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# STABILITY ANALYSIS FOR FLOWERING AND MATURITY TRAITS IN CUCUMBER (*CUCUMBERS SATIVUS* L.)

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Cucumber is an important vegetable crop grown year found for salad and pickling purposes. There is a need to develop and identify the genotypes, which can successfully be grown during summer and *Kharit* season. Response of cucumber genotypes to range of environmental conditions is an important step in the development of improved varieties. The selection of improved varieties is often inefficient due to genotype x environment interaction. Genotypes grown in multi-environmental trials may react differently to a range of climate conditions, soil characterstics or technical practices ( Lacaze and Roumet, 2004). Several methods have been proposed for determining the stability of varieties tested under different environments (Eberhart and Russell, 1966; Perkins and Jinks, 1968) and to get reliable estimates of genotype x environment interaction. A attempt has been made to identify the stable genotypes of cucumber with desirable characters for commercial cultivation.

The experimental material consisted of twenty cucumber genotypes (Table 2), including ten pure lines by public and private sectors and ten hybrids. The experiment was conducted in randomized block design with three replications under four environments during 2004-05 in *Kharif* 2004 and summer 2005 at Vegetable Research Centre of the Govind Ballabh Pant Univeristy of Agriculture and Technology, Pantnagar. Ten pure lines were selected on the basis of morphological, protein profile and geographical diversity, and ten hybrids including Pant Sankar Khira-1 were selected and used as experimental materials for studying genotype x environment interaction. The experimental material was evaluated under four different environments *viz.*, *Kharif* season sowing (E1), *Kharif season sowing* with pinching of main vine after tenth node( E2), Summer season sowing (E3), Summer season sowing with pinching of main vine after tenth node(E4). Data were recorded on five randomly selected plants on five characters, namely, node number to first male flower, days to first male flower, node number to first female flower, days to first female flower and days to first fruit harvest. The statistical techniques proposed by Eberhart and Russell (1966) was untilized to estimate genotype x environment interaction and stability parameters for different genotypes with respect to different characters.

The G x E interaction is a major factor, which determines whether or not to select widely adapted genotypes suitable for a limited subset of environments. Pooled analysis variance (Table 1) revealed that the genotypes differed significantly in respect of three characters i.e. days to first male flower, days to first female flower and days to first fruit harvest. This showed variability among the genotypes for these characters. The mean squares due to genotypes were not significant for node number to first male flower and node number to first female flower. The environmental mean square was highly significant for all characters and thus suggested that the environments were effective in influencing the performance of genotypes ( Pfahler and Linskens, 1979 and More and Munger, 1987).

The G x E interaction mean squares were significant for all the characters indication differential response of the genotypes over the four environments. Similar results was reported by Finlay and Wilkinson (1963 ), Prasad and fPitchaimuthu (2004) and Campbell and Jones (2005). Highly significant variance due to E (linear) was observed for all characters. Agasimani *et al*. (2008) also observed similar findings in cucumber. The linear component of the G x E interaction was found to be significant for characters viz., node number to first male flower, days to first male flower, days to first female flower and days to first fruit harvest except node no. To first female follower, showing that genotypes differed significantly for regression coefficient with respect to above metntioned characters. The non-linear component (pooled de4viation) of G x E interaction contributed significantly to the total G x E interaction for the characters viz., node number to first male flower, node number to first female flower and days to first harvest. Similar findings were advocated by Prasad and Singh (1990) in cucumber. Rajput *et al*. (1994) in bitter

gourd, Prasad and Pitchaimuthu (2004) in cucumber.

According to Eberhart and Russell Model, and disrable and stable genotype is the one having high mean, bi = 1 and $S^2$ di = 0. Depending upon particular character, however , the desirable mean could be towards high level or low level. Fro example days to first female flower, node to first female flower and days to first harvest, low mean could be considered as the desirable one. The stability parameters such as bi (regression coefficient) and $S^2$ di (deviation from regression ) have been presented in Tables 2.

