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EFFECTS OF AGE OF SEEDLING AND NITROGEN RATES IN THE NURSERY BED ON GROWTH, YIELD AND YIELD COMPONENTS OF BRRI dhan52 UNDER SUBMERGED CONDITION

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ABSTRACT

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during July to December 2013 in the aman season to investigate the effect of age of seedling and nitrogen rates in the nursery bed on growth, yield and yield components of BRRI dhan52. The experiment comprised of three ages of seedlings viz., 30, 35 and 40 day old and four nitrogen rate N_1-N@50 kg ha^{-1}, N_2-N@75 kg ha^{-1}, N_3-N@100 kg ha^{-1}, N_4-N@125 kg ha^{-1}. The experiment was laid out in a split plot design with three replications. Age of seedling showed significant differences for shoot weight, survivor, no. grains panicle^{-1}, panicle length, grain yield and straw yield. The highest root weight (0.072 gm^{-2}), plant height (108 cm), total tillers hill^{-1} (8.22), effective tillers hill^{-1} (7.03), non-effective tillers hill^{-1} (1.19), survivor (95.1%), grains panicle^{-1} (106.2), grain yield (5.57 t ha^{-1}), straw yield (6.26 t ha$^{-1)}$ and harvest index (0.47%) were found by transplanting 40 day old seedlings. The highest shoot weight (0.53 gm^{-2}), 1000 grain wt. (25.3g) was found by transplanting 35 day old seedlings and 30 day old seedlings produced highest sterile spikelets (28.9) and panicle length (23.8 cm). Nitrogen rate in the nursery showed significant differences for shoot weight, root weight, survivor, plant height, total tillers hill^{-1}, effective tillers hill^{-1}, non-effective tillers hill^{-1}, panicle length, grains panicle^{-1}, grain yield and straw yield. Application of 50 kg N ha^{-1} gave higher plant height (108 cm) and harvest index (0.47%). On the other hand, application of 75 kg N ha^{-1} produced highest non–effective tillers hill^{-1} (1.0), grains panicle^{-1} (100.7), 1000 grain weight (25.3 g) and harvest index (0.47%). Application of 100 kg N ha^{-1} gave highest total tillers hill^{-1} (7.85), effective tillers hill^{-1} (6.85), non–effective tillers hill^{-1} (1.0), survivor (90.5%) and grain yield (5.01 t ha^{-1}). Application of 125 kg N ha^{-1} gave highest panicle length (23.75 cm), grains panicle^{-1} (100.7), non–effective tillers hill^{-1} (1.0) and sterile spikelets (30.1). Forty day old seedlings grown with 100 kg N ha^{-1} at nursery found to be better in respect of grain yield. The result of the experiment also showed that aged seedlings regenerated quickly after desubmerge of water.

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INTRODUCTION

Submergence is one of the major constraints in rice production in Bangladesh. More than half of the total rice area is considered to be submergence-prone during the kharif season. The proportion of submergence prone area is higher (55%) in Bangladesh than in India (17%) and Nepal (9%) (UNDP and FAO, 1988). Rice is a unique crop due to its adaptability to different flooding conditions. Cultivation of submergence tolerant rice variety is helpful to mitigate damage due to submergence. Rice is grown in Bangladesh mainly in three distinct seasons namely, *aus, aman* and *boro*. Crop damage due to early or late flood is very common feature in Bangladesh. Rice is grown in 11.35 million hectares of land in Bangladesh which covers 77.07 % of the total cultivable area (BBS, 2011). Among the three rice crops, transplant *aman* rice covers the largest area of 5.65 million hectares with a production of 12.79 million tons of rice (BBS, 2011). Nursery is the integral part of the transplanted rice which contributes directly in the performance of rice in main field. Nursery can be managed by using proper seed rate and fertilizer in order to get the healthier seedlings for transplanting. Padalia (1980) and Lal and Roy (1996) explained that the success of transplanted rice cultivation depends upon the seedling. Among the different components of nursery management adequate nutrition and transplanting seedlings at the appropriate age represent important factors to obtain vigorous stands after transplanting (Lal and Roy, 1996). Above and below-ground characteristics of rice plants, before and after transplanting, vary with seedling age (Himeda, 1994) and seedling rates (Sasaki, 2004). The seedling length, dry weight, root number, root length and seedling growth increased significantly by increasing the fertility level in the nursery (Raju *et al*., 2001).

