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Response of short duration *aman* rice varieties to date of transplanting

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Abstract

An experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during June to December, 2013 to investigate the response of some short duration *aman* rice varieties to date of transplanting. The experiment consisted of three transplanting dates viz. 26 July, 5 August and 15 August and seven short duration T. *aman* rice varieties viz. BRRI dhan33, BRRI dhan39, BRRI dhan49, BRRI dhan56, BRRI dhan57, BRRI hybrid dhan4 and Binadhan-7. The experiment was laid out in split plot design with three replications. Transplanting dates were allocated into the main plot and varieties into the sub plot. Results indicate that Binadhan-7 produced the highest grain yield (4.90 t ha^{-1}), straw yield (5.58 t ha^{-1}), biological yield (10.44 t ha^{-1}), and harvest index (47.10%). Lowest grain yield (3.27 t ha^{-1}), straw yield (3.96 t ha^{-1}) and biological yield (7.20 t ha^{-1}) were produced by BRRI dhan57. BRRI dhan49 had taken the longest field duration (120 DAT) while BRRI dhan57 had taken the shortest field duration (88 DAT). Plant height (119.12 cm), number of total tillers m^{-2} (276.40), number of effective tillers m^{-2} (260.02), number of grains $panicle^{-1}$ (109.19), grain yield (4.75 t ha^{-1}), straw yield (5.22 t ha^{-1}), biological yield (9.97 t ha^{-1}) and harvest index (47.64%) were highest on 26 July transplanting; decreased on 5 August transplanting and drastically declined on 15 August transplanting. The present study concludes that the highest yield for short duration T. *aman* rice cultivation could be possible by Binadhan-7 transplanting on 26 July.

Keywords: Short duration T. *aman* rice, Transplanting dates

Introduction

Rice is the staple food of Bangladesh and the strategies and actions of Bangladeshi agriculture are guided by the goals of 'self-sufficiency' in food grain production with main focus on rice. Over 95% people depend on rice for their daily diets and it engages over 85% of the total agricultural labour force in Bangladesh. Transplant *aman* rice varieties are generally cultivated in rainfed ecosystem which covers about 48.97% of total rice area and contributes to 38.14% of total rice production in the country (BRRI, 2012). Modern varieties of T. *aman* cover about 68% of rice area in the *aman* season (BBS, 2012).

Cultivation of short duration T. *aman* rice in south-western part of Bangladesh where soil remain moist before harvest may create opportunity to reduce cost of production for mustard relay cropping (Khan *et al*., 2006). Short duration T. *aman*- rabi crops-late *boro* cropping system is a climate resilient eco-friendly technology that would help increase system productivity by 15–20% and could help towards maintaining food security in the country. (Rahman, 2013). Short duration T. *aman* rice can also create opportunity to facilitate legume pulses and green manuring crops before late *boro* sowing which can contribute significantly to achieve the twin objectives of increasing productivity and improving the sustainability of the cropping system (Quayum *et al*., 2012). Some short duration T. *aman* rice varieties (viz. BRRI dhan56, BRRI dhan57 & Binadhan-7) are not only photo insensitive, but also drought resistant (BRRI, 2010 and BINA, 2012). Choosing optimum date of transplanting for high yielding cultivars occupies an important part of high production package (Akhter *et al.,* 2007). Different authors used different planting dates to check contrasting temperature regimes, precipitation and growth periods in various T. *aman* rice varieties (Laborte *et al*., 2012; Rahman *et al*., 2004 and Rahman *et al.,* 2007). They concluded that late transplanting date coincided reproductive phase with temperature stress. But early planting could not be possible all the time due to existing cropping pattern, climate change and socio-economic condition. The study was undertaken to identify the best short duration T. *aman* rice variety and find out the optimum transplanting date.

Materials and Methods

The experiment was carried out at the Agronomy Field Laboratory of Bangladesh Agricultural University, Mymensingh, during July to December 2013. Two sets of experimental treatments were included in the study.

