

The hybrids used from Colombia and from Brasil are already in distribution to farmers of each country.

This yield trial suffered through a very dry period during the flowering time. The varieties Pelotas, Marilia and Peru 330 had a very bad performance with yields below 2300 kg/ha. A summary of the data from the remaining entries (means from four replications) can be seen in Table 1.

All three Brazilian semi-dent double hybrids when compared with ordinary Brazilian field corns are very good under our conditions, and in another experiment carried out in 1954-55, in the same field, hybrid I.A. H-4624 yielded 4660 kg/ha, about 35% more than the mean of a group of 300 common yellow dent varieties from São Paulo (Maize Genetics Coop. News Letter 30: 129).

We can see the good performance of the Mexican hybrids and also of some Colombian ones. Mexican material was later than ours and the height of the ear and plant as a rule, was very high.

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## 2. Further studies on adhesions of non-homologous centromeres and knobs.

In the 1955 News Letter data were presented on the frequency of adhesions of non-homologous centromeres at pachynema and also on the frequency of fusion of knobs on non-homologous chromosomes. Data were obtained from a strain of inbred Kys with structurally normal chromosomes and from a Kys strain homozygous for a 4-10 translocation. Additional data are now available from four different Kys strains each homozygous for a different reciprocal translocation. These studies have been confined to Kys lines because of the excellence of the pachytene preparations. Whether or not our conclusions as to the relative frequencies with which different chromosomes participate in non-homologous centromere and knob adhesions will hold for other strains is, of course, wholly conjectural.

Centromere adhesions occurred in nearly 75% of the cells observed. The kinds and frequencies of non-homologous centromere associations are given in Table 1. In those PMC with centromere adhesions the most frequently observed cells were those where two pairs only were so associated. Next in frequency were PMC where four of the 10 pairs were involved but the associations were 2 by 2--i.e., two pairs had adhered centromeres as did two other pairs in the same microsporocyte. Much less frequent were those cells with 3 cases of centromere adhesions with two chromosome pairs involved in each fusion. Occasionally a cell was found with one adhesion involving the centromeres from three chromosome pairs. Rarest of all were cells with two adhesions, one involving two and the other three chromosome pairs.

Table 1. Frequencies of different kinds of centromere adhesions at pachynema in normal KYS strains and in five different homozygous translocations (3-9, 4-6, 4-9, 4-10 and 5-6) with KYS background.

No. of adhesions per cell	No. of bivalents involved	Normal KYS		Homozygous 3-9 Translocation		Homozygous 4-6 Translocation	
		No.	%	No.	%	No.	%
1	2	148	50.9	129	67.9	132	63.5
2	4	125	42.9	53	27.9	67	32.2
3	6	10	3.4	4	2.1	5	2.4
1	3	5	1.7	1	0.5	4	1.9
2	5	3	1.1	3	1.6	-	-
		291	100.0	190	100.0	208	100.0
No. of adhesions per cell	No. of bivalents involved	Homozygous 4-9 Translocation		Homozygous 4-10 Translocation		Homozygous 5-6 Translocation	
		No.	%	No.	%	No.	%
1	2	114	62.6	76	42.2	127	63.2
2	4	60	33.0	89	47.4	67	33.3
3	6	5	2.7	8	4.4	3	1.5
1	3	2	1.1	5	2.8	3	1.5
2	5	1	0.6	2	1.1	1	0.5
		182	100.0	180	100.0	201	100.0

The average pachytene lengths of the 6 Kys strains studied are given in Table 2. The data for the structurally normal Kys line are from 6 well-spread figures at mid-pachynema where there was no obvious distortion by unequal stretching. The measurements for the homozygous 4-10 translocation are from 4 cells. Pachytene lengths for the remaining four homozygous translocation lines were each from 8 good figures. The total lengths and arm ratios found for Kys chromosomes agree well with the average values reported by Longley (1938) for different strains of maize but some differences exist. The greatest discrepancy found is that for chromosome 1 where our data give a long: short arm ratio of 1.1:1 while Longley reported a ratio of 1.3:1.

