



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; 9(3): 406-408
Received: 25-12-2025
Accepted: 28-01-2026

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Performance of pre and post-emergence herbicides in sunflower

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DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i3f.5274>

Abstract

A field study was conducted in black cotton soils of Regional Agricultural Research Station, Nabdyaal during *rabi* 2023-24, to assess the impact of different weed management practices on weed count, crop growth, yield parameters, yield as well as economics. The results revealed that lower weed density per square meter of grasses (0.71), sedges (0.71) and broad leaved weeds (0.71) as well as total weed density (0.71) and the highest weed control efficiency of 93% were recorded in weed free treatment (T₈) followed by pre emergence application of pendimethalin 37.5 CS @ 677.25 g a.i. /ha (T₇) and early post-emergence application of fluazifop-P-butyl 11.1% SL+ fomesafen 11.1% SL 250g a.i. /ha at 18 DAS (T₅). These treatments increased the capitulum diameter, number of seeds per capitulum, seed weight per capitulum. The highest seed yield of 2265 kg/ha was obtained with weed free treatment (T₈), which was closely followed by pre-emergence application of pendimethalin 37.5 CS @ 677.25 g a.i./ha (T₇)(1977 kg/ha) and early post-emergence application of fluazifop-P-butyl 11.1% SL+ fomesafen 11.1% SL 250g a.i./ha at 18 DAS (T₅)(1862 kg/ha). The highest net returns of 73066 ₹/ha and BC ratio 3.8 were recorded with pendimethalin 37.5 CS @ 677.25 g a.i. /ha as PE which was closely followed by fluazifop-P-butyl 11.1% SL+ fomesafen 11.1% SL 250 g a.i./ ha as early PoE at 18 DAS (T₅)(67,155₹/ha and 3.6:1).

Keywords: Sunflower, weed management, weed density, weed control efficiency, net returns

Introduction

Sunflower is an important oil seed crop of India. It is cultivated in an area of about 4.0 lakh ha with a production of 2.2 lakh tons and of productivity of 555 kg/ha, which is lower than the world average of 1808 kg/ha (FAO, 2017) ^[1], indicating wider scope for improving the yield potential. In Andhra Pradesh, sunflower is grown in an area of 21,000 ha with a production of 18,000 tons and productivity of 841 kg/ha. Weed infestation is one of the major constraints causing lower sunflower yield. Uncontrolled growth of weeds causes an enormous loss of nutrients, which in turn reduces the yield of sunflower up to 62% (Sumathi *et al.* 2009) ^[4]. Heavy weed infestation in sunflower is mainly due to wider spacing, slower crop growth during early stages and higher fertilizer use. Manual weeding is difficult as it is highly labour intensive and time consuming. Herbicides are effective and viable option for weed management in sunflower. Pendimethalin is the recommended pre emergence herbicide in sunflower, but it is proposed for ban, hence the present study was conducted to identify suitable pre and post emergence herbicides for effective management of weeds and to enhance productivity in sunflower.

Materials and Methods

The study was undertaken at Regional Agricultural Research Station, Nandyal campus of Acharya N.G. Ranga Agricultural University, Andhra Pradesh during *rabi* 2023-24. The soil of the experimental field was clayey in texture. The soil was low in nitrogen (125 kg/ha), medium in phosphorus (38.1 kg/ha) and high in potassium (401 kg/ ha). The experiment was laid out in Randomized Block Design with nine treatments and replicated thrice. The nine treatments comprised of Diclosulam 84% WDG 20g a.i. /ha as PE (T₁), Flumioxazin 50% SL 125 g a.i. /ha as PE (T₂), Chlorimuron ethyl 25% WP 6 g a.i. /ha as PE (T₃), Chlorimuron ethyl 25% WP 6 g a.i. /ha as early PoE (T₄), Fluazifop-P-butyl 11.1% SL+ Fomesafen 11.1% SL 250 g a.i./ ha as

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early PoE at 15-18 DAS (T_5), Quizalofop ethyl 10% EC at 37.5 g a.i. /ha at 15-20 DAS (T_6) Pendimethalin 37.5 CS @ 677.25 g a.i. /ha as PE (T_7), Weed free (Three hand weedings at 15,30 and 45 DAS) (T_8) and Unweeded control (T_9). Data were analyzed using Analysis of Variance (ANOVA) using standard variance techniques as suggested by Gomez and Gomez (1984) [2]. The sunflower hybrid NDSH 1012 was sown at a spacing of 60 cm x 30 cm. Primary tillage was done by one disc ploughing followed by two cultivator operations as secondary tillage. A common fertilizer dose of 75kg N + 90 kg P_2O_5 + 30 kg K_2O /ha was applied. Full dose of P_2O_5 and half of the dose of K_2O were applied as basal. Nitrogen applied in equal splits as basal, 30 and 50DAS. Half the dose of potassium was top dressed at 50 DAS. Required quantities of herbicides were applied as per treatment with manually operated knapsack sprayer fitted with flat-fan nozzle using a spray volume of 500 L/ha. Weed density and weed dry matter were taken from random samples at three places in the field with the help of a quadrat at 30 DAS.

