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INFLUENCE OF IMAZETHAPYR ON WEED CONTROL AND PRODUCTIVITY OF GROUNDNUT (*ARACHIS HYPOGAEA* L.) AND SUCCEEDING SORGHUM (*SORGHUM BICOLOR* L.)

M. R. UMESH[1],* N. MANJUNATHA[1], B. N. SHWETHA[2] AND N. ANAND[1]
[1]Department of Agronomy, UAS, Raichur - 584 104, Karnataka, INDIA
[2]Agricultural Research Station, Kawadimatti - 585 290, UAS, Raichur, Karnataka
e-mail: mrumeshagri@gmail.com

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***Corresponding author**

ABSTRACT
A field experiment was carried out at Raichur, Karnataka with an objective to study the yield response and weed control in groundnut by post emergent application of Imazethapyr 10% SL. Treatments consist of different doses of Imazethapyr, pre emergent pendimethalin and combined application was compared with hand weeding and weedy check. Results indicated that application of pendimethalin 30 EC @ 0.33 kg ai/ha as pre emergent followed by application of Imazethapyr 10% SL @ 0.2kg/ha recorded significantly higher groundnut pod yield (2154 kg/ha), haulm yield (2648 kg/ha), weed control efficiency (84.9 %). However, it was found significantly on par with application of Imazethapyr 10 % SL @ 0.1 kg ai/ha. Due to higher concentration of Imazethapyr 10 % SL @ 0.1 kg/ha may be preferred over 0.2 kga.i./ha. It can be concluded that application of Imazethapyr 10 % SL @ 0.1 kg ai/ha at 20 DAS was effective to control weeds, enhance productivity of groundnut.

INTRODUCTION

Productivity of oil seed crops in India is needs to be improved to achieve sustained productivity under different production system. Groundnut (*Arachis hypogaea* L.) is an important oil seed crop of India. Weed menace is a major constraint in groundnut production and it aggravate after seed emergence. Among various weed management practices chemical method has become cost effective and timely control of weeds (Verma *et al.,* 2015). It is grown throughout the year and thus weed management plays an important role for its successful cultivation. Depending upon the nature, density and period of occurrence of weeds, cause yield loss of 40-80 %. Keeping the crop weed free through manual hand weeding and hoeing, though effective, it has several limitations such as timely availability of adequate labour and difficulty in using mechanical weeders during rainy season *etc.* The only and the best alternative, seems to be application of herbicides at proper time and optimum dose. At present, pendimethalin 30 EC @ 3.3 ml/L is applied as pre-emergent followed by one hand weeding at 40 days after sowing (DAS) was recommended in groundnut growing areas. It is found to be effective for weed control upto 20-25 DAS. However, critical period of crop-weed competition in groundnut was upto 40-45 DAS (Verma *et al.,* 2015). The herbicides applied as pre-emergence may fail to provide weed control for the entire growing season due to herbicide dissipation and mode of action in the dry weather conditions. Presently,there is no effective post emergent broad spectrum herbicide for groundnut. The post-emergence herbicide like imazethapyr can be used effectively for controlling weeds in groundnut. Imazethapyr belongs to Imidazolinones a broad spectrum herbicide applied on foliage and soil. The chemical formula of Imazethapyr is [2-{4, 5 dihydro-4 methyl-4-(1- methylethyl)-5-oxo-1H-imidazol-2-yl}-5-ethyl-3 Pyridine Carboxylic acid. In India, it is recommended for, soybean, pigeonpea, sunflower *etc.* as post emergent herbicide in India (Hari Ram *et al.*, 2013). In this regard, an experiment was conducted to evaluate Imazethapyr 10 % SL for its dose and time of application on weed control and productivity of irrigated groundnut and its phytotoxic effect on succeeding sorghum.

