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Effect of water stress on growth and forage yield of three species of medics

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RESUME – *"Effet du stress hydrique sur le développement végétatif et le rendement fourrager chez trois espèces de medics". Le déficit hydrique et l'irrégularité des pluies constituent les facteurs essentiels limitant la production agricole dans le bassin méditerranéen. Notre étude a pour but d'apprécier chez quelques populations de* Medicago aculeata*,* Medicago orbicularis *et* Medicago truncatula *l'effet du déficit hydrique sur le développement végétatif et sur le rendement fourrager (feuilles + tiges). Pour cela, les plantes ont été soumises durant la phase végétative à deux régimes hydriques ; l'un satisfaisant les besoins en eau de la plante, l'autre étant déficitaire. A la fin de la phase végétative, les plantes ont été déterrées, ainsi la longueur du rameau qui a porté la première fleur, le nombre des ramifications primaires, le nombre des entre-nœuds et le rendement fourrager (feuilles + tiges) ont été évalué. Les résultats obtenus montrent que le déficit hydrique a causé des réductions importantes des différents organes de la plante ainsi qu'une chute du rendement fourrager (feuilles + tiges), et ceci chez les trois espèces de* Medicago *L.*

Mots-clés: Medicago aculeata, M. orbicularis, M. truncatula*, stress hydrique, développement végétatif, rendement fourrager.*

Introduction

In the world, agricultural production is strongly limited by environmental factors such as high temperature and salinity. The main of these constraints is the water availability that affects great areas of Algeria and induces an important decline of yields.

The annual medics are pastures self-reseeding legumes distributed in Algeria, and a very important source of protein for ruminant. They improve natural pastures, provide a source of forage with high quality, and confer benefits such as symbiotically fixed nitrogen, which becomes available to subsequent crops.

The objective of this study is to estimate the effect of water stress occurring during vegetative phase on growth and yield forage (leaves + stems) in some populations of *Medicago aculeata*, *M. orbicularis* and *M. truncatula*.

Materials and methods

The trial was conducted in 1996. Three medics species, *M. aculeata*, *M. orbicularis* and *M. truncatula* were used, each of this species is represented by four accessions coming from 1988 prospection conducted by INA-ITGC-INRAfr throughout all the Algerian territory, and multiplied in 1990, 1992 and 1993.

The sowing was realised in January 1996 at experimental farm of Agronomic National Institute (INA) under a glass shelter. Sowing density for all accessions was five seeds per pot. We have left only two plants per pot. Pots are arranged in the completely randomised design with 10 replications, and two treatments were applied:

NS : Representing a no stressed treatments; *SV :* Application a water stress, corresponding to 80% of soil drought rate during the vegetative phase.

At the end of vegetative phase, plants were harvested, and the following parameters were measured:

- Number of internodes (*NIN*).
- Number of primary branches (*NPB*).
- Fresh matter weight (leaves + stems) (*FMW*).
- Dry matter weight (leaves + stems) (*DMW*).

Results and discussion

The results obtained are represented in Table 1. The statistical analysis of the results showed the presence of highly significant differences in all the analysed characters between accessions for three species. In general, for both treatments (stressed and not stressed), *M. orbicularis*, that the later specie, had presented an important development and a higher fresh and dry matter yields than for *M. aculeata* and *M. truncatula*.

Table 1. Effect of water stress on number of internodes, number of primary branches and fresh and dry matter yield

Characters	Treatments	*M. aculeata*			*M. orbicularis*			*M. truncatula*		
		Mean	R.R	Test F.	Mean	R.R	Test F.	Mean	R.R	Test F.
NIN	NS	8.60		4.47	11.25		348.5	10.02		139.7
	SV	5.90	31.4	*	9.07	19.4	***	8.32	17.0	***
NPB	NS	9.80		15.87	11.68		151.9	10.98		34.30
	SV	6.43	31.4	***	8.93	23.6	***	7.75	29.4	***
FMW	NS	14.56		75.70	28.98		149.5	27.63		192.0
	SV	5.81	60.1	***	15.05	48.1	***	12.24	55.7	***
DMW	NS	2.46		77.78	5.31		131.0	4.30		94.78
	SV	1.20	51.2	***	2.70	49.1	***	2.24	47.9	***

NS: No stressed; SV: Stressed during vegetative phase; R.R: Reduction rate (%);
*: Significant; **: High significant; ***: very high significant.

We have noted, that the deficit shortage has caused a significant reduction of different plants organs. Similar results were obtained by Carter and Sheaffer (1983 a,b) and by Hall (1993) in *M. sativa* in case of water deficit. According to Vidal *et al*. (1981) have noted, that the water availability induces an important diminution of vegetative growth. Number of primary branches in all accessions of three species studied declines significantly under the influence of water deficiency. *M. orbicularis* has presented the weakest reduction rate (23.6%). For *M. aculeata* and *M. truncatula*, the reduction rate was respectively 29.4% and 34.4%. Gallegos and Shibata (1989) and Oussalem (1998) reported that the number of branches is significantly affected in case of water deficit in *Phaseolus vulgaris*, compared with control treatment. The number of internodes is too affected by water stress, which induces a slowing in the development of branches. The reduction is 17.0% for *M. truncatula*, 16.4% for *M. orbicularis* and 31.4% for *M. aculeata*, compared with stressed treatments. According to Brown and Taner (1983), when leaves expansion is reduced by water deficit, elongation of all internodes is also reduced in *M. sativa*. Gosse *et al*. (1982) and Hall (1993) report that the stressed plants are presented smaller stems than not stressed plants in *M. sativa*.

Forage yield (leaves + stems) decreased significantly in case of water shortage. We have noted an important reduction in vegetative biomass of 48.0% for *M. orbicularis*, 55.7% for *M. truncatula* and 60.1% for *M. aculeata*, and in dry matter yield of 47.9% for *M. truncatula*, 49.15% for *M. orbicularis* and 51.2% for *M. aculeata*. According to Duran *et al.* (1989), the effect of water stress on morphogenesis of aerial parts explains the difference of production of aerial biomass, ranging between 80 and 100%. In *M. sativa*, dry matter production is the most sensitive parameter to water rationing, a reduction of water supply from flowering phase leads to a decline of seed production and dry matter of 50% (Vidal and Pagnonec, 1985).

Conclusions

According to the results, we can conclude that the water stress occurring during vegetative phase

has caused a significant diminution of plant organs and of fresh and dry matter yield in the three species.

For both treatments (stressed and not stressed), *M. orbicularis*, that the latter specie, has presented a more important vegetative biomass than *M. aculeata* and *M. truncatula*. Whereas the higher reduction rate was obtained by *M. aculeata* for all characteristics studied.

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