The weed samples collected in paper bags were air dried in shade initially followed by oven drying at 65°C for 48 hours till they attain constant weight to determine biomass in g/m². Data on individual and total weed density was subjected to square root transformation ($x + 1$). Weed control efficiency (WCE) and weed index (WI) were calculated based on the weed biomass and seed yield, respectively.

Results and Discussion

Weed flora of the experimental field during the cropping period primarily composed of *Cynodon dactylon*, *Eleusine sps.*, *Dactyloctenium aegyptium* and *Dinerba retroflexa* among the grasses; *Trianthema portulacastrum*, *Corthomus sps*, *Phyllanthus niruri* L., *Chrozophora rotteleri* among the broad leaved weeds and *Cyprus rotundus* L among the sedges. Weed density at 30 DAS and weed control efficiency were significantly influenced by the different weed management treatments (Table 1). Lower weed density of grasses, sedges and broad leaved weeds as well as total weed density were recorded in weed free treatment (T_8), which was on par with pre emergence application of diclosulam @ 20g a.i/ha. Pre-emergence herbicides gave effective control of weeds by inhibiting the germination of the weed seeds and also killing the emerging weeds at the early stages (Vyas *et al.*, 2000) [9]. Unweeded control resulted in higher grasses, sedges and broad-leaved weed population due to unchecked and increased weed growth in all stages of crop.

The highest weed control efficiency was recorded with weed free treatment (T_8) followed by early post emergence application of fluzifop-P-butyl 11.1% SL+ fomesafen 11.1% SL 250g a.i./ha at 18 DAS(T_5). The lower weed index was recorded with weed free treatment (T_8), which had minimum weed competition and maximum seed yield. Similar favourable results were also reported by Vikram *et al.*(2020) [8].

Table 1: Effect of different weed management treatments on weed density at 30 DAS, weed control efficiency and weed index at harvest

Treatments	weed density /m ² at 30 DAS				WCE (%)	WI (%)
	Grasses	Sedges	BLWs	Total		
T ₁ : Diclosulam 84% WDG 20g a.i. /ha as PE	0.71 (0)	0.71(0)	0.71 (0)	0.71 (0)	77.8	90.5
T ₂ : Flumioxazin 50% SL 125 g a.i. /ha as PE	1.44 (1.6)	1.34 (1.3)	3.76 (13.7)	4.14 (16.6)	64.9	49.0
T ₃ : Chlorimuron Ethyl 25% WP 6 g a.i. /ha as PE	1.89 (3.1)	1.44 (1.6)	3.56 (12.2)	4.21 (17.2)	60.7	45.3
T ₄ : Chlorimuron Ethyl 25% WP 6 g a.i. /ha as early PoE	2.04 (3.7)	1.79 (2.7)	4.52 (19.9)	5.18 (26.3)	77.6	39.3
T ₅ : Fluzifop-P-butyl 11.1% SL+ Fomesafen 11.1% SL250 g a.i./ ha as early PoE at 15- 18 DAS.	1.26 (1.1)	1.18 (0.9)	1.34 (1.3)	1.94 (3.3)	84.2	17.8
T ₆ : Quizalofop ethyl 10% EC at 37.5 g a.i. /ha at 15-20 DAS	1.84 (2.9)	1.48 (1.7)	4.72 (21.8)	5.18 (26.4)	5.0	44.9
T ₇ : Pendimethalin 37.5 CS @ 677.25 g a.i. /ha as PE	1.26 (1.1)	1.30 (1.2)	1.34 (1.3)	2.02 (3.6)	76.8	12.7
T ₈ : Weed free (Three hand weedings at 15, 30 and 45 DAS)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	93.0	0.0
T ₉ : Unweeded control	2.02 (3.6)	1.70 (2.4)	4.47 (19.5)	5.04 (25.5)	0.0	46.2
S E m +/-	0.05	0.03	0.08	0.11	1.4	
C D at 5%	0.2	0.09	0.24	0.3	4.1	
CV (%)	10.2	13.4	12.7	11.9	12.3	

Note: Values in parenthesis are original values

Yield attributes and seed yield were significantly influenced by different weed management practices. Weed free treatment (T_8) followed by pre-emergence application of pendimethalin 37.5 CS @ 677.25 g a.i. /ha(T_7) and early post-emergence application of fluzifop-P-butyl 11.1% SL+ fomesafen 11.1% SL 250g a.i. /ha at 18 DAS (T_5) increased the capitulum diameter, number of seeds per capitulum, seed weight per capitulum (Table 2). This might be due to reduced weed density and higher weed control efficiency during critical period of crop weed competition thus resulting in better translocation of assimilates from source to sink during post anthesis period. The results are in line with the findings of Jat and Giri (2000) [3] and Sumathi *et al.* (2010) [5]. Yield attributes of sunflower were at lowest with unweeded control (T_9) might be due to lesser weed control efficiency and higher weed density which might have reduced the nutrient availability and utilization by the crop. Test weight was not significantly influenced by different weed management treatments.

