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RESEARCH PAPER

Influence of fluazifop-p-butyl on grassy weeds in groundnut (*Arachis hypogaea* L.) and its residual effect on succeeding crops

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Abstract : A field investigation was carried out on Vertisol soil of Main Oilseeds Research Station, Junagadh Agricultural University, Junagadh, during *Kharif* 2010 and 2011 to study the efficacy of post-emergence herbicides on *Kharif* groundnut and its residual effect on succeeding crops of wheat and gram. An experiment comprised of eight weed control treatments, *viz.*, fluazifop-p-butyl 13.4 EC @ 100, 134, 167 and 335 gha^{-1} as post-emergence, imazethapyr 10 per cent SL @125 gha^{-1}as post-emergence and pendamethalin 30 per cent EC @750 gha^{-1}as pre-emergence, two hand weeding at 30 and 45 DAS and unweeded check was conducted in Randomized Block Design with three replications. The field was infested with complex weed flora comprising both grassy (69 %) and as well as broad leaf weeds (31%). The grassy weeds *viz.*, *Echinochloa* spp., *Dinebra retroflexa* and *Brachiaria* spp. and broadleaf weeds like, *Indigofera glandulosa, Commelina benghalensis, Phyllanthus niruri, Euphorbia hirta, Digera arvensis* and *Tridax procumbens* were predominant. Results revealed that among the herbicidal treatments, fluazifop-p-butyl 13.4EC @ 167 g ha^{-1} at 20 DAS recorded significantly least number of grassy weeds and total dry weed matter with weed control efficiency (79.55%) and weed index (20.2%). The highest weed control efficiency (91.05%) was under hand weeding against grassy weeds at 60 DAS. An herbicidal treatment irrespective of its doses was not effective against broadleaf weeds. Shelling per cent, pod yield, haulm yield and kernel yield of groundnut were also superior in plots treated with fluazifop-p-butyl 13.4EC @ 167 g ha^{-1} at 20 DAS, except hand weeding treatment. Fluazifop-p-butyl 13.4 EC was found safe to groundnut and did not cause residual toxicity to succeeding crops.

Key Words : Groundnut, Weed density, Weeds control efficiency, Herbicides, Residual effect

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INTRODUCTION

Groundnut (*Arachis hypogaea* L) is an important crop worldwide, distributed across the vast area in tropical, subtropical and temperate zones. Weed infestation is one of the major constraints that limit the productivity of groundnut. Critical period of crop-weed competition for groundnut crop is ranged between 40 to 60 DAS (Singh and Patel, 1992). Generally weeds are controlled through hand weeding in groundnut, which is very expensive, laborious and sometimes damaging to the crop plants. It is, therefore, important to find out suitable herbicides that would control the weeds economically and safely. Critically viewing, the manual and mechanical methods of weed control, besides being less effective, are costly and time demanding. Mechanical method was partially effective because most of the weeds growing in intra-rows escaped in weeding. Thus, chemical weed control became a promising means to control weeds at initial stages of crop growth. Many pre - emergence herbicides control weeds only for a limited period and hence, late emerging weeds

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escape killing. So, there is ample scope for controlling weeds by application of early post emergence herbicides (Sangeetha *et al*., 2011**)**. Hence, the present experiment was carried out to evaluate the efficiency of post-emergence herbicides for control of weeds in groundnut and its influence on productivity as well as residual effect on succeeding crops.

