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INFLUENCE OF SOLE AND INTEGRATED USES OF HERBICIDE DICLOSULAM AND WEED MULCH ON WEEDS, GROWTH, PRODUCTIVITY AND ECONOMICS OF SUMMER GROUNDNUT (*Arachis hypogaea* L.)

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ABSTRACT

A field experiment was carried out at the Agriculture Farm of Palli Siksha Bhavana, Visva-Bharati, Sriniketan, West Bengal during the summer season of 2025 using the variety TAG 24 to study the effect of sole and combined use of herbicide diclosulam and weed mulch on summer groundnut. Ten treatments were used in the experiment, which was set up in a randomized block design (RBD) with three replications. The treatments consisted of T₁ (diclosulam 20 g ha⁻¹ as PE), T₂ (diclosulam 25 g ha⁻¹ as PE), T₃ (diclosulam 30 g ha⁻¹ as PE), T₄ (mulching with *Mikania micrantha* 10t ha⁻¹), T₅ (diclosulam as PE 20 g ha⁻¹ fb mulching with *Mikania micrantha* 10t ha⁻¹), T₆ (diclosulam 25 g ha⁻¹ as PE fb mulching with *Mikania micrantha* 10t ha⁻¹), T₇ (diclosulam 30 g ha⁻¹ as PE fb mulching with *Mikania micrantha* 10t ha⁻¹), T₈ (imazethapyr 100 g ha⁻¹ as PoE), T₉ (hand weeding at 20 and 40 DAS), T₁₀ (unweeded control). Among the grasses *Echinochloa colona*, *Eleusine indica*, *Digitaria sanguinalis* and *Panicum capillare* were predominant; while *Croton bonplandianum*, *Oldenlandia corymbosa*, *Ageratum conyzoides*, *Cleome viscosa*, *Indigofera tinctoria* and *Alternanthera philoxeroides* were dominated among the broad leaved weeds throughout the cropping period. Among all the herbicide and mulch combined treatments, T₇ exhibited the most effective weed suppression, recording the lowest weed density and dry weight throughout the crop growth period. Consequently, it achieved the maximum plant height, crop growth rate, pod yield (2.96 kg ha⁻¹), seed yield (2.26 kg ha⁻¹) and haulm yield (4.88 kg ha⁻¹). These values, however, were statistically at par with T₆, which registered pod yield of 2.93 kg ha⁻¹, seed yield of 2.19 kg ha⁻¹ and haulm yield of 4.63 kg ha⁻¹. The net return (₹ 1,57,451 ha⁻¹) and return per rupee invested (3.73) were recorded highest under T₇, which was at par with T₆ having net return (₹ 1,55,689 ha⁻¹) and return per rupee invested (3.71). Therefore, diclosulam 25 g ha⁻¹ as PE fb mulching with *Mikania micrantha* (T₆) is promising for effective and economic weed management in summer groundnut under lateritic soil of West Bengal.

Key words : Groundnut, *Mikania micrantha*, Mulching, Pre-emergence, Weed management.

Introduction

Groundnut (*Arachis hypogaea* L.), popularly designated as the “King of Oilseeds,” occupies a strategic position in agriculture and nutritional framework of India. Its exceptional nutritional profile comprises 48–50% oil, 26% protein, 11.5% carbohydrates, dietary fibre, calcium, iron, vitamin A and B complex. So it renders as a crop of outstanding dietary performance, particularly for rural households where it earns the title “poor man’s cashew

nut” (Patgiri, 2023). In India, 5.24 M ha groundnut were planted in 2024 – 25, yielding 10.16 million tonnes at an average productivity of 1,938 kg ha⁻¹ (Agricultural Statistics, 2024).

The summer season (March–June) offers various agronomic advantages for groundnut cultivation in this region, including assured irrigation, reduced insect-pest pressure, and beneficial utilisation of residual soil moisture, collectively positioning summer groundnut as a highly

profitable cash crop for small and marginal farmers (Moinuddin, 2023). Despite these favourable conditions, groundnut productivity remains constrained by intense competition from diverse weed flora. Early growth stages of groundnut are particularly vulnerable to weed infestation. Yield losses due to weed competition in India have been estimated to range from 24 to 70%, depending on weed species composition, density, and duration of competition (Bhowmik *et al.*, 2023). The critical period of weed competition — typically spanning the first 30–60 days after sowing — represents the most damaging phase, during which uncontrolled weed growth physically interferes with groundnut pegging, pod development, and harvesting. Effective weed management is therefore an important agronomic intervention for improving groundnut's yield potential in this region.

