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Correlation Between Drought Resistance Indices and Cotton Yield in Stress and Non Stress Conditions

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Abstract: In this research, then varieties of cotton (*Gossypium hirsutum* L.) were studied in two separate Randomized Complete Block Design (RCBD) field experiments. One of the experiments was irrigated and the other one not. The correlation between the yields in the two environments was negligible. This would imply the difficulties of yield improvement in irrigated experiments for high yield performance in dry condition. Based on the most of the estimated resistance indices except for Tol, Sahel, Siokra and Naraberay were the best varieties. For the index of drought tolerance, HAR, B-557, Backtegan, Crema and Varamin varieties were remarkable.

Key words: Cotton, drought, resistance, index

INTRODUCTION

Average rainfall in Iran is 240 mm for which the country is included in aired to semiarid areas. Studies were showed water stress is one of important factor in decreasing yield. Two factor increase reaction to yield selection, non stress environments and the highest genetic heritability.

Several yield stability analysis have been reported for identifying abiotic tolerance genotypes[1-5]. Yield evaluated in stress and non stress environments. Several selection criteria are proposed to select genotypes based on their performance in stress and non stress environments[6,7]. Stress tolerance (TOL) defined as the difference in yield between the stress (Ys) and non stress environments (Yp) and mean productivity (MP) as the average yield of Ys and Yp[7]. Researchers proposed a stress susceptibility index (SSI)[6]. Selection for yield potential is more effective under non stress conditions because of greater genetic variance and heritability under this environment[8,9]. Genotypic and genotypic-environment interaction variances are usually higher in non stress conditions. Heritability and genetic advance was greater in optimal environments[10].

Genotypes can categorized to four groups based on their performance in stress and non stress environments; genotypes express uniform performance in both stress and non stress conditions (Group A); genotypes perform favorably only in non stress environments (Group B); genotypes have the higher yield in stress environments (Group C) and genotypes perform poorly in both stress and non stress environments (Group D). The best selection index should distinguish Group A from the others[11,12].

In this research distinguish relationships between tolerance indicators and Ys and Yp. Also some cotton genotypes categorize.

MATERIALS AND METHODS

This study was conducted to evaluated resistance cotton genotypes to drought stress in Gonbad cotton research station, Iran in 1988. Ten varieties of cotton (*Gossypium hirsutum)* were studied in two separate Randomize Complete Block Design (RCBD) field experiments each with four replications to asses their drought resistance. One of the experiment was irrigated and the other one not[13,14]. Every plot was 4 rows, 6 M long. Varieties included to; Sahel, Naraberay, Siokra, Sindose, BKW-30, B-557, Backtegan, Crema, Varamin and HAR.

Yield trait were evaluated in stress and non stress environments. Drought resistance indices were defined by following formula;

1. Stress Intensity (SI) = 1-(Ys- /Yp-)
2. Mean Productivity (MP)= (Ys+Yp)/2
3. Tolerance (TOL) = (Yp-Ys)
4. Stress Susceptibility Index (SSI) = [1-(Ys/Yp)]/SI
5. Geometric Mean Productivity (GMP) =$\sqrt{(Ys \times Yp)}$
6. Stress Tolerance Index (STI) = [Ys×Yp]/(Yp-)2
7. Harmonic mean productivity (HMP)=½[(1/Ys)+(1/Yp)]

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That; Yp = The potential yield every genotype in non stress environment
Ys = The yield every genotype in stress environment
Yp-= Potential yield of all genotypes in non stress condition
s- = Yield of all genotypes in stress condition[15].

Correlation between yield and drought tolerance indices was evaluated by MSTATC and GENCOR. EXE computers programs.

RESULTS AND DISCUSSION

Stress Intensity (SI) was higher in this experiment (SI=0.60). SI ranges between 0 and 1 and the larger the value of SI, the more sever is the stress intensity[15].

Correlation between Yp and Ys was non significant (r=0.006 ns). So, yield selection in non stress conditions increased yield only in non stress environment and yield selection in stress conditions caused higher yield in this conditions (Table 1).

