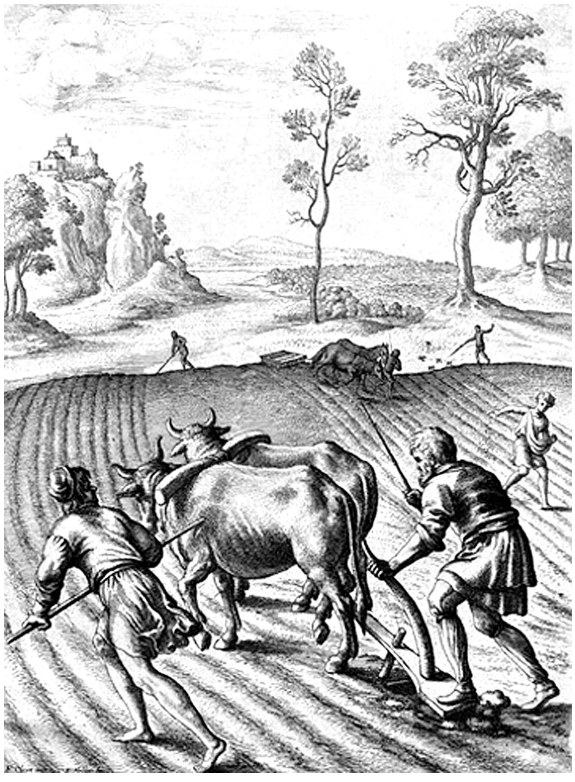
ISSN : 1812-5379 (Print)
ISSN : 1812-5417 (Online)
http://ansijournals.com/ja

JOURNAL OF AGRONOMY



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Pakistan Journal of Agronomy 1 (2-3): 64-65, 2002

Effect of Water-hyacinth Compost on Physical, Physico-chemical Properties of Soil and on Rice Yield

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Abstract: A pot experiment was set to find the effect of compost prepared from water-hyacinth on the experimental soil properties and on rice (BR-11) yield. Two months were needed to stable C/N ratio to 8 of water-hyacinth by decomposing in gunny bags. The compost has a positive effect on the formation of microaggregate of the soil. Water holding capacity also increased significantly with increasing content of water-hyacinth in the soil. Tremendous changes in cation exchange capacity were found with increasing application of water-hyacinth compost and it found 23.75% higher than the control at highest content of water hyacinth compost treatment. On the other hand, non-significant changes in pH occur with the application of the compost. Grain yield of rice also increases with the application of water-hyacinth compost in the soil and the highest 8.13% yield increase was obtained.

Key words: Water-hyacinth, rice, physiological parameters, yield

Introduction

Due to extensive and improper use of chemical fertilizers in the soil, our soil is degrading to an alarming level, causing an imbalance in the ecosystem and environmental pollution as well. To avoid these adverse effects and also for sustainable agriculture, one should rely on ecological oriented resource conserving technologies. On the other hand, organic matter contents of soil play a major role in natural ecosystems and extensive agriculture (Paul, 1984). In humid tropical region, high temperature and rainfall hasten the decomposition of organic matter. As a result organic matter need to be added in the soil frequently in tropical region.

In Bangladesh huge amounts of water hyacinth are found in the lakes, ponds and rivers causing problems in navigation, fisheries as well as deep-water rice production but water-hyacinth could be use as an effective source of soil organic matter. If the organic residues added to the soil without being well decomposed it will adversely affect plant growth by producing phyto-toxic compounds (Cocharam *et al.*, 1977; Linch, 1976). In this experiment, compost was prepared from water-hyacinth to find their effect on physical and phsico-chemical properties on the experimental soil as well on rice yield.

Materials and Methods

A pot experiment was set up in a net house at Department of Soil Science, University of Dhaka, during 1992-93 using rice (BR-11) on sandy loam soil. The soil was dried in the air, ground and passed through a 2mm sieve. Water-hyacinth plants were collected and cut into pieces and then put in gunny bags. The bags compactly filled having their mouths tied up with ropes. Afterwards, the bags were put together in a shady and upland area and allow them to decompose for a period of 2 months. The gunny bags were used to ensure that the initial anaerobic fermentation temperature was remained high enough to promote the activities of the thermophiles (Stutzenberger *et al.*, 1970) and to destroy the pathogens on the other hand (Rashid, 1998). The bags were watered from time to time to keep them moist and when the bags showed sign of rotting the contents were transferred into new bags. After the stipulated time, sample were dried in the air and pulverized. The carbon and nitrogen contents of the compost were determined. Organic carbon was determined by the wet oxidation method of Walkley and Black as outlined by Jackson (1973) and total nitrogen was determined by Kjeldahl method (Black *et al.*, 1965).

In the experiment, the treatment combinations were as follows:

T_1 = Control
T_2 = Soil + 300g Water-Hyacinth Compost (W.H.C.)
T_3 = Soil + 500g (W.H.C.)
T_4 = Soil + 1000g (W.H.C.)

There are five replications of each treatment. Six kg soil was taken in the plastic pots and required quantity of powdered compost was added to each pot. After eight months of incubation the following physical and physico-chemical properties were analyzed. The mechanical composition was determined by hydrometer method (Bouyoucos, 1962). The pH was measured by a glass electrode pH meter and water holding capacity by a pressure membrane apparatus at 0.3bar. Cation exchange capacity was determined by the Walkley and Black's rapid titration method (1934). Microaggregate analysis was carried out by the method described by Day (1965). The method was same as particle size analysis without using any dispersing agent and mechanical dispersion. Only 2 hours of mechanical shaking was used. Index of aggregation was calculated from the data of microaggregate analysis as suggested by Baver and Rhoades (1962).