The highest seed yield was obtained with weed free treatment (T_8), which was closely followed by pre- emergence application

of pendimethalin 37.5 CS @ 677.25 g a.i./ha (T_7) and early post-emergence application of fluzifop-P-butyl 11.1% SL+ fomesafen 11.1% SL 250g a.i./ha at 18 DAS (T_5). This might be due to the better weed control associated with lower weed density and improvement in yield contributing characters and ultimately increased the seed yield in these treatments compare to other treatments. The result is in conformity with the findings of Tripathi and Vivek (2001) [7] and Tadavi *et al.* (2017) [6]. The Lowest seed yield was recorded with pre emergence application of diclosulam @ 20g a.i/ha. This is due to phytotoxic effect of diclosulam which leads to low plant population.

The higher gross returns (113250₹/ha) were recorded in weed free treatment (T_8). The highest net returns (73,066 ₹/ha) were recorded in pendimethalin 37.5 CS @ 677.25 g a.i. /ha as PE which was closely followed by fluzifop-P-butyl 11.1% SL+ fomesafen 11.1% SL250 g a.i./ ha as early PoE at 18 DAS(T_5). This might be due to lesser cost of herbicide application and increased seed yield in the weed management practice than the unweeded control. The corresponding increment in benefit cost ratio recorded in treatment pendimethalin 37.5 CS @ 677.25 g

a.i. /ha as PE (T₇) is 3.8 and fluzifop-P-butyl 11.1% SL+ fomesafen 11.1% SL250 g a.i./ ha as early PoE at 18 DAS(T₅) is 3.6. This might be due to more seed yield and lower cost of

weed management through herbicides. These are in corroboration with the findings of Sumathi *et al.* (2010) ^[5].

Table 2: Effect of different weed management treatments on yield attributes, seed yield and Economics of sunflower

Treatments	Phytotoxicity score	Capitulum diameter (cm)	No. of seed/capitulum	Seed weight (g)/Capitulum	100 seed weight (g)	Seed yield (kg ha ⁻¹)	Gross returns (₹/ha)	Net returns (₹/ha)	B: C Ratio
T ₁ : Diclosulam 84% WDG 20g a.i. /ha as PE	8	16.5	728	32.1	6.04	215	10750	-4582	0.4:1
T ₂ : Flumioxazin 50% SL 125 g a.i. /ha as PE	7	13.2	593	24.0	5.86	1156	57800	28835	2.0:1
T ₃ : Chlorimuron Ethyl 25% WP 6g a.i. /ha as PE	2	13.5	615	23.8	5.93	1239	61950	32705	2.1:1
T ₄ : Chlorimuron Ethyl 25% WP 6 g a.i. /ha as early PoE	0	14.6	671	27.6	6.05	1375	68750	39505	2.4:1
T ₅ : Fluzifop-P-butyl 11.1% SL+ Fomesafen 11.1% SL250 g a.i./ ha as early PoE at 15- 18 DAS.	0	17.3	894	32.4	6.02	1862	93100	67155	3.6:1
T ₆ : Quizalofop ethyl 10% EC at 37.5g a.i./ha at 15-20 DAS	0	13.8	655	25.9	5.89	1247	62350	37885	2.5:1
T ₇ : Pendimethalin 37.5 CS @ 677.25 g a.i. /ha as PE	0	17.2	906	36.1	6.04	1977	98850	73066	3.8:1
T ₈ : Weed free (Three hand weeding at 15, 30 and 45 DAS)	0	17.6	982	38.6	6.11	2265	113250	66785	2.4:1
T ₉ : Unweeded control		12.9	576	24.9	5.88	1219	60950	33985	2.3:1
S E m +/-		0.13	24	0.96	0.22	81			
C D at 5%		0.37	72	2.7	NS	247			
CV (%)		12.2	11.5	13.0	12.6	10.5			

Conclusion

The study revealed that the weed free treatment (T₈) recorded highest weed control efficiency, yield attributes, yield and lowest weed index. Though weed free treatment (T₈) treatment has recorded the highest gross returns (Rs. 113250/-/ha), but net returns and benefit cost ratio were the highest with pendimethalin 37.5 CS @ 677.25 g a.i. /ha as PE (T₇) and this was closely followed by fluzifop-P-butyl 11.1% SL+ fomesafen 11.1% SL250 g a.i./ ha as early PoE at 18 DAS(T₅) on black cotton soils, hence application of these herbicides are recommended instead of hand weeding.

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