Dhaka Univ. J. Biol. Sci. **26**(2): 125-131, 2017 (July)

ACCUMULATION OF DIAZINON IN INDIAN SPINACH UNDER DIFFERENT DOSES OF RICE HULL

FAHMIDA AKHTER, DIDAR-UL-ALAM*, MONIRA BEGUM AND NAUSHAD ALAM

Department of Soil, Water and Environment, University of Dhaka, Dhaka-1000, Bangladesh

Key words: Bioremediant, Diazinon, Rice hull

Abstract

An experiment was conducted to determine the effect of diazinon pesticide on some chemical properties of soil and to evaluate the accumulation of diazinon in Indian spinach *(Basilla alba)* under different doses of rice hull. Diazinon application had a positive effect to reduce the electrical conductivity (EC) of soil. Values of pH were found to decrease with the addition of diazinon. Diazinon had no effect on soil organic matter content although addition of rice hull increased organic matter content in soil with time. Plant analysis showed that the application of rice hull restricted the uptake of diazinon and continuously decreased with time. Therefore, rice hull could be used to control the uptake of diazinon pesticide by short duration vegetable crops.

Introduction

Indian spinach *(Basilla alba*) originates from Asia but is now grown in most tropical regions as a leafy vegetable crop. It is usually cooked but can also be used raw in salads. Rice hulls (or rice husks) are the hard protecting coverings of grains of rice. In addition to protecting rice during the growing season, rice hulls can be put to use as building material, fertilizer, insulation material, or fuel. In medium land, rice even under puddled conditions during the critical period warranted an effective and economic weed control practice to prevent reduction in rice yield due to weeds that ranged from 28 to 48%[1].

Diazinon is used in agriculture to control insects on fruit, vegetable, nut and field crops. Increasing evidence [2] showed that eating fruit and vegetables regularly reduces the risk of cancers, high blood pressure, heart disease, diabetes, stroke, and other chronic diseases.

Only cereal production in Bangladesh reached at 20 million metric tons in 1992 which was nearly 6 million metric tons in 1950[3]. Such success was possible due to the use of pesticides for effective protection against pests and diseases besides other modern agricultural attributes. With the intensification of agriculture and increasing usage of pesticides, the need to study the side effects of pesticides on various soil properties and

*Author for correspondence: <dilafi@gmail.com>.

on the host plant is very crucial. Because the use of various agro-chemicals in the country is very much indiscriminate and therefore, pollution of environmental resources through the use of pesticide is very wide. The transport, persistence or degradation of pesticides in soil depends on their chemical properties as well as physical, chemical and biological properties of the soil. All these factors affect desorption, volatilization, degradation, uptake, run-off and leaching of pesticides [4-9].

Most of the pesticides are not easily degradable; they persist in soil, leach to ground and surface water and contaminate the environment. Depending on their chemical properties they can enter the organism, bio-accumulate in food chains and consequently influence human health. Overall, intensive application of pesticide results in several negative effects in the environment that cannot be ignored[10]. Scientists are now introducing alternative management techniques to reduce the use of pesticides. The present experiment was carried out to evaluate the effects of diazinon on some soil properties and accumulation of diazinon in Indian spinach under different doses of rice hull.

Material and Methods

A composite soil (0 - 15 cm depth) was collected from Khoksha upazila, Kushtia. The collected soil samples were air-dried for three days. Visible roots and debris were removed. After air-drying, larger and massive aggregates were broken down using a wooden hammer.

