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Effect of Planting Pattern and Weed Management on Weed Flora and Yield of Rabi Sunflower

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ABSTRACT

A field study was undertaken, at S.V. Agricultural College, Tirupati during the **rabi** seasons of 2002 and 2003 to identify effective and economical weed management options for sunflower by studying the effect of planting pattern and weed management practices on weed flora and seed yield of **rabi** sunflower. Planting pattern of 45 x 30 cm recorded significantly lower weed density and biomass thus resulting in higher seed yield over 60 x 22.5 cm. Among the weed management practices, the lowest density and biomass of weeds at harvest were recorded with hand weeding (HW) twice closely followed by fluchloralin at 0.5 kg/ha+ pendimethalin at 0.5 kg/ha supplemented with one HW at 40 DAS. However, sunflower seed yield was the highest with HW twice followed by application of pendimethalin at 1.0 kg/ha. The use of planting pattern of 45 x 30 cm and managing associated weeds with HW twice at 20 and 40 DAS or pre-emergence application of pendimethalin at 1.0 kg/ha resulted in higher net returns and seed yield of irrigated **rabi** sunflower.

Key words : Sunflower, planting pattern, weed management, weed flora, yield

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is an important oilseed crop of India and a major source of vegetable oil in the world. Our country accounted for 3.26% (1044 thousand MT) of total world production of sunflower in 2009 and the average sunflower productivity (580 kg/ha) in India was lower than the world average (1341 kg/ha) (FAO, 2010). There are several constraints in sunflower production. Weed infestation is one of the major factors for loss in yield under irrigated conditions as sunflower is usually planted at wider spacing and it grows slowly during early stages of crop growth (Wanjari *et al*., 2000). Weeds which emerge and become established during early stages of sunflower growth can be very competitive and reduce the sunflower yield potential significantly (Wanjari *et al*., 2000a). Enormous loss of nutrients due to uncontrolled weed growth (Wanjari *et al*., 2001; Sumathi *et al*., 2009) reduced the seed yield of sunflower upto an extent of 64% (Legha *et al.,* 1992). Thus, timely weed control is essential for optimizing the yields of sunflower (Pannacci *et al*., 2007). Therefore, the present study was undertaken to identify effective and economical weed management options for sunflower by studying the effect of planting pattern and weed management practices on weed flora and seed yield of **rabi** sunflower.

MATERIALS AND METHODS

An experiment was conducted on sandy loam soils of wetland block of S. V. Agricultural College, Tirupati Campus of Acharya N. G. Ranga Agricultural University for two consecutive **rabi** seasons under irrigation conditions, during 2002 and 2003. The soil was sandy loam in texture, low in available nitrogen (168 kg/ha), medium in available phosphorus (29.2 kg/ha) and available potassium (197 kg/ha) with a pH of 7.4. Twelve treatments comprising all combinations of two planting patterns (45 x 30 and 60 x 22.5 cm) with six weed management practices (Weedy check, pre-plant incorporation (PPI) of fluchloralin at 1.0 kg/ha, pre-emergence application (PE) of pendimethalin at 1.0 kg/ha, PPI of fluchloralin at 0.5 kg/ha+PE of pendimethalin at 0.5 kg/ha, PPI of fluchloralin at 0.5 kg/ha+PE of pendimethalin at 0.5 kg/ha supplemented with one HW at 40 DAS and hand weeding (HW) twice at 20 and 40 DAS were tested in a factorial randomized block design with three replications. The seeds of sunflower (cv. MSFH-17) were dibbled manually as per the treatmental

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spacing during the first fortnight of December in both the years. The required quantity of herbicides was calculated as per the treatments then, tank mixed and applied as aqueous spray by using spray fluid @ 600 l/ ha with knapsack sprayer. Fluchloralin was applied as pre-plant incorporation one day before sowing as per the treatments and pendimethalin was applied as pre emergence, immediately after sowing. The recommended dose of fertilizers was 80 kg N, 50 kg P_2O_5 and 30 kg K_2O/ ha. Full dose of phosphorus and potassium and half the dose of nitrogen were applied as basal and half of the dose of nitrogen was applied at 30 DAS. Data on weeds were recorded at harvest in each plot in two quadrats each measuring 50 x 50 cm. Weeds were counted category-wise and were removed for recording their respective weed biomass. The weed data were subjected to square root transformation ($\sqrt{}$(X+0.5) before statistical analysis.

