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Carry-over effect of metribuzin applied to soybean (*Glycine max*) on weeds and wheat (*Triticum aestivum*) under zero and conventional tillage

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ABSTRACT

Effective weed control in no-till systems is mainly dependent on herbicides. Appropriate weed management strategies, however, can reduce the amount of herbicides. In this study possible weed management was attempted in wheat (*Triticum aestivum* L. emend. Fiori & Paol.) under zero-tillage (without residue) and conventional tillage between 2006-07 and 2007-08 following residual effects of 13 weed control treatments with metribuzin applied during previous rainy (*kharif*) seasons, 2006 and 2007 in soybean [*Glycine max* (L.) Mirrill]. The experiment was laid out in a split plot design with three replications. Total density of weeds did not differ significantly between weed control measures adopted during previous rainy season. But, conventional tillage (CT) caused a significant reduction in the populations of grass, broad-leaved (e.g., *Chenopodium album* L. and *Melilotus indica* L.) and total weeds when compared with zero-tillage (ZT) without crop residues. Similarly, higher nutrient removal by weeds was under zero-tillage than under conventional tillage. In general, residual effect of all the previous season metribuzin treatments was more pronounced on the grasses (*Phalaris minor* Retz. and *Avena sterilis* ssp *ludoviciana* Dur.) when compared with *Chenopodium album* and *Melilotus indica*. Wheat yield was similar in all previous season metribuzin treatments except in weed-free check in both years. However, metribuzin at 0.5 kg/ha pre-emergence, on yield, was more effective, indicating its considerable residual effect on weeds in wheat. This treatment also gave the highest net benefit:cost ratio.

Key words : Conventional tillage, Metribuzin, Residual effect, Weed control efficiency, Wheat, Zero-tillage

Adoption of reduced tillage systems is increasing in the world because of savings in time and economic inputs. However, as tillage decreases, weed control can become a limiting factor in crop production. Moreover, changes in tillage practices can affect weed population dynamics, including weed seed distribution and abundance in soil seed bank (Mulugeta and Stoltenberg, 1997). Tillage also reduces number and diversity of weed species, but increases germination of annual weed seeds in the soil seed bank (Cardina *et al.*, 1991). Thus, in no-till systems, weed control is largely dependent on herbicides, and appropriate use of herbicides is more important when compared with traditional tillage systems mainly in years with a high yield potential (Torresen *et al*., 1999).

In no-till systems, seeds of weeds and volunteer crops are frequently deposited in the first few centimeters of top soil (Locke *et al*., 2002). Despite the mentioned restrictions for weed development in no-till systems, it is essential to control weeds before direct sowing to minimize crop yield losses in these systems (Calado, 2005). An appropriate strategy, therefore, is needed to avoid high weed infestations and to prevent unacceptable competition with crop.

Herbicide research should be cropping system-based. Cultivars of several crops including winter wheat differ considerably in their tolerance to metribuzin (Runyan *et al.,* 1982). The DT_{50} value for metribuzin is from 16 to 50 days. Locke and Harper (1991) showed that higher plant residue conditions in no-tillage soil apparently inhibited metribuzin mineralization to carbon dioxide and resulted in its accumulation, while in conventional tillage, metribuzin degradation proceeded relatively rapidly with the appearance of polar metabolites. Thus, studying residual effect of metribuzin applied to soybean in the soybean-wheat cropping system assumes relevance. This may lead to low-cost better weed management throughout the whole cropping system under different tillage systems without jeopardizing yield potential of these crops. Thus, the objective of this study was to verify residual effect of metribuzin applied to preceding soybean at different doses, volume rates and days on wheat under no-till and conventional till systems.

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MATERIALS AND METHODS

A field experiment was carried out during winter (*rabi*) of 2006-07 and 2007-08 at the Indian Agricultural Research Institute, New Delhi, on plots applied with 13 weed control treatments (Table 1) in the previous rainy (*kharif*) seasons superimposed with conventional till and no-till systems during winter in wheat. Metribuzin was sprayed as pre-emergence and pre-emergence followed by post-emergence (20 and 30 days after sowing) to previous rainy-season soybean crop. Pendimethalin was sprayed as pre-emergence. Soil was sandy loam with pH 7.9, and organic carbon 0.52% and medium in available N (272.6 kg/ha), P (18.4 kg/ha) and K (191.6 kg/ha). A pre-sowing irrigation was given to entire field to facilitate smooth germination of wheat. The conventional tillage (CT) plots were ploughed by a tractor-drawn disc plough followed by planking. Zero tillage (ZT) without residue plot was left undisturbed. Wheat var. 'PBW 343' was sown by a seed drill with a spacing 22.5 cm between rows and 100 kg/ha seed rate on 12 and 17 November in 2006 and 2007, respectively. A dose of 120 kg N/ha, 60 kg P_2O_5/ha and 40 kg K_2O/ha was applied to wheat. Nitrogen was applied in two splits; half at sowing and the remaining half at the first irrigation 21 days after sowing (DAS) at crown root initiation (CRI) stage. Nitrogen (N), P and K were applied in the forms of urea, single superphosphate and muriate of potash, respectively.

