Forage production of the drought tolerant Mediterranean forage legume tedera (Bituminaria bituminosa var. albomarginata) in the mediumrainfall zone of south Western Australia as affected by plant density and cutting frequency

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in

Acar Z. (ed.), López-Francos A. (ed.), Porqueddu C. (ed.).
New approaches for grassland research in a context of climate and socio-economic changes

Zaragoza : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 102

2012
pages 387-390

Forage production of the drought tolerant Mediterranean forage legume tedera (*Bituminaria bituminosa* var. *albomarginata*) in the medium-rainfall zone of south Western Australia as affected by plant density and cutting frequency

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Abstract. The Mediterranean perennial forage legume tedera (*B. bituminosa* var. *albomarginata*) remains green all-year-round, reducing the summer/autumn feed gap, providing high quality forage when most other pasture options have senesced. At Mount Barker Research Station in south Western Australia (annual rainfall 2010/11 of 445 mm), the forage production of two tedera accessions (T1 and T6) was studied under densities of 1, 2, 4, 8 and 16 plants m^{-2} and cutting frequencies of 1, 2, 3 and 4 times yr^{-1}. The experimental design was a split-split-plot with 4 replicates. The first two years of the experiment were kept weed-free and results are presented for the second year. The density and cutting frequency were the only highly significant effects. Densities of both 8 and 16 plants m^{-2} provided the greatest forage yield of 5.8 tonnes DM $year^{-1}$, while densities of 1, 2 and 4 plants m^{-2} produced 2.1, 2.4 and 4.5 tonnes DM $year^{-1}$ respectively. The cutting frequency of 1 yielded best with 5.8 tonnes DM $year^{-1}$ followed by 2, 3 and 4 cuttings with annual productions of 4.1, 3.7 and 2.8 tonnes DM respectively. In this environment, forage produced using densities of 8 to 16 plants m^{-2} can be accumulated and used at strategic times of the year to reduce the costs associated with supplementary feeding.

Keywords. *Bituminaria* – Tedera – Cutting frequency – Plant density.

Production de fourrage d'herbe au bitume (*Bituminaria bituminosa var. albomarginata*), légumineuse vivace méditerranéenne résistante à la sécheresse, dans la zone à précipitations moyennes d'Australie Occidentale, en fonction des facteurs de densité et de coupe

Résumé. *L'herbe au bitume (*Bituminaria bituminosa var. albomarginata*), légumineuse méditerranéenne vivace, reste verte toute l'année, assurant la transition entre les fourrages d'été et d'automne, et fournissant un fourrage de très bonne qualité, une fois épuisées la plupart des autres plantes fourragères. A la station de recherche de Mount Barker au sud de l'Australie Occidentale (pluviométrie annuelle pour 2010/11: 445 mm) la production de fourrage de deux obtentions d'herbe au bitume (T1 et T6) a été étudiée avec des densités de 1, 2, 4, 8 et 16 plantes au m^2 et des fréquences de récolte de 1, 2, 3 et 4 fois par an. Le modèle expérimental était un plan à sous-sous parcelles partagées (split-split-plots) avec 4 réitérations. Les parcelles ont été désherbées pendant les deux premières années de l'expérience et les résultats sont présentés pour la deuxième année. La densité et la fréquence de coupe étaient les deux seuls facteurs significatifs. Les densités de 8 et 16 plantes au m^2 ont produit le plus fort rendement de fourrage avec 5,8 tonnes MS par an, tandis que les densités de 1, 2, et 4 plantes par m^2 ont produit respectivement 2,2, 2,4 et 4,5 tonnes MS par an. La fréquence d'une récolte par an a été la meilleure, avec 5,8 tonnes MS annuelles, suivie de 2, 3 et 4 récoltes annuelles donnant des productions de 4,1, 3,7 et 2,8 tonnes MS par an respectivement. Dans cet environnement, le fourrage produit avec des densités de 8 ou 16 plantes par m^2 peut être gardé en réserve et utilisé à des moments stratégiques au cours de l'année, pour réduire les coûts de fourrage supplémentaire.*