A. Date of transplanting:	**B.** Variety:
i) 26July 2013 (D_1)	1)BRRI dhan33 (V_1)
ii) 5 August 2013 (D_2)	2)BRRI dhan39 (V_2)
iii) 15 August 2013 (D_3)	3)BRRI dhan49 (V_3)
	4)BRRI dhan56 (V_4)
	5)BRRI dhan57 (V_5)
	6)BRRI hybrid dhan4 (V_6)
	7)Binadhan-7 (V_7)

The experiment was laid out in a split-plot design with three replications by assigning date of transplanting in the main plot and variety in sub plot at random. Seeds were collected from the Bangladesh Rice Research Institute, Joydebpur, Gazipur and Bangladesh Institute of Nuclear Agriculture, Mymensingh. Seedlings were raised at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh. Main land was prepared according to layout in 24 July 2013. Seedlings were transplanted in the unit plots on 26 July, 5 August and 15 August 2013 respectively at the rate of three seedlings hill^{-1} maintaining spacing of 25 cm×15 cm. Fertilizer application, thinning and gap filling, weeding, irrigation and drainage and other intercultural operations were done as and when necessary according to the BRRI guideline. The crops were harvested at maturity and data on plant height (cm), number of total tillers m^{-2}, number of effective tillers m^{-2}, number of non-effective tillers m^{-2}, panicle length (cm), number of filled grains panicle^{-1}, number of sterile spikelets panicle^{-1}, 1000 grain weight (g), grain yield (t ha^{-1}), straw yield (t ha^{-1}), biological yield (t ha^{-1}), harvest index (%) and field duration (days) were collected from the randomly selected ten hills from each plot. All relevant data were analyzed using the "Analysis of Variance" technique and the mean differences were determined by Duncan's Multiple Range Test.

Results and Discussion

Effect of variety and date of transplanting on different plant characters of short duration T. *aman* rice

BRRI dhan56 produced the tallest plant of 128.53 cm. BRRI dhan57 produced the shortest plant of 110.04 cm which is statistically similar to Binadhan-7(110.51 cm) (Table 1). Transplanting on 26 July has given the tallest plant (119.12 cm). Plant height decreased with delay in transplanting (at 5 August 117. 64 cm). The shortest plant (115.11 cm) was observed for transplanting on 15 August (Table 2).

The highest number of total tillers m^{-2} was counted in Binadhan-7 (342.05) and the lowest number of tillers m^{-2} (216.38) was observed in BRRI dhan33 (Table 1). The highest number of total tillers m^{-2} (276.40) was produced from 26 July transplanting. Total tillers m^{-2} decreased with delay in transplanting at 5 August (269. 63). Maximum number of total tillers m^{-2} (360.0) was produced from 26 July transplanting of Binadhan-7 (Table 2). The lowest number of total tillers m^{-2} (161.0) was in BRRI dhan57 for transplanting on 15 August. The variation was due to varietal characters and late transplanting.

The results showed that the highest number of effective tillers m^{-2} (333.33) was produced by Binadhan-7 and BRRI dhan33 produced the lowest (202.11). The highest number of effective tillers m^{-2} was observed in 26 July. Lowest number of effective tillers m^{-2} (244.19) was produced when the seedling was planted on 15 August (Table 2). Maximum number of effective tillers m^{-2} (350.0) was produced by Binadhan-7 planted on 26 July. The lowest number of effective tiller m^{-2} (156.0) was produced from 15 August transplanting of BRRI dhan57 (Table 5).

Table 1. Effect of variety on different plant characters of short duration T. *aman* rice

Variety	Plant height (cm)	No. of tillers m^{-2}	No. of effective tillers m^{-2}	No. of non-effective tillers m^{-2}	No. of grains $panicle^{-1}$	Sterile spikelets $panicle^{-1}$	Days to PI (Day)	Days to flowering (Day)	Days to maturity (Day)
BRRI dhan33	118.98 b	216.38 c	202.11d	14.28 b	106.98ab	19.70 ab	44.00 b	59.00 b	94.00 b
BRRI dhan39	120.04 b	249.00 bc	233.44 cd	15.56ab	105.43ab	16.37 b	48.00ab	65.00 ab	102.00ab
BRRI dhan49	115.07 bc	274.17 b	258.11 bc	16.05 a	113.81 a	16.97 b	60.00 a	79.00 a	120.00 a
BRRI dhan56	128.53 a	247.00 bc	235.33 cd	11.67bc	111.27 a	21.08 a	44.00b	59.00 b	94.00 b
BRRI dhan57	110.04 c	295.44 ab	282.11 b	13.33 b	96.99 b	17.40 b	41.00c	56.00 c	88.00 c
BRRI hybrid4	115.51 bc	251.83 bc	236.44 cd	15.39ab	97.66 b	21.12 a	44.00 b	59.00 b	94.00 b
BINAdhan-7	110.51 c	342.05 a	333.33 a	9.72 c	111.89 a	15.21 c	48.00 ab	66.00 ab	102.00ab
$S\bar{x}$	2.16	8.61	8.86	1.90	4.99	0.94	0.20	0.44	0.09
CV %	5.55	9.64	10.46	14.77	14.35	15.52	1.30	2.09	0.28
LS	**	**	**	**	**	**	**	**	**

