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RESEARCH NOTE

Herbicide mixtures effect on weed control, growth and yield of groundnut

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ABSTRACT

A field study was carried out on sandy loam soils at College Farm, Agricultural College, Mahanandi, Andhra Pradesh during *Kharif*, 2024 to assess the efficacy of herbicide mixtures on weeds, growth and yield of groundnut (*Arachis hypogaea* L.). The experiment comprised of ten weed management treatments and was laid out in randomized block design with three replications. The weed density and biomass were significantly lower with hand weeding twice at 20 and 40 days after sowing (DAS) and it was closely followed by pre-emergence application (PE) of diclosulam + pendimethalin 20 + 680 g/ha followed by (*fb*) hand weeding at 40 DAS. Higher groundnut plant height, dry matter accumulation, pod yield, haulm yield and benefit-cost ratio were recorded with hand weeding twice at 20 and 40 DAS which was at par with diclosulam + pendimethalin 20 + 680 g/ha PE *fb* hand weeding at 40 DAS.

Keywords: Diclosulam + pendimethalin, Groundnut, Hand weeding, Herbicide, Weed management

Groundnut (*Arachis hypogaea* L.), is an important oilseed and leguminous crop grown in tropical and subtropical regions worldwide. It is a valuable source of nutrients including proteins, oil and vitamins. It contains 48-50% of oil, 26-28% of protein and essential vitamins and minerals. Globally, India is one of the top producers of groundnut with an area of 48.80 lakh hectares under groundnut cultivation during 2023-24. Among different states of India, Gujarat leads in groundnut production with 36.74 lakh tonnes followed by Rajasthan with 20.86 lakh tonnes. In Andhra Pradesh, the major groundnut growing districts are Sri Sathyasai, Ananthapuramu, Kurnool, Annamayya and Chittoor which together account for 63% of the area and contribute 74% to the state's total groundnut production (Government of Andhra Pradesh 2024). The productivity of groundnut is highest in Guntur district with 4.28 t/ha while the lowest productivity of 0.47 t/ha is observed in Sri Sathyasai district. The average productivity of the state during 2022-23 was 1.01 t/ha (Government of Andhra Pradesh 2024).

There are several reasons for the low productivity of groundnut in India in general and Andhra Pradesh in particular. The weed infestation is major concern. As weeds compete with crop for resources and in cause 13-85% yield loss due to weeds interference (Nambi and Sundari 2008). The yield loss due to weeds depends on the type of weeds, their density and duration of the weed infestation. At present various formulations of pre-emergence and post-emergence herbicides are available in the market that offer broad spectrum weed control which need to be evaluated for their effectiveness to control weeds, and to identify suitable herbicides to manage weeds and improve the growth and yield of groundnut. Thus, this study was undertaken to assess the weed management efficacy of tank mixed pre-emergence and post-emergence herbicides alone and in integration with inter cultivation to improve productivity of groundnut.

A field experiment was conducted during *Kharif*, 2024 at Agricultural College Farm, Mahanandi, Andhra Pradesh, India. The soil was sandy loam in texture, neutral in soil reaction (7.43), with low organic carbon (0.42%), low in available nitrogen (169 kg/ha), medium in available

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phosphorous (38 kg/ha) and high in available potassium (572 kg/ha). The trial was laid out in randomized block design with three replications. There were ten treatments including: pre-emergence application (PE) of diclosulam + pendimethalin 20 + 680 g/ha; pyroxasulfone + pendimethalin 147 + 680 g/ha PE; diclosulam + pyroxasulfone 20 + 147 g/ha PE; pendimethalin 680 g/ha PE followed by (*fb*) post-emergence application (PoE) of quizalofop-ethyl 4.5 g/ha; pendimethalin 680 g/ha PE alone; diclosulam + pendimethalin 20 + 680 g/ha PE *fb* hand weeding at 40 days after seeding (DAS); pyroxasulfone + pendimethalin 147 + 680 g/ha PE *fb* hand weeding at 40 DAS; diclosulam + pyroxasulfone 20 + 147 g/ha PE *fb* hand weeding at 40 DAS; hand weeding twice at 20 and 40 DAS and un weeded control. Herbicides were tank mixed before spraying as per the treatments.

