



Groundnut productivity and profitability as influenced by weed control measures

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ABSTRACT

A field experiment was conducted at Research Farm of Agriculture Research Station, SK Rajasthan Agricultural University, Bikaner during *Kharif* seasons of 2015 and 2016 to test the efficiency of herbicides in groundnut. The experiment comprised of 14 weed control treatments arranged in randomized block design (RBD) with three replications. Among the different herbicides tested, imazethapyr + pendamethalin 1000 g/ha recorded lowest weed density and weed biomass of both broad-leaved and grassy-weeds and significantly highest dry matter accumulation, number of pods/plant, pod, haulm and biological yield in groundnut over all the other herbicidal treatments.

Key words: Fenoxaprop p-ethyl, Groundnut, Imazethapyr, Pendimethalin, Weed management

Groundnut (*Arachis hypogaea* L.) is the second most important edible oilseed crop of the India, which is the second largest producer of groundnut in the world. Weed menace is one of the serious bottlenecks in limiting the productivity of groundnut (Chaitanya *et al.* 2012). India has a diverse climate and groundnut is grown throughout the year in *Kharif* (rainy), *Rabi*, (winter) and spring seasons in one or other part of the country. Among non-stable productivity factors, weed infestation is considered to be one of the major cause to reduce the productivity. Yield loss due to weed infestation amounts to 47% in groundnut. Weeds when allowed to compete till harvest depleted 162.8 kg N, 21.7 kg P₂O₅, 141.8 kg K₂O per ha. Weeds reduce yield by competing with the groundnut plants for resources such as sunlight, space, moisture and nutrients throughout the growing season (Regar 2017). During initial growth stages, crop canopy is relatively less, which allows higher weeds' growth making groundnut more susceptible to weeds competition in the earlier growth period of the crop. Weeds also create problem during digging and inverting procedures and reduce harvesting efficiency. Herbicides and hand weeding significantly brought down the nutrient removal by weeds and enhanced the uptake of nutrient by groundnut crop. The present study was therefore, carried out to assess the losses caused by weeds and the extent to which these losses would be minimized by use of herbicides alone or in combination with cultural methods and their effect on crop yield.

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MATERIALS AND METHODS

A field study was conducted for two years during *Kharif* season of 2015 and 2016 at Research farm of Agriculture Research Station, Swami Keshwanand Rajasthan Agricultural University, Bikaner (28.00° to 28.16°N latitude, 72.55° to 73.42°E longitude and 234.7 m (amsl). The experiment consisting of 14 weed control treatments, *viz.* pendimethalin 1.0 kg/ha (PPI), pendimethalin 1.0 kg/ha (PE), imazethapyr + pendimethalin 800 g/ha, imazethapyr + pendamethalin 900 g, imazethapyr + pendamethalin 1000 g, imazethapyr 50 g, imazethapyr 70 g/ha, imazethapyr + imazemox 60 g/ha, imazethapyr + imazemox 70 g/ha, oxyfluorfen 40 g/ha, fenoxaprop-p-ethyl 50 g/ha, propaquizafop 62 g/ha, weed free and weedy check (**Table 1**). They were evaluated in randomized block design with three replications. The soil of experimental site was loamy sand having 0.08% organic carbon, 8.2 pH, 78, 22 and 210 kg/ha available N, P and K, respectively. Groundnut '*HNG-10*' was sown on 21 June 2014, and 26 June 2015 at 30 cm row spacing and was harvested on 24 October 2014 and 28 October 2015, respectively. Recommended dose of fertilizers (20 kg N + 40 kg P + 40 kg K/ha) was applied as basal dose through urea, single super phosphate (SSP) and murate of potash (MOP) respectively. Pre-plant incorporation (PPI) of pendimethalin was done before sowing while pre-emergence application (PE) of pendimethalin was done on next day of sowing. Post-emergence application (PoE) of imazethapyr was done at 25 DAS as per the treatment with

knapsack sprayer. Weed density was recorded by using quadrates of 0.25 m² at 60 DAS in all the treatments and then converted into number of weeds/m². The weeds were dried in oven till a constant weight was observed and then transformed into weed biomass (g/m²) by using the appropriate formula. Growth, yield parameters and yield of groundnut were recorded for two consecutive years. The data on weed density were subjected to square root transformation to normalize their distribution (Gomez and Gomez 1984). Cost of cultivation, gross return and net return were calculated based on the prevailing price of inputs and outputs. Benefit cost ratio was calculated on the basis of gross return divided by the cost of cultivation. The weed density and weed biomass data were square-root transformed.

