BRAC University Journal, vol. I, no.2, 2004, pp. 59-66

EFFECTS OF DIFFERENT ANIMAL MANURES ON YIELD QUALITY AND NUTRIENT UPTAKE BY MUSTARD CV. AGRANI

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ABSTRACT

A pot experiment was carried out at the researcher's net house of Bangladesh Agricultural University, Mymensingh from November 2003 to February 2004 to find out the effects of different animal manure on yield, quality and nutrient uptake by mustard cv. Agrani. The experiment comprised of two levels of cage system poultry manure, deep litter system poultry manure, cow dung and bio-gas slurry *viz*. 10 and 20 ton ha^{-1}, one control and one chemical fertilizer @ recommended dose. Cage system poultry manure @ 20 ton ha^{-1} significantly increased the seed and straw yield of mustard and cow dung showed lower performance. In straw and seed the highest uptake of N, P, K, Ca, Mg and S was obtained from cage system poultry manure @ 20 ton ha^{-1}. Protein and oil content was also found higher in this treatment. Seed yield was found to be significantly and positively correlated with branch and effective pod per plant. Protein and oil contents of mustard seeds were increased with increasing level of animal manures though their effects were not significant. A positive and significant correlation was observed between protein and oil contents of mustard cv. Agrani. The overall results suggest that cage system poultry manure @ 20 ton ha^{-1} gave best performance among the parameters studied.

Key words: Manure, Mustard, Protein, Oil and Nutrient uptake.

I. INTRODUCTION

Organic matter (OM) is considered as the life of soil as well as storehouse of plant nutrients [1]. It plays an important role in maintaining soil fertility and productivity. OM acts as a reservoir of plant nutrients especially N, P, K, S and micronutrients and also prevents leaching of nutrients. It also improves cation exchange capacity of soil [2]. In our country, organic matter status of the soil is in so critical position that if present rate of degradation is continued, in near future our soil will become a dead matter or unfertile. Because either no or very less quantity of organic matter will remain in the soil which will not be sufficient for the soil itself. Due to poor management and intensive manipulation of soil organic matter content is getting reduced day by day [3]. About 45 % of net cultivable area of the country have less than 1% organic matter content [4]. The ever-decreasing OM content in our soils is causing nutritional imbalance including micronutrient deficiency.

Poultry manure and cow dung are good sources of organic matter and play a vital role in soil fertility improvement as well as supplying primary, secondary and micronutrients for crop production.

Nowadays a huge number of poultry industries have been established all over the country. From there, ample amount of poultry feces is produced which if not utilized properly will become a major burden and pollute the environment. Poultry farm holders use concentrates to feed their birds. As the poultry excreta are not used as fuel, these can be a very good source of manure in the crop fields. Cow dung releases nutrient slowly, so that nutrient loss is less followed by more plant uptake. Apart from being a good source of plant nutrients, organic manure improves the physical, chemical and biological properties of soils and thus increases and conserves the soil productivity. The slurry effluent, which is sometime called bio-gas slurry or bio-fertilizer, is also found to be useful as manure for crop production.

Edible oil is an integral part of our daily diet and mustard (*Brassica* sp.) is the most important oil seed crop of Bangladesh that supplies more than half of the total edible oil requirement. At present, Bangladesh is deficient in oil production. Our total edible oil requirement is 1.36 Lac tons, while we produce only 0.54 lac tons [5]. Mustard oil not only plays a great role as fat substitute in our daily diet but also nourish the economy of the nation. It is widely used as a cooking ingredient, condiment and for its medicinal value. Moreover, mustard oil cake is utilized as cattle feed and small quantities are also used as manure.

In view of the importance of this crop, attention has to be given to increase its production in order to meet the huge shortage of edible oil in the country. Very few research works have been conducted in our country regarding the effects of poultry manure, cow-dung and bio-gas slurry on yield, quality and nutrient uptake by mustard cv. Agrani. Keeping the above stated fact in view, the present study was undertaken in achieving the following objectives:

1. to examine the effect of poultry manure, cow dung and bio-gas slurry on growth, yield and quality of mustard *cv.* Agrani, and
2. to determine how much of these organic manure can compete with fertilizer.