After the determination of physical and physico-chemical properties of the experimental soil from each treatment, the pots of each treatment were prepared for rice (BR-11) production. Nitrogen, potassium, phosphorus and sulphur were applied at the rate of 45, 60, 40 and 10kg ha^{-1}, respectively as basal doses. Next, five weeks of old rice seedlings were transplanted at the rate of two hills per pot. Rice was harvested at 110 days after transplantation and different agronomical parameters were determined.

Results and Discussion

In this experiment, the C/N ratio of water-hyacinth fell rapidly to 8 within two three months and remains more or less stable. It was found (Table 1) that initially, the nitrogen content of water-hyacinth was rather higher (1.94%). This could be due to plants used were young and more succulent, this will cause higher nitrogen content in plant (Alexander, 1977) as well as in the compost. The state of aggregation of soil increases significantly with increasing water hyacinth compost in the soil (Table 2). This was due to the fact that the state of aggregation increases with increasing soil organic matter (Martin *et al.*, 1955).

Table 1: Carbon and nitrogen content and C/N ratio of the compost

Composting time (month)	C%	N%	C/N ratio
0 .0	33.0	1.94	17.0
1.5	19.0	1.58	12.0
2.0	9.0	1.13	8.0

The degree of aggregation significantly differs among the treatments (Table 2). It was 27% higher than the control where 1000g of water hyacinth was used per pot. Rashid and Iftekhar (1992) also reported that the degree of aggregation of soil increased due to water hyacinth compost. There was also positive correlation between degree of aggregation and organic carbon content in the soil among treatment means. Water holding capacity also increased due to addition of water hyacinth (Table 2) and similar results were also obtained by Rashid and Iftekhar (1992) and Kelling *et al.* (1977). Water hyacinth compost may improve water holding capacity in two ways: firstly, the particles of water hyacinth may have a direct effect as organic particles

Table 2: Mean values of state of aggregation, degree of aggregation, dispersion factor of the experimental soil with standard deviations (±) as influenced by water-hyacinth compost.

Parameters	T_1	T_2	T_3	T_4
State of aggregation (%)	14.24 ± 0.92 d	15.61 ± 1.06 c	16.25 ± 0.54 b	18.86 ± 0.98 a
Degree of aggregation	0.48 ± 0.06 c	0.53 ± 0.09 b	0.54 ± 0.08 b	0.61 ± 0.06a
Dispersion factor	28.99 ± 0.95 d	25.12 ± 0.98 c	23.29 ± 1.01b	17.69 ± 1.00 a

Table 3: Mean values of water holding capacity, cation exchange capacity, organic carbon and pH of rice (BR-11) with standard deviations (±) as influenced by water-hyacinth compost.

Parameters	T_1	T_2	T_3	T_4
Water holding capacity (%)	8.21 ± 0.98 c	9.22 ± 0.56 c	9.86 ± 0.61 b	10.16 ± 0.26 a
Cation exchange capacity (meq/100gm)	1.98 ± 0.19 d	2.93 ± 0.32 c	3.54 ± 0.11 b	4.61 ± 0.29 a
Organic carbon (%)	0.49 ± 0.08 d	0.62 ± 0.06 c	0.79 ± 0.07 b	0.89 ± 0.62 a
pH	7.12 ± 0.12 b	7.18 ± 0.09 a	7.18 ± 0.09 a	7.19 ± 0.08 a

Table 4: Mean values of fresh weight of grain and straw and number of panicle initiation of rice (BR-11) with standard deviations (±) as influenced by water-hyacinth compost

Parameters	T_1	T_2	T_3	T_4
Fresh wt. of grains/pot (g)	17.20 ± 2.54 c	17.96 ± 1.61 bc	18.31 ± 1.98 ab	18.60 ± 1.54 a
Fresh wt. of straw/pot (g)	45.83 ± 6.12 c	46.24 ± 3.79 b	46.26 ± 4.46 b	46.97 ± 5.31 a
No. of panicle/pot	14.36 ± 1.98 b	14.85 ± 2.21 ab	14.96 ± 1.25 a	15.22 ± 1.33 a

Treatments not followed by the same letter(s) are statistically significant at p = 0.05 (Duncan test).
T_1 = Control, T_2 = Soil + 300g W.H.C., T_3 = Soil + 500g W.H.C., T_4 = Soil + 1000g W.H.C.

themselves have a high water holding capacity; secondly, by influencing the physical properties of soil such as bulk density, porosity etc.

Cation exchange capacity increases markedly with increasing the content of water-hyacinth and it was found 12.30, 20.09 and 23.75% higher then control, respectively. Very slight change in pH was obtained with increase in the content of water hyacinth.

Fresh weight of grain increases slightly with increasing content of water-hyacinth compost in the treatments. It was 4.42, 6.45, 8.13% higher than control at T_2, T_3, T_4 treatments respectively (Table 3). In case of fresh weight of straw, highest weight was found 46.97g/pot at the treatment T_4 and lowest weight was found 45.83g/pot at T_1 treatment. Therefore, the highest yield increases was found 2.48% comparing the treatment T_4 with T_1. It has been found (Sarwar *et al.*, 1998, 2000) that biofertilizer has positive impact on rice farming which also support the present experimental results.

From the experiment, it can be concluded that water-hyacinth compost improve the physical and physicochemical properties of soil. Rice yield also increases slightly with water hyacinth content in the soil. Therefore, water hyacinth can be a very good source of organic fertilizer for sustainable agriculture.

Acknowledgment

The authors are grateful to Prof. Dr. G.H. Rashid of the Department of Soil, Water and Environment for his interest, encouragement and necessary help to carry out the research successfully.

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