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Effect of weeding regime and integrated nutrient management on yield contributing characters and yield of BRRI dhan49

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ABSTRACT

A field experiment was conducted at the Agronomy Field Laboratory of Bangladesh Agricultural University (BAU), Bangladesh during Aman season of 2013 to find out the effect of weeding regime and integrated nutrient management on the yield of transplaned Aman rice (cv. BRRI dhan49). The experiment comprised with five weeding regimes viz. control (no weeding), one weeding at 15 DAT, two weedings at 15 and 30 DAT, three weedings at 15, 30 and 45 DAT and application of herbicide (Pyrazosulfuran-ethyl 10 WP) @ 150 g ha^{-1} and five nutrient management viz. BRRI recommended chemical fertilizers (171-83-100-100-10 kg ha^{-1} of Urea-TSP-MoP-Gypsum-Zn, respectively), cowdung at 10 t ha^{-1}, poultry manure at 5 t ha^{-1}, 50% BRRI recommended chemical fertilizers + cowdung at 5 t ha^{-1} and 50% BRRI recommended chemical fertilizers + poultry manure at 2.5 t ha^{-1}. The highest yield contributing characters and the highest grain yield (5.50 t ha^{-1}) was obtained from the interaction between three weedings at 15, 30 and 45 DAT and 50% BRRI recommended chemical fertilizers+ poultry manure at 2.5 t ha^{-1} whereas the lowest grain yield (3.10 t ha^{-1}) was found from the interaction between no weeding and cowdung at 10 t ha^{-1}. The highest benefit:cost ratio (2.4) was obtained from the combined effect of three weedings at 15, 30 and 45 DAT with 50% BRRI recommended fertilizers + poultry manure at 2.5 t ha^{-1}.

Keywords : BRRI dhan49, integrated nutrient management, transplaned *Aman* rice, weeding regime

Rice is the staple food crop in Bangladesh and the cropping pattern of the country is predominately rice based and the most dominated cropping pattern is *Boro* - T. *Aman* rice. Out of the total production in this country about 48%, 45% and 7% come from *Boro, Aman* and *Aus* crop respectively (BBS, 2012). In Bangladesh, rice dominates over all other crops and covers 77% of the total cropped area and 93% farmers grow rice (BBS, 2011). The total area and production of rice in Bangladesh are about 11.7 million hectares and 31.88 million tons respectively (BBS, 2011). The increasing rate of population is 1.42% (BBS, 2012) and decreasing rate of agricultural land by 1% per annum (Hussain *et al.,* 2006) limit the horizontal expansion of rice area. To overcome this situation increment in rice production $unit^{-1}$ area is the only alternative to bring self-sufficiency in food production.

Weeds are the major cause of yield loss in upland rice and its control is labour intensive. The climate as well as the edaphic condition of Bangladesh are favourable for the growth of weeds. A reduction in grain yield by 40% was recorded for transplaned *Aman* rice in Bangladesh (Haque *et al.,* 2012). The soil fertility status of Bangladesh is gradually declining day by day. Most of the soils of Bangladesh have organic matter less than 1.5% and in many cases it is less than 1% (BARC, 2012). Improper soil management practices and long time intensive use of chemical fertilizers create some fertility problems through soil exhaustion as well as through interactions with other elements causing micronutrients deficiency (Rahman and Main, 1997). In addition, favourable climatic condition for microbial activities throughout the year may be responsible for this. Cowdung and poultry manure may play a vital role in soil fertility management as well as supplying primary, secondary and micronutrients for crop production. So, emphasis should be given to increase the *Aman* rice yield through the adoption of proper management especially weed control and nutrient management that might be technically effective and feasible, economically viable, socially acceptable and environmentally sound.

MATERIALS AND METHODS

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University (BAU), Mymensingh from June to November 2013. The experimental site belongs to the Old Brahmaputra floodplain (AEZ-9) with non calcareous dark-grey floodplain soil. The land was medium high with silty loam texture having pH 6.8, available N 0.13%, P 13.9 ppm, organic carbon 0.93%, K 16.3 ppm and low in organic matter content. Cowdung contains 0.57%N, 0.47%P, 0.69%K, 0.23%S and other nutrients in small quantity while the poultry manure contains high amount of secondary and micronutrients in addition to 1.18%N, 1.13%P, 0.81%K and 0.35%S (Islam *et. al.*, 2014). The

