

association in a single cell was 10 univalents, which represented 44 percent of the total. The less frequently observed type of association was eight univalents plus one bivalent, which represented 41 percent of the total. The third type of association was six univalents plus two bivalents, which made up 15 percent. From metaphase I to anaphase I, unusual features of chromosome behaviour were as follows: (1) The spindles often appeared crescent-shaped and univalent chromosomes were often distributed over the entire cell area. Hence it seemed difficult to distinguish metaphase I from anaphase I. (2) If all of the 10 chromosomes by chance oriented at the equatorial plate, it was found that they were likely to split. (3) In some cells the univalent chromosomes did not split and they were randomly distributed to the two poles. The distributions of 1-9, 2-8, 3-7, 4-6, 5-5, were all observed. As expected, the latter two were the most frequently observed ways of distribution. However, 0-10 type of distribution was not found in a limited number of sporocytes studied. (4) The 10 chromosomes of certain sporocytes were no longer distinct but divided into several conglomerate chromatin masses. These masses scattered along the spindle. After telophase I, cytokinesis in many primary sporocytes was incomplete.

At the second meiotic division, the unsplit chromosomes from the previous division divided in the normal manner, while halves of the previous split chromosomes did not. The undividing chromosomes usually failed to congress at the equator at metaphase II. On the other hand, the dividing chromosomes tended to do so. Attenuated chromatin masses were sometimes formed at anaphase II. At tetrad stage, the phenomenon of multispory consistently appeared. Micronuclei were always present.

For a test of ovule fertility the first ear of this haploid plant was pollinated by a sib. About 15 percent of the female gametes were fertile and set well developed seeds, which is much higher than expected. This high fertility is probably due to the high frequency of natural chromosome doubling in the ovules.

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1. Further studies of perennialism in derivatives of Zea.

A. Tetraploids:

Studies carried on since 1956 indicate that the prosaic breeding procedure of sibbing among the most perennial segregates in the hybrid

*Research carried out at Brookhaven National Laboratory under the auspice of the U.S. Atomic Energy Commission.

of $4n$ maize x $4n$ perennial teosinte quickly restores perennialism to 50% maize tetraploids through increasing the expression of the rhizomatous habit under selection pressure. Similarly, only two generations of selection at the 75% maize level have resulted in a progressive recovery of the perennial expression. A high degree of maize-likeness therefore appears to be compatible with the perennial expression at the $4n$ level.

B. Diploids:

Diploid derivatives of maize and perennial teosinte have been produced by making the triploid hybrid $4n$ perennial teosinte x $2n$ maize, then backcrossing this 30 chromosome hybrid back to $2n$ maize, and then intercrossing among the resulting array of aneuploids and euploids. Selection for perennialism is practiced in the post-triploid generations.

If the triploid is used as the female in the backcross to maize, the chromosome numbers in the progeny are:

First Post-Triploid Generation

<u>Chromosome No.</u>	<u>No. Plants</u>
20	1
21	3
22	7
23	8
24	9
25	10
26	11
27	5
28	6
29	3
30	0

Second Post-Triploid Generation, Obtained by Sibbing First

<u>Chromosome No.</u>	<u>No. Plants</u>
20	35
21	12
22	9
23	3
24	3
25	0
26	0
27	1
28	0
29	0
30	0

If the triploid is used as the male in the backcross to maize, the chromosome numbers in the progeny are:

First Post-Triploid Generation

<u>Chromosome No.</u>	<u>No. Plants</u>
20	8
21	3
22	1
23	0
24	1
25	1
26	0
27	2
28	3
29	2
30	3

Second Post-Triploid Generation, Obtained by Sibbing First

<u>Chromosome No.</u>	<u>No. Plants</u>
20	41
21	8
22	4
23	2
24	1
25	0
26	0
27	0
28	0
29	0
30	0

As these data indicate, there is a rapid shift to euploidy in the second post-triploid generation obtained by sibbing among the euploids and aneuploids of the first. In the third post-triploid generation, nearly all are 20 chromosome euploids, except for a few rare trisomics.

