

EFFECT OF PRE AND POST EMERGENCE APPLICATION OF DIFFERENT DOSES OF IMAZETHAPYR ALONG WITH OTHER HERBICIDES ON NUTRIENT UPTAKE BY CROP AND WEEDS

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Abstract: A field experiment was conducted during the rabi season of 2012-13 and 2013-14 at Crop research center, Chirodi, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut U.P. to study the “Effect of pre and post emergence application of different doses of imazethapyr along with other herbicides on weed dynamics, yield of black gram and succeeding mustard crop”. The soil of experimental field was sandy loam in texture, low in organic carbon and available nitrogen, medium in available phosphorus and available potassium with near to neutral in reaction. The experiment consisted of 10 treatment combination with pendimethalin @ 1000 g ha⁻¹ as pre-emergence (T₁), Imazethapyr @ 50 g ha⁻¹ at 3-4 leaf stage (T₂), Imazethapyr 70 g ha⁻¹ at 3-4 leaf stage(T₃), Imazethapyr + pendimethalin @ 800 g as pre-emergence(T₄), Imazethapyr+pendimethalin @ 900 g ha⁻¹ as pre-emergence(T₅), Imazethapyr+ pendimethalin @1000 g ha⁻¹ as pre-emergence(T₆), Imazethapyr + imazamox @ 60 g ha⁻¹at 3-4 leaf stage(T₇), Imazethapyr + imazamox @ 70 g ha⁻¹ at 3-4 leaf stage(T₈), Two hand weeding at 20 & 40 DAS (T₉) and weedy check (T₁₀). The treatments were replicated three times in a randomized block design. All weed control practices proved effective in controlling the weeds in black gram and gave significantly higher grain yield over weedy. PRE application of imazethapyr + pendimethalin (RM) at 900 g ha⁻¹ most effective control of all major weeds, resulting maximum grain yield among herbicide treatments which was at par with and PRE use of pendimethalin at 1000 g ha⁻¹ provided control of weeds with slight crop suppression which although mitigated within 10-15 days after spray resulting reduction in grain yield. This treatment influenced the uptake of nutrient by black gram and reduced density and dry matter of weeds.

Keywords: Weed control, Herbicide, Weed, Black gram, Mustered

INTRODUCTION

Globally pulse crops are grown in area of 76 m ha with a production of about 68 mt. The average productivity at the global level is about 800 kg ha⁻¹. India is the largest producer, consumer, importer and processor of pulses in the world which accounts for 33% of the world area and 22% of the world production of pulses. In India, the total pulse area is about 25 m ha with production about 18 mt. and average productivity of 750 kg ha⁻¹. The area of pulse crops has not increased much during the past 60-65 years except in 2011 and 2012 it showed an increase of 1.5 to 2.0 m ha. Among the pulse the area under black gram crop in India is 3.19 m ha and production 1.9 mt with the yield of 596 kg ha⁻¹ (Purushottam and Singh, 2015). In India, Maharashtra (23.36%), AP (18.50%), UP (12.29%), MP (11.86%), Tamil Nadu (8.64%), Karnataka (4.57%), Rajasthan (4.29%) and Orissa (3.0%) are major black gram producing states. Weed infestation causes around 50% yield reduction in black gram (Sumachandrika *et al.*, 2002). In general, yield loss due to uncontrolled weed growth in black gram ranges from 27 to 100% (Singh and Singh, 2010). To develop an effective crop management technology and to prevent the huge loss

due to weeds one has to realize that the ecological relationship in weed crop competition is a complicated phenomenon (Ganiger *et al.*, 2003). Removal of weeds at appropriate time using a suitable method is essential to obtain high yields of black gram. Presently, only pre-emergence herbicides are available which are recommended to manage weeds in *kharif* black gram. Sometimes early rains soon after the sowing make it almost impossible to spray pre-emergence herbicides on this crop. Further, many a times weeds emerge at a later stage which can be controlled by hand-weedings (Chand *et al.*, 2004). Uncontrolled weeds at critical period of crop-weed competition reduce the yield of black gram to the tune of 80-90% depending upon type and intensity of weed infestation (Kumar *et al.*, 2001). Imazethapyr, a broad-spectrum herbicide, has soil and foliar activity that allows flexibility in its application timing and has low mammalian toxicity (Tan *et al.*, 2005). Imazethapyr applied as post-emergence at 50 to 75 g ha⁻¹ shows season-long control of many weeds without injuring soybean (Ram *et al.*, 2013). In black gram, that post-emergence application of imazethapyr at 25 g ha⁻¹ had no adverse effects on rainfed black gram growth characters and resulted in statistically similar grain

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yield to that of two hand-weedings at 20 and 40 days after sowing (Nandan *et al.*, 2011).

