THE PHYSIOLOGY OF THE POLLEN OF ZEA MAYS WITH SPECIAL REGARD TO VITALITY. THESIS

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The physiology of the pollen of Zea mays with special regard to vitality. Thesis by Demetrius Ion Andronescu

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BY

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THESIS

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INDEX

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TABLE INDEX

I. THE PROBLEM

The purpose of the following investigation is to ascertain the length of time that Maize pollen retains its viability and is capable of effecting pollination and fecundation.

In hybridization work it often occurs that the silks of one plant are not receptive just at the time the pollen is developed in the plant to be crossed with it. The question then is to determine how long the pollen will keep its vitality.

The work involves two questions: first, the necessary conditions for the germination of the pollen; and second, the storage of the pollen.

II. HISTORICAL

Van Tieghem (26), Hansgirg (9) and Lidforss (13) found that pollen of many species can germinate in water or moist air. Rittinghaus (22) and many others found that pollen of very many species would germinate in sugar solution with a concentration of between 1 and 40 per cent. Mangin (16), established that agar or gelatin added to sugar solutions can increase the percentage of germination. Max Pfundt (20) found that corn pollen can germinate in a solution of cane sugar in concentration of from 15 per cent. to 35 per cent., while other grasses require 20 per cent to 50 per cent. Kny, quoted by Martin (17), says that Lilium bulbiferum, Aesculus Hippocastanum, Robinia Pseud-acacia, Pisum sativum, etc., germinate better in cane sugar solution with gelatin. Jost (12), germinating pollen on parchment soaked in distilled water and dried on filter paper, concluded that the germination of the pollen of some grasses depends entirely upon the water supply. Hans Molisch (18), found that calcium malate, malic acid, citric acid, tartaric acid, saltpeter and asparagin added to sugar solutions had a slight stimulative effect upon the germination of pollen of many species. Lidforss (13), found that a small percentage of citric acid added to sugar solution induced the germination of pollen of some species of Erica and Menziesia, while a small percentage of calcium or potassium salts or a lack of aeration prevent germination in many species. Tischler (25) obtained good germination by adding diastase to sugar solutions for Solanum rostratum and some of the Melastomaceae, Liliaceae, Lythraceae and the genus cassia of the Leguminosae. Richter (21) and others found that many kinds of pollen which failed to germinate in sugar solutions readily sent out their pollen tube if fragments of stigma from the same or nearly related species were placed in the culture. Burck (2), observed that pollen of certain species of Mussaedena would germinate in distilled water if portions of the stigmas or if levulose were added. From the work of Molisch (18), Lidforss (13) and others, it is understood that Chemotropism of carbohydrates or proteins and negative aerotropism can influence the direction of pollen tubes. Duggar (5), found that "Pollen of Corn and some other grasses, also many sedges and rushes, germinates best in a moist atmosphere and these may be sown on a dry cover-glass inverted over a cell containing water." Martin (17), found that sugar solution containing agar or gelatin allows less bursting, and 2 grams to 5 grams of gelatin added to a 0.731 volume normal solution of sucrose gave the best medium for the pollen of Trifolium hybridum and Trifolium repens. McCluer (15), reported that corn pollen seemed to retain its vitality for several days if kept dry. Webber (27), observed that corn pollen retained its vitality at least two weeks. Jost (12) found that corn pollen is viable only two days under optimum conditions. Pfundt (20), states that pollen of corn remained viable only one day, alike in 30 per cent, 60 per cent, and 90 per cent moisture. Sandsten (23) found that tomato pollen required a slightly acid medium and that apple pollen retained its viability for six months. Booth (1), germinated grape pollen in New York three weeks after it had been gathered in California. Gernert (6), using fresh pollen on old silks, old pollen on fresh silks and the intermediate combinations, declared that "no reliable cases were found, including hybrids in all the groups and many varieties, in which shoots produced kernels when pollinated with pollen that has been stored 30 hours." Burt-Davy (3), says that "in the dry climate of South Africa, the corn pollen keeps well its vitality for three days, but after five days most of it is no longer viable." Experiments mentioned in the Experiment Station Record (24), states that pollen of roses may retain its vitality for 22 days; Clivias, at least three months, some hybrids for over a year; Cannas for fifteen days or more and Aucuba for ten days. Hartley (11), says: "The pollen from the tassel of a sucker possesses all the value possessed by the pollen of the stalk that produced the sucker."

III. THE TASSEL

The maize plant is monoecious, it bears the reproductive organs in separate flowers on the same plant, but the separation is not always complete for bisexual tassels are frequently found and stamens sometimes occur in pistillate flowers.

The appearance of the pistillate flowers on the central axis of the tassel, which often occurs in many varieties of corn, suggested to Montgomery (19), " that corn and teosinate may have had a common origin.

The tassel is arranged in the form of a panicle, the branches of which are shorter nearer the base. The size and shape of tassels are various in the same variety of corn. According to Gernert (6), the corn grown in the Illinois Experiment Station has many different forms of tassel which he was able to classify into twelve distinct artificial type groups.

The tassel consists of numerous branches bearing more or less distichous rows of staminate spikelets which are arranged in pairs, one pedicellate, the other sessile. Each spikelet is protected by glumes which enclose two florets. There are three stamens in each flower, mounted on short filaments but which, as the pollen matures, lengthen and push the pollen out of the sacs. Each anther consists of two sacs, attached side by side, and having an opening or pore at the lower end for the emission of the pollen. The glumes and anthers are variously colored green, reddish-green, dark red, etc., and often the glumes are striped longitudinally with magenta or pink.

According to Harshberger (10), in an ordinary corn plant, 2,500 pollen grains are formed in a single anther and eighteen millions are given as the number produced by each plant or approximately 6,000 to 8,000 pollen grains for every ovule to be fertilized.

Usually the maize is proterandrous, the pollen being produced before the stigmas are receptive, but sometimes it has been found that the maize may be proterogynous, or synacmous.

Collins (4), describes a variety of red pop-corn from Spain which was almost entirely proterogynous. Burt-Davy (3), suggests that "probable proterogyny is a breed characteristic. It appears to be constant in Arcadia Sugar-Maize and in Wills gehu (yellow flint) while proterandry is the rule in many dent breeds."