For node number to first male fower, genotypes PCUC 208, PCUC 188 and PCUC 83 showed significant regression value, but Pant Khira 1 was highly significant. The remaining genotypes had non significant value of $b_i$ indicating average response over all the 4 environments. The genotypes PCUC 208 and PCUC 83 had $b_i$ value more than one indicatin their suitability for favourable environment. PUCU 188 and Pant Khira 1 had $b_i$ value less than one showing their consistently performance for unfavourable environments. As per Eberhart and Russell (1966) only one genotype PUCU 8 x PCUC 188 was found desirable and stable across the environments. Similar findings were reported by More and Munger (1987), Rajput *et al.* (1994) and Yadava (2003). For character days to first male flower, genotypes PUCU 81, PUCU 202 and Pant Sankar Khira 1 had $b_i$ values more than one indicating their suitablility for favourable environments. PCUC 202 x PCUC 81, PCUC 101 x PCUC 83 and Pant Khira 1 had $b_i$ values less than one indicating that these genotypes performed poorly in al environments.

The $S^2b_i$ value was significant for PCUC 202 indicating that genotype was unstable for this trait overall the environments. The remaining genotypes had $S^2d_i$ value non – significant from zero i.e. $S^2b_i$ = 0. Thus, remaining genotypes were stable. The genotypes PCUC 45, PCUC 81 x PCUC 46 and PCUC 201 x PCUC 101 had low mean for days to first male flower, bi = close to one , and $S^2b_i$ = close to zero. These genotypes could be considered as the desirable and stable. Prasad and Singh(1991), Prasad and Pichaimuthu (2004) also reported similar findings in cucumber.

All the genotypes had $b_i$ value not significantly differed from one, indicating average response of al genotypes over all the environments. The crosses PCUC 202 x PCUC 101 and PCUC 208 x PCUC 8 had significant $S^2d_i$ value . The remaining genotypes had $S^2d_i$ values non- significantly differed from zero.

The genotype PCUC 101 x PCUC 83 had lower mean value , $b_i$ value close to one and $S^2d_i$ value close to zero, followed by Pant Sankar Khira 1 ( Xi = 5.30, $b_i$ = close to one, $S^2d_i$ = close to zero). Hence , according to Eberhart and Russell (1966) , these two genotypes could be considered as stable genotypes for node no. to first female flower.

The variation among the genotypes for days to first female flower was minimal. Further, genotypes showing earliness were coupled with unstable factor such as high regression coefficient and deviation from regression. The results indicated that the genotypes PCUC 45, followed by PCUC 188, PCUC 202 x PCUC 101 and PCUC 8 x PCUC 188 were stable for earliness and can be used in breeding programme . The genotypes PCUC 45, PCUC 188, PCUC 202 x PCUC 101 and PCUC 8 x PCUC 188 had lower mean for days to first female flower , $b_i$ values close to unity and $S^2d_i$ values close to zero indicating that these fulfilled the criteria of desirable and stable genotype.

The genotype PCUC 202 and PCUC 202 x PCUC 101

Table 1. Pooled analysis of varieties for different characters in cucumber

| Characters | Mean squares | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Genotype (G) | Environment (E) | G x E | E + (G x E) | E ( linear) | G x E (linear) | Pooled deviation | Pooled error |
| D.F. | 19 | 3 | 57 | 60 | 1 | 19 | 40 | 160 |
| 1. Node number to first male flower | 0.143 | 9.48** | 0.10** | 0.57 | 28.46** | 1.97* | 0.07* | 0.04 |
| 2. Days to first male flower | 0.57** | 915.01** | 3.51* | 49.08 | 2745.04** | 6.31** | 2.00 | 2.06 |
| 3. Node number to first female flower | 0.28 | 1.07* | 0.32** | 0.36 | 3.21** | 0.12 | 0.40** | 0.09 |
| 4. Days to first female flower | 18.13** | 1109.46** | 5.070** | 60.29 | 3328.36** | 9.20** | 2.85 | 3.00 |
| 5. Days to first fruit harvest | 17.22** | 1954.97** | 6.46** | 103.89 | 5864.94** | 11.85** | 3.57** | 2.82 |

