

Off ratio chromosome 6 trait recovered from Maiz Colorado Cuarenton.

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During the course of our studies of enhancers of endosperm color in South American flint lines (Stinard, PS. 2015. A dominant enhancer of yellow color in *albescens1* mutant endosperms identified in South American orange flint lines. MNL 88, accessed at <http://www.agron.missouri.edu/mnl/88/pdf/17stinard.pdf/>) we noticed aberrant segregation of endosperm color when F2s were made between the Maize Genetic Stock Center's *y1* stock (602C) and the North Central Regional Plant Introduction Station's accession of Maiz Colorado Cuarenton (PI 162702). The ratio of yellow to white kernels was closer to 1:1 than to the expected 3:1. Additional experiments were performed to further characterize this off ratio trait (which we have named *off ratio*-MCC*).

The initial F1 between *y1* and Maiz Colorado Cuarenton was reciprocally crossed with *y1*, and counts of yellow and white kernels were made on the backcross ears. Since this cross was performed in our 2014 winter greenhouse using very few plants, the data were limited, but it was clear that the *Y1* allele from Maiz Colorado Cuarenton was transmitted normally through the female, but showed reduced transmission through the male. One such reciprocally crossed pair had 82 yellow and 74 white kernels when the F1 was the female parent, and 78 yellow and 304 white kernels when the F1 was the male parent. Samples of yellow kernels from each of these two ears were planted in our summer 2015 nursery, and the resulting plants were again reciprocally crossed with *y1*. Kernel counts from these crosses are presented in Tables 1 and 2.

All twelve plants grown from kernels from the female outcross of the F1 plant carried *off ratio*-MCC* (Table 1). Eight out of eleven plants grown from kernels from the male outcross of the F1 plant carried *off ratio*-MCC*, but three did not (Table 2). The percentage of yellow kernels on outcross ears of plants carrying *off ratio*-MCC* is somewhat variable, but averages around 27 to 28%. Although these data are limited, we can conclude that *off ratio*-MCC* is male transmissible but probably at a reduced rate (data from Table 2), and that it is linked to *y1* (data from Tables 1 and 2) but is not due to a defect that resides at the *y1* locus (data from Table 2 indicate that crossovers between *off ratio*-MCC* and *y1* can be recovered). Until more data are collected, we cannot draw any firm conclusions on the rate of male transmission of *off ratio*-MCC*, how tightly *off ratio*-MCC* is linked to *y1*, or the nature of the lesion responsible for *off ratio*-MCC* (duplication or deletion linked to *y1*, distinct genetic locus affecting pollen growth and development, etc.). Interestingly, E. A. Graner (Graner, EA. 1945. The yellow-orange endosperm of maize. *Am. Nat.* 79:187-192) also noted an off ratio trait affecting *y1* segregation ratios in his studies of South American orange endosperm lines, but the relationship of Maiz Colorado Cuarenton to Graner's lines is unknown.

Table 1. 2015 *off ratio**-MCC reciprocal cross data. Yellow kernels from a female outcross of the F1 ([Yl *off ratio**-MCC X yl] X yl) were planted. Plants were reciprocally crossed with yl testers. Columns to the left represent counts of yellow (Y) and white (y) kernels, percentage Y kernels, and 1:1 χ^2 values from female outcrosses. Columns to the right represent kernel counts, percentage Y kernels, and 1:1 χ^2 values from male outcrosses. All 1:1 χ^2 values for female outcrosses were not significant ($p < .05$). All 1:1 χ^2 values for male outcrosses were significant ($p < .05$).

Plant No.	♀ Y	♀ y	% Y	1:1 χ^2	♂ Y	♂ y	% Y	1:1 χ^2
2371-1	246	237	50.9	0.168	81	202	28.6	51.735
2371-2	204	204	50.0	0.000	110	306	26.4	92.346
2371-3	127	102	55.5	2.729	113	328	25.6	104.819
2371-4	187	204	47.8	0.739	103	272	27.5	76.163
2371-5	157	154	50.5	0.029	96	213	31.1	44.301
2371-6	218	257	45.9	3.202	102	229	30.8	48.728
2371-7	262	252	51.0	0.195	90	267	25.2	87.756
2371-8	106	127	45.5	1.893	137	365	27.3	103.554
2371-9	226	215	51.2	0.274	150	296	33.6	47.794
2371-10	205	216	48.7	0.287	88	300	22.7	115.835
2371-11	216	216	50.0	0.000	78	261	23.0	98.788
2371-12	178	176	50.3	0.011	107	256	29.5	61.160
Totals	2332	2360	49.7	0.167	1255	3295	27.6	914.637

Table 2. 2015 *off ratio**-MCC reciprocal cross data. Yellow kernels from a male outcross of the F1 ($y1 \times [Y1 \text{ off ratio}^* \text{-MCC} \times y1]$) were planted. Plants were reciprocally crossed with *y1* testers. Columns to the left represent counts of yellow (Y) and white (y) kernels, percentage Y kernels, and 1:1 χ^2 values from female outcrosses. Columns to the right represent kernel counts, percentage Y kernels, and 1:1 χ^2 values from male outcrosses. Data collected from plants yielding off ratios of Y:y kernels in male outcrosses are summarized in the top half of the table. Data collected from plants yielding 1:1 ratios of Y:y kernels in male outcrosses are summarized at the bottom. All 1:1 χ^2 values for female outcrosses were not significant ($p < .05$). All 1:1 χ^2 values for male outcrosses yielding off ratios were significant ($p < .05$). All 1:1 χ^2 values for male outcrosses yielding 1:1 ratios were not significant ($p < .05$).

Plant No.	♀ Y	♀ y	% Y	1:1 χ^2	♂ Y	♂ y	% Y	1:1 χ^2
2372-1	264	256	50.8	0.123	69	238	22.5	93.033
2372-3	193	193	50.0	0.000	136	240	36.2	28.766
2372-5	226	242	48.3	0.547	117	209	35.9	25.963
2372-7	242	224	51.9	0.695	73	365	16.7	194.667
2372-8	257	264	49.3	0.094	78	278	21.9	112.360
2372-10	214	218	49.5	0.037	99	223	30.7	47.752
2372-11	208	205	50.4	0.022	61	192	24.1	67.830
2372-12	183	192	48.8	0.216	112	267	29.6	63.391
Total off ratio	1787	1794	49.9	0.014	745	2012	27.0	582.259
2372-2	200	196	50.5	0.040	200	195	50.6	0.063
2372-4	320	316	50.3	0.025	200	195	50.6	0.063
2372-6	126	114	52.5	0.600	203	178	53.3	1.640
Total 1:1	646	626	50.8	0.314	603	568	51.5	1.046