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Efficacy of Herbicides for Weed Control in *Kharif* Groundnut [*Arachis hypogaea* (L.)]

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ABSTRACT: A field experiment was conducted at Agricultural Research Station, Mandor, Agriculture University, Jodhpur during *Kharif*, 2019 to identify the efficacy of herbicides to managing weeds and increase yield of *kharif* groundnut [*Arachis hypogaea* (L.)]. An experiment was laid out in randomized block design (RBD) with thirteen treatments such as weedy check, pre- and post-emergence herbicides and weed free check with three replication. Results indicated that among herbicide treatments application of pendimethalin + imazethapyr at 1.0 kg /ha (PE) + one manual weeding at 30 DAS significantly reduced total weed density and dry weight of weeds (broad- leaved, grassy and sedge) and increased weed control efficiency at all crop growth stages followed by pendimethalin at 1.0 kg /ha (PE) + imazethapyr at 75 g /ha at 20 DAS. Whereas, lowest weed index (4.8) and higher pod yield (3424 kg/ha) was recorded with pendimethalin + imazethapyr at 1.0 kg /ha (PE) + one manual weeding at 30 DAS followed by pendimethalin at 1.0 kg /ha (PE) + imazethapyr at 75 g/ ha at 20 DAS.

Keywords: Weed density, Weed dry weight, Weed control efficiency, Weed index, Yield.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is an important oilseed crop extensively cultivated throughout India. It is also known as poor men's cashew nut and wonder nut. India has a diverse climate allows groundnut to be cultivated throughout the year in different seasons, such as *kharif* (rainy), *rabi* (winter), and spring. In India, groundnut occupies an area of 10.11 million tonnes with a production of 5.57 million ha area and productivity of 1759 kg /ha in 2021-22 (DES, 2022). Rajasthan contributed 1.70 million tonnes from 0.79 million ha area, with an average yield of 2132 kg /ha in 2021-22 (DES, 2022). Groundnut holds immense value due to its high protein content (26%) and oil content (45%), making it a vital source of edible oil. However, weed infestation poses a significant challenge and is a serious bottleneck in limiting the productivity of groundnut (Chaitanya *et al.*, 2012). Weeds compete with groundnut plants for essential resources such as sunlight, space, moisture, and nutrients throughout the growing season (Regar, 2017). They hinder pegging, pod development, and interfere with the harvest process. Harvesting losses will be higher as a result of weed density which leads to slow drying of land during maturity period and increase rotting of mature nuts. Bansal (1993) reported that weed also causes allelopathic effects on groundnut as these work as shelter for pathogens and pests. Wesley *et al*. (2008) concluded 4 to 9 weeks from sowing to be crucial for grassy weeds and 2 to 8 week for broad leaf weeds in *kharif* groundnut. Yield losses in *kharif* groundnut due to weeds ranged from 54-71 % during early period of crop growth (Agasimani *et al.*, 2010). In attempts to mitigate weed-related losses and improve groundnut yield, herbicides and manual hand weeding have been found to be effective. Chemical weed control is, however, not a substitute for physical, cultural and biological control rather it is employed to bridge up gaps in these methods. Increasing labour cost and scarcity, drudgery, increasing energy and fuel cost, and in many situations inefficient weed control options force to choose chemical weed control as an efficient and economical alternative. Under these circumstances, chemical weed control through the application of herbicide is gaining popularity among the farming community. The study investigates the use of herbicides and cultural practices to combat this issue and enhance groundnut productivity.

MATERIAL AND METHODS

During the *kharif* season of 2019, a field experiment was carried out at Agricultural Research Station, Mandor, Agriculture University, Jodhpur to assess the

