



Agronomy

ORIGINAL ARTICLE

Growth and yield performances of tiller mutilated hybrid rice variety Dhani Gold

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ARTICLE INFORMATION

Article History

Submitted: 13 Nov 2019

Accepted: 06 Jan 2020

First online: 07 Feb 2020

Academic Editor

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ABSTRACT

An experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during July-October 2016 to investigate into the tolerance of hybrid rice variety Dhani Gold to tiller separation. The experimental treatments included (a) 3 times of tiller separation *viz.* tiller separation at 3 weeks after transplanting (3 WAT), 4 WAT and 5 WAT, and (b) 5 levels of number of tillers separated hill⁻¹ *viz.* intact hill, 1 tiller, 2 tillers, 3 tillers and 4 tillers separated hill⁻¹. The experiment was laid out in randomized complete block design with three replications. Tiller separation adversely affected the growth, in terms of plant stature and tillering ability, of Dhani Gold. Intact hill showed taller plants and higher number of tillers compared to tiller mutilated hills. With the delay in tiller separation, plant height of Dhani Gold was gradually decreased but tillering ability gradually increased. Effective tiller production was reduced only when tillers were separated after 4 WAT, but delay in tiller separation enhanced grains panicle⁻¹ production. Early separation of tillers up to 4 WAT did not affect grain yield, but separation after 4 WAT reduced grain yield of Dhani Gold. Separation of only 1 tiller hill⁻¹ at 3 or 4 WAT and intact hills produced statistically similar yield. To conclude, hybrid rice variety Dhani Gold can tolerate tiller separation to some extent. Only one tiller can be separated before 4 WAT without causing any yield reduction of mother plant, but tiller separation after 4 weeks will reduce the yield of mother plant. Therefore, farmers may be advised to separate tillers from Dhani Gold within 4 WAT for re-transplanting as a post flood crop after recession of flood water.

Keywords: Tiller separation, growth, yield, hybrid rice

Cite this article: Rahman MF, Anwar MP, Hossain MD, Rashid MH, Munira FNK, Jahan I. 2020. Growth and yield performances of tiller mutilated hybrid rice variety Dhani Gold. *Fundamental and Applied Agriculture* 5(1): 70–77. doi: 10.5455/faa.73672

1 Introduction

Rice (*Oryza sativa* L.) is the world's second most important cereal crop, and the staple food of Bangladesh. Bangladesh is the fourth highest rice producing country in the world (FAO, 2018). With the increasing population in the country, the demand of rice is also

increasing. However, the country is now producing about 34.5 million tons rough rice to feed her 160 million people (BBS, 2016). Rice is mainly grown in three seasons in Bangladesh namely aus, aman and boro. Transplant aman or monsoon rice is the main crop in Bangladesh covering the highest area of 5.59 million hectares with an annual production

of 13.48 million metric tons (BBS, 2016). The yield of the high yielding inbred rice varieties are much higher than local varieties but can't meet the increasing demand. On the other hand yield of the hybrid rice variety is very high compared to the local ones, and even higher than inbred high yielding varieties. As like other types of hybrids, hybrid rice typically displays heterosis (or hybrid vigor) such that when it is grown under the same conditions as comparable high-yielding inbred rice varieties it can produce up to 30% more rice. Hybrid crop varieties are one of the most important tools for combating world food crises (FAO, 2004). But seeds of hybrid rice are so costly that poor farmers usually don't go for hybrid rice cultivation despite its high yield potential. Farmers also can't keep their own seeds. So, if a vegetative propagation technology could be developed, it would be a huge step to make the hybrid rice popular to the farming community of Bangladesh (Anwar and Begum, 2004). Crop losses due to flash flood or late flood are regular feature in Bangladesh especially in aman season. Devastating flood destroys valuable crops especially transplant aman rice. Early flood usually damage nursery beds while late flood causes considerable damage to crop resulting severe yield reduction (Anwar and Begum, 2004). Farmers cannot re-transplant their aman rice after the recession of flood water in the early or mid-September due to unavailability of seedlings. If available, seedlings are either too young or too old to produce good crop. Thus shortage of seedlings is a great problem in this situation (Hanada, 1982).