Ground samples were sieved through a 2 mm stainless steel sieve and kept in polyethylene bags for analysis. The soil had a pH 8.2, texture - sandy loam (sand: 77.0%, 9.7% , silt: and clay: 13.3%)[11], EC- 1000 µS/m, organic matter 0.535%, Ca 3.3%, Mg-1.2%, Cl 1.2%, P 0.064%, available K 55 (mg/kg), available S 6.34 (mg/kg), available Zn 0.08 (mg/kg), available Cu 0.25 (mg/kg)[12] and diazinon 0.87 (mg/kg). Seven treatments with two replications were arranged following RCBD. Treatments were T_1 : $Di_{0\ ml}RH_{0g}$ (without Diazinon and rice hull), T_2 : $Di_{0.5\ ml}RH_{0g}$/2 kg soil, T_3 : $Di_{0.5\ ml}RH_{2g}$/2 kg soil, T_4 : $Di_{0.5\ ml}RH_{4g}$/2 kg soil, T_5 : $Di_{1\ ml}RH_{0g}$/2 kg soil, T_6: $Di_{1ml}RH_{2g}$/2 kg soil and T_7: $Di_{1ml}RH_{4g}$/2 kg soil. Fourteen bottom closed pots were used. Each pot was filled with two kg soil. In the experiment three different dozes of diazinon such as 0.0, 0.5 and 1.0 ml/2 kg of soil and rice hull at the rate of 0, 2.0 and 4.0 g/2 kg soil were applied. The experiment was carried out in the net house of the Department of Soil, Water and Environment, University of Dhaka. A basal dose of N as urea, P as TSP and K as muriate of potash were added at the rate of 70, 15 and 50 mg/kg, respectively [13]. Three seeds of Indian spinach (*Basilla alba*) were sown in each pot. After 15 days of sowing, diazinon and rice hull were applied accordingly. Three sampling times were chosen for soil and plant sample collection. The first sampling was made 6 hrs later after the application of diazinon and rice hull. The second sampling was made 15 days after the first sampling and finally the third sampling was

made after 30 days of the first sampling. Plants were watered twice daily in the morning and evening. Intercultural operations were done whenever necessary. The soil samples were dried and processed for chemical analysis[14]. Soil samples were extracted with hydrochloric-sulfuric acid[14,15]. The harvested plants were washed with tap water and wiped with tissue paper. The plant sample was cut into small pieces, air-dried, oven-dried at 70°C for 48 hrs. The plant samples were ground, sieved through a 0.2 mm sieve and stored in a polyethylene bags for chemical analyses. Plant samples were digested with concentrated nitric acid in block digester [15]. Diazinon in plant samples was determined by standard methods and extracted with hydrochloric-sulfuric acid (4:1) and volume them to 100 ml cyclic aliphatic hydrocarbon with sulphate, halogen and phosphate and cyclic aromatic hydrocarbon with sulphate, halogen and phosphate contents in soil and plant samples were determined by colorimetric method[16, 17].

Results and Discussion

Effect on soil electrical conductivity: Electrical conductivity value (210 dS/m) was found to be highest in the second sampling (Fig. 1). It was evident that the application of diazinon decreased EC in the samples collected after 15 and 30 days of interval. Treatment $Di_{0.5}RH_0$ was more effective in reducing the EC value than the treatment $Di_{1.0}RH_0$. However, when rice hull applied along with diazinon EC value dropped rapidly but with the increase in rice hull amount from 2 to 4 g along with the same doses of diazinon the changes were nearly stable. Moreover, with the increase of incubation period from 6 hrs to 15 days EC value showed significant decrease although it remains nearly unchanged after 30 days of incubation.

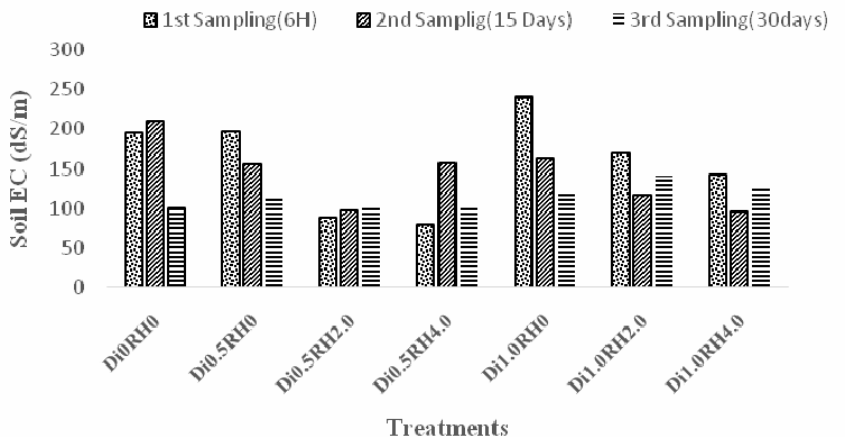

Fig. 1. EC values at different sampling periods.

