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ANTHRACNOSE OF ACACIA IN FLORIDA: OCCURRENCE AND FUNGICIDAL CONTROL[1]

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Abstract. **Several species of** Acacia **are grown in Florida as ornamentals. In recent years, more than a dozen reports of** Gloeosporium **sp. and/or** Colletotrichum **sp., associated with anthracnose-like symptoms on at least three** Acacia **spp., have appeared in the files of Florida's Division of Plant Industry. An additional report has been located in the files of the University of Florida Extension Plant Pathology Clinic. Reports are from Brevard, Charlotte, Highlands, Lee, Martin, Orange and Palm Beach Counties. An isolate of the pathogen from** Acacia cyanophylla **in Highlands County has been identified as** Glomerella cingulata **(anamorph =** Colletotrichum gloeosporioides**); the anthracnose pathogen apparently responsible for damage to** Acacia **spp. in Japan, Spain, New Guinea, and India. Inoculations have proven the pathogenicity of this isolate to** A. cyanophylla**; providing the first confirmation of anthracnose of acacia in Florida. Trials indicate control may be achieved with a number of fungicides. Chlorothalonil appears most effective.**

The nearly pantropical genus, *Acacia* Mill. (Leguminosae, subfamily Mimosoidae), is comprised of ca. 800 species of shrubs and small trees (8). *Acacia* spp. are used for timber, tannin, soil reclamation, windbreaks, fuel, conservation, and sometimes even cattle fodder where grazing is scarce (3, 8). Many species are used as ornamentals also, due in part to their often showy flowers. In the United States, acacias are grown as ornamentals in several warmer areas including the west coast, Hawaii, and southern Florida.

Few diseases significantly affect the use of acacias as ornamentals. However, losses of up to 90% of nursery seedling crops of *A. dealbata* Link. to anthracnose infections [diseases "having characteristic limited lesions, necrosis, and hypoplasia, generally caused by one of the Melanconiales", *sensu* Hawksworth *et al.* (6)] have been reported in Japan (7, 14). Indeed, anthracnose of acacia has been included in a listing of internationally dangerous forest tree diseases (14). Ito and Shibukawa (7) originally described the anthracnose pathogen as *Physalospora acaciae* Ito & Shibukawa (anamorph = *Colletotrichum acaciae* Ito & Shibukawa). The organism was later determined by Terashita (13) to be synonymous with *Glomerella cingulata* (Stonem.) Spaulding & Schrenk (anamorph = *C. gloeosporioides* (Penz.) Sacc.). Apparently, *G. cingulata* is responsible for damage to *Acacia* spp. in Spain, New Guinea, and India (1, 3) as well. Merlo (9), however, described a serious foliage disease of *A. Longi-*

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folia (Andr.) Willd. in Argentina caused by *C. dematium* f. *truncata* (Schw.) V. Arx. This paper reports anthracnose infections of *Acacia* spp. as they are known in Florida, establishes the identity and pathogenicity of the Florida pathogen, and summarizes results of fungicide trials for control of the disease.

Materials and Methods

Numerous reports of anthracnose and/or anthracnose-like infections on *Acacia* spp. have been recorded in Florida over a period of some 15 yr (Table 1). In 1981 we selected a Highlands Co. *A. cyanophylla* Lindl. isolate of a *Colletotrichum* sp. for study. This organism had been consistently isolated from anthracnose-like lesions from both stems and phyllodes (Fig. 1) of *A. cyanophylla* seedlings in a container stock nursery. Subcultures of the fungus were forwarded to J. W. Kimbrough and J. Lenne for specific identification.

