

GENETIC VARIABILITY IN AGRO-MORPHOLOGICAL AND TECHNOLOGICAL TRAITS IN A MEDITERRANEAN DURUM WHEAT POPULATION

Amamou A.⁽¹⁾, Ramchoun M.⁽²⁾, Nsarellah N.⁽¹⁾, Taghouti M.⁽³⁾ and Nachit M.⁽⁴⁾

1 : National Institute of agronomic research, INRA, Settat, Morocco, 2 : Faculty of technical Science of Settat, Morocco, 3 : National Institute of agronomic research, INRA, Rabat Morocco, 4 : International center of agricultural research in dry area, ICARDA Aleppo, Syria

To contact : amamou_ali@yahoo.fr

Abstract

Durum wheat (*Triticum turgidum* var. Durum) is a typical Mediterranean small grain crop. Its uses are multiple and depend greatly on environmental conditions during crop growth. The objective of this work is to study genetic variability of durum wheat accessions and the effect of the environment on some plant traits. Seventy six durum wheat genotypes including old local accessions and improved genotypes were planted and evaluated in two sites "Marchouch" and "Sidi El Aydi" in Morocco. Plant and grain attributes were evaluated. The genotype effect and genotype by environment interactions were significant for most of the traits. Principal components analysis was used to group genotypes according to their attributes. The differences in traits and their associations showed that they could be used effectively to broaden the genetic base of breeding purposes.

Key words : Durum wheat, accessions, Mediterranean, genetic variability, grain quality.

Introduction

In Morocco, the area planted annually with cereals varies around 5,3 Million hectares, i.e., 60 % of total agricultural lands. The production constitutes 43 % of total consumption (Bartali E., 1995). About 1.2 millions hectares of durum wheat (*Triticum durum* L. var. durum) are sown annually with an average yield of only 1,1 t/ha (ONICL 2004). The average durum wheat consumption is about 90 kg/person/year. Morocco is ranked third in the Mediterranean region and first in the North Africa and Middle East region in term of durum wheat acreage. Arid and semi arid regions (60 % of the Moroccan lands) are characterized mainly by drought and poor rainfall distribution within seasons (El Mourid et Karrou, 1996). Due to these reasons, the average yield is variable and ranges from 0,5 to 1,2 t/ha (Jouve, 1988). Grain quality in the new cultivars is only average and needs to be improved. The objective of this study is to identify new genetic resources in the Mediterranean material to be introduced in the local varieties.

Methodology

Seventy six Mediterranean durum population including old local accessions was used. The material was conducted in trials at Sidi El Aidi (SEA) and Marchouch (MCH) ; two INRA's research stations representing respectively semi arid and favorable rainfall regions. The augmented design was used with six replications and five checks (Haurani (H), Waha (W), Kourifla (K), Gidara2 (G) and Mrb5 (OMR) repeated in each block.

In the field, the agro morphological traits evaluated were plant height (H), days to heading (DH), Days to maturity (DM), number of spikes per square meter (SM), grain weight (GW) specific weight (SW), number of grains per spike (GS) thousand kernel weight (TKW) and grain yield (GY). In the laboratory, quality parameters were measured on 21 accessions from different yield classes (high, medium and low yield). The quality parameters evaluated were: Sodium Dodecyl Sulfate Sedimentation test (SDS), vitreousness % (VR), yellow index (YI) and ash content (AC). The accessions were also examined for gliadin and glutenin subunits composition.

Results

The ANOVA analysis on checks showed that the genotype and genotype by environment interaction were significant for the agro-morphological traits and for grain quality parameters. To analyze this GxE effects, principal component analysis (PCA) was used for the data of each location. The biplot for PCA analysis of all accessions and plant traits in two locations is shown in figure 1.

