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

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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 plants¹.
- AMF are primarily known to help plants acquire nutrients, although other services have been documented².
- 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:

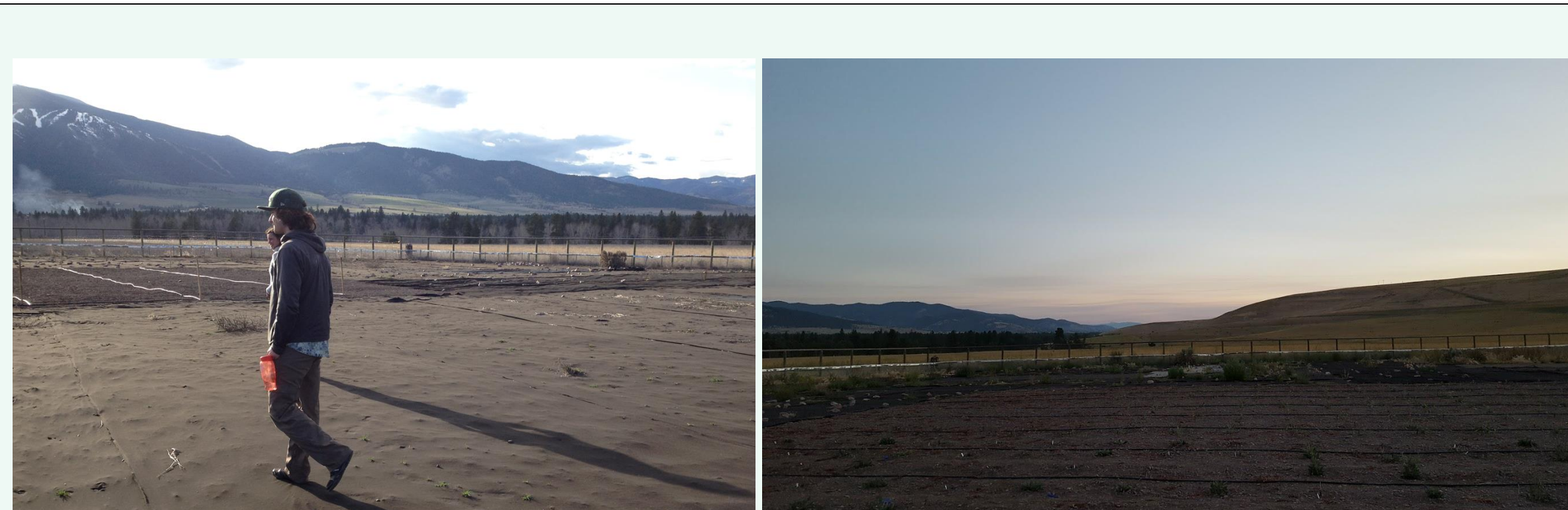
Two levels of AMF colonization: in 2017, 120 seedlings were grown in the greenhouse. Half were inoculated with AMF and the other half were grown without AMF.

Seedlings were transplanted to a field 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)

