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Effect of weed management practices on weed suppression and productivity in Groundnut (*Arachis hypogaea* L.)

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Abstract

To evaluate the effect of various weed management practices on weed dynamics, and productivity of groundnut (*Arachis hypogaea* L.), a field experiment was carried out during the *rabi* season of 2025–26 at the College Farm, Agricultural College, Polasa, Jagtial. The study utilized a Randomized Block Design with three replications to test eight distinct weed control treatments on the groundnut variety TCGS-1694. Among the herbicidal treatments, pre-emergence application of diclosulam 84 WDG @ 26 g a.i. ha⁻¹ (T₂) minimized weed density and weed dry weight and thereby recorded higher kernal and haulm yields, which is statistically at par with T₇ treatment (hand weed twice at 20 and 40 DAS) followed by pre-emergence application of pendimethalin 38.7 CS @ 700 g a.i. ha⁻¹ (T₁) both *fb* hand weeding at 40 DAS.

Keywords: Hand weeding, diclosulam, weed density, weed dry weight and yield

1. Introduction

Groundnut (*Arachis hypogaea* L.) is widely recognized as one of the most vital food legumes and oilseed crops in India, positioning the country as the world's second-largest producer of this crop. The crop serves a dual purpose as both a crucial food source and a valuable cash crop. The kernels composed of nearly 48-50% oil and 26-28% protein, groundnuts are a critical agricultural commodity for fulfilling edible oil and dietary protein requirements (Mehriya *et al.*, 2020, Reager *et al.*, 2022) [9, 12].

In India, groundnut cultivated area during both *kharif* and *rabi* seasons roughly about 5.75 m ha, production of 11.90 m t with productivity of 2,067 kg ha⁻¹. In Telangana state groundnut cultivated area is 1.1 L ha production 2.30 L t with productivity of nearly 2,093 kg ha⁻¹ (Indiastat, 2024) [3]. The yield potential of groundnut in India is restricted by an array of biotic and abiotic constraints. Weed infestation stands out as a primary impediment. Inadequate weed control triggers aggressive competition for critical resources such as soil moisture, essential nutrients, solar radiation and spatial clearance, ultimately culminating in severe yield depreciations that can span from 17% to as high as 96% (Kumar *et al.*, 2019) [5]. Heavy weed competition remains a primary factor underlying low groundnut yields. Due to its slow initial growth rate, groundnut is an inherently poor competitor against weeds, making timely management far more critical in this cropping system than in many other field crops. Consequently, maintaining a weed-free environment during the critical period of 4 to 8 weeks after planting is essential. Depending on the growing season, cultivar characteristics, weed flora composition, the duration of competition and the specific management practices employed. Weed-induced pod yield losses can fluctuate drastically, ranging from 13% to 100% (Ghosh, 2000) [2]. In India, weed competition severely impacts groundnut production, causing documented yield reductions between 24% and 70% (Jhala *et al.*, 2005) [4]. Reliance solely on manual weeding fails to guarantee satisfactory weed suppression. Furthermore, its widespread implementation is severely restricted by escalating labour wages and a shrinking agricultural workforce, driven primarily by the socio-economic shifts of rapid industrialization and urbanization (Singh *et al.*, 2023) [13]. Consequently, identifying suitable chemical alternatives that offer economical and safe weed suppression is critical. The application of sequential or tank-mixed pre- and post-emergence herbicides provides a highly viable strategy for the effective,

timely control of diverse weed flora in groundnut systems. There is a distinct need to evaluate these herbicide combinations to establish a broad-spectrum weed management protocol tailored for *rabi* groundnut cultivation.

