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RESIDUAL TOXICITY OF METRIBUZIN BASED HERBICIDE MIXTURES APPLIED IN WHEAT ON SUCCEEDING FODDER MAIZE

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SUMMARY

A field experiment was conducted during 2014-15 and 2015-16 at Research Farm, CCS Haryana Agricultural University, Hisar, Haryana (India) in a semi-arid climate to study the residual effect of metribuzin based herbicide mixtures applied in wheat on the biomass production of succeeding fodder maize. The experiment was laid out in split plot design with three replications. The treatments consisting of five varieties of wheat viz., WH 1105, HD 2967, DPW 621-50, WH 1124 and DBW 17 in main plots and six weed management practices i. e. 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. All the herbicide treatments were applied at 35 days after sowing (DAS) of wheat. Fodder maize was planted after the harvest of wheat crop to study the residual effect of herbicides. The results revealed that neither the varieties nor the herbicides/weed management practices had any influence on the number of plants at 15 and 45 DAS, plant height at 30 and 45 DAS and above ground biomass of maize at 45 DAS. Further, no visual symptom of any residual toxicity was observed in the fodder maize plants.

Key words : Wheat, maize, residual effect, clodinafop, metribuzin, pinoxaden, fenoxaprop

Wheat (*Triticum aestivum*) is the world's most widely cultivated food crop with high nutritive value and in India it is second important staple food after rice. Its importance is implicit by fact that it exceeds all other crops in area of cultivation (220 m ha) and in production (736 m tonnes), it is third after maize and rice (FAO, 2016). It is major commodity in the world food trade and basic foodstuff of the developing countries (Hussain *et al.*, 2012). India is second leading country in wheat production (95.9 m tonnes) from an area of 30.47 m ha with an average productivity of 3145 kg/ha. India's share during the year 2015-16 was 11.78 per cent in global wheat production 0.40 per cent and in global exports (Anonymous, 2017). Among the annual agricultural losses in India, weeds account for 45 per cent, insects 30 per cent, diseases 20 per cent and others 5 per cent in wheat (Kler *et al.*, 2002). Weeds compete with crop plants for moisture, nutrients, light and space, thereby depriving the crop of vital inputs. Therefore, weed competition is one of the most important constraints in crop production (Chhokar *et al.*, 2012). The weeds cause alarming decline in wheat productivity to the tune of 38.7-56.4 per cent or even more besides lowering down the quality of produce flora (Bharat and Kachroo, 2010). Fodder maize is grown in rotation with wheat by quite a large number of farmers to feed green fodder to the animals during the summer months. Maize, being a C_4 plant, has the maximum potential of per day carbohydrate productivity (Arya *et al*., 2015). Its plants are quick growing, succulent, sweet, palatable, high yielding, nutritious and free from toxicants and used safely for animals at any stage of crop growth.

Due to the large scale failure of isoproturon, danger of development of rapid resistance and cross-resistance against alternate herbicides due to their continuous use, non-adoption of herbicides like pendimethalin by farmers because of its high cost and requirement for high moisture at the time of spray, phytotoxicity due to high doses of metribuzin and proportionate changes in weed flora in cereal crops necessitates using herbicide mixtures (Yadav *et al.*, 2002; Sharma *et al.*, 2002 ; Yadav and Malik, 2005; Chhipa and Nepalia, 2015). Differential varietal sensitivity to fenoxaprop + metribuzin has been reported (Yadav *et al.*, 2012) and it is suggested to determine varietal sensitivity of fenoxaprop+metribuzin before use in field conditions (Yadav *et al.*, 2016). The application of herbicides may have the carry over effect on the succeeding crops

because of their high persistency. The persistence of herbicide cannot be considered a positive or a negative characteristic in the absolute sense. In fact, herbicides should have a certain persistence level in order to keep the crop weed free for a sufficient period and to give the crop a competitive advantage. If the herbicide remains active for too long, it can create serious problems for the production of succeeding crops due to its residual effects (Chhokar *et al.*, 2012). Sulfosulfuron and chlorsulfuron applied in wheat were found to have their residual effect on succeeding maize and sorghum crops (Chhokar *et al.*,2002; Chhokar *et al.*, 2008).