An area of 0.25 m^2 was selected randomly at two spots by throwing a quadrat of 0.5 m x 0.5 m, weed species were counted from that area, and density was expressed in number per m^2. The collected weeds were first sun-dried and then kept in an electric oven at 70^0C till the weight became constant, and dry weight was expressed as g m^{-2}. As wide variation existed in data, number and dry weight of weeds were transformed through square-root [$\sqrt{(x+0.5)}$] method before analysis of variance. Wheat was harvested manually, but was threshed by a power-operated thresher. Data on grain yield were recorded from the net plot, whereas yield attributes from five randomly selected plants at harvest.

RESULTS AND DISCUSSION

Weed population and dry weight

Major weed flora at the experimental field comprised of *Chenopodium album* L., *Melilotus indica* L. among broad-leaved weeds; *Phalaris minor* Retz., *Avena sterilis* ssp *ludoviciana* (Dur.) among grasses; and *Cyperus rotundus* L., among sedges. With regard to the residual effect of previous season weed control measures with metribuzin, it was observed that these treatments significantly reduced total weed population compared to weedy check (Table 1). *Chenopodium album* and *M. indica* were more compared to grasses during both the years. This indicated possibly greater residual effect on the grasses than these two broad-leaved weeds. As usual, the density of *C. album* was highest under weedy check. Rainy-season metribuzin application as pre-emergence or pre-emergence followed by (*fb*) post-emergence reduced its population. Similar results were observed with *M. indica*. Control of weeds before crop establishment in a no-till system decreases the potential infestation during crop development as it minimizes soil disturbance, which has a positive effect on weed emergence (Marginet *et al.*, 2000). All pre-emergence and pre-emergence *fb* post-emergence metribuzin treatments were more or less comparable with each other on their effect on weed population (Table 1) and dry weight (Table 2), and these treatments significantly decreased total number and dry weights of weeds compared to weedy check at 60 DAS during both years. Such results might have accentuated from considerable reductions in the populations and dry weights of *C. album* and *M. indica* under metribuzin pre-emergence or pre-emergence *fb* post-emergence treatments compared to weedy check. Broad-spectrum activity and persistence nature of metribuzin played a role. The results are in conformity with Singh *et al.* (2003) and Punia *et al.* (2004).

Conventional tillage resulted in a significant reduction in the populations (Table 1) and dry weights (Table 2) of *C. album, M. indica* and grasses compared to zero tillage without residue at 60 DAS (Table 1). The transformed density of *C. album* was 8.1 in conventional tillage compared to 9.0 in zero-tillage. In conventional tillage, the upper soil layers dry up very fast leading to lesser soil moisture and ultimately lesser weed emergence (Mulugeta and Stoltenberg, 1997). Similarly, weed control efficiency was higher under conventional over zero tillage due to less emergence of weeds in the early stage of crop, and later smothered by wheat crop.

Nutrient removal by weeds

Greater removal of N, P and K by weeds was registered under weedy check (Table 1). This might be due to higher production of dry biomass of weeds. There was no variation in nutrient removal by weeds in wheat crop due to applications of metribuzin as pre-emergence or as pre-emergence followed by post-emergence to previous soybean crop. However, nutrient removal by weeds was higher under zero-tillage than that of conventional tillage owing to higher population and dry weight of weeds in the former treatment.

