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Synthesis of two-chromosome double interchanges in N. crassa

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Abstract

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Two-chromosome double interchanges were synthesized in N. crassa by intercrossing single interchange strains (reciprocal translocations) each with breakpoints that involved the same two chromosomes. Chromosome arrangements that combined both of the single interchanger into the two chromosomes were established presumably by simultaneous crossovers that occurred in the two differential segments.

The scheme to synthesize there strains consisted of crossing the following I-IV single interchange strains with each other in all combinations: T(I;IV) NMI19, T(I;IV) NM140, T(I;IV) NM144, T(I;IV) NM164, T(I;IV) NM172, T(I;IV) D304. Block ascospores from these intercrosses were isolated on complete medium in random spore fashion, heat shocked at 60°C for 30 minutes, and incubated at 25°C. All progeny isolated from the intercrosses were subsequently tested by crossing them with each of the two parental single-interchange strains and a standard-normal strain. Those isolates that expressed partial sterility in each of the three testcrosses were deemed to be carrying the desired two-chromosome double interchange. By partial sterility it is meant that defective white ascospores were produced at high percentages. There ascospore abortions ranged from 24% to 62%. dependent upon the strain involved.

Linkage data were obtained for each parental strain to determine the locations of the breakpoints with respect to chromosome arms, and to help in identifying the type of intercross. It is a mandatory prerequisite for the production of two-chromosome double interchanges that the two single interchanges involved be either the opposite-arms type or the same-arms type with both exchanged segments longer in one interchange relative to the exchanged segments in the other interchange.

Five intercross combinations resulted in one or more two-chromosome double interchange strains as determined by testcrossing. This is in agreement with predictions bored on the linkage data, since the genetic mop for the parents in all of these crosses shows that each intercross is of the same-arms type with both exchanged segments longer in one interchange relative to the exchanged segments in the other interchange. The combination synthesized are listed in Table 1, column 1. The first two numbers indicate the parental interchange strains that were involved in the original intercross, the third number is the isolation number from the intercross, and the final letter indicates the mating type.

The suggestion is made that the use of two-chromosome double interchanges for the detection of linkage can reduce the number of strains required and at the same time provides on effective method for this purpose. Although the breakpoints in these newly-synthesized strains ore not for apart, there is little doubt that two-chromosome double interchanges with widely spaced breakpoints would be extremely effective in linkage detection.

Table 1.

Double interchange	mating type partial sterility	albino-2 partial sterility	osmotic-I partial sterility
144-119-57a-	-28.3	12.2	12.2
119-164-72A	41.1	25.0	17.8
140-119-23a	32.6	17.7	8.5
144-164-1A	12.7	17.7	12.7
164-172-65A	21.8	12.8	25.7

Recombination values involving genetic markers and partial sterility (that is, breakpoints) in crosses between genetic marker strains for linkage group I and the two-chromosome double interchange strains ore listed in Table 1. These data were collected from four-point linkage tests, but ore prerented in a two-point format. It is difficult to set the sequence of breakpoints relative to genes with any great degree of certainty since there ore two breakpoints in each of the chromosomes which probably hove on overlapping effect upon linkage with marker genes.

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