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BDRL, per Dept/Army ltr dtd, 28 Sept 1971

TECHNICAL MANUSCRIPT 201

MINIMUM DEW PERIOD AND TEMPERATURE REQUIRED FOR INFECTION BY PIRICULARIA ORYZAE

FEBRUARY 1965

UNITED STATES ARMY
BIOLOGICAL LABORATORIES
FORT DETRICK

U.S. ARMY BIOLOGICAL LABORATORIES
Fort Detrick, Frederick, Maryland

TECHNICAL MANUSCRIPT 201

MINIMUM DEW PERIOD AND TEMPERATURE REQUIRED FOR INFECTION BY PIRICULARIA ORYZAE

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Project 1T522301A06102

February 1965

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ABSTRACT

An equation,

$$\frac{1}{\text{hours of dew}} = 0.2650 - \frac{12.26}{\text{temperature in degrees F}}$$

describing minimum conditions of temperature and dew period required for infection of rice leaves by Piricularia oryzae Cav. has been derived. Pairs of values from the curve describing the lower 95% confidence limit of the mean function are 60 F and 12.2 hours of dew, 65 F and 10.9 hours, 70 F and 9.7 hours, 75 F and 8.6 hours, and 80 F and 7.7 hours. It is suggested that infections at these values may be rare events in nature, and that the likelihood of infection increases as these values increase. Use of the equation's lower 95% confidence limit may improve the accuracy of existing blast disease forecasts.

MINIMUM DEW PERIOD AND TEMPERATURE REQUIRED FOR INFECTION BY PIRICULARIA ORYZAE

An equation describing the minimum conditions of temperature and dew period required for infection of rice leaves by Piricularia oryzae Cav. has been derived from the published and unpublished data of Andersen,[1] Kahn[2] and others formerly of these laboratories. Generally speaking, their experiments involved holding inoculated plants at a selected temperature or narrow temperature range in a dew chamber[3] or other container with 100% relative humidity for a known length of time. In some series of tests, plants were held at a constant temperature and the length of dew period varied; in other series, dew period was the constant and plants were placed in chambers held at various temperatures. Races 1, 2, and 3 plus two isolates unidentified as to race of the fungus and the Caloro, Zenith, and Onsen varieties of rice were employed in their work.

Their data were reviewed and values of dew period and temperature at which the least number of lesions appeared were selected. Mrs. Jones then examined several mathematical expressions in an attempt to define a linear relationship between the two variables and simultaneously to fulfill a limiting requirement. She found a linear model describing minimum length of dew period as a function of temperature by taking reciprocals of both values:

$$\frac{1}{D} = a + \frac{b}{T}$$

where D = hours of dew and T = temperature in degrees F. Figure 1 shows this equation plotted together with observed values and lines indicating 95% confidence limits for the mean function.

Figure 2 shows the equation plotted in original units instead of reciprocals, the computed values of a and b (0.2650 and -12.26, respectively), and the 95% confidence limits for the mean function. As it stands, this

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1. Andersen, A.L., B.W. Henry, and E.C. Tullis. 1947. Factors affecting infectivity, spread, and persistence of Piricularia oryzae Cav. Phytopathology 37:94-110.

2. Kahn, R.P., and J.L. Libby. 1958. The effect of environmental factors and plant age on the infection of rice by the blast fungus, Piricularia oryzae. Phytopathology 48:25-30.

3. Mitchell, J.E., and E. Cherry. 1954. A variable temperature incubation chamber permitting controlled deposition of dew. Phytopathology 44:498. (Abstr.)

