Indian J. Genet., **60**(4): 471-476 (2000)

STABILITY ANALYSIS OF HIGH YIELDING WHEATS AT VARYING FERTILITY LEVELS

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(Received: February, 1997; accepted: August, 2000)

ABSTRACT

It is being increasingly realised that for sustainable crop production a new set of high yielding varieties are required which exploit favourable weather and other input conditions but suffer minimum losses when encountered with sub- optimum input conditions. The experiments described in this communication comprised six promising wheats grown in randomized block design with three replications over a range of artificially created fertility gradient for two years. The stability analysis of the genotypes following the Eberhart and Russels model was performed. On the basis of mean performance over all fertility levels, HD2329, Kundan and DL803-3 were the highest yielding wheats. Two genotypes viz., HD2329 and Kundan have the inherent attributes of responsiveness to high yielding environments as evidenced by unit linear regression coefficient (b = 1) of the stability analysis. The distinctive behaviour between the two genotypes was revealed by another stability parameter ($\sigma^2 \delta_i$) wherein the deviations from regression were the highest for HD2329, showing that the variety is suited specifically to high yielding environments. Kundan showed the minimal (σ^2_δ), indicating that the varietal performance was stable even at the lower fertility levels.

Key Words : Wheat, stability, fertility gradient, sustainability

High yielding varieties that have inherent stability in performance over different agronomic and agroclimatic conditions are of great significance in countries like India towards sustainable production and productivity. Phenotypic stability in wheat lines has been investigated by many workers[1-7]. High yielding wheat varieties with the inherent capacity of responsiveness to different levels of input factors with stability at higher levels of production facilities the identification of genotypes with stability at higher levels of production. The varieties developed so far through conventional breeding approaches are mainly suited to one set of input conditions. For the sustainable crop production a new set of high yielding varieties is required embodying genetic homoeostasis which exploit favourable weather and other input conditions but suffer minimum losses when encountered with sub-optimum input conditions.

The present investigation was therefore, undertaken (1) to quantify the deviation s caused in high yielding wheats at different fertility levels (2) identifying wheats with consistent performance over a range of fertility gradient, through stability analysis.

MATERIALS AND METHODS

The materials of the present investigation comprised 6 high yielding varieties of wheat viz., DL802-3, DL803-3, HD2329, Kundan, WH542 and CPAN3004 grown in randomized block design in 1992-93 and 1993-94 during rabi season at New Delhi. The details of pedigrees in reference to these genotypes is presented in Table 1. An artificial fertility gradient was created by applying different doses of nitrogen and phosphorus. Two levels of nitrogen N_{60} and N_{120} and three levels of phosphorus P_0, P_{30} and P_{60} were selected and the fertilizer gradient was generated through all possible combinations of nitrogen (N) and phosphorus (P) viz., $N_{60}P_0$, $N_{60}P_{30}$, $N_{60}P_{60}$, $N_{120}P_{30}$, and $N_{120}P_{60}$ for two years. N was applied in the form of urea (46% N) in two doses, first half as basal dose at the time of sowing and the second as top dressing after 3 weeks of sowing. P was applied in the form of single superphosphate (15% P) as basal dose. The plot size of each variety comprised 12 rows of 5 m length with a row to row distance of .23 m. The normal cultural practices as recommended for the high yielding varieties were followed. The statistical analysis was conducted as suggested by Eberhart and Russell[8] for stability parameters.

Table 1. Pedigree of wheat genotypes

DL802	HUW202.KS-Frond-Sono64-K Rend-E4870-S310S 47E/HD1944M
DL803	HUW202/K 7537/Black point free mutant HD2160
HD2329	SLS1B/NP852/4/PJSIB/P14//KT54B/3/K65/5/SKA/6/UP262
Kundan	Tanori71/NP890
WH542	Jup.BJYSIB//Ures
CPAN3004	RS31/WIS 245SIB

RESULTS AND DISCUSSION

The genotypes differed significantly over different fertility doses. The response curves of different wheat genotypes over a range of the fertility gradient are presented in Fig.1. The maximum response at the lowest dose ($N_{60}P_0$) was given by HD2329 (43.4 q/ha) followed by WH542 (42.9q/ha) and Kundan (41.8 q/ha). While the maximum response at the highest dose ($N_{120}P_{60}$) was given by CPAN3004 (54.8q/ha) followed by DL802(54.3 q/ha). The pooled analysis of variance indicated that both linear and non-linear components of the G × E interaction were significant. This indicated that the genotypes differed considerably with respect to their stability behaviour and the prediction of the performance of varieties over different fertility levels will be difficult based on linear models.