impact of various weed management strategies on weed indices and yield of groundnut. The physio-chemical property of experimental unit was loamy sand in texture, slightly alkaline in nature (pH 8.2), low in organic carbon (0.13 %) and available nitrogen (174 kg N/ha), whereas, medium in phosphorus (22.0 kg P_2O_5/ha) and available potassium (325 kg K_2O/ha). The bulk density of experimental field soil is 1.77 mg/m^3 and EC (0.13 dS/m). The research trial was framed with 13 treatments combinations *viz*., W_1- Pendimethalin 30 EC @ 1.0 kg/ha (PE), W_2- Pendimethalin 38.7 CS @1.0 kg/ha (PE), W_3- Pendimethalin 30 EC + imazethapyr 2 EC @ 1.0 kg/ha (PE) (ready-mix), W_4- Imazethapyr 10 SL @75 g/ha 20 DAS (PoE),W_5- Imazethapyr + imazamox (pre-mix) @ 70 g/ha 20 DAS, W_6- Pendimethalin 30 EC @ 1.0 kg/ha (PE) + imazethapyr @ 75 g/ha 20 DAS, W_7- Pendimethalin 30 EC @1.0 kg/ha (PE) + quizalofop-p-ethyl @ 50 g/ha 20 DAS W_8- Sodium aciflourfen 16.5 % + clodinafop propargyl 8 % (ready-mix) @ 200 g/ha 20 DAS, W_9- Pendimethalin 30 EC+ imazethapyr 2 EC @ 1.0 kg/ha (PE) (ready-mix) + quizalofop- p-ethyl @ 50 g/ha 20 DAS, W_{10}- Pendimethalin 30 EC @ 1.0 kg/ha (PE) + manual weeding at 30 DAS, W_{11}- Pendimethalin 30 EC + imazethapyr 2 EC @ 1.0 kg/ha (PE) (ready-mix) + manual weeding at 30 DAS, W_{12}- Weed free and W_{13}- Weedy check. Statistically experiment was replicated thrice in randomized block design (RBD). The groundnut crop variety 'HNG-69' was sown at 30 cm row-to-row spacing using 100 kg kernel/ha. All the recommended improved practices were followed in this experiment including fertilizers and plant protection measures. All the herbicides were applied as per treatment by using knapsack sprayer with flat fan nozzle using 600 litres of water per hectare. For estimating weed density, a quadrate (0.50 m x 0.50 m) was placed randomly at two spots in each plot. Broad-leaved, grassy and sedges weed counts were taken and expressed as numbers/m^2. All the weeds falling within quadrate were cut close to the ground and collected category wise in paper bags, then these weed samples were weighed after drying them in oven at 70 ˚C for 8 hours and data on dry matter were analyzed as per the standard. Net plot area was harvested for estimating pod yield of crop and converted into quintals per hectare. Weed control efficiency of each treatment was computed by using the following formula suggested by Mani *et al.* (1973):

$$\text{WCE (\%)} = \frac{DMC - DMT}{DMC} \times 100$$

Where,
WCE = Weed control efficiency
DMC = Dry matter weight of weeds in control plot
DMT = Dry matter weight of weeds in treated plot

Weed index indicates per cent reduction in crop yield due to the presence of weeds in comparison to weed-free crop and it is expressed as percentage. Weed index was calculated by using the following formula suggested by Yadav and Mishra (1982):

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

Where,
X = Yield from weed-free plot (kg/ha)
Y = Yield from treatment for which weed index is to be worked out (kg/ha)

In order to statistical analysis of the experimental data registered during investigation was carried out through adoption of appropriate method of statistical "analysis of variance" as described by Panse and Sukhatme (1978). Weed data were subjected to square root transformation ($\sqrt{x + 0.5}$) before statistical analysis. Computation of critical difference (CD) was done for treatment comparisons, wherever the variance ratio (F test) was found significant at 5 % level of probability. To elucidate the nature and magnitude of treatments effects, summary tables along with standard errors of means (SEm ±) and CD (P = 0.05) were prepared.

RESULTS AND DISCUSSION

Weed flora. The prominent weed flora of the experimental plot consisted of mixed flora of broad-leaved weeds, grassy weeds and sedges *viz., Amaranthus viridis, Celosia argentea, Corchorus trilocularis, Digera arvensis, Phyllanthus niruri, Portulaca oleracea* and *Tribulus terristris* among broad-leaved weeds, *Cynodon dactylon, Dactyloctenium aegyptium,* and *Eragrostis minor* among grassy weeds, and *Cyperus rotundus* and *Cyperus esculentus* were among sedges. However, broad-leaved weed were dominated over grassy and sedge weeds in the experimental field.

Weed density and dry weight. The weed density and weed dry weight under present study was significantly reduced due to different weed management practices compared to weedy check. Among the herbicide treatments, the significant reduction in total density and dry weight of weeds were recorded under pendimethalin + imazethapyr at 1.0 kg/ha (PE) + one manual weeding at 30 DAS and pendimethalin at 1.0 kg/ha (PE) + imazethapyr at 75 g/ha 20 DAS at all stages of crop growth. The corresponding reduction in total weed density was 82.30 and 84.82, 88.44 and 85.11, 89.13 and 86.77 per cent at 30, 60, and 90 DAS (Table 1, 2, 3) compared to weedy check. The corresponding reduction in total weed dry weight was 81.48 and 82.71, 83.27 and 79.89, 88.93 and 86.39 per cent at 30 60, and 90 DAS over weedy check (Table 4, 5, 6). This might be due to effective control of first flush of weeds by pendimethalin alone/its ready-mix formulation (PE) and subsequent flushes by application of imazethapyr (PoE) or manual weeding at 30 DAS. The results also corroborated with the finding of Kalhapure *et al.* (2013) and Pawar *et al.* (2018).

