Evaluation and valorization of Medicago laciniata, Medicago minima and Medicago truncatula populations originating from the central steppe and their symbionts

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INTRODUCTION

Forages occupy a fundamental place in the agricultural context. The development of fodder resources is not only the most logical and rational form for producing milk and meat for human consumption, but also an important element for development and protection of territories.

The insufficiency of fodder and pastoral production constitutes a great obstacle to the development of animal husbandry in Algeria. Among crops reliable to promote pastoral zones that produce forage and restore destroyed pasture land especially in arid and semi-arid areas, the genus *Medicago* L. (Fabaceae) constitutes an important genetic resource. Legumes of the genus Medicago are of special ecological and agropastoral importance in the Mediterranean regions. They are excellent candidates for pastures and cover crops in sustainable agriculture systems, such as pastures and cover crops. Medics produce high levels of good quality forage are used extensively throughout dryland farming regions of the world. They show a high potential for seed and forage production, and self regeneration ability and expressing high levels of N-fixation and protein production per hectare.

Rhizobia-legume symbiosis represents one of the most productive nitrogen-fixing systems and effectively renders the host plants to be more or less independent of other nitrogen sources and is one of the effective methods to improve the plant growth and productivity . Symbiosis between legumes and rhizobia is a classic mutualistic relationship. In return for carbohydrates provided by the host legume, the rhizobia supply nitrogen to the legume. This symbiosis provides the necessary nitrogen for plant growth and contributes to the improvement of the soil nitrogen status. The knowledge about the diversity in natural population pertaining to different stresses is necessary before the selection and application of the tolerant strains of rhizobia for biological nitrogen fixation.

Several studies have been carried out as part of research projects and institutional activities with the aim of selecting high-performing populations and strains in order to improve forage systems.

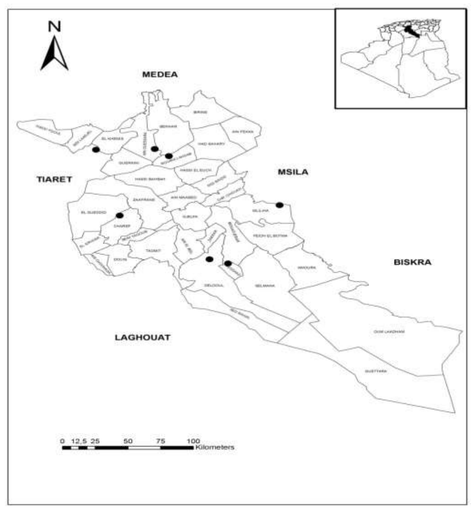
OBJECTIVSS

- Preservation of local plant genetic resources of *Medicago* L genus.
- Evaluation of different local populations of annual *Medicago* collected in different area of Algerian steppe.
- Select high-performing populations in terms of forage production, seed production, and tolerance to water deficit.
- Physiological characterization of associated *Rhizobium* strains.
- Establishment of a *Rhizobium* collection strains that nodulate populations of *Medicago* L genus .
- Improvement and diversification of forage and pasture production.
- Development of livestock farming in steppe areas.

RESEARCH ACTIVITIES

Plant case :

The plant material used in different studies consists of populations of three annual alfalfa species: *Medicago laciniata*, *Medicago minima* and *Medicago truncatula*. These populations were collected in different sites of Djelfa area by the National Institute of Agronomic Research of Algeria (INRAA) in 2005 and 2008.



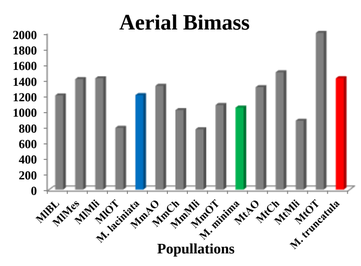
This plant material was the subject of the following studies:

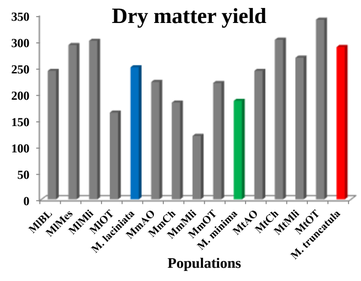
- **Biometrics** of pods and seeds. This was carried out on the collected plant material.
- **Morphological characterization**. This study focused on the aerial plant parts, root system, and nodules.
- **Agronomic evaluation** of populations (phenology, forage yield, and pod and seed yields).
- **Relationship** between nodulation and plant growth.
- Effect of **water stress** on plant growth, root development, and nodulation.