RESULTS AND DISCUSSION

Weed flora

The experimental field was infested with *Amaranthus spinosus*, *Digera arvensis*, *Trianthema portulacastrum*, *Gisekia poiedious*, *Mollugo verticillata*, *Euphorbia hirta*, *Aristida depressa*, *Portulaca oleracea*, *Cenchrus biflorus*, *Cleome viscosa*, *Tribulus terrestris*, *Corchorus tridense*, *Cyperus rotundus*, *Elusion everticillata*, *Eragrastris tennela* and *Aerva tomentosa* etc species of weeds in both the years of experimentation.

All the herbicidal treatments were able to significantly reduced weed density and biomass over weedy check (**Table 1**). Weed free treatment resulted in the lowest weed density and biomass of weeds. However, among the different treatments, pre-emergence application of imazethapyr + pendamethalin 800 g/ha and its higher doses, imazethapyr 50 and 70 g, imazethapyr + imazemox 60 and 70 g were found to be at par with each other in respect of these weed parameters. Imazethapyr + pendamethalin 800 g was found effective in reducing the density and biomass of both broad-leaf and grassy weeds followed by its higher doses. Lower density of weeds by imazethapyr + pendamethalin in reducing weed biomass might be primarily due to broad spectrum activity of herbicidal combination particularly on establishment of plants of both broad-leaf and grassy weeds and its greater efficiency to retard cell division of meristems as a result of which weeds dry rapidly. The results were confirmed by the findings of Kantar *et al.* (1999), where about 84.6% weed biomass was controlled with application of imazethapyr. Papierniks *et al.* (2003) also recommended use of imazethapyr in legumes, which inhibit acetohydroxy acid synthase and the synthesis

of branched chain amino acids. Data further revealed that application of fenoxaprop-p-ethyl 50 g/ha and propaquizafop 62g/ha as post-emergence also reduced the weed biomass compared to weedy check and other dose. Pendimethalin 1.0 kg/ha as PPI and pre-emergence was found effective in controlling grassy weeds.

Growth, yield attributes and yield

Significant lowest values of dry matter, pods/plant, kernel/pod, 100-kernel weight and shelling percentage were recorded under weedy check and the highest values for these parameters were recorded under weed free treatment (**Table 2**). Higher level of these parameters could be attributed due to low crop-weed competition in this treatment. Among herbicidal treatment, imazethapyr + pendimethalin 800 g/ha efficiently increased dry matter per plant, which was at par with its higher levels and weed free. The increase in the dry matter of groundnut was attributed to the decreased weed density and lesser biomass of weeds thus resulted in decreased competition by weeds to moisture, light and nutrients. The effect of which can be traced back to increased dry matter accumulation in stem, leaves and pods. Pannu *et al.* (1989) have reported significant reduction in the dry matter accumulation and lower pod yield in groundnut under weedy check. The dry matter production and its accumulation in reproductive parts depends upon the photosynthetic ability of the plant and can be analyzed through leaf area and dry matter accumulation in leaves, which in turn influence the photosynthetic ability, performance and yield of the crop. The results corroborated with the findings of Yadav *et al.* (2014). Pendimethalin 1.0 kg/ha as PPI and pendimethalin 1.0 kg/ha as pre-emergence was next best in increasing dry matter, pods/plant kernel/pod, 100 kernel weight and shelling percentage followed by imazethapyr + imazemox 60 and 70 g/ha. This might be due to minimizing the competition of weeds with main crop for resources, viz. space, light, nutrients and moisture with adaption of effective weed control methods. Singh and Giri (2001) also concluded that proper weed control was responsible for increase in plant height and dry matter production in groundnut. However, in case of other herbicidal treatments, imazethapyr 50 and 70 g, imazethapyr + imazemox 60 and 70 g/ha, oxyfluoren 40 g/ha, fenoxaprop p-ethyl 50 g/ha and propaquizafop 62 g/ha recorded higher yield and yield attributes of groundnut compared to weedy check but remained at par with each other.

