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Productivity and economics of rainy season groundnut as influenced by weed management practices

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ABSTRACT

Field experiment was conducted on medium black calcareous clayey soil at Junagadh Agricultural University, Junagadh during two consecutive seasons of 2013 and 2014 to study the influence of different weed management practices on productivity and economics of *Kharif* groundnut (cv. *GG-20*). Higher weed control efficiency (82.6%), herbicide efficiency index (74.1%), lower weed index (5.1%) and lesser monocot weed density were recorded with pendimethalin 0.9 kg/ha pre-emergence application (PE) followed by (*fb*) intercultivation (IC) and hand weeding (HW) at 40-45 days after seeding (DAS). Weed density of most dominated sedge weed species at 30 DAS, 60 DAS and at harvest were significantly lowered with application of pendimethalin 0.9 kg/ha PE *fb* imazethapyr 75 g/ha as post-emergence application (POE) at 25-30 DAS compared to other herbicides, which were 92.7, 93.5 and 93.0% less over the unweeded control, respectively. The same treatment also recorded the lowest weed dry biomass at harvest. Besides weed free, significantly the higher pod yield (1.75 t/ha) and net return (` 40,657/ha) and B: C ratio (2.38) were recorded with application of pendimethalin 0.9 kg/ha PE *fb* IC and HW at 40-45 DAS. No phytotoxicity symptoms has been observed with any of the herbicides applied to *Kharif* groundnut.

Key words: Economics, Groundnut, Pod yield, Weed control efficiency, Weed index, Weed management

Groundnut (*Arachis hypogaea* L.) is an important third largest oilseed crop species in the legume family (Fabaceae) cultivated in the world. In India, it occupies about 6.0 million hectare area, scattered over 260 districts of 12 states. Peanut oil is extensively used as a cooking medium, especially in central and western India and the raw peanut consumption has recently increased due to attention as a functional food for good health. India has a diverse climate, as such groundnut is grown throughout the year in *Kharif* (rainy season), *Rabi* (winter season) and summer seasons in one or other parts of the country. Area wise, about 85% groundnut is grown during the *Kharif* season under rainfed situations where the vagaries of monsoon and seasonal biotic and abiotic stresses attenuating to low productivity (Dayal 2004). In rainfed areas of Gujarat, Rajasthan and Maharashtra, semi-bunch type varieties are recommended due to their lower incidence of diseases and higher yield potential, particularly longer dormancy period.

Among the different constraints that limit the productivity of peanut in India, weed menace is one of the serious bottlenecks as peanut is confronted with repeated flushes of diverse grassy, broad-leaved and sedge weeds throughout its growing season which cause substantial 15 to 75% yield losses (Jat *et al.* 2011). Uncontrolled weed reduce the yield of *Kharif* groundnut by 54 to 71% especially during early period of crop growth (Agasimani *et al.* 2010). Therefore, weeding has to be completed before pegging. As per national web portal of Agriculture Information, when the groundnut fields are kept weed free for a period of at least first 6 weeks, there is no significant reduction in pod yield but when groundnut competes with weeds at 4 to 8 weeks the reduction in pod yield is substantial. The average loss in groundnut crop yield owing to crop-weed competition (3-6 weeks after planting) under ordinary management condition turns out to be 34%, whereas under poor management the loss may be as high as 60% in the major groundnut producing states like Tamil Nadu, Andhra Pradesh and Uttar Pradesh (Ikisan 2016).

Since cost of seed is very high in groundnut and investment on manual weeding further reduces the profit margin, a viable and economic weed control strategy is required. Pre-emergence (PE) herbicides, *viz*. pendimethalin (Patel *et al.* 2013) and oxyfluorfen (Ramalingam *et al.* 2013) and post-emergence (POE) herbicides, *viz*. imazethapyr (Kalhapure 2013) and

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quizalofop-ethyl (Samant *et al.* 2014) were found very effective in controlling weeds, higher crop yield and increased income in different parts of the country. This field experiment was conducted to evaluate suitable weed management practices for increasing groundnut productivity through weed control efficiency while reducing labour usage in groundnut production.