Yield attributes and yield of wheat

Due to greater suppression of weeds when compared with weedy check (Tables 1 and 2), the negative effect of weeds on ear bearing tillers, wheat grains/ear, 1000-grain weight and yield was reduced in the pre-emergence or pre-emergence *fb* post-emergence metribuzin applied to previous soybean crop (Table 3). The differences were significant with regard to number of ear bearing tillers, wheat grains/ear, 1000-grains weight and yield. The reasons could be the compensatory effects between yield components established during growth and development of crop, and to a lower number of weeds m^{-2} (total, broad-leaved and grasses) at heading stage of wheat. Although not significantly different, biological yields were higher in the pre-emergence and pre-emergence *fb* post-emergence metribuzin treatments (Table 3). Wheat yield did not differ significantly among weed control measures, which indicates possible negligible or no residual effect of the previous season metribuzin treatments. However, a significant effect on yield was observed in weed-free check being comparable with metribuzin 0.5 kg/ha pre-emergence resulted in significantly higher yield than others

Table 1. Weed density and nutrients removal in wheat as affected by previous season weed control measures supplemented with or without tillage during winter (Pooled data of two years).

Treatment	*Chenopodium album* (No./m^2) at 60 DAS	*Melilotus indica* (No./m^2) at 60 DAS	Grasses** (No./m^2) at 60 DAS	Total weed density (No./m^2) at 60 DAS	WCE (%)	Nutrient removal by weeds		
						N (kg/ha)	P (kg/ha)	K (kg/ha)
Weed control treatment to soybean								
Weedy check	10.1 (102)	10.4 (107.5)	2.8 (7.5)	14.8 (217.0)	0.0	25.5	12.0	20.9
Weed-free check	0.7 (0)	0.7 (0)	0.7 (0)	0.7 (0)	100	0	0	0
Pendimethalin 0.75 kg/ha pre-emergence	9.3 (85.1)	9.3 (85.2)	3.0 (8.3)	13.4 (178.6)	17.7	14.3	4.5	7.0
Metribuzin (MTZ) 0.5 kg/ha pre-emergence	8.5 (71.4)	9.3 (85.7)	2.9 (7.8)	12.9 (164.8)	24.1	11.1	4.5	6.4
MTZ 0.25 kg/ha pre-emergence	8.9 (78.9)	8.6 (74.0)	3.0 (8.3)	12.7 (161.1)	25.8	11.0	4.2	7.1
MTZ (0.1 kg/ha, 200 l/ha, 20 DAS) post-emergence*	9.3 (86.2)	9.3 (85.0)	2.9 (8.0)	13.4 (179.2)	17.4	13.2	4.4	7.5
MTZ (0.1 kg/ha, 400 l/ha, 20 DAS) post-emergence*	9.2 (83.8)	9.2 (84.1)	2.8 (7.5)	13.3 (175.4)	19.2	12.8	4.8	7.0
MTZ (0.1 kg/ha, 200 l/ha, 30 DAS) post-emergence*	9.1 (82.3)	8.6 (73.9)	2.7 (7.0)	12.8 (163.3)	24.7	12.0	4.3	6.8
MTZ (0.1 kg/ha, 400 l/ha, 30 DAS) post-emergence*	8.6 (74.0)	7.9 (62.2)	2.9 (7.8)	12.0 (143.9)	33.7	11.0	4.0	6.5
MTZ (0.2 kg/ha, 200 l/ha, 20 DAS) post-emergence*	8.3 (68.4)	8.9 (77.2)	2.7 (6.8)	12.4 (152.3)	29.8	11.4	4.1	6.6
MTZ (0.2 kg/ha, 400 l/ha, 20 DAS) post-emergence*	8.1 (64.1)	8.1 (64.1)	2.6 (6.5)	11.6 (134.7)	37.9	10.8	3.8	6.4
MTZ (0.2 kg/ha, 200 l/ha, 30 DAS) post-emergence*	8.7 (75.7)	8.6 (72.9)	2.9 (7.8)	12.5 (156.1)	28.1	11.2	4.0	6.9
MTZ (0.2 kg/ha, 400 l/ha, 30 DAS) post-emergence*	8.5 (70.7)	8.7 (74.9)	2.8 (7.5)	12.4 (153.1)	29.5	10.8	4.1	6.8
SEm ±	0.2	0.2	0.1	0.4		0.5	0.4	0.4
CD (P=0.05)	0.6	0.7	0.3	1.1		1.5	1.0	1.2
Tillage treatment to wheat								
Conventional tillage	8.1 (65.3)	8.2 (66.4)	2.5 (6.3)	11.8 (137.9)	35.8	9.8	3.6	6.3
Zero tillage	9.0 (79.8)	9.0 (81.1)	2.8 (7.7)	13.0 (168.5)	23.9	13.1	5.2	8.3
SEm ±	0.2	0.2	0.1	0.2		0.4	0.2	0.2
CD (P=0.05)	0.5	0.6	0.2	0.7		1.2	0.6	0.7

*In all the post-emergence applications of metribuzin (MTZ), metribuzin 0.25 kg/ha was applied as pre-emergence; ** Grasses include *Phalaris minor* and *Avena sterilis* ssp *ludoviciana*; Data were transformed through square-root ($\sqrt{(x+0.5)}$) method; Figures in the parentheses are original values.

