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Post-emergence herbicides for weed management in groundnut

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ABSTRACT

A field experiment was conducted at Agricultural Research Station, Kawadimatti, Karnataka during *Kharif* 2012 and 2013 to study the efficacy of post-emergence herbicides for weed management in groundnut. The trial comprised of eight treatments, out of which five treatments were of post-emergence herbicides, *viz*. quizalofop-ethyl, propaquizafiop, imazethapyr, chlorimuron-ethyl, fenoxaprop-p-ethyl. These were compared with, pre-emergence spray of pendimethalin weed free and weedy treatments. Among the post-emergence herbicides, significantly higher pod yield (2.01 t/ha) was recorded with imazethapyre, which was at par with quizalofop-ethyl (1.91 t/ha) and propaquizafop (1.87 t/ha). Imazethapyre also recorded higher net return (Rs/ha) and B:C ratio. Higher pod yield of these treatments was due to significantly lower total weeds density, weed biomass and higher weed control efficiency.

Key words: Economics, Groundnut, Post-emergence herbicides, Weed control efficiency, Weed index

Groundnut is important oil, food and forage crop of the country. India is the second largest producer of groundnut in the world. Among different constraints that limit the productivity of groundnut, weed menace is one of the serious bottlenecks (Chaitanya *et al.* 2012). The weeds emerge fast and grow rapidly competing with the crop severely for the resources namely nutrients, sunlight, and space, soil moisture and reduce the crop yield. Competitional stress of weeds exerts reduction in pod yield to the extent of 17-84% (Guggari *et al*. 1995). Thus weed management is essential to get optimum crop yield.

At present several herbicidal formulations are available in the market used as pre- and post-emergence herbicides for controlling weed complex. The pre-emergence herbicides like pendimethalin were found to be effective in controlling the weeds during early stages of groundnut crop. Use of these selective herbicides as pre-emergence herbicides provide only the initial weed control and often needs integration with one manual weeding for effective weed control. In some cases during sowing time, farmers give first priority to sow the crop rather than to use herbicides for controlling weeds. Under such situations post-emergence herbicides play an important role in managing weeds during the cropping period. The present experiment was conducted with an objective to identify post-emergence herbicides for effectively managing weeds in groundnut crop.

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MATERIALS AND METHODS

A field experiment was conducted at Agricultural Research Station, Kawadimatti, Karnataka. The soil was red sandy loam with normal soil reaction (7.53) and electrical conductivity (0.14), low in organic carbon (0.3) and available N (142 kg/ha), medium in available P_2O_5 (51 kg/ha) and K_2O (120 kg/ha).

The experiment was laid out in randomized complete block design replicated thrice comprised of eight treatments, *viz.* pendimethalin 750 g/ha as pre-emergence herbicide, post-emergence herbi-cides quizalofop-ethyl 25 g/ha, propaquizafop 50 g/ha, imazethapyr 100 g/ha, chlorimuron-ethyl 9 g/ha, fenoxaprop-p-ethyl 9.3 g/ha and a control plot (recommended practice - two hand weeding at 20 and 40 DAS along with intercultivation operation) and weedy check treatments. The experiment crop was sown on 25th July and 20th July during 2012 and 2013, respectively. Groundnut local variety (*TMV-2*) was sown at 30 x 10 cm spacing. Recommended dose of fertilizer (25:50:25 kg of N.P.K/ha) along with gypsum 500 kg/ha and Zn 25 kg/ha were applied at basal. Pre-emergence herbicide, pendimethalin 700 g/ha was sprayed on the day of sowing. Post-emergence herbicides, *viz.* quizalofop-ethyl 25 g/ha, propaquizafop 50 g/ha, imazethapyr 100 g/ha, chlorimuron-ethyl 9 g/ha, fenoxaprop-p-ethyl 9 g/ha were applied at 20 days after crop sowing (DAS). It coincides with 2-4 leaf stage of weeds. Total spray solution used was 500 l/ha. The knapsack sprayer fitted with flat fan nozzle was used for the herbicide

spray. These treatments were compared with recommended practice two hand weeding at 20 and 40 DAS with inter cultivation and weedy check. The weed density and weed biomass from one m^2 was recorded before herbicides spray and at 15, 30 and 45 days after application.

