University of Nebraska - Lincoln
DigitalCommons@University of Nebraska - Lincoln

Agronomy & Horticulture -- Faculty Publications | Agronomy and Horticulture Department

1-1925

The Occurrence of Starch and Erythrodextrin in Maize and their Segregation in the Pollen of Hybrids

T. A. Kiesselbach
University of Nebraska - Lincoln

N. F. Petersen
University of Nebraska - Lincoln

Follow this and additional works at: http://digitalcommons.unl.edu/agronomyfacpub

 Part of the Plant Sciences Commons

Kiesselbach, T. A. and Petersen, N. F., "The Occurrence of Starch and Erythrodextrin in Maize and their Segregation in the Pollen of Hybrids" (1925). *Agronomy & Horticulture -- Faculty Publications*. 424.
http://digitalcommons.unl.edu/agronomyfacpub/424

This Article is brought to you for free and open access by the Agronomy and Horticulture Department at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Agronomy & Horticulture -- Faculty Publications by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

THE OCCURRENCE OF STARCH AND ERYTHRODEXTRIN IN MAIZE AND THEIR SEGREGATION IN THE POLLEN OF HYBRIDS[1]

T. A. KIESSELBACH AND N. F. PETERSEN
University of Nebraska, Lincoln, Nebraska

Received November 4, 1924

TABLE OF CONTENTS

INTRODUCTION

A variety of maize (*Zea Mays*) differing from other known sorts in the texture of its endosperm was described by COLLINS (1909). The type of endosperm of this variety was designated as "waxy" in contrast with the starchy and sweet types of other maize. It has since been shown by WEATHERWAX (1922) that the carbohydrate of this waxy endosperm is erythrodextrin which can be distinguished from other carbohydrates by its red color reaction with iodine.

It has recently been reported by DEMEREC (1924) and BRINK and MACGILLIVRAY (1924) that this carbohydrate is also present in the pollen of this Chinese waxy variety. With plants homozygous for endosperm type, these authors found that iodine stains the pollen from starchy and waxy maize blue and reddish, respectively. When the pollen from plants heterozygous for these characters was stained with iodine, nearly equal numbers of blue and reddish pollen grains resulted.

They interpreted this as a segregation of the waxy and starchy characters in the pollen grains. LONGLEY (1924) has reported such segregation, also determined by the iodine test, in crosses of Chinese maize with starchy maize, and with annual and perennial teosinte, and in crosses between starchy and glutinous Coix. Similar results had previously been reported by PARNELL (1921) for glutinous and starchy varieties of rice and their hybrids.

[1] Contribution from the Department of Agronomy, NEBRASKA AGRICULTURAL EXPERIMENT STATION as paper No. 7, Journal Series. Published with the approval of the Director.

EXPERIMENTAL RESULTS

In experiments conducted at the NEBRASKA EXPERIMENT STATION during the summer of 1924 results were obtained which indicate that differences in staining of maize pollen with iodine should not be interpreted as segregation. In all maize tested, including varieties homozygous for starchy, sweet, and waxy endosperm types, as well as in F_1 hybrids of a waxy by starchy (Chinese × yellow flint) cross, all normally developed mature pollen gave the starch reaction with iodine. Likewise when mature pollen grains of either type were crushed, no difference was noted in the color reaction of their contents when stained with iodine. In all varieties, immature pollen which had not yet developed starch, stained reddish with iodine solution. This reddish color of immature pollen which is not limited to maize but is common in many other species, seems to be due largely if not entirely to staining of the walls of the pollen rather than the cell contents, and is later obscured by the dark stain of the starch. In sectioned pollen grains the wall stained red with iodine. The lignified tissue of the bundles of stems and leaves of maize also stain reddish with iodine solution.

Starch formation is not always simultaneous for all the pollen of an anther. This may result in a transition stage in which some of the pollen grains stain reddish and some blue. Such a condition could easily be interpreted as segregation into starchy and non-starchy pollen. At a later stage such pollen all gives a blue reaction. It would appear that the interpretation of variation in the color reaction of pollen to iodine, by the investigators cited, may be accounted for by the absence of a comparative study of pollen at various stages of maturity.

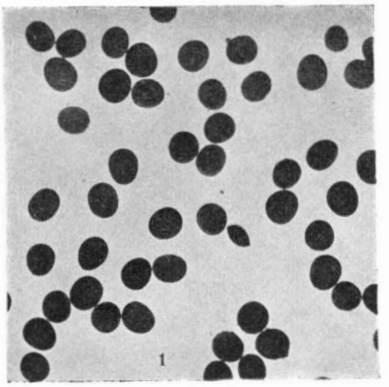
In connection with this work it was thought desirable to see if Chinese maize had erythrodextrin instead of starch in other parts of the plant, and to compare this with conditions in starchy and sweet maize. Except in the endosperm, starch has the same distribution in Chinese maize as in the starchy and sweet varieties with which it was compared. As shown by the iodine test, starch occurs in the root-tips, in young leaves and stems, persisting in the stem for a long time in the regions just above the nodes. In young ears prior to fertilization, starch was found in the shank, cob, silk, and in the kernels, where it was most abundant in the pericarp. Starch occurs throughout the very young tassels. In older tassels it occurs above the nodes of the rachis, and in the subepidermal layer of the anthers, as well as in the mature pollen.

