The development of corn containing proportionately large quantities of amylose starch initiated considerable interest during the past decade. Starch in commercial dent hybrids consists of two components, amylopectin and amylose. The amylose component is a straight-chain, or linear-type, compound formed by the chemical dehydration of a large number of glucose or dextrose units. In contrast, the amylopectin component has a branched, or nonlinear molecular, structure. The total endosperm starch of commercial dent hybrids consists of approximately 27% amylose and 73% amylopectin. Several genetic factors have been identified (1, 4, 8, 9, 12) which are associated with an increase in the amylose-starch synthesis of corn endosperm. In the amylose breeding program at Missouri, experimental hybrids which contain as much as 70% amylose have been developed.

Previous information from the breeding of high-amylose corn suggested that variation in amylose content of relatively homozygous lines was environmentally induced. For example, at the Missouri Agriculture Experiment Station it was found that high-amylose lines grown in the Florida winter nursery were higher in amylose content than the same lines grown in Missouri the following summer. The present study was subsequently initiated to evaluate the possible influence of environment on the amylose content of corn endosperm. Experiments were designed to determine whether differences in amylose content within relatively homozygous inbred lines might be due to climatic and edaphic factors associated with various geographical regions, as well as these factors associated with year effects. Affirmative results would be in general agreement with numerous earlier studies on the influence of environment on the chemical components of other crop plants.

REVIEW OF LITERATURE

Goering et al. (7) reported that geographical locations and seasonal growing conditions had no measurable effect on the amylose content of barley. Likewise, fertilizer treatment, date of planting, moisture level, and stage of maturity at harvest did not significantly affect amylose content.

Environmental conditions which have been shown to affect the chemical composition of corn grain include the effects of locations, seasons, nitrogen levels, and plant populations (3, 5, 6, 10, 11, 13). Norden et al. (10) reported that the protein content of corn was affected to a greater extent by edaphic and climatic factors than by genetic differences. Genter et al. (6) indicated that the variation in protein content attributable to environmental effects was more than twice the variation ascribable to genetic differences among corn hybrids. Protein content of corn grain has been reported to decrease with increments in the rate of planting (5, 13). Doss et al. (3) reported that the protein percentage of corn was modified by soil types, location, and seasonal differences.

MATERIALS AND METHODS

The present study was conducted in 1957, 1958, and 1959. Each of 6 entries was grown in the following 8 states: California, Georgia, Iowa, Kansas, Maryland, Missouri, North Carolina, and Wisconsin. The 6 entries are listed in Table 1 along with the major genes which determine amylose content. The stability of the 6 entries for amylose production is shown in the comparison of the amylose content of each entry at the beginning of the experiment with the 3-year average. The normal dent line, containing approximately 26% amylose, represented the wild type. It should be noted that four entries homozygous at the ae locus differ markedly in amylose content. The differences were attributed to background genotypic effects. Modifier complexes, suggested by Zuber et al. (12) and Bear et al. (2), appear to be detectable only in the presence of high-amylose determining genes, such as ae ae.

Seeds of each of the relatively homozygous entries were supplied to the cooperators at each of the eight locations. All plants were selfed or sib-pollinated and harvested ears were returned to the Missouri Agricultural Experiment Station where each ear was sampled. The 7-gram sample included 25 to 35 kernels, depending upon seed size. Kernels were taken at random from individual ears. The samples were sent to the Northern Utilization Research and Development Division Laboratory at Peoria, Illinois, where determinations were conducted for amylose content of the endosperm. The method used in the amylose analysis gave a standard deviation of approximately ±2% of the actual amylose content when applied to known amylose values.

Climatic data consisting of the average temperature and degree-days were compiled for each of the 8 locations for the 3-year period. All climatic data were for the 4-month period, June through September. The average temperature was computed by calculating the mean of the maximum and minimum daily temperatures. Degree-days represent the accumulative total daily units by which the average temperature exceeded 50°F.

EXPERIMENTAL RESULTS

A variance analysis was computed on the means of the 6 entries, 8 locations, and 3 years (Table 2). The results

Table 1—Genotypes and amylose contents of the 6 entries grown at 8 locations for 3 years.

<table>
<thead>
<tr>
<th>Entry No.</th>
<th>Genotype</th>
<th>Amylose content, %</th>
<th>Parental 3-year average, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ae/aq</td>
<td>30.0</td>
<td>30.0</td>
</tr>
<tr>
<td>2</td>
<td>ae/ae</td>
<td>40.0</td>
<td>50.0</td>
</tr>
<tr>
<td>3</td>
<td>ae/ae</td>
<td>50.0</td>
<td>50.0</td>
</tr>
<tr>
<td>4</td>
<td>ae/ae</td>
<td>55.0</td>
<td>55.0</td>
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<td>ae/ae</td>
<td>50.0</td>
<td>50.0</td>
</tr>
<tr>
<td>6</td>
<td>ae/ae</td>
<td>20.0</td>
<td>20.0</td>
</tr>
</tbody>
</table>

* Average amylose content of progeny at 8 locations in 1957, 1958, and 1959.