Vegetable Section

A CELERY EARLY BLIGHT SPRAY PROGRAM BASED ON DISEASE FORECASTING

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ABSTRACT

The number of hours of conditions favorable for *C. apii* sporulation and the number of *C. apii* spores caught daily in a continuously sampling spore trap accurately determined the threat of celery blight. If less than 8 hours of high humidity at temperatures above 15°C occurred, sporulation and subsequent blight spread were very minor. The numbers of trapped spores reached a peak around noon and only a few spores were trapped at night. Over 6000 spores were trapped per day during a blight epidemic in May, 1969. A celery spray schedule based on the weather and trap information is suggested.

INTRODUCTION

Early blight incited by *Cercospora apii* Fres. is considered to be the most important disease of Florida celery. Growers spray the crop with fungicide 20 to 35 times during the period celery is in the field. Although the cost of fungicide and fungicide application is but a modest fraction of the total celery production cost, substantial savings could be realized with an accurate disease forecasting method. The near perfect disease control during most winter months with growers using their present schedule suggests that they are applying needless fungicide. A forecasting method to accurately predict serious blight spread would be valuable to eliminate occasional serious losses when conditions favorable for disease occur. Heretofore, to avoid these occasional losses, growers usually have maintained a continuous and heavy fungicide coverage regardless of the prevailing weather or possibility of blight spread. A preliminary report has been published elsewhere (1).

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METHODS

Current weather conditions were surveyed with a rain gauge, recording hygrothermograph, and recording anemometer. The air spora was monitored by a continuously sampling spore trap (3). The trap sampled about 17 cu. ft. of air per hour. One or more spore traps were placed in large commercial celery fields (over 150 acres) for the period of November 1968 to June 1969. The hourly bands of impinged spores on petroleum jelly-coated microscope slides from the spore trap were collected daily and examined in the laboratory.

RESULTS AND DISCUSSION

The numbers of trapped spores of *Cercospora apii* showed a striking diurnal periodicity (Table I. The spores generally were formed at night under conditions of high humidity and favorable temperatures and were released as the relative humidity decreased rapidly, usually in midmorning. Few spores (less than 5% of the total) were trapped at night (between 8 P.M. and 8 A.M.).

Laboratory experiments with naturally infected detached leaves determined that the fungus required a relative humidity near 100% and temperatures between 15°C (58°F) and 30°C (86°F) for sporulation (Table II). Correspondingly, in the field the degree of *C. apii* sporulation (as monitored by the spore trap) was closely related to the number of hours of relative humidity near 100% at temperatures above 15°C (blight favorable hours), Figure 1. A relative humidity of 100% occurred nearly every night in

Table I. Hourly occurrence of C. apii spores trapped during November 1968 to June 1969.

Time	% Spores trapped
8 - 9 A.M.	11.3
9 - 10	17.1
10 - 11	16.7
11 - Noon	10.5
12 - 1 P.M.	6.8
1 - 2	7.3
2 - 3	8.5
3 - 4	5.4
4 - 5	4.4
5 - 6	4.2
6 - 7	1.9
7 - 8	1.0
8 - 8 A.M.	4.9

Table II. Temperature effects on C. apii sporulation on infected detached leaves (1).

°C	Sporulation
8	- (2)
12	±
16	++
20	+++
24	++++
28	+++
32	+
36	-

(1) Leaves held at 100% relative humidity in petri dishes.

(2) (-) indicates no sporulation; (+) slight sporulation; (++++) maximum sporulation.

the Everglades, therefore duration of nighttime temperatures above 15°C was usually the limiting factor. Less than 8 consecutive hours of high humidity at temperatures above 15°C resulted in only small numbers of spores caught the following day. As the duration of favorable sporulating conditions extended beyond 8 hours, the numbers of spores caught usually increased. Few spores (0 to 25 spores trapped/day) were caught following nighttime temperatures below 15°C regardless of the duration of the high humidity period. The amount of sporulation in periods preceding the cool weather had little influence on the amount of sporulation that occurred following the unfavorable spore-forming conditions. If temperatures below 12°C (53°F) occurred, usually two or more successive nights of favorable temperatures and high humidity were necessary for the fungus to resume significant sporulation. No periods were ever observed where several days of a few spores trapped each day was immediately followed by a day of considerable sporulation.

No blight spread was observed when less than 25 spores/day were trapped. An average of 100 spores/day resulted in only a trace of infection. Between December 5, 1968, and April 10, 1969, for 100 of 130 days the number of blight spores trapped did not exceed 25 per day. Twenty days the number totalled 25 to 100 spores/day. During the period mentioned above, spraying for blight was really only necessary for 8 to 10 days of the 130. The spore trap and hygrothermograph data would have provided the information for the grower to determine which days fungicides were needed to maintain blight control.