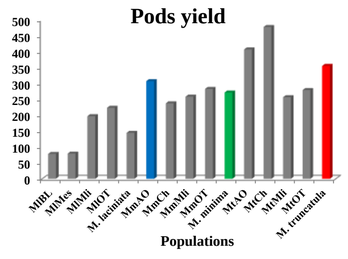
Rhizobium Case :

- **Isolation and extraction of strains:** Rhizobium strains were isolated from nodules collected from plants of different populations of the three species (Medicago laciniata, Medicago minima, Medicago truncatula). Extraction was performed from a nodule under aseptic conditions (in a laminar flow hood). The isolates obtained were stored at 4°C.
- **Physiological characterization:** Physiological characterization included the effects of temperature, salinity, and pH on the growth of the isolated strains, as well as their tolerance to water stress. Tolerance of isolates to high temperature was tested at 30, 32, 35, 40 and 44 °C. The ability of isolates to grow at different concentrations of NaCl was tested at 200, 400, 600 and 800 mM. Tolerance to extreme pH was tested at different pH values adjusted to 5.5, 6.5, 7.5, 8.5 and 9.5. The water stress tolerance of the isolated strains was evaluated using four concentrations of polyethylene glycol (PEG 6000): -0.25, -0.5, -1 and -1.5 MPa.

RESULTS







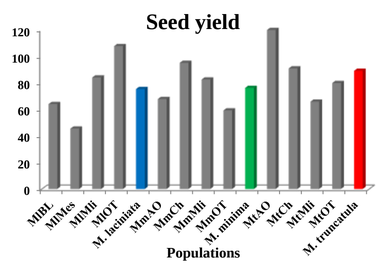
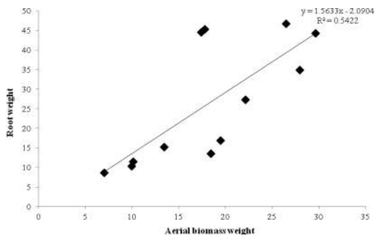
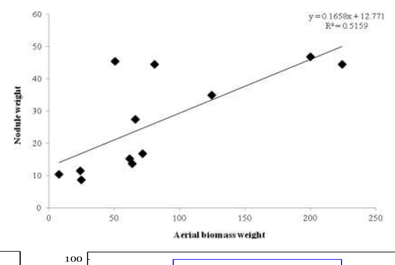
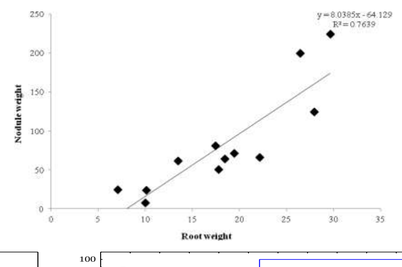


Figure 1: Evolution of forage and grain yields in *M. laciniata*, *M. minima* and *M. truncatula* populations.







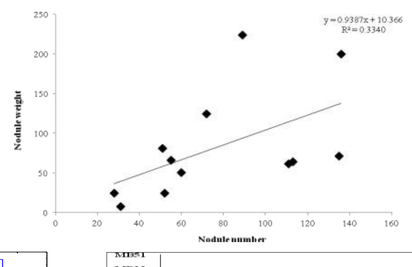


Figure 2: Relationships between plant growth and nodulation traits .

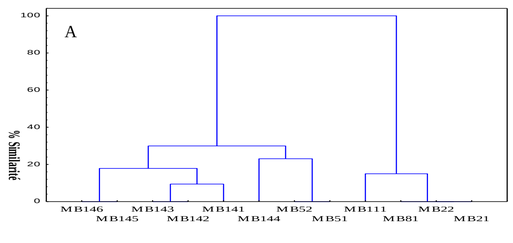


Figure 3: Dendrogram showing relationships among isolated strains based on physiologic characteristics:
A: pH
B: Nacl
C: T°
D: Combined ph, Nacl and T°