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Relative efficiency of pre- and post-emergence herbicides on weed dynamics, yield productive and economics of groundnut (*Arachis hypogaea* L.)

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ABSTRACT

A field experiment was conducted at the Crop Research Centre, School of Agriculture, ITM University, Gwalior (M.P.) during *Kharif* season 2022. The experiment was conducted with Randomized Block Design and replicated three times and comprised with ten treatments. The herbicides were used individually as well as in combinations viz; T_1 to T_9. The crop was infested with the different types of weed flora. eg; *Dinebra retroflexa* and *Digitaria sanguinalis* of grassy, *Amaranthus viridis* and *Commelina benghalensis* of Broad leaved and *Cyperus rotundus* of sedges group. Weed density of the different weed species and total weeds effected significantly due to different weed management practices, The result indicated that the total weed population and its dry weight, weed index were lowest with Oxyfluorfen (23.5%) at 100g ha^{-1} (PE) *fb* hand weeding (40 DAS). However, highest weed control efficiency was recorded with Oxyfluorfen (23.5%) at 100g ha^{-1} (PE) *fb* hand weeding (40 DAS) followed by Imazethapyr (35% EC + Imazamox (35% EC) at 180 g a.i. ha^{-1} 20 and 40 DAS. Yield attributes and yield like number of pods plant^{-1}, number of kernelspod^{-1}, Test weight(g), Pod yield (kg ha^{-1}), Haulm yield (kg ha^{-1}), Harvest index were significantly higher with T_6; Oxyfluorfen (23.5%) at 100g ha^{-1} (PE) *fb* hand weeding (40 DAS).

Key words: *Groundnut, Oxyfluorfen, Imazethapyr, Weed density, Weeds, Pod yield, Net returns*

Introduction

Groundnut (*Arachis hypogaea* L.) in India out of total production of edible oil, 67 per cent is contributed by groundnut. The demand for edible oil in the country is rising by 6 per cent per annum. Therefore, concerted efforts are now being made for increasing and stabilizing oilseed production is the third-most essential source of vegetable protein and the fourth-most important source of edible oil in the world (Guchli, 2015) and Kombiok *et al*. (2012). It belongs to the plant kingdom's leguminous family and is extensively farmed in tropical and subtropical areas between the 400 N and 400 S latitudes. It is a Brazilian native, an annual, herbaceous, geotropically auto-tetraploid legume with 2n = 40. It has earned the moniker "king of oilseed" crops. Other names for groundnut include Wonder Nut and Poor Man's Cashew Nut. It is higher in energy (567 calories per 100 g) and carbs (20%) than all vegetable oils and polyunsaturated fatty acids (oleic acid). Additionally, it is a significant source of dietary fiber. Among several factors for the reduction of productivity in groundnut, weed infestation play major role and

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reduces the yield up to 35.8% (Gharde *et al*., 2017).

The byproduct of groundnut like haulm is rich in protein content (10-12%) and groundnut cake is excellent feed and good source of organic manures (7-8 % N, 1.5 % P_2O_5 and 1.2 % K_2O) as legume, is contain root nodules to fixes atmospheric nitrogen of 200 kg N ha^{-1} (Singh *et al*., 1984)

According to Walia *et al*. (2007), there is a pressing want to investigate the potential for raising productivity through a better comprehension of the production restrictions in oilseed crops, particularly groundnut. Approximately 85% of the country's groundnut production is cultivated during the kharif season in rainfed environments, where the whims of the monsoon and seasonal biotic and abiotic pressures result in low productivity (Devi Dayal, 2004). Productivity of groundnut in India is lower than the world average. Weed menace is considered as one of the major production constraints (Chaitanya *et al.*, 2012).

Globally, Groundnut covers 315 lakh hectares with the production of 536 lakh tonnes with the productivity of 1701 kg per hectare (FAO, 2020). With annual all-season coverage of 55.71 lakh hectares, globally, India ranks first in Groundnut area under cultivation and is the second largest producer in the world with 102 lakh tonnes with productivity of 1831 kg per hectare in 2020-21 (agricoop.nic.in). In Kharif 2021-22, groundnut production was 82.54 lakh tonnes (1st advance estimates) in an area of 49.14 lakh hectares (agricoop.nic). Groundnut is cultivated in one or more (*kharif, rabi* and *summer*) seasons, but nearly 90% of acreage and production comes from *kharif crop* (June-October). In India, 70 per cent of the groundnut area and 75 per cent of the production is concentrated in the states of Gujarat, Tamil Nadu, Andhra Pradesh, Telangana, Maharashtra, Madhya Pradesh, Rajasthan and Karnataka.