Table 1. Reports of anthracnose or anthracnose-like infections on *Acacia* spp. in Florida.[z]

Host	Location	Pathogen identified	Year
Acacia sp.	Brevard Co.	*Gloeosporium* sp.[y]	1971
	Martin Co.	*Gloeosporium* sp.[y]	1981
	Palm Beach Co.	*Gloeosporium* sp.[y]	1984
	Charlotte Co.	*Colletotrichum* sp.	1976
A. auriculiformis	Martin Co.	*Colletotrichum* sp.	1982
A. cyanophylla	Highlands Co.	*Colletotrichum* sp.	1979
	Highlands Co.	*Colletotrichum* sp.	1981
	Highlands Co.	*Colletotrichum* sp.	1982
	Highlands Co.	*Colletotrichum* sp.	1983
	Highlands Co.	*Gloeosporium* sp.[y]	1979
	Highlands Co.	*Gloeosporium* sp.[y]	1980
	Lee Co.	*Gloeosporium* sp.[y]	1981
A. pycantha	Orange Co.	*Gloeosporium* sp.[y]	1978

[z]Reports from files of Florida's Division of Plant Industry except for Charlotte Co. report which is recorded in the University of Florida Extension Plant Pathology Clinic.
[y]Presumably identified as *Gloeosporium* sp. due its frequent reluctance to form setae under certain laboratory conditions.

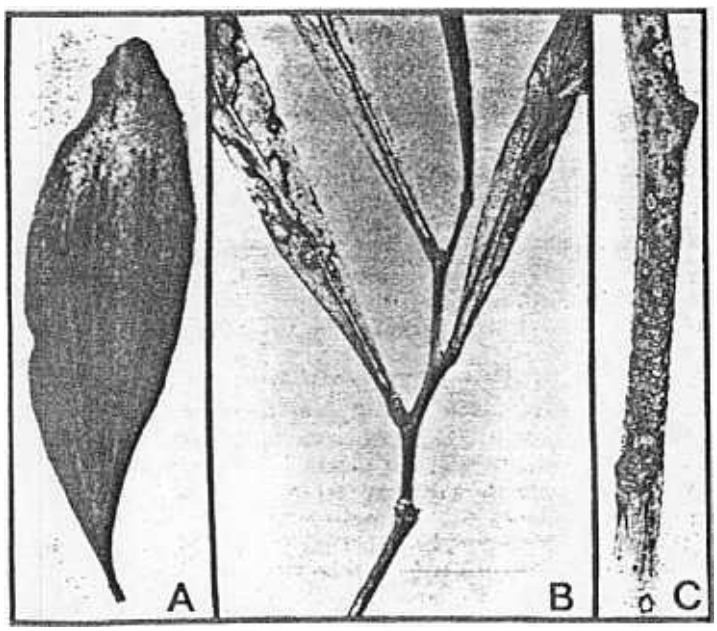

Fig. 1. Anthracnose symptoms caused by *Glomerella cingulata* (anamorph = *Colletotrichum gloeosporioides*) on *Acacia* spp. A) Incipient lesions at tip of phyllode of *A. auriculiformis*. B) Severely infected phyllodes of *A. cyanophylla*. C) Typical stem lesions on young stem of *A. cyanophylla*.

Isolate pathogenicity. To verify the pathogenicity of our *Colletotrichum* isolate, we conducted simple inoculations on *A. cyanophylla* seedlings under greenhouse conditions. The fungus was grown under continuous flourescent lighting at room temperature (ca. 24°C) on plates of acidified potato dextrose agar (APDA = PDA + 3.3 ml of 50% lactic acid/liter). After 7 days, culture surfaces were scraped with a sterile scalpel to enhance sporulation. At 14 days, cultures were flooded with deionized water and gently rubbed with a glass rod to facilitate suspension of the inoculum. Resulting conidial suspensions were filtered through 4 layers of cheesecloth before being diluted into suspensions of either 8.5×10^4 or 4.8×10^4 conidia per ml. Four seedlings of *A. cyanophylla* were then inoculated with each of the 2 conidial suspensions. Twenty ml of conidial suspension were atomized onto each inoculated seedling. Check seedlings were sprayed with 20 ml of deionized water. To facilitate surface adhesion and coverage on the test plants, two drops of Tween 80® were added to each 100 ml of both inoculum and check suspensions. Following inoculation, all seedlings were enclosed in clear plastic bags and placed on a greenhouse bench. Bags were removed after 96 hr and seedlings were evaluated for infection one day later.