II. MATERIAL AND METHODS

A pot experiment was conducted at the researcher's net house, Bangladesh Agricultural University, Mymensingh, during the period from November 2003 to February 2004. Mustard cv. Agrani (*Brassica campestris* L.) was used as the test crop. The soil was silt loam in texture having pH 6.78, 1.59% organic matter, 0.12% total N, 33.90 µg g^{-1} available P, 0.16 me 100 g^{-1} exchangeable K and 10.66µg g^{-1} available S . Six kg of processed soil was taken for each of the earthen pot of 19 cm deep and 25 cm in diameter.

There were 10 treatment combinations consisting of two rates (10 ton ha^{-1} and 20 ton ha^{-1}) of cage system poultry manure (CS-PM), deep litter system poultry manure (DLS-PM), cow-dung (CD), bio-gas slurry (BS), one control and one chemical fertilizer (recommended dose). The experiment was laid out following Completely Randomized Design (CRD) with three replications. Two sampling were done at 45 days after sowing and at final harvest. 60 pots were used for the experiment. Seeds were sown @ 10 per pot on 16 November 2003 in circular line. After germination of the seeds 5 seedlings were kept in the pot. Intercultural operations were done as and when necessary. The crop was harvested at maturity (at 96 days after sowing). Seed and straw yield were recorded from all the pots harvest. The straw and seeds from every pot was chemically analyzed for the determination of total N, protein content, oil content, P, S, K, Ca and Mg content. The plant samples (both straw and seed) were digested in nitric-perchloric acids to determine P, S, K, Ca and Mg. Total N was determined by micro-kjeldahl method [6], P by $SnCl_2$ method [7], S by turbidimetric method [8] using spectrophotometer. K and Ca content were determined directly by using flame emission spectrophotometer and Mg by complexometric method of titration. Protein was calculated by % total N × 6.25 [6]. Oil content was determined by Folsch method [9]. The uptake of nutrients were calculated by multiplying the concentration of nutrient with dry matter yield. The data were analyzed statistically and significant differences among the treatment means were determined by least significant difference [10] test for interpretation of results.

III. RESULTS AND DISCUSSION

Seed Yield

Seed yield significantly varied with different treatments (Fig 1). The highest amount of seed yield (8.68 g pot^{-1}) was obtained in CS-PM@ 20 t ha^{-1} which was statistically similar to CF (8.49 g pot^{-1}). The lowest seed yield was obtained from the control. Cage system poultry manure showed better performance in producing seed yield. Usman *et al.* [11] also found highest grain yield of rice by the application of poultry manure @ 20 t ha^{-1} . The highest concentration of nutrients especially N and P in cage system poultry manure is probably one of the main reasons for producing highest seed yield. This finding is at par with Iftikhar and Qasim [12] who showed that poultry manure increased total available N, P and K contents. Blum *et al.* [13] found sufficient quantity of essential nutrients in poultry manure. Hussain *et al.* [14] found that grain and straw yield significantly increased with P application. The result was inconsonant with Calerk and Mullians [15] who observed that poultry manure resulted in equivalent yield to that obtained using commercial fertilizer. Budhar *et al.* [16] found that yield of rice was the highest with the application of poultry manure.

