

First Report of *Plumeria* Rust, Caused by *Coleosporium plumeriae*, in Thailand

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ABSTRACT.—*Coleosporium plumeriae* Pat. is a rust fungus (Melampsoraceae) found on *Plumeria* species. The disease is characterized by the formation of powdery, bright yellow-orange, erumpent, hypophyllous, punctiform uredinia on the abaxial portion of the leaf. The spermagonial and aecial states are unknown. Urediniospores are subglobose to angular, catenulate, coarsely verrucose with bluntly capitate, annulate tubercles, germ pores un conspicuous, two or four, scattered. Lesions on the adaxial surface consist of minute spots with yellow color turning brown with age. This is the first report of a rust disease attacking leaves of *Plumeria acuminata* Ait. in Thailand.

KEY WORDS: rust; *Coleosporium plumeriae*; *Plumeria acuminata*

INTRODUCTION

Plants belonging to the genus *Plumeria* originated from West Indies and Central and South America, but they are widely cultivated in tropical and subtropical regions as an ornamental plant and can be seen grown in greenhouses. In Hawaii, the flowers are used to make wreath, and for this purpose many cultivars of *Plumeria* are being grown (Kakishima et al., 1995). In Thailand, *Plumeria* is one of the most popular and favorite ornamental trees that commonly found in parks, home gardens and landscaped establishments over the country. Its big, stout branches

enhanced by its colorful and fragrant flowers and big showy leaves (Fig. 1) provide any landscape a pleasing aesthetic scenery the whole year round.

Coleosporium plumeriae Pat. has been reported to cause rust in *Plumeria*, but for a long time period its distribution has been limited in the places of origin, West Indies and Central and North America. However, around 1989, there were successive reports of confirmed occurrences of rust caused by *C. plumeriae* in Hawaii (Ogata and Gardner, 1992), South Pacific Islands and Indonesia (Bali) (Kobayashi et al., 1994a, b), Japan (Kakishima et al., 1995), Philippines (Tanganon and Quebral, 1992) (Fig. 2). There had been no report of rust attacking *Plumeria* in Thailand (Sontirat et al., 1994). Hence, this study aimed to determine the etiology of rust attacking *Plumeria*, thereby describe its characteristic

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FIGURE 1. *Plumeria rubra* plant: A = flower, B = tree.

symptom and issuance of a warning is therefore deemed necessary.

MATERIALS AND METHODS

For electron microscopy, air-dried uredinia and leaf tissues were mounted on metal stubs, ion sputter coated with platinum-palladium and observed in a Hitachi scanning electron microscope (S-4200).

For light microscopy, uredinia and telia were cut from diseased leaves of *Plumeria rubra* L. growing in the greenhouse of the Department of Plant Pathology, Faculty of Agriculture, Chiang Mai University, Chiang Mai. Thin sections of uredinial and telial sori and urediniospores obtained from uredinia were mounted in 5% KOH or Lactophenol solution. Dry herbarium specimens have been deposited in Herbaria: Mycological Herbarium, Graduate school of Life and Environmental Sciences, University of Tsukuba (TSH).

RESULTS AND DISCUSSION

Signs and symptoms

Rust uredinia emerge as small, yellow to yellow-brown powdery sori on the lower leaf surface (Fig. 3), which then spread to the entire leaf surface and cause defoliation when

