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Performance of Early Post-Emergence Herbicide in Irrigated Groundnut (*Arachis hypogea* L.) in Red Sandy Loam Soils of Tamil Nadu

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A field investigation was carried out at Agricultural Research Station, Tamil Nadu Agricultural University, Bhavanisagar during kharif 2009 and 2010 to evaluate the early post emergence application of new formulation of imazethapyr (10% SL) on weed control in groundnut. Based on two years of field experimentation, it was found that early post emergence application of imazethapyr (10% SL) at 200 g ha^{-1} gave significantly lower total weed density, weed dry weight and higher weed control efficiency at all the stages. However, imazethapyr at 200 g ha^{-1} and 150 g ha^{-1} had slight phytotoxicity on groundnut upto 15 DAS. Application of new formulation of imazethapyr (10% SL) at 100 g ha^{-1} as early post emergence herbicide kept the weed density and dry weight below the economic threshold level and increased the pod yield (1602 and 1900 kg ha^{-1}). This treatment was found to be on par with the application of 150 g ha^{-1} (1580 and 1854 kg ha^{-1}) in groundnut.

Key words: Imazethapyr, Early Post Emergence, Groundnut, Weed Density, Weed Control Efficiency, Yield.

Groundnut (*Arachis hypogaea* L.), the "King" of oilseeds, popularly known as "Wonder nut " and "Poor man's cashew nut" is the sixth most important oilseed crop of the world. In the National scenario, Tamil Nadu shares 8.59 per cent in area and 11.44 per cent in groundnut production (Agricultural Statistics, 2009). One of the major constraints in groundnut growing is the weed menace. The losses caused by weeds are more than any other causes like insects, diseases and nematodes. Gnanamurthy and Balasubramaniyan (1998) reported that yield of groundnut reduced by 70 per cent if weed cover was more than 50 per cent. Critically viewing, manual and mechanical methods of weed control, besides being less effective, are costly and time demanding. Mechanical method is partially ineffective because most of the weeds growing in intra-rows escaped during weeding. Thus, chemical weed control seems to be 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 escape killing. So, there is ample scope for controlling weeds by application of early post emergence herbicides. In this context, the present experiments were carried out to evaluate the efficiency of EPOE imazethapyr for control of weeds in groundnut and to further study its influence on productivity.

Materials and Methods

The field experiments were conducted during kharif 2009 and 2010 at Agricultural Research Station, Bhavanisagar, Tamil Nadu Agricultural University, Tamil Nadu. The soil was red sandy loam in texture with low in available nitrogen (221 kg ha^{-1}), medium in available phosphorus (16.2 kg ha^{-1}) and high in available potassium (288 kg ha^{-1}) with pH of 7.5. The experiments were laid out in randomized complete block design with twelve treatments and replicated thrice. The treatments consisted of five doses of imazethapyr 10% SL (50, 75, 100, 150 and 200 g ha^{-1}) followed by one hand weeding at 45 DAS. The different doses of imazethapyr were compared with the recommended herbicide pendimethalin at 0.75 kg ha^{-1} combination either with hand weeding or imazethapyr at 50 g ha^{-1} at 2-3 leaf stage of weeds or one weeding with star weeder or layby application of pendimenthalin at 45 DAS, hand weeding twice at 25 and 45 DAS. Unweeded control and a weed free check was also maintained. The kharif groundnut varieties CO 2 and VRI 2 were sown manually at a spacing of 30 x 10 cm at 125 kg ha^{-1} of seed during first week of June 2009 and 2010. The experimental fields were irrigated immediately after sowing. Life irrigation was given three days after sowing, and subsequent irrigations were given as and when required. Weeding was done as per the treatment schedule. In order to study crop-weed competition, hand weeding was done once in seven days in the weed free treatment. In the treatment on hand weeding, it was given twice at 25 and 45 DAS. Herbicide treatment plots were applied with pendimethalin 30% EC at 0.75 kg a.i. ha^{-1} as pre-emergence spray on 3 DAS and a new formulation of imazethapyr 10% SL was sprayed at 2-3 leaf stage of weeds (15 DAS) as early post emergence followed by a hand weeding and earthing up on 45

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DAS. Layby application of pendimethalin 30% EC at 0.75 kg ha^{-1} was given on 45 DAS. 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, 15 and 45 DAS. In mechanically weeded plots, one weeding was given on 45 DAS with star weeder in between rows and weeds within the rows were removed manually. A fertilizer schedule of 17:34:54 kg NPK ha^{-1} in the form of urea, single super phosphate and muriate of potash, respectively were applied to all plots uniformly in lines and incorporated at the time of sowing. The entire dose of NPK was applied as basal. Gypsum at the rate of 400 kg ha^{-1} was applied in two equal splits, one at basal and another at the time of earthing up (45 DAS). The crop was harvested on second week of September during both the years. Data on total weed density and weed dry weight were recorded 30 DAS using 0.25 m^2 quadrate in 4 places at random and analyzed after subjecting the original data to log transformation. A total rainfall of 459.8 and 773.2 mm was received in 28 and 48 rainy days during the cropping period, respectively.

