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Research Article

Effect of post- emergence herbicides in groundnut and its residual effect on succeeding crops

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ABSTRACT : A field investigation was carried out at Main Oilseeds Research Station, Junagadh Agricultural University, Junagadh, during *Kharif* 2011 and 2012 on clayey soil to study the efficacy of post emergence herbicides on *Kharif* groundnut and its residual effect on succeeding crops of wheat and gram. An experiment was done with eleven treatments of post-emergence herbicides comprising weedy cheek replicated thrice in Randomized Block Design (RBD).The various weeds observed in groundnut field during *Kharif* season were, among the narrow leaved weeds the *Echinochloa colonum, Dinebra. retroflexa, Dactyloctenium aegyptium* and *Brachiaria* Spp. were more rampant. The broad leaved weeds like, *Commelina benghalensis, Digera arvensis, Indigofera glandulosa* and *Amaranthus viridis* was marked their presence in good numbers. Based on two years field experimentation, it was found that early post emergence application of Odyssey 70 % WG at 70 g ha^{1} + MSO adjuvant @ 2ml/litre of water gave significantly lower total weed density(6.34), weed dry weight(96 g m^{-2})and higher weed control efficiency (75 %). Application of new formulation of Odyssey 70 % WG at 70 g ha^{1} + MSO adjuvant @ 2ml/litre of water as early post emergence herbicide kept the weed density and dry weight below the economic threshold level and increased the pod yield, haulm yield and kernel yield (1411,2783 and 1010 kg ha^{-1}, respectively) and this was at par with early post emergence application of Imazethapyr 10% SL @ 100 g ha^{-1} + MSO adjuvant@ 2.0 ml/litre of water and Quizolofop ethyl 5% EC 50 g ha^{-1} in groundnut. Succeeding crops like wheat and gram sown immediately after the harvest of groundnut was not affected by the residue of herbicides at all different doses.

KEY WORDS : Groundnut, Weed density, Weeds control efficiency, Yield, Succeeding crops

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INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is one of the most important oilseeds crops in India. Groundnut contributes more than 50% edible oil production of the country. The demand for edible oil is rising day by day. Area as well as productivity of this crop declined drastically. Therefore, concentrated efforts are being made to increase and to stabilise the oilseeds production. One of the major constraints in groundnut production is the weed menace and losses caused by weeds are more than any other causes like insects, diseases and nematodes. Gnanamurthy and Balasubramaniyan (1998) reported that yield of groundnut was reduced by 70 per cent if when the weed cover was more than 50 per cent. Pre-plant or pre-emergence chemical weed management using selective herbicides like fluchloralin and pendimethalin followed by one hand weeding is a common practice in groundnut and most research works confirm this (Walia *et al.,* 2007). However, disturbing the soil during manual weeding, in the early stages, exposes the groundnut crop to

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new flushes of weeds. These late emerging weeds seriously affect the pegging and pod development and disrupt digging and harvesting operations and difficult to strip the pods from vines. Apart from competition for nutrients and other inputs, these late emerging weeds infest the land with weed seeds and make the land less productive in the subsequent seasons (Kanagam, 2003). There also exists another situation wherein the pre-emergence application could not be done owing to continuous rains or for other reasons. Early post-emergence herbicides offer great scope to tide over these situations. This warrants development of early post-emergence herbicides in order to effectively manage the late emerging weeds. Beneath these backdrops, newer formulation of herbicides is coming in the market with wide spectrum of weed control efficiency. The early post-emergence of new herbicides formulations are to be evaluated for their bio-efficacy of controlling wide range of weed flora, better crop growth and yield of groundnut.

