THE BACKCROSS METHOD IN PLANT BREEDING

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As early as 1922 Harlan and Pope pointed out the usefulness of the backcross method in plant breeding, especially its utility in the transfer of specific characters from one variety to another. Later, the author discussed its value in breeding disease-resistant varieties of cereals with special reference to work in developing varieties of wheat resistant to bunt, *Tilletia tritici*. There still seems to be some misunderstanding about the value of this method, due, it is believed, to a lack of appreciation of the fundamental principles involved. It seems appropriate, therefore, to describe how the backcross operates to bring about the desired results.

That homozygosity is increased at a rapid rate when plants are self-fertilized is well known to plant breeders. The proportion of homozygous individuals may be calculated from the following equation:

\[
\text{Proportion of homozygosity} = \left(\frac{2^m - 1}{2^m}\right)^n
\]

where \(m\) is the number of generations of selfing and \(n\) is the number of heterozygous genes. It is apparent that as \(m\) increases the proportion of homozygous individuals will become greater. With 10 pairs of factors over 85% of the population will be homozygous at the end of six generations. The number of homozygous genotypes equals \(2^n\) where \(n\) is the number of pairs of factors. With the 10 pairs above the homozygous plants would be equally divided among 1,024 genotypes, therefore, either parent will occur once in 1,024 times among these homozygous individuals.

If a heterozygous population is continuously backcrossed to one of the homozygous parents, homozygosity is attained at the same rate as if self-fertilization is employed. Therefore, in the above equation \(m\) becomes the number of back-crosses used. For instance, with 10 pairs of factors, if the population is backcrossed six times, 85% of the population will be homozygous, but instead of there being 1,024 different homozygous genotypes, all the homozygous individuals will be of a single genotype, namely, that of the backcross or recurrent parent.

A simple cross between a white-kerneled club wheat and a red-kerneled lax wheat, in which the characters named depend on single factors, may be used to illustrate the difference between self-fertilization and backcrossing. The percentage of homozygosity and the percentage of the entire population which will be made up of parental combinations indicated may be seen in Table 1.

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