Separated tillers of transplant aman rice from a field, not affected by flood, may be used as seedlings to rehabilitate the damage of rice. Double transplanting practice has also been suggested for transplant aman areas where transplanting is delayed due to flood water inundation (Sharma et al., 1987). The potentiality of separated tillers has been reported by many researchers (Rahman et al., 2015; Kirttania et al., 2013; Sarkar et al., 2011; Hossain et al., 2011; Parveen et al., 2008; Biswas and Salokhe, 2001). In rice, many of the late tillers do not produce panicles due to higher population (Hanada, 1982). Removal of excess tillers from the mother hill at early stage could help better development for remaining tillers and the separated tillers can be used as seedling for crop production. This technique of transplanting of separated tillers may be a promising alternative for growing post-flood transplant aman rice (Mridha et al., 1991). The detached tillers can be used as seedlings especially during scarcity of seedling after flood or other natural hazards. Paul et al. (2002) reported that tillers can be separated at 25 or 35 days after transplanting (DAT) without hampering grain yield of mother plant. Tiller separation or tiller removal is sometimes practiced in Bangladesh (Hossain et al., 1988), especially in post flood situation but scientific information in

this regard is not enough. Tolerance of mother plants to tiller separation as influenced by time of tiller separation and number of tillers to be kept with mother plant need to be tested so that the growth and yield of the mother crop are not adversely affected. The time of tiller separation is of prime importance for vegetative propagation in rice because early or late tiller separation adversely affects the plant growth and yield of crop. Therefore, tiller separation from the mother plant may be an important aspect of research regarding vegetative propagation, and use of separated tillers as seedlings for transplant aman rice cultivation under Bangladesh condition (Alam and Sheuly, 2012). In a view of the above discussion, the present study was undertaken to evaluate the potentiality of tiller separation from hybrid rice and to assess the tolerance of hybrid rice variety Dhani Gold to tiller separation in terms of time and number of tiller separation.

2 Materials and Methods

2.1 Experimental site and soil

The experiment was conducted at the Agronomy field Laboratory, Bangladesh Agriculture University, Mymensingh during the period from July to October 2016 to study the tolerance of hybrid rice variety Dhani Gold to tiller separation. Geographically the experimental site is located at 24°43'8.3"N, 90°25'41.2"E at an elevation of 18 m from the sea level. It belongs to the Sonatola soil series under the Old Brahmaputra Floodplain Agro- Ecological Zone (AEZ-9) having non-calcareous dark grey floodplain soil. The experimental field was a medium high land. Soil of the experimental field was non calcareous having silt loam texture, almost neutral in reaction, low in organic matter content and its general fertility level was also low. The experimental area is characterized by sub-tropical climate with high temperature, high humidity and heavy rainfall from April to September and scanty rainfall from October to March associated with moderately low temperature and plenty of sunshine. During the experimental period, average maximum and minimum temperature, relative humidity, rainfall and sunshine hours ranged from 26.8 to 33.2 °C, 18.1 to 29.5 °C and 81-87%, 1.0-522.7 mm, 101.8 to 204.8 hrs month⁻¹.

2.2 Experimental design and treatment

The experimental treatments included (a) 3 times of tiller separation *viz.* tiller separation at 3 weeks after transplanting (WAT), 4 WAT and 5 WAT and (b) 5 levels of number of tillers separated hill⁻¹ *viz.* intact hill, 1 tiller, 2 tillers, 3 tillers and 4 tillers separated hill⁻¹. The experiment was laid out in a randomized complete block design with three replications, where

different treatment combinations were randomly assigned in different unit plots. The total number of unit plots was 45 ($3 \times 5 \times 3$). The size of each unit plot was 10 m^2 ($4.0 \text{ m} \times 2.5 \text{ m}$). Block to block and plot to plot distance were 1.0 m and 0.5 m, respectively.

2.3 Plant material

A hybrid rice variety 'Dhani Gold' developed by the Bayer Bio Science Company was used as the plant material in this study. Dhani Gold is resistant to Bacterial Leaf Blight disease. The plant is green in color, flag leaf is erect and remains fade green after ripening of the grain. Average plant height of the variety is 100 cm and weight of 1000 grains is about 23 g. The grains are medium bold with white kernels. It requires about 110 days to complete its life cycle and produces average grain yield of 5 t ha^{-1} .

