Pollen grains from Ms ms S s and Ms ms s s plants were stained with carmine and examined. In Ms ms S s samples, about half the grains are normal in appearance and half are smaller and partially filled with starch. The latter presumably are of Ms s and ms s constitution. Some of the small grains contained two sperm nuclei and a vegetative nucleus while others apparently had only one nucleus. In Ms ms s s samples, there is no normal pollen and none of the grains contains starch. Some of the cells have a single nucleus and others show signs of degenerate nuclear material. Both S and Ms may produce a transient conditioning of the cytoplasm of the microspores. Grains of identical genotypes (Ms s and ms s) are present in the two samples examined yet in the Ms ms S s sample the abortive grains are much more normal in appearance. This difference may be due to the action of the S factor. Moreover, the ms s genotype in itself cannot produce abortion in the microspore since normal Kys pollen is of this constitution. It would seem that the Ms factor also has a conditioning effect on the cytoplasm of the PMC prior to meiosis which determines whether a microspore of ms s constitution will be entirely normal or will abort.

Ellen Dempsey

6. Heterotic effects of a chromosomal segment.

Tests for heterotic genes in the long arm of chromosome 3 were continued in 1956. A homozygous inversion 3a strain carrying the recessive a_1 allele in the inverted segment was crossed to a number of inbred lines with the A_1 allele. F_1 plants, all heterozygous for the inversion and for A:a, were backcrossed by the recessive a_1 inversion stock. On the F_1 backcrossed ears there was a ratio of 1 colored: 1 colorless kernels. The colored kernels are heterozygous for the inversion and for A:a and the colorless kernels homozygous for the inversion and for a:a. The kernels of the 2 classes were planted in replicated plots. Data for grain yield, ear height, kernel weight, ear number, and maturity are given in the following tables:

	Ave. yield per rep. in lbs.				Ave. ear height per plant in cms.			
	No. reps.	Aa	aa	't' value	No. reps.	Aa	aa	't' value
R 4	12	3.89	3.58	6.20**	12	114	106	4.60**
R 2	12	3.37	3.36	0.17	12	129	124	6.28**
O 45	12	3.35	3.17	2.00	12	115	100	7.91**
O 41	12	3.49	3.24	4.17**	12	128	120	5.65**
M 14	12	3.57	3.48	1.50	12	108	103	6.42**
K 4	12	3.55	3.41	1.52	12	131	121	6.85**
I 205	12	3.05	3.11	0.90	12	108	109	0.51
C 103	12	3.38	3.29	1.32	12	122	116	3.67**
5120 B	12	3.79	3.58	2.14	12	125	114	7.46**
K 187-2	12	2.92	2.65	2.45*	12	113	93	10.41**
38-11	12	3.62	3.39	2.88**	12	128	120	5.37**
O 7	12	3.56	3.19	3.36**	12	113	98	12.16**
WF 9	12	3.36	3.41	1.40	12	107	105	2.44*
W 26	12	3.29	3.40	1.11	12	120	112	7.07**
R 59	12	4.05	3.92	1.55	12	125	114	10.37**

** Significant at 1% level
 * Significant at 5% level

	Ave. weight of 1000 kernels in gms.				Ave. ear no. per rep.			
	No. reps.	Aa	aa	't' value	No. reps.	Aa	aa	't' value
R 4	6	187	166	2.94*	12	17.7	16.9	1.51
R 2	6	192	181	2.57*	12	14.2	14.8	2.23*
O 45	6	231	201	3.17*	12	13.1	13.2	0.27
O 41	6	199	173	3.93**	12	16.9	16.0	1.96
M 14	6	189	173	4.07**	12	15.8	16.7	1.99
K 4	6	178	159	2.28	12	18.5	18.2	0.48
I 205	6	197	184	1.86	12	12.6	13.0	2.19
C 103	6	221	205	2.48	12	13.5	13.2	0.72
5120 B	6	235	207	8.80**	12	15.5	14.3	2.17
K 187-2	6	202	177	4.41**	12	15.1	13.0	4.75**
38-11	6	218	188	6.06**	12	16.0	14.5	2.57*
O 7	6	214	205	1.59	12	18.0	14.5	6.44**
WF 9	6	223	186	12.41**	12	12.5	12.8	1.08
W 26	6	220	197	3.71**	12	13.5	14.8	2.79*
R 59	6	246	228	1.62	12	16.8	17.6	1.46

