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Performance of fenoxaprop p-ethyl and isoproturon for broad spectrum weed control in wheat

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Abstract
Weeds are one of the most important factors that impose a great threat to crop yield. Wheat is infested with diverse type of weed flora as it is grown under various agroclimatic conditions, different cropping sequence, tillage and irrigation regimes. The yield losses due to weeds varied depending on the weed species, their density and environmental factors. Among weeds, *Phalaris minor Retz* is single most dominant grassy weed in northern Indian plains causing significant yield losses. For controlling weeds in wheat, growers mostly rely on herbicides due to cost and time effectiveness. Use of herbicide mixtures has been advocated on most effective strategy for avoidance and management of herbicide resistant weeds. In order to alleviate the weed infestation in wheat to evaluate the performance of fenoxaprop p-ethyl & isoproturon for broad spectrum weed control and yield of wheat during *Rabi* seasons of two years at Crop Research Centre, Pant Nagar, U.S. Nagar. The fenoxaprop p-ethyl alone 40,60,80 and 90 g a.i.ha^{-1} and tank mix combination of fenoxaprop p-ethyl 30,40 and 50 g a.i.ha^{-1} with isoproturon 500 g a.i.ha^{-1} as well as isoproturon 1000 g a.i.ha^{-1}, weed free and weedy treatments. Tank mix combination of fenoxaprop p- ethyl 30, 40 and 50 g a.i.ha^{-1} with isoproturon 500 g a.i.ha^{-1} produce crop growth in term of dry matter, total weed population, plant height, grain: straw ratio, weed control efficiency and grain yield of wheat comparable with that of weed free condition and reduce crop weed competition.

Keywords: Isoproturon, fenoxaprop p-ethyl, broad spectrum weed control, weed efficiency, weed dry weight

Introduction
Agriculture plays an important role in economic growth, enhancing food security, poverty alleviation and rural livelihood development. It is main source of income for about 60% of people in India. Presently in India, food grains production is about 252 million tonnes (GOI 2016) [14]. However, still there exist a wide gap between the production potential and the actual production realized by the farmers.

Weed infestation is one of the main causes of low wheat yield not only in India but all over the world, as it reduces wheat yield by 37-50% (Waheed *et al*. 2009) [16]. Ries wheat is one of the most important cropping systems in northern part of the country. The *Phalaris minor* is one of the very serious problems in wheat in this cropping system and sometimes almost 65% crop losses have been reported (Chhokar *et al*. 2008) [15]. Since last 25 years, isoproturon at 1000 g a.i. ha^{-1} was taking care of both the grassy and non-grassy weed on farmer's field in wheat crop. But the recent development of resistance in P. *minor* against isoproturon (Bhan *et al*., 1998) [1] has compiled to look for alternate herbicides. Fenoxaprop p-ethyl is one such herbicide which has excellent against *Phalaris minor* in wheat but when it was mixed with 2, 4-D or tralkoxydim, performance of fenoxa prop p-ethyl against *P. Minor* decreased (Tiwari and Parihar, 1997) [2].

Isoproturon was reported also effective against a number of broad leaf weeds like *chenopodium album, Anagallis arvensis, Medicago denticulata, vicia hirsuta, Poa annua, Rumex dentatus and Lipidium sativa.* Weeds have been the most harmful biotic factor that reduces yield and quality of crop. Weeds causes upto 34% of losses in crop yield worldwide (Oerke, 2006) [3], *P.minor* causes upto 95% of yield reduction in wheat. Manual control of *P.minor* is difficult because of its mimicry with wheat plants until flowering. It produces from 300-475 seeds per plant and matures about 2 week before wheat (Yasin and Iqbal 2011) [4]. Therefore, fenoxaprop p-ethyl is a specific herbicide for control of grassy weeds and tank mixed with isoproturon during this course of investigation to achieve broad spectrum weed control. Their bio-efficacy on wheat growth was also studied.

