Research Note

CONIOTHYRIUM *LEAFSPOT: A NEWLY DESCRIBED DISEASE OF SORGHUM*[1]

In 1985 and 1986, I observed leafspot of forage and grain sorghum [*Sorghum bicolor* L.) Moench] and johnsongrass ([*Sorghum halepense* (L.) Pers.] in western Puerto Rico (Isabela, Lajas, and Mayagüez), and in Kingshill, St. Croix, Virgin Islands, not described in the sorghum disease literature.[2,3] The disease appeared mostly at and after flowering, and increased markedly in the late stages of sorghum senescense. Necrotic lesions in roughly oval form measured approximately 5 to 6 cm long and had a heavy band of marginal pigmentation (fig. 1). Most pycnidia of the causal agent were found at the center of the lesions on the upper leaf surface. The fungus was isolated on potato dextrose agar (Difco) in pure culture from diseased leaves and deposited with the American Type Culture Collection, Rockville, MD. (C-PR-1-ATCC 60807). Koch's postulates were fulfilled by artifically inoculating flowering plants of CS 3541 sorghum with an aqueous solution of 6×10^6 conidia/cm^3. Oval spots appeared 7 to 9 days after inoculation with an initial 18-hour due period in flowering plants at 28° C. First symptoms were water soaking and diffusion of wound pigments. Herbarium specimens were deposited with Cornell University Department of Plant Pathology, Plant Disease Herbarium in Ithaca, New York, and the pathogen was re-isolated repeatedly from necrotic spots in pathogenicity tests.

Conidia of the pathogen appeared to have holoblastic development. Hyaline paraphyses were interspersed among conidiophores in the hymenium (fig. 2). Conidia were distinctively thick walled, oval in form, and measured approximately 15×8 μ. Conidia were hyaline within the pycnidia and dark-walled (brown) after extrusion from the fruiting body. Conidia were aseptate before germination and uni-septate upon germination. On the basis of its development of unicellular dematiaceous conidia in pycnidia, the fungus most resembled a species of *Coniothyrium*. The only species of *Coniothyrium* described on sorghum is *C. sorghi* Saccas, found on sorghum seeds in West Africa as maturity approaches. The new leaf spot fungus has conidia several magnitudes larger than *C. sorghi,* and is found as a leaf parasite without evidence for seed infection.

Sorghum rust (*Puccinia purpurea* Cooke) pustules were highly associated with *Coniothyrium* leaf spot lesions. A high positive correlation (r=0.55**) was found between incidence of *Coniothyrium* leaf spot and rust severity in 70 sorghum lines of the Texas A&M All Disease and Insect Nursery evaluated in Isabela, Puerto Rico, in the fall of 1985. Over all lines there was a mean of 8.3 *Coniothyrium* leaf spots per leaf. Pustules on rust susceptible sorghum cultivars were the most common site of *Coniothyrium* leafspot invasion.

Over 80% of all *Coniothyrium* lesions were centered on rust pustules. Nevertheless, less than 5% of all rust pustules showed secondary invasion by *Coniothyrium* leaf spot fungus. Invaded pustules became shrivelled and only a few wrinkled nonviable appearing urediospores

[1]Manuscript submitted to Editorial Board 16 July 1987.

[2]Frederiksen, R. A., 1986. Compendium of Sorghum Diseases. APS, St. Paul.

[3]Tarr, S. A. J., 1962. Diseases of Sorghum, CMI, Surrey, England.

[4]Saccas, A. M., 1954. Parasitic Fungi of Sorghum in French Equatorial Africa, *Agron. Trop* 9:135-73.

