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in

Sulas L. (ed.).
Legumes for Mediterranean forage crops, pastures and alternative uses

Zaragoza : CIHEAM
Cahiers Options Méditerranéennes; n. 45

2000
pages 355-358

Article available on line / Article disponible en ligne à l'adresse :

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To cite this article / Pour citer cet article

Bullitta S., Saba P., Bullita P. **Seed production and its components in Sardinian germplasm of *Hedysarum coronarium* L. and *H. spinosissimum* L.** In : Sulas L. (ed.). *Legumes for Mediterranean forage crops, pastures and alternative uses* . Zaragoza : CIHEAM, 2000. p. 355-358 (Cahiers Options Méditerranéennes; n. 45)



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Seed production and its components in Sardinian germplasm of *Hedysarum coronarium* L. and *H. spinosissimum* L.

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Summary - Local populations of the two species *Hedysarum coronarium* L. and *H. spinosissimum* L. from the Sardinian region of Trexenta-Marmilla were examined for the seed yield components and seed production in the frame of a project for the biodiversity conservation and the valorization of local populations of neglected species. Seed losses occurred at harvest for *H. coronarium* accessions because of the gradual seed maturity reached within each plant, this is a problem for seed production, but considering the utilization of Sardinian prostrate growing sulla as pasture species, such feature could be turned into an useful factor for increasing the soil seed bank and allowing the subsequent plant regeneration from seeds. Preliminary results are encouraging the efforts spent in the valorization of Sardinian germplasm of *Hedysarum* species in view of its diffusion in dry areas of the Mediterranean basin.

Key-words: *Hedysarum coronarium*, *Hedysarum spinosissimum*, sulla, seed production

Résumé - On a examiné des populations locales des espèces *Hedysarum coronarium* et *H. spinosissimum* de la région sarde Trexenta-Marmilla dans le but de déterminer les composants du rendement en graines et la production de graines. Tout cela dans le domaine d'un projet pour la conservation de la biodiversité et pour la valorisation du germoplasm local d'espèces peu utilisées. On a vérifié des pertes de graines au moment de la récolte dans les populations de *H. coronarium* à cause de la maturation graduelle des graines; ce qui est négatif par rapport à la production de graines, mais, en considérant l'utilisation à paturage des populations rampantes sardes de sulla, qui peut devenir un élément utile pour augmenter la "seed bank" du sol et permettre la régénération des plantes. Ces premiers résultats encouragent de nouvelles études pour valoriser le germoplasm sarde des espèces du genre *Hedysarum* dans la perspective de sa diffusion en d'autres régions à climat sec du bassin de la Méditerranée.

Mots-clés: *Hedysarum coronarium*, *Hedysarum spinosissimum*, sulla, production de semences

Introduction

Sulla (*Hedysarum coronarium* L.) is a short lived perennial utilized as forage. Only five *H. coronarium* varieties are included in the National list and farm multiplication of local populations was a common practice in Sardinia. Nowadays, due to the diffusion of not autochthonous commercial ecotypes, farm multiplication of Sardinian sulla germplasm has been abandoned with the consequent risks of genetic erosion of valuable local genetic resources. Moreover, the Sardinian germplasm of *H. coronarium* characterized by prostrate growth is more suitable as pasture species (Bullitta *et al.*, 1998) and knowledge about seed production and regeneration capacity could be useful for its diffusion into natural pasturelands. Landscape enhancement, environmental protection and honey production could be alternative uses of sulla.

H. spinosissimum is a less known annual species, it has a prostrate growth and can be found in dry soils, no varieties of such annual sulla are available and the species deserves more attention for soil protection purposes in Mediterranean areas.

In the frame of a valorization project aimed at the diffusion of the cultivation of both species and at the exploitation of typically Mediterranean forage germplasm, local populations of both species of *sulla* were evaluated for seed yield and seed yield components. Aim of this preliminary study was to check the suitability for exploitation of the local germplasm of *sulla*. We started from the evaluation of seed yield and seed yield components in order to ascertain the real potential of both species. The increasing commercial value of *sulla* seed has focused new interest in the species and *sulla* is now being grown in new areas of northern Sardinia due to the *sulla* high production, palatability, nutritive value, different forms of exploitation and above all, the recently re-evaluated utilization of *sulla* as pasture species in sheep breeding areas (Bullitta and Sulas, 1998).

Materials and methods

Three natural populations of *H. coronarium*, part of a collection previously described (Bullitta *et al.*, 1998), and two natural populations of *H. spinosissimum*, all from the Trexenta-Marmilla region in southern Sardinia, were examined for the following characters related to seed yield components: total number of racemes per plant, average number of loments per raceme (evaluated on five racemes per plant), seeds per loment (evaluated on 50 loments per plant), thousand-seed weight, harvested seed yield per plant; two years data were collected for the perennial and one year data for the annual species. Phenology of both species was also examined. Seeding took place in December 1996 and the trial was carried out during the years 1997 and 1998 at the experimental field of Ottava on calcareous soil pH=7.4, average annual rainfalls 547 mm, average annual temperature 16.2 °C. Experimental design was a randomized block with three replicates, 14 plants per plot, spaced 1 m between and 70 cm within rows. Anova was performed separately for each group of species.

