II. REPORTS FROM COOPERATORS

BALL STATE TEACHERS COLLEGE
Muncie, Indiana

1. The relationship of aneuploidy to sterility in tetraploid maize.

Several studies have failed to show a relationship between aneuploidy and sterility in 4N maize (Punyasingh, 1947 Gen. 32:541; Kadam, 1944 Ind. J. Gen. and Plt. Br. 4:8; Fischer, 1941 Gen. 26:151; Warfield, MNL 1956). These results are not expected from the study of autotetraploids of other plants. Einset, 1947 (Am. J. Bot. 34:99) found a marked difference in fertility between euploid and aneuploid plants of tetraploid Lactuca.

It is clear that several complications arise if such a difference in fertility does not exist in maize. Most importantly, there would not be a clear limit to the range in aneuploid chromosome numbers. In fact, however, the pooled data of 557 plants of Randolph, 1935 (J. Agr. Res. 50:591), Kadam, 1944, and Catcheside, 1956 (Hered. 10:205) indicate that chromosome numbers do not occur beyond the range of 36 to 43 in the progeny of 40 chromosome plants. More significantly, Shaver (1960 U. of Ill. dissertation) in a study of 325 plants, found that the range in chromosome number among the progeny of randomly intercrossed euploids and aneuploids was likewise limited to 36 to 43.

It seems obvious that the apparent limit to the degree of aneuploidy in maize must relate to differential fertility of euploid and aneuploid gametes or zygotes or both, or that a very complex explanation for these limits must be given. If one is unwilling to take the latter course, one should expect to find a positive relationship between (at least female) sterility of a tetraploid maize plant and its degree of aneuploidy.

In the present study, 356 plants of 4N Argentine Flint were counted from root tips. Chromosomes were shortened by the method of Shaver (1960) and stained by the method of Randolph, 1935 (Stain Tech. 10:95). It seemed apparent that 4N Argentine Flint had a greater than expected proportion of euploids. Of 111 plants completely analyzed, 63.1% had 40 chromosomes. Aneuploids were correspondingly rare. These results are summarized in table 1.

Even though the Argentine Flint population is the progeny of randomly intercrossed parents of undetermined chromosome number, its distribution is highly significantly more narrow than the progeny of the pooled data of 40 chromosome plants. The more meaningful comparison, with the random progeny of Shaver, of course, shows an even greater difference. It must be admitted that, since 4N Argentine Flint seems to have a different aneuploid distribution than other maize tetraploids, it may also be different in other respects.

Table 1. Chromosome Numbers of 4N Argentine Flint, and Two Other Tetraploid Populations

Chromosome Number	Argentine Flint	Progeny of Euploid Autotetraploid Zea[1]	Random 4N Zea Population[2]
36		.7%	.9%
37		.4%	1.2%
38		7.5%	9.5%
39	14.4%	10.2%	15.7%
40	63.1%	60.7%	51.7%
41	14.4%	17.6%	14.8%
42	7.2%	2.3%	5.2%
43	.9%	.5%	.9%
Number of plants	111	557	325

1. Pooled data of Randolph, 1935, Kadam, 1944, and Catcheside, 1956.
2. Shaver, 1960.

After the initial analysis of 111 plants, the remainder were merely scanned to pick up the more rare and extreme aneuploids. At pollination, bulked pollen from 38 chromosome plants was applied to silks of 38 chromosome plants, 39's to 39's, etc. Pollinations were repeated every 24 hours to ensure that every silk was fertilized.

Pollen fertility of individual plants was assessed by fixing anthers destined to anthese within 24 hours, and then excising and staining the pollen. Pollen grains with obvious defects were considered to be aborted.

Ovule sterility was assessed by chopping off the tips and butts of each mature ear, thus removing the areas of irregular kernel distribution and areas of frequent "natural" abortion. The kernels were then removed from the rachis, the chaff removed by scraping, and the number of original ovules could then be counted and compared to the number of kernels actually produced.

Table 2 shows the pollen fertility of different chromosome number classes. All possible t-test comparisons reveal that all aneuploid classes differ significantly from the 40 chromosome class, but do not differ among each other.

