Genotype × Environment Interaction for summer dormancy and productivity in cocksfoot hybrids over three contrasted environments

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Abstract

Climate change is projected to amplify existing climate-related risks and create new risks for natural and human systems. Perennial forage species may represent a valuable alternative to annual forage crops by improving the environmental and economic sustainability of Mediterranean agro-pastoral farming systems through a reduction in soil erosion and the conservation of soil water. Under climate variability, a multi-environment experiment was conducted in Morocco under three contrasting environments—Annocer, Guich, and Tassaout—over three consecutive years (2013/214, 2014/2015, and 2015/2016).

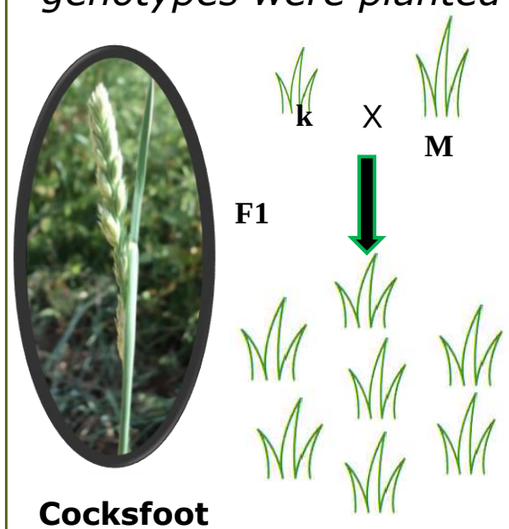
Measurements for productivity traits and summer dormancy were taken for 21 genotypes, 18 of which were (F1 hybrids) generated between two varieties of cocksfoot—Dactylis glomerata ssp glomerata and Dactylis glomerata ssp hispanica—with different ranges of senescence, parents, and Ludac values (temperate control). An evaluation of the stability and adaptability of the cocksfoot genotypes was established by AMMI (Additive Main Effects and Multiplicative Interaction) using some productivity traits (plant height, annual dry-matter production, and spring biomass) and summer dormancy to determine differences between genotypes across environments.

The present study aimed to identify the effect of environmental control on the induction of summer dormancy and identify genotypes with both mean performance and high stability.

Results indicated a large variability among genotypes from year to year and location to location. The Analysis of Variance (ANOVA) showed highly significant differences ($P < 0.0001$), which were recorded between genotypes for all measured traits, mainly due to changes in genotype rankings. Significant effects of genotype, environment, and GxE were noted. Moreover, significant correlations ($P < 0.0001$) were obtained between environments. Env2 and Env3 achieved the highest mean annual dry matter.

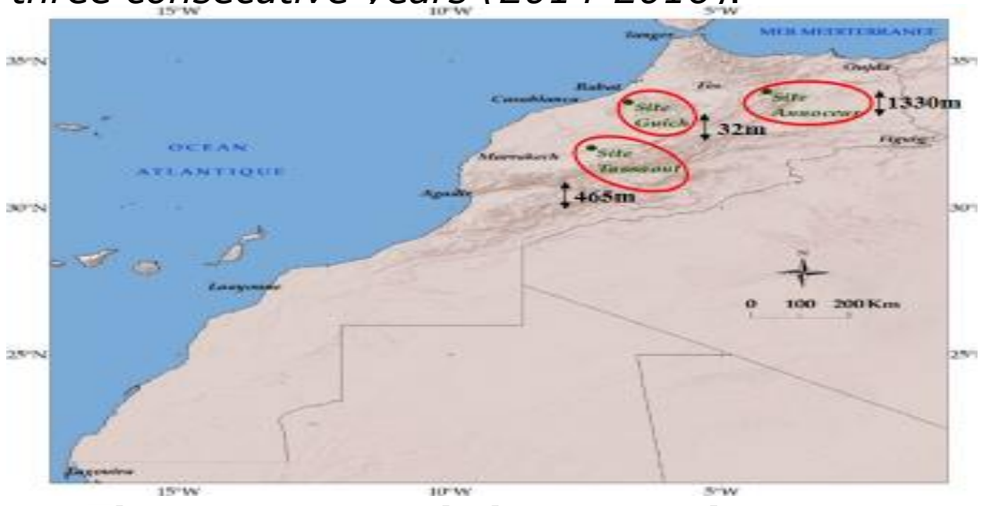
Methods

Our researchh is focused on the characterization of some hybrids generated by crossing two genotypes from two contrasted species for summer dormancy and productivity: **Kasbah** (*Dactylis glomerata ssp hispanica*) from Morocco, dormant, and **Medly** (*Dactylis glomerata ssp glomerata*) a summer active from France, under the Mediterranean climate*. Dry matter, heading date, and plant height, senescence were assessed for some selected genotypes, from the main field, those genotypes were planted in three contrasting environments in morocco for three consecutive years (2014-2016*).



