**Simulation guided establishment of heterotic pools for breeding of synthetic cultivars in faba bean**

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Synthetic cultivars of faba bean comprise a mix of two or more parental genotype components. Before release, the genotypes are grown together and undergo open pollination, hence the seeds sold to farmers are a mixture of homozygous parental genotypes and cross-pollinated F1 hybrids. Consequently, the performance of synthetic cultivars can be attributed to the per se performance of the synthetic components along with heterosis of F1 hybrids. It´s widely recognized that heterosis is high when the parental genotypes are genetically distinct, and breeders of major crops such as maize exploit heterosis systematically. Preliminary results of test-synthetics between faba bean genotypes indicated that the successful synthetics originated from crosses between distantly related parental components. Hence, development of genetically distinct heterotic pools is a useful strategy to optimize heterosis and synthetic cultivar performance in faba bean, which presently arises predominantly from specific combining ability rather than general combining ability (GCA). To optimize faba bean breeding by fixing heterosis and improving GCA, we apply a simulation-based pipeline that utilizes genome-wide SNP data to design crossing schemes that rapidly create new, distinct gene pools from an admixed founder population. The pipeline employs a chain crossing scheme that maximizes recombination and maintains diversity within pools, but promotes pool separation. To simultaneously enhance per se performance of parental components, additional crosses are conducted based on genomic predicted per se performance of cross offspring. Based on successful implementation in hybrid breeding programs in other crops, we expect this strategy to accelerated genetic gain in faba bean breeding.