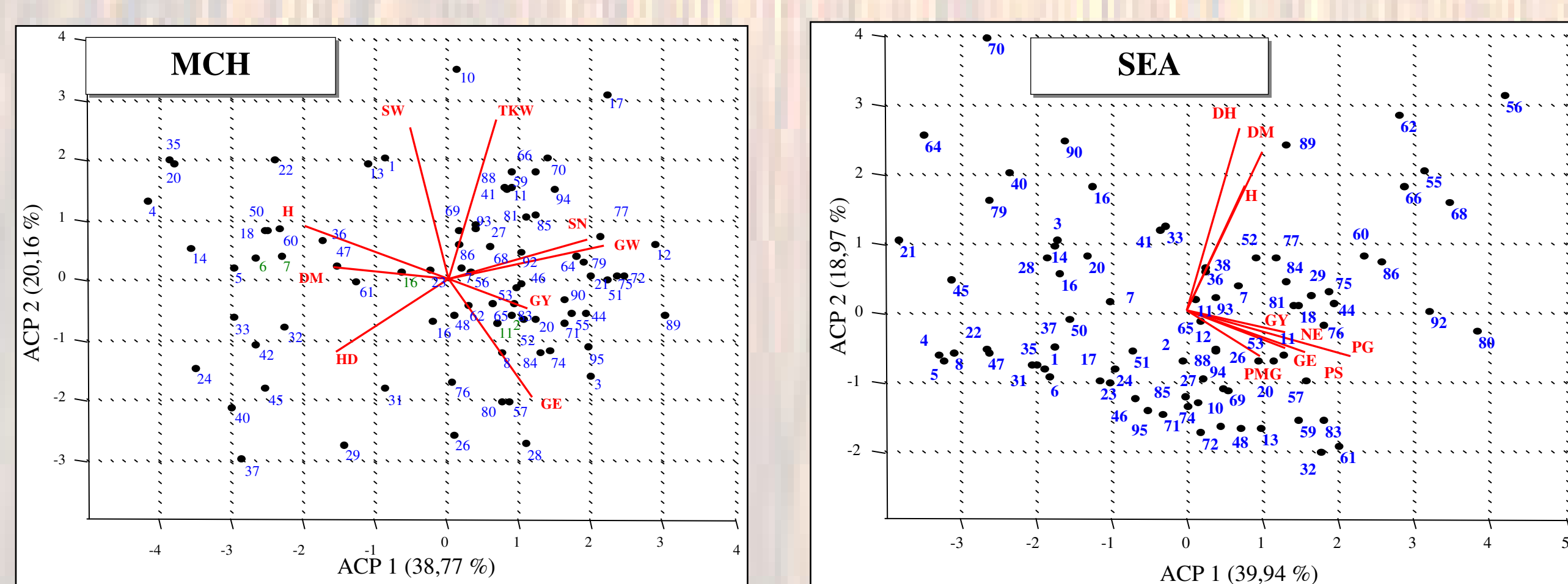


Figure 1 : Repartition of accessions in the PCA axis in SEA and MCH location for agro-morphological traits

The first axis of PCA have explained 58,93 % and 58,91 % respectively for MCH and SEA. The plant traits in the of the accessions react differently to the environment in explaining yield and in their relative associations.

In both locations, the DH, DM were correlated with plant height. In SEA site, the SM, GW, TKW, GS and SW were positively correlated to yield, but in MCH, there is a significant correlation between SN, GW and GS with yield. This results indicate an adaptation potential coming from the evolution of plant traits and their association and final yields of the accessions. Therefore this germplasm will provide plant a good genetic base for adaptation in a wheat breeding program. For grain quality, the electrophoresis shows that 58 % of the accessions carried γ -45-gliadin subunits correlated with strong durum wheat gluten. band. In general, the accessions with high SDS have a γ -45-gliadin. In deed, 77 % of the accessions with γ -45 have a SDS greater or equal to 37 ml. For the checks, Waha and Mrb5 have the γ -45-gliadin, and the others have γ -43-gliadin. For the other parameters : SDS, VR, YI and AC, high genetic variability was identified in the material studied. This germplasm represent, therefore, a promising gene pool for durum wheat crop improvement.

The PCA analysis of the quality parameters is shown in the figure 2, and the gel of the proteins of the accessions is shown in figure 3.

