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Histochemical and Morphological Studies of Carnation Stem Rot

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The superficial symptoms and signs of *Fusarium* stem rot are well known to most carnation growers; however, the microscopic activity of the fungus has not been well understood. During the past 2 years an intensive study has followed the path of "*Roseum*" as it penetrated and invaded carnation cuttings during propagation.

In order to accomplish this study, inoculated cuttings were sampled in various stages of infection and these samples were preserved for laboratory study. In the laboratory thin sections were cut from the cuttings. These sections, 1 or 2 cells thick, could be examined under the microscope. Stains were used to allow the components of the stem and the fungus to be seen clearly.

Since *Fusarium roseum* enters the plant through wounds, a careful study of wounds in the "healthy" cutting was made. Areas of damaged tissue within these noninfected stems were found associated with growth cracks (fig. 1), perlite particles adhering to the cut surface (fig. 2), and by emerging roots (fig. 3).

The pathogen, *F. roseum*, was found to penetrate areas of damage caused by emerging roots (fig. 4) as well as through the freshly cut base. Invasion of the roots and tissues of the "calus pad" at the cut.

surface quickly followed penetration. Invasion was primarily through the cell walls (fig. 5) and was limited by the woody tissues of the stem.

Sporodochia, the spore producing bodies of the fungus, were observed in the severely infected stems (fig. 6). These spore bearing bodies can be observed with the naked eye on an infected cutting as a pink crust. In addition ball-like masses of the fungus were observed within these severely infected cuttings (fig. 7). The function of these masses is not understood.

Staining tests indicated that cellulose decomposition may take place within the lesion. The presence of other major plant constituents appeared unaltered in the infected area. This information may indicate that the fungus utilizes the cell walls of the stem as a food source.

The carnation's response to the infection consisted primarily of gum-like deposits found at the lesion. These gum-like deposits were not identified by the staining tests.

This study has pointed out that emerging roots damage the stem and allow penetration of the fungus. The progress of *F. roseum* was traced through the carnation cutting allowing a better understanding of the microscopic activity of the fungus.

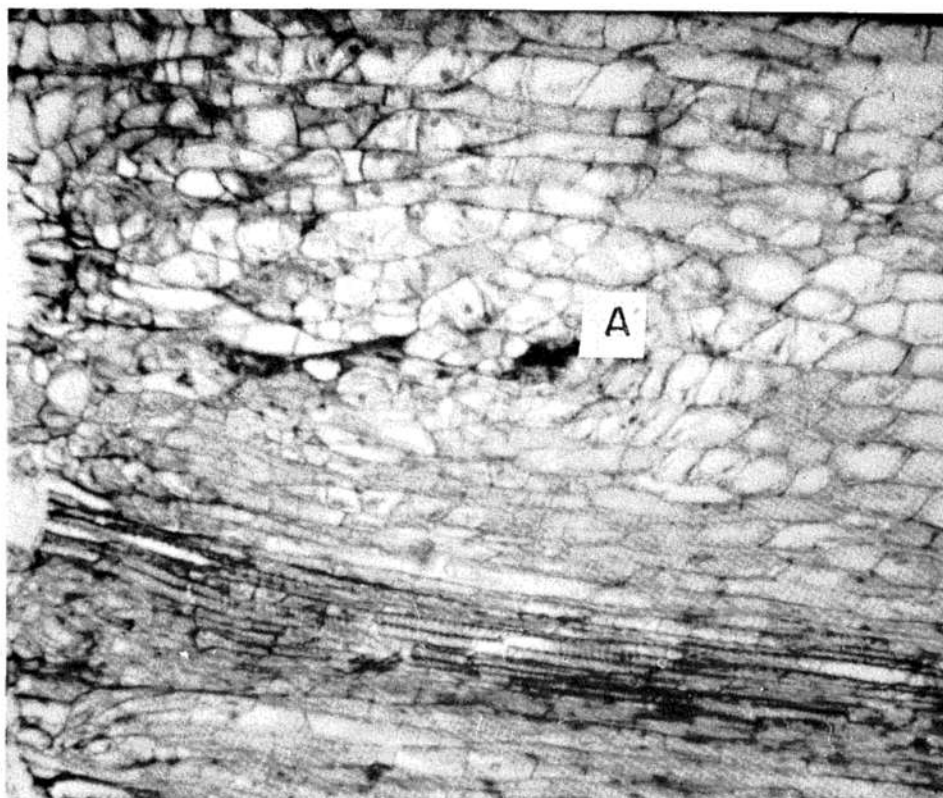


Fig. 1.--A tangential section through the base of a non-infected carnation cutting showing damaged tissue in association with a growth crack. A) Area of the growth crack (Enlarged 35 times).