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experiment consisted of five weeding regime *viz.* no weeding (control), one weeding at 15 days after transplanting (DAT), two weedings at 15 and 30 DAT, three weedings at 15, 30 and 45 DAT, application of herbicide (Pyrazosulfuran-ethyl 10WP) and five integrated nutrient management *viz.* BRRI recommended chemical fertilizers (171-83-100-100-10 kg ha^{-1} of Urea-TSP-MoP-Gypsum-Zn, respectively), cowdung at 10 t ha^{-1}, poultry manure at 5 t ha^{-1}, 50% BRRI recommended chemical fertilizers + cowdung at 5 t ha^{-1} and 50% BRRI recommended chemical fertilizers + poultry manure at 2.5 t ha^{-1}. The experiment was carried out in a randomized complete block design with three replications. Each block was divided into twenty five unit plots of size 2.5 × 2.0 m each. The distance maintained between two unit plots was 0.75 m and between blocks was 1 m. The bunds around individual plots were made firm enough to control water movement between plots. Both organic and inorganic fertilizers were applied according to the experimental treatments. The full dose of triple super phosphate (TSP), muriate of potash (MoP), gypsum, zinc, cowdung and poultry manure were applied at the time of final land preparation. Urea was top dressed in three equal splits at 15, 35 and 55 DAT as per treatments. Prior to harvest five hills were selected randomly from each experimental plot to record data on yield contributing characters. An area of 1 m^2 was selected in the middle portion of each plot to record the data on grain and straw yields. Grains were sun dried at 14% moisture level and cleaned. Straws were also sun dried properly. Finally straw and grain yield plot^{-1} were recorded and converted to t ha^{-1}. For weed dry weight samples were collected at 60 DAT by using 1 m^2 quadrate (Cruze *et al.*, 1986) from three spots in each plot at random. After drying, the dry weight of weeds in each plot was recorded. The collected data were compiled and tabulated in proper form and analyzed statistically with computer package MSTAT and the mean differences among the treatments were adjudged by Duncan's Multiple Range Test (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Effect on weeds dry weight

The interaction between weeding regime and integrated nutrient management had significant effect on total weed dry weight m^{-2} at 60 DAT. At 60 DAT, the highest weed dry weight (20.51 g) was found in no weeding with BRRI recommended chemical fertilizers and the lowest one (0.00 g) was found in three weedings at 15, 30 and 45 DAT with cowdung at 10 t ha^{-1} followed by two weedings at 15 and 30 DAT with cowdung at 10 t ha^{-1} and three weedings at 15, 30 and 45 DAT with poultry manure at 5 t ha^{-1} (Table 1). It was observed that weed dry weight exhibited decreasing trend with the increase of number of weeding. Patro *et al.* (2014) reported that weeding is responsible for significant reduction in weed density and dry weight of weeds over unweeded control. Treatment of weed free check resulted in lowest weed density and dry weight of weeds.

Effect on yield contributing characters

Yield contributing characters such as number of effective tillers hill^{-1}, number of grains panicle^{-1} and 1000-grain weight were influenced significantly due to weeding regime and integrated nutrient management. The highest number of effective tillers hill^{-1} (16.22) was obtained in the interaction between three weedings at 15, 30 and 45 DAT with 50% BRRI recommended chemical fertilizers + poultry manure at 2.5 t ha^{-1} and the lowest one (9.97) was observed in no weeding with cowdung at 10 t ha^{-1}. Datta and Gagot (1995) reported that hand weeding significantly lowered weed population and thereby increased the number of tillers. Number of grains panicle^{-1} was significantly influenced by the interaction between weeding regime and integrated nutrient management. The number of grains panicle^{-1} ranged from 103.8 to 103.8. The highest number of grains panicle^{-1} (138.6) was observed in application of herbicide with 50% BRRI recommended chemical fertilizers + poultry manure at 2.5 t ha^{-1}, which was statistically identical with application of herbicide with cowdung at 5 t ha^{-1} and one weeding at 15 DAT with BRRI recommended chemical fertilizers and the lowest number of grains (103.8) was found in no weeding with cowdung at 10 t ha^{-1}. The findings are in agreement with that of Hasan *et al.,* 2004. The highest 1000-grain weight (17.30 g) was recorded in the interaction of two weedings at 15 and 30 DAT with BRRI recommended chemical fertilizers whereas the lowest one (15.16 g) was found in the interaction of three weedings at 15, 30 and 45 DAT with BRRI recommended chemical fertilizers (Table 1).

