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Sustainable Soil Management and Conservation

16-18 APRIL 2019

Equatorial Hotel, Melaka

EDITORS

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GROWTH RESPONSE OF DIFFERENT AEROBIC RICE VARIETIES TO WATER STRESS

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INTRODUCTION

Rice (Oryza sativa L.) is one of the staple food worldwide which supports more than three billion people and provides 50% to 80% of their daily calorie intake (Khush, 2005). In Malaysia, about three-quarters of the total fresh water supply are consumed by irrigation Agriculture. About 90% of this is channeled to low rice production (Chan et al. 2012). Aerobic rice cultivation system, is where the rice crop is grown from direct seeding in non-puddle and un-flooded soil condition. This is seen as the most promising way to save water and labour (Jana et al. 2018). Water has been an important factor in agricultural and food production and at the same time a limited resource (Wang et al. 2012). Water deficit stress causes highest loss to agricultural production worldwide, leading to serious threat to sustainable agriculture. To feed a highly increasing population with depleting water supply requires crop varieties that are highly adapted to dry environments (Pandey et al. 2015).

MATERIALS AND METHODS

Glasshouse experiment was conducted at Ladang 2 Universiti Putra Malaysia (UPM). Three aerobic rice varieties used were MRIA 1, MR219-4 and MR219-9 which were developed by the Malaysian Agricultural Research and Development Institute (MARDI), Malaysian Nuclear Agency and Universiti Putra Malaysia (Abdullah et al. 2010). The varieties were sown (3 seeds/pot) in pots each containing 7 kg mineral clay soil. Water deficit stress was applied every 1, 4, 8 and 12 days watering intervals which started 26th day after sowing (DAS). The experiment was a 2 factor (3x4) with three rice varieties and four watering intervals (W1, W4, W8 and W12). Water application was 0.5 litre per pot at each irrigation schedule 26 DAS. The study was arranged in a Randomized Complete Block Design (RCBD) with 5 replications. Fertilizer applications were at 16, 36 and 60 DAS at the rate of; 120 kg N ha^{-1}, 60 kg ha^{-1} of P_2O_5 and 60 kg ha^{-1} of K_2O in the form of urea, TSP and MOP respectively (MARDI, 2014). Shoot and root dry mass, grain weight, grain filling percentage and other yield measurements were determined at harvest.

RESULTS AND DISCUSSION

Figure 1 (A, B, C and D), shows that, plant growth and yield were significantly affected by varieties and watering intervals. Shoot dry mass in MRIA 1, MR219-4 and MR219-9 at 12 days watering intervals were lower by 70%, 55% and55% respectively. Grain weight loss at 12 days watering interval in MRIA 1, MR219-4 and MR219-9 were 21%, 24% and 23% respectively.