All the weed management practices significantly enhanced pod, haulm and biological yield over weedy

check and higher yield was obtained in weed free treatment (**Table 2**). However, there was no significant difference in imazethapyr 50 and 70 g/ha, imazethapyr + imazemox 60 and 70 g/ha with each other between pod, haulm and biological yield. This might be due to the fact that weed free environment in crop facilitated better peg initiation and development at the critical growth stages of groundnut which tends to increase in number of pods/plant and pod yield/hectare. Higher profitable pod yield of summer groundnut was also reported by Raj *et al.* (2008) with keeping the crop in weed free condition. Significantly lower values of plant height, number of pods and pod yield were recorded in treatment weedy check. There was no significant effect of weed management practices on harvest index in groundnut.

Among the different herbicidal treatments, pod, haulm and biological yield of groundnut was found maximum with the treatment received imazethapyr + pendimethalin 800 g/ha, which was significantly superior to weedy check, fenoxaprop-p-ethyl 50 g/ha, propaquizafop 62 g/ha, oxyfluorfen, pendimethalin 1.0 kg/ha as PPI and pre-emergence but statistically at par with + pendimethalin 900 g/ha and 1000 g/ha, imazethapyr 50 and 70 g/ha and imazethapyr + imazemox 60 and 70 g/ha. The increase in pod yield in above treatments might be due to the fact that these treatments resulted in beneficial effect on final yield. Also the pod yield is an end product, which obviously depends upon the dry matter production of crop growth and its partitioning into reproductive parts. Patra and Naik (2001) also

Table 1. Effect of different pre- and post-emergence herbicides on weed count and weed biomass and economics in groundnut (pooled over two years)

Treatment	Weed density/m ²			Weed biomass (g/m ²)	Economics (x10 ³ /ha)		
	Broad-leaved	Grassy	Total		Cost of cultivation	Net returns	B:C ratio
Pendimethalin 1.0 kg (PPI)	7.5 (56.9)	1.51 (1.81)	7.69 (58.8)	12.94	67000	77.3	2.14
Pendimethalin 1.0 kg (PE)	7.6 (57.9)	1.56 (1.93)	7.76 (59.9)	10.38	67000	74.4	2.09
Imazethapyr + pendimethalin 800 g (PE)	2.9 (8.1)	1.33 (1.26)	3.13 (9.4)	0.99	68500	93.8	2.35
Imazethapyr + pendimethalin 900 g (PE)	2.5 (5.7)	0.89 (0.35)	2.55 (6.1)	0.58	68500	96.7	2.39
Imazethapyr + pendimethalin 1000 g (PE)	1.8 (2.6)	0.95 (0.51)	1.90 (3.1)	0.47	68500	97.3	2.40
Imazethapyr 50 g PoE 25 DAS	2.9 (7.7)	2.08 (3.91)	3.48 (11.7)	6.80	67000	83.4	2.23
Imazethapyr 70 g PoE 25 DAS	2.6 (6.6)	1.80 (2.87)	3.15 (9.5)	4.78	67000	86.3	2.27
Imazethapyr + imazemox 60 g PoE 25 DAS	2.7 (7.1)	1.70 (2.42)	3.15 (9.5)	5.75	68000	91.9	2.33
Imazethapyr + imazemox 70 g PoE 25 DAS	2.3 (5.1)	1.35 (1.54)	2.65 (6.7)	0.78	68000	89.0	2.29
Oxyfluorfen 40 g PoE 25 DAS	6.7 (48.2)	1.52 (1.84)	7.01 (50.0)	15.12	67000	65.1	1.96
Fenoxaprop p-ethyl 50 g PoE 25 DAS	6.8 (47.9)	1.30 (1.38)	6.96 (49.4)	16.16	67000	59.9	1.88
Propaquizafop 62 g PoE 25 DAS	6.8(47.1)	1.52 (1.84)	6.96 (48.9)	13.16	67000	60.2	1.89
Weed free	1.8 (2.9)	1.21 (1.09)	2.08 (4.0)	0.42	69000	100.0	2.43
Weedy check	7.9 (61.9)	2.52 (5.93)	8.26 (67.8)	20.93	64000	35.5	1.55
LSD (p=0.05)	0.44	0.40	0.43	2.44	-	-	-

Table 2. Effect of different pre- and post-emergence herbicides on dry matter, pods per plant, kernel per pod, 100-kernel weight and shelling percent of groundnut (pooled over two years)

