

Occurrence of Rust of Pangola Grass in Puerto Rico

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INTRODUCTION

Pangola grass, *Digitaria decumbens* Stent, has become an important grass for pasture in Puerto Rico. About 150,000 acres are planted to this grass because of its high quality and productivity. No diseases have been reported on Pangola grass in Puerto Rico since its recent introduction from Africa. During the last few years, a rust has caused serious damage to foliage of Pangola grass throughout the Island. The malady was found in pastures in the Corozal and Río Piedras areas. Since Pangola is one of Puerto Rico's major pasture grasses, this rust has caused concern. This paper reports findings on the causal organism, as well as on its pathogenicity and control.

REVIEW OF THE LITERATURE

During 1915-17, Arthur (1,2,3)² reported *Puccinia substriata* Ellis & Barth. on a number of hosts from Puerto Rico, including *Syntherisma digitata* (Schwartz) Hitchc. The same author (4) later included *Uredo paspalicola* under the species of *P. substriata*. In 1941, Cummins (5) reported a New Guinea collection of *Puccinia*, occurring on the same host (*Digitaria pruriens* (Trin.) Buse) of *Puccinia oahuensis* Ell. & Ev., as *Puccinia digitariae*. Apparently he did not give *P. oahuensis* consideration at that time. After having examined the telial collections obtained from Hawaii, the Philippines, New Guinea, India, Transvaal, Southern Rhodesia, Uganda, Brazil, and Puerto Rico, Cummins (6) concluded that all these collections of *Puccinia* from *Digitaria* represented a single species and should be designated as *Puccinia oahuensis*.

Although Cummins (7) reported in 1942 that *Uredo paspalicola* was synonymous with *Angiopsora compressa* and *P. tubulosa* was synonymous with *P. substriata*, he did not consider *P. substriata* a synonym of *P. oahuensis* because, in most collections, the urediospores of *P. substriata* tend to have the wall slightly thickened apically.

In 1963 Roure (11) reported from Puerto Rico *P. oahuensis* Ell. & Ev.

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² Italic numbers in parentheses refer to Literature Cited, p. 139.

on *Digitaria sanguinalis* (L.) Scop. Without knowing that *P. substriata* is not synonymous with *P. oahuensis*, he grouped *P. substriata*, *P. paspalicola* (P. Henn.) Arth. and *P. tubulosa* (Pat. & Gaill.) Arth. under the species of *P. oahuensis*.

Recently Ramachar and Cummins (10) made an extensive study of the species of *Puccinia* on the *Panicaceae*. They failed to record a single rust species on Pangola grass.

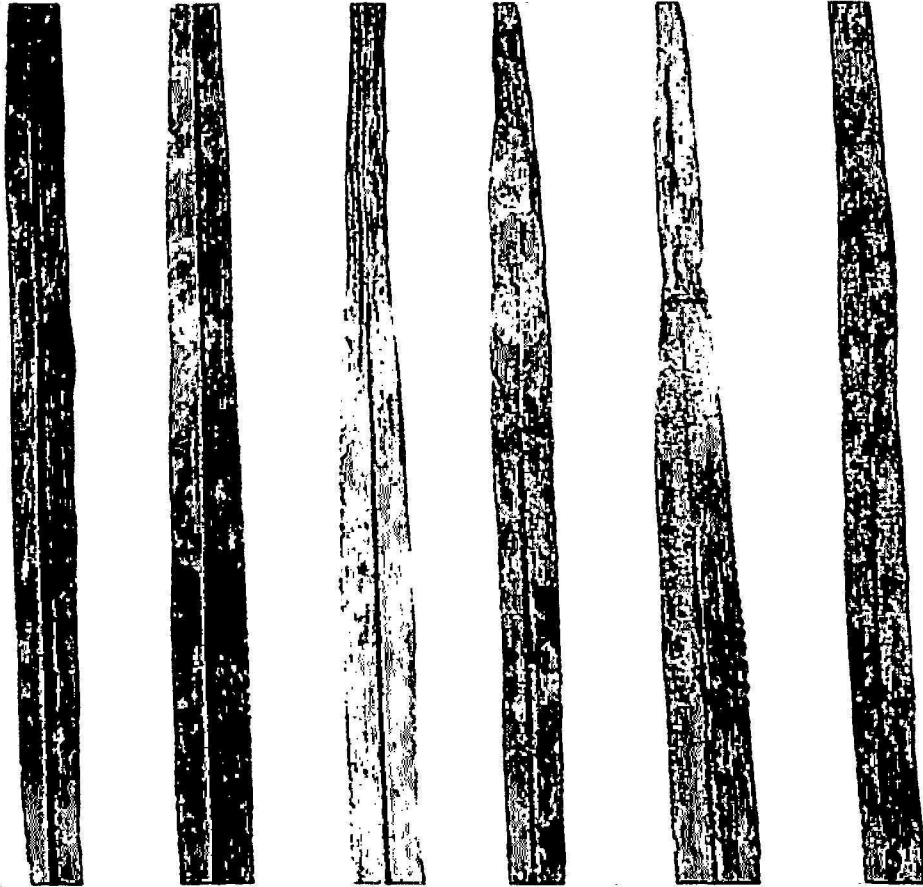


FIG. 1.—Symptoms of the rust disease on Pangola grass leaves.

