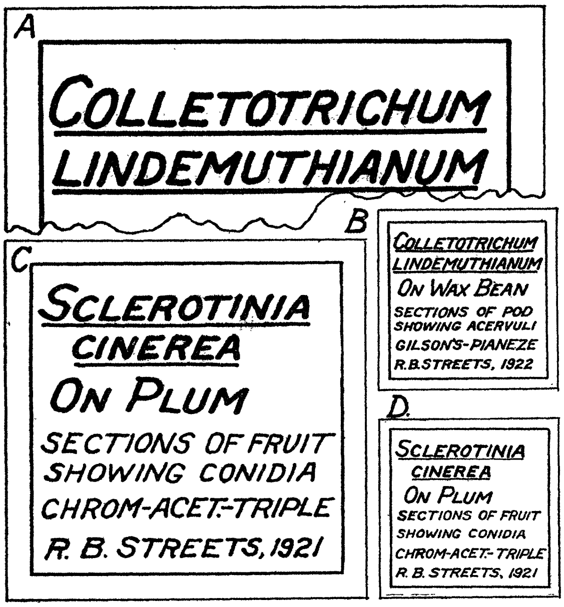

FIG. 1. Figures showing scale to which originals (A and C) are drawn to produce finished microscope slide labels (B and D) by photographic reduction. A is drawn three times size of finished label B; C is drawn twice size of D. Either scale can be used with good results.

preservative. This adhesive is a firm jell at room temperatures, but of the consistency of mucilage when heated to 60° C. in a water bath.

The adhesive is applied to the back of the prints in an even layer using a small flat brush. To facilitate a quick, even coating of the prints they should be placed upon a warm surface (an electric slide warmer is very satisfactory). The adhesive dries in about fifteen minutes, and the labels may be cut apart along the penciled guide lines. A trimming board gives very straight even margins. Both printed and gummed surfaces of the labels are fully equal to the commercial product in permanence either before or after they have been moistened and rubbed into good contact with the slides.

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SPECIAL ARTICLES

A GENETIC LINKAGE BETWEEN SIZE AND COLOR FACTORS IN THE TOMATO[1]

GENETIC factors responsible for size characters are notoriously elusive, and their actual presence in the germinal complex is largely hypothetical. They can not be isolated singly and studied as units, a mode of procedure that has led to some tangible results in the case of equally complex factors for qualitative characters. One of the most direct methods of actually proving the existence of definite size (quantitative) factors is that of linking them with the well-known system of chromosomal factors in any species. Such a method should give proof of the genetic similarity of the two types of genes.

In a large series of crosses between commercial varieties of tomatoes, involving various sizes (weights) and colors of the fruit, a definite linkage between these two types of genetic factors has been established. Color in tomato fruits is mainly determined by two different pairs of genes. One pair, *Rr*, controls the red and yellow flesh color, the former being dominant. The other pair, *Yy*, determines skin color, *Y* producing a yellow pigment in the cell walls of the epidermis of the fruit, and *y* giving a colorless condition in these cells which is recessive in inheritance. Size of fruit in tomatoes is perhaps best interpreted by the multiple factor hypothesis.

Crosses involving these two pairs of color genes and different sizes of the fruit were made reciprocally. The F_2 generations and reciprocal crosses of the F_1 plants with pure varieties of the double recessive color phase (*rr yy*), were grown with extraordinary precautions as to uniformity of treatment, replication, etc. Measurements for each plant were taken of average weight of fruit, time of flowering, two diameters of the fruit, and number of seed locules. In every case, the P_1, F_1, F_2 and backcrosses under consideration were grown during the same season.

One series of crosses and backcrosses has given some very outstanding results. In this case, the parents were the varieties Red Cherry (*RR YY*, mean fruit weight 7.3 ± 0.3 grams) and Golden Beauty (rr yy, mean fruit weight 166.5 ± 6.4 grams). The F_1 of this cross and its reciprocal, grown the same season as the P_1 and F_2 generations, had a mean fruit weight of 23.9 ± 0.4 grams indicating a noticeable dominance of the smaller fruit type. This F_1 was crossed back to the pure Golden Beauty parent and also to an unrelated variety, Yellow Peach (*rr yy*).

