A PYTHIUM STALK ROT OF CORN [1]

By CHARLOTTE ELLIOTT

Pathologist, Division of Cereal Crops and Diseases, Bureau of Plant Industry, Agricultural Research Administration, United States Department of Agriculture

INTRODUCTION

A stalk rot, later shown to be caused by a species of *Pythium*, was first observed by M. T. Jenkins [2] during late July and early August 1940, on the Potomac River bottoms of the Arlington Experiment Farm, Arlington, Va., on plants of two inbred lines of dent corn (*Zea mays* L.). All 17 plants in a row of K167, an inbred line developed at the Kansas Agricultural Experiment Station, were infected and, when 15 to 20 inches high, had fallen over just above the ground. The top of each plant could easily be lifted from the crown and root. Adjacent rows of K168 showed no infection. A few days after the discovery of the disease a similar stalk rot was observed in the same nursery in six rows of C. I.[3] 6, an inbred line developed by the Division of Cereal Crops and Diseases at the Arlington Farm. These plants were 5 feet tall and had stalks 1 inch or more in diameter. The six rows alternated with other inbreds, but infection occurred only in C. I. 6. A few plants in each of the six rows fell over, owing to rotting of the first or second internode above the soil line. In most cases the tops remained green and turgid for a week or more. Both infections appeared after a heavy rain and a subsequent period of very high temperature and high humidity. The infection did not spread and when the temperature went down appeared to cease as suddenly as it had developed.

THE DISEASE

The pythium stalk rot of corn considered here develops rapidly during a few days of very high temperature and high humidity, becomes apparent when the plants fall over, and then, when the temperature falls, progresses no farther. The fungus destroys the stalk tissue for 1 or 2 inches at one of the lower internodes, causing large plants to fall over, and then, instead of progressing to new tissue, apparently ceases its activity. The roots are abundant and healthy. There is no stunting of the plants. They are healthy and grow vigorously, and the disease becomes apparent only when the stalks bend abruptly at one of the lower internodes and fall to the ground (fig. 1). The outer rind of the cornstalk, the epidermis, the lignified cells of the hypodermis, and the inner parenchyma cells are softened, disorganized, and destroyed, leaving only the separate browned strands of vascular bundles, which cannot support the plant (fig. 2).

[1] Received for publication April 2, 1942.

[2] Principal agronomist, Division of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture.

[3] C. I. refers to accession number of the Division of Cereal Crops and Diseases. Formerly, accession numbers for the inbred lines developed in this Division were designated by the prefix "U. S." instead of "C. I." but have been changed recently to avoid confusion with the designation of U. S. hybrids.

Journal of Agricultural Research,
Washington, D. C.

Vol. 66, No. 1
Jan. 1, 1943
Key No. G-1268

FIGURE 1.—Pythium stalk rot in inbred lines of yellow dent corn. Natural infection in the field at the Arlington Experiment Farm, Arlington, Va. Photographed by M. T. Jenkins. *A*, Row 1,231, C. I. 6. Photographed August 8, 1940. *B*, Inbred lines: *a*, K168; *b*, K167; *c*, K168. Photographed July 29, 1940.

In the lignified tissue of the older plants, the rotting usually is confined to and may involve not more than 2 inches of one internode. The vascular bundles were observed to continue to function in some of

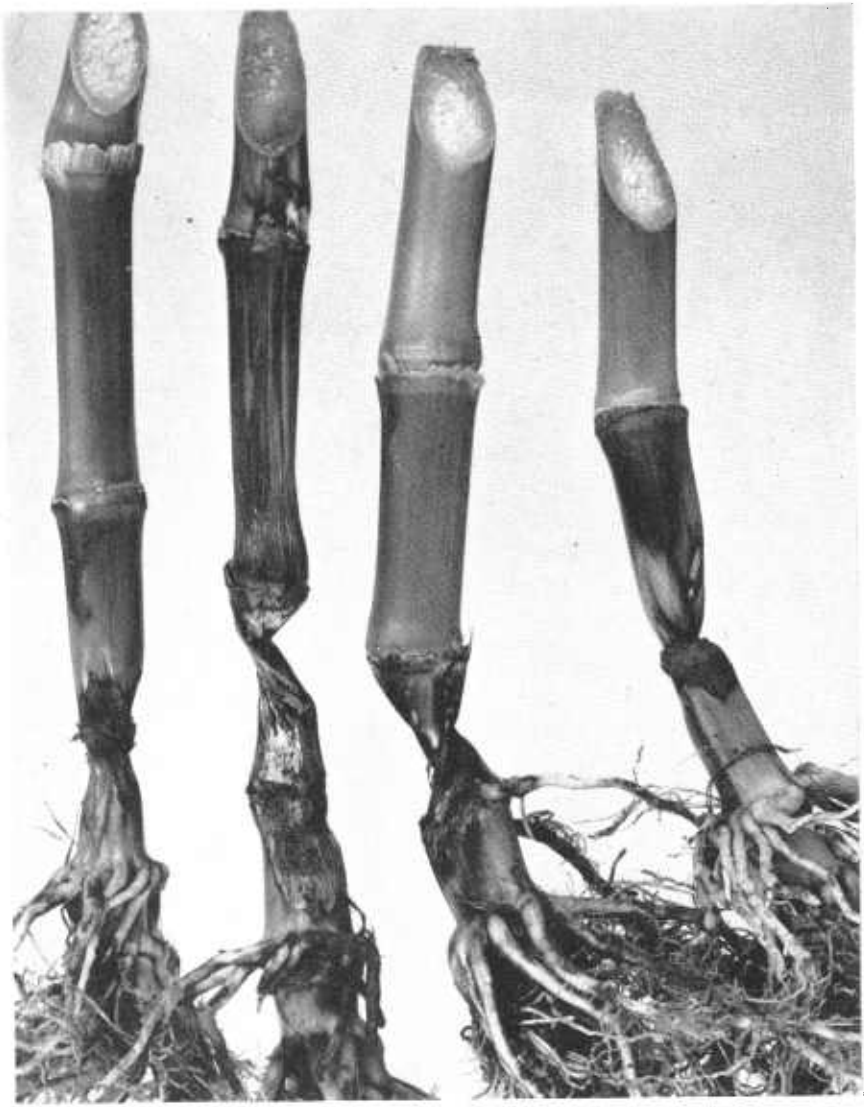

FIGURE 2.—Natural infection with pythium stalk rot in plants of inbred C. I. 6, yellow dent corn, grown at the Arlington Experiment Farm. Photographed August 6, 1940.

