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EFFECTS OF RICE MILL WASTEWATER ON COCOON PRODUCTION AND TOTAL POPULATION OF EARTHWORM, *EISENIA FETIDA* (SAVIGNY 1826) UNDER LABORATORY CONDITION

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ABSTRACT: *Water scarcity can be overcome through the reuse of treated wastewater for irrigation especially in arid and semiarid regions. However, there are several potential environmental and health risks associated with this practices. Improved plant growth and nutrients for microorganisms are also gotten from wastewater which has high nutritive value. This study investigated the effect of rice mill waste water on cocoon production and total population of earthworm Eisenia fetida under laboratory conditions. A total of five hundred (500) clitella earthworms were used for this study. The physico-chemical parameters of the rice mill wastewater were analyzed using standard methods of APHA-AWWA-WEF (2000). The study on the cocoon production and total population of E. fetida were conducted from 0 to 100% wastewater (0, 25, 50, 75 and 100%) by serial dilution for a period of 60 days to assess the suitability of rice mill wastewater for irrigational purpose. The significant difference between treatments was tested by one-way ANOVA. The wastewater had an alkaline pH (8.5), low sulphate (0.95 mg/l), DO (3.10mg/l) and COD (2.0mg/l); moderate concentration of TDS (421mg/l), calcium (47.7 mg/l), phosphate(102.27 mg/l) and high concentration of conductivity (20.50 dsm^{-1}), total solid (2550mg/l), total dissolved solids (2028 mg/l), total hardness (100 mg/l) and sodium (25.0 mg/l), earth population(53.2) At 50% of the wastewater usage there was a significant increase in cocoon production (24.24). On the basis of this research, it shows that rice mill wastewater should be either diluted to at least 50% or treated to make it suitable for irrigational purpose.*

KEYWORDS: *Eisenia fetida* population, Rice wastewater, population, Rice wastewater.

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INTRODUCTION

The scarcity of water in the arid and semi-arid region for irrigation and agricultural purposes, rice mill waste water is now served as alternative source of water (Pradhan and Sahu, 2010).

The recycling of wastewater becomes necessary for agricultural irrigation in dry zones which will help to reduce the volume of fresh water for agricultural irrigation which limits the availability of water for human consumption (Defeo *et al.*, 2011). The impact of these effluents on soil, flora and fauna directly depends on their nature, type and characteristics. The effluent compositions and the extent of pollution caused by them varies from industry to industry, depending on the nature of raw materials used, the processes involved and the type of equipment used in the processes (Antil and Narwal, 2008). The introduction of pollutants to the environment from the reusing of wastewater in agriculture is considered deleterious practices; spread of waterborne diseases, causes odor problems and causes harm to the crops. Nevertheless, the recycling of wastewater in agriculture is seen in some countries as a convenient environmental strategy which may result in some benefits for the soils, crops and farmers (Lazarova *et al.*, 2001). Constant discharge of wastewater which contains organic materials in large quantities into agricultural lands will stagnates and putrefies the soil, leading to the pollution of flowing waters and mortality of both land and aquatic organisms such as earthworms (Jessy *et al.*, 2015). Despite the agricultural importance of earthworms such soil decomposer, aerators and bio-fertilizer not much information is available on the impact of rice mill wastewater on soil organisms including earthworm. There are increase rates of industrial and human consumption of rice, thereby increasing the daily discharge of rice mill waste water and increasing the potential it's to cause damage and degrade the environment, also after a long period of continuous discharge into agricultural farms; there are negative effects on the earthworms such as immobility and poor reproduction.

MATERIALS AND METHODS

Experimental location: The research was carried out in the Biological Sciences Hydrological Laboratory Ahmadu Bello University Zaria. The Rice Mill wastewater was collected directly from the point of discharge in some sampling bottles from Kura Rice Mill having the milling capacity of 10MT day^{-1} which is located in Kano State (latitude 11ºN, longitude 009º25'E and altitude 1605m). Physicochemical parameters of the waste water namely pH, sulphate , DO, COD, TDS, phosphate, conductivity, total solid, total hardness and sodium was measured and analyzed in Water Resources Departmental Laboratory, ABU Zaria, following the procedures recommended by APHA-AWWA-WEF (2000) and the different concentrations of the waste was prepared using the serial dilution procedure according of Ben-David *et al.*, (2014).