Treatment	Dry Matter accumulation (g/plant)	Pods/plant	Kernels /pod	100-kernel weight (g)	Shelling %	Pod yield (t/ha)	Haulm yield (t/ha)	Biological yield (t/ha)	Harvest index (%)
Pendimethalin 1.0 kg (PPI)	61.8	25.6	1.75	43.1	65.7	2.71	7.35	10.07	26.9
Pendimethalin 1.0 kg (PE)	62.1	26.1	1.71	41.9	64.8	2.66	7.22	9.88	26.9
Imazethapyr + pendimethalin 800 g (PE)	78.8	29.9	1.74	43.9	65.5	3.05	8.27	11.32	26.9
Imazethapyr + pendimethalin 900 g (PE)	78.4	30.3	1.78	44.5	66.4	3.11	8.37	11.48	27.1
Imazethapyr + pendimethalin 1000 g (PE)	78.8	30.3	1.85	44.6	67.8	3.13	8.32	11.45	27.3
Imazethapyr 50 g PoE 25 DAS	65.2	26.9	1.64	43.5	65.0	2.84	7.58	10.42	27.2
Imazethapyr 70 g PoE 25 DAS	66.6	27.5	1.63	44.1	65.0	2.89	7.72	10.61	27.3
Imazethapyr + imazemox 60 g PoE 25 DAS	68.8	28.4	1.71	43.5	65.3	3.02	8.00	11.02	27.2
Imazethapyr + imazemox 70 g PoE 25 DAS	68.9	28.7	1.73	44.1	65.4	2.96	7.90	10.86	27.3
Oxyfluorfen 40 g PoE 25 DAS	60.5	23.8	1.73	44.0	64.3	2.49	6.67	9.17	27.2
Fenoxaprop p-ethyl 50g PoE 25 DAS	58.4	21.4	1.59	42.4	65.1	2.39	6.49	8.87	26.9
Propaquizafop 62 g PoE 25 DAS	59.1	22.4	1.63	42.5	65.5	2.40	6.43	8.83	27.2
Weed free	84.0	31.9	1.84	44.9	70.1	3.18	8.53	11.71	27.2
Weedy check	53.9	17.6	1.62	40.9	63.5	1.90	4.93	6.83	28.0
LSD (p=0.05)	7.1	4.5	0.09	NS	2.1	0.35	0.56	0.62	NS

reported increased pod number due to weed control treatments. The differential contribution of yield components towards pod yield was obtained with different treatments. Effective control of weeds by herbicides might have resulted in better availability of soil moisture and nutrients as evidenced by the beneficial effect on crop growth. The higher pod yield in imazethapyr + pendimethalin 800 g/ha or its higher levels over weed free might be due to suppression of weed seed germination and seedling development at early stages due to pre-emergent herbicides. Weedy check gave reduced yields due to presence of weeds and resulted in increased weed competition for growth resources, especially for moisture, nutrients and light. Similar yield reduction due to presence of weeds has been reported by Kori *et al.* (2000). Among different herbicidal treatments, imazethapyr + pendimethalin 800 g/ha recorded 72.9, 47.0 and 53.6% higher pod, haulm and biological yield over weedy check. Kantar *et al.* (1999) also observed 63.6% higher seed yield over weedy check with application of imaze.

Economics

All the weed control treatments recorded higher net returns and B:C ratio over weedy check (**Table 1**). While, highest net returns and B:C ratio was obtained with weed free treatment. Among herbicidal treatments, imazethapyr + pendimethalin 800 g/ha recorded higher net returns (₹ 93761) and B:C (2.35) ratio closely followed by its higher doses. This was due to higher pod yield and subsequently lower cost of cultivation of groundnut crop, which was increased in treatment weed free due to the higher need of human labours and their higher wages. This cost was reduced in imazethapyr 50 and 70 g/ha, imazethapyr + imazemox 60 and 70 g/ha and pendimethalin 1.0 kg/ha by using herbicides to effective control of weeds with minimizing human labours. Rao *et al.* (2011) have also reported higher net return and B:C ratio with pre- and post-emergence application of herbicides. Weedy check recorded lower net returns and B:C ratio. Tiwari *et al.* (1989) reported that the additional amount of income obtained under weed free appeared to be immaterial when compared to cost of weeding incurred to maintain weed free condition beyond eight weeks after sowing. Among other treatments, imazethapyr +

imazemox 70 g/ha resulted in higher net returns (₹ 89027) with B:C ratio of 2.29 despite the higher cost involved.

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