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Effect of triasulfuron on rice crop toxicity and its yield contributing characters in Northern India

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Abstract
A field experiment was conducted durig *kharif* season of 2014 in N.E. Borlaug Crop Research Centre of G. B. Pant University of Agriculture and Technology, Pantnagar (Uttarakhand) to evaluate the effect of different rates of triasulfuron on the performance of transplanted rice (*Oryza sativa* L.) and associated weeds. Treatments consisted of triasulfuron in three different rates i.e. 8, 10 and 12 g ha^{-1}, ethoxysulfuron at 15 g ha^{-1}, metsulfuron methyl at 4 g ha^{-1}, 2,4-D at 500 g ha^{-1}, weed free and untreated check. Experiment was laid out in Randomised Block Design with 8 treatments and 3 replications. Rice cultivar "HKR- 47" was transplanted on 8 July 2014 with spacing 20 X 10 cm. Visual crop toxicity was not observed in triasulfuron or any other herbicides treated plots. The crop grown under weed free conditions had highest test weight (23.8), though it remained at par with that grown in triasulfuron at 10 and 12 g ha^{-1} and ethoxysulfuron at 15 g ha^{-1}, while the lowest test weight was recorded in metsulfuron methyl at 4 g ha^{-1}. The longest panicles were recorded in plot treated with triasulfuron at 12 g ha^{-1} and shortest in plots treated with metsulfuron methyl at 4 g ha^{-1}.

Keywords: Triasulfuron, rice crop toxicity, yield contributing characters

Introduction
Rice crop is having great significance for feeding world population. At present it is cultivated in 114 countries with a sum total land area of around 164 mha. It's production is about 499 mtonnes which is about 11 per cent of the world's cultivated land (Anonymous, 2013) [1]**.** The world rice grain production was found to be increased from 472 mt in 2012-13 to 476 mt in 2013-14 (Government of India, 2015) [13]. Asia produces and consumes more than 90 per cent of the world's rice. In respect to India, rice contributes to about 15 per cent of agricultural GDP. It gives 40-43 per cent of calorie requirement for more than 70 per cent of Indians. Rice is grown in 44 mha and have the production of about 105 mt, with an average productivity of 2.3 t per ha (Government of India, 2015) [13]. In comparison to other major rice producing countries, the productivity of rice in India is very low (2.3 t per ha). The problem is particularly severe in *kharif* season due to the prevalence of congenial atmosphere for weed growth. The most common weeds of transplanted rice in Tarai region of Uttarakhand are - *Echinochloa colona, E.crusgalli, Digitaria sanguinalis, Ischaemum rugosum, Paspalum distichum, Cyperus rotundus, Cyperus iria, Cyperus difformis, Fimbristylis dichotoma, Fimbristylis miliacea, Scirpus spp., Ammannia baccifera, Eclipta alba, Caesulia axillaris, Commelina benghalensis, Ludwigia diffusa, L. parviflora and L. octovalvis* (Singh *et al*., 2004) [5].

Merlier (1978) [4] reported that with increase in crop–weed competition, there was progressive reduction in number and weight of rice panicles. Banerjee *et al*. (2005) [2] reported that out of the total losses weeds alone caused 33% loss.

Keeping the above points in view, the present study entitled **"**Effect of triasulfuron on rice crop toxicity and rice yield contributing characters in Northern India" was carried out at NEBCRC of Govind Ballabh Pant University of Agriculture & Technology, Pantnagar during *Kharif* season of 2014-15 with the objective to study the effect of different treatments on phytotoxicity and yield attributes of transplanted rice.

Material and methods
Experimental site
The site selected for testing was NEBCRC, Pantnagar which is located at 29°N latitude and 79.3°E longitudes and an altitude of 243.83 m above the mean sea level.

Climate and Weather
The climate of Pantnagar remains humid subtropical with hot and dry summer, cold winters and faces heavy rains during *Kharif* season (June to September). The mean annual rainfall is approximately 1364 mm in which 80-90 per cent is normally received during June to September. The relative humidity was between 85 to 90 per cent recorded at 7.00 am and from 46 to 80 per cent recorded at 2.00 pm during the crop period. The rainfall received during the growing period was 534.6 mm.

Soil Properties
The experimental site was having texture as sandy loam, organic carbon as medium and available phosphorus as medium and potassium contents and nitrogen as low. The soil was having neutral pH.

Application of Herbicides
Herbicides were applied as aqueous medium at the rate of 450 liters of water/hectare with the help of knapsack sprayer fitted with flat fan nozzle. The amount of herbicide and water required are computed on the basis of gross plot size. In weed free plots, weeds were removed with the help of *khurpi* as and when required to keep plots free from weeds. Weedy plot remained infested with the native weed population throughout the crop growing season.

Toxicity rating
Phytotoxic effect on rice crop was recorded from 0 to 10 scale at 15, 30, and 45 days after spray of herbicide. No phytotoxicity of any chemical was observed during the experimentation period. Details of the scorching scale are given in Table 1.

