Tests for Association of Genetic Factors in a Nullisomic Line of *Avena sativa* L.

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Some aneuploids in common oats, *Avena sativa* L., are now available for relating genes to specific chromosomes. Idiograms of oat species useful in classifying aneuploids were first prepared by Rajhathy and Morrison (13) and later refined by Rajhathy (12). The 3 chromosomes with satellites and the shortest chromosome are more easily distinguished in root tip cells than are the other 17 chromosomes. Utilizing the karyotypes of Rajhathy (12), chromosome 21(5) and chromosome 15(4) were each found to carry a gene for chlorophyll production.

Other nullisomics and monosomics have been characterized by certain morphological characters (1, 2, 3, 7, 10, 11). Where karyotype analysis is not successful, intercrosses offer the surest method of identifying the different monosomics. There is need to characterize a number of aneuploids and to make these available for intercrosses. Monosomics with a high transmission rate of the 20-chromosome male gamete are particularly needed.

In this study, six genetic characters were tested for their association with the missing chromosome in a naturally occurring nullisomic. Chromosome morphology studies on excised root tips showed the chromosome involved to have a submedium centromere like chromosome 5 or 6 (12) but some other chromosomes could not be ruled out (3).

MATERIAL AND METHODS

The nullisomic line used in this study was a sister line of the 'Clintland 60' variety and is similar to it except for the missing chromosome pair and the presence of male sterility. F$_1$ plants resulting from crosses of nullisomics with normal plants are monosomic and fertile. Seven varieties or selections were chosen for specific characters (Table 1) and crossed with the nullisomic line. The progenies were examined to determine whether any of 6 different characters were associated with the chromosome pair missing in the nullisomic. Crosses were made by two methods: (a) by bagging a fertile head with a male-sterile head of the same maturity; or (b) by hand-emasculation and hand-pollination. Some reciprocal crosses were made with partial male-fertile nullisomics as the pollen donor. Panicles of all F$_1$ plants were bagged in the late boot stage to ensure that no outcrossing occurred. The selfed seeds from the F$_1$ plants from all crosses were planted in the greenhouse. The resulting F$_2$ plants were classified for the nullisomic (male sterile) or disomic and monosomic condition (male fertile) on the basis of male fertility as discussed in a preceding paper (3) and for the specific characters under study for association with the missing chromosome pair in the nullisomics.

Tests were made using the F$_2$ data for association of the 6 characters with the chromosome pair missing in the nullisomic. The expected ratio in the F$_2$ of nullisomics versus monosomics and disomics combined was derived from microspore quartet analysis as discussed in a previous paper (3) and was found to be 4.85 nullisomics to 1 monosomic and disomic combined. The 1% level of significance was used in all tests for chromosome association.

RESULTS AND DISCUSSION

The results of segregation of F$_2$ plants for dense:intermediate:open panicles and a 4.85 : 1 expected ratio for nullisomics versus monosomics and disomics combined. The resulting frequencies of the respective classes were in fair agreement with the expected ratios shown by the Chi-square tests for goodness of fit. The gene for panicle type was not associated with the missing chromosome pair missing in the nullisomic condition.

Table 1. Characters tested for association with the missing chromosome pair in nullisomic 'Clintland 60' and varietal source of the character.

<table>
<thead>
<tr>
<th>Character</th>
<th>Source</th>
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<tbody>
<tr>
<td>Panicle type</td>
<td></td>
</tr>
<tr>
<td>d gene - Dense (Club)</td>
<td>Purdue 5512A7-14-2</td>
</tr>
<tr>
<td>m gene - Moderately dense</td>
<td></td>
</tr>
<tr>
<td>Seedling reaction to crown rust</td>
<td></td>
</tr>
<tr>
<td>1 gene - Susceptibility to race 202</td>
<td>Ottawa 3928-5-8</td>
</tr>
<tr>
<td>Resistance to race 294</td>
<td>C.I. 3037-6</td>
</tr>
<tr>
<td>Seedling reaction to stem rust</td>
<td></td>
</tr>
<tr>
<td>F gene - Resistance to race 7A</td>
<td>R. L. 524-5</td>
</tr>
<tr>
<td>f gene - Resistance to race 7A</td>
<td>C.I. 3037-6</td>
</tr>
<tr>
<td>b gene - Susceptibility to race 6</td>
<td></td>
</tr>
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