Disease-Forecasting Method for Groundnut Leaf Spot Diseases

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Abstract

A disease-forecasting method for groundnut leaf spot diseases was developed in Georgia in 1966. The system is based on the effects of daily minimum air temperature and duration of relative humidity equal to or greater than 95% on development of leaf spot epidemics. The system was computerized and daily spray advisories were issued to groundnut growers in the southeastern United States beginning in 1971. However, because of the availability of inexpensive fungicides that provided satisfactory control of leaf spots when applied at intervals of 14 days, the system was not widely accepted by growers in the United States. Currently there is a renewed interest in the system because of increased costs of fungicides, application costs, and the deleterious nontarget effects of some fungicides. In Virginia field trials from 1979 to 1982, the total number of fungicide applications based on the leaf spot advisory program averaged 4.25 fewer applications per season than did the number of applications on a 14-day schedule.

Résumé

Une méthode de prévision des maladies des feuilles de l'arachide : *Une méthode de prévision de maladies des feuilles de l'arachide a été développée en Georgie en 1966. La méthode est basée sur les effets de la température et de la durée d'humidité relative supérieure ou égale à 95% sur le développement des maladies des feuilles. Elle a été informatisée et des avertissements journaliers sont fournis aux planteurs, dans le Sud des Etats-Unis depuis 1971. Cependant à cause de l'existence de fongicides bon marché qui permettent un contrôle satisfaisant de la maladie, quand ils sont appliqués à des intervalles de 14 jours, la méthode n'a pas reçu, auprès des planteurs, une large audience. Il existe actuellement un regain d'intérêt pour la méthode à cause des coûts croissants des fongicides. des traitements et de l'effet nuisible de certains fongicides. Au cours d'expériences en Virginie, de 1979 à 1982, le nombre total de traitements basés sur le programme d'avertissement à été en moyenne 4,25 fois plus faible que celui aurait résulté de traitements bimensuels.*

Introduction

Early and late leaf spot, caused by *Cercospora arachidicola* Hori and *Cercosporidium personatum* (Berk and Curt.) Deighton commonly contribute to decreased productivity of groundnuts (Porter et al. 1982.) In addition to pod yield losses, reduced yield and quality of haulms is also attributable to epidemics of early and late leaf spot (Cummins and Smith 1973). Early and late leaf spot occur either alone or

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together in the same field. In some areas early leaf spot, late leaf spot, rust, and web blotch occur in the same field.

Currently groundnut foliar diseases can be managed with multiple applications of fungicides. The initial fungicide application is usually made at 30-40 days after sowing (DAS). Subsequent application is usually made at intervals of 10-14 d until 2 or 3 weeks prior to the anticipated harvest time. In the United States, fungicides are applied with tractor-propelled sprayers, fixed-wing aircraft, controlled-droplet application equipment, sprinkler-irrigation systems, and helicopters. A partial list of fungicides that have been or are currently used for management of groundnut foliar diseases in the United States is included in Table 1. The fungicides approved for management of groundnut foliar diseases in the USA have been available to growers for 15 years or longer. Several experimental compounds have been extensively evaluated in the USA. Therefore, it is probable that new fungicides will soon be approved for use in the USA.

Forecasting Method

Jensen and Boyle (1965) studied the influence of temperature, relative humidity, and precipitation on progress of leaf spot epidemics. Although it was not stated in their paper, early leaf spot was the predominant disease at that time. Since their investigations in the 1960s, late leaf spot has become the predominant foliar disease in Georgia, Florida, and Alabama (Smith and Littrel 1980). The disease-forecasting system described by Jensen and Boyle (1966) was based on the duration of relative humidity at 95% or greater and the minimum air temperature during the high-humidity periods.

The graph developed by Jensen and Boyle is presented in Figure 1. Spray or no-spray advisories are made on the basis of these temperature and relative humidity conditions. For example, when the relative humidity is equal to or greater than 95% for 10 h, and the minimum temperature is 21°C or higher for 48 h, growers are advised to apply a fungicide if a period of at least 7 d elapsed since the application of a fungicide to the groundnut foliage. The existing system is actually based on application of a fungicide after a period of time when weather conditions are favorable for disease development. With improved weather-forecasting technology, it may be possible to apply a fungicide to the foliage prior to the occurrence of weather conditions that are favorable for disease development.

The influence of temperature and leaf wetness on spore germination, penetration, colonization, lesion development, sporulation, spore release, and dispersal of C. *arachidicola* and *C. personatum* conidia has not been fully explained. In spite of these gaps in the knowledge about the epidemiology of early and late leaf spots, the Jensen and Boyle forecasting method has been successfully tested in Georgia, Virginia, North Carolina, and Texas. Home et al. (1976) prepared a good extension publication describing the use of the Jensen and Boyle disease-forecasting system in Texas.

Table 1. Partial list of fungicides that have been or are being used for management of foliar diseases of groundnut in the United States.

