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in

López-Francos A. (ed.), Jouven M. (ed.), Porqueddu C. (ed.), Ben Salem H. (ed.), Keli A. (ed.), Araba A. (ed.), Chentouf M. (ed.).
Efficiency and resilience of forage resources and small ruminant production to cope with global challenges in Mediterranean areas

Zaragoza : CIHEAM

Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 125

2021

pages 605-609

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

<http://om.ciheam.org/article.php?IDPDF=00008073>

To cite this article / Pour citer cet article

Zirmi-Zembri N., Kadi S.A. **Use of *Sulla flexuosa* (*Hedysarum flexuosum*) by breeders in Kabylia (Algeria).** In : López-Francos A. (ed.), Jouven M. (ed.), Porqueddu C. (ed.), Ben Salem H. (ed.), Keli A. (ed.), Araba A. (ed.), Chentouf M. (ed.). *Efficiency and resilience of forage resources and small ruminant production to cope with global challenges in Mediterranean areas*. Zaragoza : CIHEAM, 2021. p. 605-609 (Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 125)



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Use of *Sulla flexuosa* (*Hedysarum flexuosum*) by breeders in Kabylia (Algeria)

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Abstract. *Hedysarum flexuosum* (*Sulla flexuosa*) is a forage legume endemic to North Africa and south of Europe. Unfortunately, although its nutritional value, equal or even higher than alfalfa, this resource is classified as endangered because it spontaneously grows and is not cultivated. However, it could play a leading role in the resorption of the fodder deficit in Algeria. In order to contribute to the conservation of *Sulla flexuosa*, the collection of information on the uses of this legume by the populations is one of the most important stages. For this, from April to May 2018, an investigation focusing on the use of this legume was carried out by individual interviews of 105 breeders spread throughout the Tizi-Ouzou region in Algeria. The *Sulla* is reported in about twenty communes (districts) across the wilaya (region) where its appearance is mostly noticed by farmers in December (19.8%) or February (20.7%). For half of the breeders, *Sulla* grows mainly on sloping ground. While the vast majority (84%) distinguish between the two forms (plagiotropic or orthotropic), only about half (45.3%) maintain that it is biennial and nearly one-third (34%) think it is annual. It is the totality of the breeders who uses it in animal feeding and which signal its use also in human food. In animal feed, three quarters of breeders use it as green (feeding to the trough or pasture). The combination of the scientific research results combined with traditional and ancestral knowledge must be the basis of all breeding and genetic improvement programs leading to domestication of *H. flexuosum*.

Keywords. *Sulla flexuosa* – Fodder – Breeding – Kabylia – Algeria.

Utilisation du *Sulla flexuosa* (*Hedysarum flexuosum*) par les éleveurs en Kabylie (Algérie)

Résumé. Le *Sulla flexuosa* (*Hedysarum flexuosum*) est une légumineuse fourragère, endémique du Nord de l'Afrique et le Sud de l'Europe. Bien que sa valeur nutritive soit égale ou supérieure à la luzerne, cette espèce est classée en voie de disparition du fait qu'elle pousse d'une manière spontanée et n'est pas cultivée. Dans l'objectif de contribuer à la conservation du *Sulla flexuosa* (*Hedysarum flexuosum*), le recueil d'informations sur les usages de cette légumineuse par les populations est une des étapes les plus importantes. Une enquête ethnobotanique mettant l'accent sur l'usage fourrager de cette espèce a été réalisée en 2018 par interviews individuelles de 105 éleveurs répartis sur la wilaya de Tizi-Ouzou. Le *Sulla* est signalé dans une vingtaine de communes à travers la wilaya où son apparition est surtout remarquée par les éleveurs en Décembre (19,8 %) voire en Février (20, 7%). Pour la moitié des éleveurs, le *Sulla* pousse surtout sur les terrains en pente. Si la grande majorité (84%) distingue les deux formes plagiotrope et orthotrope, seulement près de la moitié (45,3%) soutiennent qu'elle est bisannuelle et près d'un tiers (34%) pensent qu'elle est annuelle. La totalité des éleveurs l'utilise en alimentation animale et signalent son utilisation aussi en alimentation humaine. En alimentation animale, trois quart des éleveurs l'utilise en vert (affouragement à l'auge ou pâturage). La conjugaison des résultats de la recherche scientifique (sur la morphologie, la phénologie, la biochimie et la valeur nutritive) et du savoir traditionnel et ancestral doit être le socle de tous les programmes de préservation, de sélection, d'amélioration génétique débouchant sur la domestication de *H. flexuosum*.

Mots-clés. *Sulla flexuosa* – Savoir ethnobotanique – Alimentation – Élevage – Kabylie – Algérie.