2.4 Crop husbandry and data collection

Quality seeds of Dhani Gold were soaked in water for 24 hours and then kept in gunny bags for 48 hours for sprouting. Sprouted seeds were then sown in the wet nursery bed for raising seedlings. A piece of land, selected for growing mother plants, was thoroughly ploughed with a power tiller followed by harrowing, puddling and laddering. Thirty days old seedlings were transplanted maintaining the spacing of $25 \text{ cm} \times 15 \text{ cm}$ at the rate of three seedlings hill^{-1} on 4th August. Urea, triple super phosphate, muriate of potash, gypsum and zinc sulphate fertilizers are applied to the experimental plots at the rate of 140, 90, 70, 60 and 10 kg ha^{-1} , respectively. The entire amount of triple super phosphate, muriate of potash, gypsum, and zinc sulphate were applied before final land preparation. Urea was top dressed in three equal splits at 15, 30, 45 days after transplanting (DAT). Weeding was done manually three times at 15, 30 and 45 DAT. The crop was grown as rainfed. Due to frequent rain during the crop growth period no irrigation was given. Tillers were separated at 3, 4 and 5 weeks after transplanting from the mother plant at the rate of 1 tiller, 2 tillers, 3 tillers and 4 tillers hill^{-1} as per treatments. Intact hills (no tiller separated) were also maintained as control. Necessary care was taken to ensure the normal growth of the crop. Data were collected on rice plant height and tillering ability. Different yield parameters, yield retarding characters and grain yield of rice were also observed.

2.5 Statistical analysis

The recorded data on various plant characters were statistically analyzed to find out the significance of variation resulting from the experimental treatments. Analysis of variance (ANOVA) for each of the characters under study was done with the help of computer

package MSTAT. The differences among treatment means were compared by Duncan's New Multiple Range Test

3 Results

Plant height of Dhani Gold was significantly influenced by time of tiller separation and number of tillers separated, but their interaction failed to exert any significant influence on plant height (Table 1). Plant height ranged from 102 to 107 cm among different times of tiller separation. From the result it is evident that delay in tiller separation negatively affected the plant height of Dhani Gold. Compared to tiller separation at 3 weeks after transplanting (WAT), 2 cm and 5 cm reduction in plant height were recorded in case of tiller separation at 4 and 5 WAT, respectively. Plant of Dhani Gold ranged from 102.20 to 109.50 cm among different numbers of tiller separation. Results show that tiller separation negatively affected the plant height of Dhani Gold. But there were no significant differences among the number of tillers separated hill^{-1} . It is evident from Table 1 that due to tiller separation reduction in plant height varied from 5 cm to 7 cm. Although not significant, plant height ranged from 98.97 cm to 109.50 cm among different interactions. Numerically, intact hills produced tallest plants and plant height reduced gradually with the increasing number of tiller separated hill^{-1} irrespective of time of tiller separation.

Time of tiller separation, number of tillers separated hill^{-1} and their interaction exerted significant influence on tillering ability of Dhani Gold (Table 1). Total number of tillers ranged from 8.86 to 9.61 among different times of tiller separation. It is evident from the findings that delay in tiller separation improved the tillering ability of mother plant. Increase in 0.28 and 0.75 tillers hill^{-1} were recorded when tiller separation was done at 4 and 5 WAT, respectively compared to separation at 3 WAT. Results show that tiller separation adversely affected the tillering ability of Dhani Gold. Compared to intact hill, 1.44, 2.24, 2.63 and 3.57 tiller reduction hill^{-1} was recorded in case of 1, 2, 3 and 4 tillers separated hill^{-1} . Tillering ability ranged from 7.11 to 11.40 among the interactions. Results show that irrespective of time of tiller separation, with the increase of number of tiller separated hill^{-1} the tillering ability of Dhani Gold was reduced gradually. It may be noted that intact hills produced the maximum number of tillers. On the other hand, the poorest tillering ability was recorded when 3 or 4 tillers were separated hill^{-1} .