The International Rice Research Institute (IRRI) has made considerable progress in developing a Marker Assisted Backcrossing (MABC) system for the major QTL SUBMERGENCE1 (*SUB*1), associated with submergence tolerance in rice. Through MABC, a number of new varieties have been developed by the introgression of the *SUB*1*A* gene into mega rice varieties and these new varieties can ensure rice production in flood-prone areas because of their tolerance to complete submergence (Ismail *et al.,* 2013, Mackill *et al.,* 2012 and Septiningsih *et al.,* 2013). The availability of tolerant varieties provides more opportunities for developing and validating proper management options effective in flood-prone areas, which could further boost and stabilize the productivity of these varieties (Ella *et al.,* 2006; Ella *et al.,* 2011 and Ram *et al.,* 2009). Using healthy and vigorous seedlings resulted due to sufficient nitrogenous fertilizers in the nursery produced more productive tillers and a higher grain yield, partly by better stress tolerance and decreased seedling mortality after transplanting (Raghavaiah *et al;* 1989). Application of N and P in the rice nursery produced 50% and 100% more dry matter, respectively, compared with the control treatment (Ros *et al.,* 1997). In the case of poor soil fertility or during the dry season when initial growth is slower, top dressing of nitrogen at the rate of 10 g of urea m^{-2} about two weeks after sowing increases seedling vigor (Wopereis *et al.,* 2009). Panda *et al*. (1991) and Tekrony and Egli (1991) reported higher productive tillers and yield per unit area after transplanting healthy and vigorous seedlings grown with application of adequate nitrogen at nursery bed which might be due to the decrease in mortality rate after transplanting in main field.

In transplanted rice, seedling age is an important factor for better crop yield which varied among growers. Seedling rate and age play a pivotal role in rice plant performance before and after transplanting (Himeda, 1994 and Sasaki, 2004). Most of the rice growers transplant nursery seedling after 25 to 50 days of sowing (De Datta, 1981; Wagh *et al*., 1988; Singh and Singh, 1999). However, the age of seedlings at transplanting is important because it is one of the determining factors for the number of tillers produced per hill. It has a direct effect on plant height, effective tiller number, length of panicles, grains per panicle and other yield contributing characters. The use of 30 and 60 days old seedlings did not affect yield, and using 45 day old seedlings was proved to be better than those aged 30, 60 and 75 days (Chandra *et al.,* 1988 and Khatun *et al.,* 2002). Reddy and Reddy (1992) reported that among different seedling ages (30, 45, 60 days), 30 days older seedlings exhibited better grain yield. BRRI has recommended seedling age of rice transplantation based on growing season, such as 20-30 days for the *Aus* season, 20-35 days for the T. *aman* season and 40-45 days for the *Boro* season (BRRI 1992). Tillering dynamics of the rice plant greatly depends on the age of seedling at transplanting and it was observed that 40 day old seedlings gave higher number of panicles m^{-2} than 20 or 60 day old seedlings (Rashid *et al.,* 1990).

Generally low topography of the country with major rivers draining through Bangladesh including a congested river network system occurs submergence condition in the country and 80% of Bangladesh is floodplain and makes it susceptible to flooding. Damage from submergence is most likely when the rice plant is small, and the damage seems higher if the plant nutrition is unbalanced. Therefore, improving seedling health in nursery through balanced nutrient management may lead to better crop establishment (Sakar *et al.,* 2006). Testing of different fertilizer/nutrient rate combinations in the seedbed is proposed to be performed better under submergence conditions.