RESULTS

DESCRIPTION OF SYMPTOMS

In the early stage, the affected plants show minute, irregular, yellowish brown to orange-brown spots. These spots increase in size and gain a pale-yellow halo. The lesions are usually 0.5 mm. in length, but occasionally may reach 1.0 mm. (fig. 1). The lesions rapidly take on a pustular appearance. When the disease is severe, considerable numbers of pustules develop on the leaves. These pustules usually coalesce and form large, irregular necrotic areas. Most of the affected leaves died prematurely.

IDENTIFICATION OF THE CAUSAL ORGANISM

Microscopic examination of the lesions revealed the presence of a rust of the genus *Puccinia* with the following characteristics:

The uredia are subepidermal, and rupture the epidermis under pressure to release the dense masses of orange-colored urediospores. Urediospores are obovate, golden-brown, coarsely and strongly echinulate and are 2.38 to 34 μ long x 20.4 to 27.2 μ wide (fig. 2). Urediospores have four or five equatorial pores.

The telia are small and remain long covered by the epidermis of the host. The teliospores are clavate, slightly constricted at the septum, closely compacted, and measure 35.7 to 66.3 μ long x 17 to 35.7 μ wide. The walls of

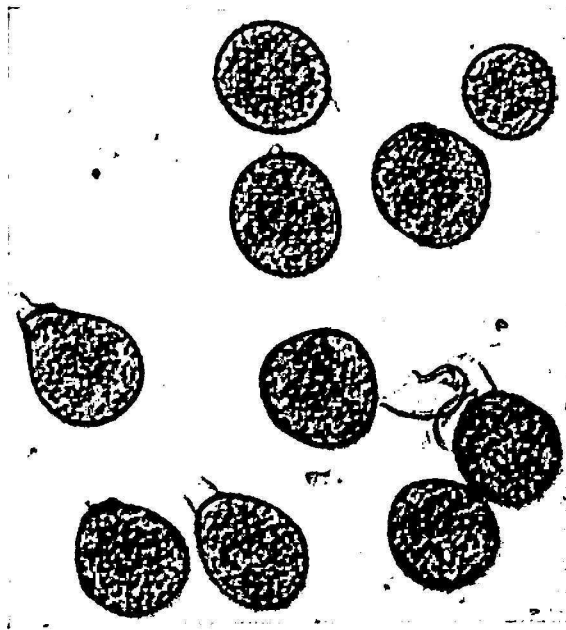


FIG. 2.—Urediospores of *Puccinia oahuensis* var. *digitaria-decumbensis*.

teliospores are chestnut-brown above, lighter below and thickened 1.7 to 5.1 μ at the apex. Pedicels of teliospores are golden to brown and short (figs. 3 and 4).

PATHOGENICITY TEST

Healthy leaves of 30 clones of different species and varieties of *Digitaria* were removed and placed in separate petri dishes (80 cm. diameter) each containing 30 ml. of 30 p.p.m. of Benzimidazole. Collection of rust from Pangola grass was "purified" by transferring single urediospores to leaves of Pangola grass plants which had been raised from presumably spore-free sets. Urediospores were sprayed on the surface of the leaves with an aid of a steam-sterilized atomizer. For each species or variety of *Digitaria*, 10 leaves were inoculated with the various rust isolates. The test was repeated once.

Pustules appeared 7 to 10 days after inoculation, and reaction types were observed from 10 to 14 days after inoculation. Reaction types under field conditions were also recorded.