the large plants of inbred C. I. 6, so that the plants lying on the ground remained green and turgid for several days (fig. 1, *A*). Longitudinal sections of infected internodes showed water-soaked, brown tissue at the margins of infected areas and a sharp line of demarcation

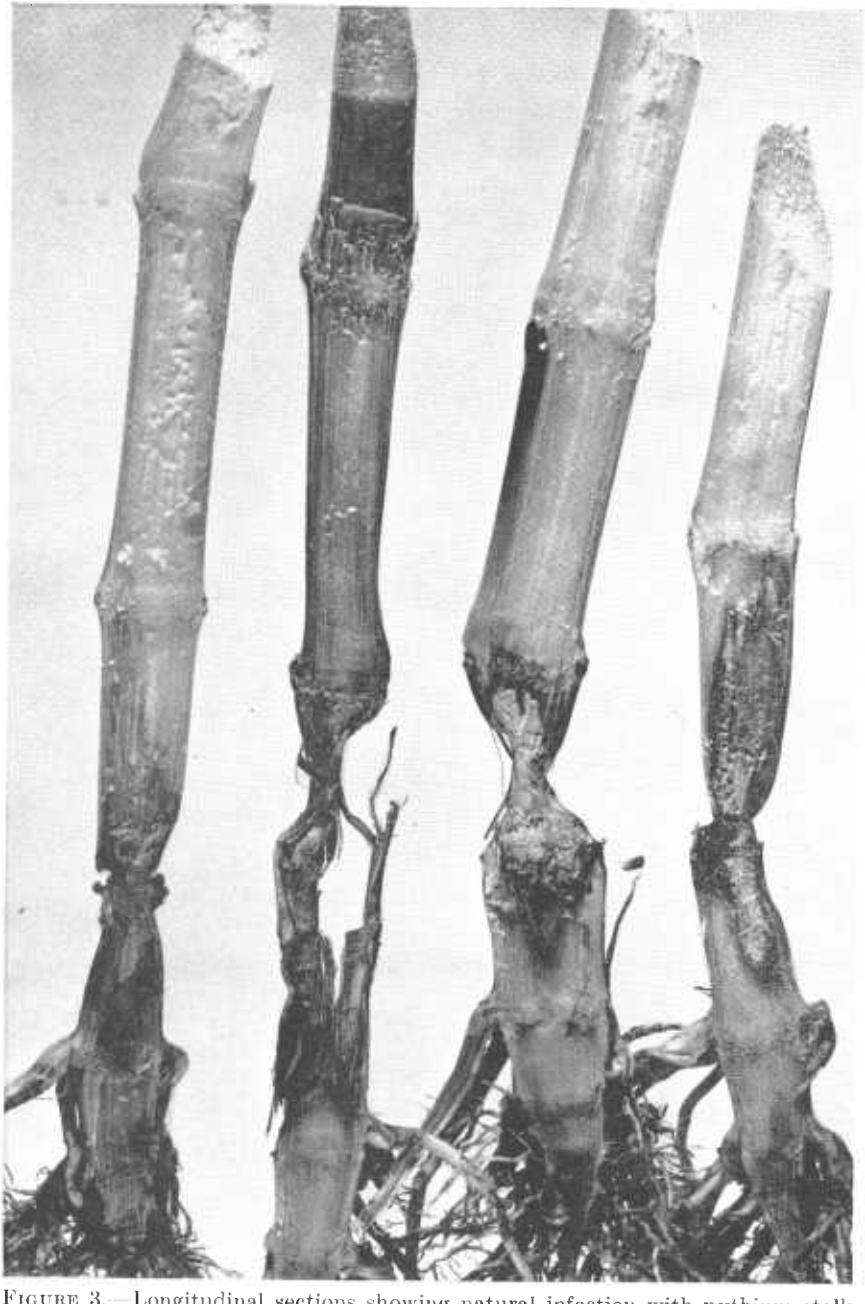

FIGURE 3.—Longitudinal sections showing natural infection with pythium stalk rot in plants of inbred C. I. 6, yellow dent corn, grown at the Arlington Experiment Farm. Photographed August 6, 1940.

between the dark-brown, water-soaked tissue and healthy tissue (fig. 3). Along this line there was often a purplish or lavender tinge.

At the Arlington Experiment Farm the infection was most severe in the tender tissue of the young plants of inbred K167, which were less than 2 feet tall, and developed first just above the ground level. It extended up the stalk through two to three internodes, or to the growing point, where infected tissue was much less clearly separated from the healthy. There was no putrid odor, as with bacterial infection, but a peculiar, characteristic odor, which has been described as "marshy."

A similar stalk rot was observed early in August 1941, in a small field of Hybrid Extra Early Yellow Dent corn growing on a farm west of Petersburg, Dinwiddie County, Va. The infection was scattered through the field but was more abundant on one side, where 20 to 25 percent of the stalks had lodged. The stalks were 1½ inches in diameter, and the plants had grown vigorously and normally with no signs of disease until they were found lying on the ground. Local rotting of internodes above the brace roots, like that in the plants of inbred C. I. 6, had caused them to lodge (figs. 4 and 5).

The field was visited about 3 weeks after the infection was first reported. Some plants had died, but in others the leaves and stalks above the rotted internodes were green and turgid, roots had developed at nodes just above the rotted internodes (figs. 5 and 6), and the growing tops had turned upward, developed tassels, and in one instance an ear (fig. 4). What was left of the rotted internodes was brown and dry. There was no evidence of bacterial infection and no odor of decay. In the interior of the stalks the rotted and healthy tissues were distinctly separated. The roots were abundant and healthy.

The development of this stalk rot in Dinwiddie County, Va., in 1941, followed a period of high temperatures, as was the case in 1940, at the Arlington Experiment Farm. The temperature and rainfall data for the two localities and for the period coinciding with or immediately preceding the observations of the disease are given in table 1.

