Indian Journal of Agricultural Sciences **92** (6): 737–40, June 2022/Article
https://doi.org/10.56093/ijas.v92i6.111327

Assessing varietal tolerance and weed control effectiveness of metribuzin-based herbicide mixtures in wheat (*Triticum aestivum*)

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Received: 02 April 2021; Accepted: 23 February 2022

ABSTRACT

A field experiment was conducted during 2014–15 and 2015–16 at Research Farm of Department of Agronomy, CCSHAU, Hisar. The experiment comprised five wheat (*Triticum aestivum* L.) varieties (WH 1105, HD 2967, DPW 621-50, WH 1124 and DBW 17) in main plots and six weed management practices, viz. metribuzin (210 g/ha), metribuzin + fenoxaprop (150 + 100 g/ha), metribuzin + pinoxaden (150 + 40 g/ha), metribuzin + clodinafop (150 + 45 g/ha), weed free and weedy check in sub-plots was conducted in split-plot design with three replications. The population and dry matter accumulation of weeds were not affected by wheat varieties. Wheat variety WH 1105 resulted in maximum grain yield and remained at par with HD 2967 and DPW 621-50, but statistically superior to DBW 17 and WH 1124. Minimum population of grassy and total weeds and dry matter accumulation by them was observed with metribuzin + fenoxaprop, being at par with other two combinations of metribuzin. But, the density and dry matter of broad leaved weeds was minimum with metribuzin alone (210 g/ha). Among herbicidal treatments, metribuzin + fenoxaprop (150 + 100 g/ha) remained superior with maximum grain yield.

Keywords: Clodinafop, Fenoxaprop, Metribuzin, Pinoxaden, Sensitivity, Wheat

Wheat (*Triticum aestivum* L.) is one of the most important staple foods in India after rice. The annual wheat production in India has been reported at 99.7 million tonnes (MT) from 29.6 million hectare (mha) registering productivity of 3371 kg/ha (GOI 2018). In Haryana, wheat is grown over 2.55 mha area with production of 12.57 MT (Anonymous 2020). As scope for expansion of area under wheat is less, the main emphasis would be on increasing the productivity of wheat by adopting improved cultivation practices. Weeds are one of the major constraints in achieving potential yield of wheat (Raj *et al.* 2020). Wheat is generally infested with both grassy and broad-leaved weeds (Asres and Das 2011). Cultural practices of weed management such as time and method of sowing, crop density, varieties, time and method of irrigation have pronounced effect on crop-weed interference (Das and Yaduraju 2011). Manual methods are also effective but physical resemblance of weeds with that of crop plant, scarcity of labourers and higher cost pose challenge. Chemical weed control is preferred because of its better efficiency along with less cost and time involvement**.** The large scale failure of isoproturon, danger of development of rapid resistance against alternate herbicides due to their continuous use (Das *et al*. 2014), non-adoption of herbicides like pendimethalin by farmers because of its high cost and high moisture requirement at the time of spray, phytotoxicity due to high doses of metribuzin and proportionate changes in weed flora in cereal crops necessitates use of herbicide mixtures (Chhipa and Nepalia 2015).

Crop varieties also differ in their competitive ability against weeds. Therefore, differences in morphological features, canopy structure and relative growth rate of varieties of a crop may be exploited towards reducing crop-weed competition. Cultivars of several crops including winter wheat differ considerably in their tolerance to metribuzin. Differential varietal sensitivity to fenoxaprop + metribuzin has been reported (Yadav *et al.* 2012). Therefore, determining varietal tolerance to fenoxaprop + metribuzin before recommendation assumes enough importance. Keeping these in view, the present study was planned and carried out involving few wheat varieties and metribuzin based herbicide mixtures.

