ATTEMPTS TO LOCALIZE THE GENE \( Ch_1 \) FOR HYBRID CHLOROSIS IN WHEAT

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SUMMARY

Using Chinese Spring monosomics two procedures were applied to localize the gene \( Ch_1 \) for hybrid chlorosis. This gene is present in certain provenances of \( Triticum macha \) var. subletshchumicum. Though the evidence is not conclusive, chromosome 2A is most likely the carrier of the \( Ch_1 \) locus.

INTRODUCTION

Hybrid chlorosis is a form of hybrid weakness in wheat. The phenomenon is based on two complementary genes, symbolized by HERMSEN (1963) as \( Ch_1 \) and \( Ch_2 \). TSUNEWAKI and KIHARA (1961) succeeded in localizing \( Ch_2 \) on chromosome 3D. The locus of \( Ch_1 \) has not yet been determined with certainty, although R. Metzger (personal communication) got evidence pointing to chromosome 2A as the possible carrier of \( Ch_1 \). The present authors tried to localize \( Ch_1 \) using the procedures presented in the next section. Though the results are not conclusive it seems advisable to record the findings obtained so far.

MATERIAL AND METHODS

The monosomic lines of Chinese Spring were kindly supplied by Dr E. R. Sears. Waninge's (1965) modified method was used for counting the chromosomes. Only the monosomics involving the chromosomes of the A and B genomes were studied, because the gene \( Ch_1 \) appeared to be present also in \( T. dicoccum \) Khapli (NISHIKAWA, 1962). The genotypes of Chinese Spring is \( ch_1ch_1Ch_2Ch_2 \); \( T. macha \) has the complementary genotype \( Ch_1ch_1ch_2ch_2 \). In \( F_2 \) Chinese Spring \( \times T. macha \) the ratio 9 chlorotic : 7 normal occurs (HERMSEN, 1963). Crossing Chinese Spring monosomics \( \times T. macha \) should produce one critical ratio in \( F_2 \), being about 291 chlorotic : 109 normal.

The first series of observations in the \( F_2 \) from Chinese Spring monosomics \( \times T. macha \) were made in 1964 and 1965. In order to minimize the possibility of univalent shift the experiment was repeated with seeds from monosomics which were checked for this irregularity. The \( F_2 \) observations made in 1967 suggested that chromosome 2A(II) might be the carrier of the \( Ch_1 \) locus.

To retest the results, only monosomic 2A was studied in the third experiment, viz in two ways. The ratios chlorotic : normal were determined in \( F_2 \)'s from ten monosomic
and three disomic $F_1$ plants from the cross Chinese Spring mono-2A × *T. macha*. In addition the following new procedure was applied.

**Chinese Spring mono-2A × $ch_1ch_1ch_2ch_2$ (variety Felix)**

↓

**Monosomic $F_1$ plants ♀ × $Ch_1Ch_1ch_2ch_2$ (T. macha)**

↓

**backcross population**

In this backcross population both disomics and monosomics segregated 1:1 for chlorosis vs. normal. Normal monosomic plants should have the genotype $Ch_1ch_2ch_2$, if chromosome 2A were the critical chromosome. If not, the genotype should be $Ch_1ch_1ch_2ch_2$. These normal monosomic backcross plants were crossed as a female with $ch_1ch_1Ch_2Ch_2$ (variety Abondance). The results expected in the progeny should be conclusive, for:

a. if 2A were the critical chromosome, the cross would be $Ch_1ch_2ch_2 × ch_1ch_1Ch_2Ch_2$, resulting in all disomic plants being chlorotic ($Ch_1ch_1Ch_2ch_2$) and all monosomic plants being normal ($-ch_1Ch_2ch_2$);

b. if 2A were not the critical chromosome the results from the cross would be 1 chlorotic : 1 normal in both the disomic and monosomic progeny.

**RESULTS**

The ratios chlorotic : normal found in the $F_2$ from Chinese Spring mono’s × *T. macha*, obtained in 1964 and 1965 are presented in the upper half of Table 1; those obtained in 1967 are in the lower part.

Among the 40 ratios in the 1964 and 1965 results four (with asterisk) significantly deviate from 9:7. Three of them show a shortage of chlorotic plants. This might be attributed to genetic backgrounds favouring early death of plants which are homozygous at both chlorosis loci. The totals all fit the ratio 9:7.

The separate ratios found in 1967, apart from those in which mono-2A is involved, fit 9:7. The totals fit 9:7, except the one with mono-1A ♀ (slight shortage of chlorotic plants, $\chi^2_{9:7} = 3.951$; see discussion above) and the one in which mono-2A is involved. The latter ratio, 64:29, shows a surplus of chlorotic plants ($P_{9:7} < 0.05$) which can hardly be explained without assuming 2A to be the critical chromosome. This being the case, 291:109 is expected and 64:29 fits this expectation very well ($P_{291:109} = 0.50-0.30$).

Therefore chromosome 2A was re-checked in two ways as explained before. Table 2 presents the ratios of 13 $F_2$ populations, ten from monosomic and three from disomic $F_1$ plants. If 2A is the critical chromosome the expectation is 291:109 in the progenies from monosomic $F_1$ plants and 9:7 in those from disomic $F_1$ plants.

The results in Table 2 fit the hypothesis of 2A being the chromosome which carries the locus $Ch_1$.

If this hypothesis is right the result of the second test should be: all disomics chlorotic and all monosomics normal. If not, both disomics and monosomics should segregate 1:1. The results from five crosses are presented in Table 3.

The asterisks mark the number of individuals which occur in a class in which they