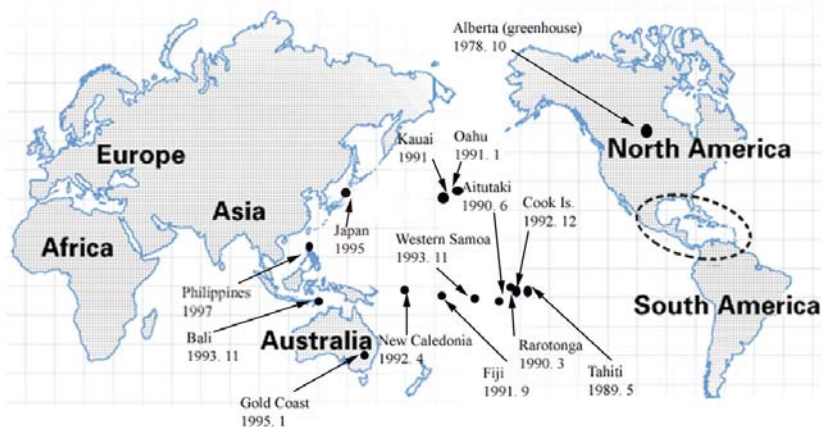


FIGURE 2. Distribution of *Plumeria* Rust. Previous area of distribution is enclosed in dotted lines. Occurrences in the Pacific and other areas confirmed through reports and herbarium specimens are indicated by name of locality, year and month recorded.



FIGURE 3. Plumeria Rust, *Coleosporium plumeriae*, uredinia on *Plumeria rubra* collected from Chiang Mai, Thailand.

infections are severe. There are causes when the entire tree becomes defoliated and the trunk and stems wither. Numerous urediniospores are produced within uredinia and these may serve as sources of infection responsible for the

spread of the disease. Along with the uredinia, glossy wax-like telia are also produced (Traquair and Kokko, 1980; Ogata and Gardner, 1992).

Morphology and taxonomy

Results of examination of specimens collected from Chiang Mai (TSH-R4314) and those from Bangkok, Thailand (TSH-R4315, 4316, 4317) showed that uredinia are produced beneath the epidermis but the latter is broken and opened up to release urediniospores upon maturity of the uredinia. Urediniospores are single-celled (Fig. 4), produced in chains, obovoid, ellipsoid or oblong-ellipsoid, and $25.2\text{-}36.4 \times 13.9\text{-}18.9 \mu\text{m}$ in size. The walls are hyaline, ca. $1.5 \mu\text{m}$ thick and the surface has big verrucae (Fig. 5). Peridial cells are seen around the uredinia. Only uredinia were found in all of the specimens, except in a specimen

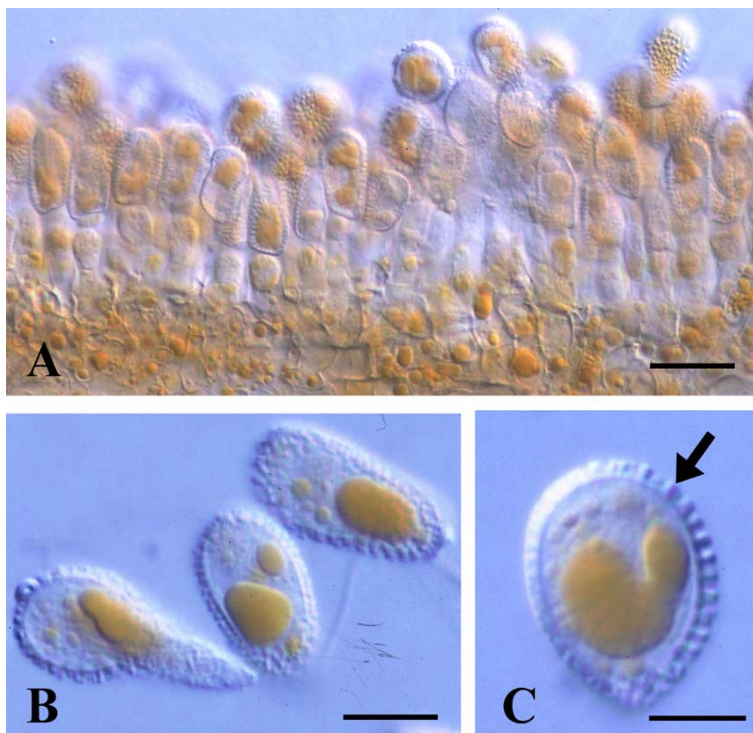


Figure 4. Uredinium and urediniospores of *Coleosporium plumeriae*; A = cross section of uredinium (Bar = $30 \mu\text{m}$), B = urediniospores (Bar = $15 \mu\text{m}$), and C = verrucose urediniospores with annulate tubercles (arrow) (Bar = $10 \mu\text{m}$).

