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Full Length Research Paper

Correlation co-efficients of component characters with seed yield and their direct effects in path analysis in fenugreek grown under six environments

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Thirty diverse genotypes of fenugreek were grown in six (E1 to E6) environments during the winter seasons for three consecutive years from 2002 to 2003 and 2004 to 2005 under high input and low input conditions, created by changing the date of sowing, spacing, fertilizer dose and other crop management practices at the Agriculture Farm of Institute of Agriculture, Visva-Bharati, West Bengal. Analysis of correlations revealed that significant and positive genotypic and phenotypic correlations of pod number, husk weight, stem weight and harvest index with seed yield did not change with the change in environmental conditions. Majority of the characters (except days to flowering and test weight) had significant and positive correlation with seed yield in all the environments except in E3, indicating the scope for selection for improving seed yield of fenugreek. The positive direct effects recorded in genotypic and phenotypic path analyses for pod number, seeds per pod and test weight were consistently greater in all the six environments. Therefore, selection of these characters in positive direction would be effective in increasing seed yield.

Key words: Correlation, direct effect, environments, morphological characters fenugreek, *Trigonella foenum-graecum* L.

INTRODUCTION

Fenugreek (*Trigonella foenum-graecum* L.) is an important leguminous crop. It is grown for seeds, leafy vegetables and fodder. It has been reported to have medicinal values to prevent constipation, remove indigestion and stimulate spleen and liver. Because of its complex chemical composition, fenugreek seeds have numerous pharmacological properties: emollient, anti-inflammatory, internal healer, antiulcer, CNS (central nervous system) and sexual stimulant (Mishkinsky et al., 1977), hypocholesterolemic (Oakenfull and Sidhu, 1990), glycemia lowering (Raghuram et al., 1994) and anti-oxidant (Ravikumar and Anuradha, 1999). Fenugreek can be a very useful annual legume crop for incorporation into short-term rotation (Moyer et al., 2003), for hay and silage (livestock) making and for fixation of atmospheric nitrogen into soils. The average productivity of fenugreek, which is third important seed spice in India, is about 1250 kg per hectare, which is considerably low. Improvement in seed yield could be achieved through selection of component characters influencing yield. An understanding of the character association of component traits with yield and their direct effects in path analysis is important for effective selection of traits for high yield. But the estimates of correlation coefficients and path coefficients are subjected to change by the environments in which the crop is grown. Therefore, this present investigation was undertaken to study the genotypic and phenotypic correlation co-efficient of component

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Table 1. Genotypic (G) and phenotypic (P) correlation co-efficients of ten component characters with seed yield in six environments.

Characters		E1	E2	E3	E4	E5	E6
Plant height	G	0.543**	0.580**	-0.371**	-0.025	0.617**	0.596**
	P	0.339**	0.451**	-0.236*	0.069	0.510**	0.521**
Branch number	G	0.255*	0.156	-0.589**	-0.007	0.718**	0.351**
	P	0.209*	0.145	-0.486**	0.106	0.625**	0.296**
Days to flowering	G	0.023	0.083	-0.442**	-0.429**	0.309**	-0.244*
	P	0.022	0.056	-0.389**	-0.355**	0.268*	-0.162
Pod number	G	0.719**	0.767**	0.910**	0.814**	0.828**	0.860**
	P	0.737**	0.790**	0.883**	0.781**	0.840**	0.798**
Pod length	G	0.577**	0.341**	-0.122	0.878**	0.452**	0.604**
	P	0.395**	0.256*	-0.047	0.597**	0.406**	0.462**
Seeds per pod	G	0.582**	0.627**	-0.361**	0.897**	0.866**	0.559**
	P	0.553	0.511**	-0.201	0.789**	0.775**	0.538**
Test weight	G	0.043	-0.003	0.530**	0.165	-0.301**	-0.152
	P	0.075	0.074	0.504**	0.190	-0.176	-0.005
Husk weight	G	0.984**	0.946**	0.533**	0.936**	0.928**	1.000**
	P	0.771**	0.807**	0.838**	0.812**	0.808**	0.803**
Stem weight	G	0.917**	0.978**	0.864**	0.828**	1.026**	0.878**
	P	0.831**	0.827**	0.721**	0.805**	0.876**	0.744**
Harvest index	G	0.227*	0.413**	0.784**	0.765**	-	0.657**
	P	0.094	0.343**	0.512**	0.526**	-	0.566**