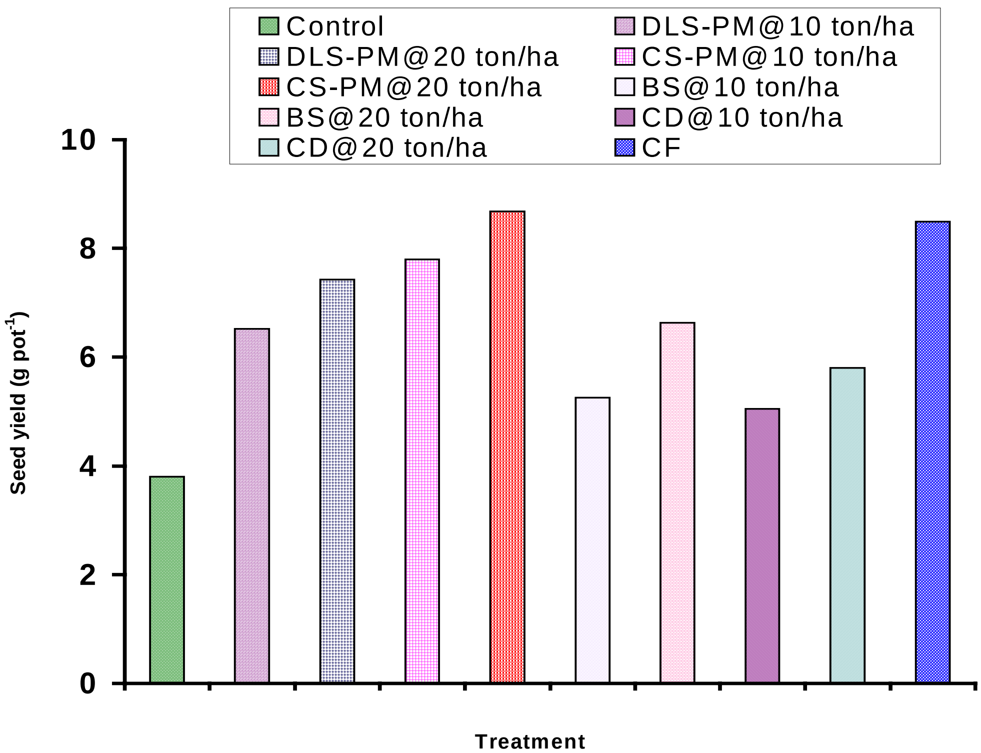

Fig.1. Effect of cage, deep litter system poultry manure, cow-dung, bio-gas slurry and chemical fertilizers on seed yield of mustard *cv.* Agrani

Straw Yield

Application of different animal manure and chemical fertilizer (CF) exert significant influence on straw yield (Fig 2,). The highest quantity of straw (26.18 g pot^{-1}) was produced by cage system poultry manure (CS-PM) @ 20 t ha^{-1} which was statistically similar to CF (25.53 g pot $^{-1}$) and dissimilar to other treatments. The lowest quantity of straw was produced by the control (16.68 g pot^{-1}). In the present study CS-PM gradually increased straw production with increasing dose. Usman *et al.* [11] also found highest straw yield with poultry manure @20 t ha^{-1}.

Nutrient Uptake

N and P uptake

The uptake of N was significantly influenced by doses of organic manures and fertilizer, which was, presented in Table 1. For both stages the maximum

N uptake in straw (109 and 147 mg plant^{-1}, respectively) was recorded in the treatment receiving CS-PM@ 20 t ha^{-1}. In case of seed, the N uptake was highest (337 mg pot^{-1}) in CS-PM@ 20 t ha^{-1} which statistically similar to CF. In all the cases the lowest uptake occurred in the control. The animal manures and fertilizer have significantly influenced the P uptake of mustard (Table 1). For both the stages of straw and for seed the P uptake was recorded maximum in the treatment CS-PM@ 20 t ha^{-1} which was 11.65, 16.45 mg plant^{-1} and 36.02 mg pot^{-1} respectively. In all cases the lowest P uptake was recorded in the control.

The results showed that N and P uptake of mustard increased with increasing rates of the treatments. Rao and Sitaramayya [17] reported that nitrogen uptake by rice was increased with integrated nutrient management of rice through conjunctive use of fertilizer urea with FYM, bio-gas slurry and poultry manure. Sengar *et al.* [18] also reported that N, P, K uptake by rice was significantly increased by the application of N fertilizer and manure.

K and S uptake

Poultry manure, bio-gas slurry, cow dung and fertilizer significantly influenced the K uptake in straw and seed

