

EFFECTIVENESS OF SELECTION BASED ON VARIABILITY ACHIEVED THROUGH
RECOMBINATION UNCOMPLICATED BY HETEROTIC EFFECTS IN NEUROSPORA

BU-138-M

K. Papa

October, 1961

A procedure was outlined in BU-103-M for determining the rate of genetic progress attained through selection by recombination of genes in Neurospora. Since Neurospora is haploid, the confusing heterotic effects are avoided. Several modifications of the procedure, as well as some preliminary results, were presented in BU-128-M. The following is a presentation of the progress achieved at present on determining the rate of genetic advance attained through selection for rapid growth rate. Additional plans for experimentation are also included. They will be carried out in an effort to substantiate our findings.

Previous investigations conducted on growth rate analyses on five different strains of Neurospora indicated considerable variability among and within strains. Growth rates were observed for 50 samples of each mating type at three different temperatures. Significant differences among temperatures and strains were obtained, as well as significant temperature x strain interactions. Although all of these data have not yet been analyzed, four of the strains are represented in figure 1.

The type of response observed in figure 1 has partially prompted the present investigations. Differential rates of progress should be expected whether one selects within inter- or intra-strain crosses and depending on the extent to which the original lines have been inbred in the intra-strain crosses. Such selection procedures should enable one to assess the value to which variability obtained through recombination, uncomplicated by heterotic effects, can be used in the study of a quantitative character such as growth rate. Information should also be obtained regarding the extent to which selection can be practiced before genotypic fixation of the lines occurs. If a point is reached at which additional progress can not be obtained then these lines should offer valuable material for additional studies.

Inter- and intra-strain crosses, including reciprocal crosses, between a Neurospora strain from Honduras and N. crassa and between a Philippine Islands strain and N. crassa have provided the experimental material for this investigation. Selection has been practiced as previously described in BU-128-M. At

