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Growth and yield of transplanted Aman rice cv. Binadhan-16 as influenced by seedling age and nitrogen fertilization at staggered transplanting

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ABSTRACT

An experiment was conducted at the Agronomy Field Laboratory of Bangladesh Agricultural University to find out the effect of age of seedlings and level of nitrogen on growth and yield of transplant Aman rice cv. Binadhan-16. T. Aman rice seedlings of four different ages (15, 20, 25 and 30-day old) were examined with four levels of nitrogen (0, 50, 70 and 90 kg N ha^{-1}). The experiment was laid out in a randomized complete block design (RCBD) with three replications. The results revealed that the effect of age of seedlings and level of nitrogen and their interaction was significant on growth, yield and yield contributing characters of transplant Aman rice. The highest plant height and total dry matter production hill^{-1} were recorded in the plots of 15-day old seedlings with 70 kg N ha^{-1}. Grain yield gradually increased with the use of relatively younger seedlings and with 15-day old seedlings produced the highest number of effective tillers hill^{-1} (8.583) and grains panicle^{-1} (122.7) as well as the highest grain yield (4.265 t ha^{-1}) and straw yield (5.392 t ha^{-1}). In case of level of nitrogen, 70 kg N ha^{-1} produced the highest grains panicle^{-1} (114.1), grain yield (4.539 t ha^{-1}) and straw yield (5.623 t ha^{-1}). Interaction effect showed that, 15-day old seedlings with 70 kg N ha^{-1} produced the highest number of effective tillers hill^{-1} (9.71), grain yield (5.17 t ha^{-1}) and straw yield (6.20 t ha^{-1}). Therefore, 15-day old seedlings with 70 kg N ha^{-1} appeared as the promising technique to obtain the highest grain yield.

Keywords: Seedling age, nitrogen level, growth, yield, transplant aman rice

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1 Introduction

Rice is the most important crop of the world and staple food of more than three billion people of the world's population. Bangladesh is an agricultural country and its agriculture is predominantly rice based. Rice is the staple food crop of the people of Bangladesh where it is extensively grown in three rice growing seasons of the year. About 75% of required calories and 55% of protein are met from rice in the average daily diet of the people (Chowdhury and Hassan, 2013). About 75.61% of total cropped area of Bangladesh is used for rice production, with annual production of 33.80 million tons from 11.01 million hectares of land (BBS, 2017). In Bangladesh, there are three distinct growing seasons of rice according to change in seasonal conditions such as Aus, Aman and Boro which account for approximately

7%, 38% and 55% of total annual rice production, respectively (BBS, 2017). Among them total Aman rice covers 55, 90,340 hectares of land with a production of 1,34,83437 metric tons (BBS, 2017). The area of the country is reducing day by day due to heavy population pressure, urbanization and sacrifice of land for other crops. That is why, farmers and agricultural scientists are diverting their attention to increase the yield through the use of modern production technologies, such as planting methods, use of quality seeds, high yielding and modern varieties, optimum age of seedling, spacing, adopting plant protection measures and seedling raising techniques.

Seedling age is an important factor due to its tremendous influence on plant height, tiller production, panicle length, grains panicle^{-1} and other yield contributing characters (Sultan et al., 2018). Generally the farmers of Bangladesh do not give proper attention to the age of seedlings at transplanting and often they use aged seedlings. If the age of seedlings is more than optimum, the seedlings produce fewer tillers due to reduced vegetative period thereby resulting in poor yield. The yield of transplant Aman rice can be increased with the improved cultivation practices like proper age of seedlings and proper nitrogen level. Optimum age of seedlings supports the plants to uptake more nutrients from the soil. So, the optimum age of seedlings can play a significant role on the growth and yield of transplant Aman rice which need to be studied. BRRI (2002) observed that number of days to 50% flowering increased with the advancement of seedling age. Nitrogen is an essential plant nutrient that plays a significant role in growth, yield and quality of rice. The important role of nitrogen fertilizers in increasing rice yields has been widely recognized, particularly after the development of modern varieties.

