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PERFORMANCE OF POULTRY LITTER BASED COMPOST ON MORPHO-PHYSIOLOGICAL CHARACTERS AND YIELD OF T. AMAN RICE AND SOIL FERTILITY

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Abstract

An experiment was carried out at the Research Field of Crop Physiology and Ecology Department, Hajee Mohammad Danesh Science and Technology University, Dinajpur from July to November 2018. The study evaluated the effects of poultry litter based composts on morpho-physiological, yield and yield contributing characters of transplanted *aman* rice (var.Binadhan-7, BRRI dhan56, BRRI dhan66) and soil fertility. The experiment was laid out in a two factorial complete randomized design (CRD) with three replications. Factor A included three varieties (Binadhan-7: V_1, BRRI dhan56: V_2, and BRRI dhan66: V_3) and factor B comprised of three fertilization levels viz. control (inorganic)-F_1, poultry litter based compost 20 ton ha^{-1}: F_2, and 30 ton ha^{-1}: F_3. The performances of plant growth parameters such as plant height, tiller number, leaf number, leaf area, SPAD value, as well as yield and yield contributing parameters, and soil chemical properties were measured. Varieties and fertilizer levels significantly influenced most of the morpho-physiological traits and yield and yield contributing characters. The tallest plant was recorded from V_2 variety (BRRI dhan56). The highest leaf number hill^{-1} (80.89 at 30 DAT) was recorded from V_3 (BRRI dhan66). The highest number of tiller was produced by the interaction of compost F_2 (20 t ha^{-1}) with V_1 (Binadhan-7). The highest effective tiller number (13.67) hill^{-1}wasrecorded from F_2 (compost 20 t ha^{-1}) with F_1 (Binadhan-7) at maturity. The longest panicle (24.16 cm) was found in F_1V_1 (inorganic with Binadhan-7) treatment. The highest 1000-grain weight (23.57 g) was recorded from F_3V_3 treatment (compost-30 t ha^{-1} with BRRI dhan66). The maximum harvest index was recorded from F_1 (inorganic) with BRRI dhan66. Soil fertility status increased with higher dose poultry litter based compost (30 t ha^{-1}).

Introduction

Rice (*Oryza sativa* L.) is the principal food crop in Bangladesh, and about 74.85% of the total arable lands are used for rice (*aus*, *aman* and *boro*) cultivation (BBS, 2018). Rice plays a dominant role in Bangladesh agriculture sinceit covers 74.85 percent of the total cropped area (BBS, 2018). The yield of rice is low (3.072 t ha^{-1}) in Bangladesh compared to other rice-growing countries (BBS, 2018). It has already been reported that decreasing organic matter in farm soils has caused significant yield reductions (Shelly *et al.*, 2016). Almost 85% of the population of Bangladesh lives in rural areas having the main occupation of farming. The government of Bangladesh has given the highest priority to increase food availability in the country (Saha *et al.*, 2009). One of the methods to reach this goal regarding increasing the food sufficiency is the reduction of the yield gap of the food grain per unit area. A modern variety of transplant *aman* can be planted intensively to augment income and welfare for low-income farmers (Sarker *et al.,* 2013). The depleted soil fertility is a major constraint to higher crop production in Bangladesh. Rice-rice is the most common cropping system in Bangladesh. Continuous practicing of this highly exhaustive cropping sequence in most irrigated fertile lands resulted in the decline of soil physio-chemical conditions in general, particularly soil organic matter (SOM) content (Liza *et al.*, 2014 and Hossaen *et al.,* 2011).

It is known that inorganic fertilizers supply only nutrients in the soil, but organic manure supplies nutrients as well as improves soil quality. The long term impact of chemical fertilizers on soils and the environment is harmful (Tilahun *et al.,* 2013, Diacono and Montemurro, 2010 and Golabi *et al.*, 2007). The use of unbalanced nutrients in the soils may be harmful in the long run causing soils an unproductive one. Indeed, sustainable production of crops cannot be maintained by using only chemical fertilizers, and similarly, it is not possible to obtain higher crop yield by using organic manure alone (Saha, 2014 and Bair, 1990). A judicious combination of organic and inorganic sources of nutrients is necessary for sustainable agriculture that can ensure food production with high quality (Islam *et al.*, 2014 and Nambiar, 1991). Integrated use of organic manure and chemical fertilizers would be quite promising not only in providing high stability in production but also in maintaining better soil fertility (Chowdhury *et al.*, 2020 and Alam, 2017). Poultry manure is another good source of nutrients in the soil. Meelu and Singh (1991) showed that 4 t ha^{-1} poultry manure along with 60 kg N ha^{-1} as urea produce grain yield of crop similar to that with 120 kg Nha^{-1} as urea alone. But direct application of poultry manure has harmful effects on soil health (Urra *et al.,* 2019). That's why it needs to be composted. Poultry litter based compost can supply a substantial amount of plant nutrients and, therefore, can contribute to crop yields (Chowdhury *et al.,* 2013, Kobra, 2016; Najafi and Abbasi, 2013).

Therefore, it is necessary to use fertilizer and manure in an integrated way to obtain sustainable crop yield without declining soil fertility. Applications of both chemical and organic fertilizers need to be applied for the improvement of soil physical properties and supply of essential plant nutrients for higher yield. The present investigation was, therefore, undertaken to develop a suitable integrated dose of poultry litter based compost for rice (var.Binadhan-7, BRRI dhan56, BRRI dhan66) and to observe the effects of different levels of inorganic fertilizers and poultry litter based compost on the yield and yield components of rice (var. Binadhan-7, BRRI dhan56, BRRI dhan66) as well as soil fertility.