Table 2. Effect of date of transplanting on plant characters of short duration T.*aman* rice

Date of transplanting	Plant height (cm)	No. of tillers m^{-2}	No. of effective tillers m^{-2}	No. of non-effective tillers m^{-2}	No. of Grains $panicle^{-1}$	Sterile spikelets $panicle^{-1}$	Days to PI (Day)	Days to flowering (Day)	Days to maturity (Day)
26 July	119.12 a	276.40 a	260.02 a	9.00 c	109.19 a	16.85 c	48.09 a	65.14 a	100.28a
5 August	117.64 b	269.63 b	260.02 a	14.26 b	103.37 b	17.47 b	47.66 b	63.76 b	99.81 b
15 August	115.11 c	258.63 c	244.19 b	17.38 a	99.87 c	19.45 a	46.66 b	62.76 b	98.19 b
$S\bar{x}$	0.65	8.79	8.75	1.39	3.33	0.71	0.16	0.32	0.04
CV %	5.55	9.64	10.46	14.77	14.35	15.52	1.30	2.09	0.28
LSD	**	**	**	**	**	**	**	**	**

Binadhan-7 produced the lowest (9.72) number of non-effective tillers m^{-2} (Table 1). The number of non-effective tillers m^{-2} was minimum (9.50) for transplanting on 26 July (Table 2). Number of non-effective tillers increase if transplanting is delayed; (in 5 August 14.26) and the maximum number of non-effective tillers m^{-2} (17.38) was produced for transplanting on 15August.

The maximum number of grains $panicle^{-1}$ (149.80) was observed in BRRI dhan33 for transplanting on 26 July. Minimum number of grains $panicle^{-1}$ (77.77) was observed respectively in BRRI dhan57 for transplanting on 15 August (Table 5).

The lowest number of sterile spikelets $panicle^{-1}$ (16.85) was recorded for 26 July transplanting and the highest number of sterile spikelets $panicle^{-1}$ (19.46) was recorded on 15 August. The highest number of sterile spikelets $panicle^{-1}$ (31.70) was counted in BRRI hybrid 4 for 15August transplanting and the lowest number of sterilespikeletspanicle^{-1} (14.30) was found inBinadhan-7 with 26 July transplanting (Table 5).

Highest 1000-grain weight (24.49 g) was obtained from BRRI dhan33 transplanted on 26 July and lowest 1000-grain weight (20.00 g) was obtained from BRRI dhan57 on 15 August transplanting (Table 6).

Effect of variety and date of transplanting on yield and yield contributing characters of short duration T. *aman* rice

Binadhan-7 produced the highest grain yield (4.90 t ha^{-1}). BRRI hybrid 4 produced 4.19 t ha^{-1} grain yields which statistically similar to BBRI dhan49 (4.20 t ha^{-1}). Third position for grain yield is BRRI dhan56 (4.04) which were statistically alike to BRRI dhan49 (4.03 t ha^{-1}) (Table 3).The highest grain yield of 4.75 t ha^{-1} was obtained at 26 July transplanting (Table 3). The second highest grain yield of 4.09 t ha^{-1} was obtained with 5 August transplanting which was statistically similar to 15 August transplanting. Yield decreased by delay in transplanting. The lowest (4.03 t ha^{-1}) yield was obtained from 15 August transplanting (Table 3). The highest grain yield (4.18 t ha^{-1}) was produced by Binadhan-7 for 5August transplanting which was statistically identical to 26 July transplanting. The lowest (3.08 t ha^{-1}) was obtained in BRRI dhan57 with 15 August transplanting (Table 6).

