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Studies on Bio-efficacy of Herbicide Mixtures for Weed Management in *Rabi* Groundnut

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ABSTRACT

A field experiment was conducted at the wetland farm of S.V. Agricultural College, Tirupati during *rabi,* 2016 to study the effect of herbicide mixtures for weed management in groundnut (*Arachis hypogeae* L.). At 20 DAS pendimethalin + imazethapyr @ 1000 g *a.i* ha^{-1} was found to be effective in controlling the weeds. Two hand weedings at 20 and 40 DAS was found to be effective to control the weeds in groundnut and recorded the lowest weed density, weed dry weight and higher weed control efficiency and yield attributes *viz,* hundred pod weight, hundred kernel weight, shelling percentage, pod yield, kernel yield and gross returns which was at par with pre-emergence application of pendimethalin @ 1000 g *a.i* ha^{-1} *fb* one hand weeding at 20 DAS and post-emergence application of imazethapyr @ 37.5 g *a.i* ha^{-1} + quizalofop-p-ehtyl @ 25 g *a.i* ha^{-1}. Among the herbicide mixtures Imazethapyr @ 37.5 g *a.i* ha^{-1} and quizalofop-p-ethyl 25 g *a.i* ha^{-1} applied as post-emergence at 2-4 leaf stage of the weeds is the effective herbicide mixture for broad spectrum weed control as well as to enhance the productivity of *rabi* groundnut.

Key words: *Groundnut, Herbicide mixtures, Pod yield, Weed management.*

Groundnut (*Arachis hypogaea* L.) is considered to be one of the most important food legume and oilseed crop in India, which is cultivated over an area of 4.7 m ha, with a production of 7.4 m t and average productivity of 1552 kg ha^{-1}. Weed infestation is one of the major constraints that limit the productivity of groundnut. Critical period of crop weed competition is ranged between 40 to 60 days after sowing. Though, groundnut is a hardy crop, but it is highly susceptible to weed preponderance due to small canopy and slow initial growth. In groundnut, weeds compete with crop plants for nutrients and remove 30-40 % of applied nutrients resulting in significant yield reduction (Dryden and Krishnamurthy, 1997). In India, yield losses of groundnut due to weeds ranged from 24-70 percent (Jhala *et al.,* 2005). Generally weeds are controlled by hand weeding, which is very expensive, laborious and shortage of labours. It is therefore important to find out suitable herbicides that will control the weeds economically and safely. Use of pre-and post-emergence herbicides mixtures offers an alternative viable option for effective and timely control of all categories of weeds in groundnut. At present, farmers are using pendimethalin @ 1000 g ha^{-1} as pre-emergence and imazethapyr as post-emergence 75 g ha^{-1} for the control of weeds in groundnut, but the choice of succeeding crops is limited because imazethapyr persists in soil and plant for longer time with a half life period of 33 months and is not effective against grasses (Sondhia *et al.,* 2015) Hence, there is a need to evaluate the pre- and post-emergence herbicide mixtures for obtaining broad spectrum weed control in *rabi* groundnut and to reduce the imazethapyr residue in soil and plant.

MATERIAL AND METHODS

A field experiment was carried out during *rabi*, 2016 at the wetland farm of S.V. Agricultural College, Tirupati. The experimental soil was sandy loam in texture, slightly alkaline in reaction (pH 7.7), low in organic carbon (0.38 per cent) and available nitrogen (158.0 kg ha^{-1}), medium in available phosphorus (23.4 kg ha^{-1}) and available potassium (211.3 kg ha^{-1}). The experiment was laid out in a randomized block design with three replications. The treatment consisted of ten weed management practices *viz.,* pre-emergence application of pendimethalin 1000 g *a.i* ha^{-1} (W_1), pre-emergence application of pendimethalin 1000 g *a.i* ha^{-1} + one

hand weeding at 20 DAS (W_2), pre-emergence application of pendimethalin + imazethapyr (pre-mix) 1000 g *a.i* ha^{-1} (W_3), post-emergence application of imazethapyr 75 g *a.i* ha^{-1} (W_4), post-emergence application of imazethapyr + imazamox (pre-mix) 70 g *a.i* ha^{-1} (W_5), post-emergence application of sodium salt of aciflurofen + cladinofop propargyl (pre-mix) 75 g *a.i* ha^{-1} (W_6), post-emergence application of imazethapyr 37.5 g *a.i* ha^{-1} + quizalofop-p-ethyl 25 g ha^{-1} (tank-mix) (W_7), post-emergence application of imazethapyr 37.5 g *a.i* ha^{-1} + propaquizafop 25 g ha^{-1} (tank-mix) (W_8), two hand weedings at 20 and 40 DAS (W_9) and unweeded check (W_{10}). The recommended doses of nitrogen, phosphorous and potassium @ 30, 40 and 50 kg ha^{-1} and gypsum @ 500 kg ha^{-1} was applied at time of flowering stage. The test variety of groundnut 'Dharani' was used in the study by adopting spacing of 22.5cm x 10 cm.