As shown in table 1, in most cases, the observed field infection types correspond with those of artificial inoculation. Some clones of *Digitaria decumbens* such as P.R. P.I. No. 6438 and 6535 exhibited a high degree of

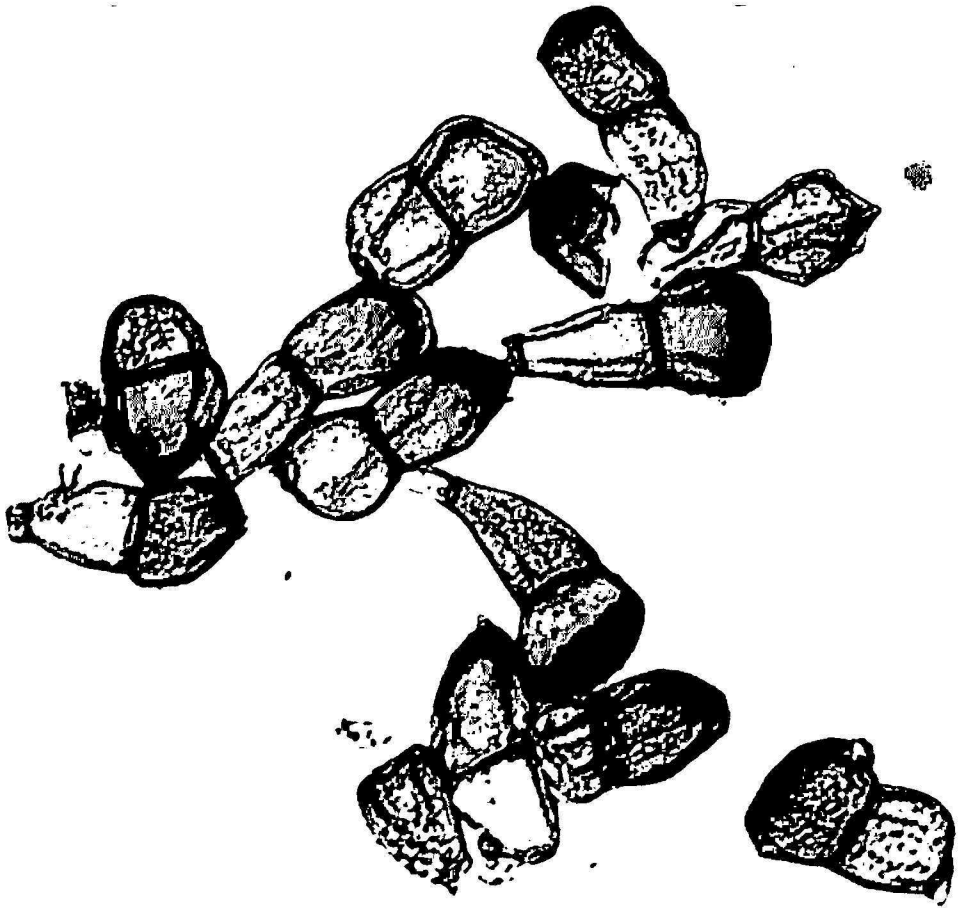


FIG. 3.—Teliospores (from dry specimen) of *Puccinia oahuensis* var. *digitaria-decumbensis*.

resistance to the Pangola rust while others such as U.S.D.A. P.I. No. 111110 were found to be highly susceptible.

CHEMICAL CONTROL

Five chemicals, Daconil³, Dyrene⁴, Dithane M-45⁵, Bay 47531⁶, and Cycocel⁷ were applied as a foliar spray at 0.05, 0.1, 0.2, 0.3 and 0.4 percent,

³ Daconil 2787—Tetrachloro isophthalonitrile; ⁴ Dyrene, a foliage fungicide, 2,4-Dichloro-6-o-chloroanilino-s-triazine; ⁵ Dithane M-45—coordination product of zinc ion and manganese ethylene bisdithiocarbamate; ⁶ Bay 47531—N-(Dichlorofluoro methylthio)-N',N'-dimethyl-N-phenylsulfamide; ⁷ Cycocel—plant growth regulant (2-Chloroethyl) trimethyl ammonium chloride.

in each case on leaves of the Pangola grass which had been previously inoculated with the urediospores of the Pangola rust and shown good symptoms of the disease. Three replications were made for each treatment. Plants sprayed with water were included as controls. Observations were made 3 weeks after plants were treated.

Results obtained indicated that Dithane M-45 is the most effective chemical for delaying pustule appearance. At 0.3 to 0.4 percent concentration, M-45 is effective in delaying pustule appearance by 80 percent for a period of 3 weeks. Daconil, Dyrene, and Bay 47531, even at 0.4 percent,

