Effect of seed sources and seed treatments on yield and yield contributing characters of rice in Bangladesh

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Abstract: The experiment was conducted in the Field Laboratory of the Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh during 2008 to find out the effect of seed sources and seed treatments on yield and yield contributing characters of T. aman rice seed. There were two seed sources (S_1-Farmer and S_2-BADC) and nine seed treatments viz. T_1-No seed treatment (check), T_2-Sorted out clean seed, T_3-Washed seed, T_4-Washed and sorted out clean seed, T_5-Seed treated with garlic extract (1:10), T_6-Seed t.reated with vitavax-200 (0.3%), T_7-Seed treatment with BAU-Biofungicide (2%), T_8-Seed treated with Brine solution (10% Nacl) and T_9-Seed treated with urea solution (2%) were used in this study. The highest total number of tiller/hill, total number leaf/hill was recorded in S_2 while the lowest was recorded in S_1. The maximum number of infected leaf/hill, %leaf infection, number of lesion/hill was recorded in S_1 while the minimum was in S_2. On the effect of seed treatment the highest total number of tiller/hill was recorded in T_4 while the lowest was T_1. The maximum infected leaf/hill, %leaf infection was recorded in T_1 while the minimum was T_4. Interaction effect of seed sources and seed treatment the highest total number of tiller/hill was recorded in S_2 x T_4 while the minimum was recorded in S_1 x T_1. The maximum %leaf infection was recorded in S_1 x T_1 while the minimum was S_2 x T_4. At the ripening stage the highest total number of tiller/hill, total number leaf/hill was recorded in S_2 while the lowest was recorded in S_1. The maximum %leaf infection, number of lesion/hill was recorded in S_1 while the minimum was S_2. On the effect of seed treatment the highest total number of tiller/hill, total number leaf/hill was recorded in T_4 while the lowest was T_1. The maximum infected leaf/hill, %leaf infection, number of lesion/hill was recorded in T_1 while the minimum was T_4. Interaction effect of seed sources and seed treatment the highest total number of tiller/hill was recorded in S_2 x T_4 while the minimum was recorded in S_1 x T_1. The maximum infected leaf/hill, %leaf infection, number of lesion/hill was recorded in S_1 x .T_1 while the minimum was S_2 x T_4. In case of seed sources the highest total number of tiller/hill, number of effective tiller/hill, number of filled grain/hill, grain yield/plot was recorded in S_2 while the lowest was S_1. The maximum ineffective tiller/hill, number of unfilled grain/hill, plant height, panicle length, 1000 grain weight was recorded in S_1 while the minimum was recorded in S_2. As regard the effect of seed treatment the highest total number of tiller/hill, number of effective tiller/hill, number of filled grain/hill, plant height, panicle length, 1000 grain weight, grain yield/plot was recorded in T_4 while the lowest was T_1. Interaction effect of seed sources and seed treatment the highest total number of tiller/hill, number of effective tiller/hill, number of filled grain/hill, grain yield/plot was recorded in S_2 x T_4 while the minimum was recorded in S_1 x T_1. Grain yield was increased by 44.39% in washed sorted out clean seed plots.

Keywords: Rice seed, sources, treatment and Yield.