Results and Discussion

Weed flora

Weed flora of the experimental field consisted of eleven species of broad-leaved weeds, five species of grasses and a sedge. Among the different weed species, the major broad-leaved weeds consisted of *Boerhaavia diffusa, Parthenium hysterophorous, Acalypha indica* and *Amaranthus viridis*; followed by grassy weeds like *Dactyloctenium aegyptium, Acrachne racemosa, Bracharia reptans* and *Chloris barbata* and sedge (*Cyperus rotundus*). Earlier investigations carried out by Walia *et al.* (2007) observed that *Commelina benghalensis* (L.)*, Acrachne racemosa* Roem. & Schult, *Cucumis trigonus* Roxb., *Eleusine aegyptiacum* (L.) Desf.*, Eleusine indica* (L.) Gaerth.*, Eragrostis diarrhena* (Schult.) Steud*, Leucas aspera* (Willd.) Spr. and *Rhyncosia capitata* Roth DC were the major weed flora in groundnut. Bhatt *et al.* (2008) observed that monocots such as *Dactyloctenium aegyptium* (L.) P. Beauv.*, Cynodon dactylon* (L.) Pers., *Cenchrus biflorus* (L.) and *Digitaria sanguinalis* (L.) ; and dicots like *Digera arvensis* (L.), *Trianthema monogyna* (L.), *Euphorbia hirta* and *Tribulus terrestris* (L.) ; and Sedge *Cyperus rotundus* (L.) are the predominant weeds in *kharif* season groundnut.

Weed density and dry weight

Early post-emergence application of new formulation of imazethapyr at 100, 150 and 200 g ha^{-1} followed by one hand weeding on 45 DAS resulted in effective control of broad leaved weeds, grasses and to some extent sedges mainly due to its broad spectrum of action. Thus, broad leaved and grassy weeds were effectively controlled with the herbicide. Application of imazethapyr at 200 g ha^{-1} resulted in the control of more than 90 per cent of weeds, but the herbicide inhibited the crop growth. Noticeable reduction of nearly 90 per cent of broad leaved weeds and grassy weeds in soybean with the application of imazethapyr at 100 and 150 g ha^{-1} as early post- emergence was reported by Sangeetha (2010). The left over weeds were controlled by manual weeding on 45 DAS. Several research findings showed that imazethapyr has successfully controlled broad leaved weeds and grassy weeds in groundnut (Dubey *et al*., 2010) and soybean (Lambade *et al.*, 2008). Early post-emergence application of imazethapyr most effectively decreased the number of annual broad leaved weeds and grassy weeds in soyabean and blackgram as reported by Singh (2009) and Veeraputhiran *et al*. (2008) support the present findings.

Weed Control Efficiency (WCE)

Weed control efficiency indicates the magnitude of effective reduction of weed dry weight by weed control treatments over unweeded control. The higher dose of EPOE imazethapyr at 200 g ha^{-1} *fb* hand weeding at 45 DAS showed very high (more than 90%) and consistent total weed control efficiency during kharif 2009 and 2010. More than 80 per cent of total weed control efficiency was obtained up to 60 DAS with EPOE imazethapyr either at 150 g ha^{-1} *fb* + HW or 100 g ha^{-1} *fb* + HW, PE pendimethalin at 0.75 kg ha^{-1} *fb* imazethapyr at 50 g ha^{-1} at 2-3 leaf stage of weeds and HW twice. Pre-emergence application of pendimethalin at 0.75 kg ha^{-1} *fb* layby application of pendimethalin at 0.75 kg ha^{-1} at 45 DAS and PE pendimethalin at 0.75 kg ha^{-1} *fb* + HW had moderate total WCE ranging from 60 to 80 per cent. EPOE imazethapyr either at 50 g ha^{-1} *fb* + HW or 75 g ha^{-1} *fb* + HW showed poor total weed control efficiencies. Higher WCE with broad-leaved weeds was recorded followed by grasses and sedge. All the weed control treatments recorded more than 70 per cent WCE. Application of EPOE imazethapyr at 200 and 150 g ha^{-1} *fb* + HW at 45 DAS recorded higher WCE during kharif 2009 (98.4 and 96.5%) and 2010 (98.8 and 97.5%) at 45 DAS compared to other treatments. This is in conformity with the experimental results of Chandel and Saxena (2001), who had reported that POE application of imazethapyr at 100 g ha^{-1} resulted in higher WCE in soybean.

Effect on crop and yield

In groundnut, among the weed control treatments, early post-emergence application of imazethapyr at 100 g ha^{-1} recorded higher pod yield of 1602 and 1900 kg ha^{-1} during 2009 and 2010, respectively due to better control of weeds at critical stages and provided favourable environment for better growth and development leading to enhanced pod yield of groundnut. The per cent increase over unweeded control during kharif 2009 and 2010 was 56.3 and 60.5, respectively. This treatment was comparable with early post emergence application of imazethapyr at 150 g ha^{-1} with a pod yield of 1580 and 1854 kg ha^{-1} during both the years. Hand weeding twice on 25 and 45 DAS and application of pendimethalin at 0.75 kg ha^{-1} followed by hand weeding at 45 DAS was the next best treatment as compared to new formulation of imazethapyr at 50, 75 and 200 g ha^{-1} and recorded higher pod yield.