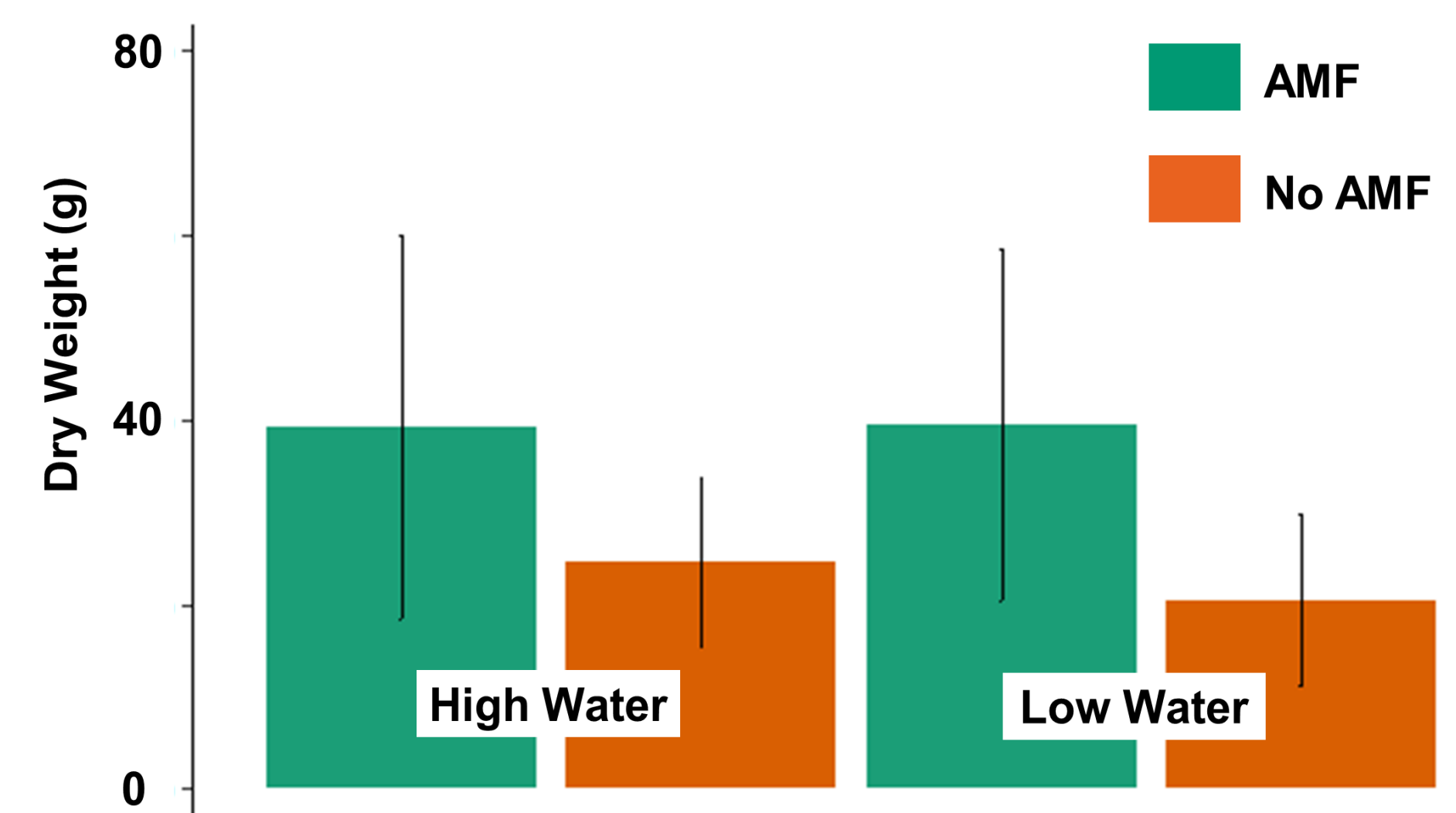


Fig 1: Total plant biomass at harvest in each treatment. Plants colonized by AMF grew more than non-colonized plants, regardless of water treatment (AMF treatment effect; $p < 0.05$). Bars are SD.