Pre-emergence herbicides etc. have been widely used in groundnut for the suppression of grassy weeds; however, their efficacy against the problematic broad leaved weeds of West Bengal has frequently been questioned, necessitating the evaluation of newer herbicides with broader-spectrum activity. Diclosulam 84% WDG, a new generation acetolactate synthase (ALS)-inhibiting pre-emergence herbicide, offers a promising solution. It is characterised by broad-spectrum activity against both grassy and broad-leaved weeds, low application rates and high specific biological activity (Musa *et al.*, 2022). However, sole dependency on single herbicide raises concerns of weed population shifts and environmental loads. Integrated Weed Management (IWM), which combines cultural, biological and chemical control tools, offers a more durable and ecologically sound approach. Mulching represents one of the most effective cultural components within an IWM framework, suppressing weed emergence through physical smothering, reduction of light availability at the soil surface, modification of soil temperature and moisture regimes. A cost-effective option for resource-limited farmers is the utilisation of locally available invasive weed biomass as organic mulch. *Mikania micrantha*, a prolific, fast-growing naturalized invasive weed widespread across West Bengal's ecosystems, offers abundant, freely available biomass. When it is applied as surface mulch, it delivers dual agronomic benefits: physical weed suppression and conservation of soil moisture (Poudel *et al.*, 2019). The strategic combination of diclosulam as a pre-emergence herbicide followed by *Mikania micrantha* mulch application represents a well IWM strategy — where the herbicide controls the initial weed flush during the most critical early growth period while the mulch layer provides sustained season-long

suppression. Hence, the present study was undertaken to find out the sole and combined effect of diclosulam and weed mulch on weeds, growth, productivity and economics of summer groundnut.

Materials and Methods

A field experiment was conducted during the summer season of 2025 at the Agricultural Farm, Palli Siksha Bhavana (Institute of Agriculture) of Visva-Bharati University, Sriniketan, West Bengal. The experimental site falls under the tropical sub-humid and lateritic zone of West-Bengal. During the crop growth period, the weekly maximum temperature ranged from 28.90°C to 38.74°C and minimum temperature from 15.93°C to 27.04°C, with average weekly sunshine hours varying from 1.17 to 8.96 hours per day. Total rainfall received during the crop season was 60.79 mm and relative humidity ranged from 44.57 to 89.43%. The experiment comprising ten treatments was laid out in a randomised block design with three replications. The treatments consisted of three doses of diclosulam 84% WDG applied as pre-emergence (PE) 20 g ha⁻¹ (T₁), 25 g ha⁻¹ (T₂) and 30 g ha⁻¹ (T₃); sole mulching with *Mikania micrantha* 10 t ha⁻¹ (T₄); diclosulam at 20, 25 and 30 g ha⁻¹ as PE followed by (fb) *Mikania micrantha* mulch 10 t ha⁻¹ (T₅, T₆ and T₇, respectively); imazethapyr 10% SL 100 g ha⁻¹ as post-emergence (T₈); hand weeding at 20 and 40 DAS (T₉); and unweeded control (T₁₀).

The seeds of groundnut variety TAG-24 were sown on 27 February 2025 at a seed rate of 80 kg ha⁻¹ with a spacing of 30 cm × 10 cm. The crop was fertilised with 20 kg N, 60 kg P₂O₅ and 80 kg K₂O ha⁻¹ applied as basal through urea, SSP and MOP, respectively. Herbicides were applied as pre-emergence using a hand-operated knapsack sprayer fitted with a flat-fan nozzle at a spray volume of 500 L ha⁻¹ at 1 DAS. *Mikania micrantha* mulch (sun-dried and chopped biomass at 10 t ha⁻¹ on dry weight basis) was spread between crop rows at 6 DAS after the emergence of the crop. Imazethapyr was applied as post-emergence at 15 DAS and hand weeding in T₉ was performed manually at 20 and 40 DAS. All other recommended agronomic practices were followed uniformly.