MATERIALS AND METHODS

Experimental site

A field experiment was conducted to evaluate application of Imazethapyr 10 % SL in groundnut during *Kharif* 2012 and its effect on succeeding sorghum crop in *Rabi* 2012-13. Experimental site was located at Agronomy farm, Main Agricultural Research Station, Raichur, Karnataka.The data of prevailing climatic parameters were collected from meteorological station located within one kilometer from experimental area. Climate is sub-tropical, average annual rainfall was 727.6 mm. The total rainfall received during June 2012 to March 2013 was 507.5 mm. Rainfall received during groundnut crop period was 309.9 mm distributed in 22 rainy days, it was much deficit over normal rainfall (31 years average). Soil is clay loam in texture, available soil nitrogen and phosphorus was medium and high in potassium. The overall pest and disease incidence during entire crop growth period

was below the threshold level. The crop was sown on 19th July, 2012 by manual line sowing at 30cm row spacing and 10 cm between plants. The groundnut variety R-2001-2 (Vijetha) was released by UAS, Raichur selected for the study. It is a high yielding variety moderately resistant to leaf spot and bud necrosis.

The weed control treatments comprised of four doses of Imazethapyr 10% SL @ 1.0, 2.0 3.0 and 4.0 g a.i./ha), pre-emergent pendimethalin followed by post-emergent Imazethapyr, Pendimethalin and hand weeding, Imazethapyr and hand weeding, weed free and weedy check (Table 1). Experiment was laid out in randomized complete block design with three replications. After two days of sowing light irrigation was provided to achieve uniform seed germination. The emerged weeds were removed manually in weed free plot throughout the crop growth period. Light irrigation was provided before post emergent herbicide spray at 20 DAS to ensure more effectiveness. Pendimethalin 30 EC @ 3.3ml/l was sprayed as per the treatments. Imazethapyr 10% SL was applied as post-emergent herbicide compared with Quizalofop ethyl @ 0.1kg a.i./ha and both of them were sprayed to respective plots on 9thAugust, 2012 (20 DAS). It coincides with 2-4 leaf stage of weeds. Total spray solution was 500l/ha. The knapsack sprayer fitted with flat fan nozzle was used for the herbicide spray. The concentration of Imazethapyr and Quizalofop ethyl for each treatment was sprayed as per the treatments.

Biometric observations

The data on weed population were recorded at different growth stages of crop before herbicide application and at 15, 30, 45 and 60 DAS with the help of quadrate (0.5 x 0.5 m) at two randomly selected places in each plot and then converted into per square meter. At the end of cropping season yield and yield attributes were recorded by random sampling of five plants as well as net plot area (16.2 m^2). The phytotoxicity rating was recorded as 10 point scale from 0-10 scale at 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 days after spray (Table 4).

The Weed index (WI) and weed control efficiency (WCE %) were calculated using following formulae

$$WCE\ \% = \frac{\text{Weed dry weight in untreated plot} - \text{Weed dry weight in treated plot}}{\text{Weed dry weight in untreated plot}} \times 100$$

$$WI\ (\%) = \frac{\text{Grain yield in weed-free plot} - \text{Grain yield in treated plot}}{\text{Grain yield in weed-free plot}} \times 100$$

The same plots treated with Imazethapyr 10% SL for groundnut were maintained without till the land and without disturbing bunds of all the treatments. The succeeding sorghum cv. M-35-1 was sown on 19th November, 2012 after harvest of groundnut crop. Observations on germination percentage, phytotoxicity, crop growth parameters and yield were recorded from succeeding sorghum crop. The economics of all the treatments were calculated by considering the prevailing prices of inputs and produce. Weed data were subjected to square root transformation to normalize their distribution before statistical analysis. The experimental data were analysed statistically by following Fischer's method of analysis of variance wherever 'F' test was significant at p = 0.05 the results have been compared among treatments based on critical difference at same level of significance.

