J. Phytol. Res. **29** (1 & 2) : 31-37, 2016 **ISSN 0970-5767**

EFFECTS OF COW DUNG AND RICE HULL ON THE GROWTH AND YIELD OF RICE GROWN IN THE MIXED SOIL

S. KARMAKER, H. R. KHAN and R. MANDAL
Department of Soil, Water and Environment, University of Dhaka, Dhaka-1000, Bangladesh.
Contact address: Shusmita Karmaker. C/O- Shyamol Karmaker. House- 10, Sector- 4, Road- 3, Uttara, Dhaka- 1230, Bangladesh.
* Corresponding author : E-mail: shusmita.karmaker@gmail.com

Effects of cow dung (CD) (0, 5, 10 t ha-1) and rice hull (RH) (0, 2, 4 t ha-1) in response to rice (BRRI 65) in mixed soil showed that agronomic attributes such as height, number of tillers and dry weight of rice plant increased significantly due to addition of CD and RH alone and their combinations. However, dry weight of rice plant did not increase due to interaction of their highest doses. Yield attributes like number of grains and yield of grain increased due to application of CD and RH alone and in combination but in case of yield of grain the trend was erratic. Moreover, the yield index, i.e., 1000-grain weight showed no definite trend due to treatments applied. Contents of N, P, K, S, Ca and Mg of shoot and grain showed an increase with the increase of doses of CD and RH alone. Interaction between CD and RH in case of P, Ca and Mg content in shoot and grain showed an almost similar result. N, K and S content of shoot and grain increased with the increase of doses due to interaction of amendments.

Keywords: Cow dung; Factorial combination; Mixed soil; Rice hull, Rice (BRRI 65).

Introduction

For ages and centuries, Bangladesh has been known as one of the most fertile land in the world. The land has been the bread and butter of our economy and its big population. Our agriculture has been using and providing the state-of-the-art techniques to increase its huge demand of food supply and it has succeeded almost 100% for feeding its 160 million of people with our own innovative ideas and techniques. The maintenance of good soil fertility is essential for sustainable crop production, which requires the regular use of organic sources of nutrient- like organic manures and biofertilizers to keep the farm income higher of the farming community. Inorganic, organic and biofertilzers are the main sources for replenishing plant nutrients in agricultural soils[1]. Use of organic fertilizer is a production system that avoids or largely excludes the use of synthetic fertilizers, pesticides, growth regulators and livestock feed additives[2].

In Bangladesh rice is abundantly produced because of its growing characters, increasing demand and favorable weather condition. CD can also be used as a co-

product in agriculture, such as manure, bio fertilizer, bio pesticides and pest repellent[3]. CD may not only act as a substitute for chemical fertilizers because it supplements organic matter, but also as a conditioner for soil[4]. RH from paddy (*Oryza sativa*) is one example of alternative material that has a great potential. A substantial area of Bangladesh is covered by problem soil of which acid soil was considered to improve its nutrient availability through mixing with requisite proportion of calcareous soil. The present study was undertaken to evaluate the effects of CD and RH to follow the yield and quality of BRRI 65 variety of rice in the mixed soil.

Materials and Methods

A pot experiment with rice (BRRI 65) was carried out during Aus season in the green house of the premises of the Department of Soil, Water and Environment, University of Dhaka. To assess the best mixing proportion, an incubation study was carried out to attain the pH around 6.8 (acid: calcareous soil ratio was being 7:3, Zhang and Li[5]. Five kilogram of air dried soil was taken in each earthen pot **(**25cm X 20cm). Three rates of each of CD (0, 5, 10, t ha^{-1}) and RH (0, 2, 4, t ha^{-1}) in all possible combinations were applied to the soil and nine treatments, in triplicate, were arranged in randomized block design. A basal dose of N, P and K at the rate of 120 kg ha^{-1}, 60 kg ha^{-1} and 80 kg ha^{-1} was applied as urea, triple super phosphate and murate of potash respectively. The fertilizers were mixed thoroughly with the soil as per treatment combinations. Soils in the pot were submerged for five days before transplantation. Five healthy seedlings of 4 weeks old, uniform in size, were transplanted in each pot. Agronomic characters and yield attributes were measured at harvest.