RESULTS AND DISCUSSION

Effect on weeds

The predominant weed species associated with groundnut are *Cyperus rotundus, Digitaria sanguinalis*, *Commelina benghalensis*, *Phyllanthus niruri*, *Cleome viscosa*, *Boerhavia diffusa* and *Dactyloctenium aegyptium.* Among the pre-emergence application of herbicides, the lowest density and dry weight of grasses, sedges and broad leaved weeds as well as total weeds and higher weed control efficiency were recorded with pre-emergence application of pendimethalin + imazethapyr (premix) @ 1000 g ha^{-1} (W_3), which was however, comparable with pre-emergence application of pendimethalin @ 1000 g ha^{-1} *fb* one hand weeding at 20 DAS (W_2) or pendimethalin alone as pre-emergence @ 1000 g *a.i* ha^{-1} (W_1), which maintained parity with each other. This might be due to pre-emergence application of pendimethalin prevented the emergence of monocots and grassy weeds by inhibiting the cell division and elongation thereby reduced shoot and root growth in the target plants. These results are in accordance with those of Sharma *et al.* (2015) and Sagvekar *et al.* (2015). Pendimathalin belong to dinitroanilines group, which don't inhibit the germination but shortly after seed germination causes the disruption of cell division and collapse. (Ashton and Monaco, 1991 and Mohanty *et al.* 1997). Imazethapyr effectively controlled the broad leaved weeds by inhibiting the enzyme acetohydroxy acid synthase (AHAS), thereby reducing the levels of three aminoacids (isoleucine, leucine and valine), which causes the disruption of protein synthesis and other subsequent bio-chemical reactions, which in turn inhibits the plant growth. These results are in accordance with Singh *et al.* 2016 who reported that application of imazethapyr + pendimethalin (pre-mix) @ 1000 g ha^{-1} was the best among the pre-mix herbicides. At 40 & 60 DAS and at harvest (Table 1), hand weeding twice at 20 and 40 DAS (W_9) recorded lower density and dry weight of grasses, sedges and broad leaved weeds as well as total weeds, which was however, comparable with pre-emergence application of pendimethalin *fb* hand weeding at 20 DAS (W_2) and post-emergence application of imazethapyr @ 37.5 g *a.i* ha^{-1} and quizalofop-p-ethyl 25 g *a.i* ha^{-1} (W_7) and these three treatments were distinctly more effective than the rest of the weed management practices tried. These results are in accordance with the findings Sharma *et al.* (2015), pre-emergence application of pendimethalin *fb* by hand weeding helps in effective control of wide spectrum of weeds during the early stages of crop growth there by limited competition for growth resources during the critical stages of crop growth.

Effect on crop

Among the different weed management practices tested (Table 2), the highest hundred pod weight, hundred kernel weight, shelling percentage, pod yield, kernel yield, oil yield and gross returns was recorded with hand weeding twice at 20 and 40 DAS (W_9), which was on par with pre-emergence application of pendimethalin *fb* one hand weeding at 20 DAS (W_2), or post-emergence application of imazethapyr + quizalofop-p-ethyl (W_7). This might be due to increased dry matter production and efficient translocation of photosynthates to pods as a result of efficient utilization of growth resources because of weed free environment during critical stages of crop growth and then resulted in higher yield attributes. These results are in conformity with those of Sharma *et al.* (2015).

Conclusion

In conclusion, the lowest weed density, weed dry weight and highest weed control efficiency and yield attributes was recorded with hand weeding twice at 20 and 40 DAS (W_9), which was on par with pre-emergence application of pendimethalin *fb* one hand weeding at 20 DAS (W_2), or post-emergence application of imazethapyr + quizalofop-p-ethyl (W_7). The highest

Table 1. Effect of different weed management practices on weed density (No. m^{-2}), weed dry weight (g. m^{-2}) weed control efficiency (%) in groundnut at harvest.

