Epidemiological Study of Anthracnose of Annual Bluegrass

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Introduction:

Epidemiology is the science of diseases in host populations. In the plant sciences we think of the population as a collection of plants. In our work we are concerned with the disease anthracnose and its effect on annual bluegrass turfs. Plant pathologists refer to disease development as an interaction between the host, pathogen, and environment. Interactions between the three is sometimes shown in a "disease triangle." Epidemiological studies involve the factors in the disease triangle plus one more factor, time. Time is important because it helps us determine rate at which the disease is progressing. Epidemiologists expand the disease triangle to include time, forming a "disease tetrahedron" (Figure 1). We have currently been looking at the factors that affect anthracnose development. Through our investigations we have tentatively developed an infection model which is presented in this article. We hope through our own model, that we will be able to forecast when anthracnose will occur and how severe the damage will be.

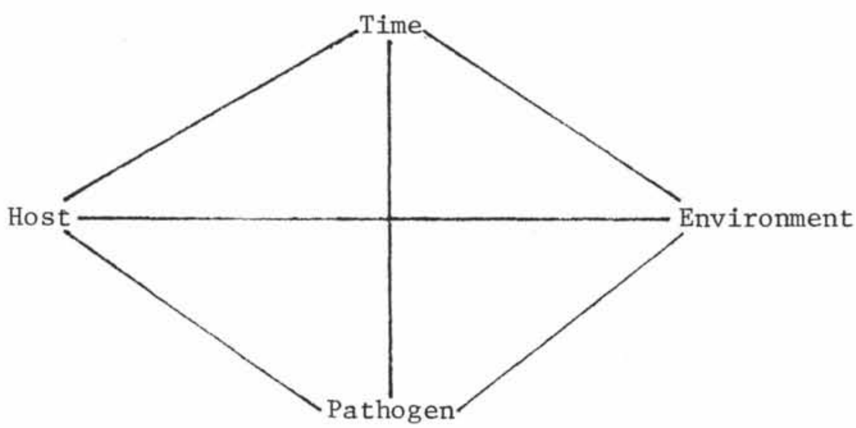

Figure 1. Disease tetrahedron.

Materials and Methods:

Environmental data was collected from Michigan State Soils Research Field Lab in East Lansing, Michigan, and Glengary Country Club in Sylvania, Ohio. During 1980, air temperature and relative humidity were monitored at the Michigan State Soils Research plots and then in 1981, leaf wetness and soil temperature measurements were added. At Glengary Country Club, air temperature, relative humidity and leaf wetness were monitored during 1981. At both locations annual bluegrass (Poa annua L.) areas were used and maintained at a height of 1.25 cm by mowing three times a week. Belford leaf wetness recorders (Belford Instruments, Co., Baltimore, Maryland 21224) were used to monitor air temperature, relative humitity, and leaf wetness at both locations. These leaf wetness recorders were set 1.30 cm above the soil surface. A Texas Instrument strip chart recorder with thermocouples was used to measure soil temperature at 5, 10, 12.5 and 25 cm depths. Environmental measurements were monitored continuously and recorded hourly from the middle of May until the middle of September.

Anthracnose disease ratings were recorded every 5 to 8 days at both loctions. Severity was based on a scale of 1 to 5 with 1 = no disease, 2 = 1-10 percent, 3 = 11-20 percent, 4 = 21-40 percent and 5 = greater than 40 percent disease incidence. Conditions suitable for each rating were figured by averaging environmental data 8-12 days preceding the rating. From previous greenhouse studies, this was the period needed for mature acervuli to develop after initial infection.

Results:

Infection model development. A regression model was developed for relating air temperature and hours of leaf wetness for anthracnose disease severity. Soil temperature and relative himidity were not found to be significant parameters for our model. A second-order model was developed of the form:

$$ASI = b_o + b_1 LW + b_2 T + b_{11} LW^2 + b_{22} T^2 + b_{12}(LW \times T) + e \quad (1)$$

in which ASI = Anthracnose Severity Index, LW = hours of leaf wetness, and T = temperature Celsius. The b values are least-squares estimates of the partial regression coefficients and e is a normally distributed random variable with mean zero and variance o^2. This model accounted for 84 percent of the observed variation in infection and all estimated coefficients were statistically significant (P = 0.05). The actual equation will be tested this summer.

At this time an ASI value of 2.5 or greater would probably require a spray (average temperature greater than 23°C and at least 6 hours of leaf wetness). This coming summer we will determine a precise threshold. It should be mentioned that this model is based on environmental conditions and does not include inoculum potential. This is important because in some cases environmental conditions may be favorable for infection, yet inoculum may not be present, thus no disease. However, from previous experience one can assume inoculum levels to be present and high enough on mature golf courses to cause anthracnose damage.

Validation of the model. We are currently conducting growth chamber studies to validate and/or modify the model. We are also planning to test our model this coming summer (1982) in field situations throughout the state of Michigan and neighboring states to check the accuracy of it.