*, ** Significant at P = 0.05 and P = 0.01, respectively.

characters with seed yield and their direct effects in path analysis in a population of 30 genotypes of fenugreek grown under six environments. Such studies will help in identifying component characters influencing seed yield of fenugreek which are less sensitive to environmental changes.

MATERIALS AND METHODS

Thirty diverse genotypes of fenugreek, collected from different parts of India, were grown during the winter seasons for three consecutive years from 2002 to 2003 and 2004 to 2005 at the Agricultural Farm of Institute of Agriculture, Visva-Bharati University, Sriniketan, India. The farm is situated under sub-humid, subtropical, lateritic belt of West Bengal, India at 23°39′ N latitude and 87°42′ E longitude with an average altitude of 58.9 amsl. In each season, the crop was grown under two different [high input (HI) and low input (LI)] environments, created by changing the date of sowing, spacing, fertilizer dose and other crop management practices. In case of high input environment, date of sowing was 1st week of November with the spacing of 25 × 7.5 cm, fertilizer dose of 30:60:60 kg ha^{-1} and need based crop management practices like proper time of thinning, weeding, hoeing, irrigation etc. were adopted. However, in case of low input environment, date of sowing was 15 days later than that of HI environment with the spacing of 20 × 5 cm, fertilizer dose of 20:40:40 kg ha^{-1} and overall crop management practices were poor. In each environmental situation, the genotypes were grown in a randomized block design with 3 replications. Each plot consisted of 6 rows of 3 m length. Data were recorded on 5 randomly selected plants from middle rows for 11 quantitative characters *viz*., plant height, branch number, days to flowering, pod number, pod length, seeds per pod, test weight, husk weight, stem weight, harvest index and seed yield. Based on mean performance and environmental index for all the characters, environments were arranged in descending order from rich (E1) to poor (E6). Data were analyzing for phenotypic and genotypic correlation coefficients (Johnson et al., 1955) and path analysis (Dewey and Lu, 1959).

RESULTS AND DISCUSSION

The genotypic and phenotypic correlation co-efficient of component characters with seed yield were estimated (Table 1) to study how seed yield was influenced by its component characters in all the environments. Genotypic and phenotypic correlations of pod number, husk weight,

Table 2. Direct effects of nine characters on seed yield in six environments

Characters		E1	E2	E3	E4	E5	E6
Plant height	G	-0.258	0.037	0.099	-0.164	-0.049	0.018
	P	-0.027	-0.004	0.049	-0.016	0.020	0.037
Branch number	G	0.973	-0.427	0.021	0.141	0.268	-0.282
	P	0.084	0.037	-0.090	-0.039	-0.082	-0.029
Days to flowering	G	-0.958	0.038	0.025	0.054	-0.438	-0.028
	P	-0.278	-0.218	0.113	0.102	-0.046	-0.049
Pod number	G	1.163	0.884	0.981	0.335	1.140	1.541
	P	0.757	0.732	0.898	0.489	0.715	0.650
Pod length	G	-0.098	-0.072	-0.03	-0.189	0.160	-0.169
	P	-0.059	-0.011	-0.003	0.001	0.009	0.049
Seeds per pod	G	0.659	0.625	0.396	0.583	0.737	0.898
	P	0.415	0.382	0.342	0.472	0.350	0.346
Test weight	G	0.833	0.375	0.348	0.604	0.581	0.242
	P	0.360	0.342	0.321	0.317	0.295	0.242
Husk weight	G	-0.288	0.160	0.210	-0.017	-0.293	-0.211
	P	0.097	0.091	0.102	0.033	0.062	0.119
Stem weight	G	-0.021	-0.177	-0.102	0.377	-0.266	-0.460
	P	0.102	0.123	0.005	0.202	0.164	0.108