RESULTS AND DISCUSSION

Weed flora

The experimental site was infested with various weed species consisting of different species of monocot and dicot weeds. The major weed flora observed in the experimental field were *Eragrostis pilosa, Setaria glauca, Paspalum dilatatum, Commelina bengalensis, Celosia argentea, Trianthema portulacastrum, Cyanodon doctylon, Cyperus rotundus, Panicum repens etc.*

The weed control treatments significantly suppressed the various weeds over weedy check at 15, 30, 45 and 60 days after spray (Table 2). Significant reduction in weed count/m^2 was recorded under all the doses of Imazethapyr 10 % SL

Table 1: Seed and haulm yield of Groundnut as influenced by weed management practices

Treatment	Dry matter at harvest (g/plant)	Pod yield per plant (g/plant)	100 kernel weight(g)	Pod yield (kg/ha)	Haulm yield (kg/ha)	Seed Oil content%	Weed control efficiency % at 60 DAS	Weed index %
Weed index (%)								
Imazethapyr 10 % SL @ 0.1 kg a.i./ha	14.3	21.6	34.3	1906	3288	46.7	76.8	15.1
Imazethapyr 10 % SL @ 0.2 kg a.i./ha	13.5	23.9	32.5	2154	2971	46.2	84.9	4.0
Imazethapyr 10 % SL @ 0.4 kg a.i./ha	12.8	20.6	34.0	1501	1780	47.2	86.0	33.1
Quizalofop ethyl 5% EC @ 0.25 kg a.i./ha	9.0	12.4	33.9	738	1414	46.5	71.5	67.1
Imazethapyr 10 % SL @ 0.1 kg ai/ha + IC at 40 DAS	13.7	22.3	34.1	1611	2206	47.0	76.0	28.2
Pendimethalin 30 EC @ 1.0 kga.i/ha + Imazethapyr 10% SL 0.1 kg ai/ha	14.1	21.6	35.9	2039	2648	46.8	76.5	9.1
Pendimethalin 30 EC @ 1.0 kg a.i/ha + hand weeding at 40 DAS	14.7	19.6	31.4	1741	3104	46.9	78.7	22.4
Hand weeding at 15 &30 DAS and intercultivation at 40 DAS	12.7	18.9	31.8	1623	3103	46.9	78.7	27.7
Weedy check	6.4	6.5	31.5	582	1116	45.9	0.0	74.1
Weed free	14.7	23.0	32.6	2244	2991	47.3	100.0	0.0
CD (p = 0.05)	2.6	3.8	NS	253	458	NS	-	-

DAS- Days after sowing, NS- Non significant; NA- Not analyzed

Table 2: Weed density and weed dry weight (g/m^2) in Groundnutat different intervals under weed management practices

Treatment	Weed density (no./m^2) Days after spraying					Weed dry weight (g/m^2)				
	Before	15	30	45	60	Before	15	30	45	60
Imazethapyr 10 % SL @ 0.1 kg a.i./ha	4.9(23.6)	6.6(43.4)	6.9(47.4)	7.7(59.2)	8.1(65.7)	5.6(31.0)	9.1(82.3)	10.9(118.6)	11.9(140.8)	12.6(157.5)
Imazethapyr 10 % SL @ 0.2 kg a.i./ha	4.8 (22.2)	5.7(31.6)	5.6(31.0)	5.9(34.4)	6.4(39.9)	5.7(31.5)	7.8(60.7)	8.9(78.3)	9.7(93.4)	10.7(114.1)
Imazethapyr 10 % SL @ 0.4 kg a.i./ha	4.7 (21.6)	5.5(29.7)	5.5(30.0)	5.9(34.2)	6.4(40.5)	5.6(30.7)	7.7(58.2)	8.5(71.8)	9.6(92.2)	11.0(119.6)
Quizalofop ethyl 5 % EC @ 0.25 kg a.i./ha	5.2(26.9)	6.7(44.8)	7.5(55.7)	8.7(74.9)	8.9(79.6)	6.2(38.1)	9.8(94.7)	12.1(147.0)	14.2(201.6)	15.0(224.9)
Imazethapyr 10 % SL@ 0.1 kg ai/ha +IC at 40 DAS	5.2 (26.6)	5.7(32.1)	7.3(52.7)	8.0(63.7)	8.9(77.9)	6.1(36.8)	8.4(70.8)	12.1(146.0)	13.6(183.2)	15.2(230.0)
Pendimethalin 30 EC @ 1.0 kg a.i/ha + Imazethapyr 10 % SL 0.1kg ai/ha	4.8 (22.1)	5.5(30.1)	6.4(40.8)	4.5(19.5)	5.7(31.7)	5.7(32.2)	8.0(63.5)	10.7(113.9)	13.8(191.0)	14.7(216.5)
Pendimethalin 30 EC @ 1.0 kg a.i/ha + hand weeding at 40 DAS	4.6 (21.1)	5.6(31.2)	5.8(33.5)	3.5(11.7)	4.7(21.9)	5.6(30.4)	8.1(65.6)	10.0(99.2)	10.1(102.4)	11.5(132.1)
Hand weeding 15 & 30 DAS and intercultivation at 40 DAS	4.8 (22.3)	5.1(25.2)	6.2(38.4)	6.5(41.8)	6.9(47.4)	5.8(33.0)	7.7(58.5)	10.2(104.1)	11.3(126.9)	12.7(159.6)
Weedy check	5.1 (25.4)	8.0(63.2)	8.4(70.1)	9.5(90.6)	(10.1)101.6	6.2(38.5)	11.3(127.8)	13.9(193.7)	18.1(325.8)	21.0(441.4)
Weed free	5.1 (25.7)	0.7(0.0)	0.7(0.0)	0.7(0.0)0.0	0.7(0.0)	6.0(36.1)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)
CD (p=0.05)										