Earthworm collection and culture

Earthworms were collected from their natural habitat in PZ irrigation farmland in Zaria and cultured in the soil collected alongside from their natural habitat in the laboratory**.** The worms were collected by hoeing and hand-sorting method (Sahu *et al.*, 1988) in the early hours of the day (8am) and were transported to the Biology Departmental Garden for sorting and acclimatization with adequate provision of food such as decayed fruits peels and dried leaves

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at the early hours of the day from their habitat. Collected specimens were identified according to Segun (1978) method,

The earthworms were cultured in earthen clay pot (50cm×40cm) as a stocking pot were lined with wire mesh netting of 1mm to protect the earthworms from predators. Five (5) holes of 10mm was made in the bottom of the earthen pot to allow free drainage of excess moisture. The experiment was carried out for 60 days

Sampling size

A total of 500 clitella worms of *Esenia fetida* were collected from the vermiculture earthen pot and introduced into 25 plastic pots each of the size 17.5cm x 8.4cm with 20 clitella earthworm each. Five sets of plastic culture pots, each with five replicates, filled with 1.5 kg of soil substrate was kept in the laboratory. Nine (9) holes of 5mm were made in the bottom of the plastic pots to allow free drainage of excess water and were kept in the Laboratory of Biology Department. After 30 minutes they were checked to ensure that all the worms had burrowed into the soil.

Determination of Reproductive rate

The rate of reproduction was calculated as the total number of cocoons produced per adult worm (Sahu and Senapati, 1988). The substrate in the different concentration was carefully poured out on a flat surface. This was closely examined every two weeks interval using the magnifying lens to pick out and count the number of cocoons found and adults in the different concentration pots, which was counted and the average readings were recorded, (Basha *et al.,* 2016).

Reproductive rate = $\frac{cocoon\ produce}{total\ no\ of\ adult \times no\ of\ days} \times 100$ cocoon/adults/week

Population

The population was determined based on natality and mortality rate observation was done daily and number of juveniles hatched per cocoon per two weeks were were recorded, mortality was determined by counting the number of dead earthworms. Worms were considered dead if they lacked any movement and did not respond to a definite tactile stimulus to the anterior end, because earthworms tend to disintegrate quickly after death, (Maboeta *et al.,* 2008). The total population (n+1) was calculated according to Derocher (2005) formula below:

$NT+1 = N_0 + (B - D)$

Where,

Nt +1 = new population size at the time t+1

N_0 = number of population at time 0

B= Natality (birth rate)

D = mortality (death rate)

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Data Analysis

Data generated were subjected to one-way analysis of variance (ANOVA) using SAS version 9.0 statistical analysis package for Windows to determine the significant difference among the concentrations of the rice mill wastewater. Tukey test was used to separate the difference between the means.

RESULTS

The effect of Cocoon production of earthworm in different concentrations of rice mill waste water is presented in Table 1. Cocoon production was significantly affected (P<0.05) rice mill waste water. The highest cocoon production were recorded in the different days of the

experiment which showed significant difference as recorded as in The lowest cocoon production were recorded in the different days of the experiment which shows significant decrease as observed in 15 days

Table 1. Cocoon production of earthworm in different concentrations of rice mill waste water

		Concentrations (mg/l)			
Days	**Control**	**25**	**50**	**75**	**100**
0	0±0.00	0±0.00	0±0.00	0±0.00	0±0.00
15	23.75±0.04[a]	20.88±0.04[c]	24.24±0.03[a]	20.57±0.06[c]	13.22±0.04[d]
30	20.12±0.04[a]	18.96±0.04[b]	18.12±0.04[c]	15.33±0.04[d]	9.31±0.02[e]
45	16.92±0.04[b]	18.88±0.04[a]	11.23±0.04[c]	9.42±0.04[d]	5.13±0.04[e]
60	11.22±0.05[a]	10.12±0.04[b]	8.02±0.04[c]	5.32±0.04[d]	3.43±0.05[e]

[a,b,c,d,e] Means with different superscripts along rows differ significantly at (P<0.05),

The influence of Earthworm population in different concentration level of Rice mill Wastewater are shown in figure 1. Earthworm population was significantly affected (P<0.05) at 25, 50, 75 and 100. The highest earthworm populations were recorded in the different days of the experiment which showed significant difference as recorded as in 15 days (67.4±0.24) at 0%, 30 days (62.4±0.24) at 0%, 45 days (23.2±0.21) at 0%, 60 days (22.4±0.24) at 0%.