EXPERIMENTAL METHODS

An experiment was conducted at research farm of Main Oilseeds Research Station, Junagadh Agricultural University, Junagadh during *Kharif* season of 2011 to 2012 with a view to determine the residual effect of herbicides applied to *Kharif groundnut* on succeeding *Rabi* wheat and gram crops. The soil was medium black in texture with low in available nitrogen (235 kg ha^{-1}), medium in available phosphorus (31.2 kg ha^{-1}) and high in available potassium (347 kg ha^{-1}) with pH of 7.9. The experiment was laid out in Randomized Complete Block Design with three replication consists of eleven treatments *viz*., T_1-Odyssey 70 % WG (52.5 g ha^1.).;T_2 Odyssey 70 % WG (61.25 g ha^1).; T_3 Odyssey 70 % WG (70 g ha^{-1}); T_4-Odyssey 70 % WG (52.50 g ha^{-1}) + Methylated Seed Oil (MSO) adjuvant @ 2ml/litre of water; T_5 Odyssey 70 % WG (62.25 g ha^1) + MSO adjuvant @ 2ml/litre of water, T_6 Odyssey 70 % WG (70 g ha^1) + MSO adjuvant @ 2ml/ litre of water; T_7 Imazethapyr 10% SL (100 g ha^{-1}) + MSO adjuvant @ 2ml/litre of water.; T_8 Imazamox 12% SL (42 g ha^{-1}) + MSO adjuvant @ 2ml/litre of water.; T_9 Quizolofop ethyl 5% EC 50.0 g ha^{-1}. ; T_{10} Fenoxoprop ethyl 9% EC 67.5 g ha^{-1}. and T_{11} untreated control. The *Kharif* groundnut variety GG 5 was sown at a spacing of 45 x 10 cm at 125 kg ha^{-1} of seed during second week of June 2011 and 2012. Herbicide treatment plots were sprayed at 2-3 leaf stage of weeds (20 DAS) as early post emergence. Calculated quantity of herbicides with a spray fluid of 500 liters ha^{-1} was sprayed uniformly over the plots using knapsack sprayer fitted with fan type nozzle (WFN 40) on 3. A fertilizer schedule of 12.5:25:00 kg NPK ha^{-1} in the form of urea and single super phosphate were applied to all plots uniformly in lines and incorporated at the time of sowing. The entire dose of NPK was applied as basal. Total weed population/m^2 was recorded at 60 DAS under each treatment with the help of quadrate measuring 1 m^2 per plot. Weed population was recorded in weedy check to work out the relative density of weeds. The weed dry matter was also recorded at 60 DAS under each plot. The crop was harvested on third week of September during both the years. After harvesting of the groundnut crop, to know the residual effect of herbicides, without disturbing the layout, each plot was manually prepared for sowing of succeeding crops. Succeeding wheat (GW 496) and gram (GG 1) were sown in each plot in *Rabi* season. The germination percentage, plant height and yield of wheat and gram crops were recorded and data were used for analysis. Data on weed density and weed biomass were transformed using √ transformations. The weed control efficiency (WCE) was worked out. The weed control efficiency was calculated as:

$$\mathbf{WCE} = \frac{\mathbf{WPU - WPT}}{\mathbf{WPU}}$$

where, WPU = Weed population in un-weeded plot, WPT = Weed population in treated plot

EXPERIMENTAL RESULTS AND ANALYSIS

The results obtained from the present study have been discussed in detail under following heads :

Effect on weeds:

The field was infested with complex weed flora comprising both narrow leaved weeds (72 %) as well as broad leaved weeds (28 %). Among the narrow leaved weeds the *Echinochloa colonum*, *Dinebra. retroflexa, Dactyloctenium aegyptium* and *Brachiaria* Spp. were more rampant. The predominance of grassy and sedge weeds have also been reported by Gowda *et al*. (2002).The broad leaved weeds like, *Commelina benghalensis, Digera arvensis, Indigofera glandulosa* and *Amaranthus viridis* was also marked their presence in good numbers. The density and dry matter of narrow leaved (8.27 and 269.7 g m^{-2}, respectively) and broad leaved (4.35 and 114.3 g m^{-2}, respectively) weeds were significantly maximum under unweeded(control)plots at 60 days after sowing of groundnut crop (Table 1). However, identical reduction in density and dry matter weeds was observed when weeds were controlled either through chemical or mechanical means. Early post-emergence application of new formulation of Odyssey 70 % WG + MSO adjuvant @ 2ml/litre of water at 52.5, 61.25, 70 g ha^{-1} resulted in effective control of broad leaved weeds, grasses and to some extent sedge due to its broad spectrum action. Thus, broad leaved and grassy weeds were effectively controlled with the herbicide. Post emergence application of Odyssey 70 % WG at the lowest dose (52.5 g ha^1) caused marginal reduction in density and dry weight of all the narrow and broad leaved

