.e.,* pre-emergence application of pendimethalin @ 1 kg *a.i* ha^{-1} + propaquizafop @ 60 g *a.i* ha^{-1} applied at 20 DAS.

Key words : Growth, Sequential application of herbicides, Sunflower, Yield.

Sunflower *(Helianthus annuus* L.) is an important oil seed crop of India. The productivity of sunflower in India is declining due to an array of biotic and abiotic factors. Weed competition is one of the important biotic constraints in sunflower production. Weeds can cause a reduction of 55 per cent of seed yield of sunflower (Wanjari *et al.,* 2000). The use of herbicides offers scope for economical control of weeds right from the beginning, giving sunflower crop an advantage of good start and competitive superiority. Pre-emergence application of herbicides such as pendimethalin, fluchloralin, metolachlor and alachlor are being used for the management of weeds in sunflower. Pre-emergence application of these herbicides provide an effective control of grasses and some of the broad-leaved weeds, but less effective against sedges. The repeated application of same herbicide for longer period leads to shift in weed flora and development of herbicide resistant weeds (Friesen *et al.,* 2000).

The weeds associated or emerged at later growth stages of the crop escape the lethal effect of pre-emergence herbicides. Further, pre-emergence herbicides can not be used effectively to control the weeds in sunflower when there is continuous rain at the time of application.

The sequential application of pre-and post-emergence herbicides in relation to weed dynamics and response of sunflower has not been investigated adequately. Keeping this in view, the present study was undertaken to evaluate the relative efficiency of sequential application of pre-and post-emergence herbicides on weed growth and productivity of sunflower.

MATERIAL AND METHODS

A field experiment was conducted at Dryland Farm, Tirupati campus of Acharya N.G. Ranga Agricultural University, Andhra Pradesh, to study the performance of pre-and post-emergence herbicides in ***rabi*** sunflower during 2010-2011. The experiment was consisted of ten treatments and replicated thrice with following weed management practices in sandy loam soils of Southern Agro-climatic Zone of Andhra Pradesh. The treatments consisted of ten weed management practices *viz.,* pre-emergence application of pendimethalin @ 1 kg *a.i* ha^{-1} (T_1), pre-emergence application of oxadiargyl @ 250 g *a.i* ha^{-1} (T_2), pre-emergence application of pendimethalin @ 1 kg *a.i.* ha^{-1} + fenoxaprop @ 60 g *a.i* ha^{-1} at 20 DAS (T_3), pre-emergence application of oxadiargyl @ 250 g *a.i* ha^{-1} + fenoxaprop @ 60 g *a.i* ha^{-1} at 20 DAS (T_4), pre-emergence application of pendimethalin @ 1 kg *a.i* ha^{-1} + propaquizafop @ 60 g *a.i* ha^{-1} at 20 DAS (T_5), pre-emergence application of oxadiargyl @ 250 g *a.i* ha^{-1} + propaquizafop @ 60 g *a.i* ha^{-1} at 20 DAS (T_6), pre-emergence application pendimethalin @ 1 kg *a.i* ha^{-1} + quizalofop @ 50 g *a.i* ha^{-1} at 20 DAS (T_7), pre-emergence application of oxadiargyl @ 250 g *a.i*

ha^{-1} + quizalofop @ 50 g *a.i* ha^{-1} at 20 DAS (T_8), Two hand weedings at 20 and 40 DAS (T_9) and unweeded check (T_{10}). Weed control efficiency (WCE) was calculated by using the following formula,

$$WCE = \frac{DM_C - DM_T}{DM_C} \times 100$$

where,

WCE = Weed control efficiency (%)

DM_C = Drymatter of weeds in the un weeded check (control)

DM_T = Drymatter of weeds in the treatment imposed plot.

The required quantities of pre-emergence (pendimethalin and oxadiargyl) and post-emergence (fenoxaprop, propaquizafop and quizalofop) herbicides were applied uniformly at 2 and 20 DAS, respectively by using spray fluid @ 600 L ha^{-1} with the help of knapsack sprayer as per the treatments. All the management practices were adopted for sunflower (cv. NDSH-1) cultivation as per the recommendations of the Acharya N.G. Ranga Agricultural University, Andhra Pradesh. The data on weed density and dry weight were subjected to square root transformation ($\sqrt{X + 0.5}$) and weed control efficiency was subjected to arcsine transformations before statistical analysis to normalize their distribution as suggested by Gomez and Gomez (1985). Returns per rupee invested were arrived by dividing the net returns of the respective treatment with its cost of cultivation.

