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Evaluation of Post Emergence Herbicides in Post Monsoon Season Groundnut under Irrigated Conditions

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A B S T R A C T

Experiment was conducted at Agricultural Research Station, Kadiri to evaluation of post emergence herbicides in groundnut under irrigated conditions. Pooled data over three years of study reveals that total number of weeds at 45 and 80 DAS was significantly lower with weed free check which was on par with pre emergence application of Pendimethalin @ 1.0 kg a.i ha^{-1} + one hand weeding. Among the herbicidal treatments, highest weed control efficiency was recorded with T3 (Pendimethalin + one HW) followed by T10 (Pendimethalin + Quizalofop Ethyl) and T11 (Pendimethalin + Immazethaphyr). Pod and haulm yields are also higher with pre emergence application of Pendimethalin @ 1.0 kg a.i ha^{-1} + one hand weeding (T3) which was significantly superior to all herbicidal treatments followed by T11 and T10. This increased yields in this treatment was due to lowest crop weed competition which resulted in more number of pods per plant and hundred pod weight. Net returns and beneficit cost ratio were also higher with T3 (Rs.39,948 ha^{-1} & 3.52) followed by T11 (Rs.32,478 ha^{-1} & 3.05) and T10 (Rs.31,662 ha^{-1} & 2.98).

Introduction

Groundnut (*Arachis hypogaea* L.) is a valuable oilseeds and accounts for 33 percent area and 45 per cent production in India. India ranks first among groundnut growing countries in the world with 6.74 m ha area and 7.99 m t production (Bhale *et al*., 2012). Weed management in groundnut has great importance as this crop suffers heavily due to weed competition in the early stage because of its short structure and initial slow growth. Unmanaged weeds in groundnut crop results in yield in yield loss as high as 70 to 75 percent (Gnanamurthy and Balasubramaniyan, 1998). The critical period of crop weed competition in groundnut was observed to be 40 to 60 days after sowing (Singh and Patel, 1992).

Generally weeds are controlled through hand weeding in groundnut, which is very expensive, laborious and sometimes damaging to the crop plant (Dubey *et al*., 2010). Mechanical weeding is economical but the timely operation is important. Herbicides on the other hand give timely and effective control of weeds and from very beginning compared to mechanical weed control. A lots of herbicides such as trifluralin, pendimethalin, alachlor, fluchloralin etc when applied alone or supplemented with one hand weeding have been found to be effective for

weed management in groundnut. Mostly these herbicides are applied as pre-plant incorporation or pre- emergence while for the control of later emerged weeds, only imazethapyr is available in the market which is applied as post emergence thus there is need for the new herbicides molecules which could control grassy weeds at later stage. Hence, quizalofop ethyl (5 % EC) has been developed for control of grassy weeds. The present study has been undertaken to evaluate the performance of quizalofop ethyl 5 %EC and Imazethapyr 10 % SL for control of grassy weeds and broad leaf weeds and to find out an appropriate dose of this herbicide and its impact on groundnut.

A field experiment was conducted during kharif season of 2012 at agricultural research station, kadiri to Evaluate the performance of post emergence herbicides in groundnut under rainfed conditions. The soils of the experimental plot was sandy loam in texture with P^H 7.5, organic matter 0.4% and available N,P,K 210, 18.9 and 250 kg/ha respectively. The experiment was laid out in randomized block Design with three replications comprising seven different weed control treatments *viz.*, Pendimethalin @ 1.0 kg a.i./ha as + 1 HW, Quizalofop Ethyl @ 50 g, 75g, 100g a.i. / ha at 20 DAS, Imazethapyr @ 50 g, 75g, 100g a.i. /ha at 20 DAS, Pendimethalin @ 1.0 kg a.i. ha + Quizalofop Ethyl @ 50 g a.i. / ha at 20 DAS, Pendimethalin @ 1.0 kg a.i. ha + Imazethapyr @ 75 g a.i. /ha at 20 DAS, Un weeded control and Weed free check. Quizalofop ethyl and imazethapyr were post emergence herbicides which were applied at 2-3 leaf stage of weeds using knapsack sprayer fitted with a flat fan nozzle with the spray volume of water 500 l/ha.