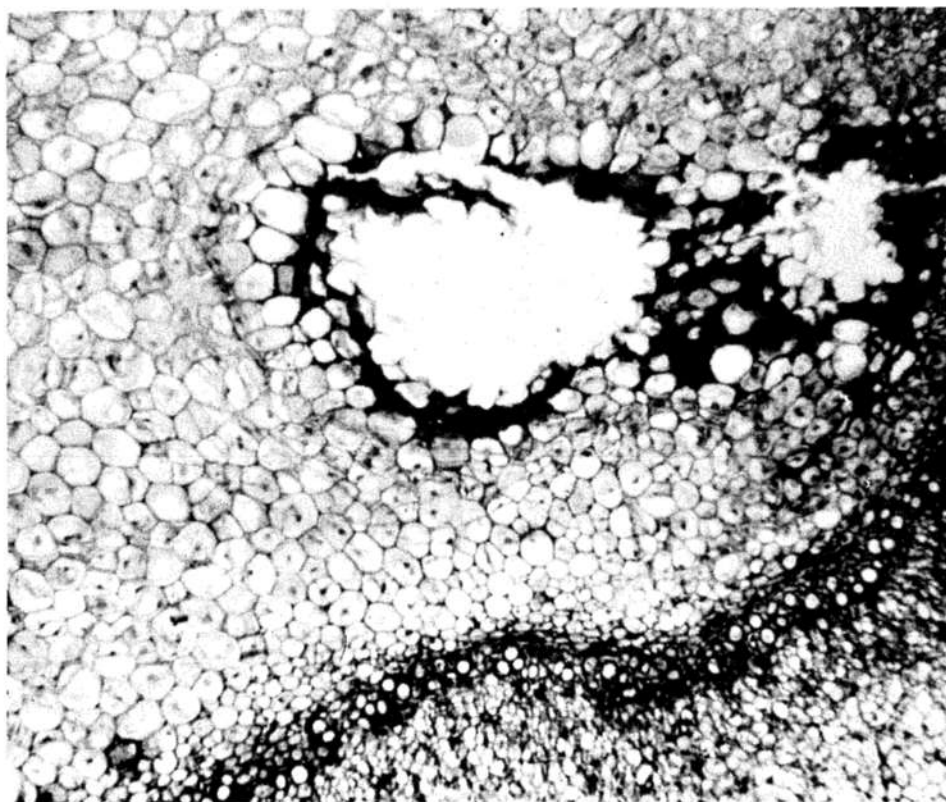


Fig. 2.--A cross section of a non-infected carnation cutting showing an area of damage associated with an adhering perlite particle found at the base of the cutting. (Enlarged 35 times).

