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Assessment of summer drought tolerance and persistence of some grass cultivars in Algerian semi arid conditions

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Introduction

Stress-tolerant forage resources are increasingly needed for the environmental and economic sustainability of extensive Mediterranean livestock systems. Perennial forages belonging to two species: *Festuca arundinacea* Schreb. (tall fescue) and *Dactylis glomerata* L. (cocksfoot) can be a valuable alternative to annuals, if they can survive across successive summer droughts. Poor persistence of sown perennial pasture grasses is a problem in regions of the World with Mediterranean climates where the most stressful, life threatening season is a summer characterised by long and often severe droughts with high temperatures. The objective of this study is to compare 14 grass cultivars in an Algerian drought prone environment in order to identify the best adapted plant material.

Materials and methods

The field study was conducted during the 2008/09 cropping season at the Sétif Agricultural Experimental Station of the Field Crop Institute (ITGC) located at 36°12′N, 5°24′E and altitude 1023 m asl. The climate is temperate continental, varying from arid to semi-arid (Fig. 1). Varieties were sown in October 2005 in a lattice design with four replicates and 10 row-plots of 2.5 m long x 2 m wide. The sowing was done by hand, where cultivars representing six types of cool-season grasses of cocksfoot and tall fescue (Table1) bred for sub-humid and semi-arid Mediterranean environments were tested in pure stands. Average seeding rate was 20 kg/ha. Nitrogen fertilizer was applied at a rate of 100 kg/ha as urea 46%. The 6 inner rows per plot were harvested in the spring when inflorescences emerged in at least 4 among the tested varieties. Dry matter yield (DMY) was determined after drying a sample of 500 g in a forced air oven at 65°C during 48 hours, Heading date (DHE) was recorded, on the outer rows, as the number of Julian days from January 1st to the date when 50% panicles fully emerged. Variation in the ground cover percent of living grown tissue was used as measure of persistence (PER) according to Casler *et al*. (2002). The collected data were statistically analyzed with STATBOX 6 Package.

Results and Discussion

Dry matter yield

Two harvests were done, in autumn and spring where significant differences have been noted between varieties (Table1). Poor autumn production is explained by the low level of soil moisture available for growth. Autumn rains usually arrive very late, and in summer there is a complete absence of rain which requires that different varieties gradually enter dormancy and thus reduce their dry matter production.

Persistence and phenology

Row cover and the number of days to head showed significant differences between genotypes (Table1). According to Volaire *et al*. (2008) early flowering was associated with drought survival in cocksfoot. Early flowering is a drought escape mechanism, which could facilitate a longer regrowth period, and consequently a greater allocation of assimilates to root growth between flowering time and onset of drought. Indeed, flowering phenology interacts significantly with a forage grass plant's capability to withstand drought stress, and early-flowering perennial grasses are more suited to environments with terminal abiotic stress, since they grow actively during winter and early spring (Piano *et al*. 2004).

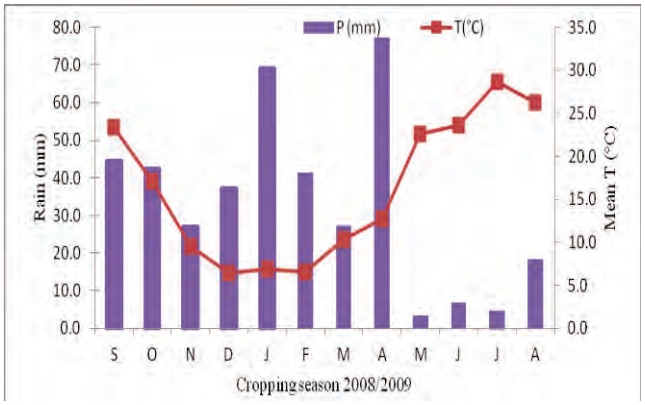

Figure 1. Monthly rainfall and average temperature recorded at the weather station of the National Office of Meteorology for 2008/09 cropping season.

Table 1. Genotypic means of the traits measured during the cropping season 2008/2009.

Species	Variety	Origin	PS1	PS2	PST	Rec1	Rec2	DEP
CocksfootNSD	Jana	ItalyX N Africa	0.3	0.6	0.9	53.9	46.5	133.7
CocksfootNSD	Medly	Mediterranean	0.2	0.6	0.9	42.1	38.4	120.0
Cocksfoot SD	Kasbah	Morroco	0.8	1.2	1.9	77.9	59.7	128.2
CocksfootNSD	Delta-1	Portugal	0.3	0.5	0.8	62.6	53.4	131.5
CocksfootNSD	Currie	Algeria	0.4	0.6	1.0	60.2	45.9	128.2
CocksfootNSD	Ottava	Italy	0.4	0.6	1.0	49.9	42.9	128.2
Tall fescueISD	Tanit	ItalyXMorroco	0.5	1.1	1.6	62.5	55.2	125.0
Tall fescue T	Sisa	Italy	0.4	1.6	2.0	43.5	42.3	125.0
Tall fescueISD	E 542	FranceXTunisia	0.4	0.7	1.1	66.5	69.8	121.0
Tall fescueISD	Centurion	ItalyXTunisia	0.6	1.2	1.9	63.4	64.6	122.5
Tall fescueISD	Flecha	Tunisia	0.7	1.3	2.0	75.1	65.4	113.5
Tall fescue T	Lutine	France	0.3	0.5	0.8	26.5	28.6	129.2
Tall fescueISD	Fraydo	Israel	0.7	1.0	1.7	57.8	40.7	119.5
	LSD	-	0.23	0.69	0.78	8.35	13.35	5.24

Autumn dry matter (PS1, t/ha), Spring dry matter (PS2, t/ha), Total dry matter (PST, t/ha), Autumn row cover (Rec1, %), Spring row cover (Rec2, %), Number of days to head (DEP, days), NSD: non summer dormant variety, SD: summer dormant variety, T: temperate, ISD: incomplete summer dormant.

Conclusion

These results show high potential for the selection of plant material adapted to the specific conditions of the semi-arid areas of the Algerian high plains, where annual rainfalls rarely exceed 400 mm/year. Varieties of tall fescue and cocksfoot, like Flecha, Fraydo and Kasbah show superior adaption. There was some evidence for better drought tolerance of earlier-heading germplasm and there is a need to increase seed supply especially of adapted cocksfoot varieties.

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