For bio-efficacy observations, three spots were selected at random and marked with pegs in each plot. Total weed density of major weed species was recorded using 0.25 m^2 quadrant in peg marked areas before herbicide application and at 15, 30 and 45 DAS, and it was converted to number of weeds per meter square area. Weed biomass was also recorded from each plot from 0.25 m^2 quadrant and computed to gram per square meter area. At the end of cropping season, yield was recorded from net plot area and computed to per hectare.

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 DISCUSSIONS

Weed flora

The weed flora in experimental plots comprised of dicots, grasses, sedges and broad-leaf weeds. Major weeds infested were *Tridax* sp., *Leptocloa* sp., *Mulugo* sp., *Phyllanthns* sp., *Cyprus* sp., *Beorhaavia* sp., *Commelina* sp.,*Cyperus rotandus,Cynodon doctylon, Digera arvensis etc*. In the first year, the selected experimental plot had more grassy weeds. Whereas in second year, the selected experimental plot had more broad-leaf weeds.

The observations on weed density at 15, 30 and 45 days after spraying of post-emergence herbicides (Table 1) revealed that imazethapyr and chlorimuron-ethyl recorded significantly lower broad-leaf weeds density over the rest of the treatments. In case of grassy weeds, lower weed density was recorded with quizalofop-ethyl which was at par with propaquizafop followed by imazethapyr. These results indicate that imazethapyr was effective in controlling both broad-leaf weeds and grassy weeds, which was in conformity with observations of Kelly *et al* (1998). Quizalofop-ethyl and propaquizafop were effective in controlling only grassy weeds. Significantly lower weed density was recorded with post-emergence spray of imazethapyr (16.76, 14.20 and 14.51/m^2) and it was at par with quizalofop-ethyl (19.26,16.98 and18.10/m^2) and propaquizafop (22.17,18.31 and 19.41/m^2) at 15, 30 and 45 days after application of herbicide. Since imazethapyr was effective in reducing weeds density significantly, it resulted in significant reduction of total weeds biomass. These results were in conformity with those of Sangeetha *et al.* (2012).

Among the post-emergence herbicide, imazethapyr recorded significantly higher weed control efficiency (66.6, 74.2 and 72.2) followed by quizalofop-ethyl (66.4, 69.2 and 67.4) and propaquizafop (60.0, 68.1 and 66.6) at 15, 30 and 45

Table 1. Weed density and total weed biomass at different stages as influenced by herbicides in groundnut (pooled data)