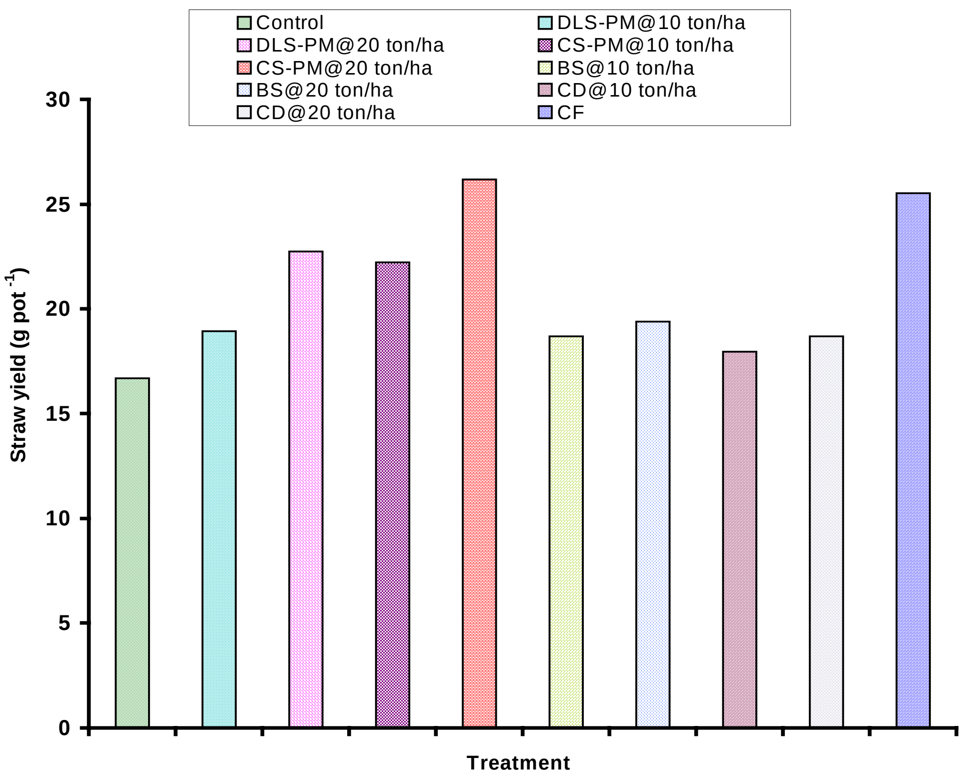

Fig.2. Effect of cage, deep litter system poultry manure, cow-dung, bio-gas slurry and chemical fertilizers on straw yield of mustard cv. Agrani

Table 1. Effect of Case system and deep litter system poultry manure, bio-gas slurry, cow dung and chemical fertilizer on nitrogen and phosphorus uptake by mustard cv. Agrani

Treatments	N uptake			P uptake		
	Straw (mg plant^{-1})		Seed (mg pot^{-1})	Straw (mg plant^{-1})		Seed (mg pot^{-1})
	45 DAS	Final harvest		45 DAS	Final harvest	
Control	39	56	129	4.29	4.24	10.64
DLS-PM@10 ton ha^{-1}	64	91	234	6.82	10.28	22.23
DLS-PM@20 ton ha^{-1}	89	117	283	9.01	14.31	25.34
CS-PM@10 ton ha^{-1}	90	123	307	8.84	12.27	29.69
CS-PM@20 ton ha^{-1}	109	147	337	11.65	16.45	36.02
BS@10 ton ha^{-1}	56	87	202	5.62	8.18	17.56
BS@20 ton ha^{-1}	64	100	250	6.32	10.14	21.28
CD@10 ton ha^{-1}	51	75	188	5.11	7.01	15.62
CD@20 ton ha^{-1}	60	87	218	6.10	8.78	18.33
CF	94	122	319	9.58	14.00	33.09
LSD	5.25	6.35	18.78	0.47	0.57	2.35
CV (%)	4.30	5.71	4.46	5.76	4.17	6.00

Note: DLS-PM = Deep Litter System Poultry Manure, CS –PM = Case System Poultry Manure, BS = Bio-gas Slurry, CD = Cow Dung

(Table 2). In straw at both the stages K uptake was recorded maximum (98.85 and 166.41 mg plant^{-1}) in CS-PM@ 20 t ha^{-1} which was statistically similar to CF at both the stages. In seed, the K uptake ranged from 25.60 to 71.26 mg pot^{-1}. The maximum uptake was occurred in CS-PM@ 20 t ha^{-1} which was statistically dissimilar to all other treatments. In all case the minimum uptake was recorded in the control. Similar result was also obtained by Sengar *et al.* [18]. They reported that N, P, K uptake by rice was significantly increased by the application of manure. S uptake was significantly affected by treatments (Table 2). In case of straw the maximum S uptake was observed 11.21 and 16.64 mg plant^{-1} respectively from CS-PM@ 20 t ha^{-1} at both the stages. In seed the highest S uptake (36.46 mg pot^{-1}) was found in the treatment receiving CS-PM@ 20 t ha^{-1} which was statistically dissimilar to all other treatments. In all cases the lowest amount of S uptake was observed in the control.