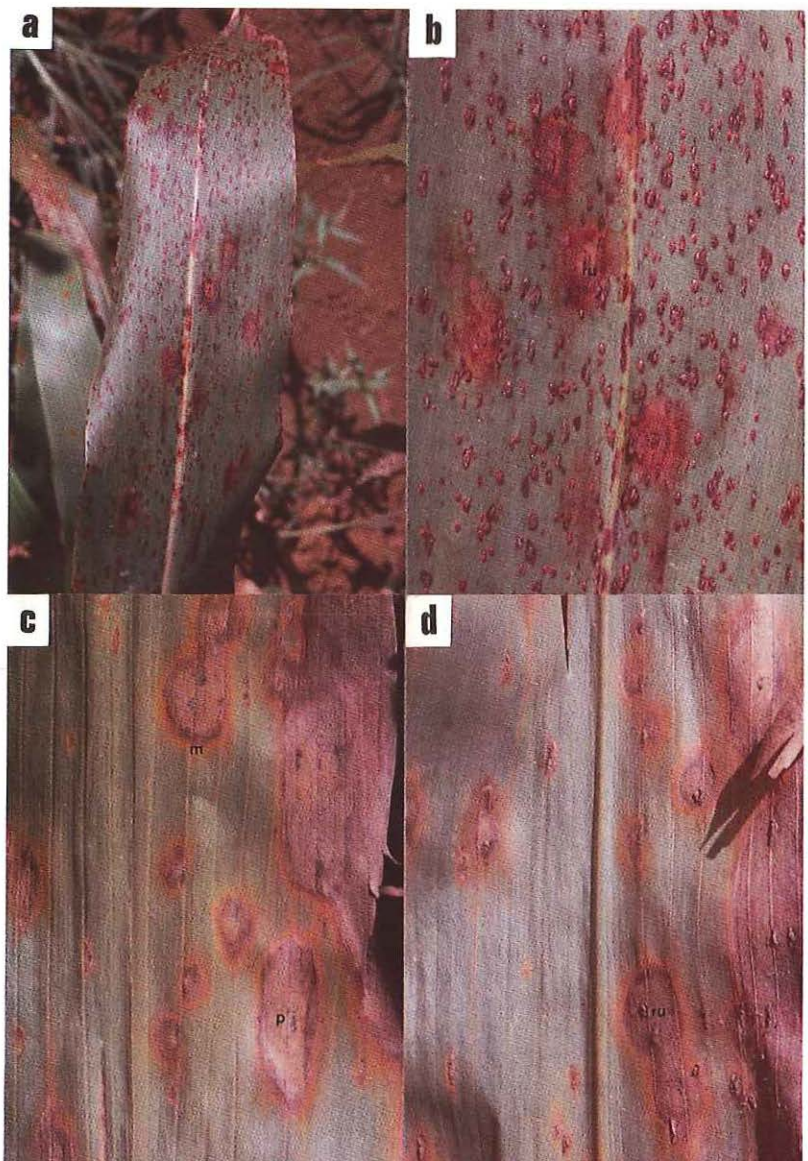

FIG. 1.—a) *Coniothyrium* leaf spots on a rust susceptible sorghum showing a purple wound reaction. Note the centering of the oval lesions on sites of rust pustules and the heavy band of wound pigment at the margin of the necrotic center and healthy plant tissue. b) Close-up (1:1) of the lower leaf surfaces. Rust uredia (ru) and wound pigment more obvious on upper than lower leaf surfaces. c) *Coniothyrium* leaf spots on the upper leaf surface on a tan sorghum plant showing low rust susceptibility. Note the chlorotic nature of the lesion margin (m) and the presence of pycnidia (p) clustered in the centers of necrotic areas. d) Inferior leaf surface of the same leaf a in lc showing remnants of rust uredia (ru) and spot expansion, which appeared greater in the tan lines than in lines showing purple

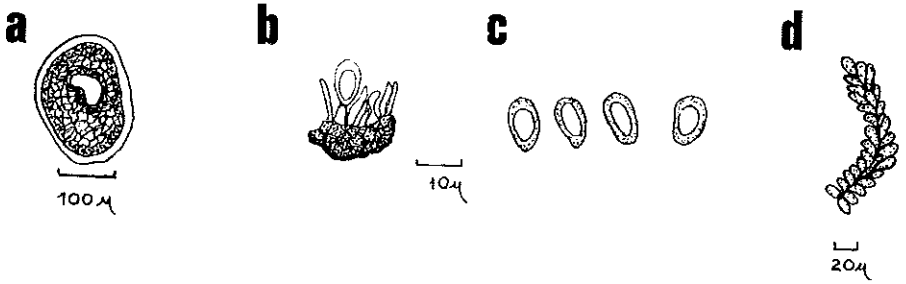

FIG. 2.—Pycnidium (a), hymenium (b), conidia (c), and the tendrils (d) of the *Coniothyrium* leaf spot fungus as found in western Puerto Rico.

were present. In several rust resistant lines, *Coniothyrium* leaf spots were centered upon hypersensitive necrotic flecks. Histological studies should uncover further clues concerning the relationships among the *Coniothyrium* leaf spot fungus, sorghum rust, and host tissue.