RESULTS AND DISCUSSION

Effect on Weeds

The weed flora of the experimental field consisted of six species of grasses, one sedge and 18 broad-leaved weeds. Among the grasses, *Digitaria sanguinalis* (L.) Scop. and *Dactyloctonium aegyptium* (L.)Willd. were the dominant species. The only sedge observed was *Cyperus rotundus* L., which was the predominant weed observed during the crop growth. Among the broad-leaved weeds, *Cleome viscosa* L., *Euphorbia hirta* L. and *Borreria hispida* (L.) K. Schum were the major weeds. The planting pattern and weed management practices significantly influenced the density and biomass of grasses, sedges and broad-leaved weeds as well as total weeds during both the years of study (Table 1). The lowest density and biomass of grasses, sedges, broad-leaved weeds and total weeds were recorded with closer planting pattern of 45 x 30 cm than the planting pattern of 60 x 22.5 cm. This might be due to early growth of crop canopy which suppressed the weed growth significantly by shading coupled with efficient utilization of resources like nutrients and soil moisture. Closely spaced crop efficiently smothered the weeds growing under canopy by preventing invasion of open space for growth and development of weeds complemented by reducing the interception of light in downward direction (Andrade *et al*., 1993).

Among the weed management practices, all the treatments caused varied reduction in the density and biomass of weed species in comparison to unweeded check. Fluchloralin at 0.5 kg/ha+pendimethalin at 0.5 kg/ha supplemented with HW at 40 DAS recorded significantly lower density and biomass of grasses, sedges, broad-leaved weeds and total weeds, but it was at par with HW twice. The next best weed management practice was pendimethalin at 1.0 kg/ha to control all categories of weeds. The above weed management practices were significantly superior in suppressing the weed density and biomass over fluchloralin at 0.5 kg/ ha+pendimethalin at 0.5 kg/ha and unweeded check. Thus, the maximum weed control efficiency was achieved with HW twice (89.3%) followed by fluchloralin at 0.5 kg/ha+pendimethalin at 0.5 kg/ ha supplemented with one HW (89.1%). The superiority of the HW twice and application of fluchloralin at 0.5 kg/ha+pendimethalin at 0.5 kg/ha supplemented with one HW at 40 DAS was continued upto later stages of crop growth in suppressing all the categories of weeds significantly. These observations are in agreement with the findings of Jat and Giri (2000). The performance of fluchloralin at 0.5 kg/ha+pendimethalin at 0.5 kg/ha was found not as good as that of individual herbicides applied at 1.0 kg/ha each due to ineffectiveness of herbicides at sub-optimal dose particularly at critical stages of crop-weed competition and lack of synergistic effect between these two herbicides to control the weeds for longer period. These results are in accordance with the results of Pasquier *et al*. (1996).

Effect on Crop

Planting pattern and weed management practices showed significant effect on dry matter production, 1000-seed weight, seed and stalk yield, harvest index and economics of **rabi** sunflower (Table 2). Planting pattern of 45 x 30 cm recorded significantly higher seed and stalk yield; and harvest index than planting pattern of 60 x 22.5 cm. Planting pattern of 45 x 30 cm recorded 8.5% higher seed yield than 60 x 22.5 cm. This was mainly due to significant increase in dry matter production by maintenance of optimum plant population per unit area. Further, the density and biomass of weeds were significantly lesser in closed planting pattern due to better canopy development of crop. The growth and development of weeds was more under wider planting pattern resulting in high biomass of weeds, greater weed competition for growth resources and lower sunflower

