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G X E INTERACTION IN SHORT DURATION RICE

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ABSTRACT

Five short duration rice genotypes *viz.*, ADT 36, ADT 41, ADT 42, IR 72 and AD 85361 were studied for stability performance under three nutrio-environments *viz.*, O (E_1), 100 kg N ha^{-1} (E_2) and 200 kg N ha^{-1} (E_3) for 18 characters. G x E interaction was significant for four characters only *viz.*, spikelets $panicle^{-1}$, grains $panicle^{-1}$, 100-grain weight and grain yield ha^{-1}. Genotypes ADT 36 and AD 85361 were the most stable and consistent ones for the traits studied in all environments.

KEY WORDS : Genotype, nutrio-environments, stability, regression

G x E interactions are important in identifying stable genotypes that interact less with the environments in which they are grown. If stability of performance or the ability to show a minimum interaction with environment is a genetic characteristic, then preliminary evaluation could be planned to identify stable genotypes. Low and high plant population or medium and high rates of fertilizers can be used to increase the number of environments possible from a fixed number of locations, and at the same time provide a greater range of environmental conditions (Eberhart and Russell, 1966) An ideal widely adapted and stable genotype is the one with high mean performance, average responsiveness to environment (b=1) and high stability ($S^{-2}di = 0$).

MATERIALS AND METHODS

Five short duration rice genotypes *viz.* ADT 36, ADT 41, and 42, IR 72 and AD 85361 were studied to assess their stability of performance under three N levels *viz.*, O (E_1), 100 kg ha^{-1} (E_2) and 200 kg ha^{-1} (E_3) in randomised block design with two replications during June to October 1994 at the Tamil Nadu Rice Research Institute, Aduthurai, Tamil Nadu. Observations were recorded for 18 characters *viz.*, plant height, panicles $plant^{-1}$, panicle length, spikelets $panicle^{-1}$, grains $panicle^{-1}$, spikelet fertility, 100-grain weight, grain yield ha^{-1}, spikelet growth factor (SPGF) kg^{-1} leaf area $plant^{-1}$ (at flowering), leaf weight ha^{-1} (at harvest), stem weight ha^{-1} (at harvest), root weight ha^{-1} (at harvest), panicle weight ha^{-1} (at harvest), total dry matter production (TDMP) ha^{-1} (at harvest), and leaf N (at panicle initiation, flowering and harvest). Statistical constants of mean for all the characters, and regression coefficient (bi) and deviation from regression ($S^{-2}di$) for the characters where G x E interaction was significant were estimated following the method proposed by Eberhart and Russell (1966).

RESULTS AND DISCUSSION

G x E interaction was highly significant for four characters only *viz.*, spikelets $panicle^{-1}$, grains $panicle^{-1}$, 100-grain weight and grain yield ha^{-1} for which stability parameters were estimated. Of the two components of G x E interaction, G x E (linear) was highly significant for spikelets $panicle^{-1}$, 100-grain weight and grain yield ha^{-1}, indicating significant differences among the genotypes for linear response to environments (b values), while pooled deviation was highly significant for grains $panicle^{-1}$, indicating significant differences among genotypes for non-linear response to environments (stability)

Table 1. Analysis of variance for stability of four characters in rice

Source	df	Mean squares			
		Spikelets panicle^{-1}	Grains panicle^{-1}	100-grain weight	Grain yield ha^{-1}
Genotypes (G)	4	1212.39*	1104.67*	0.1150**	1787058**
Environments (E)	2	124.31	6.30	0.0028	1512760**
G x E	8	302.98**	207.80**	0.0031**	31606**
E + (G x E)	10	267.24**	167.50*	0.0030**	327837**
E (linear)	1	248.62	12.60	0.0058*	3025520**
G x E (linear)	4	415.20**	88.42	0.0036**	34879**
Pooled deviation (non-linear)	10	76.30	130.88*	0.0011	11340
Pooled error	15	70.16	48.85	0.0007	4764
Non-linear:linear		1:5.44	1:0.68	1:3.27	1:3.08
σ^2g		303.14	298.96	0.0373	585151
σ^2gn		232.82	158.95	0.0024	26842
$\sigma^2g : \sigma^2gn$		1:0.77	1:0.53	1:0.06	1:0.05

*P = 0.05, **P = 0.01

(Young and Virmani, 1990); thus both predictable (linear) and non-predictable (non-linear) components contributed individually to the significant difference in stability among the genotypes for these four characters (Sastry *et al.*, 1989). The ratio of non-linear to linear component of variance revealed a major portion attainable to linear component in respect of spikelets panicle^{-1}, 100-grain weight and grain yield ha^{-1}, while non-linear component contributed more in the case of grains panicle^{-1}. Higher magnitude of E (linear) effect in comparison to G x E (linear) for 100-grain weight and grain yield ha^{-1} suggested the existence of considerable difference among environments and their predominant effects on these traits. The magnitude of genotypic variance (σ^2g) was more than that of G x E variance (σ^2gn) for these four characters, indicating the predominance of genetic variability among the genotypes than their interaction with environmental conditions (Table 1).

