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Shoot length – A tool to evaluate rice genotypes for zinc efficiency in solution culture

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ABSTRACT

Zinc deficiency is a widespread micronutrient disorder constraining rice production worldwide. A long term sustainable solution to zinc deficiency limitation is the development of rice genotypes with superior zinc efficiency. Zinc deficiency results in shortening of internodes in zinc inefficient genotypes and hence depression in shoot length at deficient zinc supply was employed as a tool to identify zinc efficient genotypes under solution culture. About 56 rice genotypes were grown with five levels of zinc (Zn 0.0, 0.025, 0.05, 0.1 and 0.2 ppm as $ZnSO_4$). The experiment was conducted with factorial completely randomized design with each treatment replicated thrice. Standard Evaluation System of Rice was employed to score genotypes for zinc stress. The per cent depression in shoot length from the optimum (0.1 ppm) was computed by employing standard formula and the genotypes were categorized as zinc efficient (a), moderately zinc efficient (b) and zinc inefficient (c) by Systat Multivariate Analysis

Keywords : Rice genotypes, Shoot length, Solution culture, Zinc efficiency.

Estimates reveal that about 50 % of soils used for cereal production in the world have low levels of plant available Zn (Graham and Welch, 1996). Correction of zinc deficiency via fertilization does not always remain a successful strategy due to agronomic and economic factors. A more efficient and sustainable solution to zinc deficiency limitation is the development and use of zinc efficient rice genotypes with root system capable of greater mobilization that can more efficiently function under low soil zinc conditions. Zinc plays a key role as a structural constituent or regulatory co-factor of a wide range of different enzymes in many important biochemical pathways as carbohydrate metabolism and protein metabolism. Zinc deficient plants show a marked reduction in plant height and develop whitish brown patches. As zinc stress results in shortening of internodes in zinc inefficient genotypes, reduction in shoot length at deficient zinc supply under solution culture may serve as a valuable tool in screening genotypes for their zinc efficiency and with this objective, the present investigation was framed.

MATERIALS AND METHODS

The experiment was conducted during 2002 - 03 in the Green house of the Department of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University. About 56 rice genotypes which include varieties, prerelease cultures and landraces were subjected to screening employing solution culture. Plastic plates with depressions, bottom severed with nylon mesh were countersunk into trays containing modified Hoagland solution (Hoagland and Arnon, 1950) as the nutrient medium. Pregerminated seedlings (five days old) were raised in the trays and the solution below was aerated with fabricated aerators. Five levels of zinc (Zn 0.0, 0.025, 0.05, 0.1 and 0.2 ppm as $ZnSO_4$) were imposed. The experiment was laid out in factorial completely randomized design with each treatment replicated thrice. The seedlings were screened at ten days interval adopting Standard Evaluation System of Rice (IRRI, 1980).

The percent depression in shoot length at 30 days was calculated as,

$$\text{Ex., Per cent depression in shoot length} = \frac{\text{Shoot length}_{\text{adequate Zn}} - \text{Shoot length}_{\text{low Zn}}}{\text{Shoot length}_{\text{adequate Zn}}} \times 100$$

The adequate level of zinc for rice under hydroponics is 0.1 ppm. The data were subjected to Systat Multivariate Analysis (Systat, 2002) and the rice genotypes were grouped as a,b,c where 'a' represents highly zinc efficient, 'b', moderately zinc efficient and 'c', zinc inefficient genotypes.

RESULTS AND DISCUSSION

The per cent depression in shoot length from that of 0.1 mg L^{-1} Zn as noted from Systat Multivariate Analysis forecasted prominent variation in zinc efficiency. The