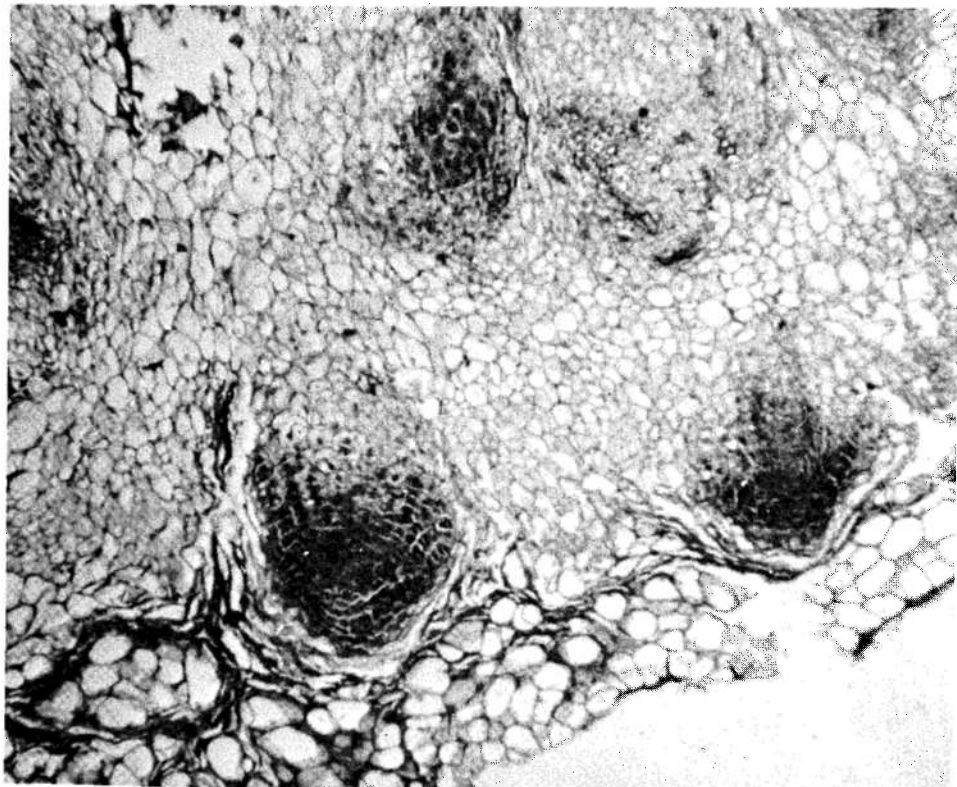


Fig. 3.--A cross section of a non-infected carnation cutting showing damage caused by adventitious roots as they grow through the stem tissue. (Enlarged 35 times).

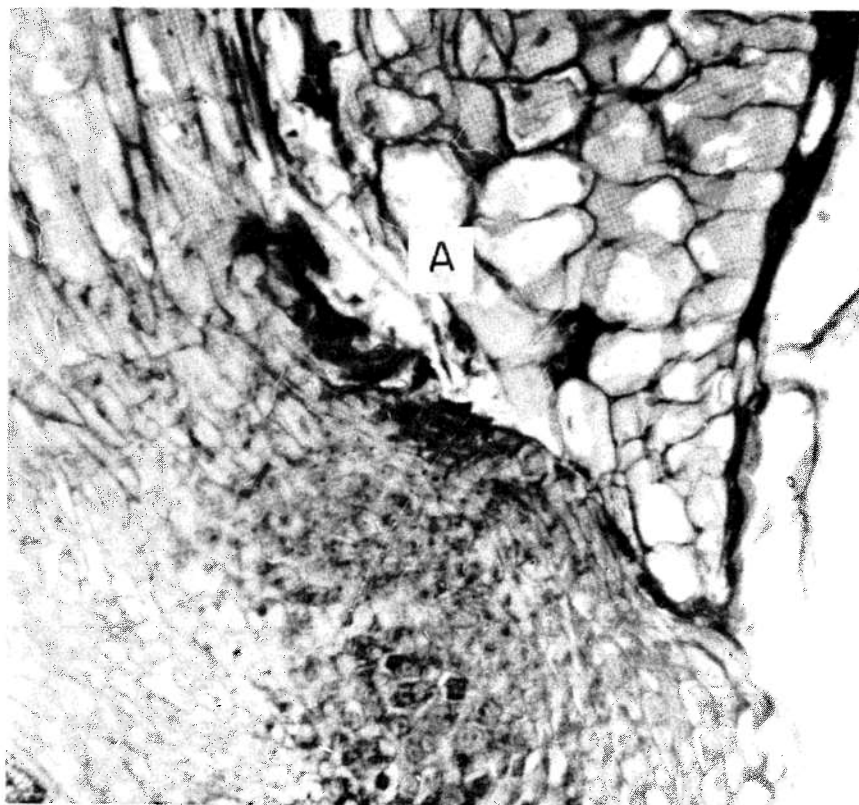


Fig. 4.--A tangential section of a carnation cutting showing an emerging adventitious root and penetration of *F. roseum* f. *cerealis* in the area damaged by the root.
A) Hypha (Enlarged 100 times).

