Temperature and Light Effects on Cultural Differences Between Races T and O of Helminthosporium maydis

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ABSTRACT

Colonies of race T were white except for cinnamon rufous to russet centers, whereas cultures of race O were dark olive gray when grown at 28 C under continuous fluorescent illumination. This cultural distinction also involves differences in sporulation. Optimum sporulation for isolates of race O was between 20-28 C in continuous light and 28 C in darkness. Optimum sporulation of race T isolates was 20 C under continuous illumination, and 24 C in continuous darkness. At high temperatures, race T was more sensitive than race O to inhibition of sporulation by light.

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Hooker et al. (4) suggested that races T and O of *Helminthosporium maydis* Nisikado & Miyake have different temperature optima. Race O is limited to the warmer regions of the United States. Extensive distribution of southern corn leaf blight in 1970 led to the hypothesis that race T has a lower temperature optimum than does race O.

Southern corn leaf blight was found for the first time in Hawaii in 1968 on the island of Kauai, and also on the islands of Maui, Molokai, Oahu, and Hawaii in 1970 (2). According to this report, race T was the prevalent strain in Hawaii in 1970. It was observed that at 28 C under continuous fluorescent irradiation, 4-day-old cultures of race T were light cinnamon rufous to russet in color, while cultures of race O were dark olive gray (10). These cultural distinctions and significant differences in sporulation at this temperature indicated that races T and O have different temperature optima for sporulation. Inhibition of sporulation at high temperatures (i.e., 28 C) with light also was observed for race T. This paper elaborates on results previously reported (3).

MATERIALS AND METHODS.—All isolates of race T were obtained in Hawaii. Isolates 154 and 159 were obtained from foliar lesions on *Zea mays* L., whereas isolate 171 was obtained from infected corn seeds. One isolate of race O, designated as 94, was isolated from Kauai in 1968. Three other race O isolates, 213-1A, 214-3*a*, and 218-10, were obtained from A. J. Ullstrup of Purdue University, Lafayette, Ind., and renumbered 160, 161, and 162, respectively.

All cultures were grown on vegetable juice agar (VJA—10% V-8 juice, 0.2% $CaCO_3$, and 1.7% agar). Mycelial discs, 6 mm in diam, were used to inoculate 9 ml of the medium in 60-mm petri dishes. Cultures were incubated for 6 days at several temperatures under continuous cool-white fluorescent lamps with a light intensity of ca. 250 ft-c at the level of the cultures, or wrapped in aluminum foil for dark treatments. Spores were suspended in a 50% sucrose-0.2% Tween 20 (polyoxyethylene sorbitan monolaurate) solution and counted on a

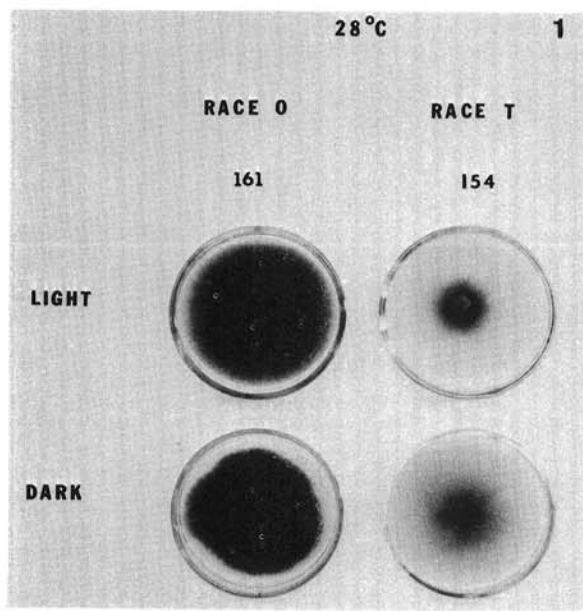
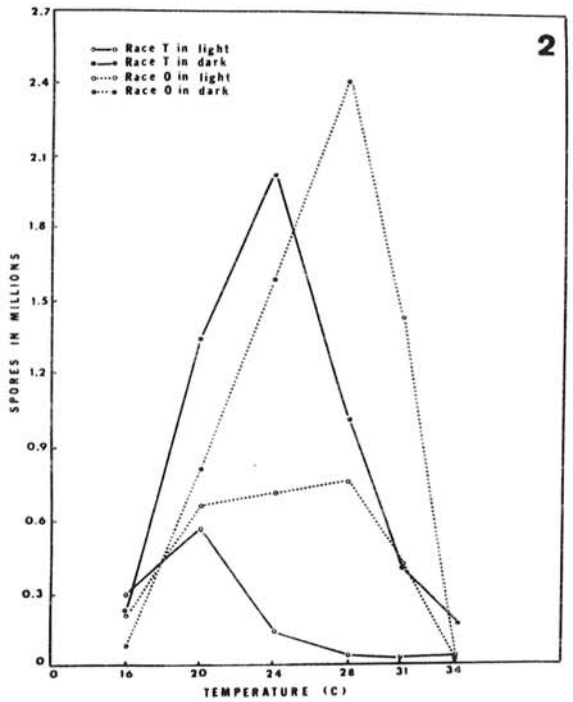


Fig. 1. Four-day-old cultures of races T and O of *Helminthosporium maydis* grown in continuous light and darkness at 28 C (note that growth in all cultures is to the edge of the plate).