TABLE 1.—*Temperature and rainfall data for the Arlington Experiment Farm and Richmond,*[1] *Va., for the periods approximately coinciding with the appearance of the stalk rot disease of corn*

Date	Arlington Experiment Farm, 1940		Richmond, Va., 1941		Date	Arlington Experiment Farm, 1940		Richmond, Va., 1941	
	Maximum temperature	Rainfall	Maximum temperature	Rainfall		Maximum temperature	Rainfall	Maximum temperature	Rainfall
	° *F.*	*Inches*	° *F.*	*Inches*		° *F.*	*Inches*	° *F.*	*Inches*
July 15	84	0	80	0	July 24	92	3.20	86	0
16	86	0	84	0	25	96	0	89	0
17	87	0	87	.39	26	100	0	98	.48
18	93	0	88	.32	27	100	0	96	0
19	97	0	89	.62	28	102	0	98	0
20	98	0	85	.01	29	95	.05	90	0
21	99	0	84	0	30	98	.01	98	0
22	99	0	83	0	31	95	0	97	0
23	92	0	84	[2] T					

[1] The disease occurred about 5 miles west of Petersburg, Va., and 20 miles south of Richmond. Weather records for Petersburg were not available.

[2] T=trace.

THE CAUSAL ORGANISM

IDENTITY

Specimens of stalk rot from the Arlington Experiment Farm, held in the culture room in glass dishes during a hot week end, developed a mat of cottony white mycelium. Transfers were made from this mycelium, and isolations also were made from pieces of rotted tissue

FIGURE 4.—Hybrid Extra Early Yellow Dent corn near Petersburg, Dinwiddie County, Va., where 20 to 25 percent of the stalks had rotted just above the ground and fallen over early in August. Photographed September 3, 1941.

washed in sterile water, held overnight in water in the refrigerator, and plated on water agar. Several isolations were made from both K167 (culture 40–F) and C. I. 6 (culture 40–G). Pure cultures showed a typical nonseptate mycelium, which when grown on corn meal-carrot agar developed an abundance of oogonia and antheridia. Pure cultures of the fungus were identified by Charles Drechsler [4] as *Pythium butleri* Subr. The history of this species has been reviewed

[4] Pathologist, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture.

by Drechsler [5] under the name of *P. aphanidermatum*. In 1934 he [6] separated *P. aphanidermatum* into two species on the basis

FIGURE 5.—Stalk rot and root formation at nodes above rotted tissue on Hybrid Extra Early Yellow Dent corn, near Petersburg, Va. Photographed September 4, 1941.

of size of fruiting bodies. Zoosporangia, zoospores, and sexual structures are larger in *P. butleri* than in *P. aphanidermatum*.

[5] DRECHSLER, C. THE COTTONY LEAK OF CUCUMBERS CAUSED BY PYTHIUM APHANIDERMATUM. Jour. Agr. Res. 30: 1035-1042, illus. 1925.

[6] DRECHSLER, C. PYTHIUM BUTLERI AND P. APHANIDERMATUM. (Abstract) Phytopathology 24: 7. 1934.

The host range and distribution of the two species are still somewhat confused. Although no extensive isolations have been made to determine the distribution of *P. butleri*, it is, according to Drechsler, a widely distributed fungus in warm climates, living near the surface of the soil and destructive to a variety of hosts. He reports [7] (p. 393) that during or immediately following periods of excessively hot moist weather this fungus may become especially destructive.

Repeated attempts were made to isolate an organism from the rotted stalks collected near Petersburg, Va., that would reproduce the disease. *Pythium*, however, was not isolated and none of the other fungi isolated produced infection. *Pythium butleri* used in the same inocu-

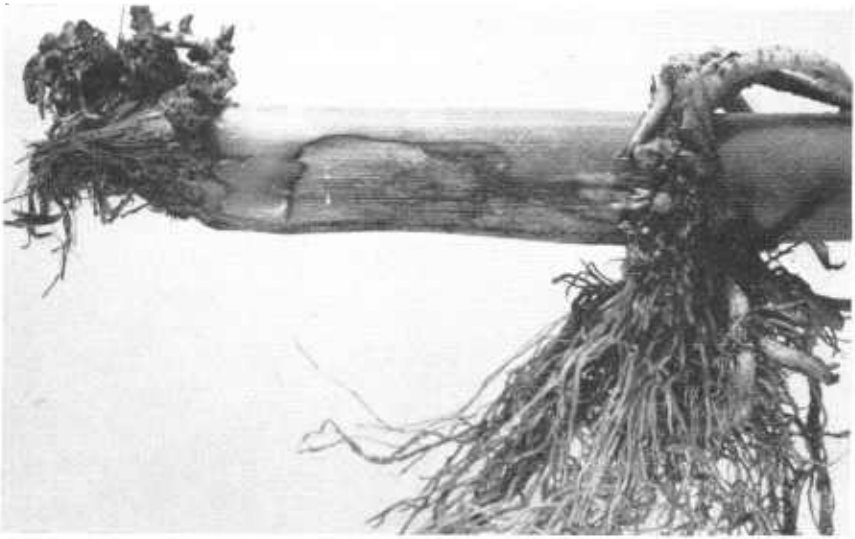

FIGURE 6.—Stalk rot, and root formation at nodes above rotted tissue, on Hybrid Extra Early Yellow Dent corn, near Petersburg, Va. Photographed September 4, 1941.

lation test produced typical stalk rot in the greenhouse at Arlington Experiment Farm. The known difficulties in isolating *Pythium* in other cases suggest that the failure to secure *Pythium* from the Petersburg corn was due to lack of fresh material and actively developing infections. The infection in the field near Petersburg, therefore, probably was due to the same fungus that caused the stalk rot in the nursery at the Arlington Experiment Farm.

PATHOGENICITY

Cultures isolated from rotted stalks of two inbred lines of yellow dent corn, K167 and C. I. 6, were tested for pathogenicity in the field and in the greenhouse at the Arlington Experiment Farm.

FIELD INOCULATIONS

Healthy plants of inbred C. I. 6, in the rows where the infection had developed, were used for inoculation with isolations from plants of K167 and C. I. 6 on August 12, 1940. The surface of the stalk

[7] DRECHSLER, C. SEVERAL SPECIES OF PYTHIUM CAUSING BLOSSOM-END ROT OF WATERMELONS. Phytopathology 29: 391-422, illus. 1939.

was washed with alcohol and mercuric chloride, an incision made, and small pieces of agar culture inserted. Three plants were inoculated with each culture. Control plants were injured in the same way but no cultures were introduced.