* Signifficant at 5% ; ** Significant at 1%

Table 2. Stability parameters of cucumber genotypes for five characters

| Genotypes | Node number to First male flower | | | Days to first male Flower | | | Node number to first female flower | | | Days to first female flower | | | Days to first fruit harvest | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\bar{X}_i$ | $b_i$ | $S^2d_i$ | $\bar{X}_i$ | $b_i$ | $S^2d_i$ | $\bar{X}_i$ | $b_i$ | $S^2d_i$ | $\bar{X}_i$ | $b_i$ | $S^2d_i$ | $\bar{X}_i$ | $b_i$ | $S^2d_i$ |
| PCUC 81 | 4.21 | 0.78 | 0.085* | 43.75 | 1.38** | 3.01 | 5.30 | 2.18 | 0.84** | 50.01 | 1.28* | 9.91* | 57.92 | 1.06 | -0.19 |
| PCUC 86 | 3.52 | 0.99 | -0.005 | 40.95 | 1.23 | -1.97 | 5.10 | 1.19 | 0.37** | 46.90 | 1.28* | -0.72 | 55.33 | 1.05 | 1.81 |
| PCUC 202 | 4.01 | 0.96 | 0.021 | 45.22 | 1.37** | 11.31** | 5.53 | 1.21 | 0.87** | 25.35 | 1.53* | 1.26 | 61.25 | 1.36** | 41.59** |
| PCUC 101 | 3.90 | 1.12 | -0.027 | 41.15 | 0.84 | 1.40 | 4.98 | 1.57 | 0.16 | 46.60 | 0.84 | 2.66 | 54.50 | 1.10 | -1.40 |
| PCUC 208 | 3.83 | 1.53* | 0.015 | 40.98 | 1.12 | -0.52 | 5.77 | 0.26 | -0.10 | 45.57 | 0.97 | -2.33 | 54.25 | 1.13 | -2.57 |
| PCUC 8 | 3.84 | 0.93 | 0.105* | 41.82 | 0.84 | -0.64 | 4.85 | 2.29 | -0.04 | 47.57 | 0.94 | 0.90 | 54.42 | 1.15 | -2.06 |
| PCUC 45 | 3.68 | 0.75 | 0.176** | 41.73 | 0.97 | -0.51 | 4.88 | 1.42 | -0.02 | 47.43 | 1.00 | -2.47 | 55.67 | 1.01 | -2.98 |
| PCUC 188 | 3.93 | 0.51* | 0.103* | 42.58 | 1.10 | -0.08 | 5.15 | 2.30 | -0.01 | 48.46 | 1.19 | 0.26 | 54.75 | 1.07 | -0.03 |
| PCUC 83 | 3.77 | 1.51* | 0.012 | 43.38 | 1.09 | -1.62 | 5.16 | -0.56 | 0.13 | 50.63 | 1.02 | -0.11 | 57.83 | 0.87 | -2.63 |
| Pant Khira-1 | 4.18 | 0.05** | -0.009 | 46.85 | 0.62** | -1.61 | 5.58 | 1.09 | 1.08** | 54.89 | 0.83 | -1.05 | 61.58 | 0.39** | -1.26 |
| PCUC 81 X PCUC 46 | 3.78 | 0.91 | -0.026 | 41.35 | 0.94 | -1.49 | 5.25 | 1.05 | 0.16 | 47.78 | 0.75 | -0.12 | 57.58 | 0.74* | -2.73 |
| PCUC 202 X PCUC 101 | 3.63 | 1.26 | 0.194** | 41.82 | 1.06 | -1.97 | 5.58 | 0.52 | 0.26* | 47.37 | 1.04 | -0.16 | 55.08 | 1.24* | -1.51 |
| PCUC 208 X PCUC 8 | 4.01 | 0.94 | 0.044 | 41.92 | 0.91 | -2.01 | 5.23 | 0.74 | 0.26* | 48.13 | 0.86 | -2.34 | 56.42 | 0.92 | -2.93 |
| PCUC 208 X PCUC 45 | 3.92 | 1.20 | 0.086* | 42.50 | 0.84 | 0.92 | 5.13 | -0.42 | 0.10 | 48.62 | 0.70* | -1.47 | 57.08 | 0.80 | -2.79 |
| PCUC 202 X PCUC 81 | 3.72 | 1.06 | -0.11 | 42.27 | 0.71* | -1.07 | 5.67 | 2.40 | -0.09 | 47.85 | 0.76 | 0.67 | 55.92 | 0.94 | -2.30 |
| PCUC 81 X PCUC 101 | 4.07 | 1.20 | -0.007 | 42.58 | 1.00 | -2.04 | 5.47 | 0.3 | 0.53** | 49.22 | 0.99 | -0.92 | 57.00 | 0.95 | 0.33 |
| PCUC 8 X PCUC 188 | 3.91 | 1.01 | 0.012 | 41.42 | 1.12 | -1.54 | 5.20 | -0.06 | 0.94** | 47.08 | 1.00 | -2.68 | 55.00 | 1.05 | -2.01 |
| PCUC 202 X PCUC 45 | 3.90 | 1.06 | -0.028 | 41.98 | 0.78 | -1.21 | 5.22 | 0.35 | 0.39** | 47.83 | 0.77 | -1.67 | 56.08 | 0.92 | -1.15 |
| PCUC 101 X PCUC 83 | 3.83 | 1.25 | -0.035 | 42.62 | 0.75* | -0.009 | 4.85 | 1.03 | 0.003 | 48.23 | 0.75 | -1.88 | 54.50 | 1.10 | -1.40 |
| Pant Sankar Khira-1 | 4.23 | 0.87 | 0.025 | 43.43 | 1.24* | -0.89 | 5.30 | 1.08 | -0.003 | 49.82 | 1.42** | 2.68 | 55.58 | 1.06 | -2.89 |
| Mean | 3.89 | 0.99 | | 42.51 | 1.00 | | 5.26 | 1.00 | | 48.61 | 1.00 | | 56.38 | 1.00 | |
| S.E.± | 0.02 | 0.23 | | 0.66 | 0.12 | | 0.13 | 1.58 | | 0.95 | 0.13 | | 1.19 | 0.11 | |

