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Editorial

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# Proposition of a New Hybrid Breeding Method Based on Genotyping, Inter-Pollination, Phenotyping and Paternity Testing of Selected Unique F1 Hybrids

**Petra Jorasch***

*Manager at Plant Breeding Innovation Advocacy, Euroseeds, Brussels, Belgium*

## Editorial

In the face of climate change, reconciling sustainability with agricultural production relies heavily on the creation of resilient, high-yielding crops with greater nutritional content that can be farmed more resource efficiently. As a result, plant breeding innovation has taken on a new level of significance. Plant breeding relies on genetic heterogeneity within crops and their relatives as a foundation for creating new plant types with improved traits [1]. Plant breeders are constantly incorporating the most cutting-edge technologies in plant biology and genetics into their breeding toolkit in order to make better use of current variety while also inducing new genetic variation. Plant breeding technologies have become increasingly accurate and efficient in recent years [2]. This breakthrough in plant breeding is based on a deeper understanding of plant genomes and the improvement of breeding procedures, allowing for more efficient, precise, and faster progress toward the desired breeding goals. As a result, these plant breeding technologies are fast being created and implemented across the seed industry, public and private research, plant species, and markets around the world. The results of a Euroseeds survey of 62 private plant breeding companies, published in this publication, show that companies are very interested in using new breeding techniques (NBTs) for a wide range of crop species and traits, and that the current regulatory situation in the EU has a negative impact on companies' decisions to invest in NBT-related R&D activities for the EU market and beyond [3].

The most limiting component in the F1 hybrid breeding technique is testing inbred lines for their combining potential, due to the large number of line to line tests required to determine hybrid performance. We present a novel F1 hybrid breeding strategy that allows a large number of line to line crosses to be evaluated for hybrid performance [4]. Inbred lines (ideally doubled haploid - DH) are bred, genotyped, and maintained from heterozygous populations. The progeny of a number of lines are randomly inter pollinated and studied. Individual plants are chosen for their superior phenotypic features in order to identify top F1 hybrids [5]. Finally, the origin of paternal lines is determined through paternity testing of just selected hybrids. A mathematical formula was created to determine the number of F1 offspring required in response to the number of inbred lines inter pollinated. For example, with 420 F1 plants in a row ($p = 0.95$), the probability of getting all offspring of paternal-parent lines in a maternal-parent row represented at least once is accomplished using this method for inter-pollination of 60 unique lines. DH lines were created utilising microspore culture in a practical experiment with white cabbage; plants were raised to maturity and genotyped at eight polymorphic SSR loci. Two groups of lines (36 and 33 lines each) were inter pollinated using two different methods: cage pollination with bumblebees or open pollination in a separate area [6]. A total of 9,858 F1 plants were sown, with 213 elite phenotypes chosen based on their phenotypic traits. 99 of them had different genetic backgrounds, and 5 of them were chosen as super exceptional. The paternal origin of selected F1 plants was determined using the same SSR markers that were used to analyse selected plants. Out of the 213 superior plants chosen, 48 were reciprocals, demonstrating the strength of single-plant selection. We show that this innovative method of hybrid generation works in white cabbage and recommend that breeders test it in a variety of vegetable and agricultural species. In addition, various other components of the suggested technique must be evaluated and verified for both practical and economic considerations [7].

Although the genetic mechanisms that induce heterosis are still unknown, breeders have developed many strategies for identifying lines with the best "combining capacity." Combining ability is a phenomenon that only occurs when certain inbred lines are crossed, complimenting each other in desired features. In a breeding cycle, plant breeders frequently develop a significant number of inbred lines, with one thousand or more being common [8]. For practical reasons, it is commonly known that performing all cross combinations is impossible. $n(n-1)/2$ crosses are necessary to perform all conceivable combinations without reciprocals (n being the number of inbred lines). It would take 4,950 non-reciprocal crosses to test the combining ability of each of a hundred lines p [9]. As a result, the first stage in a normal F1 breeding strategy is to test for "generic combining ability," which entails testing a large number of lines with one or more "tester lines." The best progeny are chosen for "specific combining ability (SCA)" testing, which involves single or reciprocal line-to-line crossing. F1 hybrid breeding techniques, particularly in vegetable breeding, often exclude testing for general combining capacity; as a result, the performance of a small number of previously determined superior seed lines is primarily examined by varied pollen parents. White cabbage was used to demonstrate such a search for optimal combining ability in regard to metabolites [10].

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***Corresponding author:** Petra Jorasch, Manager at Plant Breeding Innovation Advocacy, Euroseeds, Brussels, Belgium, Email: petrajorasch@euroseeds.eu

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