Table 1. Effect of planting pattern and weed management practices on weed density and biomass in irrigated **rabi** sunflower

Treatments	Weed density (No./m^2)								Weed biomass (g/m^2)							
	2002				2003				2002				2003			
	Grasses	Sedges	BLW	Total	Grasses	Sedges	BLW	Total	Grasses	Sedges	BLW	Total	Grasses	Sedges	BLW	Total
Planting pattern (cm)																
45 x 30	5.52	4.61	5.61	6.10	5.48	4.60	5.63	9.09	4.33	3.83	4.67	7.39	4.19	3.66	4.12	6.87
	(37.74)	(24.42)	(45.28)	(107.43)	(37.72)	(24.36)	(45.92)	(107.99)	(23.11)	(15.41)	(25.73)	(62.45)	(19.99)	(14.65)	(21.56)	(56.19)
60 x 22.5	6.09	4.89	6.05	9.86	6.05	5.02	6.25	10.04	4.64	4.07	4.87	7.82	4.58	3.91	4.40	7.41
	(46.28)	(27.09)	(51.87)	(125.23)	(45.44)	(28.15)	(54.96)	(128.56)	(24.25)	(17.20)	(28.21)	(69.68)	(23.56)	(16.61)	(23.95)	(64.12)
LSD (P=0.05)	0.17	0.08	0.17	0.60	0.17	0.08	0.19	0.50	0.12	0.17	0.12	0.46	0.19	0.17	0.12	0.46
Weed management																
Unweeded check	12.26	8.77	14.42	20.84	12.18	8.76	14.70	20.98	7.97	5.76	9.35	13.69	7.84	5.94	9.04	13.32
	(150.1)	(76.46)	(207.58)	(434.16)	(147.98)	(76.20)	(215.74)	(439.91)	(63.09)	(32.64)	(86.97)	(182.69)	(61.05)	(34.83)	(81.16)	(177.04)
Fluchloralin 1.0 kg/ha	4.69	4.31	3.97	7.34	4.44	4.42	4.40	7.59	4.65	4.23	3.82	7.29	4.61	4.26	3.87	7.28
	(19.69)	(18.04)	(15.25)	(52.98)	(19.25)	(19.03)	(18.88)	(57.16)	(21.13)	(17.38)	(14.11)	(52.61)	(20.75)	(17.67)	(14.07)	(52.49)
Pendimethalin 1.0 kg/ha	4.23	4.09	3.77	6.92	4.33	4.36	4.27	7.42	4.04	3.78	4.38	6.98	4.00	3.93	4.10	6.88
	(17.44)	(16.23)	(13.69)	(47.36)	(18.25)	(18.57)	(17.77)	(54.59)	(15.80)	(13.79)	(18.74)	(48.32)	(15.51)	(15.01)	(16.35)	(46.87)
Fluchloralin 0.5 kg+pendimethalin	5.88	5.03	5.21	9.27	5.98	4.99	5.26	9.34	4.86	4.58	5.02	8.29	4.76	4.28	5.25	8.22
0.5 kg/ha	(34.08)	(24.83)	(26.70)	(85.60)	(35.27)	(24.38)	(27.23)	(86.88)	(23.07)	(20.51)	(24.64)	(68.22)	(22.14)	(17.81)	(27.05)	(67.00)
Fluchloralin 0.5 kg+pendimethalin	3.96	3.10	3.84	6.24	3.85	3.16	3.80	6.28	2.74	2.76	3.04	4.83	2.65	2.23	2.44	4.11
0.5 kg/ha+HW	(15.19)	(9.13)	(14.19)	(38.51)	(14.33)	(9.59)	(14.01)	(38.92)	(7.03)	(7.15)	(8.71)	(22.84)	(6.53)	(4.49)	(5.43)	(16.54)
HW twice	4.00	3.21	3.94	6.39	3.96	3.20	3.94	6.36	2.66	2.62	3.03	4.71	2.67	2.04	2.31	3.95
	(15.55)	(9.83)	(15.02)	(40.00)	(15.43)	(9.77)	(15.02)	(40.22)	(6.58/)	(6.39)	(8.68)	(21.65)	(6.67)	(3.66)	(4.87)	(15.20)
LSD (P=0.05)	0.39	0.27	0.32	1.03	0.42	0.19	0.42	1.27	0.29	0.33	0.30	0.89	0.37	0.33	0.29	0.89

Figures in parentheses are original values which were subjected to square root transformation.
BLW–Broad-leaved weeds.