Materials and Methods

The field experiment was carried out at the Crop research Center, School of agriculture, ITM University, Gwalior (M.P.), during the *kharif* season of 2022. The research field is located in the Indo-Gangetic plains region of the subtropics at an elevation of 196 m above sea level with coordinates of 26° 13′ N latitude and 76° 14′ E longitude.

Treatments details

The randomized black design was replicated three times and featured a total of ten treatments. The treatments were: T_1: Hand weeding 20 and 40 DAS; T_2: Hoeing 20&40 DAS; T_3: Pendimethalin (30%EC) at 750g ha^{-1} (PE); T_4: Imazethapyr (10%EC) at 80 g a.i. ha^{-1} (PE); T_5: Oxyfluorfen (23.5%EC) at 100g ha^{-1} (PE);T_6: Oxyfluorfen (23.5%) at 100g ha^{-1} (PE) *fb* one hand weeding 40 DAS,(POE); T_7; Imazethapyr (35% EC + Imazamox (35%EC) at 180g ha^{-1} (POE); T8; Weed Check T_9; Weed free,

The groundnut variety "Kranthi" was used for the experiment, and sowing was done in 26 July 2022, keeping 45cm x15cm spacing. Pre-emergence applications were applied on the first one day after sowing, and post-emergence herbicides were applied on the 21st day of crop sowing by using a knap sack sprayer with a flat-fan nozzle and a 500 L/ha spray volume. A common dose of 40 kg N, 40kg P2O5, and 60 kg K_2O per hectare was applied as the basal dose of nutrients at the time of sowing weed density (no.m^{-2}), weed dry matter (g m^{-2}), and weed control efficiency(WCE%) observations was recorded on weed at 60 days. After crop grown number of pods per plant, number of grains per pod, pod yield, haulm yield, yield attributes, yield and economics of crop was recorded.

Cost of cultivation ha^{-1} was calculated considering the prevailing charges of operation and input cost also included. The cost of cultivation was subtracted from the gross return to determine the net return. By dividing the net return by the cost of cultivation, the benefit-cost ratio was obtained.

Statistical information on weeds and crops was examined using randomized block designs and analysis of variance (ANOVA) techniques (Gomez and Gomez, 1984). The square root transformed data $\sqrt{x} + 0.5$ on weed density and dry matter were used in an ANOVA.

Formulae were used: weed index and Weed control efficiency

$$WCE\ (\%) = \frac{DM_C - DM_T}{DM_C} \times 100$$

Where, DMC = Dry matter of weeds intheun-

Weeded check (control) DMT = Dry matter of weeds in the treated plot.

Weed index

$$WI(\%) = \frac{X - Y}{X} \quad 100$$

Where,

X = Grain yield from weed-free check or maximum yield treatment (Complete removal of weeds)
Y = Grain yield from the treated plot for which weed index is to be calculated.

Results and Discussion

Weed Flora

Sedges and weeds with broad and narrow leaves covered the experiment field. At the 60-days stage, the main weed species were *Dinebra retroflexa* (5.11%), *Digitaria sanguinalis* (5.16%), *Amaranthus viridis* (5.21%), *Commelina benghalensis* (4.81%), *Cyperus rotundus* (9.60%), and other weeds (4.82%). Other weeds include *Cynodon dicotylon*, *Euphorbia hirta, Digera arvenis*, and *Portulaca oleracea*. In Table 1, data on density, dry weight of total weeds, and weed control efficiency (WCE) recorded at the 60-days stage of crop growth have been given. At various periods of observation, the existence of the aforementioned weeds in noticeably different populations under various treatments was noted.

Effect on weed

The effectiveness of weed control was determined by how successfully weed populations were managed and how well weed control techniques outperformed weedy checks. This was greatly altered by various weed control techniques. Among all weed control methods, the higher weed control efficiency recorded with T_9 weed-free was found to be more effective; among the herbicides the most effective and recorded minimum weed control efficiency followed by T_6: Oxyfluorfen (23.5%) at 100g ha^{-1} applied first day after sowing(PE) *fb* one hand weeding at 40 DAS; T_7: Imazethapyr (35%EC + Imazamox (35%EC) at 180g ha^{-1} (POE) applied on the 20&40 day after sowing; and The lowest weed control efficiency (WCE) recorded in weedy check treatment.

