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Multivariate Analysis in Some Metric Traits of Ethiopian Durum Wheat (*Triticum turgidum* L.Var.*durum*) Landraces

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ABSTRACT

Pre-harvest sprouting (PHS) in durum wheat (Triticum turgidum L. var. durum) has negative effects on the entire pasta industry. Because of the significant role of the environment in the onset of sprout damage, durum breeders have turned to genetic resistance to control this agronomic trait. The objectives of this study were to evaluate the sprouting response of two recombinant inbred line populations of durum wheat grown at Langdon and Prosper, North Dakota, and to test the efficacy of microsatellite markers to predict the genetic variation. Population I was developed from a cross between the resistant genotype Chahba88 and the durum cultivar Vic. Population II was developed by crossing the resistant genotype IACT12 with the durum cultivar Ben. Heritability was high in the two populations (h2 = 0.7 ± 0.11 in Population I, and 0.6 ± 0.11 in Population II), which is in agreement with previous studies. Transgressive segregants were observed in both populations, and evaluation of these genotypes may help to identify durum germplasm with acceptable levels of PHS resistance combined with good agronomic and quality traits. Six polymorphic and associated loci accounted for up to 17.4% of the genotypic variation in Population I, and seven polymorphic and associated loci accounted for up to 26.5% of the genotypic variation in Population II. A region on the short arm of chromosome 5B was important in Population I, whereas in Population II the significant loci were mapped to the long arm of chromosome 6B. Further investigations of these and other genomic regions might help detect important QTLs for PHS resistance in durum wheat. Durum wheat (Triticum turgidum L. var. durum) is a self- pollinated tetraploid cereal and a traditional Mediterranean crop; with the Mediterranean Basin being the largest production area worldwide and North Africa the largest import market. Durum wheat is mainly used for the production of pasta and couscous, but also for a number of other semolina products such as frike, bourghul, and unleavened breads. Globally durum wheat covers a total of area of 20 million hectares and production of 30 million metric tons.

Key words: *Triticum turgidum L. var. durum*; *Durum wheat; Pre-harvest sprouting; Microsatellites*

Introduction

Durum wheat (*Triticum turgidum* L. var. *durum*) is a self-pollinated tetraploid cereal and a traditional Mediterranean crop; with the Mediterranean Basin being the largest production area worldwide and North Africa the largest import market [1]. Durum wheat is mainly used for the production of pasta and couscous, but also for a number of other semolina products such as frike, bourghul, and unleavened breads. Globally durum wheat covers a total of area of 20 million hectares and production of 30 million metric tons [2].

Ethiopia is the center of diversity for durum wheat. It is one of the major cereal crops grown at altitude ranging from 1500 to 3200 meter above sea level (m.a.s.l). However, the most suitable areas fall within 1900 to 2700 m.a.s.l where the annual rainfall range is between 600 and 2000 mm. It is grown over a wide range of environments, which are different in soil fertility, incidence of weeds, disease, pests and waterlogged conditions. According to Central Statistics Agency (CSA), the average yield of durum wheat in Ethiopia is estimated to be 28.46 q/ha [3].

Genetic variability among durum wheat genotypes can be estimated based on qualitative and quantitative traits. The choice of parents is of paramount importance in breeding program. For effective selection, information on nature and wheat. Similarly, information on the extent and nature of interrelationship among traits help in formulating efficient scheme of multiple trait selection. This indicates that the importance of conducting research focusing on generating genetic information on genetic variability, heritability and trait associations. Besides, knowledge of the naturally occurring diversity in a population of durum wheat landraces helps to identify diverse groups of genotypes that can be useful for the breeding program. Therefore, of this study was to estimate the magnitude of genetic diversity for yield and yield related traits of durum wheat genotypes by clustering and principal component analysis.

Material and Methods

The experiment was conducted during 2017/2018 cropping season at Dabat Agricultural Research Station under Gondar Agriculture Research Center (GARC). The experimental site is located at 248 km distant from Bahir Dar (the capital city of Amhara Regional State) and 809.09 km from Addis Ababa to the Northern part of the country, and 75.8 km from Gondar town. Dabat Research Station is located at "12°59′03″N latitude and "37°45′54″E longitude, with an altitude of 2607 m.a.s.l. The minimum annual temperature ranges between 4.6°C and 24.5°C. Dabat has a unimodal rainfall. According to the available digital data, the mean annual rainfall for the area ranges from 1250 to 1565 mm. The rainy months extend from June to the end of September, and dominant soil in the area is Vertisol [6].

A Total of 64 durum wheat genotypes were used for the present experiment. These genotypes were obtained from Institute of Bioversity Research International, Addis Ababa, Ethiopia. All the genotypes were local collection from the major durum wheat growing regions of the country [7,8]. The trial was laid down using 8 x 8 simple lattice designs. Each genotype was planted in a plot size of 1 m^2 (2.5 m x 0.4 m). Each plot had two rows with 20 cm row spacing, and the spacing between was 0.3 m, 1 m and 2 m plots, blocks and replications respectively. Seeding rate of 150 kg /ha and recommended fertilizer rate, 100 kg DAP and 50 kg Urea was used. All DAP fertilizer was applied at planting while nitrogen fertilizer was applied in split (½ at planting, ¼ at tillering and ¼ at head initiation [9,10]. Weeding and other agronomic management practices were done as per the recommendation for durum wheat.

Statistical Analysis

Analysis of variance (ANOVA) was computed to test the presence of significance differences among genotypes for studied traits. The data were collected for each quantitative trait and would be subject to analysis of variance using Proc lattice of SAS version 9.2 [8]. Fisher's protected Least Significant Difference (LSD) test at 1% or 5% level of significance was used for mean comparisons, whenever the Analysis of Variance (ANOVA) result showed difference among genotypes for traits.

Results and Discussion

The analysis of variance showed that there was highly significant ($p \leq 0.01$) difference for all traits. The significance difference among genotypes for the traits indicates that the presence of genetic variation among the genotypes which in turn suggests that selection of lines can be effective in improving both yield and quality trait. The variation observed for grain yield ranged from 7.07 to 2.92 t/ha with mean of 4.99 t/ha.

Conclusion

Information on which the extent and pattern of genetic variability in a population and its genetic diversity associated with its agronomic traits is essential for any breeding strategy and improvement program. The data obtained from the trial were subjected to the analysis of variance (ANOVA), genetic divergence analysis and principal component analysis had been computed.

The cluster analysis based on D2 analysis classified 64 durum wheat genotypes in to 12 clusters. Genotypes found in cluster V and VIII have maximum cluster distances, which possessed desirable combinations of traits and thus; the genotypes of the two clusters hold great promise as parents to obtain promising heterotic expressions in F1's and may create considerable variability, in the segregating population.

The principal component analysis revealed that first five principal components which have Eigen value greater than one had explained for about 81.5.59 % of the total variation existed among the genotypes in regard with the traits studied.

Generally, this study was conducted for one season at one location which needs to be conducted for the subsequent breeding trials by considering more locations to develop high yielding varieties. Genotypes which, showed high genetic diversity from different clusters may use as source of important traits for future durum wheat breeding program. The widened pattern and distribution of genetic diversity present among accessions helps as to source of information for the availability of ample genetic variability and used crossing to create broad hetroitic groups based on its importance traits.

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