Introduction

Rice (*Oryza sativa* L.) is the most important cereal crop and one of the major sources of calories for a large percentage of the world population, particularly in Asia (Datta, 1981). It remains the staple food for about 164.4 million people of Bangladesh (UN, 2011). It alone provides 76% of the total calories and 66% of the protein in a typical Bangladeshi diet of the people (Bhuiyan *et al.,* 2002). Rice covers about 82% of the total cropped area in Bangladesh where 9% by Aus, 48% by Aman and 43% by Boro (BBS, 2010). Approximately 76% of the total cultivable land covering 14.84 million hectares produced 31.97 million tons of rice annually (BBS, 2010). The yield of rice in Bangladesh is quite low (2.58 t/ha) compared to other rice growing countries of the world. like China (5.3 t/ha), Indonesia (4.36 t/ha), in South Korea (4.89t/ha) and Vietnam (4.72 t/ha). The average world yield of rice is 4.25 t/ha ((USDA, 2009). It is important that clean and healthy seeds are to be used as planting materials in order to increase the germination percentage and productivity. Contaminated seeds can often result in poor germination and poor seedling vigor and resulting unhealthy crops (Shenoy *et al*., 1998, Haque *et al*., 2007). Seed cleaning followed by washing decreased the seedling diseases viz. brown spot, blast, bakanae, foot rot and seedling blight (Asad *et al.,* 2002). Mathur *et al.* (2004) studied seeds of rice collected from Tangail district of Bangladesh and found germination range between 60-77% (average 66%). When such seeds were cleaned manually, the clean seeds showed a remarkable increase in germination to 82-93% (average 87%). It has been shown experimentally that only by using good quality healthy seed, rice yield could be increased by 10-15% (Mia *et al*., 2004). In the Philippines, yield increase due to use of good quality seed was 7-25% (Diaz *et al*., 2001). The farmers must be aware of the consequences of the crop losses with low quality unhealthy seeds. Therefore, the study was conducted to increase seed yield and seed quality by the treatment of chemical and biological means.

Materials and Methods

The experiment was conducted in the field laboratory, Department of Plant Pathology, Bangladesh Agricultural University (BAU), Mymensingh during 2009. The soil of the experimental plots was sandy loam in texture belongs to Sonatola soil series under Old Brahmaputra Flood Plain. The morphological description of the field according to UNDP and FAO (1988) is: Agro-ecological zone = Old Brahmaputra Flood Plain (No. 9), Land type = Medium high land, General soil type = Non-calcarius Dark Grey Floodplain, Topography = 18m above the mean soil.

There were two seed sources Viz. S_1- BADC Seed, S_2-Farmer's Seed and BRRI Dhan 40 ware used in this study. Different seed treatments viz. T_1-Control, T_2-sorted out clean seed, T_3-washed seed, T_4-washed sorted out clean seed, T_5-seed treatment with garlic extract (1:10), T_6-seed treatment with vitavax-200 (0.3%), T_7-seed treatment with

BAU-Biofungicide (2%), T_8-seed treatment with brine solution (10% Nacl), T_9- Seed treatment with urea solution (2%) were used.

The seedlings were raised in seed beds. Seed bed was divided into two halves; one half was used for farmer seed and the other for BADC seed. The seed beds were prepared by puddling the wet land with repeated ploughing followed by laddering. Seeds (500 g) were taken from each sample. The seeds were subjected to treatment as per plan before soaked in water for about 48 hours and sprouted for 3 days under shade in moist gunny bags. The sprouted seeds were then broadcasted uniformly on the well prepared seed bed and then covered with a thin layer of fine soil. The experimental field was thoroughly prepared by ploughing and cross ploughing with power tiller followed by laddering. The experiment was laid out in two factors Randomized Complete Block Design (RCBD) with 3 replications where each plot size was 10 m^2. Fertilizers applied as per recommendation of BRRI (2000) as Urea (N) 130 kg/ha, TSP (P_20_5) 600 kg/ha, MP (K_20) 60 kg/ha, Gysum (S) 30 kg/ha, Zinc Sulphate (Z) 5 kg/ha. All fertilizers except urea were incorporated to the soil during final land preparation. Urea was applied in equal three installments at 21, 45 and 70 days after transplanting (DAT).

Thirty day old seedlings were uprooted and transplanted in the field at the rate of three seedlings per hill. Hill to hill and row to row distances were 20 cm and 20 cm, respectively (BRRI, 2000). Fertilizer application, irrigation and pest control were same in all plots under study. The crop was harvested in December at full ripening stage and threshed. Threshing was done by two medium strong biting in two side of the bundle to avoid threshing of unfilled or partially filled grain. Yield component data were collected. Grain yields were taken from each plot. Grain yields were adjusted to 14% moisture content (Sarvary *et al*., 1997) and expressed as ton/ha. Analysis of variance was done and the mean differences in the efficacy of the treatments were judged by Duncan's Multiple Range Test (DMRT). Data on grain yield and disease incidence and severity were analyzed using M- STAT.

