A System of Backcross Designations for Use in Plant Breeding

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The backcross method of plant breeding is now being used very extensively, but it appears that no standard system of designating generations, derivatives, etc. has been developed or adopted. Local systems have undoubtedly been devised which are reasonably effective for breeding records on an institutional basis; but there is need for a standard, widely-adopted system which would permit concise and intelligible descriptions of materials, reports of results, etc. to plant breeders at large. As a step toward filling this need we give below the system of backcross designations which is being instituted at the University of Alberta. For the purpose of this paper it has been extended to include most of the eventualities likely to be encountered in a backcross breeding program.

The Alberta System of Backcross Designations

(Letters A, B, C, etc., are used as varietal names)

1. The backcross:
   
   \[
   (F_1 \text{ of } A \times B) \times B = A \times B_2
   \]
   
   \[
   (F_1 \text{ of } B \times A) \times A = A_2 \times B
   \]
   
   (Note that the subscript is one more than the number of backcrosses performed and is equal to the number of "doses" of the recurrent parent, that is, the number of times the recurrent parent has been used as a parent).

2. Succeeding backcross generations:
   
   \[(A \times B_2) \times B = A \times B_3\]
   
   \[(A \times B_3) \times B = A \times B_4\]
   
   etc.

3. Interruption of backcrossing by selfing:
   
   \[A \times B_4 \text{ selfed once is given by } A \times B_4(1)\]
   
   \[A \times B_4(1) \text{ selfed again is given by } A \times B_4(2)\]
   
   etc.

4. Resumption of backcrossing after selfing:
   
   \[(A \times B_4(2)) \times B = A \times B_4(2,1)\]
   
   \[(A \times B_4(2,1)) \times B = A \times B_4(2,2)\]
   
   etc.

5. Selfing alternately for the second time:
   
   \[A \times B_4(2,2) \text{ selfed is given by } A \times B_4(2,2,1)\]
   
   \[A \times B_4(2,2,1) \text{ selfed again is given by } A \times B_4(2,2,2)\]
   
   etc.

6. Continuous selfing of a backcross-self derivative:
   
   \[A \times B_4(2,2,2) \text{ selfed is given by } A \times B_4(2,2,2,1)\]
   
   \[A \times B_4(2,2,2,1) \text{ selfed again is given by } A \times B_4(2,2,2,2)\]
   
   etc.

7. Use of a higher generation hybrid in backcrossing:
   
   \[(F_3 \text{ of } A \times B) \times B = A \times B_4(3,1)\]
   
   \[(A \times B_4(3,1)) \times B = A \times B_4(3,2)\]
   
   etc.

8. Use of a backcross derivative in a new cross:
   
   \[(A \times B_4(2)) \times C = A \times B_4(2,3)\]
   
   The \(F_3\) of this cross is given by \((A \times B_4(2)) \times C \times F_3\)
   
   The \(F_2\) of this cross is given by \((A \times B_4(2)) \times C, F_2\)
   
   etc.

If the two backcross derivatives were crossed the second derivative would replace \(C\) in the above crosses.

9. In discussing backcross results where the materials involved are clearly understood it would not be necessary to mention the cross in referring to backcross generations: for example, \(B_4\) would be used to designate the second backcross generation, \(B_4(2)\) the second selfed generation following two backcrosses, etc. (In this example \(B\) does not refer to a variety but is the standard symbol for backcross generation just as \(F\) in the sense of \(F_1, F_2,\) etc., is the standard symbol for filial generation).

10. The use of \(F_1, F_2,\) etc. is restricted to the conventional uses of these symbols.

11. It is conventional to give the female parent first in stating a cross, and it seems desirable to retain this distinction if possible in backcross designations.

In the above outline we have assumed that recurrent parent \(B\), the male parent of the original cross \(A \times B\), has been used as a male parent in backcrossing. If \(A\), the female parent of the original cross \(A \times B\), were used as recurrent parent, and as a female, it would simply necessitate shifting the subscripts thus, \(A_4(2) \times B\). If however, we were to use \(A\) as the male parent of the original cross, \(B \times A\), and then decide to use it as a female recurrent parent, we would have to write \(A_4(2) \times B\), which would disregard the sexual distinction of the original cross. The difficulty would be overcome by using the recurrent parent in the same way, sexually, in both the original cross and the backcross.

The reader may lose sight of the basic simplicity of the system when it is viewed in the light of its application to unusual eventualities, such as that of section 6 of the outline. In these cases selection numbers would usually replace backcross designations in actual practice. We hope that our attempt to show the wider adaptabilities of the system will not prove prejudicial to its all-important quality of simplicity.

Another point deserving of mention is the matter of giving the first backcross a numerical value of 2 instead of 1 (see section 1 of the outline). We were influenced to adopt the "backcross + 1" value, in spite of certain undesirable features (see generation designations in section 9), by the fact that it is already in fairly general use.

It is hoped that this paper will arouse an interest in backcross designations which may lead to the development and adoption of a standard system, and that the system outlined or some modification of it might merit consideration in that connection.

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