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Analysis of Progeny For Productivity Traits and Summer Dormancy of *Dactylis glomerata* L.

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ABSTRACT

Desertification constitutes a significant risk for the persistence of native population. For forage plants growing in areas subject to prolonged and severe summer drought, the most important agronomic characteristic is not the ability to produce during drought but the ability to survive, recover in autumn, and grow actively during the rainy seasons. Dormancy is an adaptive response defined as growth suppression in summer despite irrigation, is an effective adaptation to drought observed in cocksfoot. Nevertheless, summer dormancy in cocksfoot is associated with low vegetative productivity. The objective of this study was to select hybrids with good level of production and range of dormancy in a progeny generated between a summer dormant and a summer active genotype. The preliminary results showed that some hybrids had important level of senescence similar to dormant parent with good spring biomass production, despite an expected negative correlation (r=-0.119) between the level of senescence under summer irrigation and biomass production under favourable conditions in spring.

Keywords: cocksfoot, hybrids, senescence, biomass production, summer dormancy.

Introduction

Climate change is affecting most regions of the world in recent decades, including Mediterranean region. These changes, concerning rainfall distribution and its scarcity, global heating and increased drought, are considered as a major obstacle to agricultural production, (IPCC, 2007). They affect as well the sustainability of rainfed agriculture and allow rangeland degradation. However, in these areas, the persistence of perennial herbaceous plants is mainly determined by plant survival over successive summer droughts (Lelievre and Volaire, 2009).

Dactylis glomerata L. (Cocksfoot) is an important perennial grass, having high fodder quality and increased drought resistance due to its ability to use water in the summer and grow up under relatively high temperatures. Mediterranean cocksfoot populations have developed valuable adaptive traits such as summer dormancy, defined as an absence of growth in summer despite irrigation. It is "an endogenously controlled and coupled series of processes comprising the cessation of leaf growth and senescence of herbage expressed under non-limiting water conditions in summer" (Norton *et al*., 2008).

This trait is associated to reduced water consumption (Lolicato, 2000) and to an increased survival (Oram, 1990). This could be of great interest to develop perennial grasses in Mediterranean region. Nevertheless, summer dormancy in cocksfoot is associated with low vegetative productivity (Shaimi *et al.,* 2009).

Our aim is to find hybrids with good level of production and range of dormancy in a progeny generated between a summer dormant and a summer active genotype.

Materials and methods

180 hybrids from the cross between a dormant cocksfoot (*Dactylis glomerata* ssp. Hispanica) and productive (*Dactylis glomerata* ssp. *glomerata*) and their parents were transplanted in the field, in the experimental INRA station of Guich (Latitude 34 ° 03'N, Longitude 06 ° 46'W) Rabat, Morocco. Planting was done in February 2011, spaced one meter *per* plant, in three repetitions, over a sandy soil of 1100 m^2. A fertilizer was applied at planting and consisted of 14, 28 and 14 kg/ha of nitrogen, phosphate and potash, respectively. Extra nitrogen (40 kg/ha) was applied after each cut. Soil was covered with a plastic mulch to prevent weeds, only holes of plants were uncovered. In 2012, forage yield was harvested manually on 31st of January, 2nd of April, 15th of May and 11th of September. Green material from each plant was oven dried at 70 ° C for 72 h and dry weight was recorded. The percentage of plant senescence was scored on 16th of July, according to scale (0= all tissues green, 100= no visible green tissues) and used to assess summer dormancy. Spring biomass was calculated by adding the biomass harvested after the second and the third cuts. Summer biomass refers to September harvest following full summer irrigation. Plant height was measured at flowering time for all the plants. The analyses were performed with the Statview (SAS institute Inc., Cary, NC, USA).

Results and discussion

Results show a large variability in the progeny for spring and summer biomass, height and plant senescence. In spring, correlations were established between functional traits and variables associated with aerial biomass productivity.

