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Problems and perspectives of seed production activity of forage ecotypes in Sardinia

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Abstract. In Sardinia the size of forage seed market does not seem to justify the economic convenience of a local production. Nevertheless, apart from economic reasons, several other aspects suggest the opportunity to undertake this activity. The development of seed production involving the native forage species could satisfy the requirement of adapted material to the Mediterranean environment, for pastures improvement and long lasting forage crops. Moreover this activity could represent an extra-income for agro pastoral farms. The high biodiversity of Sardinian pastures allows to exploit and select several native forage species. In the last decade, collection and evaluation studies of spontaneous pastures genotypes have been carried out. An experiment concerning different aspects of forage seed production, from planting to threshing, was planned. Several species (*Medicago arabica*, *M. polymorpha*, *Trifolium cherleri*, *T. glomeratum*, *T. resupinatum*, *T. spumosum*, *Lolium rigidum*, *L. multiflorum* and *Plantago lanceolata*) have been considered in order to study their seed production characteristics and harvestability.

Keywords. Biodiversity – Environment improvement – Ecotype valorisation – Multiuse system – Forage seed production – Harvestability.

Problèmes et prospectives de la production de semences d'écotypes fourragers in Sardaigne

Résumé. En Sardaigne le marché de semences fourragères ne semble pas justifier la convenance économique de réaliser une production locale. Néanmoins, raisons économiques à part, beaucoup d'autres aspects suggèrent la nécessité d'entreprendre cette activité. Le développement de la production de semence d'espèces natives peut satisfaire l'exigence de matériel adapté à l'environnement méditerranéen, pour l'amélioration des pâturages ou pour l'obtention de cultures fourragères durables. D'ailleurs cela peut représenter un revenu supplémentaire pour le secteur agropastoral. La grande biodiversité des pâturages sardes peut permettre d'exploiter quelques espèces natives. Lors de la dernière décennie une étude de collection et d'évaluation d'écotypes de pâturages spontanés a été conduite. Une expérience sur les différents aspects de la production de semences fourragères, du semis à la récolte, a été planifiée. Différentes espèces (*Medicago arabica*, *M. polymorpha*, *Trifolium cherleri*, *T. glomeratum*, *T. resupinatum*, *T. spumosum*, *Lolium rigidum*, *L. multiflorum* et *Plantago lanceolata*) ont été considérées dans le but d'étudier les caractéristiques de la production de semences et les problèmes de la récolte.

Mots-clés. Biodiversité – Amélioration du territoire – Valorisation d'écotypes – Système multi-usage – Production de semences fourragères – Récoltabilité.

I – Introduction

1. Forage seed sector in Sardinia

In Sardinia the most of forage seeds have an extra regional provenience. In 2007, 3,550 tons of seeds were commercialized (48% grasses, 45% legumes, 1.6% other species and 6% mixtures) (ISTAT, 2009). Considering the usual sowing densities, 116,000 hectares of forage crops were cultivated. In particular 41,000 hectares of legumes (32,000 of *Trifolium* spp., 2,000 of alfalfa,

6,000 of vetch, 350 of sulla, 700 of broad bean); 68,310 hectares of grasses (68,000 of *Lolium* spp., 200 of *Festuca* spp. and 110 of *Poa pratensis*); 1,500 hectares of other species and 5,000 hectares of mixtures. In the last twenty years the trend responds strictly to the PAC directives and the agricultural/pastoral crisis. In the decade 1990-2000 forage cultivations registered an increase of 8% from about 185,000 to 200,000 hectares, while other crops decreased, such as cereals (-29%), pulses (-42%), potatoes (-34%) and vegetables (-29%), as well as permanent pastures (-33%, from 790,000 to 525,000 hectares). On the contrary, industrial crops raised from 260 to 10,300 hectares. After the 2000 forage crops have had a decrease of 80,000 hectares, becoming 135,000 hectares in 2008.