Table 1: Effect of weed management treatments on weed density per m^2 (Nos./m^2) at 30 DAS.

Treatments	Weed density (Nos./m^2)			
	Broad-leaved	Grassy	Sedges	Total
Pendimethalin 30 EC at 1.0 kg/ha (PE)	3.8* (13.8)	2.4 (5.1)	2.0 (3.5)	4.8 (22.5)
Pendimethalin 38.7 CS at 1.0 kg/ha (PE)	3.8 (14.3)	2.4 (5.3)	2.0 (3.7)	4.9 (23.4)
Pendimethalin 30 EC + imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix)	3.2 (10.0)	2.1 (3.9)	1.9 (3.0)	4.2 (16.9)
Imazethapyr 10 SL at 75 g/ha 20 DAS (PoE)	3.6 (13.0)	2.5 (5.7)	2.0 (3.4)	4.7 (22.2)
Imazethapyr + imazamox (pre-mix) at 70 g/ha 20 DAS	3.6 (12.3)	2.4 (5.0)	1.9 (3.2)	4.6 (20.5)
Pendimethalin 30 EC at 1.0 kg/ha (PE) + imazethapyr at 75 g/ha 20 DAS	2.7 (7.0)	1.9 (3.0)	1.6 (2.0)	3.5 (12.0)
Pendimethalin 30 EC at 1.0 kg/ha (PE) + quizalofop-p-ethyl at 50 g/ha 20 DAS	3.9 (14.7)	1.6 (2.0)	2.0 (3.4)	4.5 (20.0)
Sodium aciflourfen 16.5 % + clodinafop propargyl 8 % (ready-mix) at 200 g/ha 20 DAS	4.2 (17.3)	1.6 (2.1)	2.1 (4.0)	4.9 (23.4)
Pendimethalin 30 EC+ imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix) + quizalofop- p-ethyl at 50 g/ha 20 DAS	3.3 (10.4)	1.5 (1.7)	1.7 (2.3)	3.9 (14.5)
Pendimethalin 30 EC at 1.0 kg/ha (PE) + manual weeding at 30 DAS	3.4 (11.2)	2.1 (4.0)	2.0 (3.5)	4.4 (18.7)
Pendimethalin 30 EC + imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix) + manual weeding at 30 DAS	3.0 (8.7)	1.9 (3.2)	1.6 (2.1)	3.8 (14.0)
Weed free	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)
Weedy check	7.8 (60.0)	3.4 (11.3)	2.8 (7.7)	8.9 (79.1)
SEm±	0.21	0.10	0.09	0.19
CD (P=0.05)	0.60	0.29	0.27	0.55

*$\sqrt{x+0.5}$ Subjected to square root transformation values and data in parenthesis are original values

Table 2: Effect of weed management treatments on weed density per m^2 (Nos./m^2) at 60 DAS.

Treatments	Weed density (Nos./m^2)			
	Broad-leaved	Grassy	Sedges	Total
Pendimethalin 30 EC at 1.0 kg/ha (PE)	4.5* (19.5)	2.5 (5.8)	2.5 (5.8)	5.6 (31.1)
Pendimethalin 38.7 CS at 1.0 kg/ha (PE)	4.7 (21.3)	2.5 (6.0)	2.5 (6.0)	5.8 (33.3)
Pendimethalin 30 EC + imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix)	3.8 (13.9)	2.4 (5.3)	2.3 (4.6)	4.9 (23.8)
Imazethapyr 10 SL at 75 g/ha 20 DAS (PoE)	4.3 (17.8)	2.7 (6.6)	2.4 (5.5)	5.5 (29.8)
Imazethapyr + imazamox (pre-mix) at 70 g/ha 20 DAS	3.8 (14.0)	2.4 (5.4)	2.3 (5.0)	5.0 (24.4)
Pendimethalin 30 EC at 1.0 kg/ha (PE) + imazethapyr at 75 g/ha 20 DAS	2.9 (7.8)	2.0 (3.4)	1.9 (3.1)	3.8 (14.3)
Pendimethalin 30 EC at 1.0 kg/ha (PE) + quizalofop-p-ethyl at 50 g/ha 20 DAS	4.1 (16.2)	1.7 (2.5)	2.5 (5.6)	5.0 (24.3)
Sodium aciflourfen 16.5 % + clodinafop propargyl 8 % (ready-mix) at 200 g/ha 20 DAS	4.8 (22.7)	1.8 (2.7)	2.7 (6.7)	5.7 (32.0)
Pendimethalin 30 EC+ imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix) + quizalofop- p-ethyl at 50 g/ha 20 DAS	3.6 (12.6)	1.7 (2.3)	2.0 (3.5)	4.3 (18.4)
Pendimethalin 30 EC at 1.0 kg/ha (PE) + manual weeding at 30 DAS	3.2 (9.8)	1.7 (2.3)	1.8 (2.7)	3.9 (14.9)
Pendimethalin 30 EC + imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix) + manual weeding at 30 DAS	2.7 (7.0)	1.5 (1.9)	1.6 (2.2)	3.4 (11.1)
Weed free	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)
Weedy check	8.6 (74.0)	3.7 (13.5)	3 (8.6)	9.8 (96.1)
SEm±	0.21	0.11	0.11	0.16
CD (P=0.05)	0.61	0.31	0.32	0.48

