Electronic Journal of Plant Breeding, 2(4):484-487 (Dec 2011)
ISSN 0975-928X

**Research Article**

# Stability analysis of grain yield and its components of rice (*Oryza sativa L.*) genotypes

**Ahmad Ramezani1 and Masoud Torabi1**
Agricultural and natural resource research center of Isfahan, Amiriyeh Avenue, Isfahan, Iran
*Email: masoud.agro.ir@gmail.com

(Received: 13 Jul 2011; Accepted: 29 Sep 2011)

**Abstract:**
In order to study the stability of yield and some phonological parameter an experiment was carried out with thirteen genotypes of rice under various environment conditions. The results have shown that there was a significant interaction between genotypes and different environments. A significant difference was observed between thirteen genotypes relative to yield production. The scattering of lines determined relative to trend of grain yield and regression coefficients so that the genotypes classified to four groups in terms of grain yield stability. Based on the stability in yield and qualitative parameter genotype 4 is superior to others genotypes so that it can be recommended for commercial cultivation in the Isfahan zone of Iran.

**Keywords**: Rice, stability, genotypes x Environment

## Introduction

Rice is one of the main sources of food in the world where the increased demand for rice is expected to enhance production in many parts of Asia, Africa and Latin America (Subathra Devi et al, 2011). Rice is the main factor of the lives of billions of people around the world and one of the ancient domesticated grains (~10,000 years). For more than 2.5 billion people of the world rice is main food and it cover 9% of the earth's arable land. It supplies 21% of global human per capita energy and 15% of per capital protein. Asia countries contribute for over 90% of the world's production of rice (Kanbar1 et al. 2011, Khush and Virk, 2000).

Food security program depends on by high yielding varieties by increasing yield potential and yield stability (Puji Lestari et al., 2010). The development of cultivars, which can be adapted to a wide range of diversified environments, is the ultimate goal of plant breeders in a crop improvement program. The adaptation of a cultivar over different environments is usually tested by the level of its interaction with different environments under which it is cultivated. A variety or genotype is considered to be more adaptive or stable one, if it has a high mean yield but a low degree of variation in yielding capacity when grown over varied environments (Ashraf et al., 2003). Eberhart & Russell (1966) suggested a model to test the stability of genotypes under different environments. They distinct a stable variety as having unit regression over the environments (b=1.00) and minimum variation from regression (S2di= 0). Consequently, a variety with a high mean yield over the environments, unit regression coefficient (b=1) and variation from regression as small as possible (S2di = 0), will be a superior choice as a stable variety.

One of the effective factors to study of stability is to determine interaction between genotype and environment and it was studied by many researcher on the various genotypes of rice (Ashraf et al., 2003, Aslam and Anhar, 2007, Blanche and linscombe, 2009, Kumar et al., 2010 and Puji Lestari et al., 2010). The stability of yield in cultivars in different places can be due to cultivar performance that derived from a specific collection of genes (G), the characteristic that associated factors of the environment in which it is grown (E), and the interaction between genotype and location which are usually conducted in various years and locations to satisfactorily stand for spatiotemporal variation. In the presence of large numbers of interaction (G×E), the selection of perfect cultivar will be hard because of the explanation of data is difficult for breeders (Blanche and linscombe 2009). Reichardt, et al. (2001) and Witt et al. (2001) indicated that the role of environment and methods of planting were greater than genetic factors on the yield of rice. Satit et al. (2000) mentioned that location has strongly determined yield and yield quality of rice cultivars.

The yield of the rice can be derived from number of panicles per unit area, number of grains per panicles, and weight of thousand grains (Kumar et al., 2010). Present study was carried out to evaluate eleven promising rice genotypes for their yield stability in the various locations and agro-climatic regions of province of Isfahan, Iran.

