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INFLUENCE OF TRANSPLANTING DATE ON PERFORMANCE OF *BORO* RICE VARIETIES IN LALMAI-HILL AREA

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ABSTRACT

A field experiment was conducted in Lalmai-Hill area of Cumilla with five high yielding varieties (HYV) of rice during *Boro* season (2018-2019) to evaluate their yield performance under different transplanting dates. Rice seedlings were transplanted on three different dates *viz.*, January 15 (T_1), January 30 (T_2) and February 14 (T_3). Five rice varieties *viz.*, BRRI dhan67 (V_1) BRRI dhan68 (V_2), BRRI dhan74 (V_3), BRRI dhan81 (V_4) and BRRI dhan86 (V_5) were transplanted. Results revealed that delaying of transplanting date decreased yield and return of *Boro* rice varieties. Transplanting of seedlings on February 14 decreased effective tiller hill^{-1}, filled grain panicle^{-1}, grain yield and biological yield by 13, 14, 24 and 9%, respectively, compared to seedlings transplanted on January 15. Significantly highest grain yield (5.95 t ha^{-1}) and biological yield (14.33 t ha^{-1}) were obtained from BRRI dhan74 compared with other varieties because of higher potential of its yield attributes. The highest grain yield (6.67 t ha^{-1}) and return (Tk. 158,765 ha^{-1}) were recorded from BRRI dhan74 when transplanted on January 15 as compared to other combinations. Transplanting of all other varieties on January 15 confirmed higher yield and yield return compared with delayed transplanted seedlings.

Key words: Biological yield, *Boro* rice, Grain yield, High yielding varieties, Yield return

INTRODUCTION

Rice is one of the most important food crops as it is the very good source of calories for nearly 50% of the world's population. The demand of rice as a food is increasing day by day because of its popularity in ever-growing population throughout the world

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(Asante, 2017). In Bangladesh, rice is a staple food and occupies 80% of total land area (Kabir et al., 2016). The demand of rice in Bangladesh will be 44.6 million ton by 2050 because of overpopulation (Nath et al., 2016). In addition, 'rice security' is the synonymous to 'food security' and important parameter for social stability in Bangladesh as in many other rice growing countries (Brolley, 2015; Nath, 2016).

Different environmental stresses, industrialization, urbanization and other factors gradually reduced rice and other crop production which will be great challenge to feed the rice loving people (Kabir, 2015). So, it is important task for plant scientist to increase production of rice and other food crops, to feed the ever-growing people and ensuring food security. Although the agricultural land of Bangladesh is declining @1% per annum (BBS, 2011), but it showed consistency by surplus production. The production of rice in Bangladesh is 34.4 million ton of clean rice in 2014-15 which is 2 million ton higher than desired production (Kabir et al., 2015). The increment of rice production in Bangladesh from 3.74 to 4.5 t ha^{-1} by 4 years through adapting advanced rice production technologies such as development of high yielding varieties (HYV) (BRRI, 2017). So, introduction of HYV and expand them in new area under proper agronomic management might be an important strategy as HYV are highly responsive to management practices. Along with different agronomic practices, HYV are also responsive to climatic conditions. High yielding varieties required particular climatic conditions for their different physiological process which are highly manipulated by transplanting date (Roy et al., 2019). Shifting of sowing and/ or planting date is the most important option for adjustment of specific crop growth stage with specific climatic conditions which have great impact on the growth, development and partitioning of dry matter (Patel et al., 2019). Considering the discussed facts, the experiment aimed to expand potential HYV of rice in Lalmai-Hill area at suitable transplanting date.

MATERIALS AND METHODS

Experimental location

The experiment was conducted in Lalmai-Hill area under the Upazila of Cumilla Sadar (South) and AEZ 19. It lies on 17 m above sea level. The soil of this area is composed of yellow to light brown silty loam soil. Organic matter content is low and moisture holding capacity is medium in Lalmai-Hill area. Top soil of this area is slightly acidic with low to medium P and K content.

The healthy seeds of BRRI dhan67, BRRI dhan68, BRRI dhan74, BRRI dhan81 and BRRI dhan86 were soaked in water on December 05, December 20 and January 05 for sprouting. The sprouted seeds were sown on seed bed and grown for 40 days. After growing on seedbed, 40 days old seedlings were transplanted on well prepared land at the rate of two seedling $hill^{-1}$ on January 15, January 30 and February 14 as per treatments. Fertilizers such as Urea, TSP, MOP and Gypsum were applied at the rate of 260, 90, 150 and 110 kg ha^{-1}, respectively, as per recommendation of BRRI

(Bangladesh Rice Research Institute). Different other intercultural operations and pest management were done as per requirement of the crop.