MATERIAL AND METHODS

A field experiment was conducted at Main Oilseeds Research Station, Junagadh Agricultural university, Junagadh, during *Kharif* 2010 and 2011. The soil was medium black in texture having 0.61 per cent organic carbon, 175 kg ha^{-1} available N, 24 kg ha^{-1} available P_2O_5 and 310 kg ha^{-1} available K_2O with pH 7.8. The experiment was laid out in Randomized Block Design with eight treatments and three replications. Plot size was 3.6m x 4.0m and 2.4m x 3.0m gross and net, respectively. The crop was sown at 45x10 cm spacing with 125 kg seed rate and fertilizer dose 12.5 kg ha^{-1} N and 25.0 kg ha^{-1} P_2O_5 with groundnut variety GG 5. Other cultural practices and plant protection measures were followed as per recommendations. The treatments consisted of : T_1 - Check (Unweeded); T_2 - Fluazifop-p-butyl 13.4 EC (post-eme.) @ 100 g ha^{-1}; T_3 - Fluazifop-p-butyl 13.4 EC (post-eme.) @ 134 g ha^{-1}; T_4 ,- Fluazifop-p-butyl 13.4EC (post-eme.) @ 167 g ha^{-1}; T_5 - Fluazifop-p-butyl 13.4EC (post-eme.) @ 335 g ha^{-1}; T_6 - Imazethapyr 10 per cent SL (post-eme.) @ 125 g ha^{-1};T_7- Pendamethalin 30 per cent EC (pre-eme.) @ 750 g ha^{-1}; T_8 - Hand weeding (30 and 45 DAS). Herbicides were dissolved in 500 litres water and pre-emergence herbicide was sprayed with knapsack sprayer using flat fan nozzle at 2 days after sowing. The post emergence herbicide was sprayed 20 days after sowing. The total annual rainfall received during the crop season was 1690 mm and 963 mm distributed in 71 and 45 rainy days in the *Kharif* 2010 and 2011, respectively. Data on weed density and weed biomass were recorded 60 days after sowing using 0.25 m^2 quadrate at 4 places in randam and analysed after subjecting the original data to log transformed using transformations. Growth and yield attributing as well as yield of groundnut were recorded following standard practices. Phytitoxicity of different treatments on groundnut as well as on follow up *Rabi* crop were also studied. The weed control efficiency (WCE) and weed index (WI) was worked out. The weed control efficiency was calculated as:

$$\mathbf{WCE} = \frac{\mathbf{DWC - DWT}}{\mathbf{DWC}} \times \mathbf{100}$$

where, DWC = Dry weight of weeds in unweeded control plot, DWT = Dry weight of weeds in treated plot.

The weed index was derived as :

$$\mathbf{WI} = \frac{\mathbf{X - Y}}{\mathbf{X}} \times \mathbf{100}$$

where, X = yield from hand weeded plot, Y = yield from weed treated plot for which WI is to be calculated.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Weed flora :

The field was infested with complex weed flora comprising both grassy (69 %) and as well as broad leaf weeds (31%). Species wise weed data recorded in weedy plots at 60 DAS of groundnut indicated that there was predominance of only grassy weeds in the experiment field cropped with groundnut. Among the grassy weeds, *Echinochloa* spp., *Dinebra retroflexa* and *Brachiaria* spp. marked their presence in good numbers. *Indigofera glandulosa, Commelina benghalensis, Phyllanthus niruri, Euphorbia hirta, Digera arvensis* and *Tridax procumbens* was predominant among broadleaf weeds. The predominance of grassy and sedge weeds have also been reported by several workers (Gowda *et al*., 2002; Deore *et al*., 2009 and Mundra and Maliwal, 2012) during *Kharif* season.

Weed density and weed dry matter production :

Dry weight of weeds is a better criterion of the weed-crop competition than the weed density. Higher dry weight of weed reflects more utilization of soil and environmental resources by the weeds at the expense of the crop. Data revealed that different treatment exhibited their significant influence on weed density and dry matter of weeds. The density (9.44 m^{-2}) and dry weight (741 $kgha^{-1}$) of weeds were maximum under weedy plots at 60 DAS of groundnut crop. However, identical reduction in density and dry weight of weeds was observed when weeds were controlled either through chemical or mechanical means. The density of grassy weeds at 60 DAS was significantly reduced by all herbicidal treatments, but it was remained ineffective against broadleaf weeds. Among all the herbicidal treatment, post-emergence application of fluazifop-p-butyl 13.4EC @ 335 g ha^{-1} at 20 DAS recorded significantly least number of grassy weeds (2.22 m^{-2}), total weeds (5.49 m^{-2}) and total dry weed matter (343 kg ha^{-1}) than unweeded control except hand weeding plot (Table 1). This might be due to control of weeds during early growth stage by post emergence application of fluazifop-p-butyl at 20 DAS. Further the crop covers the soil surface and smothers the growth of weeds results into least number of weeds at later stage of crop (Malunjkar *et al*., 2012). Similar observations were also made by Magani *et al*.(2012) in sesame and Grichar *et al*. (2012) in castor crop. Hand weedings done at 30 and 45 DAS significantly reduced the density (2.91m^{-2}) and dry matter (85 $kgha^{-1}$) of weeds to the maximum extent over all herbicidal treatments during both the years due to elimination of all sorts of weeds during the course of hand weeding. Similar observations were also made by Bhagat *et al*. (2002), Kumar *et al*. (2004) and Ahmed *et al*. (2008).