Materials and Methods

The experiment was conducted to find out the effect of fertilizer and manure on the yield of T. *aman* rice. It was conducted during the period from July to November 2018 in the wet season. The location of the site is Crop Physiology and Ecology Research Field, Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur. The experiment was laid out in a two factorial complete randomized design (CRD) with three replications.

Factor-A: Three varieties were V1 = Binadhan-7, V_2 = BRRI dhan56, V_3= BRRI dhan66 and **Factor-B:** Three fertilization treatment were: F1 = Control (inorganic), F_2 = compost 20 t ha^{-1}, F_3 = compost 30 t ha^{-1}.

The soil was collected from the arable land of Crop physiology and Ecology Research Field, Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur from a depth of l5 cm. The collected soil was sundried for a week, and the weeds were removed. Fifteen-kilogram soil was taken into each pot. Thus the pots were ready for planting. The pots were placed in the selected space of the research field of Crop Physiology and Ecology, HSTU, Dinajpur in 18 rows and 3 columns. The row to row and column to column distance was maintained properly.

The amounts of N, P, K, S and Zn fertilizers required per pot (control) were calculated as per the weight of soil. The full amount of TSP, MoP, gypsum and zinc sulphate was applied as basal dose before transplanting of rice seedlings for F_1 fertilization (control). Poultry litter based composts were applied150 g pot^{-1} for F_2 fertilization and 225 g pot^{-1} for F_3 fertilization. The compost used in this research was made by Kobra (2016). Composting material was poultry manure, sawdust, rice husk and ash. Chemical compositions of poultry litter based compost were N-1.6%, P-1.21%, and K-0.35% (Kobra, 2016). The seedlings of rice (var. Binadhan-7, BRRI dhan56and BRRI dhan66) were collected from BADC, Dinajpur. During seedling growing, no fertilizers were used. Proper water and pest management practices were followed whenever required. Forty days old seedlings of rice were carefully transplanted on July 23, 2018in well puddle pots. Three seedlings were sown in each pot. Intercultural operations were done to ensure the normal growth of the crop. Plant protection measures were followed as and when necessary. Soil N, P, K, S, pH, organic matter and organic carbon were measured. Soil analysis was done following standard methods at SRDI, Nashipur, Dinajpur. The data obtained for different parameters were statistically analyzed to find out the significant difference between chemical fertilizers and poultry litter based composts on the yield of transplant *aman* rice. The mean values of all the characters were calculated and analysis of variance was performed by MSTAT-C statistical software. The significance of the differences among the treatment means was estimated by Duncan's Multiple Range Test (DMRT) at 5% level of probability (Gomez and Gomez, 1984).

Results and Discussion

The experiment was conducted to find out the effect of fertilizer and manure on the yield of T. *aman* rice in different soil. The results are presented and discussed in the Tables and possible interpretations are given under the following headings.

Plant height

The effects of poultry litter based composts on plant height at different days after transplanting (DAT) were statistically significant (Table 1). Results showed that plant height increased with various doses of compost. The tallest plant was recorded in BRRI dhan56 at 30 DAT where the lengths were 74.22, 99.11, 101.3, 101.6 and 103.6 cm at maximum vegetative, booting, anthesis, and maturity stages, respectively. The shortest plant was recorded from Binadhan-7 where the lengths of the plants were 63.78, 78.78, 85.78, 88.78 and 91.22 cm at 30 DAT, maximum vegetative, booting, anthesis and maturity stages respectively. The tallest plant was recorded from F_1fertilization (inorganic) (72.78 cm at 30 DAT). The tallest plant was recorded from F_3fertilization (compost-30t ha^{-1}) (92.22 and 101.1 cm at vegetative and booting stages, respectively. And the tallest plant was recorded from F_1fertilization (inorganic) (95.44 and 98.11 cm at anthesis and maturity stages, respectively. The shortest plants were recorded from F_2fertilization (compost-20 t ha^{-1}) (64.67, 85.11, 88.00, 94 and 96 cm at 30 DAT, maximum vegetative, booting, anthesis and maturity stages, respectively). Plant height was significantly affected by the interaction between fertilization and different varieties (Table 1). Results indicated that the tallest plants (84.67, 104.7, 108, 105.3 and 107.3 cm at 30 DAT, maximum vegetative, booting, anthesis and maturity stages, respectively were found in F_2 (compost 20 t ha^{-1}) fertilization with variety V_1 (Binadhan-7), and the shortest plants (61.33cm at 30 DAT) from F_3V_2. Inorganic fertilizer may help in initial plant height enhancement due to quick nutrient availability, but later on, similar results were found by the application of other treatments (poultry litter based composts). A similar result was also reported by Hosaain *et al.* (2010) and Buri *et al.* (2006).

Number of leaves hill^{-1}

The effects of poultry litter based composts on leaf number hill^{-1} at different days after transplanting (DAT) were statistically insignificant (Table 2). Results showed that leaf number hill^{-1} increased with minimum different doses of compost. The highest leaf number hill^{-1} (80.89 at 30 DAT) was recorded from V_3. The highest leaf number hill^{-1} at vegetative and booting were recorded from V_2 (BRRI dhan56) and the highest leaf number hill^{-1} at anthesis was recorded from V_1 (Binadhan-7). The lowest leaf number hill^{-1}was recorded from V_3 (54.56) at anthesis. The different fertilization doses influenced the leaf number hill^{-1}. The highest number of leaves hill^{-1} was found from F_3 and the lowest one was for F_2 at anthesis. Leaf number hill^{-1} was insignificant.

