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Integrated crop management (ICM) for increasing rice production in Barind area

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An experiment was conducted at the Agronomy Field Laboratory, University of Rajshahi during the period from June, 2015 to December 2015 to study the effect of Integrated Crop Management (ICM) practice for increasing rice production in Barind area, Bangladesh. The experiment consisted of two factors that is, two variety which is BRRI dhan56 and BRRI dhan57, and five management practices like control, only weed management, only pest management, farmers practices and ICM practice. The experiment was laid out in Randomized Completely Block Design (RCBD) with three replications. Among the management practices, ICM gave the highest number of tillers plant^{-1}, effective tillers plant^{-1}, panicle length, number of grains panicle^{-1} and 1000-grain weight, and the lowest results were found in control. Between two varieties, BRRI dhan 56 produced the highest yield components like effective tillers plant^{-1}, number of grains panicle^{-1} and 1000-grain weight than BRRI dhan 57. BRRI dhan 56 produced the highest grain yield than BRRI dhan 57 when the field was treated with ICM. So it can be concluded that the farmers are advised to cultivate BRRI dhan 56 and adopt ICM for maximizing rice production in Barind area in Bangladesh.

Key words: Rice, variety, Integrated Crop Management (ICM), yield, Barind area.

INTRODUCTION

Geographically, Bangladesh is highly vulnerable to climate change. In particular, impact of climate variability on the agriculture and consequence on different other sectors are already evident in the drought prone High Barind tract regions. The agriculture sectors in the High Barind Tract regions are very likely to face significant yield reduction due to climate change in future. Moisture capacity of High Barind Tract soil is poor due to critical organic matter contents and low infiltration of water. These siruration make the area drought prone along with poor crop productivity.

Moreover, recent report indicates that ground water level of High Barind Tract is rapidly falling due to over exploitation of deep tube well. Transplant aman rice is the major crop which suffered regularly due to early and late drought, and planting of post rainy crop. During that time,

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the drought resistant varieties can be cultivated under rainfall condition. Drought tolerant rice varieties provide food security for farmers in Bangladesh (Habiba et al., 2013). The yield of rice depends on many factors such as varieties and suitable agronomic practices. Varieties play an important role in producing high yield of rice. The growth process of rice plant under a given agro climatic condition differs with variety (Sarker et al., 2014).

Generally, the farmers apply different agro-chemicals such as fungicide, insecticide, herbicide etc in the field indiscriminately. They also used chemical fertilizer in higher dose with a view to increase the yield of rice. Continuous application of all these agro-chemicals results in the reduction of soil fertility and productivity, soil erosion, death of beneficial insect, reduction of biodiversity, occurrence of environmental pollution and disturbance of ecological balance which is very much dangerous and a great threat for mankind in the question of their survival on the earth (Hossain and Siddique, 2015).

Integrated Crop Management (ICM) is the best way for solving all of the aforementioned problems. It combines the best of traditional methods with appropriate modern technology, balancing the economic production of crops with positive environmental management. ICM practice plays a significant role in producing higher yield of rice among the different practices. It also helps in the maintenance of soil structure and fertility, improvement of soil fertility, prevent buildup of pests, diseases and weeds, prevent damage to soil, water, avoid loss of biodiversity and reduce environmental damage and production cost, while majority of the farmers are not generally not aware and not following ICM practices. Considering the aforementioned, the present study was undertaken with the following objectives:

1. To determine the suitable management practices for rice.
2. To produce the rice in an environmental friendly way.

MATERIALS AND METHODS

The research was conducted at the Agronomy Field laboratory, University of Rajshahi, Bangladesh during the period from June to December, 2015. The experimental field was a medium high land with silty loam textured soil having pH value of 7.8. Status of nitrogen, phosphorus and cation exchange capacity was medium. The soil properties of the field were organic matter 1.8%, total available nitrogen 0.04%, available phosphorus 11.25 ppm, available potassium 58ppm and available sulphur 25.65 ppm. The treatment of the experiment include two drought tolerant varieties namely BRRI dhan 56 and BRRI dhan 57, and five management practices; control, only weed management, only pest management, farmer's practice and integrated crop management ICM. Components of ICM are seed management, soil test and fertility maintenance, modern cultivation practices, and integrated pest management. The experiment was laid out in randomized complete block design (RCBD) with three replications. The unit plot size was $10m^2$. (4 m×2.5 m). The seed were sown in nursery bed on 18 June, 2015. The experimental plots were uniformly fertilized with nitrogen, phosphorus, potash, sulphur and zinc fertilizers as recommended dose. One third nitrogenous fertilizer (urea) and all other fertilizers were applied during final land preparation as basal dose. The 2/3 urea were applied on top dressing in two equal splits, first at 30 DAT and 2nd at flowering stage. Finally, 30 days old seeding of two varieties were transplanted in the well puddled plots with three seedlings hill^{-1} on 17 July, 2015. Data were recorded on yield and yield components like total tillers plant^{-1}, effective tillers plant^{-1}, non-effective tillers plant^{-1}, panicle length, spikelets panicle$^{-1,}$ grains panicle^{-1}, 1000-grain weight, grain yield, straw yield, biological yield and harvest index. Data were analysed following the analysis of variance (ANOVA) technique, and mean differences were adjudged by Duncan's New multiple range test (DMRT) (Gomez and Gomez, 1984), with the help of computer Package MSTAT-C.

RESULTS AND DISCUSSION

The results showed that effective tillers plant^{-1}, number of grains panicle^{-1}, 1000-grain weight, grain yield and biological yield had significant effect on variety. From Tables 1 to 3, the result revealed that variety had no significant effect on total tillers plant^{-1}, non-effective tillers plant^{-1}, panicle length, spikelets panicle^{-1}, straw yield and harvest index. The maximum number of effective tillers plant^{-1}, number of grains panicle^{-1} and 1000-grain weight were observed from BRRI dhan 56. Among two varieties, BRRI dhan 56 produced the higher grain yield and biological yield (BRRI, 2013). This result was obtained for genetic makeup of the variety.

Different crop management practices also had a significant effect on most of the yield and yield contributing character like total tillers plant^{-1}, panicle length, number of spikelets panicle^{-1}, 1000-grain weight, number of grains panicle^{-1}, grain yield, straw yield, biological yield and harvest index. The result showed that the field which received integrated crop management gave the highest total tillers plant^{-1}, effective tillers plant^{-1}, panicle length, number of spikelets panicle^{-1}, 1000-grain weight, number of grains panicle and harvest index.

The maximum grain yield, straw yield and biological yield were obtained from the field that practiced ICM. This results were found because all favourable conditions received the field ICM practice. This result was supported by Wang et al. (2017). The interaction of variety and different management practices had no significant influence on yield and yield components. The effective tillers plant^{-1}, panicel length, spiekelets panicle^{-1}, grains panicle^{-1}, and 1000-grain weight were positively correlated with grain yield.

From the aforementioned discussion, it could be concluded that farmers are suggested to cultivate tranplant aman rice BRRI dhan 56 in the field which is managed by ICM practices for maximizing grain yield.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

Table 1. Effect of variety and management practices on yield and yield components of transplant aman.

Variety	No. of total tillers plant^{-1}	No. of effective tillers plant^{-1}	No. of non-effective tillers plant^{-1}	Panicle length (cm)	No. of spikelets panicle^{-1}	No. of grains panicle^{-1}	1000 grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
BRRI dhan 56	10.24	8.40^{a}	1.84	19.87	10.12	61.65^{a}	29.07^{a}	3.98^{a}	4.93	8.39^{a}	46.25
BRRI dhan 57	9.86	7.59^{b}	1.27	19.78	10.05	58.06^{b}	24.17^{b}	3.79^{b}	4.40	8.19^{b}	45.96
LS	NS	0.01	NS	NS	NS	0.01	0.01	0.05	NS	0.01	NS
Management practice											
M_0	8.76^{c}	6.66^{c}	2.52	18.80^{b}	9.78	56.91^{c}	25.82^{c}	2.42d	3.28d	5.7d	42.50^{b}
M_1	9.76^{abc}	7.88^{b}	1.16	19.77^{b}	9.88	58.56^{bc}	26.51^{abc}	3.61^{c}	3.95^{c}	7.66^{c}	46.41^{a}
M_2	9.49^{bc}	7.65^{bc}	2.58	18.91^{b}	9.98	57.76^{c}	26.30^{bc}	3.53^{c}	4.06^{c}	7.47^{c}	47.00^{a}
M_3	10.72^{ab}	8.77^{ab}	2.02	19.63^{b}	10.14	60.84^{b}	27.03^{ab}	4.633^{b}	5.35^{b}	9.98^{b}	47.14^{a}
M_4	11.33^{a}	9.77^{a}	2.00	22.01^{a}	10.66	65.20^{a}	27.47^{a}	5.04^{a}	5.58^{a}	10.62^{a}	47.46^{a}
LS	0.01	0.01	NS	0.01	NS	0.01	0.01	0.01	0.01	0.01	0.01