Nutrient content (N, P, K, S, Ca and Mg) of shoot and grain were determined following standard method. N was determined by Kjeldahl's method from concentrated H2SO4-HClO4 digest. The shoot and grain sample were digested with concentrated nitric acid and perchloric acid. P content was determined colorometrically using a HACH spectrophotometer (model no. DR5000) by developing yellow color with vanadomolybdate[6]. K content was determined by using flame photometer (JENWAY, PFP 7) as outlined by Page[7]. S content was determined by developing turbidity of suspended barium sulphate using Tween-80 stabilizer following digestion with concentrated nitric acid and perchloric acid as proposed by Page[7]. Ca and Mg in the digest were determined by the Atomic Absorption Spectrophotometer (model no. VARIAN AA240).

Results and Discussion

Results showed that application of CD (0, 5, 10 t ha^{-1}) and RH (0, 2, 4 t ha^{-1}) alone increased the agronomic and yield attributes viz. height, number of tiller, dry weight of shoot, weight of grain and 1000 grain weight of rice plant (Table 1).

Height (cm): Interaction of CD and RH increased the height of the rice plant with the increase of doses of CD and RH (Table 1). Results further showed that application of 5 t CD per ha^{-1} in association with 2 t RH per ha was found to be not significant. However, increase in the rate of RH from 2 to 4 t ha^{-1} resulted significant increase in height of the plant. Similarly, addition of 10 t CD per ha along with RH resulted significant improvement in height of the plant. Intermediate dose of CD (5 t ha^{-1}) with 2 t RH per ha caused no significant change. In contrast, 5 t CD per ha^{-1} together with 4 t RH per ha produced significant positive variation in height of the plant over

control. The results agreed favorably well with the findings of Moghadam and Heidarzadeh[8] who observed that the effect of rice husk on the height of rice plant was significant. Islam[9] also showed that the highest plant height, number of tillers hill–1 and grain yield were obtained from the combination of 50% recommended dose of fertilizer with 5 t ha^{-1} CD.

Number of tiller (pot-1): Interaction of CD and RH showed that increase of their doses increased the tiller number of rice plant. However, the application of lower dose of both CD and RH caused a significant change over the control. Results further showed that application of 5 t CD ha^{-1} in association with 2 and 4 t RH ha^{-1} caused a significant increase in tiller number of the plant. CD when applied at the rate of 10 t ha^{-1} with 4 t RH ha^{-1} resulted significant increase in number of tiller over the control (Table 1). Pratiwi and Shinogi[10] reported that application of rice husk biochar increased the growth parameters of rice plant.

Dry weight of shoot (g pot-1): Combined application of CD and RH showed that 2 t ha^{-1} RH with 5 and 10 t ha^{-1} CD application increased the dry weight of rice shoot. However, application of 4 t ha^{-1} RH with 5 t ha^{-1} CD increased the dry weight but a decrease was observed when 4 t ha^{-1} RH was applied with 10 t ha^{-1} CD (Table 1). Similarly, Moghadam and Heidarzadeh[8] also stated that the yield of dry weight of rice plant was not significant due to organic fertilization.

Weight of grain (g pot-1): CD and RH when applied combined showed a positive impact on the weight of the rice grain. Interaction of 2, 4 t ha^{-1} RH with 5 t ha^{-1} CD increased the weight of grain but in case of 10 t ha^{-1} CD the weight decreased (Table 1). Mobasser[11] reported that grain yield was significantly higher in CD treated plots compared with the unfertilized control. Hemlatha[12] also reported that incorporation of organic manure improved the rice yield.

1000 grain weight (g): In case of combined application of CD and RH, maximum weight was recorded in treatment receiving lower doses of both CD and RH i.e. 5 t ha^{-1} CD and 2 t ha^{-1} RH. The overall highest weight of 1000 grain was found to be in the treatment receiving only 10 t CD per ha recording 19.6g (Table 1). This finding is in agreement with Reddy[13] who conducted a field experiment and found that application of organic manure produced better growth components, viz., plant height, number of tillers per hill, panicle length and 1000-grain weight over the control.

