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Productive and ecophysiological characteristics of some varieties of sulla (*Hedysarum coronarium* L.) in a Mediterranean area of Tuscany

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Summary - In areas with clayey soils of Central Italy a new interest in sulla (*Hedysarum coronarium* L.) is arisen. Different utilizations than the traditional haymaking of this forage crop are now possible. Two different ecotypes (the local “Nugola” and “Teramo” from Central Italy) and two Italian cultivars (“Grimaldi” and “Sparacia”) were compared in a coastal site near Livorno (Northern Tuscany). Data collection interested some productive and ecophysiological characteristics: DM and seed production, Leaf Area Index and sward structure. Results allowed a characterization of the four genotypes, providing also information on different management possibilities.

Key-words: DM production, seed production, utilization techniques, vegetation structure

Résumé - Dans le cadre d'un intérêt croissant de *Hedysarum coronarium* dans les collines argileuses de l'Italie du Centre où on entrevoit des rôles différents au lieu de l'utilisation traditionnelle à fauche, on a comparé, dans un endroit littoral de la province de Livorno, deux populations (“Teramo” et “Nugola”) et deux variétés (“Grimaldi” et “Sparacia”). Les données expérimentales ont concerné quelques caractéristiques productives et écophysologiques: production de semence et de fourrage, Leaf Area Index et structure de la végétation. Les résultats obtenus ont permis de caractériser les provenances étudiées, et de fournir aussi des importantes indications concernant différentes possibilités de gestion.

Mots-clés: production de MS, production de graine, techniques d'utilisation, structure de la végétation

Introduction

Sulla (*Hedysarum coronarium* L.) is a typical forage crop that can be used in difficult conditions in Mediterranean environments, mainly in clayey soils. Even if lands sown with sulla in Italy have been decreasing gradually from early '50 up nowadays (Talamucci, 1998), a new interest in this crop is arisen and new roles, different from the traditional hay utilization, can be foreseen. The new importance given to this forage plant depends on the following positive characteristics: an exceptional adaptability; a great supply of nitrogen produced by symbiotic fixation (about 100 kg ha⁻¹ year⁻¹, Sarno and Stringi, 1979); a high nutritive value (Bullitta *et al.*, 1996); a satisfactory seed production (Roggero *et al.*, 1996), that contributes to an effective seed bank in the soil (Sulas *et al.*, 1999) that increases the low persistence of the crop; a high soluble carbohydrates content which allows better silage possibilities than lucerne (Borreani *et al.*, 1999; Stringi *et al.*, 1997).

For the reasons above, the sulla can improve its role in Mediterranean forage systems, that should be characterized by a productive stability and ecological sustainability based on diversification of resources and their combination (in space and time). Sulla, being extremely versatile and plastic, can efficiently contribute to the different types of productive systems (forage-grain, pastoral, multipurpose). Contribution can be useful in different utilization modalities: hay, silage and seed according to the year and seasonal climate conditions. The

aim of this paper was to contribute to the knowledge of productive and ecophysiological characteristic of this species.

Materials and methods

A trial was established (in September 1994) in a coastal environment near Livorno (Northern Tuscany) characterized by clayey soil (pH 7.9) and an annual average temperature of 14.7 °C and 958 mm of rainfall, distributed in 86 days and with an arid period of about two months (mid June to mid August). Two Italian cultivars ("Sparacia" and "Grimaldi") and two ecotypes ("Nugola" and "Teramo" from Central Italy) were compared for two years. Following data were collected in all the varieties and ecotypes:

- DM production (on 15 m² plots), under two modalities of utilization: hay cutting (one cut at 50% of flowering) and simulated grazing (2 cuts each year when canopy height was 30 cm);
- seed production with or without early spring cutting: all the seed (not hulled) was harvested by hand in sampling areas of 5 m² in 100 m² plots;
- LAI was obtained by density plants and leaf surface with planimeter. Sward structure was measured by Vertical Point Quadrates (VPQ). Both were studied in plots different from those where productions were recorded (44 m² plots) without any utilization.