MATERIALS AND METHODS

Field experiment was carried out at the Junagadh Agricultural University, Junagadh (Gujarat) on medium black calcareous soil during two consecutive *Kharif* seasons of 2013 and 2014. The soil was clayey in texture and slightly alkaline in reaction (pH 8.0 and EC 0.34 dS/m), low in available nitrogen (236.5 kg N/ha), while medium in available phosphorus (22.9 kg P_2O_5/ha) and potash (241.7 kg K_2O/ha). Ten treatments comprising of weed management practices, *viz.* pendimethalin 0.9 kg/ha PE followed by (*fb*) intercultivation (IC) and hand weeding (HW) at 40-45 days after seeding (DAS), oxyfluorfen 0.18 kg/ha Pre-emergence (PE) *fb* IC and HW at 40-45 DAS, quizalofop-ethyl 40 g/ha Post-emergence (POE) at 25-30 DAS *fb* IC and HW at 40-45 DAS, imazethapyr 75 g/ha POE at 20-25 DAS *fb* IC and HW at 40-45 DAS, pendimethalin 0.9 kg/ha PE *fb* quizalofop-ethyl 40 g/ha POE at 20-25 DAS, pendimethalin 0.9 kg/ha PE *fb* imazethapyr 75 g/ha POE at 25-30 DAS, oxyfluorfen 0.18 kg/ha PE *fb* quizalofop-ethyl 40 g/ha POE at 25-30 DAS, oxyfluorfen 0.18 kg/ha PE *fb* imazethapyr 75 g/ha POE at 25-30 DAS, weed free and unweeded control were evaluated in randomized block design replicated thrice. The gross and net plot sizes were 6.0 x 4.8 m and 5.0 x 2.4 m, respectively. The groundnut (cv. *Gujarat Groundnut-20*) was grown with standard package of practices. The crop was fertilized with 12.5-25-0 kg N-P_2O_5-K_2O/ha. Herbicides were applied as per treatments using manually operated knapsack sprayer fitted with flat fan nozzle using spray volume of 500 l/ha. Species wise weed density (number/m² area) were recorded at 30 DAS, 60 DAS and at harvest of the crop. Economics was worked out as per the prevailing market price.

RESULTS AND DISCUSSION

Effect on weeds growth

Predominant weed species identified in the experimental field were *Cynodon dactylon* (9.6%), *Asphodelus tenuifolius* (7.65%), *Commelina benghalensis* (5.95%), *Echinochloa colona* (5.3%) among the monocot species; *Eclipta alba* (8.3%), *Phyllanthus niruri* (8.1%), *Euphorbia hirta* (7.1%), *Boerhavia diffusa* (5.95%), *Portulaca oleracea* (5.1%) and *Parthenium hysterophorus* (0.6%) among the dicot weeds. *Cyperus rotundus* was noted as a major dominated sedge weed (23.7%) throughout the growing season.

Monocot weeds density were significantly lowered down at 30 DAS, 60 DAS and at harvest (5.66, 8.50 and 9.33/m², respectively) with application of pendimethalin 0.9 kg/ha PE *fb* IC and HW at 40-45 DAS, which were 82.3, 89.9 89.4% less over the unweeded control, respectively. The application of pendimethalin followed by manual weeding resulted in lower monocot weeds density (Table 1). Further, pendimethalin prevented the weeds from emerging, particularly during the initial crucial development phases of the crop as reported by Jat *et al.* (2011) and Sathyapriya *et al.* (2013) and also caused high herbicide efficiency index (74.1%).

The lowest dicot weeds density at 30 DAS (9.33/m²) was recorded with application of pendimethalin 0.9 kg/ha PE *fb* imazethapyr 75 g/ha POE at 25-30 DAS, which was 90.1% less over the unweeded control. At 60 DAS and at harvest, submission of oxyfluorfen 0.18 kg/ha PE *fb* imazethapyr 75 g/ha POE at 25-30 DAS and oxyfluorfen 0.18 kg/ha PE *fb* quizalofop-ethyl 40 g/ha POE at 25-30 DAS was found superior and counted minimum dicot weed (13.67 and 8.33 /m², respectively), although reported at par with all the other herbicides. Pre-emergence application of oxyfluorfen at 0.18 kg/ha followed by post-emergence application of imazethapyr at 75 g/ha or quizalofop-ethyl 40 g/ha at 25-30 days crop growth was found more effective in controlling of dicot weeds population.

The application of pendimethalin 0.9 kg/ha PE *fb* imazethapyr 75 g/ha POE at 25-30 DAS resulted in 92.7, 93.5 and 93.0% lesser density of sedge weeds than the unweeded control at 30 DAS, 60 DAS and at harvest, respectively. Pre-emergence application of oxyfluorfen (0.18 kg/ha) followed by post-emergence application of imazethapyr (75 g/ha) at 25-30 DAS of the crop was found more effective in control of most dominated sedge weed (*Cyperus rotundus*) under the rainfed groundnut fields of Gujarat.