RESULTS AND DISCUSSION

Effect on Weed

Among the weeds identified, the predominant weed species were *Cyperus rotundus* (40%), *Trichodesma indicum* R. Br. (26.5%), *Euphorbia thymifolia* L. (15%) and *Digitaria sanguinalis* (L.) Scop. (5%). Among the weed management practices tried, two hand weedings at 20 and 40 DAS resulted in significantly lesser density and dry weight of weeds with higher weed control efficiency (Table 1). The pre-emergence application of pendimethalin @ 1 kg *a.i* ha^{-1} + propaquizafop @ 60 g *a.i* ha^{-1} applied at 20 DAS was the next best treatment in reducing the density and dry weight of weeds due to effective control of all the categories of weeds throughout the crop growth period leading to reduced competition for growth resources. These findings are in accordance with Singh and Singh (2006). Among the weed management practices tried, pre-emergence application of oxadiargyl alone and its combination with post-emergence herbicides resulted in higher density and dry weight of weeds with poor weed control efficiency. This might be due to ineffectiveness of oxadiargyl against broad-leaved weeds in general and in particular to *Trichodesma indicum* a dominant broad-leaved weed present in the experimental plots.

Effect on crop

Pre-emergence application of pendimethalin @ 1 kg *a.i* ha^{-1} + propaquizafop @ 60 g *a.i* ha^{-1} applied at 20 DAS (T_5) resulted in significantly higher stature of growth and yield parameters *viz.,* plant height, crop drymatter production, number of total and filled seeds $head^{-1}$ and test weight. All these parameters were statistically comparable with hand weeding twice at 20 and 40 DAS due to maintenance of weed free environment throughout the crop period (Table 1). These results are in conformity with those of Bedmar (1997).

The highest seed yield of sunflower was recorded with pre-emergence application of pendimethalin @ 1 kg *a.i* ha^{-1} in combination with propaquizafop applied at 20 DAS and it was comparable with hand weeding twice at 20 and 40 DAS due to effective control of all the categories of weeds more effectively from sowing to harvesting, which resulted in better translocation of photosynthates from source to sink in these treatments. These results are in conformity with those of Poienaru *et al.* (2005) and Bedmar (1997). Pre-emergence application of oxadiargyl @ 250 g *a.i* ha^{-1} and it combination with post-emergence herbicide, fenoxaprop @ 60 g *a.i* ha^{-1} applied at 20 DAS recorded lesser seed yield of sunflower due to heavy weed infestation. The decrease in seed yield with unweeded check was 50.03 per cent compared to pre-emergence application of pendimethalin @ 1 kg *a.i* ha^{-1} + propaquizafop @ 60 g *a.i* ha^{-1} applied at 20 DAS and 42.03 per cent compared to the treatment, two hand weedings at 20 and 40 DAS.

Economics

Net returns and returns per rupee invested were significantly higher with pre-emergence application of pendimethalin @ 1 kg *a.i* ha^{-1} in combination with propaquizafop @ 60 g *a.i* ha^{-1} applied at 20 DAS due to reduced cost of weeding and increased seed yield in this weed management practice. Pre-emergence application of oxadiargyl @ 250 g *a.i* ha^{-1} alone and it combination with any post-emergence herbicides *i.e.,* fenoxaprop,

Table 1. Effect of sequential application of herbicides on weed growth, yield components and economics of *rabi* sunflower