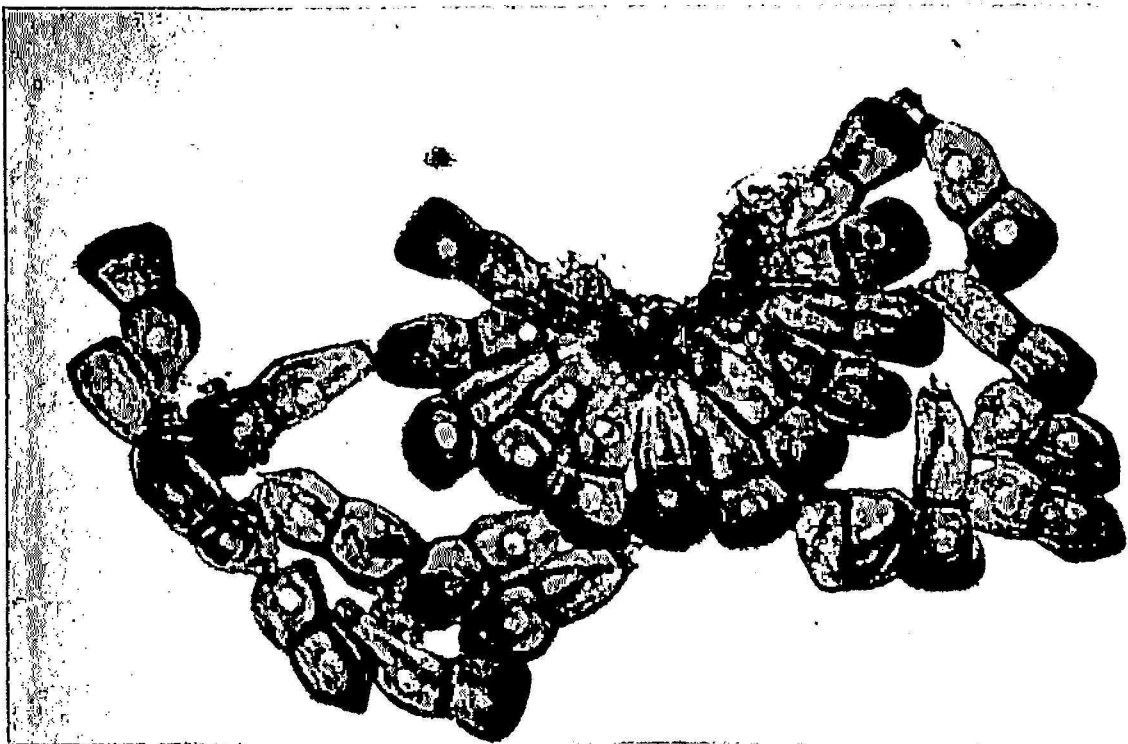


FIG. 4.—Teliospores (from fresh specimen) of *Puccinia oahuensis* var. *digitaria-decumbensis*.

had little effect on pustule appearance (approximately 20 to 30 percent for a period of 2–3 weeks). Under the condition of our tests Cycocel had no effect.

DISCUSSION AND CONCLUSION

The results obtained in these studies indicated that the characteristic, compacted, and long-covered telia of the Pangola rust resemble that of *P. oahuensis*. However, the size of the urediospores and the teliospores is so variable that Ramachar and Cummins (10) grass rust key can hardly be used to identify this Pangola rust.

According to Ramachar and Cummins (10), the urediospores of *Puccinia*

TABLE 1.—*Pathogenicity of Puccinia oahuensis on Digitaria spp.*

Species	U.S.D.A. P.I. No.	P.R.P.I. No.	Degree of infection	
			Artificial inoculation	Natural infection
1. <i>D. milangiana</i>	299695	6464	0	0
2. Do.	299695	6427	3-4* ¹	3-4
3. Do.	299696	6429	0	0
4. Do.	(A-23)	5125	3	1
5. Do.	299699	6543	0	0
6. Do.	299667	6610	0	0
7. Do. sub. sp. <i>eybesiana</i>	299716	6482	0	0
8. Do.	299681	6494	0	0
9. Do.	299713	6613	0	0
10. Do.	299736	6658	0-2	0
11. Do.	299727	6628	0	0
12. Do.	299703	6378	0	0
13. Do.	299709	6391	0	0
14. Do.	299730	6415	0	0
15. Do.	299731	6416	0	0
16. <i>D. setivalva</i>	299791	6471	0	0
17. Do.	299804	6537	0	0
18. <i>D. smutsii</i>	299808	6373	0	0
19. Do.	299828	6434	0	0
20. <i>D. milangiana</i> sub. sp. <i>eybesiana</i>	299728	6408	0	0
21. <i>D. decumbens</i>	299601	6438	0	0
22. Do.	(A-24)	5124	1-3	1-2
23. Do.	299837	6535	0	0
24. <i>D. eriantha</i>	—	5277	2-3	2-3
25. <i>D. valida</i>	299875	6433	0	0
26. <i>D. pentzii</i>	299742	6405	0	0
27. Do.	299752	6439	0	0
28. <i>D. sp.</i>	299892	6402	0	0
29. Do.	—	6523	1-3	0
30. <i>D. decumbens</i>	111110	—	2-3	2-3