Nitrogen is an integral part of protoplasm, protein and chlorophyll and plays a remarkable role in increasing cell size which in turn increases yield. The farmers usually do not apply nitrogen in their fields properly and timely. Excess amount of nitrogenous fertilizer results in lodging of plants, prolonging growing period, delaying in maturity, susceptibility to insect pests and diseases and ultimately reduces yield (Uddin, 2003). Again, nitrogen plays a vital role in increasing protein in the grains, increases tillering, vegetative growth, grain and straw yields. Efficient fertilizer management gave higher yield of crop and fertilizer cost (Hossain and Islam, 2006). Plant growth is seriously hampered when lower dose of nitrogen is applied which drastically reduces the yield.

Bangladesh Institute of Nuclear Agriculture (BINA) has recently released Binadhan-16 as a high yielding and short duration variety for T. Aman season. No remarkable research work is conducted on it. So clarification is required in case of its agronomic requirements and investigations are also needed to determine the optimum age of seedling and level of nitrogen for this particular cultivar in order to optimize the yield.

2 Materials and Methods

2.1 Experimental site and design

The experiment was conducted at the Agronomy Field Laboratory of Bangladesh Agricultural University during the period from July to December, 2016. The site is located at 24°43′8.3″N, 90°25′41.2″E, in the South-West part of Old Brahmaputra river at an altitude of 18 m. The site belongs to non-calcareous dark grey floodplain soil under Old Brahmaputra Floodplain 'AEZ-9'(UNDP/FAO, 1988). The climate of the area is sub-tropical, which is characterized by low temperature and scanty rainfall during Rabi season (October to March) and high temperature with heavy rainfall during Kharif season (April to September). The experimental field was a medium high land with well drained clay loam textured soil having a pH value 6.8. During the experimental period the maximum, minimum and average temperature ranges between 27.5 °C and 33.2 °C, 14.4 °C and 26.8 °C and 21.2 °C and 30.0 °C, respectively. While the average relative humidity, total sunshine and total rainfall ranged from 81–87%, 101.8–204.8 h month^{-1} and 0.0–522.7 mm, respectively. The experiment comprised four ages of seedlings *viz.* 15, 20, 25 and 30 days and four levels of nitrogen *viz.* 0, 50, 70 and 90 kg N ha^{-1}. The experiment was laid out in a randomized complete block design (RCBD) with three replications. The unit plot size was 4.0 m × 2.5 m. The distances maintained between blocks and plots were 1.0 m and 0.5 m, respectively.

2.2 Land preparation

The experimental field was ploughed with the help of a tractor 10 days before transplanting. It was then ploughed well with the help of country plough to make the soil ready for transplanting. Weeds and stubbles were removed and the field was then leveled by laddering. The experimental field was then divided into unit plots which were spaded one day before transplanting.. The land was fertilized as per treatment specification. The experimental plots were fertilized with nitrogen in the form of urea @ 0, 50, 70 and 90 kg ha^{-1} as per experimental treatments. Urea was top dressed in three equal splits at 15, 30 and 45 days after transplanting (DAT). In addition, triple super phosphate, muriate of potash, gypsum and zinc sulphate were applied @ 1.44, 0.96, 0.72 and 0.06 kg ha^{-1}, respectively in all plots during final land preparation.

2.3 Crop husbandry

The seedlings were transplanted on the well puddled experimental plots on 2 August, 7 August, 12 August and 17 August 2016 as per specified ages of seedlings. Three seedlings were transplanted in each hill with a spacing of 25 cm × 15 cm. Three times manual weeding were done at 15, 30 and 45 DAT. When 90% of the grains became yellow in clour, the crop was assessed to attain maturity for harvesting. Five hills (excluding the border hills and central 1 m^2 area) were selected randomly from each unit plot and uprooted before harvesting for recording data on yield components. Transplanting of 15-day old seedlings matured earlier and harvested on 2 November 2016. Transplanted as 20-day old, 25-day old and 30-day old seedlings matured later and harvested on 7 November, 12 November and 17 November 2016, respectively. Central 1 m^2 area of each plot was harvested for recording data on yield. Then the harvested crops of each plot was bundled separately, properly tagged and brought to threshing floor. The crops were then threshed and the fresh weights of grain and straw were recorded plot-wise. The grains were cleaned and finally the weight was adjusted to a moisture content of 14%. Straws were sun dried to record the straw yield per square meter. Grain and straw yields were then converted to t ha^{-1}.