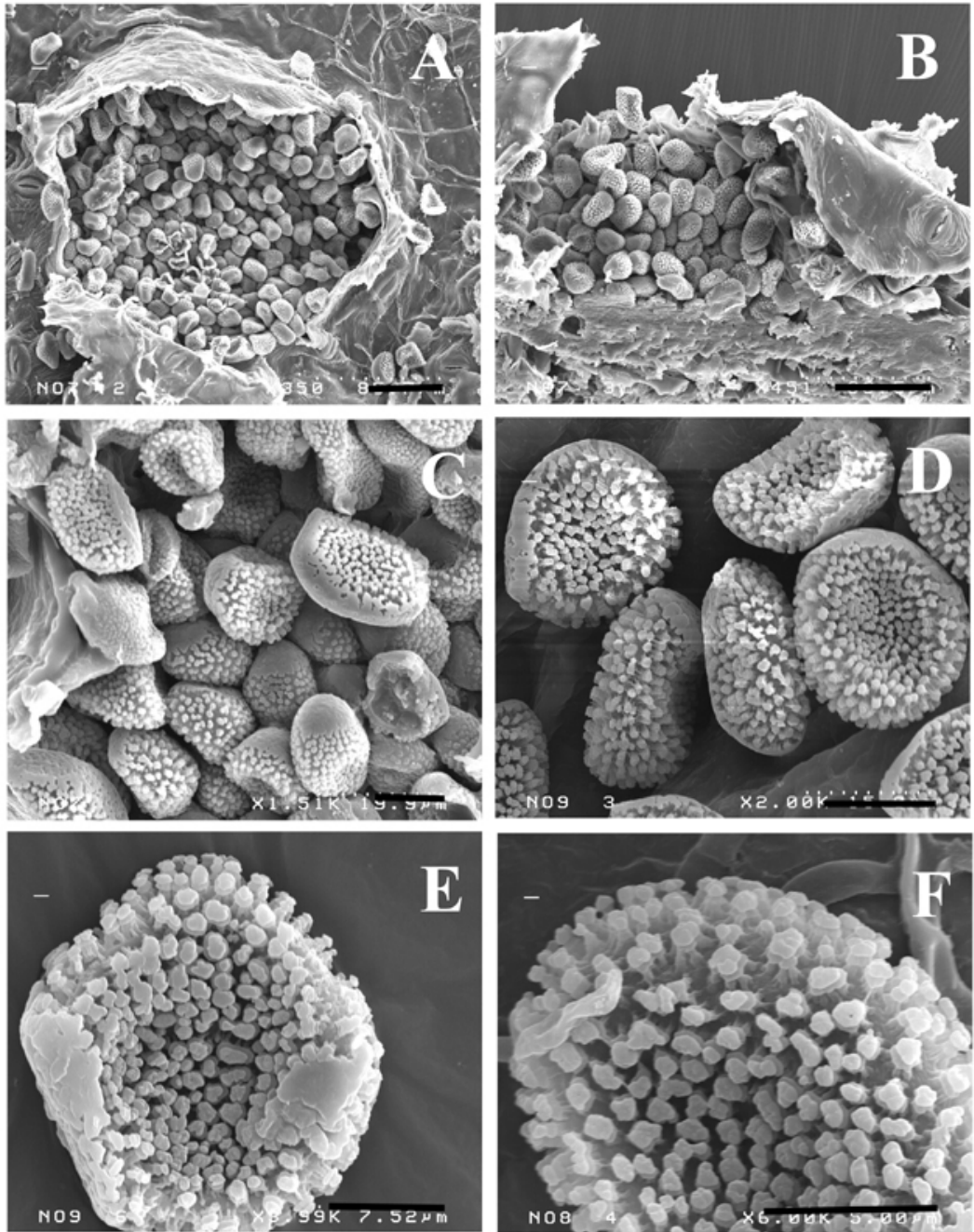


Figure 5. Scanning electron micrograph of urediniospores of *Coleosporium plumeriae*; uredinia (A and B, Bar = 50 μm), verrucose urediniospores with annulate tubercles (C and D, Bar = 10 μm) and bluntly capitate tubercles (E and F, Bar = 5 μm).

collected in in Cook Island (PDD 57192) where few telia were observed. Teliospores are clavate with thin hyaline walls. Germination probably takes place immediately after maturation of teliospores since in many cases structures which were already four-celled were also observed. Spermogonial and aecial stages are however not yet known.

