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in

Porqueddu C. (ed.), Tavares de Sousa M.M. (ed.).
Sustainable Mediterranean grasslands and their multi-functions

Zaragoza : CIHEAM / FAO / ENMP / SPPF
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 79

2008
pages 59-63

Ecologic and pastoral value of pastures of Sicilian mountains

V. Copani*, E. Riggi, S.L. Cosentino*, G. Testa* and S. Virgillito***
*Università degli Studi di Catania, Dipartimento di Scienze Agronomiche,
Agrochimiche e delle Produzioni Animali (DACPA), via Valdisavoia 5, 95123 Catania, Italy
**CNR-Istituto per i Sistemi Agricoli e Forestali del Mediterraneo (ISAFOM),
Str.le V.Lancia, Blocco Palma I, Zona Industriale, 95121 Catania, Italy

SUMMARY – In the park of Nebrodi Mountains (Sicily, Italy), from the autumn 2000 to the spring 2001 a floristic analysis and a productivity assessment in relation to agronomic treatments (N, P, N+P fertilisation and irrigation) were carried out in three pasture areas between 1148 and 815 m asl. The species with high fodder value were frequently reported in the most elevated site. The pastures of higher altitudes are included in the class of *Cirsietalia Vallis demonis,* a local variant of the *Molinio-Arrhenatheretea* class, which characterizes high altitude pastures. In warmer environments the pasture of secondary source prevails, class *Lygeo-Stipetea* and *Poetea bulbosae* (especially perennial) and *Tuberarietea guttatae* class (annual). Agronomic treatments differently increase yield regarding environment and vegetation. Best performances were obtained using phosphatic fertilisation and irrigation at lower altitudes, whereas at higher altitudes nitrogen fertilisation was the best treatment.

Keywords: Pastures biodiversity, Sicily, Braun-Blanquet, irrigation, fertilisation.

RESUME – *"Valeur écologique et pastorale des pâturages des montagnes siciliennes". Dans le parc des monts Nebrodi (Sicile, Italie), au cours de l'année 2000/2001, une étude floristique et une analyse de la productivité par rapport à différents traitements agronomiques (fumure N, P, N + P et irrigation) ont été effectuées dans trois domaines situés à une altitude de 1148 à 815 mètres. Les espèces avec une haute valeur fourragère sont très diffusées à l'altitude la plus élevée. Les pâturages de haute altitude sont inclus dans la classe* Cirsietalia Vallis *demonis qui est une variante de la* Molinio - Arrhenatheretea*. Dans la plupart des environnements situés aux hauteurs les plus basses les espèces appartenant à* Lygeo-Stipetea*,* Poetea bulbosae *et* Tuberarietea guttatae *sont les plus diffusées. Les traitements agronomiques ont déterminé une augmentation du rendement selon un degré différent par rapport à l'environnement ainsi qu'à la composition floristique.*

Mots-clés : *Diversité biologique des pâturages, Sicile, Braun-Blanquet, irrigation, fertilisation.*

Introduction

The north-eastern Sicily mountains are characterized by herbaceous vegetation among the richest and the most interesting of the Mediterranean basin (Brullo and Grillo, 1978) in terms of fodder value and number of observed species. This agro ecological variability is the result of the bioclimatic and edaphic characteristics of the area, but also of the traditionally adopted extensive livestock farming focused primarily, if not exclusively, on the use of natural mixed meadow (Cosentino and Litrico, 1992) whose stability is ensured by nomadism and transhumance (Cassaniti *et al.*, 2002). The pasture at the highest altitudes, from a phytosociological point of view, belongs to the *Molinio-Arrhenatheretea* group, with a xerica variant of the same class ascribed, as proposed by Brullo and Grillo (1978), to *Cirsietalia vallis demonis*. This group presents many endemic species probably due to the geographical insulation. At lower altitudes, where anthropic actions are more relevant, the Mediterranean meadows community of secondary origin with thermophilic species belongings to *Lygeo-Stipetea* and *Poetea bulbosae* class (especially perennial) and *Tuberarietea guttatae* class (annual) are more frequently reported.

Part of this area is subjected to the Nebrodi Park Authority regulating the main agricultural activities. The natural pastures yield potential (Cassaniti *et al.*, 1994), fodder and ecological value are requested as objective indices by this Authority for the application of structural actions programs for the park management. The analysis of the fodder and ecological value of the natural pastures and their yield response to agronomical techniques (irrigation and fertilisation) were studied within different areas of the Nebrodi Park.

Materials and methods

The study was carried out in the years 2000-2001 in three pasture areas in the park of Nebrodi Mountains (North-Eastern Sicily): Floresta (ME) 1148 m asl (37º59' lat.N, 14º52' long.E); Randazzo (CT) 815 m asl (37º54' lat. N, 14º58' long. E); Troina (EN) 830 m asl (37º41' lat. N, 14º42' long. E). The pedological association in the experimental sites belonged to Lithic Xerorthents, Typic Xerorthents, Typic e/o Lithic Xerochrepts, Eutric Cambisols. From a phyto-climatic point of view the Nebrodi Park region includes a meso-mediterranean belt and a submediterranean type belt (Brullo *et al.,* 1996), with a less extended dry summer period when compared to the typical Mediterranean environment.

