Rice (*Oryza sativa*) production response of stems biomass to severe water deficit conditions
渇水条件におけるコメ生産と茎のバイオマス量の応答に関する研究

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Introduction

As the global climate changes continue, water shortage and drought are increasingly becoming a serious limitation to rice production. Stress-induced avoidance responses such as stomata closure, reduction of organ elongation rates and slower organ production rates are well documented (Dingkuhn et al. 1999). However, the response of rice stems biomass at three critical rice growth stages (late vegetative , early reproductive and grain filling stage) to severe water deficit conditions need further evaluation.

Rice stems serve as a temporary sink to store excess photoassimilate during vegetative growth, and can provide a net carbon gain for rice growth during water limited periods. In this study, stem biomass production to progressive soil drying was evaluated in relation to some yield traits like panicle number, spikelet per panicle (SPP) and panicle dry weight (panicle DW). Our objective was to examine if the net carbon gain in the form of increased stem biomass contributes significantly to this traits during the water limited periods.

Material and Methods

A greenhouse pot experiment was carried out at the Tokyo University of Agriculture and Technology, Fuchu Campus in the summer of 2017. The experiment compared four water regimes, a well-watered (control) and three water deficit treatment in a progressive soil dry down to simulate 0.8, 0.5 and 0.2 fraction of transpirable soil water (FTSW), hereafter designated WS1, WS2 and WS3 respectively. A water balance was computed daily by weighing of pots and enabled the computation of FTSW (Fig. 1) as described by Soltani et al (2000);

$$\mathbf{FTSW} = \frac{\boldsymbol{ATSW}}{\boldsymbol{TTSW}} = \frac{\boldsymbol{Wt-Wf}}{\boldsymbol{Wi-Wf}}$$

Where ATSW is the actual transpirable soil water determined for each pot as pot weight on a specific day (Wt) minus the final pot weight (Wf), that is, the pot weight when transpirable soil water is

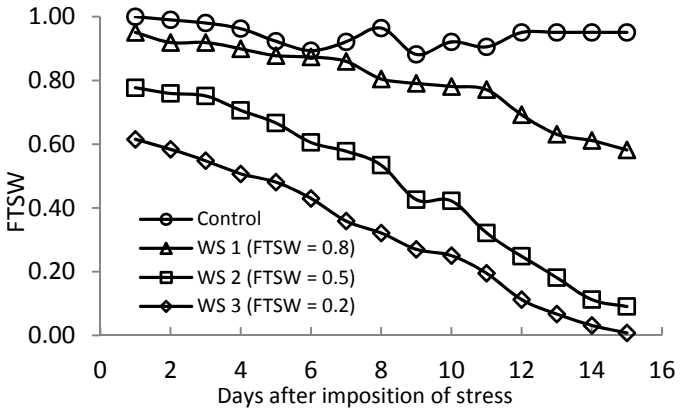

Fig.1 Fraction of transpirable soil water (FTSW) dynamics in pot experiment.

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negligible (relative transpiration is < 0.1); TTSW is the total transpirable soil water.

The rice variety IR 64 (indica ideotype) was transplanted to 1/5000-a Wagner pots (AS One Corp., Japan) with three plants per pot. Optimum fertilizer rates were applied for all treatments. The pots were arranged in a randomized complete block design with nine replications per treatment to enable destructive samplings at three time periods H1, H2 and H3 representing late vegetative, early reproductive and grain filling stage respectively.

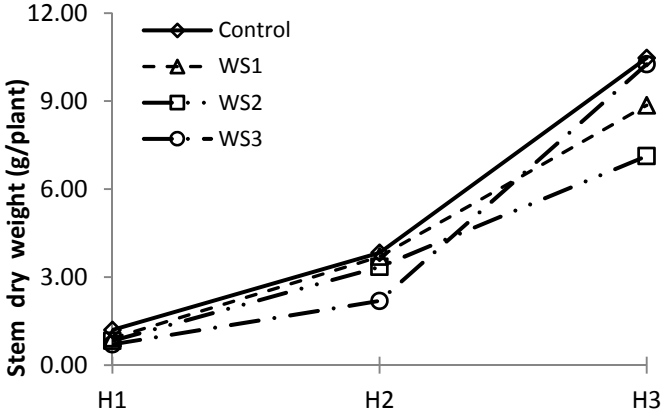

Fig.2 Effect of water deficit conditions on stem dry weight at the three critical growth periods.

Results and Discussions

In this study, the most severe water deficit condition (WS3) increased the stem biomass at the grain filling stage (Fig. 2) compared to the other water deficit regimes at the same stage (H3). This increase could be as a result of reduced remobilization of photoassimilates from rice stem to the yield traits. In addition due to the senescence of plant parts during water deficit conditions, grain filling period is shortened and this could leave too much unused carbon in the rice stem.

Table 1 shows some yield traits that contribute to final grain yield of rice. The panicle per hill in the water deficit treatments was not significantly different. However the panicles dry weights in the water deficit treatments were reduced. The reason for this reduction is due to the slow remobilization of stored photoassimilates in the stem during grain filling period. The spikelet per panicle (SPP) remained unchanged in all water treatments with no significant differences. Although source capacity of the rice stems was increased due to water deficit conditions, it did not translate to increase SPP because of the weakened sink capacity. This may be genotypic and recently improved varieties may remobilize the stored carbon quickly to improve yield traits during time of limited water. This work was partially supported by JSPS KAKENHI Grant Number 18H02295

Table 1. Yield traits of IR 64 subjected to flooded and water deficit conditions.

Water regime	Panicle/hill	Panicle DW (g/plant)	SPP
Control	15.7 a	8.0 a	10.3 a
WS1	11.3 b	7.4 ab	10.0 a
WS2	11.0 b	6.5 b	10.0 a
WS3	11.7 b	4.9 c	10.0 a

Means followed by a different letter in a column are significantly different at $p < 0.05$ according to Tukey's test.

References

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