Mean Productivity (MP) favors higher yield potential and lower stress tolerance[12,16]. Correlation between MP and Yp was significant (r=0.98, p<0.01). Correlation between MP and Ys was non significant (r=0.20 ns) (Table 1). Thus, selection based on Mp cannot be increased yield in stress environments. Naraberay, Siokra and Sahel were the best cotton genotypes based on this index (Table 2).

A larger value of TOL show more sensitivity to stress, thus a smaller value of TOL is favored. Selection based on Tol favors genotypes with low yield potential and high yield under stress conditions[11,12,16]. Correlation between tolerance and Yp was significant and positive (r=0.98, p<0.01) and relationship between Ys and ToL was non significant and negative (r=-0.19ns) (Table 1). HAR, Varamin, B-557, Backtegan and Crema genotypes were the smallest TOL, so were the best cultivars based on this index (Table 2).

Mp is based on the arithmetic means and therefore it has an upward bias due to a relatively larger difference between Yp and Ys, whereas the geometric mean is less sensitive to large extreme values[11,12]. Relationship between MP and Yp was significant and positive (r=0.90, p<0.01) (Table 1). GMP was selected Sahel, Siokra, BKW-30 and Narabery cotton genotypes (Table 2).

The smaller SSI caused the greater stress tolerance[11,12,16]. TOL and SSI were positively correlated (r=0.80, p<0.01). Correlation between SSI and Yp was significant and positive (r=0.87, p<0.01).But correlation between Yp and SSI was non significant and negative (r=-0.437ns) (Table 1). The Sahel, Siokra, Sindose and narberay had the highest SSI index (Table 2).

Harmonic Mean Productivity (HMP) correlated to Ys (r=0.78, p<0.01). Also correlation between Yp and HMP was significant (r=0.62, p<0.1) (Table 1). So selection based on HMP increased yield in stress and non stress conditions[12,16]. Sahel, Backtegan, Siokra, Naraberay and BKW-30 were maximum based on HMP index (Table 2).

Table 1: Correlation between yield and drought tolerance indices

	YP	YS	MP	GMP	TOL	SSI	STI	HMP
YP	1.00***							
YS	0.006NS	1.00***						
MP	0.98***	0.20NS	1.00***					
GMP	0.90***	0.45NS	0.97***	1.00***				
TOL	0.98***	-0.19NS	0.92***	0.79***	1.00***			
SSI	0.87***	-0.47NS	0.76***	0.57*	0.94***	1.00***		
STI	0.90***	0.43NS	0.97**	1.00***	0.80***	0.59*	1.000***	
HMP	0.62*	0.78***	0.76***	0.91***	0.46NS	0.18NS	0.90***	1.000***

NS= Non-significant, ***= Significant in p<0.01, **= Significant in p<0.05, *= Significant in p<0.1

Table 2: YS, Yp and drought tolerance indices in cotton genotypes

Genotypes	YP	YS	MP	GMP	TOL	SSI	STI	HMP
Sahel	583.1	172.6	377.84	317.22	410.51	1.17	0.48	266.33
Har	382.5	164.2	273.36	250.62	218.29	0.95	0.30	229.78
B-557	361.3	150.4	255.85	233.12	210.85	0.97	0.26	212.41
Backtegan	379.4	206.8	293.08	280.10	172.53	0.75	0.38	267.69
Sindose	472.3	171.7	321.99	284.75	300.62	1.06	0.39	251.82
Siokra	586.0	177.8	381.87	322.74	408.23	1.16	0.50	272.77
Crema	359.8	198.8	279.28	267.42	161.04	0.74	0.34	256.06
Naraberay	587.9	178.1	383.02	323.61	409.78	1.16	0.50	273.42
BKW-30	490.2	215.8	353.02	325.26	274.45	0.93	0.51	299.68
Varamin	364.1	175.7	269.90	252.90	188.50	0.86	0.31	236.98

The higher STI values caused higher stress tolerance and yield potential[11,12]. This index selected Naraberay, BKW-30, Sahel and Siokra cotton genotypes (Table 2).

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