Quality and mineral composition of forages in Mediterranean environment

Convertini G., Ferri D., Maiorana M.

in

Etienne M. (ed.).
Dynamics and sustainability of Mediterranean pastoral systems

Zaragoza : CIHEAM
Cahiers Options Méditerranéennes; n. 39

1999
pages 51-54

Quality and mineral composition of forages in Mediterranean environment

G. Convertini, D. Ferri and M. Maiorana
Istituto Sperimentale Agronomico, Via C. Ulpiani 5, 70125 Bari, Italy

SUMMARY - Artificial meadows of grasses (cocksfoot, *Dactylis glomerata* L.) and forage leguminous (sainfoin, *Onobrychis viciifolia* Scop.) were investigated as biomass yield, forage quality and mineral composition. During the years 1992-1995 on a typical litosoil of southern Italy (classified as Rhodoxeralf Lithic Ruptic), three harvest times and two cutting heights, arranged as a split-plot design, were compared. The variations of protein and neutrodetergent fibre (NDF) and mineral composition (N, P, K, Ca, Mg contents) were recorded during the whole trial period. Standard analysis of variance and comparison among mean values were performed. Quality and mineral composition of forages were affected by harvest times, above all in sainfoin in which the relationship leaves/stems of plants was modified to a greater extent than cocksfoot. Cutting heights showed poor effects on the parameters examined.

Key words: Sainfoin, cocksfoot, harvest times, cutting heights, mineral composition.

RESUME *- "La qualité et la composition minérale des fourrages en Méditerranée". Les prés artificiels de dactyle aggloméré (*Dactylis glomerata L.*) et de mélilot jaune (*Onobrychis viciifolia Scop.*) sont étudiés dans la rendement, la qualité et la composition minérale. Trois époques de fauchage et deux hauteurs de fauchage sont comparées sur un dessin expérimental (split-plot) pendant les années 1992-1995 sur un typique Litosol (Rhodoxeralf Lithic Ruptic) dans l'Italie du Midi. Les variations des protéines, de la fibre neutrodétergente et de la composition minérale sont enregistrées pendant l'entière période de l'essai. Il y a été fait l'analyse statistique et la comparaison entre la valeur moyenne. L'époque de fauchage influence sur la qualité et sur la composition minérale du fourrage, surtout sur la mélilot jaune dans la quelle le rapport entre la feuille et la tige est modifié. L'hauteur de fauchage montre un petit effet sur tous les paramètres examinées.*

Mots-clés *: Mélilot jaune, dactylis aggloméré, époque et hauteur de fauchage, composition minérale.*

Introduction

The chemical composition of plant reflects its nutrient supply in relation to growth. Weather, soil aeration and compaction, pH and relative application of other nutrients, maturity stage of sampling can influence plant composition. The concept of deficient, adequate and excessive concentration of nutrient elements as related to forage yield is definitely affected by the stage of growth at which the crop is harvested for forage (Fleming, 1973; Walsh and Beaton, 1973; Mengel and Kirkby, 1982; Bouchet and Gueguen, 1983; Onofrii *et al.*, 1985; Vecchiettini *et al.*, 1991).

The aim of this paper, carried out in an area of southern Italy characterized by summers with high temperatures and scanty rainfalls, is to study the effects determined by different harvest times and cutting heights on the quality and on the mineral characteristics of two pure permanent meadow species, a leguminous and a grass crop, growth in drought conditions.

Materials and methods

The study was conducted in the Experimental Farm of the Institute, located in Rutigliano (Southern Italy, 41° 01' latitude N, 4° 39' longitude E, 122 m a.s.l.).

The soil is a Rhodoxeralf Lithic Ruptic, according to the USDA Soil Taxonomy. The chemical, physical and hydrological properties of the soil are given in Table 1.

