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# Stability analysis for seed yield and its component characters in fenugreek (*Trigonella foenum-graecum* L.)

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**Abstract**

Fourteen genotypes of fenugreek (*Trigonella foenum-graecum*) were grown at Sriniketan (West Bengal) in four different environments during winter season for three consecutive years. Genotype x environment (G x E) interaction was studied for seed yield and its component characters namely, pods plant$^{-1}$, seeds pod$^{-1}$ and test weight. G x E interactions were highly significant for all the characters. Both linear and non-linear components of G x E interactions were highly significant, non-linear component being predominant for seeds pod$^{-1}$ and seed yield plant$^{-1}$, while linear component was predominant for test weight. However, both linear and non-linear components were equally important for pods plant$^{-1}$. The genotypes UM-129, UM-301 and UM-302 were stable.

**Key words:** fenugreek, stability analysis, *Trigonella foenum-graecum*.

Cultivation of fenugreek (*Trigonella foenum-graecum* L.) in West Bengal in India is limited and information on the possibility of commercial cultivation of the crop in this region is scanty. Stable varieties are needed for commercial cultivation over a wide range of agroclimatic conditions and preliminary evaluation can be made to identify stable genotypes through studies on genotype x environment (G x E) interactions.

Fourteen genotypes of fenugreek, collected from All India Coordinated Research Project on Spices, SKN College of Agriculture, Jobner (Rajasthan), were grown in a completely randomized block design with three replications during winter season at Horticulture Farm (1998–99) and at Agriculture Farm (1998–99, 1999–2000 and 2000–01) of Institute of Agriculture, Visva-Bharati, Sriniketan (West Bengal) (23° 39′ N, 87° 42′ E, 58.9 m MSL). The spacings adopted were 45 cm x 10 cm at Horticulture Farm and 30.0 cm x 7.5 cm during 1998–99 and 1999–2000 and 20 cm x 5 cm during 2000–01 at Agriculture Farm. A fertilizer dose of 25:50:50 NPK kg ha$^{-1}$ was applied. Normal cultural practices were followed in all the experiments except during 2000–01, where poor crop management practices were followed. Data on pods plant$^{-1}$, seeds plant$^{-1}$, test weight and seed yield plant$^{-1}$ were recorded on 10 randomly selected plants in each replication. Plot means were used for stability analysis as proposed by Eberhart & Russell (1966).

Analysis of variance in each of the four environments indicated significant differences among the genotypes for all the four characters in three out of four environments. The performance of genotypes was poor in the trial undertaken during 2000–01 where significant differences among genotypes were observed for test weight only. In the pooled analysis of variance conducted over all the four environments, the genotypes were, however, not significantly different for all the characters except test weight (Table 1). This could be attributed to high cross over G x E interactions for these characters.

The results of analysis of variance for stability indicated the presence of variations among environments and differential response of the genotypes to environmental changes as mean sum of squares due to environment and G x E interaction were highly significant for all the characters (Table 1). Significant G x E interaction for test weight in fenugreek has been reported earlier (Sharma *et al.* 1994). Regression analysis indicated that non-linear component of G x E interaction was predominant for seeds $pod^{-1}$ and seed yield $plant^{-1}$, while linear component was predominant for test weight. However, both linear and non-linear components were almost equally important for pods $plant^{-1}$.

Thus, it can be inferred that test weight is more effective for determining the stability of the genotypes rather than seeds $pod^{-1}$ and seed yield $plant^{-1}$, which have more unpredictable responses. G x E interactions and importance of both linear and non-linear components for grain yield in fenugreek have been reported earlier (Arora *et al.* 1993).

