Character association in maize under normal and excess soil moisture (ESM) conditions in different environments

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ABSTRACT: A set of forty-five genotypes including five parents, their $F_{1'}$, $F_{2'}$, and backcross generation of maize differing in their reaction to ESM conditions were used for estimating inter-character correlations between different morphological traits, planted at Pantnagar and Gorakhpur. Estimates of genotypic correlation coefficient were generally higher than phenotypic correlations coefficients in the both environments. The results revealed that the anthesis silkinig interval (ASI) showed negative correlation with the nodes bearing adventitious roots in most of the cases under both conditions.

Key words: ASI, correlation, excess soil moisture, yield, maize

The ultimate aim of a breeding programme is to evolve superior genotypes by exploiting the available genetic variability from the broad array of breeding material. To end up with superior genotypes, the knowledge of interrelationship of yield and yield related traits in a particular situation is a prerequisite. The extent of relationship between the important traits in given conditions can be studied by correlation coefficients and will aid in developing suitable selection criterion in order to choose suitable breeding procedure for developing cultivars suitable for wide range of environments. The excess soil moisture (ESM) is becoming threat to maize crop as floods affect 15 per cent of the total maize growing area and water logging problem in south-East Asia alone. In India about 25-30 per cent loss of maize production occurs every year because of ESM stress (DMR, 2001).

MATERIALS AND METHODS

The experimental materials consisted of forty-five genotypes of maize, which included five parents (three tolerant and two susceptible), their F_{1^*k} , F_{2^*k} and backcrosses, grown during *kharif* 2005 at G.B. Pant University of Agriculture and Technology, Pantnagar and Maize Farm, Belipar, Gorakhpur, in randomized block design with three replications. At both the locations, the experiments were laid down in two sets (one under normal and the other under ESM conditions). Experiments were sown in two row plots of 5 metre

length with row to row spacing of 75 cm and plant to plant distance of 25 cm. In ESM trial, waterlogging treatment was given at knee high growth stage i.e. 30 DAS, for 6 days, by keeping continuous submergence with an average depth of ponding of about 5 cm. After 6 days of ponding, water was drained out of the plots. Observations were recorded on days to 50 per cent tasseling, days to 50 per cent silking, anthesis silking interval, plant height, ear height, cob length and cob diameter for evaluation of genotypes for intercharacter relationship.

The correlations between all possible pairs of characters under study, at genotypic, phenotypic and environmental levels were worked out from the analysis of variance and covariance as suggested by Searle (1961).

RESULTS AND DISCUSSION

The present investigation, character correlation coefficients estimated in normal and ESM trials at Pantnagar and Gorakhpur are presented in the Tables 1, 2, 3 and 4, respectively.

In Pantnagar normal trial days to 50 per cent tasseling were positively and significantly correlated with days to 50 per cent silking (rp = 0.835), 100-kernel weight (rp = 0.177) and cob length (rp = 0.191) at phenotypic level. Days to 50 per cent silking were significant and positively correlated with ASI (rp = 0.449)

at phenotypic level and 100-kernel weight (rg = 0.634) and cob length (rg = 0.410) under normal conditions. Plant height was positively and significantly correlated with plant height at both genotypic (rg = 0.856) and phenotypic level (rp = 0.310). At Gorakhpur under normal conditions, days to 50 per cent tasseling were also significantly correlated with days to 50 per cent silking (rp = 0.851), days to 50 per cent tasselling were negatively and significantly correlated with AS1 (rp = 0.409 and rg = 0.338), ear height (rg = -0.296) and yield (rg = -0.308). Anthesis silking interval was negatively

and significantly correlated with ear height (rg = 0.602), yield (rg = 0.369), cob length (rg = 0.348) and cob diameter (rg = 0.407).

Under ESM conditions at Pantnagar days to 50 per cent tasseling were positively and significantly correlated with days to 50 per cent silking (rp = 0.846) and rg = 0.865) and ASI (rp = 0.654 and rg = 0.446). Days to 50 per cent silking were positively and significantly correlated with ASI (rg = 0.835 and rp = 0.796). In case of ESM trial, an important negative correlation of ASI and yield (rp = -0.143 and rg = -0.235) was observed, as

Table 1: Phenotypic correlation coefficients among different characters in environment E, under normal conditions

Character	Days to 50% silking	ASI	Plant height	Ear height	Nodes bearing adventitiou roots	Yield s	100 kernel weight	Cob length	Cob diameter
Days to 50% tasseling	0.835**	-0.061	0.079	0.053	0.002	-0.108	0.177*	0.191**	-0.033
Days to 50% silking		0.449**	0.012	-0.019	-0.054	-0.063	0.155	0.161	0.013
ASI			-0.136	-0.194	-0.116	0.052	-0.003	-0.036	0.114
Plant height				0.310*	0.071	-0.023	0.064	0.072	0.012
Ear height					0.016	0.162	0.084	0.011	0.083
Nodes bearing adventition	ous roots					-0.275	0.059	0.068	0.008
Yield							0.023	-0.261	-0.109
100 kernel weight								0.104	0.011
Cob length									0.269

Table 2: Phenotypic correlation coefficients among different characters in environment E1 under ESM conditions