Table 3. Effect of date of transplanting on yield and yield attributes of short duration T. *aman* rice

Date of Transplanting	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index %
26 July	4.17 a	5.22 a	9.39 a	44.64 a
5 August	4.09 ab	5.13 ab	9.22 ab	44.36 ab
15 August	4.03 b	5.09 c	9.12 b	44.18 b
$S\bar{x}$	0.22	0.15	0.15	0.90
CV %	7.47	11.41	8.35	5.53
LS	**	**	**	**

Table 4. Effect of variety on yield and yield attributes of short duration T. aman rice

Variety	1000 grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index %
BRRI dhan33	24.09	3.96 c	4.77 c	8.69 c	45.79 b
BRRI dhan39	21.24	4.22 b	5.31 b	9.51 bc	43.97 bc
BRRI dhan49	19.82	4.04 bc	5.62 a	9.74 b	41.56 c
BRRI dhan56	21.63	4.04 bc	4.82 c	8.84 c	45.65 b
BRRI dhan57	19.54	3.27 d	3.96 d	7.20 d	44.97 bc
BRRI hybrid 4	23.34	4.19 b	5.31 b	9.57 bc	44.52 c
Binadhan-7	20.42	4.90 a	5.58 a	10.44 a	47.10 a
$S\bar{x}$	0.41	0.17	0.19	0.15	0.82
CV %	3.42	7.47	11.41	8.35	5.53
LS	NS	**	**	**	**

Table 5. Interaction effect of transplanting date and variety on different plant characters of short duration *aman* rice

Interactions: Date of transplanting x Variety	Plant height (cm)	No. of tillers m^{-2}	No. of effective tillers m^{-2}	No. of non - effective tillers m^{-2}	Panicle length (cm)	No of filled grains panicle^{-1}	No. of sterile spikelets panicle^{-1}	Days to panicle initiation	Days to flowering	Days to maturity
D_1V_1	115.2 def	200.5 gh	186.0 hij	14.50 c-g	25.80	149.8 a	16.30 bc	44 de	61 de	95 g
D_1V_2	122.4 bcd	217.5 fg	180.5 ij	10.00 d-g	26.20	86.70 def	14.90 c	48 b	65 c	102 d
D_1V_3	113.6 def	287.5 bc	274.5 b-e	13.00 c-g	23.00	121.4 bc	17.20 bc	60 a	83 a	124 a
D_1V_4	138.6 a	253.0 c-f	247.0 d-g	6.00 g	24.75	96.60 c-f	21.60 b	45 cd	61 de	95 g
D_1V_5	108.4 ee	344.0 a	339.0 abc	5.00 g	24.10	128.5 ab	19.30 bc	43 e	57 gh	88 k
D_1V_6	120.2 cde	275.5 cd	254.5 d-g	16.00 c-g	26.60	87.20 def	14.30 c	45 cd	62 d	95 g
D_1V_7	108.2 ee	360.0 a	350.0 a	10.00 d-g	24.60	100.1 b-f	14.30 c	48 b	66 c	102 d
D_2V_1	123.0 bcd	237.5 d-g	216.0 f-i	21.50 bc	26.30	101.4 b-f	16.90 bc	48 b	59 efg	96 f
D_2V_2	120.4 cde	246.0 c-g	234.5 d-h	11.50 c-g	25.0	110.8 b-e	17.60 bc	49 b	66 c	102 d
D_2V_3	122.0 bcd	276.0 cd	248.0 d-g	8.00 fg	23.85	125.21 abc	21.40 b	59 a	78 b	120 b
D_2V_4	133.4 ab	231.0 d-g	224.5 e-h	6.50 g	25.50	113.8 bcd	18.30 bc	44 de	59 efg	94 b
D_2V_5	108.0 ee	287.5 bc	280.0 ab	7.50 fg	25.10	81.90 ef	15.80 c	41 f	56 c	88 k
D_2V_6	119.6 cde	236.0 d-g	218.0 hij	18.00 b-e	26.30	87.30 def	15.80 c	44 de	60 b	95 g
D_2V_7	111.2 def	346.5 a	335.0 a	8.50 efg	24.30	104.0 b-f	14.70 c	48 b	66 c	102 d
D_3V_1	118.6 cde	205.5 fgh	194.5 hij	11.00 c-g	24.80	105 b-f	29.20 a	43 e	58 fgh	93 i
D_3V_2	133.8 ab	276.0 cd	239.0 c-f	37.00 a	24.00	104.0 b-f	15.70 c	46 c	61 de	102 d
D_3V_3	121.6 bcd	270.5 cde	262.5 c-f	28.00 ab	23.30	112.6 bcd	15.40 c	60 a	79 b	117 c
D_3V_4	128.0 abc	224.0 efg	218.0 f-i	6.00 g	24.30	106.0 b-f	17.60 bc	43 e	58 fgh	92 j
D_3V_5	105.0 f	161.0 h	156.0 j	5.00 g	24.10	77.70 f	14.40 c	40 f	53 i	87 l
D_3V_6	118.8 cde	222.5 efg	206.5 ghi	21.00 bcd	23.40	86.70 def	31.70 a	43 e	57 gh	93 i
D_3V_7	107.8 ee	324.5 ab	316.0 ab	11.50 c-g	25.10	104.7 b-f	14.70 c	48 b	66 c	101 e
$S\bar{x}$	3.747	14.93	15.36	3.307	0.5115	8.656	1.637	0.3564	0.7727	0.162
LSD	10.75	42.81	15.88	9.486	5.467	24.83	4.695	1.022	2.216	0.4654
LS	**	**	**	**	NS	**	**	**	**	**