MATERIALS AND METHODS

A field experiment was conducted during 2014–15 and 2015–16 at Agronomy Research Farm of CCS Haryana Agricultural University, Hisar located at 29°16’N latitude and 75°7’E longitude at an elevation of 215.2 m amsl in north-west India. The climate is semi-arid with very hot summers and relatively cool winters. The soil of the experimental field was sandy loam with low organic carbon

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and nitrogen, medium available phosphorus, high potassium and slightly alkaline (*p*H 8.3). Sowing of wheat was done on November 27th, 2014 and December 5th, 2015 by seed-cum-fertilizer drill with a spacing of 20 cm from line to line at 5–6 cm depth using 120 kg seed/ha. Harvesting of the crop was done on April 4th, 2015 and April 19th, 2016. The experiment was laid out in split-plot design comprising of five wheat varieties (Table 1 and 2) in main plots and six weed management practices in sub plots, each replicated thrice. All the herbicides and their mixtures were applied at 35 days after sowing (DAS) of the crop. Observations for weed density (No./m^2) were recorded by randomly placing quadrate (0.25 m^2) in each plot at different intervals. Original data on weeds population and dry weight were subjected to square root $\sqrt{(x + 1)}$ transformation before analysis of variance (ANOVA) to reduce higher variation in observed data. Wheat data were also statistically analysed using ANOVA for split plot design and the significance of treatment means was tested at P=0.05 (probability value).

RESULTS AND DISCUSSION

Effect on weed interference and varietal tolerance: *Phalaris minor* Retz. was the major weed observed among grassy weeds and plants of *Avena ludoviciana* Dur. were also observed at some places. All other weeds [*Rumex dentatus* L.*, Chenopodium album* L.*, Melilotus indicus* (L.) All.*, Convolvulus arvensis* L.*, Anagallis arvensis* L.*, Coronopus didymus* (L.) Sm.*, Cirsium arvense* (L.) Scop*, Vicia sativa* L. and *Lathyrus aphaca* L.] were collectively classified as broad leaved weeds. The density of weeds along with their dry weight were affected by various wheat varieties to some extent, but the differences were not significant during both the years of study (Table 1 and 2). Variety WH 1105 and HD 2967 allowed less number of weeds as compared to variety DBW 17 but difference was not found significant. However, Sardana *et al.* (2017) reported that different varieties could affect the density of weeds.

All herbicidal treatments effectively suppressed weed population (Table 1) compared to weedy check plots during both the years of study. Metribuzin resulted in effective control of grassy as well as broad-leaved weeds when applied alone or in mixtures compared to weedy check in wheat in both years (Yadav *et al.* 2016). Metribuzin + fenoxaprop (150 + 100 g/ha) was found to be statistically at par with metribuzin + pinoxaden (150 + 40 g/ha) and metribuzin + clodinafop (150 + 45 g/ha) in controlling grassy weeds

Table 1 Effect of varieties and weed management practices on weed density and weed control efficiency in wheat

Treatment	Weed density (No./m^2) at harvest 2014–15			Weed density (No./m^2) at harvest 2015–16			Weed control efficiency (%) 2014–15	Weed control efficiency (%) 2015–16
	Grassy weeds	Broad leaved weeds	Total weeds	Grassy weeds	Broad leaved weeds	Total weeds	Total weeds	Total weeds
Variety								
WH 1105	2.7 (10.7)	4.0 (26.5)	4.8 (37.2)	3.1 (14.4)	4.3 (32.4)	5.3 (46.7)	77.0	77.6
HD 2967	2.8 (10.7)	4.0 (25.6)	4.8 (36.3)	3.1 (14.4)	4.3 (31.5)	5.3 (45.9)	80.5	77.8
DPW 621-50	2.8 (10.9)	4.1 (28.0)	4.9 (38.9)	3.2 (15.1)	4.4 (33.3)	5.4 (48.5)	77.4	79.0
WH 1124	2.8 (11.4)	4.0 (27.1)	4.8 (38.5)	3.2 (15.0)	4.3 (33.1)	5.3 (48.1)	78.0	77.5
DBW 17	2.8 (11.7)	4.1 (29.0)	4.9 (40.7)	3.2 (15.4)	4.3 (32.8)	5.3 (48.2)	78.6	78.5
SEm±	0.1	0.2	0.2	0.1	0.1	0.1	--	--
CD (P=0.05)	NS	NS	NS	NS	NS	NS	--	--
Weed Management								
Metribuzin (210 g/ha)	3.6 (12.0)	1.8 (2.5)	3.9 (14.5)	4.1 (16.0)	2.1 (4.0)	4.6 (20.0)	86.1	84.6
Metribuzin + clodinafop (150 + 45 g/ha)	1.8 (2.4)	3.3 (9.9)	3.6 (12.3)	2.0 (3.0)	3.4 (11.0)	3.8 (14.0)	93.8	94.1
Metribuzin + pinoxaden (150 + 40 g/ha)	1.7 (2.1)	3.3 (10.0)	3.6 (12.1)	2.0 (3.1)	3.5 (11.2)	3.9 (14.3)	94.1	94.4
Metribuzin + fenoxaprop (150 + 100 g/ha)	1.7 (1.9)	3.2 (9.1)	3.4 (11.0)	1.8 (2.2)	3.3 (10.0)	3.6 (12.2)	95.1	95.4
Weed free	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	100.0	100.0
Weedy check	6.9 (48.0)	11.5 (132)	13.4 (180)	8.1 (65.0)	12.6 (159.6)	15 (224.5)	0.0	0.0
SEm±	0.2	0.1	0.1	0.2	0.2	0.1	--	--
CD (P=0.05)	0.6	0.4	0.4	0.5	0.5	0.4	--	--

