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Effect of weed management on weed dynamics, yield and quality of groundnut (*Arachis hypogaea* L.) under Northern hill of Chhattisgarh

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Abstract
A field experiment was conducted on sandy loam soil to study the "Effect of weed management on weed dynamics, yield and quality of groundnut (*Arachis hypogaea* L.) under northern hill of Chhattisgarh''at Research-cum-instructional farm of Raj Mohini Devi College of Agriculture and Research Station, Ajirma, Ambikapur, Chhattisgarh, during *kharif* season of 2023. The experiment comprising of 9 treatments with three replications laid out in randomized block design. The results revealed that hand weeding at 20 and 40 DAS recorded significantly maximum weed control efficiency (%), lowest weed density (m^{-2}) ,lowest dry weight of weed (g m^{-2}) and lowest weed index (%), higher pod yield (1930 kg ha^{-1}), haulm yield (2610 kg ha^{-1}), harvest index (42.51%), seed index (44.74%), shelling percentage, quality parameter such as oil content (48.30%) with maximum net return (₹ 77466 ha^{-1}) and BCR (2.02). However, integrated weed management practices application of Pendimethalin @ 0.75 kg ha^{-1} PE fb Imazethapyr @ 75 g ha^{-1} at 20 DAS followed by Pendimethalin @ 0.75 k ha^{-1} PE fb Quizalofop-ethyl @ 40 g/ha at 20 DAS also recorded higher weed control efficiency, yield attributes, pod yield and haulm yield compared to other treatments.

Keywords: Groundnut, weed management, weed control efficiency, weed index

Introduction
Groundnut (*Arachis hypogaea* L.) is known as 'king' of oilseeds. It is one of the most important food, fodder and cash crop. Groundnut is also called as poor men's cashew nut. It is one of the most important foods, legume crops with higher protein (22-30%) and oil content (44-56%). Groundnut kernels are rich in vitamins *viz.*, A, B and some member of B_2 group (Bhongade and Khattar, 2020) [2]. Groundnut is also considered as a stable and nutritive as it contains the right proportion of oleic (40-45%) and linoleic (25-35%) acid. The oil cake obtained after the extraction of the oil is a valuable organic manure and animal feed as it contains 7-8% N, 1.5% P_2O_5 and 1.2% K_2O.

Globally, groundnut is cultivated on an area of 49.13 million ha with a production of 83.69 million tonnes with an average productivity 1758 kg ha^{-1}. India contributed 13.58% to the total groundnut production of the world. India ranks first in area and second in production after China. In India, groundnut is cultivated on 5.75 million ha area with a production of 10.11 million tonnes and productivity of 1759 kg ha^{-1} (Anon, 2022) [1]. In Chhattisgarh groundnut is cultivated in an area of 28990 ha with a production of 72760 tonne and productivity of 1232 kg ha^{-1} (Krishi Darshika, 2023) [8].

During the *kharif* season groundnut is extensively grown in India. Among various biotic and abiotic factors, weed infestation is the major biotic factor responsible for low productivity of groundnut. Weeds compete with the crop for nutrients, space and other resources and also impede pod development, pegging and harvesting of the crop (Kumari *et al*., 2021) [9]. Critical period of crop-weed competition for groundnut crop was reported to be upto 45 DAS and weed free environment during this period registered higher pod yield (Rao, 2000) [11]. A yield loss of 35 to 80% in groundnut due to crop weed competition (Korav *et al*., 2020) [7].

Generally weeds are controlled through hand weeding in groundnut, but it is expensive, laborious and sometimes continuous rains will interfere with timely weed control and often damage the economic produce. Effective herbicide at appropriate rate may prove as an effective weed control strategy and replace conventional methods of weed control.

In recent years, farmers are showing increased interest for use of herbicides to control weeds with the urge of reducing cost of cultivation, owing to shortage and high cost of labour (Savu *et al*., 2005) [12]. In recent years, new generation low dose high efficiency herbicide molecules are available which were found to exhibit high level of activity against all the categories of weeds with lesser half-life period coupled with low mammalian toxicity compared to high volume herbicides like Pendimethalin. Consequently, the application of herbicides to manage weeds is highly beneficial, particularly when labor is few and the field conditions do not allow for manual or mechanical weeding.

