2. Competitive pollen tube growth in Zea mays, L.*

In the previous report (M. N. L. 1958) where pollen mixtures from yellow and white sources were tested the results suggested a relation between combining ability and pollen tube growth in those cases where cytoplasmic factors apparently were not involved. The seed resulting from these pollinations were grown the following season in paired rows and the yields determined. A highly significant positive correlation was found between superior yield and the superior color class. However, in cases where the maternal parent was genetically identical to the white component of the pollen mixture used there seemed to be a preference for self pollen, in most of the cases studied, so that a negative correlation was realized. Hence, at this stage these results must be interpreted with reserve until more information becomes available with respect to the different factors which may affect pollen tube growth. It is expected that considerable light will be thrown on this aspect when the results of the present season will become available.

Additional data have supported the previous observation (M. N. L. 1958), that, with rare exceptions, varietal pollen is superior to pollen from inbreds in competition.

* (In press, Proceedings of the First South African Congress, University of Pretoria, 1958).

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3. Quantitative genetic studies.

Maize breeding in South Africa is still in the early stage characterized by wide scale sampling of germ plasm from local open pollinated varieties as contrasted to the improvement of existing inbreds. Need for knowledge of the genetic composition of these varieties is keenly felt, therefore. Five varieties were chosen accordingly and the following investigations were carried out with them.

(a) Estimation of additive and dominant components of yield variance.

Non-selected full sib (biparental) and half sib (maternal) progenies were grown in two replications of plots each containing about 40 plants. Yield was expressed in lbs. of ears per plot. Additive (G) and dominant (D) components of genetic variance were determined by the intra class correlation method (first method) assuming that co-variance of full sibs = $1/2G + 1/4D$ and covariance of half sibs = $1/4G$.

For purposes of comparison a series of biparental progenies using one pollen parent on three or four ear parents was grown in two replications for three of the five varieties. (The other two are being grown

in the current season.) These were then analyzed according to the method developed by Comstock and Robinson (Biom. 4: 254). The results of both the first and this second method are given in table 1.

Table 1. Estimated additive (G) and dominant (D) components of genetic variance for yield in five South African maize varieties.

Variety	First Method			Second Method			Mean of All Progenies
	No. of Progenies	G	D	No. of Progenies	G	D	
Robyn	48	8.20	0.12				8.3
Anveld	48	3.60	12.00	60	6.84	-2.48	7.1
Teko	52	7.72	-0.30	116	4.96	-0.44	11.1
American white flint	58	4.16	-2.92				9.0
Sahara	48	7.92	-5.64	72	4.20	0.20	8.3
Total	254	10.60	0.48				8.6

Results differ considerably among varieties and between methods and are probably subject to a large amount of random error and some bias. The half sib progenies were expected to contain some full sibs although care was taken to pollinate plants with a mixture of a large number (ca. 30) of other plants' pollen. This should cause an underestimation of D and may partly be responsible for the negative values obtained. In general however, the results from the two methods are in fair agreement with each other and with those obtained by Robinson et.al. (Genetics 40: 45) for American varieties, giving a large amount of additive and relatively little dominant variance.

The full sibs gave an over all 12% higher yield than the half sibs. Every individual variety showed this tendency. The open pollinated varieties gave intermediate yields.

(b) Frequency of recessive mutants.

The number of distinct recessive seedling characters (albino, zebra, glossy, virescent, etc.) segregating in 100 S_1's of each of the five varieties was as follows:

Robyn 21

Anveld 44

Teko 28

A. W. Flint 42

Sahara 30

(c) <u>Ability to produce heterosis.</u>

Extensive variety cross trials were carried out in South Africa in 1957. All the possible crosses among 15 varieties were tested for yielding ability in five localities. The results are in press (South African J. Agric. Sci. 1958). Crosses between the five varieties of present concern are now being tested for the fourth season in Pretoria. The amount of heterosis, expressed as yield of hybrid in percentage of parental mean, varied greatly with seasons and localities indicating marked effect of genotype-environment interaction on heterosis. The following were the mean yields of varieties, of variety crosses, and the heterosis values for each variety, over three seasons:

	Variety	All Crosses	Het. %
Robyn	11.9	10.9	97
Anveld	9.9	11.2	109
Teko	12.2	11.8	100
A.W. Flint	10.6	11.6	105
Sahara	9.1	10.3	104

(d) <u>Relation between yield variance and inbreeding coefficient.</u>

Fairly extensive trials are being conducted in the present season to determine the effect of inbreeding ($F = .125$ to $F = .75$) on variability within and between nonselected lines obtained from these varieties. Lines from some varieties (e.g. Sahara) are commonly known to maintain variability for more generations of inbreeding than others.

Preliminary results on yield obtained from 30 S_1's and their S_2's (20 plant plots, two replications) of the variety Gobi are as follows:

		Obtained	Expected
Environmental variance		259	
Genetic variance of o. p. variety	(S_0)	326	326
Genetic variance within lines	(S_1)	568	163
Genetic variance within lines	(S_2)	406	82
Genetic variance between lines	(S_1)	464	362
Genetic variance between lines	(S_2)	1577	489

The environmental component was obtained from a large number of nonsegregating progenies (not related to Gobi, but with comparable average yield) in an adjacent field. The S_o estimate was obtained from a comparison of about 150 individual noninbred plants of the variety Gobi. The expected values are based on the assumption of additive gene action for yield (see Wright, Genetics 37: 312). Deviations from the expected values could be ascribed to nonadditive gene action. The limited numbers in this preliminary experiment must be borne in mind. It is felt that genotype-environment interaction is probably a major factor in causing these discrepancies, especially since the trial included plants varying greatly in yield. As soon as more information is available on the elimination of interaction by scaling, this type of. experiment should definitely be subjected to appropriate scaling.

(e) Genotype-environment interaction.

This phenomenon is being studied with inbred and single cross material. Statistically significant differences in variability were found between different genetically nearhomogeneous progenies grown in the same field. A partititioning of variance into environmental, genetic, and interaction components was made, giving the estimates 259, 1120 and 312 respectively when differences between hybrids and inbreds were not taken into account. A correlation coefficient of -.69 was found between mean ear weight and coefficient of variability. The mean C. V. of the inbreds was 57% as compared to 22% for the single crosses. When transformed into an antilog scale, differences in variability between progenies lacked significance and the mean C. V. of inbreds was 8% compared to 10% for the hybrids. Scaling, therefore, successfully reduced genotype-environment interaction or apparent "genetic homeostasis". More detailed results appear in "Proceedings of the First South African Genetic Congress, 1958".

In view of the extreme importance of interaction in interpreting experiments in quantitative genetics, more data is being collected at present and a greater variety of scales being tested.

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1. Gene order of y, ms-si, and rg on chromosome 6.

Data from the cross y si x rg Y Si/Rg y si are 907 Y Si:23 Y si:27 y Si:
y si which gives 2.5% recombination for the y-si region. Data from selfed ears of the triply heterozygous genotype give 2231 Y Rg:983 Y rg:1107 y Rg:8 y rg indicating 9.0 ± 1.5% recombination for the y-rg region. Recovery of one rg Y Si/Rg Y Si genotype, one Rg y si/rg Y Si