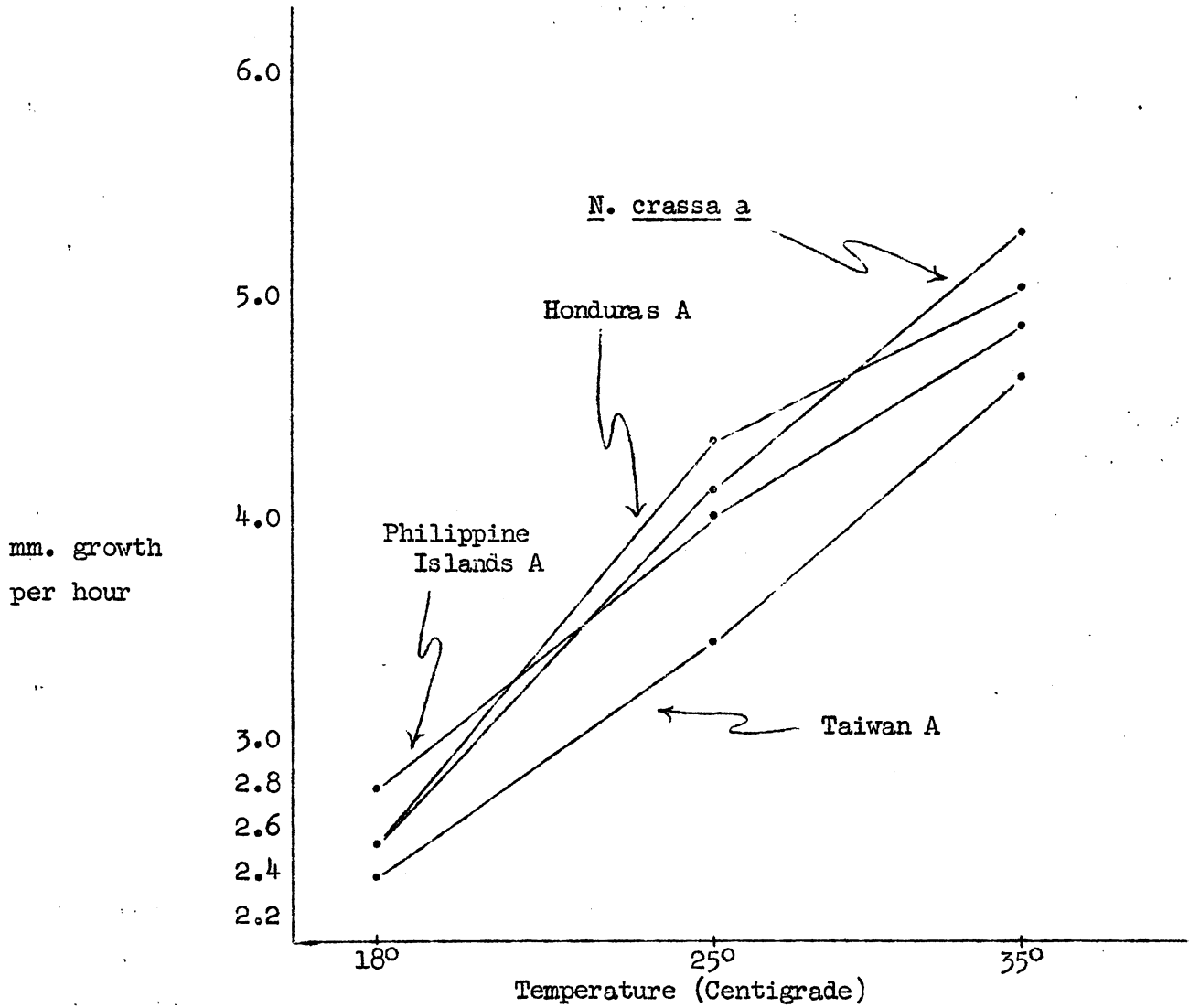


Figure 1. Mean growth rates of four strains of *Neurospora* at three different temperatures. Each mean is based on fifty observations.

the present time, selection has continued through seven cycles in some of the Honduras and N. crassa intra-crosses and fewer cycles in some of the inter-crosses involving these two strains. Selection in Philippine Islands x N. crassa crosses, which was initiated later, has been completed through three or four cycles in all of the possible crosses. Second replications are also being obtained for all crosses with the number of completed cycles being nearly the same as for the first replication.

The data obtained indicate that selection has been effective in increasing the growth rate. This increase, as one might expect, is more pronounced in the inter- as compared to the intra-strain crosses, although selection in intra-strain crosses of Honduras has resulted in an increased growth rate at 35°C. Figure 2 represents the progress of intra-strain selection in Honduras and N. crassa. From these curves it is obvious that little or no gain is being obtained by selection within N. crassa at the present time.

Progress made by selection in inter-cross material has not been included in figure 2 since essentially two to three fewer cycles have been completed in these crosses. It should be pointed out, however, that in most cases the rate of progress from inter-specific crosses has surpassed that obtained in intra-strain crosses in fewer cycles of selection. Selection has been hampered to a certain extent in the inter-strain crosses by a general loss of fertility characterized by fewer perithecia being formed, an increasing failure of ascospores to come to maturity, and a lowering of the germination of mature ascospores. If infertility problems become more acute, the methods will be employed whereby selection pressure can be relaxed enough to restore fertility before selection is continued.

Statistical analyses of the data indicate a lower genetic variance among the progeny as the number of cycles of selection increase.

The rate at which the variance is reduced appears to be directly correlated with the type of cross involved (inter- or intra-) as well as with the strain used in the original crosses. A reduced variation among progeny accompanied by no significant increase in mean growth rate for several consecutive cycles should offer some indication of the extent to which selection, in the manner outlined, can be continued. There appears to be no significant difference between reciprocal crosses. A comparison of growth curves from any two reciprocal crosses indicates no greater deviation of means in each cycle than is found between replications