Table 1: Phytotoxicity symptoms scoring and rating on crop

Crop injury symptom	Rating	Effect
No injury, Normal	0	None
Slight stunting, injury or discoloration	1	Slight
Some stand loss, stunting / discoloration	2	Slight
Injury more pronounced but not persistent	3	Slight
Moderate injury, recovery possible	4	Moderate
Injury more persistent, recovery doubtful	5	Moderate
More severe injury, no recovery possible	6	Moderate
Severe injury, stand loss	7	Severe
Almost destroyed few plants surviving	8	Severe
Very few plants alive	9	Severe
Complete destruction	10	Complete

Yield attributing characters
Number of panicles
The sampling area was of two meter row length and in that area the number of panicle were counted. The random selection of five panicles were done from 2 meter row length which was considered as the observation area.

Number of grains/panicle
The sampled panicles were manually threshed and number of total grains was counted. The number of grains/panicle were computed by taking the average of all five panicles.

Thousand grain weight
The number of the total grains from the sampled panicles were counted and the grain weight of thousand grains were computed and expressed in gram (g).

Result and Discussion
Crop toxicity
Visual observation on toxicity of herbicides to the crop recorded that triasulfuron at any rate and other herbicides did not cause any toxicity over the crop after its application during the entire crop season (Table 2). Visual crop toxicity was not observed in triasulfuron or any other herbicides treated plots.

Yield Contributing Characters
The data pertaining to yield contributing characters at pre harvest stage namely panicle per meter square, panicle length, number of grains per panicle and thousand grain weight are presented in Table 3.

Number of panicles/m^2
All the treatments produced significantly more number of panicle than weedy check. The highest number of panicle was recorded in weed free condition. All the treatments produced significantly less number of panicles than weed free condition. Among the herbicidal treatments, the highest number of panicles per m^2 was recorded with triasulfuron at 12 g ha^{-1}, being at par with triasulfuron at 10 g ha^{-1}. Lowest number of panicles were recorded in plots treated with metsulfuron methyl at 4 g ha^{-1}, which was closely followed by 2,4-D at 500 g ha^{-1}.

Panicle Length
Panicle length did not differ significantly due to different weed control treatments. Although longest panicles were recorded in weed free condition and shortest in weedy check. Among herbicidal treatments, the longest panicles were recorded in plot treated with triasulfuron at 12 g ha^{-1} and shortest in plots treated with metsulfuron methyl at 4 g ha^{-1}.

Numbers of Grains per Panicle
Number of grains per panicle exhibited significant variation owing to weed control measures.
The data given in Table 3 indicates the highest number of grains per panicle was recorded in weed free plot which was closely followed by triasulfuron at 12 g ha^{-1}, while the lowest number of grains per panicle was recorded in metsulfuron methyl at 4 g ha^{-1}.

Thousand Grain Weight
Variations in thousand grain weight attributed to weed control treatments were found significant.
The data in Table 3 indicates that all the weed control measures provide significantly better conditions than the weedy check to accumulate the dry matter in grains. The data further indicated that crop grown under weed free conditions had highest test weight (23.8), though it remained at par with

that grown in triasulfuron at 10 and 12 g ha^{-1} and ethoxysulfuron at 15 g ha^{-1}, while the lowest test weight was recorded in metsulfuron methyl at 4 g ha^{-1} which was similar to 2,4-D at 500 g ha^{-1}.

Among the herbicidal treatments, the highest thousand grain weight was recorded in triasulfuron at 12 g ha^{-1} being at par with triasulfuron at 8, 10 g ha^{-1} and ethoxysulfuron at 15 g ha^{-1} and was significantly superior to rest of the treatments.

Table 2: Phytotoxic effect of Triasulfuron 20 WG on rice crop at 7, 14, 21 and 28 Days After Application (DAA)*

Treatments	Dose (g ai ha^{-1})	Yellowing				Necrosis				Scorching				Epinasty				Hyponasty			
		7 DAA	14 DAA	21 DAA	28 DAA	7 DAA	14 DAA	21 DAA	28 DAA	7 DAA	14 DAA	21 DAA	28 DAA	7 DAA	14 DAA	21 DAA	28 DAA	7 DAA	14 DAA	21 DAA	28 DAA
Triasulfuron 20 WG	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Triasulfuron 20 WG	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Triasulfuron 20 WG	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metsulfuron methyl 20 WG	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ethoxysulfuron 15 WDG	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2,4-D	500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Weed free	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Weedy check	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

*Mean of three replications

Table 3: Yield contributing characters of rice crop

Treatment	Dose (g a.i./ha)	Number of panicles m^{-2}	Panicle length (cm)	Number of grains/panicle	1000 grain weight (g)
Triasulfuron 20 WG	8	181	22.2	115	23.1
Triasulfuron 20 WG	10	191	22.7	121	23.3
Triasulfuron 20 WG	12	197	22.7	125	23.5
Metsulfuron methyl 20 WG	4	173	22.0	112	22.8
Ethoxysulfuron 15 WDG	15	185	22.5	117	23.3
2,4-D	500	178	22.4	116	22.8
Weed free	-	231	23.0	131	23.8
Weedy check	-	101	21.5	113	22.1
S.Em ±	_	2.1	0.4	0.7	0.2
CD at 5%	_	6.3	NS	2.1	0.5

Conclusion

Triasulfuron at 12 g ha^{-1} produced the maximum number of grains per panicle, panicle length and thousand grain weight. Visual crop toxicity was not observed in triasulfuron or any other herbicides treated plots.

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