Research Article
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Effects of diazinon on nutrient availability of indian spinach under different doses of rice hull

Abstract

A pot culture experiment was conducted to study the effects of diazinon pesticide on the availability of some essential elements of plant with the application of different doses of rice hull. For this purpose, an upland leafy vegetable namely Indian Spinach (Basella alba) was used. Seven different treatments including a control following a randomized complete block design (RCBD) were used in the experimental set–up. Three samplings were done for soil and plant at three different periods viz., 6 hours, 15 days and 30 days after application of the diazinon pesticide. The soil and plant samples were analyzed in the laboratory to determine their elements (mineral nitrogen, phosphorus, potassium, sulfur, calcium and magnesium). It was revealed that the concentrations of almost all nutrients were highest in the first sampling period for soil. However, in case of the plants, concentration of the nutrients was highest in third sampling period. Sulfur and phosphorus in soil was found to be strongly correlated at 1% level during third sampling period. Mineral nitrogen of soil and diazinon showed significant correlation at 5% level in first sampling period. The concentration of nutrients decreased and became lowest during the third sampling period because of degradation of diazinon with time.

Keywords: pot culture, diazinon, rice hull, indian Spinach, treatment, sampling

Volume 4 Issue 2 - 2017

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Received: November 21, 2017 | **Published:** December 07, 2017

Introduction

Indian spinach (*Basella 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. Rice hulls are the coatings of seeds or grains of rice. In medium land, rice even under puddled conditions during the critical period warranted an effective as well as 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. Evidence shows that intake of fruit and vegetables regularly reduce the risk of cancers, high blood pressure, heart disease, diabetes, stroke, and other chronic diseases. Only cereal production in Bangladesh reduced at 0.20 million tons in 1992 which was nearly 6 million tons in 1950.[2] Such success was possible due to the use of pesticides for effective protection against pests and diseases along with other modern agricultural attributes. With the intensification of agriculture and increasing usage of pesticides, there is an urgent need to study the side effects of pesticides on various soil properties and on the host plant. Currently sprayed liquid insecticides are being causing deaths of Childs in fruits garden area of Bangladesh.[3]

The use of various agrochemicals in the country is very much indiscriminate and therefore the pollution of environmental resources is very high. The transport, persistence and degradation of pesticides in soil depend on their chemical properties as well as physical and biological properties of the soil. All these factors affect desorption, volatilization, degradation, uptake, run–off and leaching of pesticides.[4,5] Most of the pesticides are not easily degradable; they persist in soil for a long time, leach to ground water and ultimately contaminate the environment. Depending on their chemical properties they can enter into the organism, bio–accumulate in the food chain and consequently influence human health. As a whole, intensive application of pesticides results in several negative effects in the environment that cannot be ignored.[6] Scientists are now introducing alternative management techniques to reduce the use of pesticides. The present study 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.

Materials and methods

Soil sampling and processing

A composite soil sample was collected from a field of Moragasa Village situated in Khoksha Upazila of Kustia District. The collected soil samples were air–dried for three days. Visible roots and debris were removed manually. 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 further physic and chemical analyses.[7] The soil belongs to the Sarail series with sandy loam texture. It had a pH of 8.2 and EC 1000µS/m. The soil had a nitrogen, phosphorus, potassium, sulfur, calcium and magnesium content of 1.5%, 0.04%, 55mg/kg, 6.3mg/kg, 3% and 1.2% respectively.