Materials and Methods

The field study was conducted during winter season of two year data from Crop Research Centre at Pant Nagar. The predominant weeds were *P. minor, A ludoviciana, Anagallis arvensis, M. indica, Chenapodium album, Vicia sativa and C didymus.* The soil of experimental plot was sandy loam in texture, high in organic carbon, available phosphorus and medium in available potassium in Ist year, while soil in the IInd year, plot was medium in organic carbon, high in available phosphorus and potassium with pH 7.12. Ten treatments were laid out in randomized block design with four replications. The fenoxaprop p-ethyl alone at 40, 60, 80 and 90g a.i. ha^{-1} and tank mix combination of fenoxaprop p-ethyl 30, 40 and 50g a.i. ha^{-1} with isoproturon 500g a.i. ha^{-1} as well as isoproturon alone at 1000g a.i. ha^{-1}, weed free and weedy treatments. In weed free plots, weeds were removed manually with the help of *khurpi* as and when needed to keep the plots free from weeds. Weedy plot remained infested with the native weed population throughout the cropping season. Wheat cv. 'UP 2382' was sown with row distance of 20 cm and seed rate of 100 kg ha^{-1}. The crop was fertilized with the recommended dose of N, P_2O_5 and K_2O (120:80:00). The Potassium fertilizer was not applied since soil of experimental plot was not lacking in this nutrient. The crop was irrigated at crown root initiation, late tillering and boot stage during the Ist year and crown root initiation, boot and flowering stages during IInd year. At other stages, there was adequate rainfall to meet the requirement. Both the herbicides were sprayed 30 days after sowing of wheat, in the aqueous medium at 500 litres ha^{-1} water with the flat–fan nozzle of sprayer. Combinations of fenoxaprop p-ethyl and isoproturon were applied as tank mixture. The mean ranges of maximum and minimum temperature during the crop season were 20.4 ^{0}C-38.5 ^{0}C and 7.1 ^{0}C – 17.5 ^{0}C.

Results and Discussion

All the weed control treatments resulted in significant increase in the grain yield of wheat and grain: straw ratio over the weedy check. The lowest grain yield and grain: straw ratio was the obtained in weedy check which was associated with the lowest crop dry matter production, plant height, yield attributing characters and growth parameters i.e. leaf area index, mean crop growth rate and mean relative growth rate. It was due to severe crop weed competition in weedy check.

The highest grain yield (5056 kg ha^{-1}) was recorded under weed free condition. Fenoxaprop p-ethyl at 90 g a.i. ha^{-1}, and a tank mixture of fenoxaprop p-ethyl and isoproturon at 50+500 g a.i. ha^{-1}, produced gain yield at par with weed-free condition during both the years, while during Ist year the result of a tank mixture of fenoxaprop p-ethyl and isoproturon at 40+500 g a i ha^{-1} alone was at par with weed free condition. Crop growth in these treatments in term of dry matter and grain: straw ratio was also comparable with that of weed free treatments, which was due to reduced crop weed competition. Isoproturon at 1000 g a i ha^{-1} give significant less grain yield that of fenoxaprop p-ethyl at 90 g a i ha^{-1} or take mixture of fenoxaprop p-ethyl and isoproturon at 40+500 and 50+500g a i ha^{-1} and weed free condition. This yield reduction was replaced in particularly due to its lower weed control efficiency against non-grassy weeds result to less crop dry matter production and mean relative growth rate g g^{-1} day^{-1} where -as leaf area index, mean crop growth rate g $m^{-2}day^{-1}$and 1000 grain weight were at par with that of weed free condition. The lowest value of weed population was recorded under fenoxaprop p-ethyl and isoproturon at 50+500 g a i ha^{-1}, while significantly higher weed population was observed under fenoxaprop p-ethyl at 40 g a i ha^{-1} in both the years.

Different growth parameters [leaf area index, mean crop growth rate g m^{-2} day^{-1}, mean relative growth rate g g^{-1} $day^{-1}$and 1000 grain weight] in the plots treated with fenoxaprop p-ethyl 90 g a i ha^{-1} in a straight form or as a tank mixer of fenoxaprop p-ethyl and isoproturon at 50+500 g a i ha^{-1} were also at par with that of weed free condition.

