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Inheritance of Chlorophyll in F_1 Crosses Made Reciprocally Between Selfed Lines of Corn.*

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The inheritance of chlorophyll variations in plants has been investigated in detail; over one hundred chlorophyll abnormalities have been reported in Maize. Correns[1] suggested that chlorophyll deficiencies were transmitted as inclusions and plastids through the cytoplasm of the female parent during fertilization, but that none was transmitted from the male parent in the cytoplasm, along with the male nucleus to the egg. The classical example is the transmission of variegation in *Mirabilis* only through the cytoplasm of the egg, but not along with the male nucleus. Tnese findings have been confirmed by Baur[2] and are supported by East.[3]

Recently Anderson[4] has reported the results of a series of experiments and he concludes:

a. Plastids are identical and numerous in both female and male gametophytes.
b. In the pollen tube, numerous plastids were always present near the male nuclei, and as the tube is ruptured, the plastids are expelled into the cytoplasm of the embryo sac.
c. The earlier investigators fixed and preserved samples in such a manner that all the inclusions were dissolved.

In this study, the writers have on a physiological basis set up the following experiment to further determine whether maternal inheritance, as transmitted by cytoplasm of respective parent to F_1, is of any importance in inheritance studies of the chlorophyll pigments.

* Contribution from the Department of Botany and Division of Agronomy and Plant Genetics, University of Minnesota. Paper No. 1776 of the Journal Series. Aided by a grant from the Graduate School of the University of Minnesota. Assistance in the preparation of these materials was furnished by the personnel of Works Projects Administration Official Project No. 65-1-71-140, Sub-project No. 331.

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1 Correns, G., *Z. Ind. Abst. Vererb.*, 1909, **1**, 291.

2 Baur, E., *Z. Ind. Abst. Vererb.*, 1909, **1**, 330.

3 East, E. M., *Am. Nat.*, 1934, **63**, 289; 402.

4 Anderson, Lewis F., *Am. J. Bot.*, 1936, **23**, 490.

The method of sampling, storing, extracting, and quantitative analysis has previously been described by Miller and Johnson.[5]

The analytical data are presented in Table I of total chlorophyll concentration expressed as percent on a green weight basis and as milligrams per 100 sq cm of leaf surface in 15 crosses between high chlorophyll female X low male and reciprocally in low chlorophyll female high male. The values reported are the average of 2 field replications grown in 1939. The inbred parents used in these crosses differed significantly in percent total chlorophyll; the highest chlorophyll inbred parent of the low chlorophyll lines being significantly lower than the lowest parent in the high chlorophyll lines as measured by the analysis of variance in 2 field replications in 1938 and 1939.

The transmission of variegation (unequal distribution of chlorophyll in the leaves) in *Mirabilis* occurs only through the egg cell cytoplasm. This has raised the question, whether any plastids are transmitted in the cytoplasm contributed by the male parent; and if there are, of what importance is such a transmission, in comparison with that contributed by the female.

During fertilization, according to Anderson, it is possible for plastids in the cytoplasm to be carried along with the male nucleus when the pollen tube ruptures. In *Antirrhinum,* during the time that the male nucleus migrates through the cytoplasm of the embryo

TABLE I.

% Total Chlorophyll and mg of Total Chlorophyll per 100 cm² of Leaf Tissue in Reciprocal Crosses Between High and Low Chlorophyll Inbred Lines of Corn.

Cross	Inbred parents	% total chlorophyll F_1 crosses			Mg chlorophyll per 100 cm² F_1 crosses		
		H x L	L x H	Dif.	H x L	L x H	Dif.
6 x 23	.319 x .352	.367	.286	.81	7.12	5.78	1.34
x 26	x .360	.305	.289	.16	6.64	6.20	.44
x 44	x .361	.360	.357	.03	6.82	6.63	.19
x 48	x .364	.321	.328	—.07	6.28	6.70	—.42
11 x 23	.232 x .352	.299	.296	.03	6.16	6.01	.15
x 26	x .360	.274	.279	—.05	6.00	6.30	—.30
x 44	x .361	.330	.342	—.12	6.52	7.06	—.54
x 48	x .364	.288	.319	—.31	5.93	6.51	—.58
34 x 23	.273 x .352	.331	.326	.05	7.04	6.66	.38
x 26	x .360	.322	.282	.40	7.50	6.63	.87
x 48	x .364	.299	.299	.00	6.53	6.45	.08
45 x 23	.306 x .352	.342	.356	—.14	6.51	6.56	—.05
x 26	x .360	.299	.313	—.14	6.15	6.44	—.29
x 44	x .361	.361	.356	.05	6.50	7.03	—.53
x 48	x .364	.386	.375	.11	6.93	6.93	.00
	Mean	.326	.320	.05400	6.57	6.52	.049333
		Z = .21	Odds = 3.4:1		Z = .093	Odds = 1.7:1	

[5] Miller, Elmer S., and Johnson, I. J., *Am. Soc. Agron.*, 1938, **30**, 941.

sac, and while the male nucleus is in the process of fusing with the polar nuclei to form the endosperm nucleus, there are mitochondria in the vicinity of the endosperm nucleus. These mitochondria originally came from both the male and female parents.

Thus, on a cytological basis, it appears that there are species differences regarding the mechanism and importance of cytoplasmic inheritance. In *Mirabilis,* it is important with respect to leaf variegation, but in other cases, *i. e.,* corn, with odds as low as 3.4 to 1 and 1.7 to 1 for percent total chlorophyll and milligrams chlorophyll per 100 sq cm leaf surface respectively, as measured by "Students" pairing method and tables of Z, it is apparent that cytoplasmic inheritance is not an important factor in inheritance studies of chlorophyll in corn.

Summary. These studies show that maternal inheritance of chlorophylls as measured by a series of crosses made reciprocally between high and low chlorophyll inbred lines of corn is not significant, and that male and female parents each contribute equally to the genotype of the F_1 cross in respect to chlorophyll concentration.

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In vitro Experiments on Exchange of Phosphate by Enamel and Dentin.

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Krogh, Holst, and Hevesy,[1] and Manly and Bale[2] demonstrated the presence of radioactive phosphorus in the whole teeth of animals receiving a parenteral administration of compounds of this isotope. Hevesy and Armstrong[3] in an investigation in which the enamel and dentin of cats' teeth were separately studied found, using radioactive phosphorus as an indicator, the rate of exchange of phosphate by the enamel of erupted mature teeth to be about one-tenth that of the dentin. The rate of exchange was such as to make highly improbable an ability of enamel of mature teeth to undergo significant changes of composition as a result of nutritional alterations.

1 Krogh, A., Holst, J. J., and Hevesy, G., *Det. Kgl. Danske Videns, Selskab. Biol. Med.,* 1937, **13**, 13.

2 Manly, L., and Bale, W. F., *J. Biol. Chem.,* 1939, **129**, 125.

3 Hevesy, G., and Armstrong, W. D., *Proc. Am. Soc. Biol. Chem.,* 1940, XLIV.