

## Weed Dynamics and Yield of Sunflower as Influenced by Varied Planting Patterns and Weed Management Practices

C. Nagamani, S. M. Muneendra Naidu and D. Subramanyam

Department of Agronomy  
S. V. Agricultural College, Tirupati (A. P.), India

Sunflower (*Helianthus annuus* L.) is one of the most important oilseed crops in India and ranks third after soybean and groundnut as a source of edible oil. Sunflower with its versatile nature is expected to play a crucial role in the oilseed economy of the country. India accounted for 3.26% (1.044 mt) of the total world production of sunflower in 2009 and the average sunflower productivity (5.8 q/ha) in India is lower than the world average (13.41 q/ha) (FAO, 2010). Plant density affects the plant architecture and alters growth and crop developmental pattern. Maintenance of optimum plant density is one of the most important crop husbandry practices, which is responsible for the amount of radiation intercepted per unit area and significantly reduces the weed growth by reducing the availability of growth resources to the weeds. It is a well known fact that weeds compete with crop plants for nutrients, water, space and solar radiation resulting in significant yield reduction. The weed problem in sunflower is so acute that they deprive the crop of available nutrients and crop failure is not uncommon, if weeds are left uncontrolled. Sunflower plants are slow growing in initial stages which provide enough space and other resources for profuse growth and development of weeds. The reduction in seed yield of sunflower due to full weed competition is to the extent of 58% (Daugovish *et al.*, 2003). The information available on the planting pattern and weed management in sunflower is limited. Herbicides alone are not always effective in efficient weed management. Hence, it is necessary to integrate the cultural, chemical and mechanical methods of weed control, which are eco-friendly and economically viable. Hence, the present investigation was undertaken to know the effect of varied planting patterns and weed management practices on weed dynamics and yield of **rabi** sunflower.

A field experiment was conducted during **rabi** season of 2009-10 on sandy loam soils of wetland block of S. V. Agricultural College of Acharya N. G. Ranga Agricultural University, Andhra Pradesh. The soil of the experimental field was sandy loam in texture with low in organic carbon (0.25%) and available nitrogen (181 kg/

ha), medium in available phosphorus (25.5 kg/ha) and available potassium (183 kg/ha) with slightly alkaline pH (7.9) and EC 0.16 dS/m. The experiment was laid out in split-plot design with three replications. The experiment consisted of three planting patterns *viz.*, 45 × 20 cm, 45 × 30 cm and 60 × 30 cm which were assigned to main plots and seven weed management practices *viz.*, unweeded control, weed free check, intercultivation (IC) at 30 DAS, IC at 30 DAS+HW at 45 DAS, pendimethalin 1.0 kg/ha+HW at 30 DAS, oxadiargyl 0.3 kg/ha+HW at 30 DAS and oxyflourfen 0.1 kg/ha+HW 30 DAS were allotted to sub-plots. The recommended dose of fertilizers applied for sunflower crop was 75 kg N, 90 kg P<sub>2</sub>O<sub>5</sub> and 30 kg K<sub>2</sub>O/ha. The entire dose of phosphorus and potassium and half of nitrogen was applied as basal and the remaining half of nitrogen was applied in two equal splits at 25 and 55 DAS as top dressing. The required quantity of herbicides was worked out and was mixed with water and sprayed uniformly with knapsack sprayer fitted with flat fan nozzle at a spray volume of 600 l/ha, one day after sowing as pre-emergence. Category-wise weed density (No./m<sup>2</sup>) and biomass of weeds (g/m<sup>2</sup>) were recorded by putting a quadrat (0.25 m<sup>2</sup>) at two random spots in each plot at harvesting stage of crop. The sunflower cultivar NDSH-1 was sown on 14 November, 2009 and was harvested on 10 February, 2010. Data on weed density and biomass of weeds were transformed using ( $\sqrt{X+0.5}$ ) before subjected to statistical analysis and weed control efficiency (WCE) was calculated based on the biomass accumulated by the weeds.

