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Short Communication

Effect of Leaf Clipping on Yield Attributes of Modern and Local Rice Varieties

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ABSTRACT

Impact of five different types of leaf clipping on the yield attributes of modern (Binadhan-8) and local (Terebaile) rice variety was evaluated on pot experiments following a completely randomized design (CRD) with three replications. Leaves were cut according to the treatment. Data were collected on panicle length (cm), filled grain panicle^{-1}, unfilled grain panicle^{-1}, thousand grain weight (g), grain weight panicle^{-1} (g). In Binadhan-8, flag leaf alone or flag leaf with 2nd leaf and 2nd and 3rd leaves cutting showed profound reduction in grain number panicle^{-1} (35.14, 62.62, and 51.83%, respectively) and grain weight panicle^{-1} (29.18, 58.37 and 48.93%, respectively) while, cutting of 2nd leaf and 3rd leaf alone exert no significant impact compared to control. Number of unfilled grain increased with higher intensity of leaf cutting. In Terebaile, only flag leaf cut showed non-significant impact on grain number panicle^{-1} and grain weight panicle^{-1}. Profound impact was observed by cutting flag leaf with 2nd leaf (55.47 and 48.98%, respectively) and flag leaf with 2nd and 3rd leaf (58.96 and 63.13%, respectively). Leaf clipping had non-significant effect on thousand grain weight of modern variety Binadhan-8 while, it had significant effect in Terebaile.

Key words: Leaf clipping, rice variety, yield attributes

INTRODUCTION

Rice (*Oryza sativa* L.) is the staple food of about 166 million people of Bangladesh. Rice contributes about 60% GDP of the crop sector in Bangladesh and employs 47.8% of the total labour force (www. worldometers.info).

In cereal crops, yield formation is a complex process. Leaves are vitally essential organs for photosynthesis, which is a major process affecting crop growth rates and is affected by either the number or the area of the leaves. Since the productivity of a plant depends on the efficiency of its photosynthetic processes, the growth and development of leaves (Karadogan and Akgun, 2009). Leaf has important role to improve yield. During grain formation stage, the youngest flag leaf of rice remained metabolically more active. The grain yield and straw yield of rice increased significantly with the presence of flag leaf.

Leaf photosynthesis can be influenced by many plant factors such as leaf age, leaf position, sink effects, and mutual shading, as well as environmental factors such as light, temperature, nutrition, and water availability (Lieth and Pasian, 1990). Defoliation or leaf damage can decreases assimilate availability during grain filling, seed and biological yield (Echarte *et al.*, 2006).

Tiller number and flag leaf play an important role regarding growth and yield of rice. About 60-90% of the total carbon content in the panicles at harvest is obtained from photosynthesis after heading while around equal or more than 80% of nitrogen in the panicles at harvest is absorbed before heading and remobilized from vegetative organs (Mae, 1997). Misra (1986) observed both the

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economic and biological yields were closely related with optimum leaf area index of plant population of different rice varieties. Flag leaf contributed to 45% of grain yield and is the single most component for yield loss (Abou-khalifa *et al*., 2008).

The top three leaves not only assimilate majority of carbon for grain filling during ripening phase but also provide large proportion of remobilized-nitrogen for grain development during their senescence (Misra and Misra, 1991; Mae, 1997).

The grain yield and straw yield of rice increased significantly with the presence of flag leaf. Local rice variety differs from modern variety in various morphological and physiological aspects specifically in transformation of assimilation to grain development.

Considering the facts discussed above the present research work has been undertaken to determine the effect of leaf clipping on yield attributes of modern rice variety Binadhan-8 and local rice variety Terebaile.

The experiment was conducted in the net house of Plant Breeding and Biotechnology Laboratory of Khulna University, Khulna during the Boro season 2013 (January–June). Rice cultivars Binadhan-8 (modern) and Terebaile (local) were. Following leaf clipping treatments were applied for both the experiments.

L_0- Control (without leaf cutting)

L_1 - Flag leaf cut

L_2- 2nd leaf cut

L_3- 3rd leaf cut

L_4- Both flag leaf and 2nd leaf cut

L_5- Flag leaf with 2nd and 3rd leaves cut together

The experiments were laid out in a completely randomized design (CRD) with three replications.