Table 1. Physical, chemical and hydrological soil characteristics of experimental field

Shell	%	4.2
Fine soil	%	95.8
Coarse sand	%	2.9
Fine sand	%	21.1
Clay	%	51.2
Silt	%	20.6
pH		7.4
Total N	%	0.134
Organic matter	%	2.37
Available P (as P_2O_5)	ppm	51.0
Exchangeable K (as K_2O)	ppm	715.0
Water field capacity (0.03 MPa)	%	30.68
Wilting point (1.50 MPa)	%	18.26

The climate is "accentuated thermoMediterranean" (UNESCO-FAO classification), with low rainfall mostly occurring in winter months.

Two permanent meadow species (cocksfoot, *Dactylis glomerata* L., cv. Dora; sainfoin, *Onobrychis viciifolia* Scop., cv. Vala) submitted to three harvest time (carried out when the plants reached, on the average, 10, 15 and 20 cm of height) and two cutting heights (0 cm = close to the ground and 5 cm) were compared. The experimental design was a split-plot with three blocks.

On samples of plants collected from each plot and oven-dried at 80°C, crude protein and neutrodetergent fibre (NDF) contents and mineral composition were measured. Mineral components were determined by atomic absorption spectroscopy following Pinta method (1973), that allows the extraction of all plant mineral components.

Standard analysis of variance test was performed and the means compared using "Student-Newman-Keuls test".

Results and discussion

The results obtained in sainfoin and cocksfoot are reported, respectively, in Tables 2 and 3.

The mean values of quality and mineral concentration show, in both species, a satisfactory level in almost all the parameters considered. Particularly, the responses of sainfoin appeared better than those of cocksfoot, with higher levels of protein, nitrogen and Ca and lower NDF content.

In the leguminous, rather wide differences among the years were found for all the characters examined: the best results were obtained in the first and the last year for Mg and Ca levels. In 1993 for protein, nitrogen, K and P; in the phosphorus the differences among the four years trial period were smaller but statistically significant. In 1995 for Mg level.

With regard to cocksfoot, the best results were obtained for protein, NDF, nitrogen and K contents in 1992, while a large variability among the years has been observed for other nutrients.

In both species, the best harvest time seems to be that at 10 cm for protein, nitrogen NDF and phosphorus levels, even if with small differences in the latter. On the whole, the cut carried out at 10 cm appeared the most interesting, considering that the protein, N and P values usually decrease with maturity and the content of NDF increases, because its components are accumulated as the plant ages.

No significant differences in mineral composition were observed between the cutting height for all parameters tested, either in sainfoin, or in cocksfoot.

Table 2. Sainfoin chemical composition

	Protein*	NDF*	N**	K**	Mg**	Na**	Ca**	P**
Year								
1992	19.0 b	24.9 c	3.04 b	3.27 b	0.46 a	1.28 c	1.00 a	0.28 b
1993	23.2 a	30.2 b	3.71 a	3.99 a	0.32 b	1.36 b	0.41 c	0.35 a
1994	18.7 b	29.7 b	2.99 a	3.75 a	0.29 b	1.25 c	0.66 b	0.30 ab
1995	15.9 c	34.2 a	2.54 c	1.54 c	0.51 a	1.86 a	0.99 a	0.32 a
Harvest time								
10 cm	20.7 a	29.0 b	3.31 a	2.90 b	0.39 a	1.37 b	0.68 b	0.34 a
15 cm	18.8 b	30.0 a	3.01 b	3.23 a	0.40 a	1.46 ab	0.73 b	0.31 ab
20 cm	18.1 c	30.2 a	3.09 b	3.29 a	0.40 a	1.51 a	0.89 a	0.29 b
Cutting height								
0 cm	19.1 a	29.8 a	3.06 a	2.84 b	0.40 a	1.40 b	0.74 a	0.32 a
5 cm	19.3 a	29.5 a	3.09 a	3.44 a	0.39 a	1.52 a	0.79 a	0.31 a
Means	19.20	29.75	3.07	3.14	0.40	1.45	0.77	0.31