Experimental set–up

Seven treatments with two replications were arranged following a randomized complete block design (RCBD).Treatments were T_1:=$Di_{0.5}RH_{0.0}$, T_2:=$Di_{0.5}RH_{2.0}$/2kg soil, T_3:=$Di_{0.5}RH_{4.0}$/2kg soil, T_4:=$Di_{1.0}RH_{0.0}$/2kg soil, T_5:=$Di_{1.0}RH_{2.0}$/2kg soil, T_6:$Di_{1.0}RH_{4.0}$/2kg soil and T_7:=$Di_{0.0}RH_{0.0}$/2kg (without Diazinon and rice hull) soil. A total of fourteen bottom closed pots were used. Each pot was filled with two

kilogram of soil. In the present study, three different dozes of diazinon such as 0, 0.5 and 1.0ml/2kg of soil and rice hull at the rate of 0, 2.0 and 4.0g/2kg soil were applied. The study 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 50mg/kg, respectively.[8] Three seeds of Indian Spinach (*Basella alba*) were sown in each pot. After 15 days of sowing, diazinon and rice hull were applied accordingly.

Sample preparation and analysis

Three sampling times were chosen for soil and plant sample collection. The first sampling was made 6 hours 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.[9] The soil samples were extracted with hydrochloric–sulfuric acid.[9,10] 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 hours. The plant samples were ground, sieved through a 0.2mm sieve and stored in polyethylene bags for further analyses. Plant samples were digested with concentrated nitric acid in block digester.[10] Diazinon in plant samples was determined by standard methods and extracted with hydrochloric–sulfuric acid (4:1) and volume up to 100ml. Nitrogen, phosphorus, potassium, sulfur, calcium and magnesium content of both soil and plant samples was determined by the standard methods.[7,9]

Statistical analysis

All data were statistically analyzed by using Microsoft Excel and SPSS (version 12) software.

Results and discussion

Effect on nitrogen content

Mineral nitrogen content of the soil varied significantly at three different sampling periods. The highest amount of mineral nitrogen (0.06%) was observed mostly at first sampling period and then the values decreased linearly (Figure 1). In case of control treatment, the mineral content of nitrogen was increased and then decreased. Like the soil, the contents of nitrogen in plants varied significantly at three different sampling periods (Figure 2). The maximum value (0.29%) was observed at both first and third sampling periods. Amount of N decreased significantly at all periods for $Di_{0.5}RH_{2.0}$ (treatment 2) and $Di_{0.5}RH_{4.0}$ (treatment 3). However, N was increased linearly for rest of the treatments. This indicated the fact that plant uptake higher amount of nitrogen due to application of double doses of pesticides. Mineral nitrogen of soil and diazinon showed significant correlation (r=0.808) at 5% level in first sampling period. Likewise, diazinon and plant N were significantly correlated (r=0.731) at 5% level in third sampling period.

Effect on phosphorus content

It was observed that phosphorus content of the soil was decreased and then gradually increased at three different sampling periods for all treatments (except the control). The highest amount of phosphorus (0.085%) was found at first sampling period (Figure 3). On the contrary, plant phosphorus contents were varied significantly at three different sampling periods. For most of the treatments including the control, phosphorus contents of the plants (Figure 4) were more or less similar ($Di_{0.5}RH_{0.0}$–treatment 1, $Di_{1.0}RH_{0.0}$–treatment 4, treatment 6 and treatment 7). Phosphorus content was increased significantly in case of $Di_{1.0}RH_{2.0}$ (treatment 5) indicating that plants uptake higher amounts of phosphorus because of double doses of pesticides. The maximum value (0.062%) was observed at third sampling period. P and S in soil showed a strong correlation (r=0.993) at 1% level in third sampling period.

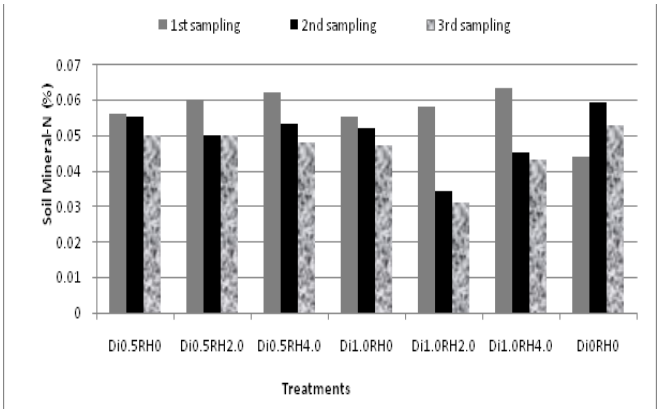

Figure 1 Soil mineral nitrogen at different sampling periods.