Note: Original data given in parentheses was subjected to square root $\sqrt{(x+1)}$ transformation before analysis.

Table 2 Effect of varieties and weed management practices on dry matter of weeds and grain yield in wheat

Treatment	Dry matter of weeds (g/m^2) at harvest			Dry matter of weeds (g/m^2) at harvest			Grain yield (t/ha)	
	2014–15			2015–16			2014–15	2015–16
	Grassy weeds	Broad leaved weeds	Total weeds	Grassy weeds	Broad leaved weeds	Total weeds		
Variety								
WH 1105	5.0 (37.3)	4.3 (30.4)	6.6 (67.7)	5.5 (48.6)	4.7 (36.8)	7.2 (85.4)	5.86	5.40
HD 2967	4.9 (38.3)	4.3 (30.8)	6.5 (69.2)	5.4 (48.7)	4.6 (36.6)	7.1 (85.3)	5.78	5.30
DPW 621-50	5.0 (40.1)	4.4 (32.5)	6.7 (72.6)	5.1 (47.6)	4.3 (35.7)	6.7 (83.3)	5.70	5.22
WH 1124	4.9 (38.5)	4.3 (31.3)	6.4 (69.9)	5.6 (51.1)	4.8 (38.7)	7.4 (89.8)	5.15	4.78
DBW 17	4.7 (37.3)	4.3 (31.7)	6.3 (69.0)	5.3 (48.6)	4.6 (37.8)	7.1 (86.4)	5.46	5.05
SEm±	0.2	0.1	0.2	0.2	0.1	0.2	0.07	0.08
CD (P=0.05)	NS	NS	NS	NS	NS	NS	0.22	0.26
Weed Management								
Metribuzin (210 g/ha)	6.4 (41.4)	2.2 (3.9)	6.7 (45.3)	7.4 (54.8)	2.4 (5.0)	7.7 (59.8)	5.15	4.73
Metribuzin + clodinafop (150 + 45 g/ha)	3.3 (10.2)	3.5 (11.1)	4.7 (21.2)	3.3 (10.3)	3.7 (12.4)	4.8 (22.8)	5.93	5.44
Metribuzin + pinoxaden (150 + 40 g/ha)	3.2 (9.1)	3.5 (11.3)	4.6 (20.5)	3.3 (9.8)	3.6 (12.2)	4.8 (22.0)	5.97	5.50
Metribuzin + fenoxaprop (150 + 100 g/ha)	2.8 (6.8)	3.4 (10.5)	4.3 (17.3)	2.8 (6.9)	3.5 (11.2)	4.3 (18.0)	6.03	5.55
Weed free	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	6.28	5.90
Weedy check	12.7 (162.3)	12.3 (151.3)	17.7 (313.7)	14.5 (211.7)	13.5 (181.7)	19.8 (393.4)	4.18	3.78
SEm±	0.2	0.1	0.2	0.2	0.2	0.2	0.14	0.17
CD (P=0.05)	0.5	0.4	0.6	0.6	0.4	0.6	0.4	0.47