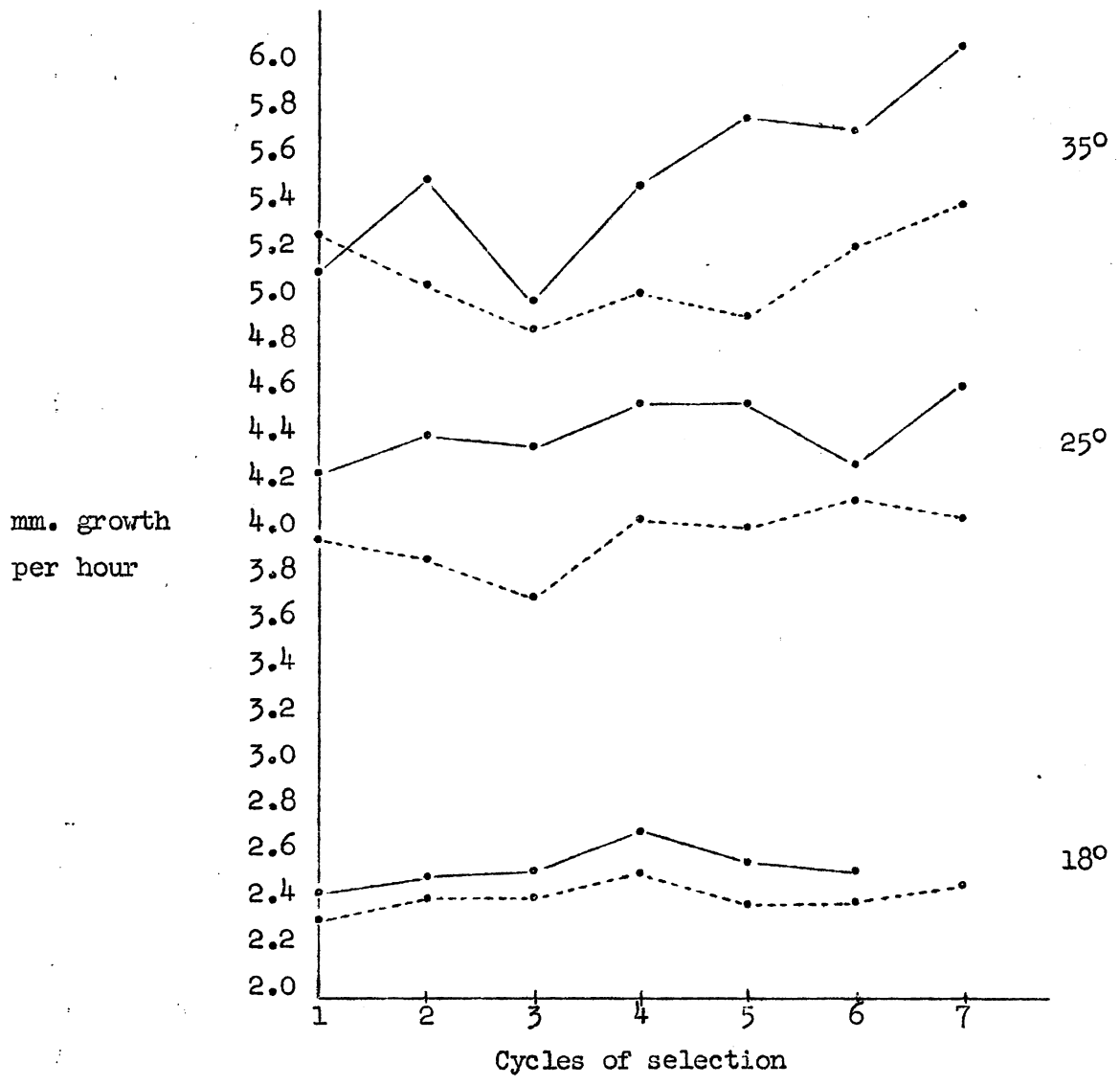


Figure 2. Mean growth rates for two intra-strain crosses of Neurospora at three temperatures. Each mean is based on forty observations.

— Honduras x Honduras
- - - N. crassa x N. crassa

of individual crosses. Therefore, extra-chromosomal effects on the system being studied seem to be eliminated. Nevertheless, selection will be continued on reciprocal crosses since they will provide additional replications.

The following additional investigations will be conducted which should contribute to a better understanding of quantitative inheritance in haploids.

1. Selection for slow growth rate with subsequent crosses between low lines and high x low lines. (Selection on this basis will be employed when no further progress can be made by the present procedure.)

2. Determination of whether or not selection is independent of temperature. (At the end of selection for fast growth rate or possibly sooner, each line which has arisen by selection at one temperature will be observed at the other two temperatures. This will give some indication as to whether or not selection for increased growth rate at one temperature is accompanied by increases at other temperatures.)

3. Comparison of unselected vs selected lines. (In order to determine whether favorable recombinants from unselected material can be obtained which will be as rapidly growing as those obtained through n cycles of selection, growth rates will be determined on a large number of progeny from each original unselected cross.)