Effect on yield

A remarkable change was observed due to the interaction between weeding regime and integrated nutrient management. The highest grain yield (5.50 t ha^{1}) was obtained from three weedings at 15, 30 and 45 DAT with 50% BRRI recommended chemical fertilizers

+ poultry manure at 2.5 t ha^{-1} and the lowest grain yield (3.67 t ha^{-1}) was obtained from no weeding with poultry manure at 5 t ha^{-1}, which was statistically identical with no weeding with 50% BRRI recommended chemical fertilizers + cowdung at 5 t ha^{-1}, one weeding at 15 DAT with 50% BRRI recommended chemical fertilizer + cowdung at 5 t ha^{-1}, one weeding at 15 DAT with poultry manure at 5 t ha^{-1} and application of herbicide with cowdung at 10 t ha^{-1} (Table 1). The findings were conformity with that of Roy and Mishra (1999), Straw yield was significantly influenced by the interaction between weeding regime and integrated nutrient management. The highest straw yield (6.89 t ha^{-1} was obtained from the interaction from three weedings at 15, 30 and 45 DAT with 50% BRRI recommended chemical fertilizers + poultry manure at 2.5 t ha^{-1} and the lowest one (4.15 t ha^{-1}) was obtained from no weeding with cowdung at 10 t ha^{-1} (Table 2). Poultry manure in combination with chemical fertilizers demonstrated superior effect in producing straw yield of rice as compared to sole application of chemical fertilizers. Pramanick *et al.,* 2014 reported that two weedings at 20 and 40 DAT in transplanted rice-lathyrus cropping system gave highest grain and yields compared to herbicide application.

Effect on harvest index

Harvest index was not significantly influenced by the interaction between weeding regime and integrated nutrient management. However, numerically the highest harvest index (45.57 %) was recorded from the interaction of three weedings at 15, 30 and 45 DAT with BRRI recommended chemical fertilizers and the lowest one (42.76%) from no weeding with cowdung at 10 t ha^{-1} interaction (Table 1). The results conformed to the findings of Hossain (2012).

Economics

The highest benefit cost ratio (2.40) was obtained in three weedings at 15, 30 and 45 DAT with 50% BRRI recommended chemical fertilizers + poultry manure at 2.5 t ha^{-1}. Excellent control of dominant grass and sedge weeds without any adverse effect on crop growth and grain and straw yields with adequate supply of nutrients through combined application of inorganic fertilizers and manure favoured higher grain and straw yields which resulted in higher net returns and benefit-cost ratio. In addition, the additional cost of cultivation for each increase of weeding regime was compensated by producing additional yield along with higher market price of rice grain and straw may be attributed to superior indices in the interactions between three weedings with 50% BRRI recommended chemical fertilizers + poultry manure at 2.5 t ha^{-1} (Table 1).

Relationship between weed dry matter production and grain yield of BRRI dhan49

To find out the relationship between weed dry matter production and grain yield of BRRI dhan49 regression analysis was done. More or less maximum weed infestation was found at 60 DAT therefore, this stage (60 DAT) was considered to find out a functional relationship between weed dry matter production and grain yield. It was observed that there was a negative relationship between weed dry matter production and grain yield of BRRI dhan49 (Figure 1). The relationship was significant at p d" 0.01. The functional relationship can be determined by the regression equation Y = -0.100x + 5.107 (R^2 = 0.805). The functional relationship revealed that 80% of the variation in grain yield could be explained from the variation in weed dry matter production at 60 DAT. On an average grain yield could be decreased at the rate of 0.1 t ha^{-1} with an increase in one unit of weed dry matter production. This finding is in agreement with that found by Hossain (2012) who reported that 57% of *Boro* rice (cv. BRRI dhan29) could be explained by the functional relationship of weed dry matter production at 45 DAT.

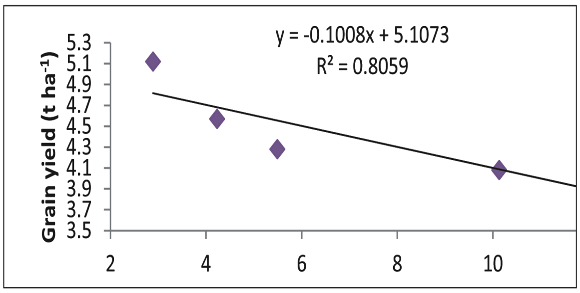

Fig. 1: Relationship between grain yield and weed dry matter production of transplant *Aman* rice (cv. BRRI dhan49) at 60 DAT

From the present study it is observed that, three weedings at 15, 30 and 45 DAT with 50% BRRI recommended chemical fertilizers + poultry manure at 2.5 t ha^{-1} showed better performance in respect of yield and yield contributing characters and benefit-cost ratio as compared to the other interactions. The performance of mixed application of chemical fertilizers and manure with adequate weedings was better than that of sole application of chemical fertilizers with minimum weeding. Therefore, three weedings at 15, 30 and 45

Table 1: Combined effect of weeding regime and integrated nutrient management on yield contributing characters and yield of BRRI dhan49