Keeping this view in mind, a study was undertaken to assess the residual effect of metribuzin based herbicide mixtures applied in wheat varieties on the biomass production of succeeding fodder maize.

MATERIALS AND METHODS

A field experiment was conducted during 2014-15 and 2015-16 at research farm, CCS Haryana Agricultural University, Hisar, Haryana (India) situated at 29°10' N latitude and 75°46' E longitude at an elevation of 215.2 m above mean sea level in a semi-arid climate. The upper soil layer of the experimental field was sandy loam, low in OC (0.41%) and nitrogen (212 kg/ha), medium in P_2O_5 (16.6 and 15.6 kg/ha) and high in K_2O (408 kg/ha) with slightly alkaline in pH (8.3), respectively. The experiment was laid out in split plot design with three replications. The treatments consisting of five varieties of wheat viz. WH 1105, HD 2967, DPW 621-50, WH 1124 and DBW 17 in main plots and six weed management practices i. e. 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. Wheat crop was sown on 27 November and 5th December during 2014-15 and 2015-16, respectively. All the herbicide treatments were applied at 35 DAS of wheat, preparing herbicide combinations by tank-mixing and repeated manual weedings were practised for maintaining the weed free plots. Fodder maize was planted after the harvest of wheat crop to study the residual toxicity of herbicides. The data collected on number of plants, plant height and biomass yield were subjected to statistical analysis as per the standard procedure described by Cochran and Cox (1967). Visual surveillance was undertaken to observe crop injury in maize. The mean weekly weather data for the wheat-fodder maize cropping seasons 2014-15 and 2015-16 have been given in Fig. 1 & 2.

RESULTS AND DISCUSSION

Plant Stand

Data on plant stand per m^2 for succeeding fodder maize crop presented in Table 1 revealed that there was no significant effect of any of the wheat varieties on plant stand of succeeding fodder maize

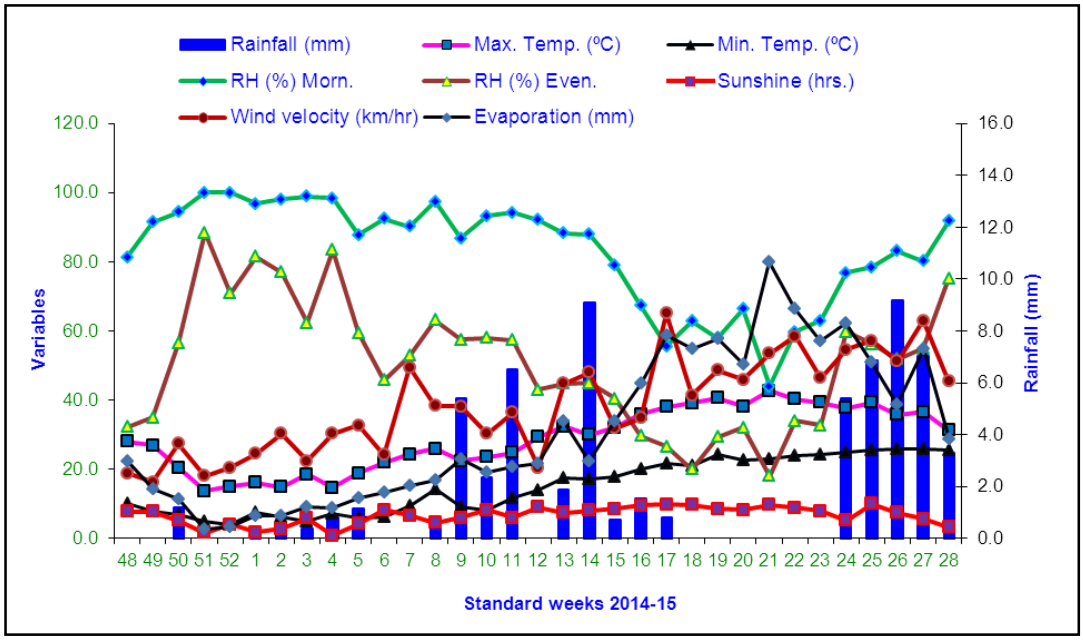

Fig. 1. Mean weekly weather data for wheat-fodder maize cropping seasons 2014-15.