Pre-emergence herbicides (diclosulam, pendimethalin, pyroxasulfone) were applied uniformly at 3 DAS and post-emergence herbicide (quizalofop-ethyl) was applied uniformly at 20 DAS, by using spray fluid 500 litres/ha with the help of knap sack sprayer as per the treatments. Groundnut variety '*TCGS-1694*' was sown by adopting spacing of 30 x 10 cm. Recommended dose of fertilizers 20:40:60 kg/ha N, P_2O_5 and K_2O was applied through urea, SSP and MOP. Entire quantity of nitrogen and potassium was applied in two splits *i.e.,* at basal and at flowering stage and full amount of phosphorous were applied as basal as per the treatments. Sulphur was applied in the form of gypsum 500 kg/ha at 45 DAS. Density and dry weight (biomass) of weeds were recorded by using quadrat (1.0 m^{-2}) in each plot. Weed data was transformed to square root transformation ($\sqrt{x+0.5}$) to normalize their distribution. Weed control efficiency was calculated as per the formula suggested by Mani *et al.* (1973). For the purpose of comparing various treatment means, the critical difference was correlated at 5% significance level as recommended by Panse and Sukhatme (1985).

Effect on weeds

Major weed flora observed in experimental plots were *Cynodon dactylon*, *Dactyloctenium aegyptium*, *Eragrostis curvula*, *Cyperus iria*, *Cyperus rotundus* in monocot category. *Amaranthus viridis*, *Boerhavia diffusa*, *Commelina bengalensis*, *Digera arvensis*, *Parthenium hysterophorus*, *Phyllanthus niruri* and *Trichodesma indicum*, amongst broad-leaved weeds category, were predominant in groundnut.

Hand weeding twice at 20 and 40 DAS recorded lower weed density, at harvest, which was at par with diclosulam + pendimethalin 20 + 680 g/ha PE *fb* hand weeding at 40 DAS (**Table 1**). The lower density of weeds was recorded with the diclosulam 20 g/ha PE might be due to the enzyme Acetolactate Synthase (ALS), which is essential for amino acid synthesis is inhibited. By ALS inhibition, diclosulam disrupts protein synthesis and cell division in the weeds leading to stunted growth and eventually death. The treatments having pendimethalin as one of the components have shown their potential against grassy and broad-leaved weeds and were successful in lowering the density of weed species confirming the findings of Gulaiya *et al.* (2023) and Mukilan *et al.* (2023). Hand weeding twice at 20 and 40 DAS recorded lower weed biomass at harvest which was at par with diclosulam + pendimethalin 20 + 680 g/ha PE *fb* hand weeding at 40 DAS (**Table 1**). Diclosulam and pendimethalin together suppress weeds by preventing amino acid synthesis, interfering with enzyme function and blocking weed growth (Gulaiya *et al.* 2023). Higher weed density and biomass was recorded in un weeded control. Higher weed control

Table 1. Weed density, weed biomass and weed control efficiency at harvest of groundnut as affected by weed management treatments

Treatment	Weed density (no/m^2)	Weed biomass (g/m^2)	WCE (%)
Diclosulam + pendimethalin 20 + 680 g/ha PE	10.85 (117.83)	15.63 (243.73)	34.38
Pyroxasulfone + pendimethalin 147 + 680 g/ha PE	12.62 (158.67)	17.04 (290.05)	21.92
Diclosulam + pyroxasulfone 20 + 147 g/ha PE	11.91 (141.33)	16.40 (268.65)	27.68
Pendimethalin 680 g/ha PE *fb* quizalofop ethyl 4.5 g/ha PoE	13.70 (187.01)	17.70 (312.91)	15.76
Pendimethalin 680 g/ha PE alone	14.53 (210.66)	18.69 (348.88)	6.08
Diclosulam + pendimethalin 20 + 680 PE g/ha *fb* hand weeding at 40 DAS	8.44 (70.67)	11.60 (134.13)	63.89
Pyroxasulfone + pendimethalin PE 147 + 680 g/ha *fb* hand weeding at 40 DAS	10.35 (106.67)	14.66 (214.33)	42.30
Diclosulam + pyroxasulfone 20 + 147 PE g/ha *fb* hand weeding at 40 DAS	9.50 (89.67)	13.75 (188.63)	49.22
Hand weeding twice at 20 and 40 DAS	7.11 (50.01)	9.47 (89.25)	75.97
Un weeded control	15.47 (239.00)	19.29 (371.48)	0.00
LSD (p=0.05)	12.70	25.60	3.90

