The Effect of Plant Population on the Yield and Quality of Annual Rye-Grass

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THE EFFECT OF PLANT POPULATION ON THE YIELD AND QUALITY OF ANNUAL RYE-GRASS

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Abstract

The primary objectives of this study were to evaluate the effect of three plant population levels (350, 750 and 1150 plants m^{-2}) on dry matter yield and forage quality (crude protein and dry matter digestibility) of four rye-grass genotypes (Barspectra, Billion, Clipper and Pollanum) used in two harvests (March and May).

The results for dry matter yield means by year, genotype, and harvest were always higher in the second harvest than in the first, and the highest total mean value was reached in the first year (5853 Kg ha^{-1}). The genotype Billion was the most stable over years. Concerning to plant population there was a trend for the highest level to conduct to the best results only in the first year, for most of the genotypes.

Protein concentration was greater in the first harvest (206 g kg^{-1}) than in the second (124 g kg^{-1}). It was also found that the best value was reached at the lowest plant population level and that Billion genotype showed the lowest content, 161 g kg^{-1}, but not very much different from the others.

For *dry* matter digestibility the highest values were found in the second year (740 g kg^{-1}) and in the first harvest (854 g kg^{-1}). The genotype Clipper presented the greatest value (740 g kg^{-1}) and so did the intermediate level of plant population.

As a general conclusion it can be stated that, for practical purposes, the intermediate population level (750 pl m^{-2}), especially in dry years, and the genotype Billion should be recommended.

Keywords: rye-grass, plant population, genotypes, forage quality

Introduction

Pasture production in mediterranean ecosystems is very irregular since the amount and distribution of rainfall determines to a great extent the availability of feedstuffs which is incompatible with slighter fluctuations on nutritional needs of livestock's along the year. This way, forage production to conserve as hay or silage plays a big role in solving the problem.

In the southern region of Portugal, mixtures of small grains with vetch (*Vicea* sp) or yellow lupin (*Lupinus luteus* L.) are the traditional forage crops. Although, lately, some farmers started to use annual rye-grass (*Lolium multiflorum* Lam.) for that purpose. Since the seed is quite expensive and the species has a very high tillering capacity, the objectives of this study were to evaluate the influence of the plant population levels on dry matter yield and forage quality, of different rye-grass genotypes, in order to access for the possibility of reducing the costs with the purchase of certified seed.

Material and Methods

The experiment was conducted for two years, 1997/98 and 1998/99 that were a humid (852 mm) and a dry (370 mm) year respectively as compared to the values for a period of thirty years (1941/70). These rainfall values were unevenly distributed and affected drastically the number of harvests, date of cutting and consequently dry matter yield.

The field trial was set up on a Luvissol of the "Revilheira" Farm, near "Reguengos de Monsaraz", in the southern region of Portugal (Alentejo), both years, in order to evaluate the

effect of three plant population, 350, 750 and 1150 plants m^{-2}, on the yield and quality of four rye-grass genotypes (Barspectra, Billion, Clipper and Pollanum). Soil analysis showed the following values: 20 and 16 mg kg^{-1} of available phosphorus, 86 and 104 mg kg^{-1} of available potassium, and pH (H_2O) values of 5,7 and 5,6 respectively in 1997 and 1998.

The experimental design was a split plot with genotypes as whole units and plant populations as subunits. The area of the plots was 8.4 m^2 (7m x 1.2m) with six rows 20 cm apart. Along with soil preparation nitrogen and phosphorus were applied at the rates of 50 and 127 Kg ha^{-1} respectively. Planting dates were October 25 in 1997 and October 1 in 1998, and a small plot seeder (Wintersteiger) was used.

The first harvest was made at the vegetative stage and the second at the flowering stage. The harvesting dates were February 25 and May 18 in 1997/98 and March 20 and May 27 in 1998/99.

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

The results for the analysis of variance of dry matter yield showed a highly significant interaction between genotype, plant population, harvest and year.

The means for dry matter yield, presented in table 1, show that the mean total values were higher in the first year, 5853 Kg ha^{-1}, than in the second, 5040 Kg ha^{-1}. Also, the second harvest conducted to better results than the first both years due to better environmental conditions for growth and development especially related with more favorable temperatures. These values were similar to what Crovetto (1996) found and slightly lower than the results obtained by Lopes (1992). With respect to the genotypes, Billion was among the best two

both years. Concerning plant population the level of 1150 plants m^{-2} conducted to the best results for all the genotypes in the first year except with respect to the Pollanum. In the second year, there were no significant differences to the intermediate level probably because there was a dry year so greater competition at a higher plant population level tended to reduce the yield for most of the genotypes. So, because of seeds are quite expensive, the seeding rate of 750 plants m^{-2} might be advisable, especially for the genotype Pollanum that even in the first year did not respond significantly to the highest population level probably because it has a higher tillering capacity.