The environmental indices were the lowest and negative under E_1 for spikelets panicle^{-1} and grain yield ha^{-1}, E_2 for grains panicle^{-1} and E_3 for 100-grain weight. The indices were the highest and positive under E_1 for grains panicle^{-1}, E_2 for 100-grain weight, and E_3 for spikelets panicle^{-1} and grain yield ha^{-1} (Table 2). Based on mean values and environmental indices, E_3 was the best for spikelets panicle^{-1} and grain yield ha^{-1} followed by E_2 for 100- grain weight and E_1 for grain panicle^{-1}. The stability parameters of the five genotypes fo four characters for which G x E interaction wa significant are presented in Table 3.

Spikelets panicle^{-1}

Genotype AD 85361 had the highest number of spikelets panicle^{-1} (161.7) and it was on par with ADT 36. ADT 36, ADT 41, IR 72 and AD 85361 had average responsiveness and stability; ADT 42 though stable was found to have below average responsiveness and thus suitable for unfavourable environments. Based on mean, bi and $S^{-2}di$ values, genotypes AD 85361 and ADT 36 were stable and consistant for the trait spikelets panicle^{-1} in all environments.

Grains panicle^{-1}

Genotype ADT 36 had the highest number of grains panicle^{-1} (133.6) and was on par with AD 85361 (125.6). All the five genotypes showed average responsiveness. ADT 42 was found to be unstable, while others were highly stable. Based on mean, bi, $S^{-2}di$ values, ADT 36 and AD 85361 were stable and consistent for grains panicle^{-1} in all environments.

Table 2. Environmental indices for four characters in rice

Environment	Spikelets panicle^{-1}	Grains panicle^{-1}	100-grain weight	Grain yield ha^{-1}
E1	-3.8467	1.0133	-0.0027	-1.1716
E2	-1.7866	-1.2066	0.0253	0.1283
E3	5.6333	0.1933	-0.0226	1.0433

E1 : 0 Kg N/ha; E2 : 100kg N/ha; E3 : 200 kg N/ha

Table 3. Stability parameters of rice genotypes

Genotype	Spikelets panicle^{-1} (no.)			Grains panicle^{-1} (no.)			100-grain weight (g)			Grain yield ha^{-1} (kg)		
	Mean	bi	$S^{-2}di$	Mean	bi	$S^{-2}di$	Mean	bi	$S^{-2}di$	Mean	bi	$S^{-2}di$
ADT 36	154.1	3.334	83.9	133.6	7.430	59.3	2.00	1.227	0.0060*	5653	1.089	-1337
ADT 41	118.8	3.333	-20.3	91.0	5.246	283.5	2.47	-0.998	-0.0004	4517	1.353*	2502
ADT 42	126.0	-3.571**	-36.2	102.0	-2.804	766.8**	2.38	3.074	0.0024	5689	0.781	10902
IR 72	120.7	0.059	393.0	94.1	-7.067	-22.2	2.42	- 0.562	-0.0002	6696	1.002	81651**
AD85361	161.7	1.841	-8.2	125.6	2.195	-22.9	2.19	2.260	-0.0006	5584	0.776	-4137
Mean	136.3	1.000	-	109.2	1.000	-	2.29	1.000	-	5628	1.000	-
SE	6.18	1.239	-	8.09	7.207	-	0.023	0.958	-	75.3	0.137	-

P* = 0.05, **P = 0.01

100-grain weight

Genotype ADT 41 had the highest 100-grain weight (2.47 g) and it was on par with IR 72 (2.42 g). All the genotypes exhibited average responsiveness; all of them except ADT 36 were found to be highly stable. Based on mean, bi and $S^{-2}di$ values, ADT 41 and IR 72 could be considered stable and consistent in their 100-grain weight in all environments.

Grain yield ha^{-1}

Genotype IR 72 was superior to all by recording the highest grain (6696 kg ha^{-1}). It was followed by ADT 42 (5689 kg), ADT 36 (5653 kg) and AD 85361 (5584 kg) which were on par with each other. All the genotypes except ADT 41 exhibited average responsiveness; ADT 41 was found to be suitable to highly favourable environments. IR 72 was highly unstable while others were stable in their performance. Based on mean, bi and $S^{-2}di$ values, ADT 42, ADT 36 and AD 85361 were found to be stable and consistent in their performance in all environments; IR 72 though the best yielder was unstable in its performance.

Based on stability parameters, ADT 36 and AD 85361 for spikelets panicle^{-1}, grains panicle^{-1} and grain yield ha^{-1}, ADT 42 for grain yield ha^{-1}, and ADT 41 and IR 72 for 100 grain weight could be identified as the most stable and consistent genotypes in all environments.

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RESEARCH NOTES

STUDIES ON SOIL AVAILABLE NUTRIENT STATUS OF KANYAKUMARI DISTRICT

The information on the resources of soils will be beneficial to practice scientific agriculture to get maximum return from each and every unit area of land. To get the soil resource information for Kanyakumari district, 55 surface samples were collected at rarious places of the district in the farmer's holdings and they were analysed for the soil available macro-and micronutrients. The macronutrients *viz.*, N analysed by alkaline permanganate method, P by Bray I method and K by flame photometry.

The Kanyakumari and district comprises of four taluks *viz.*, Kalkulam, Vilavancode, Thovalai and Agasteeswaram. With regard to the availability of macro-nutrients, the data indicated that N availability was generally low in all the four taluks and available P content was medium in Thovalai taluk and low in the other three taluks. The soil available K content was high in Vilavancode and Thovalai taluks and medium in Kalkulam and Agasteeswaram taluks. Generally in Tamilnadu, the soil available micronutrients have been determined