Effect on soil pH: Diazinon had a significant effect in changing the initial soil pH. Before the application of diazinon the pH of the soil was 8.2, while after application pH

value reduced markedly ranging from 6.0 to 7.0. Immediately after application of diazinon, i. e. after 6 hour of the application the decrease rate of pH was highest and as the incubation time increases to 15 days and then after 30 days this decrease of pH was reduced (Fig. 2). Jose *et al*.[16] reported that the application of pesticide increased the acidity of the soil. Highest pH value (7.05) was found after 30 days. Comparing with the control, diazinon as well as rice hull showed very minor effect on soil pH and soil pH values were mostly between 6.0 to 7.0 (Fig. 2).

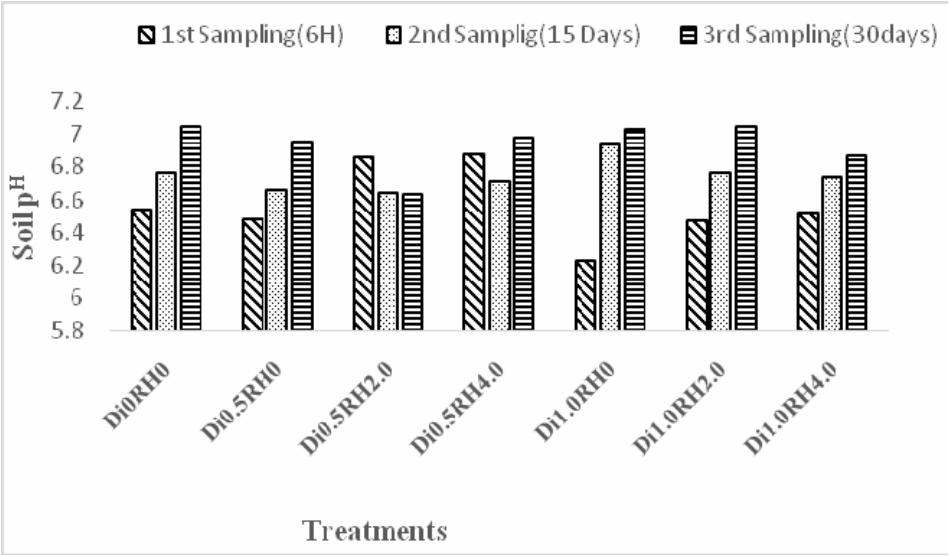

Fig. 2. Soil pH at different sampling periods.

Effect on soil organic matter: Application of diazinon and rice hull showed a positive trend on soil organic matter content. The analysis showed that the increase in rice hull from 2 to 4 g per 2 kg soil, soil organic matter content increased rapidly (Fig. 3). Although with incubation period from 6 hour to 15 or 30 days there was an increase in decomposition of rice hull with time which might have increased soil organic matter content. On the other hand, with diazinon application (0.5 ml/2 kg soil), the organic matter content of soil increased and the maximum organic matter (0.93%) were found at 15 days of incubation. However, when the diazinon was applied at 1.0 ml per 2 kg soil, the maximum organic matter content (2.49%) was observed in soil which was collected after 30 days of the application of diazinon. Organic matter content increased with time. When diazinon was applied with rice hull the organic matter content increased than the pesticide was applied alone. This indicated that diazinon had a positive impact on the organic matter content. Highest values of organic matter content (1.91, 2.69 and 2.49%) were obtained when diazinon and rice hull (4 g/2 g) applied together (Fig. 3)

