

### Effect of Carbon Dioxide on Uredospore Germ Tubes of *Puccinia striiformis*

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The germination and infection processes of *Puccinia striiformis* West. are more sensitive to the environment than those of other cereal rusts (3, 4). As early as 1940, Straib (6) suggested that CO<sub>2</sub> induces apical swelling of the germ tubes of these spores, but a direct demonstration of this was not carried out. It is now known that atmospheric ions can reduce or prevent germination of these spores (5), and carbon dioxide has also been shown to control stomatal penetration by wheat stem rust (*P. graminis* f. sp. *tritici*) (7, 8). In this communication, we report the influence of CO<sub>2</sub> on the germ tube of *P. striiformis*.

Uredospores of *P. striiformis* races 8 and 60 (1) were grown separately in the greenhouse on Michigan

Amber wheat. Spores were collected and stored in dry closed test tubes at 5 C. Experiments were conducted within 3 days after harvesting spores. For germination experiments, approximately 100 spores were floated on surfaces of deionized water in the dark at 5 C. Uredospores germinated between 60 and 70%. Germination begins in 3 hr with development of a cylindrical germ tube (Fig. 1-A). When the spores were exposed for 10 min to air containing 5% CO<sub>2</sub> after the germ tube protrusion, an apical swelling developed (Fig. 1-B). When the spores were returned to normal air, germination proceeded, and a thin tube protruded from the apical swelling (Fig. 1-C, D). Concentrations of CO<sub>2</sub> higher than 5% resulted in extrusion of the cell contents (Fig. 1-E). About 90% of the germinated spores responded to the CO<sub>2</sub> treatment. At concn lower than 5%, the effect was less pronounced. The response to CO<sub>2</sub> treatment was the same in both races tested.

The influence of various physical and chemical factors on infection structure formation from rust uredospore germ tubes was recently well established (2). Our experiments verify the suggestion of Straib (6), and show that CO<sub>2</sub> alters the morphology of the germ tube. In *P. striiformis*, CO<sub>2</sub> apparently initiates formation of swellings that are similar to appressoria formed in the absence of the host plant. This phenomenon suggests that manipulation of the air composition over the

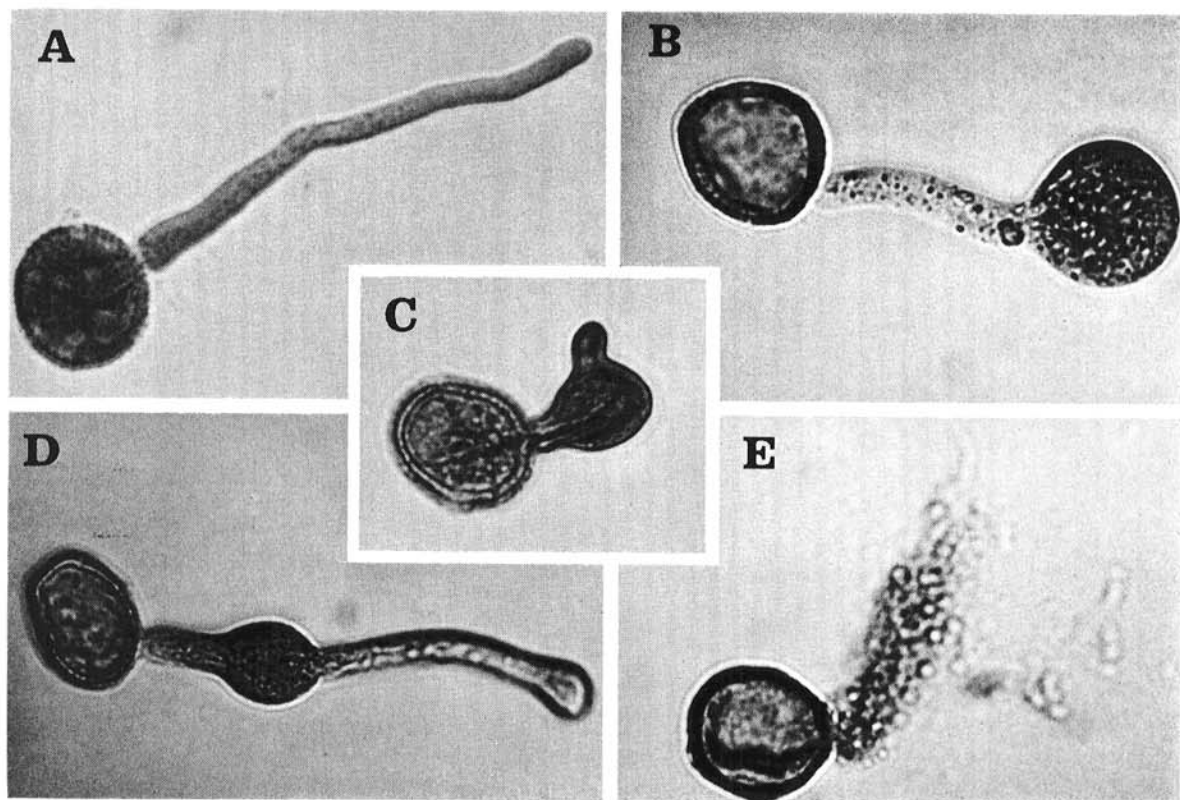


Fig. 1. Germinated uredospores of *Puccinia striiformis*: A) Germinated in normal air; B) Germinated in normal air, then exposed for 10 min to air containing 5% CO<sub>2</sub>; C) Like B, only the germinated spores transferred, then to normal air for 10 min; D) Like B, only the germinated spores transferred, then to normal air for 30 min; E) Spore with the protruding germ tube exposed to 7% CO<sub>2</sub> for 10 min.

germinating uredospores might be explored as a possible tool for culturing of this rust species axenically.

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