Materials and Methods

The experiment was conducted on sandy loam soil of Research-cum-instructional farm of Raj Mohini Devi College of Agriculture and Research Station, Ajirma, Ambikapur, Chhattisgarh during kharif seasons 2023. The total rainfall received during the crop growth season 1112.8 mm. Some important characteristics of the soil were pH 6.20, EC 0.09 dS/m, Organic carbon 0.37%, available N, P, K were 241, 12.7, and 293 kg ha^{-1} respectively. Total nine treatments, comprising seven treatments of pre-emergence or post emergence herbicides (pendimethalin 37.5%, Quizalofop ethyl, Imazethapyr Oxadiargyl) combined with hand weeding at 40 DAS, one treatment comprising only cultural practices like hand weeding at 20 and 40 DAS, three treatments comprising both pre and post emergence herbicides and one treatment as unweeded control. The experiment was laid out in randomized block design with three replications and individual plot size of 3.5 m X 3.5 m. Groundnut seeds of C.G. Mungfali -1 were sown at 30 cm row to row and 15 cm plant to plant distance. The crop was fertilized with 40:20:40 NPK kg ha^{-1}. Pre emergence application of herbicides was applied as per the treatment immediately after the sowing. All other recommended agricultural practices were done throughout the crop seasons. Yield and yield attributes, dry weight of weeds per net plot were recorded at the time of crop harvest. Economics of all the treatments was worked out. The weed control efficiency (WCE) and weed index (WI) was calculated by using following formula.

$$WCE\,(\%) = \frac{DWC\text{-}DWT}{DWC} \times 100$$

Where,
WCE = Weed Control efficiency (%)
DWC = Dry weight of weeds in weedy check plot (g)
DWT= Dry weight of weeds on treated plot (g)

Table 1: Weed dry weight, weed control efficiency (%), weed index (%) of groundnut as influenced by different weed management practices

Treatments		Weed dry weight			Weed control efficiency (%)			Weed index (%)
		20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	
T_1-	Pendimethalin @ 0.75 kg ha^{-1} PE fb HW at 40 DAS	4.9 (23.67)	18.49 (341.33)	5.33 (27.93)	68.72	24.37	91.27	28.88
T_2-	Quizalofop-ethyl @ 40 g ha^{-1} 20 DAS fb HW at 40 DAS	8.11 (65.33)	20.05 (401.33)	5.93 (34.67)	13.66	11.08	89.17	23.83
T_3-	Imazethapyr @ 75 g ha^{-1} 20 DAS fb HW at 40 DAS	8.31 (68.67)	13.08 (170.67)	5.3 (27.67)	9.26	62.19	91.35	24.78
T_4-	Oxadirgyl @ 90 g ha^{-1} 20 DAS fb HW at 40 DAS	7.64 (58)	19.29 (371.67)	6.54 (42.33)	23.35	17.65	86.77	33.16
T_5-	Pendimethalin @ 0.75 k ha^{-1} PE fb Quizalofop-ethyl @ 40 g/ha at 20 DAS	4.63 (21)	14.74 (216.67)	11.85 (140)	72.25	51.99	56.25	21.38
T_6-	Pendimethalin @ 0.75 kg ha^{-1} PE fb Imazethapyr @ 75 g ha^{-1} at 20 DAS	5.13 (26)	12.86 (165)	7.66 (58.33)	65.64	63.44	81.77	12.95
T_7-	Pendimethalin @ 0.75 kg ha^{-1} PE fb Oxadirgyl @ 90 g ha^{-1} at 20 DAS	4.74 (22)	17.86 (318.33)	14.45(208.33)	70.93	29.47	34.90	32.09
T_8-	Hand weeding at 20 and 40 DAS	6.69 (44.33)	9.86 (96.67)	4.5 (20)	41.41	78.58	93.75	0.00
T_9-	Unweeded control	8.73 (75.67)	21.26 (451.33)	17.9 (320)	0.00	0.00	0.00	53.25
	SEm±	0.17	0.11	0.17				
	CD (5%)	0.57	0.35	0.53				

Weed index

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

Where,
X = seed yield obtained from weed free plot/ treatment form maximum yield
Y = seed yield obtained from treated plot

Result and discussion

Weed flora

All three types of weeds in several families were present in the experiment field. There were seven major species in total, of which *Cynadon dactylon, Echinochloa colona, Digitaria sanguinalis* L. were found under grassy weeds; *Commelina banghalensis, Ageratumconyzoides, Mollugo verticillata* were found under broad-leaved weeds; and *Cyperus rotundus* was found under sedge weeds.