Table.1 Number of weeds m^{-2} at 45 DAS as influenced by different weed management practices during Rabi (Pooled over 3 years)

Treatment	Monocot weeds	Dicot weeds	Total weeds
T1: Un weeded control	131	63	194 (14.0)
T2: Weed free check	4	6	10 (3.2)
T3: Pendimethalin @ 1.0 kg a.i./ha as + 1 HW	7	7	14 (3.8)
T4: Quizalofop Ethyl @ 50 g a.i. / ha at 20 DAS	24	28	52 (7.3)
T5: Quizalofop Ethyl @ 75 g a.i. / ha at 20 DAS	27	37	64 (8.0)
T6: Quizalofop Ethyl @ 100 g a.i. / ha at 20 DAS	25	36	61 (7.8)
T7: Imazethapyr @ 50 g a.i. /ha at 20 DAS.	44	31	75 (8.7)
T8: Imazethapyr @ 75 g a.i. /ha at 20 DAS.	45	23	68 (8.3)
T9: Imazethapyr @ 100 g a.i. /ha at 20 DAS.	41	25	66 (8.2)
T10:Pendimethalin @ 1.0 kg a.i. ha + T4	15	9	24 (5.0)
T11: Pendimethalin @ 1.0 kg a.i./ ha + T8	19	8	27 (5.2)
CV %	--	--	14.8
SEm ±	--	--	0.76
CD (P=0.05)	--	--	1.6

Table.2 Number of weeds m^{-2} at 80 DAS as influenced by different weed management practices during Rabi (Pooled over 3 years)

Treatment	Monocot weeds	Dicot weeds	Total weeds
T1: Un weeded control	169	70	239 (15.5)
T2: Weed free check	6	6	12 (3.5)
T3: Pendimethalin @ 1.0 kg a.i./ha as + 1 HW	16	10	26 (5.1)
T4: Quizalofop Ethyl @ 50 g a.i. / ha at 20 DAS	32	36	68 (8.3
T5: Quizalofop Ethyl @ 75 g a.i. / ha at 20 DAS	33	42	75 (8.7)
T6: Quizalofop Ethyl @ 100 g a.i. / ha at 20 DAS	37	39	76 (8.8)
T7: Imazethapyr @ 50 g a.i. /ha at 20 DAS.	58	30	88 (9.4)
T8: Imazethapyr @ 75 g a.i. /ha at 20 DAS.	57	27	84 (9.2)
T9: Imazethapyr @ 100 g a.i. /ha at 20 DAS.	57	25	82 (9.1)
T10:Pendimethalin @ 1.0 kg a.i. ha + T4	20	14	34 (5.9)
T11: Pendimethalin @ 1.0 kg a.i./ ha + T8	28	12	40 (6.4)
CV %	--	--	17.4
SEm ±	--	--	1.13
CD (P=0.05)	--	--	2.3

Figures in parentheses indicate transformed values by square root transformation ($\sqrt{x+0.5}$)

Table.3 Weed Control Efficiency (WCE) at 45 DAS as influenced by weed management practices during Rabi

Treatment	2006	2007	2008	Pooled Mean
T1: Un weeded control	--	--	--	--
T2: Weed free check	97.7	92.2	95.9	95.3
T3: Pendimethalin @ 1.0 kg a.i./ha as + 1 HW	95.0	94.0	88.5	92.5
T4: Quizalofop Ethyl @ 50 g a.i. / ha at 20 DAS	79.1	79.7	51.8	70.2
T5: Quizalofop Ethyl @ 75 g a.i. / ha at 20 DAS	77.7	73.7	38.7	63.4
T6: Quizalofop Ethyl @ 100 g a.i. / ha at 20 DAS	79.1	69.0	51.0	66.4
T7: Imazethapyr @ 50 g a.i. /ha at 20 DAS.	53.2	68.5	63.0	61.6
T8: Imazethapyr @ 75 g a.i. /ha at 20 DAS.	62.3	67.6	66.3	65.4
T9: Imazethapyr @ 100 g a.i. /ha at 20 DAS.	61.8	68.9	69.4	66.7
T10:Pendimethalin @ 1.0 kg a.i. ha + T4	88.2	91.4	78.3	86.0
T11: Pendimethalin @ 1.0 kg a.i./ ha + T8	79.1	90.9	81.6	83.9

Table.4 Weed Control Efficiency (WCE) at 80 DAS as influenced by weed management practices during Rabi

