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Residual Effect of Pyrazosulfuron-ethyl Applied in Rice on Succeeding Crops

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ABSTRACT

Field and pot experiments were conducted to study the persistence of pyrazosulfuron-ethyl in soil. In pot experiment, maize, soybean, moong and sorghum were grown in succession upto three sowings at 21 days intervals at different concentrations of herbicide ranging from 0 to 0.2 ppm. Germination count, shoot height and dry weight of crops were drastically reduced at higher concentrations of herbicides in first sowing. However, in the second and third sowings differences for plant height and dry weight were less at different concentrations of herbicide indicating degradation of herbicide to safe levels. In field experiment residual carry over effects of pyrazosulfuron-ethyl applied in rice at 15 and 30 g/ha were studied using wheat, gram and pea as indicator plants. Differences were non-significant for dry matter accumulation in these plants, indicating that there was no residual effect of herbicide in soil after the harvest of rice crop.

INTRODUCTION

Transplanted rice may face yield reduction upto 39% due to uncontrolled weeds (Raju and Reddy, 1995). Weeds pose major problem in rice production and not only reduce yield but also hinder quality (Kathiresan, 2001). The use of herbicides offers selective and economic control of weeds from the beginning and gives the crop an advantage of a good start and competitive superiority. For the last many years butachlor, pretilachlor and anilophos have been recommended for pre-emergence control of grass weeds in transplanted rice. However, their application window is very narrow i. e. 0 to 3 DAT. Pyrazosulfuron-ethyl, a new herbicide has been found to be effective in controlling grassy weeds in transplanted rice (Chopra and Chopra, 2003). To generate sound and safe recommendation, persistence of pyrazosulfuron-ethyl in soil was examined under laboratory and field conditions by bioassay.

MATERIALS AND METHODS

The experiments were conducted during 2002 at Department of Agronomy, Agrometeorology and Forestry, PAU, Ludhiana. In pot experiment, the persistence of pyrazosulfuron-ethyl in loamy sand (sand 83.3%, silt 8.8% and clay 7.4%) was studied using test crops maize, soybean, sorghum and moong. The soil was treated by pipetting aliquat of aqueous stock solution prepared by using pyrazosulfuron-ethyl (10 WP). The herbicide concentrations tested were control, 0.025, 0.050, 0.075, 0.100, 0.125, 0.150, 0.175 and 0.200 ppm by weight of soil in three replications. The soil was watered to field capacity when necessary. Data on germination, plant height and dry weight of indicator plant were recorded. Ten seeds were sown and germination count was expressed as per cent of sown seed. For recording dry matter, plants were removed from the base and first sun dried and then in oven at 60ºC till constant weight was obtained. After harvesting the crop at 21 DAS every time the pots were resown and in total three sowings were done in succession to test the persistence of herbicide.

In field conditions, residual carry over of pyrazosulfuron-ethyl applied in rice at 15 and 30 g/ha was studied. The test crops chosen were wheat, gram and pea. Soil samples were taken at the time of harvest of rice crop from 0-15 and 15-30 cm soil depths. The dry matter of test crops was recorded at 30 days after sowing.

RESULTS AND DISCUSSION

Germination of maize, soybean and sorghum was reduced in the first attempt at higher concentrations (0.150, 0.175 and 0.20 ppm) of herbicide, whereas in case of moong germination was only reduced at 0.20 ppm of herbicide (Table 1). During second crop, germination of soybean was reduced at 0.175 and 0.20 ppm of herbicide, whereas that of sorghum germination was only reduced at highest concentration of 0.20 ppm. However, germination of maize and moong was not

Table 1. Residual effect of pyrazosulfuron-ethyl on germination count, shoot height and dry weight of different crops