2. Materials and Methods

To evaluate the effect of weed management practices on weed dynamics and productivity of groundnut, a field experiment was carried out during the *rabi* season of 2025–26 at the College Farm, Agricultural College, Polasa, Jagtial. The experimental site situated within the Northern Telangana Agro-climatic Zone is located at 18°50' N latitude and 78°56' E longitude with an elevation of 243.4 m above mean sea level. The study was arranged in a Randomized Block Design featuring eight treatments and three replications. The treatments comprised of T₁-Pendimethalin 38.7 CS @ 700 g a.i. ha⁻¹ (PE) at 1-2 DAS *fb* hand weeding at 40 DAS; T₂-Diclosulam 84 WDG @ 26 g a.i. ha⁻¹ (PE) at 1-2 DAS *fb* hand weeding at 40 DAS; T₃-Propaquizafop 2.5 + Imazethapyr 3.75 ME @ 125 g a.i. ha⁻¹ (Ready mix) at 20 DAS *fb* hand weeding at 40 DAS; T₄-Imazethapyr 35 + Imazamox 35 WG @ 100 g a.i. ha⁻¹ (Ready mix) at 20 DAS *fb* hand weeding at 40 DAS; T₅-Diclosulam 84 WDG @ 26 g a.i. ha⁻¹ (PE) at 1-2 DAS *fb* Propaquizafop 2.5 + Imazethapyr 3.75 ME @ 125 g a.i. ha⁻¹ (Ready mix) at 20 DAS; T₆-Diclosulam 84 WDG @ 26 g a.i. ha⁻¹ (PE) at 1-2 DAS *fb* Imazethapyr 35 + Imazamox 35 WG 100 g a.i. ha⁻¹ (Ready mix) at 20 DAS; T₇-Hand weeding at 20 and 40 DAS; T₈-Weedy check.

The groundnut variety TCGS-1694 was sown on 4th November, 2025 with a crop geometry of 22.5 × 10 cm. The gross and net plot dimensions were 4.5 × 3.2 m and 3.6 × 2.8 m, respectively. Pre-emergence (PE) herbicide treatments were applied at 1 day after sowing (DAS), whereas post-emergence (PoE) herbicide were applied at 20 DAS using a knapsack sprayer equipped with a calibrated flat-fan nozzle to deliver accurate amount of the spray volume. Manual hand weedings were completed according to the treatment schedule. Except for the varying weed control practices, all standard agronomic operations and plant protection protocols for *rabi* groundnut were uniformly applied across all treatment plots throughout the crop growth cycle.

Data on weed dynamics including weed density, weed dry weight and weed control efficiency (WCE) were recorded at distinct crop growth stages (20, 40 and 60 DAS). At crop maturity, yield attributes specifically the number of pods plant⁻¹, kernels pod⁻¹, shelling percentage (%) and 100-kernel weight alongside total kernel and haulm yields (kg ha⁻¹) were observed. The collected experimental data were subjected to analysis of variance (ANOVA) protocols appropriate for a Randomized Block Design. Treatment means were subsequently compared using the critical difference (CD) test at a 5% (P = 0.05) level of significance.

$$\text{Weed Control Efficiency (\%)} = \frac{\text{DMc} - \text{DMt}}{\text{DMc}} \times 100$$

Where, WCE = Weed Control Efficiency (%)

DMc = Dry matter of weeds in unweeded check (Control)

DMt = Dry matter of weeds in treatment plot

$$\text{Weed index} = \frac{X - Y}{X} \times 100$$

X- Seed yield from a weed free plot

Y- Seed yield from a treated plot

3. Results and Discussion

3.1 Weed flora

Throughout the crop growth period, the experimental field faced a mixed infestation of grasses, sedges and broad-leaved weeds. The dominant grass species were *Cynodon dactylon* (L.), *Digitaria sanguinalis* (L.) and *Dinebra retroflexa* (L.) while the sedge community was represented by *Cyperus rotundus* (L.). Additionally, the broad-leaved weed flora consisted of *Boerhavia erecta* L., *Amaranthus viridis* L., *Trianthema portulacastrum* L., *Commelina benghalensis* (L.), *Phyllanthus niruri* (L.), *Phyllanthus madraspatensis* (L.), *Tridax procumbens* (L.), *Portulaca oleracea* (L.) and *Parthenium hysterophorus*. The weed species identified in this study align with those previously documented by Malunjkar *et al.* (2012)^[7] and Suseendran *et al.* (2019)^[16].

