Scorpiurus muricatus L.: an interesting legume species for Mediterranean forage systems

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Abstract

Scorpiurus muricatus L. (prickly scorpion's tail) is a legume species widely distributed as a spontaneous plant in Mediterranean pastures. In Sicily, farmers ascribe to this species a very high palatability and galactogogue effect, so that its abundance increases the value of the pasture. However, despite its worthy traits, the use of *S. muricatus* as a forage within cropping systems has not been well investigated. A field experiment was performed during two growing seasons in a semiarid Mediterranean environment to acquire information on the productivity of *S. muricatus* in comparison with other forage species grown in Mediterranean areas (e.g. berseem clover, burr medic, subterranean clover) and on its response to different cutting managements (cuts made in different phenological stages). Results showed that *S. muricatus* can provide biomass yield similar to, and in some cases higher than, that of the other forage legumes evaluated, differing from these species in its temporal distribution of the biomass accumulation. The findings contribute to define the role that *S. muricatus* could play in improving the productivity sustainability of the Mediterranean forage systems.

Keywords: biomass, cutting management, berseem clover, burr medic, subterranean clover

Introduction

Scorpiurus muricatus L. (common name: prickly scorpion's tail) is a self-reseeding annual legume fairly common in native pastures throughout the Mediterranean regions, particularly in Morocco, Algeria, Portugal, Spain, southern France and southern Italy. The species shows broad tolerance to soil type and pH and provides considerable biomass of good quality (Di Giorgio *et al.*, 2009). In Sicily, farmers ascribe to *S. muricatus* a very high palatability and a high galactogogue effect; so much so that when it is abundant the economic value of the pasture generally increases. Although *S. muricatus* could represent a very interesting species to be used as forage in Mediterranean cropping systems, the use of this legume within such systems is not well documented. Very few studies have been conducted to evaluate the effects of different cutting managements on the productivity and regrowth ability after defoliation of *S. muricatus*, and even fewer have investigated the behaviour of this species in comparison with other annual legumes utilized or utilizable for forage production in the Mediterranean areas. To address this knowledge gap, we performed a field experiment by growing, in pure stands, *S. muricatus* and other three legume species (burr medic, *Medicago polymorpha* L.; berseem clover, *Trifolium alexandrinum* L.; and subterranean clover, *Trifolium subterraneum* L. subsp. *Brachycalycinum*) commonly grown (or potentially utilizable) in the Mediterranean forage systems.

Materials and methods

A field experiment was conducted during the 2008-2009 and 2009-2010 growing seasons at the experimental farm Pietranera (37°30' N, 13°31' E; 178 m a.s.l.). In both growing seasons, the experiments were on a Vertic Haploxerept soil (525 g kg^{-1} clay, 227 g kg^{-1} silt, and 248 g kg^{-1} sand; pH 8.2; 16.8 g kg^{-1} total C and 1.78 g kg^{-1} total N). The experiment was set up in a split-plot design with four replications. Treatments consisted of four forage legume species (*S. muricatus*, berseem clover, burr medic, and subterranean clover) grown in pure stands, and four different cutting managements: T1 = first cut at 100 days after sowing (DAS) and cuts of regrowth every 28 days; T2 = first cut at 128 DAS and cuts of

regrowth every 28 days; T3 = first cut at 156 DAS and cut of regrowth after 28 days; T4 = cut at 184 DAS. In both years, the previous crop was wheat. Soil was ploughed in August and harrowed after the first autumn rainfalls; before harrowing, 69 kg P_2O_5 ha^{-1} was applied in all treatments. Crops were hand-sown in both seasons in the last 15 days of December using, for each species, the seeding rate ordinarily adopted by farmers in the area (900, 400, and 900 viable seeds m^{-2} respectively for burr medic, subterranean clover, and berseem clover); on the basis of previous experiments performed on *S. muricatus* in the same area, a density of 400 viable seeds m^{-2} was used for this species. Plots were 4.0×7.0 m (16 rows, 0.25 m apart and 7 m long). Seeds were not inoculated with *Rhizobium* before planting because prolific nodulation occurs naturally at the experimental site. All plots were hand-weeded. Each plot was harvested by hand at the scheduled dates, and all plants were cut at 5-cm stubble height. At crop harvesting, total fresh weight was determined and a sample of plant material taken from the centre of the subplots was dried at 60°C for 36 h and then weighed to determine the dry matter yield.

A mixed model according to the experimental design was used on the combined 2-year data set, with year as a random factor. Treatment means were compared using Fisher's protected least significant difference (LSD) test at the 5% probability level. During the experimental period total rainfall was 715 mm in 2008-2009 and 810 mm in 2009-2010 (+30 and +47% than the long-term average for the area, respectively).

