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Effect of seedling age on the growth, yield and yield components of rice

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Key words: Seedling age, Dry matter production, Growth and yield

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Abstract

This research was conducted at the Bangladesh Rice Research Institute (BRRI) Gazipur Farm during T. *Aman* seasons of 2014 and 2015 to determine the tillering pattern, growth, yield and yield components rice as affected by seedling age. The treatments were six different ages of seedling, such as 15, 20, 25, 30, 35, and 40 days. The treatments were arranged in a RCB Design with three replications. The variety BRRI dhan46 was used in this experiment. The unit plot size was 4m X 4m. One seedling per hill at 20cm X 20cm spacing was transplanted. Irrespective of seedling ages, the stem dry weight of all sampling dates increased slightly at PI stage (about 60 DAT) then sharply increased at FS (about 90 DAT) after that decreased and reached minimum at maturity stage. The leaf dry weight also followed the same trend as stem dry weight. The panicle dry weight in all the treatments sharply increased from flowering to maturity stage. Irrespective of seedling ages, the tiller number gradually increased with the DAT and reached maximum at 45 DAT then gradually decreased and reached minimum at ripening and maturity stage. Fifteen -day -old seedling produced the highest number of tiller per hill from 15 to 120 DAT. The lowest number of tillers was recorded in 40- day- old seedling in all the sampling dates. The panicle number m^{-2} also increased with decreasing seedling age. It was the highest in 15- day- old seedling and lowest in 40- day- old seedling. Fifteen to 30 -day- old seedling produced statistically identical and higher number of grain $panicle^{-1}$ and 40 -day- old seedling gave the lowest number of grain $panicle^{-1}$. The highest grain yield obtained from 15- day-old seedling transplanted plot followed by 20, 25, 30, 35 and lowest in 40- day-old but no significant difference was observed from 15 to 30- day- old seedling.

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Introduction

Rice (*Oryza sativa* L.) belongs to the family Gramineae and its the dominating over all other crops in respect of economic and social significance. It is the extensively cultivated crop for half of the world's population (FAO, 2010). It is grown throughout the year in the country, but the yield of this crop is low (Hasanuzzaman *et al.*, 2009). In Bangladesh transplant *Aman* rice contributes about 38.80 % of total rice production and covers 48.69 % of total rice area but the average yield is below the potential level (BBS, 2020). The total area of rice production of Bangladesh is about 11.42 million hectares with a production of 36.60 million metric tons (BBS, 2020). Thus, the seedling age increases due to delay in transplanting, though they were sown at the same time. This practice of transplanting seedling at different days having different ages is termed as staggered planting. The age of seedling is an important factor because it has tremendous influence on the growth and development, tiller production, grain formation and other yield contributing characters of rice (Islam *et al.*, 1981). For optimum yield, age of seedlings at transplanting of a suitable variety at a particular season may not be suitable for other varieties at another season. With increasing seedling age, rice tiller number, pre-anthesis dry matter accumulation, remobilization efficiency and contribution to grain yield, as well as post-anthesis photosynthesis amount decreased, causing reductions in the number of effective panicles, the total number of grains per panicle, the sink capacity per tiller, and grain yield (Liu *et al.*, 2017). It is very important to find out the optimum age of seedlings of a variety for a particular season. Determining how to compensate grain yield loss is crucial for improving rice cultivation technology. Therefore, the present experiment was conducted to determine the effect of seedling age on the growth, yield and yield components of rice.

Materials and methods

Study area

The experiment was conducted at the West Byde of BRRI farm, Gazipur during T. *Aman* 2014 and 2015 seasons. The experimental field situated at 23° 59 ©33©© © N and 90° 24© 19© © E at an elevation of 8.4 m from the mean sea level, and its characterized by sub-tropical climate. The soil of field was clay loam of shallow brown terrace under Madhupur tract (AEZ 28), the experimental field classified as a Chhiata clay loam, hyperthermic Vertic Endoaquept.

