CROSSING-OVER ACROSS THE CENTROMERE IN THE MATING-TYPE CHROMOSOME OF *NEUROSPORA CRASSA*

OSAMA M. RIFAAT
Faculty of Agriculture, University of Cairo, Giza, Egypt
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The frequency of crossing-over in the two short regions on opposite arms, adjacent to the centromere of the mating-type chromosome of *Neurospora crassa* is controlled, independently in each arm, by at least two genes with equal and additive effect. These genes segregate on inbreeding and cause great variability in both the frequency of recombination and the frequency of second-division segregation of loci situated within these regions. Recombination values between loci situated beyond these sensitive regions is not affected; the relative increase or decrease in their centromere distances may be attributed to change in the recombination frequency about the centromere only.

**Introduction**

The majority of *Neurospora crassa* strains used in genetical work originate from at least three different wild-type stocks: LINDEGREN A and a; ABBOTT 4A and 12a; and CHILTON a. Mutants of these, have been intercrossed for many years, and since few workers have kept detailed pedigrees of crosses, the wild-type ancestry of most of them is unknown.

Variations in crossover frequencies have been known for a long time, and have often been attributed to the genetic background of the strains. TEAS (1947), observed that the centromere distance of a threonine marker was reduced in crosses with an ABBOTT 12a strain. Crosses between strains of LINDEGREN origin and a second threonine strain of mixed ABBOTT 4A and LINDEGREN 25a parentage also resulted in reduction of centromere distances. This was attributed to a chromosomal aberration in the ABBOTT stocks, but SINGLETON (1948) suggested that it may also be due to failure in synapsis.

Similarly, HOLLOWAY (1953, 1954), found that the centromere distance of *mt* was significantly increased when strains with ABBOTT ancestry were used. BARRATT (1954) has listed many cases where variability in the centromere distance of *mt* and other loci could be
attributed to the presence or absence of either Abbott 4 or Abbott 12, and concluded that the effects were unlikely to be due to any simple aberration. Frost (1955) found essentially similar effects. In the case of mt, the variability in crossing-over with the centromere was correlated with the use of several genotypically different wild-type strains. Genetic factors controlling the patterns of crossing-over were shown to segregate, and it was suggested that the Lindegren strains differed from Abbott 12a by one gene, and from Abbott 4a by at least two genes. Stadler (1956), concluded that many genes controlled the frequency of crossing-over. Rifaat (1956) found that the recombination and second division segregation frequencies between loci near the centromere of the mating-type chromosome appeared to be controlled by at least two genes (or groups of genes) with equal and additive effect. These operate independently in each arm and segregate on inbreeding.

The present results show the sensitivity of the centromere region to genetic factors influencing crossing-over. It appears that a number of factors are involved.

Materials and Methods

The strains of Neurospora crassa used in this work were supplied by the Faculty of Agriculture, Cairo University. They were originally obtained from stocks at the Botany School, Cambridge University. The methods used were essentially those of Beadle & Tatum (1945), as modified by Catcheside (unpub.), and Frost (1955). Linkage values were estimated by Fisher's scoring system (Fisher, 1946), as discussed by Rifaat (1957, 1958). Centromere distances were deduced by halving the percentages of second division segregation asci (Lindegren, 1932, 1936). For the calculation of standard errors from tetrads see Perkins (1953) and Rifaat (1956).

Results

Data from four-marker cross

In Table 1 an analysis is given of 144 asci of a cross between mt, arg–3, (30300) and cr, me–6, (35809). Although the relative sequence of the markers is in agreement with that found by other workers,