A Simplified Method for Establishing the Three-Point Order of Genes from F₃ Data

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THE method outlined herein for determining the linear order of genes from F₃ data seems to have considerable merit because of time-, labor-, and space-saving features. It is especially useful where the genes are closely linked, because only a few crossovers will establish the order.

For example, let it be assumed that linked factors a and b for two seedling and factor c for a mature-plant character are being tested for their order in the chromosome. If a and b, e. g., are in coupling, the genotypic constitution of the F₁ would be as follows, depending on the order of the genes:

\[
\begin{array}{c}
1 \quad a \quad b \quad C \\
A \quad B \quad c \\
\end{array}
\quad \text{or}\quad
\begin{array}{c}
2 \quad a \quad C \quad b \\
A \quad c \quad B \\
\end{array}
\quad \text{or}\quad
\begin{array}{c}
3 \quad C \quad a \quad b \\
c \quad A \quad B \\
\end{array}
\]

Only the singly recessive c c F₂ plants need be harvested and tested in F₃ for the seedling characters determined by a and b. If there has been no crossover, the F₂ plants will be A A B B c c, but a crossover (ignoring doubles) could occur in either of the intervals between the genes, resulting in plants with the constitutions indicated below.

Parental (noncrossover) chromosome

\[
\begin{array}{c}
1 \quad A \quad B \quad c \\
2 \quad A \quad c \quad B \\
3 \quad c \quad A \quad B \\
\end{array}
\]

Single crossover in the first interval

\[
\begin{array}{c}
1 \quad A \quad B \quad c \\
2 \quad a \quad B \quad c \\
3 \quad a \quad c \quad B \\
\end{array}
\]

Parental (noncrossover) chromosome

\[
\begin{array}{c}
1 \quad A \quad B \quad c \\
2 \quad A \quad c \quad B \\
3 \quad c \quad A \quad B \\
\end{array}
\]

Single crossover in the second interval

\[
\begin{array}{c}
1 \quad a \quad b \quad c \\
2 \quad A \quad c \quad b \\
3 \quad c \quad A \quad b \\
\end{array}
\]

With a little consideration it becomes apparent that by determining the genotypic constitution of the singly recessive plants and assigning them to the proper crossover classes indicated above, the crossovers in the two intervals between the genes will establish positively the order of the genes.

An example will be given to show how the method has been used on diploid wheat. The genes e-2 for early maturity; yg, for yellow-green

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