Maximum temperatures following inoculation were too low to be favorable for rapid development of the disease. Results of this inoculation are given in table 2, and the temperature and rainfall

TABLE 2.—*Results of inoculations in the field, August 12, 1940, of large plants of inbred C. I. 6, yellow dent corn, with cultures isolated July 30 and Aug. 3, 1940, from stalk rot lesions on K167 and C. I. 6*

Culture No.	Plants—			
	Inoculated	Fallen over		With partial stalk rot
		Aug. 16	Sept. 11	
	Number	*Number*	*Number*	*Number*
40–F–1a 1 [1]	3	0	0	3
40–F–2a [1]	3	0	0	0
40–F–3 [1]	3	0	0	3
40–G–3a 1 [2]	3	0	0	0
40–G–4c [2]	3	1	1	3
40–G–5c [2]	3	0	0	0
40–G–5b [2]	3	0	0	3
Controls	3	0	0	0

[1] Isolated from inbred K167.
[2] Isolated from inbred C. I. 6.

records for the period from August 12 to September 22, 1940, at the Arlington Experiment Farm, are given in figure 7.

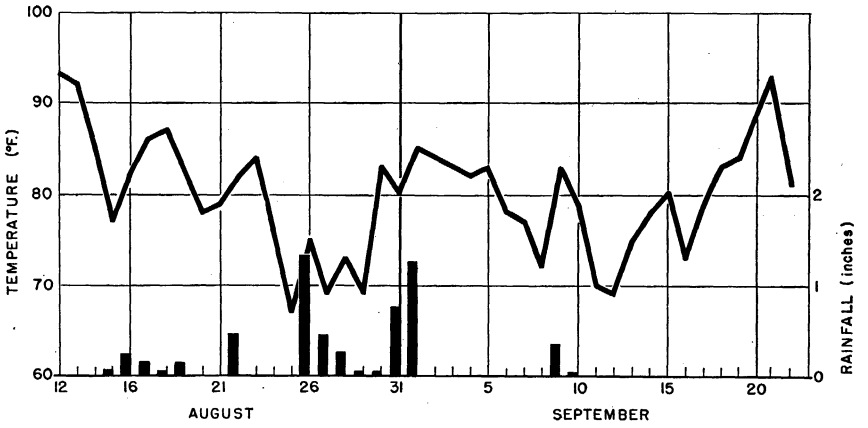

FIGURE 7.—Daily maximum temperatures and rainfall at the Arlington Experiment Farm from August 12 to September 22, 1940.

The results of an inoculation with culture 40–G–4c, which caused rotting of the inoculated internodes so that the plant fell over 4 days after inoculation, are shown in figure 8, *A*. A longitudinal section of this plant (fig. 8, *B*) shows the results of inoculations in two internodes. The infection in the lower internode progressed less rapidly than that in the upper. Some of the inoculated plants were not

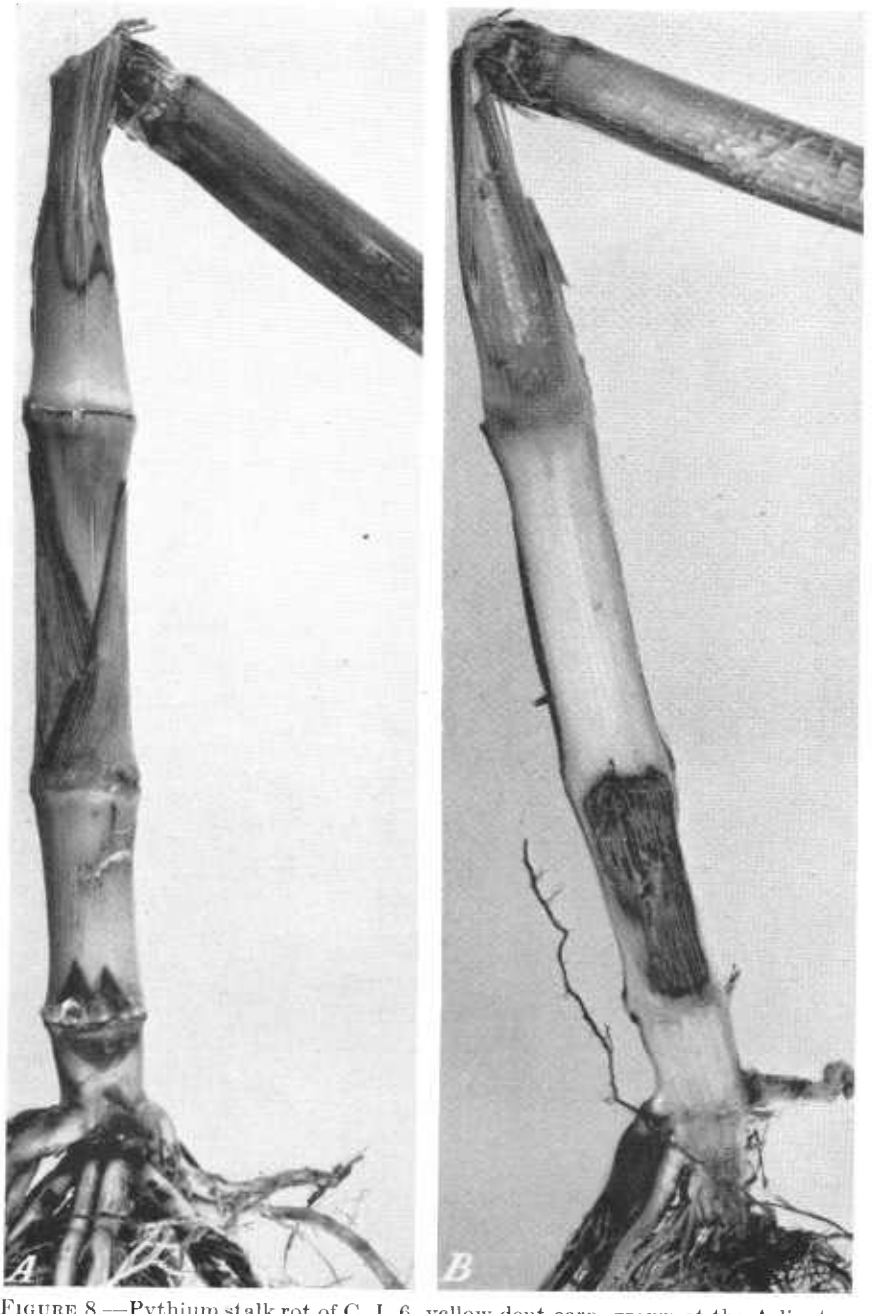

FIGURE 8.—Pythium stalk rot of C. I. 6, yellow dent corn, grown at the Arlington Experiment Farm. Plant inoculated August 12, 1940, with *Pythium butleri*, culture 40–G–4c; fallen over August 16, 1940; photographed August 24, 1940. *A*, External view; *B*, longitudinal section.

