J. Agrofor. Environ. 3 (1): 95-99 2009 ISSN 1995-6983

Fertilizer management through soil test value interpretation in two local varieties of transplant *Aman* rice

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Abstract: The experiment was carried out to study fertilizer management through Soil Test Value Interpretation (STVI) on two local varieties of transplant *Aman* rice, viz. *Nizersail* and *Basiraj* under three fertilizer recommendations - STVI recommendation, BRRI (Bangladesh Rice Research Institute) recommendation and AEZ (Agro-ecological Zone) recommendation. The experiment was laid out in a randomized complete block design with three replications. Fertilizer recommendations, rice varieties and their interactions had significant effect on most of the yield and yield contributing characters. The highest number of total tillers hill^{-1} (13.20), effective tillers hill^{-1} (10.43), grains panicle^{-1} (77.08), number of total grains panicle^{-1} (87.32), grain yield (2.91 t ha^{-1}), biological yield (7.54 t ha^{-1}) and harvest index (38.57%) were recorded with the STVI fertilizer recommendation. AEZ fertilizer recommendation showed lowest values for above mentioned parameters except harvest index. *Nizersail* had higher plant height (77.82 cm, numerical value), number of total tillers hill^{-1} (14.72), number of effective tillers hill^{-1} (10.62), grains panicle^{-1} (79.68), number of total grains panicle^{-1} (89.24), grain yield (2.93 t ha^{-1}) and harvest index (40.08%) than that of *Basiraj* while *Basiraj* contributed to higher number of sterile spikelets panicle^{-1} (11.86), weight of 1000-grains (17.73 g), straw yield (4.85 t ha^{-1}), biological yield (7.63 t ha^{-1}) than that of *Nizersail*. Therefore, STVI fertilizer recommendation can be an effective management procedure of fertilizers in transplant Aman rice.
Key words: Fertilizer management, Soil test value interpretation and transplant *Aman* rice.

Introduction

Transplant *Aman* rice covers the largest area of about 49.24 million hectares and has the production of about 102.19 million metric tons of rice (BBS, 2006). Average yield of rice in Bangladesh is around 2.42 t ha^{-1} which is lower than the world average (2.9 t ha^{-1}) and frustratingly below the highest (6.1 t ha^{-1}) country demonstrated like in Korea (Swaminathan, 1997). The present decline or stagnation of major crop yield in Bangladesh is the cumulative effect of many soil related constraints. The important factors are nutrient mining, depletion of soil organic matter, imbalanced fertilization, scanty use of bio- and organic fertilizers and poor management practices (Miah and Karim, 1995).

Fertilizer is one of the main inputs for crop production on modern agriculture. Fertilizer management through recommendation is important for the realization of potential grain yield and nutrient uptake than single application of fertilizer (Talashilker and Vimol, 1986). Besides, fertilizer management can play an important role in sustaining higher yield of crops as well as in maintaining fertility status of soils on a long-term basis. So, proper fertilizer recommendation through fertilizer management should be followed for realizing higher yield of transplant *Aman* rice.

Soil test value interpretation is an important element in nutrient management. Soil tests used to evaluate fertility status of the soil nutrients that are expected to become plant available. Soil test values do not measure total amounts of nutrients and (these soil test values) do not vary greatly from year to year. These constant results can be easily applied by proper fertilizer management (Marx *et al.*, 1996). This experiment was conducted to study fertilizer management through soil test value interpretation in two local varieties of transplant *Aman* rice with an aim to find out the way of using efficient and balanced fertilizers among three fertilizer recommendations.

