



INFLUENCE OF AZOLLA WITH DIFFERENT LEVELS OF UREA IN RICE PRODUCTION IN SOUTH WEST BANGLADESH

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Abstract: A pot experiment was conducted on Satla soil series in Terokhada Upazilla, Khulna during the boro season (February to June) to see whether *Azolla* (biofertilizer) could be grown together with BRRI dhan 28 and to compare the effect of the recommended dose of N (100 kg N ha⁻¹) with that of different combinations of urea and *Azolla* (all treatments having the recommended doses of P, K, S and Zn). The experiment was laid out in a completely randomized design with 5 treatments and 4 replications. *Azolla pinnata* applied 0.2 kg m⁻² grew well with BRRI dhan 28. The highest amount of grain yield of 2.35 t ha⁻¹ was produced by the application of 75 Kg N ha⁻¹ with *Azolla*. One layer of *Azolla* with 50 kg ha⁻¹ urea-N produced almost same amounts of grain. Thus the rate of 0.2Kg m⁻² *Azolla* inoculums as N source along with 50-75% Urea-N ha⁻¹ appeared to be a good practice in reducing the use of costly urea (chemical N source) fertilizer by about 25-50%.

Keyword: Satla soil series, *Azolla*, rice, biofertilizer, nitrogen, urea

About 50% land area of *Terokhada* Upazilla under Khulna district is occupied by a number of peat soil beels where only two soil series viz. Satla and Harta were found. Satla soil series is found in more than half of the area. Satla soil includes seasonally to almost perennially flooded, poorly to very poorly drained, very dark grey to black and very dark grayish brown, organic soils below the topsoil (SRDI staff, 1973 and 1985-1993). These soils are developed by organic material derived from decomposed swamp grasses and reeds in the peat basin areas occupying low lying basin depressions of Khulna-Gopalganj beel areas (Parent, 2003). It poses several limitations for successful crop production due to unfavorable effects of certain and/or chemical properties of soil such as very poor drainage, moderate deep flooding and low bearing capacity and low nutrient status though it is somewhat where there is mineral topsoil (Brammer, 2000). For growing crops in this area fertilizer recommendations should be made for individual crops.

Rice is mainly cultivated in one or two cropping seasons in the peat basins for its limitations. So, the farmer can grow rice in limited area and they need to apply large amount of urea which increase production cost. The problem can be solved by reducing urea application and/or by using an alternate source like *Azolla* which is available in Terokhada. Among the fertilizer elements nitrogen plays a key role in rice production and it is required in large amount compared with other

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fertilizers (Khan and Rahman, 2008). Most of the agricultural soils of Bangladesh are deficient in Nitrogen. The continuous application of chemical fertilizers have adverse effect on soil fertility and the status of soil organic matter in the croplands of Bangladesh has been decreasing day by day (Meah, 1994).

Yield potentialities of rice declined due to use of continuous and imbalance chemical fertilizers, but use of green manure maintained good soil fertility level. Therefore, green manuring, use of organic manure and biofertilizers should receive priority in maintaining soil fertility and also reducing cost for urea. The small, free-floating water fern *Azolla*, considered a 'green gold mine' (Wagner, 1997) offers a new significant contribution to agriculture which fixes atmospheric N through the symbiotic association with *Anabaena azollae* that lives inside the dorsal lobes of *Azolla* leaves potentially supplying a substantial amount of N to the rice crop (Moore, 1969). *Azolla* can fix 22–40 Kg N ha⁻¹ within 30 days (Peoples *et al.*, 1995).

The *Azolla*-*Anabaena* symbiosis has already become a potential biofertilizer for rice production due to its high N₂-fixing abilities, rapid growth and easily decomposable characteristics. This *Azolla* approach is especially attractive in lieu of the high N fertilizer cost and the growing need to improve rice grain yield with minimum adverse environmental effects associated with the intensive use of chemical fertilizer (De Macale and Vlek, 2004). Although *Azolla* is a potential source of naturally fixed N, information regarding the use of *Azolla* in combination with nitrogen fertilizer is insufficient. Therefore, the present study was conducted in Satla series to evaluate its fertility status and to determine the influence of *Azolla* on yield of the rice.