Treatment	2006	2007	2008	Pooled Mean
T1: Un weeded control	--	--	--	
T2: Weed free check	96.7	92.2	91.8	93.6
T3: Pendimethalin @ 1.0 kg a.i./ha as + 1 HW	86.0	94.0	78.0	86.0
T4: Quizalofop Ethyl @ 50 g a.i. / ha at 20 DAS	71.7	79.7	49.0	66.8
T5: Quizalofop Ethyl @ 75 g a.i. / ha at 20 DAS	72.3	73.7	39.8	61.9
T6: Quizalofop Ethyl @ 100 g a.i. / ha at 20 DAS	73.7	69.0	37.8	60.2
T7: Imazethapyr @ 50 g a.i. /ha at 20 DAS.	55.3	68.5	73.8	65.9
T8: Imazethapyr @ 75 g a.i. /ha at 20 DAS.	61.3	67.6	67.0	65.3
T9: Imazethapyr @ 100 g a.i. /ha at 20 DAS.	61.7	68.9	66.7	65.8
T10:Pendimethalin @ 1.0 kg a.i. ha + T4	84.7	91.4	74.8	83.6
T11: Pendimethalin @ 1.0 kg a.i./ ha + T8	76.0	90.9	79.2	82.0

Table.5 Pod and haulm yield of groundnut as influenced by weed management practices during Rabi

Treatment	Pod Yield (Kg ha^{-1})				Haulm Yield (Kg ha^{-1})			
	2006	2007	2008	Pooled Mean	2006	2007	2008	Pooled Mean
T1: Un weeded control	264	354	336	318	1667	1438	1512	1539
T2: Weed free check	2116	2316	2212	2215	4574	4680	4468	4574
T3: Pendimethalin @ 1.0 kg a.i./ha as + 1 HW	1947	2289	1933	2056	4426	4502	4296	4408
T4: Quizalofop Ethyl @ 50 g a.i. / ha at 20 DAS	1868	1602	1053	1508	4074	3864	3485	3808
T5: Quizalofop Ethyl @ 75 g a.i. / ha at 20 DAS	1859	1659	1026	1515	4000	3850	3400	3750
T6: Quizalofop Ethyl @ 100 g a.i. / ha at 20 DAS	1842	1668	1073	1528	4000	3912	3418	3777
T7: Imazethapyr @ 50 g a.i. /ha at 20 DAS.	1768	1540	1469	1592	4000	3800	3806	3869
T8: Imazethapyr @ 75 g a.i. /ha at 20 DAS.	1832	1568	1493	1631	4000	3860	3812	3891
T9: Imazethapyr @ 100 g a.i. /ha at 20 DAS.	1830	1562	1500	1631	3944	3818	3820	3861
T10:Pendimethalin @ 1.0 kg a.i. ha + T4	1932	1762	1540	1745	4167	4074	3900	4047
T11: Pendimethalin @ 1.0 kg a.i./ ha + T8	1917	1728	1668	1771	4111	4010	4068	4063
CV %	13.2	14.1	15.2	12.5	12.2	15.0	12.8	13.3
SEm ±	104.0	109.3	112.2	97.8	155.3	176.4	149.5	128.4
CD (P=0.05)	217	228	234	204	324	368	312	268

Table.6 Number of pods and hundred pod weight of groundnut as influenced by weed management practices during Rabi

