INDEX OF TRANSMISSIBILITY AND GENETIC VARIATION IN SPRING WHEAT SEEDLINGS UNDER WATER DEFICIT CONDITIONS

Ijaz Rasool Noorka, Ihsan Khaliq and M. Kashif
Department of Plant Breeding & Genetics, University of Agriculture, Faisalabad

Hundred wheat genotypes were sown in polythene bags in green house for seedling traits evaluation under water deficit condition such as emergence percentage, emergence index, emergence rate index, energy of emergence, mean emergence time desiccation tolerance index and percent seedling recovery. Analysis of variance revealed significant differences among genotypes in most of traits. The estimates of genetic variance were smaller than their respective phenotypic variance for all the traits. The correlation of some seedling trait was positive and significant with each other. The estimates of coefficient of variability (CV %) ranged within 30.45 to 11.06. The heritability percentage was found 92.66 as maximum while 16.64 as minimum. Genetic variation, heritability and correlation estimates indicated that desiccation tolerance index and percent seedling recovery might be useful while selecting for seedling parameters in wheat under water deficit conditions.

Keywords: Genetic variability, seedling, survival after desiccation, heritability and correlation

INTRODUCTION

A near perfect crop stand can be obtained by using high quality seed that ensure high germination percentage under favorable conditions. Among seedling traits, emergence percentage has been extensively used as an indication for seedling vigor Jafri *et al*. (1991). So, high emergence percentage followed by high seedling vigor is necessary for attaining good crop stand. Wheat breeders are continuously trying to improve the wheat yield through numerous methods to ensure good crop stand which directly or indirectly depends upon good quality seed. A reliable and efficient screening technique may facilitate isolation of drought resistance genotypes. Good survival of genotypes after desiccation will be useful in developing a stable variety Winter *et al*. (1988). Poor germination and un even crop stand are main constraints of low yield in food crops Du and Tuong 2002). The survival was considered a next important seedling trait by Chang and Loresto (1986) and Farooq *et al*. (2006).

Hafid and Smith (1998) studied the impact of drought during the reproductive phase of wheat. Similarly Kameli and Loesel (1996), investigated the effect of water stress on growth of *Triticum durum* in relation to sugar accumulation and water status of wheat plant. Sharma and Bhargava (1996) investigated the genotypic variability in wheat for total water content and excised leaf water loss under moisture stress conditions. Similarly, Hussain *et al*. (1987) and Chowdhry *et al*. (1999) studied variability of wheat genotypes to water stress.

In view of the above research work it was planned to study genetic variability for various seedling traits as well as desiccation tolerance index and percent seedling recovery of wheat genotypes. The prime objective was the identification of drought tolerant genotypes suitable for cultivation and their utilization in future breeding programs.

MATERIALS AND METHODS

The experiment was conducted in green house in the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad. One hundred varieties/lines of wheat were collected from National Cereal Breeding programmes and International Research Organizations. The layout used was complete randomized design with three replications. The seeds were sown in 18x9 cm polythene bags filled with measured quantity of normal field soil (450 gm/bag). Two seeds of each variety were sown in each bag to ensure full crop stand at uniform depth of 3 cm. The bags were arranged in iron trays, each genotype was comprised of five bags per replication.

The following seven traits were taken in to consideration.

Emergence percentage

Counting was started immediately when first seedling was emerged in any bag from then to on wards measurements were made daily at 1700 h. The numbers of visible seedling were recorded. The measurement continued until there was no further increase and it was calculated according to the following formula given by (Smith and Millet, 1964).

$$E\% = \frac{\text{Total number of seedling emerged 18 DAP} \times 100}{\text{Total number of seeds grown}}$$

DAP = Days after planting

Emergence index

It is the estimate of emergence rate of seedlings and was calculated as described in Association of Official Seed Analysis (1983).

$$E = \frac{\text{No. of seed emerged at first count} + \text{No. of seed emerged at final count}}{\text{Days of first count} + \text{days of final count}}$$

Emergence rate index

Emergence rate index for each treatment and replication was calculated as emergence index divided by emergence percentage.

$$ERI = \frac{\text{Emergence index}}{\text{Emergence percentage}}$$

Energy of Emergence

Energy of emergence was computed according to the method as delineated by Ruan *et al*. (2002) it is the percentage of emerged seedlings three days after sowing.

Mean Emergence time

Mean emergence time was calculated according to the equation of Ellis and Roberts (1981) as under

$$M = \frac{\sum Dn}{\sum n}$$

Where n is the number of seed which were germinated on day D and D is the number of days counted from the beginning of emergence.

Desiccation tolerance index

The plants were well watered until 2-3 leaf stage which is considered proper stage for seedling evaluation as suggested by ISTA (International Seed Testing Association, 1997 then the water was with held due to which most of seedlings were appeared to dead.

Then the plants were re-watered and survival was counted after re-growth in each replication. The number of recovered seedlings and at the same time number of dead seedlings were counted daily according to O'Toole *et al*. (1978).