Student-Newman-Keul test (P≤0.05). Columns with different letters are significantly different at P≤0,05.
* Percentage
** g/100 g DM

Table 3. Cocksfoot chemical composition

	Protein	NDF	N	K	Mg	Na	Ca	P
	%	%	g/100 g DM					
Year								
1992	17.1 a	45.4 b	2.74 a	4.89 a	0.41 b	2.23 a	0.22 b	0.26 b
1993	8.6 d	49.2 a	1.38 d	1.98 b	0.32 b	0.90 bc	0.22 b	0.33 a
1994	15.2 b	49.0 a	2.43 b	4.05 a	0.34 b	1.72 b	0.31 b	0.26 b
1995	13.5 c	50.9 a	2.16 c	3.11 a	0.54 a	2.71 a	0.92 a	0.36 a
Harvest time								
10 cm	14.4 a	47.3 c	2.30 a	3.35 b	0.42 a	1.53 b	0.40 a	0.34 a
15 cm	13.2 b	48.6 b	2.11 b	3.58 a	0.40 a	2.28 a	0.43 a	0.28 b
20 cm	13.2 b	50.0 a	2.11 b	3.60 a	0.41 a	1.86 b	0.43 a	0.31 ab
Cutting height								
0 cm	13.8 a	48.3 b	2.21 a	3.53 a	0.40 a	1.88 a	0.40 a	0.32 a
5 cm	13.5 a	49.0 a	2.16 a	3.48 a	0.41 a	1.89 a	0.44 a	0.29 a
Means	13.60	48.63	2.18	3.51	0.41	1.89	0.42	0.31

Student-Newman-Keul test (P≤0.05). Columns with different letters are significantly different at P≤0,05.

Conclusions

The four trial years pointed out the following:

(i) The best quality and mineral composition were obtained in the first and in the second year for sainfoin, in the first one for cocksfoot, while in the following years there was a decline due to maturity of plants.

(ii) The sainfoin provided a forage with better quality than cocksfoot, with higher levels of protein and N and lower NDF content.

(iii) The harvest time at 10 cm appeared the best among those examined, above all in sainfoin.

(iv) Between the cutting heights, statistical significant differences were not found.

Acknowledgements

Authors have equally contributed to this work. Research supported by the Italian Research Council, Rome, Italy.

References

Bouchet, J.P. and Gueguen, L. (1983). Particularités de la nutrition mineral. *Bull. Tech. CRZV. Theix, INRA, 53:* 85-99.

Fleming, G.A. (1973). Mineral composition of herbage. In *Chemistry and Biochemistry of Herbage*, Butler G.W. and Bailey R.W. Academic Press, London, New York, San Francisco.

Mengel, K. and Kirkby, E.A. (1982). *Principles of Plant Nutrition.* International Potash Institute, Worblaufen-Bern/Switzerland, p. 655.

Onofrii, M., Tomasoni, C., Berardo, N. and Perenzin, M. (1985). Effetto della concimazione azotata sulla produzione quanti-qualitativa di prati monofiti di graminacee nella pianura irrigua lombarda. *Riv. Di Agron.*, 19: 189-198.

Pinta, M. (1973). Méthodes et référence pour la détermination des éléments mineraux dans les vegetaux. Détermination des éléments Ca, Mg, Fe, Mn, Zn, Cu par absorption atomique. *Oleagineux,* 2: 87-92.

Vecchiettini, M., Cinti, F., Gaspari, F. and Giardini, A. (1991). Influenza dell'epoca di taglio sulla resa e sulla qualità del foraggio di erba mazzolina (*Dactylis glomerata* L.) e coda di topo (*Phleum pratense* L.). *Riv. Di Agron.*, 25, 2: 253-262.

Walsh, L.M. and Beaton, J.D. (1973). *Soil Testing and Plant Analysis.* Soil Science Society of America, Inc. Madison, Wisconsin USA, p. 491.