The experiment was carried out in Lalmai-Hill area at three different locations (Sanonda, Sudhonnopur and Gabtoli village) by following Randomized Complete Block Design (RCBD) with three replications. Each location was considered as one replication. The experiment was sown in factorial fashion, keeping transplanting date as factor A and varieties as factor B. The size of unit plot was 3 m × 3 m. Plot to plot distance were 1m. However, the treatments were as follows:

Factor A: Transplanting dates (T)

i. Transplanting on 15 January (T_1)

ii. Transplanting on 30 January (T_2)

iii. Transplanting on 14 February (T_3)

Factor B: Variety (V)

i. BRRI dhan67 (V_1)

ii. BRRI dhan68 (V_2)

iii. BRRI dhan74 (V_3)

iv. BRRI dhan81 (V_4)

v. BRRI dhan86 (V_5)

Data on number of effective tillers hill^{-1}, number of grain panicle^{-1}, 1000-grain weight, grain yield, straw yield, biological yield, harvest index and yield return were collected.

Biological yield and harvest index were calculated by using the following formula:

Biological yield= Grain yield + Straw yield.

$$\text{Harvest Index (H.I.)} = \frac{\text{Economic yield (grain yield)}}{\text{Biological yield (total dry weight)}}$$

Total input cost and overhead cost were similar for all varieties and transplanting date as inputs and management cost for all treatments were same. So, cost effective variety were identified by considering yield return. Return of grain yield and straw yield were calculated by multiplying yield with market value of respective products. The market price of rice grain and straw during experimental time were measured by surveying local market in Taka (Tk) (Table 1).

Table 1. Market value of grain and straw of different rice varieties in Lalmai-Hill area in 2019.

Name of the item	Market price (Tk ton^{-1})
BRRI dhan67 (Grain)	21500
BRRI dhan68 (Grain)	20100
BRRI dhan74 (Grain)	18800
BRRI dhan81 (Grain)	24150
BRRI dhan86 (Grain)	18800
Irrespective of variety (Straw)	4000

The return of grain yield, straw yield and total marketable yield were calculated using the following formula:

Return of grain yield = Total grain yield (t ha^{-1}) × Market price of rice grain (Tk t^{-1})

Return of straw yield = Total straw yield (t ha^{-1}) × Market price of rice straw (Tk t^{-1})

Return of total marketable yield = Return of grain yield + Return of straw yield

Statistical analysis was done using Statistix10 and mean separation was done by LSD at 5% level of significance (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Effective tillers $hill^{-1}$

Different transplanting dates affected effective tillers $hill^{-1}$. Transplanting of rice seedlings on January 15 produced the highest number of effective tillers $hill^{-1}$ (14.83) which was statistically similar with transplanting of rice seedlings on January 30 (Table 2). Results revealed that early planting produced comparatively higher number of effective tillers and late planting produced lower effective tillers $hill^{-1}$. This result in corroborate with Roy et al. (2019) who reported that, production of effective tillers decreased in *Boro* rice when transplanted after 15 January due to poor fertilization and other environmental factors.

Varietal variation did not affect the number of effective tillers $hill^{-1}$. Interactive effect of transplanting date and variety on tiller $hill^{-1}$ was non-significant (Table 2).

Filled grain $panicle^{-1}$

The number of filled grain $panicle^{-1}$ greatly influenced by variation of transplanting date. Early planting (15th January) produced highest number of filled grain $panicle^{-1}$ (102.51) and late planting (14th February) produced lowest number of filled grain $panicle^{-1}$ (Table 2). Our findings in agreement with Roy et al. (2019) who noted that, late planted *Boro* seedlings resulted lower grain yield by decreasing grain number.

