Table 1
Fractional losses of A Sh_2 following electric-field treatments of ++/a sh_2 males.

Male	Fractional category 1/2	1/4	1/8	1/16	limit	Total	No. A Sh kernels
1 (Control)		1	4	3	8	16	991
3 (40 min)		3	3	8	5	19	686
11 (3.5 hr)	5	7	3	15	23	53	1359
Total	5	11	10	26	36	88	3036

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1. Preferential pairing in trisomic plants containing an irradiated chromosome.

Pollen from plants with normal chromosomes 3 containing the A_1 allele was given 1000 r and used to fertilize standard trisome 3 plants which were homozygous for a_1. The gene segregation from the resulting trisome 3 plants (A/a/a) when used as the pollen parent is given in Table 1. Corresponding control data are given in Table 2.

The control data in Table 2 indicate that the theoretical ratio of 1 A : 2 a is held to very closely. There is only one progeny out of twenty-five in which the percentage of A gametes is significantly higher than 33.3%, but this may be expected at the .05% level. The interaction chi square of 32.7 with 24 degrees of freedom is not significant. The data are homogeneous.

In the case of the trisomes with an irradiated chromosome, it is an entirely different situation. Six of the 26 plants had transmission frequencies of A gametes significantly lower than 33.3% and six others had rates which were significantly higher than 33.3%. The former was

Table 1

	No. A gam.	Total gamet.	% A	X^2 (1:2)		No. A gam.	Total gamet.	% A	X^2 (1:2)
1	523	1280	40.85	31.3**	14	218	650	33.54	0.0
2	207	532	38.91	7.6**	15	462	1379	33.50	0.0
3	462	1201	38.47	14.4**	16	703	2110	33.32	0.0
4	572	1493	38.31	16.5**	17	248	746	33.24	0.0
5	178	465	38.28	5.1*	18	278	852	32.51	0.2
6	343	931	36.84	5.3*	19	233	749	31.10	1.7
7	256	699	36.62	3.4	20	133	431	30.85	1.3
8	262	728	35.99	2.2	21	161	566	28.44	4.7*
9	375	1047	35.82	2.8	22	230	824	27.91	10.6**
10	311	1435	35.61	3.4	23	142	766	18.54	75.1**
11	689	1961	35.14	2.9	24	97	566	17.14	67.2**
12	280	817	34.27	0.4	25	83	522	15.90	76.4**
13	140	410	34.15	0.1	26	30	1101	2.97	464.2**

Table 2
Control

	No. A gam.	Total gam.	% A	X^2		No. A gam.	Total gam.	% A	X^2
1	173	468	36.96	3.7	14	279	831	33.57	0.0
2	171	467	36.62	2.2	15	135	405	33.33	0.0
3	344	943	36.48	4.3*	16	137	416	32.93	0.0
4	176	484	36.36	2.1	17	220	673	32.69	0.1
5	527	1485	35.49	3.1	18	531	1641	32.36	0.7
6	556	1581	35.17	2.4	19	196	607	32.29	0.3
7	967	2765	34.97	3.3	20	202	631	32.01	0.5
8	265	765	34.64	0.6	21	390	1229	31.73	1.5
9	463	1338	34.60	1.0	22	286	932	30.69	3.0
10	481	1401	34.33	0.6	23	167	546	30.59	1.9
11	296	865	34.22	0.3	24	162	540	30.00	2.7
12	311	911	34.14	0.3	25	180	602	29.90	3.3
13	288	851	33.84	0.1	Total	7903	23377	33.81	2.4

expected, but the latter was not, since there was no indication of "negative preferential pairing" when In 3a chromosomes were used in an earlier experiment. The term, "negative preferential pairing," may not be a good one. It is possible that the pairing is still preferential and that the tacit assumption that "the greater the structural homology between two chromosomes is, the greater is their pairing affinity at meiosis" needs to be examined critically. It has been observed that synapsis in hybrids is often more regular than in the parental inbreds. One explanation is that this is merely an expression of the greater physiological efficiency of the hybrid. However, it is possible if the following hypothesis has any merit that certain structural differences may enhance the pairing affinity of chromosomes.

Let us consider the spatial orientation of two homologous chromosomes prior to synapsis, i.e., at the leptotene stage of meiosis. To perhaps oversimplify the matter, they will either be in reverse or non-reverse position in regard to order of their pairing code units. See figures 1 and 2.

A B C D E F G H I

I H G F E D C B A

Fig. 1

Reverse Orientation

A B C D E F G H I

A B C D E F G H I

Fig. 2

Non-reverse Orientation

It may be easily imagined that the initiation of synapsis in the reverse orientation might be very difficult; one of the chromosomes or part of one would have to be rotated 180°. If, however, a small inversion has been induced as is shown in Fig. 3 and Fig. 4, then pairing could take place with less difficulty when the chromosomes are in the reverse orientation. As the chromosomes slither past each in their random movements, the directionally homologous segments could make the initial contact and facilitate synapsis along the rest of the chromosome. A small inversion would not seriously hamper synapsis when the chromosomes were in the non-reverse orientation.

A B D C E F G H I

I H G F E D C B A

Fig. 3

A B D C E F G H I

I H G F E D C B A

Fig. 4

No cases of "negative preferential pairing" were found when In 3a chromosomes were irradiated. This is probably because an inversion is already present and the chromosomes do not need help in pairing in the reverse orientation.

Any additional inversions would not help much and would hamper pairing in the non-reverse orientation.