TABLE 1
Effect of wheat varieties and their weed management on succeeding fodder maize crop

Treatment	2014-15					2015-16					Mean of two years				
	No. of plants/ m^2		Plant height (cm)		Biomass at 45 DAS	No. of plants/ m^2		Plant height (cm)		Biomass at 45 DAS	No. of plants/ m^2		Plant height (cm)		Biomass at 45 DAS
	15 DAS	45 DAS	30 DAS	45 DAS		15 DAS	45 DAS	30 DAS	45 DAS		15 DAS	45 DAS	30 DAS	45 DAS	
A. Varieties															
WH 1105	47.0	61.3	65.5	129.8	346.6	46.8	59.7	64.3	130.5	348.7	46.9	60.5	64.9	130.2	347.7
HD 2967	46.6	62.9	64.2	130.4	378.9	46.0	62.2	64.1	131.3	381.5	46.3	62.6	64.2	130.9	380.2
DPW 621-50	49.2	61.9	67.1	132.4	361.3	47.7	60.2	67.5	133.4	364.1	48.5	61.1	67.3	132.9	362.7
WH 1124	47.2	63.7	66.6	134.6	372.0	45.8	63.4	67.3	135.4	375.4	46.5	63.6	67.0	135.0	373.7
DBW 17	49.7	58.7	64.2	133.4	374.8	49.1	58.1	65.3	135.0	380.2	49.4	58.4	64.8	134.2	377.5
SE(m)	0.8	1.4	1.7	2.0	15.0	1.4	1.6	1.6	1.3	18.0	1.0	1.4	0.8	1.8	16.1
CD (5%)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
B. Weed Management															
Metribuzin 210 g/ha at 35DAS	48.9	63.1	65.0	132.0	352.5	48.5	62.5	64.9	133.9	358.2	48.7	62.8	65.0	133.0	355.4
Metribuzin+Clodinafop 150+45 g/ha at 35DAS	49.7	60.9	65.4	131.8	377.1	48.5	59.2	64.5	134.0	383.6	49.1	60.1	65.0	132.9	380.4
Metribuzin+Pinoxaden 150+40 g/ha at 35DAS	45.1	62.5	65.2	131.6	369.3	45.1	62.5	65.2	131.2	368.0	45.1	62.5	65.2	131.4	368.7
Metribuzin+Fenoxaprop 150+100 g/ha at 35DAS	49.5	62.0	65.2	131.3	363.5	48.5	61.6	65.8	134.9	373.7	49.0	61.8	65.5	133.1	368.6
Weed free	48.4	62.7	66.4	133.5	368.2	46.9	61.1	66.4	132.0	365.3	47.7	61.9	66.4	132.8	366.8
Weedy check	46.0	59.0	65.9	132.5	369.8	44.8	57.4	67.2	132.8	370.9	45.4	58.2	66.6	132.7	370.4
SE(m)	1.3	1.4	1.2	1.4	14.1	1.8	2.3	1.2	1.3	14.8	1.4	1.6	0.5	1.7	14.2
CD (5%)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