Soil sample was collected from Cola beel of Terokhada Upazilla under Khulna district. The soil belongs to the Satla soil series of the Peat Basin AEZ having pH 7.2, organic matter 3.45%, total N 0.23%, available P, K and S were 9.40 ppm, 0.38 Cmol kg⁻¹ and 120.20 ppm respectively. The soil was silty clay in texture. Fifty day old, healthy seedlings of BRRI dhan 28 were collected and water fern *Azolla pinnata* was collected from local beel of Terokhada. Twenty equal sized plastic pots were filled with 8 Kg soil per pot and prepared for seedlings transplantation. Weeds and stubbles were removed from the soils. The pot experiment was carried out during Boro season of the year 2011 (February to June). The experiment was laid out in a completely randomized design with four replications. There were 5 treatments as follows:

T0: Control (No *Azolla*, No N); T1: *Azolla* only; T2: *Azolla* + 50% Urea-N; T3: *Azolla* + 75% Urea-N; T4: 100% of Urea-N only.

Every dose of N fertilizer was applied in 3 equal splits at 15, 45 and 60 days after transplanting (DAT) because, Urea becomes available to plants within three days after application and remains available about one week and Urea lost through leaching, volatilization etc. N @ 100 Kg ha⁻¹ as Urea, P @ 86.4 Kg ha⁻¹ as triple super phosphate (TSP), K @ 56.8 Kg ha⁻¹ as muriate of potash (MoP), S @ 34.6 Kg ha⁻¹ as Gypsum and Zn @ 44.4 Kg ha⁻¹ as Zinc sulphate were applied as basal to all experimental pots (BARC, 2005). Fifty day old seedlings of BRRI dhan 28 were transplanted on 2nd February 2011 having three seedlings hill⁻¹ at 20 cm x 15 cm spacing thus 4 hills pot⁻¹. *Azolla* was applied at the rate of 0.2 Kg m⁻² pot⁻¹. The first weeding was done after 25 days of transplanting and 2nd weeding was done after 45 days of transplanting. Weeding was done by uprooting.

Water is very important for rice cultivation. Sufficient water level was maintained as plant needed and for growing *Azolla*. During fertilizer application water was removed and after 3 days water was applied again to increase the effectiveness of fertilizer. Enough water was maintained up to milk dough stage and from hard dough stage water was drained for ripening.

Furadan (insect killer) @ 3 Kg ha⁻¹ was applied to check any possible insect attack. Proper care was taken also to control the pest attack.

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The crop was harvested on 15 June as it matured. From each pot one hill was selected randomly and uprooted carefully without any damage of the plants and grains. The height of rice plant, length of root, number of effective tiller hill⁻¹, panicle length and grain yield were recorded from the sampled hill.

Grain yield of rice for different treatments varied from 0.81 t ha⁻¹ to 2.35 t ha⁻¹ (Table 1). The highest grain yield was obtained with the treatment T3 (*Azolla* + 75% Urea-N). Alam *et al.* (2002) reported 2.94 to 6.95 t ha⁻¹ grain yield.

Table 1: Effect of *Azolla* on grain yield, panicle length (cm), plant height (cm), root length (cm), and number of effective tillers hill⁻¹.

Treatments	Grain yield (at 14% moisture)		Panicle length (cm)	Plant height (cm)	Root length (cm)	Effective tillers hill ⁻¹
	t ha ⁻¹	% increase over control				
T0	0.81c	-	14.92c	68.50b	26.25c	5.50
T1	1.43b	77	15.50abc	63.50c	26.0c	7.75
T2	1.45ab	79	16.10abc	65.75bc	28.25abc	6.75
T3	2.35a	190	17.08a	72.25a	30.25a	8.0
T4	1.54ab	90	17.42a	72.25a	28.50ab	7.25
Level of significance	**		*	*	**	NS
S \bar{X}	0.52		0.59	2.09	0.67	0.72
CV (%)	14.57		7.31	2.10	4.83	13.59

[T0 = Control; T1 = *Azolla*, No N; T2 = *Azolla* + 50% Urea-N; T3 = *Azolla* + 75% Urea-N; T4 = 100% of Urea-N.