*$\sqrt{x+0.5}$ Subjected to square root transformation values and data in parenthesis are original values

Table 3: Effect of weed management treatments on weed density per m^2 (Nos./m^2) at 90 DAS.

Treatments	Weed density (Nos./m^2)			
	Broad-leaved	Grassy	Sedges	Total
Pendimethalin 30 EC at 1.0 kg/ha (PE)	3.6* (12.7)	2.3 (4.7)	2.3 (4.9)	4.8 (22.3)
Pendimethalin 38.7 CS at 1.0 kg/ha (PE)	3.7 (13.0)	2.3 (4.8)	2.3 (5.0)	4.8 (22.8)
Pendimethalin 30 EC + imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix)	3.3 (10.4)	2.1 (4.0)	2.1 (3.8)	4.3 (18.3)
Imazethapyr 10 SL at 75 g/ha 20 DAS (PoE)	3.5 (12.0)	2.3 (5.0)	2.2 (4.3)	4.7 (21.3)
Imazethapyr + imazamox (pre-mix) at 70 g/ha 20 DAS	3.4 (10.8)	2.2 (4.2)	2.1 (4.0)	4.4 (19.1)
Pendimethalin 30 EC at 1.0 kg/ha (PE) + imazethapyr at 75 g/ha 20 DAS	2.6 (6.0)	1.8 (2.7)	1.7 (2.5)	3.4 (11.2)
Pendimethalin 30 EC at 1.0 kg/ha (PE) + quizalofop-p-ethyl at 50 g/ha 20 DAS	3.4 (11.2)	1.6 (2.2)	2.2 (4.3)	4.3 (17.7)
Sodium aciflourfen 16.5 % + clodinafop propargyl 8 % (ready-mix) at 200 g/ha 20 DAS	3.7 (13.5)	1.7 (2.4)	2.5 (5.6)	4.7 (21.5)
Pendimethalin 30 EC+ imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix) + quizalofop- p-ethyl at 50 g/ha 20 DAS	3.2 (10.0)	1.6 (1.9)	1.9 (3.0)	3.9 (14.9)
Pendimethalin 30 EC at 1.0 kg/ha (PE) + manual weeding at 30 DAS	2.9 (7.7)	1.6 (2.0)	1.7 (2.2)	3.5 (11.9)
Pendimethalin 30 EC + imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix) + manual weeding at 30 DAS	2.5 (5.7)	1.5 (1.8)	1.5 (1.7)	3.1 (9.2)
Weed free	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)
Weedy check	8.3 (68.3)	3.1 (9.2)	2.8 (7.2)	9.2 (84.7)
SEm±	0.18	0.11	0.10	0.14
CD (P=0.05)	0.53	0.33	0.28	0.42

*$\sqrt{x+0.5}$ Subjected to square root transformation values and data in parenthesis are original values

Table 4: Effect of weed management treatments on dry weight of weeds (g/m^2) at 30 DAS.