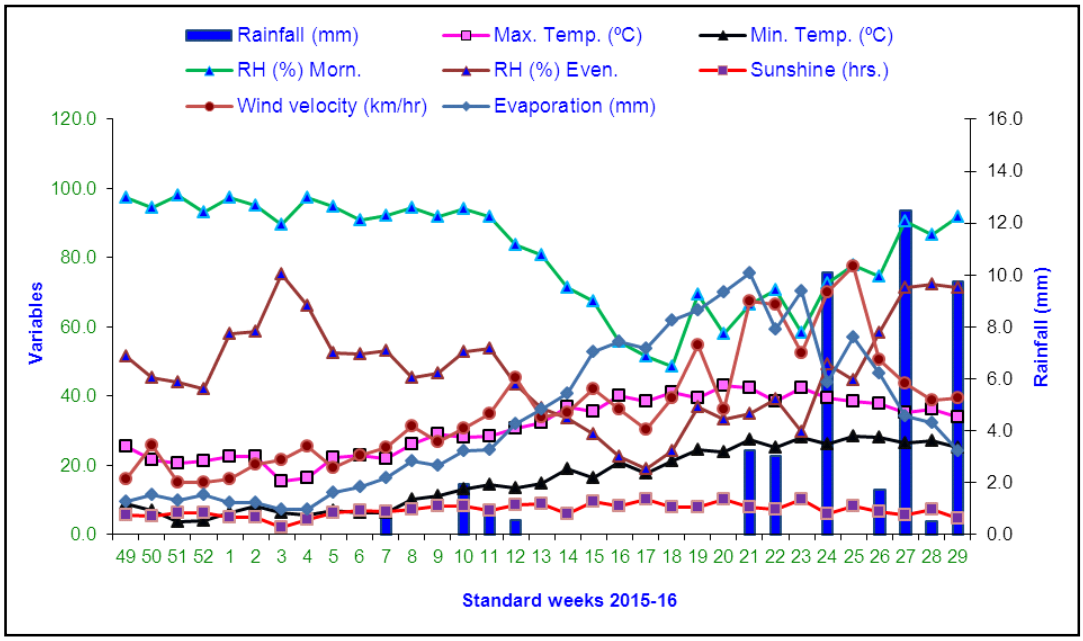

Fig. 2. Mean weekly weather data for wheat-fodder maize cropping seasons 2015-16.

crop at 15 and 45 DAS during 2014-15 and 2015-16. Similarly, none of the weed management practices applied in wheat crop resulted in any effect on number of plants of succeeding fodder maize at 15 and 45 DAS during both the years. Kaur *et al.* (2007) and Bajya *et al*. (2015) also reported no carryover effects of herbicides in terms of crop stand.

Plant Height

Plant height of succeeding fodder maize crop at 30 and 45 DAS was statistically similar to each other in all the plots of different preceding wheat varieties and did not show any significant difference during 2014-15 and 2015-16 (Table 1). Similar to plant stand, there was no significance of different weed management practices applied in wheat on the plant height of succeeding fodder maize crop at 30 and 45 DAS during both the years. Bajya *et al.* (2015) also reported that there were no phytotoxic effects of wheat herbicides on plant height of succeeding maize.

Aboveground Biomass Production

The data on aboveground biomass production by the succeeding maize (Table 1) indicated that there was no significant effect due to any of the varieties of previous wheat crop on the biomass of succeeding fodder maize crop at 45 DAS during 2014-15 and 2015-16. Similarly, application of different weed management treatments in preceding wheat did not result in any significant effect on above ground green fodder production of succeeding fodder maize at 45 DAS during both the years. Chopra and Chopra (2005), Kaur *et al.* (2007) and Bajya *et al.* (2015) also reported similar findings of no carryover effects of wheat herbicides on succeeding crop.

Per cent Crop Injury in Maize

Visual surveillance of fodder maize sown after the experimental wheat did not show any sign of injury to maize crop plants due to the various herbicide treatments applied in preceding wheat crop during 2014-15 or 2015-16. This is in conformity with the results of Kaur *et al.* (2007) and Bajya *et al.*(2015).

CONCLUSION

Metribuzin alone or tank-mix applied in wheat did not have any negative impact on the plant stand, crop growth and biomass production of succeeding fodder maize crop.

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