Besides points of rust reaction, the margin and tips of healthy leaves and perforations by fall armyworm (*Spodoptera frugiperda*) were sites of *Coniothyrium* leaf spots (fig. 3). Sorghum producing purple wound pigments (*P*__) showed 10.9% foliar rust coverage and 10.7 *Coniothyrium* lesions per leaf, whereas tan wound lines [*pp*) showed 6.5% rust and 6.6 *Coniothyrium* lesions per leaf, respectively. These differences were highly significant ($P=0.01$ on the basis of tests of *t*-values. Moreover, highly significant differences ($P=0.01$) were found in lesion length between tan (2.4 cm) and purple (1.3 cm) lines. Figure 1 illustrates these reactions. Purple wound pigment is associated with increased rust and in turn with greater numbers of *Coniothyrium* leaf spot. Pigmentation which occurs after the pathogen invasion is concentrated in a band, appears to be associated with limited expansion of the necrosis. Within rust reaction classes and pigmentation groupings, diverse *Coniothyrium* leaf spot reactions were noted. Sorghum lines 84CS944, SC326-6, 81EON85, R6113, and 81B-6078 showed no *Coniothyrium* leaf spots and low rust severity. These lines may be promising sources of resistance for developing resistance to these two diseases.

Worldwide about 25 species of *Coniothyrium* are reported.[5] Many *Coniothyrium* species reported may be doubtful since many are differentiated only by the host plant on which they were discovered. Species of *Coniothyrium* are associated with cankers, diebacks, rots, and leaf spots on many diverse plants.[6] In this genus, the common canker fungus (*C. fuckelii*) and the brand canker fungus (*C. wernsdorfiae*), both attacking roses (*Rosa* spp.), are the best described and most studied.[7,8] Conidial measurements of the sorghum leaf spot fungus are different from those of the two well-described rose pathogens. In Puerto Rico, there are reports of *Coniothyrium* leaf spot pathogens on yucca, plantain, *Caladium* spp., rice, royal palm and guinea grass.[9] Their relationships, if any, are hard to assess until they are better described and comparative studies are conducted. All host species are monocots and there is a distinct possibility that some or all of these could be synonyms. The opportunistic entry of the *Coniothyrium* on sorghum, its preference for stages of senescence, and its prolific

[5]Ainsworth, G. C., 1971. The Directory of Fungi, CMI, Surrey, England.
[6]Pirone, P. O., 1978. Diseases and Pests of Ornamentals, John Wiley & Sons, N. Y.
[7]Horst, K., 1983. Compendium of Rose Diseases, APS, St. Paul, MN.
[8]Waterman, A. M., 1930. Diseases of Rose by Coniothyrium., *J. Agric. Res.* 40:805-27.
[9]Stevenson, J. A., 1975. Fungi of Puerto Rico, Reed Herb. XXIII, Beltsville, MD.

