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Annual ryegrass yields under supplemental irrigation

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SUMMARY – A two-year field trial was conducted to evaluate the effect of supplemental irrigation on increasing and stabilizing yield and quality of forage produced by annual ryegrass in southern Portugal. The following four irrigation treatments were tested: rainfed (control), and irrigation up to 25%, 50% and 100% of soil water holding capacity. In both years, the importance of irrigation was evident in order to increase and stabilize forage production because even with the lowest amount of water application it was possible to at least double the number of harvests. Also the best response was reached for the 100% treatment. The beneficial effect of increasing water application was more noticeable in the second year. Crude protein and digestible dry matter yields showed similar responses to dry matter yield, except in the first year for crude protein yield, whose values were not significantly different between the three irrigation treatments.

Keywords: Productivity, nutritive value, annual ryegrass.

RESUME *– "Rendements annuels du ray-grass avec irrigation d'appoint". Une expérience a été conduite, pendant deux ans, pour évaluer l'effet d'une irrigation additionnelle pour augmenter et stabiliser la production et la qualité du fourrage produit par le ray-gras d'Italie au sud du Portugal. On a testé les traitements suivants: sans arrosage (témoin), et arrosage de 25%, 50% et 100% de la capacité de captation d'eau du terrain. Pendant les deux années, il a été mis en évidence l'importance de l'irrigation pour augmenter et stabiliser la production fourragère parce qu'avec la plus petite irrigation appliquée, on a doublé le nombre de coupes. La meilleure réponse a été atteinte avec l'irrigation de 100%. À la seconde année on a vu un effet bénéfique plus notable avec les augmentations d'eau appliquées. Pour les productions de protéine brute et de matière sèche digestible on a obtenu des réponses similaires à celles de la production de matière sèche, excepté pour la production de protéine brute lors de la première année, avec des valeurs qui n'ont pas montré de différences significatives pour les trois traitements d'irrigation.*

Mots-clés : *Productivité, valeur nutritive, ray-grass d'Italie.*

Introdution

In southern Portugal, annual ryegrass (*Lolium multiflorum* Lam.) yield is strongly affected by soil water availability in early autumn and especially late spring. This species is usually cultivated under rainfed conditions allowing usually for two harvests. Lourenço and Palma (2001) reported total dry matter yield values ranging from 5274 to 6790 kg ha^{-1}. In another work, the same authors (2005) presented also values, but lower than 3500 kg ha^{-1}. This shows the great variability of forage production of the region depending mostly on total amount and rainfall distribution along the year. Supplemental irrigation can increase and stabilize yields, but since water is becoming an expensive and scarce resource, it is important to investigate the response of this species to irrigation.

Material and methods

The experiment was conducted in 2003/04 and 2004/05. The first year, in spite of October being very rainy, was a dry year since the amount of rainfall (433 mm) was lower than the normal (634 mm), just like in 2004/05 (428 mm). On the other hand, in the first year the temperatures were higher than the normal except in October, but in the second, the temperatures only became higher than average after March. The field trials were set up in a luvissol of the Experimental Center of Currais, located near Évora (14 km), with 82 mg kg^{-1} of P_2O_5, 62 mg kg^{-1} of K_2O, and pH (H_2O) of 5.78 in 2003, and 120 mg kg^{-1} of P_2O_5, 96 mg kg^{-1} of K_2O, and pH (H_2O) of 6.25 in 2004. The following four irrigation

treatments were tested: rainfed (control), and irrigation up to 25%, 50% and 100% of soil water holding capacity. The seeded area of 8100 m^2 was divided into four areas, one for each treatment. A sprinkler irrigation system was used with two lines for each of the three irrigation treatments. A profile probe PR1/4 was used to monitor soil water content at different depths (10, 20, 30, and 40 cm). The values measured, usually twice a week, were used to adjust the irrigation requirements, estimated by the Cropwat model (FAO, 1992) using meteorological data and the Penman-Monteith equation (Allen *et al*., 1994), in order to maintain the soil water content at each desired irrigation treatment level. Planting dates were on October 8, 2003, and November 27, 2004, using the Pollanum variety and seeding at the rate of 750 alive seeds m^{-2} (38 kg ha^{-1}). In the first year harvest dates were March 8, May 11, June 15, and July 13 and, in the second, were December 16, March 14, April 13, May 25 and July 6. Eight randomised samples, of 1 m^2 each, were harvested in each irrigation treatment to evaluate forage production. After harvests, 50 kg ha^{-1} of nitrogen were applied.