There was increase in the LAI, CGR and RGR of the crop with increase in the rate of fenoxaprop p- ethyl of crop growth during both the years. Significantly highest LAI, CGR and RGR was recorded where fenoxaprop p-ethyl were applied at 90 g a i $ha^{-1}$of crop growth in comparison to remaining rates of fenoxaprop p-ethyl during both the years. Similarly application of fenoxaprop p-ethyl and isoproturon as a tank mixture the LAI, CGR and RGR of the crop increased with increase in the rate of fenoxaprop p-ethyl and significantly more LAI, CGR and RGR of the crop was recorded at 50+500 g a i ha^{-1} of crop growth in comparison to remaining rate of tank mixture, but the difference between 40+500 and 50+500 g a i ha^{-1}during Ist year were not significant. Significantly highest LAI,CGR and RGR was observed in weed free treatment over weedy check and plot treated with herbicides, result at par with a tank mixtures of fenoxaprop p-ethyl and isoproturon at 50+500 g a i ha^{-1}during both the years except 120 days stage during Ist year.

Significantly highest weed control efficiency was observed in a tank mixture of fenoxaprop p-ethyl and isoproturon at 50+500 g a i ha^{-1} of crop growth during both the years, result at par with fenoxaprop p-ethyl at 80 and 90 g a i ha^{-1}. While lowest value with respect to weed control efficiency was recorded where fenoxaprop p-ethyl was applied at 40 g a i ha^{-1}during both the years. Among the plots treated with herbicides, significantly highest value with respect to crop weed competition index was observed in fenoxaprop p-ethyl at 40 g a i ha^{-1} during both the years. However, significantly lowest crop weed competition index was recorded in a tank mixture of fenoxaprop p-ethyl and isoproturon at 50+500 g a i ha^{-1}during both the years, results at par with fenoxaprop p-ethyl at 80 and 90 g a i ha^{-1} and a tank mixture of fenoxaporp p-ethyl and isoproturon at 40+500 g a i ha^{-1} during both the years.

Significantly lowest dry matter for total weeds was observed in a tank mixture of fenoxaprop p-ethyl and isoproturon at 50+500 g a i ha^{-1} during both the years over all the treatment and weedy check. With increase in rate of fenoxaprop p-ethyl, there was decrease in dry matter of total weed either in a alone or as a tank mixture with isoproturon at 500 g a i ha^{-1}during both the years. The average weed control efficiency of fenoxaprop p-ethyl alone with dose at 40, 60 and 80 g a i $ha^{-1}$was low (47.51 to 75.54%) in comparison to isoproturon alone (68.34%) or mixture of fenoxaprop p-ethyl with isoproturon (61.46% to 78.03%). The highest degree of crop weed competition in the fenoxaprop p-ethyl treated plot reduced the important yield and yield attributes.

Thus, combinations of fenoxaprop p-ethyl with isoproturon increased the weed control spectrum with the control of grassy as well as non-grassy weeds and decreased the crop-weed competition which favoured the crop growth as well as yield attributes and ultimately the grain yield of wheat.

Table 1: Effect of weed control treatments on the wheat yield and associated weeds

