FACTORS AFFECTING THE GERMINATION OF ORCHID SEEDS

JOSEPH ARDITTI
Department of Organismic Biology
University of California
Irvine, California 92664

INTRODUCTION

The Orchidaceae is one of the largest and most diverse of all plant families, consisting of 500–800 genera and 20,000–30,000 species (Garay 1960, Schultes and Pease 1963). It is also among the most widely distributed. Its representatives may be found from the Arctic to the Antarctic; in bogs, deserts, valleys, plains, hills, mountains, and even below ground (Hatch 1953).

Sizes of orchid plants vary from a few (3–4) mm. to several meters, whereas flowers may range from 2–3 mm. to 15–20 cm. or more in diameter. Some flowers are beautiful, e.g., Cattleya Lindl. and Phalaenopsis Blume, but

1Supported in part by grants from the American Orchid Society, The Loeb Foundation, The Orchid Society of Southern California, and The Society of Sigma Xi.
others are grotesque, e.g., Gongora Ruiz & Pav. and Stanhopea Frost & Hooker. They may be of almost any color from pure white to almost pitch black (although none are pure black).

These wide variations necessitate numerous adaptive characteristics. Growth habits and forms are often the result of such adaptations; for example, certain orchids may contain little or no chlorophyll (Senn 1927) and are therefore saprophytic or parasitic (Burgeff 1932, Hamada 1939, Campbell 1962, 1963, Hamada and Nakamura 1963). The specialized flower structure has resulted in very specific pollination mechanisms (Darwin 1888) which include pseudo-copulation (Ames 1948), self pollination (Knudson 1956, Summerhays 1951), and cross pollination (Dunsterville and Garay 1959). Extremely close relationships between flowers, their structures, and their pollinators have evolved. (Dunsterville and Garay 1959, Dodson and Frymire 1961, Dodson 1962). The pollinating agents may be insects (Lepidoptera, Diptera, and Hymenoptera), birds, and possibly bats (Dunsterville and Garay 1959, Dodson and Frymire 1961, Dodson 1962).

Perhaps the most interesting adaptive features of the Orchidaceae are those occurring in the physiology of their seed germination (Constantin 1917). Unfortunately, the evolutionary origins of these features are lost in antiquity and are now merely matters for speculation (Ames 1948). The subtle complexity of conditions required by germinating orchid seeds may best be appreciated by recalling that more than 2,000 years elapsed between the original description of what Dioscorides assumed to be an orchid (Ames 1948, Schultes and Pease 1963) by Theophrastus and the first published description of an orchid seedling (Salisbury 1804). Ninety-five more years elapsed before it was discovered almost by accident that in nature orchid seeds will germinate only if infected by a fungus (Bernard 1899). Finally, 20 additional years had to pass before orchid seeds were germinated asymbiotically on a medium containing inorganic salts and sucrose (Knudson 1921, 1922). At present, quantities of orchid seeds are easily germinated asymbiotically and yet our knowledge of their exact requirements is still limited.

At least three distinct periods may be delineated in the investigations dealing with orchid seed germination. During the initial period, investigations were at first limited to observation and later, following the discovery of orchid mycorrhiza, to studies of symbiotic relationships (Bernard 1899, 1900, 1903, 1904a, b, 1905, 1906a, b, 1908, 1909, Ramsbottom 1922a, b, 1929, Wolff 1923a, Lami 1927a, Cordemoy 1904, Burgeff 1936, 1959). In the early phases of the second period, which began with Knudson's publications, the merits of symbiosis and asymbiosis were argued, sometimes violently, by their partisans (Constantin 1925, 1926, Constantin and Magrou 1922, Knudson 1924, 1925, 1927, 1929, 1930, Burgeff 1936, 1959, Bultel 1924-1925, 1926). Later the effects of various ions (LaGarde 1929, Wynd 1933a), sugars (Quednow 1930, Wynd 1933b), vitamins (Noggle and Wynd 1943, Meyer 1943, Mariat 1944, 1948, 1952, Bahme 1949), hormones (Mariat 1952, Withner 1959a), and other complex organic additives (Knudson 1922, Quednow 1930) were examined. At present investigators are attempting the study of the physiology of orchid seed germination in