GENETICAL AND CYTOLOGICAL STUDIES IN *ALLIUM*

III. TWO GENES IN *A. FISTULOSUM*

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Since Tschermak's studies (1916) the genic analysis of morphological and physiological traits in the onion, *A. Cepa*, has been continued by foreign investigators. No studies, however, dealing with *A. fistulosum*, which is more familiar to us than the former species, have been undertaken.

The writer found in 1945 a genetic variant of *A. fistulosum*, which is almost unable to excrete wax on the epidermis of its tubal leaves; the color of the leaves being somewhat yellowish green compared with the waxy green color of the normal plant and easily distinguishable by the color of their seedlings from the latter normal plant.

Concerning the characters *waxy* vs. *nonwaxy*, several modes of heredity are already confirmed. For example, in *Triticum* an inhibitor must be assumed. In corn, the certation takes place between *waxy* and *nonwaxy* pollen grains after pollination. In *Avena*, *Pirus*, *Prunus*, *Rubus*, *Secale* and *Bryonia* simple mendelian inheritance was recognized, *waxy* being dominant over *nonwaxy* except in the last species. In *Canna*, *Pisum*, *Ricinus* and *Salix* the genetic type for these characters is not simple.

The writer, moreover, found in 1946 a plant of *A. fistulosum*, which segregates nonviable pale yellow seedlings among otherwise green sisters. On the production of chlorophyll in *A. Cepa*, genetical studies have been reported since Rasmusson (1920). The complete formation of chlorophyll in it has been inferred to depend upon a set of several genes. In corn, more than twenty different dominant genes must be present if chlorophyll is to be formed, the effect of the absence of anyone of these genes being a chlorophyll deficiency. The genetical features concerning chlorophyll formation in *A. fistulosum* will be now elucidated in detail.

Cross-experiments

1. *Nonwaxy* seedling

It is easy to tell *nonwaxy* from the normal *waxy* within a month after germination. The F_1 plant between *nonwaxy* and *waxy* is *waxy*, and in the F_2 offspring, segregation as indicated in the table below was observed.

Table 1. F_2 of cross, *nonwaxy* $\times$ *waxy*

Phenotype	<i>waxy</i> (+)	<i>nonwaxy</i> (nw)	Total	
observed	77	25	102	$\chi^2=0.013$
Expected in a 3:1 ratio	76.5	25.5	102	$P>0.9$

The result is in close agreement with a 3:1 ratio, and implies that the waxless seedling is inherited as a simple mendelian recessive.

2. *Yellow* seedling

A plant which was hybrid for nonviable pale *yellow* seedling, which was produced spontaneously, when self-pollinated, gave the following segregation in the offspring. The segregation ratio was verified immediately after germination.

Table 2. Self-fertilization of a plant spontaneously heterozygous for nonviable *yellow*

Phenotype	<i>green</i> (+)	<i>yellow</i> (y)	Total	
Observed	288	100	388	$\chi^2=0.04$
Expected in a 3:1 ratio	291	97	388	$P>0.8$

It is evident that the difference between *green* and pale *yellow* is due to a single gene.

To ascertain whether the genes affecting *nonwaxy* and pale *yellow* situate on the same chromosome or on the different ones, a plant which was dihybrid for these characters was raised from a crossing of plants which were monohybrid for waxless and pale yellow.

3. Relation between *nonwaxy* and pale *yellow* seedling

A plant which was dihybrid for these characters was normal and self-pollination in it revealed a simultaneous digenic segregation, the numerical data being given in the table below.

Table 3. F_2 in a cross involving both pairs of alleles

Phenotype	<i>normal</i> (++)	<i>nonwaxy</i> (nw +)	<i>yellow</i> (+ y, nw y)	Total	
Observed	365	114	160	639	$\chi^2=0.36$
Expected in a 9:3:4 ratio	359.4	119.8	159.8	639	$P>0.80$

It was verified that these genes for absence of bloom and pale yellow act as simple recessives independently to normal waxy and green.

Résumé

In the present paper the writer has determined by an analysis of *A. fistulosum* that two genes are responsible for *nonwaxy* (nw) and nonviable pale *yellow* (y) seedlings, which are inherited as recessives to normal. These genes, nw and y, are situated on different chromosomes.

Literature

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