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# Seed production of native Mediterranean forage species

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**Abstract.** Sardinian pastures are well adapted to weather conditions of the Mediterranean basin, where the precipitation mainly falls in autumn-winter and absent in summer. Rainfall is the most critical climatic parameter affecting the forage seed yield due to its annual and seasonal variability. For example, in San Michele experimental farm (Southern Sardinia, Italy), the last 4 years rainfall showed significant annual (from 320 to 682 mm) and seasonal variations. These conditions point out the need to identify and develop resilient forage species that are not currently available in the Sardinian seed market. Several years ago, some forage ecotypes were selected from Sardinian pastures biocoenosis. Nowadays, our studies aim to focus on seed production of *Tetragonolobus purpureus* Moench, *Trifolium spumosum* L. and *Medicago scutellata* (L.) Miller, that require different harvesting and selection strategies owing to their specific morpho-physiological characteristics. This paper reports some preliminary data and observations on the difficulty in seed harvesting of these three ecotypes. Results show that harvesting with a common cereal harvester machine has been effective for *Tetragonolobus purpureus* Moench, while unsuitable for *Medicago scutellata* (L.) Miller.

Keywords. Biodiversity - Native forage species - Sardinian pastures - Seed production.

#### Production de semences d'espèces fourragères indigènes méditerranéennes

**Résumé**. Les pâturages sardes sont bien adaptés aux conditions météorologiques méditerranéennes, où les précipitations, concentrées en automne-hiver et absentes en été, sont le paramètre le plus critique en raison de la variabilité annuelle et saisonnière. Par exemple, à la ferme expérimentale de San Michele (Sardaigne du sud, Italie), les précipitations des quatre dernières années ont montré des différences significatives à la fois annuellement (de 320 à 682 mm) et notamment saisonnières et mensuelles. Ces conditions soulignent la nécessité de cultiver des espèces fourragères résilientes qui, pour le moment, ne sont pas disponibles sur le marché des semences en Sardaigne. Il y a plusieurs années, quelques écotypes fourragers ont été sélectionnés parmi la biocénose des pâturages sardes. Nos études sont actuellement destinées à visent la production de semences de Tetragonolobus purpureus Moench, Trifolium spumosum L. et Medicago scutellata (L.) Miller, qui nécessitent des stratégies de récolte et de sélection différentes en raison de leurs caractéristiques morpho-physiologiques spécifiques. Cette étude présente des données préliminaires et des observations sur les trois écotypes concernant la difficulté de la récolte des semences. La récolte avec une machine ordinaire de céréales s'est avérée efficace pour Tetragonolobus purpureus Moench, bien qu'elle ne convienne pas pour Medicago scutellata (L.) Miller.

Mots-clés. Biodiversité – Espèces fourragères indigènes – Pâturages sardes – Production de semences.

## I – Introduction

In Sardinia, native pastures show a high biodiversity (Spanu *et al.*, 1997; Vargiu *et al.*, 2002) and its botanical species, particularly legumes, as well as feeding livestock, contribute to good agricultural practices (rotations, green manure, grassing) and to multiuse systems (environmental restoring, gardening, honey production, gastronomic, medicinal) (Osman *et al.*, 1990).

At present, the forage seed available on the market is expensive and often does not guarantee the expected results. The varieties are not selected for Sardinian pedo-climatic and agro-ecological conditions, where rainfall, generally concentrated in the cold season, is the most critical climatic parameter

given that forage crops are generally grazed in winter and mown for hay in spring. Rainfall presents a high seasonal and annual variability; in San Michele experimental farm located in Southern Sardinia (Italy), rainfall in the last four years registered significant annual differences with respect to the average, ranging from 62% to 135%, as well as an overall seasonal or monthly variability. These conditions point out the need to promote a local seed activity based on forage ecotypes selected from pastures in order to guarantee the availability of resilient Mediterranean species. However, in Sardinia, the low level of forage seeds purchases, amounting to about 5-6 million euros annually calculated on the basis of crops areas (ISTAT), does not seem to justify its economic convenience. Nevertheless, other reasons, apart from the merely economic ones, suggest to undertake seed production activity and its support by the Institutions. First of all, the preservation of territory, considering that Sardinia includes the 25% of Italian pasture, and furthermore the need to guarantee success and ecocompatibility of forage crops and multiuse in the Mediterranean environment.

Several ecotypes locally collected, belonging to different species, are currently under evaluation both for forage and environmental aims (Vargiu and Spanu, 1999; Vargiu *et al.*, 2000; Vargiu *et al.*, 2008; Vargiu and Franca, 2008). To assess the agronomic interest of the ecotypes, it is necessary to consider their capacity for establishment and development, the presence of weeds, the potential yield, the forage quality and the ease of seeds harvesting. As regards the multifunctional interests, it is particularly important to know the different specific characteristics (e.g. habitus, colour of flowers, particularity of legumes, biodiversity). The first evaluations, carried out in different environmental conditions, focused on the traditional self-reseeding legumes (subterranean clovers and annual medics) due to their productive aspects, both quantitative and qualitative. An ecotype of *Medicago scutellata* (L.) Miller proved to be very interesting in terms of its productivity performances. The main obstacle to commercial spreading of these species lies on the difficulty of seed harvest that is performed by suction because the ripe pods fall down to the ground. Our studies focused on species that can be easily harvested with cereals threshers and in particular to the ecotypes of *Tetragonolobus purpureus* Moench and *Trifolium spumosum* L. in order to overcome the difficulties of seed harvesting (Vargiu and Spanu, 2016).