The study was, therefore, undertaken with one recently developed submergence tolerant variety BRRI dhan52 with the following objectives:

- To find out the best age of seedlings for transplanting in submergence prone area.
- To see the performance of different levels of nitrogen in raising seedlings in nursery and this effects in the main field after desubmergence of flood water.

MATERIALS AND METHODS

The experiment was conducted at the Agronomy field laboratory, Bangladesh Agricultural University, Mymensingh during the period from July to December 2013 to see the effect of age of seedling and nitrogen rates in the nursery bed on growth, yield and yield components of BRRI dhan52.

The experiment was laid out in split plot design with three replications. According to the design of the experiment, the age of seedling was placed in main plots and nitrogen rate in sub plots. The same design was followed in transplanting the seedling in main field for study the yield and yield components of rice. The unit plot size in main plot was 2.5m x 4.0m.variety BRRI dhan52 was used as test crop. BRRI dhan52, a high yielding variety of transplant aman rice, developed by the Bangladesh Rice Research Institute, has been used as the test crop in the experiment. Life cycle of this variety ranges from 140-145 days under normal condition and under flash flood for 14 days it will be from 155-160 days. The plant may attain a height of 115-120 cm with 8-10 tillers hill^{-1}. Its panicle length is 25-30 cm and each panicle contains about 110-120 grains. Weight of 1000 grains of the variety is 23-76 g. The main characteristic of this variety is it can with stand against flash flood of about 10-15 days. The variety produces the average grain yield up to 4.0-4.5 t ha^{-1} under flash flood but under normal condition it gives 4.5-Three seedling age D_1 (30-day old), D_2 (35-day old) and D_3 (40-day old), and four rates of nitrogen 50, 75, 100 and 125 kg ha^{-1} included as experimental treatments. The phosphorus and potassium were used as 50 kg P_2O_5 and 50 kg K_2O in each plot through triple super phosphate and muriate of potash. Nitrogen was applied through urea.

Sprouted seeds were sown in the well prepared nursery bed on 6 July 2013, 11 July 2013 and 16 July 2013 to get 30, 35 and 40 day old seedlings for transplanting. Before seed sowing nitrogen were applied @ 50, 75, 100, 125 Kg ha^{-1}. Proper care was taken to raise the seedlings in the seedbed.

The layout of the experimental field was made on 5 August 2013 finally; the individual plots were prepared before transplanting. The same design was followed in the main field which was done in nursery bed for seedling rising. Fertilizers through urea, triple super phosphate, muriate of potash, gypsum and zinc sulphate, were applied to the plots @ 75 kg N, 8 kg P, 40 kg K, 10 kg S and 3 kg Zn ha^{-1}, respectively. Except urea all other fertilizers were applied as basal dose at the time of final land preparation and the whole amount of urea was top dressed in three equal splits, at 5 days after desubmergence of water on 07/09/2013, second on 01/10/2013 and third on 23/10/2013. Forty day, thirty five day and thirty day old seedlings were transplanted in the field as per treatment combinations.

After ten days of transplanting the whole plot was submerged with water from the deep tube well with water depth of 1 m. To maintain this water depth additional water was added regularly in the plot. After 15 days of submergence, the plot was completely desubmerged by draining the water. After desubmergence, the field was found almost damaged and no seedlings hills^{-1} were found to dead but after days they started to regenerate when first dose of urea was applied.

The experimental plots were weeded three times. Algal growth was minimized by partially removing algae from the water surface daily using a small fish net filter. The crop was infested by rice stem borer and green leaf hopper, which were successfully controlled by applying Bifer, Hezinon 60 EC, Sidial ACI 5 g and Virtako as per recommended dose.