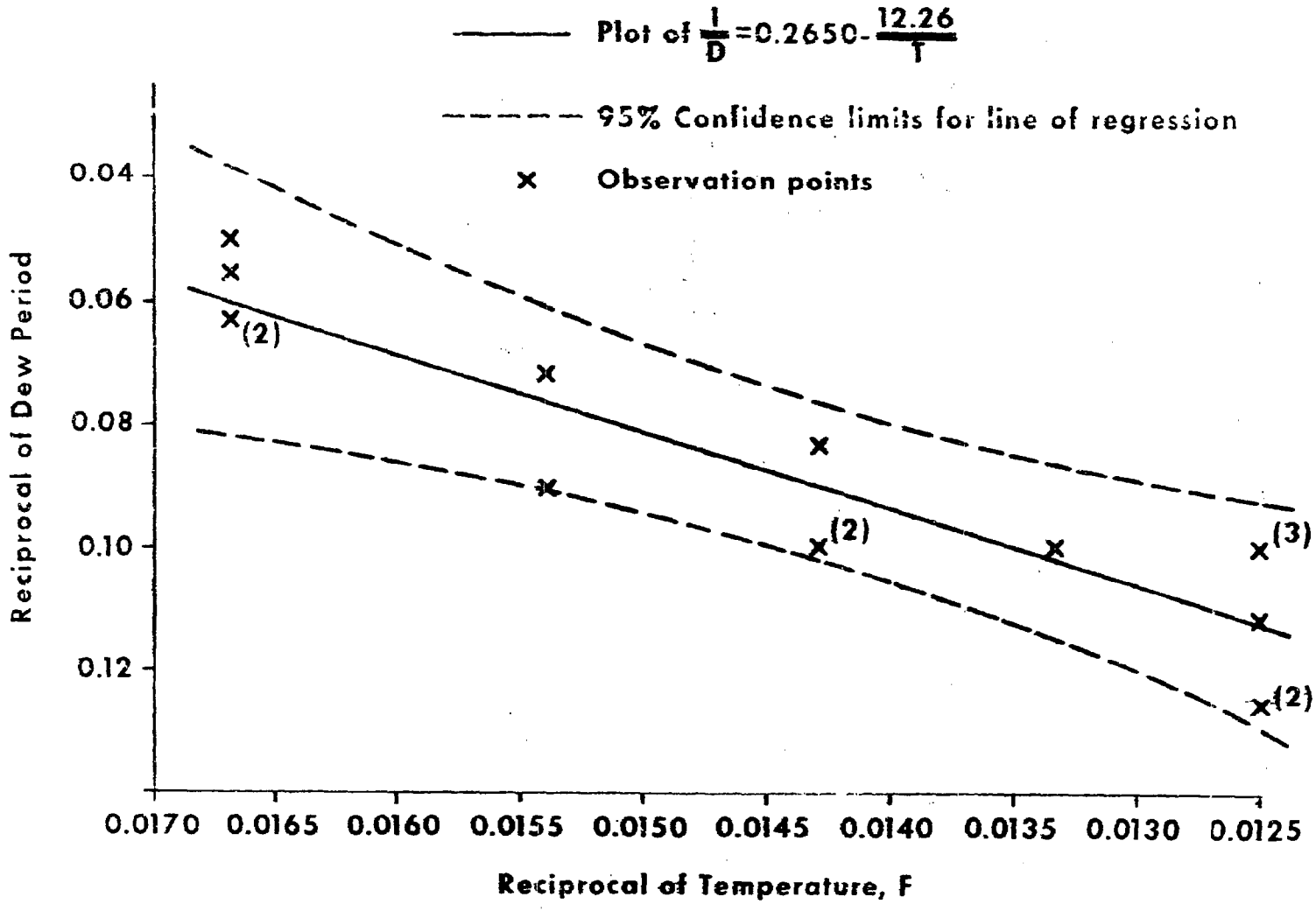

Figure 1. Minimum Dew Period Required for Infection as a Function of Temperature.

