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Genetic erosion of perennial forage grasses in Morocco: First observations

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SUMMARY – Morocco has one of the richest flora in the western Mediterranean region due to the diversity of ecological and climatic conditions. This positions Morocco as one of the main centres of diversity for *Phalaris*, *Festuca* and *Dactylis* spp. Unfortunately, this wealth is threatened by several factors, such as drought and intensive grazing pressure. In order to safeguard germplasm *ex situ* and to evaluate the rate of genetic erosion, two collections of *Phalaris aquatica*, *Festuca arundinacea* and *Dactylis glomerata* were realized in Morocco in 2004 and 2007 within the framework of the PERMED project. A total of 64 accessions from 41 sites were collected from different areas: Middle and High Atlas, Rif mountains and coastal region. Site observation during collection trips has confirmed the scarcity of the target species by comparing the collected information to the previous collection data of 1994. Therefore, further collections should be obtained and actions should be initiated for the *in situ* conservation of these threatened species.

Key words: Genetic resources, perennial grasses, collect, genetic erosion.

RESUME – "Erosion génétique de graminées pérennes au Maroc : Premières observations". Grâce à la diversité du climat et du relief, le Maroc possède l'une des plus riches flores de la région ouest méditerranéenne. Ceci a fait du Maroc le centre de diversité de certaines espèces comme *Phalaris*, *Festuca* et *Dactylis* sp. Malheureusement, cette richesse est menacée par plusieurs facteurs tels que la sécheresse et le surpâturage. Dans l'objectif de sauvegarder le germoplasme et d'évaluer le degré d'érosion génétique, deux collectes de *Phalaris aquatica*, *Festuca arundinacea* et *Dactylis glomerata* ont été conduites en 2004 et en 2007 dans le cadre du projet PERMED. Un total de 64 accessions a été collecté sur 41 sites, dans différentes régions : Moyen et Haut Atlas, le Rif et le littoral. L'observation des sites de collecte a confirmé la rareté des espèces collectées en comparaison avec les collectes antérieures, notamment celle de 1994. Par conséquent, d'autres collections doivent être réalisées et des mesures de conservation *in situ* de ces espèces cibles doivent être prises.

Mots-clés : Ressources génétiques, graminées pérennes, collecte, érosion génétique.

Introduction

The Moroccan perennial grasses germplasm present high agronomic value as demonstrated by many authors (Piano and Pusceddu, 1989; Reed, 2004). The most important characteristics are: hot dry summer survival, summer dormancy, better autumn-winter growth, good seed production and the high frequency of tall fescue endophyte infection, involved in the biotic and abiotic stresses resistance if suitable strains are selected (Silsbury, 1961; Mc Williams and Kramer, 1968; Reed *et al.*, 1980).

Collection of the Moroccan germplasm has been widely exploited by breeders from different countries. Several ecotypes have been used to produce commercial cultivars. Also, many ecological and agronomic characters have been successfully incorporated into existing varieties e.g. *Dactylis glomerata* (cv. Kasbah), *Festuca arundinacea* (cvs. Demeter, Maris jebel) and the *Phalaris aquatica* (cvs. Atlas PG, Sirocco, El Golia).

The clear genetic erosion occurring in Morocco has accelerated the need to collect, conserve and evaluate the available genetic resources in Morocco (Rumbaugh and Graves, 1983; Francis, 1987 and Cunningham *et al.*, 1997).

The objective of this paper is to report results of two collection trip undertaken during 2004 and 2007, in the context of PERMED project.

Materials and methods

Two targeted collection trips of *P. aquatica*, *F. arundinacea* and *D. glomerata* were conducted in Morocco on July and August 2004 and 2007. The prospections have covered coastal region and Atlas and Rif Mountains. Altitudes varied from 300 to 1520 m. A total of 41 sites were sampled in four geographical areas:

- (i) Rif (Provinces Taounate, Taza, Chaouen and Tetouen): 13 sites.
- (ii) Middle Atlas (Provinces of Ifrane, El Hajjeb, Azrou and Oulmes): 15 sites.
- (iii) High Atlas (Provinces of Errachidia, Benimellal, Azilal and Agadir): 8 sites.
- (iv) Coastal region (Provinces of El Jadida, Larache and Tangier): 5 sites.

Detailed passport data were gathered at each site including location, altitude (electronic meter) and soil type. From 5 to 50 individual plant were sampled and bulked as an accession to ensure an adequate population sampling. We managed to collect green plants when it was impossible to collect seeds.