Several successive nights of weather favorable for blight sporulation usually resulted in an increasing number of spores trapped. For example, an extended period of very favorable blight weather occurred in May 1969 and the number of spores trapped progressively increased. A maximum of over 6000 spores were trapped per day and substantial blight spread correspondingly occurred (Figure 3).

Observations over several years have shown that improvement of celery transplant survival and increase in plant growth and yield resulted when a fungicide spray was applied to the plants immediately after the transplants were set in the field (Berger, unpublished data). This first fungicide application is strongly suggested for all seasons. After this initial application, the suggested frequency of application is determined by the number of hours favorable for blight and the number of spores trapped (Table III). At the beginning of the celery transplant setting

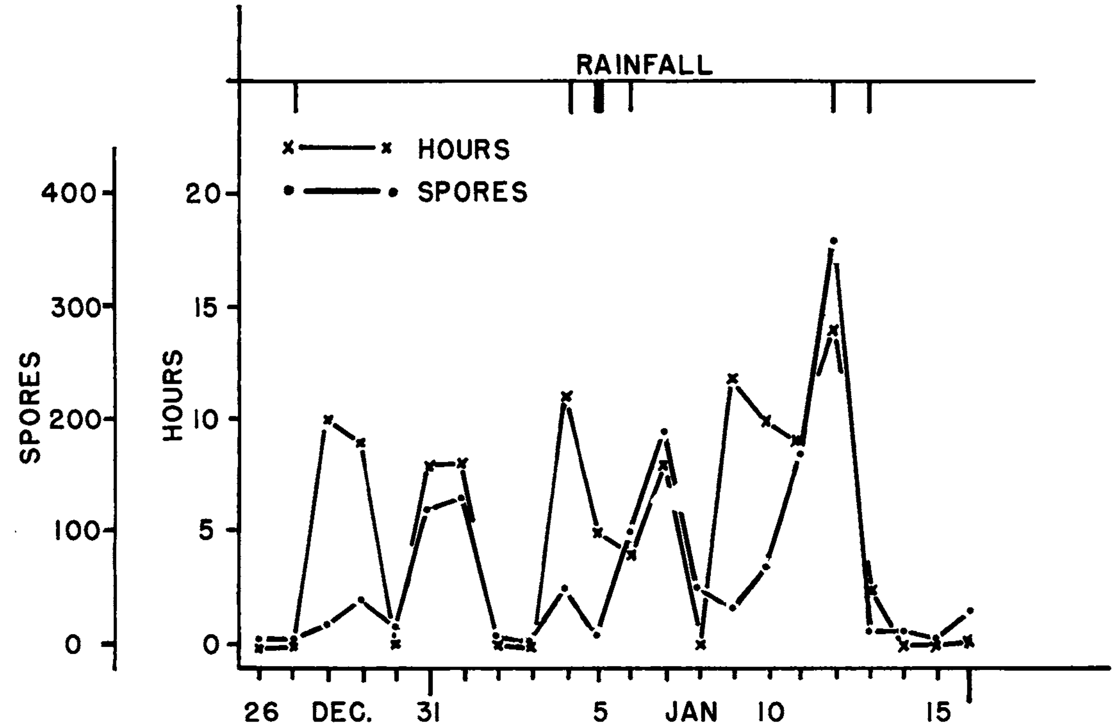

Figure 1.—Effect of rainfall and hours of 100% relative humidity at temperatures above 58°F on numbers of *C. apii* spores trapped during winter months 1968-69.

season in late summer (August 15), very favorable blight weather with frequent rain showers usually occurs so growers should maintain a moderate to heavy frequency fungicide spray schedule (2 to 4 times per week). As the season progresses into late fall and early winter the number of hours favorable for blight decreases and this can be used as a criterion for the timely reduction of the frequency of application without the danger of blight build-up. The spore trap would provide added data to accurately determine the frequency of application. During most winter months the frequency of application can be extended to once a week or once every 2 weeks. During the winter months growers could realize additional savings over and above that obtained by fewer sprays by using less expensive (and usually less effective) fungicides or by using reduced rates of their standard material. As in late fall, the hygrothermograph (measuring the number of hours favorable for blight) and the spore trap (monitoring the number of blight spores trapped per day) provide an accurate means to determine spray frequency. Unseasonable warm spells during the winter months would be clearly revealed as increases in the number of hours favorable for blight and the associated increase in fungal activity would be shown in the spore trap monitoring. The spray

Table III. Suggested celery spray schedule based on number of *C. apii* spores trapped and number of blight favorable hours.