Maturity of crop was determined when 80-85% of the seeds become golden yellow in color. Five hills (excluding border hills) were randomly selected from each plot and uprooted before harvesting for recording of necessary data. After sampling, a harvest area of 1 m x 1 m was selected in the middle portion of each unit plot to harvest at full maturity and the yields of both grain and straw were recorded after thoroughly drying in the sun. The grains were cleaned and then sun dried and the grain yield plot^{-1} was recorded at 14% moisture content. The straw was also sun dried to record the straw yield plot^{-1}. Finally, grain and straw yields plot^{-1} were converted to t ha^{-1}.

Data Analysis

Data on crop characters were collected from the plants of the sample five hills. The grain, straw, biological yields and harvest index were recorded from the harvested one square meter area of each plot. Data on yield and yield contributing characters such as root weight (g m^{-2}), shoot weight(g m^{-2}), survivor (%), plant height (cm), number of total tillers $hill^{-1}$, number of effective tillers $hill^{-1}$, number of non-effective tillers $hill^{-1}$, panicle length (cm), number of grains $panicle^{-1}$, weight of 1000 grain (g), sterile spikelet $panicle^{-1}$, grain yield (t ha^{-1}), straw yield (t ha^{-1}) and Harvest Index (%). The data were tabulated in proper form and subject to statistical analysis with the help of computer package MSTAT programme and the significance of mean differences was adjudged by Duncan's Multiple Range Test (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Results of the present study regarding seed density in nursery, seedlings age and nutrient management and their interaction on the yield and yield components have been presented in Tables 1 to 3 and discussed below.
Seedling age had significant effect on the plant characters under study except root weight (gm^{-2}), plant height (cm), total tillers, effective tillers, non-effective tillers, 1000 grain weight (g), sterile spikelets and harvest index (%). Forty day old seedling produced highest plant height (108 cm), total tillers (8.22), effective tillers (7.03), non-effective tillers (1.19), root weight (0.072 g m^{-2}), survivor (95.1%), grains $panicle^{-1}$ (106.2), grain yield (5.57 t ha^{-1}), straw yield (6.26 t ha^{-1}) and harvest index (0.47%). Thirty five day old seedling produced highest 1000 grain weight (25.3g), shoot weight (0.53) and thirty day old seedling produced highest sterile spikelets (28.9) and panicle length (23.8cm) (Table 1).

Rate of nitrogen showed significant differences for all the characters except 1000 grain weight (g), sterile spikelets, grains $panicle^{-1}$ and harvest index (%). Among four rates of nitrogen, application @ 50 kg ha^{-1} gave highest plant height (108 cm) and harvest index (0.47%). It also gave lowest total tillers (7.52), effective tillers (6.78), non-effective tillers (0.74), grains $panicle^{-1}$ (99.1), survivor (87.4%), grain yield (4.73 t ha^{-1}), and straw yield (5.41 t ha^{-1}). On the other hand, application of N @ 75 kg ha^{-1} produced highest non–effective tillers (1.0), grain $panicle^{-1}$ (100.7), 1000-grain weight (25.3) and harvest index (0.47%) but the shortest panicle (23.52cm). Application of N @ 100 kg ha^{-1} gave highest total tillers (7.85), effective tillers (6.85), non–effective tillers (1.0), shoot weight (0.53), survivor (90.5%), grain yield (5.01 t ha^{-1}) and shortest plant (103 cm), sterile spikelet $panicle^{-1}$ (24.5), harvest index (0.46%). Application of N @ 125 kg ha^{-1} gave highest panicle length (23.75 cm), grains $panicle^{-1}$ (100.7), shoot weight (0.54), root weight (0.077), non–effective tillers (1.0) and sterile spikelet (30.1) but lowest effective tillers (6.78), 1000-grain weight (25.1 g) and harvest index (0.46%) (Table 2).