Dry matter yield was determined after oven drying at 65ºC during 48 to 72 hours. Crude protein was analyzed by the Kjeldhal standard procedure (AOAC, 1975), and in vitro dry matter digestibility by the Tilley and Terry technique (Tilley and Terry, 1963).

Results and discussion

Irrigation treatments always supplied much higher yields (Fig. 1), and at least doubled the number of harvests as compared to rainfed treatment, allowing for a higher and more regular forage distribution along the year.

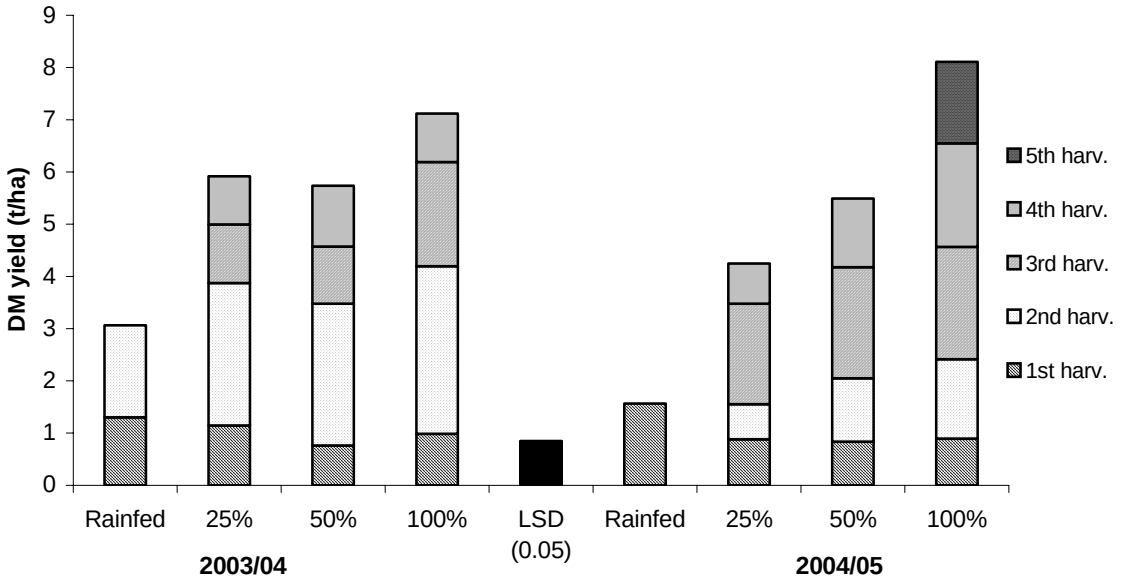

Fig. 1. Dry matter yield by irrigation treatment and year.

In the first year there were no significant differences between the 25 and 50% irrigation treatments while in the second, dry matter yield increased significantly for all the treatments. In both years, the 100% watering conducted to the best results but the costs and amount of water available might be constraints to use this treatment in the future.

With respect to protein yield the advantage of irrigation seemed to be even greater since the values (Fig. 2) were more than 50% higher as compared to the results for rainfed conditions, both years.

The greater response to water application for this variable was found in the second year because there were significant increases for all the treatments.