Table 3 shows the ovule fertility of each chromosome class. All possible t-test comparisons reveal that all aneuploid classes except the scanty 38 class differ significantly from the euploid 40 class, but that the aneuploid classes are not significantly different from one another.

Table 2. Pollen Fertility Among Chromosome Number Classes of 4N Argentine Flint Maize.

Chromosome Number	Number of Plants	Average % Fertile
38	5	91.9
39	8	91.6
40	32	96.1
41	14	91.6
42	11	89.6

All Possible t tests	
38 vs. 39	t = .181
38 vs. 40	t = 5.250**
38 vs. 41	t = .18
38 vs. 42	t = .96
39 vs. 40	t = 2.73*
39 vs. 41	t = .04
39 vs. 42	t = .61
40 vs. 41	t = 4.81**
40 vs. 42	t = 3.24**
41 vs. 42	t = .81

Table 3. Ovule Fertility Among Chromosome Number Classes of 4N Argentine Flint Maize.

Chromosome Number	Number of Plants	Average % Fertile
38	2	30.7
39	12	60.6
40	29	76.6
41	15	67.4
42	9	48.0

All Possible t tests	
38 vs. 39	t = 2.09
38 vs. 40	t = 3.33
38 vs. 41	t = 2.58
38 vs. 42	t = 1.08
39 vs. 40	t = 4.42**
39 vs. 41	t = 1.60
39 vs. 42	t = 1.43
40 vs. 41	t = 3.22**
40 vs. 42	t = 3.51**
41 vs. 42	t = 1.68

Next, correlation coefficients were run to determine if male and female fertility from plant to plant were related. As shown in table 4, even though all r values are positive, only within the 42 chromosome class was the correlation significant at the 5% level. However, the r value for the overall population was highly significant. One can conclude that aneuploidy affects both male and female sterility, but that additional factors may have an additional, and perhaps largely independent, effect.

It is believed the present results differ partially from those of other workers because of the fact that in this study experimental units were classified for chromosome number directly by cytological methods, whereas this stratification in other researches was merely tested as a statistical possibility. However, one cannot rule out the

Table 4. Coefficient of Correlation Between Male and Female Fertility of Individual Plants.

Within the 39 class:	r = .329
Within the 40 class:	r = .252
Within the 41 class:	r = .289
Within the 42 class:	r = .632*
Overall disregarding classes:	r = .458**

possibility that 4N Argentine Flint, a long-time tetraploid, may behave differently than other maize autotetraploids in the characters studied.

D. L. Shaver

CARGILL, INCORPORATED RESEARCH DEPARTMENT
Grinnell, Iowa

Studies at this station involving ultraviolet irradiation of pollen attempt to demonstrate some of the subtle changes which may be masked in large scale and/or long continued irradiation of this type in heterozygous populations. Recurrent irradiation involving 60-110 plants per generation in the check and treatment populations of homozygous diploid HD73, and long term inbred B14 have, after four generations of irradiation, yielded nothing of the spectacular. Irradiation has resulted in poorer stands in some generations, and in the occurrence of occasional monoploids and a single triploid (unproven cytologically). The series will be continued for two or more generations with seed of each generation placed in cold storage. Plans call for an eventual variance analysis in several quantitative traits to detect the presence of induced effects of an individually small, but cumulative, nature.

The possibility of selection pressure accompanying the exposure of pollen to ultraviolet was tested in 1960 in a latin square trial comparing the double cross (Wf9xM14) x normal (Os 420x187-2) with (Wf9xM14) x irradiated (Os420x187-2). The three-way crosses (Wf9x M14) x normal Os420, (Wf9xM14) x irradiated Os420, (Wf9xM14) x normal 187-2, and (Wf9xM14) x irradiated 187-2 were also included. Irradiation had no detectable effect upon harvest moisture or stalk quality. Yields of the two three-way crosses, in sharp contrast to the very slightly reduced double cross, were markedly lowered. The reduction was significant in the case of (Wf9xM14) x irradiated Os420. The full significance of this has not yet been determined.