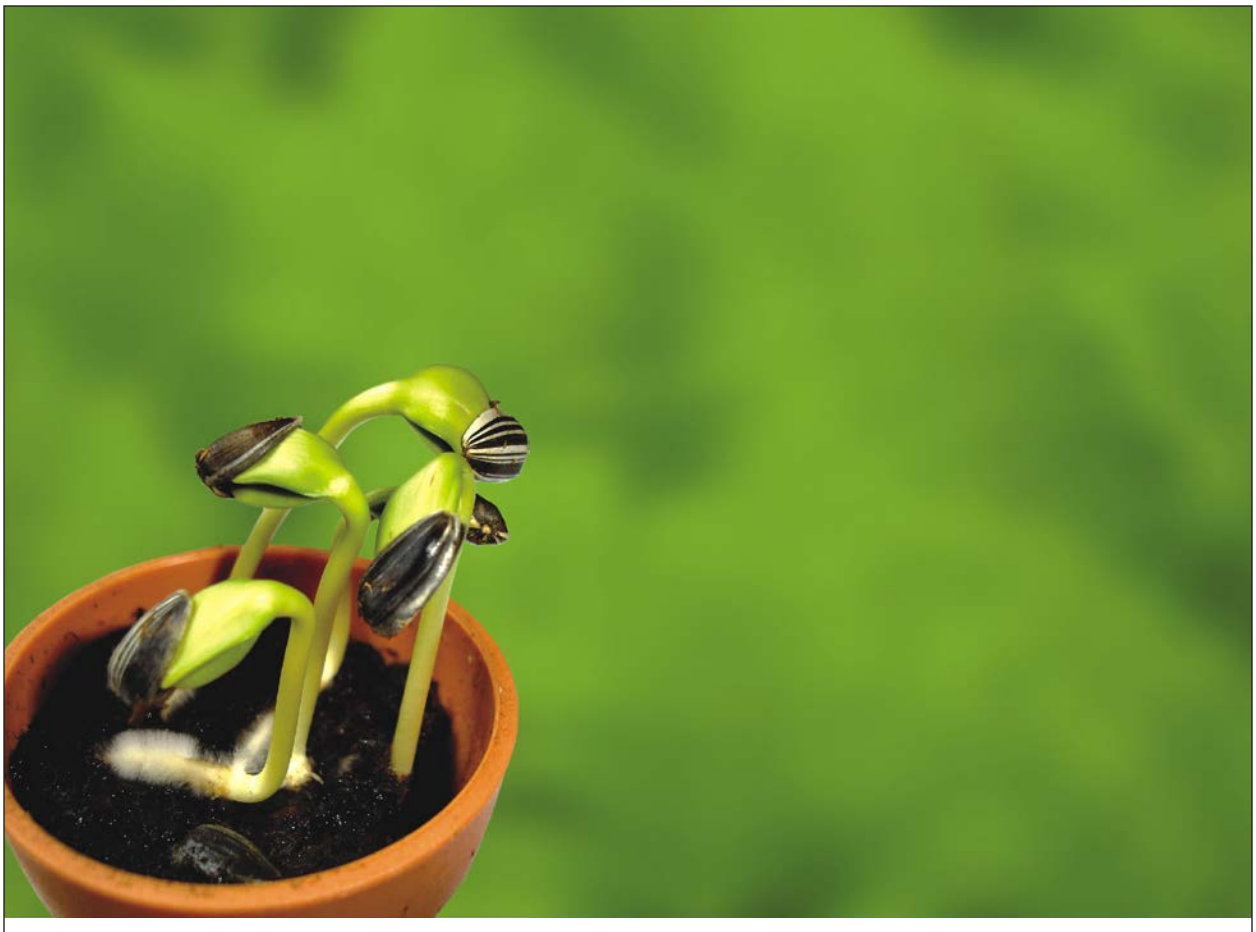

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Genetic Divergence Study of Durum Wheat (*Triticum durum* Desf) Genotypes Grown in Tigray, Ethiopia