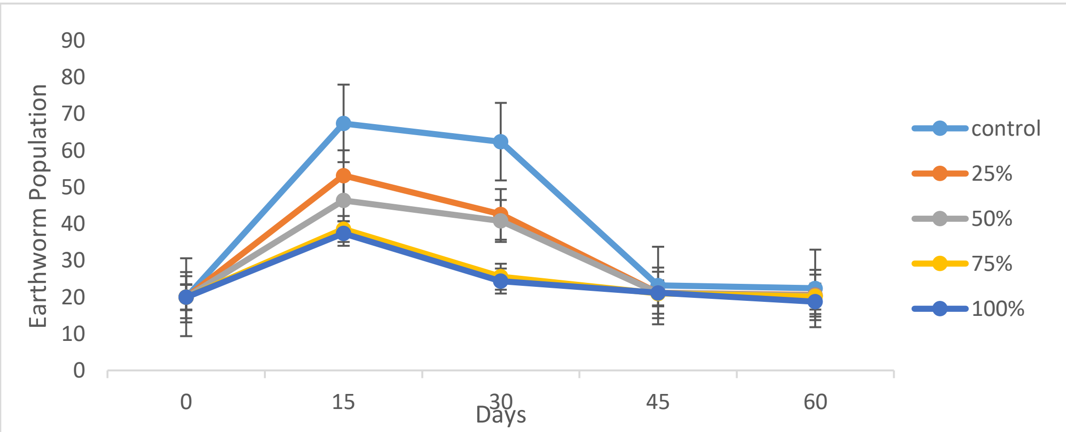

Figure 1: Earthworm population in different concentrations level of rice mill wastewater.

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DISCUSSION

Cocoon Production

This study revealed that earthworm cocoon production was found to be significantly low in all the different concentrations compared to control. Cocoon production decreased in higher concentration of the wastewater and this agrees with the findings of Sunil *et al.,* (2008), who also reported there are low cocoon counts at higher concentrations. This could higher concentrations of the physico chemical parameters.

High peak of cocoon production was observed at 50% of the rice mill wastewater due to increase in the populations of the earthworms which also agrees with the findings of Fordman *et al.,* (1998), who observed that at the onset of cocoon production, the number of cocoons peaked at 50% of rice mill wastewater concentration.

Rate of cocoon reproduction decreased steadily with respect to increase in concentrations, however, these observations are in agrees with the findings of Padhan and Sahu (2010), who carried out a study on the effect of the different concentration of rice mill waste water on the earthworm which was used to determine the reproduction rate of *Drawida willsi and* found out that the rate of cocoon production decreases at higher concentrations levels which could be as a result of secondary metabolite such as phenolics, saponnins, lignin and essential oils present in the rice mill wastewater.

Earthworm population

The population of the earthworms was significantly low in all the different concentration as compared to the control. This could be attributed to the effects of the rice mill wastewater having high concentration of sodium, chloride and conductivity which is above the permissible level of wastewater restriction for irrigation by Food and Agricultural Organization 1985,

This agrees with the findings of Earnest and Lauratta, (2015) who reported that death of earthworms were observed at higher concentration which had a significant effect on the populations.

Furthermore, (Sunil et al., 2008) reported high concentration of the wastewater is detrimental to the population of earthworm Eisenia fetida and Allolobophora parva as high mortality rate was recorded in the course of the experiment which could be as a result of secondary metabolite such as phenolics, saponnins, lignin and essential oils presence in the waste water as reported by Pradhan and Sahu, (2010).

CONCLUSION

The effect of the rice mill wastewater on cocoon production, earthworm populations showed best performance at 50% concentration of the rice mill wastewater and further decrease in total nitrogen as the population of the earthworm decreases. Rice mill wastewater should be diluted to at least 50% or treated to make it suitable for irrigational purpose. However, further

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works on the effect of rice mill effluent on soil and crop system is needed to reach a better conclusion.

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