RESEARCH ARTICLE

DROUGHT RESISTANCE PARAMETERS AS SELECTION PARAMETERS TO IDENTIFY DROUGHT TOLERANT RICE GENOTYPES

A.K. Mall and Varucha Misra*

ICAR-Indian Institute of Sugarcane Research, Lucknow-226 002, U.P.
Email: Ashutosh.Mall@icar.gov.in

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Abstract: Multidimensional effect of drought on rice cultivation in Asia is a recurring climatic event. about 4.62 and 6 million ha area of rice in India in year 2002 and 2009, respectively had been reduced alone due to drought. The development of high yielding drought tolerant rice varieties for diverse nature of drought prone upland ecology is still in its infancy and germplasm still needs to be improved in rainfed eastern India. Considering this, this study has been done to evaluate early maturing genotypes over the season for upland areas of sufficient and deficit moisture regimes. Twenty seven genotypes in advanced yield trial less than 100 days (AYTLT 100 days) were tested for drought tolerance and yield performance. Results showed that Genotype x environment interaction accounted for 32 per cent of the total sum of squares, with environment and genotype responsible for 25 per cent and 43 per cent. There was also significant variation in the delay in flowering among drought stressed genotypes in which flowering time was similar under irrigated condition. Similarly, significant genotypic differences in Drought susceptibility index (DSI) based on grain yield (t ha^{-1}) in each year was also observed. Yield reduction was above 50 per cent except Lalsar in all the environments, while, yield reduction varied from 83.33 per cent in Brown Gora up to 99.28 per cent in RR 366-5 under severe drought stress. In case of desirable stability factor, among the genotypes, only Lalsar followed by CR 143-2-2 showed desirable stability factor for grain yield (t ha^{-1}). Results also revealed that 66 out 78 estimates of correlations assumed significant in all the years and out of 66 estimates of significant correlations, forty two had positive sign and fourteen were negative, mostly estimates were common in nature and led to similar inferences in all the years. Furthermore, the biplot analysis for indices showed that drought resistance parameters and their interaction with drought tolerance parameters were highly significant ($P<0.001$) and accounted for 94.6 and 3.6 per cent of the treatment combination sum of squares, respectively.

Keywords: Drought, DSI, DTE, G X E interaction, rice, biplot analysis

Abbreviations: AYTLT 100 days- Advanced Yield Trial Less Than 100 days, RY_{WW} - Relative yield under well water, RY_{SS} -Relative yield under stress condition, GMP - Geometric Mean, STI- Stress Tolerance Index, TOL- Stress Tolerance, MP- Mean Productivity, GMP- Geometric Mean Productivity, YRR- Yield Reduction Ratio, TOL- Stress Tolerance, DTI- Drought Tolerance Index; DSI- Drought Susceptibility Index, DTE- Drought Tolerant Efficiency, GY- Grain Yield; DFF- Days To Fifty Per Cent Flowering, HI- Harvest Index

REFERENCESS

Ahmad, R., Qadir, S., Ahmad, N. and Shah, K.H. (2003). Yield potential and stability of nine wheat varieties under water stress conditions. *International Journal of Agriculture and Biology*, **5 (1)**: pp 7-9.

Bernier, J., Atlin, G.N., Rachid, S., Kumar, A. and Spaner, D. (2008). Breeding upland rice for drought resistance. *J. Sci. Food Agric.* **88:** pp 927-939.

Chang, T.T., Loresto, G.C. and Tagumpay, O. (1974). Screening rice germplasm for drought resistance. *SABRAO J*. **6:** pp 9-16.

Chauhan, J.S., Tyagi, M.K., Kumar, A., Nashaat, N.I., Singh, M., Singh, N.B., Jakhar, M.L. and Welham, S.J. (2007). Drought effects on yield and its components in Indian mustard (*Brassica juncea* L.). *Plant Breeding*, **126**: pp 399-402.

Clark, J.M., Depauw, R.M. and Townley-Smith, T.F. (1992). Evaluation of Methods for Quantification of Drought Tolerance in Wheat. *Crop Sci.*, **32**: pp 723-728.

De Datta, S.K., Malabuyoc, J.A. and Aragon, E.L. (1988). A Field Screening Technique for Evaluating Rice Germplasm for Drought Tolerance during the Vegetative Stage. *Field Crops Research*, **19:** pp 123-134.

Feranandez, G.C.J. (1992). Effective selection criteria for assessing plant stress tolerance. In: Adaptation of food crops to temperature and water stress, Kuo C. G. (Ed.). AVRDC Publication, Shanhua, Taiwan, ISBN: 92-9058-081-X, pp: 257-270.

Fischer, K.S. and Wood, G. (1981). Breeding and selection for drought tolerance in tropical maize. In: Proc. Symp. on Principles and Methods in Crop Improvement for Drought Resistance with Emphasis on Rice, IRRI, Philippines.

