Web Blotch of Peanut in Virginia

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ABSTRACT

Phipps, P. M. 1985. Web blotch of peanut in Virginia. Plant Disease 69:1097-1099.

Web blotch of peanut was first observed in Virginia during the fall of 1979. The disease was not detected in field surveys in 1980, but a few localized outbreaks were observed in fields annually between 1981 and 1984. *Phoma arachidicola* was isolated from leaf lesions. Conidia, microsclerotia, and crop residues from infested fields were effective inocula to reproduce the disease in greenhouse tests. Spanish-type cultivars (Argentine and Chico) were highly susceptible to infection and subsequent defoliation. The reactions of Virginia-type cultivars ranged from resistant (NC 3033) to highly susceptible (NC 17). Evidence that web blotch of peanut may have been introduced into Virginia with the passage of Hurricane David in 1979 is presented.

Additional key word: epidemiology

Web blotch of peanut was first observed in the United States in Texas during the 1972 growing season (6). Soon thereafter, the disease was found in most peanut-producing states in the Southeast and Southwest (12). With the exception of reported significant yield losses in Texas (6,7) and Oklahoma (11), web blotch has been considered to be of minor importance in the United States (9). The increased planting of Florunner, a runner-type cultivar with moderate resistance to web blotch (4,7,10), and the decreased planting of highly susceptible Spanish-type cultivars may explain the diminishing importance of the disease in both regions (9).

Before the reported occurrence of web blotch in the United States, what appears to be the same disease (1,5,13) had been reported in Australia, Argentina, Rhodesia, South Africa, Brazil, and Russia (12). As a result of severe outbreaks between 1967 and 1974, web blotch was reported as one of the most serious diseases of peanut in certain areas of southern Africa (5). On the basis of developmental and morphological features of the asexual stage, the causal fungus was named *Phoma arachidicola* Marasas, Pauer, & Boerema (5). The sexual stage has been observed to develop on sterilized peanut leaves and under natural conditions in infested crop residues (13,14). The nomenclature of the sexual stage has included *Mycosphaerella arachidicola* Choch., *M. argentinensis* Frezzi, and *Didymosphaeria arachidicola* (Choch.) Alcorn, Punith., & McCarthy (12). More recently, the sexual stage was designated *Didymella arachidicola* (Choch.), Taber, Pettit, &Philley (14).

This paper reports the first occurrence of web blotch of peanut in Virginia and discusses a plausible mechanism of introduction. Pathogenicity tests with commercial Virginia-type cultivars and selected breeding lines were performed to assess the genetic vulnerability of current and future peanut crops in the Virginia-Carolina production area. A portion of the findings in this study was summarized in a preliminary report (8).

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Accepted for publication 24 June 1985 (submitted for electronic processing).

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MATERIALS AND METHODS

In addition to routine annual disease surveys, about 25 peanut fields in southeastern Virginia were surveyed after discovery of web blotch in October 1979. Isolates of *P. arachidicola* were obtained after symptomatic leaflets were rinsed in tap water, surface-sterilized for 1 min in 0.5% sodium hypochlorite, and plated on acidified potato-dextrose agar (PDA).

The susceptibility of peanut cultivars and breeding lines to web blotch was determined in greenhouse inoculations of 4-wk-old seedlings in 10-cm-diameter clay pots. Test 1 was conducted using symptomatic leaf tissues as inoculum. Leaves were collected on 13 December 1979 from crop residues in a field that had shown severe web blotch of peanut on 2 October. Inoculum was prepared by comminuting 5 g of leaves in 350 ml of water with a blender for 2 min (1 min at low speed and 1 min at high speed). The suspension of comminuted tissue was then applied to the upper surfaces of leaves with a camel's-hair brush. Inoculum for test 2 was obtained from 2-wk-old cultures of *P. arachidicola* on PDA in 9-cm-diameter petri dishes. Cultures were incubated at room temperature (25 ± 2 C). The contents of two dishes were placed in a blender with 120 ml of water and comminuted 15 sec at low speed and 1 min at high speed. The total volume was adjusted to 200 ml, and eight drops of Tween 80 were added. As in test 1, the inoculum was applied to the upper surfaces of leaves.

