

## RESILIENT AGROSILVOPASTORAL SYSTEMS

### CGIAR RESEARCH PROGRAM ON LIVESTOCK

Aims to increase the productivity of livestock agri-food systems in sustainable ways across the developing world.

## Managing agrosilvopastoral systems: promoting native forage legume species

***Hedysarum carnosum* Desf.:** an important halophytic pastoral legume that tolerates stressful conditions in arid and semi-arid rangelands

Dryland pastoral landscapes are characterized by unpredictable climate change and frequent ecological disasters such as drought and livestock diseases. The impacts of climate change will lead to more droughts that will affect millions of people in the world's poorest regions. In addition, dryland inhabitants are increasingly affected by climate change as the resources to which they have access are marginal in nature. Facing such constraints, forage legumes – including the genus *Hedysarum* (sulla) – have many advantages for use in improvement of rangelands and forage production.



**Scientific name:**  
*Hedysarum carnosum*  
Desf.

**Common names:**  
Sulla carnososa, sulla of Sousse,  
سلة سوسة

**Location:**  
Tunisia, Algeria, Morocco,  
Malta, southern Italy &  
Spain

### Benefits:

- Good development with annual rainfall of 300 mm
- Adapted to regions with cool winters
- Occurs in elevated and lower arid zones
- Very high yields even under stressful conditions (6–10 t of DM per ha)
- Leaves produce 300 kg of nitrogen per ha
- Tolerates up to 18 g of NaCl per L
- Tolerant to drought stress (25% relative water soil content)
- Highly palatable to ruminants, 0.6 FU per kg DM
- Can desalinize moderately salt-affected soil
- Melliferous plant (15 hives per ha)

Recent research has paid increasing attention to halophyte species, as they tolerate not only salinity, but also several other stresses. In this context, sulla carnososa or sulla of Sousse (*Hedysarum carnosum* Desf.) is a halophytic pastoral legume that tolerates stressful conditions (it tolerates up to 18 g salt per L). Indeed, it can remove salt from salt-contaminated soil. This plant can maintain its maximum biomass production potential mainly due to the maintenance of Na<sup>+</sup> concentration and water content. In addition, it is able to absorb the major nutrients despite the presence of salt in soil solution.

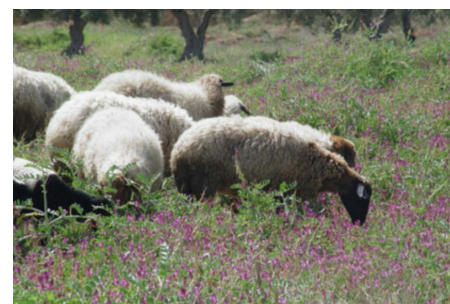
*Hedysarum carnosum* belongs to the extra-zonal ecological group of more or less argilophilous messicolous plants of semi-arid regions, where it can achieve good development with annual rainfall of 300 mm. It occurs in elevated arid zones, and also in lower zones but does not tolerate inundation. It can also be found in regions with cool winters, with average rainfall of 100–150 mm.



*Hedysarum carnosum* mature pods



*Hedysarum carnosum* at flowering stage, central Tunisia



Sheep grazing *Hedysarum carnosum*, central Tunisia

*Hedysarum carnosum* is tolerant to drought at the germination stage (58.5–80.3% germination at an osmotic pressure of –20 bar) and can maintain a significant photosynthetic area despite severe water stress. This species has a great capacity to maintain its hydrated tissue at 25% of useful water reserve in the soil and can yield 10.56 g dry matter (DM) per plant and 15.84% of total nitrogen per g DM. This ability to maintain a good production capacity under conditions of high water-deficit is related to its physiological and morphological mechanisms of tolerance. At salinity of 15 g per L, *H. carnosum* can maintain a germination rate of 67.6%. It is able to provide 60% of its control yield at 300 mM of NaCl, which is related to its tolerance mechanisms – particularly maintaining a significant photosynthetic area, good tissue hydration, and high osmotic adjustment capacity even under conditions of high salinity.

*Hedysarum carnosum* is an excellent rotational crop, especially with wheat, since it both cleanses and enriches soil for which the risk of erosion is considerable and there is a lack of organic matter. It is also a palatable species used for animal feed, honey production, and protecting soil against erosion. *H. carnosum* improves soil structure and increases its fertility in nitrogen and organic matter. As a leguminous plant it is able to nodulate, and its nitrogenous matter has digestibility of 47.5%.

### Establishment and Management

Successful growth of *H. carnosum* requires preparing the seedbed well in advance; soil should be prepared with 20–25 cm tillage or a chisel pass at 30–35 cm depth.

Clean and not too-thin soil is strongly recommended. Seeds in pods should be sown from the beginning of September to mid-October, and shelled seeds from the end of September until the beginning of October. Seeding in December should be avoided.

#### Contact

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Sowing rate is 30–40 kg of seeds in pods per ha and 10–15 kg of shelled seeds per ha. The use of manure for is beneficial for *H. carnosum* establishment and development but is not advisable for economic reasons and because it is a pioneer plant that establishes well in poor soil. Depth of seeding depends on the seed type used and the sowing date. Seeding is generally superficial: 2–3 cm deep for shelled seeds and 5 cm for seeds in pods.

With its high dry matter yields (5–6 and 6–10 t of DM per ha in first and second year, respectively) and ease of cutting, *H. carnosum* is suitable for green forage, grazing, or hay or silage. It should be cut at early flowering as the stems can become woody after flowering and quality will be much lower despite higher yields. In addition, this plant can leave about 300 kg per ha of nitrogen in the soil, which enhances interest in its use in rotation with cereals.

### Effective Management

- Good seedbed: 20–25 cm tillage or a chisel pass at 30–35 cm depth.
- Time of seeding: from September for seeds in pods and end of September until the beginning of October for shelled seeds
- 30–40 kg/ha of seeds in pods and 10–15 kg/ha of shelled seeds
- Depth of seeding: 2–3 cm deep for shelled seeds and 5 cm for seeds in pods
- Dry matter yields: 5–6 t of DM/ha in first year and 6–10 tons of DM/ha in second year
- Suitable as green forage crop or grazing or for hay or silage
- Can leave about 300 kg/ha of nitrogen in the soil

#### ICARDA's Rangeland Ecology and Forages unit (REF)

The REF team promotes advances in rangeland ecology and pasture management in the dry areas. This series of factsheets is dedicated to the characterization of promising range and forage species aimed at alleviating the feed gap, limiting water runoff and soil erosion, restoring degraded rangelands and maintaining a healthy ecosystem.