

Natural seed bank drives diversity

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Each year, poppies disperse seeds that grow into a new generation of flowers. Sometimes, some of the seeds postpone their germination for a few years, for example when they're covered by a layer of sand. Only when the sand disappears, do they start to sprout. Margriet Oomen did mathematical research into the influence of this phenomenon on the

genetic diversity of a population.

This principle, in which [poppy seeds](#) are dormant and do not reproduce, is an example of a natural [seed](#) bank. After a few years, the seeds can 'wake up' and join the active population of poppies again. In addition to plants, the seed bank phenomenon also occurs in bacteria. When conditions are unfavorable, for example when there is little food, they can change into so-called endospores—a [dormant state](#) in which they can survive [extreme conditions](#). They can remain endospores for years until conditions improve and they transform back into bacteria," says Oomen.

Seed banks increase diversity

During her Ph.D. research at the Mathematisch Instituut, Oomen and her supervisors Frank den Hollander (UL) and Andreas Greven (Friedrich-Alexander Universität Erlangen Nürnberg) used a [mathematical model](#) to study the effect of a seed bank on [diversity](#) in a population of plants or bacteria. It turns out that the seed bank phenomenon increases the genetic diversity of a population and can even prevent the loss of diversity.

Red and purple poppies

Imagine a field filled with red and purple poppies. Without a seed bank, these flowers disperse seeds once a year, some of which end up favorably and survive the winter, hatching the following spring. The seeds of the red flowers germinate into red poppies, the seeds of the purple flowers into purple ones. How many of each color is determined by chance and by the previous generation. The more red poppies in the first generation, the greater the chance that after a few years all the flowers will be red. The diversity is then lost," says Oomen. The probability of this happening can be calculated with the mathematical

Fisher-Wright model. I have looked at how diversity changes when you add a seed bank to that model.

When dormant seeds awaken

Dormant seeds in a seed bank do not contribute to reproduction for years. It can happen that in that period the diversity disappears in the active, reproducing generation. "You then have, for example, a meadow full of red poppies," says Oomen. The diversity seems lost. But if there are still purple seeds in the seed bank, they can wake up and ensure that your meadow is once again filled with purple poppies, which will then reproduce. In this way, the seed bank can serve as a kind of reservoir, increasing diversity and even preventing diversity from being lost.

Made possible by a mathematical trick

"That a seed bank increases diversity was no surprise," says Oomen. But how that happens exactly was difficult to model mathematically. We have come up with a trick that now enables us to do so. The discovery that long-dormant seeds can make the difference between whether or not diversity is lost, was new.

Oomen estimates that it will be some time before the model—which also has applications in other branches of mathematics—trickles down to biology. "The result is still very theoretical and abstract."

Provided by Leiden University

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