Results and discussion

Treatments T1 and T2 allowed us to harvest, respectively, 4 cuts and 3 cuts for all the species except for burr medic (3 and 2 cuts respectively); T3 provided 2 cuts only for berseem and subterranean clover; T4 consisted of only one cut. On average, *S. muricatus* had a dry matter production similar to, or in some cases higher than, that of the other annual legumes included in the study (Table 1).

The mean value observed for *S. muricatus* (850 g DM m^{-2}) is higher than the value found by Abbate and Maugeri (2007) for the species, and in line with the findings of Di Giorgio *et al.* (2009). *Scorpiurus muricatus* showed the slowest initial growth rate when compared with the other legumes, its biomass production, at the first cut of T1, being equal to 39, 55 and 77% of the biomass productions of berseem clover, burr medic and subterranean clover, respectively (Figure 1). On the whole, *S. muricatus* exhibited a high regrowth ability after defoliation, showing a good aptitude to utilizations based on intense, but spaced in time, defoliations. This ability was lower compared with that of berseem clover (which is reputed to be a species with a very high aptitude to this kind of utilization) but markedly higher than burr medic and subterranean clover, both species having a high capacity for regrowth but particularly suited for grazing (based on light but frequent defoliations). Moreover, *S. muricatus* showed a good productivity potential in the late growth stages, as shown by the dry matter yields in the last cuts of T1 and T2, where *S. muricatus* proved to be the most productive species. Thanks to this characteristic, *S. muricatus* could be integrated with other forage resources in the Mediterranean cropping systems, giving an important late contribution to forage supply and, therefore, extending the grazing season.

Table 1. Total biomass yield (g DM m^{-2}) by legume species and cutting management strategy. Data are means of two years.[1,2]

Cutting management	*Scorpiurus muricatus*	*Medicago polymorpha*	*Trifolium alexandrinum*	*Trifolium subterraneum*	Average
T1	698	354	928	583	641 c
T2	754	612	964	648	744 b
T3	934	702	965	965	891 a
T4	1,015	733	791	1,050	897 a
Average	850 b	600 c	912 a	811 b	

[1] See Materials and methods for details.

[2] The interaction 'Cutting management × Legume species' is significant at $P<0.001$ (least significant difference = 81). Different letters denote significant differences at $P<0.05$.

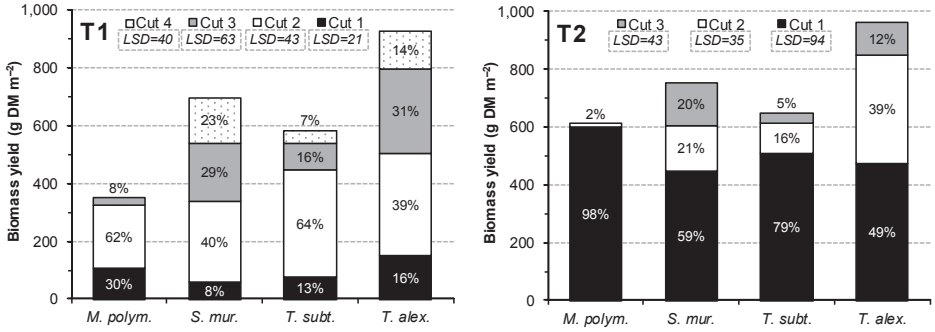

Figure 1. Biomass yield (g dry matter (DM) m^{-2}) by legume species and cutting management strategy (T1 and T2). Each histogram is divided into sub-histograms representing the biomass yield at each cut within each cutting management strategy. The proportion of each cut to the total biomass accumulated by each species is reported within each histogram. To compare the biomass yields given by the legume species at each cut, the significance and the LSDs are reported under the legend of each cut.

Conclusions

Results from the present study represent a contribution to the evaluation of the potential of *S. muricatus* to be used as a forage crop in the Mediterranean cropping systems. In particular, our research has shown that *S. muricatus*:

- has high dry matter productivity similar to, or in some cases higher than, that of other annual legumes commonly grown (or potentially utilizable) in the Mediterranean forage systems;
- is well-suited to cutting management strategies based on repeated defoliations; nevertheless, it is necessary to identify the timing for the first utilization in order to fully exploit the potential of the species, being the latter quite slow in the initial plant growth.

Moreover, since in both years total rainfall was markedly higher than the long-term average for the area, it will be necessary to carry out further research to test the behavior of *S. muricatus* under more typical rainfall conditions.

References

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