

The relatively high frequency of type 6 may be the result of there being two bivalents of chromosome 6 at the first metaphase in these cases. If these bivalents are far apart on the first metaphase plate, the two chromosomes 6 will probably be far apart in the first telophase nuclei and all through second division. However, from the high frequency of type 3, we could perhaps say that in most cases the mirror image spatial relationships of the chromosomes in the two first telophase nuclei are generally lost in the "swing flanking movement" of the chromosomes to form the second metaphase plates which are, of course, 90 degrees off from the plane of the first metaphase plate.

The results are very preliminary. The system is simple but needs definition. Studies will be made to see if the frequency of mononucleolate spores is related to the rate of quadrivalent formation for chromosome 6. Tetraploids heterozygous for an inversion on chromosome 6 should have a higher frequency of dinucleolate spores. Also by correlating the size of the spore after it leaves the quartet with the number of nucleoli, it should be possible to determine the time sequence of nucleolar fusion.

G. G. Doyle

4. Tetraploid gene segregation as studied with a repulsion phase marking system.

This system has been described in previous reports. It allows for the identification of all of the euploid and aneuploid types of tetraploids and the determination of many of the parameters of tetraploid gene segregation such as double reduction, numerical nondisjunction, the relative transmission frequencies of euploid and aneuploid gametes, and the viabilities of aneuploid zygotes and plants.

The gene segregation patterns of three euploid and four aneuploid types are given in Table 2.

Table 2
Gene Segregation of Euploid and Aneuploid Tetraploid Maize

Genotype	No. of plants tested	No. of gametes tested	Observed		Expected	
			% <u>A sh</u>	% <u>a Sh</u>	% <u>A sh</u>	% <u>a Sh</u>
2(A sh)2(a Sh)	320	62,431	20.11	21.01	21.43	21.43
3(A sh)1(a Sh)	54	9,344	49.78	2.95	53.57	3.57
1(A sh)3(a Sh)	49	8,175	2.41	52.27	3.57	53.57
3(A sh)2(a Sh)	11	1,730	28.67	7.05	25.00	8.33
2(A sh)3(a Sh)	11	1,561	6.66	27.48	8.33	25.00
2(A sh)1(a Sh)	25	3,840	47.27	21.22	53.33	20.00
1(A sh)2(a Sh)	13	1,625	20.86	49.54	20.00	53.33

The observed values are in general agreement with the expected values, which are computed on the basis of random chromatid assortment. There is a small deficiency in most of the A sh classes. This probably is the result of the ears getting wet, since shrunken kernels disintegrate rapidly. The last two harvest seasons have been very rainy. The data should be corrected for this.

In the case of the (4n-1) or trisomic tetraploids the expected frequency of A sh gametes from the 2(A sh)1(a Sh) plants is 53.33% while the observed value is only 47.27%. There is a corresponding decrease in the number of a Sh gametes from the 1(A sh)2(a Sh) plants. This may be explained on the basis of the lowered transmission frequencies of (2n-1) or monosomic gametes. The gametic output of 1(A sh)2(a Sh) plants on the basis of random chromatid segregation is A sh/A sh 1/30, A sh/a Sh 8/30, a Sh/a Sh 6/30, A sh 5/30 and a Sh 10/30. An equation may be set up to solve for the frequency of monosomic gamete transmission, designated as m.

$$6/15 (1 - m) + 10/15 m = .495 \quad (\text{decimal fraction of } \underline{a Sh} \text{ gametes})$$

Solving this equation, the percentage of gametes which function are 35.6% monosomic and 64.4% disomic.

A related problem is the relative viability of $(4n-2)$ or disomic tetraploids. Disomic tetraploids should be produced by self-fertilization of trisomic tetraploids in the proportion of $1/4$ if there is no competition between euploid and aneuploid gametes. Table 3 gives the results of progeny tests from 63 A Sh kernels produced by selfing two $2(\underline{A sh})1(\underline{a Sh})$ plants.

There is a clear indication that disomic plants are probably very rare due to decreased viability or zygotic lethality. The population of 63 plants came from a total of 110 seeds. There were 9 additional plants which did not have enough seeds to be categorized into genotypes. Plants with less than 50 seeds were not tabulated. These nine plants all had some A Sh seed so they were not disomic. Out of 72 plants not one was a disomic; if disomics were fully viable and there was no gametic competition, we would expect 18 of them. There is also a reduction in the number of trisomics. If disomic plants are inviable, then 52.6% or 33 plants should be trisomic. There were 27% or 17 trisomic plants.

Aneuploidy is, therefore, an important factor in tetraploid semi-sterility.

Table 3
Genotypes resulting from the self fertilization of two
 $2(\underline{A sh})1(\underline{a Sh})$ plants

Parent	3(Ash) 1(aSh)	2(Ash) 2(aSh)	1(Ash) 3(aSh)	2(Ash) 1(aSh)	1(Ash) 2(aSh)	1(Ash) 1(aSh)
1	23	17	2	8	5	0
2	0	3	1	1	3	0
Total	23	20	3	9	8	0
Ob. Percent	36.5	31.8	4.8	14.3	12.7	0
Expected Percent	15.8	12.5	2.6	36.2	16.4	16.4

Aneuploidy is caused by numerical non-disjunction originally. Aneuploids in the population contribute additional aneuploids to the next generation, but at reduced frequencies. They would probably be eliminated

from the population in a few generations, but the supply is being constantly replenished by errors in the meiosis of eutetraploids. Additional data on numerical non-disjunction are presented in Table 4.

Table 4
Numerical non-disjunction in tetraploid maize

Cross	Number of plants with the genotypes of:				
	2(Ash) 2(aSh)	3(Ash) 2(aSh)	2(Ash) 3(aSh)	2(Ash) 1(aSh)	1(Ash) 2(aSh)
4(aSh) X 4(Ash)	219	3	6	6	1
4(Ash) X 4(aSh)	62	2	3	1	0
Total	281	5	9	7	1

Progeny tests were made on 303 plants from a cross of 4(aSh) X 4(Ash) or the reciprocal. It may be seen from Table 2 that each of the five expected genotypes gives very characteristic ratios and may be readily distinguished. All ears with fewer than 100 kernels were discarded.

There were 14 plants (4.53%) which resulted from trisomic gametes and 8 (2.59%) which were from monosomic gametes. If this difference is valid, it probably is due to the fact that hypoploid zygotes are less viable than hyperploid ones. It would appear also that aneuploid gametes function more frequently on the female side than they do on the male. There were 14 cases of aneuploidy attributable to the female and only 8 in the case of the male. Additional data are required to settle some of these points.

G. G. Doyle

5. The synthesis of artificial allotetraploid maize.

An artificial allotetraploid maize would be true breeding for chromosome number and the partial sterility resulting from aneuploidy could be eliminated. In addition, it would be a true breeding hybrid.