In a column, figures with the same letters do not differ significantly as per DMRT
** = Significant at 1% level of probability,
NS = statistically not significant
Here, D= date of transplanting; D_1=26 July, D_2=5 August and D_3=15 August;
V= variety; V_1= BRRI dhan33, V_2= BRRI dhan39, V_3= BRRI dhan49, V_4= BRRI dhan56, V5= BRRI dhan57, V6= BRRI Hybrid dhan4 and V_7= Binadhan-7

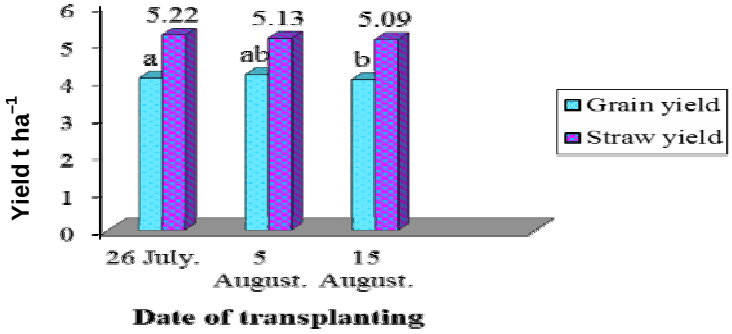

Fig. 1. Yield (t ha^{-1}) of T. aman rice at different dates of transplanting

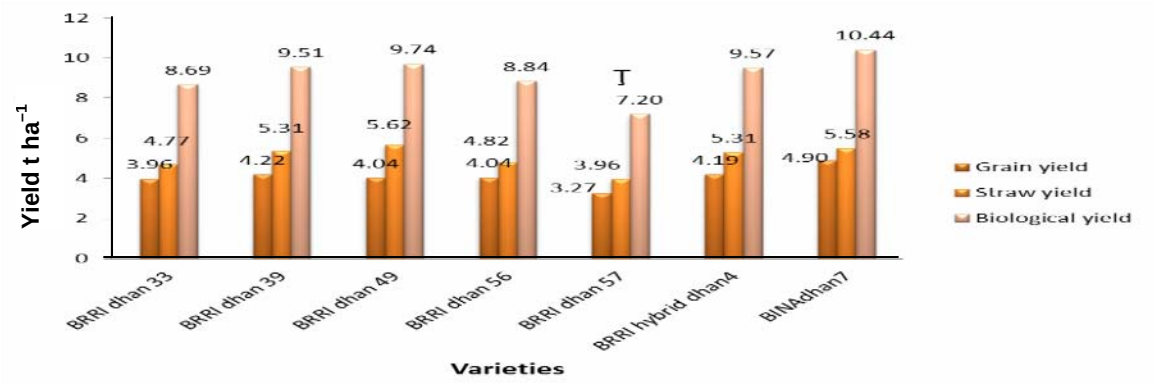

Fig. 2. Yield (t ha^{-1}) of some short duration T. aman rice varieties

The highest straw yield (5.67t ha^{-1}) is produced by BRRIdhan49 (Fig. 2) which statistically similar to Binadhan-7. The lowest (3.96 t ha^{-1}) straw yield was produced by BRRI dhan57.The highest straw yield (5.22 t ha^{-1}) was obtained for 26 July transplanting. The lowest straw yield (5.09 t ha^{-1}) was obtained from 15 August. The lowest (3.39 t ha^{-1}) straw yield was found with BRRI dhan57 for transplanting on 15 August (Table 6).