Plants in both tests were covered with polyethylene bags after inoculation and incubated at 21 C (±3 C) in low-intensity reflected daylight. After 5 days of incubation, the bags were removed and plants were placed on a greenhouse bench protected with shade cloth. Air temperatures in the greenhouse during both tests prevailed near 24 C but ranged from 18 to 30 C. Eight and five replicates of one plant per pot were used in test 1 and test 2, respectively. Disease symptoms were recorded weekly and expressed as a percentage of adaxial leaf tissue with necrosis.

Test 3 was conducted to determine the efficiency of conidia and microsclerotia (chlamydospore clusters) as inoculum. Conidia were obtained from pycnidia of *P. arachidicola* produced on autoclaved peanut leaves. Leaves were placed on 9-cm filter paper disks in petri dishes, autoclaved at 121 C for 15 min, and inoculated with *P. arachidicola*. After 2 wk of incubation at 25 C (±2 C), conidia were observed in droplets of ooze from pycnidia on leaves. A suspension of conidia was prepared after plates were flooded with water, and the suspension was filtered through lens paper to remove mycelial fragments. A hemacytometer was used to standardize inocula at levels of 4,200, 42,000, and 420,000 conidia per milliliter. Microsclerotial inoculum was obtained by comminuting 2-wk-old cultures of *P. arachidicola* on PDA with a blender as described for test 2. To remove mycelial fragments, the microsclerotia were washed on a 325-mesh sieve. No attempt was made to standardize the density of microsclerotia in the inoculum. Tween 80 (four drops per 100 ml) was added to inocula just before inoculation of leaves.

RESULTS AND DISCUSSION

Field observations. On 2 October 1979, web blotch of peanut was observed for the first time in Virginia, causing a foliar disease of Florigiant peanut in the city of Suffolk. The disease had not been detected previously in routine annual surveys of fields. In the few weeks before harvest in 1979, the disease was found in two additional fields also in Suffolk. Symptoms of the disease were essentially identical to those described in previous reports (1,5,6). In some cases, web blotch appeared to be more severe than early leaf spot (*Cercospora arachidicola*), which is considered the most serious foliar disease of peanut in Virginia. Symptoms of both diseases are shown in Figure 1. No significant losses in yield from web blotch were believed to have occurred in 1979 because of the limited as well as late occurrence of the disease.

Web blotch of peanut was not observed in Virginia in 1980. This was not surprising because the 1980 growing season was hot and dry and previously diseased fields were planted to corn. Previous reports (2,10) have indicated that wet, cool weather was important in triggering outbreaks of web blotch in peanuts. On 17 September 1981, web blotch was found on Florigiant peanut in the same three fields where it was first seen in 1979. Additionally, the disease was found on Florigiant peanut in another field on 18 September within the city of Suffolk and on the same cultivar in a field in Sussex County on 21 September. The disease was not detected in field surveys before these dates in 1981. At each location where the disease was found, peanuts had been planted in 1979, followed by corn in 1980. In 1982, web blotch was found on Florigiant peanut in one field in Dinwiddie County on 18 August and in two fields in Suffolk on 20 and 28 September. All three fields had been managed on a 3-yr rotation of peanut with corn, and the previous peanut crop had been planted in 1979. In 1983, web blotch was found in only one field, which was one of the fields where the disease was first detected. In 1984, the disease was not found in fields with known previous infestations, but a late-season outbreak was confirmed in one field in Suffolk. No losses in yield as a result of web blotch were apparent in any year of these surveys, and overall, the disease appeared less intense each year after the first appearance in 1979.

According to clinical records from North Carolina State University, web blotch of peanut was present in at least three counties in October 1979, one field in July 1980, and three counties in September 1981 (M. K. Beute and A. Hisada, *personal communication*). No records were found of this disease in North Carolina before 1979.