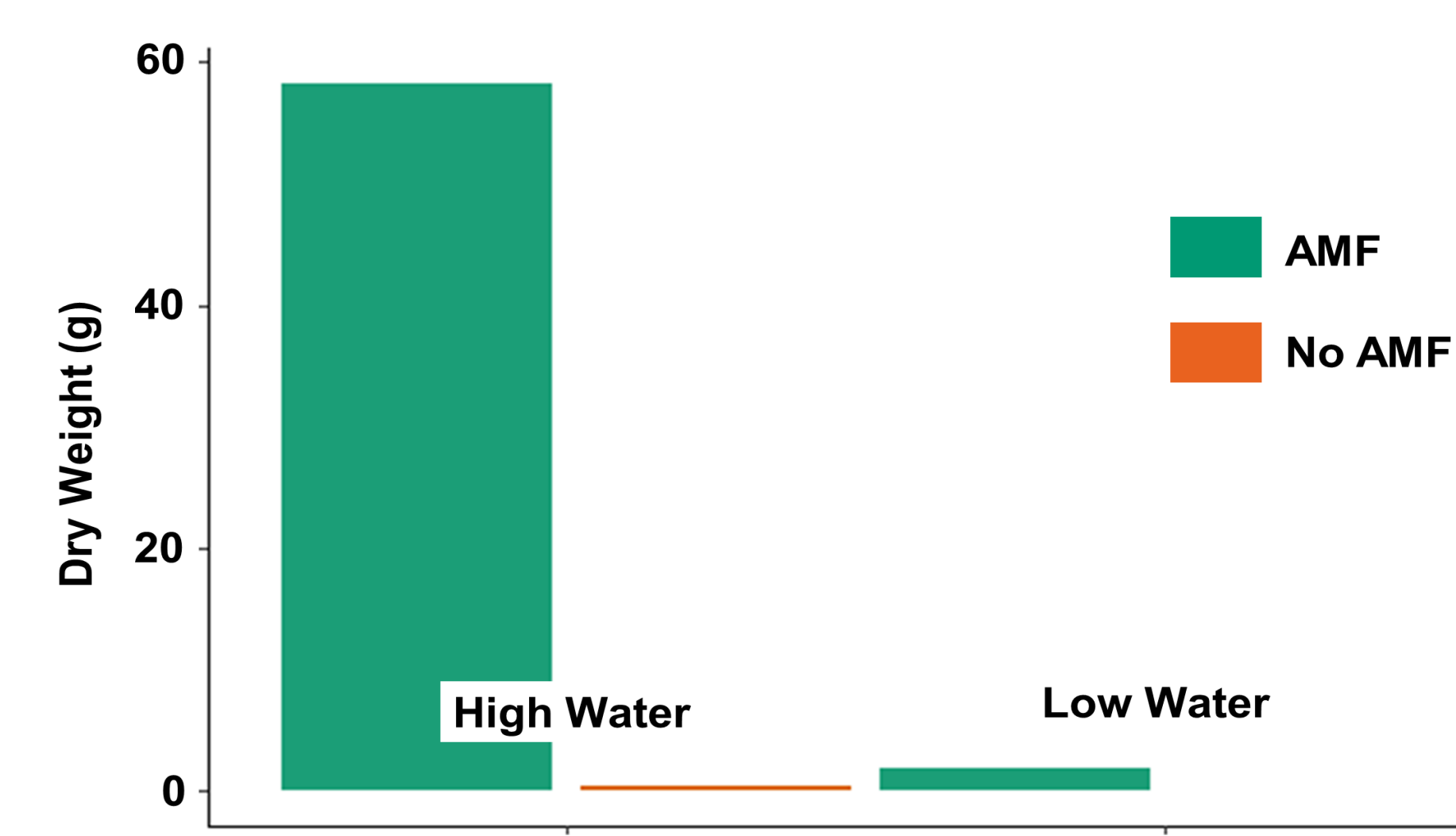


Fig 2: Total biomass of flowers in each treatment. Plants colonized by AMF produced more flowers than plants grown without AMF, but the effect was much larger under high water ($p < 0.05$). Bars are SD.



