DEVELOPMENT OF FERTILIZER RECOMMENDATION FOR MUSTARD-BORO-T.AMAN RICE CROPPING PATTERN UNDER KARATOYA-BANGALI FLOOD PLAIN SOILS

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ABSTRACT

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An experiment was conducted at Gabtali, Bogra (AEZ-4) for three years (2001-2004) to determine the optimum fertilizer doses for Mustard-Boro-T. aman cropping pattern which enhanced total production and profit. Six nutrient management packages including one farmers' practice and one control were tested. The other four treatments were soil test based (STB) fertilizer dose for moderate yield goals (MYG) and High yield goals (HYG), STB based fertilizer dose for HYG plus mustard oil cake (400 kg/ha) and fertilizer dose as per country's Fertilizer Recommendation Guide (FRG'97). Three years average results of HYG gave higher yield performance of crops compared to the other treatments. The mean yield performance of treatment T_2 (HYG) over three years of mustard, Boro and T. aman were 1.11, 5.59 and 3.39 t/ha, respectively. The average gross margin (Tk.17408/ha) and MBCR (3.77) of mustard was the highest in T_2 (HYG). Similarly the highest gross margin (Tk .38597 /ha) and mean benefit and cost return (MBCR) (2.77) of Boro rice were observed from T_2 (HYG). It was also observed that the highest gross margin (Tk .23718 /ha) and MBCR of T. aman obtained from T_2.

Key words: High yield goal, Mustard-Boro-T.aman cropping pattern, Karatoa Bangali Flood Plain Soils.

INTRODUCTION

Mustard-Boro-T.aman is one of the major cropping patterns under Karatoya Bangali flood plain soils in Bogra district. Soil fertility and productivity status of this area are not satisfactory due low to medium organic matter content in soil, imbalance use of inorganic fertilizer, use of high yielding modern crop varieties. The nitrogen (N), phosphorus (P) and potassium (K) contents of the soil was low and sulphur content was medium (Table 1). A crop production system with high yield targets cannot be sustainable unless balanced nutrient inputs are supplied to soil against nutrient removal by crops (Bhuiyan *et al.* 1991). Available data indicate that the soil fertility in Bangladesh is in declining trend (Karim *et at*. 1994; Ali *et al*. 1997) which is responsible for declining crop yields (Anon. 1996; Cassman *et al*. 1995). The use of chemical fertilizers as a supplemental source of nutrients has been increasing steadily in Bangladesh. However most of the farmers usually do not apply fertilizers in balanced proportions (Anon. 1997).

The present system of fertilizer application is mostly based on the nutrient requirement of individual crops ignoring the carry-over effect of the organic or inorganic fertilizer applied to the preceding crop. Organic or inorganic sources of nutrients applied to preceding crop can benefit the succeeding crop to a great extent (Singh *et al*. 1998; Hegde, 1998) and the system productivity may become sustainable through integrated use of organic and inorganic sources of nutrients (Singh and Yadav, 1992). Hence, it is important to develop a cropping system based fertilizer dose for specific agro-ecological zones. Therefore, the present study was cried out to find out a cropping system based fertilizer dose of organic and inorganic sources of nutrients and to determine the economic dose of nutrients for Mustard-Boro-T.aman rice cropping system for Karatoya Bangali Flood plain at Bogra district under AEZ-4.

MATERIALS AND METHODS

The experiment was conducted over three consecutive years at farmers' field of Gabtali MLT site under Bogra district during the period from November 2001 to December 2004. The experimental site was medium high land belonging to the agro-ecological zone Karatoya Bangali flood plain (AEZ-4). The soil was silty clay loam with low to medium organic matter content (1.79%) and soil pH near to neutral in nature. The N, P and K content was low (Table 1). Average of three years annual rainfall of the site was 2093 mm. Average maximum temperature was 30.03^o C and minimum temperature was 21.15^o C. The cropping pattern of the experiment was Mustard-Boro-T.aman rice. There was a turn around time of 5-30 days between two crops. Each crop was grown for three seasons in the same plot. Before starting the experiment soil samples were collected from farmers' field and were analyzed in Bangladesh Institute of Nuclear Agriculture (BINA) laboratory, Mymensingh. The experiment was laid out in a RCB design with six dispersed replications. The unit plot size was 10m×10m constant for the whole cropping pattern. After getting the results of soil analysis value, fertilizer doses were estimated with the help of soil analysis value as per treatment concerned. The variety of Mustard, Boro and T.aman rice were Tori-7, BRRIdhan-28 and

BRRIdhan-32 respectively. Six different fertilizer packages were tested and the details of the treatments were: T_1 (ED_1)= Estimated inorganic fertilizer doses for moderate yield goal (MYG), T_2 (ED_2)= Estimated inorganic fertilizer doses for high yield goal (HYG), T_3 (IPNS)= Integrated nutrient management for high yield goal), T_4 (FRG'97)= Fertilizer doses as per BARC fertilizer recommendation guide'97, T_5 (EP)= Local farmers practice (Average of 40 farmers data) and T_6 (Control).