Higher weed control efficiency and herbicide efficiency index were recorded with pre-emergence application of pendimethalin 0.9 kg/ha PE *fb* IC and HW at 40-45 DAS. The same treatment also recorded the lowest weed index (5.1%). Administration of

Table 1. Effect of different weed management treatments on weed density (no./m²) in *Kharif* groundnut (mean of two years)

Treatment	Monocot weed density at			Dicot weed density at			Sedge weed density at		
	30 DAS	60 DAS	Harvest	30 DAS	60 DAS	Harvest	30 DAS	60 DAS	Harvest
Pendimethalin 0.9 kg/ha PE *fb* IC and HW at 40-45 DAS	2.47 (5.66)	3.02 (8.67)	3.12 (9.33)	3.34 (12.68)	3.81 (14.98)	3.96 (16.34)	2.40 (5.28)	2.97 (8.45)	2.58 (6.27)
Oxyfluorfen 0.18 kg/ha PE *fb* IC and HW at 40-45 DAS	3.15 (9.67)	3.99 (15.60)	3.88 (15.00)	3.62 (13.16)	3.74 (13.69)	4.61 (20.83)	3.57 (12.30)	3.92 (14.93)	4.03 (15.90)
Quizalofop-ethyl 40 g/ha POE at 25-30 DAS *fb* IC and HW at 40-45 DAS	3.61 (12.61)	3.87 (14.62)	3.76 (13.75)	3.38 (10.99)	4.17 (16.98)	3.95 (15.16)	3.43 (11.40)	4.16 (16.90)	3.24 (10.26)
Imazethapyr 75 g/ha POE at 20-25 DAS *fb* IC and HW at 40-45 DAS	3.37 (11.00)	4.45 (19.50)	4.46 (19.46)	3.28 (10.50)	4.03 (16.00)	3.65 (13.00)	4.05 (16.03)	3.74 (13.57)	3.50 (11.87)
Pendimethalin 0.9 kg/ha PE *fb* Quizalofop-ethyl 40 g/ha POE at 20-25 DAS	2.94 (8.66)	2.97 (8.50)	3.26 (10.50)	3.21 (9.85)	3.89 (14.80)	4.02 (15.97)	2.26 (4.66)	2.46 (5.62)	2.79 (7.40)
Pendimethalin 0.9 kg/ha PE *fb* Imazethapyr 75 g/ha POE at 25-30 DAS	3.10 (9.16)	3.21 (9.83)	3.32 (11.17)	3.04 (9.33)	4.42 (19.14)	3.08 (9.34)	2.18 (4.38)	2.10 (4.00)	2.09 (4.10)
Oxyfluorfen 0.18 kg/ha PE *fb* Quizalofop-ethyl 40 g/ha POE at 25-30 DAS	2.49 (5.83)	3.33 (10.67)	3.86 (14.50)	3.32 (10.57)	4.15 (17.00)	2.97 (8.33)	3.07 (8.94)	2.89 (7.95)	3.28 (10.46)
Oxyfluorfen 0.18 kg/ha PE *fb* Imazethapyr 75 g/ha POE at 25-30 DAS	3.42 (11.33)	3.88 (15.00)	4.54 (20.57)	3.51 (12.19)	3.73 (13.67)	3.68 (13.34)	2.35 (5.10)	2.21 (4.55)	2.86 (7.93)
Weed free	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)
Unweeded control	5.55 (32.06)	9.20 (84.86)	9.42 (88.35)	9.76 (95.20)	9.56 (93.97)	10.07 (101.20)	7.78 (60.30)	7.90 (62.04)	7.63 (57.90)
LSD (P=0.05)	0.44	0.52	0.53	0.40	0.46	0.56	0.38	0.38	0.49

Transformation data (figure in parentheses are original values) $\sqrt{x+0.5}$; *fb* = followed by

Table 2. Effect of different weed management treatments on weed parameters in *Kharif* groundnut (mean of two years)

Treatment	Total weed biomass (kg/ha)	Weed index (%)	Weed control efficiency (%)	Herbicide efficiency index (%)
Pendimethalin 0.9 kg/ha PE *fb* IC and HW at 40-45 DAS	23.20 (547)	5.1	82.6	74.1
Oxyfluorfen 0.18 kg/ha PE *fb* IC and HW at 40-45 DAS	35.07 (1286)	13.6	60.9	58.5
Quizalofop-ethyl 40 g/ha POE at 25-30 DAS *fb* IC and HW at 40-45 DAS	31.53 (994)	12.9	66.8	59.9
Imazethapyr 75 g/ha POE at 20-25 DAS *fb* IC and HW at 40-45 DAS	25.03 (635)	14.4	78.1	57.1
Pendimethalin 0.9 kg/ha PE *fb* quizalofop-ethyl 40 g/ha POE at 20-25 DAS	28.63 (825)	13.7	71.8	58.3
Pendimethalin 0.9 kg/ha PE *fb* imazethapyr 75 g/ha POE at 25-30 DAS	23.00 (531)	12.0	82.6	61.5
Oxyfluorfen 0.18 kg/ha PE *fb* quizalofop-ethyl 40 g/ha POE at 25-30 DAS	27.36 (750)	14.0	75.2	57.7
Oxyfluorfen 0.18 kg/ha PE *fb* imazethapyr 75 g/ha POE at 25-30 DAS	24.18 (648)	15.8	81.1	54.5
Weed free	0.71 (0)	0.0	100	-
Unweeded control	55.79 (3148)	45.5	0.0	-
LSD (P=0.05)	2.01	-	-	-