Fischer, R.A. and Maurer, R. (1978). Drought resistance in spring wheat cultivars. I. Grain yields responses. *Aust. J. Agric Res*. **29**: pp 897-912.

Fukai, S. and Cooper, M. (1995). Development of drought resistant cultivars using physio-morphological traits in rice. *Field Crop Research* **40**: pp 67-86.

Gauch, H.G. and Zobel, R.W. (1996). AMMI analysis of yield trials. In: Genotype by environment interaction, Kang, M. S. and H. G. Gauch (Eds.). Boca Raton CRC, New York, USA, pp 85-122.

*Corresponding Author

Golabadi, M.A., Arzani, S.A.M. and Mirnohammadi, Maibody (2006). Assessment of drought tolerance in segregating population in durum wheat. *Afr. Agric J. Res.* **1**: pp 162-171.

Golestani, S.A. and Assad, M.T. (1998). Evaluation of four screening techniques for drought resistance and their relationship to yield reduction ratio in wheat. *Euphytica* **103**: pp 293-299.

Gomez, K.A. and Gomez, A.A. (1984). Statistical Procedures for Agricultural Research (2nd Edition). John Wiley & Sons. Inc. 680 p.

International Rice Research Institute (1996). Standard Evaluation System for Rice (4th Edition). International Rice Testing Programme, International Rice Research institute, Los Banos, Philippines.

International Rice Research Institute (2009). CropStat 7.2 for Windows. Crop Research Informatics Laboratory, International Rice Research Institute, Los Banos, Philippines.

Kamoshita, A., Babu, R.C., Boopathi, N.M. and Fukai, S. (2008). Phenotypic and genotypic analysis of drought-resistance traits for development of rice cultivars adapted to rainfed environments. *Field Crop Research* **109**: pp 1-23.

Kaya, Y., Palta, C. and Taner, S. (2002). Additive main effects and multiplicative interactions analysis of yield performance in bread wheat genotypes a cross environments. *Turk. J. Agric.* **26**: pp 275-279.

Kumar, A., Bernier, J., Verulkar, S., Lafitte, H.R. and Atlin, G.N. (2008). Breeding for drought tolerance: direct selection for yield, response to selection and use of drought tolerant donors in upland and lowland adapted populations. *Field Crop Research* **107**: pp 221-231.

Maurya, D.M. and O'Toole, J.C. (1986). Screening upland rice for drought tolerance. In: Progress in upland rice research; Proceedings of the 1985 Jakarta Conference. IRRI, Los Banos, Laguna, Philippines.

Nazari, L. and Pankniyat, H. (2010). Assessment of drought tolerance in barley genotypes. *Journal of Applied Science* **10 (2)**: pp 151-156.

Ouk, M., Basnayake, J., Tsubo, M., Fukai, S., Fischer, K.S., Cooper, M. and Nesbitt, H. (2006). Use of drought response index for identification of drought tolerant genotypes in rainfed lowland rice. *Field Crops Research* **99**: pp 48–58.

Pantuwan, G., Fukai, S., Cooper, M., Rajatasereekul, S. and O'Toole, J.C. (2002). Yield response of rice (*Oryza sativa* L.) genotypes to different types of drought under rainfed lowlands Part 1 Grain yield and yield components. *Field Crops Research* **73:** pp 153-168.

Panwar, L.L., Joshi, V.N. and Mashit, A. (2008). Genotype x environment interaction in scented rice. *Oryza* **45 (1):** pp 103-109.

Ramirez, Vallejo, P. and Kelly (1998). Traits related to drought resistance in common bean. Euphytica **99**: pp 127-136.

Rosielle, A.A. and Hamblin, J. (1981). Theoretical aspects of selection for yield in stress and non stress environments. *Crop Science* **21**: pp 943-946.

Saba, J., Moghaddam, M., Ghassemi, K. and Nishabouri (2001). Genetic properties of drought resistance indices. *J. Agric. Sci. Technol*. **3**: 43-49.

Wadea, L.J., McLarena, C.G., Quintanaa, L., Harnpichitvitaya, D., Rajatasereekul, S., Sarawgi, A.K., Kumar, A., Ahmed, H.U., Sarwoto, Singh, A.K., Rodriguez, R., Siopongco, J. and Sarkarung, S. (1999). Genotype by environment interactions across diverse rainfed lowland rice environments. *Field Crops Research* **64:** pp 35-50.

Zou, G.H., Liu, H.Y., Mei, H.W., Liu, G.L., Yu, X.Q., Li, M.S., Wu, J.H., Chen, L. and Luo, L.J. (2007). Screening for Drought Resistance of Rice Recombinant Inbred Populations in the Field. *Journal of Integrative Plant Biology* **49** (10): pp 1508-1516.