Treatments	Rate g a.i. ha^{-1}	Total weed Population (No m^{-2}) at 120 DAS*		Total weed dry matter (g m^{-2}) at 120 DAS*		Crop dry matter (gm^{-2}) at 120 DAS*		Grain: Straw Ratio		Grain Yield (kg ha^{-1})	
		I year	II Year	I year	II Year	I year	II Year	I year	II Year	I year	II Year
Fenoxaprop p-ethyl	40	122 (4.81)	105 (4.66)	62.6 (4.15)	52.0 (3.97)	845.4	1019.2	0.57	0.57	3534	3826
Fenoxaprop p-ethyl	60	85 (4.45)	76 (4.34)	42.8 (3.65)	33.8 (3.55)	924.8	1102.8	0.61	0.60	4060	4263
Fenoxaprop p-ethyl	80	77 (4.35)	70 (4.26)	34.0 (3.55)	24.3 (3.23)	1125.3	1159.9	0.63	0.62	4267	4684
Fenoxaprop p-ethyl	90	73 (4.30)	67 (4.22)	31.2 (3.47)	20.1 (3.05)	1152.5	1298.4	0.62	0.63	4366	4876
Fenoxaprop p-ethyl + Isoproturon	30+500	100 (4.61)	97 (4.58)	45.1 (3.83)	35.4 (3.59)	942.2	1108.2	0.63	0.59	4139	4302
Fenoxaprop p-ethyl + Isoproturon	40+500	83 (4.42)	73 (4.30)	29.8 (3.43)	23.3 (3.19)	1154.7	1250.5	0.64	0.61	4449	4680
Fenoxaprop p-ethyl + Isoproturon	50+500	66 (4.20)	58 (4.07)	27.1 (3.34)	18.9 (2.99)	1162.5	1300.2	0.64	0.63	4716	4896
Isoproturon	1000	90 (4.51)	68 (4.23)	37.1 (3.64)	29.0 (3.40)	1082.3	1220.7	0.62	0.59	4133	4438
Weed free	-	0	0	0	0	1188.5	1320.3	0.65	0.64	4917	5195
Weedy	-	181 (5.20)	158 (5.07)	109.7 (4.71)	98.4 (4.60)	715.0	878.1	0.43	0.43	1958	2243
SEm+_ LSD (P=0.05)	-	0.05 0.14	0.04 0.12	0.03 0.07	0.02 0.07	10.26 29.77	19.66 57.04	0.022 0.064	0.007 0..022	220.00 638.37	112.63 326.82

Log (x+1) transformed values and original values are in parentheses.* DAS - Days after sowing

Table 2: Effect of Weed control treatments on the wheat yield and associated weeds

Treatments	Rate g a.i. ha^{-1}	Plant height (cm) at 120 DAS*		Leaf area index at 120 DAS*		Mean crop growth rate g m^{-2} day^{-1} at 90-120 DAS*		Mean relative growth rate g g^{-1} day^{-1} at 90-120 DAS*		1000 grain weight (g)		Crop Weed Competition Index		Weed control efficiency % at 120 DAS	
		I year	II Year	I year	II Year	I year	II Year	I year	I year	I year	II Year	I year	II Year	I year	II Year
Fenoxaprop p-ethyl	40	85.6	86.6	1.29	1.34	3.47	3.73	.0039	.0032	40.74	42.72	28.10	26.35	47.92	47.10
Fenoxaprop p-ethyl	60	87.7	90.1	1.38	1.48	3.91	4.06	.0041	.0036	43.83	45.46	17.45	17.96	66.08	45.60
Fenoxaprop p-ethyl	80	91.3	91.8	1.53	1.60	4.61	4.72	.0077	.0043	46.57	47.31	13.22	9.66	71.54	75.38
Fenoxaprop p-ethyl	90	93.5	93.6	1.69	1.89	5.30	5.77	.0080	.0045	47.06	48.54	9.49	7.44	71.54	79.54
Fenoxaprop p-ethyl + Isoproturon	30+500	89.2	89.2	1.37	1.58	3.50	3.80	.0039	.0031	43.99	45.30	15.84	17.03	58.89	64.02
Fenoxaprop p-ethyl + Isoproturon	40+500	92.9	93.1	1.64	1.82	4.92	5.07	.0083	.0034	46.57	47.83	11.22	9.93	72.82	76.28
Fenoxaprop p-ethyl + Isoproturon	50+500	94.2	95.2	1.75	1.96	5.70	5.97	.00084	.0046	47.12	48.57	4.09	5.61	75.28	80.79
Isoproturon	1000	89.8	92.0	1.57	1.65	4.50	4.01	.0078	.0042	46.52	46.62	15.95	14.47	66.17	70.51
Weed free	-	95.6	95.7	1.81	2.00	6.01	6.08	.0090	.0061	48.15	48.94	0	0	100	100
Weedy	-	80.7	81.8	1.12	1.11	2.02	3.16	.0029	.0028	37.99	39.28	60.19	56.46	0	0
SEm+_ LSD (P=0.05)	-	0.94 2.73	1.62 4.70	0.025 0.073	0.059 0.170	0.29 0.84	0.67 1.93	.0002 .0006	.0006 .0019	0.65 1.87	0.69 1.99	3.78 10.99	2.03 5.89	0.55 1.59	0.75 2.19