Materials and Methods

Two local varieties of transplant *Aman* rice viz., *Nizersail* and *Basiraj* were used as test crops in the experiment. Two factors were included in the study-A) 2 Varieties viz., i) *Nizersail* (V_1) and ii) *Basiraj* (V_2) B) 3 Fertilizer recommendations viz., i) STVI fertilizer recommendation 84-56-57- 60 Kg Urea (N)-TSP (P_2O_5)-MOP (K_2O)-Gypsum(S)ha^{-1}(F_1), ii) BRRI variety specific fertilizer recommendation *Nizersail:* 90-50-35-50 kg Urea (N)-TSP (P_2O_5) –MOP (K_2O)-Gypsum (S) ha^{-1} (F_2) *Basiraj:* 90-50-35-50 kg Urea (N)-TSP (P_2O_5) -MOP (K_2O)-Gypsum (S) ha^{-1} and iii) AEZ fertilizer recommendation 74-15-50-33 kg Urea (N)-TSP (P_2O_5)-MOP (K_2O)-Gypsum (S) ha^{-1} (F_3) Zinc (2.12 ppm) here. The experiment was laid out in a randomized complete bock design with three replications. The size of each unit plot was 4.0 m × 2.5 m. The distance between blocks and plots were 1 m and 0.75 m, respectively. Soil samples were analyzed for determination of N, P, K, S, Zn at Soil Resources Development Institute (SRDI), Mymensingh. Healthy and vigorous seeds of the selected rice varieties (*Nizersail* and *Basiraj*) were collected from Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh. Pre-germinated seeds were sown in the wet nursery bed on 15 August, 2007. The layout of the experimental field was done on 2 October, 2007 in accordance with the experimental design after the land was ready for transplanting of seedlings. As N was low in soil (0.13%), N was applied in three equal splits as Urea. The first one-third was applied at final land preparation and the second one-third was given at rapid tillers stage (20 Days after transplantion). Both of these installments were applied as broadcast and incorporated with soil followed by weeding. The third installment was applied as broadcast at 5-7 days before panicle initiation stage (45 DAT). The land was fertilized as per treatment. 34 days old seedlings were uprooted carefully. Thirty days old seedlings were transplanted on 3 October 2007 at 25 cm × 15 cm spacing giving two seedlings hill^{-1}. Intercultural operations like gap filling, irrigation, weeding, insect pest control were done whether necessary. The crop was harvested at full

maturity (i.e on 8 January, 2008). Five hills (excluding border hills) were randomly selected from each plot for recording necessary data on various plant characters. The grain yield was finally converted to t ha^{-1} and adjusted at 14% moisture level. After harvest data on different parameters were recorded, compiled and tabulated in proper form for statistical analysis. Analysis of variance was done with the help of computer package MSTAT. The mean differences among the treatments were tested with Duncan's Multiple Range Test (Gomez and Gomez, 1984).

Results and Discussion

Different fertilizer recommendations on two rice varieties had noticeable influence on the yield and yield attributes of transplant rice. However, plant height was not significantly influenced by variety as well as fertilizer recommendations. The interaction effect between rice varieties and fertilizer recommendations was also insignificant.

Total number of tillers $hill^{-1}$ was significantly influenced by rice varieties and fertilizer recommendations at 1% level of probability. The total number of tillers $hill^{-1}$(14.72) was higher in *Nizersail* than that (10.24) of *Basiraj* (Table1). Hussain *et al.* (1989) reported that total number of tillers $hill^{-1}$ differed among the varieties. The variation in total number of tillers $hill^{-1}$ might be due to varietals characters. None of the varieties could reach their maximum potential of tiller production might be due to continuous cloudy sky and rainfall in the experimental field during the vegetative growth stage for 15 days. Table 2 showed that the highest number (13.20) at the STVI fertilizer recommendation and the lowest number of total tillers $hill^{-1}$ (11.92) was found at AEZ fertilizer recommendation which was statistically identical with BRRI variety specific fertilizer recommendation. Zhou *et al.* (1998) found that N, P and K nutrition increased the number of tillers $hill^{-1}$ of rice plants. Fertilizer recommendations and variety did not interact significantly with each other in terms of total number of tillers $hill^{-1}$ (Table 3).

Variety had significant (1% level of significance) effect on number of effective tillers $hill^{-1}$. The results indicated that the number of effective tillers $hill^{-1}$ (10.62) was greater in *Nizersail* than that (8.83) of *Basiraj* (Table 1). Significant variation among the varieties was also reported by BRRI (1979, 1991) and Om *et al*. (1998). Number of effective tillers $hill^{-1}$ was significantly influenced due to the effect of fertilizer recommendations at 5% level of significance. Data revealed that the highest number of effective tillers $hill^{-1}$ (10.43) was obtained from *Nizersail* at STVI fertilizer recommendation and the lowest number (8.95) was found in *Basiraj* at AEZ variety specific fertilizer recommendation (Table 2). This trend of results is in agreement with the findings of Penar and Avila (1983). Analysis of variance presented that the number of effective tillers $hill^{-1}$ was not significantly affected due to interaction between variety and fertilizer recommendations.

