GEORGIA EXPERIMENT STATION
Experiment, Georgia
Department of Agronomy

1. <u>The relative importance of genetic and environmental factors in determining oil content and oil composition of corn grain</u>.

The relative magnitude of variance component estimates is useful in determining the importance of sources of variation. The importance of genetic (hybrids) variation relative to environmental (planting dates and locations) variation for oil content and oil composition was studied in 1962 and 1963. Nine commercial hybrids were planted on three dates (1962: April 20, May 9, May 25; 1963: April 10, May 3, May 27) at Experiment, Georgia. Variance component estimates for oil content and for 5 fatty acids of corn oil are given in Table 1. The component of variance due to hybrids was about 6 or more times greater than the variance due to planting date. The variance component due to the hybrid X planting date interaction was very small as compared to the other variance components. The results show that the genetic or hybrid factor is much more important than the environmental or planting date factor in determining oil content and oil composition.

Nine commercial hybrids were grown at 5 locations in 1962 and at 6 locations in 1963 for determination of oil content and oil composition of the grain. Locations in Georgia included the Mountain, Limestone Valley, Piedmont, and Upper Coastal Plain regions. These locations differ in soil type, temperature, and amount of rainfall. Variance component estimates for oil content and for 5 fatty acids are given in Table 2 for both years. The relative magnitude of the variance component due to locations was from 2 to 3 times less than the hybrid variance component in 1962 and even greater differences existed in 1963. Although the hybrid X location interaction was significant for several characters, the magnitude of this variance component was quite small as compared to the other sources of variation. Therefore, hybrids (genetic factors) were more important in determining oil content and oil composition than locations (environmental factors).

Total oil content was determined with Nuclear Magnetic Resonance (NMR) by the Clinton Corn Processing Company, Clinton, Iowa. Fatty acid composition of the oil was

Table 1

Variance Component Estimates from the Combined Analysis of 9 Hybrids Planted on 3 dates in 1962 and 1963

Character	σ^2_d 1962	σ^2_d 1963	σ^2_h 1962	σ^2_h 1963	σ^2_{hd} 1962	σ^2_{hd} 1963	σ^2_e 1962	σ^2_e 1963
Palmitic	0.00	0.00	0.80**	0.60**	0.06	0.10	0.15	0.44
Stearic	0.01*	0.06**	0.07**	0.12**	0.01	0.00	0.04	0.04
Oleic	0.07	0.47**	1.78**	2.74**	0.00	0.28	1.85	1.51
Linoleic	0.22	0.78**	3.31**	4.76**	0.00	0.17	1.80	2.22
Linolenic	0.00**	0.00	0.01**	0.00	0.00	0.01	0.01	0.03
Oil (%)	0.00	0.01**	0.27**	0.21**	0.00	0.01	0.04	0.02

*, ** Mean square significant at the 5% and 1% level, respectively.

σ^2_d = variance due to date of planting; σ^2_h = variance due to hybrids; etc.

Table 2

Variance Component Estimates from the Combined Analysis of 9 Hybrids Planted at 5 Locations in 1962 and 6 Locations in 1963

Character	σ^2_l 1962	σ^2_l 1963	σ^2_h 1962	σ^2_h 1963	σ^2_{hl} 1962	σ^2_{hl} 1963	σ^2_e 1962	σ^2_e 1963
Palmitic	0.18**	0.14**	0.77**	1.04**	0.00	0.09*	0.27	0.22
Stearic	0.06**	0.07**	0.07**	0.08**	0.03**	0.02*	0.02	0.04
Oleic	0.97**	1.42**	1.77**	4.05**	0.85*	0.21	1.34	1.80
Linoleic	2.03**	2.88**	3.73**	8.06**	1.09*	0.33	1.73	1.70
Linolenic	0.01**	0.01**	0.01**	0.00*	0.00	0.00	0.01	0.04
Oil (%)	0.07**	0.07**	0.21**	0.22**	0.04**	0.04**	0.03	0.03

*, ** Mean square significant at the 5% and 1% level, respectively.

σ^2_l = variance due to locations; σ^2_h = variance due to hybrids; etc.

determined with gas chromatography by J. E. Marion of the Food Processing Department at the Georgia Experiment Station.

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2. Correlation coefficients involving oil content and five fatty acids of corn oil.

In addition to genetic studies involving fatty acids of corn oil, it is desirable to determine the relationships which exist among the fatty acids or between the fatty acids and total oil content. Nine commercial hybrids were grown at five locations in 1962 and at six locations in 1963. Plantings were made on three dates at one of these locations in both years. Correlation coefficients were calculated for hybrids at individual locations and also for individual hybrids over locations. Results were similar for both 1962 and 1963. Therefore, only a representative sample of correlation coefficients are given in Table 1 for the individual locations in 1963 and for the total over locations in 1962 and 1963.

In general, all correlations involving linolenic acid were very low and nonsignificant. As palmitic acid increased, there was a tendency for stearic acid to increase. Palmitic acid and oil content were positively correlated and palmitic acid and linoleic acid were negatively correlated. Stearic acid had a weak positive correlation with oleic acid and oil content. A quite high negative correlation was obtained between stearic and linoleic acids. The two major fatty acids in corn oil are oleic and linoleic. These two fatty acids have a very high negative correlation coefficient. Work at the University of Illinois has indicated that oleic and linoleic acid content of the oil is controlled by a single gene. The Illinois workers have proposed that oleic acid is the precursor of linoleic acid. If this is true, then a negative correlation approaching the value of 1 would be expected on a single kernel basis. A quite high positive correlation existed between oleic acid and oil content and a high negative correlation was shown between linoleic acid and oil content. However, the relationship of oleic and linoleic acids with oil content is not so high that selection for high oil and high linoleic acid could not be made. Some inbred lines and hybrids have been found to be high in oil content and in linoleic acid proportion of the oil.

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