Spore count/ day*	Blight favorable hours/day*	Spray frequency times/week
0 - 100	0 - 8	1
100 - 300	8 - 12	2
300 - 500	12 - 15	3
Over 500	15 - 24	3 - 7

*Based on general prevailing trend. See text for explanation.

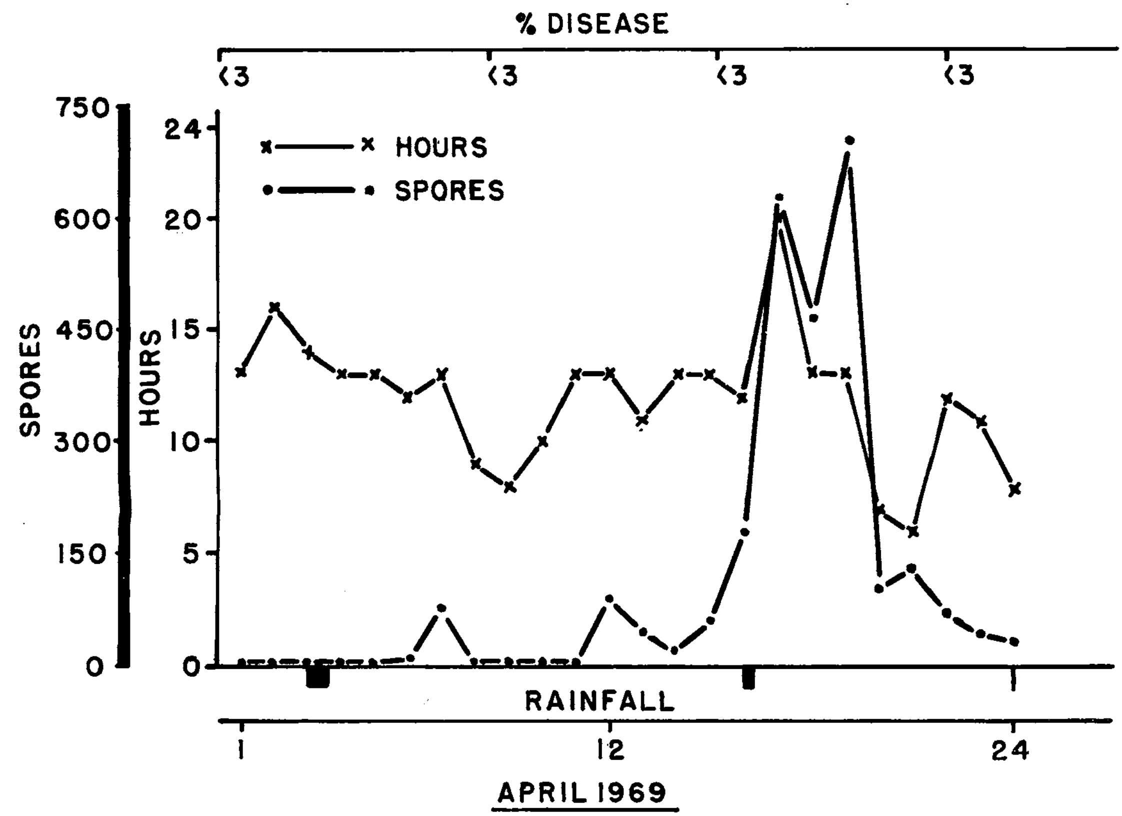

Figure 2.—Effect of number of hours of 100% relative humidity at temperatures above 58°F on number of C. apii spores trapped April 1-24, 1969.

schedule could be adjusted accordingly. In spring, the number of hours favorable for blight increase and the two instruments can be accurately used to determine exactly when to shorten frequency of application to achieve satisfactory blight control.

