Air Sampling to Detect Spores of Helminthosporium maydis Race T

Jack R. Wallin and Daniel V. Loonan

Research Plant Pathologist and Research Technician, respectively, ARS, USDA, Ames, Iowa 50010.

Project 1820 and Journal Series Paper No. J-7520 of the Iowa Agriculture and Home Economics Experiment Station, Ames. Cooperative investigation of the Iowa Station and the ARS, USDA.

Accepted for publication 18 July 1973.

ABSTRACT

Airborne spores of *Helminthosporium maydis* race T among and above corn (*Zea mays*) plants at Ames, Iowa were sampled during 1969, 1970, 1971, and 1972 by the Kramer-Collins air suction and Rotorod samplers to determine whether spore counts could be related to southern corn leaf blight (SCLB) lesion development in surrounding corn plantings. The Rotorod collected more spores than did the Kramer-Collins sampler. However, the number of spores trapped was not great in any of the 4 yr. The highest daily number recorded over the 4-yr period, 1,019, from about 19,000 liters of air, was trapped on 19 September 1972. Presumably, no great quantities of spores are produced, and spores do not remain airborne in quantity in the field under the weather conditions that occurred during the sampling periods.

Phytopathology 64:41-44

Massive spore showers on the Corn Belt were suggested by plant pathologists as the cause of the devastating southern corn leaf blight (SCLB) epidemic of 1970. If this is so, monitoring airborne spores of the SCLB fungus, *Helminthosporium maydis* Nisikado & Miyake, race T, would be a useful tool for detecting inoculum and predicting outbreaks of the disease. The results of air sampling to detect spores of the fungus during 1969 through 1972 are presented.

MATERIALS AND METHODS.–The Kramer-Collins sampler (2) was used during the 4 yr, 1969-1972, and a Rotorod sampler (1) during 1971-1972. With the Kramer-Collins sampler, spores in the outside air are pulled through a tube by a vacuum pump and impinged upon a silicone-coated microscope slide propelled across the air stream by a clock mechanism. The clock is cammed so that outside air is pulled through the sampler for 2 min each 15 min, or 8 min/h over a 24-h period. This was adjusted to 3-min periods, or 12 min/h, during 1972. The device samples about 23 liters of air per min. The slides were changed at 0800 CST, taken to the laboratory where a drop of water and a cover glass were placed upon the silicone surface, and then examined with a microscope.

The Rotorod spore-collecting surface was a cellulose tape with adhesive on both sides. Strips of tape were pressed on the front side of each metal arm of the U-shaped spore-collecting rod. This collector samples about 60 liters of air per min, about three times as much as the suction type. After exposure, the strips were removed from each rod in the laboratory and attached to a microscope slide. A drop of water and a cover glass were then applied, and the spores were counted under a microscope. The drop of water was essential to bring out the natural appearance of the spores; otherwise, the spores appeared as shriveled objects of various shapes. A Rotorod sequential spore sampler was operated over a 7-h period, 0700-1400, and the rods were spun during the entire time. In 1972, the sequential sampler was adjusted to run 3 min per 15 min, or 12 min/h, the same period of time as the suction type. The sequential sampler was placed in the corn plot, and two other individual samplers were operated from 1100-1200 daily on the roof of the four-story Plant Pathology building, 3.22 km (2 mi) from the nearest corn field.

RESULTS.–Hourly spore counts of the suction sampler are for those days that the sampler operated the full 24 h; counts of partial days were eliminated.

The number of spores trapped in the corn plot by the Kramer-Collins sampler during the 4-yr period seemed low. Counts were obtained on 20 complete days on 1969, 51 in 1970, 136 in 1971, and 126 in 1972 (Table 1).

In 1969, the Kramer-Collins sampler was started 30 July, and the first spore was caught 31 July. Only a few spores were noted until 18 August, when the numbers increased. Although the total number of spores was not great, most spores were caught between 1100 and 1500 h.

In 1970, air sampling was initiated 10 June, and the first spore was caught 17 June. Many more spores were trapped in 1970 than in 1969. In 1970, the greatest number was caught between 1000 and 1500 h. As in 1969, the spores increased in number 18 August.