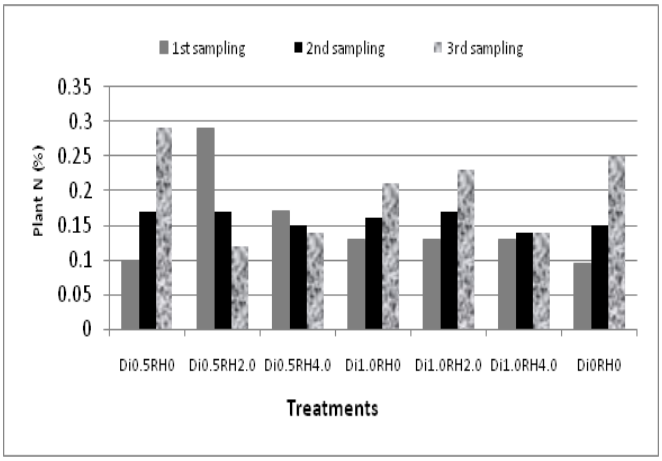

Figure 2 Plant nitrogen at different sampling periods.

Effect on potassium content

Potassium content of the soil was found to be decreased gradually during all three sampling periods. It was applicable for all the treatments including the control (Figure 5). The content of plant potassium was similar at first and second sampling periods followed by a gradual decrease in third sampling period (Figure 6). The highest amount of potassium was found at first sampling period for both the soil (1.98%) and plant (0.94%). In case of potassium content at different rates of diazinon and rice hull as a bioremediator showed linear behavior at various growth stages of Indian Spinach, which is indicated by the ideal soil conditions for plant growth. K showed a significant correlation with both S (r=0.699) and P (r=0.699) in soil at 5% level in second sampling period. Diazinon and plant K and were significantly correlated (r=0.677) at 5% level in third sampling period.

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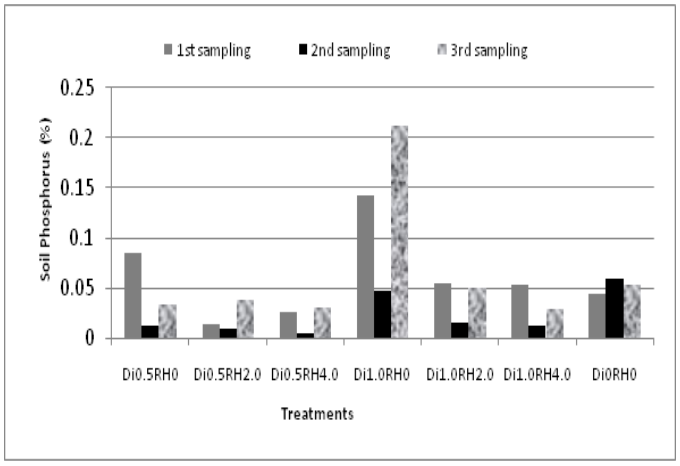

Figure 3 Soil phosphorus at different sampling periods.

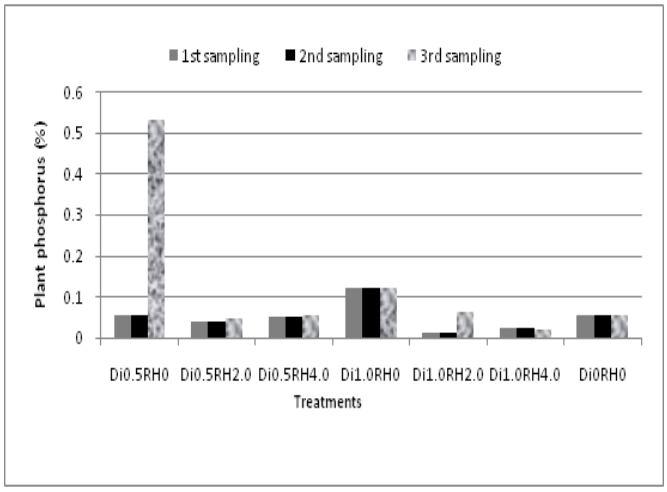

Figure 4 Plant phosphorus at different sampling periods.