The F_2 data, with respect to color of fruit, showed the di-hybrid distribution of four color classes, *RY*, *Ry*, *rY* and *ry*. The mean weight of fruit in grams for these four kinds of fruits was as follows:

	Red Fruits—R		*Yellow Fruits—r*	
	Y	*y*	*Y*	*y*
F_2 means—	22.0 ± 0.7	37.3 ± 1.8	21.9 ± 1.4	46.6 ± 5.6
Differences—	15.3 ± 1.9		24.7 ± 5.8	

It is perfectly obvious that the types with colorless skin (*y*) are consistently heavier than those with

[1] Paper No. 4, Department of Genetics, Iowa State College, Ames, Iowa.

the yellow (Y) skin, whether the fruits are red or yellow in flesh color. In other words, there is a significant tendency for the F_2 fruits to vary towards the parental types as regards both skin color and weight, since the large parent (Golden Beauty) contributed the y factor, and the smaller parent (Red Cherry) the Y factor. The differences noted above are statistically significant, because the one between the two sorts of red fruits is 8 times its probable error, and the other difference is 4.3 times its probable error.

Verification for this relation between skin color and weight factors was afforded by two series of backcrosses of the same F_1 plant used to produce the F_2. In the backcross to the pure Golden Beauty parent, the same four color types appeared in the progenies, but in approximately equal numbers. The mean weights (in grams) for the four colors of this backcross and its reciprocal are as follows:

	Red Fruits—R		*Yellow Fruits—r*	
	Y	y	Y	y
Backcross to				
G. B. parent	50.4 ± 2.9	84.1 ± 4.5	52.6 ± 2.3	75.3 ± 3.2
Differences—	33.7 ± 5.3		22.7 ± 3.9	

Here, likewise, the tendency for the y type of fruit to be heavier than the Y class is apparent. Among both the red and yellow fruits, the differences in weight between the skin color classes are statistically significant, being approximately 6 times their respective probable errors of the difference.

Another backcross to the same F_1 plant gives further evidence. In this case the Yellow Peach variety was used reciprocally on the F_1 of Red Cherry × Golden Beauty with the following results:

	Red Fruits—R		*Yellow Fruits—r*	
	Y	y	Y	y
Backcross to				
Y. P. Variety	28.5 ± 0.9	45.3 ± 1.6	31.1 ± 1.3	41.0 ± 1.7
Differences—	16.8 ± 1.8		9.9 ± 2.1	

When it is recalled that the Yellow Peach variety used in this backcross was in no way related to the parents or F_1, it becomes evident that the situation is perhaps general and not specific for the particular varieties of the cross.

Accordingly, the evidence from three distinct sources admits of the same conclusion that the color factor pair Yy is closely linked with genetic factors for weight of fruit. On the modern theory of inheritance the same chromosome that carries y in the Golden Beauty variety also bears a major factor for a greater weight of fruit.

It is interesting to note that red and yellow flesh color, dependent on genes R and r, seem to be independent of weight. This is true not only for the varieties noted above, but also for a large series of crosses involving the well-known varieties, Bonny Best and Yellow Cherry. The details of these crosses are reserved for a future report when larger progenies will be available so that small differences might be detected and checked biometrically.

It might be added that the number of seed locules also exhibits a linkage with the Yy color factors but to a somewhat lessened degree. This is to be expected, however, since weight and number of locules in the F_2 generation show a high correlation ($r = .6056 \pm .0427$). The same general relation exists between Yy and time of flowering, although in this case the correlation between weight and time of flowering is not very high, r having a value of $.2799 \pm .0622$. These evidences of a linkage between the color genes Yy, and both time of flowering and number of seed locules merely afford other sources of verification for the situation proved with respect to weight of fruit.

A final proof for the general situation rests with a cross between a small variety with colorless skin and a larger variety with yellow skin, the reverse of the Golden Beauty × Red Cherry cross. If the *small* size of fruit is then found to be linked with the y color factor, the case is complete. Such a cross has been made, involving the Yellow Peach and Bonny Best varieties, but at least two generations of plants are still required to obtain the adequate data. Meanwhile, it is hoped that other investigators may test this linkage with different varieties of tomatoes under other conditions. It opens a fertile field of research for testing the fundamental relation between genetic linkages involving quantitative characters and those correlations so conveniently studied by multiple correlation methods with their path coefficients and coefficients of determination.

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THE ELECTROMAGNETIC NATURE OF COLLOIDAL, ENZYME AND CATALYTIC ACTION AND ITS SIGNIFICANCE

It is well known that when a colloidal solution of platinum is mixed with a solution of peroxide of hydrogen, there occurs an evolution of oxygen gas, set free from the peroxide of hydrogen molecule.

If, instead of mixing these two solutions, the peroxide of hydrogen solution is put in a fermentation tube, and in a test tube is put a solution of colloidal platinum, and the two solutions are then connected by an electrical conductor, such as a copper, iron or preferably a platinum wire, there