In column figures with same letters or without letter do not differ significantly where as figures with dissimilar letters differ significantly as per DMRT.

** = significant at 1% level; * = significant at 5% level; NS = Not significant; CV = Coefficient of variation]

Number of effective tillers hill⁻¹ for different treatments varied from 5.5 to 8 (Table 1). Latif *et al.* (2011) reported an average 13 tillers hill⁻¹.

The panicle length of the rice for different treatments varied from 14.92 cm to 17.42 cm (Table 1). The highest panicle length was obtained with the treatment T4 (100% of Urea-N). Latif *et al.* (2011) found the highest 28 cm panicle length.

The rice plant height was found to vary from 63.50 cm to 72.25 cm (Table 1) for different treatments. The highest plant height was obtained with the treatment T3 (*Azolla* + 75% Urea-N) and T4 (100% of Urea-N). Latif *et al.* (2011) found plant height maximum 92 cm. The root length of the experimented rice plant for different treatments varied from 26 cm to 30.25 cm (Table 1). The highest root length was obtained with the treatment T3 (*Azolla* + 75% Urea-N).

The results also showed that application of *Azolla* along with 50 to 75 Kg N ha⁻¹ might be better substitutes for the recommended dose of urea fertilizer for BRRI dhan 28 production in Boro season which grown on soil with medium level of N. Sinha *et al.* (1999) observed that *Azolla- Anabaena* complex is very efficient in waterlogged rice paddy fields, contributing significant levels of nitrogen and organic matter thereby improving the physic-chemical properties of soils.

Grain yield increased significantly due to application of *Azolla* with urea in different combinations. The highest grain yield recorded in treatment T3 was not significantly different

from T4 (100% of Urea-N) and T2 (*Azolla* + 50% Urea-N). Treatment T4 was not significantly different in grain yield from T1 (*Azolla*, No N) and T2 (*Azolla* + 50% Urea-N). However, all the treatments produced significantly higher amounts of grain over the T0 (control). Similar result was reported by Alam *et al.* (2002).

The variation in numbers of effective tillers hill⁻¹ for different treatments was not statistically significant. So the results showed that application of *Azolla* along with urea in different combinations have no significant effect on effective tiller numbers of the cultivated rice plant.

Panicle length increased significantly due to application of *Azolla* and urea in different combinations. The highest panicle length was not significantly different from T1 (*Azolla* only) to T3 (*Azolla* + 75% Urea-N) where treatment T1 and T2 (*Azolla* + 50% Urea-N) was not significantly different from T0 (control). The results thus showed that application of *Azolla* along with urea in different combinations has significant effect on panicle length which might have effect on grain yield.

The highest plant height was significantly different from treatment T0 (control) to T3 (*Azolla* + 75% Urea-N) where treatment T0 and T2 (*Azolla* + 50% Urea-N) was not significantly different. Treatment T1 (*Azolla* only) and T2 gave similar results. The results thus showed that application of *Azolla* along with urea in different combinations has significant effect on the plant height which might have effect on grain yield.

Root length increased significantly due to application of *Azolla* and urea in different combinations. The highest root length was not significantly different from T2 (*Azolla* + 50% Urea-N) and T4 (100% of Urea-N) where treatment T2 was not significantly different from T0 (control) and T1 (*Azolla* only). The results thus showed that application of *Azolla* along with urea in different combinations has significant effect on panicle length which might have effect on nutrient uptake thus grain yield.

Pot experiment resulted that *Azolla* could be grown simultaneously with rice (cv. BRRI dhan 28) in Satla soil series. Grain yield, panicle length, plant height and root length of the rice increased significantly due to application of *Azolla* and urea in different combinations. The too low grain yield could be recovered by conducting the experiment in field. The variation in effective tillers hill⁻¹ for different treatments was not statistically significant. The results of this experiment clearly showed that application of *Azolla* along with 50 to 75 Kg N ha⁻¹ can save 25 to 50 Kg N fertilizer ha⁻¹ which can reduce production cost by about Tk. 625-1250 ha⁻¹. Beside N, availability and uptake of other nutrients might be influenced by *Azolla*. So, future researches should study *Azolla*-nutrients interactions.

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