*Figures in parentheses indicates squares root transformed values; *fb*: followed by; PE: pre-emergence application; PoE: post-emergence application

Table 2. Growth, yield and economics of groundnut as influenced by different weed management treatments

Treatment	Plant height (cm)	DMP (kg/ha)	No. of pods per plant	Shelling percentage	Pod yield (kg/ha)	Haulm yield (kg/ha)	Net returns (₹/ha)	B:C ratio
Diclosulam +pendimethalin 20 + 680 g/ha PE	33.7	5573	32.1	67.8	1551	3312	36714	1.75
Pyroxasulfone + pendimethalin 147 + 680 g/ha PE	32.2	5222	31.1	66.8	1455	3162	29067	1.57
Diclosulam + pyroxasulfone 20 + 147 g/ha PE	33.1	5385	31.6	67.5	1516	3206	32323	1.63
Pendimethalin 680 g/ha PE *fb* quizalofop-ethyl 4.5 g/ha PoE	31.5	5184	30.3	66.2	1356	3008	26256	1.54
Pendimethalin 680 g/ha PE alone	30.9	4984	29.6	65.7	1305	2974	24690	1.52
Diclosulam + pendimethalin 20 + 680 g/ha PE *fb* hand weeding at 40 DAS	36.3	6019	33.7	69.8	1813	3637	47998	1.93
Pyroxasulfone + pendimethalin 147 + 680 g/ha PE *fb* hand weeding at 40 DAS	34.4	5686	32.8	68.1	1676	3412	38104	1.70
Diclosulam + pyroxasulfone 20 + 147 g/ha PE *fb* hand weeding at 40 DAS	35.2	5842	33.1	68.9	1783	3586	43904	1.81
Hand weeding twice at 20 and 40 DAS	38.8	6298	34.2	70.3	1901	3775	52264	2.00
LSD (p=0.05)	3.6	587	3.3	6.0	178	427	9554	0.20

fb: followed by; PE: pre-emergence application; PoE: post-emergence application

efficiency was observed in hand weeding twice at 20 and 40 DAS confirming the findings of Goud *et al.* (2023).

Effect on crop

Groundnut growth parameters at harvest were significantly influenced by different weed management treatments (**Table 2**). Maximum groundnut plant height and dry matter production, number of pods per plant, shelling percentage, higher pod and haulm yields were recorded with hand weeding twice at 20 and 40 DAS which was at par with diclosulam + pendimethalin 20 + 680 g/ha PE *fb* hand weeding at 40 DAS (**Table 2**). This could be because of removal of weeds during crucial time, increasing the amount of light, moisture and space available to the plant. It could also increase plant height (Deepa *et al.* 2017), produce large leaves, greater dry matter production (Kundu *et al.* 2021; Srinivasan *et al.* 2024) and a greater number of pods leads to increase the production of dry matter. It is also because of less competition from weeds for growth resources during the crop development cycle, which encouraged the groundnut growth. Increased pod and haulm yield was the outcome of the combined action of all these growth and yield factors. Cumulative effect of lower weed density, higher WCE and lesser nutrient removal by weeds occurred as a result of reduced crop weed competition, better crop environment and higher uptake of nutrients by groundnut. Subramanyam *et al.* (2020) also observed significantly higher pod and haulm yield with pre-emergence application of diclosulam 20 g/ha supplemented with HW at 40 DAS. Sridhar *et al.* (2021) reported that highest pod yield with diclosulam 27 g/ha PE *fb* hand weeding at 50 DAS due to low crop weed competition throughout the crop growth. The lowest groundnut plant height, dry matter production observed in weedy check confirmed findings of Ravi *et al.* (2023) Suseendran *et al.* (2019).

Higher net returns and benefit-cost ratio (**Table 2**) were observed with hand weeding twice at 20 and 40 DAS which was comparable with diclosulam + pendimethalin 20 + 680 g/ha PE *fb* hand weeding at 40 DAS supporting the findings of Subramanyam *et al.* (2020).

Conclusion

It can be concluded that hand weeding twice at 20 and 40 DAS or diclosulam + pendimethalin 20 + 680 g/ha PE *fb* hand weeding at 40 DAS were observed to be the most effective and economically viable integrated weed management options for enhancing the productivity and maximizing the profitability of groundnut in sandy loam soils of Scarce Rainfall Zone of Andhra Pradesh.

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