Herbicide dose (ppm)	Maize			Soybean			Moong			Sorghum		
	Germination (%)	Height (cm)	Dry weight (mg/plant)	Germination (%)	Height (cm)	Dry weight (mg/plant)	Germination (%)	Height (cm)	Dry weight (mg/plant)	Germination (%)	Height (cm)	Dry weight (mg/plant)
First harvest												
Control	100	37.4	67	100	26.7	95	100	23.9	45	100	21.1	15
0.025	100	27.0	60	100	23.2	88	100	22.5	36	100	19.7	14
0.050	100	17.6	46	100	22.3	74	100	21.2	28	100	19.4	14
0.075	100	15.4	37	100	22.4	68	100	20.5	28	100	18.4	13
0.100	100	14.7	32	100	17.1	67	100	20.3	24	100	16.8	12
0.125	100	12.9	31	100	16.8	66	100	20.2	23	100	14.4	11
0.150	93.3	12.4	17	93.3	16.2	64	100	19.2	16	93.3	13.5	11
0.175	86.6	4.8	15	86.6	13.8	59	100	19.1	16	93.3	13.3	10
0.200	73.3	2.3	7	73.3	10.3	54	93.3	18.8	14	86.6	9.8	10
LSD (P=0.05)	-	2.8	7	-	7.3	20	-	2.4	4	-	3.9	3
Second harvest												
Control	100	38.9	73	100	33.8	95	100	24.6	33	100	4.0	21
0.025	100	37.2	65	100	32.6	88	100	24.0	31	100	21.8	20
0.050	100	34.6	62	100	31.6	66	100	23.2	26	100	21.1	17
0.075	100	34.3	55	100	31.6	65	100	22.7	22	100	21.0	17
0.100	100	31.8	54	100	31.3	65	100	21.5	21	100	20.8	17
0.125	100	23.8	51	100	30.3	64	100	21.1	18	100	20.7	16
0.150	100	22.8	46	100	30.1	58	100	20.6	18	100	20.2	14
0.175	100	20.8	46	93.3	25.9	56	100	18.4	18	100	19.7	14
0.200	100	18.7	44	86.6	23.2	54	100	15.4	16	93.3	19.5	14
LSD (P=0.05)	-	6.6	12	-	NS	22	-	3.6	5	-	NS	NS
Third harvest												
Control	100	38.6	107	100	36.6	87	100	23.7	21	100	22.7	19
0.025	100	35.3	91	100	29.1	85	100	22.6	18	100	21.5	16
0.050	100	31.2	71	100	28.7	72	100	21.3	17	100	20.6	13
0.075	100	29.3	59	100	28.0	72	100	21.3	17	100	20.0	10
0.100	100	27.0	58	100	25.2	70	100	20.4	16	100	19.8	10
0.125	100	24.7	55	100	25.1	58	100	20.3	16	100	19.6	90
0.150	100	24.5	42	100	23.0	54	100	18.2	14	100	19.5	9
0.175	100	23.6	31	100	22.3	53	100	18.0	12	100	18.1	8
0.200	100	17.8	27	100	19.6	45	100	17.3	12	100	17.0	7
LSD (P=0.05)	-	5.4	15	-	4.0	12	-	3.2	3	-	NS	2

NS–Not Significant.

affected. It indicated that soybean was most sensitive. In third sowing, germination of all the crops was 100% and there was no effect on the germination of different crops. This indicated that herbicide was safe for germination of succeeding sensitive crops after 42 days of its application.

With the increase in concentration of pyrazosulfuron-ethyl, shoot height of all the crops i. e. maize, soybean, moong and sorghum decreased significantly in all the successive three sowings (Table 1). There was drastic reduction in shoot height in first sowing at all concentrations of herbicide and decrease in shoot height from 0.025 to 0.20 ppm was 2.3 to 37.4 cm in case of maize, 10.3 to 26.7 cm in case of soybean, 18.8 to 23.9 cm in case of moong and 9.8 to 21.1 cm in case of sorghum. However, in second and third sowings although the differences in shoot height were significant but decrease in shoot height was not as drastic as it was in first sowing.