**Material and Methods**

Eleven promising rice genotypes (2, 4, 6, 88, 97, 104, 130, 173, 268, 341, 347 and two check varieties namely Sazandegi and Zayanderood were evaluated in terms of yield stability through Landrace of Iran for three years during 2007-2009 at Isfahan province. The experiment was laid out in a randomized complete block design (RCBD) with four replications. Nursery sowing was carried out in the end of April and planting (2-3 seedling $hill^{-1}$) of seedlings was done in the end of May. Seedlings aged 25-30 days were transplanted at a spacing of 15 cm within rows spaced at 20 cm. Suggested dosage of 'P' and 'K' along with 50% of 'N' ( 75:75:90 kg NPK $ha^{-1}$) was applied at the time of planting and 25% of 'N' was top dressed twice 1st at 30 and $2^{nd}$ at 60 days after transplanting. Observations on plant height (cm), days to 50% flowering, and maturity, number of panicle per plant and grain yield (ton/ha) were recorded after adjusting to 14% moisture level. The mean values for all the traits across the environments were subjected to stability analysis (Eberhart and Russell, 1966). Combined analysis of data performed by analysis of variance considering location as random and genotypes as fixed by using SAS package (SAS, 1996).

**Results and Discussion**

Combined variance analysis of data showed that the genotype (G) and environment (E) differences were significant relative to days to flowering; plant height and grain yield (Table 1) which indicated a wide range of variability among the genotypes performance. The GxE interaction when tested by collective error it was significant for all the factors, indicating that the majority of interaction was linear in nature and forecast over the environments was possible (Satit et al., 2000 and Sarawgi et al., 2000). The variation in both liner trend and non liner trend relative to grain yield were significant, where it was corroborated by Kulkarni et al., (2000). Eberhart and Russell (1966) confirmed that a need for considering both the linear and non-linear trend in order to evaluate yield and other parameters of stability of genotypes as well as both the linear regression coefficient and deviation from regression for phenotypic stability. The data on the three stability parameters including mean performance (xi), regression coefficient (bi) and deviation from regression (S2di) have been shown in the table 2 relative to various factors.

The divergence from regression for maturity was significant in the genotype 2 and 104 whereas genotype 130 showed approximately a unit regression and low S2di value. Four rice genotypes (4, 97, 173 & 347) and two checks exhibited significant deviation from regression for panicle number. However they showed no significant deviation from regression for Grain yield, days to flowering and plant height. It is difficult to generalize stability for all genotypes relative to all observation because the genotypes used in this study did not exhibit a uniform stability and response pattern for different observations. Eberhart and Russell (1966) indicated that if the observations were associated with high performance of yield so properly the selection of genotype only for yield will be effective.
There was no significant correlation between regression (S2di) with mean performance (xi) and regression deviation (S2di) with regression coefficient (bi) and from this point in can be observed that these stability parameters might be under the control of different genes located on different chromosomes where it was confirmed by Reddy and Chaudhary (1991) and Singh et al. (1995).

Based on observed results genotype 4 exhibited high stability of yield where the regression coefficient was near unity with low deviation from regression. Therefore the genotype 4 was superior to other and strongly recommended for planting at multi location trials at regions of Isfahan province.

Based on Eberhart and Russell, 1966, (method of analysis of stability) when the yield of cultivars is more than total average, the regression coefficient equal to one and there is minimum deviation from the regression line that means there is stability in cultivar. Regarding to figure 1 as diagrammatic representation the genotype 4 presented a high performance in yield production, low deviation from the regression line and the regression coefficient nearby 1 so that it was superior among genotypes in terms of yield stability and recommendable for all environments. The genotypes 2, 88 and 268 presented average amount of three mentioned parameters so that they showed a considerable stability and suitable for favorable environments. From Table 2 the genotypes can be divided in to four categories as following:

i. Genotypes with high mean, bi=1 and no significant difference in S2di are suitable for general adaptation, so that they can be recommendable for all environmental conditions and they are considered as stable genotypes where genotype 4 was included.

ii. Genotypes with high mean, bi>1 with no significant difference in S2di are considered as genotype with average stability where genotypes 2, 88 and 268 were included and they can be recommend for favorable environments.

iii. Genotypes with low mean, bi< 1 with no significant difference in S2di are considered as genotype with low stability where genotype 97 and 173 were included.

iv. Genotypes with a few bi values with significant difference in S2di are unstable are considered as genotype with poor stability.

Based on results in some genotypes the yield production was high as in genotypes 2, 4, 88,104 and 268, but there was a high variance by various environments which is why those genotypes have average stability. The genotypes with high yield and average yield stability are recommendable for favorable environments.

Based on results genotypes 2, 4, 88,104 and 268 produced high value of grain yield but the stability of them was varied. The rice genotype 4 not only exhibited a high grain yield over the population mean, but also the regression coefficient and deviation from regression was minimum so that genotype 4 was stable than other genotypes. The genotypes 2, 88,104 and 268 indicated moderate stability. Thus, it is concluded that the rice genotype 4 is ideally adaptable and stable and could be recommended for multi location of Isfahan province of Iran.