Treatments	Weed dry weight (g/m^2)			
	Broad-leaved	Grassy	Sedges	Total
Pendimethalin 30 EC at 1.0 kg/ha (PE)	2.1* (3.8)	1.2 (1.1)	1.8 (2.8)	2.9 (7.7)
Pendimethalin 38.7 CS at 1.0 kg/ha (PE)	2.1 (4.0)	1.4 (1.5)	1.9 (3.1)	3.0 (8.6)
Pendimethalin 30 EC + imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix)	1.8 (2.6)	1.2 (0.8)	1.7 (2.4)	2.5 (5.9)
Imazethapyr 10 SL at 75 g/ha 20 DAS (PoE)	2.0 (3.5)	1.3 (1.1)	1.8 (2.7)	2.8 (7.3)
Imazethapyr + imazamox (pre-mix) at 70 g/ha 20 DAS	1.9 (3.1)	1.2 (1.0)	1.7 (2.5)	2.7 (6.5)
Pendimethalin 30 EC at 1.0 kg/ha (PE) + imazethapyr at 75 g/ha 20 DAS	1.5 (1.9)	1.1 (0.7)	1.4 (1.6)	2.2 (4.2)
Pendimethalin 30 EC at 1.0 kg/ha (PE) + quizalofop-p-ethyl at 50 g/ha 20 DAS	2.0 (3.5)	0.9 (0.3)	1.8 (2.7)	2.6 (6.5)
Sodium aciflourfen 16.5 % + clodinafop propargyl 8 % (ready-mix) at 200 g/ha 20 DAS	2.2 (4.2)	0.9 (0.4)	2.0 (3.6)	2.9 (8.1)
Pendimethalin 30 EC+ imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix) + quizalofop- p-ethyl at 50 g/ha 20 DAS	1.8 (2.9)	0.9 (0.2)	1.5 (1.9)	2.3 (5.0)
Pendimethalin 30 EC at 1.0 kg/ha (PE) + manual weeding at 30 DAS	2.0 (3.4)	1.2 (0.9)	1.8 (2.6)	2.7 (6.9)
Pendimethalin 30 EC + imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix) + manual weeding at 30 DAS	1.6 (2.1)	1.1 (0.7)	1.5 (1.7)	2.2 (4.5)
Weed free	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)
Weedy check	3.6 (12.4)	1.7 (2.3)	3.2 (9.6)	5 (24.3)
SEm±	0.10	0.04	0.08	0.10
CD (P=0.05)	0.29	0.21	0.23	0.28

*$\sqrt{x+0.5}$ Subjected to square root transformation values and data in parenthesis are original values

Table 5: Effect of weed management treatments on dry weight of weeds (g/m^2) at 60 DAS.

Treatments	Weed dry weight (g/m^2)			
	Broad-leaved	Grassy	Sedges	Total
Pendimethalin 30 EC at 1.0 kg/ha (PE)	3.9* (14.6)	1.8 (2.8)	2.8 (7.6)	5.0 (25.0)
Pendimethalin 38.7 CS at 1.0 kg/ha (PE)	4.1 (16.0)	1.9 (3.0)	2.9 (8.0)	5.2 (27.0)
Pendimethalin 30 EC + imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix)	3.4 (11.0)	1.8 (2.6)	2.7 (6.6)	4.6 (20.3)
Imazethapyr 10 SL at 75 g/ha 20 DAS (PoE)	3.7 (13.0)	2.0 (3.4)	2.8 (7.2)	4.9 (23.6)
Imazethapyr + imazamox (pre-mix) at 70 g/ha 20 DAS	3.4 (11.2)	1.8 (2.6)	2.8 (7.1)	4.6 (21.0)
Pendimethalin 30 EC at 1.0 kg/ha (PE) + imazethapyr at 75 g/ha 20 DAS	2.6 (6.3)	1.4 (1.4)	2.2 (4.2)	3.5 (11.9)
Pendimethalin 30 EC at 1.0 kg/ha (PE) + quizalofop-p-ethyl at 50 g/ha 20 DAS	3.6 (12.5)	1.3 (1.2)	2.7 (7.0)	4.6 (20.7)
Sodium aciflourfen 16.5 % + clodinafop propargyl 8 % (ready-mix) at 200 g/ha 20 DAS	4.2 (17.0)	1.4 (1.3)	3.1 (9.0)	5.3 (27.4)
Pendimethalin 30 EC+ imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix) + quizalofop- p-ethyl at 50 g/ha 20 DAS	3.3 (10.6)	1.1 (0.6)	2.3 (5.0)	4.1 (16.2)
Pendimethalin 30 EC at 1.0 kg/ha (PE) + manual weeding at 30 DAS	3.0 (8.8)	1.3 (1.1)	2.0 (3.4)	3.7 (13.3)
Pendimethalin 30 EC + imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix) + manual weeding at 30 DAS	2.5 (6.0)	1.1 (0.8)	1.9 (3.1)	3.2 (9.9)
Weed free	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)
Weedy check	6.3 (39.6)	2.2 (4.6)	3.9 (15.0)	7.7 (59.2)
SEm±	0.19	0.09	0.14	0.15
CD (P=0.05)	0.55	0.25	0.40	0.43

*$\sqrt{x+0.5}$ Subjected to square root transformation values and data in parenthesis are original value

Table 6: Effect of weed management treatments on dry weight of weeds at 90 DAS.