Table 2. Effect of transplanting date and variety on yield contributing parameters of *Boro* rice varieties in Lalmai-Hill area

Treatments	Effective tiller hill^{-1} (No.)	Filled grain panicle^{-1} (No.)	Unfilled grain panicle^{-1} (No.)	1000-grain wt. (g)
Transplanting Date				
T_1	14.83 a	102.51 a	22.18 b	23.97 a
T_2	14.51 a	98.82 b	24.55 b	23.85 b
T_3	12.87 b	88.49 c	28.84 a	23.54 c
LSD $_{(0.5)}$	1.44	2.62	2.51	0.09
CV (%)	13.65	3.63	13.35	0.51
Variety				
V_1	13.34	98.35 a	22.1 c	24.38 c
V_2	13.21	92.05 b	21.63 c	26.84 a
V_3	14.91	101.6 a	27.25 b	26.56 b
V_4	14.72	99.14 a	23.15 c	19.95 e
V_5	14.15	91.9 b	31.83 a	21.2 d
LSD $_{(0.5)}$	NS	3.39	3.24	0.12
CV (%)	13.65	3.63	13.35	0.51
Transplanting Date × Variety				
T_1 V_1	14.33	105.13	17.62	24.44 f
T_1 V_2	13.33	97.00	19.16	27.12 a
T_1 V_3	16.00	107.47	24.60	26.78 bc
T_1 V_4	15.63	105.84	20.76	20.03 j
T_1 V_5	14.87	97.13	28.76	21.45 h
T_2 V_1	13.41	101.08	21.94	24.73 e
T_2 V_2	13.71	95.34	19.46	26.80 b
T_2 V_3	15.23	103.54	25.99	26.40 d
T_2 V_4	15.43	99.97	24.50	20.05 j
T_2 V_5	14.73	94.19	30.87	21.26 h
T_3 V_1	12.28	88.84	26.72	23.95 g
T_3 V_2	12.59	83.82	26.26	26.58 cd
T_3 V_3	13.5	93.8	31.16	26.52 d
T_3 V_4	13.1	91.62	24.19	19.76 k
T_3 V_5	12.86	84.39	35.87	20.89 i
LSD $_{(0.5)}$	NS	NS	NS	0.20
CV (%)	13.65	3.63	13.35	0.51

T_1= Transplanting of seedlings on 15 January V_1= BRRI dhan67 V_4= BRRI dhan81
T_2= Transplanting of seedlings on 30 January V_2= BRRI dhan68 V_5= BRRI dhan86
T_3= Transplanting of seedlings on 14 February V_3= BRRI dhan74 NS= Non-significant

Significantly highest number of filled grain panicle^{-1} (102.60) produced by BRRI dhan74 which is statistically similar with BRRI dhan67 and BRRI dhan81 (Table 2). Our results are in line with previous findings (Roy et al., 2019; Sultana et al., 2020) who noted that number of filled grain varied with varietal variation. Interaction of transplanting date and variety had no effect on number of filled grain panicle^{-1} (Table 2).

Unfilled grain panicle^{-1}

The number of unfilled grain panicle^{-1} varied with the variation of transplanting date (Table 2). Late-planted seedlings (14th February) produced significantly highest number of unfilled grain panicle^{-1} (28.41). Early-planted seedlings (15th January) produced the lowest number of unfilled grain panicle^{-1} which was statistically similar with the treatment transplanted on January 30. Late planting increased unfilled grain panicle^{-1} due to tropical-storm related lodging, heat damage during heading, flowering stage of rice (Reza et al., 2011).

Significantly highest number (31.83) of unfilled grain panicle^{-1} noticed in BRRI dhan86 (Table 2). The lowest number (21.62) of unfilled grain panicle^{-1} observed in BRRI dhan68, which was statistically similar with BRRI dhan67 and BRRI dhan81. Interaction of transplanting date and variety showed no influence on unfilled grain panicle^{-1} (Table 2).

Thousand grain weight

Thousand grain weight decreased with delay of transplanting (Table 2). The highest 1000-grain weight (23.97 g) was recorded from early-planted rice seedlings (Transplanted on 15th January) and the lowest 1000-grain weight (23.54 g) was recorded from seedlings transplanted on February 14. Proper planting time ensures optimum temperature and sunshine hours during flowering, heading and dough stage which increase fertilization and partitioning (Reza et al., 2012; Patel et al., 2019). Early-planted seedlings (15th January transplantation) usually exposed the panicle initiation, booting, heading and flowering stage during second half of February when temperature remain around 30^{o}C which conforms optimum temperature for proper fertilization and partitioning. Consequently, filled grain panicle^{-1} and thousand grain weight increased in early-planted seedlings.

Thousand grain weight usually varies from variety to variety due to differences on individual seed size and weight. Our results revealed that thousand grain weight influenced by varietal variation (Table 2). The highest 1000-grain weight (26.84 g) was observed in BRRI dhan68 and the lowest 1000-grain weight (21.20 g) was recorded in BRRI dhan86. Our results are in line with Roy et al. (2019) who reported that 1000-grain weight varied with varietal variation.