Nutrient content of rice shoot: The nutrient content (N, P, K, S, Ca and Mg) of rice shoot at harvest have been quantified and the results thus obtained have presented in Table 2. With the increasing doses of CD, the content of N in shoot increased and similar trend was maintained in the case of RH too (Table 2). Addition of 5 t ha^{-1} of CD with 2 and 4 t ha^{-1} of RH increased the content of N of rice shoot. On the contrary, higher doses of CD (10 t ha^{-1}) with RH (2, 4 t ha^{-1}) caused a decrease in N content insignificantly. Among the single doses, the highest content of N was recorded to be 1.30 % due to the addition of 10 t ha^{-1} CD. Content of P in plant tissue as influenced by added CD and RH alone and an increasing trend was maintained. Combined application of CD and RH showed that P content was increased around 55 % at the highest rate of both CD (10 t ha^{-1}) and RH (4 t ha^{-1}). When CD was applied at the rate of 5 t ha^{-1} with RH (2, 4 t ha^{-1}) showed an identical result that is 0.12%. However, the variation between the higher doses of both the amendments resulted an irregular change in

Table 1. Effects of CD and RH on the agronomic and yield attributes of rice (BRRI 65**)** plant.

Treatments	Height (cm)	Number of tiller (pot-1)	Dry weight (g pot-1)	Weight of grain (g pot-1)	1000-grain weight (g)
CD_0RH_0	49.9	27	11	0.72	16.2
CD_0RH_2	53.7	31	10.9	0.71	14.6
CD_0RH_4	56	32.6	12.4	0.99	17.8
CD_5RH_0	53.3	31	11.9	0.77	13.7
CD_5RH_2	56.9	33	12.3	1.37	17.5
CD_5RH_4	58.9	35	13.7	1.34	14.1
$CD_{10}RH_0$	58.1	34	12.4	1.34	19.6
$CD_{10}RH_2$	62.7	35	13.8	0.97	12.6
$CD_{10}RH_4$	64.3	36.3	12.1	1.33	15.6
LSD at 5%	6.34	2.88	NS	0.547	5.55

CD (Cow dung) - 0, 5, 10 t ha^{-1}; RH (Rice hull) - 0, 2, 4 t ha^{-1}

Table 2. Effects of CD and RH on the nutrient content (%) of rice (BRRI 65) shoot.

Treatments	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)
CD_0RH_0	0.95	0.09	1.26	0.65	0.25	0.105
CD_0RH_2	1.25	0.13	1.42	0.69	0.34	0.129
CD_0RH_4	1.29	0.14	1.43	0.71	0.35	0.126
CD_5RH_0	1.24	0.13	1.32	0.67	0.36	0.119
CD_5RH_2	1.30	0.12	1.46	0.72	0.35	0.127
CD_5RH_4	1.35	0.12	1.46	0.75	0.36	0.130
$CD_{10}RH_0$	1.30	0.14	1.33	0.75	0.39	0.116
$CD_{10}RH_2$	1.27	0.14	1.45	0.76	0.40	0.117
$CD_{10}RH_4$	1.29	0.14	1.26	0.78	0.41	0.127
LSD at 5%	0.0931	0.078	NS	3.716	NS	NS

CD (Cow dung) - 0, 5, 10 t ha^{-1}; RH (Rice hull) - 0, 2, 4 t ha^{-1}

Table 3. Effects of CD and RH on the nutrient content (%) of rice (BRRI 65) grain.

Treatments	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)
CD_0RH_0	1.51	0.19	0.23	0.25	0.009	0.064
CD_0RH_2	1.65	0.20	0.26	0.29	0.015	0.079
CD_0RH_4	1.79	0.22	0.38	0.31	0.017	0.081
CD_5RH_0	1.62	0.20	0.37	0.31	0.025	0.087
CD_5RH_2	1.75	0.19	0.35	0.41	0.012	0.081
CD_5RH_4	1.78	0.21	0.33	0.43	0.011	0.081
$CD_{10}RH_0$	1.81	0.21	0.31	0.51	0.023	0.082
$CD_{10}RH_2$	1.84	0.27	0.35	0.52	0.014	0.088
$CD_{10}RH_4$	1.85	0.42	0.41	0.61	0.013	0.097
LSD at 5%	0.174	0.053	0.095	0.930	0.00547	0.0109

CD (Cow dung) - 0, 5, 10 t ha^{-1}; RH (Rice hull) - 0, 2, 4 t ha^{-1}

the content of P of rice shoot (Table 2). Verma[14] reported that incorporation of organic manure increased the N and P contents of rice shoot and grain.

