Germination and Parasitation of the Resting Sporangia of

Synchytrium endobioticum

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Summary

The cytoplasmic organization of the long-lived, thick walled resting stage of the sporangium of Synchytrium endobioticum (Schilb.) Perc. is described. The cytoplasm of the resting sporangium contains a large number of closely packed lipid bodies and irregular electron dense bodies, which are interspaced with fine channels of cytoplasm. These ultrastructural observations are discussed in relation to the hypothesis of Bally (1912) and Curtis (1921) that zoospore primordia are already present during the resting stage. It is shown that the "zoospore primordium" is actually a lipid body and an osmiophilic body and the strands postulated to connect the individual "zoospore primordia" are actually the fine channels of cytoplasm.

A new inner wall layer is laid down prior to the start of the germination. It is this wall layer which will protrude to form the vesicle in which sporogenesis takes place. The germination process observed, protrusion of a vesicle through a crack in the sporangial wall, the migration of the sporangial content into the vesicle, and the formation of a single, membrane-bound sporangium within this vesicle, is in full agreement with the recent light microscopic studies of Sharma and Cammack (1976). These observations support the transfer of S. endobioticum from the subgenus Mesochytrium to the subgenus Microsynchytrium (both sensu Karling 1964).

A major objective of the study, to obtain ultrastructural evidence for the location of the meiotic divisions in the life cycle, was not fulfilled.

Three different fungi were observed to parasitize the resting sporangium of S. endobioticum. These infections are discussed in relation to other mycoparasites of plant pathogenic fungi. The possibility of using a mycoparasite for the biological control of potato wart disease is considered to be without practical relevance.

Keywords: Fungus; Parasite; Potato wart disease; Resting sporangia; Synchytrium.
1. Introduction

Only incomplete information is available on the factors which are decisive for the germination of phycomycete resting sporangia, and on the ultrastructural changes which take place during germination. Among plant parasitic species where the spread of infection and survival of the fungus is based on the resting sporangium these two areas have attracted special interest (e.g., Olpidium brassicae, vector for TNV (Teakle and Gold 1963), Physoderma maydis, causal agent of brown spot disease of maize (Lange and Olson 1980), and Sclerospora spp. causing downy mildews on various tropical and subtropical crops (Safeulla 1976, Pratt 1978).

The germination of the resting sporangia of S. endobioticum, the causal agent of potato wart disease, was described early in this century, based on light microscopic observations (Percival 1910, Curtis 1921), and since then few studies have been presented on this topic (Karling 1964, Sharma and Cammack 1976) and so far no efficient method has been described for the synchronization of the germination of the resting sporangia of S. endobioticum. Most inoculation experiments with S. endobioticum resting sporangia have been carried out without the possibility of observing germinating sporangia, as the inoculations are performed by applying either small pieces of wart tissue (Lemmerzahl 1930), or a soil compost containing the resting sporangia (Speckermann and Kotthoff 1924), and establishment of a new infection is seen as proof that germination of the sporangia has taken place.

The very short-lived nature of the individual steps in the germination process constitutes another major part of the problem in describing the germination of the S. endobioticum resting sporangia. This is especially true for electron microscopy studies, where it is only possible to study a rather limited number of resting sporangia. The fact that the germination of resting sporangia of S. endobioticum is most efficient when the wart material is subjected to the microbial degradation found in the soil makes electron microscopy studies even more difficult as inorganic material is incompatible with the ultrathin sectioning required for electron microscopy.

The complexity of a soil borne plant parasitic fungus is brought into perspective when it is observed that other microorganisms may not only be involved in the degradation of the surrounding host tissue but may also parasitize the resting sporangia. Previously, an infection with virus-like tubules has been described from an isolate of S. endobioticum which showed a decrease in the pathogenicity of the fungus (Lange and Olson 1979).

2. Materials and Methods

The isolate of S. endobioticum (Schilb.) Perc. (race 1) used in the present study is the same as the isolate used in the study of the development of the resting sporangia and the zoosporangia (Lange and Olson 1980a and b, respectively). In addition to the inoculation