Several experiments, mostly carried out under controlled conditions, have shown that arbuscular mycorrhizal (AM) symbiosis enhances nutrient uptake and improves drought tolerance of host plants.

The aim of this field experiment, carried out in a typical Mediterranean environment, was to determine the effect of AM symbiosis on forage yield, quality, and biological N₂ fixation of berseem (*Trifolium alexandrinum* L.) grown under both late drought stress and well-watered conditions.

### Materials and Methods

**Treatments were:**
1. **soil moisture regime:** rainfed (drought stress) or well-watered during regrowth.
2. **crop mycorrhization:** AM inoculation (+Myc) or AM suppression (–Myc). AM suppression was achieved by spraying plots with systemic fungicides once per month starting from sowing. AM inoculation involved the application of a commercial AM inoculum (*Glomus intraradices* and *G. mosseae*). Minimal rainfall occurred during the spring (61 mm, 55% below long-term average), resulting in late drought stress conditions for crops in the rainfed treatments. Well-watered crop received sprinkle irrigation (total of 90 mm, starting at 116 days after sowing [DAS]). A split-plot experimental design (4 replicates) was used. Berseem was hand-sown on 3 Jan. 2008. Plots were cut at 5 cm stubble height at 76 (1st cut), 116 (2nd cut), and 144 (3rd cut) DAS. The ¹⁵N isotope dilution technique was used to estimate N₂ fixation by berseem, using annual ryegrass as the reference crop.

### Results

**AM infection at 55 DAS was significantly lower in the –Myc than the +Myc treatment (7.0 and 32.4%, respectively; P < 0.001).**

At 76 DAS (1st cut), root dry matter (DM) yield, aboveground biomass (both removed and residual), and respective Leaf Area Indices (LAIs) were significantly higher in the +Myc than the –Myc treatment, whereas at 116 DAS (2nd cut) no significant effects of mycorrhization treatment were observed.

At 144 DAS (3rd cut), AM symbiosis resulted in a significant increase in biomass yield, total N uptake, total amount of N fixed, and proportion of N derived from the atmosphere in the drought-stressed treatment, only.

The results suggest that AM symbiosis could play a key role in alleviating the stress effects of late drought on forage production and N₂ fixation of berseem grown in semiarid areas.

### Table: Effects of mycorrhization (M) and water availability (W) on berseem at 3rd cut

<table>
<thead>
<tr>
<th></th>
<th>Drought stress</th>
<th>Well-watered</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>–Myc</td>
<td>+Myc</td>
</tr>
<tr>
<td>Biomass</td>
<td>g DM m⁻²</td>
<td>50.1</td>
</tr>
<tr>
<td>N uptake</td>
<td>g N m⁻²</td>
<td>5.27</td>
</tr>
</tbody>
</table>

**Above-ground**

- **LAI**
  - 1.99
  - 2.12
  - 3.98
  - 4.22
- **N uptake**
  - 12.3
  - 13.7
  - 16.9
  - 16.2

**Below-ground**

- **Mycorrhizal infection**
  - 40.4
  - 52.9
  - 50.3
  - 52.7

**Whole plant**

- **Ndfa**
  - % 40.0
  - 52.9

**Effects of mycorrhization (M) and water availability (W) on berseem at 3rd cut. +Myc, and –Myc for mycorrhizal inoculated and mycorrhizal depressed crops, respectively.**