

## **Joint regression analysis for heat tolerant rice genotypes cultivated in different nursery**

**تحليل الانحدار المشترك لتراكيب وراثية من الرز المتحمل لدرجات الحرارة العالية  
والمزروعة في مشاتل مختلفة**

Fawzi Z. Azzo, Abd Al-Jalel R. Abod, Thamer A. Suod,  
Abd Al-Karem H. Kadim, Muhamad H. Hamed, Ather A. Ismail  
Seed Technology Center/Ministry of Science and Technology  
Email: [fawzizead\\_azzo@yahoo.com](mailto:fawzizead_azzo@yahoo.com)

### **Abstract**

The experiment was conducted to evaluate 54 heat tolerance rice genotypes at Multi-locations including 9 locations in 8 countries (China, Republic of Korea, Philippines, Thailand, Egypt, Senegal, Iraq and besides tow location in India). The target of this study was to select promising genotypes that could have highest grain yields (t/ha) and early maturity and stable by using joint regression analysis (JRA). The Results showed that there were significant differences in flowering date and grain yield (t/ha) characters among genotypes and locations at (0.05). 29 Genotypes superiority in grain yield (t/ha) for nine environment and 11 of 29 genotypes showed their superiority in Iraqi environment. Joint Regression Analysis (JRA) show that 6 genotypes of 11 genotypes which superiority in grain yields (t/ha) have medium stable in Iraqi environment.

### **الخلاصة**

نفذت تجربة تقييم 54 تراكيب وراثية من الرز المتحمل لدرجات الحرارة في مواقع متعددة لزراعة الرز تضمنت 9 مواقع في 8 دول (الصين، جمهورية كوريا، الفلبين، تايلند، مصر، سنغال، العراق وموقعين في الهند). تهدف الدراسة إلى انتخاب تراكيب الوراثة واعدة من الرز ملائمة للبيئة العراقية وذات حاصل حبوب عالي (طن / هكتار) ومبكرة في التزهير ومستقرة باستخدام تحليل الانحدار المشترك JRA. اظهرت النتائج وجود فروق معنوية في صفتي التزهير وحاصل الحبوب (طن / هكتار) بين التراكيب الوراثة والمواقع عند مستوى احتمال 0.05. تفوق 29 تركيب وراثية بحاصل الحبوب (طن / هكتار) في البيئات التسعة واطهر 11 من 29 تركيب وراثي تفوق في البيئة العراقية. أظهر نتائج تحليل الانحدار المشترك وجود 6 تراكيب وراثية من أصل 11 تركيب وراثي متفوق في حاصل الحبوب (طن / هكتار) متوسط الاستقرار للبيئة العراقية.

### **Introduction**

In the last years the global warming phenomenon coming out by high temperature and this affect field crops specially rice and this effect cause killing pollen before fertilization causing low yield. High temperature across growing season affect maturity where (1) found that temperature between 10.9 – 28.7C° cause early maturity in rice and temperature degree between 11 – 24.4 C° cause late maturities. In another study (2) founds that the best temperature for flowering of rice was 33.7 C° whereas pollen heat tolerance is 4 hours while. (3) founds that the rice genotypes with heat tolerance from 39 to 43 C° in the flowering time. (4) detected one heat tolerance genotypes of rice from 14 genotypes which cultivar in June. (5) limited one rice genotype with high yield and adaptation to different environment and the Joint regression analysis of variance were significant except genotypes x environment for 19 rice genotypes cultivars in 2 locations and for 2 years. (6) studies 36 genotypes of rice separated to 3 maturity groups (early, medium, late) cultivated in 4 locations for 3 years found one genotype with high yield and suitable for all environments and all the Joint regression analysis of variance were significant. In the another study (7) found significant differences in the Joint regression analysis of variance and early flowering genotype with high yield from 11 rice genotypes cultivars in 12

## **The 2<sup>nd</sup> Scientific Conference of the College of Science 2014**

environments. Genotype At581 was superior in yield and adaption in all environments (6 locations in Sri Lanka) (8). Joint regression analysis of variance was significant for all sources of variance except genotypes and locations at 0.05 and 4 rice genotypes were adapted for all environments

(6 environments for 2 years) (9). (10) show limited stabile genotypes and sensitive genotypes for different environment for plant high character when they study 40 genotypes of aromatic rice cultivars in 16 environments.

The target of this research was to study the adaptability of genotypes to different environments especially in Iraq with early flowering and high grain yield.

