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Effect of Tillage, Raking and Weeding on the Growth, Yield and Economics of Aus Rice (cv. BR 20)

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Abstract: The experiment was conducted to evaluate the performance of Aus rice (CV. BR 20) under variable management. The treatments consisted of three tillage (Viz. 1 tillage, 2 tillage and 4 tillage) and three cultural practices (Viz. 2 raking, 2 weeding and 2 raking + 2 weeding). The Aus rice increased yield both for more tillage and cultural practices. Significantly, the highest grain yield (2.92 t ha⁻¹) was obtained from 4 tillage with 2 raking and 2 weeding at 15 and 30 days after sowing (DAS). Though the treatment, 4 tillage with 2 raking and 2 weeding gave the highest yield but the benefit cost ratio (BCR) was found to be low (1.08) in this treatment. One tillage and two raking (15 and 30 DAS) was economically profitable practice with grain yield of 2.51 t ha⁻¹ which also gave gross return of TK. 21520 ha⁻¹, net return TK. 8731 ha⁻¹ and BCR 1.68.

Key words: Tillage, raking, weeding, yield, aus rice

Introduction

Rice is the principal food crop in Bangladesh. It occupies 81% of the total cultivated area in Bangladesh. About 31.5% GDP comes from agriculture and 50% GDP to agriculture comes from rice (Anonymous, 1999). Aus rice is grown in 3.87 million acreage in 1997-98 and about 31.30% of the total Aus rice is under modern variety (MV). The contribution of Aus rice to total rice production is 14.50% (Anonymous, 1999). The demand for rice is increasing with the increase of population, while the cultivated land for rice is not increasing due to many factors like crop diversification, crop competition as well as the pressure of urbanization and industrialization. Therefore, rice output must be increased to keep pace with predicted population growth. This can be achieved only by mounting accelerated production programmes incorporating MV rice along with proper inter cultural practices (Quayum *et al.*, 1995). The role of various tillage operations in a land has different physical, chemical and biological changes in soil. Recently, the reduced tillage techniques have been gaining popularity. Minimum tillage practice has an appeal to farmers since it reduces labour cost (Blevins, 1971). The reduced tillage system sometimes provides protection against short duration drought by contributing toward efficient use of water (Jones, 1969). However, the advantages of minimum tillage over maximum tillage is often questioned (Maurya and Lal, 1980). Again, weeding of Aus rice had also good response for yield. An effective weed management practice is necessary for higher crop production and better economic return (Gaffer *et al.*, 1988). But most effective and economic cultural practices for weed control in Aus rice are not clearly known to our cultivators. In Bangladesh, weeds are generally controlled by raking and hand weeding. Hence, the present investigation was conducted to evaluate the performance of Aus rice under different combinations of these two cultural practices with different soil tillage.

Materials and Methods

The experiment was conducted at the Agronomy Field Laboratory of the Hajee Mohammad Danesh Science and Technology University, Dinajpur during the period from 6th April to 27th July 2001 to evaluate the effect of minimum tillage under different inter cultural practices on yield and yield contributing characters of Aus rice (CV. BR 20). The experimental treatments were consisted of 3 tillage viz. 1 tillage, 2 tillage, 4 tillage, 2 raking, 2 weeding and

2 raking + 2 weeding. A split-plot design was used and the experimental field was divided into 4 blocks and each block was again divided into 3 main-plots and 3 sub-plots. The tillage operations were randomly assigned into the main plots and the cultural practices into the sub-plots. The individual plot size was 4x2.5 m². Inter-plot spacing was 0.5 m and Inter-block was 1.0 m. The crop was fertilized with 57.96 N, 36.00 P₂O₅, 24.00 K₂O, 11.16 S and 4.03 kg ha⁻¹ Zn through Urea, TSP, MP, Gypsum and Zinc sulphate, respectively. Seeds were sown in line on 6th April 2001, maintaining spacing of 25x10 cm². Three seeds were placed in each whole point. First raking and second raking were done at 15 and 30 days after sowing (DAS). Two weeding were done with niri in the respective plots first at 15 DAS and the second at 30 DAS. Two raking and two weeding were done alternatively at 10 days interval. The grain weight was recorded at 12% moisture content basis. The crop was harvested during 27th July, 2001. Data on yield and yield contributing characters were recorded and analyzed statistically. Economic analysis was done on the basis of prevailing market price of the input and output products.

