Network of Plants

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Networks are a very powerful instrument for the characterisation of a variety of different phenomena. Plants for example are particularly suitable to be described by network theory. Here we present a couple of applications Plants emission of Volatile Organic Compounds (VOCs) [1] is involved in a wide class of ecological functions, as VOCs play a crucial role in plants interactions with biotic and abiotic factors. Accordingly, they vary widely across species and underpin differences in ecological strategy. In this paper, VOCs spontaneously emitted by 109 plant species (belonging to 56 different families) have been qualitatively and quantitatively analysed in order to provide an alternative classification of plants species. In particular, by using bipartite networks methodology from Complex Network Theory, and through the application of community detection algorithms, we show that is possible to classify species according to chemical classes such as terpenes and sulfur compounds. Such complex network analysis allows to uncover hidden plants relationships related to their evolutionary and adaptation to the environment story. Similarly, despite the common misconception of nearly static organisms, plants do interact continuously with the environment and with each other. It is fair to assume that during their evolution they developed particular features to overcome similar problems and to exploit possibilities from environment. In this paper we introduce various quantitative measures based on recent advancements in complex network theory that allow to measure the effective similarities of various species. By using this approach on the similarity in fruit-typology ecological traits we obtain a clear plant classification in a way similar to traditional taxonomic classification. This result is not trivial, since a similar analysis done on the basis of diaspore morphological properties do not provide any clear parameter to classify plants species. Complex network theory can then be used in order to determine which feature amongst many can be used to distinguish scope and possibly evolution of plants. Future uses of this approach range from functional classification to quantitative determination of plant communities in nature [2].
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[1] The Network of plants volatile organic compounds G. Vivaldo, E. Masi, C. Taiti, G. Caldarelli, S. Mancuso Scientific Reports 7 11050 (2017).
[2] Network of plants how to measure similarities between plants G. Vivaldo, E. Masi, C. Pandolfi, G. Caldarelli, Scientific Reports 6 27077 (2016)

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