Number of non-effective tillers $hill^{-1}$ was significantly affected by variety as well as fertilizer recommendations at 1% level of significance. *Nizersail* produced higher number of non-effective tillers $hill^{-1}$ (4.04), which was followed by *Basiraj* (2.80) (Table 1). The highest number of non-effective tillers $hill^{-1}$ (3.73) was found in STVI fertilizer recommendation and the lowest number (3.23) was found in BRRI variety specific fertilizer recommendation (Table 2). The interaction effect of fertilizer recommendations and variety was not significant on number of non-effective tillers $hill^{-1}$(Table 3).

Grains $panicle^{-1}$ was also significantly influenced by rice varieties and fertilizer recommendations. *Nizersail* showed higher number of grains $panicle^{-1}$ (79.68) than that (67.92) of *Basiraj* (Table 1). BRRI (1991), Kamal *et al.* (1998) and Devarju *et al.* (1988) also reported the variation in grains $panicle^{-1}$ due to varietals differences. STVI fertilizer recommendation produced significantly the highest number of grains $panicle^{-1}$ (77.08) and the lowest number (69.60) on AEZ fertilizer recommendation (Table 2). According to Mondal *et al.* (1990), the number of grains $panicle^{-1}$ of rice was increased with the increasing rates of N, P, K. The interaction effect between the fertilizer recommendations and variety on the number of grains $panicle^{-1}$ was significant at 1% level of significance. The highest number of grains $panicle^{-1}$ (84.13) was obtained from the interaction between *Nizersail* with STVI fertilizer recommendation.

Number of sterile spikelets $panicle^{-1}$ was significantly influenced by varieties and fertilizer recommendations at 1% and 5% level of significance, respectively.The number of sterile spikelets $panicle^{-1}$ (11.86) was higher in *Basiraj* than that (9.79) of *Nizersail* (Table 1).This variation might due to the genetic make up of two different varieties which may determine the process of filling the spikelets with the assimilates and the environmental factors, such as short duration of sunshine hours during the grain filling of *Basiraj* and longer sunshine duration during the grain filling of *Nizersail*. According to Om *et al.* (1998) there were higher yields in the year of 48.4% more sunshine hours than the years of less sunshine hours. The highest number of sterile spikelets $panicle^{-1}$ (11.4) was obtained from AEZ fertilizer recommendation and the lowest number (10.23) was found from STVI fertilizer recommendation (Table 2). Asif *et al.* (1997) reported that application of N, P and K decreased the number of sterile spikelets $panicle^{-1}$ of rice. Number of sterile spikelets $panicle^{-1}$ was not significantly influenced by the interaction between fertilizer recommendations and varieties (Table 3).

Number of total grains $panicle^{-1}$ was also significantly influenced by variety, fertilizer recommendations and their interactions at 1% level of probability. *Nizersail* gave higher number of total grains $panicle^{-1}$ (89.24) than that (79.80) of *Basiraj* (Table 1). This result is also supported by the findings of BRRI (1991) and Chowdhury *et al.* (1993). The highest number of total grains $panicle^{-1}$ (87.32) was obtained from STVI fertilizer recommendation while the lowest number (81.00) was found in AEZ fertilizer recommendation (Table 2). These results are in agreement with the findings of Mian and Eunus (1978). It was evident from the results that higher level of N produced higher number of total grains $panicle^{-1}$. The highest number of total grains $panicle^{-1}$ (93.53) was found in *Nizersail* with STVI fertilizer recommendation

and the lowest number (77.70) were found in *Basiraj* with AEZ fertilizer recommendation (Table 3). In general,

Table 1. Effect of variety on yield and yield contributing characters of transplant *Aman* rice (*Nizersail* and *Basiraj*)