Number of tiller hill^{-1}

The effects of poultry litter based composts on tiller hill^{-1}at different days after transplanting (DAT) were statistically significant (Table 3). Results showed that the number of tillers hill^{-1} increased with various doses of compost. The highest number of tiller number hill^{-1} was recorded from V_2 variety (BRRI dhan56) (15.33, 14.89, 15.56, 13.11 and 14.11 at 30 DAT, maximum vegetative, booting, anthesis and maturity stages, respectively). The shortest plant was recorded from V_1 variety (Binadhan-7) (13, 13.44, 14.89, 12.78 and 13.44 at 30 DAT, maximum vegetative, booting, anthesis and maturity stages, respectively). The highest tillers number hill^{-1} were recorded from F_1 (inorganic) (15.33, 15.33, 13.67 and 15.44 at 30DAT, maximum vegetative, anthesis and maturity stages respectively). The highest tillers number hill^{-1}were recorded from F_3 (compost-30 t ha^{-1}) (16.22 at booting stage). The lowest tillers number hill^{-1}were recorded from F_2 (compost-20 t ha^{-1}) (12.56, 11.89 and 13.89 at 30 DAT, vegetative, booting stages, respectively). The lowest tiller number hill^{-1} was recorded from F_3 (compost-30 t ha^{-1}) (11.78 and 12.33 at anthesis and maturity stages, respectably).

Table 1. Effect of fertilization on plant height of different rice varieties at different stages

Treatments	**Plant height (cm)**				
Varieties	**30 DAT**	**Vegetative**	**Booting**	**Anthesis**	**Maturity**
V_1=Binadhan-7	63.78b	78.78b	85.78b	88.78b	91.22b
V_2=BRRI dhan56	74.22a	99.11a	101.3a	101.6a	103.6a
V_3=BRRI dhan66	65.11b	90.67a	98.56a	94.22ab	97ab
Level of significance	**	**	*	**	**
		Fertilization			
F_1=Inorganic	72.78a	91.22	96.56ab	95.44	98.11
F_2=Compost 20 tha^{-1}	64.67b	85.11	88.00b	94.00	96.00
F_3=Compost 30 tha^{-1}	65.67b	92.22	101.10a	95.11	97.67
Level of significance	**	NS	*	NS	NS
		Interaction			
V_1	64.00bc	82.33bc	90.67ab	92.33cd	96.33bc

Treatments		Plant height (cm)				
F_1	V_2	62.67bc	72.00c	71.00b	86.33d	88.ood
	V_3	64.67bc	82.00bc	95.67a	87.67d	89.33cd
	V_1	84.67a	104.7a	108.00a	105.3a	107.30a
F_2	V_2	70.00b	90.67ab	93.67a	101.7ab	103.7ab
	V_3	68.00bc	102.0a	102.30a	97.67abc	99.67ab
	V_1	69.67b	86.67b	91ab	88.67d	90.67cd
F_3	V_2	61.33c	92.67ab	99.33a	94.00b-d	96.33bc
	V_3	64.33bc	92.67ab	105.30a	100.00a-c	104.00ab
Level of significance		**	*	*	**	**
CV (%)		5.00	7.99	11.10	5.82	5.49

In a column, means followed by a different letter(s) differed significantly by Duncan's Multiple Range Test at $P \leq 5\%$ level of probability.
NS indicates insignificant, *indicates significant at 5% level of probability
**indicates significant at 1% level of probability

Table 2. Effect of fertilization on leaf number of different rice varieties at different stages

Treatments		Leaf number			
Varieties		**30 DAT**	**Vegetative**	**Booting**	**Anthesis**
V_1=Binadhan-7		67.56	85.56ab	90.11	54.56
V_2=BRRI dhan56		69.56	94.33a	93.11	53.89
V_3=BRRI dhan66		80.89	75.56b	91.56	51.67
Level of significance		NS	*	NS	NS
		Fertilization			
F_1=Inorganic		77.11	90.22ab	95.56a	57.00
F_2=Compost 20 tha^{-1}		63.56	70.11b	81.78a	49.67
F_3=Compost 30 tha^{-1}		77.33	95.11a	97.44a	53.44
Level of significance		NS	*	NS	NS
		Interaction			
	V_1	80.00	98.00	90.67	58.67
F_1	V_2	54.67	68.33	89.33	54.67
	V_3	68.00	90.33	90.33	50.33
	V_1	77.67	104.0	100.7	58.33
F_2	V_2	59.00	76.67	78.67	45.67
	V_3	72.00	102.3	100.00	57.67
	V_1	73.67	68.67	95.33	54.00
F_3	V_2	77.00	65.33	77.33	48.67
	V_3	92.00	92.67	102.00	52.33
Level of significance		NS	NS	NS	NS
CV (%)		28.98	23.32	17.94	15.78

In a column, means followed by a different letter(s) differed significantly by Duncan's Multiple Range Test at $P \leq 5\%$ level of probability.
NS indicates insignificant
*indicates significant at 5% level of probability
**indicates significant at 1% level of probability

Number of effective tillers hill^{-1}

The effects of varieties on the number of effective tillers hill^{-1} at different days after transplanting (DAT) were statistically significant (Figure 1). Results showed that the number of effective tiller hill^{-1} increased with various doses of poultry-based compost. The highest number of effective tiller hill^{-1} was recorded from V_2 (BRRI dhan56) (11.44 and 12.33 at anthesis and maturity stage, respectively). The lowest number of effective tillers hill^{-1} was recorded from V_3 (BRRI dhan66) (10.89 and 11.56 at anthesis and maturity stage, respectively). The number of effective tillers hill^{-1} was influenced by different fertilization presented in Fig. 2. It was observed that F_1 (inorganic) produced the highest number of effective tillers hill^{-1} (11.89 at anthesis stage), and F_2 (compost-20 t ha^{-1}) showed the lowest result (12.33 at maturity stage). The number of effective tillers hill^{-1} was significantly affected by the interaction between varieties and fertilization (Fig. 3). Results indicated that the highest number of effective tillers hill^{-1} (12.67, 13.67) was found in the combination of V_1F_2 (Binadhan-7 with compost-20 t ha^{-1}). Nitrogen availability may play an important role in the tiller generation. Inorganic fertilizer is a good source of available nitrogen with flooding irrigation as per Islam *et al.* (2014), Shaha (2014) and Hossain (2010). Alam *et al.* (2012) also stated similar findings.