3.2 Weed parameters

At 20 DAS, the lowest weed density, weed dry weight and the highest weed control efficiency were recorded in T₂ (Diclosulam 84 WDG @ 26 g a.i. ha⁻¹ (PE) at 1-2 DAS *fb* hand weeding at 40 DAS) (13.53 no. m⁻², 3.07 g m⁻² and 86.97% respectively) resulting from effective early-season control by the pre-emergence herbicide. This treatment was on par with T₅ (Diclosulam (PE) *fb* Propaquizafop + Imazethapyr at 20 DAS) (13.97 no. m⁻², 3.19 g m⁻² and 86.49%), T₆ (Diclosulam (PE) *fb* Imazethapyr + Imazamox at 20 DAS) (14.24 no. m⁻², 3.23 g m⁻² and 86.30%) and T₁ (Pendimethalin (PE) *fb* hand weeding at 40 DAS) (17.97 no. m⁻², 4.43 g m⁻² and 81.21%). Treatments T₃, T₄ and T₇ exhibited higher weed density and dry weight during this period as post-emergence herbicides and hand weeding had not yet been applied. T₈ (Weedy check) recorded the highest weed density (93.53 no. m⁻²) and weed dry weight (23.58 g m⁻²). Similar trends were documented by Parthipan (2020)^[11] and Dhayal *et al.* (2022)^[1].

At 40 DAS, T₇ (Hand weeding at 20 and 40 DAS) recorded the lowest weed density (3.72 no. m⁻²), weed dry weight (2.56 g m⁻²) and the highest weed control efficiency (96.67%). Among the herbicide treatments, T₅ recorded lower weed density (8.13 no. m⁻²), weed dry weight (8.44 g m⁻²) and higher weed control efficiency (89.01%) which at par with T₆ (19.50 no. m⁻², 9.13 g m⁻² and 88.10%), T₃ (20.29 no. m⁻², 9.26 g m⁻² and 87.93%) and T₄ (21.83 no. m⁻², 9.36 g m⁻² and 87.80%). T₁ and T₂ recorded moderate weed density. While T₈ (Weedy check) recorded the highest weed density (197.97 no. m⁻²) and weed dry weight (76.77 g m⁻²). These results are in accordance with those of Kumar *et al.* (2020)^[6] and Sridhar *et al.* (2021)^[14].

At 60 DAS, the lowest weed density, weed dry weight and the highest weed control efficiency were recorded in T₇ (Hand weeding at 20 and 40 DAS) (5.60 no. m⁻², 3.90 g m⁻² and 96.57% respectively). This treatment statistically comparable to T₂ (Diclosulam (PE) *fb* hand weeding at 40 DAS) (7.11 no. m⁻², 4.8 g m⁻² and 95.77%), T₁ (Pendimethalin (PE) *fb* hand weeding at 40 DAS) (6.09 no. m⁻², 5.02 g m⁻² and 95.58%), T₄ (Imazethapyr + Imazamox *fb* hand weeding) (7.74 no. m⁻², 5.16 g m⁻² and 95.45%) and T₃ (Propaquizafop + Imazethapyr *fb* hand weeding) (8.4 no. m⁻², 5.31 g m⁻² and 95.33%). The sequential herbicide treatments T₅ and T₆ recorded comparatively higher weed density, weed dry weight and lower weed control efficiency. T₈ (Weedy check) recorded the highest weed density (293.77 no. m⁻²) and weed dry weight (113.54 g m⁻²). Similar trends were observed in previous studies by Sukumar *et al.* (2018)^[15] and Yadav *et al.* (2025)^[17].

Across the evaluated weed management practices, T₂ Diclosulam (PE) *fb* hand weeding at 40 DAS recorded the lowest weed index (2.92%) followed by T₁ (Pendimethalin (PE) *fb* hand weeding at 40 DAS) (4.61%). Intermediate weed index values were recorded with T₃ (12.26%) and T₄ (14.21%) whereas T₅ (20.02%) and T₆ (25.04%) recorded comparatively higher weed indices. T₈ (Weedy check) recorded the highest weed index (58.38%), indicating maximum yield reduction due to severe and uninterrupted weed competition.