2.4 Statistical analysis

The recorded data were compiled and tabulated in proper form for statistical analyses. The collected data were statistically analyzed using "Analysis of variance" technique with the help of computer program, MSTAT-C. The significance of mean differences among the treatments was adjudged by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

3 Results and Discussion

3.1 Effect of seedling age on growth

Plant height, number of tillers $hill^{-1}$ and total dry matter $hill^{-1}$ (TDM) were significantly influenced by the age of seedlings (Table 1). Plant height gradually increased in course of time and reached maximum at final sampling date. At 60 DAT, the tallest plant (94.47 cm) was obtained when 25-day old seedlings were transplanted while the shortest one (35.90 cm) was obtained in 15-day old seedlings. The increase in plant height might be due to better growth and vigour of 25-day old seedlings after transplanting. Plant height gradually increased in all DATs. Similar results were also reported by Saha et al. (2017) and Kumar (2001) who found that transplanting of 30-day old seedlings attained significantly higher plant height as compared to 20 and 25-day old seedlings. On the other hand, the highest number of tillers $hill^{-1}$ (9.67) and total dry matter (3.10) were recorded in 15-day old seedlings while the corresponding lowest values were recorded from 30-day old seedlings (Table 1). The lowest tiller production in older seedlings might be due to old age of seedling which discouraged the early growth of tillers due to recovery shocking of the seedlings. The number of tillers $hill^{-1}$ significantly influenced by age of seedling and maximum tillering occurred at 45 DAT. The maximum number of tillers $hill^{-1}$ at 45 DAT was due to the favourable and juvenile condition of rice plant to produce more tilers. After 45 DAT the number of tillers decreased and the trend continued up to harvest. This trend was due to tiller mortality of side tillers. In a previous experiment the maximum number of tillers was reported at 50 DAT and then the trend declined (Hasanuzzaman et al., 2009). The highest total dry matter at younger seedlings might be due to more number of tillers that accumulated more dry matter. Similar results were also reported by Liu et al. (2017) who reported higher dry matter production by younger seedlings.

3.2 Effect of N fertilization on growth

Plant height, number of tillers $hill^{-1}$ and total dry matter $hill^{-1}$ (TDM) were significantly influenced by different levels of nitrogen (Table 1). All growth parameters were gradually increased in course of time and reached maximum at final sampling date. At 45 DAT, the plant height was significantly influenced by nitrogen level. The highest value was obtained from treatment N2 (70 kg N ha^{-1}) while the lowest value was recorded at treatment N0 (0 kg N ha^{-1}) (Table 1). This might be due to increase in cell division and enlargement at higher nitrogen level. In a similar study, Ethan et al. (2011) observed that there were significant increases in plant height with increasing levels of nitrogen when compared with control. The number of tillers $hill^{-1}$ increased with increase in level of nitrogen and reached maximum at 45 DAT. The highest value was obtained at 70 kg N ha^{-1} and the lowest value was obtained at 0 kg N ha^{-1}. The highest value of plant height and number of tiller might be due to application of higher dose of nitrogen, which supplies adequate nitrogen in initial growth for its luxurious growth and more tillering. The usefulness of increased nitrogen on growth attributes like plant height, number of tillers per hill and dry matter production was also reported by Amrutha et al. (2016). Total dry matter production was significantly influenced by the level of nitrogen. The highest total dry matter production was obtained at 70 kg N ha^{-1} and the lowest value was obtained at 0 kg N ha^{-1}. This might be due to higher number of tiller production at higher doses of nitrogen which led to increased dry matter production. In an earlier research it was

Table 1. Effect of seedlings age on growth and dry matter production at different days after transplanting