Table 3. Effect of fertilization on tiller number of different rice varieties at different stages

Treatments		**Tiller number**				
Varieties		**30DAT**	**Vegetative**	**Booting**	**Anthesis**	**Maturity**
V_1=Binadhan-7		13.00	13.44	14.89	12.78	13.44
V_2=BRRI dhan56		15.33	14.89	15.56	13.11	14.11
V_3=BRRI dhan66		13.67	13.22	15.56	12.11	12.78
Level of significance		Ns	NS	NS	NS	NS
Fertilization						
F_1=Inorganic		15.33	15.33	15.89	13.67	15.44
F_2=Compost 20 tha^{-1}		12.56	11.89	13.89	12.56	12.56
F_3=Compost 30 tha^{-1}		14.11	14.33	16.22	11.78	12.33
Level of significance		Ns	*	NS	NS	**
Interaction						
	V_1	17.00a	16.33	14.67	14.00	15.33ab
F_1	V_2	8.33b	11.67	15.00	13.00	13.33abc
	V_3	13.67ab	12.33	15.00	11.33	11.67c
	V_1	16.67a	17.33	17.00	14.00	16a
F_2	V_2	15.67a	12.00	13.00	13.00	12.67bc
	V_3	13.67ab	15.33	16.67	12.33	13.67abc
	V_1	12.33ab	12.33	16.00	13.00	15ab
F_3	V_2	13.67ab	12.00	13.67	11.67	11.67c
	V_3	15.00a	15.33	17.00	11.67	11.67c
Level of significance		*	NS	NS	NS	**
CV (%)		18.49	21.70	20.16	17.52	15.75

In a column, means followed by different letter(s) differed significantly by Duncan's Multiple Range Test at $P \leq 5\%$ level of probability.
NS indicates insignificant
*indicates significant at 5% level of probability
**indicates significant at 1% level of probability

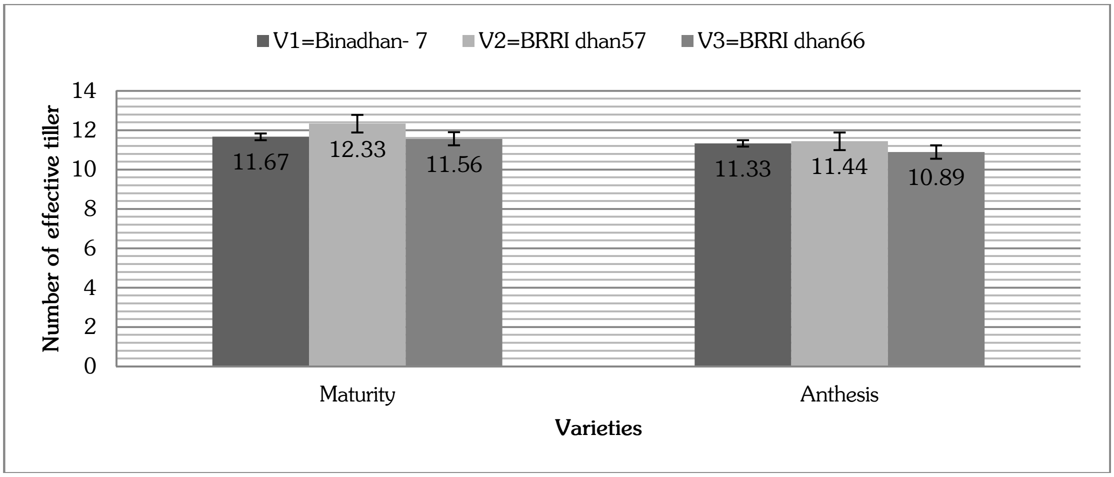

Fig. 1. Effect of different varieties on effective tiller/hill at anthesis and maturity stages

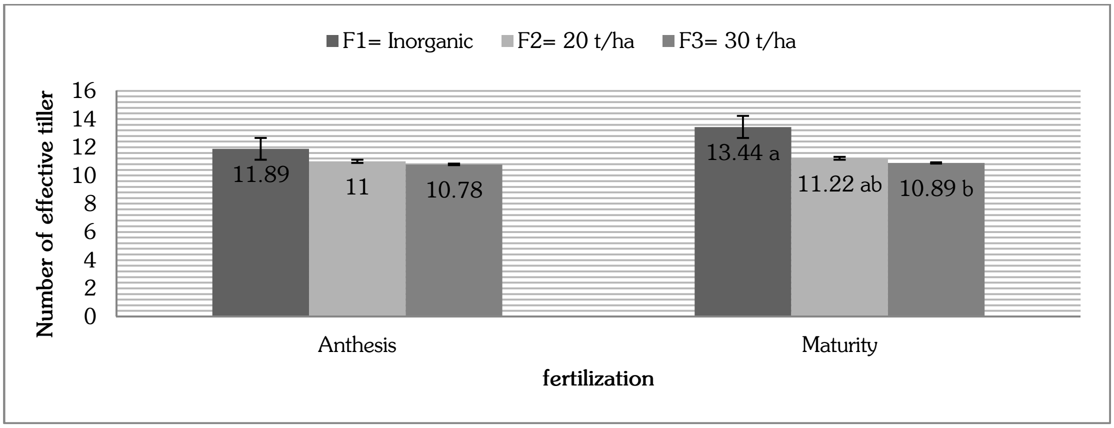

Fig. 2. Effect of different fertilization on effective tiller/hill in rice at anthesis and maturity stages