The final value of seedling survival by subtracting seedling died, desiccation tolerance index was calculated according to the following formula Peacock *et al*.,(1990).

$$\text{Desiccation tolerance index} = \frac{\text{Final number of dead seedligs}}{\text{Final emergence number}}$$

Percent seedling recovery

It is the measure of percent recovery or re-growth of seedlings after desiccation and is calculated by the formula as given by Blum *et al*. (1980) and Peacock *et al*. (1990).

$$\text{Percent seedling recovery} = \frac{\text{No. of plant resuming growth}}{\text{Total number of seedling}} \times 100$$

Statistical Analysis

The data thus obtained were subjected to analysis of variance by Steel *et al*. (1996) and simple correlation coefficients were calculated between seedling traits Genetic component of variance by Robinson *et al*., (1951) Heritability estimates were made in broad sense as described by Burton and Devance (1953).

RESULTS AND DISCUSSIONS

Analysis of variance was performed for all seven traits (Table 1). Differences among genotypes were highly significant for most of traits indicating high variability among genotypes.

The results are highly significant for most of the characters which shows reliability of characters for genetic studies .The reproducibility and consistency of the genotypic difference determined seedling growth and correlation information suggests seedling growth test could be reliable and efficient technique for screening moisture stress tolerance in wheat germplasm. A large range of variability was observed in emergence percentage, emergence index, emergence rate index, energy of emergence, mean emergence time, desiccation tolerance index and percent seedling recovery. The magnitudes of CV (%) were found maximum for energy of emergence,

Table 1. Mean square of seedling traits of spring wheat

S.O.V.	d.f.	Emergence percentage	Emergence index	Emergence rate index	Energy of emergence	Mean emergence time	Desiccation tolerance index	Percent seedling recovery
Replication	2	234.33**	2.75*	0.00	184.33	0.099	0.001	8.16
Genotypes	99	391.58**	3.19**	0.00	303.96**	0.196**	0.347**	3484.64**
Error	198	75.07	0.68	0.00	90.06	0.122	0.009	89.58

*Significant at P<0.05 ** Significant at P<0.01 NS = Non significant percent seedling recovery, mean emergence time and emergence index (30.45, 29.42, 16.73, 16.59) respectively. However, the value of CV (%) for emergence percentage, emergence rate index, desiccation tolerance index were found lower. Similar findings have also been reported by Medhi and Asghar (1999).

This study shows genotypic and phenotypic differences in emergence percentage, emergence index, emergence rate index, energy of emergence, mean emergence time, desiccation tolerance index and percent seedling recovery. In general, the estimated genetic variances were smaller than their respective phenotypic variances for all the seedling traits studies (Table 2).

The different parameter studied under present study can be beneficial in screening wheat genotypes at seedling traits. High positive correlation coefficient (r = 0.94) between energy of emergence and emergence index and (r = 0.856) between energy of emergence and emergence rate index and r=0.801 between emergence percentage and emergence index which predict an importance in breeding program Jaffri *et al*. (1991). It is evident that good emergence percentages as well as maximum energy of emergence and less mean emergence time having maximum present seedling recovery favored a variety to escape through the hazards of the stress conditions. This study concluded that selection for these traits will be effective in further breeding programs due to significant genetic variability and heritability which existed for all seedling and emergence traits.

Table 2. Genotypic and phenotypic variances coefficient of variation (CV%), broad sense heritability ($h^2_{B.S}$) of seedling traits wheat genotypes.

Traits	Emergence percentage	Emergence index	Emergence rate index	Energy of emergence	Mean emergence Time	Desiccation tolerance index	Percent seedling recovery
Mean (x)	31.167	78.367	4.969	0.063	2.091	0.675	32.17
Variance (g)	71.299	105.50	0.837	0.000019	0.0244	0.0112	1131.68
Variance (P)	161.356	180.575	1.517	0.000094	0.1468	0.1216	1221.26
CV %	30.45	11.06	16.59	13.63	16.73	14.13	29.42
$h^2_{B.S}$.%	44.18	58.42	55.18	19.64	16.64	92.51	92.66

Information on heritability provides the relative practicability of character. The estimates of broad sense heritability obtained from wheat genotypes were significant for all traits; these results are in agreement with those of Naheen and Mehdi (1993). The estimates of Broad sense heritability ranged from 44.18 to 92.66% for energy of emergence, emergence index, percentage desiccation tolerance index and percent seedling recovery; which suggested the selection for these traits will be effective.

The information on correlation permits the feasibility of indirect selection for various parameters (Table 3) such relationship provides useful information to the plant breeder in identifying traits that have little or no importance in selection programs.

REFERENCES

Association of Official Seed Analysis (AOSA). 1983. Seed vigour testing hand book. Contribution No. 32 to the hand book on seed testing.