### **Materials and methods**

This study was carried out during the agricultural season of 2010 in Mishkhab Rice Research Station / Iraq. 54 heat tolerant rice genotypes from International Rice Research Institute were sown in 28/6/2010 using dry cultivars technique. Each genotype cultivated in 7 rows 5m length with 3 replications. The experiment was fertilized by NP fertilizer 27:27 amount 200 kg/ha with sowing as first stage. After 45 day the experiment fertilized by Urea fertilizer (N 46%) amount 120 kg/ha as second stage. The same experiment was carried out in 8 location out side Iraq as follow: China-Guzhang, Hunan (A), Republic of Korea-Suwon (B), Philippines-Munoz, Nueva Ecija (C), Thailand-Udon Thani (D), India-Kapurthala, Punjab (E), India-Dalip Nagar, Kanpur (F), Egypt-Sakha (G), Senegal-Saint Louis (H) and Iraq-Mishkhab (I). The total experiment units were 1458 unit. Randomized Complete Block Design was used. The data was analyzed by using Cropstat 7 software and the means of flowering date and grain yield (t/ha) compared by using Least Significant Difference (LSD) at level 0.05. Joint Regression Analysis up taking at 0.05 by using command cross site analysis (11 and 12). This command calculated Joint Regression without using replicates that mean using environments as a replicates and the interaction be come as error mean square (table 1).

### **Results and discussion**

Significant differences were found in all source of Joint regression analysis of variance under significant level of (0.05) for flowering and grain yield (t/ha) (table 1). These results compatible with (5, 6 and 7) whom found a significant difference in joint regression analysis of variance.

Table 1: joint regression analysis of variance of date to flowering and grain yield (t/ha) for 54 heat tolerant rice cultivars in 9 environments.

S. O. V.	df	MS for date to flowering (days)	MS of grain yield (t/ha)
Environment	8	2364.74*	138.324*
Genotypes	53	1034.23*	4.277*
Interaction	424	390.87	1.966
Reg.	53	667.144*	4.119*
Dev.	371	351.41	1.658
Total	485		

The results in table 2 showed that genotype 3 have early flowering (55.33) days and there were no significant difference between genotypes 12, 31, 43, 2, 33 and 49 respectively. Genotypes 46 was the latest in flowering (112) days and it was not differ with genotypes 25, 19, 17, 10, 23, 26, 27, 20, 16, 44, 15 and 52. In the same table we found that genotypes 3 and 9 had significant regression coefficient then another genotypes.

## **The 2<sup>nd</sup> Scientific Conference of the College of Science 2014**

The results of table 3 showed that genotype 17 was superior in grain yield (3.86) t/ha and there were no significant difference between genotypes 15, 10, 44, 21, 20, 24, 29, 27, 16, 25, 36, 34, 35, 19, 50, 52, 26, 28, 51, 1, 53, 41, 42, 33, 39, 54, 9 and 40. The lowest grains yield was (1.1) t/ha for genotype 43 and it was not significantly differ from 12, 2, 49, 3, 4, 32, 31, 47, 7, 46, 30, 18, 13, 5, 45, 11, 6, 8, 23, 22, 48 and 14. Also, the results showed significant differences in regression coefficient between genotypes 2, 3, 4, 17, 22, 43, 46 and 54 and anther genotypes. The superiority of genotypes 17 were in 4 locations of 9, while it was found in the best 5 genotypes in grain yields (13).

From table 2 and 3 we found genotypes 33 and 42 were early in flowering and have high yield and there were no significant differences between them. These results compatible with (6 and 7) and in restriction the superior genotypes in grains yield t/ha and early in flowering by using joint regression analysis.

Table 2: Mean of flowering date and bi of 54 heat tolerance rice genotypes cultivate in 9 environments in 2010.