Highest biological yield (10.40 t ha^{-1}) was obtained from Binadhan-7 and the lowest one (7.20 t ha^{-1}) was produced from BRRI dhan57 (Table 4). The highest biological yield (9.97 t ha^{-1}) was produced from 26 July transplanting .The lowest biological yield (9.12 t ha^{-1}) was produced from 15 August which was statistically similar with 5 August transplanting (Table 3). The highest biological yield (10.83 t ha^{-1}) was produced by Binadhan-7 for 26 July transplanting. The lowest biological yield (6.47 t ha^{-1}) was produced by the transplanting on 15 August of the variety BRRI dhan57 (Table 6).

Highest harvest index (47.10 %) was produced by Binadhan-7. Highest harvest index (44.45%) obtained from 26 July transplanting and the lowest harvest index (44.13%) from 15 August transplanting (Table 3). The highest harvest index (48.91%) was observed in Binadhan-7 with 26 July transplanting (Table 6). Binadhan-7 shown highest Harvest index among other varieties in different planting date respectively. Planting in 26 July has shown highest harvest index for all the varieties. Binadhan-7 has given highest grain yield and 26 July is the most suitable transplanting date in terms of producing grain yield. So the harvest index of Binadhan-7 on 26 July transplanting was highest and it was the most suitable combination among all other experimental treatments.

Date of transplanting significantly affect the duration of different phenological stages of aman rice. Days to panicle initiation (41.66 DAT), days to flowering (56.77 DAT) were shortest in BRRI dhan57 and it matured at 88 DAT (shortest field duration was observed) while days to panicle initiation (60.77 DAT), days to flowering (79.88 DAT) were longest in BRRI dhan49 and matured at highest 120 DAT (Table 1).

Binadhan-7 requires 102 DAT to mature and it was the most suitable variety showing highest yield. 15 August transplanting gives the shortest field duration and lowest yield because during the month of September temperature was 23.15°C which might have been forced the plant to mature early. Again, 26 July transplanting date showed the long duration of maturity (100days). 26 July is the most optimum date of transplanting as is produced highest yield. Binadhan-7 is the best short duration variety and 26 July is the optimum date of transplanting in *aman* season.

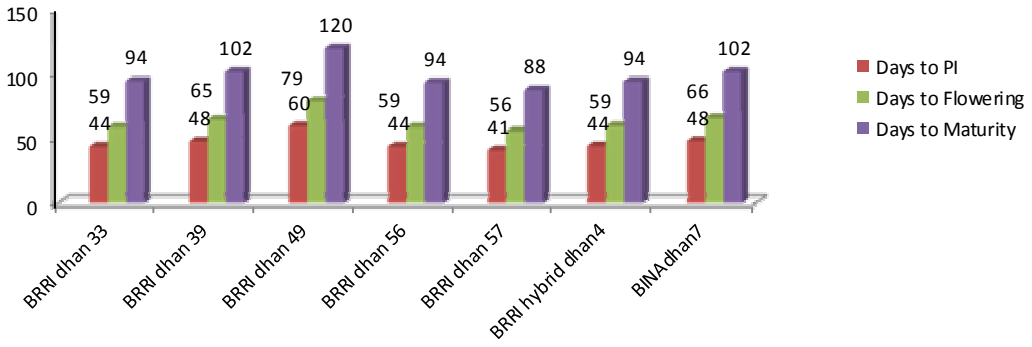

Fig. 3. Field durations of phenological stages of some T. *aman* rice varieties

Conclusion

Based on the results of the present study the following conclusions may be drawn by Binadhan-7 transplanted on 26 July has given the best result for grain yield. Optimum transplanting date for grain yield of short duration *aman* rice was 26 July. Higher grain yield was obtained from early than late transplanting. Yield decreased on 5 August transplanting and for 15 August transplanting yield of all the varieties was lowest.

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