Single application of CD and RH caused an increase in the K content of rice shoot. In case of interaction, application of 5 t ha^{-1} CD with RH (2, 4 t ha^{-1}) also showed an increase in K content. Though at the highest rate of CD (10 t ha^{-1}) with RH (2 t ha^{-1}) showed an increase but the content of K was decreased when 4 t ha-1 RH was applied (Table 2). Bramachari[15] reported that productivity and K content of rice plant was positively improved due to organic fertilization. Application of CD and RH alone increased the S content of shoot. Interaction of CD and RH showed an increase in the sulfur content of rice shoot too (Table 2). Hossain[16] reported that application of CD and urea increased the S content of rice plant and grain.

When CD and RH were applied alone it caused an increase in Ca content of rice shoot (Table 2). Addition of CD with RH showed a gradual increase in the calcium content of rice shoot. Moreover, the effect of interaction showed an almost same result. Highest dose of CD (10 t ha^{-1}) with RH (2 and 4 t ha^{-1}) produced insignificant improvement. Application of CD and RH alone caused an increase in Mg content of rice shoot (Table 2). CD alone produced an increase in Mg content of shoot of rice about 13% and 10% over the control when applied at the rate of 5 and 10 t ha^{-1} respectively (Table 2). On the other hand, RH alone at the rate of 2 and 4 t ha^{-1} caused an increase around 22% and 20% over the control respectively. Interaction between CD and RH resulted almost similar trend in the Mg content of rice shoot.

Nutrient content of rice grain: Quality of rice grain has been assessed in terms of nutrient content (Table 3). Content of N in grain of rice plant increased significantly when CD and RH applied alone (Table 3). The interaction between intermediate doses of CD (5 t ha^{-1}) and RH (2 t ha^{-1}) also showed an increase in N content of grain. Moreover, with the increasing doses of CD and RH also resulted significant increase in the same. The increase of CD from 5 to 10 t ha^{-1} produced a significant positive result.

The interaction between the highest dose of CD (10 t ha^{-1}) and RH (4 t ha^{-1}) showed an insignificant increase in the content of N of rice grain. P content of rice grain increased when CD and RH were applied alone (Table 3). Among the interactions, the amendments caused changes in P content of grain. It is noted that the increase due to interactions among the doses of amendments were higher at the highest rates when compared with lower doses. The effect was not significant between 2 t RH x 5 t CD ha^{-1} but it is significant between 2 t RH x 10 t CD at 0.1% level. Data revealed that the highest content of P was recorded in grain due to combined effect of the highest doses attaining 0.42% in grain. The present result is in accordance with Verma[14] who reported that incorporation of organic manure increased the N and P contents of rice shoot and grain. Similarly, Oahiduzzaman[17] stated that application of CD increased the N content of rice grain and also found maximum P content in grain due to application of CD (5.5 t ha^{-1}).

K content of rice grain increased when CD and RH applied alone over the control. The interaction between 2 t RH ha^{-1} and highest dose of CD i.e. 10 t ha^{-1} produced a significant result. Moreover, when the amount of RH increased from 2 to 4 t ha^{-1} also produced significant positive variation in the content of K of grain. Similar effect was observed when the amount of CD increased from 5 to 10 t ha^{-1} (Table 3). Basu[18] reported that application of CD and chemical fertilizers had significant effect on the content of K in rice grain. When CD and RH were applied alone caused an increase in S content of rice grain. Interaction of both the amendments showed significant variation among themselves. Combination of moderate and highest doses of CD and RH improved the S content of grain (Table 3).

An increasing trend was maintained in the Ca content of rice grain when CD and RH were applied alone over the control (Table 3). Combined effect of the intermediate doses produced 0.012% in Ca content of grain. However, in case of combined effect of highest doses, the content of Ca attained about 0.013%. Actually the overall effect of interaction between CD and RH produced almost similar effect. Application of CD and RH alone produced a significant increase in Mg content of rice grain when compared with the control (Table 3). Interaction of CD and RH of intermediate doses caused an insignificant change in result. However, interaction of the highest doses produced a significant result. Basu[18] reported that application of CD and chemical fertilizers had significant effect on the content of Ca and Mg of rice grain.

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