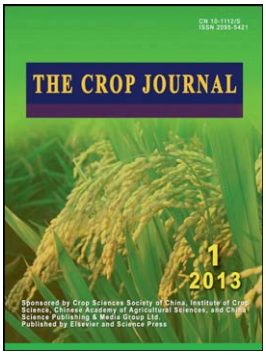

A new method for evaluating the drought tolerance of upland rice cultivars

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A new method for evaluating the drought tolerance of upland rice cultivars

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Abstract: Worldwide, approximately 27 million ha of rice are grown in upland rather than paddy fields, and is subject to drought stress. To counter this stress, it is desirable to breed new rice cultivars with improved drought tolerance. For breeding purposes, especially for breeding upland rice, it is desirable to develop a simple and accurate method to evaluate rice drought tolerance. We describe a new method that can be used to evaluate efficiently the drought tolerance degree (DTD) of upland rice cultivars, and call it the DTD method. DTD is defined as the mean of the ratios of green leaf length to total leaf length of the top three leaves in every rice seedling after drought treatment, and thus takes values from zero to one. To test whether the DTD method works effectively to evaluate drought tolerance of upland rice cultivars, we determined the DTD values of 13 upland rice cultivars showing varying degrees of drought tolerance in drought-tolerance trials. The *idr1-1* mutant, which displayed the strongest drought tolerance of the 13 cultivars as identified by drought-tolerance trials under severe drought stress, had the highest DTD value and *297-28*, displaying the weakest drought tolerance, had the lowest DTD value. Further analyses of water potential, survival rate, panicles per plant, spikelets per panicle, seed setting rate, yield per plant, and contents of proline, chlorophyll, and malondialdehyde (MDA) indicated that DTD values are in general correlated with the values of these traits, making this new method useful for assessing the drought tolerance of upland rice cultivars. These results show that the DTD method is a simple, direct and relatively accurate evaluation method for drought-tolerance breeding of upland rice.

Keywords: Upland rice; Breeding; Drought tolerance degree (DTD); New evaluation method

Abbreviations: DTD, drought tolerance degree; MDA, malondialdehyde; ABA, abscisic acid; PMM, precise moisture measurement

1. Introduction

Crop growth and production are strongly affected by abiotic and biotic stresses [1]. When crops are subjected to drought stress, numerous changes occur at the physiological, metabolic, and molecular levels in comparison with crops grown under nonstressed conditions [2, 3]. Although studies of the drought tolerance of crops have been performed for many years [4–8], the mechanisms by which crops respond to drought stress remains largely unknown, greatly hindering the improvement of drought-tolerant crops.

Rice feeds nearly half of the world's population [7, 9]. It is thought [10–12] that rice originated and evolved in tropical and subtropical areas, and it is generally sensitive to drought. Water deficit is one of the major environmental constraints severely reducing rice yields [13]. Asian cultivated rice (*Oryza sativa* L.) can be categorized into two groups: *indica* and *japonica* subspecies. In each subspecies, there are two different ecotypes:

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