Blum, A., B Sinmena and Zivo. 1980. An evaluation of seed and seedling drought tolerance screening tests in wheat. Euphytica. 29:727-736.

Table 3. Correlation coefficients among various seedling traits in spring wheat under water deficit condition

Traits	Emergence percentage	Emergence index	Emergence rate index	Mean emergence Time	Desiccation tolerance index	Percent seedling recovery
Emergence index	0.80**					
Emergence rate index	0.19	0.73**				
Mean emergence Time	-0.15	0.62**	0.86**			
Desiccation tolerance index	-0.38**	-0.35**	-0.12	0.12		
Percent seedling recovery	0.37**	0.35**	0.13	-0.12	-0.99**	
Energy of emergence	0.60**	0.94**	0.86**	-0.72**	-0.31**	0.31**

* Significant at P<0.05 ** Significant at P<0.01 NS = Non significant

Burton, G.W. and E.H. Devance. 1953. Quantitative inheritance in pearl millet (*Pennisetum glaucum* L.). Agron. J. 43:409-417.

Chang, T.T. and G.C. Loresto. 1986. Screening techniques for drought resistance in rice in chopra vi. Paroda Rs. (eds.) Approaches for incorporating drought and salinity resistance in crop plants. Oxford and IBH, New Dehli.

Chowdhry, M.A., I. Rasool, I Khaliq, T. Mahmood and M.M. Gilani. 1999. Genetics of some Metric traits in spring wheat under normal and drought environments. RACHIS. 1(1):34-38.

Du, L.V. and T.P. Tuong. 2002. Enhancing the performance of dry seeded rice: effects of seed priming, seedling rate, and time of seedling. In Pandey, S. Mortimer, M., Wade, L. Tuong, T.P. Lopes, K. and B. Hardy eds. Direct seedling: Research Strategies and Opportunities. International Research Institute, Manila, Philippines. 241-256.

Ellis, R.A. and E.H. Roberts. 1981. The quantification of ageing and survival in orthodox seeds. Seed Sci. and Technol. 9:373-409.

Farooq, M., S.M.A. Basra, R. Tabassum and I. Afzal. 2006. Enhancing the performance of direct seeded fine rice by seed priming. Plant Prod. Sci. 9(4):446-456.

Hafid, R. and D.H. Smith. 1998. Morphological attributes with early season drought tolerance in spring wheat in a Mediterranean environment. Euphytica. 10:273-282.

Hussain, F., A. Khan and M. Jamal. 1987. Response of wheat genotype to stress. Sarhad J. Agric. 3:533-542.

ISTA (International Seed Testing Association). 1997. In Hand Book for Seedling Evaluation. Zurich, Switzerland.

Jafri, S.J., S.S. Ali, A. Mehmood and M.A. Butt. 1991. Genetic parameters for seedling vigor in some rice (*Oryza sativa* L.) genotypes. JAPS. 1:223-225.

Kameli, A. and D.M. Loesel. 1996. Growth and sugar accumulation in durum wheat plant under water stress. New Phytiol. 132:57-62.

Mehdi, S.S. and M.J. Asghar. 1999. Genetic variability, heritability and genetic advance for seedling traits in Sorghum genotypes. Sci. Int. (Lahore). 11:113-116.

Naheem, H.A. and S.S. Mehdi. 1993. Selection indices for several seedlings traits in a random mating population of sunflower. HELLA. 19:11-18.

O'Toole, J.C., R.S. Aquino and K. Alluri. 1978. Seedlings stage drought response in rice. Agron. J. 70:1101-1103.

Peacock, J.M., F.R. Bidinger and P. Soman. 1990. An approach to screening for drought resistance and Thermo-tolerance in sorghum and pearl millet. Proceedings of an international conference on current developments in salinity and drought tolerance of plants. 7-11 January. 1990, Tandojam, Pakistan.

Robinson, H.F., R.E. Combstock and P.H. Harvey. 1951. Genetic and phenotypic correlations in corn and their implication in selection. Agron. J. 3:282-287

Ruan, S., Q. Xue and K. Tylhowska. 2002. The influence of priming on germination of rice (*Oryza sativa* L.) seeds and seedlings emergence and performance in flooded soils. Seed Sci. & Technol. 30:61-67.

Sharma, B.J. and L.K. Bhargava. 1996. Genotypic variability for total water content and excised leaf under moisture stress conditions. Ann. Biol. 12:225-228.

Smith, P.G. and A.H. Millet. 1964. Germinating and sprouting responses of tomato at low temperature. J. Am. AOC. Hort. Sci., 84:480-484

Steel, R.G.D., J.H. Torrie and D.A. Dickey. 1996. Principal and Procedures of Statistics. A Biometrical Approach McGraw Hill Book Co., New York, USA.

Winter, S.R., J.T. Musick and K.B. Poter. 1988. Evaluation of screening techniques for breeding drought resistance winter wheat. Crop Sci., 28:512-516.