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Yield and Quality of Rice as Affected by Molybdenum Applied With Chemical Fertilizers and Organic Matter

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ABSTRACT

A field experiment was conducted at the field laboratory of the Department of Agronomy, Bangladesh Agricultural University, Mymensingh to evaluate the effect of molybdenum (Mo) with recommenced chemical fertilizer and organic matter on yield and quality of rice cv. BRRI dhan 30. Three levels of Mo viz. 0, 100 and 200 ppm were applied with recommended dose of chemical fertilizers (80, 15, 40, 10, 1.5 kg ha^{-1}NPKSZn) and organic matter as both cow dung and compost. Plant height, number of ear bearing tillers hill^{-1}, straw yield and biological yield were maximum when 100 ppm Mo was applied with chemical fertilizer. Number of total spikelets panicle^{-1}, grains panicle^{-1}, nitrogen content, nitrogen uptake in grain and straw, and protein content in grain were recorded better when 100 ppm Mo was applied with cowdung. Those parameters were minimum when 0 ppm Mo was applied with either cowdung or compost or NPK. The best performance was obtained when 100 ppm Mo was applied either with recommended fertilizers or with cow dung/compost. The performance of rice with 200 ppm of Mo was better than no addition of Mo in respect of yield and yield contributing characters.

Key words: Molybdenum, quality, rice, yield.

INTRODUCTION

Rice (*Oryza sativa. L*) is the most important cereal crop in Bangladesh. Approximately 75% of the total cultivated land covering about 11.58 million hectares (ha) produces approximate 30 million tons of rice annualy BBS (2006). In Bangladesh, per ha yield of rice is much lower (3.55 t/ha) than that of Australia, Korea Republic and China (9.7, 6.6 and 6.2 t/ha, respectively) FAO (2007). One of the main reasons for low yield is considered for use of imbalance fertilizers or lack of soil micronutrient, especially Magnesium (Mg), Boron (B) and Molybdenum (Mo) (Jahiruddin *et al.,* 1995). On the contrary of the total nutrients used in the country, Nitrogen (N) alone constitutes about 80% which may lead to nutrient imbalance in the soil plant ecosystem. Molybdenum participates in the nitrate reduction system of nitrogen metabolism in higher plants and it is associated with the biochemical fixation of nitrogen and nitrate assimilation (De, 1999). The reduction of oxidised form of nitrogen, nitrate to ammonia, is a biological redox potential system. Significant increase in protein content of grains increased due to application of Mo. Thus, lack of Mo impares not only physiological processes of plant, but also grain quality.

Soil organic matter in Bangladesh is below critical level (1.5%) (BARC, 1997). The climate of tropical countries like Bangladesh is a major constraint to the maintenance of soil organic matter.

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Cowdung is the most ancient organic matter source and has long been considered as a desirable soil amendment. The present experiment has been designed to analyze the effects of Mo with recommended fertilizers and organic matter on the yield and quality of rice.

MATERIALS AND METHODS

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh, during the period from July 2004 to December 2004. The soil of the experiment field belongs to Non calcareous Dark Grey Flood Plain Soil under the Sonatola Series of Old Brahmaputra Flood Plain which falls in Agroecological zone-9. The experiment was laid out in a Randomized Complete Block Design (RCBD) with four (4) replications. Layout of the experiment was done with inter-plot spacing of 0.75 m and inter-block spacing of 1.0 m. The unit plot size was 6 m^2 (3 m X 2 m) and total numbers of unit plots were 36. Row to row and plant to plant spacing were 20 cm and 15 cm, respectively. Rice variety BRRI dhan 30 was used in this experiment. The experimental plots were fertilized with 80, 15, 40, 10, 1.5 kg ha^{-1} NPKSZn and 0 ppm, 100 ppm and 200 ppm Mo ha^{-1}, respectively in the form of urea, triple super phosphate, muriate of potash, gypsum, zinc sulphate and ammonium molybdate. The plots or treatments in which organic fertilizer such as decomposed cowdung or farm yard manure (FYM) and compost were applied @ 7 kg $plot^{-1}$ and 14 kg $plot^{-1}$, respectively. The value of nutrient composition such as NPKS of cowdung and compost were 1.6, 0.2, 3.4, 0.2 and 0.8, 0.05, 0.5 and 0.2, respectively and was subtracted from the original rate of fertilizer. Total amount of the chemical fertilizer without urea were applied as basal dose. Urea was applied as top dressing in three equal splits, at 7 days after transplanting (DAT), 30 DAT and 45 DAT, respectively. The control plots received no organic fertilizer and Mo, but other fertilizers were used as common doses. Thirty three days old seedlings were transplanted on August 9, 2004 and harvested on November 27, 2004 (108 DAT). There was negligible infestation of insect-pests during the crop growth period. Yet to keep the crop growth in normal, basudin was applied at tillering stage @ 17 kg ha^{-1} while diazinon 60 EC @ 850 ml ha^{-1} were applied to control stem borer and rice bug. The grain and straw samples were analyzed for N content following semimicro Kjeldahl procedure. To estimate the protein in grain, grain nitrogen was multiplied by 5.95 (Anonymous, 1980). The result was expressed in percentage. The analysis of variances of various plant characters, nitrogen content and uptake were done with help of computer package M-STAT Program. The mean differences among the treatments were compared by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