Causal fungus. Isolates of the causal fungus were identified as *P. arachidicola* and confirmed by Taber and Pettit (13) to be the same fungus that has caused web blotch of peanut in Argentina, South Africa, Georgia, Oklahoma, and Texas. Cultures of the fungus on PDA showed an appressed form of creamy white mycelial growth. A dark brown to black coloration developed as the fungus produced pigmented chlamydospores either in clusters or chains as illustrated in previous reports (1,5). The clusters of chlamydospores resembled the fungal survival structures that are commonly called microsclerotia. The fungus produced numerous pycnidia in culture along cuts made in the mycelium and agar with a scalpel. Conidia from these fruiting bodies were hyaline, mostly obovoid, and one-celled. On autoclaved peanut leaves, the fungus produced an abundance of pycnidia that exuded conidia; these conidia were more cylindrical with rounded ends and mostly one-septate. Naturally infected leaves collected in 1979 and 1981 showed similar pycnidia with one-septate conidia. When these leaves were incubated in moist chambers, droplets of exudate containing conidia emerged from the ostioles within 24 hr. No perithecia of the causal fungus were found in field samples, and they were not observed to develop in laboratory cultures.

Pathogenicity tests. Isolates of *P. arachidicola* collected in 1979 and 1981 produced similar disease symptoms after inoculation of Florigiant peanut in greenhouse tests. When temperatures prevailed at or below 25 C, the typical blotch type of symptom was apparent within 10–14 days. If temperatures prevailed near 30 C for extended periods, symptom development was slower and appeared more as a necrotic web rather than as a distinct blotch. As a result of these observations, determinations of cultivar susceptibility were performed during the winter, when ambient temperatures higher than 25 C were infrequent. Inoculations with conidia and chlamydospores produced symptoms that were identical to those produced by inoculations with comminuted, dried leaves from naturally infected plants. The number of blotches that developed on leaflets increased as the density of conidial inoculum was increased.

As reported by Smith et al (10), Virginia- and runner-type cultivars were more resistant to web blotch than Spanish-type cultivars. Among commercial cultivars, Florunner and NC 6 showed the highest degree of resistance (Table 1). Florigiant and NC 17 were the most susceptible of the Virginia-type commercial cultivars. Breeding lines currently used as sources of resistance to important diseases varied in their reactions to web blotch. Argentine and Chico are Spanish-type cultivars used as sources for breeding resistance to Cylindrocladium black rot (CBR). Both were highly susceptible to web blotch. NC 3033, a Virginia-type line with good CBR resistance, was highly resistant to web blotch.

Origin and epidemiology. The sudden appearance of web blotch in Virginia and North Carolina in 1979 was believed to result from introduction of airborne inoculum. Four storms labeled as hurricanes Bob, Henri, Frederick, and David carried high winds and rainfall into the peanut production areas of the southeastern United States in 1979. David was the only major storm to enter Virginia and North Carolina (Fig. 2). According to records of the National Weather Service, this storm originated off the coast of Africa on or about 25 August. On a westward course, Hurricane David passed across the Atlantic Ocean and began a northwest direction as it passed over Puerto Rico and the Dominican Republic on 1 September. At this time, the storm began to move northward, forming an arc that crossed portions of several states on the Atlantic Coast. On 5 September, the storm produced heavy rains and high winds as it passed over the peanut-producing areas of northeastern North Carolina and

Table 1. Susceptibility of peanut cultivars and breeding lines to web blotch caused by *Phoma arachidicola*

Entry	Severity of foliar symptoms[y] Test 1	Test 2
Argentine	40 a[z]	60 a
Chico	32 b	41 ab
NC 17	...	41 ab
Florigiant	36 ab	36 bc
Early Bunch	22 c	35 bc
GK 3	20 cd	32 bcd
VGP-1	...	30 bcde
VA81B	...	29 bcde
Sunbelt Runner	...	28 bcde
NC 7	30 b	25 bcde
Florunner	17 cd	15 cde
Tifton 8	...	14 cde
NC 6	22 c	12 de
NC 3033	13 d	9 e

[y]Severity of foliar symptoms was scored on a scale of 0–100, where 0 = no leaf necrosis and 100 = total leaf area necrotic.
[z]Means in columns followed by the same letter(s) are not significantly different at $P = 0.05$ according to Duncan's new multiple range test.