Genotypes	mean	bi	Genotypes	mean	bi
1	81.44	0.14	28	89.89	0.74
2	71.11	-0.62	29	91.78	0.95
3	55.33	-4.51*	30	92.89	1.52
4	87.89	1.63	31	66.89	5.14
5	86.44	0.95	32	87.56	1.05
6	89.78	0.90	33	72.33	2.04
7	87.33	0.84	34	93.89	0.29
8	90.22	1.19	35	85.11	0.87
9	88.44	-0.35*	36	86.22	0.81
10	101.56	0.95	37	82.22	0.76
11	86.44	1.07	38	90.67	0.75
12	59.33	4.09	39	91.56	1.03
13	86.33	0.30	40	83.78	0.97
14	93.11	0.81	41	82.00	0.79
15	94.78	0.21	42	70.00	4.33
16	97.44	0.44	43	80.22	1.74
17	101.78	0.11	44	96.56	0.97
18	83.11	-2.38	45	86.22	1.01
19	102.33	1.31	46	112.00	2.89
20	97.44	0.47	47	93.67	1.62
21	89.89	0.47	48	88.78	1.33
22	91.67	1.78	49	73.67	2.65
23	100.33	1.10	50	81.67	0.24
24	85.89	0.53	51	89.33	0.59
25	104.22	2.09	52	94.56	1.18
26	100.22	0.81	53	93.78	0.99
27	99.78	0.77	54	88.56	1.41
LSD 0.05	18.26				

## **The 2<sup>nd</sup> Scientific Conference of the College of Science 2014**

Table 3: Mean of grain yield (t/ha) and bi of 54 heat tolerance rice genotypes cultivate in 9 environments in 2010.

Genotypes	mean	bi	Genotypes	mean	bi
1	2.78	0.64	28	2.78	1.03
2	1.37	0.16*	29	3.33	1.00
3	1.52	0.13*	30	1.87	1.14
4	1.58	0.16*	31	1.61	0.35
5	1.99	1.20	32	1.60	0.81
6	2.18	1.04	33	2.69	1.06
7	1.86	1.14	34	3.08	0.71
8	2.19	1.38	35	3.08	0.99
9	2.68	1.40	36	3.11	1.31
10	3.54	1.34	37	2.53	0.70
11	2.13	0.96	38	2.44	1.16
12	1.26	0.40	39	2.69	1.10
13	1.98	1.08	40	2.64	0.98
14	2.37	0.91	41	2.74	1.31
15	3.62	1.36	42	2.70	1.29
16	3.28	1.47	43	1.10	0.14*
17	3.87	1.70*	44	3.52	0.84
18	1.90	0.41	45	2.06	1.08
19	3.07	1.29	46	1.87	-0.10*
20	3.46	1.46	47	1.72	0.93
21	3.49	0.85	48	2.37	1.51
22	2.36	-0.12*	49	1.51	0.80
23	2.28	0.90	50	3.01	1.24
24	3.34	1.23	51	2.78	1.32
25	3.11	1.36	52	2.89	1.49
26	2.86	1.21	53	2.77	1.45
27	3.33	1.42	54	2.69	1.67*
LSD 0.05	0.52				

Seven genotypes were early in flowering and there were not significant differences between them (3, 12, 31, 43, 2, 33 and 49) and the two genotypes (3 and 9) which had significant in regression coefficient interred in biplot (figure 1). Figure 1 showed that genotypes 2 and 33 in the top and the inside of the triangle leans that these genotypes adapted to all environments and the genotype 2 have medium high stable and genotypes 33 was medium low stable. From the same figure we showed that genotype 33 near to regression line (1) mean that this genotype adapted to difference environments this compatible with (13) who mentioned that this genotype early in flowering in 4 environments (A, C, D and E) from 9 environments.

Twenty nine genotypes (17, 15, 10, 44, 21, 20, 24, 29, 27, 16, 25, 36, 34, 35, 19, 50, 52, 26, 28, 51, 1, 53, 41, 42, 33, 39, 54, 9 and 40) showed highest grains yield and not significantly differ interred with eight genotypes (2, 3, 4, 17, 22, 43, 46 and 54) which had not significant differences between them in biplot (figure 2). We found genotypes 2, 3, 4, 43, inside and down of the triangle these mean that special adaptation to unfavorable environments (11 and 12) this compatible with (13) who found these genotypes were non superior in the environment of this study as soon as the regression coefficient was significant for these genotypes.