3.3 Yield

Among the weed management practices, T₇ (Hand weeding at 20 and 40 DAS) recorded the highest kernel yield (2512 kg ha⁻¹) and

haulm yield (5452 kg ha⁻¹). Which was statistically equivalent to T₂ (Diclosulam 84 WDG @ 26 g a.i. ha⁻¹ (PE) at 1–2 DAS *fb* hand weeding at 40 DAS) (2426 and 5301 kg ha⁻¹) respectively and T₁ (Pendimethalin 38.7 CS @ 700 g a.i. ha⁻¹ (PE) at 1–2 DAS *fb* hand weeding at 40 DAS) (2302 and 5222 kg ha⁻¹) respectively. Comparing the post-emergence herbicide applications, T₃ performed better followed by T₄, whereas sequential herbicide treatments T₅ and T₆ recorded comparatively lower kernel and haulm yields. T₈ (Weedy check) recorded the lowest kernel yield (912 kg ha⁻¹) and haulm yield (2600 kg ha⁻¹). These results are consistent with the observations of Mathukia *et al.* (2017) [8], Sridhar *et al.* (2021) [14] and Naik *et al.* (2022) [10].

Table 1: Weed density (No. m⁻²) at 20, 40 and 60 DAS as influenced by different weed management in groundnut

Tr. No.	20 DAS				40 DAS				60 DAS			
	Grasses	Sedges	BLW	Total	Grasses	Sedges	BLW	Total	Grasses	Sedges	BLW	Total
T ₁	1.67 (2.30)	3.31 (10.48)	2.38 (5.18)	4.30 (17.97)	2.78 (7.23)	4.21 (17.24)	6.10 (36.87)	7.86 (61.34)	1.73 (2.59)	1.66 (2.26)	1.62 (2.13)	2.73 (6.09)
T ₂	2.48 (5.63)	2.16 (4.19)	2.05 (3.71)	3.75 (13.53)	3.35 (10.81)	3.22 (9.78)	6.02 (35.92)	7.54 (56.51)	1.91 (3.17)	1.62 (2.14)	1.51 (1.80)	2.76 (7.11)
T ₃	3.62 (12.63)	3.48 (11.68)	7.81 (60.45)	9.23 (84.76)	2.06 (3.78)	2.67 (6.64)	3.22 (9.87)	4.56 (20.29)	1.97 (3.43)	1.73 (2.56)	1.70 (2.41)	2.98 (8.40)
T ₄	3.93 (15.06)	3.45 (11.44)	7.64 (58.00)	9.22 (84.49)	2.25 (4.61)	2.71 (6.91)	3.29 (10.31)	4.73 (21.83)	2.01 (3.54)	1.68 (2.33)	1.54 (1.88)	2.87 (7.74)
T ₅	2.41 (5.33)	2.24 (4.59)	2.13 (4.05)	3.80 (13.97)	1.98 (3.44)	2.48 (5.97)	2.94 (8.13)	4.21 (17.24)	3.39 (10.97)	3.66 (12.92)	3.79 (13.89)	6.19 (37.78)
T ₆	2.50 (5.75)	2.19 (4.32)	2.16 (4.17)	3.84 (14.24)	2.18 (4.27)	2.45 (5.52)	3.20 (9.72)	4.47 (19.50)	3.62 (12.71)	3.44 (11.40)	3.75 (13.58)	6.17 (37.69)
T ₇	3.54 (12.07)	3.67 (12.95)	7.41 (54.50)	8.94 (79.53)	1.37 (1.44)	1.30 (1.23)	2.05 (3.72)	2.63 (6.40)	1.69 (2.35)	1.62 (2.12)	1.28 (1.13)	2.47 (5.60)
T ₈	3.85 (14.36)	3.34 (10.73)	8.29 (68.44)	9.68 (93.53)	4.81 (22.62)	4.68 (21.49)	12.42 (153.85)	14.09 (197.97)	6.55 (42.50)	6.00 (35.54)	14.69 (215.74)	17.15 (293.77)
S. Em ±	0.14	0.12	0.311	0.33	0.11	0.17	0.23	0.30	0.14	0.11	0.16	0.2
CD (P=0.05)	0.44	0.37	0.94	0.99	0.33	0.52	0.69	0.90	0.43	0.35	0.5	0.61