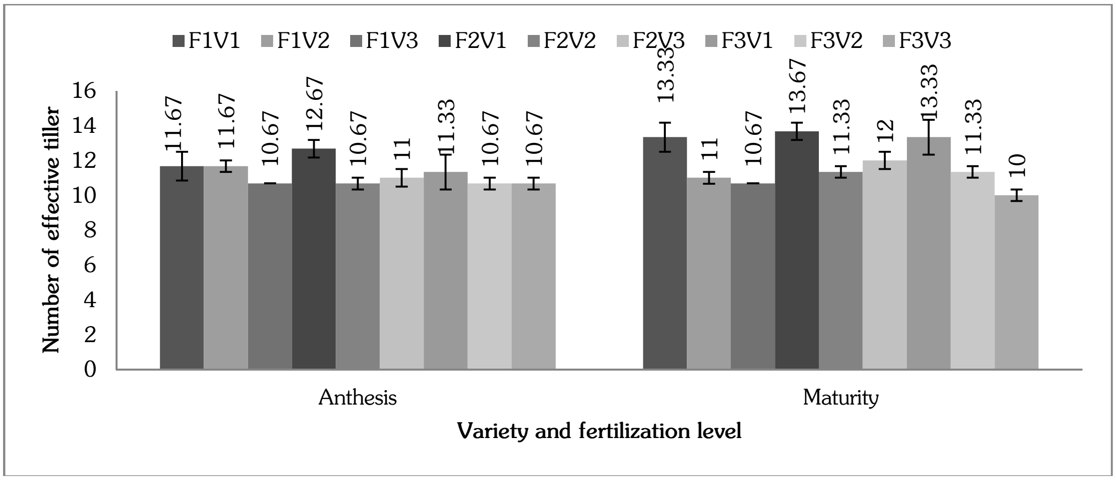

Fig.3. Interaction effect between different varieties and different fertilization on effective tiller/hill in rice at anthesis and maturity stages

Stem dry weight hill^{-1}

Stem dry weight per plant was affected by the interaction between variety and fertilization presented in Table 4. At the maximum vegetative stage, the highest stem dry weight per plant (9.93g) was obtained in V_3F_2 (BRRI dhan66 with compost-20 t ha^{-1}), and the lowest stem dry weight plant^{-1} (6.2 g) was obtained in V_3F_1 (BRRI dhan66 with inorganic). At the booting stage, the highest stem dry weight plant^{-1}(15.29 g) was obtained in V_3F_3 (BRRI dhan66 with compost-30 t ha^{-1}) and the lowest stem dry weight plant^{-1}(10.30 g) was obtained in V_2F_2 (BRRI dhan56 with compost-20 t ha^{-1}). At the anthesis stage, the highest stem dry weight plant^{-1}(42.14g) was obtained in V_1F_2 (Binadhan-7 with compost-20 t ha^{-1}), which was statistically similar in V_1F_1 (Binadhan-7 with inorganic) (42.02 g), and the lowest stem dry weight plant^{-1}(27.65 g) was recorded from V_2F_3 (BRRI dhan56 with compost-30 t ha^{-1}).

Leaf dry weight hill^{-1}

Leaf dry weight plant^{-1} was affected by the interaction between variety and fertilization presented in Table 4. At the vegetative stage, the highest leaf dry weight plant^{-1} (8.26 g) was obtained in V_3F_2 (BRRI dhan66 with compost-20 t ha^{-1}) and the lowest leaf dry weight plant^{-1} (5.50 g) was obtained in V_1F_3 (Binadhan-7 with compost-30 t ha^{-1}). At the booting stage, the highest leaf dry weight plant^{-1} (9.86 g) was obtained in V_3F_3 (BRRI dhan66 with compost-30 t ha^{-1}) and the lowest leaf dry weight plant^{-1} (6.65 g) was obtained in V_2F_3 (BRRI dhan56 with compost-30 t ha^{-1}).

Table 4. Effect of fertilization on stem dry weight and leaf dry weight of different ricevarieties at different stages

Treatments		**Stem dry weight (g)**			**Leaf dry weight (g)**		
Varieties		**Vegetative**	**Booting**	**Anthesis**	**Vegetative**	**Booting**	**Anthesis**
V_1=Binadhan-7		7.44	11.93	37.28	6.91	8.18	4.66
V_2=BRRI dhan56		9.24	13.17	37.29	7.52	8.18	4.52
V_3=BRRI dhan66		7.38	13.29	34.87	6.22	8.23	4.33
Level of significance		NS	NS	NS	NS	NS	NS
Fertilization							
F_1=Inorganic		9.00	13.18	41.37a	7.28	8.44	4.91
F_2=Compost 20 tha^{-1}		6.62	11.47	30.57b	5.73	7.17	4.13
F_3=Compost 30 tha^{-1}		8.44	13.74	37.50a	7.64	8.98	4.47
Level of significance		NS	NS	**	NS	NS	NS
Interaction							
F_1	V_1	9.60	12.27	42.02a	8.12	8.23	4.81
	V_2	6.52	12.33	33.95a-c	5.63	7.80	4.91
	V_3	6.20	11.20	35.87a-c	7.00	8.51	4.27
F_2	V_1	10.83	14.47	42.14a	8.23	8.90	5.26
	V_2	6.96	10.30	30.09bc	6.06	7.08	3.70
	V_3	9.93	14.73	39.63a	8.26	8.57	4.61
F_3	V_1	6.56	12.80	39.96a	5.50	8.19	4.66
	V_2	6.40	11.77	27.65c	5.50	6.65	3.80
	V_3	9.19	15.29	37ab	7.66	9.86	4.52
Level of significance		NS	NS	**	NS	NS	NS
CV (%)		23.83	23.35	16.31	28.18	22.20	19.13

In a column, means followed by a different letter(s) differed significantly by Duncan's Multiple Range Test at $P \leq 5\%$ level of probability.