Weed density and dry weight were recorded category-wise by placing a 50 cm × 50 cm quadrat randomly in each plot at 30, 60, 90 DAS and at harvest. After collection, the weeds were cleaned thoroughly, sun dried for 3 days and then oven-dried at 70–72°C till constant weight was achieved and expressed as g m⁻². Weed data were square root transformed ($\sqrt{x + 0.5}$) prior to statistical analysis. Yield attributes and seed yield of

groundnut were recorded at harvest. Phytotoxicity of herbicides on groundnut was assessed visually using a 0–10 rating scale at 0, 1, 3, 5, 7 and 10 DAS.

The Soxhlet extraction method was used to estimate the oil content of groundnut seeds. Groundnut seeds should be dried, ground then a certain amount is transferred to a filter paper and put in a Soxhlet extraction apparatus. A solvent, named petroleum benzene ether, was heated to the boiling point in the unit, causing it to evaporate and ascend the reflux condenser. When the rising solvent condensed on the reflux condenser's cool surface and fell onto it, the oil in the groundnut sample in the thimble was dissolved. The mixture of oil and solvent trickled back down into the round-bottom flask over a few hours. The weight of extracted oil was recorded and then calculated to get the oil percentage in the respected seeds by following formula:

Oil content (%)

$$= \frac{\text{Weight of oil extracted (g)}}{\text{Weight of the seed loaded into the unit (g)}} \times 100\%$$

Using established analytical techniques, the Kjeldahl method was used to determine the nitrogen content of groundnut kernels. Using the following formula, the crude protein content (%) was determined by multiplying the nitrogen percentage by the conversion ratio of 6.25:

$$\text{Crude protein (\%)} = \text{Nitrogen (\%)} \times 6.25$$

On a dry weight basis, the protein content was reported as a percentage. The data were statistically analysed at 5% level of significance following Gomez and Gomez (1984).

Results and Discussion

Sedges were absent in the experimental field throughout the growing period, while grasses and broad leaved weeds predominated. Among the grasses *Echinochloa colona*, *Eleusine indica*, *Digitaria sanguinalis* and *Panicum capillare* were predominant; while *Croton bonplandianum*, *Oldenlandia corymbosa*, *Ageratum conyzoides*, *Cleome viscosa*, *Indigofera tinctoria* and *Alternanthera philoxeroides* were dominated among broad leaved weeds throughout the cropping period. Similar results on weed flora in West Bengal's lateritic soil have also been reported by Bhuimali (2025) and Bhowmik *et al.* (2023). Developing successful weed management techniques requires an understanding of the composition of weed flora.

Observation on phytotoxicity

Visual evaluation of herbicide-induced phytotoxicity on groundnut (Table 1) was carried out at 0, 1, 3, 5, 7 and

10 days after application (DAA). No phytotoxic symptoms in terms of epinasty, hyponasty, necrosis, vein clearing, wilting, stunted growth or yellowing were observed in the groundnut crop under any of the treatments at any observation. This confirmed that diclosulam at varying doses as PE and imazethapyr as PoE were completely safe to the groundnut crop at the tested doses.

Weed population and dry weight

All weed management treatments significantly reduced weed growth except unweeded control (T_{10}) which recorded the highest weed population and dry weight. The minimum population and dry weight of total weeds were recorded under two hand weeding (T_9). Among all the herbicide and mulch integrated treatments, the diclosulam 30g ha^{-1} as PE fb mulching with *Mikania micrantha* 10 t ha^{-1} (T_7) recorded the minimum population and dry weight of total weeds at 30 and 60 DAS, closely followed by diclosulam 25 g ha^{-1} as PE fb mulching with *Mikania micrantha* 10 t ha^{-1} (T_6) as shown in Tables 2 and 3. These results are in agreement with Fatima and Duary (2020), Malik *et al.* (2021), Sar *et al.* (2025), who reported integrated use of herbicide and mulch to record the lowest weed population and dry weight.