Earthen pots of 11"(27.94 cm) in upper diameter and 9"(22.86 cm) in height were used for the experiments. Every pot was filled with 8 kg of dry soil treated with bleaching powder @ 100 mg per kg soil to kill soil borne pathogen. Fertilizer doses were 0.22, 0.13, 0.08, 0.03 and 0.14g urea, TSP, MoP, zinc sulphate and Gypsum respectively for kg^{-1} dry soil.

One-third of urea and full doses of other fertilizers were applied as basal doses and then incorporated to soil by hand. Rest of the two-third urea was applied in two equal splits at 15 and 45 days after transplanting. Forty-three-day-old seedlings were transplanted at the rate of single seedling in each pot on 7 February 2013. Irrigation and other intercultural operations were done as and when required. Leaf clipping was done prior to panicle emergence stage following the assigned treatment. Binadhan-8 and Terebaile were harvested on 28 April 2013 and 10 May 2013 respectively. Yield contributing data were recorded as follows: panicle length, grain number $panicle^{-1}$, unfilled grain number $panicle^{-1}$, thousand grain weight (TGW), grain weight $panicle^{-1}$. All the data were analyzed by MSTAT-C. The differences between the treatment means were determined by using Duncan's new multiple range test (DMRT).

Significant effect of leaf clipping was noticed in most of the parameters studied in both the rice cultivars. In Binadhan-8, the highest number of filled grain $panicle^{-1}$ was found in control plants (104.00) which did not vary significantly from 2nd and 3rd leaf cut. Significant reduction in filled grains takes place by flag leaf cut (35.14%), flag leaf with 2nd leaf cut (62.62%) and flag leaf with 2nd and 3rd leaf cut (51.83 %). Unfilled grain number increased with higher intensity of leaf cutting and was the highest (79.40) in flag leaf with 3rd leaf cut (133.59%), which was similar with flag leaf with 2nd leaf cut (65.91). The lowest unfilled grain was in the control (33.99) which did not vary with 3rd leaf cut alone (39.57). Flag leaf cut and 2nd leaf cut showed the similar and moderate values (Table 1). TGW did not vary due to leaf cutting. Grain weight $panicle^{-1}$ was the highest in control plants (2.33 g), which was not affected due to 2nd leaf and 3rd leaf cut. Grain weight significantly reduced due to flag leaf cut (29.18%), flag leaf with 2nd leaf cut (58.37%) and flag leaf with 2nd and 3rd leaves cut (48.93%).

Table 1. Effect of leaf clipping on yield attributes of modern rice cultivar Binadhan-8.

Treatment (Leaf clipping)	Panicle length (cm)	Filled grain panicle $^{-1}$	Thousand grain weight (g)	Grain weight panicle $^{-1}$ (g)
L_0	24.97	104.00 a	21.37	2.33 a
L_1	20.65	67.45bc (35.14)	21.57	1.65bc (29.18)
L_2	24.93	95.37ab (8.29)	20.04	2.11ab (9.44)
L_3	26.11	91.60ab (11.92)	21.73	2.12ab (9.01)
L_4	23.27	38.88c (62.62)	20.44	0.97d (58.37)
L_5	23.56	50.10c (51.83)	20.66	1.19cd (48.93)
CV (%)	7.85	15.57	6.61	14.22
Level of significance	NS	0.01	NS	0.01

Data in a column accompanied by the same letter (s) are not significantly different at the 1% level as per DMRT. Figures in the parenthesis indicate the percent reduced / increased over the control. CV= Coefficient of variation; NS= Not significant. L_0- Control (without leaf cutting), L_1 - Flag leaf cut, L_2- 2nd leaf cut, L_3- 3rd leaf cut, L_4- Both flag leaf and 2nd leaf cut, L_5 - Flag leaf with 2nd and 3rd leaves cut together.