**References**

Ashraf, M., A.Bakhh and A. M Haqqani. 2003. Genotype – environment interaction for grain yield in Chickpea (Cicer arientum L.) . *Pakistan J. Bot.,* **35**(2): 181-186.

Aslam, A. and A. Anhar. 2007. Genotype – environment interaction and yield stability of several yield components among adapted rice cultivars in west Sumattera. *Zuriat,* **18**(2): 100-105.

Blanche, S.B and linscombe, S.D 2009. Stability of rice grain and whole kernel milling yield is affected by cultivar and date of planting 2009. *Agron.J.,* **101**: 22-528.

Eberhart, S.A. and Russell, W.A. 1966. Stability parameters for comparing varieties. *Crop Sci.,* **6**:36- 40.

Kanbar1, A., Katsuhiko Kondo2 and H.E. Shashidhar3 .2011. Comparative efficiency of pedigree, modified bulk and single seed descent breeding methods of selection for developing high-yielding lines in rice (*Oryza sativa L.*) under aerobic condition. *Elect. J. Pl. Breed.,* **2**(2):184-193.

Khush, G. S. AND Virk, P.S., 2000, Rice breeding Achievements and Future Strategies. *Crop Improv.,* **27**: 115-144.

Kulkarni N., Nirmala D.G. and G. Sarojini. 2000. G x E interaction for quality traits in mutants of Samba Mahsuri. *Oryza,* **37**(1): 72-74.

Kumar, B.M.Dushyantha , Y.G.Shadakshari and S L Krishnamurthy. 2010. Genotype x Environment interaction and stability analysis for grain yield and its components in Halugidda local rice mutants *Elect. J. Pl. Breed.,* **1**(5): 1286- 1289.

Pugi lestari A. Buang .A., Ahmad J.; and Hajrial A. 2010. Yield stability and adaptability of aromatic new plant type (NPT) rice lines. J. *Agron. Indonesia*, **38** (3) : 199 – 204.

Reddy J.N. and D. Choudhary. 1991. Stability for grain yield and its components in rice. *Oryza,* **28**: 295-299.

Reichardt, W.R. de Jesus; L.H. Man, and L. Kunnot. 2001. Soil biochemical and microbiological clues to the sustainability of intensive rice intercropping systems in Southeast Asia. In: S. Peng and B. Hardy (ed.) Rice Research for Food Security and Poverty Alleviation. *IRRI.:* 459–467.

Sarawgi A. K., Kumar A, Sengar S.S, Kumar R., Bhambri M.C. Siopongeo J, Mc Laren C.G. and L.J. Wade. 2000. Genotype by environment interactions for identifying improved rice genotypes in rainfed low land of eastern Madhya Pradesh, India. In: Souvenir on the Rainfed Low Land Drought Workshop. International Rice Research Institute, Manila, Phillipines.p4

Satit R., Dome H., Chaluay B., Pitak P., Charoenchai M., Ekasit S., Siravit R.,Piboonwat Y., Sukvittaya P., Tawee T., Surapong S., Mc Laren C.G. and L.J. Wade. 2000. Experiments on genotype by environment (G x E) interactions for identifying improved genotypes of rainfed lowland rice for North-East Thailand. In: Souvenir on the Rainfed Lowland Drought Workshop. International Rice Research Institute, Manilla , Phillipines.p3

Singh N.K., Sharma V.K. and P.B. Jha. 1995. G x E interaction for grain yield and related traits in Indica rice. *J. Res. (BAU),* **7**(1): 121-125.

Subathra Devi A., V.Krishnasamy, M.Raveendran1, N.Senthil1 and S.Manonmani2. 2011. Molecular and genetic dissection of peduncle elongation in rice. *Elect. J. Pl. Breed.,* **2**(1):1-7.

Witt, C., A. Dobermann, G.C. Simbahan, and H.C. Gines. 2001. Balanced nutrient management and beyond. In: S. Peng and B. Hardy (eds.) Rice Research for Food Security and Poverty Alleviation. *IRRI*, 469–478.