sufficiently rotted to fall over. Longitudinal sections of representative stalks of these plants are shown in figure 9. The control plant showed some discoloration around the wound (fig. 9, *A*). All four inoculated stalks showed distinct rotting of the parenchyma tissue, particularly the stalk in figure 9, *B*, which was inoculated with culture

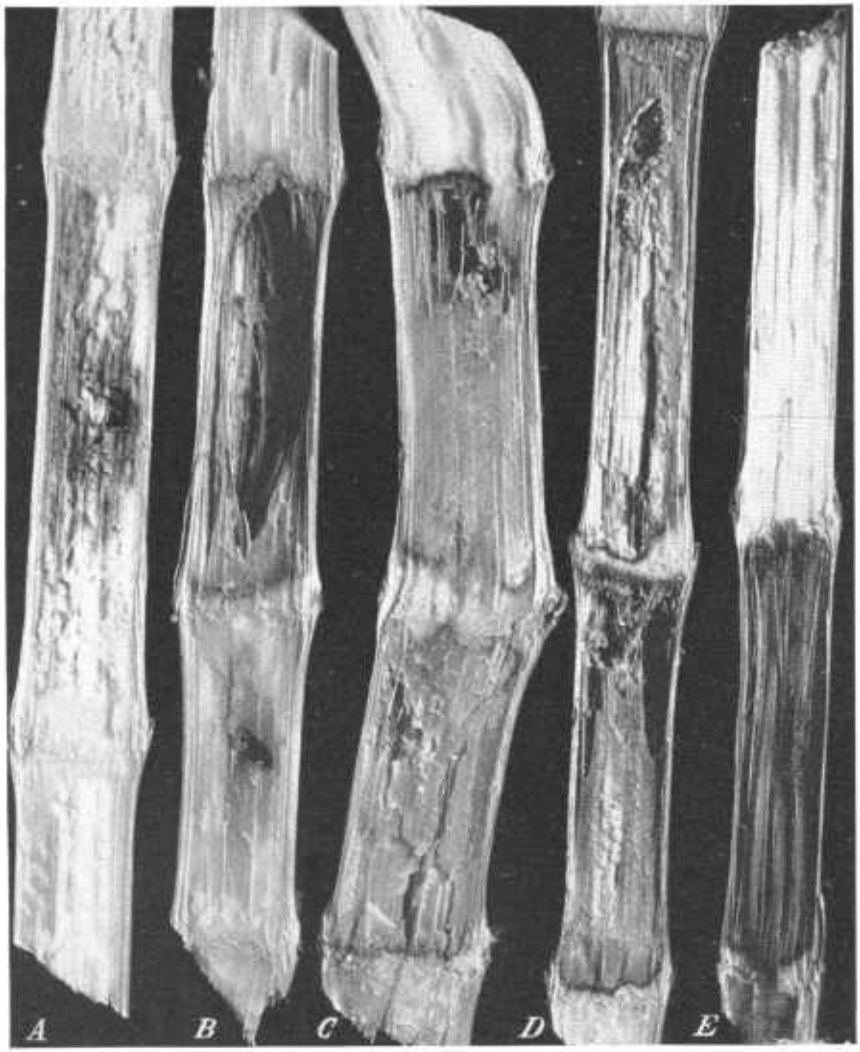

FIGURE 9.—Pythium stalk rot on inbred C. I. 6, yellow dent corn, grown at the Arlington Experiment Farm. Inoculated August 12, 1940, with cultures of *Pythium butleri* isolated from stalk rot; photographed September 9, 1940. *A*, Wounded, uninoculated; *B*–*E*, inoculated with cultures 40–G–4c, 40–F–1a_1, 40–G–5b, and 40–F–3, respectively.

40–G–4c isolated from C. I. 6, and that in figure 9, *E*, which was inoculated with culture 40–F–3 isolated from K167. The latter stalk easily yielded to pressure, and there was little tissue left except the vascular bundles and part of the outer rind. All three plants

inoculated with culture 40–G–5b (fig. 9, *D*) showed typical water-soaked rotting and brown margins. Although the infection did not progress far enough for the plants to fall over, they were so weakened that the rind easily yielded to pressure. All three plants inoculated with culture 40–F–1a_1 (fig. 9, *C*) also showed typical rotting. There was no putrid odor from the infected tissue in any of these plants. *Pythium butleri* was reisolated from several of the rotted stalks.

Seed of inbred C. I. 6 was planted in the field at the Arlington Experiment Farm early in August 1940. On September 12, when the plants were about 12 inches high, inoculations were made with 13 isolations. Of six plants inoculated with each culture, two were uninjured and had the culture placed between leaf sheath and stalk, two had the stalk scratched with a needle and the culture placed between leaf sheath and stalk, and two had cultures inserted into a scalpel wound in the stalk. No infection resulted in any of these inoculated plants, apparently because environmental conditions were unfavorable. For over a week following this inoculation, daily maximum temperatures were below 90° F. and there was no rainfall.

Greenhouse Inoculations

Inoculations in the greenhouse were made (1) to determine whether *Pythium butleri* would produce a root rot of dent corn inbred lines similar to that caused by *P. arrhenomanes* as described previously,[8] (2) to obtain additional proof of the pathogenicity of the cultures of *P. butleri* isolated from the rotted stalks of dent corn described above, and (3) to test the relative susceptibility of inbred lines of dent corn to this species of *Pythium*.

In all greenhouse inoculation tests, plants were grown in sterilized white sand, to which iron as iron magnetite, 1 part in 100 by weight, was added before sterilization. The plants were grown in 6-inch pots, washed before each test for 5 minutes in 1:50 commercial formaldehyde solution, and watered with a nutrient solution, as described in a previous publication.[8] Greenhouse benches were sprayed with the formaldehyde solution. The seed was rinsed in alcohol and held for 10 minutes in a 1:1,000 mercuric chloride solution, rinsed, and germinated in Petri dishes on wet filter paper. After planting, the seedlings were allowed to grow for several days before inoculation or until they were well established.

The first test was begun November 30, 1940. In this test, the sand in 40 pots containing plants of inbred C. I. 6 was inoculated by placing centimeter squares of agar cultures near the edge of the pot, on opposite sides of the plant. Four cultures were used, 40–F–3 and 40–F–1a_1, isolated from inbred K167, and 40–G–5b and 40–G–4c, isolated from inbred C. I. 6. Ten pots were inoculated with each culture, and corresponding sterile agar was added to the sand in 10 control pots. Weekly measurements of height showed the same increase in inoculated and control plants. On December 16, when the sand was washed from the roots, there was no evidence of root rot. Daily maximum temperatures in the greenhouse during this period ranged from 78° to 104° F.