Results

As it appears from the first year results shown on table 1, no statistically significant differences were found among the examined seed yield components of the three populations, except for the number of racemes per plant that was higher in the populations Suelli and Mandas compared to Furtei.

Table 1: Means and LSD for each examined character of the *H. coronarium* populations in the first year.

Accessions	Days to flowering (no.)	Racemes plant ⁻¹ (no.)	Loments raceme ⁻¹ (no.)	Seeds loment ⁻¹ (no.)	Thousand seed weight (g)	Harvested seeds plant ⁻¹ (g)
Furtei	105	94	28	2,3	4.35	8.4
Suelli	111	163	31	1.7	3.44	12.5
Mandas	111	166	37	1.8	4.02	10.9
LSD 0.05	ns	28	ns	ns	ns	ns

In the second year, there were statistically significant differences among the accessions for the number of seeds per loment, such observed values as well of those observed in the first year were inferior to the 2,9 and 2,6 seeds per loment reported by Satta *et al.* (2000) and to the 2,5 seeds per loment reported by Negri (1987) for the same species.

In the second year there were statistically significant differences in flowering, with fifteen days difference from the earliest Furtei in comparison to the others; days to flowering were calculated in the second year from the beginning of regrowth after useful rainfalls in late summer. The number of loments per raceme observed in the second year was less than half of the values observed in the first year. As a comparison, the following seed yield components were recorded for the sulla commercial variety "Grimaldi": average number of loments raceme⁻¹ 11, average seeds loment⁻¹ 2.6, 1000 seed weight 5.1 g.

Table 2: Means and LSD for each examined character of the *H. coronarium* populations in the second year.

Accessions	Days to flowering (no.)	Racemes plant ⁻¹ (no.)	Loments raceme ⁻¹ (no.)	Seeds Loment ⁻¹ (no.)	Thousand seed weight (g)	Harvested seeds plant ⁻¹ (g)
Furtei	166	230	12	1.1	3.16	4.2
Suelli	180	326	14	1.8	3.17	9.4
Mandas	181	239	14	1.3	3.45	4.7
LSD 0.05	5	ns	ns	0.5	ns	ns

It should be mentioned that rainfalls at spring time were 76.6 mm in the first year while they were 172.8 at spring time in the second year and weather conditions could have affected the efficiency of pollinators. Also, an experiment on commercial varieties of sulla was established nearby in the second year and their contemporary and more profuse flowering could have attracted insects that visited more such varieties than the local populations. For all the *H. coronarium* populations, the harvested seeds per plant were considerably lower than expected because of the high losses at harvest and threshing. Harvest losses were due to the gradual reaching of seed ripening within each plant. Losses in harvested seed yield due to reduced harvest efficiency and the need of improvement for such aspect to better exploit the sulla seed yield potential are also mentioned by Martiniello (1994) and Satta *et al.* (2000).

Results on harvested seeds and seed yield components of the *H. spinosissimum* accessions are shown on table 3.

Table 3: Means and LSD for the examined characters of *H. spinosissimum* accessions.

Accessions	Days to flowering (no.)	Racemes plant ⁻¹ (no.)	Loments raceme ⁻¹ (no.)	Seeds loment ⁻¹ (no.)	Thousand seed weight (g)	Harvested seeds plant ⁻¹ (g)
Senorbì	117	80	6.1	2.1	5.2	5.2
Arixi	129	71	6.5	2.1	4.3	4.0
LSD 0,05	ns	ns	ns	ns	ns	ns

Although no statistically significant differences were found among the accessions, it is remarkable the twelve days difference in flowering date. It should also be pointed out that almost no seed losses occurred at harvest while such losses were quite high in *H. coronarium* populations. Compared with perennial sulla, the annual accessions had lower number of racemes per plant and lower number of loments per raceme while seeds per loment and thousand seed weight were slightly higher.

Conclusions

The presence and activity of pollinators together with a favorable climatic trend at flowering and seed ripening influences *H. coronarium* seed production as reported by several other authors (Negri, 1987; Martiniello, 1994; Satta *et al.*, 2000). The observed seed losses at harvest that cause problems for *H. coronarium* seed production, could be turned into an useful factor for increasing the soil seed bank and allowing the subsequent plant regeneration from seeds considering the utilization of Sardinian prostrate growing sulla accessions as pasture species, as suggested by Sulas *et al.* (1999). The less known *H. spinosissimum* can be considered a promising new species for soil protection purposes on arid slopes of Mediterranean areas and its seed production seems to be less affected by harvest losses compared to the perennial sulla.

Acknowledgements

The skilful technical assistance of S. Nieddu and A.P. Stangoni is acknowledged.

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