Cocksfoot

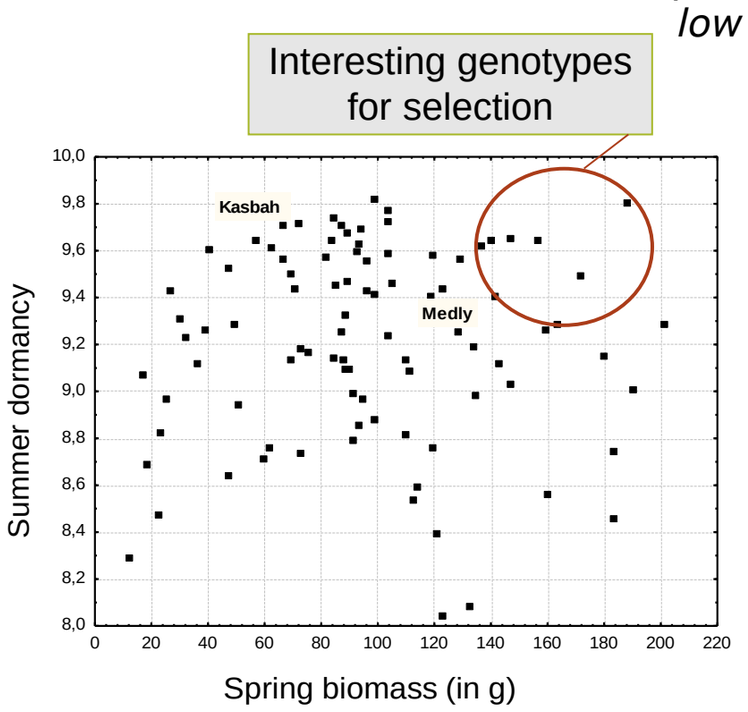
Field in Guich station

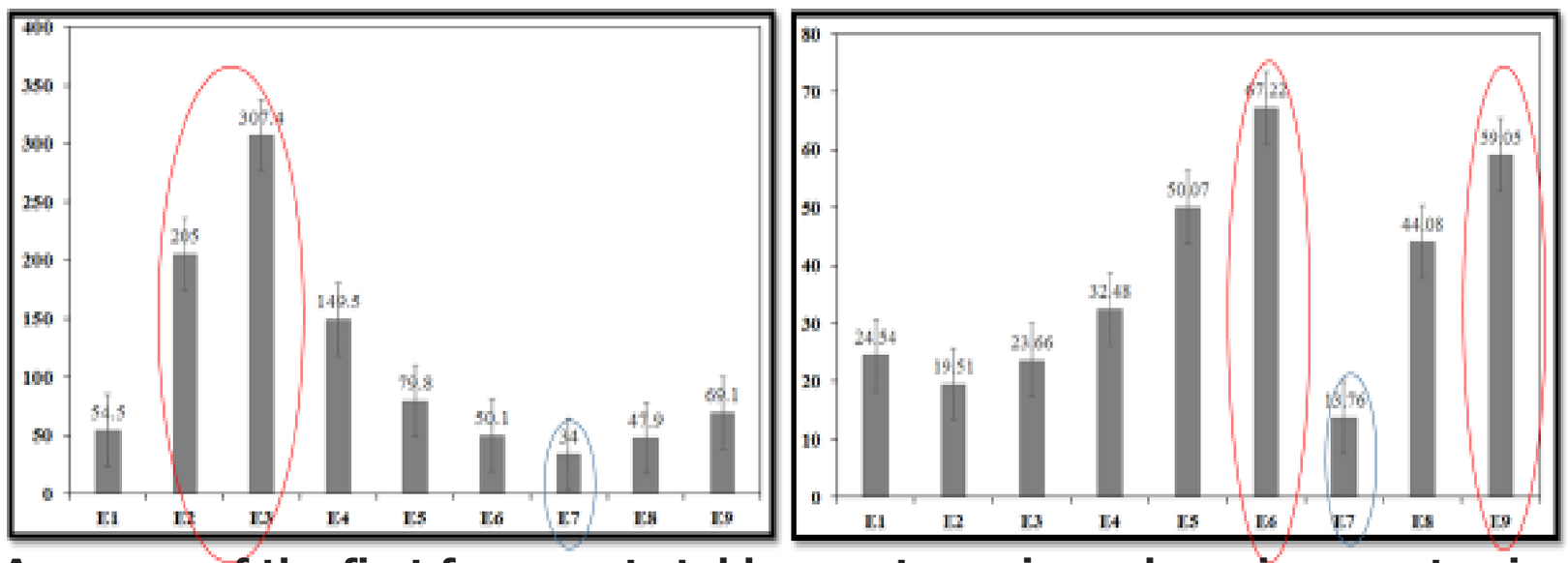


Three contrasted chosen environments

Results

- *Results are promising, revealing different responses to each environment.*
- *The differences between selected phenotypes were more marked on the sites with high yield potential than on the sites with low yield potential, particularly in environment (E2, E3).*





Averages of the first four most stable genotypes in each environment using AMMI analysis, for productivity (g/plant) and summer dormancy (%) traits.

Conclusion

- The response to a genotype-environment interaction depends on the adaptation of the genotype to the environment chosen for its cultivation.
- This adaptation, which covers morphological, physiological or behavioral changes, is the result of different mechanisms, genetic selection and/or phenotypic plasticity….