On autumn 2000 and spring 2001 visual floristic and non destructive studies were conducted according to the Braun-Blanquet methodology (1964). Pignatti (1982) nomenclature and life form according to Raunkiaer (1934) were adopted. The fodder value was reported according to Immamorati and Veri scale (1986) (see Table 1).

In two of the above mentioned sites (Randazzo and Floresta), adopting a randomized blocks design with three replicates (50 m^2 each) the productivity of a natural pasture has been compared with those obtained from four treatments: irrigation (once in spring); nitrogen fertilisation (100 kg ha^{-1} in the spring); nitrogen-phosphorus fertilisation (100 kg ha^{-1} of N and 120 unit ha^{-1} of P_2O_5 respectively in spring and winter); phosphorus fertilisation (120 unit ha-1 of P_2O_5 in winter).

In order to simulate the grazing management system the Corral and Fenlon (1978) harvesting method has been adopted. The growth rate in terms of dry matter daily produced (kg ha^{-1} d^{-1}) was obtained using the "mobile-average" method, adding the obtained values for each day of the whole production period the total biomass yield was calculated.

Results and discussion

The floristic analysis of these pastures identified 120 species in Troina, 106 in Randazzo and 95 in Floresta (Table 1). In Floresta the legumes species (25.3%) predominates followed by composite (17.9%) and grasses (15.8%); in Randazzo composite and legumes represented the 51% of the species detected, followed by grasses (14.1%). Also in Troina composite and legumes are the most important species present in the pasture (43.4%), followed by grasses (11.7%). High grazing value species were recorded in Floresta, mainly represented by *Lolium perenne* L. which had an average ground cover index (Braun Blanquet, 1964) of 2.5*, Trifolium pratense* L. (2.0)*, Cynosurus cristatus* L. (2.5)*, Dactylis glomerata* L. (1.5), *Trifolium repens* L. (1.5). In Randazzo, in addition to *Lolium perenne* L. (2.0), high ground cover index were observed for *Hedysarum coronarium* L. (2.0)*, Dactylis hispanica* Roth. (2.0)*, Avena barbata* Potter (1.5). In Troina among the species with high cover index *Dactylis hispanica* Roth. (2.0)*, Foeniculum vulgare* Mill. (2.0)*, Dasypirum villosum* (L.) Borbas (2.5)*, Ferula communis* L. (2.5)*, Hedysarum coronarium* L. (3.5)*, Medicago rugosa* Desr. (2.0) were reported.

The life form (Raunkiaer, 1934) shows a clear difference in the amount of individual forms in the three environments. In Floresta the greates amount of hemicryptophytes (46.3%) was recorded. Conversely, the terophyite group is the most frequently observed in Troina and Randazzo (57.5% and 56.6% respectively) (Table 1).

In the pastures of Floresta the first three groups of pasture value (excellent, optimum and good forage) (Innamorati and Veri, 1986) represent the 55% of the species, characterized by significantly higher values of coverage than the not pabular (Table 1). Also in the remaining areas the number of species belonging to the first three groups of grazing value is high (50% and 42% respectively for Randazzo and Troina), but this value declines when related to the covering level, even though the best forage species remain at the first places for cover index.

At the lowest altitude the grazing started at the end of March and ended in the second half of June (84 days), in Floresta started in the first ten days of May and ended in the second ten days of July (77 days) (Fig. 1). The treatments did not affect the length of the production period.

Table 1. Botanical family, life form and fodder value of the vegetation in the three studied environments

	Troina		Randazzo		Floresta	
	Species (no.)	%	Species (no.)	%	Species (no.)	%
Family						
Compositae	26	21.7	27	25.5	15	15.8
Graminaceae	26	21.7	15	14.1	17	17.9
Leguminosae	14	11.7	27	25.5	24	25.3
Other families	54	45.0	37	34.9	39	41.1
Life form						
Hemicryptophytes	33	27.5	34	32.1	44	46.3
Therophytes	69	57.5	60	56.6	41	43.2
Geophytes	14	11.7	9	8.5	9	9.5
Chamaephytes	4	3.3	3	2.8	1	1.1
Fodder value						
5=excellent	19	15.8	19	17.9	22	23.2
4=optimum	9	8.5	12	11.3	14	14.7
3=good	21	17.5	22	20.8	16	16.8
2=mediocre	46	38.3	32	30.2	31	32.6
1=bad	25	20.8	21	19.8	12	12.6
Total no. species	120		106		95	