In May 1941, a second test for root rot was made by similar sand inoculations of 13 inbred lines of dent corn. All seedlings, after

[8] Elliott, C. Relative susceptibility to pythium root rot of twelve dent corn inbreds. Jour. Agr. Res. 64: 711–723, illus. 1942.

being transferred from Petri dishes to sand April 26, had grown for 2 weeks on the same greenhouse bench. Daily maximum temperatures in the greenhouse at Arlington Experiment Farm during the experiment for May and June 1941 are given in figure 10.

The results agree with those of the previous test. The mean heights of the plants of all 13 inbreds on May 12, when the inoculations were made, were as follows: Uninoculated, 32.8 cm.; inoculated, 35.1 cm. At the end of the experiment the respective means were 111.2 and 118.2 cm. Rates of growth were not retarded by the inoculation, and when the sand was washed from the roots, more than 4 weeks

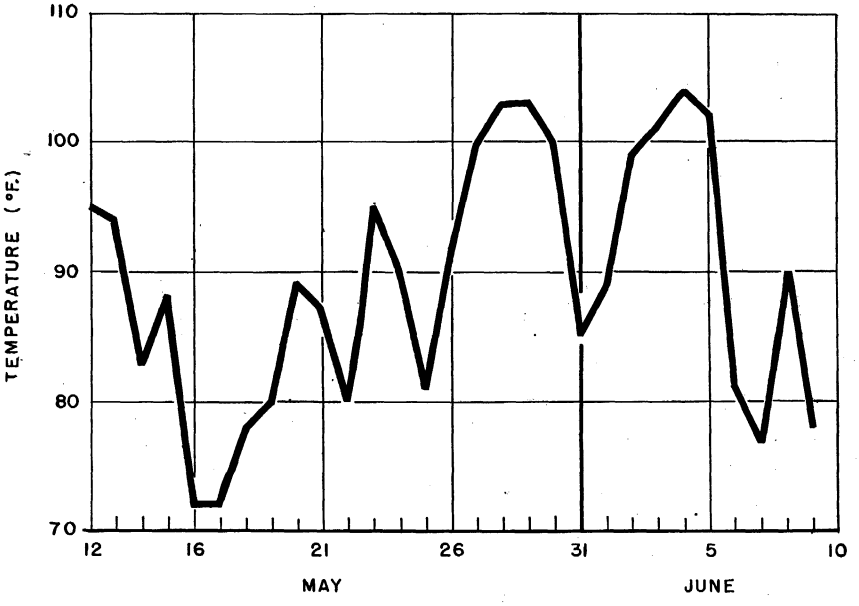

FIGURE 10.—Daily maximum temperatures in the greenhouse at the Arlington Experiment Farm during May and June 1941.

after inoculation, there was no evidence of root rot in any of the inbred lines.

Another test for root rot was made during the summer of 1941. On June 27, 13 inbred lines were grown in sand cultures and inoculated by placing cultures of 40–G–4c in the sand on opposite sides of each plant. Four pots of each were inoculated, and two of each were used as controls. Plants in inoculated sand grew as well as those in uninoculated sand, and when the sand was washed from the roots, August 4, there was no evidence of root rot. Roots in both inoculated and control plants were abundant and not discolored.

Direct inoculations of corn plants in the greenhouse to test the pathogenicity of fungus isolations from stalk rot were begun December 7, 1940. Five plants were inoculated with each of four cultures by placing pieces of agar cultures inside the lower leaf sheath. So far as could be observed, the plants had not been wounded. The results of this inoculation are given in table 3. Daily maximum temperatures in the greenhouse at Arlington Experiment Farm during the experiment, December 7 to 17, were 82°, 98°, 94°, 93°,

90°, 96°, 104°, 90°, 94°, 100°, and 97° F., respectively. Four days after inoculation, three plants inoculated with culture 40–F–3 developed stalk rot near the point of inoculation and fell over. One plant inoculated with culture 40–F–$1a_1$ had fallen over. Five days after inoculation, all five plants inoculated with culture 40–F–3 and two inoculated with each of the other three cultures had rotted and fallen. None of the five controls became infected.

Figure 11 shows the results of the test just described. Apparently *Pythium butleri* is able to penetrate unwounded stalk tissue.

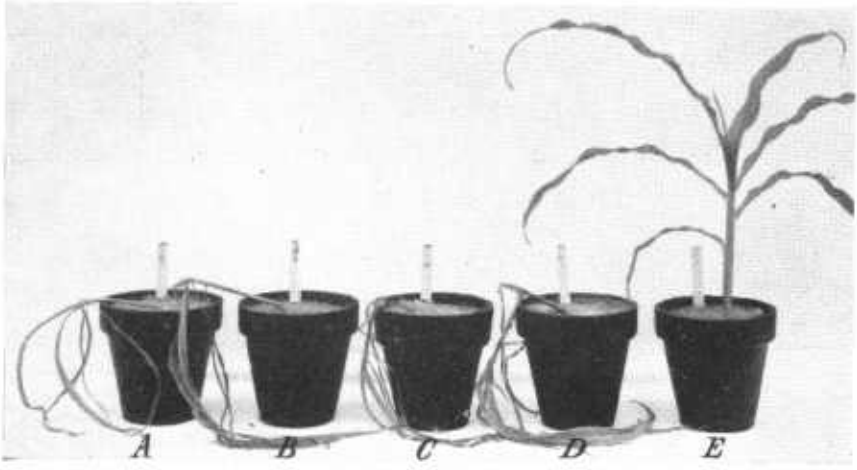

FIGURE 11.—Stalk rot of inbred C. I. 6, yellow dent corn, grown in sand plus nutrient solution in the greenhouse at the Arlington Experiment Farm. Inoculated December 7, 1940, with *Pythium butleri*, cultures (*A*) 40–F–3, (*B*) 40–G–5b, (*C*) 40–F–$1a_1$, and (*D*) 40–G–4c, respectively, isolated from rotted stalks. *E*, Uninoculated control. Photographed December 12, 1940.