The interaction between seedling age and nitrogen rate showed significant effect on different characters of BRRI dhan52 except effective tillers, non-effective tillers, survivor (%), plant height (cm), panicle length (cm), grain $panicle^{-1}$, 1000-grain weight, sterile spikeket $panicle^{-1}$, straw yield, grain yield and harvest index. Forty day old seedlings with application of N @ 50 kg ha^{-1} gave highest plant height (114). Forty day old seedlings with application of N @ 75 kg ha^{-1} gave highest harvest index (0.48%). Forty day old seedlings with application of N @ 100 kg ha^{-1} gave highest effective tillers (23.7), grain $panicle^{-1}$ (108), grain yield (5.81), straw yield (6.39) and lowest plant height (101cm), panicle length (22.cm). Forty day old seedlings with application of N @ 125 kg ha^{-1} gave higher survivor (94.7%), grains $panicle^{-1}$ (108). Thirty five day old seedlings with application of N @ 75 kg ha^{-1} produced highest 1000 grain weight (25.5 g). Thirty five day old seedlings with application of N @ 100 kg ha^{-1} resulted highest panicle length (24.3 cm) and lowest sterile spikekets $panicle^{-1}$ (22.8), 1000 grain weight (24.9). Thirty five day old seedlings with the application of N @ 125 kg ha^{-1} gave highest harvest index (0.48%) and lower total tillers (6.22). On the other hand thirty day old seedlings with application of N @ 50 kg ha^{-1} produced lowest effective tillers (18.5), grain yield (3.92 t ha^{-1}), straw yield (4.45 t ha^{-1}) and survivor (79.6%). Thirty day old seedlings with application of N @ 100 kg ha^{-1} gave lowest grains $panicle^{-1}$ (93), plant height (114 cm). Thirty day old seedlings with application of N @ 125 kg ha^{-1} gave highest total tillers (8.89), sterile spikelet $panicle^{-1}$ (32.5) and lowest harvest index (0.44%) (Table 3).

Interaction between age of seedling and nitrogen rate had no significant effect on grain yield. The highest grain (5.81 t ha^{-1}) was produced by transplanting 40 day old seedlings with the application of N @ 100 kg ha^{-1} and the lowest grain yield (3.92 t ha^{-1}) was produced by transplanting 30 day old seedlings with the application of N @ 50 kg $ha^{-1.}$

Table 1. Effect of seedling age on yield and yield components of rice cv. BRRI dhan52

Seedling age	Shoot weight (g m^{-2})	Root weight (g m^{-2})	Survivor (%)	Plant height (cm)	Total No. of tillers hill^{-1}	No of effective tillers hill^{-1}	No of non effective tillers hill^{-1}	Panicle length (cm)	No of grains panicle^{-1}	No. of sterile spikelets panicle^{-1}	1000 grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest Index (%)
D_1	0.47	0.064	82.0	103	7.78	6.92	0.83	23.8a	94.4a	28.9	25.2	4.09b	4.91b	0.45
D_2	0.53	0.064	91.0	106	7.25	6.47	0.78	23.6a	100.6a	25.3	25.3	5.02a	5.64a	0.47
D_3	0.52	0.072	95.1	108	8.22	7.03	1.19	23.4a	106.2a	26.7	25.2	5.57a	6.26a	0.47
LSD (P=0.05)	0.05	0.06	0.80	3.86	1.35	9.9	0.194	1.112	13.45	3.26	0.8134	0.6706	0.6725	0.0179
$S\bar{x}$	0.01	0.02	0.20	0.9787	0.4990	0.4258	0.0758	0.2831	3.426	0.8326	0.2072	0.1708	0.1713	0.00456
Level of significance	*	NS	*	NS	NS	NS	NS	*	*	NS	NS	*	*	NS
CV%	12.09	24.27	1.50	6.54	13.14	11.80	58.19	4.05	3.57	23.09	2.07	3.16	5.71	2.56

Figures having common letter(s) do not different significantly, * = Significant at 5% level of probability, NS = Not significant
D_1 = 30 day old, D_2 = 35 day old, D_3 = 40 day old