Spring production differed significantly ($P<0.0001$) among genotypes. A Mediterranean cultivar of cocksfoot 'Medly' was more productive than Kasbah in spring, 22% of hybrids were more productive to both parents. In summer some hybrids produced more than Medly, while Kasbah produced little biomass.

Plant height differed among hybrids and parents ($P<.0001$). Height of 63% of hybrids exceeded the parents (Figure 1). Spring biomass was positively correlated with plant height ($r=0.593$),this correlation is presented in (Figure 2). The same result was, reported by Mefti *et al.,* (2008) on perennial grasses.

Dormancy was approached by senescence score, since Norton *et al.* (2006) suggested that leaf senescence could be used to identify summer dormancy. Plant senescence levels ranged from 5 to 95%. Some hybrids expressed high levels of senescence exceeding parents. Under summer irrigation, spring biomass was inversely correlated with senescence of aerial tissues ($r=-0.119$). However this correlation is weak and many hybrids produced sufficient spring biomass and also had enhanced senescence scores (Figure 3).

Our results show that it is possible to combine the two traits, summer senescence and spring productivity in some hybrids from the progeny. The significant variability among the studied cocksfoot progeny could be exploited to create cultivars with a high level of summer dormancy and a good vegetative production.

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Figure 1. Distribution of cocksfoot population generated from summer dormant and summer-active cultivars for plant height (cm)