Involvement of the different chromosome pairs is clearly not at random but in general appears to be related to their relative pachytene lengths. Using the data in Table 2 (page 126), the expected number of centromere adhesions are given in Table 3 (page 128) on the hypothesis that the frequency with which the centromere of a specific chromosome pair adheres to other centromeres is a function of its relative pachytene length. Considering the normal Kys strain, the high chi-square value for the total of the 10 pairs appears to invalidate this hypothesis but a closer inspection shows that the only significant individual difference is for chromosome 5 and that for the remaining nine chromosomes there is a close relationship between pachytene length and frequency of centromere adhesion. The anomalous behavior of chromosome 5 is apparent also in the five translocation strains where the observed number of adhesions it undergoes is consistently higher than expected.

A check on the validity of this hypothesis is afforded by the data from the five translocation strains where the relative length of certain chromosomes has been drastically changed. If the frequency of centromere adhesions is a function of relative chromosome length then the translocated chromosomes whose lengths have been modified should show differences in adhesion frequencies. This is precisely what was observed with only two exceptions. In the homozygous 4-6 translocation, chromosome 6<sup>4</sup> had fewer adhesions than expected on the basis of its relative length and in the 4-9 homozygous translocation the 4<sup>9</sup> pair had significantly more adhesions than the calculated number. In general, however, the data are consistent with the hypothesis that the frequency of centromere adhesions depends in some unknown fashion upon the relative pachytene lengths.

The data on non-homologous knob associations given in the 1955 News Letter have been extended by observations on the 4 additional strains mentioned above. As was found previously, the larger knobs on chromosomes 5 and 7 are involved more frequently than the smaller knobs. The heterochromatic satellite located on the 4<sup>6</sup> chromosome in the homozygous T4-6 stock occasionally fused with other knobs although in its usual position such association has not been observed. Multiple knob associations occurred in less than 1% of the total number of cells recorded.

Table 2. Lengths in micra and arm ratios of inbred KYS chromosomes and those of five homozygous translocations in comparison with Longley's data.

Normal KYS					Homozygous 3-9 Translocation				
Chrom.	S	L	Total length	Arm ratio	Chrom.	S	L	Total length	Arm ratio
1	40.17	45.73	85.90	1.1:1	1	39.42	47.45	86.87	1.2:1
2	31.52	34.46	67.98	1.2:1	2	32.40	36.00	68.40	1.1:1
3	20.39	40.17	60.56	2.0:1	3 <sup>9</sup>	22.29	26.01	48.30	1.2:1
4	22.25	35.23	57.48	1.6:1	4	22.68	34.02	56.70	1.5:1
5	29.05	31.52	60.57	1.1:1	5	29.72	31.95	61.67	1.1:1
6	11.74	36.46	48.20	3.1:1	6	11.11	34.09	45.20	3.1:1
7	11.12	33.37	44.49	3.0:1	7	11.15	34.08	45.33	3.1:1
8	11.12	35.23	46.35	3.2:1	8	10.41	34.97	45.38	3.3:1
9	14.21	27.19	41.40	1.9:1	9 <sup>3</sup>	12.63	42.35	54.98	2.4:1
10	9.27	25.96	35.23	2.8:1	10	9.12	26.60	35.72	2.9:1
Σ	200.84	347.32	548.16	-	Σ	200.93	347.62	548.55	-
Homozygous 4-9 Translocation					Homozygous 4-10 Translocation				
Chrom.	S	L	Total length	ratio	Chrom.	S	L	Total length	ratio
1	39.04	46.36	85.40	1.2:1	1	40.58	45.90	86.48	1.1:1
2	32.45	36.66	69.11	1.1:1	2	31.06	39.66	70.72	1.3:1
3	20.22	39.18	59.40	1.9:1	3	21.08	41.82	62.90	2.0:1
4 <sup>9</sup>	17.70	36.02	53.72	2.0:1	4 <sup>10</sup>	12.24	22.10*	34.34	1.8:1
5	28.01	32.89	60.90	1.2:1	5	27.08	33.54	60.62	1.2:1
6	12.46	35.98	48.44	2.9:1	6	11.78	34.68	46.46	2.9:1
7	12.01	34.13	46.14	2.8:1	7	13.14	32.86	46.00	2.5:1
8	11.07	35.80	46.87	3.2:1	8	10.66	34.00	44.66	3.2:1
9 <sup>4</sup>	13.27	26.54	39.81	2.0:1	9	12.46	25.16	37.62	2.0:1
10	9.48	25.91	35.39	2.7:1	10 <sup>4</sup>	11.44	45.78	57.22	4.0:1
Σ	195.71	349.47	545.18	-	Σ	191.52	355.50	547.02	-