TABLE 3.—*Results of greenhouse inoculations of inbred C. I. 6, yellow dent corn, grown in sand plus nutrient solution, with cultures of Pythium butleri isolated from stalk rot at Arlington Experiment Farm*

[Inoculations made without wounding plants, December 7, 1940]

Culture No.	Plants—		
	Inoculated	Fallen over—	
		Dec. 11	Dec. 12
	Number	*Number*	*Number*
40–F–3	5	3	5
40–G–5b	5	0	2
40–F–$1a_1$	5	1	2
40–G–4c	5	0	2
Controls	5	0	0

On June 6, 1941, 13 inbred lines of dent corn were inoculated to test the pathogenicity of culture 40–G–4c and to obtain information on possible differences in susceptibility to attack by *Pythium butleri*. Five plants of each inbred were inoculated by inserting mycelium into the stalk 1 to 2 inches above the soil line. Similar incisions were

made in 5 control plants of each inbred. The results are given in figure 12, *A* and *B*, and in table 4.

Maximum greenhouse temperatures for June 6, 7, 8, and 9 were 98°, 96°, 97°, and 94° F., respectively, and the humidity was high. On June 9, 3 days after inoculation, all but 8 of the 65 inoculated

FIGURE 12.—Thirteen inbred lines of dent corn, grown in sand plus nutrient solution; planted April 26, 1941. *A*, Stalks wounded at base June 6, 1941, but not inoculated; photographed June 9, 1941. *B*, Plant inoculated June 6, 1941, by wounding and inserting *Pythium butleri* into lower internode of stalk; photographed June 9, 1941. (Plants at farther end of bench were not inoculated.)

plants had fallen over. The stalk tissue was water-soaked and rotted for 1 to 2 inches around the point of inoculation. The attendant who watered the plants over the week end said they were lying flat on the bench on Sunday, only 48 hours after inoculation. All the inoculated plants were cut lengthwise to determine the extent of

rotting. Only 1 inbred, Ill. Hy., showed any marked resistance. In this line, only 1 plant in 5 fell over and rotting around the point of inoculation was very limited. In Ky. 13, 3 out of 5 plants fell over, and likewise 4 out of 5 plants of Ill. R4 and Ia. L317. Five inbreds were very susceptible.

TABLE 4.—*Inbred lines of dent corn inoculated June 6, 1941, with Pythium butleri, culture 40–G–4c, to determine differences in susceptibility to stalk rot*

Inbred—	Plants—			Reaction to inoculation
	Inoculated	Fallen over June 9	With stalk rot	
C. I. 6:	*Number*	*Number*	*Percent*	
Inoculated	5	5	100	Very susceptible.[1]
Control	5	0	0	
Ill. Hy.:				
Inoculated	5	1	20	Resistant.
Control	5	0	0	
C. I. 540:				
Inoculated	5	5	100	Susceptible.
Control	5	0	0	
C. I. 5:				
Inoculated	5	5	100	Moderately susceptible.
Control	5	0	0	
Ia. L289:				
Inoculated	5	5	100	Very susceptible.
Control	5	0	0	
Ia. Mc401:				
Inoculated	5	5	100	Very susceptible.
Control	5	0	0	
Ky. 13:				
Inoculated	5	3	60	Moderately susceptible.
Control	5	0	0	
C. I. 1:				
Inoculated	5	5	100	Very susceptible.
Control	5	0	0	
Ill. R4:				
Inoculated	5	4	80	Moderately susceptible.
Control	5	0	0	
C. I. 4–8:				
Inoculated	5	5	100	Susceptible.
Control	5	0	0	
Ia. L317:				
Inoculated	5	4	80	Moderately susceptible.
Control	5	0	0	
Ind. Tr.:				
Inoculated	5	5	100	Very susceptible.
Control	5	0	0	
Ia. B1 345:				
Inoculated	5	5	100	Susceptible.
Control	5	0	0	

[1] Very susceptible=rot spreading throughout the stalk and into the growing point; no sharp line of demarcation between rotted and healthy tissue. Susceptible=rot spreading beyond inoculated internode, but sharp line between infected and healthy tissue. Moderately susceptible=rotting mostly confined to inoculated internode. Resistant=very limited rotting around point of inoculation.

On July 29, 1941, a limited number of plants of the same 13 inbreds were inoculated with culture 40–G–4c, to test further differences in susceptibility and to test again the ability of the fungus to infect uninjured as well as injured stalk tissue. This experiment was discontinued August 4, 6 days after the inoculations were made. The results are given in table 5.

Daily maximum greenhouse temperatures during the period July 29 to August 4, 1941, were 91°, 96°, 100°, 100°, 100°, 102°, and 102° F., respectively. In spite of these temperatures, conditions apparently were less favorable for infection than in the previous test; infection developed less rapidly and differences between inbreds were somewhat more apparent. Ill. Hy. and Ky. 13 again were the most resistant inbreds. While none of the plants of C. I. 6 fell over, sections of

inoculated stalks showed definite internal rotting. Infection developed most rapidly in C. I. 540, C. I. 5, Ia. L289, and C. I. 1; C. I. 4–8 and Ind. Tr. were almost as susceptible. Infection again developed without wounding.

TABLE 5.—*Results of greenhouse inoculations of 13 inbred lines of dent corn with Pythium butleri, culture 40–G–4c, July 29, 1941, Arlington Experiment Farm*

Inbred and method of inoculation [1]	Plants—				Remarks
	Inoculated	Rotted and fallen over—			
		3d day	4th day	6th day	
C. I. 6:					
Inoculated:	*Number*	*Number*	*Number*	*Number*	
Wounded	1	0	0	0	Internode water-soaked inside.
Not wounded	3	0	0	0	
Control	2	0	0	0	
Ill. Hy.:					
Inoculated:					
Wounded	2	0	0	0	Brown rot ½ inch around inoculation.
Not wounded	3	0	0	0	
Control	1	0	0	0	
C. I. 540:					
Inoculated:					
Wounded	1	0	1	1	
Not wounded	3	1	1	1	
Control	2	0	0	0	
C. I. 5:					
Inoculated:					
Wounded	1	1	1	1	
Not wounded	3	0	0	0	
Control	2	0	0	0	
Ia. L289:					
Inoculated:					
Wounded	1	1	1	1	
Not wounded	3	0	0	1	
Control	2	0	0	0	
Ia. Mc401:					
Inoculated:					
Wounded	1	0	0	1	
Not wounded	3	0	0	0	
Control	2	0	0	0	
Ky. 13:					
Inoculated:					
Wounded	1	0	0	0	Brown rot ½ inch around inoculation.
Not wounded	3	0	0	0	
Control	2	0	0	0	
C. I. 1:					
Inoculated:					
Wounded	1	1	1	1	
Not wounded	3	0	0	0	
Control	2	0	0	0	
Ill. R4:					
Inoculated:					
Wounded	1	0	0	1	
Not wounded	3	0	0	0	
Control	2	0	0	0	
C. I. 4–8:					
Inoculated:					
Wounded	1	0	1	1	
Not wounded	3	0	0	0	
Control	2	0	0	0	
Ia. L317:					
Inoculated:					
Wounded	1	0	0	0	Rotted 1 inch around inoculation.
Not wounded	3	0	0	1	
Control	2	0	0	0	
Ind. Tr.:					
Inoculated:					
Wounded	1	0	1	1	
Not wounded	3	0	0	0	
Control	2	0	0	0	
Ia. B1 345:					
Inoculated:					
Wounded	1	0	0	0	
Not wounded	2	0	0	1	
Control	0	0	0	0	

[1] In each case the wounded inoculated plants had mycelium introduced into an incision in their stalks, and the unwounded ones had it placed between the stalk and lower leaf sheath.

