Are plants more intelligent than we assumed?

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Plants are also able to make complex decisions. At least this is what scientists from the Helmholtz Center for Environmental Research (UFZ)

and the University of Göttingen have concluded from their investigations on Barberry (*Berberis vulgaris)*, which is able to abort its own seeds to prevent parasite infestation. The results are the first ecological evidence of complex behaviour in plants. They indicate that this species has a structural memory, is able to differentiate between inner and outer conditions as well as anticipate future risks, scientists write in the renowned journal *American Naturalist* —the premier peer-reviewed American journal for theoretical ecology.

The European barberry or simply Barberry (*Berberis vulgaris*) is a species of shrub distributed throughout Europe. It is related to the Oregon grape (*Mahonia aquifolium*) that is native to North America and that has been spreading through Europe for years. Scientists compared both species to find a marked difference in parasite infestation: "a highly specialized species of tephritid fruit fly, whose larvae actually feed on the seeds of the native Barberry, was found to have a tenfold higher population density on its new host plant, the Oregon grape", reports Dr. Harald Auge, a biologist at the UFZ.

This led scientists to examine the seeds of the Barberry more closely. Approximately 2000 berries were collected from different regions of Germany, examined for signs of piercing and then cut open to examine any infestation by the larvae of the tephritid fruit fly (*Rhagoletis meigenii*). This parasite punctures the berries in order to lay its eggs inside them. If the larva is able to develop, it will often feed on all of the seeds in the berry. A special characteristic of the Barberry is that each berry usually has two seeds and that the plant is able to stop the development of its seeds in order to save its resources. This mechanism is also employed to defend it from the tephritid fruit fly. If a seed is infested with the parasite, later on the developing larva will feed on both seeds. If however the plant aborts the infested seed, then the parasite in that seed will also die and the second seed in the berry is saved.

When analysing the seeds, the scientists came across a surprising discovery: "the seeds of the infested fruits are not always aborted, but rather it depends on how many seeds there are in the berries", explains Dr. Katrin M. Meyer, who analysed the data at the UFZ and currently works at the University of Goettingen. If the infested fruit contains two seeds, then in 75 per cent of cases, the plants will abort the infested seeds, in order to save the second intact seed. If however the infested fruit only contains one seed, then the plant will only abort the infested seed in 5 per cent of cases. The data from fieldwork were put into a computer model which resulted in a conclusive picture. Using computer model calculations, scientists were able to demonstrate how those plants subjected to stress from parasite infestation reacted very differently from those without stress. "If the Barberry aborts a fruit with only one infested seed, then the entire fruit would be lost. Instead it appears to 'speculate' that the larva could die naturally, which is a possibility. Slight chances are better than none at all", explains Dr. Hans-Hermann Thulke from the UFZ. "This anticipative behaviour, whereby anticipated losses and outer conditions are weighed up, very much surprised us. The message of our study is therefore that plant intelligence is entering the realms of ecological possibility."

But how does the Barberry know what is in store for it after the tephritid fruit fly has punctured a berry? It is still unclear as to how the plant processes information and how this complex behaviour was able to develop over the course of evolution. The Oregon grape that is closely related to the Barberry has been living in Europe for some 200 years with the risk of being infested by the tephritid fruit fly and yet it has not developed any such comparable defence strategy. These new insights shed some light on the underestimated abilities of plants, while at the same time bringing up many new questions.

More information: Katrin M. Meyer, Leo L. Soldaat, Harald Auge, Hans-Hermann Thulke (2014): "Adaptive and selective seed abortion

reveals complex conditional decision making in plants." *The American Naturalist*. Vol. 183, No. 3, March 2014

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