Fungicide trials. Four fungicides were evaluated for control of anthracnose infections on *A. cyanophylla* seedlings. Materials and rates employed are described in Table 2. Fungicides were applied to run-off one day before artificial inoculation of test seedlings with conidial suspensions of our *Colletotrichum* isolate. Triton B-1956® was used as a sticker-spreader at a rate of 1 drop/liter with all treatments (including check) except chlorothalonil (Daconil 2787®). Test seedlings were inoculated as described previously with the following modifications: 1) conidial inoculum was produced on carnation leaf pieces on water agar (2), and 2) inoculum concentration was 5.0×10^4 conidia/ml. Test seedlings were again enclosed in clear plastic bags and placed on a greenhouse bench. Bags were removed after 96 hr and disease ratings were performed 3 days later. The percentage of seedlings and the percentage of leaves exhibiting symptoms within each treatment were recorded. In addition, each infected leaf was subjectively rated as 0, 5, 25, 50, or 100% infected based on a visual assessment of symptom severity (Fig. 2). Overall disease ratings for each treatment were derived as the product of % infected seedlings X % infected leaves X mean % leaf tissue necrosis. Stem lesions were also recorded.

Table 2. Fungicide treatments evaluated for control of anthracnose on *Acacia cyanophylla*.[z]

Fungicide[y]	Concentration g/liter	lb./100 gal	tsp/gal
Benomyl (Benlate®50 WP)	1.2	1.0	2
Chlorothalonil (Daconil 2787®75 WP)	1.8	1.5	3
Mancozeb (Manzate 200®80 WP)	1.8	1.5	
Copper Hydroxide (Kocide 101®77 WP)	3.6	3.0	

[z]Applied to run-off one day prior to inoculation with pathogen.
[y]Triton B-1956 Sticker-Spreader employed @ 1 drop/liter (4 drops/gal) with all treatments (including checks) except chlorothalonil.

Growth/temperature study. To estimate the cardinal temperatures for growth of our *Colletotrichum* isolate we grew the fungus on APDA plates at 10, 17, 20, 27, 30, and 35°C. Five replicate plates of the fungus were used at each of the 6 temperatures. Periodic measurements were performed over a period of 27 days, after which radial mycelial growth at each temperature was averaged and expressed as mm/day.

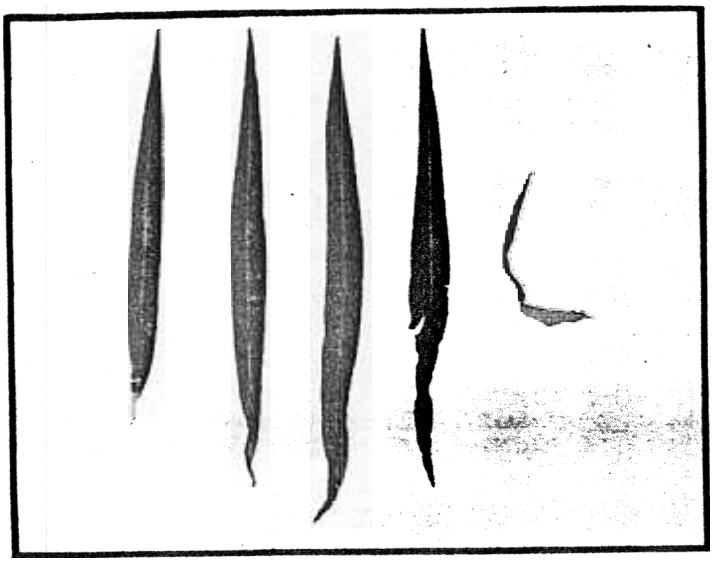

Fig. 2. Phyllodes of *Acacia cyanophylla* exhibiting representative 0, 5, 25, 50 and 100% symptom severities employed in disease severity ranking.