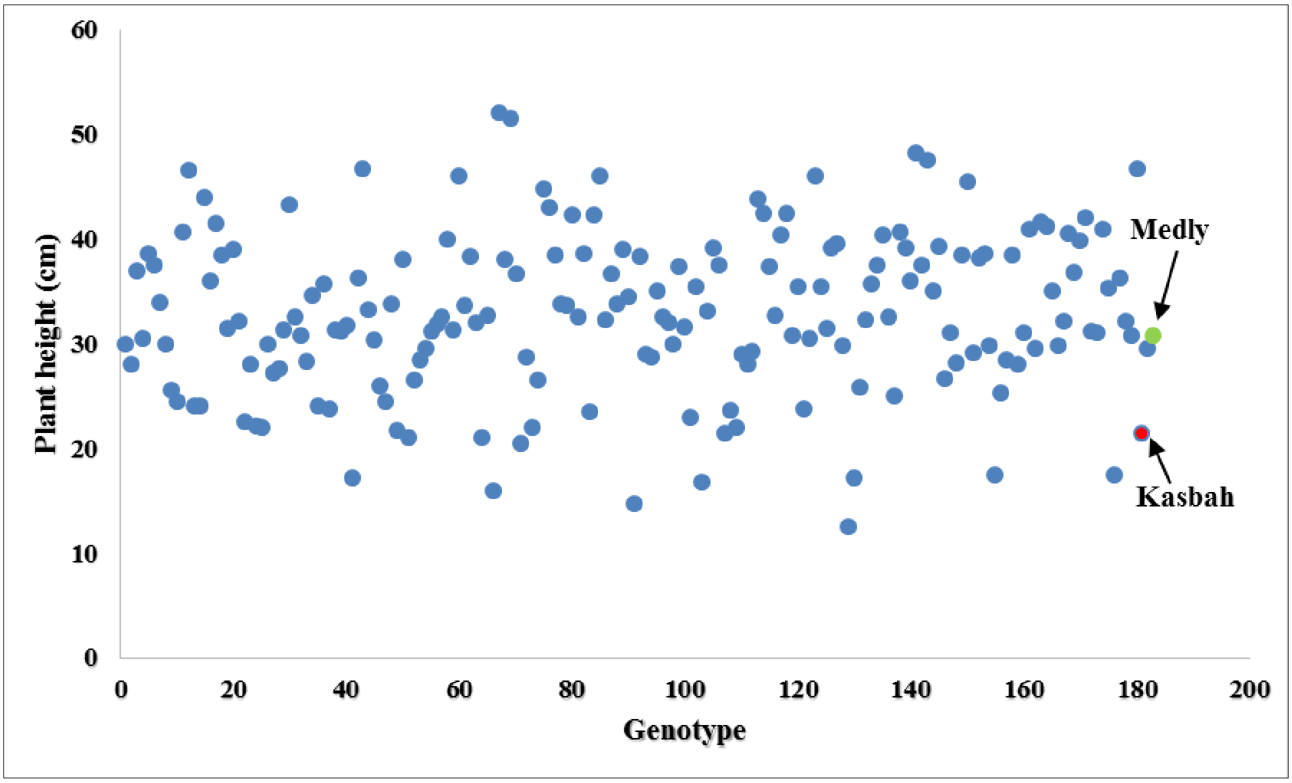


Figure 2. Relationships between spring biomass (g/plant) and plant height (cm) under summer irrigation of cocksfoot population generated from summer dormant and summer-active cultivars