According to these data, in Sardinia the small size of forage seed market (about 5-6 millions euros) does not seem to justify the convenience to undertake a local seed production activity. Nevertheless, apart from economic reasons, other aspects suggest the opportunity of its realization, possibly supported by the Institutions.

First, a seed production addressed to the native forage species could fulfil the need of adapted materials for the Mediterranean environments, in order to ensure the success of pastures improvement and forage cultivations in long-lasting and eco-compatible way. Besides, the rising demand for multifunctional uses, such as cover crops for parks, gardens or fruit trees, botanical/didactical/tourist itineraries and re-establishment of degraded areas (escarpments, quarries, fire breaks, etc.) (Osman *et al.*, 1990; Caredda *et al.*, 2002) have to be taken into account.

Sardinian pastures, characterized by high biodiversity (Spanu *et al.*, 1997; Vargiu *et al.*, 2002). represent a source of forage ecotypes useful for forage and/or multiuse purposes, with regard to their specific biometric characteristics.

2. Studies on native forage seeds

In some pastoral sites of Sardinia a collection activity concerning native forage species, though not available on the seed market, was carried out (Vargiu and Spanu, 1999). The most interesting materials were tested in different pedo-climatic conditions for forage and environmental uses (Vargiu *et al.*, 2000, 2008). In the last years, our studies regard the technical-economic possibility to undertake seed production activity of the mentioned ecotypes. The evaluation focuses on their agronomic performances, on the bases of seasonal and annual weather variability.

This paper reports one year observation (2008/2009) concerning seed production characteristics and harvestability of some forage ecotypes.

II – Materials and methods

The trial was carried out in the experimental farm of San Michele (39°10' N, 3°20' E, 150 m a.s.l.) in southern Sardinia (Cagliari), on a medium-deep soil limited in nutrients except for potassium (typic palexeralf soil, USDA Soil Taxonomy). Long term rainfall is 460 mm, scarcely distributed from October to May. Winter temperatures seldom reach 0°C, while average maximum temperature is 32°C in July.

The studied ecotypes belong to the species *Medicago arabica*, *M. polymorpha*, *Trifolium cherleri*, *T. glomeratum*, *T. resupinatum*, *T. spumosum* and *Lolium rigidum*, *L. multiflorum* and *Plantago lanceolata*.

Plots were adapted to use the conventional harvest machineries. Their size ranged from 1.40 hectares to 50 m² depending on seed availability. No experimental design was planned because it was preferred to focus on harvest problems in open field conditions.

The ecotypes were planted on 30 December 2008. It was a late planting owing to continuous rain during the autumn period. Sowing densities for different ecotypes were: *Medicago arabica* and *M. polymorpha* 30 kg/ha, *Trifolium cherleri*, *T. glomeratum*, *T. spumosum*, *Lolium rigidum* and *L. multiflorum* 25 kg/ha, *T. resupinatum* and *Plantago lanceolata* 15 kg/ha.

Fertilization was performed on 18 February 2009 (40 units of nitrogen per hectare). Chemical weeding was performed on 6 April 2009 employing 2,4 DB on legumes and tribenuron methyl on grasses. In spring some cleaning-mowing were done in order to remove the most developed weeds. Flowering dates were monitored. Seed harvesting started on 17 June 2009 utilizing a modified grain thresher. The earliest specie was *Lolium rigidum* followed by *Trifolium* spp., *Plantago lanceolata* and *Lolium multiflorum*. *Medicago polymorpha* was harvested with a "Horwood Bagshaw" vacuum seed harvester. In *T. cherleri*, *T. spumosum* and *T. resupinatum* this machinery was also used to harvest the basal pods sited below the cutting height of grain harvester. *Medicago arabica* pods were picked up manually because of the presence of an annual medic weed with very similar seeds.

III – Results and discussion

The registered annual rainfall was 581 mm (Fig. 1). Persistent rains in autumn and winter caused a late and difficult sowing. Dry conditions in early spring reduced the vegetative growing. Winter temperatures never went below 0°C.