weeds (5.41 and 3.51, respectively) but reduction was more pronounced when Odyssey 70 % WG was applied with MSO adjuvant @ 2.0 ml/litre of water at 52.5 g ha^{-1} or higher rates (61.25 to 70 g ha^{-1}). Early post-emergence application of Odyssey 70 % WG most effectively decreased the number of annual broad leaved weeds and grassy weeds in cluster bean as reported by Patil *et al*. (2013) lend support to the present findings. These finding also corroborate the results reported by Kumar *et al*. (2004), Ahmed *et al*. (2008) and Sangeetha (2010).

Weed control efficiency (WCE) during the *Kharif* seasons at 60 DAS under different weed control treatments, varied significantly (Table 1). Pre-emergence application of Odyssey 70 % WG (70 gha^{l}) + MSO Adjuvant @ 2ml/litre of water at 20 DAS was recorded significantly highest narrow leaved, broad leaved and total weeds control efficiency (84.7%, 52.1% and 75.0%, respectively) than any other weed control treatment (Table 1). The lowest weed control efficiency was recorded by unweeded treatment. This might be due to the continuous competition of groundnut crop with the obnoxious weed species for nutrient and moisture. Ramkrishna *et al.* (1990) and Dubey *et al*. (2010) observed the similar trend in efficacy of herbicide in groundnut crop.

Effect on crop:

Pod (723 kg ha^{-1}), haulm (1462 kg ha^{-1}) and kernel (497 kg ha^{-1}) yields attained the minimum value when weeds were not controlled throughout the season. This caused severe competitive stress on crop plants for growth resources and led to inferior yield attributing traits (shelling per cent and 100 kernel weight) hence had minimum pod and kernel yields. Among the herbicidal weed control treatments, early post-emergence application of Odyssey 70 % WG at 70 g ha^{l} with Methylated Seed Oil (MSO) adjuvant@ 2.0 ml/litre of water recorded significantly higher pod yield, haulm and kernel yield (1411, 2783 and 1010 kg ha^{-1}, respectively) due to better control of weeds at critical stages thus providing favourable environment for better growth and development leading to enhanced pod yield of groundnut. The percentage increase of pod, haulm and kernel yield over unweeded control was 95.2, 90.4 and 103.2 per cent, respectively. This might be due to translocation and accumulation of photosynthates to pods and kernels which resulted in appreciable increase in the yield attributing characters in groundnut. This treatment was comparable with early post emergence application of Imazethapyr 10% SL @ 100 g ha^{-1} with MSO adjuvant@ 2.0 ml/litre of water(1328 kg ha^{-1}) and Quizolofop ethyl 5% EC

Table 1 : Weed density, weed dry matter and weed control efficiency as affected by weed control treatments (mean of two years)