Effect on dry weight of weed, WCE, WI

The results indicated (Table 1) that the significantly the highest dry weight of weed at 40 DAS (451.33 g m^{-2}) was observed under the unweeded control as compared to all other treatments. The significantly lower dry weight of at 40 DAS was recorded under hand weeding at 20 and 40 DAS. which was at par with treatments Pendimethalin @ 0.75 kg ha^{-1} PE fb Imazethapyr @ 75 g ha^{-1} at 20 DAS, Imazethapyr @ 75 g ha^{-1} 20 DAS fb HW at 40 DAS and Pendimethalin @ 0.75 k ha^{-1} PE fb Quizalofop-ethyl @ 40 g/ha at 20 DAS. The highest weed control efficiency at 40 DAS (78.58%) and the lowest weed index (0.0%) were recorded under hand weeding at 20 and 40 DAS. Similarly, Pendimethalin @ 0.75 kg ha^{-1} PE fb Imazethapyr @ 75 g ha^{-1} at 20 DAS, Imazethapyr @ 75 g ha^{-1} 20 DAS fb HW at 40 DAS and Pendimethalin @ 0.75 k ha^{-1} PE fb Quizalofop-ethyl @ 40 g ha^{-1}at 20 DAS recorded remarkably higher weed control efficiency 63.44, 63.44 and 51.9%, followed by weed free treatment, respectively. Similar result was reported by Kalhapure *et al*. (2013) [6], Dubey and Gangwar (2012) [4], Vora *et al.* (2019) [15].

Effect on yield attributes

The data showed that significantly the highest number of pods (36.67), seed index(44.74) and shellling% (68.67%) were recorded under hand weeding at 20 and 40 das treatment, which was followed by Pendimethalin @ 0.75 kg ha^{-1} PE fb Imazethapyr @ 75 g ha^{-1} at 20 DAS (33.93, 43.42 and 67.67 respectively) and Pendimethalin @ 0.75 k ha^{-1} PE fb Quizalofop-ethyl @ 40 g ha^{-1} at 20 DAS (32.67, 42.35,

67.33 respectively). Similar result was reported by Sharma *et al.* (2012) [14].

Effect on yield

Among different weed control treatments (Table 2) the significantly the highest pod yield of groundnut was recoded under unweeded control (1930 kg ha^{-1}), which was followed by Pendimethalin @ 0.75 kg ha^{-1} PE fb Imazethapyr @ 75 g ha^{-1} at 20 DAS (1680 kg ha^{-1}) and Pendimethalin @ 0.75 k ha^{-1} PE fb Quizalofop-ethyl @ 40 g/ha at 20 DAS (1517.33 kg ha^{-1}). In case of haulm yield the significantly the highest haulm yield of groundnut was recoded under hand weeding at 20 and 40 DAS (2610 kg ha^{-1}), which was followed by Pendimethalin @ 0.75 kg ha^{-1} PE fb Imazethapyr @ 75 g ha^{-1} at 20 DAS (2449 kg ha^{-1}) and Pendimethalin @ 0.75 k ha^{-1} PE fb Quizalofop-ethyl @ 40 g ha^{-1}at 20 DAS (2396.67 kg ha^{-1}). In case of harvest index the significantly the highest harvest index of groundnut was recoded under hand weeding at 20 and 40 DAS (42.51%), which was followed by Pendimethalin @ 0.75 kg ha^{-1} PE fb Imazethapyr @ 75 g ha^{-1} at 20 DAS (40.69) and Imazethapyr @ 75 g ha^{-1} 20 DAS fb HW at 40 DAS (39.06%). The unweeded control treatment recorded significantly the lowest pod yield (902.33 kg ha^{-1}), haulm yield (1567.67kg ha^{-1}) and harvest index (36.56%). Similar result was reported by Geetha *et al.* (2016) [5], Rao *et al.* (2011) [10].

Oil content (%)

Oil content in kernel were significantly influenced by different weed-management practices (Table). Among all the weed-control practices, Hand-weeding at 20 and 40 DAS recorded significantly highest oil content (48.30%) but it was statistically at par with Pendimethalin @ 0.75 kg ha^{-1} PE fb Imazethapyr @ 75 g ha^{-1} at 20 DAS as compared to weed management treatments and oil content (40.30%) obtained under Unweeded control plot, but it was statistically at par with Oxadirgyl @ 90 g ha^{-1} 20 DAS fb HW at 40 DAS. The results are in agreement with the findings of Sharma *et al.* (2015) [13].

Economics

The maximum gross return (115800), net return (77466) and BCR (2.02) was recorded under hand weeding at 20 and 40 DAS which was followed by Pendimethalin @ 0.75 kg ha^{-1} PE fb Imazethapyr @ 75 g ha^{-1} at 20 DAS over other weed control treatment. Under paucity of labour, farmers are advised to carry out Pendimethalin @ 0.75 kg ha^{-1} PE fb Imazethapyr @ 75 g ha^{-1} at 20 DAS for economical weed control in groundnut. Similar observations were noted by Dixit *et al.* (2016) [3].

