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Selection criterion (ia) for drought tolerance in bread wheat

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Abstract

In a study of correlations among different drought conferring traits in segregating generations under moisture stress and non-stress environments, excised leaf water loss (ELWL) showed negative correlations with relative water content (RWC) and grain yield and RWC showed positive associations with grain yield. Based on these interrelationships, it can be concluded that for improving grain yield under dry land conditions low ELWL and high RWC can be used as selection criteria in segregating generations while breeding for drought tolerance.

Introduction

Water supply is restricted in many parts of the world and productivity in these areas can only be increased by the development of crops that are well adapted to dry conditions. Genetic improvement of crops involves selection of suitable plant traits in segregating populations from a cross. But, selection methods should be rapid and capable of evaluating plant performance at a critical developmental stage in both small and large populations. However, the available selection methods/criteria are not very suitable to adopt on a single plant basis in a segregating generations. Therefore, in the present study correlations among some drought conferring traits have been worked out in segregating generations under both moisture stress and moisture non-stress conditions.

Material and Methods

The experimental materials used for the present study consisted of three generations *viz.*, F_2, BC_1 and BC_2, generated from each of the four crosses namely, S4 x HPW89, Hindi 62 x HS240, VL421 x HS240 and VL421 x PBW175 involving three diverse drought tolerant (Hindi 62, VL421 and S4 (CIMMYT drought tolerant stock) and three diverse drought susceptible (HS240, PBW175 and HPW89) cultivars. These three populations of each of the four crosses were evaluated in the compact family block design with three replications under moisture stress (E_1) and moisture non-stress (E_2) environments. Each net plot had six rows for F_2 and four rows for back cross (BC_1 and BC_2) generations. The inter row and intra plant distance was 23 cm and 5cm, respectively. Hundred plants from F_2 and forty five plants from BC_1 and BC_2 generations were selected from all the replications (3) from both the environments to record the data for excised leaf water loss (ELWL %), relative water content (RWC%) following the method of Clarke (1987) and Barrs (1968), respectively and also for grain yield . The present investigation was carried out at the experimental farm of the Department of Plant Breeding and Genetics, CSK HPKV, Palampur situated at an elevation of about 1300 m amsl during *rabi* 2002-2003. The total precipitation received during the crop season (Nov.-May) was 213.9 mm with evaporation loss of 98mm. However, the rainfall was not evenly distributed through out the crop season, rather it was erratic which resulted in moisture stress conditions at different plant growth stages (Table 1). The minimum and maximum temperature varied between 3.6 to 17.9°C and 14.32 to 32.7°C, respectively.

For computing correlation coefficients, analysis of covariance were performed in all possible paired combinations of various traits studied under moisture stress and moisture non-stress environments.The significance of coefficients of correlation was tested against 'r' values given by Fischer and Yates (1963) at (n-2) degree of freedom.

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Table 1. Distribution of rainfall, temperature regimes and drought stress during the crop season

Period	Temperature (°C) Max.	Min.	Rainfall (mm)	Stress (duration)	Crop growth stage
Nov. 5-Dec. 2	24.1	7.3	0.00	28 (0)	Germination
Dec. 3-Dec. 31	20.3	4.0	0.00	29 (0)	CRI and tillering
Jan.1-Jan..28	19.7	3.6	4.00	28 (1)	Tillering
Jan. 29-Feb. 25	18.0	4.0	98.10	28 (11)	Jointing
Feb. 26-Mar. 25	24.7	6.6	78.10	28 (7)	Anthesis
Mar. 26-Apr. 29	28.0	11.8	33.6	28 (13)	Grain filling & dough
Apr. 30-May 20	32.7	17.0	0.10	21 (1)	Dough and maturity

Figures in parentheses indicate the number of rainy days.

Results and Discussion

Excised leaf water loss exhibited significant negative correlation with relative water content mostly in all the generations of the crosses studied under both the environments. ELWL exhibited negative correlation with grain yield in F_2 in two crosses *viz.*, Hindi62/HS240 and VL421/HS240 under both the environments and in BC_1 under E_1 in most of the crosses. It is inferred from the present study that ELWL is a desirable physiological trait and its negative correlation with RWC and GY specifically under moisture stress environment would be useful as selection parameter while breeding for drought tolerance (Table2). The above findings are also in general agreement with earlier results of Meenakshi (2003). McCaig and Ramagosa (1989) also reported association between ELWL and initial water content.

Relative water content showed positive correlation with grain yield mostly in all the generations under both the environments. From these results it is inferred that RWC is a very important drought tolerance conferring trait and should be considered as a selection criterion while breeding for drought tolerance as it exhibited positive correlation with GY under either E_1 or both the environments (Table 2). Ashraf *et al.* (1996) and Meenakshi (2003) also reported association of RWC with grain yield.

From the above study, it appears that excised leaf water loss and relative water content are of paramount importance as selection criteria while breeding for drought tolerance.

Table 2. Correlation coefficients of some drought conferring traits associated among themselves in F_2, BC_1 and BC_2 generations

			S4/HPW89			Hindi62/HS240			VL421/HS240			VL421/PBW175		
			ELWL	RWC	GY	ELWL	RWC	GY	ELWL	RWC	GY	ELWL	RWC	GY
ELWL	F_2	E1		-0.21*	-0.08		-0.37*	-0.28*		-0.33*	-0.40*		-.40*	-0.18
		E2		-0.07	-0.26*		-0.27*	-0.25*		-0.17	-0.23*		-0.16	-.20*
	BC_1	E1		-0.25	-0.29*		-0.19	-0.25		-0.38*	-0.46*		-0.75*	-0.42*
		E2		-0.45*	0.01		-0.24	-0.01		-0.52*	-0.40*		-0.48*	-0.36*
	BC_2	E1		-0.49*	-0.21		-0.48*	-0.48*		-0.60*	0.03		-0.53*	-0.24
		E2		-0.29*	0.04		-0.22	-0.38*		-0.39*	-0.22		-0.37*	-0.20
RWC	F_2	E1			0.13			0.33*			0.35*			0.11
		E2			0.14			0.08			0.19*			0.27*
	BC_1	E1			0.27			0.38*			0.36*			0.38*
		E2			0.23			0.05			0.53*			0.56*
	BC_2	E1			0.31*			0.39*			-0.18*			0.22
		E2			0.13			0.38*			0.09			0.18

Critical value (2-tail 0.05) = ± 0.28 (BC_1 and BC_2) and ± 0.19 (F_2)

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