Ca and Mg uptake

Calcium uptake of straw and seed was significantly influenced by treatments (Table 3). At both the stages in straw the highest Ca uptake (10.62 and 20.48 mg plant^{-1}) was recorded from the treatment receiving CS-PM@20 t ha^{-1} which was statistically dissimilar to other treatments at 45 DAS but statistically similar to CF at final harvest. The lowest Ca uptake (3.3 and 7.63 mg plant^{-1}, respectively) occurred in control. In seed the highest Ca uptake (39.93) was found in CS-PM@ 20 t ha^{-1} and the lowest (9.5mg pot^{-1}) was observed in the control. Magnesium uptake was significantly affected by treatments (Table 3). At both the stages in straw the maximum Mg uptake (12.39 and 20.48mg plant^{-1}) was observed in CS-PM@ 20 t ha^{-1} which was statistically dissimilar to all other treatments at 45 DAS but at final harvest statistically similar to CF. The lowest Mg uptake (4.29 and 8.48 mg plant^{-1}, respectively) was found in the control. In seed the maximum Mg uptake (39.93 mg pot^{-1}) was observed in CS-PM@ 20 t ha^{-1} which was statistically dissimilar to all other treatments. The lowest Mg uptake (11.40 mg pot^{-1}) was observed in the control.

Protein and Oil Content

The protein content in seed was significantly influenced by different treatments (Table 4). The highest quantity of protein in seed was found in CS-PM@ 20 t ha^{-1} which was statistically identical to CF, DLS-PM @ 20 t ha^{-1}. The minimum seed protein was recorded from the control. The highest increase of protein content in seed over control was also found in CS-PM@ 20 t ha^{-1} and lowest increase was found in BS @ 10 t ha^{-1} (Table 4).

Dixit and Gupta [19] reported that farm yard manure or biofertilizer either alone or in combination showed an increasing tendency of protein content in rice grain. The treatments had no significant effect on seed oil content (Table 4). How ever the seed oil content ranged from 40.25 to 44.11%. The highest seed oil content was recorded from CS-PM@ 20 t ha^{-1} (44.11%) and lowest from the control (40.25%).

Table 2. Effect of Case system and deep litter system poultry manure, bio-gas slurry, cow dung and chemical fertilizer on potassium and sulphur uptake by mustard cv. Agrani

Treatments	K uptake			S uptake		
	Straw (mg $plant^{-1}$)		Seed (mg pot^{-1})	Straw (mg $plant^{-1}$)		Seed (mg pot^{-1})
	45 DAS	Final harvest		45 DAS	Final harvest	
Control	33.00	77.45	25.60	3.30	4.66	9.50
DLS-PM@10 ton ha^{-1}	52.68	129.36	48.90	6.45	11.20	20.86
DLS-PM@20 ton ha^{-1}	87.19	145.61	58.70	9.01	14.81	26.75
CS-PM@10 ton ha^{-1}	74.88	147.74	62.29	8.32	13.77	27.51
CS-PM@20 ton ha^{-1}	98.85	166.41	71.26	11.21	16.64	36.46
BS@10 ton ha^{-1}	46.99	112.90	41.84	5.46	10.37	17.67
BS@20 ton ha^{-1}	57.75	125.81	52.38	6.72	12.89	23.21
CD@10 ton ha^{-1}	43.29	103.36	38.15	4.81	8.87	14.98
CD@20 ton ha^{-1}	53.71	118.17	43.79	6.36	10.84	19.14
CF	92.68	162.61	66.50	10.36	15.93	35.30
LSD	6.55	7.97	4.66	0.57	0.63	1.11
CV (%)	6.00	6.63	5.38	4.67	5.07	4.82

Note: DLS-PM = Deep Litter System Poultry Manure, CS –PM = Case System Poultry Manure, BS = Bio-gas Slurry, CD = Cow Dung

Table 3. Effect of Case system and deep litter system poultry manure, bio-gas slurry, cow dung and chemical fertilizer on calcium and magnesium uptake by mustard cv. Agrani