Treatments	Weed dry weight (g/m^2)			
	Broad-leaved	Grassy	Sedges	Total
Pendimethalin 30 EC at 1.0 kg/ha (PE)	4.9* (23.4)	1.9 (3.3)	3.1 (9.2)	6.0 (35.9)
Pendimethalin 38.7 CS at 1.0 kg/ha (PE)	4.9 (24.0)	2.0(3.4)	3.3 (10.4)	6.2 (37.8)
Pendimethalin 30 EC + imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix)	4.4 (19.0)	1.8 (2.9)	2.9 (7.8)	5.5 (29.7)
Imazethapyr 10 SL at 75 g/ha 20 DAS (PoE)	4.7 (22.2)	2.0 (3.7)	3.0 (8.6)	5.9 (34.6)
Imazethapyr + imazamox (pre-mix) at 70 g/ha 20 DAS	4.6 (20.5)	1.9 (3.1)	2.9 (7.9)	5.7 (31.5)
Pendimethalin 30 EC at 1.0 kg/ha (PE) + imazethapyr at 75 g/ha 20 DAS	3.5 (12.0)	1.5 (1.9)	2.4 (5.5)	4.5 (19.3)
Pendimethalin 30 EC at 1.0 kg/ha (PE) + quizalofop-p-ethyl at 50 g/ha 20 DAS	4.6 (20.9)	1.4 (1.5)	3.0 (8.3)	5.6 (30.6)
Sodium aciflourfen 16.5 % + clodinafop propargyl 8 % (ready-mix) at 200 g/ha 20 DAS	5.1 (26.1)	1.4 (1.5)	3.4 (11.3)	6.3 (38.9)
Pendimethalin 30 EC+ imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix) + quizalofop- p-ethyl at 50 g/ha 20 DAS	4.3 (17.8)	1.3 (1.2)	2.6 (6.1)	5.1 (25.1)
Pendimethalin 30 EC at 1.0 kg/ha (PE) + manual weeding at 30 DAS	3.9 (14.7)	1.3 (1.3)	2.3 (4.7)	4.6 (20.7)
Pendimethalin 30 EC + imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix) + manual weeding at 30 DAS	3.4 (11.0)	1.3 (1.1)	2.0 (3.6)	4.0 (15.7)
Weed free	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)
Weedy check	10.9 (119.5)	2.6 (6.3)	4.1 (16.1)	11.9 (141.9)
SEm±	0.23	0.08	0.15	0.20
CD (P=0.05)	0.68	0.24	0.43	0.57

*$\sqrt{x+0.5}$ Subjected to square root transformation values and data in parenthesis are original values

Weed control efficiency. A perusal of data shows that weed control efficiency (WCE) was affected to a great extent by different weed management treatments (Table 7). At 30 DAS stage, significantly higher WCE was recorded under pendimethalin (PE) + imazethapyr (PoE) followed by pendimethalin + imazethapyr at 1.0 kg/ha (PE) + one manual weeding at 30 DAS and pendimethalin + imazethapyr (PE) + quizalofop-p-ethyl (PoE) to the magnitude of 82.6, 81.2 and 79.1%, respectively. At the subsequent stages of crop growth *i.e*. 60, 90 DAS, numerically higher WCE was obtained due to pendimethalin + imazethapyr at 1.0 kg/ha (PE) + one manual weeding, pendimethalin at 1.0 kg/ha (PE) + imazethapyr at 75 g/ha 20 DAS, pendimethalin at 1.0

kg/ha (PE) + one manual weeding at 30 DAS and pendimethalin + imazethapyr at 1.0 kg/ha (PE) + quizalofop-p-ethyl at 50 g/ha 20 DAS compared to rest of the herbicidal treatments. The corresponding value of WCE was to the tune of 83.0 and 88.7, 79.6 and 86.3, 77.0 and 85.3, 72.2 and 82.2 % at 60 and 90 DAS. This might be due to reduce weed density and weed dry weight under the effect of pre- and post-emergent herbicidal application. Pawar *et al.* (2018) also observed that the application of pendimethalin at 1.5 kg/ha (PE) + imazethapyr at 75 g/ha (PoE) resulted in obtaining higher WCE. This might be due to PE and PoE application of herbicides that have longer effect on controlling the monocot as well as dicot weed population and thereby increasing weed control efficiency. Kalhapure *et al.* (2013) also reported higher weed control efficiency with pendimethalin 1.5 kg/ha (PE) + imazethapyr 0.15 kg/ha (PoE) + one hand-weeding at 40 DAS due to lower weed dry matter production. The results so obtained are in close conformity with finding of Kumar *et al.* (2013) and Singh *et al.* (2019).