Mots-clés. Bituminaria – *Tedera – Fréquences de récolte – Densités.*

I – Introduction

After a worldwide search for perennial forage legumes adapted to Mediterranean environments typical of much of southern Australia, Real and Verbyla (2010) and Real *et al.* (2011) concluded that the outstanding candidates were tedera plants (*Bituminaria bituminosa* var. *albomarginata* and var. *crassiuscula*). *Bituminaria bituminosa* (L.) C.H. Stirton is widely distributed in the Mediterranean Basin and Macaronesia. A large diversity exists in the Canary Islands in habitats ranging from the coastal semi-arid areas (annual rainfall 150-300 mm; var. *albomarginata*) to the high elevation sub-humid zones [up to 500 mm annual rainfall; var. *crassiuscula*; (Méndez *et al.* 2006)]. For centuries in these regions, tedera has been one of the preferred choices by farmers for feeding dairy goats (Méndez and Fernández 1990; Real *et al.* 2009).

In Australia, the potential value of tedera for livestock production has been confirmed in preliminary agronomic and animal house studies. In south Western Australia, we studied thousands of single-spaced plants established from seedlings, rows established by seeds, and plants in small plot trials in three low rainfall sites (approx. 350mm) established in 2006. Most survived, even those sown in drought years, grew significant biomass and remained green and leafy year-round – most importantly, during summer and autumn with minimal leaf shedding since 2006 despite regular and severe defoliation by grazing or cutting. This remarkable year round growth and retention of green feed has previously only been seen in a few shrubs and can provide a strategic fodder supply over the traditional summer/ autumn dry period, a major advantage over lucerne (Real *et al.* 2008; Real and Verbyla 2010). Preliminary results of a PhD student at the University of Western Australia confirmed that tedera is able to tolerate drought conditions by applying several physiological and morphological mechanisms. These mechanisms allow high water use efficiency in comparison with lucerne which has a deep root system and sheds its leaves to cope with drought. Tedera has proven to be a very drought tolerant plant even in pot trials where access to stored moisture is not possible.

The objective of this study was to evaluate the dry matter production of tedera accessions at five plant densities and four cutting frequencies in a Mediterranean medium rainfall zone.

II – Materials and methods

1. Site description

The experiment was conducted at the Department of Agriculture and Food, Western Australia (DAFWA) Research Station at Mount Barker, Western Australia, Australia (Lat. -34.627735; Long. 117.550880). The soil is a coarse loam with $pH_{(CaCl2)}$ = 4.4 on the surface and $pH_{(CaCl2)}$ = 5.4 from 10 cm to 20cm deep. The annual rainfall is winter dominant with a 100 year average of 733.2 mm. Summers are hot and autumn and winters mild with no below zero temperatures.

2. Field design, site preparation, plant material and management

The trial consisted of a split-split-plot design with 4 replicates. Two accessions of *B. bituminosa* var. *albomarginata* (T1, T6) were used. Accessions were assigned to main plot, density (1, 2, 4, 8 and 16 plants m^{-2}) and cutting frequency (1, 2, 3 and 4 cuts yr^{-1}) were considered as split-plot and split-split-plot respectively. Each experimental unit was 1 m^2. Inoculated 6-week old seedlings were transplanted at a uniform spacing within each split-split-plot on 17th June 2009. Once plants were established, they were cut to 2-4 cm from the ground in November 2009, January 2010, April 2010, August 2010, November 2010, January 2011, April 2011 and/or August 2011 depending on the cutting frequency treatment allocation. The experiment was kept weed free during the experimental period. For the densities of 8 and 16 plants m^{-2} only the four central plants of each plot were cut, dried and weighed. Remaining plants were cut and discarded. For the densities of 1, 2 and 4 plants m^{-2}, where it was assumed that competition

among plants within a plot would be negligible; all plants within a plot were cut, dried and weighed. All samples were dried at 60 °C for 4 days and DM is expressed on a per plot (1 m^2) basis.