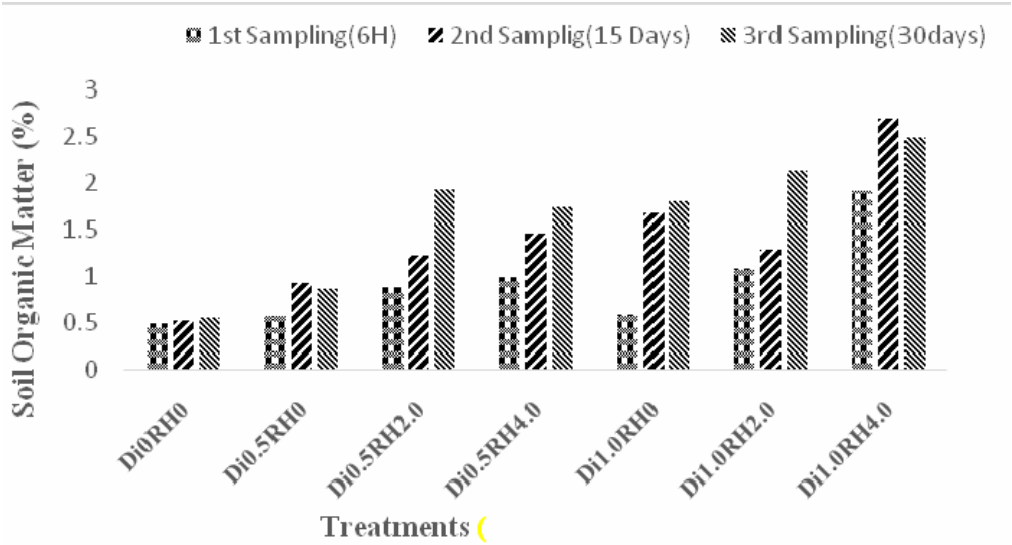

Fig. 3. Soil organic matter at different sampling periods.

Effect of rice hull on diazinon accumulation: With the application of diazinon at highest rate (1 ml/2 kg soil), concentration of diazinon in Indian spinach was found to be reduced by rice hull application. The accumulation of diazinon in Indian spinach was decreased with time. Rice hull acted as a bioremediant and its application reduces the concentration of the pesticide in the plant (Table 1).

Table 1. Effects of diazinon and rice hull on the concentration (mg/kg) of diazinon in Indian spinach.

Treatments	1st sampling (6 hrs)	2nd sampling (15 Days)	3rd sampling (30 days)
T_1: $Di_0RH_{0g/kg}$(control)	0.001 ± 0.001	0.77 ± 0.012	0.019 ± 0.001
T_2: $Di_{0.5ml}RH_{0/2kg}$	0.297 ± 0.007	0.286 ± 0.004	0.176 ± 0.004
T_3: $Di_{0.5ml}RH_{2g/2kg}$	0.267 ± 0.005	0.693 ± 0.010	0.023 ± 0.003
T_4: $Di_{0.5ml}RH_{4g/2kg}$	0.348 ± 0.008	0.903 ± 0.005	0.006 ± 0.002
T_5: $Di_{1.0ml}RH_{0g/2kg}$	0.318 ± 0.001	0.824 ± 0.010	0.13 ± 0.006
T_6: $Di_{1.0ml}RH_{2g/2kg}$	0.246 ± 0.010	0.356 ± 0.010	0.055 ± 0.006
T_7: $Di_{1.0ml}RH_{4g/2kg}$	0.341 ± 0.004	0.885 ± 0.006	0.009 ± 0.001

However, by using rice hull at the rate of 2 g (along with lowest dose of diazinon) concentration of diazinon in the three consecutive sampling periods was found to be reduced by 76.98, 40.29 and 98.02%, respectively. Although the lowest percentages of

reduction of pesticide was 22.16% at 15 days of sampling period when rice hull were applied at the rate of 4 g with same dose of diazinon (Table 1). During the 3rd sampling period, maximum decrease in the content of diazinon was found in plant samples. Therefore, experiment revealed that the rice hull works as a biore-mediant.

