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MOVEMENT AND MOBILITY OF ATRAZINE HERBICIDE IN SOIL

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Abstract

Glass columns were used to study movement and mobility of atrazine herbicide in alluvial and calcareous soil samples. Commercial atrazine (Gesaprin) was applied to soil columns at 2 rates. Atrazine was successively leached with water and detected in soil segments and leachat,. Although atrazine was percolated in all segments of alluvial and calcareous soil, yet most of the applied atrazine was retained in the upper 15 cm. As the application rate of atrazine was increased from 1 kg/feddan to 2kg/feddan, the recovered amounts of Atrazine from each segment (5 cm) increased in both alluvial and calcareous soils. The value of the extracted atrazine from the alluvial soil was much higher in the upper 10 cm compared to that extracted from the calcareous one. Concentration of atrazine in leachate of the calcareous soil was much higher than that of the alluvial one and this indicates that atrazine may percolate in the calcareous soil much more easier than in the alluvial soil, thus contaminating the underground water.

INTRODUCTION

Distribution and depth of herbicide in a soil profile is dependent upon numerous factors. Ivey and Andrews (1965) demonstrated that leaching of herbicides was affected by the solubility of herbicides and the characteristics of the soil. Gomes *et al.* (1961) indicated that pesticides were less leached in the heavier textured soils and organic soils in comparison with lighter textured soils. Parka and Tepe (1969) attributed the resistance of herbicides to leaching to their being bound to the soil. Burnside *et al.* (1963) compared the leaching of Monuron, S imazine and Atrazine, and found that atrazine showed the greatest leaching than the other two herbicides. Harris (1966) reported that chlorinated hydrocarbon insecticides exhibited no movement. whereas some of the benzoic acid herbicides exhibited maximum mobility. The S-Triazines and substituted phenyl urea herbicides were much more mobile than Disulfoton and phorate. Weber and Whitacre (1982) studied the mobility of herbicides in soil columns under saturated and unsaturated flow conditions. They concluded that Bromacil was considerably more mobile than Buthidazole. Because of their high water solubility, both herbicides were much more mobile than Atrazine. The Present study was undertaken to investigate the movement and leaching of atrazine in soil by using soil columns.

MATERIALS AND METHODS

An alluvial soil sample was taken from Bahtim Agriculture Experimental Station together with a sample of the calcareous soil from El-Nubaria and were used in this experiment. Soil samples were air dried, sieved through 2 mm sieve. Quadruplicate of each sample were packed in columns having an inside diameter of 3.5 cm and a length of 30 cm, and the total depth of the packed soil was 25 cm. Upward movement of water from a free water supply was applied to facilitate downward movement of the herbicide under investigation. Low and high contents of commercial Atrazine (Gesaprim) while used at rates of 1 and 2kg /feddan and commonly dissolved in 500 liters of water, were prepared by dissolving 100 and 200 mg of Gesaprim in 1L of distilled water. Equivalent diluted volumes necessary to the surface area of the column were applied. Alicots of 150 ml of water were successively applied to glass columns during 10 days, and the leachate of each column was collected in a clean suitable container. The soil columns were then sliced into 5 cm segments, and the soil was air dried, mixed thoroughly, and kept for chemical extraction.

Atrazine was extracted from soil by shaking 5g of soil with 100ml of distilled water for 2h. The suspentions were left to stand for 24 h, then reshaken for another 2h, followed by centrifugation (20.000) for 20 min. Atrazine in 5 ml of the supernatant solutions was determined spectrophotometrically at a wave length of 436.5 um according to Pyridine-alkali method described by Ragab and Mc collum (1968).

The alluvial soil under investigation was clayey textured (1.5% organic matter, pH 8.2, and 38 meq/100g cation exchange capacity). The calcareous soil was sandy loam textured (1.00% organic matter, pH 7.6 and 11.5 meq/100g cation exchange capacity).

RESULTS AND DISCUSSION

The mobility of herbicides in soils influences their performance and ultimate dissipation. The most satisfactory method for evaluating the relative mobility of a given herbicide through soil is one which approximates actual field conditions and which is reproducible. Leaching of herbicides through soil columns more closely approximates field conditions than other methods (Weber and Whitacre 1982).