DAS= Days after sowing, IC = Intercultivation, Figures in parenthesis are original values

over untreated control. Among weed control treatments, application of Imazethapyr 10 % SL @ 0.1& 0.2 kg a.i./ha as post-emergent at 20 DAS was found to be effective for monocot, dicot and sedge type of weeds. Lower total weed count/m^2 was found in plots after 30 days of Imazethapyr 10 % SL spray and higher weed count/m^2 was found in quizalofop ethyl 5 % EC application at 20 DAS. It implied that, these herbicide concentrations have influenced on weed control. After 60 days after application lower weed count/m^2 was recorded in Imazethapyr 10 % SL @ 0.1 kg ai/ha and 0.2kg a.i./ha over untreated control (132.9/m^2). Habimana *et al.* (2013) reported similar observation that pendimethalin (0.75 kg/ha) at 3 DAS *fb* Imazethapyr @ 0.1 kg ai/ha at 20 DAS recorded minimum weed density and weed dry weight as compared to application of pendimethalin alone.

Among herbicide applied treatments, significantly lower weed dry weight was recorded with application of Imazethapyr 10 % SL @ 0.2 kg a.i./ha (114.1 g/m^2) followed by Imazethapyr 10 % SL@ 0.1 kg a.i./ha (157.5 g/m^2) over untreated control (441.4 g/m^2). It was consistently reduced weed biomass accumulation up to 60 days after sowing. Highest weed control efficiency were recorded with application of Imazethapyr 10 % SL @ 0.2 kg a.i./ha (84.9 %) and 0.4 kg a.i./ha (86 %). Due to phytotoxic effect at 400 g/ha during initial stages yield and yield attributes were get reduced. Imazethapyr at 0.1 kg ai/ha was found best treatment by giving more seed yield. Sangeetha *et al.* (2012) reported that spraying of Imazethapyr @ 0.2 kg ai/ha at 15 DAS as early post emergent significantly decreased the weed dry weight followed by 0.1 kg ai/ha. Billore *et al.,* (1999) reported that Imazethapyr 0.075 kg ai/ha can be used effectively for controlling weeds in soybean without any adverse effect on the crop.

Post emergence application of Imazethapyr @ 0.4 and 0.2 kg/ha recorded higher WCE at 60 DAS followed by Imazethapyr @ 0.1 kg/ha. More reduction of weed dry weight by reducing the weed density in these treatments might have resulted in higher WCE. Vyas and Jain (2003) also reported higher WCE after post-emergence application of Imazethapyr. Jha and Monika Soni (2013) also observed maximum weed control efficiency (80 %) with the application of pendimethalin (0.75 kg ai/ha) *fb* Imazethapyr (0.75 kg ai/ha) in soybean. Basavaraj Kumbar, *et al.* (2014a) reported that application of Imazethapyr 10 % SL recorded significantly higher plant height, dry matter production per plant, pod yield and yield components over unweeded and other herbicides application.