In 1971, air sampling was initiated 1 May, and the first *H. maydis* spore was caught 1 May by the Rotorod sampler, 6 days before the first corn plants emerged in the test plots. Spores were more numerous than in 1969, but fewer than in 1970, even in June and early July when the blight lesions were relatively more numerous than in 1970. Spore counts were highest between 1000 and 1500 h. During the 3-yr period, a secondary high count was noted at 0600, not long after sunrise.

The spore counts from the Kramer-Collins collector were disappointing in 1971, when blight developed earlier than in 1970 and much more rapidly. Low spore counts were obtained also in Arkansas, Illinois, Indiana, Mississippi, Ohio, and Tennessee where similar samplers were operated (3).

In 1972, the samplers were started 5 May, before

TABLE 1. Hourly total number of spores of *Helminthosporium maydis* race T trapped and percent caught each h with the Kramer-Collins sampler during growing seasons of 1969 through 1972

Hour	Spore counts					
	1969[a]	1970[b]	1971[c]	1972[d]	Total	Percent per hour
0100	5	13	11	15	44	2.2
0200	5	16	18	13	52	2.7
0300	2	13	17	9	41	2.1
0400	2	11	10	9	32	1.6
0500	5	17	22	6	50	2.6
0600	3	25	15	12	55	2.8
0700	1	20	14	6	41	2.1
0800	5	40	14	10	69	3.5
0900	5	57	24	14	100	5.1
1000	10	88	21	19	138	7.0
1100	11	94	23	40	168	8.6
1200	10	94	20	24	148	7.6
1300	11	91	28	31	161	8.2
1400	3	85	21	19	128	6.5
1500	6	66	17	12	101	5.2
1600	6	71	20	14	111	5.7
1700	5	65	13	12	95	4.9
1800	4	45	15	14	78	4.0
1900	7	35	14	12	68	3.5
2000	3	30	15	11	59	3.0
2100	7	21	14	24	66	3.4
2200	2	20	10	28	60	3.1
2300	2	21	17	12	52	2.7
2400	5	18	10	8	41	2.1
totals	125	1,056	403	374	1,958	

[a] Count for 20 complete days.
[b] Count for 51 complete days.
[c] Count for 136 complete days.
[d] Count for 126 complete days.

corn was planted, and were operated through 19 September. The first spore was caught 5 May by the Rotorod. Although very little susceptible corn was planted in 1972, about the same number of spores were caught by the suction sampler as in 1971. Highest spore counts were obtained between 1000 and 1300 h. Another high count was noted at 2100 h. The spores may have originated from the three or four fields of severely blighted Texas male sterile corn in the Ames area, and, perhaps, from some resistant corn cultivars, because lesions developed on some of the resistant N (normal cytoplasm) corn in our plot.

The 1971 data indicated a great difference in the number of spores caught by the Kramer-Collins vs. the Rotorod samplers. The Rotorod samplers on the roof and the sequential sampler in the field caught a total of 33 spores per 32,400 liters of air on 13 May; the Kramer-Collins sampler caught none. A high daily count on 13 May was never exceeded until 31 July, almost 3 mo later. The largest increases in air spore concentration were detected by the Rotorod samplers in the field and on the roof. The Kramer-Collins sampler recorded only gradual, slight increases.

The Rotorod sampler, which operated 7 h per day, recorded the largest increases in the number of spores captured on and after 30 July. The number of spores caught during 18-30 July ranged from 1-67 per day per 25,200 liters of air. From 1-31 August, when low temp and low rainfall conditions prevailed (conditions supposedly unfavorable for SCLB development) spore counts ranged from 1-442 per 25,200 liters of air per day. On 7 days during the period, counts were 80 or more spores per 25,200 liters of air per day.

For the 1971 season, weekly counts from the two types of samplers were highest in August (Fig. 1). Monthly total spore counts were: May, 100; June, 180; July, 443; and August, 1,765. Two phenomena were apparent: (i) total numbers of spores increased during July and August even though drought and low temperatures were unfavorable for blight, and (ii) in spite of totaling the daily spore counts (2,488) per 36,816 liters of air for two types of samplers in the field, the numbers were very low.