	Plant height (cm)				Number of tillers hill^{-1}				Total dry matter hill^{-1} (TDM)			
	15 DAT	30 DAT	45 DAT	60 DAT	15 DAT	30 DAT	45 DAT	60 DAT	15 DAT	30 DAT	45 DAT	60 DAT
Seedling age (d)												
15 (A1)	35.90 c	62.15 b	83.10 c	92.97 a	6.32 a	9.11 a	9.67 a	9.38 a	0.67 a	1.29 a	2.16 a	3.10 a
20 (A2)	39.00 b	60.58 b	83.92 bc	92.95 a	5.78 b	8.83 b	9.33 a	8.89 b	0.63 ab	1.18 b	2.04 b	2.92 b
25 (A3)	39.07 b	70.08 a	88.25 a	94.47 a	5.53 b	8.33 c	8.62 b	8.28 c	0.60 b	1.01 c	1.93 c	2.86 c
30 (A4)	42.78 a	70.85 a	85.63 b	90.77 b	5.39 b	7.58 d	8.17 c	7.99 d	0.49 c	0.93d	1.76 d	2.69 d
Sig. level	**	**	**	**	**	**	**	**	**	**	**	**
CV (%)	4.42	3.27	2.46	2.16	12.02	3.18	4.6	2.58	9.18	6.92	5.19	2.27
N fertilization (kg ha^{-1})												
0 (N0)	38.92	65.48	83.57 c	92.08	5.38 b	7.77 d	7.97 d	7.69 d	0.50 c	0.95 d	1.66 d	2.44 d
50 (N1)	39.33	66.42	85.48 b	94	5.80 ab	8.77 b	9.35 b	8.89 b	0.64 a	1.16 b	2.06 b	3.08 b
70 (N2)	39.03	66.39	87.45 a	92.48	6.20 a	9.10 a	9.80 a	9.62 a	0.67 a	1.26 a	2.25 a	3.24 a
90 (N3)	39.47	65.39	84.40 bc	92.58	5.57 b	8.21 c	8.67 c	8.33 c	0. 57 b	1.04 c	1.92 c	2.83 c
Sig. level	NS	NS	**	NS	*	**	**	**	**	**	**	**
CV (%)	4.42	3.27	2.46	2.16s	12.02	3.18	4.6	2.58	9.18	6.92	5.19	2.27
Interaction (A × N)												
A1 × N0	36.07	63.47 bc	82.47 def	93.27abcd	5.86	8.13e	8.53	8.27ef	0.59	1.13bc	1.85	2.73hi
A1 × N1	35.6	64.13 b	84.00cde	96.60 a	6.4	9.47ab	10.2	9.83b	0.72	1.39a	2.26	3.23bc
A1 × N2	35.8	61.40 bc	85.07 cd	91.07 cd	6.73	9.87a	10.6	10.30a	0.74	1.50a	2.48	3.48a
A1 × N3	36.13	59.60 cd	80.87 ef	90.93 cd	6.26	8.97cd	9.26	9.10c	0.62	1.15bc	2.03	2.96ef
A2 × N0	38	56.93 d	79.33 f	89.40d	5.26	8.00ef	8.27	7.80g	0.56	0.95e	1.7	2.39j
A2 × N1	39.2	62.13 bc	83.80cde	93.27abcd	5.93	9.40abc	9.87	9.33c	0.67	1.24b	2.16	3.12cd
A2 × N2	38.33	62.47bc	87.13bc	96.00a	6.2	9.73a	10.4	10.20ab	0.69	1.41a	2.35	3.33b
A2 × N3	40.47	60.80bc	85.40cd	93.13abcd	5.46	8.20e	8.73	8.20efg	0.6	1.10bcd	1.93	2.85fg
A3 × N0	39.67	70.60a	86.40bcd	95.07ab	5.26	7.50g	7.6	7.37h	0.48	0.91ef	1.7	2.35jk
A3 × N1	40.2	71.07a	89.80ab	95.73abs	5.53	8.67d	8.8	8.40de	0.67	1.04cde	1.95	3.09d
A3 × N2	38.53	69.20a	91.73a	92.87abcd	6.06	9.00bcd	9.47	9.27c	0.69	1.11bc	2.2	3.18cd
A3 × N3	37.87	69.47a	85.07cd	94.20abc	5.26	8.13e	8.6	8.07efg	0.57	0.96de	1.88	2.83gh
A4 × N0	41.93	70.93a	86.07bcd	90.60cd	5.13	7.43g	7.47	7.33h	0.38	0.79f	1.38	2.27k
A4 × N1	42.33	68.33a	84.33cde	90.60cd	5.33	7.53fg	8.53	8.00efg	0.5	0.96de	1.86	2.86efg
A4 × N2	43.47	72.47a	85.87cd	90.00d	5.8	7.80efg	8.6	8.70d	0.59	1.01cde	1.97	2.97e
A4 × N3	36.07	71.67a	86.27bcd	92.07bcd	5.26	7.53fg	8.07	7.93fg	0.47	0.94e	1.84	2.69i
Sig. level	NS	**	**	**	NS	**	NS	**	NS	*	NS	**
CV (%)	4.42	3.27	2.46	2.16	12.02	3.18	4.6	2.58	9.18	6.92	5.19	2.27