Table 1. Different nutrient management packages used in Mustrd-Boro-T.aman rice cropping pattern during experimentation

Treatments	Mustard (Tori-7) N-P-K-S-Zn-B-MOC* (kg/ha)	Boro (BRRIdhan-28) N-P-K-S (kg/ha)	T.aman (BRRIdhan-32) N-P-K-S (kg/ha)
T_1 (ED_1)	65-28-29-14-1-0.5-0	94-20-47-11	65-15-33-7
T_2 (ED_2)	88-37-42-17-1.5-0.5-0	132-29-66-16	88-17-42-9
T_3 (IPNS)	68-30-37-17-1.5-0.5-400	132-29-66-16	88-17-42-9
T_4 (FRG'97)	65-15-30-15-1-1-0	100-15-40-10	65-5-30-3
T_5 (FP)	52-15-27-14-0-0-0	69-12-26-7	52-10-26-0
T_6 (Control)	0-0-0-0-0-0-0	0-0-0-0	0-0-0-0

*MOC=Mustard oil cake

The mustard was sown on 25-27 November, 2001 and harvested on 4-10 February, 2002. The second year cycle the mustard was sown on 3-7 November, 2002 and harvested on 11-30 January, 2003. The third year cycle of mustard was sown on 15-22 November, 2003 and harvested on 11-18 February, 2004. The seed rate was 8 kg/ha in all three consecutive years. Entire amount of P, K, S, Zn, B and half of N of different plots was applied during final land preparation for mustard. Rests N was applied on 32-34 days after sowing. After harvesting the mustard, the second crops (Boro and T.aman) were transplanted on the same plot one by one during crop season. Entire amount of P, K, S and one third of N were applied as basal. One third of urea was applied as rapid tillering stage and the remaining was applied before panicle initiation stage for both boro and T.aman. 45 to 47 days old seedling of boro rice were transplanted in well puddle soil on 9-15 February, 1-7 February and 15-24 February in 2002, 2003 and 2004, respectively. The seed rate of boro was 50 kg/ha in all three consecutive years and the crop was harvested on 9-21 May in 2002, 2-8 May in 2003 and 6-12 May in 2004.

Third crop T. aman rice was transplanted on 10-20 July in 2002, 22-30 July in 2003 and 3-15 August in 2004. The seed rate of T. aman rice was also 50 ka/ha and the crop was harvested on 26-28 October in 2002, 4-10 November in 2003 and 10-18 November in 2004. Intercultural operation such as weeding, thinning, gap filling, pest and disease control were done according to requirement for three crops. Data on yield and yield attributes along with other parameters were recorded. Cost and return analysis was done for net return and marginal benefit cost ratio for different treatments.

Table 2. Initial soil status of different selected farmers' field

Sample No.	Analyzed results							
	pH	Total-N (%)	K(m.eq/100)	P(m.eq/100)	S µg/g	B µg/g	Zn µg/g	OM (%)
1.	5.6	0.10L	0.14L	8.3L	20M	0.29L	0.98M	1.7L
2.	5.7	0.10L	0.12L	8.1L	20.1M	0.25L	0.50L	1.72M
3.	5.6	0.08VL	0.20M	8.5L	20M	0.25L	0.82L	1.46L
4.	5.9	0.09VL	0.10L	6.5L	10L	0.25L	0.46L	2.16M
5.	6.3	0.10L	0.10L	7.1L	17.3M	0.1VL	0.70L	1.89M
6.	6.4	0.11L	0.09VL	2.1VL	9.6L	0.22L	0.70L	1.85M
Average	5.9	0.097L	0.125L	6.67L	16.17M	0.223L	0.76L	1.79M

L=Low, VL=Very low, M=Medium, OM=Organic matter

RESULTS AND DISCUSSION

Performance of Mustard

The Effect of different nutrient management packages on the yield of mustard were significantly differed among the treatments (Table 3). The highest grain yield (1.11 t/ha) was obtained from T_2 (ED_2) followed by IPNS treated plots (1.02 t/ha) where soil test based fertilizer dose for higher yield goal was applied. Fertilizer doses for MYG produced yield with 0.74 t/ha which was identical to FRG'97 (0.59 t/ha) and farmers practice (0.47 t/ha). Addition of mustard oil cake along with soil test based fertilizer dose for high yield was compared to soil test based fertilizer dose for high yield goal (ED_2). Mollah *et al*. (2006) reported that the addition of cowdung along with soil test based fertilizer dose for high yield goal (IPNS) did not increase grain yield as compared to soil test based fertilizer dose for high yield goal (ED_2). In ED_2 only inorganic fertilizer dose was applied but IPNS mustard oil cake at the rate of 400 kg/ha was applied along with inorganic fertilizer. About 80 and 57% yield was increased over control and farmers practice from ED_2. Almost similar trend was observed in straw yield of mustard.