Treatment	Broad-leaf weed density (no/m^2)				Grassy weed density (no/m^2)				Total weed density (no/m^2)				Total weed biomass (g/m^2)			
	Before	15 DAA	30 DAA	45 DAA	Before	15 DAA	30 DAA	45 DAA	Before	15 DAA	30 DAA	45 DAA	Before	15 DAA	30 DAA	45 DAA
Pendimethalin	1.22 b	1.35 bc	1.85 b	1.81 b	1.70 b	1.92 d	1.99 c	2.11 c	2.06 b	2.33 d	2.61 d	2.79 d	1.93 b	1.98 d	2.12 d	2.24 c
	(1.56)	(1.93)	(2.96)	(3.33)	(3.00)	(3.69)	(3.95)	(4.46)	(4.56)	(5.61)	(6.91)	(7.78)	(3.59)	(3.91)	(4.62)	(5.32)
Quizalofop-ethyl	2.91 a	3.83 a	3.85 a	3.89 a	5.65 a	2.11 cd	1.59 c	1.71 c	6.35 a	4.37 c	4.12 c	4.24 c	3.95 a	4.06 c	3.95 c	4.07 b
	(8.46)	(14.78)	(14.40)	(15.18)	(32.04)	(4.48)	(2.59)	(2.92)	(40.50)	(19.26)	(16.98)	(18.10)	(15.23)	(16.43)	(15.66)	(16.63)
Propaquizafop	2.81 a	3.83 a	3.92 a	3.91 a	5.69 a	2.73 c	1.82 c	1.89 c	6.33 a	4.70 c	4.26 c	4.34 c	3.98 a	4.36 c	3.99 c	4.09 b
	(7.88)	(14.67)	(14.88)	(15.38)	(32.13)	(7.50)	(3.43)	(3.76)	(40.01)	(22.17)	(18.31)	(19.14)	(15.40)	(19.22)	(16.08)	(16.89)
Imazethapyr	2.95 a	1.94 b	1.96 b	1.94 b	5.75 a	3.58 b	3.27 b	3.25 b	6.69 a	4.90 c	3.75 c	3.80 cd	4.17 a	3.83 c	3.50 c	3.65 b
	(8.81)	(3.85)	(3.47)	(3.90)	(32.79)	(12.91)	(10.73)	(10.62)	(45.27)	(16.76)	(14.20)	(14.51)	(16.93)	(14.74)	(12.33)	(13.44)
Chlorimuron-ethyl	3.00 a	1.83 b	1.91 b	1.83 b	5.55 a	5.72 a	5.84 a	5.90 a	6.28 a	6.03 b	6.09 b	6.18 b	4.00 a	5.62 b	5.85 b	6.02 a
	(8.98)	(3.52)	(3.17)	(3.43)	(30.77)	(32.92)	(34.20)	(35.04)	(39.75)	(36.44)	(37.37)	(38.47)	(15.54)	(31.54)	(34.25)	(36.31)
Fenoxaprop-p-ethyl	2.95 a	4.00 a	4.19 a	(4.18 a	5.87 a	6.00 a	6.05 a	6.11 a	6.54 a	7.22 a	7.32 a	7.40 a	4.08 a	6.64 a	6.85 a	6.89 a
	(8.73)	(16.05)	(17.05)	17.55)	(33.97)	(36.24)	(36.60)	(37.43)	(42.70)	(52.29)	(53.65)	(54.98)	(16.13)	(44.19)	(46.95)	(47.51)
Control	0.74 b	0.91 c	0.95 c	0.93 c	1.11 b	1.02 e	0.79 d	0.88 d	1.17 b	1.29 e	1.02 e	1.22 e	0.97 c	1.12 d	1.07 e	1.16 d
	(0.59)	(0.86)	(0.46)	(0.96)	(0.85)	(1.09)	(0.68)	(0.85)	(1.44)	(1.95)	(1.14)	(1.80)	(0.49)	(1.36)	(1.17)	(1.54)
Weedy check	2.93 a	3.93 a	4.19 a	4.19 a	5.84 a	5.97 a	6.08 a	6.13 a	6.42 a	7.14 a	7.33 a	7.40 a	4.14 a	6.64 a	6.85 a	6.91 a
	(9.02)	(15.77)	(17.24)	(17.74)	(33.67)	(36.29)	(37.44)	(38.11)	(42.68)	(52.06)	(54.68)	(55.84)	(17.17)	(45.65)	(47.98)	(48.54)
LSD (P=0.05)	0.53	0.61	0.641	0.647	0.985	0.798	0.756	0.786	1.144	1.013	0.991	1.039	0.79	0.95	0.958	0.976

*DAA-Days after application of post emergence herbicides, figures in the parenthesis are the original values and subjected to square root transformation

Table 2. Weed control efficiency (%), weed index (%), yield and economics as influenced by herbicides in groundnut (pooled data)