Table 2. Effect of planting pattern and weed management practices on irrigated **rabi** sunflower seed yield, net returns and benefit : cost ratio

Treatments	Dry matter production (t/ha)		1000-grain weight (g)		Seed yield (kg/ha)		Stalk yield (kg/ha)		Net returns (Rs./ha)		B : C ratio	
	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
Planting pattern (cm)												
45 x 30	5.37	5.22	43.4	42.7	1603	1554	3585	3464	11712	10797	2.07	1.97
60 x 22.5	5.18	5.06	41.4	40.7	1451	1458	3421	3296	9511	9393	1.86	1.83
LSD (P=0.05)	0.07	0.05	0.90	0.70	83.0	61.0	85.0	58.0	412	373	0.06	0.06
Weed management												
Unweeded check	2.87	2.69	31.3	29.4	732	692	1946	1820	876	80	1.09	1.01
Fluchloralin 1.0 kg/ha	5.78	5.68	45.8	45.1	1804	1699	3906	3809	14790	13164	2.39	2.22
Pendimethalin 1.0 kg/ha	5.89	5.77	46.0	45.5	1861	1743	4068	3941	15411	13610	2.42	2.24
Fluchloralin 0.5 kg+pendimethalin 0.5 kg/ha	5.40	5.29	40.4	40.1	1316	1375	3384	3253	8085	9882	1.75	1.91
Fluchloralin 0.5 kg+pendimethalin 0.5 kg/ha+HW	5.63	5.52	44.5	44.5	1537	1502	3606	3429	9997	10781	1.85	1.92
HW twice	6.03	5.89	46.2	45.8	1914	1824	4137	4044	14515	12964	2.16	2.02
LSD (P=0.05)	0.15	0.13	1.9	1.30	194	125	188	132	897	848	0.12	0.12

seed yield. These results are in conformity with Andrade *et al.* (1993).

Higher values of sunflower dry matter production, 1000-seed weight, seed and stalk yield were recorded with HW twice, and were at par with pendimethalin at 1.0 kg/ha alone. These two weed management practices are significantly superior with respect to seed and stalk yield over fluchloralin at 0.5 kg/ha+pendimethalin at 0.5 kg/ha and unweeded check. Uncontrolled weeds in sunflower resulted in 62.0% reduction in yield over the HW twice. Mean of two years' data showed that HW twice and pendimethalin @1.0 kg/ha produced 62.5 and 53.0%, respectively, higher sunflower seed yield than unweeded check. The better performance of above two weed management practices might be due to reduced weed density and biomass of all categories of weeds during critical period of crop-weed competition thus resulting in better translocation of assimilates from source to sink during post-anthesis period (Poonguzhalan *et al.,*1996).

Economics

The highest net returns and B : C ratio were recorded with closer planting pattern of 45 x 30 cm than 60 x 22.5 cm. Application of pendimethalin at 1.0 kg/ha resulted in highest net returns and B : C ratio and it was comparable with fluchloralin at 1.0 kg/ha. This was mainly due to low cost of herbicides than manual hand weedings. Both these treatments increased the net returns by Rs.771 and 238 and B : C ratio by 0.24 and 0.22, respectively, over HW twice in spite of recording statistically similar sunflower seed yields.

The present investigation revealed that use of planting pattern of 45 x 30 cm and managing associated weeds with HW twice at 20 and 40 DAS or pre-emergence application of pendimethalin at 1.0 kg/ha resulted in higher net returns and seed yield of irrigated **rabi** sunflower.

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