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The potential role of alternative legumes from Asinara island for multiple uses in difficult environments

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Summary - Natural populations of the species *Astragalus hamosus* L., *Lotus cytisoides* L., *Lotus edulis* L., *Lotus ornithopodioides* L., *Ornithopus compressus* L. and *Anthyllis tetraphylla* L., usually neglected and regarded as unimportant species, have been examined with the aim to establish their potential role for multiple uses on difficult Mediterranean areas. Species were chosen on the basis of their adaptation to marginal environments, their origin was from stressful environments of Asinara island and of the north western Sardinian coast. Some important characters for the survival of the species in difficult and overgrazed Mediterranean areas were observed: high pods and seed production, small seed size, hardseededness, early flowering, prostrate growth. Moreover, *A. tetraphylla* showed interesting ornamental features. All species deserve more attention.

Key words: alternative pasture legumes

Résumé - On a examiné des populations naturelles des espèces *Astragalus hamosus* L., *Lotus cytisoides* L., *Lotus edulis* L., *Lotus ornithopodioides* L., *Ornithopus compressus* L. and *Anthyllis tetraphylla* L. dans le but d'établir leur rôle potentiel pour des usages multiples en milieu méditerranéen. On a choisi les espèces selon leur adaptation aux environnements difficiles. Toutes les espèces observées ont montré des caractéristiques utiles à la persistance en environnements difficiles: remarquable production de graines et de gousses, petites graines, dureté des graines, précocité de floraison, port rampant. De plus, l'espèce *A. tetraphylla* a présenté des caractéristiques intéressantes du point de vue ornemental. On pense que toutes les espèces examinées peuvent être utilisées pour la protection des sols en terrain pauvre et dans les zones sèches du bassin méditerranéen et qu'elles méritent une plus grande attention.

Mots-clés: légumineuses, usage alternatif au pâturage

Introduction

The following alternative pasture legume species: *Astragalus hamosus* L., *Lotus cytisoides* L., *Lotus edulis* L., *Lotus ornithopodioides* L., *Ornithopus compressus* L. and *Anthyllis tetraphylla* L., taken from marginal areas of the Asinara island and Asinara gulf in N.W. Sardinia, have been grown under rainfed conditions in order to ascertain their potential role for multiple uses in Mediterranean environments. Main purpose of the research was to find suitable species for soil protection and sward improvement on slopes and abandoned or degraded Mediterranean areas. The species were chosen on the basis of their diffusion and adaptation to particularly difficult environments such as rocky soils, steep slopes with very shallow soils, sandy salt soils.

L. cytisoides is a perennial prostrate species with yellow flowers, very widespread in coastal rocky areas also on gravels and sometimes on sand (Pignatti, 1982). Its prostrate growth, perenniality, resistance to drought stress and the adaptation to very poor soils contribute to justify the interest of the species for uses in stressful environments for soil protection on slopes of Mediterranean areas. *L. edulis* is a semiprostrate annual species with yellow flowers and fleshy pods, it occurs in coastal areas in arid environments (Pignatti, 1982). *L. ornithopodioides*, is an annual prostrate species with yellow flowers and flat pods, palatable for grazing animals, widespread in ungrazed areas and adapted to grow under

shade. *A. hamosus* is an annual prostrate or semiprostrate species, with white racemose flowers (Pignatti, 1982), occurs on calcareous, schistose and clay soils from sea level up to 1300 m a.s.l. (Bennett *et al.*), it is a well productive species, no commercial varieties are available. *A. tetraphylla* is an annual and prostrate species, with yellow flowers, it occurs from 0 to 1000 m a.s.l. (Pignatti, 1982), on calcareous soils, it has good palatability (Salsano, 1996). It could be interesting for soil protection and embellishment of slopes because of the adaptation to grow on shallow soils of slopes and for its peculiar swollen calix persisting until seed maturity and the corolla colour both representing appreciable ornamental characters. *O. compressus* L. (yellow serradella), is an annual typically prostrate species, it occurs in dry, acid, sandy soils from sea level up to 300 m (Bennet *et al.*), it is considered a good pasture species quite productive and with a good survival under grazing, adapted to grow in poor and degraded soils, it has a high content of hard seeds (Salsano, 1996).

Although the examined species are little known in comparison to more traditional annual legumes such as clovers and medics, the obtainment of useful information on production and adaptation to cropping is surely useful to decide about their suitability for multiple uses either as forages or for landscape and environment improvement in stressful Mediterranean environments. Suitable species and varieties for pastureland regeneration and multi-use are particularly needed in Mediterranean areas where commercial varieties selected for more temperate environments are often unsuitable to the peculiar climatic, edaphic and cropping conditions.

Materials and methods

Evaluations took place at the experimental field of Ottava in N.W. Sardinia, pH 7.6, average annual rainfalls 547 mm. Four accessions of *A. hamosus*, four of *L. cytisoides*, four of *L. ornithopodioides*, four of *L. edulis*, two of *O. compressus* and one of *A. tetraphylla*, were examined. The origin of all plant materials was the Asinara island and the overlooking coast of North Western Sardinia. Plants grew under rainfed conditions and rainfalls during trial period was equal to 414 mm. Experimental design was a randomized block with three replicates twelve plants per plot. The following measurements were taken on 1 meter spaced plants: days to flowering, stems per plant, longer stem length, pods length, number of pods per plant, seeds per pod, 1000 seed weight, hardseededness, seed yield per plant, dry matter per plant. Pods were harvested manually then threshed by machine. Analysis of variance was performed separately for each group of species.