Study of univalency at AI and of segregation of genetic markers in the triploid interspecific hybrid indicates that 20 chromosome plants found in the first post-triploid generation should have about 42% teosinte chromatin and about 58% maize chromatin. Pachytene analysis of such plants reveals several regions of pairing failure or apparent failure, including at least one large internal region and several smaller terminal regions. Failure to form bivalents, however, is rare.

Percentage of good pollen in 10 euploid plants of the first post-triploid generation ranged from 18% to 82%. Among 20 chromosome plants in the second post-triploid generation the proportion of good pollen ranged from 69% to 97%, and in the third post-triploid generation from 80% to 96%.

Twenty-one percent of the seedlings of the second post-triploid generation prove to carry lethal factors, and 10% of the seedlings in the third post-triploid generation likewise carry lethals.

The study of both pollen abortion and lethality of offspring indicates that perennial teosinte carries genetic lesions which act as diploid-lethals, but which are apparently functionally viable at the $4n$ level. Pachytene analysis indicates considerable non-homology between the genomes of maize and perennial teosinte. Since even in spite of very strong selection for teosinte characters, especially perennialism, in the post-triploid generations, these derivatives are still maize-like in morphology, it is probable that there is a strong tendency to eliminate teosinte chromatin at the 20 chromosome level, presumably in conjunction with the elimination of diploid-lethal factors.

Even though one must concede that we have as yet no good measure of how much teosinte chromatin may persist in advanced generation 20 chromosome plants, it is a clear result that we have not been able to demonstrate perennialism in any 20 chromosome plant. This is even true of the first post-triploid generation 20 chromosome plants which must carry large amounts of teosinte chromatin since these cannot have yet suffered post-triploid elimination of teosinte segments. It has also been impossible to demonstrate perennialism among the whole gamut of aneuploids found in the first or later post-triploid generations. A few of these are able to regrow a new generation of culms after maturing seed, thus appearing perennial (Maize News Letter 36:5) for a time. However, totipotency is lost among the axillary buds of the second generation culms, and the plants die.

Only recently, one 21 chromosome plant has been found which appears to be truly perennial, and has been cloned to 15 propagules. It is now producing fourth generation branches from third generation culms. It is hoped that this plant or clone, which cytogenetically undoubtedly represents the simplest form in which perennialism in Zea has yet been observed, will furnish a beginning point for definitive studies of the cytological, genetic, and biochemical basis of perennialism in Zea.

Donald L. Shaver

2. Further studies of the inheritance of two interspecific traits in derivatives of maize and teosinte.

Distichy of ears and photoperiodism are two traits which are considered to be taxonomically useful in distinguishing maize from teosinte. Both of these traits have been found in maize as well as in teosinte. That photoperiodism in maize can be inherited as a monogenic trait is not doubted. The inheritance of distichy, however, has been variously reported to be monogenic and polygenic.

It is suggested that very close taxonomic affinities of the two forms would be indicated if both traits were inherited in maize and teosinte as expressions of the same loci.

The inheritance of distichy was studied in selfed backcrosses of (eight-rowed Longfellow Flint x Fla. teosinte)xLongfellow Flint. If Florida Teosinte carries a locus which can confer distichy in a 75% maize background, then 1/2 of the selfed backcross progenies should segregate 3:1 for the presumed recessive distichous trait:

<u>Progeny No.</u>	<u>Distichous plants</u>	<u>Polystichous plants</u>
557	0	16
558	5	8
559	10	0
560	7	8
561	11	1
562	6	7
564	5	10
565	0	3
566	6	5

It is obvious that the expression of distichy in this 75% maize background is not monogenic. Moreover, there was no evidence of the expression of the type of photoperiodism conferred by the id locus in pure maize.