Table 2. Effect of nitrogen rate in nursery on yield and yield components of rice cv. BRRI dhan52

Rate of nitrogen	Shoot weight (g m^{-2})	Root weight (g m^{-2})	Survivor (%)	Plant height (cm)	Total no. of tillers hill^{-1}	No. of effective tillers hill^{-1}	No. of non effective tillers hill^{-1}	Panicle length (cm)	No. of grains panicle^{-1}	No. of sterile spikelets panicle^{-1}	1000 grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest Index (%)
N_1	0.45	0.054	87.4	108a	7.52a	6.78a	0.74a	23.64a	99.1	26.0	25.2	4.73b	5.41b	0.47
N_2	0.49	0.064	89.0	105a	7.82a	6.81a	1.0a	23.52a	100.7	27.4	25.3	4.90a	5.52ab	0.47
N_3	0.54	0.072	90.5	103a	7.85a	6.85a	1.0a	23.62a	101.1	24.5	25.2	5.01a	5.78a	0.46
N_4	0.54	0.077	90.3	106a	7.82a	6.78a	1.0a	23.75a	100.7	30.1	25.1	4.94a	5.67ab	0.46
LSD (P=0.05)	0.06	0.016	1.32	6.86	1.009	0.7954	0.5388	0.9484	3.550	6.178	0.6658	0.1534	0.3163	0.01291
$S\bar{x}$	0.02	0.005	0.44	2.310	0.3394	0.2677	0.1814	0.3192	1.195	2.079	0.2241	0.05164	0.1065	0.004346
Level of significance	*	*	*	*	*	*	*	*	NS	NS	NS	*	*	NS
CV (%)	12.09	24.27	1.50	6.54	13.14	11.80	58.19	4.05	3.57	23.09	2.07	3.16	5.71	2.56

Figures having common letter(s) do not different significantly, * = Significant at 5% level of probability
NS = Not significant, N_1 = 50 kg N ha^{-1}, N_2 = 75 kg N ha^{-1}, N_3 = 100 kg N ha^{-1}, N_4 = 125 kg N ha^{-1}

Table 3. Interaction effects of seedling age and rate of nitrogen in nursery on growth and yield of BRRI dhan52

Treatment combination		Shoot weight ($g\ m^{-2}$)	Root weight ($g\ m^{-2}$)	Survivor (%)	Plant height (cm)	Total no. of tillers $hill^{-1}$	No. of effective tillers $hill^{-1}$	No. of non effective tillers $hill^{-1}$	Panicle length (cm)	No. of grains $panicle^{-1}$	No. of sterile spikelets $panicle^{-1}$	1000 grain weight (g)	Grain yield ($t\ ha^{-1}$)	Straw yield ($t\ ha^{-1}$)	Harvest Index (%)
Seedling age	Rate of nitrogen in nursery														
D_1	N_1	0.538	0.082	79.6	102	7.00ab	6.67	0.33	23.9	94	25.5	25.0	3.92	4.45	0.47
	N_2	0.550	0.051	81.3	102	7.56ab	6.78	0.78	23.8	97	31.7	25.3	4.22	4.92	0.46
	N_3	0.562	0.080	83.3	101	7.67ab	6.56	1.11	23.6	93	25.7	25.3	4.09	5.01	0.45
	N_4	0.647	0.124	83.6	106	8.89a	7.67	1.11	23.7	94	32.5	25.2	4.14	5.23	0.44
D_2	N_1	0.544	0.058	88.6	108	7.56ab	6.67	0.89	23.2	100	27.3	25.4	4.88	5.41	0.47
	N_2	0.606	0.099	91.0	107	7.67ab	6.44	1.22	23.0	101	23.2	25.5	5.04	5.75	0.47
	N_3	0.673	0.071	91.6	106	7.55ab	6.89	0.67	24.3	102	22.8	24.9	5.13	5.93	0.46
	N_4	0.612	0.110	92.6	104	6.22b	5.89	0.33	24.2	100	24.1	25.2	5.01	5.50	0.48
D_3	N_1	0.510	0.069	94.0	114	8.00ab	7.00	1.00	23.7	103	25.3	25.3	5.39	6.37	0.46
	N_2	0.629	0.101	94.6	107	8.22ab	7.22	1.00	23.7	105	27.1	25.0	5.44	5.98	0.48
	N_3	0.602	0.137	94.6	101	8.33a	7.11	1.22	22.9	108	24.8	25.4	5.81	6.39	0.47
	N_4	0.712	0.080	94.7	109	8.33a	6.78	1.55	23.2	108	29.6	25.0	5.65	6.29	0.47
LSD (P=0.05)		0.10	0.028	2.29	11.89	0.784	1.378	0.933	1.643	6.150	3.602	1.53	0.266	0.548	0.022
$S\bar{x}$		0.03	0.009	0.77	4.002	0.588	0.464	0.314	0.553	2.070	2.079	0.388	0.089	0.184	0.008
Level of significance		*	*	NS	NS	*	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV %		12.09	24.27	1.50	58.19	6.54	13.14	11.80	4.05	3.57	23.09	2.07	3.16	5.71	2.56