Note: Original data given in parentheses was subjected to square root $\sqrt{(x + 1)}$ transformation before analysis.

during both the years (Table 1). The application of metribuzin 210 g/ha was superior to weedy check in controlling grassy weeds. Malviya (2012) has also reported similar results. Application of 210 g/ha metribuzin alone was found to be best among the herbicidal treatments in controlling the density of broad-leaved weeds during both years and it was superior to other weed management treatments (Table 1). Further, combinations of metribuzin + fenoxaprop (150 + 100 g/ha), metribuzin + pinoxaden (150 + 40 g/ha) and metribuzin + clodinafop (150 + 45 g/ha) resulted in statistically at par population of broad leaved weeds.

All herbicide treatments significantly reduced dry matter of grassy, broad leaved and total weeds in wheat in both years (Table 2). The combination of metribuzin with fenoxaprop resulted in highest reduction in dry matter accumulation by grassy weeds, which differed significantly with weedy check, but was at par with other two combinations of metribuzin. Metribuzin alone also significantly reduced the dry matter accumulation by grassy weeds than weedy check, but the dry matter under this treatment was significantly higher than that obtained in plots treated with other herbicide combinations. The herbicidal treatment of metribuzin (210 g/ha) resulted in significant decrease in dry matter accumulated by broad leaved weeds compared with other treatments, where metribuzin (150 g/ha) was applied in combination during both the years. Herbicide combinations metribuzin + fenoxaprop (150 + 100 g/ha), metribuzin + pinoxaden (150 + 40 g/ha) and metribuzin + clodinafop (150 + 45 g/ha) being at par with each other, reduced the dry matter accumulation by broad leaved weeds as compared to weedy check, but they were inferior to application of metribuzin (210 g/ha) alone during 2014–15 and 2015–16. The results are in conformity with the findings of Kumari *et al.* (2013). Highest weed control efficiency (WCE) was observed in wheat variety HD 2967 during 2014–15 and in DPW 621-50 during 2015–16 (Table 1). As usual, season long weed-free plots led to highest WCE in both years. Among herbicidal treatments, combination of metribuzin and fenoxaprop proved best and resulted in highest weed control efficiency (95.1% and 95.4%) during 2014–15 and 2015–16, respectively. Application of metribuzin 210 g/ha resulted in lowest WCE during both the years. Similar observations were also reported by Yadav *et al.* (2016).

Based on visual phytotoxicity (0–10 scale) recorded at 10 and 20 days after spraying indicated that no variety was found to be susceptible to the herbicides. Although some freckles/spots appeared on leaves of wheat variety HD 2967 after spray in plots treated with metribuzin (210 g/ha) and tank mix application of metribuzin + fenoxaprop (150 + 100 g/ha), the symptoms disappeared within 1–2 weeks, and had no adverse effect on the crop growth and productivity (data not given). So, all the varieties used in the study were found to be tolerant to these herbicide treatments.

Effect on wheat yield: Wheat variety WH 1105 proved best among all the varieties by producing highest grain yield and remained statistically at par with WH 2967 and DPW 621-50, while producing 13.8 and 13.0% higher grain yield than variety WH 1124, and 7.3 & 6.9% higher grain yield than variety DBW 17 during 2014–15 and 2015–16, respectively (Table 2). These differences in yield may be ascribed to the differences in genetic makeup of the varieties and variation in their ability to cope with weed interferences. Similar findings of differences in yield and yield attributes among wheat varieties were also reported by Mauriya *et al.* (2015).

The weed management practices significantly influenced the wheat grain yield during both the years. Among herbicidal treatments, metribuzin + fenoxaprop (150 + 100 g/ha) produced the maximum grain with 44.26 and 46.83% higher grain yield than weedy check, and the former was statistically at par with weed free plots and remaining two combination treatments i.e., metribuzin + pinoxaden (150 + g/ha) and metribuzin + clodinafop (150 + 45 g/ha). Metribuzin (210 g/ha) produced significantly better grain (23.21 and 25.13% higher) yield as compared to weedy check, but it was inferior to combination treatments of metribuzin and other herbicides (Table 2). This might be the result of lesser competition posed by weeds due to their suppression in weed free and herbicide treated plots. Findings of Sidhu *et al.* (2014) support these results. Tomar and Tomar (2014) also observed similar trend of increase in yield of wheat.