stem weight and harvest index with seed yield were significant and positive in all the environments. This indicated that pattern of correlations of these characters was not changed with the change in environments. Positive correlations of seed yield with pod number, stem weight and harvest index (Saha and Kole, 2001; Banerjee and Kole, 2004) and husk weight and harvest index (Dash and Kole, 2000; Saha weight (Kole and Mishra, 2006; Kole and Tiwari, 2006) have been reported earlier.

In case of pod length and seeds per pod, significant positive correlation with seed yield was observed in all the environments, except E3 where correlation was non significant in case of pod length and negatively significant in case of seeds per pod. Significant positive correlations of seed yield with pod length and seeds per pod (Saha and Kole, 2001; Banerjee and Kole, 2004, Prajapati et al., 2010) have been reported earlier. However, non significant correlation of seed yield with pod length (Dash and Kole, 2000) and negative association between seed yield and seeds per pods (Khattab et al., 1991) have been reported.

In case of test weight, correlation was non significant in E1, E2, E4, E6 and positively significant in E3 and negatively significant in E5. Non significant or negatively significant correlations (Dash and Kole, 2000; Saha and Kole, 2001; Banerjee and Kole, 2004) and positive correlation (Jat, 2004; Gangopadhyay et al., 2009; Prajapati et al., 2010) have been reported earlier. Plant height and branch number had changed correlation from significantly positive values in E1, E2 (except branch number), E5 and E6 to negatively significant values in E3 and non significant values in E4. In E2 also, branch number showed non significant correlation. Positive and significant correlations of plant height and branch number with seed yield (Sharma et al., 1990; Dash and Kole, 2000) were observed. Non significant correlations of seed yield with plant height (Banerjee and Kole, 2004) and branch number (Saha and Kole, 2001) have also been reported.

Correlation of days to flowering was non significant in E1, E2 and negatively significant in E3, E4, E6 and positively significant in E5. Correlations of days to flowering with grain yield were non significant (Banerjee and Kole, 2004), negatively significant (Dash and Kole, 2000) and positively significant (Saha and Kole, 2001).

The results revealed that genotypic correlation of a character with seed yield in an environment resembled closely its phenotypic correlation. Majority of the characters (except days to flowering and test weight) had significant and positive correlation with seed yield in all the environments except E3, indicating the scope for selection for improving seed yield of fenugreek.

The results of path analysis (Table 2) revealed that direct effect in genotypic path analysis showed changes in different environments in case of plant height, branch number, days to flowering, pod length, husk weight and stem weight. Days to flowering had negative direct effect in both path analyses under both rich (E1) and poor (E6) environments while it had positive values in moderate (E2, E3, E4 and E5) environments. Direct effect of days to flowering has been reported as negative (Ayanoglu et al., 2004) and positive (Chandra et al., 2000; Prajapati et al., 2010). Plant height, branch number and pod length had very low direct effects in phenotypic path analysis.

Pod number, seeds per pod and test weight had high positive direct effects (although variable in magnitude) in both genotypic and phenotypic path analyses in all the six environments. High positive direct effects for pod number and seeds per pod (Dash and Kole, 2000; Ayanoglu et al., 2004; Banerjee and Kole, 2004; Datta et al., 2005; Gangopadhyaya et al., 2009), and test weight (Dash and Kole, 2000; Ayanoglu et al., 2004; Prajapati et al., 2010) have been reported. Consistently high positive direct effects of the direct yield components in path analyses in all the six environments indicated that selection for higher pod number, more seeds per pod and higher test weight will be effective in increasing seed yield.

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