The collected and evaluated material is stored for the time being for medium term at 4°C in a cold store. Some ecotypes of *Dactylis* has being multiplied last year, the rest of material will be multiplied next growing seasons and afterwards, will be packed in aluminium foil bags and maintained in deep freezers at -18°C as a base collection. The rest of the seeds for each ecotype will be safeguarded in the cold room store as an active collection for future trials.

Results and discussion

A total of 41 sites were found during these collection trips. We consider a site each location from which the seeds of an ecotype were collected. This number is considered as low regarding the widespread perennial grasses in Morocco. Indeed, in comparison with the 1994 collection, which prospected the same regions and found 87 sites, our collection trip has shown lower number of sites. This could be attributed to several factors such as the severe drought, which has occurred since that time (1994) and has drastically affected plant species abundance. Furthermore, overgrazing was an additional factor that affects the survival of many palatable species such as grasses.

A summary of the collected species in the four geographical regions is presented in Table 1. Noteworthy was the finding that the Rif mountains contained both more sites and more genetic diversity for most of the target species. The Rif mountains with the highest rainfall areas were reportedly niche for perennial grasses followed by Middle Atlas mountains which still contain some genetic diversity for the target species. Unfortunately, High Atlas mountains and Coastal region were characterised by less genetic diversity, and thus could be considered as high degraded area.

Table 1. Number of accessions by grass species collected in the geographical regions of Morocco in 2004 and 2007

Species	Rif	Middle Atlas	High Atlas	Coastal regions	Total
<i>Dactylis glomerata</i>	8	10	8	2	28
<i>Festuca arundinacea</i>	4	5	3	1	13
<i>Phalaris aquatica</i>	11	4	3	5	23
Total	23	19	14	8	64

Dactylis glomerata was the most commonly collected species and occurred at 28 out of the 41 sites, mainly in Rif and Middle, High Atlas mountains followed by *Phalaris aquatica*, which was the most abundant species in coastal region. *Festuca arundinacea* had a more limited distribution. For the coastal region, only few accessions were sampled.

The Fig. 1 show the number of ecotypes for each species collected during 1994 by Cunningham *et al.* (1997) and during 2004 and 2007 collections.

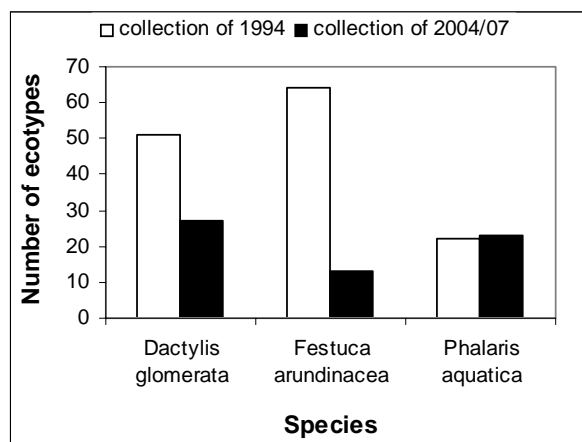


Fig. 1. Number of ecotypes for three perennial grasses collected in 1994 and 2004-07 collection missions.

Comparing the Cunningham *et al.* and our collection, we found that there was some evidence for a genetic erosion of tall fescue and cocksfoot.

Festuca is seriously threatened by overgrazing. In the most prospected area, plants were overgrazed and therefore couldn't produce seeds. The abundance has dramatically decreased and in some areas it was impossible to collect any seeds.

Dactylis seems to be less threatened in comparison to *Festuca*, despite drought which has occurred during the last years in addition to intensive grazing. Summer dormancy, which characterises cocksfoot, could be an advantage allowing relative survival of this specie.

In contrast, *Phalaris* was more frequent, especially in the Rif Mountains. According to the literature and our observations, *Phalaris* is the most resistant taxa to drought. This is due to the ability of its deep and well developed root system to supply water during the summer to the dormant culms at the soil surface (McWilliams and Kramer, 1968).

Conclusions

According to the collection data, genetic erosion is evident for *Festuca* and *Dactylis*, while the *Phalaris*, seems to be less affected. The main objective of our work was to contribute to the conservation of plant genetic resources by collecting, evaluating and safeguarding for an *ex situ* conservation. The collected material is transplanted in the field and greenhouse for characterisation, and evaluation (date of heading, plant height, summer dormancy, autumn-winter growth, green and dry matter yield etc.).

The genetic erosion, as demonstrated in this collection trip, became so urgent that actions have to be made as soon as possible to safeguard what still remains in some protected area, or rich biodiversity region, such as the Rif. *In situ* conservation is one of the promising issues to conserve these valuable genetic resources. Its implementation however needs more public awareness and more funds to guaranty its success.

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