Variety	Plant height (cm)	No. of total tillers hill^{-1}	No. of effective tillers hill^{-1}	No. of non-effective tillers hill^{-1}	No. of grains panicle^{-1}	No. of sterile spikelets panicle^{-1}	No. of total grains panicle^{-1}	Wt. of 1000 grains (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
Nizersail (V_1)	77.82	14.72a	10.62a	4.04a	79.68a	9.79b	89.24a	16.64b	2.93a	4.38b	7.31b	40.08a
Basiraj (V_2)	77.29	10.24b	8.83b	2.80b	67.92b	11.86a	79.80b	17.73a	2.78b	4.85a	7.63a	36.43b
Level of significance	NS	**	*	**	**	**	**	**	**	**	**	**
$S_{\bar{x}}$	-	0.129	0.288	0.074	0.361	0.182	0.349	0.093	0.011	0.011	0.018	0.043

Table 2. Effect of fertilizer recommendations on yield and yield contributing characters of transplant *Aman* rice (*Nizersail* and *Basiraj*)

Fertilizer recommendations	Plant height (cm)	No. of total tillers hill^{-1}	No. of effective tillers hill^{-1}	No. of non-effective tillers hill^{-1}	No. of grains panicle^{-1}	No. of sterile spikelets^{-1}	No. of total grains panicle^{-1}	Wt. of 1000 grains (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
STVI fertilizer recommendation (F_1)	76.42	13.20a	10.43a	3.73a	77.08a	10.23b	87.32a	16.87b	2.91a	4.63b	7.54a	38.57a
BRRI fertilizer recommendation (F_2)	77.90	12.33b	9.80ab	3.23b	74.42b	10.85ab	85.25b	17.23a	2.86b	4.69a	7.55a	37.90c
AEZ fertilizer recommendation (F_3)	78.35	11.92b	8.95b	3.30b	69.60c	11.40a	81.00c	17.47a	2.81c	4.51c	7.32b	38.30b
Level of Significance	NS	**	*	**	**	*	**	*	**	**	**	**
$S_{\bar{x}}$	-	0.159	0.352	0.091	0.442	0.223	0.428	0.113	0.013	0.013	0.022	0.053

Table 3. Effect of interactions between rice varieties and fertilizer recommendations on yield and yield contributing characters of transplant *Aman* rice (*Nizersail* and *Basiraj*)

Intera-ctions	Plant height (cm)	No. of total tillers hill^{-1}	No. of effective tillers hill^{-1}	No. of non-effective tillers hill^{-1}	No. of grains panicle^{-1}	No. of sterile spikelets panicle^{-1}	No. of total grains panicle^{-1}	Wt. of 1000 grains (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
V_1F_1	77.20	15.33	11.53	4.47	84.13 a	9.42	93.53 a	16.57	2.97 a	4.37 d	7.33 b	40.43 a
V_1F_2	77.27	14.67	10.80	3.80	80.17 b	9.79	89.90 b	16.63	2.92 a	4.37 d	7.29 b	40.00 b
V_1F_3	79.00	14.17	9.53	3.87	74.13 c	10.18	84.30 c	16.73	2.90 a	4.39 d	7.29 b	39.80 b
V_2F_1	75.63	11.07	9.33	3.00	70.03 d	11.03	81.10 d	17.17	2.85 b	4.89 b	7.74 a	36.70 c
V_2F_2	78.53	10.00	8.80	2.67	68.67 d	11.92	80.60 d	17.83	2.80 b	5.01 a	7.82 a	35.80 d
V_2F_3	77.70	9.67	8.37	2.73	65.07 e	12.61	77.70 e	18.20	2.70 c	4.63 c	7.34 b	36.80 c
Level of significance	NS	NS	NS	NS	**	NS	**	NS	*	**	**	**
Sx –	-	-	-	-	0.626	-	0.605	-	0.018	0.018	0.316	0.075

interactions of higher level of N and P, K, S found to be better in producing total grains panicle-1.

Weight of 1000-grains of rice was significantly affected by varieties and fertilizer recommendations. *Basiraj* had higher weight of 1000-grains (17.73 g) than that (16.64g) of *Nizersail* (Table1). Table 2 showed that AEZ fertilizer recommendation produced the highest weight of 1000-grains (17.47 g) and STVI fertilizer recommendation produced the lowest weight of 1000-grains (16.87 g). The interaction due to variety and fertilizer recommendation was not significant in respect of weight of 1000-grains (Table 3).