Common name	Chemical name
Benomyl	methyl 1-(butylcarbamoyl)-2-benzimidazolecarmate
Captafol	cis-N [(1, 1, 2, 2,-tetrachloroethyl)thio] -4- cyclohexene-l,2-discarboximide
Chlorothalonil	tetrachloroisophthalonitrite
Copper ammonium carbonate	copper ammonium carbonate
Copper hydroxide	copper hydroxide
Fentin hydroxide	triphenyltin hydroxide
Mancozeb	zinc ion and manganese cthylenebisdithiocarbamate 80%, a coordination product of manganese 16%, zinc 2%, and ethylenebisdithiocarbamate 62%
Maneb	manganese ethylenebisdithiocarbamate
Sulfur	elemental sulfur

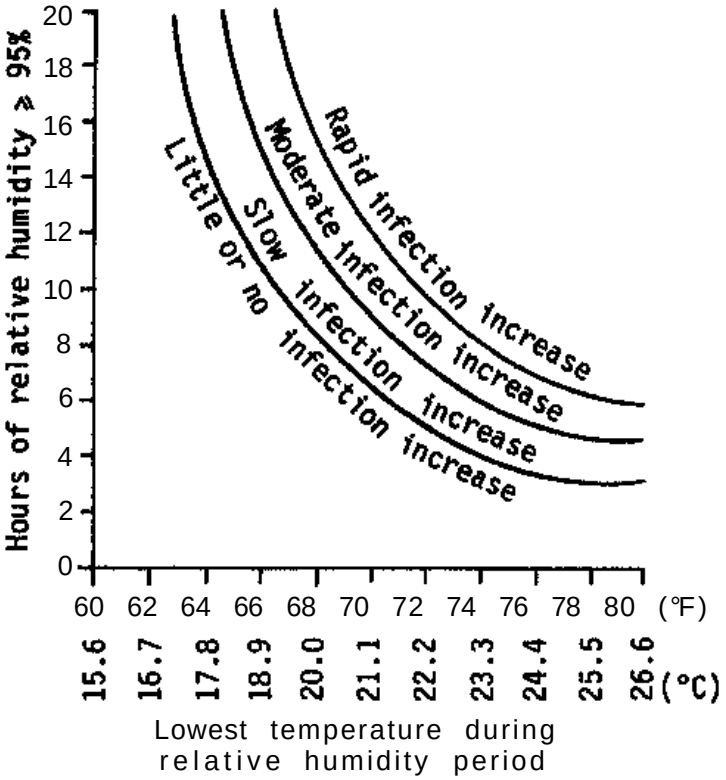

Figure 1. Classification of infection using daily meteorological observations.

In 1966 the forecasting system was first used to develop daily advisories for growers in the southeastern United States. During the growing season, daily advisories were issued on a teletype network and transmitted to growers by radio and television. The Jensen and Boyle method was evaluated in replicated field plot tests at Plains, Georgia, during 1969, 1970, and 1971 (Smith et al. 1974). During these three growing seasons, the interval between applications ranged from 7-19 d, depending on temperature and relative humidity conditions at the test site. The number of applications per season ranged from seven to eight over three growing seasons. A minimum fungicide-application interval of 7 d was used because of assumed adequate crop protection for a period of at least 7 d.

Parvin et al. (1974) developed a computer program for producing a worded daily groundnut leaf spot spray advisory in 1971. The computerized advisory was compared with advisories issued by a National Weather Service agricultural meteorologist over three growing seasons. With the exception of a few marginal situations, the computer-produced advisories were identical to those prepared by an agricultural meteorologist.

In 1976 an agroenvironmental monitoring system (AEMS) was established in Virginia (Phipps and Powell 1984). This computerized system consisted of electronic sensors and microprocessors for data acquisition. This approach for preparation of leaf spot advisories eliminated the problems associated with the use of hygrothermographs and the time-consuming clerical work required for processing data obtained from a hygrothermograph. Bailey and Matyac (In Press) recently developed a portable electronic weather station for deployment of a groundnut leaf spot spray advisory in North Carolina.

In Virginia the value of groundnut leaf spot advisories generated by a computerized agroenvironmental monitoring system was determined in field tests conducted in 1979, 1980, and 1982. In this time period 4.2S fewer fungicide applications per season were made on the basis of the advisory schedule as compared with the usual schedule, i.e., fungicide applications at 14-day intervals. Although leaf spot incidence was greater in plots sprayed in accordance with the advisory method than in plots sprayed on a 14-day schedule, pod yields were not significantly different (Phipps and Powell 1984). As a result of these tests, Virginia growers are now using the advisories as a basis for scheduling fungicide applications.

In some areas where groundnuts follow groundnuts in the crop-production system, onset of disease occurs earlier and the probability of substantial crop loss is higher because crop rotation is not part of the crop-management system. When cultivars with resistance to early and/or late leaf spot become available to growers, it may be necessary to modify the existing advisory program. As new fungicides become available to growers, it will also be important to monitor the development of fungicide-tolerant strains so that appropriate crop-management decisions can be made to prevent crop losses attributable to these strains. In areas where both irrigated and rainfed crops are produced, it will be necessary to monitor environmental conditions within fields.

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