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# Quality and dry matter yield of triticale forage in winter and late-spring in Southwestern Spain

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**Abstract.** Special soil and climate conditions of the *dehesa* ecosystem in the south west of Spain have an influence in herbaceous biomass production, causing moments with a lack of feed for extensive livestock along the year. In this paper the possibility to introduce triticale crop for a double use (by grazing or cutting in winter and cut at late spring) to cover winter and summer deficiencies in animal feed, has been studied. Triticale varieties were, var. Fronteira, var. Alter and two experimental cultivars from the Portuguese National Agricultural Research Institute, called INIA 1 and INIA 2. As control, a variety of Italian ryegrass, was used. The experiment was carried out in a *dehesa* in the SW of Spain during three years (2008-09, 2009-10 and 2010-11). On average some triticale cultivar (INIA 1 and INIA 2) biomass yields were similar to the reference treatment one, giving rye-grass the lowest biomass in dry years. Alter and INIA 2 did not show decrease in DM yield when a cut in winter was applied but show an increment in quality (high CP content and low NDF).

**Keywords.** Extensive pastures – Livestock – Dehesa – Silvopastoral.

## **Rendement en matière sèche et évaluation de la qualité à différents stades de croissance du fourrage de triticale dans le sud-ouest de la Péninsule Ibérique**

**Résumé.** Les conditions climatiques et édaphiques de l'écosystème de *dehesa* dans le sud ouest de l'Espagne ont une influence dans la production de biomasse herbacée, causant des moments de l'année avec un manque d'aliments pour l'élevage extensif. Dans ce travail la possibilité d'introduire de la culture de triticale pour une double utilisation (par le pâturage ou la coupe en hiver et coupés à la fin du printemps) afin de couvrir les carences d'hiver et d'été dans l'alimentation animale, a été étudié. Les variétés de triticale ont été, var. Fronteira, var. Alter et deux cultivars expérimentaux du National Agricultural Research Institute de Portugal, appelés INIA 1 et INIA 2. Comme traitement de référence, une variété de ray-grass italien, a été utilisé. L'expérience a été réalisée dans une *dehesa* dans le sud-ouest de l'Espagne pendant trois ans (2008-09, 2009-10 et 2010-11). En moyenne, certains rendements en biomasse de cultivars de triticale (INIA 1 et INIA 2) étaient similaires au traitement de référence; le ray-grass donne le plus bas rendement en biomasse dans les années sèches. Alter et INIA 2 ne montrent une baisse de rendement en MS quand un coupé en hiver a été appliqué, mais montrent une augmentation de la qualité (plus de contenu en protéines et faible en fibres).

**Mots-clés.** Pâturages extensives – Élevage – Dehesa – Sylvopastoral.

## **I – Introduction**

Shallow soils and erratic climatic conditions are the *dehesa* main characteristics, that make herbaceous pastures not to be enough to feed animal livestock in these areas, specially in winter and summer time (Pérez, 2005). The intra- and inter-annual irregularity involves the necessity of a good management of the *dehesa* by farmers, in order to avoid the disappearance of these kind of farms (Olea, 2011). All this demands the introduction of forage crops to use the biomass, either by grazing or by cutting and preserving. Commonly, to supplement summer necessities,

forage crops as triticale are used (Delogu *et al.*, 2002). In this paper the possibility to cut or graze triticale in winter and cut and conserve it at the end of the spring is studied, regarding the forage quantity and quality.

## II – Material and methods

The experiment was carried out in the 2008-09, 2009-10 and 2010-11 agricultural seasons, in a *dehesa* of the south west of Spain, with Mediterranean semiarid climate (Fig. 1). Each elemental plot ( $18 \text{ m}^2 = 3 \text{ m} \times 6 \text{ m}$ ) was divided in 2 for the different treatment (cut in spring at grain milky stage and cut in winter before tillering, simulating grazing plus cut the regrowth in spring) and had 4 replications, with acid soils (pH 5.4) and middle organic matter (2.4%) content. The 4 triticale cultivars were; Fronteira, Alter and 2 cultivars still in study by the Portuguese National Agricultural Research Institute which were called INIA 1 and INIA 2, sown at  $150 \text{ kg ha}^{-1}$  rate. The control was *Lolium multiflorum* westerworld type (cv. Tetrawest) and was sown at  $30 \text{ kg ha}^{-1}$  rate.