I – Introduction

In Algeria, spontaneous flora is estimated by Abdelguerfi and Ramdane (2003) at about 3139 species. Most of the forage and pastoral resources come from natural environment (Abdelguerfi *et al.*, 2000). To enrich the knowledge of useful spontaneous species, ethnobotanical surveys are necessary

(Kébenzikato *et al.*, 2015). The genus *Hedysarum* is composed of a large number of species including annual and perennial forage, widely distributed around the world (Le Houérou, 2001). In Algeria, there are several species that are highly localized (Abdelguerfi-Berrekia *et al.*, 1988). Among these species, *Hedysarum flexuosum* characterized by an Ibero-North African distribution (Ben fadhel *et al.*, 2006), endemic to north-central Algeria (Abdelguerfi-Berrakia *et al.*, 1991) and develops in regions with average rainfall greater than 550 mm (Abdelguerfi and Laouar, 1999). This legume could play a major role in reducing the fodder deficit in the country. Unfortunately, although its nutritional value is equal or even higher than alfalfa (Kadi *et al.*, 2011; 2012; Zirmi-Zembri and Kadi, 2016), this resource is classified as endangered (Groom, 2012) because it grows spontaneously and is not cultivated. In order to contribute to the conservation of *Sulla flexuosa* by its valorization, the collection of information on the uses of this legume by the populations is one of the most important stages.

II – Materials and methods

This study was carried out on the whole territory of the wilaya (district) of Tizi-Ouzou (<http://wilaya-tiziouzou.dz/>), which is located between 36°43' and 36°91' of latitude North and between 3°79' and 4°72' of longitude East and which covers an area of 3993 Km². It is located in the north of Algeria, 100 km east of the capital Algiers. This wilaya has one of the highest afforestation rates in the country (38%), due to favorable bioclimatic conditions (subhumid and humid), is mostly mountainous relief. For geographical and historical reasons, it has remained relatively isolated and agro-industrial development has not led to a significant decline in customary practices (Meddour *et al.*, 2009).

Firstly, we carried out a pre-survey coupled with a bibliographical search on the presence of *Hedysarum flexuosum* at the Tizi-Ouzou wilaya. In addition, we used the database created on this legume at our laboratory of animal nutrition and animal products at the Department of Agronomy at the Faculty of Biological and Agronomic Sciences of the Mouloud Mammeri University of Tizi-Ouzou.

It includes questions on the different uses of *Sulla flexuosa* in the food, feed and medicinal fields. Survey fact sheets have been drawn up which provide information on *Sulla* identification by farmers, the various uses of *Sulla* for human and animal consumption and long-term prospects and strategies. In this paper, only the aspect relating to the forage character of the plant will be developed. The data were collected from April to May 2018 through direct and individual interviews of 105 breeders taken at random.

The data collected was coded and entered into a spreadsheet file on the Microsoft EXCEL® 2013 software. For this preliminary study, only the frequency calculation was used using the Stat Box® V.6.4 software.

III – Results and discussion

A total of 105 survey cards were completed. The majority of respondents are over 30 (73.58%) and male (100%). The *Sulla* is reported in twenty communes (sub-district) out of the 67 in the wilaya.

The plants of *Sulla flexuosa* are noticed by the breeders especially in December (near 20%) or in February (close to 21%). 52% of breeders were reported from September to December (Fig. 1). This difference in the date of appearance of *Sulla* can be explained by the fact that germination of this plant dependent on the first autumn rains which must be early and abundant for the emergence of integumentary dormancy. According to Medjebeur *et al.* (2018), the delay in germination increases with the severity of both water and salt stress.

For half of the farmers (51.8%), *Sulla* grows mainly on sloping land, and for one third (37.74%) of them, it is present on plots with a mixed relief of the flat and the slope. Only one-tenth of breeders (10%) encounter it on flat soils only (Fig. 2). According to Abdelguerfi-Berrekia *et al.* (1991), *H. flexuosum* is able to provide very interesting yields on sloping marl soils, soils with difficult and marginal topography and low productive potential.

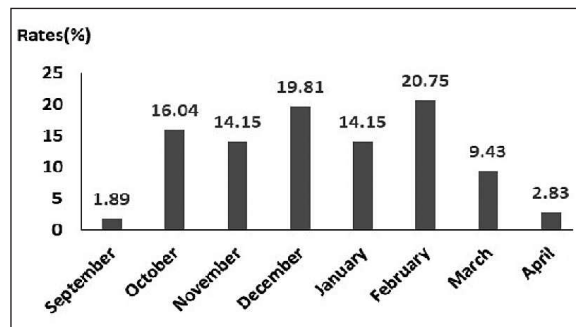


Fig. 1. Month of appearance of *Sulla flexuosa* in the study area according to the breeders.

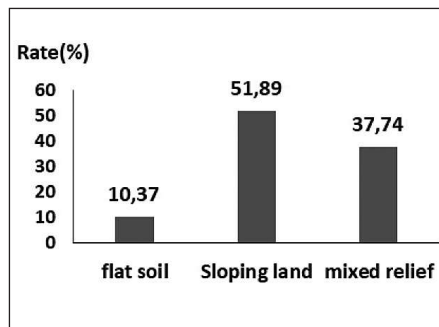


Fig. 2. Frequency of the different reliefs of plots in *Sulla flexuosa* according to the breeders.