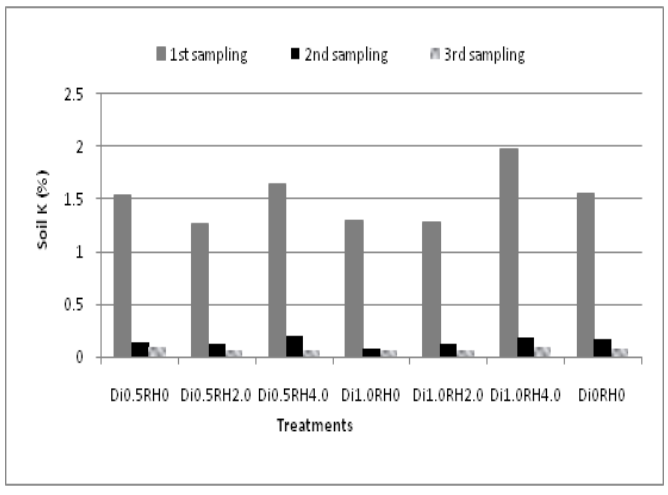

Figure 5 Soil potassium at different sampling periods.

Effects on sulfur content

It was found that sulfur content of the soil varied significantly at three different sampling periods for both soil and plant. In case of soil, the sulfur contents were first increased and then decreased for most of the treatments including the control treatment 1, treatment 3, –treatment 4, treatment 5, and treatment 7 (Figure 7). The maximum value (0.69%) was observed at second sampling period. This could be due to the application rate of bioremediant. However, sulfur contents of plants followed a definite trend. The content was same in the first and second sampling period followed by an increase in third sampling period (Figure 8). The highest value (2.52%) was found in third sampling period for $Di_{1.0}RH_{2.0}$ (treatment 5). P and S in soil showed a significant correlation (r=0.790) at 5% level in first sampling period. Similarly, in the second sampling period, both of them were strongly correlated (r=0.961) at 1% level of significance.

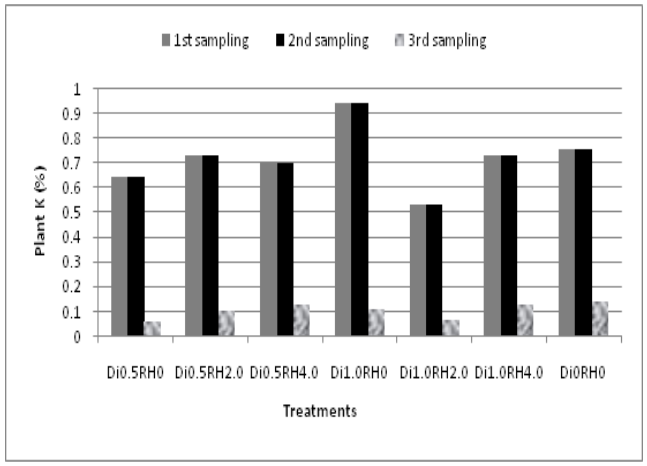

Figure 6 Plant potassium at different sampling periods.