** Significant at 1% level
 * Significant at 5% level

	Ave. days from planting to half silking			
	No. reps.	Aa	aa	't' value
R 4	12	69.2	69.7	2.08
R 2	12	68.8	69.1	1.73
O 45	12	66.3	65.2	3.67**
O 41	12	69.7	69.4	1.42
M 14	12	68.4	68.3	0.36
K 4	12	71.9	71.3	1.87
I 205	12	66.9	66.2	1.85
C 103	12	68.3	68.9	2.22*
5120 B	12	67.4	67.5	0.50
K 187-2	12	65.2	64.9	1.43
38-11	12	67.0	66.9	0.40
O 7	12	65.3	65.2	0.40
WF 9	12	62.9	64.1	6.32**
W 26	12	66.1	66.5	1.43
R 59	12	66.2	66.5	2.64*

** Significant at 1% level
 * Significant at 5% level

The kernels from selfed ears of F_1 plants were planted at random in the field without classifying for aleurone color. The F_2 plants were detasseled and the intervening rows of an $\underline{a_1}$ tester used as pollen source. Plants having ears with only colored kernels are homozygous for the chromosome 3 segment from the inbred line, those with half colored and half colorless kernels are heterozygous for the inverted segment, and those with only colorless kernels are homozygous for the inversion. Data for grain yield, ear height, ear number, and maturity are presented below:

	Ave. yield per plant in gms.						't' value		
	No. plants	AA	No. plants	Aa	No. plants	aa	AA vs Aa	AA vs aa	Aa vs aa
R 4	36	72.9	86	96.2	34	101.8	3.58**	4.60**	1.54
R 2	70	99.2	120	116.0	52	108.5	2.42**	1.65	1.48
O 45	61	118.2	124	131.2	61	108.9	2.52**	1.52	4.82**
O 41	35	110.5	90	116.4	31	103.3	1.00	0.99	2.11*
M 14	67	106.8	124	125.8	53	113.7	4.23**	1.34	2.43**
I 205	42	94.7	64	104.2	39	107.3	1.44	1.59	0.42
C 103	27	99.1	82	122.9	32	103.7	3.08**	0.47	2.53**
5120 B	42	101.8	86	117.6	44	109.5	2.68**	0.99	1.28
K 187-2	47	116.0	119	113.7	59	103.5	0.38	2.06*	1.96
38-11	32	95.1	77	111.4	35	98.1	2.04*	0.36	1.76
O 7	44	119.0	71	133.6	33	113.1	1.98*	0.71	2.74**
WF 9	53	112.1	109	116.8	66	116.5	0.74	0.59	0.05
W 26	60	82.3	119	101.1	52	98.2	4.29**	3.15**	0.58
R 59	36	92.1	85	115.3	32	88.2	3.22**	0.52	3.74**

** Significant at 1% level
 * Significant at 5% level

	Ave. ear height per plant in cms.						't' value		
	No. plants	AA	No. plants	Aa	No. plants	aa	AA vs Aa	AA vs aa	Aa vs aa
R 4	36	91	86	94	34	90	1.52	0.15	1.62
R 2	70	106	119	105	52	96	0.16	3.28**	4.16**
O 45	61	94	124	88	61	77	2.04*	5.78**	4.61**
O 41	35	100	90	110	31	100	2.66**	0.15	2.63**
M 14	67	70	124	76	53	73	2.95**	1.11	0.87
I 205	42	90	64	105	39	111	5.15**	6.38**	1.98
C 103	27	84	82	85	32	82	0.32	0.53	1.13
5120 B	42	106	86	111	44	105	1.68	0.57	2.31**
K 187-2	47	107	119	104	59	85	1.42	7.24**	7.36**
38-11	32	128	76	122	35	100	1.87	7.24**	6.31**
O 7	44	126	70	124	33	109	0.39	4.32**	4.37**
WF 9	53	101	109	102	66	96	0.25	1.30	2.15*
W 26	56	100	113	102	49	88	0.58	3.62**	5.37**
R 59	36	125	84	122	32	108	0.71	4.47**	4.98**