Table 1. Effect of weed control treatments on the total weed density (No. m^{-2}), total weed dry weight (g ha^{-1}), weed control efficiency (%) and yield (kg ha^{-1}) in groundnut

Treatment	Kharif 2009				Kharif 2010			
	Total weed density (No.m^{-2})	Total weed dry weight (gm^{-2})	WCE (%)	Yield ($kgha^{-1}$)	Total weed density (No.m^{-2})	Total weed dry weight (gm^{-2})	WCE (%)	Yield ($kgha^{-1}$)
T_1 : EPOE imaze. 10 % SL at 50 g ha^{-1} *fb* HW at 45 DAS	19.79 (136.01)	5.56 (28.89)	22.8	900	8.51 (70.43)	4.95 (22.48)	65.5	1014
T_2 : EPOE imaze. 10 % SL at 75 g ha^{-1} *fb* HW at 45 DAS	17.33 (96.66)	5.05 (23.46)	37.4	1133	7.81 (59.02)	4.45 (17.76)	72.7	1296
T_3 : EPOE imaze. 10 % SL at 100 g ha^{-1} *fb* HW at 45 DAS	10.99 (35.00)	2.90 (6.43)	82.8	1602	5.48 (27.99)	2.55 (4.50)	93.1	1900
T_4 : EPOE imaze. 10 % SL at 150 g ha^{-1} *fb* HW at 45 DAS	9.18 (23.99)	2.60 (4.74)	87.3	1580	4.51 (18.33)	2.32 (3.40)	94.8	1854
T_5 : EPOE imaze. 10 % SL at 200 g ha^{-1} *fb* HW at 45 DAS	8.65 (21.67)	2.30 (3.28)	91.3	1142	3.70 (11.67)	1.99 (1.97)	97.0	1368
T_6 : PE pendi. at 0.75 kg ha^{-1} *fb* HW at 45 DAS	14.22 (62.33)	4.05 (14.44)	61.4	1420	8.25 (66.10)	4.18 (15.49)	76.2	1630
T_7 : PE pendi. at 0.75kg ha^{-1} *fb* imaze. at 50g ha^{-1}	10.71 (39.33)	2.89 (6.36)	83.0	1470	4.82 (21.23)	2.46 (4.07)	93.8	1725
T_8 : PE Pendi. at 0.75kg ha^{-1} *fb* star weeder weeding on 45 DAS	14.50 (65.00)	3.77 (12.19)	67.5	1224	8.48 (69.87)	4.21 (15.71)	75.9	1424
T_9 : PE Pendi. at 0.75 kg ha^{-1} *fb* layby pendi. at 0.75 kg ha^{-1} on 45 DAS	13.88 (58.67)	3.71 (11.78)	68.5	1380	8.01 (62.20)	4.15 (15.24)	76.6	1626
T_{10} : HW twice on 25 and 45 DAS	5.73 (5.00)	1.78 (1.16)	96.9	1486	3.13 (7.80)	1.86 (1.45)	97.8	1810
T_{11} : Unweeded control	23.61 (190.01)	6.28 (37.45)	-	800	16.60 (273.46)	8.20 (65.16)	-	834
T_{12} : Weed free check	5.73 (5.00)	1.62 (0.63)	98.3	1648	1.73 (1.00)	1.49 (0.23)	99.7	2056
SEd	1.35	0.45		63	0.73	0.38		75
CD (P = 0.05)	3.46	1.14		158	1.51	0.78		187

EPOE imazethapyr 10 % SL (New formulation) to T_1-T_5 and imazethapyr 10% SL (Pursuit) toT_7 were applied when weeds were at 2-3 leaf stage (15 DAS) Figures in parentheses are original values

Weed free check and herbicide treatments had provided favourable environment to the groundnut during its critical periods of growth, which in turn resulted in enhanced yield attributing characters like number of pegs $plant^{-1}$, matured pods $plant^{-1}$, peg to pod per cent and shelling percentage. These might be due to low level of weed competition at critical phases of crop growth (upto 60 DAS), which would have favoured the groundnut crop to utilize the available resources to the maximum extent. The results are in accordance with the findings of Kalaiselvi *et al*. (1998) and Manickam *et al*. (2000), who have reported that the efficient utilization of soil moisture and nutrients created a favourable condition for the development of gynophores into the soil resulting in maximum number of pegs and matured pods in groundnut.

Conclusion

From the results of the present study, it could be concluded that early post emergence application of imazethapyr at 100 g ha^{-1} at 2-3 leaf stage of weeds along with one hand weeding at 45 DAS will be better for effective weed control to increase yield in groundnut.

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