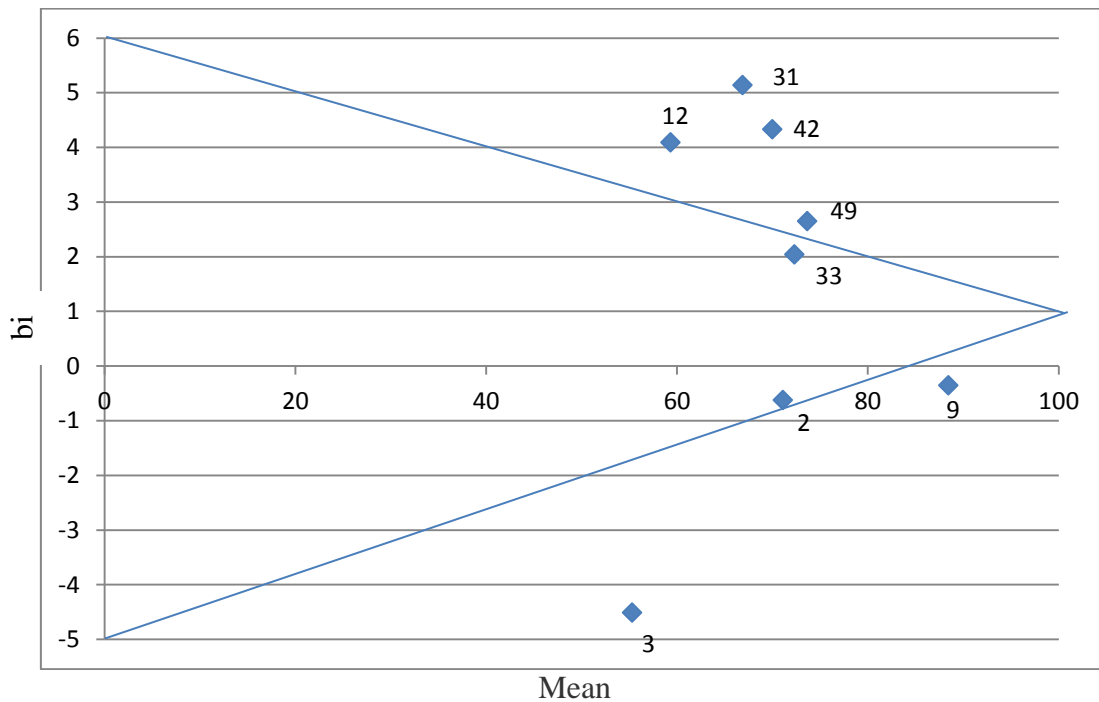


Figure1: Biplot of flowering date mean and bi of 54 heat tolerant rice genotypes cultivated in 9 Locations in 2010.

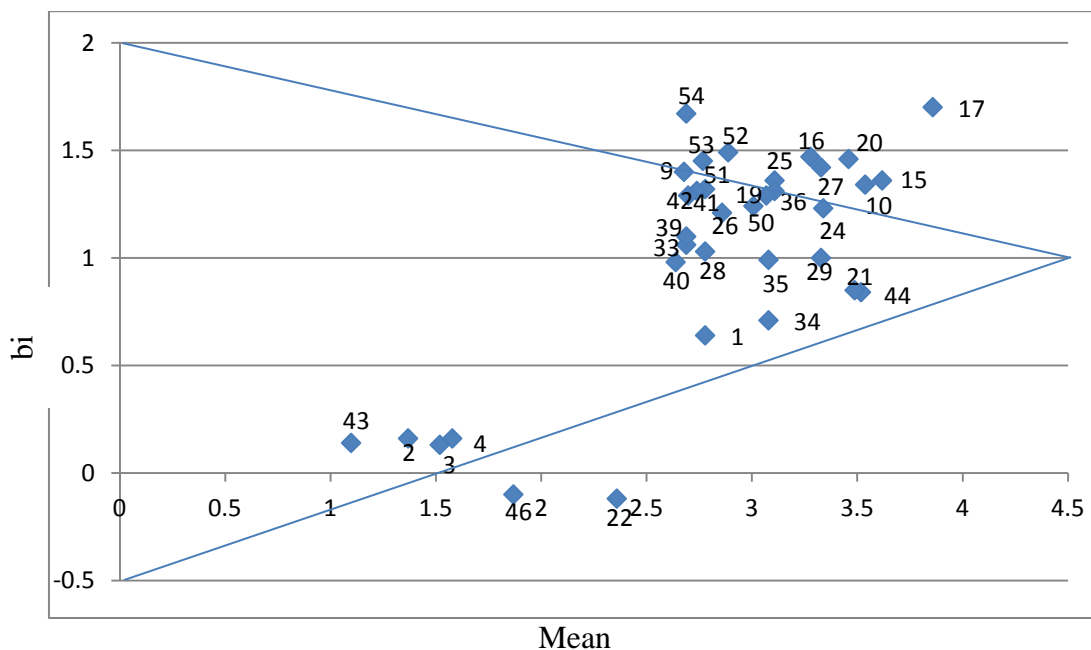


Figure2: Biplot of grains yield mean (t/ha) and bi of 54 heat tolerant rice genotypes cultivated in 9 Locations in 2010.

