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# Press Release

## How plants protect their offspring from environmental risks

### Biologists from the University of Tübingen have successfully demonstrated parental environmental effect – and how this arises through evolution

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Plants are capable of not only passing on genetic variations to their offspring but also information on their environment. This phenomenon is known as the parental environmental effect and is influenced by climate conditions as well as population density which affects the degree of competition for resources. A new study by plant ecologists at the University of Tübingen has confirmed that this ability contributes to the adaptation of species to their environment. In greenhouse and field studies, scientists have shown for the first time that the parental environment effect can adapt through natural selection. The study also showed that the ability of plants to prepare offspring for environmental conditions can even vary between populations within a species.
This research was recently published in the journal New Phytologist: http://onlinelibrary.wiley.com/wol1/doi/10.1111/nph.14436/abstract

Parental environmental effects require that parent plants predict the environmental conditions of their offspring and prepare them accordingly. This is mainly beneficial in constantly changing environments such as desert regions with highly variable rainfall. The team of researchers from Tübingen and Hohenheim set out to answer to what extent the predictability of future environmental conditions influences the evolution of the parental environment effect in a year long study of plants in arid ecosystems.

Many species can only survive in these conditions if they create a seed bank in the soil. “Some of the seeds remain dormant in the ground," says Dr. Christian Lampei, lead author of the study. "If the parent generation can determine the best time for germination this can minimize losses in a bad year." In a previous study, the working group of plant ecologist Katja Tielbörger in Tübingen had already found that the parental environment effect causes many seeds to germinate after dry years and only a few seeds remain in seed banks. After rainy years, seeds germinate less, and more seeds remain in the soil. Scientists had concluded that the reason for this was the expected competition. After a rainy, productive year, a

higher population density is to be expected which causes greater competition for resources. Increasing reserves in seed banks which will germinate later help plants to give their offspring favorable conditions by avoiding competition.

The scientists were able to demonstrate this theoretical model of the parental environmental effect in the current study. The authors examined two annuals, a brassicaceae (*Biscutella didyma*) and a grass (*Bromus fasciculatus*), and compared the extent of the parental environment effect in four populations from northern to southern Israel, which are exposed to different climatic conditions. They grew plants under controlled conditions and with different irrigation levels to compare seed germination. In addition, they reviewed data on long-term rainfall, and monitored population density and average seed production: Based on this data they calculated how well the number of competing plants in a year could be predicted by rainfall and which effects the expected competition had on seed production.

Their results demonstrated the parental environmental effect in one of the species studied, *Biscutella didyma* (*Brassicaceae)*. The parental environmental effect grew steadily stronger from the most wet to the most dry population – the dryer the climate, the greater parents prepared their offspring for environmental conditions. At the same time, the relationship grew between the amount of rainfall the previous year and the population density. The better the competition could be predicted for the coming year, the greater the parental environment effect was pronounced. In years with a high population density, plants produced fewer seeds on average – this confirms the assumption that delaying germination by keeping reserves during such years is advantageous.

Much to the surprise of the authors, the grass did not show the expected parental environmental effect. This again confirms the finding of previous studies that annuals use additional strategies to survive in variable ecosystems. "*Bromus fasciculatus* exhibited a high resistance to dry conditions. That could make a seed bank superfluous," suspects Lampei.

While previous studies have shown that parental environmental effects of certain types are observed, the present study shows how the parental environmental effects varies within species between populations – and that these differences did not occur by chance, but most likely by natural selection.

**Publications** Lampei, C. Metz, J. and Tielbörger, K. (2017), Clinal population divergence in an adaptive parental environmental effect that adjusts seed banking. New Phytologist. doi: 10.1111/nph.14436

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