Results and Discussion

Effect of seed sources and seed treatments on tillering and leaf infection in 2008: Effect of seed sources on number of tiller/hill at tillering stage varied significantly (Table 1). The highest total number of tiller/hill (9.93) and total number of leaf/hill (34.99) was recorded in S_2, while the lowest counts were recorded in S_1. The maximum number of infected leaf/hill (24.84), %leaf infection (30.30) and number of lesion/hill (36.51) were recorded in S_1 while minimum in S_2. Effect of seed treatment at tillering stage varied significantly (Table 2). The highest total number of tiller/hill (12.00) was recorded in T_4 and the lowest (7.83) was recorded in T_1. The maximum total number of leaf/hill (37.85) was found in T_4 and minimum (27.48) was recorded in T_1. Infected leaf/hill was found highest number (23.32) in T_1 and lowest (10.48) was recorded in T_4.

Table 1. Effect of seed sources, seed treatments and their interaction effect at tillering stage on growth parameters in 2008

Seed sources	Total no. of tiller/hill	Total no. leaf/hill	No. of infected leaf/hill	%leaf infection	No. of lession/hill
S1	9.00	31.63	24.84	30.30	36.51
S2	9.93	34.99	10.01	14.15	18.58
LSD (P≥ 0.05)	0.47	1.67	1.15	1.42	2.05
Seed treatments					
T_1	7.83	27.48	23.32	26.90	32.23
T_2	8.83	33.35	16.73	19.27	21.68
T_3	9.67	34.13	19.57	24.22	26.95
T_4	12.00	37.85	10.48	16.10	19.02
T_5	9.00	33.28	18.70	25.58	30.33
T_6	9.33	34.18	14.15	20.60	28.95
T_7	10.83	35.37	11.70	18.12	22.08
T_8	8.67	32.57	19.78	24.18	34.82
T_9	9.00	31.57	22.42	25.08	31.83
LSD (P≥ 0.05)	0.689	2.990	2.990	3.061	4.112
Interactions					
S_1 X T_1	7.67	26.57	32.23	36.30	41.80
S_1X T_2	8.33	32.20	23.47	24.93	28.73
S_1 X T_3	9.33	33.13	27.93	34.97	40.43
S_1 X T_4	11.00	35.40	14.47	19.90	25.40
S_1 X T_5	9.00	31.03	28.60	37.33	44.57
S_1 X T_6	9.00	32.53	17.83	27.63	35.23
S_1 X T_7	9.67	34.37	16.40	23.57	29.30
S_1 X T_8	8.33	30.57	28.37	33.77	40.93
S_1 X T_9	8.67	28.87	34.27	34.33	42.17
S_2 X T_1	8.00	28.40	14.40	17.50	22.67
S_2 X T_2	9.33	34.50	10.00	13.60	14.63
S_2 X T_3	10.00	35.13	11.20	13.47	13.47
S_2 X T_4	13.00	40.30	6.50	12.30	12.63
S_2 X T_5	9.00	35.53	8.80	13.83	16.10
S_2 X T_6	9.67	35.83	10.47	13.57	22.67
S_2 X T_7	12.00	36.37	7.00	12.67	14.87
S_2 X T_8	9.00	34.57	11.20	14.60	28.70
S_2 X T_9	9.33	34.27	10.57	15.83	21.50
LSD (P≥ 0.05)	0.974		3.708	4.329	5.815

Table 2. Effect of seed sources, seed treatments and their interaction effects on growth parameters at ripening stage in 2008