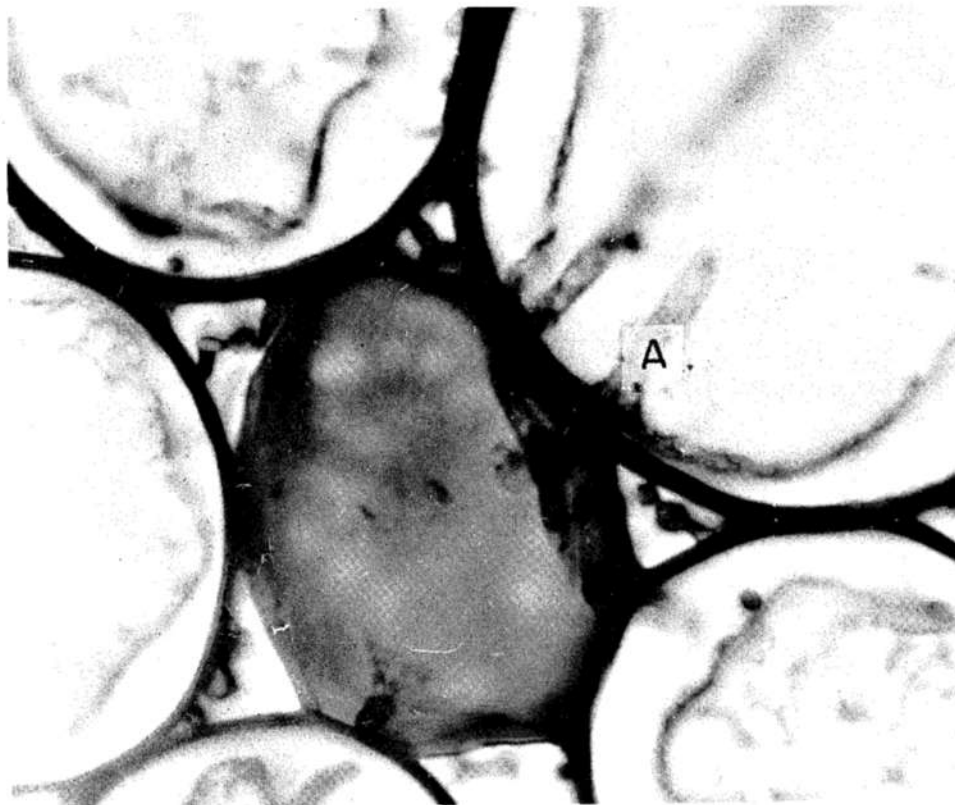


Fig. 5.--A cross section of an infected carnation cutting showing the penetration of F. roseum f. cerealis through cell walls in the pith parenchyma.
A) Hyphae (Enlarged 450 times).

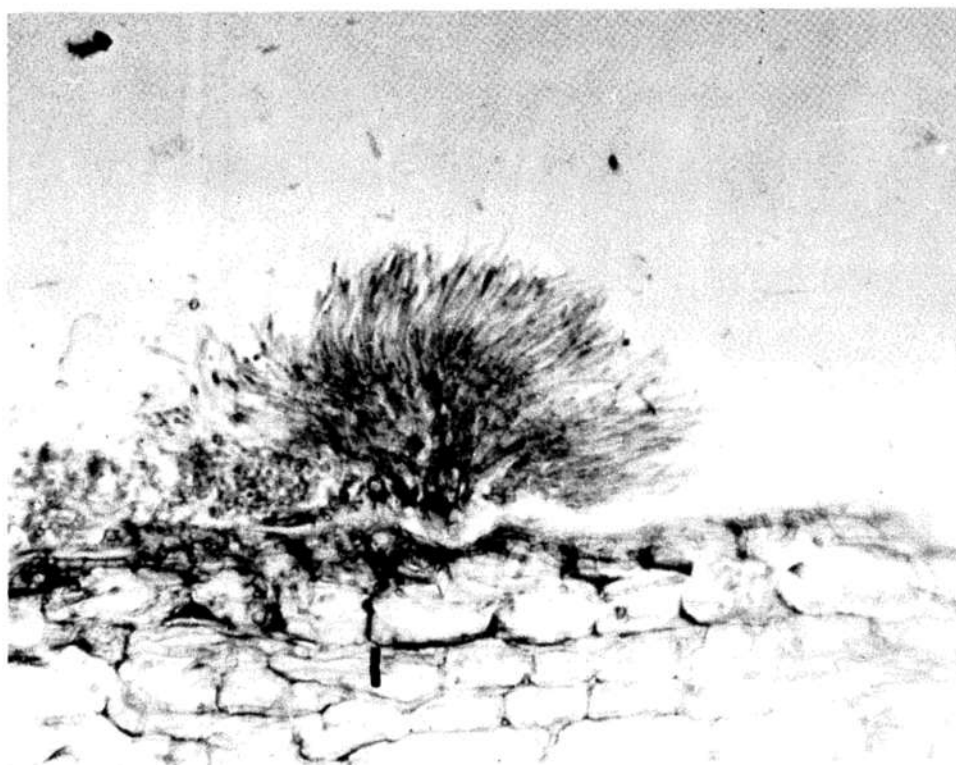


Fig. 6.--A sporodochium of Fusarium roseum f. cerealis found at the epidermis of a severely infected carnation cutting.



Fig. 7.--A tangential section of a carnation cutting severely infected with F. roseum f. cerealis showing a stroma-like mass of hyphae within the stem. A) Stroma-like mass (Enlarged 100 times).