Weekly counts from the two types of samplers were totaled for the 1972 season (Fig. 2). Note the spore counts in May, long before the incidence of any corn blight lesions in the area. Undoubtedly, these spores became airborne locally by farmer's rotary hoeing and from outdoor corn piles and cribs where infected ears overwintered and released viable spores from cobs, kernels, and tiny fragments of corn silks during shelling (4). More spores were trapped in 1972 than in 1971. From May through 19 September, the most spores (2,694) were caught by all traps during the 19 days of September when

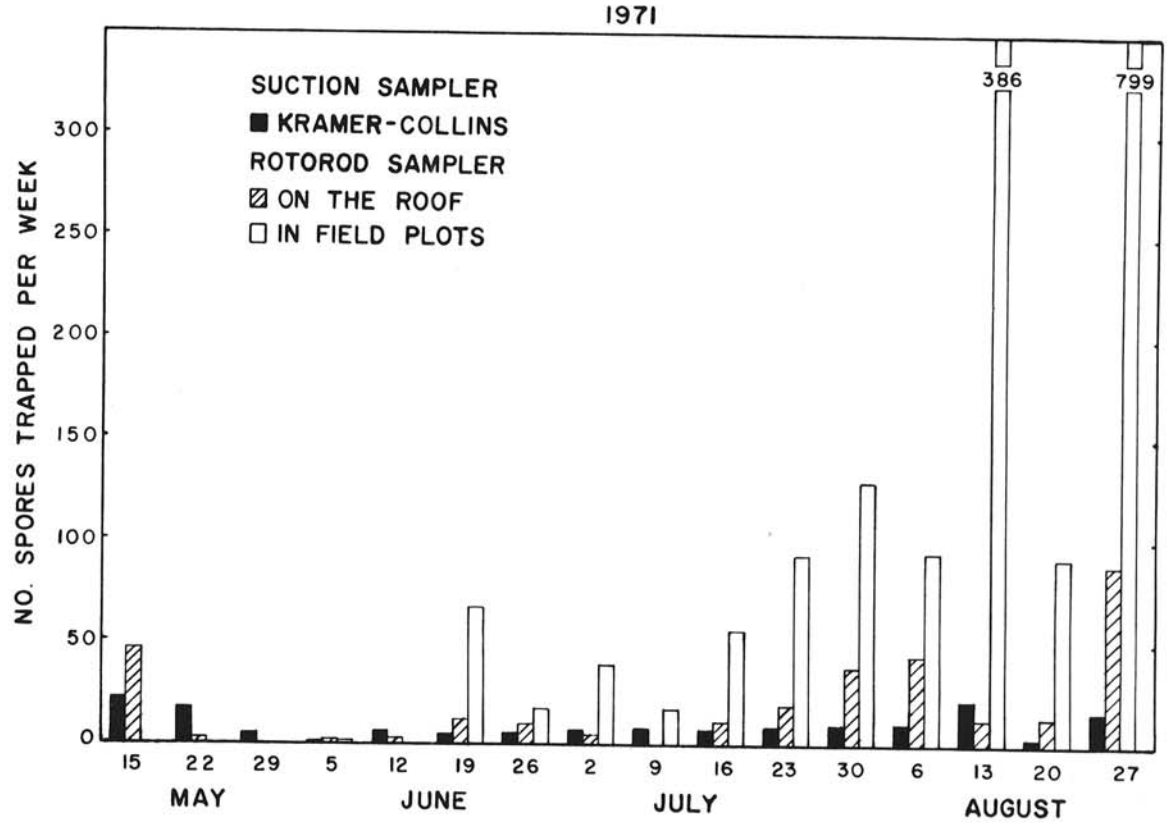

Fig. 1. Weekly counts of *Helminthosporium maydis* race T spores from Kramer-Collins sampler in the field and Rotorod samplers in the field and on roof of a building, 18.24 m. high, 3.22 km (2 mi.) from the nearest corn field during 1971.