Results and Discussion

Agronomic performance: All the parameters under study except plant height and weight of 1000 grains were significantly influenced by tillage method (Table 1). Total tillers per hill, effective tillers per hill, number of grain per panicle, number of filled grain per panicle, grain yield, biological yield and harvest index were significantly higher in four tilled plots (T₄). Highest grain yield (2.79t ha⁻¹) was obtained from the 4 tilled plots as a result of higher total tillers per hill, effective tillers per hill and number of filled grain per panicle. These results corroborate the findings of Subramaniam *et al.* (1970) who obtained the maximum grain yield of rice with conventional tillage than that with the minimum tillage. Mahapatra and Parsuram (1964) recommended 4 ploughing for direct seeding of rice. Rosario and Cabrilla (1996) also observed that 4 to 6 tilled plots gave significantly higher grain yield as compared to the zero tillage or minimum tillage. Effect of raking and weeding were also found to be positive (Table 2). Highest total tillers per hill (12.72), effective tiller per hill (9.73), number of grain per panicle (84.70) and grain yield (2.74t ha⁻¹) were obtain from 2 raking + 2 weeding (R₂+W₂). Plant height was not significantly affected by raking and weeding. Among the two inter cultural practices (raking and weeding), weeding showed better performance for the yield and yield contributing characters. Grain yield in 2 weeding was 3.97 t ha⁻¹, which was 3% higher than 2 raking. The similar findings were also reported by Islam *et al.* (1980). This might be due to higher effective tillers per hill, panicle length, number of filled grain per panicle and weight of 1000 grains. The highest (4.04 t ha⁻¹) and lowest (3.91 t ha⁻¹) straw yields were produced by 2 raking + 2 weeding and 2 raking, respectively. Almost similar trend was found in case of Harvest Index, where highest index was obtained from 2 raking + 2 weeding and the lowest from 2 raking. Biological yield was significantly highest (6.78 t ha⁻¹) in the plots receiving 2 raking + 2 weeding than those in the two weeded plot or in the two raked plot. The results agree well with Faruque and Mamun (1991) who expressed that 2 raking followed by 2 weeding were more effective than single raking once or twice. The interaction of tillage operations and cultural practices showed significant effect on number of non-bearing tillers per hill, grain

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Table 1: Effect of tillage operation on yield and yield contributing characters of Aus rice (cv. BR 20)

Parameters	Treatments		
	One tillage (T ₁)	Two tillage (T ₂)	Four tillage (T ₄)
Plant height (cm)	96.12	97.53	97.64
Total tillers hill ⁻¹	11.57c	12.21b	12.77a
Non-bearing tillers hill ⁻¹	2.68c	2.84b	2.99a
Effective tillers hill ⁻¹	8.88b	9.37a	9.79a
Panicle length (cm)	20.56b	21.37a	21.61a
Number of grains panicle ⁻¹	78.63c	81.34b	83.19a
Number of filled grains panicle ⁻¹	54.04c	56.35b	57.86a
Number of sterile spikelets panicle ⁻¹	24.59b	24.98ab	25.35a
Weight of 1000 grains (g)	22.77	23.10	23.32
Grain yield (t ha ⁻¹)	2.55c	2.65b	2.79a
Straw yield (t ha ⁻¹)	3.96b	4.10a	4.23a
Biological yield (t ha ⁻¹)	6.51c	6.75b	7.02a
Harvest index (%)	39.17b	39.26b	39.74a

Table 2: Effect of different intercultural practices on yield and yield contributing characters of Aus rice (cv. BR 20)

Parameters	Treatments		
	Two raking (R ₂)	Two weeding (W ₂)	Two raking + Two weeding (R ₂ +W ₂)
Plant height (cm)	95.42	97.43	98.47
Total tillers hill ⁻¹	11.51c	12.32b	12.72a
Non-bearing tillers hill ⁻¹	2.72c	2.83b	2.98a
Effective tillers hill ⁻¹	8.78c	9.50b	9.73a
Panicle length (cm)	20.49b	21.33a	21.73a
Number of grain panicle ⁻¹	76.97c	81.53b	84.70a
Number of filled grains panicle ⁻¹	53.78c	56.11b	58.35a
Number of sterile spikelets panicle ⁻¹	23.18c	25.42b	26.35a
Weight of 1000 grains (g)	22.78b	23.45a	23.55a
Grain yield (t ha ⁻¹)	2.58c	2.66b	2.74a
Straw yield (t ha ⁻¹)	3.91b	3.97ab	4.04a
Biological yield (t ha ⁻¹)	6.49c	6.63b	6.78a
Harvest index (%)	39.75b	40.12ab	40.41a

Table 3: Interaction effect of tillage operation and different intercultural practices on yield and yield contributing characters of Aus rice (cv. BR 20)