Table 2. Weed dry weight (g/m^2) in wheat at 60 DAS as affected by previous season weed control measures supplemented with or without tillage during winter (Pooled data of two years).

Treatment	*Chenopodium album* (g/m^2)	*Melilotus indica* (g/m^2)	Grasses** (g/m^2)	Total weed dry weight (g/m^2)
Weed control treatments to soybean				
Weedy check	4.5 (19.5)	3.7 (13.0)	5.5 (29.5)	7.9 (61.9)
Weed-free check	0.7 (0)	0.7 (0)	0.7 (0)	0.7 (0)
Pendimethalin 0.75 kg/ha pre-emergence	4.3 (18.2)	3.6 (12.1)	5.2 (26.7)	7.6 (56.9)
Metribuzin (MTZ) 0.5 kg/ha pre-emergence	4.1 (16.6)	3.4 (11.0)	4.7 (21.6)	7.0 (49.2)
MTZ 0.25 kg/ha pre-emergence	3.9 (14.4)	3.2 (9.7)	4.6 (20.1)	6.7 (44.1)
MTZ (0.1 kg/ha, 200 litre/ha, 20 DAS) post-emergence*	4.1 (16.1)	3.4 (10.7)	4.2 (17.2)	6.7 (44.0)
MTZ (0.1 kg/ha, 400 litre/ha, 20 DAS) post-emergence*	4.1 (16.4)	3.4 (11.0)	4.1 (16.4)	6.7 (43.8)
MTZ (0.1 kg/ha, 200 litre/ha, 30 DAS) post-emergence*	4.1 (16.0)	3.4 (10.7)	3.6 (12.2)	6.3 (38.9)
MTZ (0.1 kg/ha, 400 litre/ha, 30 DAS) post-emergence*	4.1 (16.1)	3.4 (10.7)	3.9 (14.8)	6.5 (41.6)
MTZ (0.2 kg/ha, 200 litre/ha, 20 DAS) post-emergence*	3.7 (13.1)	3.1 (8.7)	4.1 (16.0)	6.2 (37.7)
MTZ (0.2 kg/ha, 400 litre/ha, 20 DAS) post-emergence*	3.5 (11.5)	2.9 (7.7)	4.1 (16.2)	6.0 (35.3)
MTZ (0.2 kg/ha, 200 litre/ha, 30 DAS) post-emergence*	3.9 (14.4)	3.2 (9.6)	4.2 (17.1)	6.5 (41.2)
MTZ (0.2 kg/ha, 400 litre/ha, 30 DAS) post-emergence*	3.7 (13.0)	3.1 (8.7)	4.3 (17.9)	6.4 (39.5)
SEm ±	0.1	0.1	0.1	0.2
CD (P=0.05)	0.3	0.3	0.4	0.6
Tillage treatment to wheat				
Conventional tillage	3.6 (12.8)	3.0 (8.6)	4.0 (15.6)	6.1 (37.0)
Zero tillage without residues	4.0 (15.7)	3.3 (10.5)	4.5 (19.1)	6.8 (45.2)
SEm ±	0.1	0.1	0.1	0.1
CD (P=0.05)	0.3	0.2	0.3	0.4

* In all the post-emergence applications of metribuzin (MTZ), metribuzin 0.25 kg/ha was applied as pre-emergence;

** Grasses include *Phalaris minor* and *Avena sterilis* ssp *ludoviciana;* Data were transformed through square-root ($\sqrt{(x+0.5)}$) method; Figures in the parentheses are original values.

(Table 3). Wheat yield was influenced by growing season rainfall, particularly at grain filling during April–May.