Among all weed control methods, the lower weed index recorded with T_9 weed-free among the herbicides the lowest weed index (WI) recorded inT_6: Oxyfluorfen (23.5%) at 100g ha^{-1} applied first day after sowing(PE) *fb* one hand weeding at 40 DAS. T_7: Imazethapyr (35%EC + Imazamox (35% EC) at 180g ha^{-1} (POE)applied on the 20&40 day after sowing; The highest weed index (WI) recorded in weedy check treatment.

Guggari *et al*. (1995) observed that weeds can be controlled up to 30–35 percent by pre-emergence applications of herbicides. This was caused by the pre-emergence herbicide's broad-spectrum activity, which can be seen in the roots and leaves of the affected plants. Affected plants die soon after emergence or if a subsequent emergence from the soil takes place (Satyanarayana Regar *et al*., 2021). and the timely weeding, which can reduce the population of weeds Oxyfluorfen (23.5%) at 100g ha^{-1} (PE) *fb* hand weeding (40 DAS). The crop canopy has restricted weed development as shown by plant height and the greater number of branches per plant, which cannot allow weeds to grow rapidly.

Table 1. Effect of different weed control treatments on weed density (no. m^{-2}), dry matter (g m^{-2}), Weed Control Efficiency (%), weed index at 60 days

S. No.	Treatment	Weed density (no. m^{-2})	Weed dry weight (g m^{-2})	WCE (%)	Weed Index (WI)
T_1	Hand weeding (20 and 40 DAS)	10.67 (113.53)	8.17 (66.22)	69.286	12.27
T_2	Hoeing (20 and 40 DAS)	10.53 (110.75)	7.73 (59.42)	77.111	10.98
T_3	Pendimethalin (30% EC) at 750g ha^{-1} (PE)	12.12 (146.93)	11.57 (133.93)	47.053	34.06
T_4	Imazethapyr (10% EC) at 80g ha^{-1} (PE)	12.03 (144.99)	11.47 (131.00)	51.806	32.76
T_5	Oxyfluorfen (23.5% EC) at 100g ha^{-1} (PE)	12.16 (149.60)	11.62 (136.17)	46.976	35.36
T_6	Oxyfluorfen (23.5%) at 100g ha^{-1} (PE) fb hand weeding (40 DAS)	10.90 (118.42)	8.32 (68.85)	62.839	12.90
T_7	Imazethapyr (35% EC + Imazamox (35% EC) at 180g ha^{-1} (POE)	10.96 (119.73)	8.52 (72.11)	68.136	21.32
T_8	Weed Check	14.69 (216.23)	15.83 (251.07)	100.000	51.98
T_9	Weed free	0.71 (0.00)	0.71 (0.00)	69.286	0.00
	SEm+	0.95	0.44	--	-
	C.D.at 5%	0.95	1.32	--	-

Note: Fig. in parenthesis are the original values, X=√5e+ 0.5 transformation

This treatment combination reduced the weed population at harvest.

Irrespective of weed-free treatment (hand weeding as and when required), significantly lower weed density (No. m^{-2}) and weed biomass at the 60-day stage were recorded with the among the herbicide application of T_6: Oxyfluorfen (23.5%) at 100g ha^{-1} applied first day after sowing(PE) *fb* one hand weeding at 40 DAS is at par with the T_7: Imazethapyr (35% EC + Imazamox (35% EC) at 180g ha^{-1} (POE) applied on the 20 and 40 day after sowing. On the T_8: weed check treatment, significantly greater weed weight and density were noted.

