

ABSTRACT

Water deficit is a severe environmental stress and the major constraint on plant productivity. Water deficit cause an array of morpho-anatomical, physiological and biochemical changes in plants, which affects plant growth and development and may lead to a drastic reduction in economic yield. The adverse effect of drought stress can be mitigated by developing crop plants with drought tolerance using various genetic approaches. To attain the target, a thorough understanding of physiological responses of plants to drought stress and possible strategies for improving crop drought tolerance is imperative. Several studies were carried out on physiology of plant growth, but there have been limited reports which explored on the combined effects of stress factors. Therefore, the present study was attempted to relate physiological traits under water deficit condition and explore the possibility of utilizing it for further crop improvement in rice. Three commercial Malaysian rice varieties namely MR232, MR220 and MR219 were grown incompletely randomized block design with five replications. Plants were subjected to drought stress by withholding water at four important growth stages (seedling, tillering, panicle initiation and grain filling stage) for a period of 7-10 days. Drought stress symptom was noticed by wilting of leaves. At the time of wilting, physiological parameters like root and shoot length, chlorophyll a and b content, total chlorophyll content, chlorophyll stability index, relative water content, proline accumulation and protein content were estimated for both controlled and stress induced plants. Drought stress increases the root growth and the highest root growth was observed in all three varieties on 65th day. A significant ($p < 0.05$) increase in the root growth from 25th, 45th and 65th day in MR220 and MR219 due to drought. Whereas shoot length decreases gradually at progressive stages in all three varieties. A greater percentage differences in shoot growth was noticed in MR219. Total chlorophyll content was witnessed to decrease progressively under drought stress in all three varieties. A decrease in chlorophyll stability index was noticed during 25th and 45th day, thereafter it increased at 60th and 90th days in all three rice varieties. A sharp significant ($p < 0.05$) decline in relative water content was recorded among the genotypes at all the stages of growth, among the varieties, MR220 had greater value for relative water content when subjected to drought stress. Under drought stress the proline

content had increased invariably in all the three varieties. Greater differences in proline biosynthesis between control and stressed plant were noticed in MR232 followed by MR219 and MR220. The protein content decreased significantly ($p < 0.05$) in all the cultivars when subjected to drought stress. Moderate to high estimates of genotypic variance, broad sense heritability was for chlorophyll a, total chlorophyll, chlorophyll stability index and protein. The high estimates indicated that the physiological parameters had inherent potential for drought improvement program. Moreover, all parameters used in the study are fair enough to distinguish between tolerance and susceptible genotypes. Therefore, these parameters could be considered as key indicators for laboratory screening in determining drought tolerance in rice plants.