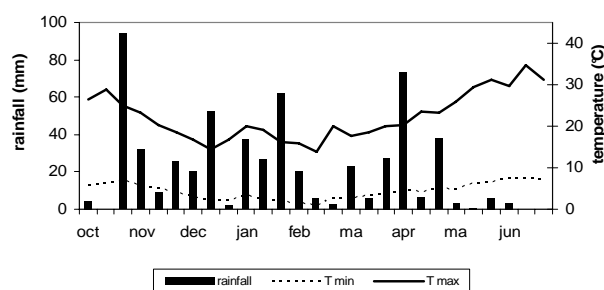


Fig. 1. Thermopluviometric graphic.

The less developed and competitive legumes species (*T. glomeratum*, *T. resupinatum*, *T. spumosum*) were covered by weeds. The treatment with 2,4 DB was not effective on weeds and caused phytotoxic effects.

Concerning flowering *Medicago polymorpha* ecotype proved to be the earliest genotype (7th April, i.e. 10 days earlier *M. arabica* and *Plantago lanceolata*).

The two ecotypes of *T. glomeratum* and *T. resupinatum* showed a difference of 10 days in the flowering date (the 13th and the 22nd May), preserving the characteristics showed in their original sites. Among weeds, a spontaneous annual medic (*Medicago polymorpha* L.) was very widespread. Seed production of *Trifolium* spp. harvested with the grain harvester did not contain seeds from medic weed. On the contrary, seed production of *T. cherleri* and *T. spumosum* harvested with vacuum-seed harvester were not completely separable from the medic weed seeds. The percentage of vacuum-harvested seed yield respect to the total amount ranged from 30% in *T. spumosum* to 60% in *T. cherleri* (Nutt and Loi, 1999).

Seed production of species and ecotypes of the same specie resulted very different in quantity

and characteristics (Table 1). Seed yield ranged from 84 to 485 kg/ha in *M. arabica* and *L. rigidum* respectively; 1000 seed weight ranged from 0.3 g in *Plantago lanceolata* to 3.2 g in *L. rigidum*. The number of seeds per square metre ranged from 3,994 in *M. arabica* to 66,940 in *Plantago lanceolata*.

Table 1. Seed production parameters of ecotypes

Specie and accession	Plot size (m ²)	Plot yield (kg)	Yield per hectare (kg)	1000 seed weight (g)	Seed number N/m ²
<i>Plantago lanceolata</i> 133	400	8.08	202	0.302	66,940
<i>Lolium multiflorum</i> 96	50	0.65	130	2.555	5,096
<i>Lolium rigidum</i> 144	400	19.41	485	3.220	15,069
<i>Trifolium cherleri</i> 16	400	8.78	219	2.085	10,523
<i>Trifolium glomeratum</i> 40	400	6.04	151	0.445	33,944
<i>Trifolium glomeratum</i> 128	400	11.22	281	0.308	53,595
<i>Trifolium resupinatum</i> 122	200	2.41	120	0.573	20,995
<i>Trifolium resupinatum</i> 125	50	0.65	129	0.483	26,791
<i>Trifolium spumosum</i> 87	400	9.15	229	1.928	11,867
<i>Medicago arabica</i> 63	300	2.51	84	2.093	3,994
<i>Medicago polymorpha</i> 74	14,100	530.00	376	2.677	14,041

IV – Conclusions

The studied ecotypes showed different performances for seed production. In Mediterranean environment, especially for the less competitive legumes, the weed control is the main problem. Given the inefficacy of chemical control, it would be necessary to study some agronomic strategies such as: "false sowing", crop rotations and conservative soil tillage techniques (Giambalvo *et al.*, 1999a,b) in order to reduce the impact of weeding.

The present agricultural/zootechnical crisis makes it difficult to evaluate the convenience to undertake a forage seed production activity in Sardinia only on the basis of economic reasons. On the other hand, the importance to save and valorise the local pasture plants biodiversity and the necessity of adapted materials to our environment (Loi *et al.*, 1995), for pasture improvement, forage crops and multiuse systems, suggest to continue this activity with the aim to develop the local seed production of native forage ecotypes.

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