

Nomenclature for single and multiple backcrosses in a self-pollinated crop

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In our computerized management of pedigree data, we find that the present nomenclature does not allow us to describe a backcross in all its aspects. There are two ways to make a cross (A/B or B/A); for each cross, there are four ways of making a backcross depending on which parents is backcrossed and whether as female or male. For the eight possible variants, the standard cross nomenclature provides for only four distinct expressions. The problem with present backcross terminology is that it does not allow for exact recording of the actual cross, which is important if a program needs to know how a cross was made. In practice, this also means that there is no way to identify the cytoplasm of the progeny from the cross nomenclature. For multiple backcrosses, the ambiguities grow geometrically.

We suggest adding letters between the \hat{O} and the \bar{O} to indicate whether the recurrent parent in a backcross is used as female (F) or male (M). In multiple backcrosses, the sequence of these letters - from left to right - corresponds to the sequence in which the backcrosses are made. The cytoplasmic parent is always at the beginning (left) of the pedigree statement. Thus A//A/B which is now written A*2/B, would become A*FF/B in the proposed new nomenclature. A reciprocal backcross A/B//A, which is now written A*2/B, would become A*FM/B, thus accurately recording the sequence of backcrosses. B/3/A/B//B now shown as A/3*B, would be B*MMF/A in the proposed system.

This is not a trivial issue, particularly when crosses are made between widely separated taxa. (e.g. the F1 is male-sterile and so can only be used as the female in a subsequent backcross). Breeding strategies may depend on the elimination of chromosomes, and thus they may dictate backcrosses in which the female/male roles of the parents and the F1 are already pre-determined.

We are suggesting that the short version backcross pedigree will be the \hat{O} default \bar{O} in the Wheat Pedigree Management System and Wheat Field Book System, the modules of the International Wheat Information System which manage pedigrees and fieldbooks, respectively. However, the system will start recording an expanded backcross pedigree which can be printed out if a program like Wheat Coefficient of Parentage needs the exact crossing procedure.

The expanded backcross pedigrees should always be read from left to right starting with the cytoplasmic donor. This will indicate the exact order in which the multiple cross was made relative to the use of the backcross parent.

For example: A*FMM/B

indicates that the F1 was A/B with A as the female parent (F; cytoplasmic donor); then this F1 was crossed with A as a male recurrent parent (M) twice; in longhand the cross would be A/B//A/3/A.

As complexity of backcrosses increase, the possibility of the present system failing to accurately record the crosses increases, as can be seen in the following examples.

Cross: A/8/A/7/A/6/A/5/A/4/A/3/A/B//A

Short method: A*8/B

Expanded: A*FMFFFFFF/B

or:

Cross: B/7/B/5/B/3/A/B//B/4/B/6/B/8/B

Short method: A/8*B

There are eight cases for making a BC1; please note: F \hat{E} = Female; M = Male

Case	Cross	Short	Expanded
1.	A/B//A	A*2/B	A*FM/B
2.	A/B//B	A/2*B	A/MM*B
3.	A//A/B	A*2/B	A*FF/B
4.	B//A/B	A/2*B	B*MF/A
5.	B/A//A	B/2*A	B/MM*A
6.	B/A//B	B*2/A	B*FM/A
7.	A//B/A	B/2*A	A*MF/B
8.	B//B/A	B*2/A	B*FF/A

There are sixteen cases for making a BC2; again note:

F = Female; M = Male

Case	Cross	Short	Expanded
1.	A/B//A/3/A	A*3/B	A*FMM/B
2.	A/3/A/B//A	A*3/B	A*FMF/B
3.	A/B//B/3/B	A/3*B	A/MMM*B
4.	B/3/A/B//B	A/3*B	B*MMF/A
5.	A//A/B/3/A	A*3/B	A*FFM/B
6.	A/3/A//A/B	A*3/B	A*FFF/B
7.	B//A/B/3/B	A/3*B	B*MFMA
8.	B/3/B//A/B	A/3*B	B*MFF/A
9.	B/A//A/3/A	B/3*A	B/MMM*A
10.	A/3/B/A//A	B/3*A	A*MMF/B
11.	B/A//B/3/B	B*3/A	B*FMM/A
12.	B/3/B//A/B	B*3/A	B*FMF/A
13.	A//B/A/3/A	B/3*A	A*MFMB
14.	A/3/A//B/A	B/3*A	A*MFF/B
15.	B//B/A/3/B	B*3/A	B*FFM/A
16.	B/3/B//B/A	B*3/A	B*FFF/A

We believe that this proposed nomenclature will cover our needs for exact transcription of BC's in self pollinated crops when needed, but we would like to receive comments from anyone.