Table 2: Dry weight of plant (g), Number of pod plant,$^{-1}$ pod yield plant^{-1} (g), pod yield kg ha^{-1}, haulm yield (kg ha^{-1}), harvest index (%) of groundnut as influenced by different weed management practices

Treatments	Dry weight of plant (g)			Number of pod plant^{-1}	Pod yield plant^{-1} (g)	Pod Yield (Kg ha^{-1})	Haulm yield (Kg ha^{-1})	Harvest Index (%)
	40 DAS	60 DAS	At harvest					
Pendimethalin @ 0.75 kg ha^{-1} PE fb HW at 40 DAS	0.93	13.27	37.10	20.33	12.13	1372.67	2325.00	37.12
Quizalofop-ethyl @ 40 g ha^{-1} 20 DAS fb HW at 40 DAS	0.90	10.53	31.87	25.47	14.07	1470.00	2310.00	38.89
Imazethapyr @ 75 g ha^{-1} 20 DAS fb HW at 40 DAS	0.91	11.87	32.93	21.53	12.89	1451.67	2265.00	39.06
Oxadirgyl @ 90 g ha^{-1} 20 DAS fb HW at 40 DAS	0.77	5.40	27.10	17.87	9.56	1310.67	2211.00	37.22
Pendimethalin @ 0.75 k ha^{-1} PE fb Quizalofop-ethyl @ 40 g/ha at 20 DAS	1.01	16.33	37.40	32.67	14.89	1517.33	2396.67	38.77
Pendimethalin @ 0.75 kg ha^{-1} PE fb Imazethapyr @ 75 g ha^{-1} at 20 DAS	1.02	18.67	39.20	33.93	14.89	1680.00	2449.00	40.69
Pendimethalin @ 0.75 kg ha^{-1} PE fb Oxadirgyl @ 90 g ha^{-1} at 20 DAS	0.80	8.87	29.20	19.80	11.99	1290.00	2130.00	37.72
Hand weeding at 20 and 40 DAS	1.26	26.80	45.60	36.67	16.33	1930.00	2610.00	42.51
Unweeded control	0.77	4.50	21.77	15.33	6.21	902.33	1567.67	36.56
SEm±	0.07	0.85	1.12	1.12	0.81	3.25	1.98	0.06
CD (5%)	0.21	2.55	3.35	3.36	2.45	9.75	5.94	0.19

Table 3: Seed index, shelling%, oil content (%), cost of cultivation (₹ ha^{-1}), gross return (₹ ha^{-1}), net return (₹ ha^{-1}), B:C Ratio of groundnut as influenced by different weed management practices

	Treatments	Seed index	Shelling %	Oil content (%)	Cost of cultivation (₹ ha^{-1})	Gross return (₹ ha^{-1})	Net return (₹ ha^{-1})	B:C Ratio
T_1	Pendimethalin @ 0.75 kg ha^{-1} PE fb HW at 40 DAS	39.50	65.33	46.50	36714	82360	45646	1.24
T_2	Quizalofop-ethyl @ 40 g ha^{-1} 20 DAS fb HW at 40 DAS	40.61	67.33	46.40	37136	88200	51064	1.36
T_3	Imazethapyr @ 75 g ha^{-1} 20 DAS fb HW at 40 DAS	40.52	66.67	45.60	36804	87100	50296	1.36
T_4	Oxadirgyl @ 90 g ha^{-1} 20 DAS fb HW at 40 DAS	35.25	58.67	44.40	36879	77400	40521	1.10
T_5	Pendimethalin @ 0.75 k ha^{-1} PE fb Quizalofop-ethyl @ 40 g/ha at 20 DAS	42.35	67.33	46.80	35516	91040	55524	1.55
T_6	Pendimethalin @ 0.75 kg ha^{-1} PE fb Imazethapyr @ 75 g ha^{-1} at 20 DAS	43.42	67.67	46.87	34185	100800	66615	1.95
T_7	Pendimethalin @ 0.75 kg ha^{-1} PE fb Oxadirgyl @ 90 g ha^{-1} at 20 DAS	35.89	64.33	43.70	35259	78640	43381	1.23
T_8	Hand weeding at 20 and 40 DAS	44.74	68.67	48.30	38334	115800	77466	2.02
T_9	Unweeded control	34.40	54.00	40.30	32334	54140	21806	0.66
	SEm±	0.73	1.48	0.44		195	195	0.005
	CD (5%)	2.20	4.43	1.32		986	586	0.016

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