Figures in parentheses are original, weed density transformed to $\sqrt{x + 0.5}$

Table 2: Weed dry matter (g. m⁻²) at 20, 40 and 60 DAS as influenced by different weed management in groundnut

Tr. No	20 DAS				40 DAS				60 DAS			
	Grasses	Sedges	BLW	Total	Grasses	Sedges	BLW	Total	Grasses	Sedges	BLW	Total
T ₁	0.90 (0.32)	1.85 (2.94)	1.29 (1.17)	2.22 (4.43)	2.27 (4.67)	3.27 (10.19)	3.38 (10.92)	5.13 (25.78)	1.70 (2.39)	1.18 (0.89)	1.50 (1.74)	2.35 (5.02)
T ₂	1.40 (1.47)	1.16 (0.85)	1.12 (0.75)	1.89 (3.07)	2.99 (8.45)	2.41 (5.33)	3.33 (10.61)	4.99 (24.40)	1.73 (2.49)	1.15 (0.83)	1.41 (1.49)	2.30 (4.80)
T ₃	2.85 (7.64)	1.94 (3.28)	3.57 (12.23)	4.86 (23.15)	1.63 (2.16)	2.09 (3.86)	1.93 (3.24)	3.12 (9.26)	1.73 (2.50)	1.22 (0.98)	1.53 (1.83)	2.41 (5.31)
T ₄	2.89 (7.87)	1.93 (3.21)	3.62 (12.61)	4.92 (23.69)	1.64 (2.20)	2.05 (3.68)	1.99 (3.48)	3.14 (9.36)	1.74 (2.53)	1.26 (1.08)	1.43 (1.55)	2.38 (5.16)
T ₅	1.39 (1.44)	1.21 (0.96)	1.13 (0.79)	1.92 (3.19)	1.62 (2.12)	1.94 (3.26)	1.89 (3.05)	2.99 (8.44)	3.17 (9.55)	2.94 (8.13)	3.62 (12.59)	5.55 (30.27)
T ₆	1.43 (1.55)	1.18 (0.89)	1.14 (0.79)	1.93 (3.23)	1.64 (2.20)	2.01 (3.55)	1.97 (3.39)	3.10 (9.13)	3.28 (10.26)	2.98 (8.41)	3.53 (11.94)	5.58 (30.60)
T ₇	2.86 (7.67)	2.03 (3.64)	3.54 (12.01)	4.88 (23.31)	1.24 (1.04)	0.96 (0.42)	1.26 (1.10)	1.75 (2.56)	1.58 (2.00)	1.13 (0.78)	1.27 (1.11)	2.10 (3.90)
T ₈	2.90 (7.90)	1.88 (3.02)	3.63 (12.66)	4.91 (23.58)	3.95 (15.08)	3.72 (13.31)	6.99 (48.37)	8.79 (76.77)	5.23 (26.84)	4.90 (23.46)	7.98 (63.24)	10.68 (113.54)
S. Em ±	0.09	0.08	0.11	0.17	0.10	0.10	0.16	0.17	0.11	0.10	0.15	0.19
CD (P=0.05)	0.26	0.24	0.34	0.51	0.31	0.29	0.49	0.51	0.32	0.31	0.44	0.59

Figures in parentheses are original, weed dry weight transformed to $\sqrt{x + 0.5}$

Table 3: Weed control efficiency (%) and weed index (%) as influenced by different weed management practices in groundnut