Results

Anova results did not show any significant statistical difference among the accessions of *A. hamosus*, a high variability within populations was present for each examined character and this could have hidden differences between accessions. Taking into account the extra-productive purposes for soil protection, the prostrate growth and the high number of both pods per plant and seeds per pod, should assure a suitable re-establishment of the species and a good soil covering.

Accessions of *L. cytisoides* showed statistically significant differences only for legume length and dry matter per plant. Although it is a less productive species than the others in term of pods, seeds and dry matter produced per plant, it deserves studies because it is one of the few perennial legumes to be found in poorer lands of dry Mediterranean areas. Further aspects are the seed shattering at pods maturity favouring seed dispersal, the small seed size that enhances seed survival and dispersion after animal ingestion, the prostrate growth improving soil covering by plants and resistance to grazing.

Table 1: Accessions means and LSD for each examined character.

Species and Accessions	Stems (n)	Stem max length cm	Pod length cm	Pods plant ⁻¹ (n)	Seeds pod ⁻¹ (n)	1,000 seed weight g	Harvested Seed plant ⁻¹ g	Dry matter plant ⁻¹ g
<i>A. hamosus</i>								
Cala Oliva	37	58	3.1	583	15.9	3.5	20.1	32.7
Pta Capone	30	53	3.4	802	16.8	2.3	23.5	31.6
Stintino	17	51	3.7	438	14.2	2.2	12.2	21.6
Baia Ostina	34	56	2.9	910	14.6	2.2	28.0	45.1
LSD 0.05	ns	ns	ns	ns	ns	ns	Ns	ns
<i>L. cytisoides</i>								
Cala Oliva	30	34	3.7	134	19.9	1.3	1.8	3.9
Pelosa	36	35	4.4	390	20.4	1.3	4.3	4.7
Baia Ostina	44	40	3.6	658	19.2	2.2	5.8	7.1
LSD 0.05	ns	ns	0.2	ns	ns	ns	Ns	1.5
<i>L. edulis</i>								
Cala Reale	22	43	3.7	123	24.3	7.5	18.5	6.9
Cala Oliva	14	36	3.5	76	20.7	7.7	10.5	5.3
Pelosa	15	44	3.5	105	23.8	7.4	14.8	4.4
Lu Riscattu	11	36	3.1	25	24.4	6.6	2.8	1.1
LSD 0.05	7.1	ns	0.2	26	ns	0.4	6.2	0.4
<i>L. ornithopodioides</i>								
Cala Reale	17	41	4.2	766	16.6	1.9	16.4	5.9
P.del Bianco	12	42	4	502	17.1	1.9	11.1	3.4
Sorso	11	41	4.2	656	17.8	1.7	15.2	5
Castelsardo	20	44	4.2	734	17.5	1.8	17	4
LSD 0.05	4.6	ns	ns	ns	0.8	ns	Ns	ns
<i>O. compressus</i>								
Diga	48	75	4.8	667	8.2	3.1	16	14.5
Tumbarino	48	70	4.8	840	8	3.1	18.5	9.6
LSD 0.05	ns	ns	ns	ns	ns	ns	Ns	ns

L. ornithopodioides accessions showed statistically significant differences only for the number of stems and the number of seeds per pod, a peculiarity of the species were the undehiscent legumes kept by the plant after maturity, useful for seed production but less useful for self reseeding, although this character was present at different levels in the examined populations.

O. compressus accessions were not statistically different for all the examined characters, the species was among the most productive in terms of dry matter and harvested seed per plant.

High variability was found within the only *A. tetraphylla* accession. Values ranged from 6.9 to 31.7 g of seeds produced per plant, from 1.2 to 2 seeds per pod, from 143 to 2779 pods per plant, from 23 to 71 cm of stem max length, from 2 to 3.2 g of dry matter yield per plant. The high seed yield obtainable, the prostrate growth, the useful ornamental peculiarity in the swollen calix conformation and color that persist until seed maturation can suggest the employment of *A. tetraphylla* for slopes embellishment.

The harvested seed production inferior to that expected on the basis of the measured seed yield components was mainly due to the presence of not viable seeds in *A. hamosus*, seed shattering because of dehiscent pods at maturity in *L. cytisoides*, not viable seeds and some seed shattering in *L. ornithopodioides*, not viable seeds and seed threshing difficulties in *L. edulis* and *O. compressus*.

As shown on table 2, a high range of dates of flowering was observed, from a minimum of 122 days to flowering in *A. hamosus* to a maximum of 162 days to flowering in *L. Cytisoides*.

A high level of hard seededness, important for maintaining the seed banks from year to year, was widespread among the examined species as it is shown on table 2.

Table 2: Average days to flowering (DTF) and average percentage of hard seeds (HS).

	<i>A. tetraphylla</i>	<i>A. hamosus</i>	<i>L. cytisoides</i>	<i>L. edulis</i>	<i>L. ornithopodioides</i>	<i>O. compressus</i>
DTF (n)	126	122	162	149	157	154
HS (%)	92	82	67	94	90	80

Conclusions

All the examined species could be potentially useful for soil protection purposes in poor soils and dry areas of the Mediterranean basin. Such species surely deserve more attention considering the fact that they showed advantageous characters for species growing in dry regions; according to Roggero and Porqueddu (1999), species growing in dry regions would infact take advantage in early maturing, production of a high number of pods per plant and production of numerous and small sized seeds, the latter considered an ecological and agronomic advantage as it limits competition between reproductive and vegetative growth.

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