RESULTS

Treatment effects on yield and yield attributes, N contents, N uptake in grain and straw and protein in grain are presented in Table 1 and 2.

Plant height of BRRI dhan 30 was significantly influenced by the application of Mo with NPK and organic matter. The highest plant height (121 cm) was recorded from the treatments T_2 (NPK+100 ppm Mo) and the lowest plant height (115.4 cm) was found from T_4 (cowdung+0 ppm Mo).

Number of ear bearing tillers $hill^{-1}$ ranged from 5.9 to 7.6. The highest number (7.6) of productive tillers $hill^{-1}$ produced in T_2 (NPK+100 ppm Mo) and the lowest in T_7 (compost+0 ppm Mo). However, when 100 ppm Mo was added to the treatments, the numbers of bearing tillers hill-1 were the maximum.

Number of filled grains $panicle^{-1}$ varied significantly across the grains $panicle^{-1}$ ranged from 88.0 to 106.0 and the highest number was obtained in the treatment T_5 (cowdung+100 ppm Mo). All the treatments had higher number of grains $panicle^{-1}$ compared to T_7 (compost+0 ppm Mo) which had the lowest. Application of 100 ppm molybdenum with NPK or organic matter was found to be more effective in producing more grains $panicle^{-1}$.

Table 1. Effect of molybdenum with NPK and organic matter on yield and yield contributing characters of BRRI dhan 30

Treatment	Plant Height (cm)	Bearing Tillers hill^{-1} (No.)	Grains panicle^{-1} (No.)	1000 grain wt (gm)	Grain Yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological Yield (t ha^{-1})
T_1	120.5a	6.5bc	88.0de	23.5	4.5a	5.8b	10.5abc
T_2	121a	7.6a	99.9bc	23.4	4.8a	6.4a	11.4a
T_3	118.7ab	6.9ab	94.6cd	23.4	4.7a	6.1ab	10.6ab
T_4	115.4b	6.1bc	99.0bc	23.4	4.1ab	5.1c	9.5d
T_5	115.4b	6.0ab	106.0a	23.3	4.8a	5.7bc	10.7abc
T_6	115.7b	6.5bc	100.0b	23.3	4.4a	5.5bc	10.1bcd
T_7	120.7a	5.9c	88.8e	23.3	3.7b	5.7bc	9.6cd
T_8	120.5a	7.0ab	95.0bcd	23.5	4.1ab	5.9ab	10.2bcd
T_9	119.8ab	6.3bc	92.7be	23.2	4.1ab	5.8b	10bcd
CV (%)	2.54	8.83	2.60	1.6	7.18	4.81	4.26
Sx ±	1.53	0.29	1.28		0.16	0.14	0.22
F-test	**	**	*	NS	*	*	*

In a column figures having similar letter(s) do not differ significantly whereas figures having dissimilar letters differ significantly according to Duncan New Multiple Range Test (DMRT). NS = Not significant: * = Significant at 1% level of probability: ** = Significant at 5% level of probability

Legend: T_1 (NPK+0 ppm Mo) T_4 (cow dung+0 ppm Mo) T_7 (compost+0 ppm Mo)
T_2 (NPK+100 ppm Mo) T_5 (cow dung+100 ppm Mo) T_8 (compost+100 ppm Mo)
T_3 (NPK+200 ppm Mo) T_6 (cow dung+200 ppm Mo) T_9 (compost+200 ppm Mo)

Table 2. Effect of molybdenum with NPK and organic matter on nitrogen content (%), nitrogen uptake in grain and straw and protein (%) in grain of BRRI dhan 30