**Table 1: Analysis of variance for stability performance for grain yield and associated traits in rice**

| Sources | DF | Days to 50% flowering | Plant height (cm) | Panicle number | Grain yield (ton/ha) | Maturity |
|---|---|---|---|---|---|---|
| Genotypes | 12 | 24.46** | 95.53** | 27.09ns | 1.75ns | 58.29** |
| Environments | 4 | 1055.43** | 1473.91** | 836.47** | 23.88** | 62.57** |
| Genotypes x environments | 48 | 18.15** | 54.36* | 23.79* | 1.84* | 35.99** |
| Env(linear) | 1 | 308.05** | 4665.61** | 15.02ns | 37.90** | 2.43ns |
| Pooled deviation | 39 | 4.53 | 5.91 | 42.56 | 0.31 | 33.37 |
| Pooled error | 195 | 10.55 | 25.61 | 15.19 | 1.24 | 15.83 |

* & ** Significant at P=0.05 and P=0.01 respectively when tested against pooled error.

**Table 2: Stability parameters for days to 50% flowering, plant height, panicle number and grain yield**

| Genotypes | Grain yield (T ha-1) | | | Days to 50% flowering | | | Maturity | | | Plant height (cm) | | | Panicle number | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Xi | Bi | S2di | Xi | Bi | S2di | Xi | Bi | S2di | Xi | Bi | S2di | Xi | Bi | S2di |
| 2 | 8.43 | 1.61 | 0.41 | 113 | 1.02 | 11.87 | 141 | -0.87 | 301.35** | 26 | 0.98 | 2.48 | 26 | 0.77 | 0.62 |
| 4 | 8.36 | 1.49 | 0.02 | 116 | 0.77 | 0.21 | 154 | 0.39 | 2.78 | 27 | 1.00 | 0.98 | 24 | 1.12 | 97.15** |
| 6 | 7.52 | 0.99 | 0.27 | 116 | 0.92 | 5.91 | 153 | 0.50 | 8.79 | 23 | 0.78 | 16.59 | 29 | 1.42 | 11.06 |
| 14 | 7.99 | 1.66 | 0.11 | 114 | 1.27 | 3.19 | 150 | 0.73 | 8.14 | 27 | 1.18 | 0.78 | 25 | 1.06 | 28.87** |
| 88 | 8.32 | -0.61 | 0.05 | 114 | 0.85 | 6.07 | 152 | 1.29 | 5.98 | 25 | 1.25 | 12.51 | 28 | 0.81 | 8.64 |
| 97 | 7.37 | -0.11 | 0.58 | 113 | 0.26 | 8.39 | 150 | -0.04 | 22.40 | 29 | 1.20 | 2.63 | 22 | 0.91 | 162.06** |
| 104 | 8.15 | 2.23 | 1.07 | 114 | 1.24 | 9.13 | 150 | 0.74 | 29.44* | 26 | 1.09 | 8.91 | 28 | 0.81 | 9.16 |
| 130 | 7.66 | 1.05 | 0.11 | 114 | 1.11 | 2.58 | 152 | 1.12 | 4.29 | 24 | 0.89 | 6.09 | 27 | 0.74 | 2.26 |
| 173 | 7.16 | 0.72 | 0.19 | 114 | 1.08 | 2.99 | 150 | 0.84 | 6.20 | 27 | 1.14 | 0.62 | 30 | 0.99 | 83.12** |
| 213 | 8.30 | 1.50 | 0.84 | 115 | 1.20 | 0.90 | 150 | 2.41 | 3.70 | 28 | 1.01 | 4.11 | 32 | 1.10 | 46.63** |
| 268 | 8.07 | 0.75 | 0.10 | 113 | 0.89 | 5.54 | 150 | 1.61 | 21.89 | 25 | 0.85 | 0.77 | 28 | 1.35 | 3.82 |
| 341 | 7.81 | 0.82 | 0.16 | 114 | 1.14 | 1.77 | 151 | 1.93 | 5.55 | 27 | 0.76 | 9.35 | 27 | 0.85 | 9.73 |
| 347 | 7.93 | 0.87 | 0.07 | 114 | 1.24 | 0.25 | 150 | 2.29 | 13.30 | 25 | 0.84 | 10.99 | 31 | 1.06 | 90.10** |

* and ** significant at p- 0.05 and p-0.01 respectively, bi-regression coefficient and S2di-deviation from the regression