Grain yield was significantly influenced by varieties and fertilizer recommendations at 1% level of significance. The grain yield (2.93 t ha^{-1}) was higher in *Nizersail* than that (2.74 t ha^{-1}) of *Basiraj* (Table 1). Low grain yield of *Basiraj* might be due to the following reasons: higher percent of sterile spikelets $panicle^{-1}$ due to a number of reasons stated earlier. Late transplanting (beyond 15 September) is also a factor for lower grain yield of two varieties (as their average yield 3-3.5 t ha^{-1}). As a result of continuous cloudy sky and short sunshine duration, the solar radiation interception in the plant canopy during grain filling period might be too low to produce enough assimilate to fill the spikelets produced. However, grain yield differences due to variety were also reported by Manoj *et al.,* (1996), and Om *et al.,* (1998). The highest grain yield (2.91 t ha^{-1}) was achieved at STVI fertilizer recommendation and the lowest (2.81 t ha^{-1}) was found in AEZ fertilizer recommendation (Table 2). Sharma and Bali (2001) found that yield and total N, P and K uptake of rice increased significantly with the increase in levels of NPK. In an experiment Singh *et al.* (2001) assess the integrated effect of chemical fertilizers (NPK) on grain yield and nutrient availability and they found that rice yields continued to increase significantly with increasing NPK level up to 100% of the recommendation rate. Grain yield was significantly influenced by the interaction between the fertilizer recommendations and varieties at 5% level of significance. The highest grain yield (2.97 t ha^{-1}) was obtained from the interaction between *Nizersail* with the STVI fertilizer recommendation which was identically followed by the interaction V_1F_2 (2.92 t ha^{-1}), V_1F_3 (2.90 t ha^{-1}), V_2F_1 (2.85 t ha^{-1}) and V_2F_2 (2.80 t ha^{-1}).The lowest grain yield (2.70 t ha^{-1}) was obtained from the interaction between *Basiraj* with AEZ fertilizer recommendation (Table 3).

Straw yield was also significantly influenced by varieties, fertilizer recommendations and their interactions at 1% level of significance. The higher straw yield (4.85 t ha^{-1}) was obtained in *Basiraj* than that (4.38t ha^{-1}) of *Nizersail* (Table 1). The highest straw yield (4.69 t ha^{-1}) was obtained from BRRI fertilizer recommendation followed by STVI fertilizer recommendation (4.63 t ha^{-1}) and the lowest straw yield (4.51 t ha^{-1}) was obtained from AEZ fertilizer recommendation (Table 2). The highest straw yield (5.01 t ha^{-1}) was obtained from the interaction between *Basiraj* with the BRRI fertilizer recommendation which was followed by V_2F_1 (4.89 t ha^{-1}) and V_2F_3 (4.63 t ha^{-1}).

Biological yield was significantly influenced by varieties, fertilizer recommendations and their interactions at 1% level of significance. The highest biological yield (7.63 t ha^{-1}) was obtained from *Basiraj* and the lowest biological yield (7.31 t ha^{-1}) was found from *Nizersail* (Table 1). Gu *et al.* (1991) recorded variable biological yield among varieties. The highest biological yield (7.55 t ha^{-1}) was obtained from the BRRI fertilizer recommendation which was statistically similar with STVI fertilizer recommendation. The lowest biological yield (7.32 t ha^{-1}) was obtained from AEZ fertilizer recommendation (Table 2).

Variety as well as fertilizer recommendation and their interaction showed significant influence on harvest index at 1% level of significance. *Nizersail* contributed to higher value of harvest index (40.08%) than that (36.43%) of *Basiraj* (Table 1). Table 2 showed that the highest value of harvest index (38.57%) was obtained from the STVI fertilizer recommendation which was followed by AEZ fertilizer recommendation (38.30%) and the lowest harvest index (37.90%) was obtained from the BRRI fertilizer recommendation. The highest value of harvest index (40.43%) was found in the interaction between STVI fertilizer recommendation and *Nizersail* and the lowest value of harvest index (36.70%) was obtained from the interaction between STVI fertilizer recommendation and *Basiraj* (Table 3).

It can be concluded that *Nizersail* showed best yield and yield contributing characters under STVI fertilizer recommendation at 84-56-57-60 Kg Urea (N)-TSP (P_2O_5)-MOP (K_2O)-Gypsum(S) ha^{-1}.

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