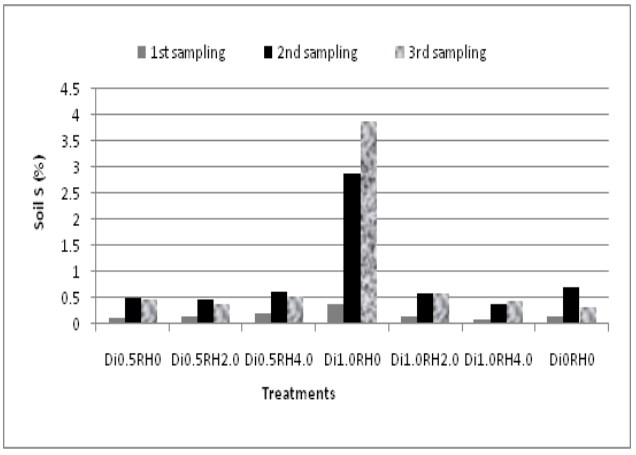

Figure 7 Soil sulfur at different sampling periods.

Effect on calcium content

At the first sampling time in all cases, the calcium content was higher than other two for both soil and plant except treatment 5 and treatment 6 due to the different application rate of rice hull but some rate of diazinon. In case of control, Ca content was decreased for soil and vice versa for plant (Figure 9 & Figure 10). The highest value was found at first and third sampling period for soil (4.62%) and plant (14%) respectively. Ca and K in soil showed strong correlation (r=0.859) at 1% level for third sampling period.

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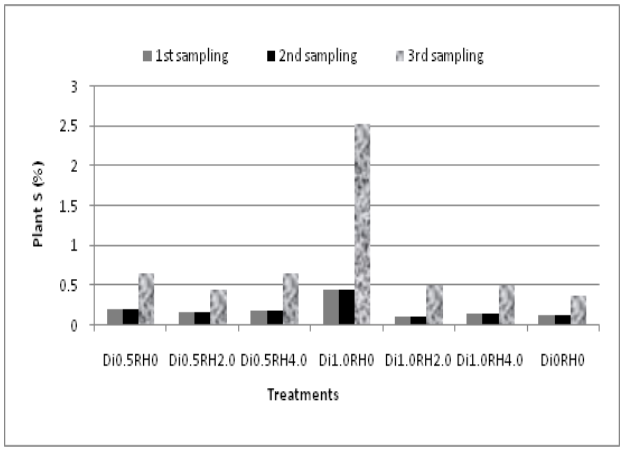

Figure 8 Plant sulfur at different sampling periods

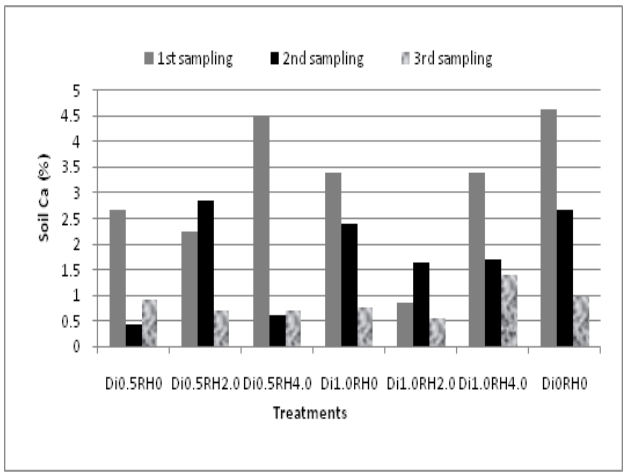

Figure 9 Soil calcium at different sampling periods.

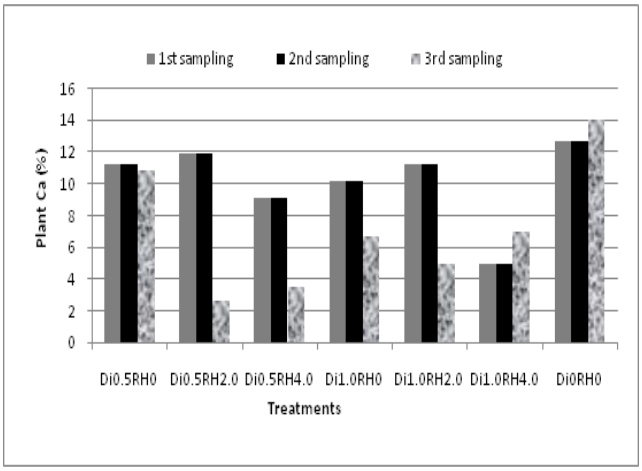

Figure 10 Plant calcium at different sampling periods.