Table 3. Effect of different nutrient management practices on the yield of Mustard, Boro rice and T.aman rice (Average of 3 years)

Treatments	Yield of Mustard (t/ha)		Yield of Boro (t/ha)		Yield of T.aman (t/ha)	
	Grain	Straw	Grain	Straw	Grain	Straw
ED_1	0.74	2.48	4.87	6.01	2.85	4.40
ED_2	1.11	2.53	5.59	6.44	3.39	4.83
IPNS	1.02	2.60	5.22	6.35	3.14	4.65
FRG'97	0.59	2.34	4.77	6.03	2.76	4.39
FP	0.47	1.94	4.14	5.58	2.45	4.30
Control	0.21	0.761	2.07	2.94	1.69	2.76

Performance of Boro

In three years the highest grain yield (5.59 t/ha) was obtained from ED_2 where only inorganic fertilizer was used in the treatment (Table 3). The second highest yield (5.22 t/ha) was obtained from IPNS treatment. Fertilizer management packages ED_2 and IPNS increased 62 and 60% of grain yield over control and 25 and 20% over farmers practice, respectively. The treatment ED_1, ED_2 and IPNS showed higher yield than Fertilizer Recommendation Guide'97 but the FRG'97 gave the higher yield than farmers practice (FP). These findings corroborate well to Mollah *et al*. (2006) and Ishaque *et al*. (1998). Straw yield of boro was found similar in all the treatments except control.

Performance of T. aman rice

The average yield of three years showed that the highest grain yield (3.39 t/ha) was obtained from ED_2 and it was similar with IPNS (3.14 t/ha) and ED_1 (2.85 t/ha) (Table 3). Addition of mustard oil cake to the first crop (mustard) followed by addition of soil test based fertilizer dose (IPNS) in T. aman rice did not increase grain yield as compared to soil test based fertilizer dose ED_2. Mollah *et at*. (2006) also found that the addition of mustard oil cake in soil test based fertilizer dose in mustard (first crop) did not increase grain yield of T. aman rice as compared to soil test based fertilizer dose. Fertilizer management packages ED_2, IPNS and ED_1 had 50, 46 and 40% of grain yield over control and 27, 21 and 14% over farmers' practice, respectively. Almost similar trend was observed in straw yield of T. aman rice.

Cost and Return Analysis

Cost and return analysis of different fertilizer nutrients in Mustard–Boro–T.aman rice cropping pattern among average of three years are presented in Table 4. The highest gross return was Tk. 23465/ha, gross margin Tk. 17408/ha and MBCR (3.77) of mustard from T_2 among the treatments. Similarly the highest gross return was Tk. 45145/ha, gross margin Tk. 38597/ha and MBCR (2.27) of boro rice from T_2. In that case of T.aman rice, the three years average gross return (Tk. 27840/ha), gross margin (Tk. 23718/ha) and MBCR (1.69) were also found in T_2. The lowest three years average gross return, gross margin and MBCR were obtained in T_6 for all the crops.

Table 4. Cost and return analysis of different nutrient management practices in Mustard- Boro-T.aman rice cropping pattern (Average of 3 years)

Treatments	Yield (t/ha)		Gross return (Tk./ha)	*Variable cost (Tk./ha)	Gross margin (Tk./ha)	MBCR
	Grain	Straw				
			Mustard			
$T_1(ED_1)$	0.740	2.48	16040	4523	11517	2.49
$T_2(ED_2)$	1.11	2.53	23465	6057	17408	3.77
T_3(IPNS)	1.02	2.60	21700	9088	12612	2.73
T_4(FRG'97)	0.59	2.34	12970	3987	8983	1.94
T_5(FP)	0.474	1.94	10450	2719	7731	1.67
T_6 (Control)	0.212	0.761	4621	-	4621	-
			Boro			
$T_1(ED_1)$	4.87	6.01	39530	4581	34949	2.06
$T_2(ED_2)$	5.59	6.44	45145	6548	38597	2.27
T_3(IPNS)	5.22	6.35	42325	9221	33104	1.95
T_4(FRG'97)	4.77	6.03	38790	3987	34803	2.05
T_5(FP)	4.14	5.58	33840	2719	31121	1.83
T_6(Control)	2.07	2.94	16995	-	16995	-
			T.aman			
$T_1(ED_1)$	2.85	4.40	23575	3285	20290	1.44
$T_2(ED_2)$	3.39	4.83	27840	4122	23718	1.69
T_3(IPNS)	3.14	4.65	25875	7152	18723	1.33
T_4(FRG'97)	2.76	4.39	22895	2143	20752	1.48
T_5(FP)	2.45	4.30	20525	2218	18307	1.30
T_6(Control)	1.69	2.76	14055	-	14055	-

*Variable cost = Cost involved in fertilizer purchase and application, additional labor cost for harvest of additional product

Grain yield of all the crops grown in Mustard-Boro–T.aman rice cropping pattern was higher in ED_2 closely followed by integrated nutrient management (IPNS). Regarding cost and return analysis the higher gross margin was also found in the same treatments. But due to additional cost of mustard oil cake in IPNS increase the variable cost and reduce the MBCR in comparison to ED_2. On the basis of three years study, considering the yield and economic return the fertilizer dose ED_2 (Estimated inorganic fertilizer doses for high yield goal) may be recommended for Mustard-Boro-T.aman rice cropping pattern in Karatoya Bangali Flood plain soils (AEZ-4).

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