NS indicates insignificant

*indicates significant at 5% level of probability

**indicates significant at 1% level of probability

At the anthesis stage, the highest leaf dry weight plant^{-1} (5.26 g) was obtained in V_1F_2 (Binadhan-7 with compost-20 t ha^{-1}), and the lowest leaf dry weight plant^{-1} (3.7 g) was recorded from V_2F_2 (BRRI dhan56 with compost-20 t ha^{-1}).

Root dry weight hill^{-1}

Root dry weight plant^{-1}was affected by the interaction between variety and fertilization presented in Table 5. At the vegetative stage, the highest root dry weight plant^{-1}(4.3g) was obtained in V_3F_2 (BRRI dhan66 with compost-20 t ha^{-1}), and the lowest root dry weight plant^{-1}(2.18g) was obtained in V_2F_2 (BRRI dhan56 with compost-20 t ha^{-1}). At the booting stage, the highest root dry weight plant^{-1}(3.86g) was obtained in V_2F_1 (BRRI dhan56 with inorganic), and the lowest root dry weight plant^{-1}(2.65g) was obtained in V_3F_2 (BRRI dhan66 with compost-20 t ha^{-1}).At the anthesis stage, the highest root dry weight plant^{-1}(3.01g) was obtained in V_1F_1Binadhan-7 with inorganic), and the lowest root dry plant^{-1} (2.2g) was recorded from V_2F_3 (BRRI dhan56 with compost-30 t ha^{-1}).

Leaf area

Leaf area evaluated for different varieties and fertilization is presented in Table 5. Leaf area was found with almost similar in each treatment. The maximum leaf area was recorded from V_2 (BRRI dhan56) (5588 cm^2 and 5229 cm^2 at vegetative and booting stages, respectively) and the maximum leaf area was recorded from V_1 (Binadhan-7) (3126 cm^2 and 3159 cm^2 at anthesis and maturity stages, respectively).

Table 5. Effect of fertilization on root dry weight and leaf area of different rice varieties at different stages

Treatments		Root dry weight (g)			Leaf area (cm^2)			
Varieties		Vegetative	Booting	Anthesis	Vegetative	Booting	Anthesis	Maturity
V_1=Binadhan-7		2.79	3.05	2.67	5028	5151	3126	3159
V_2=BRRI dhan56		3.29	3.29	2.61	5588	5229	2805	3119
V_3=BRRI dhan66		2.92	3.35	2.46	4500	5210	2905	3116
Level of significance		NS	NS	NS	NS	NS	NS	NS
Fertilization								
F_1=Inorganic		3.08	3.13	2.78	5305	5352	3096	3156
F_2=Compost 20 tha^{-1}		2.59	2.92	2.32	4227	4628	2675	3058
F_3=Compost 30 tha^{-1}		3.34	3.65	2.64	5585	5610	3065	3181
Level of significance		NS	NS	NS	NS	NS	NS	NS
Interaction								
F_1	V_1	2.93	2.82	3.01	5755	5169	3297a	2924
	V_2	2.66	3.86	2.52	4163	5135	3082ab	3458
	V_3	2.80	2.89	2.48	5167	5150	2997ab	3096
F_2	V_1	3.40	3.45	2.76	6095	5557	2989ab	3356
	V_2	2.18	3.58	2.25	4667	4356	2338b	2634
	V_3	4.30	2.65	2.84	6003	5774	3089ab	3367
F_3	V_1	2.90	3.65	2.58	4065	5331	3003ab	3188
	V_2	2.93	2.98	2.20	3850	4392	2603ab	3080
	V_3	2.93	3.22	2.60	5584	5908	3109ab	3081
Level of significance		NS	NS	NS	NS	NS	*	NS
CV (%)		21.69	21.44	22.90	23.83	18.06	18.80	17.18

In a column, means followed by a different letter(s) differed significantly by Duncan's Multiple Range Test at $P \leq$ 5% level of probability.

NS indicates insignificant

*indicates significant at 5% level of probability

**indicates significant at 1% level of probability

The maximum leaf area was recorded from F_3 (compost-30 t ha^{-1}) (5585 cm^2, 5610 cm^2 and 3181 at vegetative, booting and maturity stages, respectively), and the maximum leaf area was recorded from F_1 (Inorganic) (3096 cm^2 at anthesis stage). At the vegetative stage, the highest leaf area (6095 cm^2) was obtained in V_3F_2 (BRRI 66 with compost-20 t ha^{-1}) and the lowest leaf area (3850 cm^2) was obtained in V_2F_3 (BRRI dhan56 with compost-30 t ha^{-1}). At the booting stage, the highest leaf area (5908 cm^2) was obtained in V_3F_3 (BRRI dhan66 with compost-30 t ha^{-1}), and the lowest leaf area (4356 cm^2) was obtained in V_2F_2 (BRRI dhan56 with compost-20 t ha^{-1}). At the anthesis stage, the highest leaf area (3109 cm^2) was obtained in V_3F_3 (BRRI dhan66 with compost-30 t ha^{-1}) and the lowest leaf area (2338 cm^2) was obtained in V_2F_2 (BRRI dhan56 with compost-20 ton ha^{-1}). At the maturity stage, the highest leaf area (3458 cm^2) was obtained in V_2F_1 (BRRI 56 with inorganic), and the lowest leaf area (2634 cm^2) was obtained in V_2F_2 (BRRI dhan56 with compost-20 t ha^{-1}).