Figures having common letter(s) do not different significantly, * = Significant at 5% level of probability
NS = Not significant, D_1 = 30 day old, D_2 = 35 day old, D_3 = 40 day old
N_1 = 50 kg N ha^{-1}, N_2 = 75 kg N ha^{-1}, N_3 = 100 kg N ha^{-1}, N_4 = 125 kg N ha^{-1}

CONCLUSION

From the present experiment, it can be concluded that 40 day old seedlings with application of N @ 100 kg ha^{-1} in the nursery bed was found to be the best possible combination for seedling raising of BRRI dhan52 and their best field performance for achieving highest grain yield under submerged condition.

COMPETING INTEREST

The authors declare that they have no competing interests.

REFERENCES

1. BBS (Bangladesh Bureau of Statistics), 2011. Statistical Year Book of Bangladesh Bureau of Statistics, Statistics Division, Ministry of planning, Government of People's Republic of Bangladesh.
2. BRRI, Annual Report for 1992. Bangladesh rice research Institute, Joydebpur, Gazipur, Vol. 329, 1992.
3. Chandra D and GB Manna, 1988. Effect of planting date, seedling age and planting density in late planted wet season rice. International Rice Research Notes, 13: 30.
4. De Datta SK, 1981. Principles and Practices of Rice Production. Singapore: Wiley and Sons.
5. Ella ES, ML Dionisio-Sese and AM Ismail, 2011. Application of silica at sowing negatively affects growth and survival of rice following submergence. Philippine Journal of Crop Science, 36: 1-11.
6. Ella ES and AM Ismail, 2006. Seedling nutrient status before submergence affects survival after submergence in rice. Crop Science, 46: 1673 -1681.
7. Gomez KA and AA Gomez, 1984. Statistical Procedure for Agricultural Research. Second Ed., John Wiley and Sons, New York. p 680.
8. Himeda M, 1994. Cultivation technique of rice nurseling seedlings: Review of research papers and its future implementation. Agriculture and Horticulture, 69: 679-683.
9. Ismail AM, SU Singh, S Singh, HM Dar and JD Mackill, 2013. The contribution of submergence-tolerant (Sub 1) rice varieties to food security in flood prone rainfed lowland areas in Asia. Field Crops Research, 152: 83-93.
10. Khatun A, MIU Mollah, IH Rashid, MS Islam and AH Khan, 2002. Seasonal effect of seedling age on the yield of rice. Pakistan Journal of Biological Science, 5: 40-42.
11. Lal M and RK Roy, 1996. Effect of nursery seeding density and fertilizer on seedling growth.
12. Mackill DJ, AM Ismail, US Singh, RV Labiosand and TR Paris, 2012. Development and Rapid Adoption of Submergence-Tolerant (Sub1) Rice Varieties. Advances in Agronomy, 115: 303-356.
13. Padalia CR, 1980. Effect of age of seedling on the growth and yield of transplanted rice. Oryza 81:165-167.
14. Panda MM, MD Reddy and AR Sharma, 1991. Yield performance of rainfed lowland rice as affected by nursery fertilization under conditions of intermediate deep water (15-50cm) and flash flood. Plant and soil, 132: 65-71.
15. Raghavaiah CV, BC Ghosh and MK Jana, 1989. Nursery Management for Rice Grown in Intermediate Deep Water. International Rice Research Notes, 14: 31-32.
16. Raju RA, MN Reddy and B Gangwar, 2001. Nursery fertilization of rice (*Oryza sativa*) with native weed vegetation. *Indian Journal Agronomy,* 46: 94-100.
17. Ram PC, MA Mazid, AM Ismail, PN Singh, VN Singh, MA Haque, U Singh, ES Ella and BB Singh, 2009. Crop and Resource Management in Flood-Prone Areas: Farmers Strategies and Research Development, In: S. M. Haefele and A. M. Ismail, Eds., Proceedings Natural Re-source Management for Poverty Reduction and Environ- mental Sustainability in Fragile Rice-Based Systems, Los Baňos (Philippines), International Rice Research Institute, 82-94.
18. Rashid MA, ML Aragon and GL Denning, 1990. Influence of variety, seedling age and nitrogen on growth and yield of rice grown on saline-soil. Bangladesh Journal of Rice, 1: 37-47.
19. Reddy KS and BB Reddy, 1992. Effect of Transplanting Time, Plant Density and Seedling Age on Growth and Yield of Rice. Indian Journal of Agronomy, 37:18-21.
20. Ros C, RW Bell and PF White, 1997. Effect of Nursery Applications of N and P on Rice Yield, Kasetsart. Journal of Natural Sciences, 3: 96-105.