Interaction of transplanting date and variety greatly influenced 1000-grain weight of *Boro* rice (Table 2). The highest 1000-grain weight (27.12 g) was recorded from

BRRI dhan68 when transplanted on January 30 and the lowest 1000-grain weight (19.76 g) recorded from BRRI dhan86 when transplanted on February 14.

Grain yield

Grain yield of rice was significantly affected by transplanting date (Table 3). The highest grain yield (5.26 t ha^{-1}) was obtained from early-transplanted seedlings (Transplanted on January 15) and the lowest grain yield from late-transplanted seedlings (Transplanted on February 15). Delayed transplanting decreased grain yield because of lower filled grain $panicle^{-1}$ and 1000-grain weight. Chopra et al. (2006) reported that maximum yield of rice was obtained when rice plants exposed to appropriate temperature range by controlling sowing and/ or transplanting time. Proper planting time ensures optimum temperature and sunshine hours during flowering, heading and dough stage which increase fertilization and partitioning (Reza et al., 2011; Patel et al., 2019). Delayed transplanting causes higher disease and insect incidence, tropical storm-related lodging. Late transplanting also causes possible heat damage during heading, flowering and the grain filling stage (Reza et al., 2011). Our results revealed that early-transplanted seedlings confirmed higher grain yield and late-transplanted seedlings confirmed lower grain yield. These results in agreement with studies of Ali et al. (2019) who reported that yield reduction started after transplanting of 21st January at Cumilla districts in case of different *Boro* rice varieties.

Grain yield of *Boro* rice influenced by varietal variation (Table 3). The highest grain yield (5.95 t ha^{-1}) was obtained from BRRI dhan74 and the lowest grain yield (3.96 t ha^{-1}) from BRRI dhan86. BRRI dhan74 produced the highest grain yield compared with others as it also produced highest effective tillers and filled grain compared with others. Our results are supported by several previous studies (Mannan et al., 2012, Hussain et al., 2014; Chowhan et al., 2019 and Ali et al., 2019). They reported that different varieties showed different grain yield by showing differences in effective tillers $hill^{-1}$, filled grain $panicle^{-1}$ and 1000-grain weight.

Interactive effect of transplanting date and variety significantly influenced the grain yield of *Boro* rice. The highest grain yield (6.67 t ha^{-1}) was recorded from BRRI dhan74 when transplanted on January 15 (Table 3). BRRI dhan74 had higher potentiality in higher grain yield production by producing the highest number of effective tillers $hill^{-1}$ and number of grain $panicle^{-1}$. Early-transplanted seedlings also showed potential in production of effective tillers per hill, grain per panicle and consequently grain yield. The lowest grain yield (3.80 t ha^{-1}) was recorded from BRRI dhan67 when transplanted on February 14 as late-transplanted seedling showed lower filled grain per panicle and lower effective tillers per hill.

Table 3. Effect of transplanting date and variety on grain yield, straw yield, biological yield and harvest index of *Boro* rice varieties in Lalmai-Hill area.

Treatments	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index
Transplanting date				
T_1	5.26 a	8.02	13.28 a	0.4 a
T_2	4.92 b	8	12.92 b	0.38 b
T_3	4.02 c	8.01	12.03 c	0.33 c
LSD $_{(0.5)}$	0.13	NS	0.20	0.01
CV (%)	3.72	2.77	2.09	3.18
Variety				
V_1	4.31 c	8.35 b	12.658 b	0.34 c
V_2	4.98 b	6.91 d	11.892 c	0.42 a
V_3	5.95 a	8.38 b	14.331 a	0.42 a
V_4	4.45 c	7.7 c	12.146 c	0.37 b
V_5	3.96 d	8.71 a	12.677 b	0.31 d
LSD $_{(0.5)}$	0.17	0.21	0.26	0.01
CV (%)	3.72	2.77	2.09	3.18
Transplanting Date × Variety				
$T_1 V_1$	4.79 ef	8.45	13.236 b	0.36 cd
$T_1 V_2$	5.63 c	7.08	12.705 c	0.44 a
$T_1 V_3$	6.67 a	8.38	15.039 a	0.44 a
$T_1 V_4$	4.86 e	7.71	12.562 c-e	0.39 b
$T_1 V_5$	4.37 gh	8.46	12.834 bc	0.35 e
$T_2 V_1$	4.34 gh	8.32	12.658 cd	0.34 de
$T_2 V_2$	5.29 d	6.81	12.096 fg	0.44 a
$T_2 V_3$	6.26 b	8.49	14.752 a	0.42 a
$T_2 V_4$	4.52 fg	7.63	12.145 e-g	0.37 bc
$T_2 V_5$	4.18 hi	8.77	12.953 bc	0.32 ef
$T_3 V_1$	3.80 j	8.28	12.079 fg	0.31 f
$T_3 V_2$	4.03 ij	6.84	10.876 h	0.37 bc
$T_3 V_3$	4.94 e	8.26	13.201 b	0.37 bc
$T_3 V_4$	3.98 ij	7.75	11.731 g	0.34 e
$T_3 V_5$	3.34 k	8.91	12.244 d-f	0.27 g
LSD $_{(0.5)}$	0.29	NS	0.45	0.02
CV (%)	3.72	3.72	2.09	3.18