Yield contributing parameters like number of effective tillers hill^{-1} and number of grains panicle⁻¹ were significantly affected by time of tiller separation, number of tillers separated hill^{-1} and their interaction; but 1000-grain weight was found independent of both the factors (Table 1). Results show that tiller

Table 1. Effect of time of tiller separation, number of tillers separated hill⁻¹ and their interaction on growth and yield contributing characters of hybrid rice variety Dhani Gold

Treatment	Plant height (cm)	Total tillers hill ⁻¹ (nos.)	Effective tillers hill ⁻¹ (nos.)	No. of grains panicle ⁻¹	1000-grain weight (g)
Separation time (T)					
3 WAT	107.00a	8.86 c	6.41 a	143.30 b	24
4 WAT	104.90ab	9.14 b	6.45 a	145.50 a	23.99
5 WAT	102.00 b	9.61 a	5.14 b	144.30ab	24.14
Level of significance	**	**	**	**	NS
Tillers separated (N)					
Intact hill	109.50a	11.18 a	7.20 a	145.10ab	23.99
1 tiller hill ⁻¹	104.60 b	9.74 b	6.15 b	145.40ab	24.02
2 tiller hill ⁻¹	103.50 b	8.94 c	5.73 c	146.10a	24.02
3 tiller hill ⁻¹	103.50 b	8.55 d	5.47 c	144.80ab	24.1
4 tiller hill ⁻¹	102.20 b	7.61 e	5.44 c	142.40c	24.08
Level of significance	**	**	**	**	NS
Interaction (T × N)					
3 WAT × Intact hill	109.5	11.40a	7.20a	144.7cde	23.99
3 WAT × 1 tiller hill ⁻¹	107.2	9.10 c	6.70 ab	141.3ef	23.94
3 WAT × 2 tiller hill ⁻¹	106.3	8.46cd	6.03cd	147.3 abc	24.18
3 WAT × 3 tiller hill ⁻¹	106.8	7.73ef	5.86 d	143.3def	23.88
3 WAT × 4 tiller hill ⁻¹	105.4	7.60 ef	6.26bcd	139.7 f	23.98
4 WAT × Intact hill	109.5	11.07a	7.20a	145.3bcd	23.99
4 WAT × 1 tiller hill ⁻¹	105.2	10.17b	6.53 bc	147.7abc	23.95
4 WAT × 2 tiller hill ⁻¹	104.1	8.53cd	6.33 bcd	141.3 ef	23.96
4 WAT × 3 tiller hill ⁻¹	103.8	8.80 c	6.23bcd	149.0 ab	24.12
4 WAT × 4 tiller hill ⁻¹	102.1	7.16 f	5.96cd	144.3cde	23.95
5 WAT × Intact hill	109.5	11.07a	7.20a	145.3 cd	23.99
5 WAT × 1 tiller hill ⁻¹	101.3	9.96 b	5.23e	141.3 ef	24.18
5 WAT × 2 tiller hill ⁻¹	100.1	9.83 b	4.83ef	149.7a	23.92
5 WAT × 3 tiller hill ⁻¹	99.93	9.13 c	4.33fg	142.0def	24.3
5 WAT × 4 tiller hill ⁻¹	98.97	8.06 de	4.10 g	143.3def	24.3
Level of significance	NS	**	**	**	NS

WAT = Weeks after transplanting

separation at 4 weeks after transplanting resulted in highest number of effective tillers and late separation reduced effective tiller production. Increase in number of tillers separated hill⁻¹ negatively affected the number of effective tillers hill⁻¹. Effective tillers hill⁻¹ production ranged from 4.10 to 7.20 among the interactions. It is clearly evident that irrespective of time of tiller separation, with the increase in number of tiller separated hill⁻¹ effective tillers production was reduced gradually. Grains panicle⁻¹ production, on the other hand was enhanced due to late separation of tillers, and was unaffected up to separation of 3 tillers hill⁻¹. Only, 4 tillers separation hill⁻¹ resulted in reduced grain production hill⁻¹. Among the interactions, the maximum number of grains panicle⁻¹ was produced when 2 tillers were separated hill⁻¹ at five weeks after transplanting which was even higher

than that produced by intact hill. Among the yield retarding characters, number of non-effective tillers hill⁻¹ was significantly affected by time of tiller separation, number of tillers separated hill⁻¹ and their interaction; but number of sterile spikelets panicle⁻¹ was significantly affected by only interaction (Table 2). It is evident that late separation of tillers increased non-effective tiller production and higher number of tiller separation reduced non-effective tiller production. Among the interactions, late separation at 5 WAT of 1 or 2 or 3 tillers hill⁻¹ resulted in the similar and the highest non-effective tiller production. Grain yield of Dhani Gold was significantly influenced by time of tiller separation, number of tillers separated hill⁻¹ and their interaction (Fig. 1).