\* It should be noted that the long arm of the 4<sup>10</sup> chromosome is the short arm of chromosome 4.

Table 2. Cont'd.

Homozygous 4-6 Translocation					Chromosome Atlas (after Longley)				
Chrom.	S	L	Total length	ratio	Chrom.	S	L	Total length	ratio
1	39.05	44.96	84.01	1.1:1	1	35.87	46.52	82.39	1.3:1
2	31.90	38.91	70.81	1.2:1	2	29.51	36.97	66.48	1.2:1
3	20.35	41.66	62.01	2.0:1	3	20.51	41.49	62.00	2.0:1
4 <sup>6</sup>	12.51	26.67	39.18	2.1:1	4	22.47	36.31	58.78	1.6:1
5	28.18	33.00	61.18	1.2:1	5	27.37	32.45	59.82	1.1:1
6 <sup>4</sup>	22.82	39.74	62.56	1.7:1	6	11.91	36.82	48.73	3.1:1
7	12.40	32.47	44.87	2.6:1	7	12.44	34.34	46.78	2.8:1
8	11.00	33.82	44.82	3.1:1	8	11.26	36.22	47.48	3.2:1
9	14.01	27.62	41.63	2.0:1	9	15.21	28.03	43.24	1.8:1
10	9.26	26.22	35.48	2.8:1	10	9.81	27.12	36.93	2.8:1
Σ	201.48	345.07	546.55	-	Σ	196.36	356.27	552.63	-

Homozygous 5-6 Translocation				
Chrom.	S	L	Total length	ratio
1	38.64	46.48	85.12	1.2:1
2	31.30	36.12	67.42	1.2:1
3	20.46	40.92	61.38	2.0:1
4	21.45	35.75	57.20	1.7:1
5 <sup>6</sup>	31.91	37.93	69.84	1.2:1
6 <sup>5</sup>	6.02	34.92	40.94	5.8:1
7	11.50	34.00	45.50	3.0:1
8	11.90	34.30	46.20	2.9:1
9	13.24	27.09	40.33	2.0:1
10	8.82	26.46	35.28	3.0:1
Σ	195.24	353.97	549.21	-

Table 3. Comparisons of the observed frequencies of centromere adhesions with the expected frequencies calculated on basis of chromosome length.

Normal KYS				Homozygous 3-9 Translocation				Homozygous 4-6 Translocation			
Chrom.	ob.	exp.	$\chi^2$	Chrom.	ob.	exp.	$\chi^2$	Chrom.	ob.	exp.	$\chi^2$
1	87	105.3	3.18	1	72	86.9	2.55	1	74	89.8	2.78
2	69	83.3	2.45	2	52	68.7	4.06*	2	64	75.7	1.81
3	71	74.3	0.15	39	59	48.5	2.27	3	65	66.2	0.02
4	75	70.5	0.29	4	63	56.9	0.65	46	51	41.9	1.98
5	112	74.3	19.13**	5	85	61.9	8.62**	5	92	65.4	10.82**
6	50	59.1	1.40	6	42	45.3	0.24	64	48	66.8	5.30*
7	67	54.5	2.87	7	47	45.4	0.06	7	56	47.9	1.37
8	63	56.7	0.68	8	56	45.5	2.42	8	57	47.9	1.73
9	43	50.8	1.98	93	50	55.1	0.47	9	46	44.5	0.06
10	35	43.2	1.56	10	24	35.8	3.89*	10	31	37.9	1.26
$\Sigma$	672	672.0	33.69**	$\Sigma$	550	549.6	25.23**	$\Sigma$	584	584.0	22.36**