Treatments	Ca uptake			Mg uptake		
	Straw (mg $plant^{-1}$)		Seed (mg pot^{-1})	Straw (mg $plant^{-1}$)		Seed (mg pot^{-1})
	45 DAS	Final harvest		45 DAS	Final harvest	
Control	3.30	7.63	9.50	4.29	8.48	11.40
DLS-PM@10 ton ha^{-1}	6.67	15.68	19.56	7.74	14.80	26.10
DLS-PM@20 ton ha^{-1}	9.01	18.51	25.26	10.60	17.89	32.69
CS-PM@10 ton ha^{-1}	8.32	18.15	26.88	9.88	17.53	33.98
CS-PM@20 ton ha^{-1}	10.62	20.48	32.12	12.39	20.48	39.93
BS@10 ton ha^{-1}	4.68	13.80	15.37	6.05	13.25	19.36
BS@20 ton ha^{-1}	6.30	15.24	19.89	7.35	15.82	25.19
CD@10 ton ha^{-1}	4.07	11.48	12.84	5.55	10.96	17.12
CD@20 ton ha^{-1}	5.50	13.00	17.40	9.67	13.55	20.30
CF	9.80	19.11	28.74	11.20	19.11	36.12
LSD	0.65	1.70	1.11	0.76	1.70	3.36
CV (%)	5.11	6.53	5.14	5.28	6.58	7.53

Note: DLS-PM = Deep Litter System Poultry Manure, CS –PM = Case System Poultry Manure, BS = Bio-gas Slurry, CD = Cow Dung

Table 4. Effect of Cage system and deep litter system poultry manure, cow dung, bio-gas slurry and chemical fertilizer on protein and oil content of mustard cv. Agrani

Treatments	Protein content (%)	% increased over control	Oil content (%)	% increased over control
Control	21.25	-	4025	-
DLS-PM@10 ton ha^{-1}	22.42	5.22	41.41	2.80
DLS-PM@20 ton ha^{-1}	23.78	10.64	42.35	4.96
CS-PM@10 ton ha^{-1}	23.75	10.53	43.71	7.92
CS-PM@20 ton ha^{-1}	24.31	12.59	44.11	8.75
BS@10 ton ha^{-1}	22.25	4.50	41.26	2.44
BS@20 ton ha^{-1}	23.04	7.77	43.14	6.70
CD@10 ton ha^{-1}	22.69	6.35	41.18	2.26
CD@20 ton ha^{-1}	23.68	10.26	42.44	5.16
CF	24.05	11.64	43.20	6.83
LSD (0.05)	1.43	-	2.69	-
CV (%)	3.62	-	3.74	-

Note: DLS-PM = Deep Litter System Poultry Manure, CS –PM = Cage System Poultry Manure, BS = Bio-gas Slurry, CD = Cow Dung

Per cent increase of oil content in seed over control was maximum in CS-PM@ 20 t ha^{-1} and minimum in CD@ 10 t ha^{-1}. The relationship between seed protein and seed oil content was found significantly and positively correlated (Fig. 3.) The positive correlation indicated that an increase in seed protein would increase seed oil content.

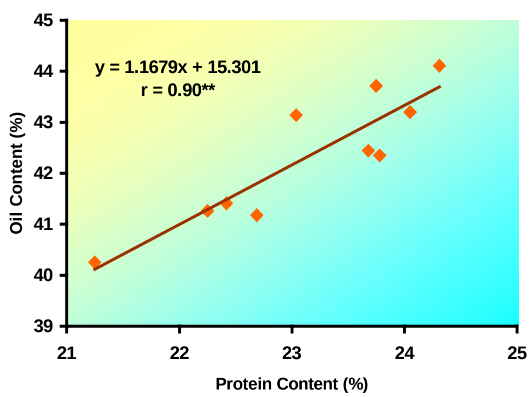

Fig.3. Relationship between seed protein and oil content in mustard cv. Agrani

IV. CONCLUSION

From the above discussion, it may be concluded that cage system poultry manure @ 20 t ha^{-1} can be applied for maximum yield and quality production of mustard cv. Agrani and nutrient uptake was also highest in this treatment. Finally the treatments can be ranked as CS-PM @ 20 t ha^{-1} ≥ CF > CS-PM @ 10 t ha^{-1} > DLS-PM @ 20 t ha^{-1} > BS @ 20 t ha^{-1}> DLS-PM @ 10 t ha^{-1} > CD @ 20 t ha^{-1} > BS @ 10 t ha^{-1} > CD @ 20 t ha^{-1}.

Acknowledgements

The authors are grateful to Chief Farm Supervisor, Bangladesh Agricultural University, Mymensingh and Genetics Division, Bangladesh institute of Nuclear Agriculture, Mymensingh for providing necessary physical support.

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