Treatment	Nitrogen content (%)		Nitrogen uptake (kg ha^{-1})			Protein (%) in grain
	Grain	Straw	Grain	Straw	Total	
T_1	1.57a	0.42def	74.2b	25.1cd	99.6c	9.25a
T_2	1.59a	0.55b	79.3a	36.4a	115.7a	9.40a
T_3	1.58a	0.50bc	77.5ab	31.6b	109.1b	9.34a
T_4	1.39b	0.36f	60.8d	19.3e	80.1e	8.23b
T_5	1.63a	0.65a	79.4a	38.4a	117.7a	9.63a
T_6	1.40b	0.40ef	65.1cd	22.9de	88.0d	8.29b
T_7	1.36b	0.40ef	53.1e	23.7de	77.0e	8.05b
T_8	1.57a	0.48cd	67.7c	29.4bc	98.4c	9.28a
T_9	1.41b	0.46cde	60.4d	27.6bcd	80.0d	8.35b
CV (%)	3.67	5.45	3.67	3.37	7.96	5.95
Sx ±	0.03	0.16	0.16	1.16	1.17	0.96
F-test	*	*	*	*	*	*

In a column figures having similar letter(s) do not differ significantly whereas figures having dissimilar letters differ significantly according to Duncan New Multiple Range Test (DMRT). NS = Not significant: * = Significant at 1% level of probability: ** = Significant at 5% level of probability

Legend: T_1 (NPK+0 ppm Mo) T_4 (cow dung+0 ppm Mo) T_7 (compost+0 ppm Mo)
T_2 (NPK+100 ppm Mo) T_5 (cow dung+100 ppm Mo) T_8 (compost+100 ppm Mo)
T_3 (NPK+200 ppm Mo) T_6 (cow dung+200 ppm Mo) T_9 (compost+200 ppm Mo)

The treatment T_8 (compost+100 ppm Mo) and T_1 (NPK+0 ppm Mo) produced the maximum 1000-grain weight (23.5) and T_9 (compost+200 ppm Mo) produced the minimum 1000-grain weight (23.2).

The highest grain yield of 4.80 t ha^{-1} was recorded with T_2 (NPK+100 ppm Mo), while the lowest grain yield was recorded 3.70 t ha^{-1} from T_7 (compost+0 ppm Mo).

Straw yield of T_2 was the highest (6.40 t ha^{-1}) and that of T_4 was the lowest (5.10 t ha^{-1}). The highest straw yield was attributed due to plant height and number of total tillers hill^{-1}. In all cases 100 ppm of Mo showed better straw yields.

The highest biological yield (11.4 t ha^{-1}) was produced in T_2 (NPK+100 ppm Mo) which was statistically similar with T_3 (NPK+200 ppm Mo), T_1 (NPK+0 ppm Mo) and T_5 (cowdung+100 ppm Mo), the lowest (9.5 t ha^{-1}) biological yield was obtained from T_4.

The highest percentage of nitrogen (1.63) was recorded in the grain of T_5 (cowdung+100 ppm Mo), while the lowest (1.36%) was in T_7 (compost+0 ppm Mo). In case of straw the highest nitrogen content (0.65%) was in T_5 and the lowest (0.36%) was in T_4.

The maximum total N uptake of 117.7 kg ha^{-1} was observed in T_5 (cowdung+100 ppm Mo) which was identical to that of T_2 (NPK+100 ppm mo). The lowest N uptake of 77.0 kg ha^{-1} was recorded in T_7 (compost+0 ppm Mo).

The highest protein (9.63%) was recorded from T_5 (cowdung+100 ppm Mo) and the lowest (8.05%) was recorded from T_7 (compost+0 ppm Mo).

DISCUSSION

Molybdenum and organic matter (cow dung) did not show any positive effect in case of plant height. However, Mo with NPK and organic matter (compost) produced relatively higher plant height compared to Mo with cow dung. Such results might be due to lower N releasing rate from cow dung and thus, N uptake was slowed down compared to NPK fertilizer and compost. The present results were in agreement with the findings of Ganwar *et al.* (1996), who reported that molybdenum (micronutrient) treatment in rice increased plant height.