In a column, figures with the same letter(s) or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT), ** = Significant at 1% level of probability; NS = Not significant

reported that dry matter production in rice was increased with the increase in nitrogen rates (Singh et al., 2006).

3.3 Interaction effect on growth

The interaction of age of seedlings and level of nitrogen exhibited significant influence on plant height, number of total tillers hill^{-1} and total dry matter at different sampling dates (Table 1). At 60 DAT, the highest plant height (96.60 cm), number of total tillers hill^{-1} (10.30) and total dry matter (3.48 g hill^{-1}) were recorded in the interaction of 15-day old seedlings with 70 kg N ha^{-1}. This might be due greater availability of nitrogen and effective uptake of nutrients by the younger seedlings at higher dose. On the other hand, the lowest values were obtained in 30-day old seedlings with 0 kg N ha^{-1} for those growth parameters (Table 1). Similar results were reported by Moro et al. (2016) who reported significant interaction between age of seedling and level of nitrogen in plant height, number of tillers and total dry matter production in rain-fed lowland rice.

3.4 Effect of seedling age on yield

Yield components and yield were significantly affected by the age of seedlings (Table 2). The highest plant height (102.5 cm), the highest number of total tillers hill^{-1} (9.10) and the highest number of effective tillers hill^{-1}(8.59) were found in 15-day old seedlings. Plant height is an imperative yield trait that is controlled by the genetic makeup of the plant, as well as growing conditions, seedling vigour, and nutrient status. The result of this experiment shows that plant height increased significantly by planting younger seedlings as compared to older ones. The highest plant height was recorded with younger seedlings (15-day). This might be due to higher phyllocrone production in younger seedlings before entering into reproductive stage as well as less transplanting shock at this stage (Sarwar et al., 2011). These results are supported by Mishra and Salokhe (2008) who found higher plant height from younger seedlings (12-day) as compared to older (30-day) ones. Number of total tillers hill^{-1} exhibited a trend of decrease with the increase in seedling age. Younger seedlings produced

Table 2. Effect of seedlings age on growth and dry matter production at different days after transplanting