Sr. No.	Treatments	Weed density/m^2 at 60 DAS			Weed dry matter at 60 DAS (g/m^2)			Weed control efficiency at 60 DAS (%)		
		Narrow leaved weeds	Broad leaved weeds	Total weeds	Narrow leaved weeds	Broad leaved weeds	Total weeds	Narrow leaved weeds	Broad leaved weeds	Total weeds
1.	Odyssey 70% WG @52.5g/ha	5.41 (28.8)*	3.51 (11.9)	8.92 (40.7)	113.9	73.6	187.5	57.8	35.6	51.2
2.	Odyssey 70% WG @61.25/ha	4.6 (20.9)	3.58 (12.3)	8.19 (33.2)	82.6	76.5	159.0	69.4	33.1	58.6
3.	Odyssey 70% WG @70g/ha	4.37 (18.7)	3.40 (11.1)	7.76 (29.8)	73.9	68.6	142.5	72.6	40.0	62.9
4.	Odyssey 70% WG @52.5g/ha + MSO adjuvant@ 2.0 ml / litre	3.69 (13.1)	3.20 (9.9)	6.89 (23.0)	51.9	61.2	113.1	80.8	46.5	70.6
5.	Odyssey 70% WG@61.25g/ha + MSO adjuvant@ 2.0 ml / litre	3.48 (11.6)	3.15 (9.4)	6.63 (21.1)	46.0	58.5	104.4	83.0	48.8	72.8
6.	Odyssey 70% WG @70g/ha + MSO adjuvant@ 2.0 ml / litre	3.29 (10.4)	3.05 (8.8)	6.34 (19.3)	41.2	54.8	96.0	84.7	52.1	75.0
7.	Imazethapyr 10 % SL @100 g/ha + adjuvant @ 2.0 ml / litre	3.65 (12.9)	3.59 (12.4)	7.25 (25.3)	50.8	77.1	127.9	81.2	32.5	66.7
8.	Imazamox 12% SL@42g/ha + adjuvant@ 2.0 ml / litre	5.64 (31.4)	3.66 (12.9)	9.30 (44.3)	124.0	80.0	204.0	54.0	30.0	46.9
9.	Quizolofop ethyl 5%EC 50g/ha	3.42 (11.2)	3.42 (11.2)	6.84 (22.5)	44.4	69.6	114.0	83.5	39.1	70.3
10.	Fenoxoprop ethyl 9% EC 67.5g/ha	4.16 (16.9)	3.50 (11.8)	7.66 (28.7)	66.9	73.2	140.0	75.2	36.0	63.5
11.	Control (Unweeded)	8.27 (68.3)	4.35 (18.4)	12.62 (86.7)	269.7	114.3	383.9	0.0	0.0	0.0
	LSD(P=0.05)	0.62	0.39	0.69	28.67	16.19	32.9	-	-	-

*Original figures in parenthesis were subjected to square root transformation (√) before statistical analysis. DAS- days after sowing

50 g ha^{-1} (1332 kg ha^{-1}) in respect of pod yield. Similar trend was also found in kernel yield of groundnut. Yield attributing characters like number of 100 kernel weight and shelling percentage found significant effect by different treatments. These might be due to low level of weed competition at critical phases of crop growth (upto 60 DAS) which favoured the groundnut crop to utilize the available resources to the maximum extent, which ultimately reflected on higher growth and yield attributing characters. The results are in accordance with the findings of Dubey *et al*. (2010), Malunjkar *et al*.(2012) and Patil *et al.(*2013) who have reported that the efficient utilization of soil moisture, nutrients and light created a favourable condition for the development of gynophores into the soil which leads to maximum number of pegs and matured pods in groundnut.

Residual effects of on succeeding crops:

The residual effects of different herbicides on wheat and gram crops were recorded in terms of germination per cent, plant height and yield. The results revealed that germination of succeeding wheat and gram crops recorded at 30 DAS was not significantly affected by residual effect of herbicide applied to groundnut. The plant stand of wheat ranged from 87.1 to 91.5 per cent and gram from 87.3 to 90.1 per cent under all the treatments at 30 DAS. Further, plant height recorded at harvest was also unaffected due to residual effect of different doses of herbicides applied in groundnut. Yield of wheat and gram showed no distinct variation due to different dose of herbicides (Table 3). The mean grain/seed yield of wheat ranged between 3625 to 3750 kg ha^{-1} and gram ganged between 984 to 1010 kg ha^{-1}. This result is in line with the results of Sangeetha (2010) and Patil

Table 2 : Effect of different treatments on yield attributes, pod yield haulm yield, kernel yield and oil per cent of groundnut (mean of two years)