Effect on magnesium content

The contents of magnesium varied significantly at all different sampling periods for both soil and plant. It was found that magnesium content in soil was highest at first sampling time for all treatments except treatment 1 and treatment 3 because of the same rate of diazinon but different rate of rice hull application (Figure 11). For plant, the Mg content showed linear relation except treatment 5 (Figure 12). The highest value was found at first sampling period for both soils (7.39%) and plant (2.518%). Mg and Ca in soil showed a significant correlation (r=0.671) at 5% level in first sampling period. However, Mg in plant and diazinon was strongly correlated (r=0.850) at 1% level for second sampling period. The results showed that, mineral N was decreased for soil but increased for the plant samples. The mineral N content was highest in case of first sampling period and then it decreased as the pesticide and rice hull degraded. Rice hull restricted diazinon to persist in soil which helped to increased nitrogen uptake by plants. Other nutrient elements viz., P, K, Ca and Mg were decreased gradually for both soil and plant. However, the scenario was quite different for S. The highest content of S was found in third sampling period. S degrades and becomes more available to plants as it is present in diazinon structure.

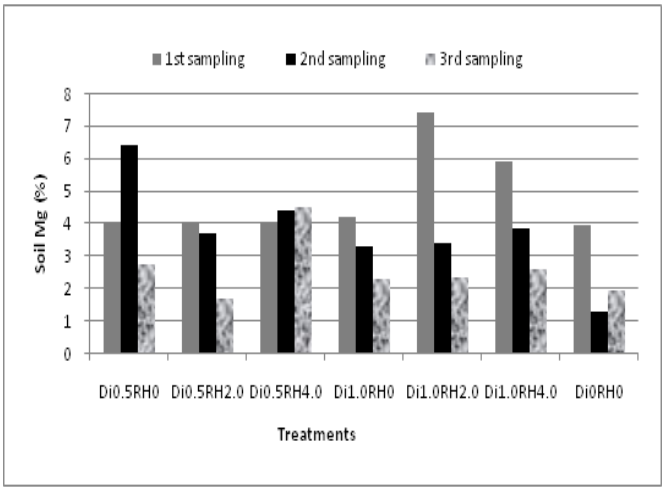

Figure 11 Soil magnesium at different sampling periods.

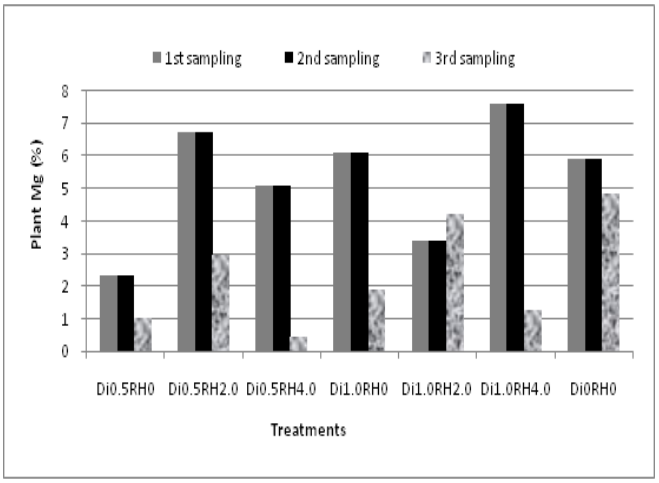

Figure 12 Plant magnesium at different sampling periods.

Acknowledgements

None.

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Conflict of interest

The author declares no conflict of interest.

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