In black gram, weeds could be controlled by hand weedings (Chand *et al.*, 2004). The removal of weeds from growing crops facilitates easy harvesting and gives a high quality produce without admixture with weed seeds. Chemical weed control can be adopted quite in time and in situations. Which manual or mechanical weeding is difficult? The degree of reduction of yield in black gram depends on the density, biomass, and duration of weed species and the fertility status of soil. Therefore, weed control by mechanical means alone is not feasible and there is an urgent need of adopting chemical methods of weed control at least for the period when the crop plants are subjected to keen competition with weeds. Various research workers have tried imazethapyr and pendimethalin 30 EC in different pulse crops and reported positive results on grassy and non-grassy weeds. Pendimethalin 30 EC applied as pre emergence was also found effective to control mostly annual grasses and broad leave weeds.

MATERIAL AND METHOD

A field study entitled "Effect of pre and post emergence application of different doses of imazethapyr along with other herbicides on weed dynamics, yield of black gram and succeeding mustard crop, was carried out to find out the effect of different herbicides and mechanical weeding on control of weeds and crop performance. The experiment was conducted at Crop Research Centre of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U. P.). Field experiment was carried out in the *kharif*, 2012 - 2013 and *Rabi* season 2012, 2013 and 2013-2014. The mean annual rainfall is 1220.8 mm and 458 mm received during 2012-13 and 2013-14, respectively, which 80- 90 % is received from June to September. Winter season extends from November to March, where in Frost occurs generally in the end of December and may continue up to the end of January. The mean minimum temperature ranges from 3 to 9^oc in winter while during summer the mean maximum temperature varies from 43 to 45^oc in May. Mean relative humidity varies in the range of 67 to 84 % from mid-July to end of February and decreases thereafter gradually to about 77.14% by the end of May till first week of June. The soil of experimental field was sandy loam in texture, low in organic carbon and available nitrogen, medium in available phosphorus and available potassium with

near to neutral in reaction. The experiment consisted of 10 treatment combination with pendimethalin @ 1000 g ha⁻¹ as pre-emergence, Imazethapyr @50 g ha⁻¹ at 3-4 leaf stage, Imazethapyr 70 g ha⁻¹ at 3-4 leaf stage, Imazethapyr + pendimethalin @ 800 g as pre-emergence, Imazethapyr+pendimethalin @ 900 g ha⁻¹ as pre-emergence, Imazethapyr+ pendimethalin @1000 g ha⁻¹ as pre-emergence, Imazethapyr + imazamox @ 60 g ha⁻¹ at 3-4 leaf stage, Imazethapyr + imazamox @ 70 g ha⁻¹ at 3-4 leaf stage, Two hand weeding at 20 & 40 DAS and weedy check (T₁₀). The treatments were replicated three times in a randomized block design. Objectives of study were to study the bio-efficacy of different herbicides for weed control in black gram, to study the direct and residual effect of different weed control treatments on growth yields attributes and yields of black gram and succeeding mustard crop respectively, to work out the N, P and K uptake by crop and weeds by different weed control treatment and to compute the economics of different treatment.