Finlay & Wilkinson (1963) considered linear regression as a measure of stability, whereas Eberhart & Russell (1966) emphasized that both linear (bi) and non-linear ($S^2di$) components of regression be considered while judging the phenotypic stability of a genotype. Breese (1969) and Paroda & Hayes (1971) underlined that linear regression should simply be regarded as a measure of response of a particular genotype, whereas deviation around regression should be considered as a measure of stability; genotypes with lowest deviation being the most stable and vice versa. Accordingly, in the present study, the mean (ī) and deviation from regression ($S^2di$) of each genotype were considered for stability and linear regression (bi) was used for testing the response of genotypes (Table 2).

*Pods $plant^{-1}$:* Only one genotype, RMT-143 showed stability for this character as indicated by non-significant $S^2di$. This genotype had a mean below population mean and bi=1. This genotype may, therefore, be poorly adapted to all the environments.

*Seeds $pod^{-1}$:* Eight genotypes showed stability for this trait, of which only three exhibited values above mean (11.80). These three genotypes, UM-127, UM-128 and UM-129 had regression coefficient of unity or close to unity indicating their adaptation to all environments.

**Table 1.** Analysis of variances (mean sum of square) for stability of four characters in fenugreek

| Source | df | Pods $plant^{-1}$ | Seeds $pod^{-1}$ | Test weight | Seed yield $plant^{-1}$ |
|---|---|---|---|---|---|
| Genotype (G) | 13 | 63.77 | 0.754 | 3.160** | 1.560 |
| Environment (E) | 3 | 1619.10** | 65.430** | 12.950** | 41.050** |
| G x E | 39 | 57.29** | 0.798** | 0.715** | 1.130** |
| E + (G x E) | 42 | 168.85 | 5.410 | 1.590 | 3.980 |
| Environment (linear) | 1 | 4857.29** | 196.290** | 38.860** | 123.150** |
| G x E (linear) | 13 | 51.54++ | 0.492++ | 1.380** | 0.473++ |
| Pooled deviation | 28 | 55.87** | 0.883** | 0.353** | 1.354** |
| Pooled error | 104 | 1.42 | 0.224 | 0.048 | 0.042 |