Results and discussion

DM yields of the two years of trial are shown in Table 1. There is a considerable effect of the year on production, due almost exclusively to the different rainfall distribution: such effect has remarkable consequence on production under both utilization techniques. In the first year all varieties produced almost the same quantity, the best performance was obtained by the ecotype (Nugola, 0.57 t ha⁻¹). A significant effect of the utilization modality was recorded. The second year had favourable climatic conditions and the effect of utilization was highly significant (4.62 vs. 2.49 t ha⁻¹), hay production was almost double than in simulated pasture. Differences among varieties were significant, Grimaldi produced more than 4 t ha⁻¹. No interaction was recorded in both years. DM production was affected by very high variability confirming the strong dependence of sulla productions on climatic and on utilization conditions.

Table 1. Average DM production (t ha⁻¹).

		1995	1996
Variety	Sparacia	0.35 c	3.57 b
	Grimaldi	0.43 b	4.07 a
	Nugola	0.57 a	3.37 b
	Teramo	0.35 c	3.18 c
Utilization technique	Hay	0.49 a	4.62 a
	Grazing	0.35 b	2.49 b

Values with the same letter are not significantly different for p<0.05.

Seed production of sulla was evaluated in relation to forage production. Seed yield (Fig. 1) of the four tested varieties under the two different utilization modalities was strongly affected by the year, confirming what seen for DM production. The negative effect of the early cut on seed yield seemed to be more affecting than climatic conditions, in fact the average production of the first year without spring cut (775 kg ha⁻¹) was higher than that obtained in the second year from plots subjected to early cut (550 kg ha⁻¹). The above

negative effect could be noticed also for seed yield components, as reported by previous researches (Roggero *et al.*, 1996).

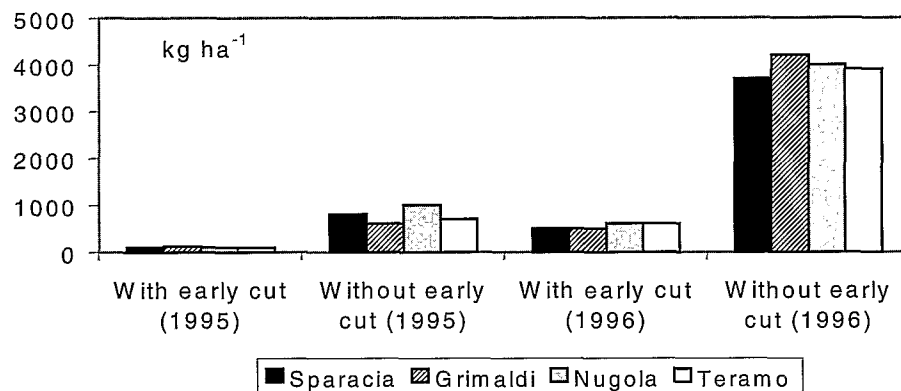


Fig. 1. Seed production (not hulled) for the 4 varieties in relation to forage utilization.

The LAI trends changed during the two years of trial (Fig. 2). Not only was different the maximum value (from about 4 in Nugola the first year, to 9 in Grimaldi and Teramo the second year), but it was also reached before during 1996, when average LAI value was maintained for a longer period at higher level. Annual DM production was correlated to average annual LAI ($r^2=0.68+$) but not to the maximum LAI reached.