Growth parameters

All weed management treatments significantly influenced growth parameters of groundnut at 30 and 60 DAS as per Table 5. The maximum plant height was recorded under hand weeding at 20 and 40 DAS (T_9) at both the observations, owing to reduced crop-weed competition ensuring better availability of nutrients, moisture and light to the crop. Among the herbicide and mulch integrated treatments, diclosulam 30 g ha^{-1} as PE fb mulching with *Mikania micrantha* 10 t ha^{-1} (T_7) recorded significantly higher plant height, closely followed and at par with diclosulam 25 g ha^{-1} as PE fb mulching with *Mikania micrantha* 10 t ha^{-1} (T_6). LAI and chlorophyll followed a trend similar to plant height across all treatments at 30 and 60 DAS. The maximum number of nodules was recorded under T_7 , followed by T_9 and T_6 at 30 DAS. The unweeded control (T_{10}) recorded the minimum nodule count at both observations. Intense weed competition in unweeded plots adversely affected root growth and rhizobial activity, resulting in poor nodulation. Similar results were reported by Fatima *et al.* (2020) and Rabari *et al.* (2024). The highest CGR was recorded under T_9 , reflecting superior dry matter accumulation due to minimal crop-weed competition. Among combined treatments of herbicide and mulch, T_7 recorded the highest

Table 2 : Effect of weed management practices on phytotoxicity in summer groundnut.

Treatments	Wilting										Stunting										Yellowing									
	DAA										DAA										DAA									
	0	1	3	5	7	10	0	1	3	5	7	10	0	1	3	5	7	10	0	1	3	5	7	10						
T ₁ : Diclosulam 20 g ha ⁻¹ as PE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
T ₂ : Diclosulam 25 g ha ⁻¹ as PE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
T ₃ : Diclosulam 30 g ha ⁻¹ as PE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
T ₄ : Mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
T ₅ : Diclosulam 20 g ha ⁻¹ as PE fb mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
T ₆ : Diclosulam 25 g ha ⁻¹ as PE fb mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
T ₇ : Diclosulam 30 g ha ⁻¹ as PE fb mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
T ₈ : Imazethapyr 100 g ha ⁻¹ as PoE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
T ₉ : Hand weeding at 20 and 40 DAS																														
T ₁₀ : Unweeded control																														

CGR and was at par with T₆, both being significantly superior to sole herbicide or sole mulch treatments. The unweeded control (T₁₀) recorded the lowest CGR at both observation periods, indicating severe suppression of crop growth due to unchecked weed growth. Similar observations were reported by Teja and Duary (2018) and Sar *et al.* (2025).

Yield attributes and yield

All weed management treatments significantly influenced the yield attributes and yield of groundnut. Hand weeding at 20 and 40 DAS (T₉) recorded the maximum total no of pods per plant, matured pods per plant, number of kernels per pod and seed index as shown in table 5, while the unweeded control (T₁₀) recorded the minimum values of all these parameters owing to severe crop-weed competition during the critical growth period. Among the herbicide and mulch integrated treatments, diclosulam 30 g ha⁻¹ as PE fb mulching with *Mikania micrantha* 10 t ha⁻¹ (T₇) recorded significantly higher values for all yield attributes and was at par with diclosulam 25 g ha⁻¹ as PE fb mulching with *Mikania micrantha* 10 t ha⁻¹ (T₆), both being superior to sole herbicide (T₁-T₃) and sole weed mulch (T₄) treatments. Improved kernels per pod and seed index under integrated treatments reflect enhanced assimilate partitioning to developing seeds resulting from higher LAI, chlorophyll content and CGR recorded under these treatments. These findings are in conformity with Fatima *et al.* (2020), Kumar *et al.* (2019) and Malik *et al.* (2021), who reported significantly higher yield attributes under integrated herbicide and mulch treatments compared to sole weed management practices.

Table 3 : Effect of weed management practices on population of weeds at 30 and 60 DAS in summer groundnut.