T_1= Transplanting of seedlings on 15 January; T_2= Transplanting of seedlings on 30 January; T_3= Transplanting of seedlings on 14 February; V_1= BRRI dhan67; V_2= BRRI dhan68; V_3= BRRI dhan74; V_4= BRRI dhan81; V_5= BRRI dhan86; NS= Non-significant

Straw yield

Transplanting of *Boro* rice seedlings in different date did not affect straw yield (Table 3). Varietal variation significantly influenced straw yield of *Boro* rice. Different variety showed differences in straw yield (Table 3). The highest straw yield (8.71 t ha^{-1}) was recorded from BRRI dhan86 and the lowest (6.91 t ha^{-1}) from BRRI dhan68. Interaction of transplanting date and variety had no influence on straw yield of *Boro* rice (Table 3).

Biological yield

Variation in transplanting date influenced biological yield (Table 3). Early-transplanted seedlings (Transplanted on January 15) produced highest biological yield (13.28 t ha^{-1}) and late-planted seedlings (Transplanted on January 30) produced lowest biological yield (12.03 t ha^{-1}). The highest biological yield was observed from early-transplanted seedlings as the highest grain yield was observed from early-transplanted seedlings. Similar results are also reported by Mannan et al., (2012) who reported that the yield and yield attributes decreased with delaying of transplanting dates.

Varietal variation significantly influenced biological yield of *Boro* rice (Table 3). The highest biological yield (14.33 t ha^{-1}) was recorded from BRRI dhan74 and the lowest biological yield (11.89 t ha^{-1}) was recorded from BRRI dhan68. These results agree with Roy et al. (2019) who noted that different varieties showed different grain yield, straw yield and biological yield.

Interaction of transplanting date and variety affected biological yield of *Boro* rice (Table 3). The highest biological yield (15.04 t ha^{-1}) was recorded from the BRRI dhan74 when transplanted on January 15. Similar results were also found from BRRI dhan74 when transplanted on January 30. However, the lowest biological yield recorded from BRRI dhan68 when transplanted on February 14.

Harvest index

The harvest index of *Boro* rice varied with the variation of transplanting date (Table 3). The highest harvest index (0.4) was observed from early-transplanted seedlings and the lowest (0.33) from late-transplanted seedlings. Grain yield of *Boro* rice decreased with delaying of seedling transplanting which consequently influenced harvest index in similar way.

Varietal variation also influenced harvest index of rice (Table 3). The highest harvest index (0.42) was observed from BRRI dhan68 and BRRI dhan74 and the lowest harvest index (0.31) from BRRI dhan81.

Interaction of transplanting date and variety also significantly influenced harvest index of *Boro* rice (Table 3). The highest harvest index recorded from BRRI dhan68 and BRRI dhan74 when transplanted on January 15 and 30. The lowest harvest index (0.27) recorded from BRRI dhan86 when planted on February 14.

Yield return

Transplanting dates had significant effect on yield return as different transplanting date showed different grain yield, straw yield and total marketable yield (Grain yield + Straw yield) (Table 4). The highest grain yield return (108,159 Tk ha^{-1}) was recorded from early transplanted seedlings (Transplanted on January 15) as transplanting on this date also produced highest grain yield. Our findings revealed that return decreased gradually with delay of transplanting date. This reduction of monetary advantages along with delay of transplanting date was due to gradual reduction of grain yield. However, the lowest grain yield return was recorded from the seedlings transplanted on February 14.

Transplanting dates had no impact on straw yield return as straw yield were not varied with transplanting date. Return of total marketable yield also varied with the variation of transplanting date (Table 4). Transplanting of seedlings on February 14 showed lowest return (114,904 Tk ha^{-1}) for total marketable yield.