Treatments	weed density (No. m^{-2})			Weed dry weight (g. m^{-2})			Weed control efficiency (%)
	Grasses	Sedges	BLWs	Grasses	Sedges	BLWs	
W_1: Pre-emergence application of Pendimethalin 1000 g *a.i* ha^{-1}	29.00	246.67	31.33	9.33	23.33	8.20	40.94
	(5.41)	(15.70)	(5.55)	(3.22)	(4.93)	(3.03)	(39.35)
W_2: Pre-emergence application of Pendimethalin 1000 g *a.i* ha^{-1} + one hand weeding at 20 DAS	18.00	181.33	16.00	6.47	17.37	3.00	61.13
	(4.30)	(13.47)	(4.05)	(2.73)	(4.29)	(2.00)	(51.53)
W_3: Pre-emergence application of Pendimethalin + imazethapyr (pre-mix) 1000 g *a.i* ha^{-1}	34.67	258.00	36.00	10.20	24.13	9.00	37.45
	(5.89)	(16.09)	(6.00)	(3.35)	(5.01)	(3.16)	(37.01)
W_4: Post-emergence application of imazethapyr 75 g *a.i* ha^{-1}	45.33	255.00	27.5	14.50	24.61	8.01	31.07
	(6.72)	(15.98)	(5.48)	(3.95)	(5.20)	(2.91)	(33.86)
W_5: Post-emergence application of imazethapyr + imazamox (pre-mix) 70 g *a.i* ha^{-1}	31.67	254.00	34.33	9.47	23.47	8.40	40.22
	(5.65)	(15.96)	(5.88)	(3.23)	(4.95)	(3.06)	(38.86)
W_6: Post-emergence application of sodium salt of acifluorfen + clodinofop propargyl (pre- mix) 75 g *a.i* ha^{-1}	44.33	299.33	44.00	14.33	30.40	13.20	16.45
	(6.66)	(17.26)	(6.56)	(3.92)	(5.66)	(3.77)	(23.91)
W_7: Post-emergence application of imazethapyr 37.5 g *a.i* ha^{-1} + quizalofop-p-ethyl 25 g *a.i* ha^{-1} (tank-mix)	19.00	183.33	18.33	6.87	17.53	3.20	60.20
	(4.46)	(13.57)	(4.33)	(2.80)	(4.31)	(2.05)	(50.96)
W_8: Post-emergence application of imazethapyr 37.5 g *a.i* ha^{-1} + propaquizafop 32g *a.i* ha^{-1} (tank-mix)	33.33	256.00	34.67	9.80	23.93	8.80	38.57
	(5.77)	(16.03)	(5.91)	(3.28)	(4.99)	(3.13)	(37.84)
W_9: Two hand weedings at 20 and 40 DAS	16.67	172.67	17.33	6.20	17.13	2.73	62.50
	(4.13)	(13.70)	(4.23)	(2.68)	(4.26)	(1.93)	(52.33)
W_{10}: Unweeded check (control)	58.67	452.67	59.67	18.27	38.00	17.33	-
	(7.71)	(21.98)	(7.69)	(4.35)	(6.21)	(4.25)	
S.Em ±	0.20	0.34	0.18	0.13	0.15	0.12	2.87
CD (P = 0.05)	0.61	1.01	0.55	0.38	0.44	0.37	8.67

Table 2. Hundred pod weight, hundred kernel weight (g), pod yield, kernel yield, oil yield (kg ha^{-1}) and gross returns of groundnut as influenced by different weed management practices

	Treatments	Hundred pod weight (g)	Hundred kernel (g)	Pod yield (kg ha^{-1})	Kernel yield (kg ha^{-1})	Oil yield (kg ha^{-1})	Gross returns (₹ ha^{-1})
W_1:	Pre-emergence application of pendimethalin @ 1000 g *a.i* ha^{-1}	106.33	45.47	1452	991	453	89546
W_2:	Pre-emergence application of pendimethalin @ 1000 g *a.i* ha^{-1} + one hand weeding at 20 DAS	111.10	48.80	1633	1157	537	100460
W_3:	Pre-emergence application of pendimethalin + imazethapyr (pre-mix) @ 1000 g *a.i* ha^{-1}	104.21	43.60	1373	919	415	84800
W_4:	Post-emergence application of imazethapyr @ 75 g *a.i* ha^{-1}	103.80	43.27	1359	902	407	83960
W_5:	Post-emergence application of imazethapyr + imazamox (pre-mix) @ 70 g *a.i* ha^{-1}	105.60	44.87	1439	979	444	88768
W_6:	Post-emergence application of sodium salt of acifluorfen + clodinofop propargyl (pre-mix) @ 75 g *a.i* ha^{-1}	98.40	40.73	1248	802	350	77110
W_7:	Post-emergence application of imazethapyr @ 37.5 g *a.i* ha^{-1} + quizalofop-p-ethyl @ 25 g *a.i* ha^{-1} (tank-mix)	110.00	48.33	1623	1141	527	9886
W_8:	Post-emergence application of imazethapyr @ 37.5 g *a.i* ha^{-1} + propaquizafop @ 32 g *a.i* ha^{-1} (tank-mix)	104.69	44.00	1404	947	427	86683
W_9:	Two hand weedings at 20 and 40 DAS	112.30	49.73	1654	1175	548	101793
W_{10}:	Unweeded check (control)	92.13	37.20	1133	686	288	70134
S.Em ±		0.94	0.80	31.02	30.2	15.89	1859.44
CD (P = 0.05)		2.84	2.43	94	90	48	5639

gross returns were realized with hand weeding twice at 20 and 40 DAS, while the highest net returns and benefit-cost ratio were recorded with pre-emergence application of pendimethalin *fb* hand weeding at 20 DAS, which was closely followed by post-emergence application of imazethapyr @ 37.5 g *a.i* ha^{-1} and quizalofop-p-ethyl @ 25 g *a.i* ha^{-1}.

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