Treatments	Population of weeds (No. m ⁻²)					
	30 DAS			60 DAS		
	Grass	BLW	Total	Grass	BLW	Total
T ₁ : Diclosulam 20 g ha ⁻¹ as PE	12.77(162.67)	4.81(22.67)	13.63(185.33)	16.38(268.00)	6.04(36.00)	17.45(304.00)
T ₂ : Diclosulam 25 g ha ⁻¹ as PE	11.20(125.33)	4.04(16.00)	11.88(141.33)	14.98(224.00)	5.34(28.00)	15.88(252.00)
T ₃ : Diclosulam 30 g ha ⁻¹ as PE	11.14(124.00)	3.71(13.33)	11.72(137.33)	13.53(182.67)	4.53(20.00)	14.25(202.67)
T ₄ : Mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	14.57(212.00)	7.15(50.67)	16.22(262.67)	18.15(329.33)	7.75(60.00)	19.73(389.33)
T ₅ : Diclosulam 20 g ha ⁻¹ as PE fb mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	11.10(122.67)	2.65(6.67)	11.39(129.33)	13.33(177.33)	4.37(18.67)	14.01(196.00)
T ₆ : Diclosulam 25 g ha ⁻¹ as PE fb mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	10.04(101.33)	2.39(5.33)	10.31(106.67)	12.02(145.33)	3.12(9.33)	12.41(154.67)
T ₇ : Diclosulam 30 g ha ⁻¹ as PE fb mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	9.00(81.33)	2.12(4.00)	9.23(85.33)	10.82(117.33)	2.39(5.33)	11.07(122.67)
T ₈ : Imazethapyr 100 g ha ⁻¹ as PoE	13.18(173.33)	5.92(34.67)	14.44(208.00)	16.58(274.67)	6.87(46.67)	17.94(321.33)
T ₉ : Hand weeding at 20 and 40 DAS	4.04(16.00)	1.65(2.67)	4.34(18.67)	4.37(18.67)	2.39(5.33)	4.94(24.00)
T ₁₀ : Unweeded control	17.98(322.67)	8.11(65.33)	19.71(388.00)	20.01(400.00)	8.67(74.67)	21.80(474.67)
SEm(±)	0.35	0.25	0.37	0.40	0.22	0.40
CD at 5%	1.04	0.74	1.11	1.19	0.66	1.18
CV%	5.29	10.09	5.27	4.96	7.43	4.60

Table 4 : Effect of weed management practices on dry weight of weeds at 30 and 60 DAS in summer groundnut.

Treatments	Dry weight of weeds (g m ⁻²)					
	30 DAS			60 DAS		
	Grass	BLW	Total	Grass	BLW	Total
T ₁ : Diclosulam 20 g ha ⁻¹ as PE	5.88(34.07)	4.75(22.09)	7.53(56.16)	6.54(42.39)	4.85(23.04)	8.12(65.43)
T ₂ : Diclosulam 25 g ha ⁻¹ as PE	5.22(26.83)	4.10(16.31)	6.03(43.13)	5.93(34.72)	4.33(18.28)	7.31(53.00)
T ₃ : Diclosulam 30 g ha ⁻¹ as PE	4.49(19.68)	3.65(12.88)	5.18(32.56)	5.28(27.44)	3.89(14.68)	6.52(42.12)
T ₄ : Mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	7.47(55.41)	7.04(49.07)	10.25(104.48)	9.14(83.29)	7.17(50.93)	11.60(134.23)
T ₅ : Diclosulam 20 g ha ⁻¹ as PE fb mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	3.94(15.09)	2.18(4.27)	4.45(19.36)	5.13(25.85)	2.98(8.44)	5.89(34.29)
T ₆ : Diclosulam 25 g ha ⁻¹ as PE fb mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	3.32(10.64)	2.63(6.48)	3.92(17.12)	4.33(18.27)	2.77(7.27)	5.10(25.53)
T ₇ : Diclosulam 30 g ha ⁻¹ as PE fb mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	2.7(6.95)	2.38(5.31)	3.27(12.25)	3.98(15.57)	2.47(5.64)	4.63(21.21)

Table 4 continued...

Table 4 continued...

T ₈ : Imazethapyr 100 g ha ⁻¹ as PoE	6.76(45.16)	5.81(33.24)	7.93(78.40)	7.92(62.20)	5.93(34.69)	9.87(96.89)
T ₉ : Hand weeding at 20 and 40 DAS	2.05(3.71)	1.93(3.40)	2.74(7.11)	2.22(4.44)	2.29(4.75)	3.11(9.19)
T ₁₀ : Unweeded control	11.04(121.53)	9.00(80.99)	12.33(202.52)	11.34(128.12)	9.10(82.88)	14.53(211.00)
SEm(±)	0.16	0.23	0.34	0.40	0.22	0.40
CD at 5%	0.47	0.68	1.02	1.19	0.66	1.18
CV%	5.19	9.11	9.31	4.96	7.43	4.60

Table 5 : Effect of weed management practices on growth parameters of summer groundnut.