The grain yield of wheat and yield attributes differed significantly due to tillage and weed control measures. Conventional tillage had significantly higher number of ear bearing tillers, wheat grains/ear, 1000-grain weight resulting in higher grain yield. This might have resulted from greater photosynthesis and hence better translocation of photosynthates besides larger sink and stronger reproductive phase, as reflected in maximum effective tillers/m row, grains/ear and 1000-grain weight. This might be due to increased availability of major plant nutrients in conventional tillage that resulted in better growth, development of yield attributes and finally grain yield (Arshad *et al.,* 1995). Singh *et al.* (1998) also observed higher grain yield of wheat in conventional tillage than zero-till wheat.

Nutrient uptake by wheat

The uptake of N, P and K by wheat crop was significantly influenced by previous-season weed control measures in both years (Table 3). Differences in the uptake of N, P and K due to tillage level were also significant during both years. Highest uptake of all these nutrients by wheat crop was resulted from weed-free check, and these uptakes were significantly higher than that in weedy check and other pre-emergence and pre-emergence *fb* post-emergence metribuzin treatments applied in the previous season. Conventional tillage resulted in higher uptake of N, P and K by wheat compared to zero-tillage in both years. Arshad *et al.* (1995) reported increased availability of NO_3-N under conventional tillage that results in better growth and development, and ultimately higher grain yield. Weed growth varying across pre-emergence and pre-emergence *fb* post-emergence metribuzin treatments, and alterations in micro-climate (soil structure, moisture, diurnal temperature and light exposure) due to tillage in wheat could influence weed competition (Singh *et al.*, 1998), which, in turn, produced negative impact on yield and nutrient uptake of wheat under no-till conditions. This was mainly due to the fact that previous season pre-emergence and pre-emergence *fb* post-emergence metribuzin treatments offered considerably lower residual effect on weeds in succeeding wheat.

Economics

It was observed that following a pre-emergence or pre-emergence *fb* post-emergence metribuzin application to soybean, conventionally-tilled wheat was superior to

Table 3. Yield attributes and yield of wheat and nutrient uptake as affected by previous season weed control measures supplemented with or without tillage during winter (Pooled data of two years).

Previous season weed control measures	EBT (No./m row)	Grains/ ear	1000-grain weight (g)	Grain yield (t/ha)	Biological yield (t/ha)	Soybean yield (t/ha)	Nutrient uptake by wheat (kg/ha)		
							N	P	K
Weed control treatment to soybean									
Weedy check	76.4	29.6	35.9	3.34	8.78	0.86	79.0	14.0	133.3
Weed-free check	92.5	43.6	41.6	4.35	10.00	1.46	101.8	20.0	172.5
Pendimethalin 0.75 kg/ha pre-emergence	82.0	36.6	39.8	3.52	9.83	1.18	89.9	15.9	167.6
Metribuzin (MTZ) 0.5 kg/ha pre-emergence	81.7	37.5	40.0	3.90	9.91	1.30	96.3	17.0	171.3
MTZ 0.25 kg/ha pre-emergence	79.8	36.7	37.8	3.48	9.01	1.19	87.3	16.9	155.4
MTZ (0.1 kg/ha, 200 l/ha, 20 DAS) post-emergence*	76.7	35.6	38.4	3.19	9.14	1.21	85.6	15.0	155.7
MTZ (0.1 kg/ha, 400 l/ha, 20 DAS) post-emergence*	79.4	35.7	37.9	3.40	9.15	1.08	84.3	14.4	154.3
MTZ (0.1 kg/ha, 200 l/ha, 30 DAS) post-emergence*	75.3	39.9	39.7	3.60	8.92	1.12	90.4	15.4	149.9
MTZ (0.1 kg/ha, 400 l/ha, 30 DAS) post-emergence*	76.9	38.7	38.4	3.63	9.47	1.10	92.7	15.1	160.4
MTZ (0.2 kg/ha, 200 l/ha, 20 DAS) post-emergence*	78.1	36.5	38.7	3.39	8.23	1.07	88.4	14.5	144.8
MTZ (0.2 kg/ha, 400 l/ha, 20 DAS) post-emergence*	72.3	37.8	37.9	3.49	9.39	1.01	88.4	14.4	156.2
MTZ (0.2 kg/ha, 200 l/ha, 30 DAS) post-emergence*	73.8	38.1	39.5	3.80	9.77	1.11	95.2	17.1	162.9
MTZ (0.2 kg/ha, 400 l/ha, 30 DAS) post-emergence*	73.4	36.9	38.0	3.62	8.60	1.02	85.3	14.9	147.2
SEm±	3.2	1.3	0.3	0.2	0.5	0.06	2.4	0.4	3.7
CD (P=0.05)	9.4	3.8	0.9	0.5	NS	0.17	7.0	1.3	10.9
Tillage treatments to wheat									
Conventional tillage	80.2	43.1	41.7	3.9	10.2		94.6	17.5	162.5
Zero tillage without residues	81.9	39.2	38.8	3.3	8.3		84.3	14.3	150.9
SEm±	1.6	1.3	0.3	0.1	0.2		2.2	0.4	2.5
CD (P=0.05)	NS	3.7	0.9	0.3	0.6		6.5	1.1	7.3

* In all the post-emergence applications of metribuzin (MTZ), metribuzin 0.25 kg/ha was applied as pre-emergence.