Tables 1and 2 give the amounts of Atrazine detcted in different segments of alluvial and calcareous soil columns at the end of the leaching period, respectively. In the alluvial soil of Bahtim, the amount of atrazine recovered from the 2nd segment, i. e. 5-10cm, is the highest amount under both rates of application. The recorvered Atrazine from the 2nd segment in the alluvial soil amounted to 11.7 and 19.79 ppm at low and high rates of application, respectively. The same trend is also noticed in the calcareous soil of El-Nubaria. This finding holds true with those observed by many investigators who found that most of applied Atrazine is located in the first 4 inches from soil surface, (Harris 1966; Dawson *et al.*, 1968; Weber and Whitacre 1982). In a study of the persistence of Simazine, one of the s-triazine family in some soils of Egypt, Rizk *et al.*, (1973) stated that there was a progressive depression in the amount of Simazine remaining in the upper 4 inches of the soil with time, and this depression was more rapid for the high rates of Simazine. They added that the amount of Simazine residues in the first 2 inches from the soil surface was greater than the amount remaining in the second two inches. These results were true for the different rates of Simazine under short and long irrigation intervals after 2 and 4 months from Simazine application, whereas the reverse was true

Table1. Concentration (ppm) of recovered Atrazine (Gesaprim) from different segments and in leachate from the alluvial soil of Bahtim.

Depth cm	Low application rate 1kg/feddan	High application rate 2 kg/feddan
0 - 5	9.89	13.65
5 - 10	11.77	19.79
10 - 15	7.00	10.41
15 - 20	5.29	6.82
20 - 25	4.61	6.65
Leachate	0.64	0.76

Table 2. Concentration (ppm) of recovered atrazine (Gesaprim) from different segments and in leachate from the calcareous of El-Nubaria.

Depth cm	Low application rate 1kg/feddan	High application rate 2 kg/feddan
0 - 5	6.31	10.92
5 - 10	12.28	13.14
10 - 15	11.60	10.58
15 - 20	5.12	8.19
20 - 25	5.12	8.02
Leachate	1.11	1.26

after 6 and 8 months from Simazine application with short irrigation intervals.

Table 1 shows that the concentration of the recovered atrazine from the 3rd segment of the alluvial soil, i. e. 10-15cm, is lower than that from the 2nd segment. This result is noticeable for both low and high application rates of atrazine.

Data in Tables 1 and 2 reveal that much further decrease is noticed in the concentration of atrazine recovered from the last two segments in both alluvial and calcareous soils. The decrease is consistent with the added rates of atrazine in both soils. Thus in case of the alluvial soil, the recovered atrazine from either fourth and fifth segments is 5.29 and 4.61 ppm at low rate of application and 6.82 and 6.65 at higher rate, respectively. Consequently, it may be concluded that the recovered atrazine is almost constant in the last 2 segments. The calcareous soil exhibited Similar results for the last 2 segmetns too. However the recovered atrazine was much higher than that obtained in the case of the alluvial soil as the soil received higher application rate of Atrazine. In the light of the obtained results it may be concluded that no matter the rate of applied atrazine is, the top 3 segments (upper 15 cm) contain most of the added Atrazine in both soils. The superiority of the alluvial soil to retain higher amounts of Atrazine, in the upper 10cm, compared with the calcareous soil may be attributed to differences in clay content and the nature of mineralogical comopsition.

Data in Tables 1 and 2 show the values of Atrazine in leachate from the alluvial and calcareous soil. The lowest amount of leachate Atrazine is recorded for the alluvial where the concentration of Atrazine in leachate are 0.64 and 0.76 ppm at low and high application rates, respectively. However the concentrations of leached Atrazine in the calcareous soil are 1.11 and 1.26 ppm corresponding to the previously mentioned rates, respectively. Consequently it may be concluded that percolation of atrazine was noticed in both soils and this may be attributed to the anionic nature of atrazine. However such percolation was much higher in the case of calcareous soil.