Character	Days to 50% silking	ASI	Plant height	Ear height a	Nodes bearing dventitiou roots	Yield s	100 kernel weight	Cob length	Cob diameter
Days to 50% tasseling	0.846**	0.654*	0.023	0.182	-0.098	0.119	-0.129	-0.186*	-0.201
Days to 50% silking		0.796**	-0.073	0.188	-0.083	-0.009	-0.157	-0.245	-0.210
ASI			-0.164	0.001	-0.29	-0.143	-0.141	-0.216	-0.142
Plant height				0.729**	0.272	0.153	0.148	0.209	0.213
Ear height					0.159	0.205	0.053	0.158	-0.158
Nodes bearing adventition	ous roots					-0.098	-0.016	0.108	0.199
Yield							0.007	-0.058	0.070
100 kernel weight								0.061	0.069
Cob length									0.508**

lower ASI reflects the degree of tolerance to ESM stress. Rathore et al. (1998) and Zaidi et al. (2003) also observed the same findings for these traits. Yield and 100-kernel weight also had a positive correlation. At Gorakhpur also days to 50 per cent tasseling were positively and significantly correlated with days to 50 per cent silking (rp = 0.712 and rg = 0.754) and also with 100-kernel weight (rp = 0.349 and rg = 0.439) under ESM conditions. Days to 50 per cent silking were significantly and positively correlated with ASI (rp = 0.70 and rg = 0.768). Yield was found to be negatively and significantly correlated with nodes bearing adventitious

roots (rp = -0.321 and rg = -0.382) which is contradicting to the findings of Rathore *et al.* (1996) and Zaidi and Singh (2001). Plant height was positively correlated to yield (rp = 0.110 and rg = 0.172) at Gorakhpur and also at Pantnagar (rp = 0.153 and rg = 0.152), which are confirmation to the findings of Lizaso and Ritchie (1997) and Mathur *et al.* (1997). In ESM trials, nodes bearing adventitious roots should be more in order to support the plant growth under ESM conditions, which is evident form the correlation of this trait with ASI and yield at both the locations.

Table 3: Phenotypic correlation coefficients among different characters in environment E2 under normal conditions

Character	Days to 50% silking	ASI	Plant height	Ear height	Nodes bearing adventitiou roots	Yield s	100 kernel weight	Cob length	Cob diameter
Days to 50% tasseling	0.851**	-0.409**	-0.019	-0.088	0.031	-0.211	0.105	-0.167	-0.117
Days to 50% silking		0.130	-0.026	-0.022	0.004	-0.087	0.162	-0.174	-0.087
ASI			-0.009	0.128	-0.052	0.247	0.084	0.013	0.070
Plant height				0.067	0.124	-0.093	0.097	-0.062	0.086
Ear height					0.155	0.083	-0.015	-0.063	0.103
Nodes bearing adventition	us roots					-0.278*	-0.105	-0.019	-0.057
Yield							0.136	-0.008	0.091
100 kernel weight								0.002	-0.066
Cob length									0.176

Table 4: Phenotypic correlation coefficients among different characters in environment E2 under ESM conditions

Character	Days to 50% silking	ASI	Plant height	Ear height	Nodes bearing adventitiou roots	Yield s	100 kernel weight	Cob length	Cob diameter
Days to 50% tasseling	0.712**	0.006	0.122	-0.140	0.188	-0.171	0.349*	0.033	-0.057
Days to 50% silking		0.707**	0.060	-0.108	-0.046	-0.055	0.285	0.043	0.012
ASI			-0.037	-0.012	-0.255	0.093	0.054	0.028	0.074
Plant height				0.099	0.11	0.053	0.101	-0.087	-0.186
Ear height					-0.028	0.199	-0.15	-0.055	-0.088
Nodes bearing adventition	ous roots					-0.321*	-0.131	0.017	-0.058
Yield							0.042	-0.092	-0.026
100 kernel weight							4	0.098	0.034
Cob length									0.265

Generally, correlation coefficients at genotypic levels were similar in direction but of higher magnitude than phenotypic correlation coefficient for most of the intercharacter associations. This suggested the prepondrence of environmental factors, which might have suppressed the expression of character association at phenotypic level.

In any breeding programme directed to improve the yield under ESM conditions it is necessary to conduct experiments under both the conditions as selection for yield under stress is much less efficient than under non-stress conditions (Blum, 1988). Further due importance is to be given to the growth parameters like ASI, nodes bearing adventitious roots and there interrelationships to the yield.

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REFERENCES

- Blum, A. (1988). Plant breeding for stress environments. CRC Press, Boca, Raton, F1.
- DMR. (2001). Annual report, Directorate of Maize Research (DMR). 49th Annual Maize Workshop, Directorate of Maize Research, held at C.S. Azad University of Agriculture and Technology, Kanpur (U.P.), India, 5-9 April, 2001.

- Lizaso, J.I. and Ritchie, J.T. (1997). Maize shoot and root response to root zone saturation during vegetative growth. *Agron. J.*, 89: 125-134.
- Mathur, R.K., Lal, C., Bhatnagar, S.K., Jain and Gour, H.K. (1997). Effect of growing conditions on character association in maize (*Zea mays L.*). *Ann. Agric. Res.*, 18: 503-507.
- Rathore, T.R., Warsi, M.Z.K., Lothrop, J.E. and Singh, N.N. (1996). Production of maize under excess soil moisture conditions. 1st Asian Regional Maize Workshop, 10-12 Feb, 1996, P.A.U., Ludhiana, Pp. 56-63.
- Rathore, T.R., Warsi, M.Z.K., Singh, N.N. and Vasal, S.K. (1998). Production of maize under excess soil moisture conditions. 2nd Asian Regional Maize Workshop, PCCARD, Los Banos, Philipines, Feb. 23-27, 1998.
- Searle, S.R. (1961). Phenotypic, genotypic and environmental correlations. *Biometrics*, 17: 474-480.
- Zaidi, P.H. and Singh, N.N. (2001). Effect of water logging on growth, biochemical compositions and reproduction in maize. *J. Plant Biol.*, 28: 61-67.
- Zaidi, P.H., Rafique, S. and Singh, N.N. (2003). Response of maize (*Zea mays* L.) genotypes to excess soil moisture stress: morpho-physiological effects and basis fo tolerance. *European J. Agron.*, 19 (3): 383-399.