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ABSTRACT

In any crop improvement program, the presence of genetic divergence is an important entry point for selection and hybridization. A trial was executed using twenty durum wheat genotypes with the objective of determining the genetic divergence and trait variability in durum wheat genotypes. The study was carried out in Ofla district, Tigray during the 2014 cropping season using a randomized complete block design. The inter-cluster distance of the twenty durum wheat genotypes ranges from 0.57536 in cluster one to 212.02335 in cluster four. The maximum inter-cluster distance was between cluster two and cluster four which was 212.0233. The clustering analysis classified the twenty durum wheat genotypes into four distinct clusters and the first cluster accommodates 15 durum genotypes including the two release genotypes. The second cluster consists of three durum wheat genotypes. The third and fourth clusters similarly contained each one durum wheat genotype. Cluster two and cluster four was highly divergent and crossing program between these clusters could result better segregating population in durum wheat breeding program.

Key words: Durum wheat, cluster analysis, genetic divergence

INTRODUCTION

Wheat is believed to have originated in South Western Asia, where it has been grown for more than 10,000 years. Bread wheat (*Triticum aestivum* L.) and durum wheat (*T. turgidum* L.) are the two principal types of wheat grown in Ethiopia. Ethiopia is considered to be one of the centers of genetic diversity to durum wheat while bread wheat has been introduced recently. Wheat is grown in the highlands of Ethiopia at an altitudinal range of 1500-3200 masl. However, the most suitable area falls from 1900-2700 masl, where the annual rainfall range is between 600 and 2000 mm (Hailu *et al*., 1991).

In Ethiopia durum and bread wheat species, each occupy approximately equal proportion of the area under wheat production. However, changes in the relative proportions of wheat types grown in Ethiopia has been reported more recently, with durum and bread wheat occupying approximately 30 and 70%, respectively (CSA., 2012).

Variation is the occurrence of differences among individuals due to differences in their genetic composition and/or the environment in which they are raised. If the characteristic expression of two individuals could be measured in an environment to be exactly identical for both, differences in

expression would result from genetic control and hence such variation is called genetic variation (Welsh, 1990). Knowledge on the extent of genetic divergence and genetic relationships among genotypes is a prerequisite for a successful breeding programme. For breeding and selecting desirable traits, a good understanding of the pattern and extent of genetic divergence is important (Maniee *et al*., 2009). The more the genetic diverse parents, the greater the chances of obtaining higher heterotic expression in F1s and broad spectrum of variability in segregating population.

Different studies in Ethiopian durum wheat landraces in general and specificity collections from Tigray wider genetic variability have been reported (Hailu *et al*., 2006). However, the relative proportion of durum wheat compared with bread wheat in the farming system of Southern Tigray is very low and showed implication of genetic erosion. This could be due to low yielding and lodging nature of the local durum wheat genotype. Hence, it is very important to see the performance and determine the extent and pattern genetic divergence in the exotic durum wheat genotypes in Tigray Region.

MATERIALS AND METHODS

Description of the study area: The present research was carried out in Ofla district, Tigray, Ethiopia, located at 12°31' N latitude and 39°33' E longitude. Twenty durum wheat genotypes (Table 1) were evaluated during the 2014 cropping season. The trial was laid in a randomized complete block design with four replications. A plot consisting of six rows of 2.5 m length and spacing of 0.2 m between rows was used. A seed rate of 150 kg ha^{-1} and fertilizer rates of 62 and 46 kg ha^{-1} N and P_2O_5, respectively, were applied.

Data collected

Days to Heading (DH): Number of days from planting to the date on which 50% of plants on the four middle rows of the plant set heads.

Days to Maturity (DM): Number of days from planting to the stage, when 75% of plants have reached maturity.