Treatments	Growth parameters									
	Plant height (cm)		No. of nodules plant ⁻¹		LAI		Chlorophyll content(mg g ⁻¹)		CGR (g m ⁻² day ⁻¹)	
	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	0-30 DAS	30-60 DAS
T ₁ : Diclosulam 20 g ha ⁻¹ as PE	13.68	34.79	14.40	57.20	0.26	1.09	0.88	1.94	1.77	3.70
T ₂ : Diclosulam 25 g ha ⁻¹ as PE	14.27	35.25	14.33	58.00	0.24	1.19	0.89	1.64	1.93	3.76
T ₃ : Diclosulam 30 g ha ⁻¹ as PE	14.83	36.43	14.07	58.20	0.28	1.22	0.92	1.99	2.04	4.30
T ₄ : Mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	12.99	33.79	13.93	56.80	0.22	1.02	0.76	1.49	1.55	4.77
T ₅ : Diclosulam 20 g ha ⁻¹ as PE fb mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	14.92	36.87	24.78	59.80	0.26	1.48	0.93	1.53	2.08	4.38
T ₆ : Diclosulam 25 g ha ⁻¹ as PE fb mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	15.79	39.01	24.63	63.20	0.26	1.6	0.95	2.16	2.24	4.82
T ₇ : Diclosulam 30 g ha ⁻¹ as PE fb mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	15.93	40.51	27.86	69.20	0.33	1.64	0.99	1.84	2.25	4.87
T ₈ : Imazethapyr 100 g ha ⁻¹ as PoE	13.09	34.19	13.53	53.63	0.21	0.84	0.78	1.7	1.71	4.87
T ₉ : Hand weeding at 20 and 40 DAS	16.1	42.67	25.46	74.33	0.34	1.92	1.06	1.66	2.49	5.24
T ₁₀ : Unweeded control	11.6	29.81	12.23	46.40	0.2	0.78	0.76	1.55	1.38	4.17
SEm(±)	0.52	1.00	1.34	2.14	0.03	0.09	0.06	0.15	0.05	0.18
CD at 5%	1.55	2.97	3.99	6.35	0.09	0.28	NS	NS	0.14	0.54
CV%	6.26	4.76	12.56	6.20	19.5	12.83	12.26	14.67	4.34	6.99

Table 7 demonstrated that the highest seed yield (2.51 kg ha⁻¹) and haulm yield (4.92 kg ha⁻¹) were recorded under two hand weeding (T₉), closely followed by T₇ (2.26 kg ha⁻¹ and 4.88 kg ha⁻¹, respectively) and T₆ (2.19 kg ha⁻¹ and 4.63 kg ha⁻¹, respectively). Among sole herbicide treatments, diclosulam 30 g ha⁻¹ as PE (T₃) recorded the highest seed and haulm yield. The lowest seed yield (0.68 kg ha⁻¹) and haulm yield (2.14 kg ha⁻¹)

were recorded under the unweeded control (T₁₀). Protein content of groundnut kernels was significantly influenced by weed management treatments. The highest protein content was recorded under T₉ (23.71%), closely followed by T₆ (23.50%) and T₇ (23.45%) while the unweeded control (T₁₀) recorded lowest protein content (19.81%). Oil content remained non-significant across the treatments, ranging from 41.33% to 47.21%. These

Table 6 : Effect of weed management practices on yield attributes of summer groundnut.

Treatments	Yield attributes			
	Total no. of Pods plant ⁻¹	Matured pods plant ⁻¹	No. of Kernels pod ⁻¹	Seed index (g)
T ₁ : Diclosulam 20 g ha ⁻¹ as PE	16.10	12.60	1.08	31.17
T ₂ : Diclosulam 25 g ha ⁻¹ as PE	15.25	11.98	1.31	33.95
T ₃ : Diclosulam 30 g ha ⁻¹ as PE	16.26	13.53	1.36	31.60
T ₄ : Mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	18.05	14.65	0.77	29.17
T ₅ : Diclosulam 20 g ha ⁻¹ as PE fb mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	17.55	13.55	1.31	32.98
T ₆ : Diclosulam 25 g ha ⁻¹ as PE fb mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	18.54	15.41	1.38	33.32
T ₇ : Diclosulam 30 g ha ⁻¹ as PE fb mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	18.89	15.89	1.32	33.32
T ₈ : Imazethapyr 100 g ha ⁻¹ as PoE	15.40	11.46	1.09	32.36
T ₉ : Hand weeding at 20 and 40 DAS	17.30	15.17	1.43	34.79
T ₁₀ : Unweeded control	15.23	12.40	0.58	28.33
SEm(±)	1.42	1.05	0.11	1.45
CD at 5%	NS	3.13	0.33	4.31
CV%	14.57	13.26	16.69	7.83

Table 7 : Effect of weed management practices on yield, quality and economics of summer groundnut.