Blanket flower (*Gaillardia aristata*)

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

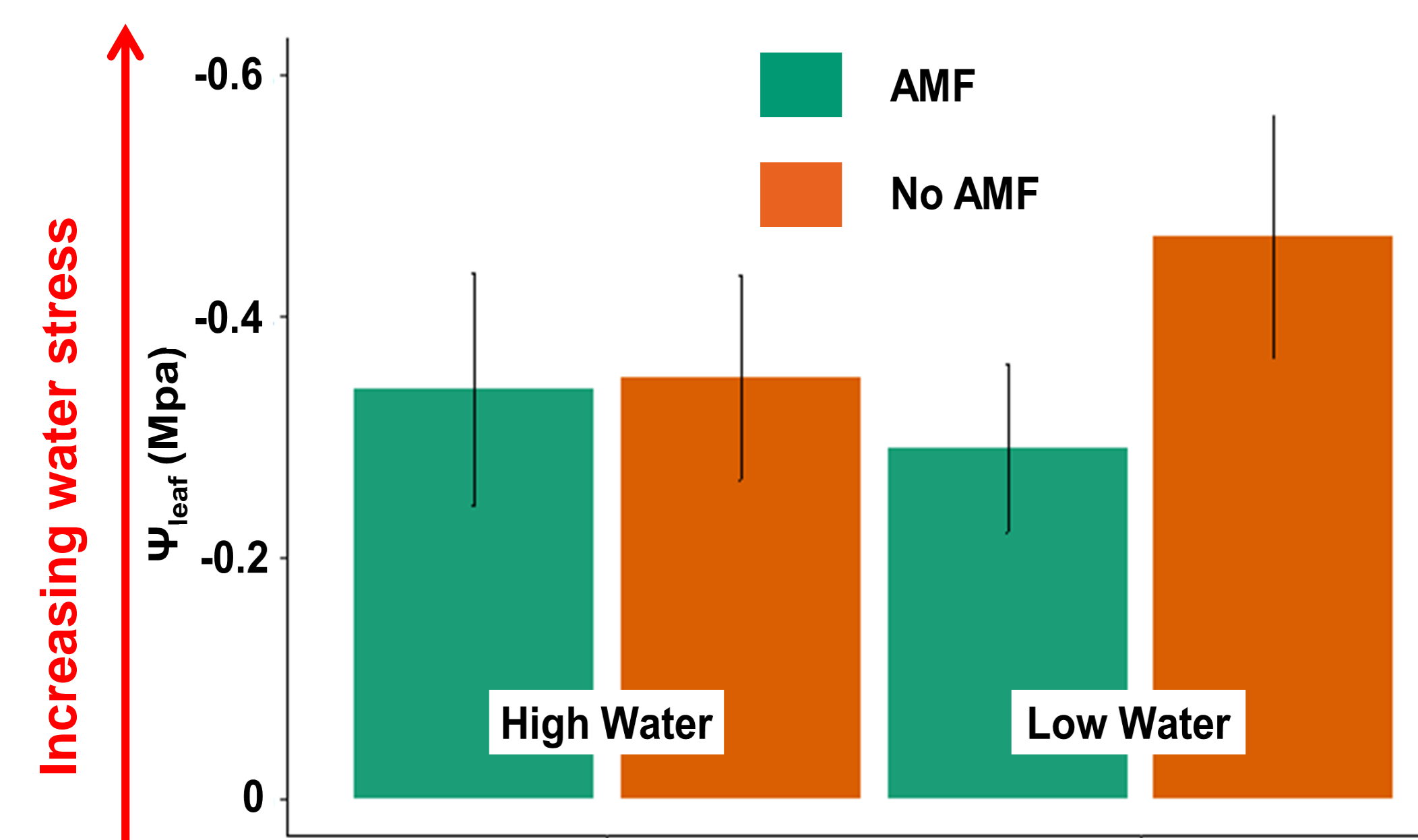


Fig 3: Leaf water status (Ψ_{leaf}) in each treatment. Plants grown without AMF under low water were significantly more water stressed than plants in all other treatments (significant AMF x water treatment interaction; $p < 0.05$). Bars are SD.