21. Sarkar RK, JN Reddy, SG Sharma and AM Ismail, 2006. Physiological Basis of Submergence Tolerance in Rice and Implications for Crop Improvement. Current Science, 91: 899-906.
22. Sasaki R, 2004. Characteristics and Seedlings Establishment of Rice Nursling Seedlings. Japanese Agricultural Research Quarterly, 38: 7-13.
23. Septiningsih EM, BCY Collard, S Heuer, J Bailey- Serres, AM Ismail and DJ Mackill, 2013. Applying Genomics Tools for Breeding Submergence Tolerance in Rice, In: R. K. Varshney and R. Tuberosa, Eds., *Translational Genomics for Breeding*: *Abiotic Stress*, *Yield and Quality*, 1st Edition, John Wiley and Sons, New York, pp. 9-30.
24. Singh G and OP Singh, 1992. Effect of age and number of seedlings per hill^{-1} on yield and yield attributes of rice under rain fed lowland. Crop Research Hisar, 5: 417-419.
25. Singh RS and SB Singh, 1999. Effect of age of seedling, N levels and time of application on growth and yield at rice under irrigated conditions. Oryza, 36: 351-354.
26. Tekony DM and DB Egli, 1991. Relationship of seed vigour to crop yield. A review Crop Science, 31: 816 - 822.
27. UNDP and FAO, 1988. Land Resources Appraisal of Bangladesh for Agricultural Development. Report 2. Agro-ecological Regions of Bangladesh. United Nations Development Programme, and Food and Agriculture Organization. pp. 212-221.
28. Wagh RG, SA Khanvilkar and ST Thorat, 1988. Effect of age of seedlings at transplanting, plant densities and nitrogen fertilization on the yield of rice variety R711. *Oryza* 25: 188–190.
29. Wopereis MCS, MJ Kropff and AR Maligaya, 2009. The seedling nursery, PLAR-IRM Curriculum: Technical Manual, pp. 45-48.