¹ Infection types: 0, Immune—no rust pustules developed; 1, very resistant—rust pustules extremely small (less than 0.5 mm. long); 2, moderately resistant—pustules small to medium (0.5-1.0 mm long); 3, moderately susceptible—pustules medium in size (1.0 mm. long); and 4, very susceptible—pustules large (more than 1.0 mm. long) and often united.

oahuensis are mostly more than 29 μ long and teliospores are mostly less than 45 μ long. The urediospores of this rust, however, as shown in table 2, are mostly less than 29 μ long and the teliospores mostly more than 45 μ long. In view of this variation in spore size, and considering that the appearance of the urediospores and teliospores closely resembles that of *P. oahuensis*, the studied Pangola grass rust has tentatively been identified

as a variant of *Puccinia oahuensis*, namely *Puccinia oahuensis* var. *digitaria-decumbensis*.

The rust specimen obtained from Pangolagrass in the Río Piedras area was also examined by Dr. F. D. Kern. In a recent letter to the author, Dr. Kern (13) stated: "About the rust on Pangola grass (*Digitaria decumbens*) I am still calling it *Puccinia oahuensis*. In this I have good company. I sent a specimen to Dr. Cummins and received this reply (June 2, 1967), 'I do agree with you that the rust of *Digitaria decumbens* is *Puccinia oahuensis*'."

The type specimen is preserved in the Department of Plant Pathology for future reference.

Although several investigators (8, 9, 12) were able to delay pustule appearance of plant rusts by foliar application of Cycocel and certain systemic

TABLE 2.—Frequency of distribution and size of the urediospores and teliospores of a variant of *Puccinia oahuensis* from Pangola grass

Urediospores				Teliospores			
Length (μ)	Number of urediospores	Width (μ)	Number of urediospores	Length (μ)	Number of teliospores	Width (μ)	Number of teliospores
23.8–25.4	2	20.4–22.0	1	35.7–40.8	4	17.0–22.1	23
25.5–28.8	25	22.1–23.0	14	40.9–45.0	6	22.2–25.5	17
28.9–30.6	16	23.1–25.0	26	45.1–49.3	14	25.6–28.9	7
30.7–34.0	7	25.1–27.2	9	49.4–66.3	26	29.0–35.7	3

fungicides, results obtained in these studies are not too satisfactory. Except for Dithane M-45, none of the chemicals tested effectively delayed appearance of pustule.

Since a great number of species and clones of *Digitaria* such as *D. decumbensis* P.R. P.I. No. 6438 and 6535 exhibited a high degree of resistance to the Pangola rust, replacing current susceptible clones with the resistant ones seems to be the best way to control the disease.

SUMMARY

Pangola grass (*Digitaria decumbens* Stent) rust was first observed in Puerto Rico at the Corozal Substation and then in the Solís farm at the Río Piedras Station. A study of the urediospore and teliospore morphology revealed that this Pangolagrass rust resembles *Puccinia oahuensis* Ell. & Ev., except that the urediospores are shorter and the teliospores are longer. In view of this size variation, and considering the fact that the general appearance of the rust resembles that of *P. oahuensis*, the Pangola grass rust has tentatively been identified as a variant of *P. oahuensis*.

Results of pathogenicity tests indicate that a great number of species or clones of *Digitaria* are resistant to the rust.

Among the chemicals tested, Dithane M-45 seemed to be the most promising for delaying the appearance and development of pustules.

RESUMEN

La roya de la yerba Pangola (*Digitaria decumbens* Stent) se observó por primera vez en Puerto Rico en la Subestación de Corozal y luego en la Finca Solís de la Estación Experimental Agrícola en Río Piedras. Un estudio sobre la morfología de las urediosporas y teliosporas reveló que esta roya de la yerba Pangola se parece a la *Puccinia oahuensis* Ell. & Ev., excepto en que las urediosporas son más cortas y las teliosporas más largas.

En vista de esta variación en el tamaño y considerando el hecho de que la apariencia general de esta roya de la Pangola se parece a la de la *P. oahuensis*, fue que la roya de la Pangola se identificó tentativamente como una variante de la *P. oahuensis*.

Los resultados de la pruebas de patogenicidad indicaron que un gran número de especies o clones de la *Digitaria* son resistentes a esta roya.

Entre los agentes químicos que se probaron, tal parece que el Dithane M-45 es el que más promete en cuanto a demorar la aparición y desarrollo de las pústulas.

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