Seed sources	Total no. of tiller/hill	Total no. of leaf/hill	No. of infected leaf/hill	% leaf infection	No. of lession/hill
S_1	8.67	17.20	19.31	29.83	69.66
S_2	9.26	18.88	18.77	27.60	66.32
LSD (P≥ 0.05)	0.47	1.25	0.90	1.24	2.25
Treatments					
T_1	7.50	15.20	26.40	38.37	79.87
T_2	8.67	18.95	17.95	31.18	64.27
T_3	9.33	17.35	16.93	33.77	70.45
T_4	11.33	20.88	14.18	21.68	53.77
T_5	8.17	17.18	17.42	29.52	69.52
T_6	8.67	17.88	19.58	25.57	69.28
T_7	10.17	21.35	14.98	22.67	58.83
T_8	8.00	17.12	21.13	27.73	73.25
T_9	8.83	16.42	22.78	27.92	72.67
LSD (P≥ 0.05)	0.873	1.293	2.127	2.311	5.422
Interactions					
S_1 X T_1	7.33	14.97	27.27	42.87	86.37
S_1X T_2	8.67	17.70	20.33	35.77	64.63
S_1 X T_3	9.00	17.17	17.20	37.73	68.67
S_1 X T_4	10.67	20.13	14.50	20.53	56.93
S_1 X T_5	8.33	15.03	19.57	30.37	72.00
S_1 X T_6	8.33	15.73	20.50	24.00	69.37
S_1 X T_7	9.33	20.57	14.30	21.87	57.03
S_1 X T_8	8.00	17.67	20.37	27.47	74.97
S_1 X T_9	8.33	15.80	19.73	27.83	76.93
S_2 X T_1	7.67	15.43	25.53	33.87	73.37
S_2 X T_2	8.67	20.20	15.57	26.60	63.90
S_2 X T_3	9.67	17.53	16.67	29.80	72.23
S_2 X T_4	12.00	21.63	13.87	22.83	50.60
S_2 X T_5	8.00	19.33	15.27	28.67	67.03
S_2 X T_6	9.00	20.03	18.67	27.13	69.20
S_2 X T_7	11.00	22.13	15.67	23.47	60.63
S_2 X T_8	8.00	16.57	21.90	28.00	71.53
S_2 X T_9	9.33	17.03	25.83	28.00	68.40
LSD(P≥ 0.05)	1.235	1.829	3.008	3.268	7.668

The highest %leaf infection (26.90%) was found in T_1 and the lowest (16.10%) was recorded in T_4. The maximum number of lesion/hill (34.82) was recorded in T_8 and minimum (19.02) was in T_4. Interaction effect of seed treatment and seed source varied significantly in all the parameters except total number of leaf/hill. The highest total number of tiller/hill (13.00) was recorded in S_2 x T_4 and lowest (7.67) was recorded in S_1 x T_1. Higher infected leaf/hill (40.30) was recorded in S_2 x T_4, while the lower (26.57) was recorded in S_1 x T_1. The highest total number of infected leaf/hill (34.27) was obtained from S_1 x T_9 and lowest (6.50) was recorded in S_2 x T_4. The highest %leaf infection (36.30%) was found in S_1 x T_1 and lowest (12.30%) was recorded in S_2 x T_4. The maximum number of lesion/hill (41.80) was found in S_1 x T_1 and lowest (14.87) was recorded in S_2 x T_7.

Effect of seed sources and seed treatment on tillering and leaf infection at ripening stage in 2008: Effect of seed source on growth parameters at ripening stage varied significantly (Table 2). The highest total number of tiller/hill (9.26), total number of leaf/hill (18.88) and number of infected leaf/hill (18.77) was recorded in S_2, while the lowest was recorded in S_1. The maximum % leaf infection (29.83) and number of lesion/hill (69.66) were obtained in S_1, while the minimum was recorded in S_2. Effect of seed treatment at ripening stage varied significantly. The highest total number of tiller/hill (11.33) was recorded in T_4 and the lowest (7.50) was recorded in T_1. The maximum total number of leaf/hill (20.88) was recorded in T_4 and the minimum (15.20) was recorded in T_1. The highest number of infected leaf/hill (26.40) was found in T_1 and the lowest (21.68) was recorded in T_4. The highest %leaf infection (38.37%) was found in T_1 and the lowest (21.68%) was recorded in T_4. The maximum lesion/hill (79.87) was found in T_1 and the minimum (53.77) was recorded in T_4. Interaction effect of seed source and seed treatment varied significantly. The highest total number of tiller/hill (12.00) was found in S_2 x T_4 and the lowest (7.33) was recorded in S_1 x T_1. Maximum number of leaf/hill (22.13) was found in S_2 x T_7 and minimum (14.97) was recorded in S_1 x T_1. Number of infected leaf/hill (27.27) was found in highest number in S_1 x T_1, while lowest (13.87) in S_2 x T_4. The highest %leaf infection (42.87%) was found in S_1 x T_1 and lowest (20.53%) was recorded in S_1 x T_4. The maximum number of lesion/hill (86.37) was recorded in S_1 x T_1 and minimum (50.60) was recorded in S_2 x T_4.