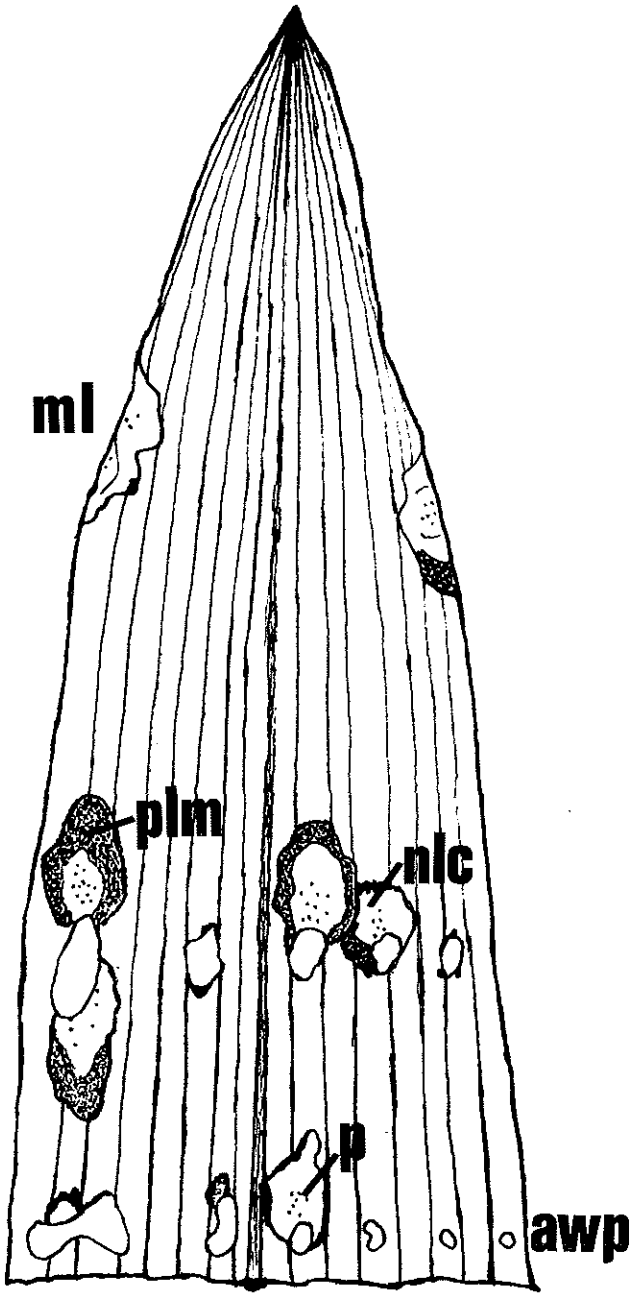

FIG. 3.—Association of *Coniothyrium* leaf spot to armyworm perforations (awp) and margins of leaf tips (ml) as found in western Puerto Rico. Pycnidia (p), necrotic lesion centers (nlc), and pigmented lesion margins (plm) are illustrated for better interpretation of the drawing. Lesions and the leaf are drawn to scale, whereas pycnidia are enlarged for sake of better illustration.

growth on ordinary laboratory media are characteristics not usually associated with highly specialized plant parasitic fungi with a very narrow host range. Determining host ranges of *Coniothyrium* leaf spot fungi would be helpful in understanding their survival, spread, and strategies for their control.

The sorghum leaf spot fungus studied appeared to have several similarities to *Botryodiplodia theobromae* which occurs on numerous hosts in tropical lowlands. Both fungi show hymenial paraphyses, holoblastic development of thick walled conidia, similar length to wide ratios in conidia, delayed development of conidial pigmentation, powdery conidial tendrils, opportunistic wound parasitism and delayed septation of conidia.[10] Besides possible confusion with *B. theobromae, Coniothyrium* leafspot causes roundish elliptical lesions with dark fruiting specks (pycnidia) which could be confused with foliar anthracnose [*Colletotrichum graminicola* (Ces.) Wils]. The late discovery and description of the *Coniothyrium* leafspot disease of sorghum may have resulted from these possible confusions.

Before flowering, sorghum shows a marked ability to resist foliar pathogens and to recover from stress. In most lines this ability is lost during maturation and plants become heavily diseased and defoliated near physiological maturity.

Coniothyrium leaf spot of sorghum should not be considered alone but as one factor among many contributing to degenerative decline of sorghum. Senescence, rust, insect damage, environmental stresses, and other diseases appear to play major roles in the premature and rapid deterioration of sorghum plants nearing maturity. A visibly diseased area from one *Coniothyrium* leaf spot may exceed the area of a single rust pustule by more than 50 times. This illustrates the potentially powerful role of *Coniothyrium* leaf spot in degenerative decline. Rust losses in Puerto Rico are from 20 to 50% on rust susceptible sorghum lines as evidenced by higher yields after a rust specific fungicide application in rust susceptible cultivars. Besides possible magnification of rust losses, *Coniothyrium* leaf spot could increase armyworm damage. In sorghum in Puerto Rico more insecticide is applied for armyworm control than for any other insect pest. Future research should focus on defining the physiological basis of degenerative declines in sorghum, and the role of pest complexes in this process. Controlling this decline might allow more multiple harvesting in sorghum, control disease more effectively, reduce pest losses efficiently, utilize the long tropical growing seasons and increase sorghum's utility for producers.

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[10]Punithalingam, E., 1976. *Botryodiplodia theobromae*, CMI, Res. Plant Path Fungi 5198, Kew. Surrey, England.