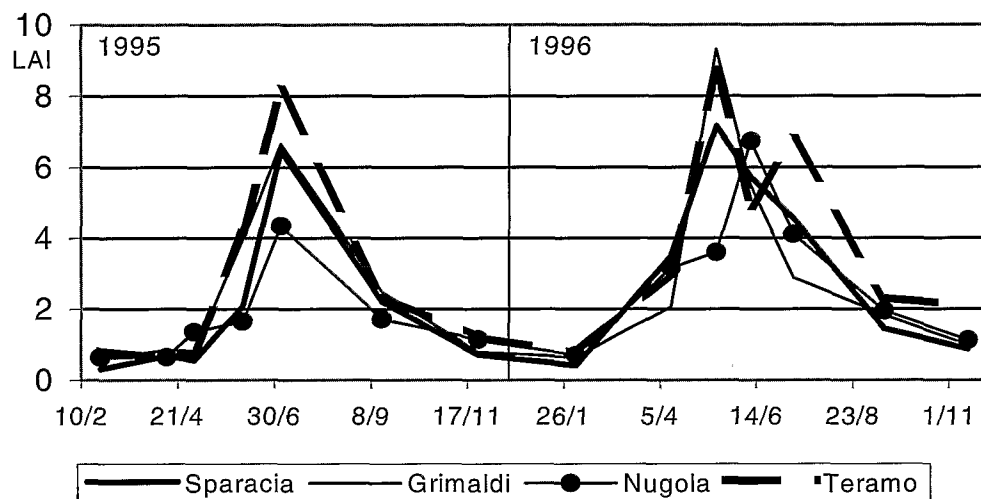


Fig. 2. LAI trends for each variety in the two years.

The structures recorded in April in the two years are shown in fig. 3. Number of contacts of leaves was high and concentrated in the bottom layers during the first year. The density of biomass was concentrated above in the second year. Differences became more relevant in the second year: Sparacia and Teramo had the greatest concentration of leaves in the lower layers of the sward (i.e. are more suitable for grazing) while Nugola and Grimaldi had a more regular distribution along the profile (more suitable for hay).

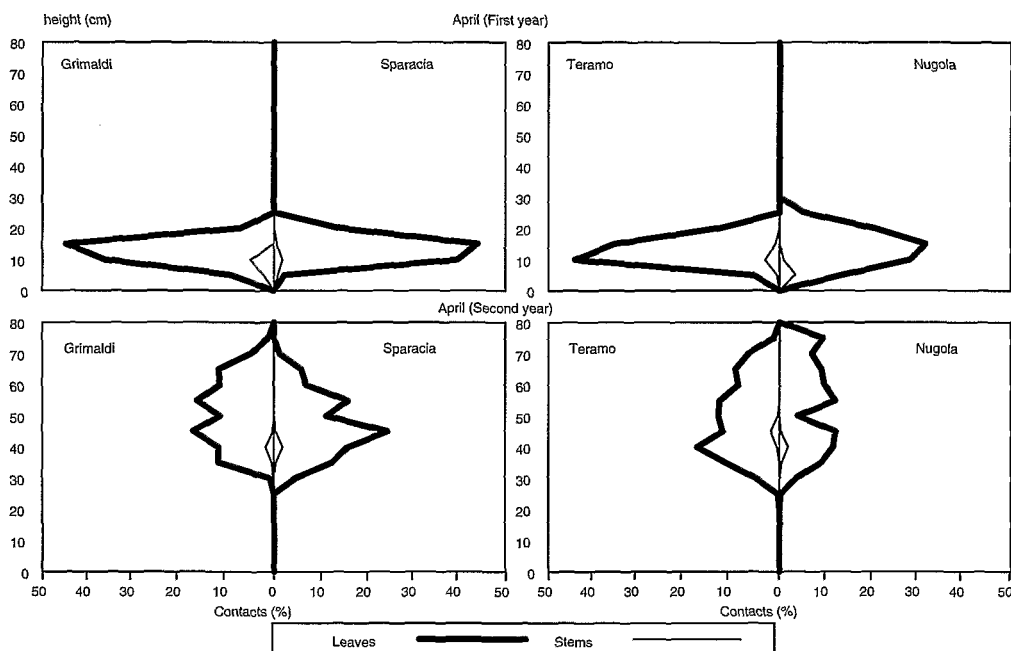


Fig. 3. Biomass distribution obtained by VPQ (comparison of two years in the same month).

Conclusions

Results allowed a preliminary characterization of the studied genotypes concerning some productive and ecophysiological parameters. The study provided also information on the plasticity of this species, that includes varieties suitable for grazing (Teramo and Sparacia from Southern Italy) and others for cutting (Grimaldi and Nugola from the Centre). The possibility of different utilizations according to climatic conditions (for forage in good year and for seed in bad year) is very important for species that give diversified and irregular productions. During the cold years when hay yield is compromised sulla gives the possibility of good incomes through seed productions. Unfortunately it does not seem possible a combinative utilization in the same year, for the insufficient seed production when the sulla is utilized also for forage.

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