3. Statistical analyses

Dry Matter weight was analysed using Genstat 14th Edition (2011). The design was a split-split-plot design considering accession, density and cutting frequency as the main-plot factor, split-plot factor and split-split-plot factor, respectively. ANOVA was conducted to study the significance of all effects and their interactions and LSD were used at a 5% significance to compare means of significant effects.

III – Results and discussion

Results are presented only for the second year of the experiment from August 2010 to August 2011. The density and cutting frequency were the only highly significant effects with accessions T1 and T6 having overall non-significantly different means of 4102 and 4108 kg DM ha^{-1} respectively. The mean annual yield for each cutting regime and the five plant densities is presented in Fig. 1.

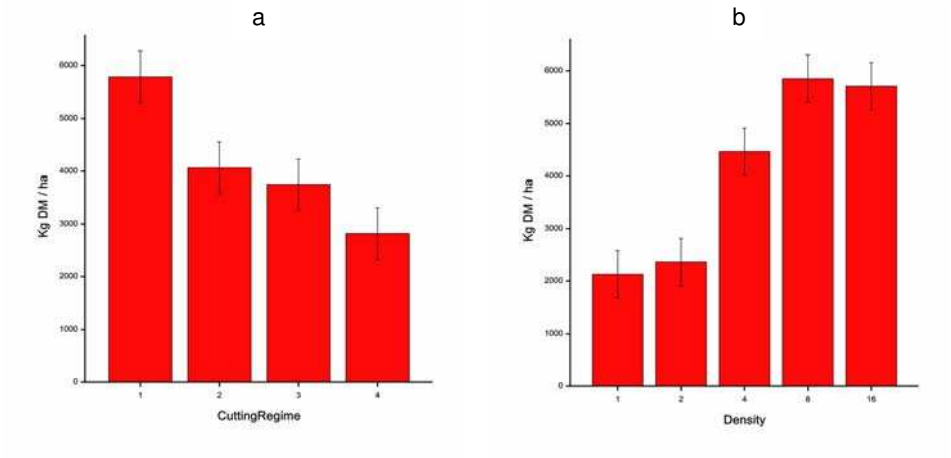

Fig. 1. Mean annual yield for four cutting regimes (a) and five plant densities (b).

Densities of both 8 and 16 plants m^{-2} provided the greatest forage yield of 5.8 tonnes DM $year^{-1}$, while densities of 1, 2 and 4 plants m^{-2} produced 2.1, 2.4 and 4.5 tonnes DM $year^{-1}$ respectively. The cutting frequency of 1 yielded best with 5.8 tonnes DM $year^{-1}$ followed by 2, 3 and 4 with annual productions of 4.1, 3.7 and 2.8 respectively. In this environment using densities of 8 to 16 plants m^{-2} tedera forage can be accumulated and used at strategic times of the year when other forages may be limiting. Similar results were obtained by Suriyagoda et al. (2012a, b) using a similar field design with the same two tedera accessions in three low rainfall sites in Western Australia evaluated from 2008 to 2010. Again plant densities of 8 to 16 proved the most productive however in these drier environments, three cuttings per year were concluded to be the optimum to have a good balance of production with forage quality. More cutting times per year resulted in leafier vegetative growth and better nutritional quality when compared with those cut less often.

IV – Conclusions

Forage production of *B. bituminosa* var. *albomarginata* was determined by plant density and cutting frequency. Plant densities of 8 to 16 plants / m^2 maximise productivity, while a reduced number of cuttings per year maximize production.

Acknowledgments

This study was supported by Future Farm Industries Cooperative Research Centre. The authors would like to thank Mount Barker research station manager, Mr. Ross Ramm for his valuable support in the project.

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