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1. Relationship of the number of photoperiod cycles to paramutant R-gene expression.

In MGCNL 1968 we reported that light-dark cycles at the time of tassel initiation controlled the level of paramutant R-gene expression. The present report shows that the number of light-dark cycles at the time of tassel differentiation can determine the level of paramutant R expression in testcross kernels.

Test plants were grown under constant light conditions supplied by ten 200W fluorescent lamps supplemented by twelve 50W incandescent lamps; temperatures were maintained at 26°C. During the first 25 days of plant development, plants were kept in constant light except for the dark periods administered at specific plant ages. Since preliminary experiments showed plants were ready for tassel induction at 13 days, dark cycles were administered to seedlings beginning at ten days.

Seed genotypes in inbred W22 background were RR^{st} heterozygotes; the R^{st} allele used was known to give paramutant-R (called R' hereafter) scores with intermediate levels of pigmentation. Groups of 12 plants each were tested for the effect of one, two, three or six light-dark (L:D) cycles consisting of 12 hours of light followed by 12 hours of darkness. Following L:D treatment of each group, plants were held in constant light until the 25th day; all experimental groups were then transplanted to field conditions until maturity. At anthesis, all L:D-treated plants were testcrossed to females grown under field conditions. Because variation in R' expression has been noted in single tassels, several pollinations were made from single plants on different days during the week of pollen shed. All pollinations from a single plant were recorded as single plant means and reported in the experimental group means. Testcross kernels were scored at harvest time by methods outlined in our previous MGCNL reports. Differences found in scores of R' in testcross kernels, as a result of L:D treatments had to be pollen transmitted.

Table 1 shows that the pigment scores for R' expression increased with the number of light-dark cycles given the seedlings; treatment means show this relationship is linear for the period tested. Seedling

sensitivity to L:D cycles begins toward the end of the second week of seedling development--our preliminary experiments had shown this to be the period seedlings are ready for floral induction at the temperature and light intensities available.

Table 1

R' testcross scores following L:D treatments administered during tassel initiation

No. of L:D Cycles	Age of Plant	No. of Plants Tested	No. of Pollinations Scored	Group Means	Treatment Means
1	12-13	7	11	9.29	9.17
	14-15	10	20	8.80	
	16-17	5	7	8.31	
	18-19	11	29	10.29	
2	11-13	10	28	9.76	10.70
	13-15	11	32	9.94	
	15-17	10	33	12.40	
3	11-14	11	36	11.03	11.49
	15-18	9	28	11.95	
6	10-16	12	47	12.02	13.20
	12-18	11	44	14.04	
	16-22	8	22	13.53	

To provide for optimal pigment formation in testcross seeds under late summer conditions, August 18 was selected as a pollination cut-off date. Plants which received fewer L:D cycles reach anthesis later; therefore fewer plants with one L:D cycle could be included in the above data. However, objections that score differences reported reflect differences in pollination time are not supported by our existing data since the latest pollinations from plants given six L:D cycles were still consistently darker than those receiving one L:D cycle where both pollinations were made the same day.

The data above raise many more questions than answers. What internal mechanism in somatic tissue is capable of response to environment at

this tassel initiation stage of development? What memory mechanism receives and stores this information in the pollen and then reflects the environmental response in pigment cell differentiation in the endosperm of the testcross parent? Such a mechanism must possess an additive capability for the one to six L:D cycles during flower initiation. While this short-term memory offers no special conceptual problems beyond those of differentiation of cells in the individual treated, to account for the above data as a carry-over effect from the pre-tassel somatic tissue, through the pollen, to the endosperm formed in the testcross on the female, does strain existing genetic models.

We have previously reported the paramutational additive effect on R-expression of R^{st} through ten generations; it is possible that the environmental effects recorded above may now help to determine the ontogenetic times that R' is susceptible to additive "suggestion" from both paramutation and the environment.

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1. The effect of linkage and breakage between the elements of locus Rp_1.

It has been shown (Saxena and Hooker, 1968) that several dominant "alleles" at Rp_1 (Rp_1^a, Rp_1^c, Rp_1^k) consist of closely linked genes for resistance and susceptibility to different biotypes of Puccinia sorghi. The elements conditioning resistance to a portion of the rust biotypes in two complex "alleles" can be recombined with resultant broadening in spectrum of resistance. Results reported here are from a study in progress undertaken to observe the effect of breakage on these recombined elements for resistance.

The recombinant Rp_1^c-Rp_1^k (linkage 0.16 ± 0.03%) was used for this study and the following testcross: Rp_1^c-Rp_1^k a_1 a_2 c r pr / rp_1 a_1 a_2