Transformation data (figure in parentheses are original values) $\sqrt{x+0.5}$; *fb* = followed by

pendimethalin 0.9 kg/ha PE *fb* imazethapyr 75 g/ha POE at 25-30 DAS, reduced 83.1% weed biomass over the unweeded control (Table 2) and statistically comparable with pre-emergence application of pendimethalin 0.9 kg/ha *fb* IC & HW at 40-45 DAS and oxyfluorfen 0.18 kg/ha PE *fb* imazethapyr 75 g/ha POE at 25-30 DAS. This might be attributed due to the effective control of weeds under these treatments, which reflected in less density of weeds, higher weed control efficiency (82.6%), least weed index (5.1%), maximum herbicide efficiency index (74.1%) and ultimately production of low weed biomass.

The unweeded control witnessed significantly highest weed species count, weed index and weed dry biomass they were controlled, which favored luxurious weed growth and results in 45.5% less pod yield over the weed free situation.

Effect on crop yield and economics

Different weed management practices influenced the pod and haulm yield significantly and the highest pod and haulm yield (1.85 and 3.01 t/ha, respectively) were recorded with the weed free condition, which was statistically remained on the same bar with pre-emergence application of

Table 3. Effect of different weed management treatments on yield and economics of *Kharif* groundnut (pooled of two years)

Treatment	Yield (t/ha)		Cost of cultivation (x10^3 `/ha)	Net return (x10^3 `/ha)	B: C ratio
	Pod	Haulm			
Pendimethalin 0.9 kg/ha PE *fb* IC and HW at 40-45 DAS	1.75	2.90	29.48	40.66	2.38
Oxyfluorfen 0.18 kg/ha PE *fb* IC and HW at 40-45 DAS	1.60	2.75	29.74	34.47	2.16
Quizalofop-ethyl 40 g/ha POE at 25-30 DAS *fb* IC and HW at 40-45 DAS	1.61	2.80	29.36	35.39	2.21
Imazethapyr 75 g/ha POE at 20-25 DAS *fb* IC and HW at 40-45 DAS	1.58	2.77	29.66	33.96	2.14
Pendimethalin 0.9 kg/ha PE *fb* quizalofop-ethyl 40 g/ha POE at 20-25 DAS	1.59	2.81	29.61	34.64	2.17
Pendimethalin 0.9 kg/ha PE *fb* imazethapyr 75 g/ha POE at 25-30 DAS	1.63	2.78	29.91	35.24	2.18
Oxyfluorfen 0.18 kg/ha PE *fb* quizalofop-ethyl 40 g/ha POE at 25-30 DAS	1.59	2.74	29.87	33.93	2.14
Oxyfluorfen 0.18 kg/ha PE *fb* imazethapyr 75 g/ha POE at 25-30 DAS	1.56	2.68	29.49	33.12	2.12
Weed free	1.85	3.01	35.38	38.33	2.08
Unweeded control	1.01	1.80	26.50	14.18	1.54
LSD (P=0.05)	0.17	0.25	-	-	-

pendimethalin 0.9 kg/ha *fb* IC and HW at 40-45 DAS (Table 3). The higher yields under this treatment could be ascribed to lower density and biomass of weeds, which reduced the crop-weed competition and crop had not faced stress for available nutrients, moisture, light and space as compared to under heavy weed infestation throughout the growing season. Significantly, lowest pod and haulm yield (45.5 and 40.1% less over weed free, respectively) were recorded under the unweeded control due to deprived growth and development of yield attributing characters of the crop (Dutta *et al.* 2005, Kalhapure *et al.* 2013 and Jadhav *et al.* 2015).

The economics of different weed management practices revealed that next to weed free, the maximum net returns (` 40,657/ha) was accrued under pre-emergence submission of pendimethalin 0.9 kg/ha PE *fb* IC and HW at 40-45 DAS (Table 3). Benefit cost ratio was higher (2.38) with PE of pendimethalin 0.9 kg/ha *fb* IC and HW at 40-45 DAS. However, weed free practice of weed management recorded lowest B: C ratio (2.14) due to higher cost of cultivation owing to higher wages of manual weeding. Unweeded control also recorded the lowest net returns (` 14,179 /ha) and B: C ratio (1.54).

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