Table 4. Effect of weed control measures on economics of soybean-wheat cropping system (Pooled data of two years)

Weed control measures to soybean	Soybean-wheat (conventional- tilled)			Soybean-wheat (zero- tilled)		
	Cost of cultivation (x10^3 ₹/ha)	Net returns (x10^3 ₹/ha)	Net B:C ratio	Cost of cultivation (×10^3 ₹/ha)	Net returns (×10^3 ₹/ha)	Net B:C ratio
Weedy check	19.83	33.02	1.67	19.10	26.18	1.37
Weed-free check	24.99	44.45	1.78	24.26	37.61	1.55
Pendimethalin 0.75 kg/ha pre-emergence	20.67	39.01	1.89	19.93	32.17	1.62
Metribuzin (MTZ) 0.5 kg/ha pre-emergence	21.37	42.30	1.99	20.63	35.47	1.72
MTZ 0.25 kg/ha pre-emergence	20.71	37.43	1.81	19.97	30.60	1.53
MTZ(0.1 kg/ha, 200 l/ha, 20 DAS) post-emergence*	21.18	35.06	1.66	20.45	28.23	1.38
MTZ (0.1 kg/ha, 400 l/ha, 20 DAS) post-emergence*	21.18	35.45	1.68	20.45	28.61	1.40
MTZ (0.1 kg/ha, 200 l/ha, 30 DAS) post-emergence*	21.18	36.78	1.74	20.45	29.94	1.47
MTZ (0.1 kg/ha, 400 l/ha, 30 DAS) post-emergence*	21.18	37.88	1.79	20.45	31.04	1.52
MTZ (0.2 kg/ha, 200 l/ha, 20 DAS) post-emergence*	21.45	33.33	1.56	20.71	26.50	1.28
MTZ (0.2 kg/ha, 400 l/ha, 20 DAS) post-emergence*	21.45	35.26	1.65	20.71	28.43	1.38
MTZ (0.2 kg/ha, 200 l/ha, 30 DAS) post-emergence*	21.45	39.39	1.84	20.71	32.56	1.57
MTZ (0.2 kg/ha, 400 l/ha, 30 DAS) post-emergence*	21.45	34.95	1.63	20.71	28.12	1.36

*In all the post-emergence applications of metribuzin, metribuzin 0.25 kg/ha was applied as pre-emergence zero-tilled wheat on weed control (Table 4). Metribuzin at 0.5 kg/ha pre-emergence was most superior irrespective of tillage levels, and fetched higher net returns and net benefit-cost ratio compared to others in the soybean-wheat system. Pendimethalin 0.75 kg/ha pre-emergence, and metribuzin 0.25 kg/ha pre-emergence *fb* metribuzin 0.2 kg/ha at 30 DAS with a volume rate of 200 litres/ha, were intermediate, but the next best treatments. Weed-free check maintained by manual weeding was costlier than the herbicide, pre-emergence or pre-emergence *fb* post-emergence applications. This indicates that one season herbicide application is not enough to bring down weed competition in the following cropping system. Herbicide application during both rainy (soybean) and winter (wheat) seasons would be more useful. Otherwise, herbicide may be suitably combined with manual, mechanical or cultural/ecological methods in a season or across the seasons in soybean-wheat cropping system. Wheat may be grown with conventional tillage, which proved more beneficial than zero-tillage without residue.

Thus, it was observed that zero tillage without residues in wheat following pre-emergence or pre-emergence *fb* post-emergence metribuzin treatments in soybean experienced more weed infestation, resulting in lower wheat yield. In contrast, conventional tillage following previous season weed control measures, particularly metribuzin 0.5 kg/ha pre-emergence, resulted in better weed suppression and higher wheat yield. This could be a more economic option of wheat cultivation under soybean–wheat system, and, therefore, may be recommended.

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