Treatments and experimental design

The treatments were six different ages of seedling such as 15, 20, 25, 30, 35, and 40 days. The variety BRRI dhan46 was used in this seasons. The treatments were arranged in a Randomized Complete Block Design (RCBD) with three replications. The unit plot size was 4 m X 4 m. Fertilizer were used in BRRI recommended dose. One seedling per hill at 20cm X 20cm spacing was transplanted.

Data collection

Tillers were counted from transplanting to maturity with 15 days intervals. Dry weight of leaf, stem and panicle were taken 15 days interval from 15 days after transplanting (DAT) to maturity of crop. Yield and yield components data were also taken at maturity. The collected data were analyzed using Crop Stat Software program.

Results and discussion

Tiller Production

The numbers of tillers produced at different days after transplanting (DAT) were significantly affected by seedling ages (Fig 3). Regardless of seedling ages, the tiller number gradually increased with the DAT and reached maximum at 45 DAT then gradually decreased and reached minimum at ripening and maturity stage i.e. 105 to 120 DAT. Fifteen days old seedling produced the highest number of tiller per hill from 15 to 120 DAT which was statistically identical with the tiller number produced from 20 and 25 days old seedling. The lowest number of tillers was recorded in 40 days old seedling in all the sampling dates which was statistically similar to the tiller number produced from 35 days old seedling. Kim *et al.* (1999) observed that 10-day old seedling had more vigorous stem elongation and higher tillering ability compared with 15- and 40-day old seedlings.

It was observed that the tiller production was higher among 30-day old seedlings transplanted in T. *Aman* season than others (Khatun 1995).

Dry Matter Production

The dry matter weight of leaves stems and panicles were recorded at 15 days interval from transplanting to maturity of the crop as affected by seedling ages (Fig 4). Irrespective of seedling ages, the stem dry weight of all seedling ages increased gradually and reached maximum at 75 to 90 DAT (flowering stage) then decreased and reached minimum at maturity stage. The leaf dry weight also followed the same trend as stem dry weight. The panicle dry weight in all the treatments sharply increased from flowering to maturity stage. The panicle dry weight of lower seedling ages at 105 DAT and maturity stage comparatively higher than the older seedling ages. It has been observed that stem and leaf dry weight increased up to flowering stage after that decreased but panicle dry weight increased from flowering to maturity indicating that dry matter transferred from stem and leaf to the panicles.

Yield and yield components

The tiller number m^{-2}, panicle number m^{-2}, grain panicle^{-1} and grain yield were significantly affected by seedling age but 1000 grain weight were not significantly affected by seedling age (Table 4).

Tiller number

The 15 days old seedling produced the highest number of tiller. The tiller number m^{-2} decreased gradually with increasing seedling age and the lowest number of tiller was recorded in 40 days old seedling.

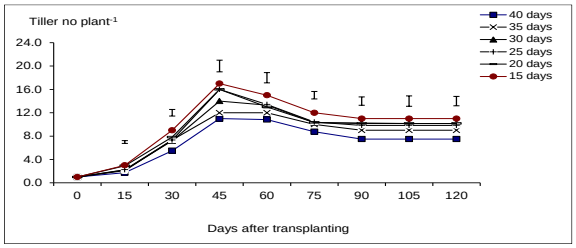

Fig. 1. Tiller number at different days after transplanting (DAT) as affected by seedling ages in T. *Aman* 2014. *(Vertical bar represent the Lsd (0.05) value indicates the differences between different seedling ages under same sampling date)*

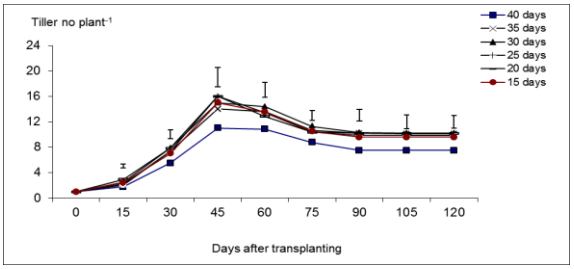

Fig. 2. Tiller number at different days after transplanting (DAT) as affected by seedling ages in T. *Aman* 2015. *(Vertical bar represent the Lsd (0.05) value indicates the differences between different seedling ages under same sampling date)*

Fifteen to 30 days old seedling gave statistically similar number of tiller m^{-2}. Roy and Sattar (1992) reported similar findings observing less tiller number in younger seedlings compared to older ones.