Table 1: Durum wheat genotypes used in the study

Entry code	Genotype
1	34th IDONMD/89/off2011
2	IDON-2009_off/222/2009
3	DSP2009_off. F3.2H.291_meh.1H.158
4	DSP2009_off. F4.2H.695_meh.2H.245
5	CD11_Y10BEK SEL/25/off2011
6	CD11_Y10BIR SEL/97/off2011
7	CD10_MCDZ-off
8	CDS10MSELT-DZmeh81/2010
9	CD11_Y10BEK SEL/115/off2011
10	DSP2009_off. F4.2H.976_meh.3H.291
11	CD11_Y10 BIR SEL/197/off2011
12	CD11_Y10 BIR SEL/95/off2011
13	CD11_Y10 BIR SEL/98/off2011
14	CDS10MS ELT-DZmeh61/2010
15	34th IDONMD/110/off2011
16	DSP2009_off. F4.1H.429
17	34th IDONMD/111/off2011
18	Mukiye
19	Hitosa
20	Local

Thousand Kernel Weight (TKW): Weight of the 1000 sample seed in gram per plot taken at random.

Plant Height (PH): Plant height is a distance in centimeter from the ground surface to the tip of the spike excluding the awns of randomly taken plants in the plot by measuring.

Spike Lengths (SL): Spike length of the main tiller of each plant from base to tip excluding the awns was measured in centimeter.

Kernel Numbers Per Spike (KNPS): Kernel numbers per spike were recorded by counting the number of kernels produced on the main tiller of each plant.

Grain Yield (GY): Grain yield was obtained by weighting the four middle rows adjusted at 12% moisture content.

Statistical analysis: The genetic distance between clusters was determined using the Mahalanobis D^2 statistics using the SAS 9.2. Clustering analysis was done using the ward method and the number of clusters were determined by looking the criteria (CCC), pseudo (PSF) and pseudo (PST^2) statistics. The dendrogram was used the minitab 16 statistical software.

RESULTS

Intra-and inter-cluster D^2 analysis: Durum wheat genotypes clustered in the same group (intra-cluster) given as the diagonal numbers and genotypes grouped in different cluster (inter-clusters) was given in Table 2. The inter cluster distance of the twenty durum wheat genotypes ranges from 0.57536 in cluster one to 212.02335 in cluster four. The maximum inter-cluster distance was between cluster two and cluster four which is 212.02335. Cluster one and cluster four were the second divergent 135.57953. The lowest inter-cluster distance was obtained between cluster one and two which is 24.9100 (Table 2). The durum wheat genotypes in cluster one had lower intra cluster distance 0.57536. The intra cluster distance of cluster two, three and four were 3.79424 and 5.99146, respectively.

Cluster analysis: Cluster analysis revealed the presence of four major clusters (Fig. 1). The first cluster accommodates 15 durum wheat genotypes including the two released genotypes (Table 3). The second cluster consists of three durum wheat genotypes. The third and fourth clusters similarly contained each one durum wheat genotype (Table 3).

Cluster mean value of the 20 durum wheat genotypes: The divergent cluster four was mainly characterized for its low yield, lower number of spikes per plant and shorter spike length. Cluster

Table 2: Intra-cluster and inter-cluster distance D^2 values among the four clusters

Clusters	1	2	3	4
1	0.57536	24.9100	64.29246	135.57953
2		3.79424	83.58374	212.02335
3			5.99146	95.52302
4				5.99146