In figure 2 we found that genotypes 44 and 21 inside and near the head of triangle and this means that these two genotypes were the best adapted to all environment (11 and 12) and this compatible to (13) which were superior these in nine environments, genotypes 29, 34, 35, 1 and 40 showed high medium stable. Genotypes 24, 36, 19, 50, 26, 28, 33, 39, 41, 42, 51 and 9 showed low medium stable. From the same figure we found genotypes 35 and 29 near to regression line (1) these mean

## **The 2<sup>nd</sup> Scientific Conference of the College of Science 2014**

that these genotypes were favor to difference environment and compatible with (13) who found that these genotypes were superior in environment A.

### **Conclusions and Recommendations**

It could conclude from this study that genotypes 1, 10, 15, 16, 24, 34, 35, 39, 51, 52, and 53 were superior in grain yield and there were no significant difference between them under nine environments specially Iraqi environment (13). Genotypes 1, 24, 34, 35, 39 and 51 were medium stable so it could recommend that interred these genotypes in plant breeding program to develop the rice local variety.

### **Reference**

1. Nahar, K., J. K. Biswas, A. M. M. Shamsuzzaman, M. Hasanuzzaman and H. N. Barman (2009). 'Screening of Indian rice (*Oryza sativa* L.) genotypes against low temperature stress.' *Botany Research International* 2(4): 295-303.
2. Jagadish, S. V. K., P. Q. Croufurd and T. R. Wheeler (2007). 'High temperature stress and spikelet fertility in rice (*Oryza sativa* L.)' *Journal of Experimental Botany* 58(7): 1627-1635.
3. Guan-fu, F., S. Jian, X. Jie, L. Xi-yuan, Z. Xiu-fu, W. Xi, L. Ming-kai and T. Long-xing (2012). 'Thermal resistance of common rice maintainer and restorer lines to high temperature during flowering and early grain filling stages.' *Rice Science*. 19(3)
4. Prasad, P. V. V., K. J. Boote, L. H. Allen Jr, J. E. Sheehy and J. M. G. Thomas (2006). 'Species, ecotypes and cultivar differences in spikelet fertility and harvest index of rice in response to high temperature stress.' *Field Crops Research* 95: 398-411.
5. Aremu, C. O., K. A. Okeleye and O. J. Ariyo (2005). 'On – farm evaluation of interspecific rice hybrids for stable performance in fertilizer and no fertilizer environment.' *Nigerian Journal of Genetic* 19: 34-42.
6. Das, S., R. C. Misra, M. C. Patnaik and S. R. Das (2010a). 'G x E interaction, adaptation and yield stability of mid-early rice genotypes.' *Indian Journal of Agricultural Research* 44(2): 104-111.
7. Das, S., R. C. Misra, S. K. Sinha and M. C. Pattanaik (2010b). 'Variation in streptomycin-induced bleaching and dark induced senescence of rice (*Oryza sativa*) genotypes and their relationship with yield and adaptation.' *Journal of Plant Breeding and Crop Science* 2(6): 139-147.
8. Anputhas, M., S. Samita and D. S. Z. Abeywardena (2011). 'Stability and adaptation analysis of rice cultivars using environment – centered yield in two ANOVA model.' *Communications in Biometry and Crop Science* 6(2): 80-86.
9. Maji, A. T., A. S. Gana, E. O. Bright, M. N. Ukwungwu and A. A. Ochigbo (2011). 'Genotype x environment analysis of upland medium duration, nationally coordinated rice evaluation trials (CRET) for varietal recommendation.' *American Journal of Experimental Agriculture* 1(4): 486-493.
10. Shahidullah, S. M., M. M. Hanafi, M. Shrafuzzaman, M. A. Hakim and M. R. Karim (2011). 'Plant stature of aromatic rice genotypes in the environment of Bangladesh.' *Journal of Environment and Biology* 32: 821-82.
11. Finlay, K. W. and G. N. Wilkinson (1963). 'The analysis of adaptation in a plant – breeding programme.' *Australian Journal of Agriculture Research* 14: 742-754.
12. Eberhart, S. A. and W. A. Russell (1966). 'Stability parameters for comparing varieties.' *Crop Science* 6: 36-40.
13. Redona, E. D. (2010). Summary report of the INGER nurseries. IRRI. 58-113.