The vast majority of breeders (84%) distinguish the two plagiotropic and orthotropic forms of *Sulla* populations (Fig. 3) irrespective of the region, which corroborates the results of Ben Fadhel *et al.* (2006) for which, the Algerian populations of *Sulla flexuosa* are distinguished in particular by an erected port with intense branching and leaves with a large number of leaflets. This character is of great importance for the exploitation of this forage by allowing modes of manual and / or mechanical mowing. The plants with strict plagiotropic ports are only present by 2.83% of the breeders surveyed against 13.21% of strictly erect (orthotropic) plants.

Nearly half of the respondents (45.3%) say that *Sulla flexuosa* is biannual and nearly one third (34%) think it is annual (Fig. 4). The irregularity of appearance of this forage species is related to the abiotic factors of the region and mainly the precocity and the intensity of the precipitations. According to Bell *et al.* (2003), *Sulla flexuosa* is an annual species and the degree of seed softening in *Hedysarum* sp. is an important selection criterion in the development of new cultivars.

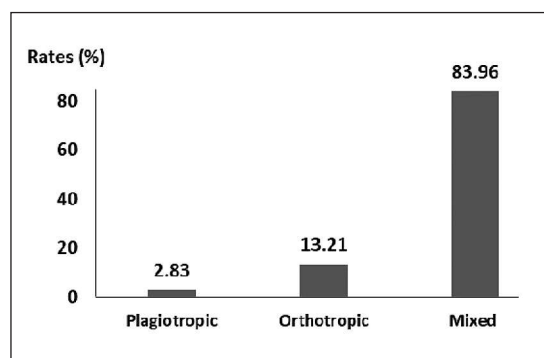


Fig. 3. Frequency of the different architectures of *Sulla flexuosa* according to breeders.

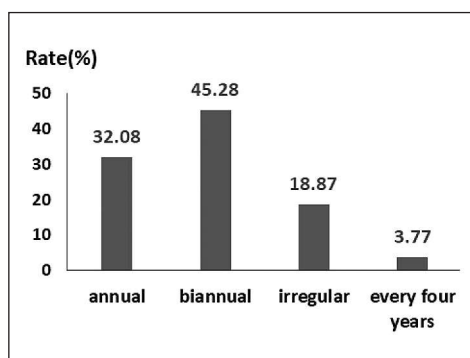


Fig. 4. Frequency of cyclicity of *Sulla flexuosa* according to breeders.

All the breeders surveyed use *Hedysarum flexuosum* for animal feed but also indicates its use in human nutrition.

In animal feed, three quarters of breeders (75%) use it in green, whether for feeding at the trough or grazing (Fig. 5). Natural populations of *Hedysarum flexuosum* provide winter and spring grazing with good nutritional value (Abdelguerfi-Berrakia *et al.*, 1991). Around the world, the use of *Sulla* is reported in sheep feeding (Bonanno *et al.*, 2011), goats (Di Trana *et al.*, 2015), cows (Chaves *et al.*, 2006) and rabbits (Kadi *et al.*, 2011 and 2012). This legume is an effective example of a multipurpose species also exploited for environmental protection, landscape enhancement and honey production (Jerković *et al.*, 2010).

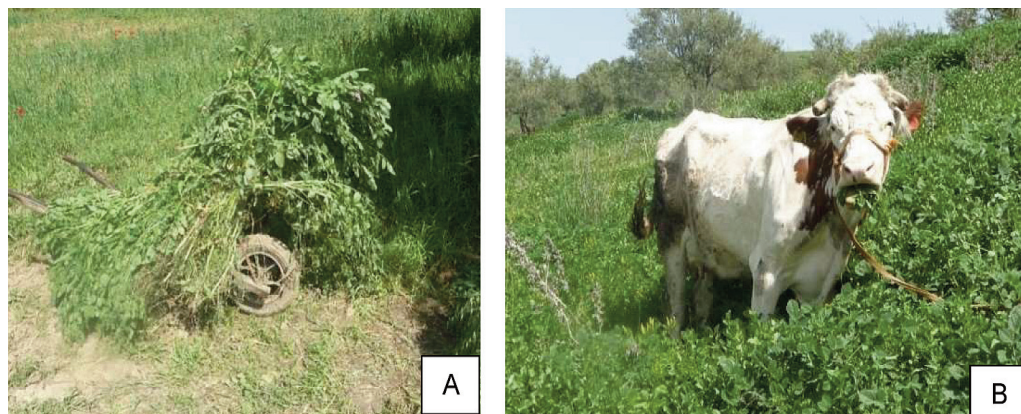


Fig. 5. Use in green *H. flexuosum*, the most popular mode in the study area. A: harvested for feeding at the trough. B: In pasture.

IV – Conclusions

Sulla flexuosa, spontaneous forage resource, is widely used in livestock feeding in this rearing area. It is used in green, pasture or forage at the trough and / or dry in the form of hay.

In a context of global warming and the need to ensure food security, it is imperative to implement the means necessary for its domestication and recovery.

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