The best plant parents: Genetically as divergent as possible with similar preferences

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Evaluation of heterosis for grain yield in field trial. Credit: Norman Philipp/ IPK

A team of researchers led by IPK Gatersleben has succeeded in providing answers to a long unsolved question in the breeding of plant hybrids. Their conclusions: the more diverse in genetics, than better, but only in cases of similar preferences.

It has been shown that hybrids become increasingly productive depending on the genetic distance between their parents. The question of whether there is an optmimal genetic distance can definitely be answered negatively, assuming that the parents are adapted to similar environments. This study is published in *Science Advances*.

For decades, plant breeding has made use of the heterosis phenomenon: Parents genetically as different as possible are crossed to produce offspring performing better than their parents on average. The so-called hybrid breeding is applied very successfully for maize, sugar beets, rye or sunflowers. The maximum genetic distance between the parents to generate the best hybrid performance had not previously been clarified. Two studies in the 1960s came up with contradictory results. While one suggested that the genetic distance of the parents should be maximized, the other suggested that the increased performance of the offspring decreases again from a certain point of diversity.

"Thanks to progress in quantitative genetics, we were able to show that there is no optimum for the genetic distance of the parents," explains Prof. Dr. Jochen Reif. He heads the Department of Breeding Research at the Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) and the affiliated Quantitative Genetics research group there. "Heterosis increases steadily with the genetic distance between the parents. Parent populations can be as far apart as possible without their offspring losing performance."

This is a decisive finding for plant breeding, since it is no longer necessary to fear that the optimal genetic distance has been missed. However, it is important to be careful when it comes to the origin of the parent populations. "Parent populations must be adapted to the environment in which their offspring are to be cultivated, otherwise negative dominance effects can occur," the geneticist explans.

"Thanks to our latest developments in biometry and quantitative genetics, coupled with the extensive data material from the breeding industry, we were finally able to bring clarity to this long-standing issue," says Prof. Dr. Jochen Reif. "In the future, plant breeders will be able to select crossing partners on a rational basis for breeding new hybrid varieties, even for an organism as complex as wheat."

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