Treatment	Number of pods plant -1				Hundred pod weight (g)			
	2006	2007	2008	Pooled Mean	2006	2007	2008	Pooled Mean
T1: Un weeded control	17.3	3.3	11.3	10.6	58.2	70.0	84.7	71.0
T2: Weed free check	22.2	23.8	22.2	22.7	69.5	94.0	87.5	83.7
T3: Pendimethalin @ 1.0 kg a.i./ha as + 1 HW	21.1	19.3	20.1	20.2	66.8	86.0	91.0	81.3
T4: Quizalofop Ethyl @ 50 g a.i. / ha at 20 DAS	18.2	17.1	15.8	17.0	62.3	86.7	80.3	76.4
T5: Quizalofop Ethyl @ 75 g a.i. / ha at 20 DAS	19.0	14.5	15.4	16.3	62.8	85.0	81.7	76.5
T6: Quizalofop Ethyl @ 100 g a.i. / ha at 20 DAS	19.1	15.5	15.9	16.8	61.7	85.3	80.0	75.7
T7: Imazethapyr @ 50 g a.i. /ha at 20 DAS.	17.6	16.7	17.3	17.2	60.8	86.3	84.5	77.2
T8: Imazethapyr @ 75 g a.i. /ha at 20 DAS.	17.9	15.3	16.7	16.6	60.2	86.0	84.7	77.0
T9: Imazethapyr @ 100 g a.i. /ha at 20 DAS.	18.0	18.9	17.3	18.1	58.3	83.0	84.7	75.3
T10:Pendimethalin @ 1.0 kg a.i. ha + T4	20.3	20.3	19.5	20.0	66.7	89.0	89.0	81.6
T11: Pendimethalin @ 1.0 kg a.i./ ha + T8	19.5	19.5	20.8	19.9	63.8	85.3	91.0	80.0
CV %	12.8	13.8	12.8	14.1	10.8	12.1	13.1	13.5
SEm ±	1.2	1.1	1.0	1.2	2.1	2.0	1.82	1.7
CD (P=0.05)	2.4	2.3	2.1	2.5	4.3	4.2	3.8	3.6

Table.7 Hundred kernel weight and shelling percentage of groundnut as influenced by weed management practices during Rabi

Treatment	Hundred kernel weight (g)				Shelling %			
	2006	2007	2008	Pooled Mean	2006	2007	2008	Pooled Mean
T1: Un weeded control	23.8	30.0	34.0	29.3	64.5	64.7	75.7	68.3
T2: Weed free check	30.0	37.3	39.0	35.4	71.0	71.0	72.7	71.6
T3: Pendimethalin @ 1.0 kg a.i./ha as + 1 HW	29.2	36.7	43.8	36.6	70.2	69.3	76.8	72.1
T4: Quizalofop Ethyl @ 50 g a.i. / ha at 20 DAS	28.0	36.0	39.7	34.6	65.7	69.0	78.7	71.1
T5: Quizalofop Ethyl @ 75 g a.i. / ha at 20 DAS	28.0	34.7	41.2	34.6	68.2	66.7	77.2	70.7
T6: Quizalofop Ethyl @ 100 g a.i. / ha at 20 DAS	27.3	34.0	41.0	34.1	68.3	70.7	77.3	72.1
T7: Imazethapyr @ 50 g a.i. /ha at 20 DAS.	24.7	34.7	37.0	32.1	67.7	70.7	70.7	69.7
T8: Imazethapyr @ 75 g a.i. /ha at 20 DAS.	26.3	35.0	34.8	32.0	69.7	70.7	69.5	70.0
T9: Imazethapyr @ 100 g a.i. /ha at 20 DAS.	26.2	34.2	38.7	33.0	69.5	70.0	72.5	70.7
T10:Pendimethalin @ 1.0 kg a.i. ha + T4	28.8	35.0	43.3	35.7	70.0	69.3	78.7	72.7
T11: Pendimethalin @ 1.0 kg a.i./ ha + T8	28.3	35.3	44.8	36.1	69.8	69.7	79.3	72.9
CV %	9.7	14.6	14.6	16.2	10.4	11.2	10.4	13.4
SEm ±	1.0	0.96	0.96	1.15	2.3	1.8	1.73	1.66
CD (P=0.05)	2.1	2.0	2.0	2.4	4.8	3.8	3.6	3.5

Table.8 Economics of groundnut as influenced by different weed management practices during Rabi (Pooled over 3 years)

Treatments	Cost of cultivation (Rs ha^{-1})	Gross returns (Rs ha^{-1})	Net returns (Rs ha^{-1})	Benefit cost ratio
T1: Un weeded control	13610	9489	-4121	0.70
T2: Weed free check	17116	59949	42833	3.50
T3: Pendimethalin @ 1.0 kg a.i./ha as + 1 HW	15860	55808	39948	3.52
T4: Quizalofop Ethyl @ 50 g a.i. / ha at 20 DAS	14960	41508	26548	2.77
T5: Quizalofop Ethyl @ 75 g a.i. / ha at 20 DAS	15635	41625	25990	2.66
T6: Quizalofop Ethyl @ 100 g a.i. / ha at 20 DAS	16310	41977	25667	2.57
T7: Imazethapyr @ 50 g a.i. /ha at 20 DAS.	14410	43669	29259	3.03
T8: Imazethapyr @ 75 g a.i. /ha at 20 DAS.	14810	44666	29856	3.02
T9: Imazethapyr @ 100 g a.i. /ha at 20 DAS.	15210	44636	29426	2.93
T10:Pendimethalin @ 1.0 kg a.i. ha + T4	16010	47672	31662	2.98
T11: Pendimethalin @ 1.0 kg a.i./ ha + T8	15860	48338	32478	3.05