Weed index. Data shows that the range of weed competition index varied from 4.8 to 58.9 % under different herbicidal treatments (Table 7). The lowest weed index (4.8 %) was noticed under application of pendimethalin + imazethapyr at 1.0 kg/ha (PE) + one manual weeding at 30 DAS followed by pendimethalin at 1.0 kg/ha (PE) + imazethapyr at 75 g/ha 20 DAS (5.5 %) compared to weed check.

Table 7: Effect of weed management treatments on weed control efficiency, weed index and pod yield in groundnut.

Treatments	Weed control efficiency (%)			Weed index (%)	Pod yield (kg/ha)
	30 DAS	60 DAS	90 DAS		
Pendimethalin 30 EC at 1.0 kg/ha (PE)	67.5	57.0	74.3	33.2	2407
Pendimethalin 38.7 CS at 1.0 kg/ha (PE)	63.5	53.2	72.8	34.7	2352
Pendimethalin 30 EC + imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix)	75.2	65.2	78.8	20.9	2848
Imazethapyr 10 SL at 75 g/ha 20 DAS (PoE)	69.8	59.6	75.7	30.1	2519
Imazethapyr + imazamox (pre-mix) at 70 g/ha 20 DAS	72.6	63.9	77.5	22.9	2778
Pendimethalin 30 EC at 1.0 kg/ha (PE) + imazethapyr at 75 g/ha 20 DAS	82.6	79.6	86.3	5.5	3398
Pendimethalin 30 EC at 1.0 kg/ha (PE) + quizalofop-p-ethyl at 50 g/ha 20 DAS	72.5	64.1	78.0	27.6	2611
Sodium aciflourfen 16.5 % + clodinafop propargyl 8 % (ready-mix) at 200 g/ha 20 DAS	65.3	52.6	72.5	36.7	2278
Pendimethalin 30 EC+ imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix) + quizalofop- p-ethyl at 50 g/ha 20 DAS	79.1	72.2	82.2	10.5	3222
Pendimethalin 30 EC at 1.0 kg/ha (PE) + manual weeding at 30 DAS	70.8	77.0	85.3	10.9	3207
Pendimethalin 30 EC + imazethapyr 2 EC at 1.0 kg/ha (PE) (ready-mix) + manual weeding at 30 DAS	81.2	83.0	88.7	4.8	3424
Weed free	100.0	100.0	100.0	0.0	3602
Weedy check	0.0	0.0	0.0	58.9	1482
SEm±	-	-	-	-	128.5
CD (P=0.05)	-	-	-	-	374.9

It was on account of obtaining the lowest weed density and weed dry matter in these treatments which ultimately provided nearly weed free situation and enhanced yield parameters and ultimately pod yield. Patel *et al.* (2017) observed the lowest weed index with application of pendimethalin at 1.0 kg/ha (PE) + imazethapyr 75 g/ha 15-20 DAS (PoE) which was followed by hand weeding and interculturing at 20 and 40 DAS. The lower values of weed index with these treatments were due to lower weed dry biomass and higher weed control efficiency. These results are in agreements with the findings of Bhale *et al.* (2012), Kalhapure *et al.* (2013), Kumar *et al.* (2013) and Mehriya *et al.* (2021).

Pod yield. A critical examination of data reveals that pod yield of groundnut was significantly influenced due to different weed management treatments (Table 7). Significantly higher pod yield (3424 kg/ha) was obtained under pre-emergent application of pendimethalin + imazethapyr at 1.0 kg/ha + one manual weeding followed by pendimethalin at 1.0 kg/ha (PE) + imazethapyr at 75 g/ha 20 DAS (3398 kg/ha), pendimethalin at 1.0 kg/ha (PE) + one manual weeding at 30 DAS (3207 kg/ha) and pendimethalin + imazethapyr at 1.0 kg/ha (PE) + quizalofop-p-ethyl at 50 g/ha 20 DAS (3222 kg/ha) compared to rest of the herbicidal treatments. The corresponding increase was to the extent of 131.1, 129.2, 116.3 and 117.4 per cent over weedy check. This might be due to reduced competition of weeds with groundnut for space, light, nutrients and moisture with application of effective weed control methods. Weed free environment facilitated better peg initiation and development at the critical growth stages of groundnut resulting in increase

in pod yield. Similar results were also reported by Patel *et al.* (2017) and Mehriya *et al.* (2021).