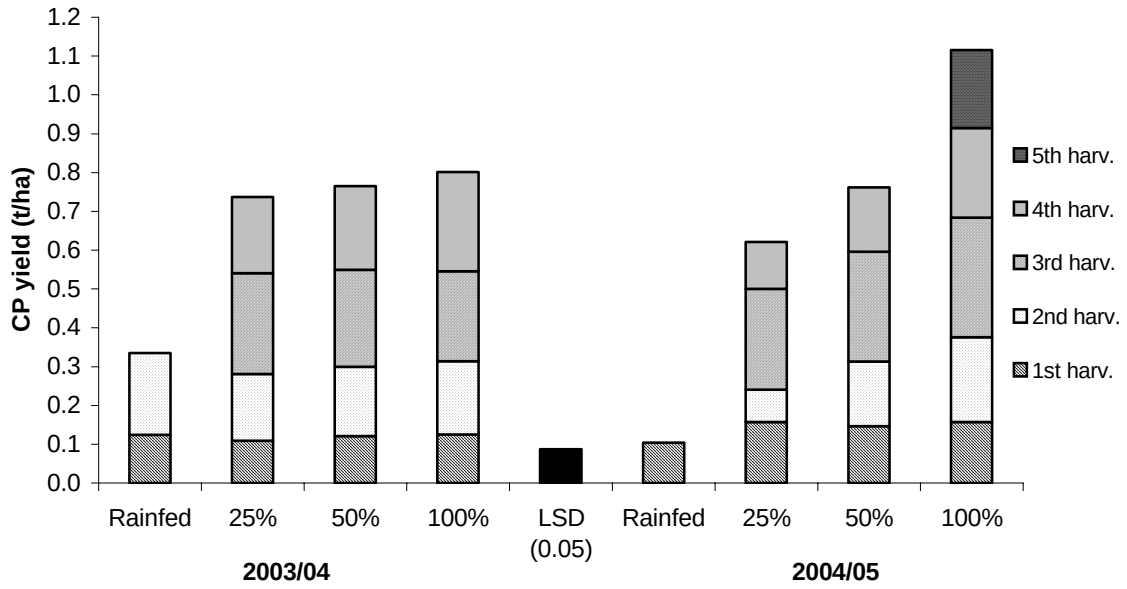

Fig. 2. Crude protein yield by irrigation treatment and year.

The results for dry matter digestibility yields (Fig. 3) also indicated that even the lowest irrigation treatment was much better than the rainfed one.

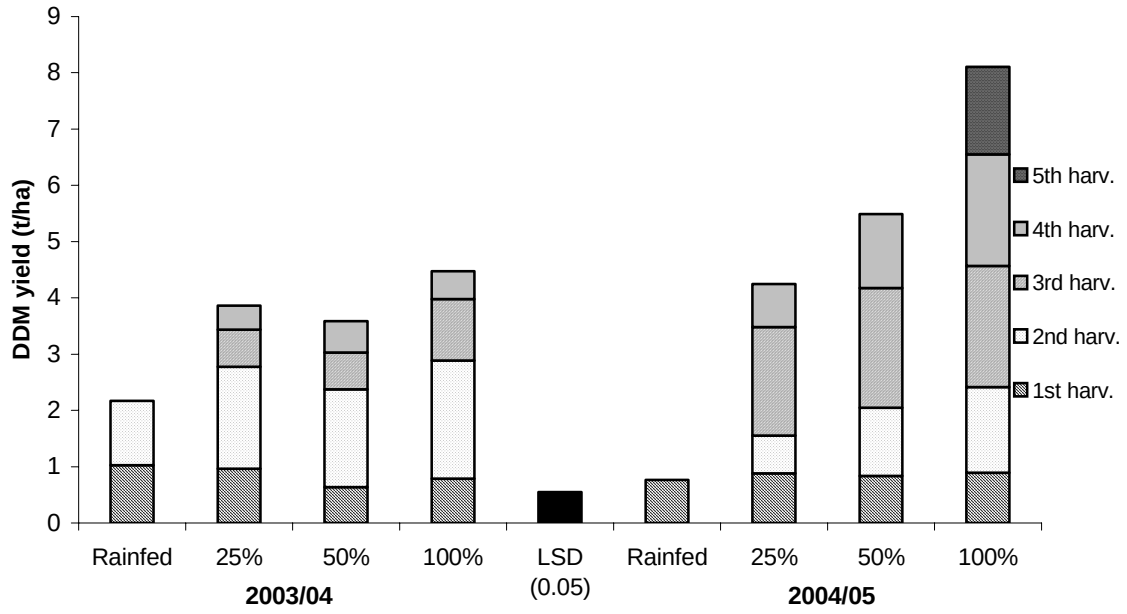

Fig. 3. Digestible dry matter yield by treatment and year.

The values for the different irrigation treatments showed a similar trend to dry matter yield results.

Conclusions

As a general conclusion, it can be stated that in years drier than the normal, such as 2003/04 and 2004/05, even a small amount of water can make a big difference in stabilizing the curve of forage

production along the year, doubling the number of harvests as in the first year or more than doubling as in the second. The maximum value was reached for the 100% treatment both years. The beneficial effect on dry matter yield by increasing the amount of water application was more evident in the second year.

With respect to crude protein and digestible dry matter yields, the differences between the control and the irrigation treatments were also noticeable. Between the irrigation treatments there were no significant differences only for crude protein yield in the first year.

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