Effect of seed sources, seed treatments and their interactions on yield components in 2008: Effect of seed sources on yield and yield contributing characters varied significantly (Table 3). The highest total number of tiller/hill (10.30), number of effective tiller/hill (9.26), number of filled grain/hill (107.15) and grain yield/plot (3.68 t/ha) were recorded in S_2, while the lowest was recorded in S_1. The maximum ineffective tiller/hill (1.11), number of unfilled grain/hill (24.11), plant height (28.53

cm), panicle length (8.32 cm) and 1000 grain weight (26.26 g) were recorded in S_1 and minimum was recorded in S_2. Effect of seed treatments on yield contributing characteristics varied significantly. The highest number of tiller/hill (12.00) was found in T_4 and the lowest (9.17) was recorded in T_1. The maximum number of in effective tiller/hill (1.67) was found in T_1 and minimum (0.67) was recorded in T_4. The highest number of effective tiller/hill (11.33) was found in T_4 and the lowest (7.50) was obtained in T_1. Number of filled grain/panicle varied significantly among the treatments. The highest number of filled grain/panicle (129.80) was found in T_4 and the lowest (83.27) was recorded in T_1. Maximum number of unfilled grain/panicle (36.18) was found in T_1 and minimum was (14.28) recorded in T_4. The maximum number of plant height (34.04 cm) was found in T_4 and the minimum (25.52 cm) was recorded in T_1.

Table 3. Effect of seed source, seed treatments and their interactions on yield components in 2008