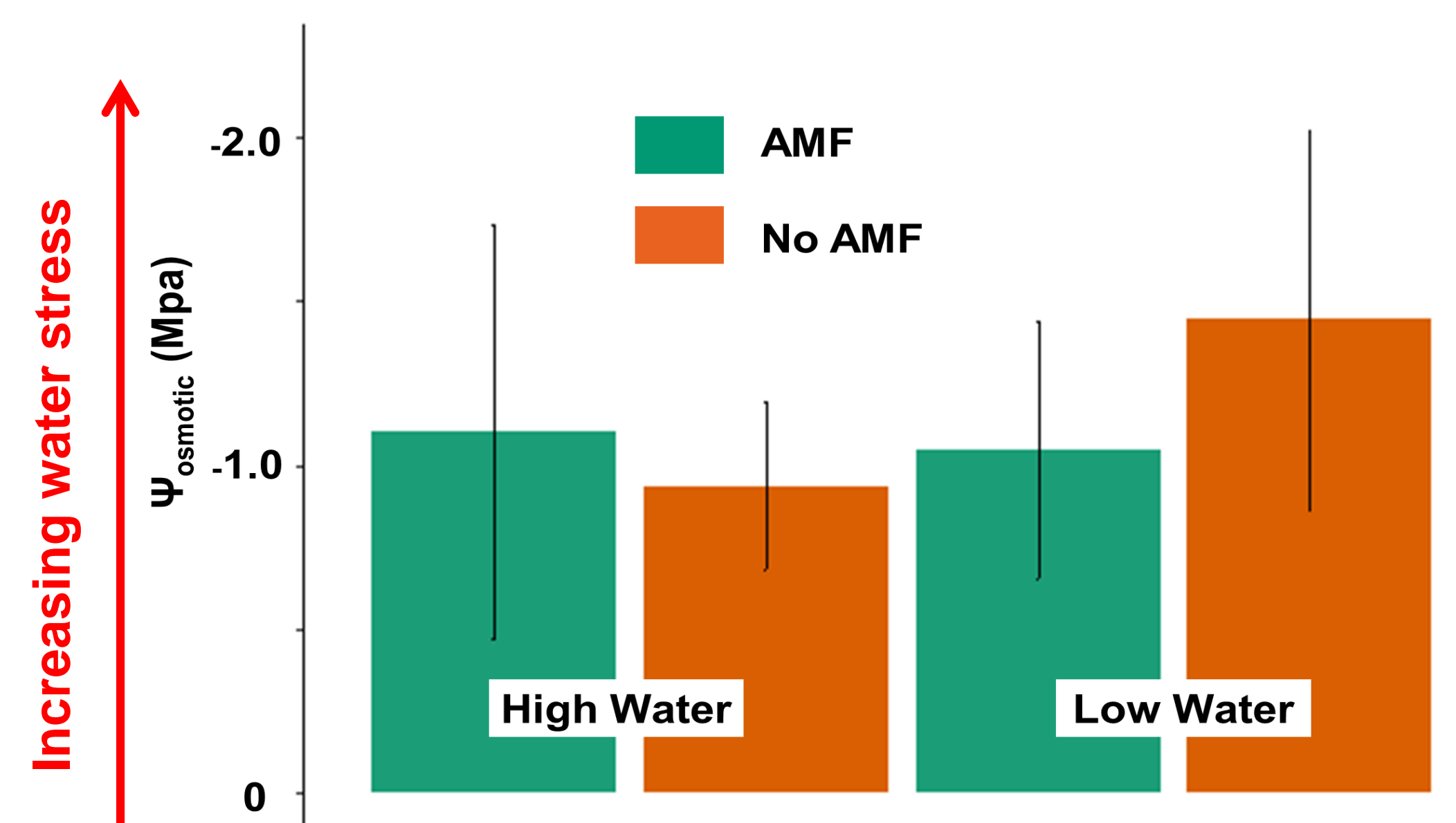


Fig 4: Leaf osmotic potential ($\Psi_{osmotic}$) at harvest in each treatment. Plants without AMF under low water tended to be more water stressed ($p_{AMF \times water \text{ treatment interaction}} = 0.06$). Bars are SD.

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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