Researchers develop guide to measure evolution of plants that benefit from others

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Plants that facilitate the survival and reproduction of other species can also make them evolve, something that has been ignored in most studies on the subject. Researchers from the Desertification Research Center (CIDE, CSIC-UV-GVA), together with scientists from Mexico and Switzerland, have established a guide to study the evolutionary changes of plants that benefit from other plants.

A study published in the journal *Trends in Plant Science* establishes the necessary method to measure the evolution of plant traits that benefit from facilitation. This methodology allows integrating this interaction between plants together with other ecological interactions such as pollination or seed dispersal, which are key components of biodiversity. The study is led by the Desertification Research Center (CIDE), a joint center of the University of Valencia (UV), the Spanish National Research Council (CSIC) and the Valencian Government, in collaboration with researchers from the Experimental Station of Arid Areas (EEZA-CSIC), from the National Autonomous University of Mexico and the Institute of Agricultural Sciences (Switzerland).

In natural ecosystems, species that share the same habitat can interact positively (displaying behaviors such as facilitation or mutualism), or negatively (through competition, predation or parasitism). These interactions largely determine the structure and functioning of the ecosystem, marking not only the present conditions, but also determining the evolutionary changes of the connected species in the past and the future.

Evolutionary studies have traditionally placed the emphasis on negative interactions as the engine of natural selection, the mechanism by which the adaptive change of the characteristics of the species (phenotype) occurs. Now, an international group of researchers led by CIDE scientists has provided empirical evidence of positive interactions offered by nature, establishing a method to study the traits of species that evolve as a consequence of this type of relationship.

The study focuses on an interaction known as 'facilitation' between plants, in which some species called 'nurses," which have adaptations that allow them to establish themselves in stressful environments, modify their closest physical environment allowing the establishment of other less adapted species to this type of environment, called 'beneficiaries."

Nurse plants 'benefit' their associated plants by building favorable niches, accumulating nutrients, providing shade, or protecting them from herbivores.

Facilitation as an 'evolutionary engine'

"Although in ecological theory, facilitation has been considered for a long time as a selective force, this issue has hardly been addressed at an experimental level because most studies have estimated the effects of plants that favor the fitness of other plants without considering the traits that mediate interaction, an approach that lacks crucial information from an evolutionary point of view," explains Miguel Verdú, a CIDE researcher who led the study.

"In this study we propose a conceptual framework that allows us to understand how facilitation acts as an evolutionary motor, in addition to discerning what mechanisms enable nurse plants to become selective agents of the traits of the beneficiary plants," adds researcher José Mª Gómez Reyes, of the Experimental Station of Arid Zones (EEZA-CSIC).

Guide to study evolution by facilitation between plants

"The evidence that facilitation exerts selective pressure on the beneficiary plants requires demonstrating that the relationship between the phenotypic trait and the well-being of the beneficiary plant is modified in the presence of the beneficiary species. An illustrative example would be the case of the evolution towards large seeds when these germinate better than the small ones under a nurse plant, but not when they are outside of it," exemplifies Miguel Verdú.

Since nurse plants can select the traits of the beneficiary, increasing the probability of interaction and the health of the beneficiary once the interaction has occurred, it is important to elucidate the weight of both components. The conceptual and methodological framework presented in the published study addresses these questions. The importance of this model lies in the possibility of measuring the strength with which the nurse plants can promote the evolution of the traits of their beneficiary plants, serving as a 'guide' to study the changes.

More information: M. Verdú et al, Facilitation and plant phenotypic evolution, *Trends in Plant Science* (2021). DOI: 10.1016/j.tplants.2021.04.005

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