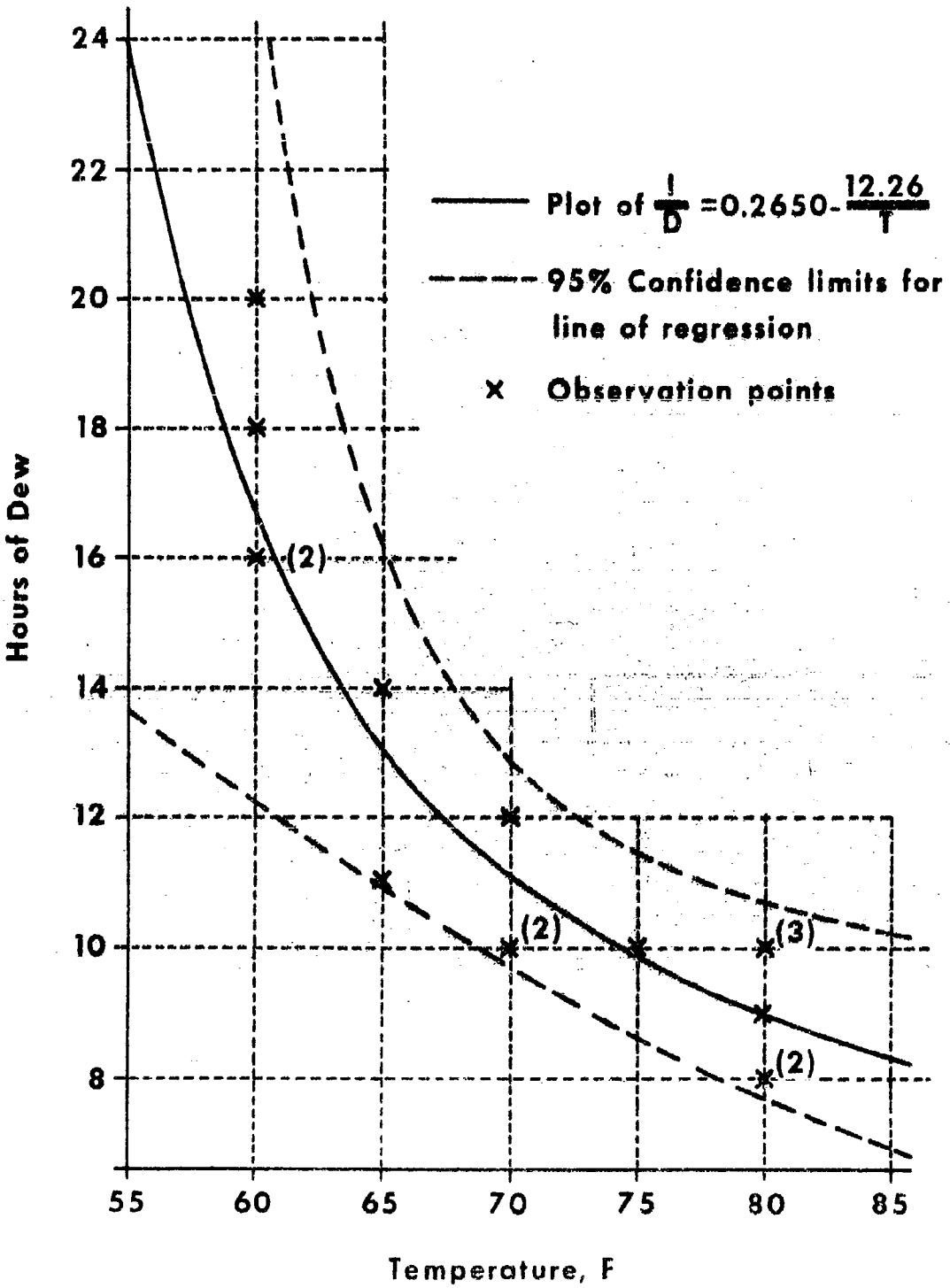

Figure 2. Minimum Dew Period Required for Infection as a Function of Temperature.

equation merely approaches a description of the minimum conditions required for infection, because an observer cannot see less than 1 lesion. There is always the possibility that if higher concentrations of inoculum had been used or if more leaf area had been inoculated, a lesion would have appeared at some lesser value of temperature or time; or that if closer intervals on the temperature or time scales had been used, an equation with narrower confidence limits might have been derived.

Computed asymptotes were 46.25 F for temperature and 3.78 hours of dew as the other variable becomes infinite. Of course, infinitely long dew periods or infinitely high temperatures do not occur in the natural environment of rice plants. These asymptotes, however, do indicate that infection will not occur unless related values of both variables rise above some limits.

In using the equation to determine whether a particular combination of dew period and temperature will permit infection when there is no other factor limiting, it may prove most useful to consider values that fall above the lower 95% confidence limit of the curve describing the mean function. Pairs of values from this lower limit are 60 F and 12.2 hours of dew, 65 F and 10.9 hours, 70 F and 9.7 hours, 75 F and 8.6 hours, and 80 F and 7.7 hours. Infections in nature may or may not prove to be rare events when these conditions occur. In either case, it is certain that at values somewhat greater than these, infections will be more numerous. Use of this equation, together with spore trapping and other presently employed forecasting practices, is expected to improve the accuracy of blast disease forecasts.

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