### Effect on Weeds

The predominant weed flora observed in the experimental field consisted of *Cynodon dactylon* (L.) Pers., *Cyperus rotundus* L., *Celosia argentea* L. and *Digera arvensis*. Weed density and biomass of weeds were significantly influenced by varied planting patterns and weed management practices. Significantly the lowest density and biomass of grasses, sedges, broad-leaved

weeds and total weeds were obtained with the planting pattern of 45 × 30 cm over the rest of the planting patterns studied i. e. 45 × 20 cm and 60 × 30 cm (Table 1). Optimum planting pattern of 45 × 30 cm might have created better microenvironment to shift the balance in favour of crop and suppressed weed growth and development. Further, crop plants would have smothered weeds denying the light and space resulting in reduced weed dry weight. Similar results were reported by Pradeep and Shanmugasundaram (1996). Besides weed

free check, the lowest total weed density and biomass accumulation of all categories of weeds were recorded with pendimethalin 1.0 kg/ha+HW at 30 DAS being statistically on par with oxyflourfen 0.1 kg/ha+HW at 30 DAS. Pre-emergence application of herbicides might have prevented the weed emergence at initial stages upto 30 DAS followed by hand weeding found to be good enough to take care of late emerging weeds and these results are in accordance with those of Rathore and Gautham (2003).

Table 1. Weed flora at harvest as influenced by varied planting patterns and weed management practices

Treatments	Weed density (No./m <sup>2</sup> )				Biomass of weeds (g/m <sup>2</sup> )				WCE (%)
	Grasses	Sedges	BLWs	Total	Grasses	Sedges	BLWs	Total	
<b>Planting pattern</b>									
45 × 20 cm	13.52 (3.39)	162.40 (11.30)	18.32 (3.84)	194.25 (12.34)	6.78 (2.45)	27.13 (4.67)	11.30 (3.09)	45.22 (5.97)	67.06
45 × 30 cm	12.72 (3.30)	132.39 (10.11)	16.28 (3.61)	161.38 (11.15)	6.26 (2.35)	25.07 (4.47)	10.44 (2.96)	41.78 (5.72)	67.63
60 × 30 cm	14.95 (3.53)	189.64 (12.32)	19.98 (4.00)	224.56 (13.36)	7.32 (2.54)	29.28 (4.85)	12.20 (3.21)	48.80 (6.21)	67.26
LSD (P=0.05)	0.10	0.24	0.08	0.27	0.08	0.12	0.07	0.13	-
<b>Weed management</b>									
Unweeded control	38.44 (6.23)	478.67 (21.84)	64.99 (8.08)	582.10 (24.09)	20.86 (4.62)	83.42 (9.15)	34.76 (5.93)	139.03 (11.80)	-
Weed free check	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	100.00
IC at 30 DAS	20.98 (4.63)	190.03 (13.76)	14.73 (3.90)	225.74 (15.00)	9.14 (3.10)	36.56 (6.08)	15.23 (3.96)	60.93 (7.83)	55.77
IC at 30 DAS+HW at 45 DAS	14.44 (3.86)	170.07 (13.01)	13.45 (3.73)	197.97 (14.04)	7.38 (2.80)	29.53 (5.47)	12.30 (3.57)	49.21 (7.04)	64.25
Pendimethalin 1.0 kg /ha+1 HW at 30 DAS	6.79 (2.70)	86.34 (9.24)	10.72 (3.34)	103.85 (10.14)	3.22 (1.92)	12.89 (3.65)	5.37 (2.42)	21.49 (4.68)	84.44
Oxadiazyl 0.3 kg/ha+HW at 30 DAS	8.38 (2.98)	109.00 (10.42)	12.16 (3.55)	129.54 (11.36)	3.55 (2.01)	14.23 (3.83)	5.92 (2.53)	23.70 (4.91)	82.93
Oxyflourfen 0.1 kg/ha+HW at 30 DAS	7.08 (2.75)	96.21 (9.74)	11.30 (3.43)	114.59 (10.64)	3.37 (1.96)	13.51 (3.73)	5.63 (2.47)	22.51 (4.79)	83.85
LSD (P=0.05)	0.17	0.70	0.16	0.72	0.13	0.25	0.13	0.29	-

Figures in parentheses indicate square root transformed ( $\sqrt{X+0.5}$ ) values.

The planting pattern of 45 × 30 cm resulted in the highest WCE. The effect of planting pattern on weed index was non-significant. This might be due to closer spacing which might have reduced the weed growth. Besides weed free check, the highest WCE and lowest WI were obtained with pendimethalin 1.0 kg/ha+HW at 30 DAS (Tables 1 and 2). The next best treatment was oxyflourfen 0.1 kg/ha+HW at 30 DAS. This might be due to continuous weed free conditions with weed free check and effective management of weeds with

pendimethalin 1.0 kg/ha+HW at 30 DAS and oxyflourfen 0.1 kg/ha+HW at 30 DAS.