  

Homozygous 4-9 Translocation				Homozygous 4-10 Translocation				Homozygous 5-6 Translocation			
Chrom.	ob.	exp.	$\chi^2$	Chrom.	ob.	exp.	$\chi^2$	Chrom.	ob.	exp.	$\chi^2$
1	69	76.4	0.72	1	81	96.2	2.37	1	82	90.8	0.85
2	50	61.9	2.29	2	64	78.6	2.71	2	64	71.9	0.87
3	45	53.1	1.24	3	59	69.9	1.70	3	68	65.5	0.10
49	64	48.1	5.26*	410	44	38.2	0.88	46	67	61.1	0.57
5	81	54.5	12.89**	5	100	67.4	15.77**	56	95	74.5	5.64*
6	31	43.4	3.54	6	45	51.6	0.84	65	32	43.7	3.13
7	43	41.3	0.07	7	56	51.1	0.50	7	54	48.5	0.62
8	52	42.0	2.38	8	52	49.6	0.12	8	59	49.3	1.91
94	30	35.6	0.88	9	37	41.8	0.55	9	36	43.1	1.17
10	23	31.7	2.39	104	70	63.6	0.64	10	29	37.6	1.97
$\Sigma$	488	488.0	31.66**	$\Sigma$	608	608.0	26.08**	$\Sigma$	586	586.0	16.83

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Two clear cases of knob and centromere adhesion were found. These involved the knob on 5 with the centromeres of 4<sup>6</sup> and 7 and the satellite on the 5<sup>6</sup> chromosome with the 6<sup>5</sup> centromere. Although hypotheses to account for the non-randomness of knob associations could be presented, none have been adequately tested.

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### 1. Orange variegated pericarp.

Orange variegated pericarp is one of the relatively rare mutants arising in variegated pericarp stocks. The mutant P allele responsible for this phenotype affects both pericarp and cob color. Orange variegated pericarp shows (1) self colored stripes similar to those of variegated pericarp and (2) a homogeneous orange-red ground color between these stripes, rather than colorless as in ordinary variegated. The cob exhibits only a slight flush of color, with occasional larger flecks of red. The allele associated with this mutant phenotype is designated P<sup>OV</sup>OV. The present studies indicate that P<sup>OV</sup>OV is composed of the gene, P<sup>RR</sup>, and a transposable element similar to the Modulator (Mp) of the P<sup>VV</sup> allele. The transposable element is designated Mp'. The orange variegated allele has been isolated from eight different Wisconsin P<sup>VV</sup> stocks. In all cases tested, the mutant allele "activates" Dissociation (Ds).

The mutational pattern and the mutational spectrum of povov are similar to those of P<sup>VV</sup>. The phenotype of the ears produced by plants grown from kernels on orange variegated ears is, for the most part, the same as that of the parent ear both in the frequency of the self colored striping and in the shade of ground color. A low percentage of ears (2 to 3% in stocks graded to inbred W22R) exhibit a markedly lower frequency of striping and a lighter shade of ground color. This class is referred to as "orange light variegated" and is due to the presence of a transposed Mp' in the genome in addition to the P<sup>OV</sup>OV allele. Self red ears occur with about the same frequency as orange light variegated ears in these families.

Twinned sectors of orange light variegated and self red pericarp have been observed on heterozygous orange medium variegated ears (povov/pwr). Five twin spots with a minimum number of three kernels in either sector have been further tested. The phenotypes of the progeny ears were in accord with the expected types. Each of these plants was tested for the ability to activate Ds. All plants in the control families (orange medium variegated sibs) and in the families representing