EXPERIMENTAL FINDING

Total weed

The effect of weed management practices on total weeds density recorded at 20, 40 and 60 DAS was significant. The significantly minimum total weeds density was found with two hands weeding over rest of the treatment and at par with imazethapyr + pendimethalin@ 900 g ha⁻¹as pre emergence at all crop stages except 20 DAS during 2012 and 2013. At 60 DAS and at harvest stage total weeds density was found significantly minimum 15.83, 14.33 and 12.83, 11.90 m⁻² with two hand weeding over rest of the treatment and at par with imazethapyr + pendimethalin @ 900 g ha⁻¹as pre emergence during 2012 and 2013. The maximum total weeds density was found with weedy check during both the years. Among the herbicide total weeds density was found significantly lower with imazethapyr + pendimethalin@ 900 g ha⁻¹as pre emergence over rest of the treatment during 2012 and 2013. All weed control treatments were able to check increase in weed population and biomass as compared to weedy check (Table 4.7). At initial stage of 20 and 40 DAS, pre-emergence application of imazethapyr + pendimethalin @ 900 g ha⁻¹ were found superior in controlling weed population and biomass than other treatments which might be due to reason that pre-emergence application of these herbicides checked the emergence of germinated weeds seeds. Shaikh *et al.* (2002) reported the effectiveness of

pendimethalin as pre-emergence application in black gram crop.

Total weeds dry matter

At all stage, the significantly minimum total dry matter was found under imazethapyr + pendimethalin@ 900 g ha⁻¹ as pre emergence over other treatment during 2012 and 2013. The maximum total dry matter was found with weedy check during both the years. The total dry matter production of weeds in weedy check treatment increased up to 60 days crop stage (Table 4.13). The dry matter production of total weeds in weedy check treatment was increased with the advancement of crop growth till harvest. It might be due to early growth at population during subsequent stage. Walia (2009) also reported that weeds have an edge over the crop plants with respect to their growth and development because of early germination and quick initial growing habits.

Grain yield (qha⁻¹)

All weed control treatments gave significantly higher grain yield over weedy check. Significantly highest grain yield was recorded 9.68 and 10.15 qha⁻¹ under two hand weeding over rest of the treatment except at par with imazethapyr + pendimethalin@ 900 g ha⁻¹ during 2012 and 2013, respectively. Among the herbicide application imazethapyr + pendimethalin@ 900 g ha⁻¹ was found significantly higher grain yield 9.65 and 9.78 qha⁻¹ over rest of the treatment during both the years. The minimum grain yield was recorded 4.15 and 5.13 qha⁻¹ under weedy check. Among the herbicide application imazethapyr + pendimethalin @ 900 g ha⁻¹ was found significantly higher straw yield 18.22 and 18.35 qha⁻¹ over rest treatment and at par pendimethalin @ 1000 g ha⁻¹ as pre emergence during both the years. The minimum straw yield was recorded 15.62 and 16.38 qha⁻¹ under weedy check. Two hand weedings at 20 and 40 DAS produced highest grain yield which might be attributed to desired plant stand per unit area and grain weight plant⁻¹. It was followed by the weed control imazethapyr + pendimethalin @ 900 g ha⁻¹. These treatments had lower density and dry weight of weeds right from 40 DAS till harvest stage which facilitated good growth of crop plants particularly in reproductive phase and weeds were not allowed to exert sufficient competition to reduce the crop yield. These results are in accordance with those of Punia (2014), Kumar *et al.* (2015).

Total nutrient (NPK) uptake by crop

All weed control treatments gave significantly higher total NPK uptake by crop kg ha⁻¹ was recorded with

two hand weeding over rest treatment except at par with pendimethalin @ 1000 g ha⁻¹ and imazethapyr + pendimethalin @ 900 g ha⁻¹ during 2012 and 2013, respectively. Among the herbicide application imazethapyr + pendimethalin@ 900 g ha⁻¹ was found significantly higher total NPK uptake by crop kg ha⁻¹ over rest treatment and at par with pendimethalin @ 1000 g ha⁻¹ during both the years. The minimum total NPK uptake by crop kg ha⁻¹ was recorded under weedy check during both years. Among weed control treatments, highest N, P, K uptake was recorded under treatment of two hand weedings followed by the treatments imazethapyr + pendimethalin @ 900 g ha⁻¹. These are attributed to higher grain and straw yield in these treatments. Due to best crop weed competition, crop plants in these treatments observed higher amount of nutrients and increased the production of grain and straw. These results corroborate with the findings of Chhodavadia *et al.* (2013) Kavita *et al.* (2014b) Singh and Yadav (2015).