Table 2. Estimates of stability parameters for different genotypes of wheat

Variety	Yield (q/ha)	Mean plot yield (Xi)	Regression coefficient (bi ± sb)	Mean squarred deviations $\sigma^2 \delta_i$
DL802-3	42.31	5.84	0.49 ± 0.034	0.14*
DL803-3	46.30	6.39	0.63 ± 0.049	0.03
HD2329	47.46	6.55	1.26 ± 0.086	0.28**
Kundan	46.38	6.4	1.20 ± 0.092	0.07
WH542	43.19	5.96	0.72 ± 0.156	−0.01
CPAN3004	43.91	6.06	1.37 ± 0.110	0.05
C.D. (P = 0.05)	2.39	0.33		

It is evident from the Table 2 that the linear component (bi) was significant for all genotypes while the non-linear component $\sigma^2\delta_i$ was significant for only two genotypes viz., DL802-3 and HD2329, this indicated that most of the GXE interaction was linear in nature. On the basis of individual parameters of adaptability Xi, bi and δ^2di, the following conclusions can be made about the genotypes

HD 2329: It recorded the highest per plot yield 6.55 Kg (47.5 Q/ha), above average response and the significant mean squarred deviations from the regression line. Therefore, this genotype was specifically adapted to the high yielding environments. This genotype embodied the specific adaptation to the high yielding environments.

Kundan : It was at par with HD2329 on the basis of the mean performance (46.4 q/ha), with the unit linear regression coefficient but recorded the non-significant mean squarred deviation from regression. This indicated that the genotype embodied the general adaptation across all the fertility levels, besides responding to the highly favourable environments, it is expected to perform well even in the low yielding environments.

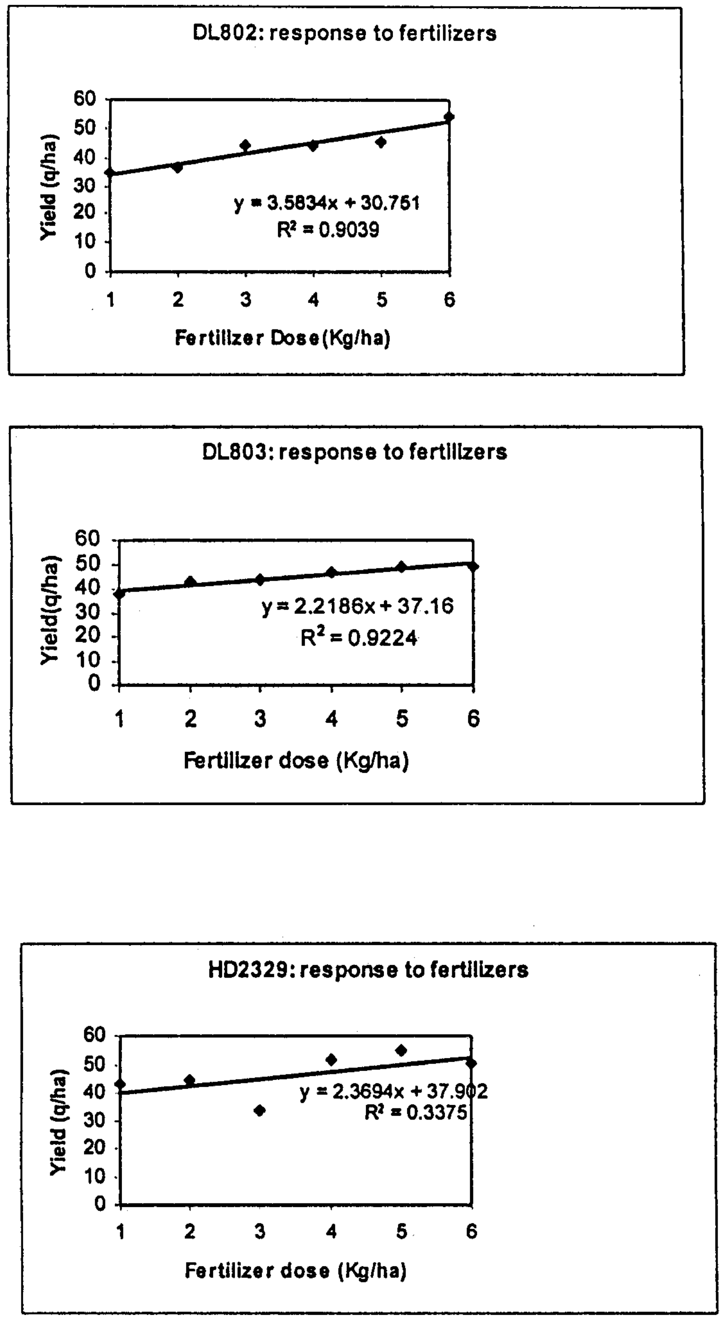
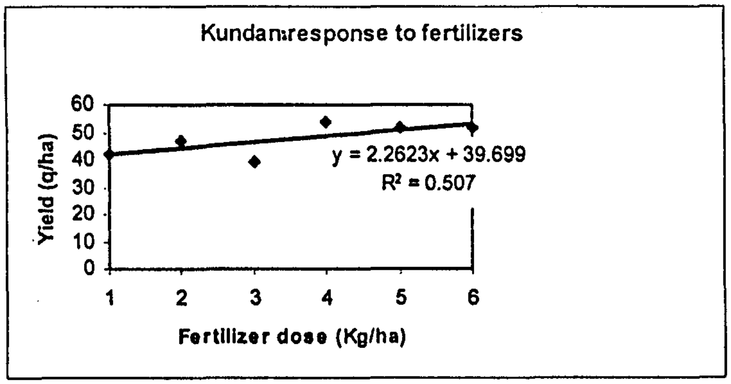
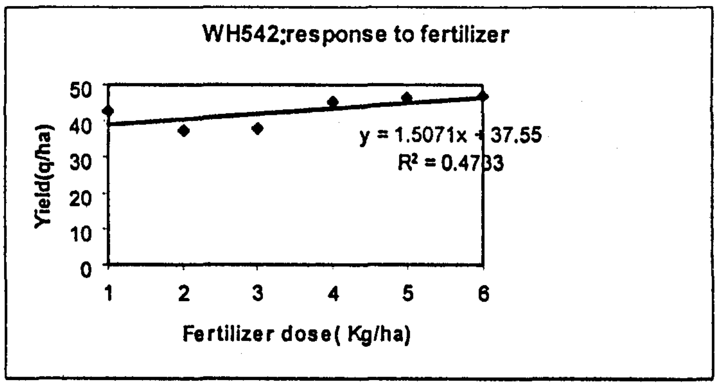