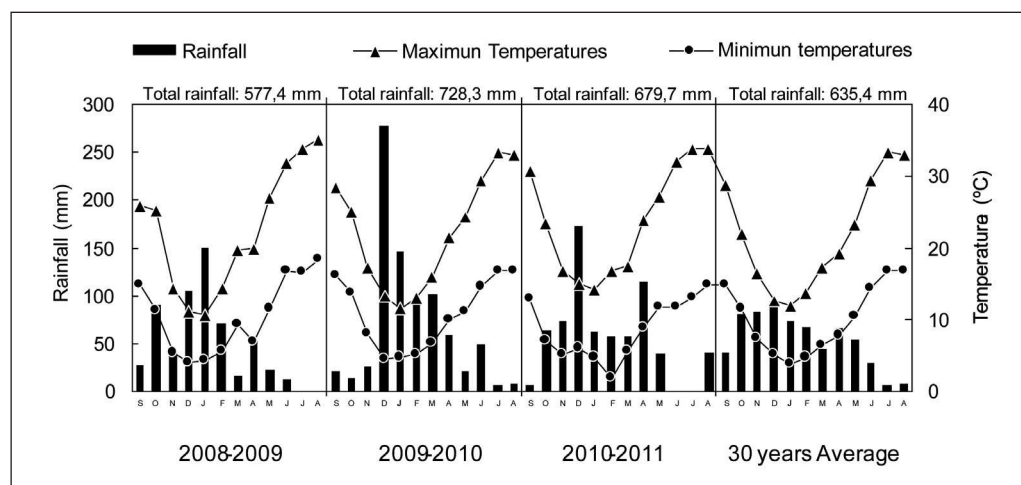


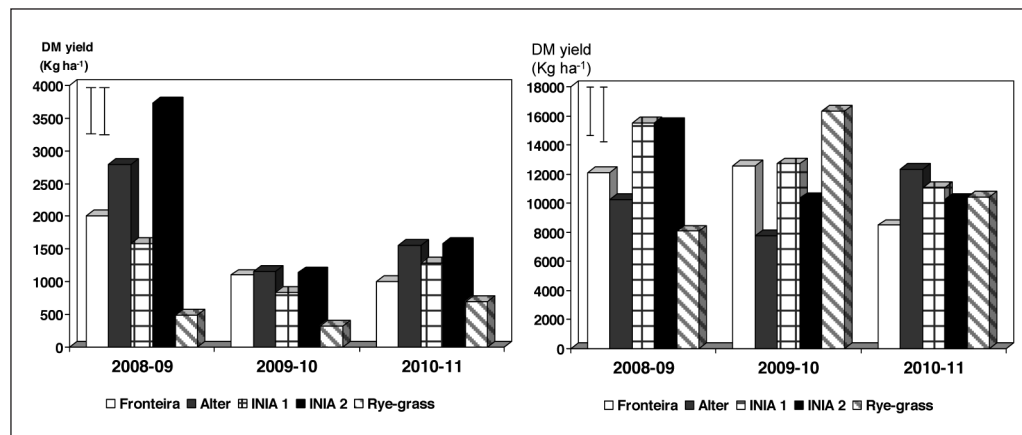
Fig. 1. Annual and monthly rainfall and temperature (monthly mean of maximum and minimum) in 2008-09, 2009-10 and 2010-2011 years and 30 years average in the experiment location.

Nitrogen fertilization was applied part in sowing moment and part after winter cut ( $37 + 9 \text{ kg N ha}^{-1}$ ). Dry matter yield (DM), crude protein (CP), organic matter digestibility (OMD) and neuter detergent fibre (NDF) were determined on the collected samples following the official methods. Data results from the samples were subjected to variance analysis to determine the different treatment effect on the forage parameters, using Fisher test of least significant difference (LSD) at  $P \leq 0.05$ , for the treatment averages.

## III – Results and discussion

DM yield, CP, OMD and NDF were studied in winter and late spring cuts, having in the second date two possibilities; with or without winter cut (**b** and **a** cut respectively). In case of DM yield “with winter cut”, winter DM was added to spring DM yield. No significant differences were found for CP, OMD or NDF in *year x cultivar* interaction in winter, but in DM yield. Figure 2 (right) shows

higher DM yield in 2008-09 year than in 2009-10 and 2010-11 (with no significant differences between them), and how every triticale cultivar provide higher DM yield than rye-grass. INIA 2 and Alter triticales were the best cultivars regarding DM biomass in winter each year. Winter CP content ranges between 18.1 and 20.3 % with no significant differences between cultivars, either having no signification the year (16.7 – 20.5 %) (Table 1). Winter NDF (Table 1) were higher in 2008-09 (39.7%) and 2009-10 (40.9%) years than in 2010-11 (38.8%). Regarding the cultivars, Alter and INIA 2 had the higher NDF content (42.7– 41.8 %) and rye-grass the lower (34.1%). Rye-grass and triticale INIA 1 showed higher OMD (84.3 and 82.5 % respectively) than the rest of triticales, having INIA 2 and Alter the lowest OMD values (79.8 and 79.4 % respectively).