Interaction (Weeding regime × INM)	Total dry weight of weed(g)	No. of effective tillers hill^{-1}	No. of grains panicle^{-1}	1000-grain weight(g)	Grain yield(t ha^{-1})	Straw yield(t ha^{-1})	Harvest index (%)	B : C ratio
$W_0 \times N_1$	20.51a	12.33fg	116.6f-i	16.55a-c	4.25h	5.24gh	44.83	1.47
$W_0 \times N_2$	8.66h	9.97j	103.8k	16.27bc	3.10m	4.15n	42.76	1.07
$W_0 \times N_3$	12.48d	10.78i	111.4i-k	16.19c	3.67l	4.57m	44.55	1.25
$W_0 \times N_4$	9.46g	12.11fg	125.7b-f	16.08c	3.71kl	4.63lm	44.46	1.27
$W_0 \times N_5$	15.53b	14.22c	125.0b-g	15.96cd	4.50fg	5.60de	44.55	1.65
$W_1 \times N_1$	14.68c	12.56ef	130.8ab	16.31bc	4.33gh	5.20gh	45.08	1.51
$W_1 \times N_2$	6.94j	10.57i	117.6e-i	15.96cd	3.67l	4.75klm	43.59	1.20
$W_1 \times N_3$	10.32f	11.33h	124.8b-g	16.48bc	3.83j-l	4.78jkl	44.48	1.35
$W_1 \times N_4$	7.29j	12.22fg	111.3i-k	15.73cd	3.92jk	4.95ij	44.20	1.43
$W_1 \times N_5$	11.42e	14.22c	123.1b-g	16.46bc	4.67ef	5.87c	44.31	1.90
$W_2 \times N_1$	7.86i	13.44d	120.1d-i	17.30a	4.86c-e	5.91c	45.13	2.06
$W_2 \times N_2$	0.00p	11.78gh	111.9h-k	17.11ab	4.00ij	5.12hi	43.86	1.39
$W_2 \times N_3$	4.92m	11.78gh	121.6b-h	16.06c	4.33gh	5.30fgh	44.96	1.57
$W_2 \times N_4$	2.53o	13.11de	120.6c-i	16.25c	4.67d-f	5.65de	45.25	1.96
$W_2 \times N_5$	5.81kl	15.57b	125.4b-f	15.96cd	5.00c	6.09b	45.08	2.33
$W_3 \times N_1$	5.37m	14.22c	127.2b-e	15.16d	5.25b	6.27b	45.57	2.34
$W_3 \times N_2$	0.00p	11.89gh	119.1d-i	16.48bc	4.90cd	6.10b	44.54	2.13
$W_3 \times N_3$	3.82n	12.56ef	127.9b-d	16.11c	4.95c	6.15b	44.59	2.22
$W_3 \times N_4$	0.00p	14.11c	124.2b-g	16.23c	5.00c	6.25b	44.45	2.27
$W_3 \times N_5$	5.25lm	16.22a	123.9b-g	15.88cd	5.50a	6.89a	44.39	2.40
$W_4 \times N_1$	9.29g	13.0de	120.6c-i	16.04c	4.50fg	5.47ef	45.13	1.65
$W_4 \times N_2$	2.25o	11.44h	105.7jk	16.13c	3.83j-l	4.90jk	43.87	1.30
$W_4 \times N_3$	5.04m	11.78gh	115.0g-j	16.41bc	4.17hi	5.23gh	44.36	1.51
$W_4 \times N_4$	4.75m	12.33fg	130.7a-c	16.31bc	4.25h	5.33fg	44.37	1.47
$W_4 \times N_5$	6.14k	14.33c	138.60a	15.81cd	4.67ef	5.67d	45.16	1.93
Sx	0.19	0.19	2.98	0.25	0.07	0.06	-	1.02
Level of significance	**	**	**	**	**	**	**NS**	**
CV(%)	**4.77**	**2.55**	**4.27**	**2.71**	**2.91**	**1.96**	**1.36**	**3.78**

*In a column, figures with same letter(s) or without letter do not differ significantly whereas figures with dissimilar letters do not differ significantly as per DMRT. Prices of urea Tk. 12kg^{-1}, TSP Tk. 25 kg^{-1}, seed Tk. 40 kg^{-1}, grain price Tk. 20 kg^{-1}, straw Tk. 3 kg^{-1}, labour wage Tk. 225day^{-1}, **Significant at 1 % level of probability; NS = Not significant; N_1: BRRI recommended chemical fertilizers; N_2: Cowdung at 10 t ha^{-1}; N_3: Poultry manure at 5 t ha^{-1}; N_4: 50% BRRI recommended chemical fertilizers + cowdung at 5 t ha^{-1}; N_5: 50% BRRI recommended chemical fertilizers + poultry manure at 2.5 t ha^{-1}; W_0: No weeding; W_1: One weeding at 15 DAT; W_2: Two weedings at 15 and 30 DAT; W_3: Three weedings at 15, 30 and 45 DAT; W_4: Application of herbicide.*

DAT with 50% BRRI recommended chemical fertilizers + poultry manure at 2.5 t ha^{-1} may be promising for the maximization of rice yield.

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