Fig. 1. Linear response of wheat genotypes DL 802, DL 803 and HD 2329 over fertilizer doses





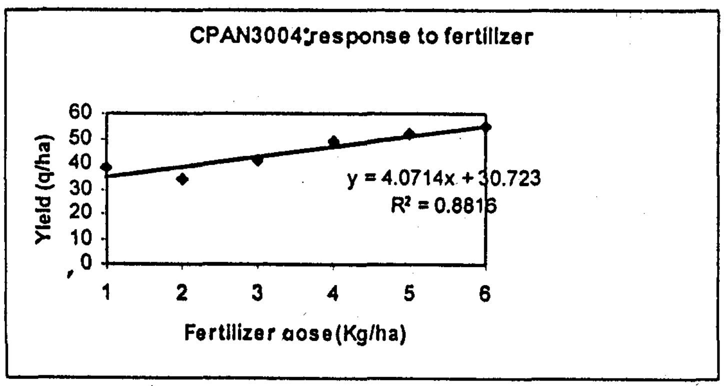


Fig. 2. Linear response of wheat genotypes Kundan, WH 542 and CPAN 300 over fertilizer doses

DL803-3 (Kanchan) : Its mean performance in respect of Xi (46.3 q/ha) and $\delta^2 d_i$ were similar to Kundan but the bi value was less than unity, thereby indicating that the genotype had the genetic homoeostasis to give stable yields under the low yielding environments, however the responsiveness to high fertility levels may not be assured.

CPAN3004 : It had above average response and non significant mean squared deviation but its mean (43.9q/ha) was below the general mean (44.9 q/ha). This indicates that the variety may not be widely acceptable.

WH542 : The genotype embodied the above average response and the non significant mean squarred deviations. The mean performance (43.2 q/ha) however was significantly below the general mean. The variety, therefore may not perform as good as other varieties.

DL802-3 : Both the regression coefficient and the mean squarred deviations were significant but its performance (42.3 q/ha) was significantly below the general mean (44.9q/ha).

REFERENCES

1 G. S. Bhullar, K. S. Gill and A. S. Khera. 1977. Stability analysis over various filial generations in bread wheat. Theoret. Appl. Genet., **51**: 41-44.

2. J. S. Choubey, E. V. D. Sastry and J. S. Chaubey. 1981. Stability analysis of yield and yield components in some Indian and Mexican varieties of wheat. Ind. J. agric. Sci., **51**: 611-614.

3. K. S. Gull, G. S. Nanda and G. Singh. 1984. Stability analysis over seasons and locations of multilines of wheat (*Triticum aestivum* L). Euphytica., **33**: 489-495.

4. O. P. Luthra, S. N. Kakar and R. K. Singh. 1976. Genotype environment interaction and ranking of varieties in wheat. Proc. 3rd Intern. Congress. SABRAO, 3(d): 22-25.

5. A. M. B. Moniem. 1987. Genotypic stability analysis of yield and related agronomic characters in wheat-agropyron derivatives under varying watering regimes. Theoret. Appl. Genet., **73**: 737-743.

6. P. N. Rasal, R. N. Thete, S. D. Ugale and A. D. Dumbre. 1988. Stability analysis for yield in wheat. J. Maharashtra Agric. Univ., **13**: 4-6.

7. W. W. Wagorie, W. O. Vogel, R. Little and D. L. Danial. 1995. Towards the identification of stable wheat varieties for Uganda. *In*: Breeding for disease resistance with emphasis on durability. Proc. of Regional Workshop for Eastern, Central, Southern Africa, Njoro, Kenya.

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