This two-year study indicates that weed density and weed dry matter accumulation was not affected by various wheat varieties. Minimum density and dry matter accumulation of weeds along with highest weed control efficiency were observed with metribuzin + fenoxaprop, being at par with other two combinations of metribuzin. The density and dry matter of broad-leaved weeds however were minimum with metribuzin (210 g/ha). All herbicidal treatments except metribuzin alone resulted into higher grain yield of wheat. All the varieties studied were found to be tolerant to these herbicide mixtures at the recommended doses.

REFERENCES

Anonymous 2020. Economic survey of Haryana 2019–20. Department of Economic and Statistical Analysis, Haryana, India.

Asres B and Das TK. 2011. Diversity and integrated management of weeds in highland wheat of Northern Ethiopia. *Plant Protection Quarterly (Australia)*. **26**(1): 8–16.

Chhipa K G and Nepalia V. 2015. Effect of weed control and phosphorus sources on productivity of wheat (*Triticum aestivum*). *Indian Journal of Agricultural Research* **49**(2): 180–84.

Das T K and Yaduraju N T. 2011. Effects of missing-row sowing supplemented with row spacing and nitrogen on weed competition and growth and yield of wheat. *Crop and Pasture Science* **62**(1): 48–57.

Das T K, Ahlawat I P S and Yaduraju N T. 2014. Littleseed canarygrass (*Phalaris minor*) resistance to clodinafop-propargyl in wheat fields in north-western India: Appraisal and management. *Weed Biology and Management* **14**(1):11–20.

GoI 2018. *Agricultural Statistics at a Glance*. Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture.

Kumari A, Kumar S, Singh B and Dhaka A. 2013. Evaluation of herbicide alone and in combination for weed control in wheat. *Indian Journal of Weed Science.* **45**(3): 210–13.

Malviya H. 2012. 'Evaluation of metribuzin in combination with clodinafop, sulfosulfuron and pinoxaden for weed control in wheat [*Triticum aestivum* (L.)]'. MSc. Thesis, Rajmata Vijyaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (Madhya Pradesh).

Mauriya A K, Maurya D C, Maurya V K and Verma R K. 2015. Effect of zinc application methods on yield attributes, yield and nutrient uptake in wheat (*Triticum aestivum*) varieties under sodic soil. *Indian Journal of Agronomy* **60**(1): 82–86.

Raj R, Das T K, Kaur R, Shekhawat K, Singh R and Singh V K. 2020. Effects of nitrogen and densities on interference and economic threshold of *Phalaris minor* in wheat. *Crop Protection*. **135**: 105215

Sardana V, Mahajan G, Jabran K and Chauhan B S. 2017. Role of competition in managing weeds: An introduction to the special issue. *Crop Protection* **95**: 1–7.

Sidhu A S, Gill M S, Saini M S, Singh S and Singh P. 2014. Herbicidal control of problematic weeds in wheat. *Indian Journal of Weed Science* **46**(4): 326–29.

Tomar S K and Tomar T S. 2014. Effect of herbicides and their tank-mixture on weed dynamics and yield of zero-tilled wheat (*Triticum aestivum*) under rice-wheat cropping system of eastern Uttar Pradesh. *Indian Journal of Agronomy* **59**(4): 624–28.

Yadav A, Hooda V S, Bir Dharam and Duhan A. 2012. Screening the sensitivity of wheat varieties against fenoxaprop + metribuzin. *(In) Proceeding of National Seminar on Sustainable Agriculture and Food Security: Challenges in Changing Climate,*Directorate of Research CCS HAU Hisar, March 27-28, 2012, pp. 255–256.

Yadav D B, Yadav A, Punia S and Chauhan B S. 2016. Management of herbicide-resistant *Phalaris minor* in wheat by sequential or tank-mix applications of pre- and post-emergence herbicides in North-Western Indo-Gangetic Plains. *Crop Protection* **89**: 239–47.