Short communication

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Leaching behaviour of atrazine and metribuzin in different soil types

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Maize and sugarcane are among the major crops cultivated in Salem district, Tamil Nadu. Major yield reduction under irrigated and rainfed ecosystem is due to severe infestation of weeds. To overcome this weed menace, farmers are using pre-emergence herbicides namely atrazine and metribuzin. Hence, persistence and mobility of these herbicides in different soil types needs to be studied in depth for better weed control efficiency and reducing the soil residual toxicity. Study on leaching potential would also helpful in assessing the efficacy of herbicides since the maximum weed seed bank deposition would be more in top soil surface (0-5 cm) and if the herbicides leach below this point then there is possibility of reduction in weed control efficiency.

To study the leaching behavior of atrazin and metribuzin under different soil texture, a soil column study was conducted. Surface soil samples (red sandy soil and clayey soil) which were not even treated with atrazine and metribuzin,were collected from 0-15 cm top soil layer at Tapioca and Castor Research Station (TCRS), Yethapur, Tamil Nadu. The collected soil samples were air dried and sieved of 1 mm. PVC pipe of 10.5 cm internal diameter was used for the study and were cut in to two equal halves of 60 cm length and joined together using adhesive tapes. The muslin cloth was tied at one end and processed soil was gently packed (approximately 6 kg) in PVC columns of 60 cm length. One day before the herbicide application (on 14.5.2014), 500 ml of water was added from the top to precondition the soil and allowed to drain naturally. The calculated quantity of test herbicides was applied by diluting with 10 ml of water in the respective PVC columns as detailed below on next day (15.5.2014). Atrazine and metribuzin were applied in recommended and double the recommended dose by calculating the surface area of the PVC pipe ðr^2 = 3.14 x 5.25^2 =86.67 cm^2. Then the atrazine was applied in soil columns at recommended dose (500 g/ha (A_1) (sorghum, pearlmillet and maize); 1.0 kg/ha (A_2) (sugarcane); double the recommended dose (A_3, 2.0 kg/ha) and meribuzin recommended dose (M_1 250 g/ha) and (M_2, 500 g/ha). One day after herbicide application, 200 ml of water was added daily in two splits by 9.00 am and 5.00 pm for 7 days continuously. To avoid disturbances on the soil surface while adding water, a thin film of sand layer was added above the herbicide applied surface. After 7 DAHA (days after herbicide application), adhesive tape was cut in to two equal halves using sharp knife. The herbicide activity was determined at different depths through bioassay test using blackgram as a sensitive plant.

Then the soil columns were separated into different layers from 0 -5, 5 -10, 10 -15, 15-20, 20-30,30-40,40-50 and 50-60 cm and filled individually in the water proof polythene bags at different soil depths and different doses of herbicide were applied separately as per the treatments. Bioassay test was conducted to study the leaching behavior of herbicides in different soil depths by sowing blackgram seeds at the end of 7 DAHA (days after herbicide application) (23.5.2014) in different soil depths, and watered daily.

Bio-assay test of herbicides

(A_1)· At recommended dose in sorghum, pearlmillet and maize, germination of blackgram seedlings was delayed in top 0– 5 and 5 -10 cm at 3 DAS (26.5.2014) compared to other deep layers. At 7 DAS; chlorotic patches were observed in all the seedlings raised from 0- 40 cm depths This showed that at recommended dose, atrazine traces are found in 0- 40 cm and atrazine could leach maximum up to 40 cm.

(A_2)· At recommended dose in sugarcane, germination of seedlings was delayed in top 0 – 5 cm and 5-10 cm at 3 DAS compared to other deeper layers. At 7 DAS, chlorotic patches were observed in all the seedlings raised from 0- 40 cm depths. This showed that atrazine traces are found in 0 –50 cm and atrazine could leach maximum up to 50 cm depth.

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Table 1. Bio- assay test of atrazine and metribuzin in clayey soil type

Soil depths (cm)	Seedlings germinated (no.)	Shoot length (cm)	Root length (cm)	Seedlings germinated (no.)	Shoot length (cm)	Root length (cm)
	Atrazine applied at 1.0 kg/ha			Metribuzin applied		
0 - 5	10	14.2	2.1	Root and shoot length could not be measured proportionately. Root length varied from 6 cm to 12 cm and shoot length were in the range of 9 - 10 cm. Leaf tip was burnt and chlorotic symptoms observed up to a soil depth of 0 - 25 cm.		
5 - 10	10	12.5	2.0			
10 - 15	9	15.7	2.5			
15 - 20	9	15.7	2.1			
20 - 25	10	15.8	2.3			
25 - 30	10	14.7	1.5			
30 - 35	9	15.7	1.0			
35 - 40	8	15.7	1.4			
40 - 45	7	7.4	1.8			
45 - 50	9	9.0	1.5			
50 - 55	7	6.6	1.5			

(A_3). At double the recommended dose, similar trend as A_2 was observed. This showed that atrazine traces are found in 0– 50 cm and atrazine could leach up to a maximum depth of 40 cm.

(M_1). Under normal dose of metribuzin, normal germination was observed in all the depths. However, at 7 DAS chlorotic symptoms was observed in all the depths, which showed that metribuzin could leach up to a depth of 60 cm and even more deeper layers in red soil type.

(M_2). Under double the recommended dose of metribuzin, normal germination was observed. However, at 7 DAS, chlorotic symptoms was observed in all the depths, which showed that metribuzin could leach up to a depth of 60 cm and even more deeper layers.

In control, germination was uneven at 3 DAS. However, on 7 DAS all the seedlings were observed without any chlorotic patches even with uneven germination. This showed that chlorotic patches occured due to traces of tested herbicide.

It was concluded that in red soils, atrazine traces were observed up to 0 - 40 cm soil layers in 500 kg/ ha; up to 50 cm in 1.0 kg/ha and 2.0 kg/ha. Mertribuzin at recommended dose (250 g/ha) and double the recommended dose (500 g/ha) can leach up to a depth of 60 cm soil depth in red soil type.

Bio-assay test of herbicides in clayey soil type

No chlorotic symptoms and delayed germination was observed in seedlings emerged at depths up to 35 cm in clayey soil type. Germination was delayed only in 30 - 40, 40 -50 and 50 - 60 cm in atrazine applied plot. This might be due to poor soaking of water at deeper depths. Gowda *et al*. (1993) reported that mobility of pendimethalin in the 0-5 cm layer was greater than 5-10 cm depth and very little movement occurred at 10-15 cm depth. Sondhia (2007) reported that approximately 80% of pendimethalin was found distributed in 0-12 cm depth due to slow mobility.

SUMMARY

A laboratory soil column experiment was conducted to study the leaching behavior of atrazine and metribuzin in red sandy soil and clayey soil type of TCRS, Yethapur. In atrazine applied plot, chlorotic patches were observed in all the seedlings raised from 0 - 40 cm depths (0 – 5, 5–10,10-15, 15-20, 20 -30 and 30- 40 cm. Chlorosis was not observed in the seedlings raised in the soil depths of 40 - 50 cm and 50 -60 cm.This showed that atrazine traces are found in a depth of 0-40 cm. Application of metribuzin showed chlorosis in all the depths and also showed tip burning in blackgram. From this study, it can be recommended that metribuzin should not be applied in red sandy soil and clayey loam soil (loose soil texture) as this would result in poor weed control efficiency since they are subjected to leaching in deeper layers.

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