Over 50% of the total number of spores were usually trapped by noon (Table I) and therefore observation of the trap slides at noon generally revealed the threat of blight for that particular day (2). Determining the blight threat at noon would allow the grower the afternoon and the following morning to achieve fungicide coverage of his crop to prevent serious blight spread during a critical period. Application of fungicide by aircraft may be necessary to achieve rapid coverage of extensive acreages. A schedule based on the exact day when sporulation occurs is far superior to any system based on symptom development, for in the case of celery early blight, the first signs of infection occur 10 to 12 days following spore penetration of the susceptible tissue. If a grower were to determine spray frequency by the amount of disease present, considerable blight spread could occur in the intervening 2-week period between infection and symptom expression. In this latter event, the grower would essentially always be 2 weeks behind in determining the actual threat and development of blight. A system based on symptoms is dangerous and occasionally costly (Figure 2). The grower of the crop which the trap was monitoring was achieving fully satisfactory control before April 15, 1969, using his regular twice-a-week schedule. However, this schedule was not nearly adequate to control the blight spread originating with heavy sporulation occurring April 16-18, 1969. Blight originating from spores during this 3-day period showed up as typical symptoms 2 weeks later (April 27-30). Excess stripping because of stalk infection arising from that blight period reduced yields about 200 crates

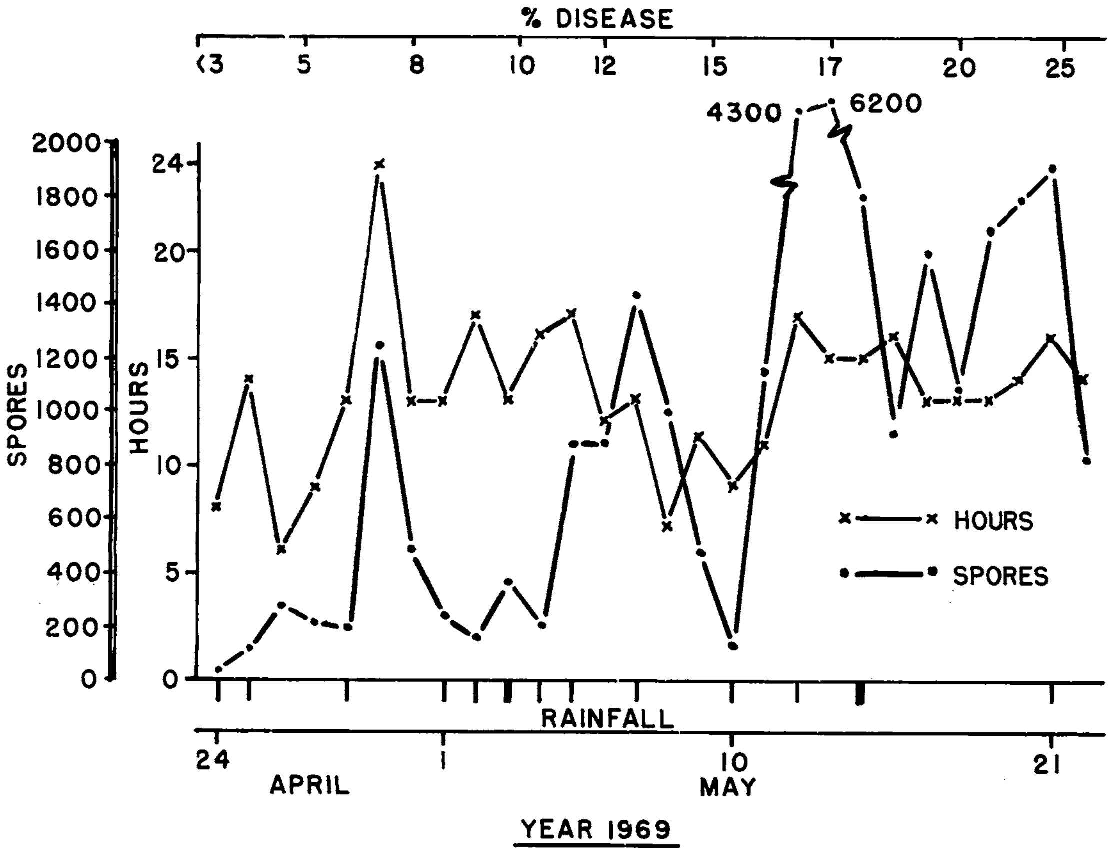

Figure 3.—Effect of number of hours of 100% relative humidity at temperatures above 58°F and rainfall on number of C. apii spores trapped April 24-May 21, 1969, with corresponding disease.

per acre with nearly 100 acres involved. This infection period led to extensive secondary infection cycles in the ensuing weeks necessitating daily spraying the remainder of the season to achieve disease control. This one disease period is believed to have cost this grower over $100,000 in reduced yields and in the necessary increased cost in sprays for blight control.

The forecasting system based on spore trap and weather data should be tempered by good common sense. The age of the crop, the variety, the amount of disease already present in the field, and past, current and forecasted weather would be additional guidelines to the grower for determining application frequency to achieve satisfactory blight control and still realize substantial savings in fungicide.

LITERATURE CITED

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