Treatment	Weed control efficiency (%)			Weed index (%)	Pod yield (t/ha)	Haulm yield (t/ha)	Gross return (x10^3 `/ha)	Net return (x10^3 `/ha)	B:C ratio
	15 DAA	30 DAA	45 DAA						
Pendimethalin	91.2 a	90.0 a	88.5 a	3.9 e	2.14 a	3.45 a	82.53 a	49.71 ab	2.53 a
Quizalofop-ethyl	66.4 b	69.3 b	67.4 b	14.2 cd	1.91 a	3.28 ab	74.77 a	41.40 b	2.25 a
Propaquizafop	60.0 b	68.1 b	66.6 b	15.9 c	1.87 a	3.26 ab	73.47 a	41.28 b	2.29 a
Imazethapyr	66.6 b	74.2 b	72.2 b	9.9 d	2.01 a	3.32 ab	76.48 a	43.47 ab	2.32 a
Chlorimuron-ethyl	29.3 c	27.3 c	24.6 c	36.4 b	1.39 b	2.77 bc	54.09 b	22.96 c	1.74 bc
Fenoxaprop-p-ethyl	3.6 d	2.4 d	2.3 d	46.4 a	1.19 b	2.53 c	46.29 b	15.30 d	1.50 c
Control	96.9 a	97.5 a	97.0 a	0 e	2.24 a	3.54 a	85.78 a	46.26 a	2.18 ab
Weedy check	0.0 d	0.0 d	0.0 d	48.8 a	1.14 b	2.36 c	44.65 b	14.43 d	1.48 c
LSD (P=0.05)	11.28	12.16	11.31	4.81	0.39	0.69	1.48	7.43	0.45

DAA-Days after application of herbicides, market price of groundnut pod: 2012- ` 450/t, 2013- ` 310/t

DAA. Significant reduction in total weeds biomass by these treatments might have contributed for higher weed control efficiency over rest of post-emergence herbicides.

Control (2 HW + IC) plot has recorded significantly lower total weed density, total weed biomass and higher weed control efficiency over rest of the treatments and it was followed by pre-emergence herbicide pendimethalin (along with one intercultivation). Whereas weedy check recorded significantly higher total weed density and total weed biomass and lower weed control efficiency.

Yield and economics

Pod yield was significantly influenced by post-emergence herbicides (Table 2). Pod yield of groundnut recorded significantly higher in weed free plot (2.24 t/ha). Among the post-emergence herbicides imazethapyr recorded higher pod yield (2.01 t/ha). These results were in concurrence with those of Chaitanya *et al.* (2012), whose higher seed yield of groundnut by effective post-emergence herbicides was due to effective control of grassy and broad-leaf weeds.

Two hand weeding and one intercultivation treatments have recorded significantly higher yield (2.24 t/ha) which was at par with pre-emergence herbicide treatment pendimethalin (2.14 t/ha) and post-emergence imazethapyr (2.01), quizalofop-ethyl (1.91 t/ha) and propaquizafop (1.87 t/ha). Similar trend was noticed in case of haulm yield end gross return.

Net return (` 49707/ha) and benefit cost ratio (2.53) was recorded significantly higher in treatment with pre-emergence spray of pendimethalin followed by post-emergence spray of imazethapyr (` 43474/ha and 2.32) as the higher pod yield was achieved with lower cost of cultivation by these treatments. Net return and benefit cost ratio in quizalofop-ethyl (` 41397/ha and 2.25) and propaquizafop (` 41281/ha and 2.29) treatments were at par with imazethapyr treatment. Sasikala *et al.* (2004) reported highest net return with post-emergence application of imazethapyr after pre-plant incorporation of fluchloralin in groundnut crop. Significantly lower pod yield, net return and B:C ratio was recorded in treatments with weedy check and it was at par with post-emergence application of chlorimuron-ethyl and fenoxaprop-p-ethyl as they failed to effectively control the weeds. It may be concluded that imazethapyr 100 g/ha as post-emergene application can manage both grassy as well as broad-leaf weeds and results in higher yield and net returns of groundnut.

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