Sr. No.	Treatments	Pod yield (kg/ha)	Haulm yield (kg/ha)	Kernel yield (kg/ha)	Shelling (%)	100 kernel weight (g)
1.	Odyssey 70% WG @52.5g/ha	894	1937	629	70.38	35.50
2.	Odyssey 70% WG @61.25/ha	1000	2266	717	71.69	35.74
3.	Odyssey 70% WG @70g/ha	1039	2263	729	70.13	35.84
4.	Odyssey 70% WG @52.5g/ha + MSO adjuvant@ 2.0 ml / litre	1016	2456	729	7158	36.63
5.	Odyssey 70% WG@61.25g/ha + MSO adjuvant@ 2.0 ml / litre	1090	2423	771	70.75	36.72
6.	Odyssey 70% WG @70g/ha + MSO adjuvant@ 2.0 ml / litre	1411	2783	1010	71.77	36.74
7.	Imazethapyr 10 % SL @100 g/ha + adjuvant@ 2.0 ml / litre	1328	2690	937	70.57	37.61
8.	Imazamox 12% SL@42g/ha + adjuvant@ 2.0 ml / litre	988	2323	682	68.99	34.78
9.	Quizolofop ethyl 5%EC 50g/ha	1332	2621	959	71.99	36.79
10.	Fenoxoprop ethyl 9% EC 67.5g/ha	1057	2507	740	69.99	35.83
11.	Control(Unweeded)	723	1462	497	68.80	33.30
	LSD(P=0.05)	211	388	147	1.27	2.00

Table 3 : Residual effect of weed control treatments on germination count, plant height and yield of succeeding crops(mean of two years)

Sr. No.	Treatments	Wheat			Gram		
		Germination %	Plant height (cm)	Grain yield (kg/ha)	Germination %	Plant height (cm)	Seed yield (kg/ha)
1.	Odyssey 70% WG @52.5g/ha	89.1	81.1	3650	87.3	37.2	950
2.	Odyssey 70% WG @61.25/ha	91.2	82.1	3700	88.9	36.9	1000
3.	Odyssey 70% WG @70g/ha	90.3	79.1	3675	86.9	38.0	990
4.	Odyssey 70% WG @52.5g/ha + MSO adjuvant@ 2.0 ml / litre	87.1	78.9	3700	88.7	39.3	1010
5.	Odyssey 70% WG@61.25g/ha + MSO adjuvant@ 2.0 ml / litre	90.4	80.1	3750	87.3	38.6	958
6.	Odyssey 70% WG @70g/ha + MSO adjuvant@ 2.0 ml / litre	88.2	80.3	3725	89.0	40.2	979
7.	Imazethapyr 10 % SL @100 g/ha + adjuvant@ 2.0 ml / litre	91.5	79.0	3625	88.3	41.2	1000
8.	Imazamox 12% SL@42g/ha + adjuvant@ 2.0 ml / litre	90.6	79.4	3700	88.6	39.5	958
9.	Quizolofop ethyl 5%EC 50g/ha	90.2	78.9	3663	90.1	38.9	979
10.	Fenoxoprop ethyl 9% EC 67.5g/ha	89.4	80.2	3650	88.4	37.8	984
11.	Control(Unweeded)	90.6	79.6	3650	88.2	40.1	1005
	LSD(P=0.05)	NS	NS	NS	NS	NS	NS

NS=Non-significant

et al. (2013) who reported that, the early post-emergence application did not leave any residue in the soil and there was no toxic effect to the succeeding crops of wheat and gram. It might be shown that new formulation of herbicide with different doses could be very effective against most of the broad leaved and grassy weeds in groundnut.

Conclusion:

The results indicated that early post-emergence application of Odyssey 70 % WG + MSO adjuvant@ 2.0 ml/ litre of water at 70 g ha^{-1} can keep the weed density and dry weight reasonably at lower level and enhance the productivity of groundnut. The new formulation of early post emergence application of Odyssey 70 % WG at 70 g ha^{1} + MSO adjuvant@ 2.0 ml/litre of water, Imazethapyr 10% SL @ 100 g ha^{-1} + MSO adjuvant@ 2.0 ml/litre of water and Quizolofop ethyl 5% EC 50 g ha^{-1} applied in groundnut was found to be safe on the succeeding crops and this might be due to detoxification of herbicides in soil and do not adversely affect the growth and yield of the succeeding crops in terms of germination, plant height, and grain yield of the succeeding wheat and gram crops.

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