SPAD value

SPAD value was significantly influenced by poultry litter based composts, but the SPAD value was not significantly influenced in the case of varieties (Table 6). Result revealed that SPAD value was increased with the use of composts. The highest SPAD value (48.74) was recorded from $F_3$and the lowest SPAD value (44.77) from F_2 at vegetative stages in other stages SPAD value was not significant. The interaction effect of fertilization and different varieties was significantly influenced by SPAD value at vegetative and booting stages.

Table 6. Effect of fertilization on SPAD value of different rice varieties at different stages

Treatments		Stages		
Varieties		**Vegetative**	**Booting**	**Anthesis**
V_1=Binadhan-7		47.44	40.77	46.76
V_2=BRRI dhan56		44.57	41.16	45.62
V_3=BRRI dhan66		49.33	40.71	46.77
Level of significance		NS	NS	NS
		Fertilization		
F_1=Inorganic		47.83ab	41.48	45.53
F_2=Compost 20 tha^{-1}		44.77b	39.49	46.73
F_3=Compost 30 tha^{-1}		48.74a	41.67	46.88
Level of significance		*	NS	NS
		Interaction		
	V_1	47.57ab	42.13ab	46.60
F_1	V_2	44.8b	39.73ab	46.17
	V_3	49.97ab	40.43ab	47.50
	V_1	46.37ab	39.57ab	43.97
F_2	V_2	43.27b	40.30ab	46.07
	V_3	44.07b	43.60a	46.83
	V_1	49.57ab	42.73ab	46.03
F_3	V_2	46.23ab	38.43b	47.97
	V_3	52.20a	40.97ab	46.30
Level of significance		*	*	NS
CV (%)		7.48	5.98	5.38

In a column, means followed by a different letter(s) differed significantly by Duncan's Multiple Range Test at $P \leq 5\%$ level of probability.

NS indicates insignificant

*indicates significant at 5% level of probability

**indicates significant at 1% level of probability

The highest SPAD value (52.20) at the vegetative stage was recorded from F_3V_3 (compost -30 t ha^{-1} with BRRI dhan66), and the lowest SPAD value (43.27) was recorded from F_2V_2. The highest SPAD value (43.60) at the booting stage was recorded from F_2V_3. The lowest SPAD value (38.43) was recorded from F_3V_2 at the booting stage. SPAD value was significantly influenced by poultry litter based composts but the SPAD value insignificant in the case of varieties (Table 8). Result revealed that SPAD value was increased with the use of composts. The highest SPAD value (48.74) was recorded from F_3 and the lowest SPAD value (44.77) from F_2 at the vegetative stages, whereas in other stages SPAD value was not significant.

The interaction effect of fertilization and different varieties was significantly influenced by SPAD value at vegetative and booting stages. The highest SPAD value (52.20) at the vegetative stage was recorded from F_3V_3whreas the lowest SPAD value (43.27) was recorded from F_2V_2 at the vegetative stage. The highest SPAD value (43.60) at the booting stage was recorded from F_2V_3 and the lowest SPAD value (38.43) from F_3V_2 at the booting stage. Zubaer *et al.* (2007) and Chowdhury *et al.* (2020) found a similar result at drought conditions that compost and nutrients increased chlorophyll contents in a crop plant.

Panicle length

Panicle length was not significantly influenced by poultry litter based composts but significantly influenced by different rice varieties (Table 7). The longest panicle length (22.9 cm) was produced by V_1 (Binadhan-7), and the shortest panicle length (20.48 cm) produced by V_3 (var. BRRI dhan66). Panicle length was not significantly influenced by poultry litter based composts (Table 9). Interaction between fertilizer and different rice varieties significantly influenced the panicle length. The longest panicle (24.16cm) found in F_1V_1 (inorganic with Binadhan-7) treatment and the shortest one (19.83cm) found in F_3V_3 (compost-30 t ha^{-1} with BRRI dhan66). Sarker *et al.* (2013) and Haque (2013) was found similar results of increased panicle length due to the application of manure on rice plants.

1000-grain weight

Production of rice yield also depends on 1000-grain weight, which was significantly influenced by poultry litter based composts, but the 1000-grain weight was not significantly influenced by varieties (Table 7). Results revealed that the highest 1000-grain weight (22.23g) was recorded from $F_3$and the lowest 1000-grain weight (19.66 g) was recorded from F_2. This result was in agreement with the reports of Aziz (2008).

The interaction effect of fertilizer and different varieties significantly influenced the 1000-grain weight. The highest 1000-grain weight (23.57 g) was recorded from F_3V_3 treatment and the lowest 1000-grain weight (19.27 g) was recorded from F_1V_2 (inorganic with BRRI dhan56).

Grain yield

Grain yield was significantly influenced by poultry litter based composts, but the grain yield (g pot^{-1}) was not significantly influenced in the case of varieties (Table 7). Result revealed that grain yield was increased with the use of composts. The highest grain yield (23.61 g pot^{-1}) was recorded from F_1 (inorganic). The lowest grain yield (14.32 g pot^{-1}) was recorded from F_2 (compost-2 t ha^{-1}). The interaction effect of fertilizer and different varieties was significantly influenced by grain yield. The highest grain yield (24.58 g pot^{-1}) was recorded from F_3V_1 (compost-30 t ha^{-1} with Binadhan-7). The lowest grain yield (11.98 g pot^{-1}) was recorded from F_2V_2 (compost -20 t ha^{-1} with BRRI dhan56).Islam *et al.* (2013) and Najafi and Abbasi (2013) also found a similar result in rice production. Saleque *et al.* (2004) reported that the application of compost increased the yield of rice.