Table 2. Effect of time of tiller separation, number of tillers separated hill⁻¹ and their interaction on growth and yield retarding characters of hybrid rice variety Dhani Gold

Treatment	NET tillers hill ⁻¹	Ster spik. panicle ⁻¹
Separation time (T)		
3 WAT	2.44 b	10.58
4 WAT	2.69 b	10.73
5 WAT	4.47 a	10.23
Level of significance	**	NS
Tillers separated (N)		
Intact hill	3.97 a	10.63
1 tiller hill ⁻¹	3.58ab	10.35
2 tiller hill ⁻¹	3.21 b	10.88
3 tiller hill ⁻¹	3.07 b	10.22
4 tiller hill ⁻¹	2.16 c	10.5
Level of significance	**	NS
Interaction (T × N)		
3 WAT × Intact hill	4.20a-c	10.63a-d
3 WAT × 1 tiller hill ⁻¹	2.40 d	10.71a-d
3 WAT × 2 tiller hill ⁻¹	2.43 d	11.03ab
3 WAT × 3 tiller hill ⁻¹	1.86d-f	9.82b-d
3 WAT × 4 tiller hill ⁻¹	1.33 ef	10.72a-d
4 WAT × Intact hill	3.86 bc	10.63a-d
4 WAT × 1 tiller hill ⁻¹	3.63 c	10.92a-c
4 WAT × 2 tiller hill ⁻¹	2.20de	10.55a-d
4 WAT × 3 tiller hill ⁻¹	2.56d	10.05a-d
4 WAT × 4 tiller hill ⁻¹	1.20 f	11.52a
5 WAT × Intact hill	3.86bc	10.63a-d
5 WAT × 1 tiller hill ⁻¹	4.73ab	9.42cd
5 WAT × 2 tiller hill ⁻¹	5.00 a	11.05ab
5 WAT × 3 tiller hill ⁻¹	4.80ab	10.79a-d
5 WAT × 4 tiller hill ⁻¹	3.96bc	9.27d
Level of significance	**	*

WAT = Weeks after transplanting; NET = Non-effective tillers, Ster. spik. = Sterile spikelets

Maximum grain yield (5.52 t ha⁻¹) was recorded when tillers were separated at 4 WAT, which was statistically similar to that (5.41 t ha⁻¹) when separation was done at 3 WAT. The lowest grain yield was recorded when tiller separation was done at 5 WAT. It may be noted that late tiller separation resulted in grain yield reduction by almost 1 t ha⁻¹. The maximum grain yield (6.02 t ha⁻¹) was recorded in case of intact hills. The lowest grain yield was recorded when 4 tillers were separated hill⁻¹ (4.72 t ha⁻¹) which was statistically similar to that (4.83 t ha⁻¹) produced when 3 tillers were separated hill⁻¹. It may be noted that with the increase in number of tiller separation grain yield of Dhani Gold was gradually reduced. It was observed that grain yield was reduced up to 17% compared to intact hill when 1 or 2 tillers were separated, while for 3 or 4 tillers

separation the yield reduction was around 21%. The negative influence of lower number of effective tillers and grains panicle⁻¹ reduced the grain yield. In case of interaction, separation of 1 tiller hill⁻¹ at 3 or 4 WAT resulted in statistically similar grain yield to intact hill. On the other hand, separation of 3 or 4 tillers hill⁻¹ at 5 WAT produced the lowest grain yield. It is evident from this study that with the delay in tiller separation and increase in number of tiller separation grain yield of Dhani Gold was gradually reduced.