Table 4. Effect of transplanting date and variety on return of grain yield, straw yield and biological yield return of *Boro* rice varieties in Lalmai-Hill area

Treatments	Grain yield return (Tk ha^{-1})	Straw yield return (Tk ha^{-1})	Marketable yield return (Tk ha^{-1})
Transplanting date			
T_1	108159 a	32056	140214 a
T_2	100990 b	32015	133005 b
T_3	82864 c	32040	114904 c
$LSD_{(0.05)}$	2734.2	NS	2744.8
CV (%)	3.76	2.77	2.84
Variety			
V_1	92591 d	33405 b	125996 c
V_2	100127 c	27643 d	127770 c
V_3	111925 a	33510 b	145435 a
V_4	107516 b	30777 c	138293 b
V_5	74529 e	34850 a	109380 d
$LSD_{(0.05)}$	3529.8	858.36	3543.6
CV (%)	3.76	2.77	2.84

Treatments	Grain yield return (Tk ha^{-1})	Straw yield return (Tk ha^{-1})	Marketable yield return (Tk ha^{-1})
Transplanting Date × Variety			
T_1 V_1	102949 e	33792	136741 cd
T_1 V_2	113096 bc	28313	141409 c
T_1 V_3	125258 a	33507	158765 a
T_1 V_4	117264 b	30827	148091 b
T_1 V_5	82225 g	33840	116065 f
T_2 V_1	93210 f	33292	126502 e
T_2 V_2	106262 de	27236	133498 d
T_2 V_3	117713 b	33964	151677 b
T_2 V_4	109118 cd	30507	139624 cd
T_2 V_5	78647 g	35077	113724 fg
T_3 V_1	81614 g	33131	114745 f
T_3 V_2	81023 g	27379	108402 g
T_3 V_3	92803 f	33059	125862 e
T_3 V_4	96165 f	30997	127163 e
T_3 V_5	62717 h	35633	98350 h
LSD $_{(0.05)}$	6113.8	NS	6137.6
CV (%)	3.76	2.77	2.84

T_1= Transplanting of seedlings on 15 January, T_2= Transplanting of seedlings on 30 January, T_3= Transplanting of seedlings on 14 February; V_1= BRRI dhan67, V_2= BRRI dhan68, V_3= BRRI dhan74, V_4= BRRI dhan81, V_5= BRRI dhan86, NS= Non-significant

Varietal variation greatly influenced the return of grain yield, straw yield and total marketable yield (Table 4). The highest grain yield return (111,925 Tk ha^{-1}) was recorded from BRRI dhan74 and the lowest monetary advantages (74,529 Taka) recorded from BRRI dhan86. The highest straw yield return (34,850 Tk ha^{-1}) was recorded from BRRI dhan86 and the lowest from BRRI dhan68. However, the highest marketable yield return (145,435Tk ha^{-1}) was recorded from BRRI dhan74 and lowest return (109380 Tk ha^{-1}) from BRRI dhan86.

The combined effect of variety and transplanting date had great impact on return of grain yield and total marketable yield (Table 4). Interaction of transplanting date and variety had no impact on straw yield return. The highest grain yield return (125,258 Tk ha^{-1}) recorded from BRRI dhan74 when transplanted on January 15 and the lowest return (62,717 Tk ha^{-1}) of grain yield from BRRI dhan86 when transplanted on February 14. Similarly, the highest marketable yield return (158,765 Tk ha^{-1}) was recorded from BRRI dhan74 when transplanted on January 15 and the lowest return from BRRI dhan86 when transplanted on February 14.

CONCLUSION

Our experimental results suggested that transplanting of *Boro* rice on January 15 produced higher effective tiller hill^{-1}, filled grain panicle^{-1}, 1000-grain weight, grain yield, biological yield, harvest index and return than the delayed-transplanted seedlings (Transplanted on January 30 and February 14). Delaying of transplanting date decreased yield attributes, yield and return. Varietal variation also showed variation on yield of *Boro* rice. The highest grain (5.95 t ha^{-1}) and biological yield (14.33 t ha^{-1}) and marketable yield return (Tk. 145,435 ha^{-1}) were recorded from BRRI dhan74 compared with other varieties. Transplanting of BRRI dhan74 on January 15 showed the highest grain yield and return and transplanting of BRRI dhan86 on February 14 showed the lowest grain yield. However, transplanting of any varieties after 15 January decreased grain yield and biological yield. Considering yield and return BRRI dhan74 is the most cost-effective variety for Lalmai-Hill area among the tested varieties.

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