The various weed management techniques had a substantial impact on the groundnut yield characteristics and economics (Table 2). Significantly higher numbers of pods and kernels per pod were recorded in T_6: Oxyfluorfen (23.5%) at 100g ha^{-1} applied first day after sowing (PE) *fb* hand weeding at 40 DAS is at par with the T_7: Imazethapyr (35% EC + Imazamox (35% EC) at 180g ha^{-1} (POE) applied on the 20 and 40 day after sowing

Effect on Groundnut

Significantly higher yield was recorded in T_9: Weed-free (1807 kg ha^{-1}). Among herbicides higher yield was recorded in T_6: Oxyfluorfen (23.5%) at 100g ha^{-1} applied first day after sowing (PE) *fb* hand weeding at 40 DAS (1552.00 kg ha^{-1}) which is at par with T_7: Imazethapyr (35% EC + Imazamox (35%EC) at 180g ha^{-1} (POE) applied on the 20 and 40 day after sowing (1520.00 kg ha^{-1}) Significantly lower yield was recorded with the T_8 weedy-check (866.67kg ha^{-1}), because of a severe weed infestation.

Economics

Among all the herbicide treatments, the highest net return was recorded with T_6: Oxyfluorfen (23.5%) at 100g ha^{-1} applied first day after sowing (PE) *fb* hand weeding at 40 DAS (88691 ha^{-1}), which is on par with T_7: Imazethapyr (35%EC + Imazamox (35%EC) at 180g ha^{-1} (POE) applied on the 20&40 day after sowing (78765.64ha^{-1}); lowest return was recorded in T_8; weedy check the (41769 ha^{-1}). The benefit-cost ratio recorded a higher T_6: Oxyfluorfen (23.5%) at 100g ha^{-1} applied first day after sowing(PE) *fb* hand weeding at 40 DAS, followed by (INR 2.29), followed by with T_7: Imazethapyr (35%EC) + Imazamox (35%EC) at 180 g ha^{-1} (POE) applied on the 20&40 day after sowing (INR 2.10). Similarly, Sasikala *et al*. (2004) and Rao *et al*. (2011) have also reported higher net return and B.C ratio with integration and utilizing of pre- and post- emergence applications of herbicides in groundnut increased Benefits and BC ratio.T_8 Weed check recorded lowest benefit cost ratio (B.C) (INR1.34).

Conclusion

Based on the experimental results it concluded that Pre-emergence doses may help boost groundnut pod production and net returns. When compared to the other treatments, using Oxyfluorfen (23.5%) at 100 g a.i. ha^{-1} applied first day after sowing *fb* one

Table 2. Effect of different treatments on yield attributes and economics of groundnut

S. No.	Treatment	Number of pods (plant^{-1})	Number of kernels (plant^{-1})	Test Weight (g^{-1})	Pod yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Net returns (INRha^{-1})	B-C ratio (INR re^{-1} Invested)
T_1	Hand weeding (20 and 40 DAS)	28.62	2.71	35.81	1563.33	3980.00	85084	1.97
T_2	Hoeing (20 and 40 DAS)	29.17	2.77	36.87	1606.67	4066.67	87059	2.01
T_3	Pendimethalin (30%EC) at 750g ha^{-1} (PE)	22.44	2.08	28.90	1290.00	3713.33	65938.86	2.02
T_4	Imazethapyr (10%EC) at 80g ha^{-1} (PE)	22.80	2.10	29.12	1313.55	3824.26	68381.71	2.12
T_5	Oxyfluorfen (23.5%EC) at 100g ha^{-1} (PE)	22.01	2.06	28.54	1210.00	3608.67	63815	1.95
T_6	Oxyfluorfen (23.5%) at 100g ha^{-1} (PE) fb one hand weeding (40 DAS)	27.95	2.61	34.57	1552.00	3970.00	88691	2.29
T_7	Imazethapyr (35% EC + Imazamox (35% EC) at 180g ha^{-1} (POE)	27.12	2.54	34.31	1520.00	3956.67	78765.64	2.10
T_8	Weed Check	19.77	1.90	26.25	866.67	3100.00	41769	1.34
T_9	Weed free	33.41	3.26	42.42	1807.07	4183.33	83967.39	1.37
	SEm+	4.04	0.40	5.24	192.81	469.52	--	--
	C.D. at 5%	28.62	2.71	NS	1563.33	3980.00	--	--

hand weeding at 40 DAS and Imazethapyr (35%EC + Imazamox (35% EC) at 180 g a.i. ha^{-1} applied on the 20 and 40 day after sowing showed superior results in terms of reducing weed density and dry weight of weeds. It is regarded as an appropriate substitute for groundnuts with a greater B-C ratio and broad-spectrum weed control.

Conflict of interest

There is no conflict of interest.

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