Nutrient (NPK) uptake by weeds

All weed control treatments gave significantly lower NPK uptake by weed 2.01 and 1.84 kg ha⁻¹ was recorded with two hand weeding over rest treatment except at par with pendimethalin @ 1000 g ha⁻¹ and imazethapyr + pendimethalin@ 900 g ha⁻¹ during 2012 and 2013, respectively. Among the herbicide application pendimethalin @ 1000 g ha⁻¹ was found significantly lower NPK uptake by black gram kg ha⁻¹ over rest treatment and at par with imazethapyr + pendimethalin@ 900 g ha⁻¹ during both the years. The maximum NPK uptake by 29.83 and 27.88 kg ha⁻¹ was recorded under weedy check during both the years.

CONCLUSION

All weed control practices proved effective in controlling the weeds in black gram and gave significantly higher grain yield over weedy. Pre emergence application of imazethapyr + pendimethalin at 900 g ha⁻¹ was found most effective herbicides for control of all major weeds resulting maximum grain yield among herbicide treatments. This treatment influenced the uptake of nutrient by black gram and reduced density and dry matter of weeds. As per the finding of imazethapyr + pendimethalin (RM) at 900 g ha⁻¹ or pendimethalin alone should be adopted for the control of weeds in black gram without any phytotoxicity on black gram and succeeding mustard crop.

Table 1. Grain and Straw yield (qha⁻¹), Nutrient uptake by plant (Kg ha⁻¹) and Nutrient uptake by weeds (Kg ha⁻¹) as affected by different weed control treatments.

Treatment	Grain yield (qha ⁻¹)		Straw yield (qha ⁻¹)		Total Nutrient uptake by plant (Kg ha ⁻¹)						Nutrient uptake by weeds (Kg ha ⁻¹)					
	2012	2013	2012	2013	N		P		K		N		P		K	
					2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Pendimethalin @ 1000 g ha ⁻¹ as pre-emergence	8.65	9.10	17.55	18.30	54.98	57.52	6.45	6.99	27.88	28.83	3.42	3.02	0.75	0.61	6.29	5.38
Imazethapyr @50 g ha ⁻¹ at 3-4 leaf stage	6.48	7.25	16.48	17.20	41.99	45.21	4.74	5.05	22.08	23.12	9.62	8.38	1.69	1.45	18.29	22.31
Imazethapyr 70 g ha ⁻¹ at 3-4 leaf stage	7.84	7.92	17.44	18.19	49.93	50.48	5.47	5.84	23.84	25.16	7.29	6.57	1.41	1.20	13.88	21.96
Imazethapyr + pendimethalin (RM) @ 800 g as pre-emergence	7.42	7.88	17.40	18.15	47.47	50.60	5.24	5.90	22.99	26.67	8.33	7.19	1.50	1.28	15.79	13.21
Imazethapyr+pendimethalin (RM) @ 900 g ha ⁻¹ as pre-emergence	9.65	9.78	18.22	18.35	57.22	62.90	6.99	8.00	29.00	30.31	2.28	2.05	0.51	0.45	4.14	3.61
Imazethapyr+pendimethalin (RM) @1000 g ha ⁻¹ as pre-emergence	8.43	8.98	17.53	18.28	53.35	54.97	6.24	6.76	26.76	26.96	4.21	3.69	0.92	0.79	7.84	6.67
Imazethapyr + imazamox (RM) @ 60 g ha ⁻¹ at 3-4 leaf stage	7.96	8.52	17.42	18.17	49.61	53.46	5.93	6.57	24.26	26.16	5.23	4.59	1.04	0.87	9.84	15.37
Imazethapyr + imazamox (RM)@ 70 g ha ⁻¹ at 3-4 leaf stage	8.15	8.68	17.45	18.20	51.18	54.88	6.17	6.91	25.24	29.99	4.90	4.39	1.00	0.86	9.20	8.03
Two hand weeding at 20&40 DAS	9.68	10.15	18.25	19.00	60.65	65.82	8.27	9.38	31.82	34.45	2.01	1.84	0.47	0.41	3.65	3.36
Weedy check	4.15	5.13	15.62	16.38	27.30	34.69	3.42	4.20	16.32	20.32	29.83	27.88	7.36	6.58	53.94	50.33
SEm (±)	0.32	0.34	0.18	0.21	2.19	1.87	0.61	0.80	1.39	1.98	0.79	0.41	0.11	0.11	0.91	0.89
CD(P=0.05)	0.97	1.04	0.55	0.64	6.57	5.61	1.83	2.41	4.16	5.95	2.12	1.16	0.36	0.35	2.67	2.58

Table 2. Total weed density (no. m⁻²) as affected by weed control treatments at various stages of crop growth.