In Terebaile, leaf clipping exhibits significant effect on yield attributes except panicle length. Number grain panicle^{-1} did not vary from control due to flag leaf cut and 3rd leaf cut. Number of filled grain reduced significantly due to 2nd leaf cut (18.57%), flag leaf with 2nd leaf cut (55.47%) and flag leaf with 2nd and 3rd leaves cut (58.96%). Number of unfilled grain increased with higher intensity of leaf cutting. The highest number of unfilled grain was in flag leaf with 2nd leaf cut (76.94) which was 482.44% higher than control (13.21). Rest of the treatments had statistically similar values with the control (Table 2). TGW decreased with the progressive increase in leaf clipping and the highest value was in the control treatment (22.20 g) and the lowest value (15.27 g) was in flag leaf with 2nd and 3rd leaves cut (31.22% less). Only flag leaf, 2nd leaf and 3rd leaf cut exhibits no significant impact on TGW compared to control rather than flag leaf together with 2nd leaf as well as 2nd and 3rd leaves cut. Grain weight

Table 2. Effect of leaf clipping on yield attributes of local rice cultivar Terebaile.

Treatment (Leaf clipping)	Panicle length (cm)	Filled grain panicle $^{-1}$	Thousand grain weight (g)	Grain weight panicle $^{-1}$ (g)
L_0	21.24	92.55ab	22.20a	1.98a
L_1	20.84	86.46ab (6.58)	21.23ab (3.92)	1.95a (1.52)
L_2	19.63	75.36b (18.57)	19.95ab (10.14)	1.59ab (19.69)
L_3	22.62	100.7a (8.81)	20.27ab (8.69)	2.10a (6.06)
L_4	21.25	41.21c (55.47)	17.92bc (19.28)	1.01bc (48.98)
L_5	20.67	37.98c (58.96)	15.27c (31.22)	0.73c (63.13)
CV (%)	8.63	12.91	10.02	15.92
Level of significance	NS	0.01	0.05	0.01

Data in a column accompanied by the same letter (s) are not significantly different at the 1% level as per DMRT. Figures in the parenthesis indicate the percent reduced / increased over the control. CV= Coefficient of variation; NS= Not significant. L_0- Control (without leaf cutting), L_1 - Flag leaf cut, L_2- 2nd leaf cut, L_3- 3rd leaf cut, L_4- Both flag leaf and 2nd leaf cut, L_5 - Flag leaf with 2nd and 3rd leaves cut together.

panicle^{-1}was not changed due to flag leaf, 2nd leaf and 3rd leaf cut alone compared to control (1.98 g). Flag with 2nd leaf and flag leaf with 2nd and 3rd leaf cut showed marked reduction in grain weight panicle^{-1} where the latter one bears the lowest value (0.73 g), which was 63.13% less than the control.

DISCUSSION

Leaf clipping effects significantly on the yield attributes of both modern and local rice varieties. In the modern variety, the impact of flag leaf cut was prominent rather than 2nd and 3rd leaf cut alone but profound impact was observed by flag leaf together with 2nd leaf and 2nd as well as 3rd leaves cut. It indicates that, flag leaf plays a vital role in the supply of assimilate to panicle in absence of 2nd leaf or 2nd as well as 3rd leaves. This result is in agreement with earlier reports that, flag leaf contributed to 45% of grain yield (Misra, 1995) and is the single most component for yield loss (Abou-Khalifa *et al.*, 2008). In local variety, number of filled grain and grain number panicle^{-1} did not vary significantly in absence of flag leaf compared to the control. It indicates that 2nd and 3rd leaves can compensate for the flag leaf. Marked impact was noticed by cutting flag leaf together with 2nd leaf and 2nd as well as 3rd leaves. Similar finding was also reported by Misra and Misra (1991) and Mae (1997), who stated that the top three leaves not only assimilate majority of carbon for grain filling during ripening phase but also provide large proportion of remobilized-nitrogen for grain development during their senescence. Abou-Khalifa *et al.* (2008) showed that in rice leaf clipping, L5, L4, L1, L2 and L3 treatments the loss of grain yield was 59.87, 94.92, 44.89, 29.58 and 19.98% of control, respectively. Leaf cutting exhibits non-significant impact on TGW of modern variety but it was significant in local variety. This result was supported by Abou-Khalifa *et al.* (2008) who stated that in case of leaf cutting, hybrid rice cultivar H5 had relatively higher but non-significant TGW than the traditional inbred Egyptian local rice cultivar Sakha 103.

CONCLUSIONS

In modern variety, flag leaf plays a vital role in grain development, which could not be substituted by 2nd and 3rd leaves but in local variety, 2nd and 3rd leaves can be an effective substitute for grain development in absence of flag leaf. Leaf clipping had non-significant effect on TGW of modern variety while it was significant in local variety.

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