FACTORS AFFECTING IRISH POTATO POLLEN
GERMINATION IN AN ARTIFICIAL
ENVIRONMENT

J. R. King1 and Titus M. Johnston2

INTRODUCTION

Interest in the pollen grain as a biological unit, and in the reaction of pollens to artificial environments, has been considerable for nearly three-quarters of a century, when it was first found that pollen would germinate in water alone (Green, 1891 & 1894; and Correns, 1889; Molisch, 1893, and Lidfoss, 1896, as cited by Brink, 6). The interest in pollen has broadened during the twentieth century to include studies on its structure and basic physiology, including, in particular, its reactions to various stimuli; however, among the several hundred reports on pollen behavior under both natural and so-called artificially-induced environmental conditions, very little data have been, thus far, of concrete aid to the plant breeder. Actually, the problems involved in such studies are extensive and interrelated. Good pollen handling methods must necessarily be dependent on a knowledge of the viability of a batch of pollen at any particular time; consequently, the development of a reliable viability test for the pollen-in-question is a prerequisite to proper handling of that pollen. Since viability tests, especially as based on germination percentages, have been erratic for the pollens of all horticultural crops, continuing studies on pollen potency tests are being made at Baton Rouge. The results of certain studies on Irish potato pollens are reported in this paper.

Various types of media have been used in attempts to ascertain from percentages of germination the viability of batches of pollen; nevertheless, the reliability of such tests has always been subject to doubt. Occasional evidence of an apparent close agreement between germination percentages on artificial media and under natural conditions has been presented, East and Park, (13).

The primary function of an artificial culture medium is to supply water, Visser, (34); and the pollens of a number of plants have been reported as having germinated on water alone (Adams, 1; Knight, 18; Righter, 26; Visser, 34), although erratic germination was observed in hanging drops of pollens from the Prunoidae and the Pomoidae, Nebel and Ruttle, (22).

There is little doubt any longer but that pollen germination and pollen tube growth are related to the osmotic properties of the medium (Adams, 1; Martin and Yocum, 21; Brink, 6; Waddington, 35; Roberts and Struckmeyer, 27; and Visser, 34). Many pollen grains can adjust themselves to various osmotic conditions, whereas other pollens may germinate under more specific conditions, presumably as controlled by the turgor pressure that a grain can maintain, Visser, (34).

1Accepted for publication February 24, 1958.
2Associate Professor, Department of Horticultural Research, Louisiana State University, Baton Rouge, La.
3Formerly Graduate Assistant, Department of Horticultural Research, Louisiana State University, Baton Rouge, La.
Some pollens do not seem to need external nutrients for germination, whereas others do. These nutrients, such as certain sugars, are thought to control only the diffusion rate of water in the initiation of germination; and it is likely that most pollen grains of many plants receive from within the grain the necessary nutrients for tube growth, Visser, (34). There is considerable experimental evidence which indicates that the best culture media for pollens contain sucrose (Sandsten, 28; Adams, 1; Brink, 6; Stout and Clark, 30; Uspensky, 33; Traub and O'Rork, 32; Crane and Brown, 10; King and Hesse, 15; and Raptopoulos, 25) to list only a few reported studies; however, the concentration of sucrose for optimum germination varies considerably among pollens of different species and even sometimes for one pollen.

The possible influence of the hydrogen-ion concentration of the pollen culture medium has received surprisingly little attention; although it is known that pollens do respond to varying pH levels of the medium, Brink, (7).

Among the growth promoting substances and other chemicals which have been found to influence pollen germination are: thiamine (Dandliker, et al, 11; and Smith, 29), colchicine (Smith, 29 and Loo and Hwang, 20), lactoflavin, ascorbic acid, 3- indole-acetic acid (Cooper, 9 and Larson and Tung, 19), boron (Addicot, 2; Thompson, and Batjer, 31; and Faull, 14), Magnesium sulphate (Paton, 24; Loo and Hwang, 20), potassium phosphate, potassium chloride, ferric sulphate, Paton, (24). Batjer and Thompson, (5), tested thirty-three growth substances on pollens of Milla and Tropaeolum.

Temperature and humidity are prominent among factors which influence pollen germination in a so-called artificial environment, and have received considerable attention in studies on pollen viability (Sandsten, 28; Dorsey, 12; Anthony and Harlan, 3; Buchholz and Blakeslee, 8; Uspensky, 33; King and Hesse, 15; Olmo, 23; and many others; whereas limited studies have shown that carbon, hydrogen, oxygen, and minor elements influence pollen germination (Van Tiegham, 1896, cited by Brink, 6; Anthony and Harlan, 3; Nebel and Ruttle, 22; and Bair and Loomis, 4).

PROCEDURES AND RESULTS

GENERAL PROCEDURE:

Collection, and culture of the pollens were carried out as reported by King, (16). The culture medium used contained 2 per cent agar (U.S.P. #1, 15 per cent sucrose) except in tests 2 and 4. The pollens were cultured at 60° F., for 12 to 24 hours (except in test 5). Preliminary tests had indicated that maximum germination in a culture could not be expected with certainty in less than 12 hours, whereas cultures held at 60° F. for more than 24 hours were apt to encourage the growth of fungi.

Germination percentages were calculated from counts of germinated grains within a total of 100 in any one area. Sufficient replications were made for a representative average of the germination percentages. The magnification used in these studies was 150X.

4This term must be considered in a broad sense, and cannot be thought of as maximum, or total, viability of the pollen being tested.