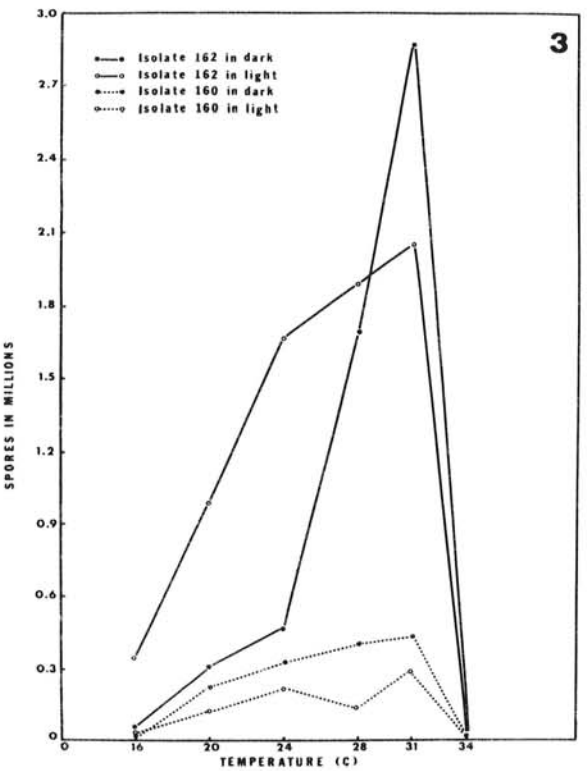


Fig. 2-3. Effect of temperature and light on sporulation of *Helminthosporium maydis.* **2)** Races T and O; results for race T are averages of isolates 154, 159, and 171; results for race O are averages of isolates 94 and 161. **3)** Race O isolates 160 and 162 of *H. maydis.*

hemocytometer. Treatments were replicated 3 times, and the experiment was repeated once.

RESULTS AND DISCUSSION.—Cultural differences between isolates of race O (isolates 94 and 161) and race T (isolates 154, 159, and 171) were pronounced at 28 C under fluorescent irradiation. Four-day-old cultures of race O were uniformly dark olive gray as contrasted with race T, which appeared cream to white, except around the original inoculum which was light cinnamon rufous to russet (10) (Fig. 1). Thirteen other isolates of race T were examined; all closely resembled these test isolates. Difference in sporulation between race O and race T also was greatest at 28 C under fluorescent irradiation. Under these conditions, race O isolates produced 17 to 18 times more spores than isolates of race T. At temperatures other than 28 C and 31 C, irrespective of light or darkness, the two races were not readily distinguishable.

Sporulation of race O in continuous darkness was most abundant at 28 C, whereas in continuous illumination, sporulation varied little from 20 to 28 C (Fig. 2). This indicated a broad temperature optimum for sporulation in light. On the other hand, maximum sporulation of race T cultures under continuous irradiation was at 20 C, whereas in continuous darkness, 24 C was the optimum temperature for sporulation. These results for race T were similar to the findings of Lukens et al. (8) that conidial formation for race T was maximum at 18 C in light and 18-23 C in darkness.

Above 20 C, the higher level of sporulation in darkness as compared to sporulation in light indicates that at these temperatures, light inhibits sporulation in both races and is especially pronounced in race T. Lukens et al. (8) also found that sporulation of race T was inhibited by light at temperatures above 23 C. High temperature-light induced inhibition of sporulation in *H. maydis* is similar to that reported for *Alternaria dauci* (5, 11), *A. solani* (7), *A. tomato* (1, 5), and *Stemphylium botryosum* (5).

Sporulation response to temperature and light was similar for all three race T test isolates. Two of the four race O isolates were similar (isolates 94 and 161), whereas sporulation of isolates 160 and 162 diverged considerably from the other 2 race O isolates (Fig. 3). Nevertheless, both could be distinguished readily from race T because neither showed the high degree of inhibition of sporulation at high temperatures. The optimum temperature for sporulation in light and darkness for isolates 160 and 162 was 31 C (Fig. 3).

Uniform cultural characteristics of 16 1970-1971 race-T isolates suggest that there is a lack of genetic diversity. This parallels findings of Nelson et al. (9) and Leonard (6) that there was a preponderance of mating-type A among recent race T isolates. Leonard suggested that with time there should be a more even distribution of mating types among race T isolates. Similarly, the diversity in cultural characteristics of race O may arise in race T, providing that the distinctive cultural characteristics of recent race T isolates are determined independent of pathogenicity.

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