	Plant height (cm)	Tot till. hill^{-1}	Eff. till. hill^{-1}	Panicle length (cm)	Grains panicle^{-1}	Ster. spikelet panicle^{-1}	TGW (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	HI (%)
Seedling age (d)										
15 (A1)	102.5a	9.10a	8.58a	22.20a	122.7a	7.93c	26.41a	4.27a	5.39a	44.06a
20 (A2)	96.10b	8.70b	8.11b	21.43b	110.9b	10.45b	25.40b	3.94b	5.03b	43.82a
25 (A3)	98.97b	8.17c	7.49c	21.51b	106.3b	11.06ab	24.63c	3.76c	4.89c	43.29ab
30 (A4)	96.45b	7.68d	6.90d	20.86c	99.82c	11.62a	24.20c	3.49d	4.69d	42.65b
Sig. level	**	**	**	**	**	**	**	**	**	**
CV (%)	3.97	3.2	3.01	3.15	5.06	10.12	3.42	3.03	2.14	5.65
N fertilization (kg ha^{-1})										
0 (N0)	98.75	7.58 d	6.87 d	21.25	107.0 b	11.31a	24.63 b	3.29 d	4.44 d	42.51 b
50 (N1)	98.7	8.61 b	8.02 b	21.7	109.9 ab	9.83 bc	25.36 ab	3.93 b	5.14 b	43.29 b
70 (N2)	98.78	9.47 a	8.89 a	21.55	114.1 a	9.34 c	25.60 a	4.54 a	5.62 a	44.60 a
90 (N3)	98.8	7.99 c	7.33 c	21.49	108.7 b	10.58 ab	25.05 ab	3.69 c	4.80 c	43.41 b
Sig. level	NS	**	**	NS	*	**	*	**	**	**
CV (%)	3.97	3.2	3.01	3.15	5.06	10.12	3.42	3.03	2.14	2.6
Interaction (A × N)										
A1 × N0	102.6	8.11de	7.50fg	21.69	117.87	8.73	25.6	3.59gh	4.75gh	43.06
A1 × N1	104.9	9.50b	9.00b	22.65	123.19	7.62	26.75	4.20c	5.38cd	43.79
A1 × N2	103.8	10.13a	9.71a	22.22	128.34	7.23	27	5.17a	6.20a	45.46
A1 × N3	98.8	8.66 c	8.11de	22.24	121.29	8.13	26.3	4.10cd	5.24de	43.9
A2 × N0	93.13	7.60fg	6.93hi	21.34	108.86	11.23	24.8	3.33ij	4.43i	42.91
A2 × N1	95.8	9.11 b	8.53c	21.54	111.06	9.91	25.7	4.06cde	5.20de	43.84
A2 × N2	98.47	10.08a	9.60a	21.42	113.23	9.78	25.9	4.62b	5.63b	45.07
A2 × N3	97	8.00ef	7.38fg	21.42	110.29	10.89	25.2	3.74fg	4.87gh	43.44
A3 × N0	99.8	7.33g	6.60ij	21.52	103.91	12.26	24.3	3.19jk	4.37ij	42.21
A3 × N1	100.6	8.28cde	7.66f	21.35	105.43	10.64	24.7	3.86ef	5.07ef	43.23
A3 × N2	96.73	9.15b	8.50cd	21.54	111.3	10.12	25	4.44b	5.45c	44.89
A3 × N3	98.73	7.90ef	7.20gh	21.62	104.53	11.21	24.5	3.52hi	4.70h	42.82
A4 × N0	97.2	7.26g	6.41j	20.44	97.5	13	23.8	3.03k	4.21j	41.87
A4 × N1	95.8	7.53fg	6.86hi	21.27	99.92	11.16	24.3	3.61gh	4.92fg	42.29
A4 × N2	96.13	8.50cd	7.73ef	21.03	103.33	10.21	24.5	3.92def	5.21de	42.95
A4 × N3	96.67	7.40f	6.61ij	20.68	98.52	12.11	24.2	3.40hi	4.42i	43.49
Sig. level	NS	**	**	NS	NS	NS	NS	**	**	NS
CV (%)	3.97	3.2	3.01	3.15	5.06	10.12	3.42	3.03	2.14	2.6

In a column, figures with the same letter(s) or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT), ** =Significant at 1% level of probability, NS = Not significant; TGW = 1000-grain weight, HI = harvest index