Parameters	Treatments								
	T ₁ +R ₂	T ₁ +W ₂	T ₁ +R ₂ +W ₂	T ₂ +R ₂	T ₂ +W ₂	T ₂ +R ₂ +W ₂	T ₄ +R ₂	T ₄ +W ₂	T ₄ +R ₂ +W ₂
Plant height (cm)	94.35	96.34	97.70	96.03	97.64	98.92	95.91	98.28	98.82
Total tillers hill ⁻¹ (nos.)	10.81	11.84	12.03	11.63	12.25	12.75	12.07	12.87	13.39
Non-bearing tillers hill ⁻¹	2.62f	2.68ef	2.73de	2.74de	2.84c	2.92b	2.82cd	2.97b	3.19a
Effective tillers hill ⁻¹	8.20	9.17	9.29	8.88	9.40	9.83	9.27	9.90	10.20
Panicle length (cm)	20.05	20.52	20.50	20.60	21.51	22.01	20.83	21.95	22.03
Number of grains panicle ⁻¹	75.15	78.57	82.17	76.90	82.11	85.07	78.85	83.91	86.87
Number of filled grains panicle ⁻¹	52.09	53.82	55.20	53.84	56.49	58.70	55.43	58.02	60.14
Number of sterile spikelets panicle ⁻¹	23.07	24.77	25.94	23.07	25.61	26.37	23.41	25.89	26.73
Weight of 1000 grains (g)	22.53	23.18	23.27	22.79	23.52	23.66	23.00	23.64	23.73
Grain yield (t ha ⁻¹)	2.51f	2.56ef	2.60de	2.58de	2.64cd	2.71c	2.67c	2.79b	2.92a
Straw yield (t ha ⁻¹)	3.95	4.00	4.05	4.06	4.10	4.20	4.10	4.19	4.25
Biological yield (t ha ⁻¹)	6.46f	6.56ef	6.65de	6.64de	6.74cd	6.91b	6.77c	6.98b	7.17a
Harvest index (%)	38.85	39.02	39.10	38.89	39.17	39.22	39.44	39.97	40.73

In a column, means having similar letter(s) do not differ significantly at 1% level of probability.

Table 4: Economic analysis on the effect of tillage and different intercultural practices on Aus rice (cv. BR 20)

Treatments	Gross return (Tk. ha ⁻¹)	* TVC (Tk. ha ⁻¹)	** Other cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	Benefit cost ratio (BCR)
T ₁ +R ₂	21520	2700	10088	12788	8732	1.68
T ₁ +W ₂	21920	6300	10340	16640	5280	1.32
T ₁ +R ₂ +W ₂	22250	6700	10368	17068	5182	1.30
T ₂ +R ₂	22120	5000	10249	15249	6871	1.45
T ₂ +W ₂	22580	8600	10501	19101	3479	1.18
T ₂ +R ₂ +W ₂	23170	9000	10529	19529	3641	1.19
T ₄ +R ₂	22790	9600	10571	20171	2619	1.13
T ₄ +W ₂	23720	13200	10823	24023	303	0.99
T ₄ +R ₂ +W ₂	24690	13600	10851	24451	239	1.01

* TVC includes cost of tillage, raking and weeding, ** Other cost includes labour cost for seeds sowing, harvesting, carrying, processing; common cost/treatment for the price of seed, fertilizer, insecticide; interest of fixed and running capital. T₁ = Tk. 2300 ha⁻¹; T₂ = Tk. 4600 ha⁻¹; T₄ = Tk. 9200 ha⁻¹, R₂ = Tk. 400 ha⁻¹ and W₂ = Tk. 4000 ha⁻¹. Price of grain is Tk. 7.00 kg⁻¹ and Straw = Tk. 1.00 kg⁻¹.

yield and biological yield (Table 3). When 4 tillage with 2 raking + 2 weeding applied then highest number (3.19) of non-bearing tillers per hill was produced which was statistically superior to other cases but while 1 tillage with 2 raking applied then lowest number of non-bearing tillers per hill was produced which was statistically similar to 1 tillage with 2 weeding. Similarly 4 tillage with 2 raking + 2 weeding produced the highest grain yield (2.92 t ha^{-1}) and biological yield (7.17 t ha^{-1}), which were statistically superior to others, but the lowest grain yield (2.51 t ha^{-1}) and biological yield (6.46 t ha^{-1}) were produced from 1 tillage with 2 raking which was statistically similar to 1 tillage with 2 weeding. Harvest index was not significantly affected by the interactions involved in the experiment.

Economic performance: Gross return was found to be highest (Tk. 24690 ha^{-1}) in the treatment of 4 tillage with 2 raking + 2 weeding (Table 4). But due to highest total variable cost (TVC) of Tk. 13600 ha^{-1} in this treatment the benefit cost ratio (BCR) was low (1.01). Again, the TVC (Tk. 2700 ha^{-1}) recorded with 1 tillage with 2 raking was 80.15% less than the treatment of 4 tillage with 2 raking + 2 weeding. The highest net return (Tk. 8731 ha^{-1}) and higher BCR (1.68) as obtained from this treatment ($T_1 + R_1$) is due to less cost involved. The benefit cost ratio in all the treatments was found to be lower than one indicating that investment in more than one tillage operation and weeding were not very profitable practice.

From the study, it can be concluded that through 4 tillage with 2 raking + 2 weeding gave the highest grain yield with higher cost involvement and was not economic. But 1 tillage with 2 raking (at 15 and 30 DAS) gave fairly good yield with better economic return. For the resource poor farmers, the treatment of 2 tillage with 2 raking may also be recommended.

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