had $b_i$ values significantly more than one, whereas PCUC 81 x PCUC 46 and Pant Khira 1 had $b_i$ values less than on showing that these genotypes were adapted for unfavorable environments. The remaining genotypes had $b_i$ values not significantly different from one indication average response over all the environments. All genotypes had $S^2d_i$ values non – significantly differed from zero, except PCUC 202 , Which indicates that this genotype was unstable for days to first fruit harvest over all the environments. For greater stability of days to first frit harvest five genotypes (PUCU 188, PUCU 45, PCUC 46, PCUC 8 x PCUC 188 and Pant Sankar Khira 1) showed low mean performance with , $b_i$ close to one , $S^2d_i$ approaching zero.

On the basis of above findings it can be concluded that the genotypes found stable for various characters were PCUC 8 x PCUC 188 for node no. to first male flower; PCUC 45 , PCUC 81 x PCUC 46 and PCUC 202 x PCUC 101 for days to first male flower ; PUCU 101 x PCUC 83 for node no. to first female flower; PUCU 45 , PCUC 188 ,PCUC 202 x PCUC 101 and PCUC 8 x PUCU 188 for days to first female flower and PCUC 188 , PUCU 45 , PCUC 46 , PCUC 8 x PCUC 188 and Pant Sankar Khira -1 for days to first fruit harvest. Considering the over all performance PCUC 45 and PCUC 8 x PCUC 188 were found promising and stable for most of the characters.

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