Panicle number

The panicle number m^{-2} also increased with decreasing seedling age. It was the highest in 25 days old seedling which was statistically identical with the number of panicle produced from 15 to 35 days old seedling. Forty days old seedling gave the lowest number of panicle. This result agreed with the findings of Raju *et al.* (1989).

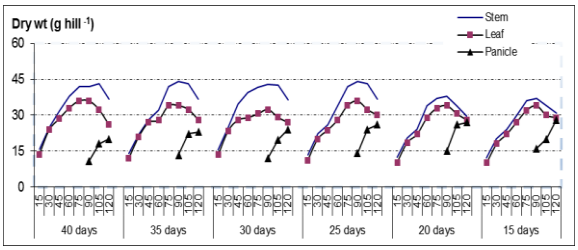

Fig. 3. Dry matter changes in leaves, stems and panicles of rice at different days after transplanting (DAT) as affected by different seedling ages at T. *Aman* 2014.

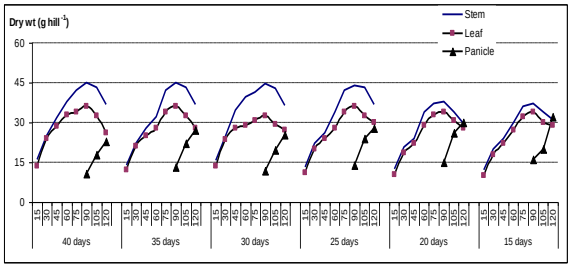

Fig. 4. Dry matter changes in leaves, stems and panicles of rice at different days after transplanting (DAT) as affected by different seedling ages at T. *Aman* 2015.

Grain number

Fifteen to 35 days old seedling produced higher number grain panicle^{-1} which was statistically identical. Forty days old seedling gave the lowest number of grain panicle^{-1}. This result agreed with the findings of Raju *et al.* (1989).

Grain yield

The highest grain yield was observed in 15 days old seedling transplanted plot which was statistically identical with 20, 25, 30 and lowest in 40 days old seedling. These results agreed with the findings of Khatun *et al.* (2002) and Alam *et al.* (2002).

Table 4. Yield and yield components of rice as affected by different seedling ages in boro 2015 and 2016 seasons.

Seedling ages		Tiller m^{-2} (no.)		Panicle m^{-2} (no.)		Grain panicle^{-1} (no.)		1000- grain wt. (g)		Grain yield (t ha^{-1})	
2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
40 days	40 days	196	246	187	236	92	84	23.65	22.87	3.50	4.11
35 days	35 days	253	254	250	243	94	94	24.19	23.27	4.31	4.67
30 days	30 days	264	258	250	253	98	93	23.54	23.87	4.70	5.08
25 days	25 days	267	260	253	259	98	94	24.22	23.60	4.80	5.11
20 days	20 days	268	261	254	251	96	90	23.54	22.95	4.89	5.12
15 days	15 days	280	262	256	253	97	92	23.59	22.88	5.27	5.23
LSD at 5% level	LSD at 5% level	4.8	6.63	5.3	11.49	3.0	3.02	ns	ns	0.53	0.63

In a column, different small letters indicate the differences between treatments, ns=Not significant.

Conclusion

Yield and yield components was higher in younger seedling used plot that produced more tillers and panicles. The plants those are produced from younger seedlings translocate more carbohydrate from source to sink might be the reason of higher yield in younger seedling used plot.

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