On September 9, 1941, *Pythium butleri*, culture 40–G–4c, isolated originally from inbred C. I. 6, was used to inoculate cucumber (*Cucumis sativus* L.), and three kinds of squash (*Cucurbita pepo* L.), namely, crookneck, Patty Pan, and Vegetable Marrow, in evaporating dishes in the laboratory. The two latter had very young tender tissue; the two former, rather old and hard tissue. Incisions were made in each specimen and pieces of mycelium were introduced

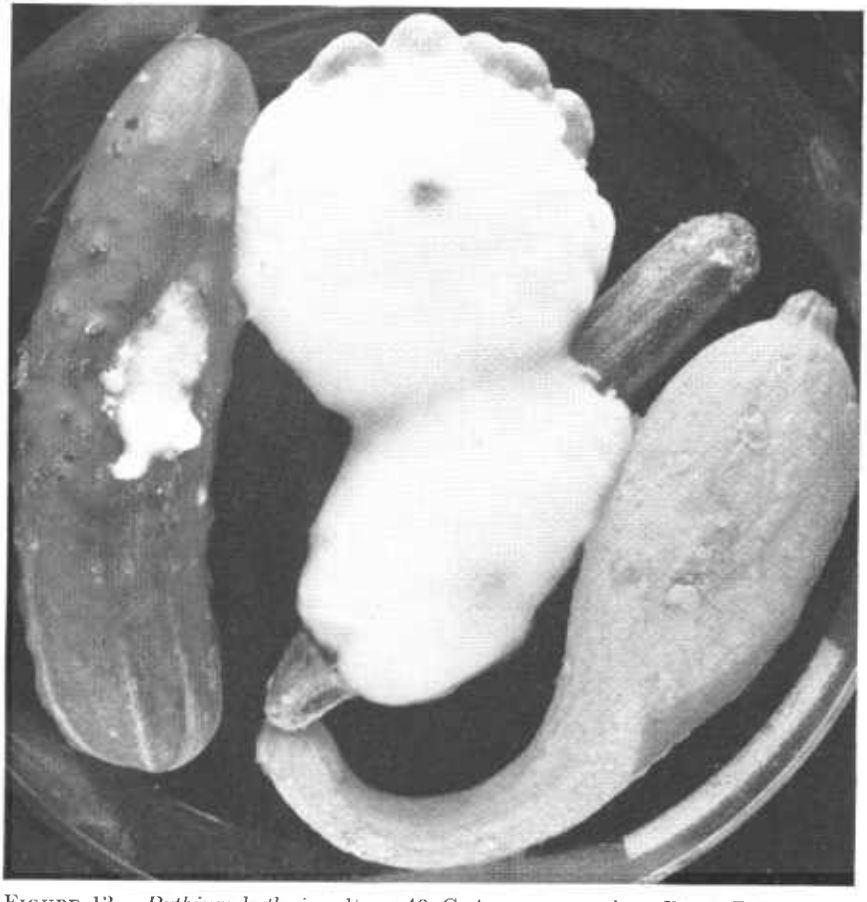

FIGURE 13.—*Pythium butleri*, culture 40–G–4c, on cucumber, Patty Pan squash crookneck squash, and Vegetable Marrow. Inoculated September 9, 1941; photographed September 11, 1941. September 15, 1941, all four were covered with an abundant mass of white mycelium.

Maximum temperatures in the laboratory on September 9 and 10 were 95° and 96° F. and the humidity was high. After 24 hours both Patty Pan squash and Vegetable Marrow showed water-soaked areas around the point of inoculation. Two days after inoculation these two squashes were almost covered with a cottony white mass of mycelium (fig. 13) similar to that described and illustrated by Dreechsler [9] for this fungus. A white mycelium had broken out in several places for 2 inches around the inoculation on cucumber. Six days

[9] See footnote 5.

after inoculation, all four specimens were practically covered with an abundant growth of white mycelium.

CONTROL

Inasmuch as the disease developed only on certain corn inbreds in the nursery and not on inbreds in alternating rows, and as inoculations have shown that some inbreds are more resistant to infection than others, it seems that the best means of control is through the use of resistant strains.

Because of the exacting thermal requirement of *Pythium butleri*, it seems probable that this stalk rot may be of importance only in the southern parts of the Corn Belt.

SUMMARY

Stalk rot of two inbred lines (K167 and C. I. 6) of yellow dent corn (*Zea mays*) was observed in the field at the Arlington Experiment Farm in late July and early August 1940. The rotting in the larger plants was limited to one or more of the internodes above the brace roots. Infected plants fell over but remained green and turgid for several days. The infection became apparent after a period of hot humid weather. Successful inoculations with cultures isolated from this stalk rot were made during periods of high temperature and high humidity, but inoculations made when the temperature was lower produced little or no infection.

Pythium butleri Subr. was isolated from the rotted internodes and the disease was reproduced on inbred C. I. 6 in the field and in the greenhouse by inoculations with this fungus. Infections developed on both wounded and unwounded inoculated stalks.

Greenhouse inoculations on inbred C. I. 6 and on 12 other inbred lines of dent corn showed that some lines were more resistant than others. C. I. 5, Ia. L289, C. I. 1, and C. I. 540 were susceptible, and Ill. Hy. and Ky. 13 were resistant.

In greenhouse inoculations, *Pythium butleri* did not attack the corn roots.

Cultures of *Pythium butleri* isolated from rotted cornstalks rapidly rotted squashes and cucumber and covered them with a cottony mass of white mycelium, typical of this fungus.

What appeared to be the same disease occurred in a commercial field of hybrid corn near Petersburg, Va., August 1941.