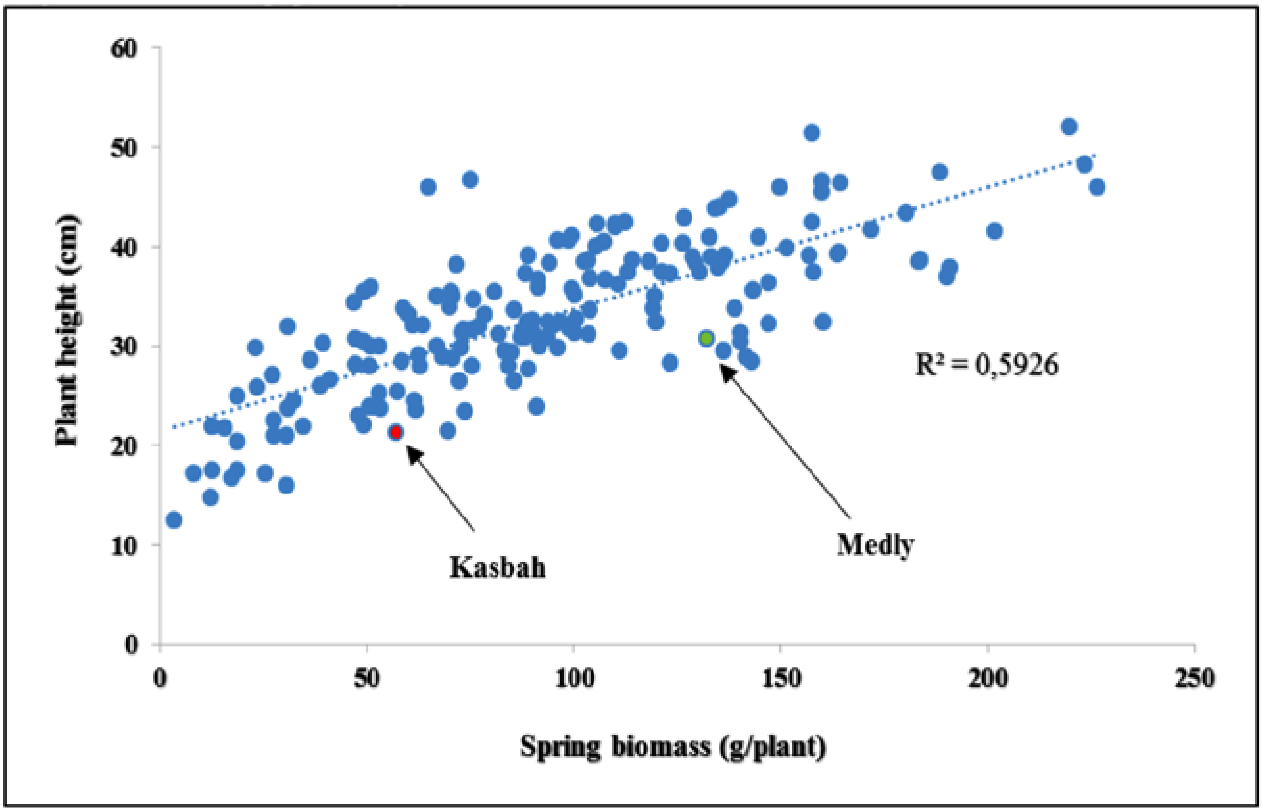
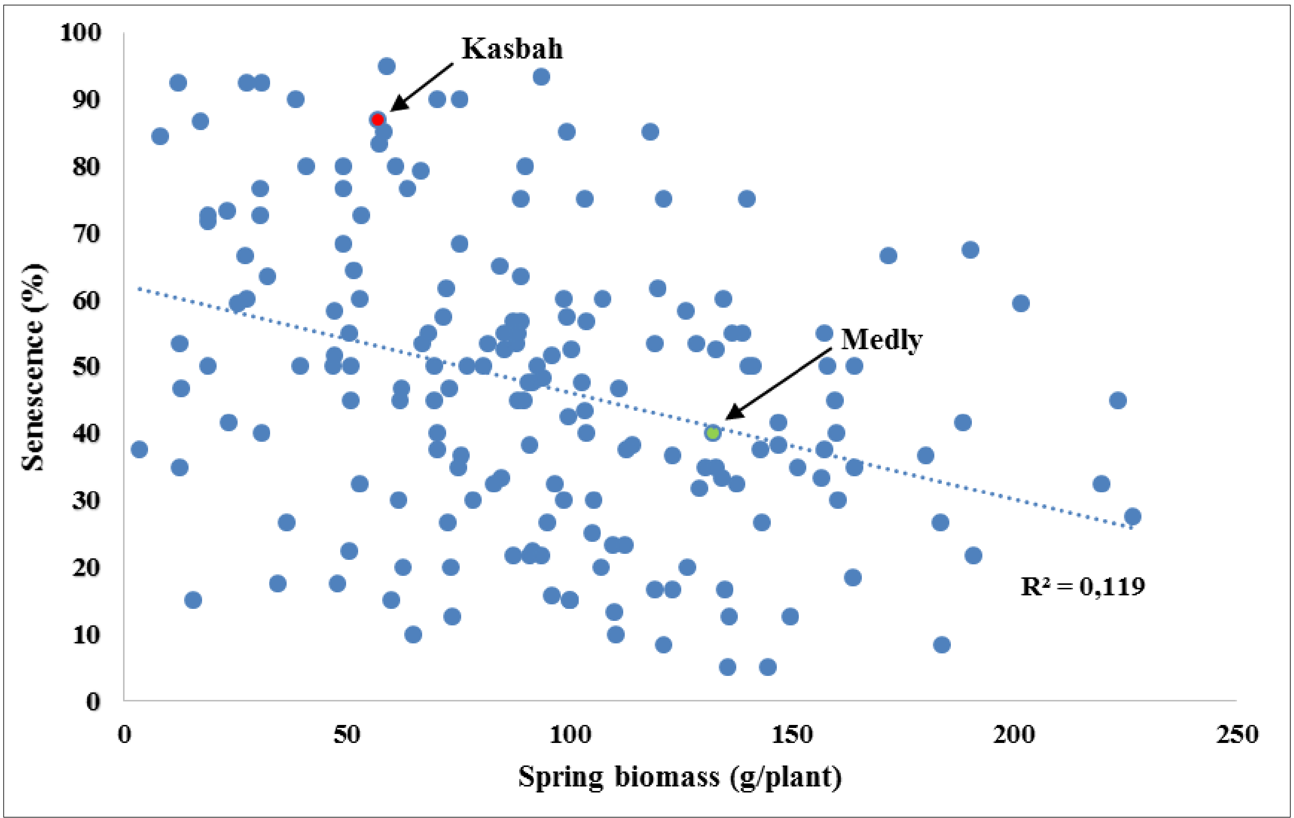


Figure 3. Relationships between spring biomass (g/plant) and senescence (%) under summer irrigation of cocksfoot population generated from summer dormant and summer-active cultivars



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