Treatment details	Weed control efficiency (%)			Weed index (%)
	20 DAS	40 DAS	60 DAS	
T ₁ -Pendimethalin 38.7 CS @ 700 g a.i. ha ⁻¹ (PE) at 1-2 DAS fb hand weeding at 40 DAS	81.21	66.42	95.58	4.61
T ₂ -Diclosulam 84 WDG @ 26 g a.i. ha ⁻¹ (PE) at 1-2 DAS fb hand weeding at 40 DAS	86.97	68.22	95.77	2.92
T ₃ -Propaquizafop 2.5 + Imazethapyr 3.75 ME @ 125 g a.i. ha ⁻¹ (Ready mix) at 20 DAS fb hand weeding at 40 DAS	-	87.93	95.33	12.26
T ₄ -Imazethapyr 35 + Imazamox 35 WG @ 100 g a.i. ha ⁻¹ (Ready mix) at 20 DAS fb hand weeding at 40 DAS	-	87.80	95.45	14.21
T ₅ -Diclosulam 84 WDG @ 26 g a.i. ha ⁻¹ (PE) at 1-2 DAS fb Propaquizafop 2.5 + Imazethapyr 3.75 ME @ 125 g a.i. ha ⁻¹ (Ready mix) at 20 DAS	86.49	89.01	73.34	20.02
T ₆ -Diclosulam 84 WDG @ 26 g a.i. ha ⁻¹ (PE) at 1-2 DAS fb Imazethapyr 35 + Imazamox 35 WG 100 g a.i. ha ⁻¹ (Ready mix) at 20 DAS	86.30	88.10	73.05	25.04
T ₇ -Hand weeding at 20 and 40 DAS	-	96.67	96.57	0.00
T ₈ -Weedy check	-	-	-	58.38

Table 4: Yield as influenced by different weed management practices in groundnut

Treatment details	Kernal yield (kg ha ⁻¹)	Haulm yield (kg ha ⁻¹)
T ₁ -Pendimethalin 38.7 CS @ 700 g a.i. ha ⁻¹ (PE) at 1-2 DAS fb hand weeding at 40 DAS	2302	5222
T ₂ -Diclosulam 84 WDG @ 26 g a.i. ha ⁻¹ (PE) at 1-2 DAS fb hand weeding at 40 DAS	2426	5301
T ₃ -Propaquizafop 2.5 + Imazethapyr 3.75 ME @ 125 g a.i. ha ⁻¹ (Ready mix) at 20 DAS fb hand weeding at 40 DAS	2088	4762
T ₄ -Imazethapyr 35 + Imazamox 35 WG @ 100 g a.i. ha ⁻¹ (Ready mix) at 20 DAS fb hand weeding at 40 DAS	2029	4759
T ₅ -Diclosulam 84 WDG @ 26 g a.i. ha ⁻¹ (PE) at 1-2 DAS fb Propaquizafop 2.5 + Imazethapyr 3.75 ME @ 125 g a.i. ha ⁻¹ (Ready mix) at 20 DAS	1856	4461
T ₆ -Diclosulam 84 WDG @ 26 g a.i. ha ⁻¹ (PE) at 1-2 DAS fb Imazethapyr 35 + Imazamox 35 WG 100 g a.i. ha ⁻¹ (Ready mix) at 20 DAS	1711	4172
T ₇ -Hand weeding at 20 and 40 DAS	2512	5452
T ₈ -Weedy check	912	2600
S. Em ±	85.62	169.07
CD (P=0.05)	259.70	512.84

4. Conclusion

Among the different herbicide applications, diclosulam 84 WDG @ 26 g a.i. ha⁻¹ (PE) at 1–2 DAS fb hand weeding at 40 DAS proved as the most effective herbicidal treatment, recorded significantly lower weed density and weed dry weight, higher weed control efficiency, improved kernel and haulm yields. Therefore, this treatment can be recommended as an efficient and economically viable weed management practice for maximizing productivity and profitability of groundnut under the conditions of the study.

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