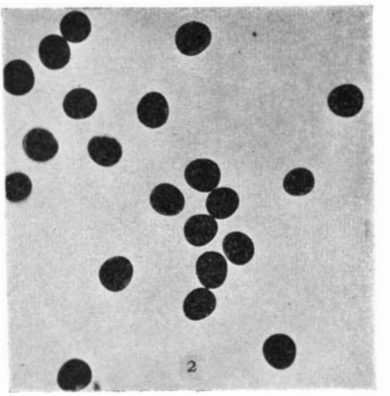
The seed from which the pure Chinese maize was grown was obtained

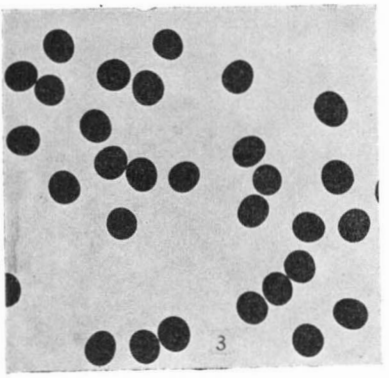
EXPLANATION OF PLATE 1

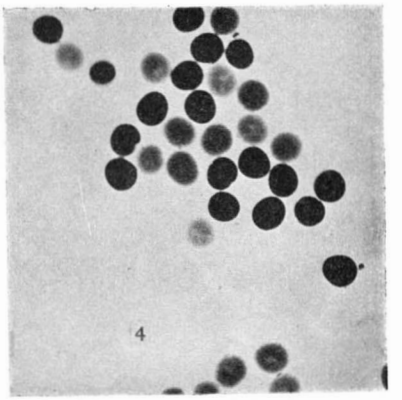
All figures are photomicrographs of pollen stained comparably with iodine in chloral hydrate solution.

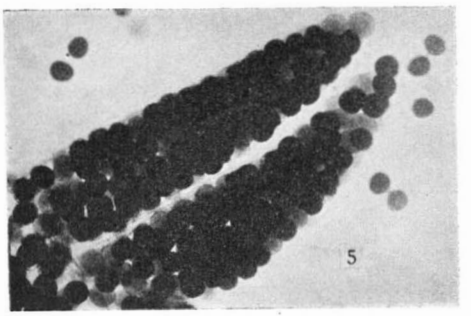
FIGURE 1.—Pollen of starchy maize at shedding stage.
FIGURE 2.—Pollen of "waxy" Chinese maize at shedding stage.
FIGURE 3.—Pollen of F_1 hybrid between Chinese and flint maize at shedding stage.
FIGURE 4.—Pollen of F_1 hybrid of Chinese $\times$ flint maize at the transition stage when the grains show a difference in staining which might be mistaken for segregation.
FIGURE 5.—Pollen from hybrid at same stage as in figure 4, still in the anther.


1


2


3


4


5

from COLLINS last spring. That involved in the hybrids was obtained from the same source in 1922.

The investigators cited have used different forms of iodine solutions and all have obtained similar color reactions. We have used three forms of iodine solutions, namely (1) ordinary iodine in potassium iodide, (2) alcoholic iodine solution, and (3) a solution of chloral hydrate to which iodine solution had been added. Comparable results were had for all forms of solution, though the iodine solution in chloral hydrate proved advantageous especially for pollen in the anthers because of its more rapid penetration and clearing qualities.

LITERATURE CITED

BRINK,[2] R. A., and MACGILLIVRAY, J. H., 1924 Segregation for the waxy character in maize pollen and differential development of the male gametophyte. Amer. Jour. Bot. **11**: 465-469.

COLLINS, G. N., 1909 A new type of Indian corn from China. U. S. Dept. Agric., Bur. Plant Industry Bull. 161, pp. 1-30.

DEMEREC,[2] M., 1924 A case of pollen dimorphism in maize. Amer. Jour. Bot. **11**: 461-464.

LONGLEY, ALBERT E., 1924 Chromosomes in maize and maize relatives. Jour. Agric. Res. **28**: 673-681.

PARNELL, F. R., 1921 Note on the detection of segregation by examination of the pollen of rice. Jour. Genetics **11**: 209-212.

WEATHERWAX, P., 1922 A rare carbohydrate in waxy maize. Genetics **7**: 568-572.

[2] BRINK'S results were briefly given in Wisconsin Agric. Exp. Sta. Bull. 362, pp. 108-109, and DEMEREC'S observations were mentioned by JONES in the Bot. Gaz. **75**: 427-428.