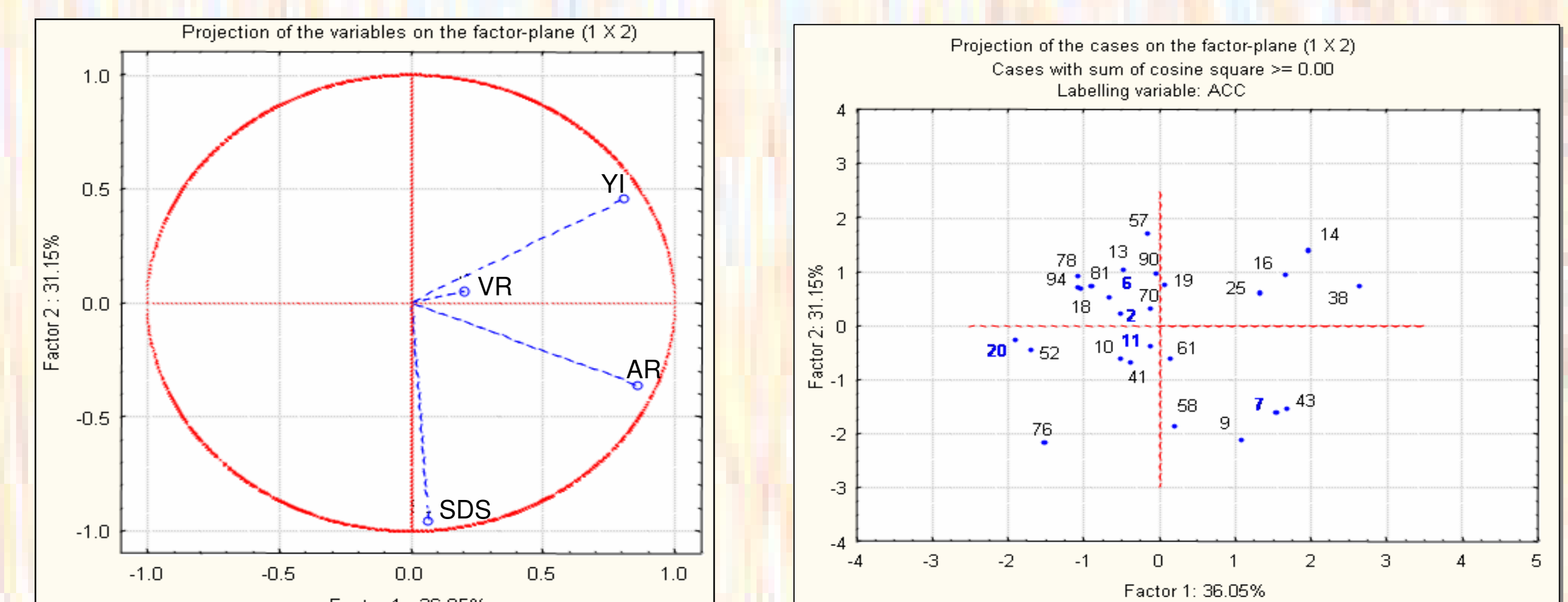


Figure 2 : Quality parameters in the PCA axis in SEA and MCH

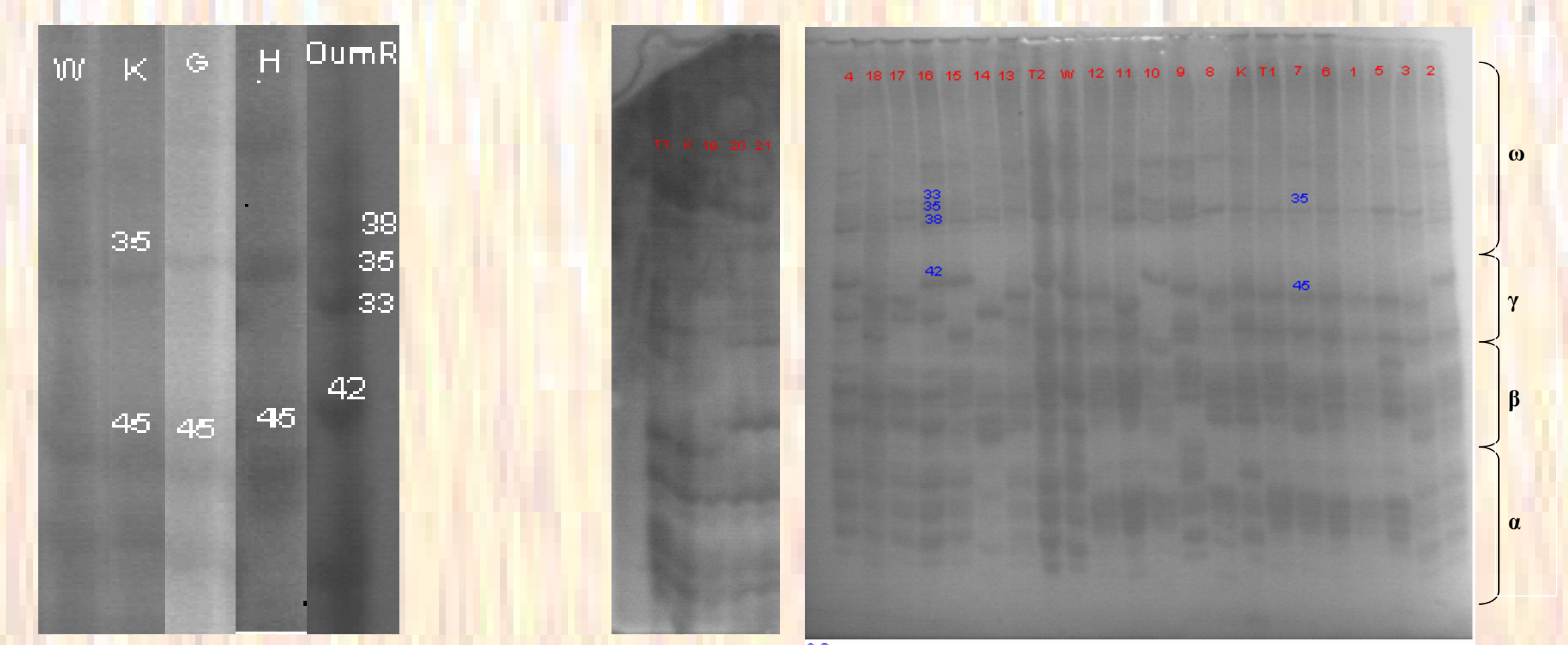


Figure 3 : Gel of accessions and checks for gliadin content

The principal component analysis explain 67,20 % of the variability. The VR and YI are correlated positively, but YI and SDS are Moderately negatively correlated. There is no good correlation the other traits. The accession n°14 have a very high yellow index, n°43 have high value of ash rate and n°58 have a high value of SDS.

Conclusion

The local population and improved lines present important variability for the agro-morphological and grain quality traits, and show significant possibilities to be used by the Moroccan breeding program for the benefit of the Moroccan environments. In durum wheat, good grain quality was independent from good adaptation.

References

- Bartali El Houssine, systemes post recolte des cereales au Maroc fevrier 1995
- El Mourid M. and Karrou M., 1996. Agriculture in arid semi-arid regions of Morocco: Challenges and prospects. Al Awamia. 92: 69-81.
- Jouve, 1988 ; MARA/FAO, 1982 ; Crawford et Purvis, 1986. In Ecologie des céréales en zones semi-arides. M. Karrou et al., 2001. INRA, Maroc.
- ONICL (2004) : Division des études, des statistiques et de l'information, Maroc.

Special thanks to :

- E.U. funded TRITIMED, project : "Exploiting the wheat genome to optimize water use in Mediterranean Ecosystems" for providing funds and genetic material
- GCP - INRA Morocco funded project : "Bridging genomics, genetic resources and breeding to improve wheat and barley production in Morocco" for financing this communication.