In this context, the current paper reports some *ex situ* observations of these three ecotypes, as regards the biological cycle and in particular the technique of seed harvest that is a key node in the seed production activity.

# II – Materials and methods

Seeding of the three local genotypes of *Medicago scutellata* (L.) Miller, *Tetragonolobus purpureus* Moench and *Trifolium spumosum* L. was carried out at San Michele experimental farm (Southern Sardinia, Italy), on November 21, 2014. The site is characterized by a medium-deep soil limited in nutrients except for potassium (typic palexeralf soil, USDA Soil Taxonomy) and Mediterranean climatic conditions. Long term rainfall of 460 mm is distributed from October to May with a large annual and seasonal variability. Winter temperatures seldom reach 0°C, while maximum temperature average is 32°C in July.

The plot size was 10 m<sup>2</sup> with 3 replications. The sowing was done in eight rows 18 cm apart using an experimental plot seeder (Hege 80). The seeding rates are shown in Table 1. During the development, phenological cycle was observed.

Seed was harvested with a cereal combine modified for small seeds (Nutt and Loi, 1999); pods positioned at the lower height of the cutter bar were manually collected.

Seed yield data were not statistically analysed, because of the high differences in the morpho-physiological characteristics (habitat, earliness, pods and seed size) of the three ecotypes.

## III – Results and discussion

Biological cycle analysis showed significant earliness differences (Table 1). In the pastures, the different phenological characteristics determine the lengthening of the flowering period, useful for honey production and amenity aims.

| Table 1. S | eeding density, | phenological | cycle of the | different forage | ecotypes and | d seed ha | vest date |
|------------|-----------------|--------------|--------------|------------------|--------------|-----------|-----------|
| ir         | n 2015          |              |              |                  |              |           |           |

| Ecotypes                 | Seeding density<br>kg ha <sup>-1</sup> | Beginning<br>of flowering | 50% of flowering | Full flowering | Harvesting |
|--------------------------|--|---------------------------|------------------|----------------|------------|
| Medicago scutellata      | 80 kg/ha                               | 9 April                   | 13 April         | 17 April       | 11 June    |
| Tetragonolobus purpureus | 80 kg/ha                               | 1 April                   | 5 April          | 13 April       | 5 June     |
| Trifolium spumosum       | 30 kg/ha                               | 23 April                  | 29 April         | 2 May          | 11 June    |

The harvest represents a critical phase of the seed production activity, due to the strategies that the species put into action (prostrate bearing, scalar maturation, spontaneous dissemination) to spread and persist under the Mediterranean conditions and grazing. *Tetragonolobus purpureus* was totally collected by the harvester cereal machine; in the other ecotypes, after harvesting, the residual pods in the field were manually harvested (Table 2) in a variable ratio on the total seed production from 53% (*Trifolium spumosum*) to 92% (*Medicago scutellata*).

| Ecotypes                 | Harvest<br>machine | Manually collecting | Total<br>weight | % harvester<br>machine | 1000 seed<br>weight | Seeds<br>no./m <sup>-2</sup> |
|--------------------------|--------------------|---------------------|-----------------|------------------------|---------------------|------------------------------|
| Medicago scutellata      | 65.0               | 700.3               | 765.3           | 8                      | 19.6                | 3905                         |
| Tetragonolobus purpureus | 248.2              | _                   | 248.2           | 100                    | 23.8                | 1043                         |
| Trifolium spumosum       | 299.7              | 337.8               | 637.5           | 47                     | 1.7                 | 37500                        |

| Table 2. Seed production (g 10 m | ) collected with harvester and/or manually | / and number of seeds for m <sup>2</sup> |
|----------------------------------|--|--|
|----------------------------------|--|--|

# **IV – Conclusions**

In Sardinia, native pastures represent a seed bank useful for forage and multifunctional aims. A local seed production activity of native forage species could meet the requirement of adapted materials to the Mediterranean environment, for pastures improvement, long lasting forage crops growing and multiuse systems. Moreover, this activity could represent an extra-income for agro-pastoral farms.

Given the current agricultural crisis and the still unresolved seed harvesting technique, it is difficult to start-up a native seed production activity towards as "merely forage species"; instead, it also ought to spread their market by addressing to multiuse systems. Moreover, especially for certain uses (gardening, gastronomic and medical, etc.) the valorisation could requires different packaging from the usual ones and lighter than the classic 25 kg format for sale in agriculture.

Furthermore, the marketing strategies could be useful to support the sustainability of forage seed production from the economic point of view.

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