Straw yield

The straw yield was significantly influenced by poultry litter based composts (Table 7). Result revealed that straw yield was increased with the use of composts. But the straw yield was not significantly influenced in varieties. The highest straw yield (18.19 g) was recorded from F_1 (inorganic). The lowest straw yield (14.76 g) was recorded from F_3. The combined effect of compost and different varieties significantly influenced the straw yield. The highest straw yield (18.6 g) was recorded from F_2V_1 (compost 20 t ha^{-1} with Binadhan-7). The lowest straw yield (13.5 g) was recorded from F_3V_3 (compost-30 t ha^{-1} with BRRI dhan66) treatment.

Harvest index

As a useful index of measuring the plant biomass converted into fruitful economic yield, the harvest index was significantly influenced by poultry litter based composts (Table 7). The harvest index was not significantly influenced by varieties. Results revealed that the harvest index was increased with the use of different composts treatment. The highest harvest index (58.2%) was recorded from F_3 (compost 30t ha^{-1}). The lowest harvest index (47.89%) was recorded from F_2 (compost-20 t ha^{-1}). The combined effect of poultry litter based composts and different varieties significantly influenced in harvest index. The highest harvest index (62.78%) was recorded from F_1V_3 (Inorganic BRRI dhan66). The lowest harvest index (45.04%) was recorded from F_2V_2 (compost 20t ha^{-1} BRRI dhan56).

Table 7. Effect of fertilization on yield parameters of different varieties of rice

Treatments		**Yield parameters**				
Varieties		**Panicle length (cm)**	**Grain yield g pot^{-1}**	**1000 grain weight (g)**	**Straw yield (g pot^{-1})**	**Harvest index (%)**
V_1=Binadhan-7		22.9a	21.63	20.80	16.09	57.03
V_2=BRRI dhan56		22.49a	17.74	20.11	16.66	50.47
V_3=BRRI dhan66		20.48b	19.49	22.26	15.50	54.79
Level of significance		**	NS	NS	NS	NS
			Fertilization			
F_1=Inorganic		22.60	23.61a	21.28ab	18.19a	56.19a
F_2=Compost 20 tha^{-1}		21.85	14.32b	19.66b	15.3b	47.89b
F_3=Compost 30 tha^{-1}		21.42	20.92a	22.23a	14.76b	58.2a
Level of significance		NS	**	**	**	*
			Interaction			
F_1	V_1	24.16a	24.28ab	20.9ab	18.17a	57abc
	V_2	22.5abc	16.71bcd	19.27b	16.03abc	51.31abc
	V_3	22.05abc	23.91ab	22.23ab	14.07bc	62.78a
F_2	V_1	22.97ab	21.98ab	20.15ab	18.6a	53.54abc
	V_2	22.11abc	11.98d	19.3b	14.67abc	45.04c
	V_3	22.38abc	19.26abcd	20.89ab	16.7abc	52.82abc
F_3	V_1	20.66bc	24.58a	22.8a	17.8ab	58.04ab
	V_2	20.94bc	14.29cd	20.42ab	15.2abc	47.33bc
	V_3	19.83c	19.59abc	23.57a	13.5c	59.01ab
Level of significance		**	**	**	**	**
CV (%)		7.14	19.16	7.66	15.72	13.26

In a column, means followed by a different letter(s) differed significantly by Duncan's Multiple Range Test at $P \leq 5\%$ level of probability.

NS indicates insignificant

*indicates significant at 5% level of probability

**indicates significant at 1% level of probability

Soil chemical properties

Results revealed that organic matter was increased with the use of different composts treatment (Table 8). The highest organic matter (2.328%) and the highest organic carbon (1.29%) were found in the case of F_3 (compost 30 t ha^{-1}).The lowest organic matter (1.03%) and the lowest organic carbon (0.49%) were found in the case of F_1 (inorganic). The change of pH value was insignificant by the application of fertilization. Results revealed that N, P, K, S content of the soil was increased with the use of different composts treatment. The highest N (0.102%), P (130.0µg/g soil), K (0.449ppm/100g soil), S (62.04µg/g soil) was found in F_3 (compost 30 t ha^{-1}) treatment. The lowest N (0.0856%), P (110.0 µg/g soil), K (0.37 ppm/100g soil), S (39.92µg/g soil) was found in F_1 (inorganic) treatment. A similar trend was also found by Liza *et al.* (2014) and Salaque *et a*l. (2004) due to the application of organic manure.

Table 8. Effect of fertilization on soil chemical properties

Treatments							
Fertilization	**pH**	**Organic matter (%)**	**Organic carbon (%)**	**N(%)**	**P (µg/g soil)**	**K (ppm/100 g soil)**	**S (µg/g soil)**
F_1=Inorganic	6.529	1.030c	0.49b	0.0856	110.0b	0.37b	39.92c
F_2=Compost 20 tha^{-1}	6.650	1.912b	1.13a	0.090	126.4a	0.436a	49.24b
F_3=Compost 30 tha^{-1}	6.618	2.328a	1.289a	0.102	130.0a	0.449a	62.04a
Level of significance	NS	**	**	NS	**	**	**
CV (%)	1.85	20.78	22.73	22.09	6.72	8.02	11.94

In a column, means followed by a different letter(s) differed significantly by Duncan's Multiple Range Test at $P \leq 5\%$ level of probability.
NS indicates insignificant
*indicates significant at 5% level of probability
**indicates significant at 1% level of probability

Conclusion

According to the present study, it could be suggested that the rice is grown with Compost-30 t ha^{-1} along with var.Binadhan-7) revealed to get the optimum yield. However, these findings need to be further investigated and evaluated in the different agro-ecological zone before the final recommendation for the farmers.

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