Results and Discussion

Our *Colletotrichum* isolate was identified by J. W. Kimbrough (personal communication) as *C. gloeosporioides* (Penz.) Sacc. This identification was subsequently confirmed by J. Lenne (personal communication) who also observed and confirmed the organism's sexual stage, *Glomerella cingulata* (Stonem.) Spaulding & Schrenk.

Isolate pathogenicity. All plants inoculated with our *C. gloeosporioides* isolate were infected and exhibited lesions typical of those observed in the field (Fig. 1) and/or described by others (7, 14). Lesions began as dark brown, punctate, circular to irregular spots of <1.5 mm in diameter, often with distinctly gray centers. As infections advanced, lesions frequently coalesced, resulting in large irregular blotches of necrotic tissues on phyllodes. In many cases, infections were apparently initiated at phyllode tips, after which they progressed in a basipetal direction. Stem lesions sometimes completely girdled smaller stems. Reisolation of *C. g ocosporioides* from inoculated seedlings was consistent and confirmed the pathogenic role of this organism. Noninoculated checks remained symptomless.

Fungicide trials. All check seedlings in the fungicide screening trial became infected and exhibited typical anthracnose lesions. All 4 of the fungicides tested provided some protection against infection although they varied in their relative efficacies (Table 3). Terashita (12) reported that monthly sprays of Bordeaux mixture were useful in controlling anthracnose of acacia in nursery seedbeds. Hashimoto (5) also endorsed fungicidal control of this disease using repeated sprays of Bordeaux mixture + ethyl mercuric phosphate or dithane (i.e., mancozeb). In our trials, copper hydroxide (Kocide 101®) was quite effective as a control whereas mancozeb (Manzate 200®) was the least effective of the four materials tested. Chlorothalonil (Daconil 2787®) provided the greatest protection, which for all practical purposes was complete.

Growth/temperature study. The growth response of our *C. gloeosporioides* isolate to temperature is shown in Fig. 3. This growth/temperature response curve is similar in shape to that published by Hartung *et al.* (4) for a blueberry isolate of *C. gloeosporioides* from Michigan. However, the optimal temperature for growth of the fungus reported by Hartung et al. was was 20°C while that recorded in our study was 27°C. Also, Hartung et al. reported significantly reduced growth for their isolate at 30°C. In contrast, our isolate continued to grow almost as fast at 30° (4.53 mm/day) as it did at 27°C (4.67 mm/day). In this regard, our isolate performed in a manner apparently more typical of the species (10). The degree to which this and perhaps other isolate differences are stable and/or important is unknown. However, it appears that our isolate is well adapted to the warmer temperatures often preferred or required by frost-intolerant *Acacia* spp. and so prevalent in south Florida.

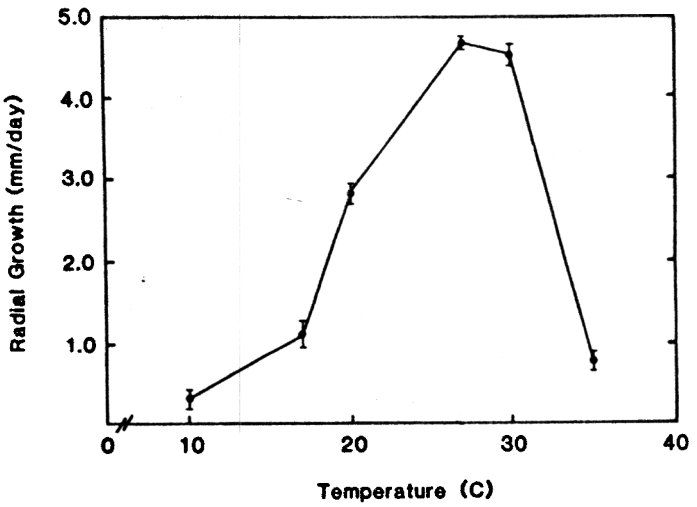

Fig. 3. Growth/temperature response curve for a Highlands County — *Acacia cyanophylla* isolate of *Glomerella cingulata* (anamorph = *Colletotrichum gloeosporioides*).