Number of ear bearing tillers $hill^{-1}$ was partially consistent with the results of Ganwar *et al.* (1996) and Tewari *et al.* (1988). They reported that Mo and organic matter increased ear bearing tillers $hill^{-1}$ for better nitrate nitrogen utilization. Results of number of filled grains $panicle^{-1}$ were in agreement with that of Tewari *et al.* (1988), who reported that Mo along with NPK or organic matter increased the number of filled grains $panicle^{-1}$. It is well known that 1000-grain weight is a genetical character. In the same variety thus was no significant variation in a 1000-grain weight between treatments to treatment. Application of Mo with organic matter produced the highest number of panicle $hill^{-1}$ spikelets $panicle^{-1}$ and grains panicle as well as panicle weight which ultimately contributed for the highest grain yield. It was also observed that in all treatments with 100 ppm Mo had better result grain than that with yield other Mo dose or control. Treatments with on Mo doses with NPK and cow dung showed better results than that of other Mo doses with compost. These better grain yields with 100 ppm Mo with NPK or cow dung were mainly contributed by higher number of ear bearing tillers, total spikelets $panicle^{-1}$ and grains $panicle^{-1}$. Although the grain yields obtained within each group of NPK with Mo, cow dung with Mo and compost with Mo produced similar yield, the plots where Mo were added produced higher grain yield than that in non-added plots. The results were in agreement with that of Sheudzhen *et al.* (1985) who reported that Mo with NPK increased rice yield. Similar results were also obtained by Tewari *et al.* (1988). In all cases 100 ppm of Mo showed better straw yields. Sabrah *et al.* (1995) and Maskina *et al.* (1987) who observed that straw yields were greater with compost than in untreated plots. Biological yield was attributed by higher grain and straw yield of rice plant. These results were in agreement with the findings of Sabrah *et al.* (1995) who reported that biological yield increased with application of organic matter @ 0.0, 16.5, 33.0, 49.5 and 66.0 t ha^{-1} into the soil.

Highest Nitrogen content in grain and straw might be due to the balanced nitrogen uptake from cow dung. Application of Mo presumably caused higher released of nitrate and nitrate reductase engymes which ultimately contributed for higher uptake of Nitrogen in grain and straw. Thus, nitrogen content in grain and straw were high. The results were in agreement with Scheudzhen *et al.* (1992) who reported that in rice trace element increased total nitrogen content in leaf, stem and grain at tillering, heading and maturity.

The result of nitrogen uptake in grain and straw was similar to Sheudzhen *et al.* (1985). They reported that Mo or trace element increased N uptake in plants and application of organic matter in rice increased N uptake in grain and straw.

Protein content in grain was generally high with 100 ppm molybdenum applied in combination of NPK, cowdung or compost. Application of molybdenum probably caused higher release of nitrate and nitrite reductase enzymes which was ultimately contributed for higher uptake of N in grain and straw. It therefore improved protein content in grain and straw.

CONCLUSION

In conclusion, it was obvious that plants received 100 ppm Mo either with NPK or organic matter showed better performance in terms of yield contributing characters and grain yield. Nitrogen content and up take in grain and straw, were better when 100 ppm or 200 ppm Mo was added with NPK or organic matter either as cow dung or compost. The addition of Mo also influenced protein percentage of grain.

LITERATURE CITED

Anonymous, 1980. “Official Method of Analysis”. Association of Official Analytical Chemist, Washington DC. pp. 20-44.

BARC, 1997. “Fertilizer Recommendation Guide”. Bangladesh Agricultural Research Council, Dhaka. 41 pp.

BBS, 2006. “Statistical Year Book of Bangladesh”. Bangladesh Bureau of Statistics, Ministry of Planning, Dhaka, Bangladesh. pp. 42-46.

De, G. C. 1999. "Fundamentals of Agronomy." Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. 159 pp.

FAO, 2007. “FAO Statistical Year Book 2006-2007 (Vol. 3). FAO, Rome. 64 pp.

Ganwar, S. K. Dasgupta, M. K. and Ghosh, D. C. 1996. Rice growth as affected by post management schedules and its impact on grain yield. *In* "Agro System Management". Proceeding of National Symposium, 18-21 February 1989. pp. 61-67.

Gomez, K. A. and Gomez, A. A. 1984. "Statistical Procedures for Agricultural Research” (Second Edn.). John Wiley and Sons, New York. pp. 139-240.

Jahiruddin, M., Ali, M., Hossain, S. M. A., Ahmed, M. U. and Haque, M. M. 1995. Effect of boron on grain set, yield and some other parameters of wheat cultivars. *Bang J Agril Sci* **22**, 179-184.

Maskina, M. S., Singh, Y. and Singh, B. 1987. Wheat straw management for rice on a course-texture soil. *Int Rice Res News* **12**(2), 40.

Sabrah, R. E. A, Majid, H. M. A and Rebie, P. K. 1995. Optimizing physical properties of a sandy soil for higher productivity using town refuse compost in Saudi-Arabia. *J Arid Env* **29**(2), 253-262.

Sheudzhen, A. K., Ryman, V. T. and Chizhikova, O. I. 1985. Effect of trace elements on the chemical composition and yield of rice. *Agrokhimiya* **11**, 82-84.

Tewari, T. N. L., Yadav, D. N. and Chaturvedi, G. S. 1988. Response of blue-green algae fertilized with molybdenum to yield and yield attributes of rice. *Narendra Deva J Agril Res* **3**(1), 17-19.