* DAS - Days after sowing

References

1. Bhan VM, Kumar S, Dhaliwal GS, Arora R, Randhawa NS, Dhawan AK. Integrated management of *Phalaris minor* in rice wheat ecosystem in India. Ecological Agriculture and Sustainable Development, Chandigarh India 15-17 November, 1998, 400-415.
2. Tiwari RB, Parihar SS. Weed Management in wheat Indian Journal of Agronomy. 1997; 42(4):724-728.
3. Oerke EC. Crop losses to pests. J Agric. Sci. 2006; 144:31-43.
4. Yasin M, Iqbal Z. Chemical control of grassy weeds in wheat (*Triticum aestivum* L.) Germany: LAP LAMBERT Acad. Pub., 2011, 76p.
5. Chhokar RS, Malik RK. Isoproturon resistance in *Phalaris minor* and its response to alternate herbicides. Weed technology. 2002; 16:116-123

6. Verma SK, Singh SB, Singh Ghanshyam, Rai OP. Performance of varieties and herbicides on production potential of wheat (*Triticum aestivum*) and associated weeds. Indian Journal of Weed Science. 2007; 39 (3&4):230-233.
7. Walia US, Brar LS, Dhaliwal BK. Resistance of isoproturon in *Phalaris minor* Ritz in Punjab. Plant Protection Quarterly. 1997; 12:138-140.
8. Singh G, Singh VP. Compatibility of clodinafop proparyl and fenoxaprop p-ethyl with carfentrazone ethyl, metsulfuron methyl and 2,4-D. Indian Journal of Weed Science. 2005; 37(1&2):01-05.
9. Malik RS, Malik RK, Pawar RS, Bhan VM. The influence of surfactant on the performance of grassy herbicides applied under complex weed flora situation in wheat. Indian Journal of Agronomy. 1989; 34:217-221.
10. Rajashekar B, Sudharashni V, Neema Parveen SK, Shivacharan G. Knowledge of farmers about integrated weed management practices in major crops. International Journal of Farm Sciences. 2017; 7(1):33-36.
11. Singh SS, Singh SD, Sharma SS, Punia, Singh H. Performance of tank mixture of metribuzin with clodinafop and fenoxaprop for the control of mixed weed flora in wheat. Indian Journal of Weed Science. 2005; 37:09-12.
12. Banga RS, Yadav A. Effect of fenoxaprop and sulfosulfuron alone and a tank mixture against complex weeds in wheat. Indian Journal of Weed Science. 2004; 36:163-165.
13. Brar LS, Walia US. Bio-efficacy of substituted urea herbicide against *Phalaris minor Retz* in wheat. Indian Journal of Weed Science. 1993; 25:1-5.
14. GOI. Agricultural statistics at a glance Department of Agriculture, Cooperation & Farmers Welfare, Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare. Government of India. 2016, 488.
15. Chhokar RS, Sharma RK, Chauhan DS, Mongia AD. Evaluation of herbicides against *Phalaris minor* in wheat in north western Indian plains. Weed Research. 2008; 46(1):40-49.
16. Waheed AR, Qureshi GS, Jakhar, Tareen H. Weed community dynamics in wheat crop of district Rahim Yarkhan, Pakistan. Pakistan Journal of Botany. 2009; 41(1):247-254.