In a column, figures having similar letters (s) or without letters (s) do not differ significantly, whereas figures that are having dissimilar letters (s) differ significantly having 1% level of probability (as per DMRT). NS = Non significant; M_0 = No Management; M_1 = Only weed management; M_2 = Only pest management; M_3 = Farmers practices; M_4 = Integrated crop management; LS = Level of significance.

Table 2. Interaction effect of variety and management practices on yield and yield components of transplant amanr rice.

Treatment	No. of total tillers plant^{-1}	No. of effective tillers plant^{-1}	No. of non-effective tillers plant^{-1}	Panicle length (cm)	No. of spikelets panicle^{-1}	No. of grains panicle^{-1}	1000 grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
V_1M_0	8.98	6.66	3.22	18.84	9.78	57.50	28.40	2.46	3.26	5.72	43.00
V_1M_1	9.66	7.65	1.22	19.61	10.22	59.10	28.81	3.66	4.10	7.76	47.16
V_1M_2	9.55	7.87	2.66	18.66	9.72	58.76	29.00	3.58	4.00	7.58	47.22
V_1M_3	10.44	8.89	2.22	20.06	10.27	63.18	29.47	4.68	5.43	10.11	46.29
V_1M_4	10.66	9.55	2.05	22.20	10.61	69.61	29.70	5.11	5.66	10.77	47.44
V_2M_0	8.55	6.66	1.83	18.76	9.78	56.32	23.23	2.38	3.30	5.68	41.90
V_2M_1	10.22	8.11	1.11	19.93	9.55	57.92	24.20	3.55	4.03	7.58	46.83
V_2M_2	9.44	7.42	2.50	19.16	10.23	56.76	23.60	3.46	3.90	7.36	47.01
V_2M_3	11.00	8.66	1.83	19.20	10.01	58.50	25.47	4.58	5.26	9.84	46.54
V_2M_4	12.00	9.99	1.94	21.83	10.70	60.78	24.37	4.96	5.50	10.46	47.42
LS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS = Non significant; V_1= BRRI dhan56; V_2 = BRRI dhan57; M_0 = No Management; M_1 = Only weed management; M_2 = Only pest management; M_3 = Farmers practices; M_4 = Integrated crop management'; LS = Level of significance.

Table 3. Simple correlation coefficient between yield and yield components of transplant aman rice.

Treatment	No. of total tillers plant^{-1}	No. of effective tillers plant^{-1}	No. of non-effective tillers plant^{-1}	Panicle length (cm)	No. of spikelets panicle^{-1}	No. of grains spike^{-1}	1000grain weight (g)	Grain yield (t ha^{-1})
No. of total tillers plant^{-1}	1	0.782**	0.041	0.443*	0.283	0.253	-0.040	0.657**
No. of effective tillers plant^{-1}	-	1	-0.130	0.639**	0.339	0.526*	0.162	0.842**
No. of non-effective tillers plant^{-1}	-	-	1	-0.226	0-.288	0-.053	0.119	-0.150
Panicle length (cm)	-	-	-	1	0.207	0.425*	0.189	0.518**
No. of spikelets panicle^{-1}	-	-	-	-	1	0.317	0.131	0.318
No. of grains panicle^{-1}	-	-	-	-	-	1	0.557**	0.689**
1000grain weight (g)	-	-	-	-	-	-	1	0.268
Grain yield (t ha^{-1})	-	-	-	-	-	-	-	1

**Correlation is significant at the 0.01 level (2-tailed).

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