Seed sources	No. of tiller/ hill	No. of ineffective tiller/hill	No. of effective tiller/hill	No. of filled grain/hill	No. of unfilled grain/hill	Plant height/ hill (cm)	Panicle length/ hill (cm)	1000 grain wt. (g)	Grain yield (t/ha)
S_1	9.78	1.11	8.67	100.96	24.11	28.53	8.32	26.26	3.56
S_2	10.30	1.04	9.26	107.15	22.74	28.27	8.30	26.23	3.68
LSD (P≥ 0.05)	0.50	0.31	0.50	2.82	1.35	0.72	0.30	0.26	4.27
Treatments									
T_1	9.17	1.67	7.50	83.27	36.18	25.52	7.44	25.78	2.63
T_2	9.67	1.00	8.67	105.00	21.98	26.65	8.05	26.72	3.58
T_3	10.33	1.00	9.33	111.76	20.20	26.44	8.33	25.74	4.21
T_4	12.00	0.67	11.33	129.80	14.28	34.04	9.72	27.02	4.73
T_5	9.33	1.17	8.17	94.61	27.05	28.85	7.97	26.27	3.13
T_6	9.67	1.00	8.67	105.70	20.48	27.62	7.77	25.99	3.95
T_7	10.83	0.67	10.17	123.08	17.15	30.95	9.21	26.66	4.50
T_8	9.33	1.33	8.00	91.72	26.38	27.94	8.33	25.83	2.91
T_9	10.00	1.17	8.83	91.53	27.14	27.57	7.96	26.18	2.91
LSD (P≥ 0.05)	1.030	0.500	0.873	6.005	3.563	2.075	0.762	0.6329	7.269
Interactions									
S_1 X T_1	9.00	1.67	7.33	81.70	30.70	25.99	7.32	25.83	2.54
S_1X T_2	9.67	1.00	8.67	99.56	23.42	26.71	8.48	26.78	3.46
S_1 X T_3	10.00	1.00	9.00	106.97	22.25	26.32	7.77	25.63	4.21
S_1 X T_4	11.33	0.67	10.67	126.93	16.44	31.18	9.49	27.03	4.66
S_1 X T_5	9.67	1.33	8.33	93.28j	24.54	31.17	8.25	26.28	2.97
S_1 X T_6	9.33	1.00	8.33	100.54	23.63	26.88	7.88	26.22	4.10
S_1 X T_7	10.00	0.67	9.33	121.46	18.47	30.43	9.06	26.39	4.44
S_1 X T_8	9.33	1.33	8.00	90.06	28.49	29.40	8.51	25.79	2.78
S_1 X T_9	9.67	1.33	8.33	88.14	29.07	28.69	8.15	26.36	2.83
S_2 X T_1	9.33	1.67	7.67	84.84	41.66	25.04	7.56	25.73	2.73
S_2 X T_2	9.67	1.00	8.67	110.43	20.53	26.59	7.62	26.66	3.70
S_2 X T_3	10.67	1.00	9.67	116.55	18.14	26.55	8.88	25.84	4.21
S_2 X T_4	12.67	0.67	12.00	132.67	12.13	36.91	9.96	27.02	4.81
S_2 X T_5	9.00	1.00	8.00	95.94	29.55	26.54	7.69	26.27	3.28
S_2 X T_6	10.00	1.00	9.00	110.85	17.33	28.36	7.66	25.77	3.83
S_2 X T_7	11.67	0.67	11.00	124.71	15.83	31.47	9.37	26.92	4.53
S_2 X T_8	9.33	1.33	8.00	93.39	24.27	26.49	8.15	25.87	3.06
S_2 X T_9	10.33	1.00	9.33	94.92	25.20	26.44	7.76	26.01	3.02
LSD (P≥ 0.05)	1.457	NS	1.235	8.493	5.039	2.395	NS	NS	10.28

The highest panicle length (9.72 cm) was found in T_4, while the minimum (7.44 cm) was recorded in T_1. Highest 1000-seed weight (27.02 g) was found in T_4 and lowest (25.78 g) was recorded in T_1. The highest grain yield/plot was recorded in T_4 (4.73 t/ha) and the lowest (4.63 t/ha) was recorded in T_1. The findings are supported by Asad *et al*., (2002). According to Mathur *et al.,* (1998) manual seed cleaning by farmers resulted in better looking, healthier crops and produced more grain yield and average increase in rice yield by 510Kg ha^{-1}. The interaction effect of seed treatments and seed sources varied significantly except number of ineffective tiller/hill, panicle length and 1000 grain weight. The highest number of tiller/hill (12.67) was found in S_2 x T_4 and the lowest (9.00) was recorded in S_1 x T_1. The maximum effective tiller/hill (12.00) was found in S_2 x T_4 and the minimum (7.33) was recorded in S_1 x T_1. The highest filed grain/panicle (132.67) was found in S_2 x T_4 and the lowest (81.70) was recorded in S_1 x T_1. Maximum number of unfilled grain/panicle (41.66) was found in S_2 x T_1 and minimum (12.13) was recorded in S_2 x T_4. The highest plant height/hill (36.91 cm) was found in S_2 x T_4, while lowest (26.32 cm) was recorded in S_1 x T_3. Panicle length/hill and 1000 grain weight was not varied significantly. Higher panicle length and 1000-grain weight (9.49 cm and 27.03 g, respectively) were recorded in S_1 x T_4, while lower by 7.32 and 25.63, respectively were recorded in S_1 x T_1, S_1 x T_3. The highest grain yield (4.8 t/ha) was recorded in S_2 x T_4, while the lowest (2.54 t/ha) was recorded in S_1 x T_1.

In conclusion the present study farmers can be used BADC seed and washed sorted out clean seed for better yield. This practice is environment friendly and help in avoiding the use of costly chemicals.

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