The overall impact of anthracnose on *Acacia* spp. in Florida is unknown. We have personally observed infections on ornamental trees in several areas of south Florida, and other infections have been widely reported (Table 1). However, the only serious damage we have observed has been sustained by *A. cyanophylla* seedlings in a container stock nursery where close spacing and overhead irrigation were common cultural practices. Under these conditions the

Table 3. Relative efficacies of 4 fungicides tested for control of anthracnose on *Acacia cyanophylla*

Treatment	Seedlings infected (%)	Stem lesions	Total phyllodes evaluated	Phyllodes infected (%)	Average tissue necrosis/phyllode (%)[z]	Disease rating (%)[y]
Check	100	+	72	69.0	13.0	8.97
Mancozeb (Manzate 200®)	88	+	68	27.0	12.0	2.85
Benomyl (Benlate®)	100	+	77	39.1	4.0	1.56
Copper Hydroxide (Kocide 101®)	88	+	77	28.0	6.0	1.48
Chlorothalonil (Daconil 2787®)	25	—	73	7.0	2.0	0.04

[z]See Fig. 2.
[y](% seedlings infected) x (% phyllodes infected) x (% tissue necrosis/phyllode)/10,000.

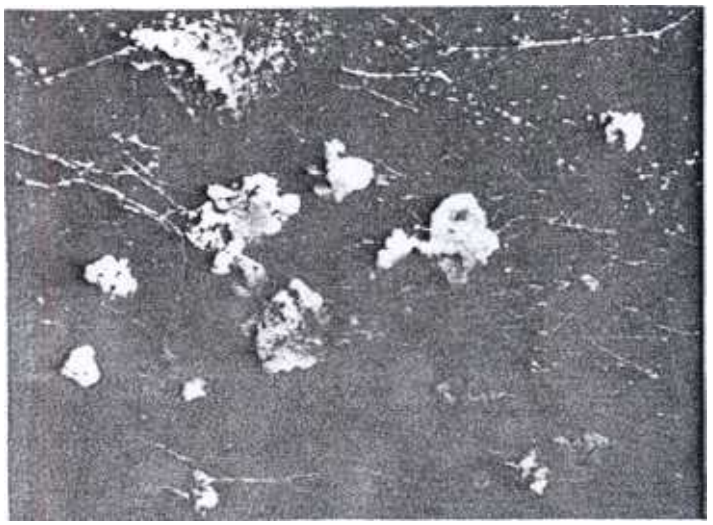

Fig. 4. Profuse conidial masses of *Colletotrichum gloeosporioides* produced on necrotic phyllodes of *Acacia cyanophylla* under conditions of high temperatures and relative humidity.

pathogen sporulates profusely (Fig. 4), and entire seedling crops have been lost to the disease.

Colletotrichum gloeosporioides is reported to overwinter in plant debris (11) as well as infected acacia seed (5, 14). In fact, infected seed has been considered the most important source of primary anthracnose infections in nursery crops (14). Limited isolations (authors-unpublished) have failed to confirm a seed-borne aspect in Florida. Indeed, the cosmopolitan distribution of *C. gloeosporioides* (10) suggests that the pathogen would hardly be dependent upon seed transmission.

Anthracnose of acacia represents a noteworthy potential threat to acacia production in Florida. Greater problems with this disease are likely to be experienced in nurseries and greenhouses as opposed to landscape settings due to the pathogen's propensity to build up under conditions of warm temperatures and high humidities (10) often enhanced by "closed quarters". Clearly, however, anthracnose of acacia is not the "internationally dangerous" disease it has been considered previously (14). Good cultural practices including 1) the use of clean soil (12), 2) various seed treatments if necessary (5, 12), 3) sanitation, 4) minimal overhead irrigation (10), and 5) the use of fungicides (5, 12 and Table 2) in certain cases (in accordance with label restrictions and local regulations) provide the grower with an effective battery of control strategies for minimizing losses to anthracnose infections.

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