more tillers than the older ones which might be due to less root damage and minimum transplanting shock, as younger seedlings can more easily establish themselves after transplanting in the main field (Sarwar et al., 2011). Similar results were also reported by Haque (2002) and Sarwar et al. (2011) who recorded maximum number of tillers at 10-day old seedlings, compared to 20, 30 and 40-day old seedlings. The longest panicle (22.20cm), grains panicle^{-1} (122.7), 1000-grain weight (26.41), grain yield (4.27 t ha–1) and straw yield (5.39 t ha^{-1}) were obtained from 15-day old seedlings. Similar trend was reported by Luna et al. (2017). Number of grains panicle^{-1} exhibited a trend of decrease with the increase in age of seedlings. This finding is inconformity with that of Razzaque et al. (2000). Younger seedlings produced more grains panicle^{-1} than the older ones due to longer vegetative period when spikelets were formed in the panicle before emergence of the panicles. The highest grain yield was found after transplanting seedlings as young as 15-day compared to yields with 20, 25 and 30-day old seedlings, which might be due to the increase in yield contributing characters at this stage. Grain yield was constantly reduced with older seedlings, which is associated with lower yield attributes. These findings confirm some earlier studies on younger seedlings (Horie et al., 2005; Mishra and Salokhe, 2008). All crop characters, yield components and grain and straw yields showed the lowest values in 30-day old seedlings because of their long stay in the nursery bed, which resulted in basal node formation in the seedlings. So, the seedlings which stayed more time to get established in the main field subsequently reduced the number of effective tillers hill^{-1} compared to younger seedlings.

3.5 Effect of N fertilization on yield

The highest plant height number of total tillers hill^{-1}(9.47),number of effective tillers hill^{-1}(8.89), number of grains panicle^{-1}(114.1), 1000-grain weight(25.60), grain yield (4.54) and straw yield (5.62) were recorded from 70 kg N ha^{-1} (Table 2). The number of sterile spikelets panicle^{-1} was lowest at 70 kg N ha^{-1}. On the other hand, the lowest values were recorded at 0 kg N ha^{-1} for the corresponding growth parameters (Table 2). It was revealed from the result that plant height increased with levels of nitrogen and reached the highest at 70 kg N ha^{-1}. This was probably due to higher uptake of applied nitrogen and greater availability of soil nutrients. The result is supported by the findings of Saha et al. (2017) who reported that plant height increased with increase in levels of nitrogen and recorded the highest plant height at 90 kg N ha^{-1}. The number of total and effective tillers varied significantly and increased with increase in level of nitrogen. This may be due to greater availability and higher uptake of nitrogen which creates a nitrogen flow towards growing tillers that led to increased number of tillers. In earlier findings, Rahman et al. (2007) also reported that umber of tillers in rice increased significantly with increase in nitrogen rates. The increase in grain yield could be because nitrogen supply increases leaf area index (Salem, 2006), leaf chlorophyll content (Salem et al., 2011) and nutrient uptake (Hussaini et al., 2008).

3.6 Interaction effect on yield

Yield components and yield were significantly influenced by the interaction between seedlings age and level of nitrogen except plant height, panicle length, number of grains panicle^{-1}, number of sterile spikelets panicle^{-1} and 1000-grain weight (Table 2). The highest number of total tillers hill^{-1}(10.13) and number of effective tillers hill^{-1}(9.71) were found in 15-day old seedling with 70 kg N ha^{-1}. Besides, the highest values of grain yield (5.17t ha^{-1}) and straw yield (6.20 t ha^{-1}) were observed in interaction of 15-day old seedlings with 70 kg N ha^{-1}. The highest grain yield at 15-day old seedling with 70 kg N ha^{-1} might be due to greater nutrient availability and nutrient uptake by the younger seedlings which led to increased plant height, more number of tillers hill^{-1}, total dry weight, and number of effective tillers hill^{-1}. A similar observation was also reported by Patel et al. (2010) who found higher grain yield of rice with increase in nitrogen level at younger seedlings of rice. On the other hand, the lowest values were recorded in 30-day old seedlings with 0 kg N ha^{-1} for those parameters (Table 2).

4 Conclusions

From the experiment, it can be concluded that, growth and yield of transplant Aman rice cv. Binadahn-16 are significantly affected by the age of seedling and the level of nitrogen. Among the ages of seedlings and levels of nitrogen used, 15-day old seedlings with 70 kg N ha^{-1} appeared as the promising technique to obtain the highest grain yield. The research findings may be helpful to cultivate transplant Aman rice cv. Binadahn-16 with suitable age of seedling and proper nitrogen fertilizer levels.

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Conflict of Interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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