References

1. Behera B and SG Singh 1999. Studies on weed management in monsoon season crop of tomato. Indian J. Weed Sci. **31**(1-2): 67.
2. Dietary guidelines for Americans 2005. US Department of Health and Human Services and US. Department of Agriculture 2005.
3. Habibullah AKM and SM Imamul Huq 1992. Impact of intensive agriculture, hydrochemicals and populations on the quality of environment in Bangladesh. Paper presented at the seminar on "Environmental Soil Science", 8-15 August, 1992, Edmonton, Alberta, Canada.
4. Shegunoa P, J Klanoa and I Holoubek 2007. Residues of organochlorinated pesticides in soil from the Czech Republic. Environ. Poll. **146**(1): 257-261.
5. Toan V, V Thao, J Walder, HR Schmutz and C Ha 2007. Contamination by selected organochlorine pesticides (OCPs) in surface soils in Hanoi, Vietnam. Bull. Environ. Cont. and Toxi. **78**(3): 195-200.
6. Li XH, W Wang, J Wang, XL Cao, XF Wang, JC Liu, XF Liu, XB Xu, and XN Jiang 2008. Contamination of soils with organochlorine pesticides in urban parks in Beijing, China. Chemosphere **70** (9):1660-1668.
7. Hildebrandt A, S Lacorte and D Barcelo 2009. Occurrence and fate of organochlorinated pesticides and PAH in agricultural soils from the Ebro river basin. Arc. Environ. Cont. and Toxi. **57**(2): 247-255.
8. Jiang YF, XT Wang, Y Jia, F Wang, MH Wu, GY Sheng and JM Fu 2009. Occurrence, distribution and possible sources of organochlorine pesticides in agricultural soil of Shanghai, China. J. Hazardous Materials **170**(2): 989-997.
9. Ferenez L and A Balog 2010. A pesticide survey in soil, water and foodstuffs from central Romania. Carpathian J. Earth and Environ. Sci. **5***(1):* 111-118,
10. Russell C and CB Schultz 2009. Effects of grass-specific herbicides on butterflies: an experimental investigation to advance conservation efforts. J. Insect Conserv. **14**(1): 53-63.
11. Soil Survey Division Staff 1993. Soil Survey Manual. United States Department of Agriculture. pp. 63-65. Retrieved 30 August 2014.
12. Bremner JM 1965. Inorganic forms of nitrogen in "Methods of Soil analysis" (C. A. Black, Ed), Agronomy No 9, Part 2 pp. 1149-78. Amer. Soc. Agron Madison, Wisconsin.
13. BARC (Bangladesh Agriculture Research Council) 2012. Fertilizer Recommendation Guide. Soils Publication No. 45. pp. 274.
14. Imamul Huq SM and MD Alam 2005. A Handbook on Analysis of Soil, Plant and Water. Bangladesh-Australia Centre for Environmental Research (BACER-DU), University of Dhaka, Dhaka-1000. pp. 245.
15. Jackson ML 1958. *Soil Chemical Analysis*. Prentice-Hall Inc., New Jersey. pp. 498

16. Rasuljan M, S Jasmin and M Rubna 1991. Investigation of spectrophotometric method for determination of organophosphorus pesticides. J. Chem. Sc. Pak. **13**(4): 1-7.

17. Jose Antonia Garcia-Perez, Enrique Alarcon, Yesica Hernandez and Christian Hernandez 2016. Impact of litter contaminated with glyphosate-based herbicides on the performance of Pontoscolex corethrurus, soil phosphatase activities and soil pH. Applied Soil Ecol. **104**: 31-41.

(Manuscript received on 26 January, 2017; revised on 5 April, 2017)