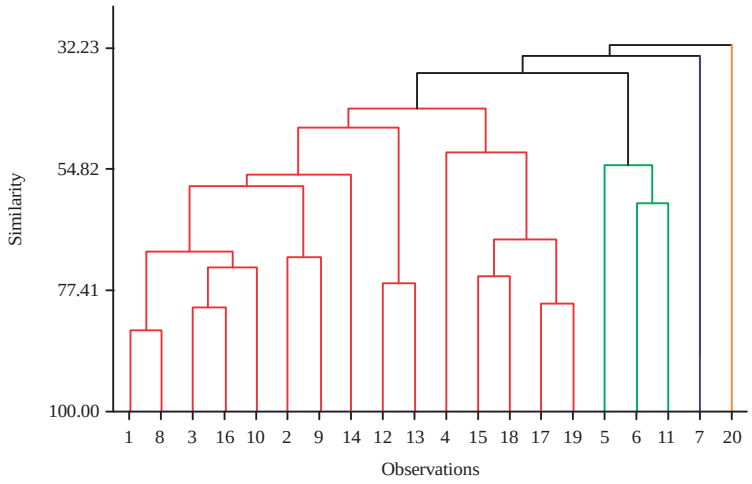

Fig. 1: Dendrogram of 20 durum wheat genotypes used in the study

Table 3: Composition of the clusters of durum wheat genotypes

Clusters	Genotype
1	34th IDONMD/89/off201, CDS10MSELT-DZmeh81/2010 , DSP2009_off. F3.2H.291_meh.1H.158, DSP2009_off. F4.1H.429, DSP2009_off.F4.2 H.976_meh.3H.291, IDON-2009_off/222/2009, CD11_Y10BEK SEL/115/off 2011, CDS10MS, ELT-DZmeh61/2010 and CD11_Y10 BIR SEL/95/off 2011, CD11_Y10BIRSEL/98/off2011, DSP2009_off. F4.2H.695_meh.2H.2 45, 34th IDONMD/110/off2011, Mukiye, 34th IDONMD/111/off2011 and Hitosa
2	CD11_Y10BEK SEL/25/off2011, CD11_Y10BIR SEL/97/off2011, CD11_Y10 BIR SEL/197/off2011
3	CD10_MCDZ-off
4	Local check

Table 4: Mean values of seven traits of 20 durum wheat in four clusters

	Clusters			
Variables	1	2	3	4
HD	66.5938	64.5000	73.083	69.167
MD	96.8125	97.3333	108.250	102.083
PH	73.9250	84.2500	79.067	75.433
SL	5.3844	5.3042	5.458	5.342
TKW	51.5375	58.9667	55.767	54.400
Seed	37.6875	34.2833	40.400	26.833
Yield	36.2989	39.3602	42.802	34.270

HD: Days to heading, MD: Days to maturity, PH: Plant height, SP: Spike length, TKW: Thousand kernel weight

three with only one durum wheat genotype, having higher grain yield, higher number of seeds per speak, longer days to maturity, longer days to heading date and longer spike length. Cluster two was characterized by higher plant height and higher thousand seed weight. The first cluster with 15 durum wheat genotypes were mainly with lower thousand weight and lower yield as well (Table 4).

DISCUSSION

The maximum inter-cluster distance was between cluster two and cluster four, the distance implying the existence of genetic variability and the distinct nature of the durum wheat genotypes. Hence, hybridization between such genotypes having wider genetic background could result in

obtaining better heterosis, segregation and recombination for enhancing yield and yield related traits in any crop improvement program (Sharma *et al*., 2013; Tsegaye *et al*., 2012; Maniee *et al*., 2009). The minimum genetic distance in cluster one and two implying narrow genetic base of the genotypes and this could be associated with the pedigree of the genotypes and in such cases the level of obtaining outstanding lines is lesser.

The clustering analysis classified the twenty durum wheat genotypes into four distinct clusters and this implying the presence of diversity in the durum wheat genotypes and the tendency of obtaining promising parent for crossing and for direct consumption using the mean value is also possible (Varma *et al*., 1992). There was no association between the clustering pattern and geographic location of the durum wheat genotypes. The local check was identified divergent located in the fourth cluster and this could be the adaptative nature of the genotype to the growing environment. Similar research report was obtained by Tsegaye *et al*. (2012) and Gashaw *et al*. (2007). Generalized divergence of genotypes are genetically related whereas diverse cultivars are classified into different clusters.

CONCLUSION

The twenty durum wheat genotypes were categorized in to four major clusters. Cluster two and cluster four was highly divergent and crossing program between these clusters could result better segregating population in durum wheat breeding program in Tigray Region.

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