Groundnut cultivar kadiri-6 was sown in lines with a spacing of 30 cm × 10 cm. All recommended packages of practices except weed control was adopted in the experimental plot during the experiment. Fertilizer at 20 kg N/ha, 45 kg P/ha and 50 kg K/ha was applied in each plot through urea, single superphosphate and muriate of potash at the time of sowing of groundnut. Observation on weeds density were recorded at 30 & 60 days after herbicide application by randomly placing a quadrate of 1 m × 1 m at two places in each plot. The Weeds inside each Quadrate were uprooted, cleaned and dried. After drying, weight and weed control efficiency was calculated by using the formula WCE= (weed biomass in unweeded control – weed biomass in managed treatment)/weed biomass in unweeded control × 100. Yield and yield component of groundnut were recorded at harvest.

Pooled results

Pooled data over three years of study reveals that total number of weeds at 45 and 80 DAS was significantly lower with weed free check which was on par with pre emergence application of Pendimethalin @ 1.0 kg a.i ha^{-1} + one hand weeding. Weed density due to Quizalofop Ethyl and Imazethaphyr did not differ significantly at any dose. At both the stages weed density is at par among T3, T10 and T11. Significantly lowest weed dry weight m^{-2} was recorded due to T3 (Pre emergence application of Pendimethalin + one hand weeding) which was on par with weed free check at 45 DAS and while, significantly varied at 80 DAS. The next lowest weed dry weight was recorded with T10 and T11 which were at par together and also with T3 at both 45 and 80 DAS. Weed dry weight m^{-2} did not differ among Quizalofop Ethyl and Imazethaphyr at any doses. Among the herbicidal treatments, highest weed control efficiency was recorded with T3 (Pendimethalin + one HW) followed by T10 (Pendimethalin + Quizalofop Ethyl) and T11 (Pendimethalin + Immazethaphyr). Pod and haulm yields are also higher with pre emergence application of Pendimethalin @ 1.0 kg a.i ha^{-1} + one hand weeding (T3) which was significantly superior to all herbicidal treatments followed by T11 and T10. This

increased yields in this treatment was due to lowest crop weed competition which resulted in more number of pods per plant and hundred pod weight. Net returns and beneficit cost ratio were also higher with T3 (Rs.39,948 ha^{-1} & 3.52) followed by T11 (Rs.32,478 ha^{-1} & 3.05) and T10 (Rs.31,662 ha^{-1} & 2.98). Though the pod and haulm yields do not varied significantly due to Quizalofop Ethyl and Imazethaphyr at different doses, considering the economics these two post emergence herbicides varied significantly. Among these two post emergence herbicides, Imazethaphyr has recorded significantly higher gross returns, net returns and benefit cost ratio over Quizalofop Ethyl. Further considering the net returns and benefit cost ratio, 50 g ai ha^{-1} for Quizalofop Ethyl and 75 g ai ha^{-1} for Imazethaphyr is found optimum dose. The results generated gains support from the other reports (Prathap singh *et al*., 2014)

From this study, it can be concluded that:

Pre emergence application of Pendimethalin @ 1.0 kg a.i ha^{-1} + one hand weeding is the best for weed management, higher pod yields and net returns in irrigated groundnut during Rabi.

Imazethaphyr is significantly superior over Quizalofop Ethyl in terms of weed control efficiency and economic returns in irrigated groundnut during Rabi.

Application of any of these two post emergence herbicide alone without any pre emergence herbicide or hand weeding would not result in significant weed control in irrigated groundnut during Rabi.

Considering the net returns and benefit cost ratio, 50 g ai ha^{-1} for Quizalofop Ethyl and 75 g ai ha^{-1} for Imazethaphyr is found optimum dose.

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