### Effect on Crop

The highest stature of yield attributes viz., number of filled seeds/head and test weight was noticed with the planting pattern of 45 × 30 cm (Table 2). This might be due to higher dry matter production and effective partitioning of assimilates during post-anthesis period,

Table 2. Yield attributes and yield, weed index, net returns and benefit : cost ratio of sunflower as influenced by varied planting patterns and weed management practices

Treatments	No. of filled seeds/head	100-seed weight	Seed yield (kg/ha)	Stalk yield (kg/ha)	Weed index	Net returns (Rs./ha)	Benefit : cost ratio
<b>Planting pattern</b>							
45 × 20 cm	736	5.32	1405	2717	24.30	6917	1.36
45 × 30 cm	829	5.80	1559	2823	21.39	10299	1.57
60 × 30 cm	694	5.15	1280	2539	24.59	5478	1.29
LSD (P=0.05)	35	0.13	94	85	NS	-	-
<b>Weed management</b>							
Unweeded control	600	4.34	814	1806	55.92	-1567	0.90
Weed free check	853	6.29	1852	3110	0.00	13905	1.72
IC at 30 DAS	664	4.78	1067	2442	42.59	7092	1.14
IC at 30 DAS+HW at 45 DAS	771	5.31	1488	2759	19.28	9263	1.53
Pendimethalin 1.0 kg/ha+HW at 30 DAS	803	5.88	1614	2975	12.62	10623	1.58
Oxadiazinyl 0.3 kg /ha+HW at 30 DAS	786	5.63	1511	2839	18.05	8243	1.44
Oxyflourfen 0.1 kg/ha+HW at 30 DAS	795	5.77	1557	2919	15.52	10123	1.56
LSD (P=0.05)	57	0.28	72	117	3.59	-	-

allocating current as well as reserved assimilates towards yield attributes. The results are in accordance with those of Bindra and Kharwara (1992). Besides weed free check, the highest number of seeds/head and 100-seed weight were resulted with pendimethalin 1.0 kg/ha+HW at 30 DAS. This might have effectively controlled weeds providing ideal conditions during critical stages of crop growth for improved availability of growth resources, especially nutrients, which in turn accelerated the production of photosynthates and their better translocation to sink. The findings are in confirmity with those of Shylaja and Sundari (2008).

Seed and stalk yields of sunflower were significantly influenced by varied planting patterns and weed management practices. Significantly the highest seed and stalk yields were recorded with the planting pattern of 45 × 30 cm. The planting pattern of 45 × 30 cm recorded 17.9% higher yield over 60 × 30 cm. The results are corroborative with those of Nayak *et al.* (2001) and Avit Sen *et al.* (2002). This was mainly due to increased availability of growth resources to the crop resulting from lesser weed competition and maintaining optimum plant population per unit area with the planting pattern of 45 × 30 cm spacing. Besides weed free check, the highest seed and stalk yields were registered with pendimethalin 1.0 kg/ha+HW at 30 DAS, which were statistically on par with oxyflourfen 0.1 kg/ha+HW at 30 DAS. This might be ascribed to elevated growth profile since germination, which led to excellent source sink relationship. Sumathi *et al.* (2009) reported that heavy

weed infestation in unweeded check reduced the yield by 62% over the best weed management practice of HW twice.

### Economics

The planting pattern of 45 × 30 cm recorded the highest net returns and benefit : cost ratio due to higher seed yield and maintenance of lesser weed growth in this treatment. The highest net returns and benefit : cost ratio were recorded with weed free check, which was due to reduced cost of weeding with weed free check and production of higher economic returns. The next best treatment was pendimethalin 1.0 kg/ha+HW at 30 DAS.

In conclusion, the study revealed that the highest yield as well as economic returns could be realized in sunflower with the planting pattern of 45 × 30 cm (74,074 plants/ha) coupled with weed free check. However, in case of areas where the labour scarcity or prohibitive cost exists, the next alternative without draining either the economic yield or the net profit, the weed management practice of pendimethalin 1.0 kg/ha+HW at 30 DAS can be followed.

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