Crude protein and dry matter digestibility can be seen in table 2. Crude protein values where greater in the first harvest, 206 g Kg^{-1}, as it would be expected since the plants were in the vegetative stage. These results did not differ from what was found by Lyttleton (1973) but were slightly lower than what was reported by Sulc (1993). The genotypes Barspectra, Pollanum and Clipper presented the best results. Lower plant populations conducted to higher values of crude protein what it is not surprising since it is expected greater availability of nitrogen for the plants because of less competition, and nitrogen may have increased crude protein values as it was found by Lourenço *et al*. (1993).

Dry matter digestibility was higher in the second year (740 g Kg^{-1}) and similarly to what happen with crude protein was also greater in the first harvest (854 g Kg^{-1}) for the same reason. This trend is in accordance to what was stated by Duthil (1980). With respect to the genotypes and plant population, the highest values were found for Clipper and the lowest population levels.

As a conclusion, it can be stated that by the right choice of the genotype some gain can be obtained with respect to the yield and quality of the forage produced, and that yields are quite variable from year to year depending greatly on the amount and distribution of rainfall.

Also in this study, the intermediate level of plant population, 750 plants m^{-2}, seemed to be the most advisable.

References

Association of Official Analytical Chemists (AOAC) (1975). Official Methods of Analysis, 12th ed. AOAC, Washington D.C.

Crovetto, G. M. (1996). Nutritive value of Italian rye-grass (*Lolium multiflorum* Lam*)* silage comparison between double and single cut. Instituto di Zootecnia Generale, Milano, Italy.

Duthil, J. (1980). Production de forrages. 3me Edition Mundi-Prensa, pp. 30-129.

Lopes, V. R. (1992). Avaliação agronómica de populações regionais de azevém verdeal (*Lolium multiflorum* Lam). O Minho a Terra e o Homem. DRAEDM, Março, pp. 23-32.

Lourenço, M. E.V. et al. (1993). Yield and quality of irrigated summer - annual forages in Southern Portugal as affected by nitrogen fertilization. In: Optimization of Plant Nutrition, pp. 417-423, Fragoso, M. A. C. and Beusichen, M. L. van ed.. Kluwer Academic Publishers, London, 1993.

Lyttleton, J. W. (1973). Proteins and nucleic acids. Chemistry and Biochemistry of Herbage, 1, Academic Press, London, pp. 63-103.

Sulc, R. M. (1993). Ryegrass companion crops for alfalfa establishment. Agronomy Journal, January/February, **85**: 75-80.

Tilley and Terry (1963). A two-stage technique for the *in vitro* digestion of forage crops. J. British Grass. Soc., **18**: 104-111.

Table 1 - Dry matter yield (kg ha^{-1}) by year, genotype, plant population (plants m^{-2}) and harvest

	Harvests		Mean	Total	Harvests		Mean	Total	General total Mean
	First	Second			First	Second			
	1997				**1998**				
Billion									
350	2616	2860	2738	5476	1356	4117	2737	5473	5475
750	2691	3318	3005	6009	1563	4001	2782	5564	5787
1150	2793	3491	3142	6284	1496	3862	2679	5358	5821
Mean	2700	3223	2962	5923	1472	3993	2733	5465	5694
Barspectra									
350	2391	2883	2637	5274	1370	3113	2242	4483	4879
750	2561	2907	2734	5468	1237	3539	2388	4776	5122
1150	2584	3148	2866	5732	1557	3299	2428	4856	5294
Mean	2512	2979	2746	5491	1388	3317	2353	4705	5098
Clipper									
350	2538	3207	2873	5745	1137	3344	2241	4481	5113
750	2826	3662	3244	6488	1432	3330	2381	4762	5625
1150	3231	3559	3395	6790	1369	3278	2324	4647	5719
Mean	2865	3476	3171	6341	1313	3317	2315	4630	5486
Pollanum									
350	2728	2605	2667	5333	1152	3687	2420	4839	5086
750	2562	3267	2915	5829	1490	4208	2849	5698	5764
1150	2466	3343	2905	5809	1489	4065	2777	5554	5682
Mean	2585	3072	2829	5657	1377	3987	2682	5364	5511
Year mean	2666	3188	2927	5853	1388	3654	2521	5040	5447

LSD (0.05) for the means: year total = 21; year x harvest = 46; genotype x year = 52; genotype x population x year = 121.

Table 2 – Crude protein and dry matter digestibility (g kg^{-1}) by year, genotype, plant population and harvest

	Crude Protein	Dry matter digestibility
Year		
1997	164	718
1998	166	740
LSD(0.05)	4	3
Genotypes		
Barspectra	167	733
Billion	161	727
Clipper	166	740
Pollanum	167	717
LSD(0.05)	3	4
Plants m^{-2}		
350	167	731
750	165	733
1150	163	725
LSD(0.05)	2	3
Harvests		
First	206	854
Second	124	605
LSD(0.05)	2	3