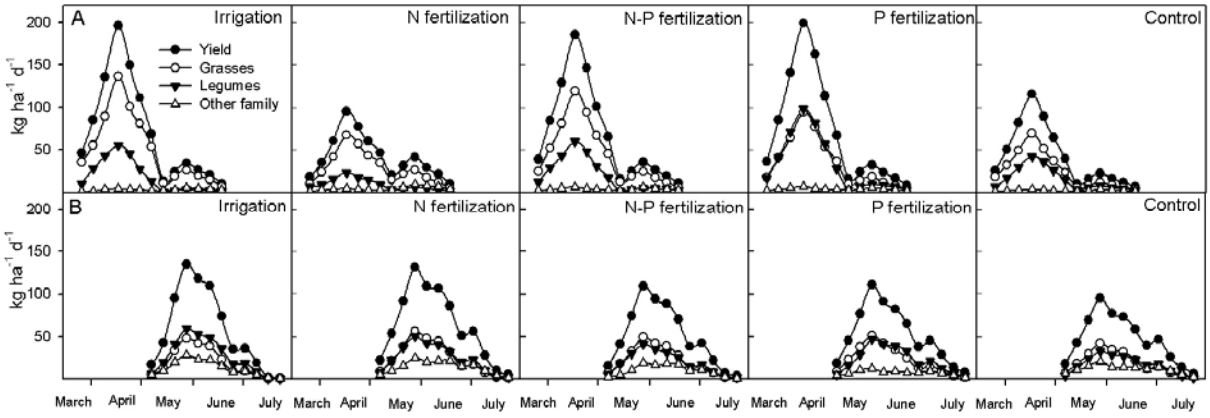

Fig. 1. Seasonal changes in rate of yield (kg ha^{-1} day^{-1} DM). A= Randazzo; B=Floresta.

The growth rate showed, in both environments an increasing trend until a maximum value of 180 kg ha^{-1} d^{-1} in Randazzo and 140 kg ha^{-1} d^{-1} in Floresta, respectively reached in the middle of April and at the end of May.

Subsequently this rate declined more rapidly in Randazzo, where it reached values lower than 30 kg ha^{-1} d^{-1} from mid-May, than in Floresta where the lowest value has been reported on the beginning of July (50 kg ha^{-1} d^{-1}).

In Randazzo irrigation, N+P, and P treatments have doubled these values, whereas the only nitrogen fertilisation did not change. Conversely, in Floresta, irrigation and nitrogen fertilisation determined an increase of 50% of the intensity of growth.

The control productivity in Randazzo, equal to 3.86 t ha^{-1} (Table 2), resulted not different from N treatment (3.84 t ha^{-1}) and significantly lower than P fertilisation (6.49 t ha^{-1}), irrigation (6.46 t ha^{-1}) and N+P fertilisation (6.19 t ha^{-1}) undifferentiated among them. This response is probably related to the

high legume species frequency (especially sulla sweet vetch). On opposite, in Floresta nitrogen fertilisation significantly increased the yield (5.26 t ha^{-1}) compared to control, P and N+P (3.97, 4.25 and 4.37 t ha^{-1} respectively), but undifferentiated from irrigation treatment (4.80 t ha^{-1}). The reported irrigation benefit appeared of a greater amount in the lower altitudes where the water deficit occurred earlier (Cassaniti *et al.*, 2002).

Table 2. DM yield (t ha^{-1}) in relation to the studied treatments. For each column different letters are significantly different (P<0.05 SNK test)

Treatment	Randazzo	Floresta
Irrigation	6.46 a	4.80 ab
Nitrogen	3.84 b	5.26 a
Nitrogen+Phosphorus	6.19 a	4.25 bc
Phosphorus	6.49 a	4.37 bc
Control	3.86 b	3.97 c
Mean	5.37	4.60

In Randazzo the contribution to the yield of grasses and legumes are equivalent and represents the 90% of total biomass (Table 3); N, N+P and irrigation influenced this proportion in favour to grass; P substantially did not change the proportion observed in the control.

Table 3. Botanical family contribution (mean) in relation to the agronomic treatments

	Botanical family	Treatment				
		Irrigation	N	N+P	P	Control
Randazzo	Grasses	62.3	56.7	57.1	41.8	45.4
	Legumes	27.0	26.4	29.9	46.3	43.6
	Other family	10.7	16.8	13.0	11.9	11.0
Floresta	Grasses	29.4	35.0	39.0	39.6	37.7
	Legumes	41.4	37.9	38.8	43.1	34.5
	Other family	29.2	27.1	22.2	17.4	27.8

In Floresta the two families are the 70% of the biomass. This amount is maintained both in N and N+P treatments; P treatment increases the presence of legumes (43% on the mean) against the other families whereas irrigation reduces the presence of grass.

Conclusions

The relevant biodiversity characterizing the natural grassland of the Nebrodi Mountains highlight the ecological value of these environments. From an agronomic point of view is however possible to do further improvements which should be chosen after careful consideration of the characteristics of flora and environmental conditions.

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