4 Discussion

Bangladesh is a flood-prone delta and therefore crops are grown here in the aman (monsoon) season is highly vulnerable to seasonal and flash floods. Different crops especially transplant aman rice are damaged to a great extent by devastating floods almost every year. After recession of flood water farmers usually can't replant their aman rice mostly because of unavailability of seedlings; even available, the seedlings are either too young or too old to produce satisfactory yield. Thus scarcity of rice seedlings is a great problem and therefore if seedlings can be made available farmers can go for rehabilitation of their flood affected aman rice crop as soon as flood water recedes. The best option available to overcome this situation is to separate few tillers from the aman rice, not affected by flood, and re-transplant those splitted tillers as a post-flood transplant aman crop (Paul et al., 2003; Anwar and Begum, 2004; Khan et al., 2008; Sarkar et al., 2002). Tiller separation and replanting for various reasons is an age-old practice in Bangladesh (Hossain et al., 1988). But tolerance of mother plant to tiller separation in terms of time of separation and number of tillers separated is very important before going for tiller separation to ensure the potential yield of mother plant. If tiller separation significantly reduces yield of mother crop farmers will never go for tiller separation. In this study an attempt was made to identify the tolerance level of hybrid rice variety Dhani Gold to tiller separation, and thus to evaluate the potentiality to grow its splitted tillers as a post-flood crop without affecting the productivity of mother crop. In this study, growth of hybrid rice Dhani Gold was evaluated in terms of plant height and tillering ability. It was observed that tiller separation exerted a negative effect on both plant height and tillering ability of Dhani Gold. Tiller separation resulted in reduced plant height and early separation of tillers resulted in less reduction in plant height compared to late separation. Similarly, reduction in plant height was gradually increased with the increase in number of tiller separation.

Negative effect of late tiller separation on plant height of rice has also been reported by many others (Mamin et al., 1999; Paul et al., 2002). Disturbance of mother plants at late vegetative stage might be

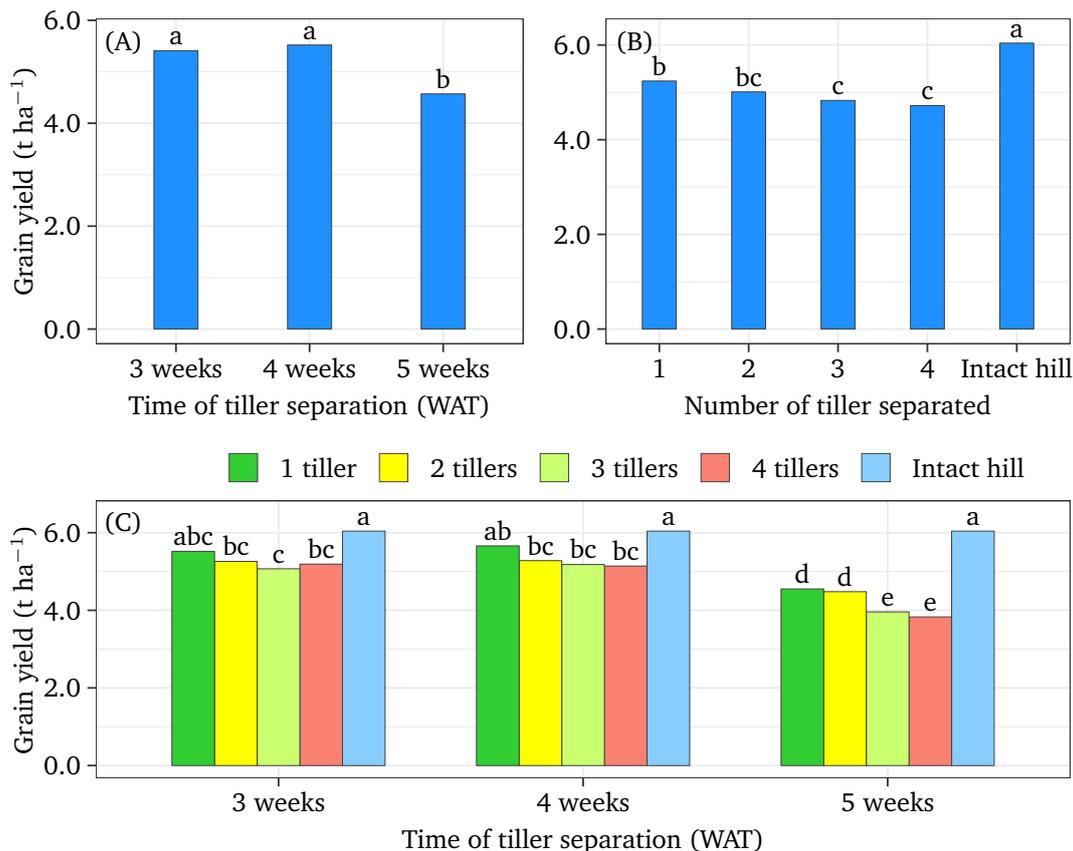


Figure 1. Effect of time of tiller separation, number of tillers separated hill⁻¹ and their interaction on yield of hybrid rice variety Dhani Gold. WAT = weeks after transplanting