Phytotoxicity effect

Groundnut plants were continuously monitored for all phytotoxicity symptoms and crop health as described in methodology. The ratings were given from 0 to 10 scale on severity of phytotoxicity. There was no phytotoxicity symptoms was observed with application of Imazethapyr 10 % SL @ 0.1 kg a.i./ha and 0.4 kg a.i./ha.As the herbicide induced toxicity reduced with the increasing age of the crop recovered. Gonzalez *et al.* (1996) reported that, the herbicidal action on rhizobium could involve inhibition of symbiosis process and interfere with mobility between root and bacteria which could disrupt sequential exchange of signals both parameters.

Groundnut yield

The pod and haulm yield of groundnut was significantly influenced by herbicide application and weed management practices (Table 1). Significantly higher groundnut pod yield was recorded with application of Imazethapyr 10 % SL @ 0.2 kg a.i./ha (2,154 kg/ha)

Table 3: Phytotoxicity, germination percentage, plant height and yield of sorghum as influenced by application of post emergent herbicide Imazethapyr 10 % SL to Groundnut

Treatment	Phototoxic effect (%) 7 DAG	15 DAG	Germination (%)	Plant height (cm)	Grain yield (kg/ha)	Stover yield (kg/ha)
Imazethapyr 10 % SL @ 0.1 kg a.i./ha	0	0	93.0	138	999	1789
Imazethapyr 10 % SL @ 0.2 kg a.i./ha	1	1	83.1	143	820	1603
Imazethapyr 10 % SL @ 0.4 kg a.i./ha	3	4	77.2	116	750	1514
Quizalofop ethyl 5% EC @ 0.25 kg a.i./ha	0	0	95.0	129	1132	1825
Imazethapyr 10 % SL@ 0.1 kg ai/ha +IC at 40 DAS	0	0	90.2	119	960	1482
Pendimethalin 30 EC @ 1.0 kga.i/ha + Imazethapyr 10% SL 0.1 kg a.i./ha	0	0	92.0	127	942	1509
Pendimethalin 30 EC @ 1.0 kg a.i/ha + hand weeding at 40 DAS	0	0	93.5	123	1164	1980
Hand weeding at 15 &30 DAS and intercultivation at 40 DAS	0	0	94.3	143	1170	2001
Weedy check	0	0	97.2	132	1009	1927
Weed free	0	0	96.4	139	1138	1969
CD @ 5%	-	-	-	20.7	222	280.4

followed by application @ 0.1 kg a.i./ha (1,906 kg/ha). However, lower pod yield was recorded in untreated control weedy check (582 kg/ha). The extent of reduction in pod yield was 74 % over weed free (2244 kg/ha). Kernel oil content was not significantly influenced by herbicide application. Lower pod yield per plant and dry matter production were recorded in quizalofop ethyl 5% EC and untreated control. Sudharshana *et al.*, (2013) reported that despite better weed control achieved in Imazethapyr double dose treatment, highest pod yield was recorded in recommended dose where seed inoculation was done compared to Imazethapyr double dose. Jha and Monika Soni (2013) reported that application of pendimethalin (0.75 kg ai/ha) *fb* Imazethapyr (0.75 kg a.i./ha) to soybean recorded maximum weed control efficiency (80 %), lower weed density, weed dry weight and higher seed yield and monetary returns. Basavaraj Kumbar *et al.* (2014) and Aarti Shirvas *et al.* (2013) also reported that groundnut yield economics was higher with application of Imazethapyr 10 % SL @ 0.1 kg a.i./ha at 20 DAS.

