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Arbuscular Mycorrhizal Fungi Ameliorate the Negative Effects of Drought on Blanket Flower

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Introduction:

- Arbuscular mycorrhizal fungi (AMF) colonize approximately 80% of all vascular land plants[1].
- AMF are primarily known to help plants acquire nutrients, although other services have been documented[2].
- In the intermountain west, AMF may also be important to enhance plant drought tolerance.
- We examined the effects of AMF on drought response in blanket flower **(*Gaillardia aristata*).**

Research Questions:

- **Is the relative contribution of AMF to growth and flowering greater under drought than non-drought?**
- **Is the relative contribution of AMF to plant water status greater under drought than non-drought?**

Materials and Methods:

Two levels of AMF colonization: in 2017, 120 seedlings were grown in the greenhouse. Half were inoculated with AMF and the other half were grown without AMF.

Seedlings were transplanted to a field to site (MPG ranch) that was devoid of AMF.

Two watering regimes: half of the seedlings received low water and the other half supplemental water.

10 plants per treatment were sampled for:

•Leaf pre-dawn water potential (Ψ_{leaf}), a measure of plant water status (drier when more negative) in late July and early August.
•Vegetative and reproductive biomass and osmotic potential ($\Psi_{osmotic}$), also an indicator of water stress (more stressed when more negative), in late August.

The field site had been covered by a black sheet for several years and devoid of AMF.

Results:

AMF increased plant growth (Fig. 1) and flowering (Fig. 2)

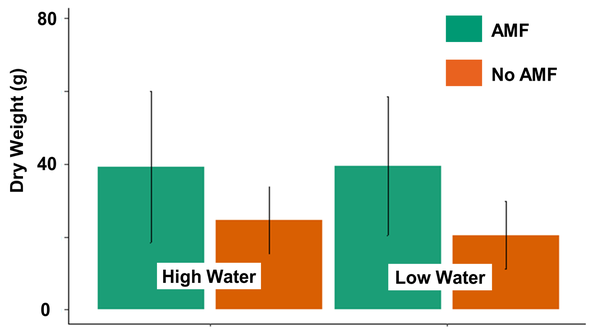

Fig 1: Total plant biomass at harvest in each treatment. Plants colonized by AMF grew more than non-colonized plants, regardless of water treatment (AMF treatment effect; $p < 0.05$). Bars are SD.

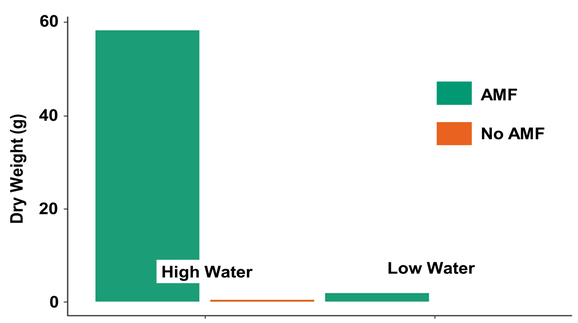

Fig 2: Total biomass of flowers in each treatment. Plants colonized by AMF produced more flowers than plants grown without AMF, but the effect was much larger under high water ($p < 0.05$). Bars are SD.

Blanket flower (*Gaillardia aristata*)

Under low water, AMF improve plant water status (Figs. 3 and 4)

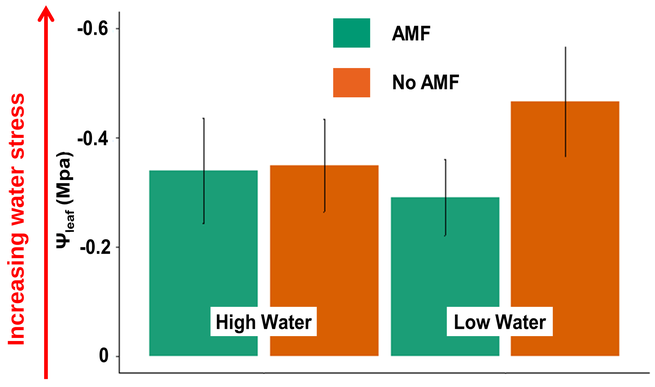

Fig 3: Leaf water status (Ψ_{leaf}) in each treatment. Plants grown without AMF under low water were significantly more water stressed than plants in all other treatments (significant AMF x water treatment interaction; $p < 0.05$). Bars are SD.

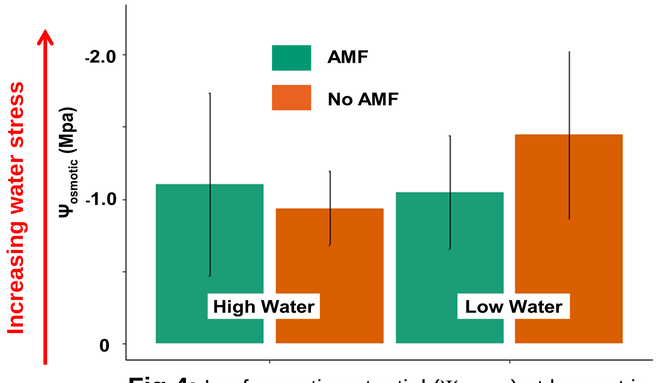

Fig 4: Leaf osmotic potential ($\Psi_{osmotic}$) at harvest in each treatment. Plants without AMF under low water tended to be more water stressed ($p_{AMF \times water\ treatment\ interaction} = 0.06$). Bars are SD.

Conclusions:

•AMF enhanced growth of blanket flower regardless of watering regime, possibly due to greater nutrient uptake when plants were grown with AMF.

•AMF enhanced flowering in blanket flower, particularly under high water

•Despite no water treatment effect on growth, plants without AMF under low water suffered from more water stress.

•Our results suggest that AMF may improve drought tolerance in blanket flower, which may become important under climate change and drought.

•**Future research** should examine the mechanisms underlying the increased drought tolerance by AMF.

Literature Cited:

1 Smith, S.E. & Read, D.J. (2008). *Mycorrhizal symbiosis*. Academic Press, London.

2 Delavaux, C.S., Smith-Ramesh, L.M. & Kuebbing, S.E. (2017). Beyond nutrients: a meta-analysis of the diverse effects of arbuscular mycorrhizal fungi on plants and soils. *Ecology*, 98, 2111–2119.

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