Table 2. Weather summary for September 1979 in Suffolk, VA

Weather parameter	Sept. 1979 (no. of days)	Mean for Sept. 1933–1983 (no. of days)
Max. temp. > 25 C	21	21.5
Min. temp. < 15 C	11	12.4
Mean temp. > 25 C	5	5.0
Rainfall > 0.25 cm	13	5.3
Rainfall > 1.30 cm	4	4.3
Rainfall > 2.50 cm	1	1.3
Rainfall > 5.00 cm	1	0.4
Rainfall > 10.00 cm	1	0.1

Fig. 1. Comparison of large blotch symptom caused by *Phoma arachidicola* and the smaller, discrete spots caused by *Cercospora arachidicola* on Florigiant peanut.

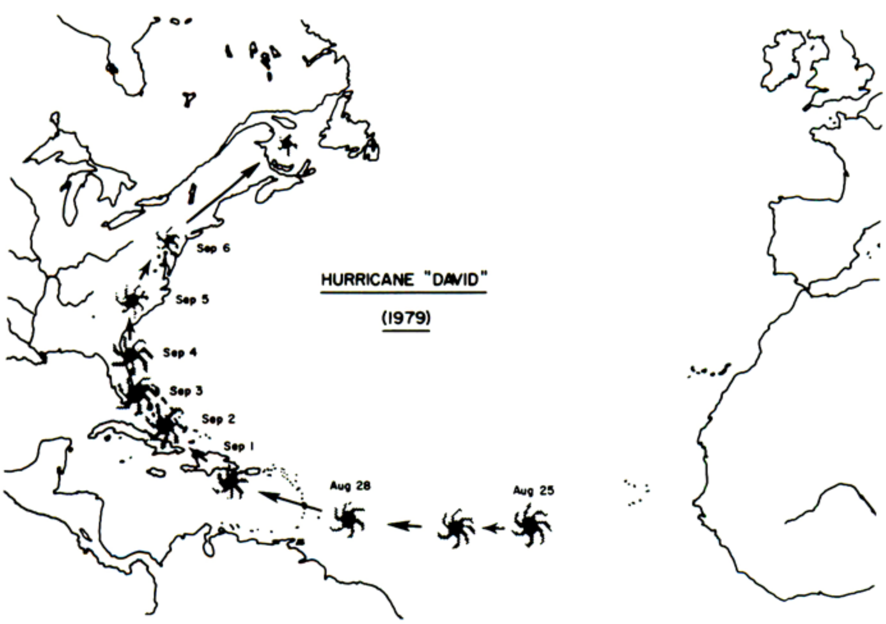

Fig. 2. Path of Hurricane David through the Caribbean region and into the southeastern United States in 1979.

southeastern Virginia. Although ambient temperatures during September were near normal, accumulated rainfall and the number of days with rainfall deviated considerably from normal (Table 2).

More evidence supporting the hypothesis that Hurricane David was capable of carrying fungal propagules and introducing *P. arachidicola* into the region was obtained from clinical records at the Tidewater Research Center. On 26 September 1979, *Puccinia arachidis* was found on peanut leaf specimens from Southampton County, Virginia. Although not the first occurrence of peanut rust in Virginia, this was the first confirmed occurrence of the disease in 1979. Peanut rust is endemic in the Caribbean region of the Western Hemisphere (3). Outbreaks of peanut rust in the United States result from long-distance dissemination of urediniospores, since the causal fungus lacks alternate hosts for perpetuation during the break of several months between crop seasons (15).

Web blotch was believed initially to pose a serious threat to peanut production in Virginia because of frequently cool late-season temperatures and the relatively high susceptibility of the widely planted cultivar, Florigiant. Factors responsible for the apparent static or declining incidence of web blotch after the outbreak in 1979 remain unknown. Crop rotation, recent increases in plantings of less susceptible cultivars (NC 6, NC 7), and cold winter temperatures in the region may be contributing factors.

ACKNOWLEDGMENTS

I wish to thank M. B. Britt and G. M. Arrington for technical assistance and T. A. Ritter of the National Weather Service in Norfolk for daily coordinates of Hurricane David in 1979.

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