**Fig. 2. Winter DM yield (RIGHT) (kg ha<sup>-1</sup>) in year  $\times$  cultivar interaction. Vertical bars show difference for the same level of year (left) and different level of year (right) and average of the spring DM yield (LEFT) (kg ha<sup>-1</sup>) in year  $\times$  cultivar interaction. Vertical bars show difference for the same level of year (left) and different level of year (right).**

In winter, year had an important influence in DM yield; in spring DM yield had no significance, either with one or two cuts. However, significance appears when an interaction with cultivar is studied. Regarding the number of cuts, applying only one cut in late spring provides, on average, a significant higher DM yield (13,076 kg ha<sup>-1</sup>) than adding winter and spring biomass (10,081 kg ha<sup>-1</sup>). In Fig. 2 (left) it is possible to observe that INIA 1 and INIA 2 are always, even it rains a lot or not, between the cultivars with higher DM yield, while rye-grass and Alter have an important dependence of the rain; the more rain the higher DM yield in rye-grass and opposite in Alter. Similar DM yields (12,900 – 16,300 kg ha<sup>-1</sup>) were referred by Delogu *et al.* (2002) for similar climate conditions. It is concluded that the more rainfall the better is the production (Peltonen-Sainio and Järvinene, 1995), but authors as Cossani *et al.* (2009) affirm that is the distribution of the rainfall the one that influences the final DM yield. That could explain the lower DM yield in some cultivars in wet years (2009-10 and 2010-11) with reference to dry year (2008-09) due to a ponding in the soil of the experiment.

Table 1 shows the differences in CP and NDF regarding the significant interaction cultivar  $\times$  number of cuts. Study provides that means in CP are higher in 2008-09 than in other years, as well as in forage with two cuts facing one and being INIA 1 one of the cultivars with the lowest CP content. No differences were found between cuts regarding NDF content, but between years, having the lowest value of NDF, 2008-09 year. Fronteira and rye-grass showed higher NDF con-

**Table 1. CP (%) and NDF (%) for one and two cuts in the four triticale cultivar and the rye-grass studied. Different letters show a significant difference**

Cultivar	Cuts	CP (%)	NDF (%)
Fronteira	1 cut	10.17 abc	56.41 ab
	2 cuts	10.61 ab	56.78 a
Alter	1 cut	8.94 cde	52.90 cd
	2 cuts	11.26 a	52.38 cd
INIA 1	1 cut	8.24 e	53.38 cd
	2 cuts	8.23 e	56.66 ab
INIA 2	1 cut	8.76 de	54.46 bc
	2 cuts	10.06 abc	52.27 d
Rye-grass	1 cut	9.40 bcde	56.88 a
	2 cuts	9.77 bcd	56.97 a

tent than the rest of triticales. CP decreases in the course of plant life, according to Rojas *et al.* (2004) due to the organs differentiation (leaves, stem and spike). Carrasco López *et al.* (1999) obtained CP values near to 20% in winter time, while Lithourgidis *et al.* (2006) obtained lower CP content, due probably to the low rate of N fertilization used in that experiment (8 kg N ha<sup>-1</sup>). OMD results (data not shown) had a high significant negative correlation with NDF ( $r = 0,90^{***}$ ); that it is to say that the higher fibre content the lower digestibility the forage has. Fibre results from this study are higher to the ones indicate by Maças (1999) (in early growth stages), but similar to the ones referred by Assefa and Ledin (2001), Delogu *et al.* (2002) and Francia *et al.* (2006). All this is not in agreement with Sinclair and Senligman (1995), who explained that the lower was the rainfall in growth stages, the faster rises the leaf/stem ratio, increasing the lignification process therefore, the amount of fibre in the forage. Anyway again the ponding conditions in wet years could explain the low quality in biomass. Nousiainen *et al.* (2003) and Kozloski *et al.* (2005) found the same correlation between NDF and OMD, and this is widely used to predict forage quality.

## IV – Conclusions

Regarding the DM yield in winter, INIA 2 and Alter showed the highest values. These two triticales did not suffer a decrease in DM yield in spring facing not applying a cut in winter but the quality of their forages was better than the rest, presenting higher CP content and lower NDF than the other triticales when a cut in winter was applied. So in conclusion using INIA 2 and Alter grazed in winter and cut in late spring is the best option to cover feed deficiencies in *dehesa* farms.

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