CONCLUSION

On the basis of present investigation concluded that herbicidal weed management in groundnut through application pendimethalin @ 1.0 kg/ha (PE) + imazethapyr @ 75 g/ha 20 DAS and pendimethalin + imazethapyr @ 1.0 kg/ha (PE) + one manual weeding at 30 DAS were found most effective for reducing weed density and weed dry weight and conducive for obtaining higher pod yield.

FUTURE SCOPE

1. These findings are based on one season experimentation and needs to be validated through further research to formulate recommendation for groundnut growers of this region.
2. In addition there is a need to study herbicide residues in soil at different intervals and their potential long-term impacts on soil health and subsequent crops.
3. Monitoring and analyzing the development of herbicide-resistant weed populations over time and strategizing measures to mitigate resistance.
4. Future line of work is to exploring innovative formulations and application techniques to enhance herbicide efficiency, minimize off-target drift, and reduce environmental impact.

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REFERENCES

Agasimani, C. A., Shanwad, U. K., Arvindkumar, B. N. and Shivamurthy, S. D. (2010). Integrated weed management - A long term case study in groundnut-wheat cropping system in northern Karnataka. *Research Journal of Agricultural Sciences, 1*(3), 196-200.

Bansal, G. L. (1993). Allellopathy and weed Science. Proceedings in international symposium on integrated weed management for sustainable agriculture. *Indian Society of Weed Science*, *1*, 283-87.

Bhale, V. M., Karmore, J. V., Patil, Y. R. and Krishi, D. P. D. (2012). Integrated weed management in groundnut (*Arachis hypogaea* L.). *Pakistan Journal of Weed Science Research, 18*, 733-73.

Chaitanya, S., Shankaranarayana, V. and Nanjappa, H. V. (2012). Chemical weed management in Kharif groundnut. *Mysore Journal of Agricultural Science, 46*(2), 315-319.

Directorate of Economics and Statistics (DES). (2022). Ministry of Agriculture and Farmers Welfare (MoA & FW), Govt. of India.

Kalhapure, A. H., Shete, B. T. and Bodake, P. S. (2013). Integration of chemical and cultural methods for weed management in groundnut. *Indian Journal of Weed Science*, *45*(2), 116-119.

Kumar, Y., Saxena, R., Gupta, K. C., Fagaria, V. D. and Singh, R. (2013). Yield attributes and yield of groundnut (*Arachis hypogaea* L.) as influenced by weed management practices in semi arid region. *Journal of Crop and Weed*, *9*(2), 185-189.

Mani, V. S., Malla, M. C., Gautam, K. C. and Bhagwandas (1973). Weed killing chemicals in potato cultivars. *Indian Farming, 32*(8), 17-18.

Mehriya, M. L., Sarita, Borana, H. and Geat, N. (2021). Effective and profitable weed management in rainy season groundnut grown under arid zone of Rajasthan. *Indian Journal of Weed Science*, *53*(3), 269–274

Panse, V. G. and Sukhatme, P. V. (1978). Statistical methods for agricultural workers. *Indian Council of Agricutural Research*, New Delhi. 152.

Patel, J. C., Patel, D. M., Patel, B. J., Patel, P. P. and Ali, S. (2017). Effect of herbicides on weed control and yield of *kharif* groundnut (*Arachis hypogaea* L.). *Legume Research*, *40*(2), 374-378.

Pawar, S. B., Mahatale, P. V., Thakare, S. S. and Sawarkar, S. D. (2018). Weed management in groundnut with tank-mix application of post emergence herbicides. *International Journal of Current Microbiology and Applied Science, 6*, 2169 – 2173.

Regar, S. N. (2017). Herbicidal weed control in groundnut (*Arachis hypogaea* L.). M. Sc. Thesis submitted to SKRAU, Bikaner.

Singh, S. P., Yadav, R. S., Godara, S. L., Kumawat, A. and Birbal. (2019). Herbicidal weed management in groundnut (*Arachis hypogaea*). *Legume Research,* 0976-0571.

Wesley, J. V., Burke, I. C., Clewis, S. B., Thomas, W. E. and Wilcut, J. W. (2008). Critical period of grass vs. broadleaf weed interference in peanut. *Weed Technology, 22*, 68-73.

Yadav, J. P. and Mishra, M. R. C. (1982). *Naveen Prayogic Krishi. A hand book of Agriculture*. Kanti Prakashan, Etawah.

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