Succeedingcrop

Significantly higher seed germination percentage was recorded in weed free plot (97.2 %) and weedy check (96.4 %) lowest in Imazethapyr 10% SL @ 0.2 kg a.i./ha (87.2 %) sprayed plots (Table 4). The phytotoxicity effect on succeeding sorghum in terms of necrosis, chlorosis or wilting was observed in Imazethapyr 10% SL @ 0.4 kg a.i./ha applied plots and not observed in rest of the treatments.

Results of the study inferred that depending upon weed intensity, application of Imazethapyr 10 % SL @ 0.2 kg a.i./ha as post emergence in groundnut at 20 DAS was found to be effective. Since, it also on par with Imazethapyr 10 % SL @ 0.1 kg a.i./ha lower concentration may be preferred over higher concentration. Pendimethalin followed by Imazethapyr @ 1.0 kg a.i./ha could be an alternative to pre-emergence pendimethalin and hand weeding at 40 DAS.

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REFERENCES

AartiShrivas, M. Kaleem, Suryendra, S. and Sandeep Kumar Chandrawanshi 2013. Bio-efficacy of Imazethapyr at various doses in *kharif* Groundnut (*Arachishy pogaea*L.) on sandy loam soil. *Legume Res.* **36(4):** 368-370.

Basavaraj Kumbar, Ramachandra Prasad, T. V.,Somashekar, K. S.,Veeresh Hatti, M. Y. Ullash and Madhukumar, V. 2014. Evaluation of doses of new herbicide fluazifop-P-butyl 13.4 EC for grassy weeds management in irrigated Groundnut. *The Bioscan.* **9(3):** 1135-1137.

Basavaraj, Kumbar, Ramachandra Prasad, T. V., Sanjay, M. T., Mallikarjuna, G. B., Veeresh Hatti and Madhukumar, V. 2014a. Influence of weed management practices on crop growth, nutrient uptake and yield of groundnut under irrigation condition. *The Bioscan.* **9(4):** 1843-1846.

Billore, S. D., Joshi, O. P. and Ramesh, A. 1999. Energy production through herbicidal weed control in soybean. *Indian J. Agril. Sci.* **69:** 770-772.

Gonzalez, A., Gonzalez-Murua, C., Royuela, M., 1996. Influence of Imazethapyr on *Rhizobium* growth and its symbiosis with pea. *Weed Sci.* **44:** 31-37.

Habimana, S., Murthy, K. N., Shankaralingappa, B. C., Sanjay, M. T. Ramachandra C., 2013. Efficiency and economics of weed control with pre- and post-emergence herbicides in soybean (*Glycine max* L.). *Asian J. Plant Sci. Res.* **3(4):** 18-20.

Hari Ram, Guriqbal Singh, Navneet Aggarwal, G. S., Buttar Onkar S. 2013. Standardization of rate and time of application of imazethapyr weedicide in Soybean. *Indian J. Plant Prot.* **41(1):** 33-37.

Jha, A. K. and Monika Soni 2013. Weed management by sowing methods and herbicides in soybean. *Indian J. Weed Sci.* **45(4):** 250-252.

Sangeetha, C., Chinnusamy, C., Prabhakaran, N. K. 2012. Efficacy of imazethapyr on productivity of soybean and its residual effect on succeeding crops. *Indian J. Weed Sci.* **44(2):** 135-138.

Sudharshana, C., Ram Prakash, T., Jayasree, G., Pratap Kumar Reddy, A. 2013. Effect of pendimethalin and imazethapyr on nodulation, nitrogen fixation and nitrogenase activity and yield in groundnut (*Arachis hypogaea* L.). *Int. J. Bio-Res. Stress Mangt.* **4(2):** 309-313.

Verma, S. K., Singh, S. B. Meena, R. N. Prasad, S. K., Meena R. S. and Gaurav 2015. A Review of weed management in India: The need of new directions for sustainable Agriculture. *The Bioscan.* **10(1):** 253-263.

Vyas, M. D., Jain, A. K. 2003. Effect of pre and post-emergence herbicides on weed control and productivity of soybean (*Glycine max). Indian J. Agron.* **48(4):** 309-311.