Some derivatives of the irradiated In 3a chromosomes from the original experiment have been reintroduced into trisomic 3 plants and the amount of preferential pairing has been redetermined. This was done by taking plants grown from colored (A) kernels from the testcross, a/a X A/a/a, and crossing them to the standard trisome 3 stock (a/a/a) and crossing the resulting trisomes as the pollen parent to the a/a tester. The results are given in Table 3.

In the first case in Table 3, the A locus has probably crossed over onto a normal chromosome. The chi square tests for a fit to a 1 A : 2 a ratio. It is significantly higher than 33.3% A. Perhaps a chromosome aberration which now causes negative preferential pairing has been retained.

Table 3

Original % A	Derived Trisome case #	No. of A gametes	Total gametes	% A	(X^2)!
17.15	1	334	905	36.90	5.1*
15.65	2	58	369	15.72	0.0
18.14	3	63	463	13.60	8.7**
	4	81	743	10.90	25.6**
	5	46	447	10.29	18.5**
	6	115	1072	10.73	39.3**
	7	140	906	15.45	4.4*
	8	269	2277	11.81	61.3**
	9	360	2402	15.00	16.2**
11.54	10	161	1057	15.23	14.2**
	11	121	830	14.58	7.2**
	12	142	693	20.49	0.8
12.56	13	107	886	12.08	0.2
10.23	14	121	830	14.58	17.0**
	15	42	375	11.20	0.5
	16	192	814	23.58	1.2
	17	151	2000	7.55	15.8**
	18	147	674	21.81	0.0
	19	93	748	12.43	3.7
	20	42	347	12.10	1.6

! See text for explanation of chi square tests

In the cases 2 - 11, 13 - 15, 17, 19, and 20 the chi square tests for a correspondence between the original transmission rate of A and the derived one. In cases 2, 13, 15, 19, and 20 the rate has been unaffected. The other cases 3 - 11, 14, and 17 show a shift in the amount of preferential pairing, possibly due to the loss of positively or negatively acting aberrations by crossing over.

In cases 12, 16, and 18, the amount of preferential pairing has reverted to that expected from In 3a alone (22% A), again probably by crossing over.

Unfortunately the data are too limited to make any sweeping conclusions. It is apparent that the level of pairing affinity is heritable and that it would be possible to map the location of these "synaptic mutations."

Another method of detecting preferential pairing has been devised and tested. Pollen from wx/wx plants was given 1000 r and used to fertilize trisome 9 plants which were homozygous for Wx. The pollen from the resulting trisomic plants (Wx/Wx/wx) is stained with iodine and is scored for Wx and wx. The results of this experiment are given in Table 4.

Table 4

	Control			Irradiated			
	No. wx gametes	Total gametes	% wx	No. wx gametes	Total gametes	% wx	X^2 (wx=23.22)
1	182	708	25.71	6	146	681	21.44	1.2
2	182	731	24.90	7	128	656	19.51	4.9*
3	158	684	23.10	8	114	635	17.95	9.6**
4	144	654	22.02	9	119	676	17.60	12.0*
5	129	646	19.97	10	109	621	17.55	11.1**
Total	795	3423	23.22	11	106	652	16.26	17.4**
inter. X^2 = 8.23 (not sig.)				12	88	605	14.54	31.3**

As may be seen in Table 4 the average frequency of wx pollen in the five control trisomes was 23.22%. The interaction chi square was only 8.23 with 4 degrees of freedom, so the data are homogeneous. Testing the frequency of wx pollen in the trisome 9 plants which received an irradiated wx chromosome against the value of 23.22% it was found that six out of seven plants gave an indication of preferential pairing.

The advantages of this method may be readily apparent. It is possible to examine a hundred thousand pollen grains or more if necessary and thus it is possible to detect very small differences in the level of preferential pairing. Also it is feasible to look for rare spontaneous changes in chromosome structure affecting chromosome pairing without having to plant an acre of tester plants. One possibility, which now can be tested easily, results from non-homologous pairing of a univalent (the pairing with itself) in a trisome. Crossing over in this non-homologously paired region would lead to the formation of an inversion.

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1. Japanese local races of maize resistant to the virus disease, corn stunt.

Four virus diseases are known to occur in maize under natural conditions. Stunt disease transmitted by the smaller brown planthopper, Delphaiodes striatella Fallén, is the most harmful one in Japanese maize production. A great deal of damage by virus disease is done to maize cultivation in the southern district of Japan, especially in Kyūshū.

Over a period of 2 years many varieties were tested for resistance to stunt disease at the Miyakonozyō Sub-station of the Miyazaki Agricultural Experiment Station, Miyazaki Prefecture. Seventy materials (48 Japanese local races, 17 varieties introduced from foreign countries, and 5 recommended hybrids) were tested in 1963. The results showed that all but 2 Japanese races, Kamigane-1 and Suyame-inno-1, had high susceptibility to this disease. Frequency (%) of diseased plants and index of susceptibility* was over 50% and 1.70 respectively. However, Kamigane-1 showed only 13.5% and 0.42, and Suyama-inno-1 showed 24.4% and 0.65 respectively.

In 1964, two hundred eighteen races (151 Japanese local races and 67 races collected from foreign countries, of which 17 were from Thailand), were tested. It is said that most of the Thailand races originated from the progenies of Guatemala Golden Yellow Flint Hybrid. All but some Thailand and the 2 Japanese races mentioned above had low resistance to the disease, showing similar values regarding susceptibility as the test in 1963. The values in some Thailand races varied from 9.4% to 45.2% and 0.3 to 1.4. The values of Kamigane-1 were 12.5% and 0.3, and those of Suyama-inno-1 were 6.3% and 0.1 respectively.