Treatments	Crop growth stages								Weed dry matter	
	20 DAS		40 DAS		60 DAS		At harvest		At harvest	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Pendimethalin @ 1000 g ha ⁻¹ as pre-emergence	4.16 (20.87)	4.46 (18.95)	4.65 (20.67)	4.48 (19.17)	5.42 (28.43)	5.13 (25.33)	4.85 (22.67)	4.61 (20.40)	5.02 (24.28)	4.77 (21.87)
Imazethapyr @50 g ha ⁻¹ at 3-4 leaf stage	10.78 (115.37)	10.57 (110.86)	8.13 (65.33)	7.69 (58.33)	9.03 (80.67)	8.71 (75.00)	8.28 (67.67)	7.87 (61.00)	8.62 (73.46)	8.18 (65.98)
Imazethapyr 70 g ha ⁻¹ at 3-4 leaf stage	11.02 (120.50)	10.79 (115.46)	6.67 (43.67)	6.34 (39.30)	7.70 (58.33)	7.41 (54.00)	7.12 (49.83)	6.84 (45.93)	7.44 (54.42)	7.14 (50.13)
Imazethapyr + pendimethalin (RM) @ 800 g as pre-emergence	6.56 (42.03)	5.60 (30.40)	7.61 (57.00)	7.35 (53.17)	8.42 (70.00)	8.05 (64.00)	7.68 (58.00)	7.25 (51.67)	7.97 (62.65)	7.53 (55.74)
Imazethapyr+pendimethalin (RM) @ 900 g ha ⁻¹ as pre-emergence	3.87 (14.03)	3.67 (12.57)	3.73 (13.50)	3.61 (12.17)	4.28 (17.40)	4.11 (16.00)	3.93 (14.57)	3.79 (13.40)	4.10 (15.91)	3.95 (14.61)
Imazethapyr+ pendimethalin (RM) @ 1000 g ha ⁻¹ as pre-emergence	5.27 (26.97)	5.05 (24.68)	5.03 (24.50)	4.91 (23.17)	6.05 (35.67)	7.41 (31.50)	5.40 (28.33)	5.13 (25.43)	5.60 (30.50)	5.32 (27.35)
Imazethapyr + imazamox (RM) @ 60 g ha ⁻¹ at 3-4 leaf stage	10.42 (107.73)	10.21 (103.43)	5.72 (32.17)	5.53 (29.90)	6.99 (48.00)	6.63 (43.00)	6.04 (35.60)	5.76 (32.23)	6.28 (38.44)	5.97 (34.77)
Imazethapyr + imazamox (RM)@ 70 g ha ⁻¹ at 3-4 leaf stage	10.23 (103.77)	9.99 (98.97)	5.50 (29.50)	5.26 (26.83)	6.58 (42.33)	6.27 (38.33)	5.84 (33.17)	5.62 (30.67)	6.06 (35.78)	5.82 (33.04)
Two hand weeding at 20&40 DAS	9.95 (98.07)	9.71 (93.30)	3.26 (10.17)	3.24 (9.57)	4.10 (15.83)	3.91 (14.33)	3.70 (12.83)	3.58 (11.90)	3.85 (13.93)	3.72 (12.96)
Weedy check	11.33 (127.19)	11.13 (123.00)	13.50 (181.33)	13.17 (172.50)	14.66 (214.00)	14.25 (202.33)	13.81 (190.00)	13.46 (180.33)	14.32 (204.32)	13.94 (193.58)
SEm (±)	0.10	0.12	0.16	0.14	0.11	0.11	0.11	0.13	0.12	0.13
CD(P=0.05)	0.31	0.36	0.48	0.42	0.34	0.33	0.35	0.38	0.36	0.40

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