** Significant at 1% level
* Significant at 5% level

	Ave. ear number per plant						't' value		
	No. plants	AA	No. plants	Aa	No. plants	aa	AA vs Aa	AA vs aa	Aa vs aa
R 4	36	1.03	86	1.18	34	1.18	1.93	1.85	0
R 2	70	1.21	120	1.15	52	1.09	1.05	1.68	0.99
O 45	61	1.13	124	1.18	61	1.05	0.81	1.52	2.45**
O 41	35	1.20	90	1.31	31	1.13	1.22	0.74	1.96
M 14	67	1.03	124	1.14	53	1.13	2.33**	2.07*	0.17
I 205	42	1.02	64	1.08	39	1.18	1.30	2.48**	1.53
C 103	26	1.04	82	1.00	32	1.00	1.79	1.15	0
5120 B	42	1.12	86	1.14	44	1.23	0.31	1.33	1.31
K 187-2	47	1.36	119	1.36	59	1.07	0	3.99**	4.21**
38-11	32	1.00	77	1.16	35	1.00	2.47**	0	2.61**
O 7	44	1.17	71	1.25	33	1.00	0.92	2.24*	2.89**
WF 9	53	1.19	109	1.10	66	1.06	1.45	2.03*	0.65
W 26	60	1.07	119	1.19	52	1.15	2.16*	1.24	0.60
R 59	36	1.22	85	1.35	32	1.19	1.36	0.27	1.67

** Significant at 1% level
* Significant at 5% level

	Ave. days from planting to silking						't' value		
	No. plants	AA	No. plants	Aa	No. plants	aa	AA vs Aa	AA vs aa	Aa vs aa
R 4	36	65.1	85	64.9	31	64.6	0.54	1.28	0.54
R 2	67	63.7	111	62.4	49	63.2	3.52**	1.12	1.98*
O 45	56	63.4	113	61.3	54	61.4	5.38**	3.89**	0.10
O 41	31	65.5	81	65.6	28	64.8	0.32	1.68	2.61**
M 14	56	62.3	107	61.8	48	62.6	1.41	1.00	2.17*
I 205	42	62.1	60	62.8	36	63.0	1.33	1.89	0.68
C 103	27	65.2	78	65.0	29	65.5	0.37	0.47	0.95
5120 B	38	65.3	82	65.1	41	65.9	0.51	1.18	1.87
K 187-2	42	63.7	104	63.6	50	63.0	0.15	1.35	1.32
38-11	22	66.5	57	66.6	32	65.9	0.12	0.78	1.05
O 7	43	66.4	65	65.5	31	65.5	2.18*	1.63	0
WF 9	49	62.4	104	62.7	63	64.4	0.72	3.35**	3.41**
W 26	54	63.9	104	63.0	44	63.2	2.05*	1.26	0.50
R 59	26	72.6	60	70.2	24	70.9	4.06**	2.15*	1.08

** Significant at 1% level
* Significant at 5% level

After 3 successive years' tests it is concluded that certain inbred lines carry genes in the long arm of chromosome 3 which give a heterotic effect when tested against the same segment in the inversion strain. This heterotic effect is shown in both grain yield and ear height. The grain yield data obtained from 1954 to 1956 and the maturity data obtained in 1955 and 1956 are not consistent. This might be attributed to differences in the conditions of different growing seasons. As indicated in the tables of grain yield and ear number of both backcrossed and F_2 materials, the larger ear number is, in most cases, related to the greater yield in the heterozygous classes over the homozygous classes in those inbred lines which show significant differences. Data for ear height obtained in the last two years from backcrossed materials show highly significant differences between heterozygous and homozygous inversion classes, except in one inbred line, I 205, which showed a significant difference in 1955 but not in 1956. This is also true in the F_2 materials as shown in the table presented in this paper. The differences in kernel weight are highly significant in most inbred lines in both years. These differences are either due to the heterotic genes from the inbred lines or the 15.75% ovule abortion in the class heterozygous for inversion (3.31% in the class homozygous for inversion). From these experiments it is also concluded that the method of using paracentric inversions for testing genes affecting agronomic characters, such as yield and ear height, as suggested by Dobzhansky and Rhoades in 1938, is effective.

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