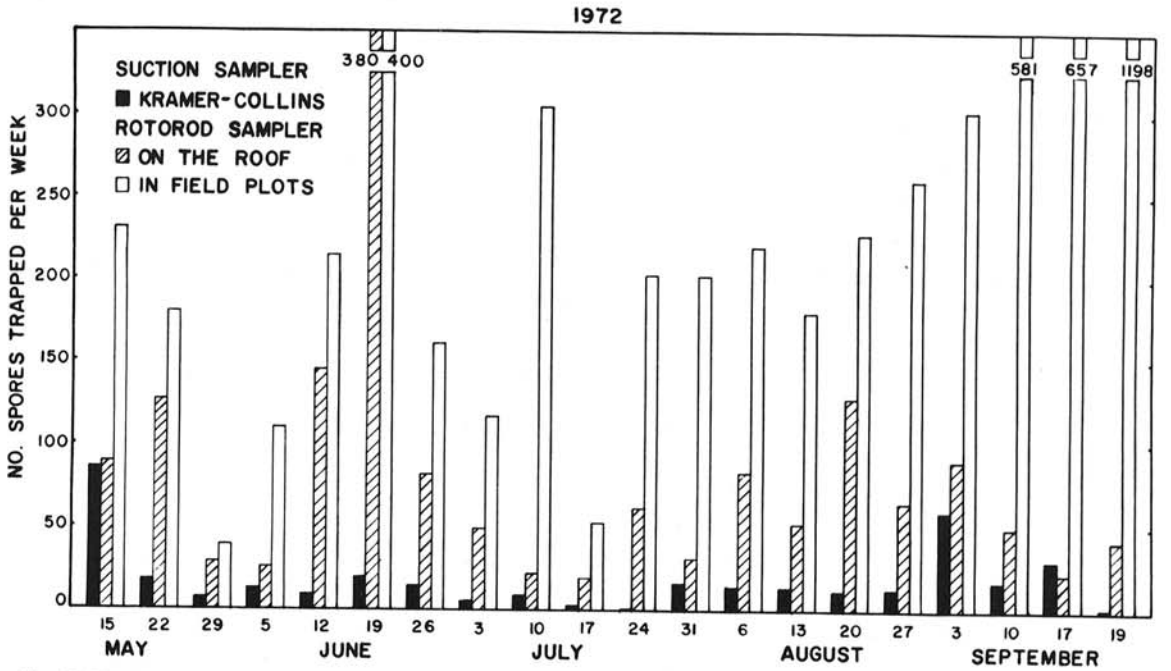

Fig. 2. Weekly counts of *Helminthosporium maydis* race T from the Kramer-Collins spore sampler in the field and Rotorod samplers in the field and on roof of a building, 18.24 m. high, 3.22 km (2 mi.) from the nearest corn field during 1972.

18,864 liters of air per day were sampled. The high spore count was considered the result of harvesting blighted corn for silage during this period.

The greater spore counts of 1972 indicated that inoculum was produced in spite of the minimal amount of susceptible corn planted, and that conditions must have been extremely favorable for lesion development and spore production. These high counts would have provided the basis for a warning of increased blight development and a blight alert.

Although more *H. maydis* spores were trapped in 1971 and 1972 because of the longer sampling periods, the numbers were low compared with those trapped for such pathogens as *Cercospora beticola* Sacc., the sugarbeet leaf-spot fungus (J.R. Wallin, *unpublished*), and *Puccinia recondita* Rob. ex Desm. *tritici*, the wheat leaf rust fungus (J.R. Wallin, *unpublished*). Spores trapped hourly from plots infected with these fungi were too numerous to count accurately. For example, when we were studying the spread of the wheat fungi in 1970, more than 5,000 leaf rust spores per 4,416 liters of air per day were trapped, or twice as many as the *H. maydis* spores caught all season in 1971 and nearly as many as caught during the 5 mo in 1972. This raises a question concerning the ability of *H. maydis* to sporulate, and the ability of spores of this size to remain airborne. Possibly, their wt, size, and shape cause them to fall out quickly after they are released and airborne.

The Rotorod sampler was the more efficient collector for airborne spores of *H. maydis*; however, our unit was not constructed to operate on a 24-h basis like the Kramer-Collins trap.

Spore counts should indicate the level of SCLB development in the field and aid in forecasting the disease, but our spore counts seemed to underrate the level of the disease in the field. Airborne spores and blight will be monitored during the coming season when, supposedly, no susceptible corn will be planted.

LITERATURE CITED

1. AEROSOL LABORATORY, STANFORD UNIVERSITY. 1957. The Rotorod sampler. Second Semiannual Report. CML. 186, Stanford University Press.
2. KRAMER, C.L., and S. M. PADY. 1966. A new 24-hr spore sampler. Phytopathology 56:517-520.
3. WALLIN, J.R. 1973. Spore sampling of Helminthosporium maydis race T in 1971. Plant Dis. Rep. 57:298-299.
4. WALLIN, J. R., D.V. LOONAN, and A. H. EPSTEIN. 1972. Incidence of Helminthosporium maydis race T in Iowa, 1971. Plant Dis. Rep. 56:660-661.