Table 1 : Effect of different treatments on weed density, weed dry matter and weed control efficiency of groundnut (mean of two years)

Sr. No.	Treatments	Weed density/m^2 at 60 DAS			Weed dry matter at 60 DAS (kg ha^{-1})			Weed control efficiency at 60 DAS (%)			Mean weed index (%)
		Grassy weeds	Broad leaf weeds	Total weeds	Grassy weeds	Broad leaf weeds	Total weeds	Grassy weeds	Broad leaf weeds	Total weeds	
1.	Check (Unweeded)	5.60	3.84	9.44	469	272	741	0.00	0.00	0.00	56.2
		(31.07)	(14.33)	(45.40)							
2.	Fluazifop-p-butyl 13.4 EC	2.47	3.61	6.08	99	249	348	78.98	8.22	53.04	27.1
	@ 100 g ha^{-1}	(5.63)	(12.57)	(18.20)							
3.	Fluazifop-p-butyl 13.4 EC	2.42	3.43	5.84	98	256	354	79.12	5.89	52.27	20.4
	@ 134 g ha^{-1}	(5.40)	(11.27)	(16.67)							
4.	Fluazifop-p-butyl 13.4EC	2.40	3.28	5.68	96	239	335	79.55	11.90	54.75	20.2
	@ 167 g ha^{-1}	(5.27)	(10.33)	(15.60)							
5.	Fluazifop-p-butyl 13.4EC	2.22	3.27	5.49	96	247	343	79.62	9.08	53.76	22.1
	@ 335 g ha^{-1}	(4.47)	(10.20)	(14.67)							
6.	Imazethapyr 10% SL	2.49	3.29	5.77	103	260	363	78.05	4.17	50.97	26.6
	@ 125 g ha^{-1}	(5.77)	(10.33)	(16.10)							
7	Pendamethalin 30% EC	3.38	3.19	6.57	141	251	392	69.96	7.61	47.10	26.9
	@ 750 g ha^{-1}	(10.97)	(9.73)	(20.70)							
8	Hand weeding	1.39	1.52	2.91	42	43	85	91.05	84.29	88.57	0.0
	(30 and 45 DAS)	(1.43)	(1.87)	(3.30)							
	LSD(P=0.05)	0.39	0.49	0.74	47	27	62	-	-	-	-

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

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)	Oil %
1.	Check (Unweeded)	567	849	390	68.80	35.80	49.11
2.	Fluazifop-p-butyl 13.4 EC @ 100 g ha^{-1}	943	1308	677	71.78	38.10	49.51
3.	Fluazifop-p-butyl 13.4 EC @ 134 g ha^{-1}	1030	1462	751	72.93	36.30	50.12
4.	Fluazifop-p-butyl 13.4EC @ 167 g ha^{-1}	1033	1465	747	72.30	36.26	50.02
5.	Fluazifop-p-butyl 13.4EC @ 335 g ha^{-1}	1008	1395	731	72.55	36.76	49.83
6.	Imazethapyr 10% SL @ 125 g ha^{-1}	950	1319	672	70.74	40.68	49.86
7.	Pendamethalin 30% EC @ 750 g ha^{-1}	946	1307	670	70.87	39.76	49.42
8.	Hand weeding (30 and 45 DAS)	1294	1744	946	73.09	40.14	49.78
	LSD(P=0.05)	153	186	81	0.92	NS	NS

NS=Non-significant

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.	Check (Unweeded)	89.4	82.1	3550	84.3	35.2	1020
2.	Fluazifop-p-butyl 13.4 EC @ 100 g ha^{-1}	90.0	81.1	3700	85.9	35.9	980
3.	Fluazifop-p-butyl 13.4 EC @ 134 g ha^{-1}	89..3	80.1	3600	84.0	36.0	1100
4.	Fluazifop-p-butyl 13.4EC @ 167 g ha^{-1}	90.1	88.9	3600	84.7	37.3	1000
5.	Fluazifop-p-butyl 13.4EC @ 335 g ha^{-1}	89.4	79.1	3650	83.3	36.6	1010
6.	Imazethapyr 10% SL @ 125 g ha^{-1}	88.2	80.3	3625	85.0	37.2	1050
7	Pendamethalin 30% EC @ 750 g ha^{-1}	91.5	79.0	3725	84.3	38.2	1000
8	Hand weeding (30 and 45 DAS)	90.0	81.4	3600	83.5	36.5	990
	LSD(P=0.05)	NS	NS	NS	NS	NS	NS