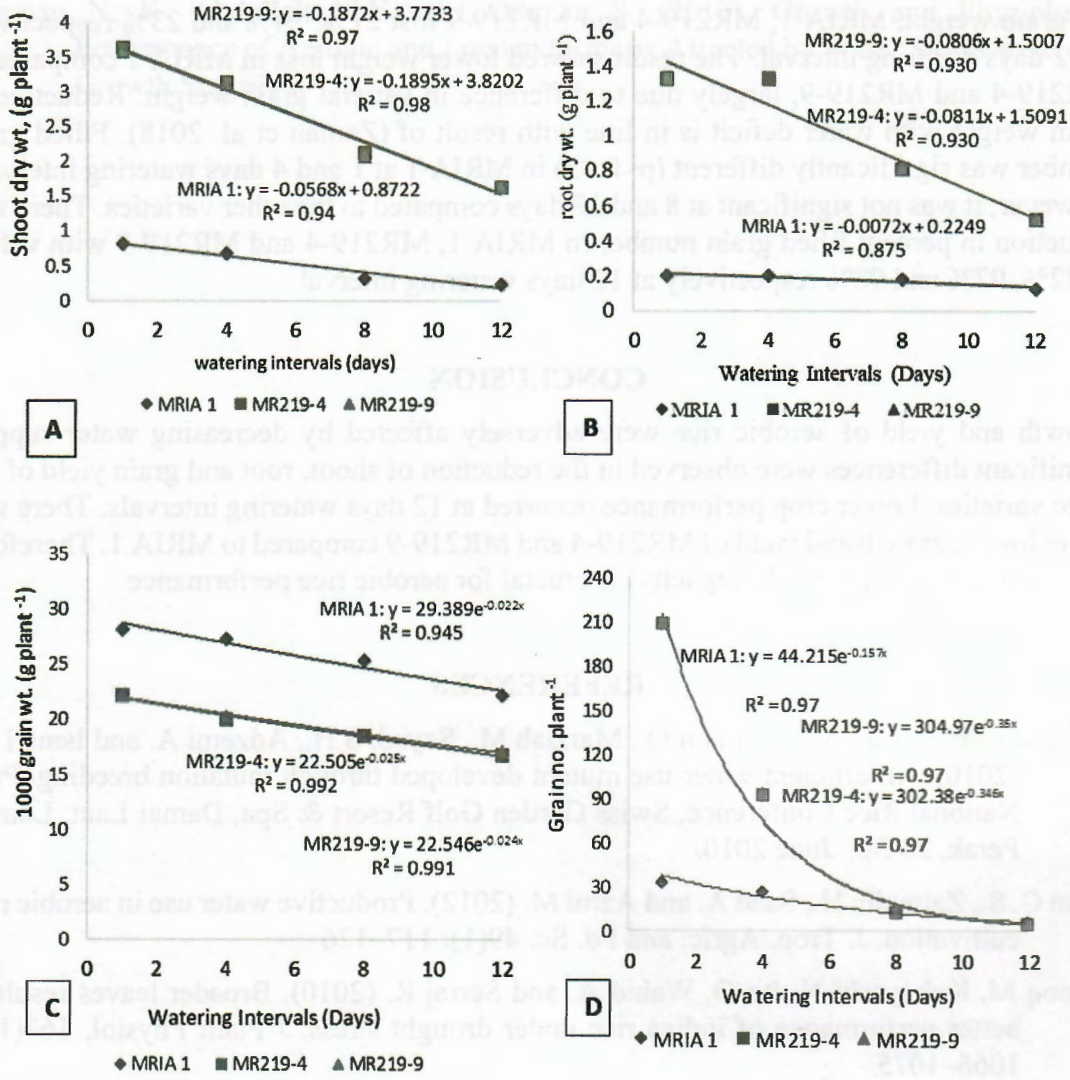

Figure 1: Effect of variety, watering intervals on Shoot and root dry matter (A and B), on 1000 grain weight and filled grain number (C and D). Means followed with the same letter within a column are not significantly different ($p<0.05$) from each other as determined using Tukey HSD.

There were differences in the amount of water lost among the varieties. MRIA 1 lost 70% of shoot dry mass at 12 days watering intervals compared to MR219-4 and MR219-9 that lost 55% each at the same water treatment. The decline in shoot dry mass with increase in drought severity could be due to restricted root growth, nutrients uptake, photosynthesis among other reasons. This is in line with the findings of (Farooq et al. 2010) who reported an increase biomass with adequate water supply. The root dry mass followed similar trend as MRIA, MR219-4 and MR219-9 lost 38%, 61% and 61% respectively at 12 days watering intervals. This reduction in root growth might be due to reduced root elongation and growth due to reduced water supply as supported by the work of (Feng et al. 2012).

On grain weight, MRIA 1, MR219-4 and MR219-9 lost 21%, 24% and 23% respectively at 12 days watering interval. The result showed lower weight loss in MRIA 1 compared to MR219-4 and MR219-9, largely due to difference in varietal grain weight. Reduction in grain weight with water deficit is in line with result of (Zaman et al. 2018). Filled grain number was significantly different ($p<0.05$) in MRIA 1 at 1 and 4 days watering intervals. However, it was not significant at 8 and 12 days compared to the other varieties. There was reduction in percent filled grain number in MRIA 1, MR219-4 and MR219-9 with values of 82%, 97% and 98% respectively at 12 days watering interval.

CONCLUSION

Growth and yield of aerobic rice were adversely affected by decreasing water supply. Significant differences were observed in the reduction of shoot, root and grain yield of the three varieties. Lower crop performance occurred at 12 days watering intervals. There was lower loss in growth and yield of MR219-4 and MR219-9 compared to MRIA 1. Therefore, adequate water supply (field capacity) is crucial for aerobic rice performance

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