The effects of *Ziziphus lotus* in improving neighboring plants’ moisture content and ecosystem productivity under drought stress

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• Water availability is the most important limiting factor for plant growth in Mediterranean ecosystems, where low precipitation can drive vegetation to marginal conditions.

• Therefore, plants must make a conservative use of available water, exploit all possible water sources and benefit from any water facilitation effects produced by closely associated neighbors (nurse plants).
Our Aim...

• ...to investigate the role that *Z. lotus* may play as a nurse plant by influencing, among other factors, (a) stem moisture content of neighboring *Thymbra capitata* (L.) Cav., and (b) the spatial aggregation of its population.

*Z. lotus* is a deciduous deep rooted (up to 60 m, Le Houérou 1972) scrub found usually in dry to semi deserted areas of the thermo-Mediterranean vegetation belt.
Our Aim...

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*T. capitata* is a characteristic species of phryganic vegetation in the Mediterranean basin.

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*Photo by Constantinou E*
Introduction

- We studied a lowland semi-arid arborescent matorral with *Ziziphus lotus* (L.) (priority habitat type *5220*) in Rizoelia, Cyprus in the eastern Mediterranean.
Methods

- The site is a gypsicric formation (Regosols-leptic Gypsisols) where the soil is shallow and poor in humus.
- Its altitude (71 - 80 m) and its location near the seashore determine a thermo-Mediterranean climate.
- Hot, dry summers occur from May until mid October and rainy, mild winters from November until March (mean annual temperatures of 19-20 °C, mean annual precipitation 300 – 350 mm).
We worked with 11 *Z. lotus* plants, between 1.5 m to 2 m tall, and between 3 m to 6 m in diameter.
Methods

*Thymbra capitata* L. Cav.

We also worked with 70 *Thymbra capitata* plants, between 40 – 50 cm in height and 0.5 – 1 m in diameter.
Study area in Rizoelia matorral – Zone selection

Legend
- T. capitata (0-5 m)
- T. capitata (10-15 m)
- T. capitata (5-10 m)
- Z. lotus
- Zone 0-5 m
- Zone 10-15 m
- Zone 5-10 m
- Experimental area
• In the 3 successive zones from *Z. lotus* plants, we measured the shoot nightfall and predawn moisture content (M.C) of 70 *T. capitata* individuals.

• 3 times during the mid and late dry summer season (July, Aug, Nov) and 1 during the wet season (Feb) in 2015-2016.

• We measured M.C. by weighing fresh stem samples and then reweighing them after drying (140 samples per season).

• We also counted the number of *T. capitata* plants within each of our three successive zones, and then we estimated the number of *T. capitata* plants per m².
The smallest the distance *T. capitata* grew from *Z. lotus*, the significantly higher was the difference (%) between predawn and nightfall shoot moisture content (M.C.) in *T. capitata* in July. P=0.0001 *(with predawn shoots having a higher M.C.)*
The difference decreased in August.
Results

And **reappeared** after the first Autumn rains in November.
Results

$r^2=0.62$

$P=0.0001$

$n=69$

And was even present during the very dry winter of 2015-16 in February.
In order to test our hypothesis that *Z. lotus* acts as a nurse plant for *T. capitata* we estimated the number of *T. capitata* plants per m² in each successive zone.

The shortest the distance *T. capitata* grew from *Z. lotus*, the higher (significantly) the number of *T. capitata* plants per m².

- Zone 0-5 m: 0.44 /m² ±0.08
- Zone 5-10 m: 0.25/m² ± 0.03
- Zone 10-15 m: 0.17/m² ±0.03
• Hydraulic lift (Richards and Caldwell, 1987) is the process of transferring at night time, water acquired by roots from deep and moister soil layers to upper and dryer soil layers, when the upper layers become dry.

• Thus, *T. capitata* closer to the *Z. lotus* plants may have been able to obtain additional moisture at night time because of hydraulic lift conducted by the *Z. lotus* root system.

• Particularly during the seasons that top soil dried up but deeper moisture was still available (e.g. July)
Conclusions

• Therefore, the significant spatial aggregation between the two species seems to be related to different mechanisms of facilitation, mainly increased water (and likely nutrient availability).

• It seems that hydraulic lift produced by the very deep rooted *Z. lotus* must play a key role in the processes described above.

• We suggest that *Z. lotus* can assist in alleviating drought stress impacts and improve ecosystem productivity, appearing to have a strong potential in helping mitigate drought affects that can result from climatic change in arid and semi-arid ecosystems.

Thank you for your attention!
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