responsible for reduced plant height as stated by Anwar and Begum (2004). Unlike plant stature, tiller ability of Dhani Gold was reduced less due to late tiller separation compared to early separation. But like plant height, tillering ability of Dhani Gold gradually reduced with increased number of tiller mutilation. Anwar and Begum (2004) also reported similar observations when tiller separation was done in hybrid rice Sonar Bangla 1. Khan et al. (2008), on the other hand, reported contrasting findings from their research where they mutilated tillers from an inbred rice variety BRR1 dhan41. The differences might be due to the variation in genetic characteristics between hybrid and inbred rice. In general, tillering ability of rice decreases with the increasing competition for light and other resources (Ishizuka and Tanaka, 1963) and therefore, removal of tillers is expected to promote light distribution within canopy and photosynthetic efficiency of the rice plant as well (Yoshida, 1981). In contrast to the present findings, Biswas and Salokhe (2005) opined that the retillering ability of rice increases with higher intensities of tiller separation.

As observed in this study, all the yield contributing characters and yield of Dhani Gold were reduced when tiller separation was done at 5 WAT compared

to 3 and 4 WAT which confirms that late separation of tillers negatively affect the productivity of rice. Similar findings were observed by Khan et al. (2008) who concluded that late separation of tillers after 3 weeks of transplanting impaired the yield contributing characters like bearing tillers hill⁻¹ and grains panicle⁻¹ but enhanced number of non-bearing tillers hill⁻¹. Findings of the present study showed that yield contributing characters and yield of Dhani Gold registered a decreasing trend with the increased number of tiller splitting, and intact plants from where no tiller was separated exhibited the highest productivity. Compared to intact hills, the maximum of 36% yield reduction was occurred when 3 or 4 tillers hill⁻¹ were separated at 5 WAT. On the other hand, separation of only 1 tiller hill⁻¹ at either 3 or 4 WAT resulted in no significant reduction in grain yield of Dhani Gold as compared to intact hills. Reduction in productivity hybrid rice Dhani Gold due to late separation of more than 2 tillers hill⁻¹ was due to the poor performances of yield contributing characters. Yield retarding characters like non-effective tillers hill⁻¹ also contributed to the yield reduction due to tiller separation since number of effective tillers hill⁻¹ were gradually increased with the delay in tiller separation and increasing number of tillers separated. Similar findings

have been reported by many researchers (Paul et al., 2002; Anwar and Begum, 2004; Khan et al., 2008) who found that early separation of minimum number of tillers has very minimum effect on the productivity of mother rice plant. This could be attributed to the reduced shading effect on lower portion of plant which facilitates increase assimilate synthesis and ultimately promotes the growth of newly formed tillers (Tsuno and Yamaguchi, 1989). Another possible reason may be that removal of excess leaf area through tiller separation increases the availability of additional space for growth of more tillers (Roy et al., 1990).

5 Conclusions

Present study confirms that hybrid rice variety Dhani Gold is tolerant to tiller separation to some extent. If only 1 tiller hill⁻¹ is separated at or before 4 weeks after transplanting the yield performance of mother crop will remain unaffected. But late separation of 2 or more tillers hill⁻¹ after 4 WAT will result in significant yield reduction. Therefore, farmers can separate only 1 tiller hill⁻¹ from hybrid rice Dhani Gold before 4 weeks after transplanting and replant to restore the crop damaged by unexpected natural hazards like flood without sacrificing the productivity of mother crop. Furthermore, vegetative propagation through mutilated tillers can be practiced to save the cost of hybrid rice seeds which price is sky-high.

Conflict of Interest

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

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The Official Journal of the
Farm to Fork Foundation
ISSN: 2518–2021 (print)
ISSN: 2415–4474 (electronic)
<http://www.f2ffoundation.org/faa>