

## Dark Therapy of Bean Rust

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### ABSTRACT

When beans lightly infected with rust (less than 20 pustules/cm<sup>2</sup> of the uredinal stage of *Uromyces phaseoli* [Pers] Winter on *Phaseolus vulgaris* L. 'Pinto') were held in the dark for 5 days or more, the rusted and nonrusted tissues were usually killed; but when held 3 days or less in darkness, neither tissue was severely injured. When beans, of which portions of the leaves had ca. 100 pustules/cm<sup>2</sup>, were placed in darkness for 2 to 4 days at 3 to 10 days

after inoculation and then removed to the greenhouse, most of the rusted tissue became water-soaked and died, whereas the nonrusted tissue did not. If the fungus in the rusted tissue was killed with heat (5-50 sec at 50 C) before the dark treatment, the rusted tissue responded almost like the nonrusted tissue.

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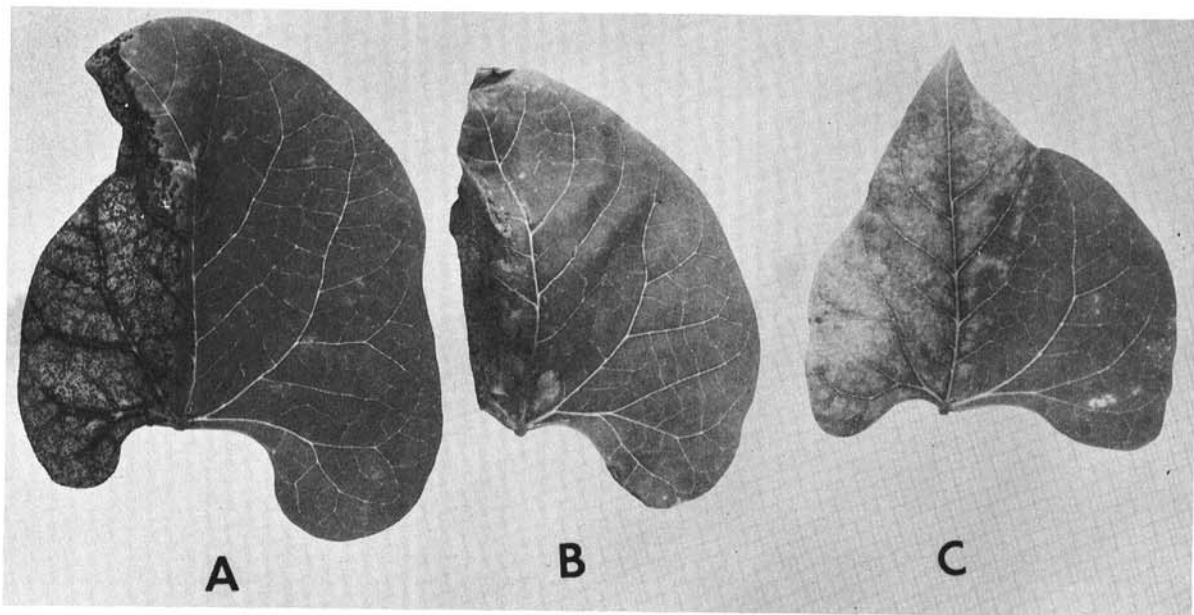
It is likely that environment always has a differential effect on host and pathogen. In most cases, such as with ordinary temperature, humidity, and light, this differential effect may be inconspicuous, but with extremes of environment, one member of the host-fungus complex may be killed and the other uninjured, as with heat therapy of bean rust (2). The effect of prolonged darkness on rust infections has been extensively studied (1, and many others might be cited) and darkness has been shown to suppress rust infection, but complete killing of the infections by darkness, the dependence of this killing on infection dosage, and the protective action of heat therapy on the host tissues seem not to have been reported.

**MATERIALS AND METHODS.**—Pinto (highly susceptible) and Kentucky Wonder beans (resistant due to hypersensitivity) were grown in 3-inch pots of sand:peat:fertilizer mixture in a greenhouse at ca. 21 C. The primary leaves were inoculated with *Uromyces* at 9 to 12 days from seeding to give 0 to ca. 200 pustules/cm<sup>2</sup>. Inoculation with dilute inoculum or a range of concentrations of inoculum involved spraying the leaves with a spore suspension. When severely infected leaves were required, inoculation involved dipping the leaves or parts of them in an inoculum suspension, or applying the inoculum with a brush; either procedure provided a sharp demarcation between inoculated and noninoculated tissue. Pustules can be satisfactorily counted up to ca. 100 lesions/cm<sup>2</sup>; leaves more severely affected than this are usually considered to

have ca. 200 pustules/cm<sup>2</sup>. At 1 to 12 days after inoculation, plants were placed in dark, dry chambers at ca. 21 C, left for 1 to 7 days, and returned to the natural light of the greenhouse, and the survival of the healthy and rusted tissue was noted. To kill the rust fungus without injury to the host, infected leaves were held in water at 50 C for 5 to 50 sec.

**RESULTS.**—Periods in darkness of 1 or 2 days, never or rarely, respectively, had a clear effect on host or rust development. A period of 6 days in darkness always killed all plants, including completely healthy ones. Thus, beans are less tolerant of darkness than cereals (1), but much more tolerant than cucumbers. The effective period for demonstrating a differential effect on normal and rusted tissue was 2 to 5 days in darkness. When plants with severely infected leaves at 3 to 12 days after inoculation were held in darkness for 3 days, there was usually some killing of the rusted tissue. This rusted tissue appeared water-soaked but turgid on removal from the dark, and usually dried out and died in a few hours when returned to the greenhouse. For plants held in darkness for 3 or 4 days, there was usually survival of some of the pustules adjacent to the healthy tissue, but for plants held in darkness for 5 days, all tissue with pustules was usually killed (Fig. 1).

Dark therapy was usually effective only on severely infected leaves. On leaves with 0 to 50 pustules/cm<sup>2</sup>, most pustules survived the dark treatment though occasional pustules were killed, as manifested by "dark-collapsed" tissue. The longer the



**Fig. 1.** Dark therapy of bean rust. All leaves were on plants seeded 16 August and inoculated on the left halves 25 August. Photographed 7 September 1971. A) Control, not further treated. B) Placed in darkness 0600 31 August and returned to greenhouse bench 0600 4 September. C) Heated 10 sec at 50 C at 0600 31 August, placed in darkness, and returned to greenhouse bench 4 September. The rust and the rusted tissue of (B) were killed. The rusted tissue of (C) became chlorotic but was not further injured.

dark period, the higher the mortality of well-separated lesions. In Pinto leaves in which the rust was killed by heat (Fig. 1), or in rust-resistant Kentucky Wonder leaves in which no pustules developed, the rusted inoculated tissue was not killed by the dark treatment.

#### LITERATURE CITED

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2. YARWOOD, C. E. 1963. Heat therapy of bean rust. *Phytopathology* 53:1313-1316.