**Significant at 1% level; ++Significant at 1% level, when tested against pooled error

**Table 2.** Mean performance and stability parameters for four characters in fenugreek

| Genotype | Pods plant$^{-1}$ | | | Seeds pod$^{-1}$ | | | Test weight | | | Seed yield plant$^{-1}$ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | μ | bi | $S^2di$ | μ | bi | $S^2di$ | μ(g) | bi | $S^2di$ | μ(g) | bi | $S^2di$ |
| RMT-1 | 26.75 | 0.49 | $46.76^{**}$ | 11.24 | $1.22^{**++}$ | 0.24 | 11.34 | 1.38 | $0.54^{**}$ | 3.75 | 0.92 | $2.00^{**}$ |
| RMT-143 | 28.43 | $0.97^{**}$ | 1.59 | 11.93 | $1.34^{**++}$ | $1.77^{**}$ | 12.16 | 2.34 | $0.99^{**}$ | 3.59 | $0.93^{*}$ | 0.15 |
| UM-32 | 30.54 | 1.30 | $97.21^{**}$ | 11.60 | $1.02^{**}$ | $1.51^{**}$ | 12.04 | 0.77 | $0.58^{**}$ | 4.12 | 1.05 | $3.57^{**}$ |
| UM-34 | 25.85 | $0.72^{*}$ | $19.34^{**}$ | 10.74 | $0.94^{**++}$ | 0.09 | 10.20 | $1.27^{*}$ | 0.07 | 3.02 | 0.75 | 1.20 |
| UM-116 | 26.58 | 0.52 | $41.84^{**}$ | 12.23 | $0.67^{**++}$ | $1.35^{**}$ | 11.94 | 0.94 | $0.42^{**}$ | 3.67 | $0.70^{*}$ | 0.07 |
| UM-117 | 25.12 | 0.72 | $3.77^{*}$ | 11.73 | $1.08^{**++}$ | 0.03 | 12.81 | 0.81 | $0.88^{**}$ | 3.72 | $0.82^{*}$ | 0.04 |
| UM-118 | 31.93 | 1.24 | $40.91^{**}$ | 11.76 | $0.93^{**++}$ | 0.18 | 12.74 | 0.95 | $0.36^{**}$ | 4.73 | 1.29 | $1.70^{*}$ |
| UM-127 | 34.28 | $1.40^{*}$ | $33.30^{**}$ | 12.14 | $0.84^{**++}$ | 0.13 | 11.71 | $1.10^{**}$ | 0.03 | 4.71 | 1.24 | $1.33^{*}$ |
| UM-128 | 34.54 | 1.64 | $285.34^{**}$ | 11.88 | $1.01^{**}$ | 0.15 | 13.73 | -0.26 | $0.17^{*}$ | 4.97 | 1.22 | $4.20^{**}$ |
| UM-129 | 35.94 | $1.09^{*}$ | $25.36^{**}$ | 12.21 | $1.04^{**++}$ | 0.39 | 11.71 | $1.23^{**+}$ | 0.04 | 4.79 | $1.26^{**}$ | 0.08 |
| UM-144 | 29.42 | $0.81^{*}$ | $5.63^{*}$ | 11.68 | $1.02^{**}$ | $0.81^{*}$ | 10.77 | $2.06^{*}$ | $0.24^{**}$ | 3.53 | 0.80 | 0.56 |
| UM-301 | 36.26 | $1.51^{*}$ | $29.13^{**}$ | 11.60 | $1.24^{**++}$ | 0.19 | 12.38 | -0.23 | 0.00 | 4.63 | 1.22 | 0.21 |
| UM-302 | 33.44 | $1.08^{*}$ | $13.53^{**}$ | 12.31 | $0.93^{**++}$ | $1.61^{**}$ | 11.94 | $0.91^{*}$ | 0.04 | 4.64 | $1.17^{*}$ | 1.15 |
| UM-304 | 26.26 | 0.50 | $118.49^{**}$ | 12.22 | $0.72^{**++}$ | $1.32^{**}$ | 11.18 | 0.72 | 0.07 | 3.56 | 0.63 | $2.11^{**}$ |
| Grand mean | 30.38 | 1.00 | | 11.80 | 1.00 | | 11.90 | 1.00 | | 4.10 | 1.00 | |
| SE | 4.32 | 0.40 | | 0.54 | 0.25 | | 0.34 | 0.36 | | 0.67 | 0.39 | |

μ=Mean; bi=Regression coefficient; $S^2di$=Mean square deviation from regression; SE=Standard error

*, ** Significantly different from zero at 5% and 1% levels, respectively

+, ++ Significantly different from unity at 5% and 1% levels, respectively.

*Test weight:* Six genotypes had non-significant $S^2di$ indicating their stability for this character. Out of six genotypes, only UM-301 and UM-302 had mean higher than average mean and UM-302 had bi=1. Therefore, UM-302 is well adapted to all environments.

*Seed yield plant$^{-1}$:* Seven genotypes had seed yield higher than population mean out of which only three genotypes namely, UM-129, UM-301 and UM-302 had non-significant $S^2di$. The genotypes UM-129 and UM-302 had bi values not significantly different from unity. These two genotypes would, therefore, be adapted to all environments. The highest yielding genotype UM–128, followed by two other high yielding genotypes, UM-118 and UM-127 were very unpredictable as only the non-linear component of regression was significant.

It has been generally considered that non-stable genotypes have higher yield potential than stable genotypes because their specific adaptation is usually directed towards performance in favourable environments. However, stability and high yield are not mutually exclusive (Heinrich *et al.* 1985) as observed in UM-129 and UM-302.

The stable genotypes UM-129 and UM-301 were stable for seeds pod$^{-1}$ and test weight, while UM-302 was stable for test weight only. The other genotypes, which were stable for seed yield, were unstable for one or more component characters. Hence, plasticity in the expression of the component characters seems to be responsible for stability of seed yield.

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