Two studies reveal new ideas on plant form, function and competitive nature

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Credit: Wikipedia.

(Phys.org)—Two large international teams of researchers have conducted two separate analysis of the nature of plants and each has found something new. Both teams have had their work published in the latest issue of the journal *Nature*—the first looks at trait commonalities among plant forms that allow for surviving natural selection. The second looks at the traits that are responsible for giving plants a competitive

advantage. Jonathan Levine of the Institute of Integrative Biology in Switzerland, offers a News & Views piece on the work done by the two teams and explains why such studies are becoming more important as scientists attempt to predict how plants may fare in light of global warming.

As Levine points out, the bulk of plant research to date has been mainly species related, whether to learn more about them individually or to compare them with others. In this new approach, the idea is to focus more on the functional traits that plants share in order to better understand their basic underpinnings.

In the first study, the researchers looked at six basic traits shared by all vascular plants: density, height, leaf mass to area ratio, seed mass and nitrogen density found in the leaves. To uncover commonalities or differences in traits for plants across the globe that have not been noticed before, the researchers ran queries on a database called, TRY—it holds information on 46,085 plants which includes approximately 5.6 million traits. After much analysis, the researchers discovered that approximately 75 five percent of all of the differences between plant species came down to just two factors: overall size and leaf strategy (how they go about maintaining their existence).

In the second study the research team focused on competition between forest tree species most specifically on just three traits: height, leaf area per mass and the density of its wood. They also conducted their research by querying the TRY database, this time looking at data on more than 3 million trees that covered over 2,500 species located in forests in 6 different biomes. They report that they expected to find that functional traits would predict the way that competition between trees worked in the forests, but found no evidence that showed that differences in traits minimized competition between the trees in a given area—instead they found that it was certain trait values that tended to be more predictive of

competitive advantage of one species over another.

More information: Sandra Díaz et al. The global spectrum of plant form and function, *Nature* (2015). DOI: 10.1038/nature16489

Abstract
Earth is home to a remarkable diversity of plant forms and life histories, yet comparatively few essential trait combinations have proved evolutionarily viable in today's terrestrial biosphere. By analysing worldwide variation in six major traits critical to growth, survival and reproduction within the largest sample of vascular plant species ever compiled, we found that occupancy of six-dimensional trait space is strongly concentrated, indicating coordination and trade-offs. Three-quarters of trait variation is captured in a two-dimensional global spectrum of plant form and function. One major dimension within this plane reflects the size of whole plants and their parts; the other represents the leaf economics spectrum, which balances leaf construction costs against growth potential. The global plant trait spectrum provides a backdrop for elucidating constraints on evolution, for functionally qualifying species and ecosystems, and for improving models that predict future vegetation based on continuous variation in plant form and function.

Georges Kunstler et al. Plant functional traits have globally consistent effects on competition, *Nature* (2015). DOI: 10.1038/nature16476

Abstract
Phenotypic traits and their associated trade-offs have been shown to have globally consistent effects on individual plant physiological functions, but how these effects scale up to influence competition, a key driver of community assembly in terrestrial vegetation, has remained unclear. Here we use growth data from more than 3 million trees in over 140,000 plots across the world to show how three key functional

traits—wood density, specific leaf area and maximum height—consistently influence competitive interactions. Fast maximum growth of a species was correlated negatively with its wood density in all biomes, and positively with its specific leaf area in most biomes. Low wood density was also correlated with a low ability to tolerate competition and a low competitive effect on neighbours, while high specific leaf area was correlated with a low competitive effect. Thus, traits generate trade-offs between performance with competition versus performance without competition, a fundamental ingredient in the classical hypothesis that the coexistence of plant species is enabled via differentiation in their successional strategies5. Competition within species was stronger than between species, but an increase in trait dissimilarity between species had little influence in weakening competition. No benefit of dissimilarity was detected for specific leaf area or wood density, and only a weak benefit for maximum height. Our trait-based approach to modelling competition makes generalization possible across the forest ecosystems of the world and their highly diverse species composition.