NS=Non-significant

Weed control efficiency and weed index :

Weed control efficiency (WCE) during mean of two years (*Kharif* seasons of 2011 and 2012) at 60 DAS under different weed control treatments, varied significantly (Table 1). The application of fluazifop-p-butyl 13.4 EC at the lowest dose (100 g ha^{-1}) had the lower WCE because of poor control of grassy weeds, but it was well marked when fluazifop-p-butyl 13.4 EC was applied at higher rates (137 to 335 g ha^{-1}). The poor WCE was found in broadleaf weeds by different herbicides treatment. Among the herbicides application of fluazifop-p-butyl 13.4 EC @ 335 g ha^{-1} recorded maximum WCE of grassy weeds (79.62%) at 60 DAS and it was closely followed by fluazifop-p-butyl 13.4EC @ 167 g ha^{-1} (Table 1). Maximum total WCE (88.57%) was recorded under two hand weeding at 30 and 45 DAS due to elimination of all weeds. The lowest mean weed index was noticed in fluazifop-p-butyl 13.4 EC @ 167 g ha^{-1} (20.2 %). The yield reduction up to 56.2 per cent was recorded if field kept un-weeded. This might be due to the continuous competition of groundnut crop with the obnoxious weed species for nutrient and moisture. Prabhu *et al.* (2011), Bhalel *et al*. (2012) and Malunjkar *et al.* (2012) observed the similar trend in efficacy of herbicide in groundnut crop.

Effect on crop :

The significant differences were found with respect to pod yield, haulm yield, kernel yield and shelling while, non significant differences were recorded in 100 kernel weight and oil per cent in pooled results (Table 2). A perusal of data on pod, haulm and kernel yield revealed that the hand weeding (T_8) produced significantly higher pod yield (1294 $kgha^{-1}$), haulm yield (1744 $kgha^{-1}$) and kernel yield (946 $kgha^{-1}$) over all the treatments in pooled results. While, significantly lowest pod, haulm and kernel yield (567, 849 and 390 $kgha^{-1}$, respectively) was recorded under unweeded control (T_1). This caused severe competitive stress on crop plants for growth resources and led to inferior yield attributing hence had minimum pod and kernel yields. Among the herbicidal weed control treatments, early post-emergence application of fluazifop-p-butyl 13.4EC @ 167 gha^{-1} recorded significantly higher pod yield (1033 $kgha^{-1}$), haulm yield (1465 $kgha^{-1}$) and kernel yield (747 $kgha^{-1}$) due to better control of weeds at critical stages consequently providing favourable environment for better growth and development leading to enhanced pod yield of groundnut. This treatment was analogous with application of fluazifop-p-butyl 13.4 EC @ 134 g ha^{-1} (1030 $kgha^{-1}$) in respect of pod yield. Similar trend was also found in haulm and kernel yield of groundnut. Yield increase under treatments T_2, T_3, T_4, T_5, T_6, T_7 and T_8 over unweeded control was by 66, 82, 82, 78, 68, 67 and 128 per cent, respectively in pooled (Table 2). 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. Shelling found significant effect by different treatments. The results are in agreement with the findings of Dubey *et al*. (2010), Malunjkar *et al*. (2012) and Patil *et al.* (2013) in groundnut, Magani *et al.* (2012) in sesame, Grichar *et al.* (2012) in castor and Muhammad *et al.* (2000) in mungbean.

Residual effects of on succeeding crops :

Herbicides fluazifop-p-butyl applied in groundnut did not show any kind of phytotoxicity on the succeeding crops, *viz.*, wheat and gram. 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 (Table 3). The mean grain/ seed yield of wheat ranged between 3550 to 3725 $kgha^{-1}$ and gram between 980 to 1100 $kgha^{-1}$. 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.

Conclusion :

The results showed that early post-emergence application of fluazifop-p-butyl 13.4EC @ 167 gha^{-1} can keep the weed density, dry weight of grassy weeds and weed index reasonably at lower level with higher weed control efficiency and enhance the productivity of groundnut. The post emergence application of fluazifop-p-butyl 13.4 EC applied in groundnut was found to be safe on the succeeding crops of wheat and gram.

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