

Conservative and profligate water use patterns found in *Cicer* and *Lupin* species

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Conservative and profligate water use patterns found in *Cicer* and *Lupin* species

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Abstract:

Terminal drought constrains yield in chickpea and lupins. Both crops have limited genetic variation in the domesticated gene pool, while wild progenitors are highly diverse. Does this greater genetic diversity translate into wider adaptive potential? Water use strategies are closely related to drought tolerance. Previous studies showed different water use strategies under varying VPD conditions found to be linked to drought tolerance.

In this study, whole plant water use response was assessed gravimetrically in wild and domesticated *Cicer* and *Lupin* lines against changing vapor pressure deficit (VPD) conditions on a clear day in an uncooled glass house. *Cicer* species have a more profligate water use than *Lupin* species ($P < 0.001$). Domesticated chickpea has narrow, conservative water use patterns ($P = 0.148$), while wild species tend to be more profligate ($P = 0.001$). However, the range of VPD responses was much wider in wild compared to domesticated chickpea, and there were no differences between *C. echinospermum* and *C. reticulatum*. Wild counterparts had a wide range of response ranging from very conservative to highly profligate. This wide genetic variation in either species can be exploited by breeders to develop drought tolerant lines targeted at different regions. We anticipate that a conservative water use pattern may be advantageous in heavy soil, while profligate water use may be useful in light soils.

In Lupins, *L. angustifolius* has a more conservative water use than *L. luteus* ($P = 0.04$). Unlike *Cicer*, in both *Lupin* species there were no wild/domesticated differences in mean VPD response (*L. angustifolius* ($P = 0.392$) and *L. luteus* ($P = 0.365$)). In *L. angustifolius*, both wild and domesticated lines showed similar range of VPD responses, but in *L. luteus*, all domesticated lines were conservative, while wild lines had a wider range of VPD responses ranging from conservative to profligate.

Chickpea was domesticated for more than 10,000 years and adapted to grow in stored soil moisture. When limited amount of water available for whole plant growth season, it is advantageous for the crop to be conservative. Wild relatives of chickpea, on the other hand, grow as winter annuals in in-season rainfall. In such scenario, before water is lost to competitors or environment, it's advantageous to use water rapidly. Wild relatives are grown in different habitats as individuals/close to other species/population, and thus might have developed diverse adaptive mechanisms to use water resources. Lupin was domesticated only 100 years ago. Both wild and domesticated Lupins are grown in in-season rainfall. As a recently domesticated crop and grown in similar environments as its wild counterparts, Lupin had very less time to diverge for adaptive traits.

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