Similarly, dry weight of crop plants in first sowing also decreased significantly with the increase in concentration of herbicide (Table 1 and Figs. 1-3). Maize crop showed almost linear decreasing trend in dry matter accumulation with concentration of herbicide at all the three harvests. At higher concentrations (0.100, 0.125, 0.150, 0.175 and 0.20 ppm), dry weight of all crops was very low. It showed that pyrazosulfuron-ethyl concentrations from 0.10 ppm onwards affected the growth of indicator plants. In the second and third crops, differences for dry weight were less and plants

Table 2. Residual effect of pyrazosulfuron-ethyl applied for weed control in rice on dry matter of succeeding crops

Treatment	Soil depth	Dry matter of different crops (mg/plant)		
		Wheat	Gram	Pea
Untreated check		207	53	107
Pyrazosulfuron ethyl (15 g/ha)	0-15	205	47	99
	15-30	202	55	113
Pyrazosulfuron ethyl (30 g/ha)	0-15	199	46	67
	15-30	198	53	85
LSD (P=0.05)		NS	NS	NS

NS–Not Significant.

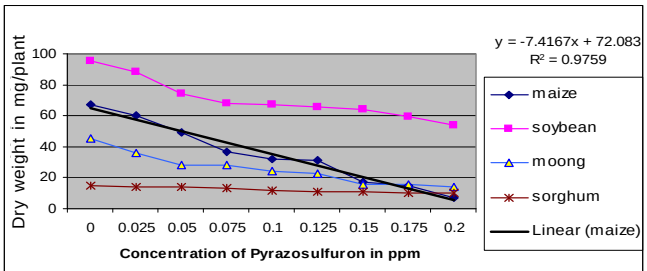

Fig. 1. Dry weight of crops (mg/plant) at first harvest.

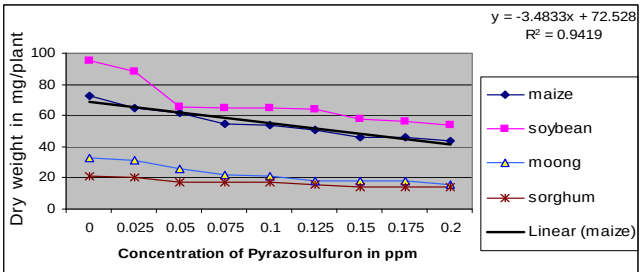

Fig. 2. Dry weight of crops (mg/plant) at second harvest.

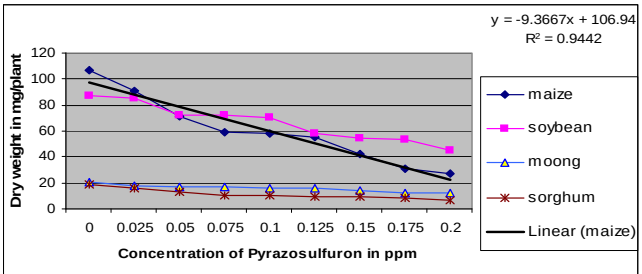

Fig. 3. Dry weight of crops (mg/plant) at third harvest.

accumulated more dry weight as compared to first harvest even at higher concentrations of herbicide. Data revealed that pyrazosulfuron-ethyl get degraded to safe level by 60 days onwards of its application in pot experiment (Table 1). As the rice crop remains in the field for a long time before the sowing of succeeding crops, pyrazosulfuron-ethyl is expected to degrade to safe levels for the succeeding crops.

When wheat was grown in soil samples drawn from 0-15 and 15-30 cm depth, after rice harvest, the dry matter accumulation by wheat seedlings showed that pyrazosulfuron-ethyl did not affect its growth (Table 2). In case of gram and pea, the differences in dry matter accumulation were non-significant, however, there was slight decrease in dry matter accumulation in the soil taken from 0-15 cm depth and the differences were very narrow in the lower layer of soil (15-30 cm) at lower dose (15 g/ha) of herbicide. Thus, it showed that there was not appreciable amount of herbicide residues present in the soil after the harvest of rice crop which could affect the succeeding crops.

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