Treatments	Seed yield (t ha ⁻¹)	Haulm yield (t ha ⁻¹)	Oil content (%)	Protein content (%)	Cost of cultivation (₹ ha ⁻¹)	Gross return (₹ ha ⁻¹)	Net return (₹ ha ⁻¹)	Return per rupee invested
T ₁ : Diclosulam 20 g ha ⁻¹ as PE	1.39	3.83	43.12	21.89	54606	159786	105180	2.93
T ₂ : Diclosulam 25 g ha ⁻¹ as PE	1.63	4.25	45.13	22.23	55023	175522	120499	3.19
T ₃ : Diclosulam 30 g ha ⁻¹ as PE	1.90	4.30	46.48	22.86	55439	193438	137998	3.49
T ₄ : Mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	0.98	2.33	42.00	20.37	54691	124923	70232	2.28
T ₅ : Diclosulam 20 g ha ⁻¹ as PE fb mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	1.95	4.48	45.89	23.22	56942	197553	140611	3.47
T ₆ : Diclosulam 25 g ha ⁻¹ as PE fb mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	2.19	4.63	46.40	23.50	57359	213048	155689	3.71
T ₇ : Diclosulam 30 g ha ⁻¹ as PE fb mulching with <i>Mikania micrantha</i> 10 t ha ⁻¹	2.26	4.88	46.87	23.45	57775	215227	157451	3.73
T ₈ : Imazethapyr 100 g ha ⁻¹ as PoE	1.32	3.11	42.07	20.41	53889	142839	88949	2.65
T ₉ : Hand weeding at 20 and 40 DAS	2.51	4.92	47.21	23.71	71335	234110	162775	3.28
T ₁₀ : Unweeded control	0.68	2.14	41.33	19.81	52355	100229	47874	1.91
SEm(±)	0.10	0.10	1.60	0.46	-	4936.44	4936.44	0.09
CD at 5%	0.29	0.30	NS	1.38	-	14665.24	14665.24	0.26
CV%	9.90	4.43	6.22	3.62	-	4.87	7.20	5.00

findings are in conformity with Malakiya *et al.* (2023), Harikesh *et al.* (2021), who reported that weed management treatments did not exert significant influence on oil content of groundnut.

Economics

As per Table 7, among all the treatments, hand weeding at 20 and 40 DAS (T_9) incurred the highest cost of cultivation ($\text{₹ } 71,335 \text{ ha}^{-1}$) due to high labour cost, while the unweeded control (T_{10}) recorded the lowest ($\text{₹ } 52,355 \text{ ha}^{-1}$). The highest net return ($\text{₹ } 1,62,775 \text{ ha}^{-1}$) was recorded from hand weeding (T_9), closely followed by T_7 ($\text{₹ } 1,57,451 \text{ ha}^{-1}$), which was at par with T_6 ($\text{₹ } 1,55,689 \text{ ha}^{-1}$). The highest return per rupee invested was recorded under T_7 (3.73), which was at par with T_6 (3.71).

Conclusion

The integrated use of diclosulam as pre-emergence with *Mikania micrantha* mulch recorded significantly higher growth parameters, yield attributes, yield and economic returns compared to sole application of diclosulam or weed mulch alone. Although, diclosulam 30 g ha^{-1} as PE fb mulching with *Mikania micrantha* 10 t ha^{-1} (T_7) was the most effective treatment, it was at par with diclosulam 25 g ha^{-1} as PE fb mulching with *Mikania micrantha* 10 t ha^{-1} (T_6) in all parameters studied. Therefore, diclosulam 25 g ha^{-1} as pre-emergence followed by mulching with *Mikania micrantha* at 10 t ha^{-1} appears to be a promising, efficient and cost-effective integrated weed management practice for groundnut cultivation in lateritic soil of West Bengal.

Conflicts of interest

The authors declares that they don't have any conflicts of interest.

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