As herbicides are becoming widely used especially in the newly reclaimed soil, great attention has to be paid lest they should cause a serious pollution to underground water.

REFERENCES

1. Burnside, C. C., C. R. Fenster and G. A. Wicks. 1963. Dissipation and leaching of monuron, simazine and atrazine in Nebraska soils. Weeds, 11 : 209 - 213.

2. Dawson, J. H., V. P. Bruns and W. J. Clore. 1968. Residual monuron, diuron and simazine in a Vineyard soil. Weed Sci. 16 : 63 - 65.

3. Gomes, R. D., D. W. Bohmont and H. P. Alley. 1961. Factors affecting leaching of pesticides. Am. Soc. Sugar beat Technologists, 11 : 287.

4. Harris, C. I. 1966. Adsorption, movement and phytotoxicity of monuron and S-trazine herbicides in soils. Weeds, 14 : 6 - 10.

5. Ivey, M. J. and H. Andrews. 1965. Leaching of Simazine, atrazine, diuron and ACPA in soil columns. Proc. 5th weed Conf., 18 : 670 - 684.

6. Parka, S. J. and J. B. Tepe. 1969. The disappearance of Trifluraline from field soils. Weed Sci., 17 : 119 - 122.

7. Ragab, H. and J. P. Mc Collum. 1968. Colorimetric methods for the determination of Simazine and related chloro-s-trazine. J. Agric. Food Chem.,16 (2):284-289.

8. Rizk, T. Y. , A. E. El-Tabbakh, and M. I. Fayed. 1973. Persistence of Simazine in soil. V-penetration and speed of detoxication of residual Simazine under different irrigation regimes. Egypt. Pest . Conf. Cong. Assiut, 1 : 380 - 388.

9. Weber, J. B. and D. M. Whiacre. 1982. Mobility of herbicides in soil columns under saturated and unsaturated flow conditions. Weed Sci., 30 : 579 - 584.

حركة وانتقال مبيد الأترازين فى الأرض

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أجريت تجربة لدراسة حركة مبيد الحشائش " الأترازين " فى التربة وذلك باستخدام أعمدة زجاجية حيث عبئت عينة من تربة طينية جافه هوائيا وأخرى من تربة جيرية فى تلك الأعمدة ذات قطر داخلى ٥ر٣ وارتفاع عمود التربة بها ٢٥ سم . أضيف الأترازين التجارى (جيسبريم) للتربة بمعدلين (١ر٢ كجم / فدان). أجريت عملية الغسيل للمبيد على فترات امتدت لمدة ١٠ أيام حيث تلقى كل عمود زجاجى حجما أجماليا من الماء قدرة ١٥٠ مل وجمع الراشح الناجم من عمليات الغسيل بكل عمود حيث قطعت الأعمدة لوحدات بسمك ٥ سم وجففت التربة بداخل هذه الوحدات هوائياً وخلطت جيدا ثم استخلص الاترازين فى ٥ جم منها ثم قدر لونيا وقدر تركيز الأترازين ايضا فى الراشح.

دلت النتائج المتحصل عليها إنه بالرغم من أن الأترازين قد تغلغل فى كل وحدات عمود التربة سواء الطينية أو الجيرية إلا أن معظم الأترازين المضاف قد تركز فى مسافة ١٥ سم العليا من العمود وأن قيمة الأترازين المستخلص من كافة وحدات عمود التربة قد تزايدت بزيادة معدل الإضافة إلى ٢ كجم/ فدان سواء للتربة الطينية أو الجيرية.

أوضحت النتائج أن الأترازين المستخلص من التربة الطينية أعلى من مثيله فى التربة الجيرية فى مسافة ١٠ سم العليا.

كان تركيز الأترازين أعلى فى راشح التربة الجيرية بالمقارنة بالتربة الطينية وهذا يشير إلى أن تغلغل الأترازين فى التربة الجيرية أكثر سهولة بالمقارنة بالتربة الطينية مما يؤدى إلى تلوث الماء الجوفى فى حالة التربة الجيرية بالمقارنة بالتربة الطينية.