Treatments	Weed density (No m^{-2})	Weed dry weight (g m^{-2})	Weed control efficiency (%)	Plant height (cm)	Crop dry matter production (kg ha^{-1})	No. of filled seeds $head^{-1}$	100-seed weight (g)	Seed yield (kg ha^{-1})	Net returns (‘ ha^{-1})	Cost of cultivation (‘ ha^{-1})	Returns per rupee invested
T_1:Pre-emergence application of pendimethalin @ 1 kg *a.i* ha^{-1}	367.62 (19.19)	184.43 (13.60)	20.89 (27.20)	137	4110	478	5.22	1545	39,804	18,906	2.10
T_2:Pre-emergence application of oxadiargyl @ 250 g *a.i* ha^{-1}	364.75 (19.11)	194.52 (13.96)	16.52 (23.98)	130	3291	378	4.60	1296	28,642	20,606	1.38
T_3:Pre-emergence application of pendimethalin @ 1 kg *a.i* ha^{-1} + fenoxaprop @ 60 g *a.i* ha^{-1} applied at 20 DAS	293.81 (17.16)	124.99 (11.20)	46.36 (42.93)	139	4238	554	5.34	1663	43,108	20,086	2.14
T_4:Pre-emergence application of oxadiargyl @ 250 g ha^{-1} + fenoxaprop @ 60 g *a.i* ha^{-1} applied at 20 DAS	313.85 (17.73)	163.95 (12.82)	29.64 (32.97)	132	3546	416	4.88	1372	30,350	21,786	1.39
T_5:Pre-emergence application of pendimethalin@ 1 kg *a.i* ha^{-1} + propaquizafop @ 60 g *a.i* ha^{-1}applied at 20 DAS	276.83 (16.65)	114.58 (10.73)	50.83 (45.47)	148	4994	591	5.87	2105	59,812	20,178	2.96
T_6:Pre-emergence application of oxadiargyl @ 250 g *a.i* ha^{-1} + propaquizafop @ 60 g *a.i* ha^{-1} applied at 20 DAS	298.98 (17.31)	150.02 (12.27)	35.62 (36.64)	133	3855	427	5.17	1452	33,298	21,878	1.52
T_7:Pre-emergence application of pendimethalin @ 1 kg *a.i* ha^{-1} + quizalofop @ 50 g *a.i.* ha^{-1} applied at 20 DAS	281.62 (16.80)	118.01 (10.89)	49.35 (44.63)	140	4434	574	5.64	1800	47,814	20,586	2.32
T_8:Pre-emergence application of oxadiargyl @ 250 g *a.i.* ha^{-1} + quizalofop @ 50 g *a.i.* ha^{-1} applied at 20 DAS	301.18 (17.37)	155.22 (12.48)	33.39 (35.30)	133	3523	413	5.08	1367	29,660	22,286	1.33
T_9:Two hand weedings at 20 and 40 DAS	104.28 (10.24)	31.85 (5.69)	86.33 (68.30)	142	4779	578	5.83	1815	46,310	22,660	2.04
T_{10}:Un-weeded check	436.22 (20.90)	233.03 (15.28)	-	126	3072	340	4.39	1052	22,716	17,260	1.31
SEm ±	0.16	0.17	0.60	2.7	77	12	0.12	55	1,470	-	0.12
CD (P = 0.05)	0.50	0.50	1.81	8.0	229	37	0.35	163	4,386	-	0.35

Figures in Paranthesis Indicates Square Root Transfored Values

propaquizafop and quizalofop recorded lesser net returns and returns per rupee invested due to increased cost of herbicides in these treatments with poor weed control efficiency.

In conclusion, the present study has revealed that pre-emergence application of pendimethalin @ 1 kg *a.i* ha^{-1} + propaquizafop @ 60 g *a.i* ha^{-1} applied at 20 DAS resulted in the highest seed yield of sunflower with higher net returns and returns per rupee invested.

LITERATURE CITED

Bedmar F 1997. Bermuda grass *(Cynodon dactylon)* control in sunflower *(Helianthus annuus* L.), soybean *(Glycine max* L.) and potato *(Solanum tuberosum* L.) with post emergence herbicides. *Weed Technology.* 11: 683-688.

Friesen S L J Ferguson G M Hall JC 2000. Management strategies for attenuating herbicide resistance: untoward consequence of their promotion. *Crop Protection*. 19, 891-895.

Gomez K A and Gomez A A 1984. Statistical procedure for agricultural research. *International Rice Research Institute*, Manila, Philippines. 305.

Poienaru S Sarpe N and Sarpe I 2005. The chemical control of *Sorghum halopense* species in sunflower culture of danube meadow. Communications in *Agricultural and Applied Biological Sciences*. 70(3): 471-474.

Singh D K and Singh K N 2006. Weed control in sunflower *(Helianthus annuus* L.) under temperate conditions of kashmir valley, *Indian Journal of Agronomy*. 51(3): 225-227.

Wanjari R H Yaduraj N T and Ahuja K N 2000. Critical period of weed competition in spring sunflower. *Indian Journal of Weed Science*. 32 (1&2): 17-2.

(Received on 17.06.2011 and revised on 30.06.2011)