The above morphological features strongly coincides with descriptions of *Coleosporium plumeriae* Pat (Patouillard, 1902; Saccardo, 1905; Arthur, 1907; Sydow and Sydow, 1915; Gallegos and Cummins, 1981). However, *C. plumeriae* found in a greenhouse in Canada (Traquair and Kokko, 1980) was reported to have urediniospores 25-27×16-24 μm in size, slightly smaller than in the other descriptions.

Coleosporium plumeriae was originally described by Patouillard (1902) based on a rust specimen bearing uredinia and telia on *Plumeria alba* L. collected in Guadalupe Is., West Indies. On the other hand, basing on a rust specimen collected by Berkeley on a species of *Plumeria* (probably *P. rubra* L.) in Santo Domingo Is., West Indies and using *Uredo domingensis* Berk. (Sydow and Sydow, 1924) as the type, Arthur (1918) established a new combination, *Coleosporium domingensis* (Berk.) Arthur considered *C. plumeriae* as its synonym (Arthur, 1924, 1934). Likewise, the rust *Uredo plumieriicola* Hennings described by Hennings (1904) from a species of *Plumeria* collected in Peru, S. America was also considered as an identical species. However, since the type species of Arthur (1918) did not have the tetial but only the uredinial stage, establishing *Coleosporium* sp. upon this is considered invalid based on nomenclatural rules (Farr et al., 1989). Thus, it is more appropriate to use *C. plumeriae* as the scientific name of the rust of *Plumeria*, and *U. domingensis* and *C. domingensis* must be considered as its synonyms. However, in the case of *Uredo plumieriicola* described in Peru, there is a need to examine the type specimen and clarify the difference from *C. plumeriae*, since its description indicates that it has slightly smaller urediniospores than *C. plumeriae*.

TABLE 1. Host plants of the Plumeria Rust, *Coleosporium plumeriae*.

<i>Plumeria acutifolia</i> Poir.
<i>P. alba</i> L.
<i>P. emarginata</i> Griseb.
<i>P. krugii</i> Urban.
<i>P. lutea</i> Ruiz et Pav.
<i>P. obtusa</i> Bert. et A. DC.
<i>P. rosea</i>
<i>P. rubra</i> L.

Locality and hosts

As mentioned previously, the rust of *Plumeria* was first described on *P. alba* in Guadalupe Is., West Indies in the 1900's (Patouillard, 1902), and within a period of around 90 years after that, it was reported in a relatively limited distribution. Its occurrences were reported in West Indies, Central America, South America (Colombia, Venezuela), and the United States of America (Florida, Texas) on woody plants in the family Apocynaceae (Table 1) that 8 species of *Plumeria* were recorded as hosts (Arthur, 1907, 1915, 1916, 1918, 1924, 1927, 1934; Farr et al., 1989; Gallegos and Cummins, 1981; Kern and Chardon, 1927; Saccardo, 1905; Sydow and Sydow, 1915, 1924). Starting with a confirmation of its occurrence in Tahiti, South Pacific (PDD 15101) in 1989, it was then confirmed and reported in succession in South Pacific Islands (Rarotonga: PDD 57192, Aitouki: PDD 57638, Cook Island: PDD 61892, Fiji: PDD 59355, 59356, 60079, West Samoa: PDD 62972, New Caledonia: Kohler and Pellegrin, 1992), Hawaii Islands (Oahu, Kawaii) (Ogata and Gardner, 1992), Golden Coast, Australia (PDD 63804 = TSH-R1471) and Bali Is., Indonesia (Kobayashi et al., 1994a, b; TSH-R1406, 1407). Most of these occurrences were reported on cultivated *P. rubra*, although it was also reported in *P. acutifolia* (PDD 56101) in Tahiti, in *P. alba* in New Caledonia, and in *P. obtusa* in Hawaii. And, quite exceptionally, it was also reported in *P. rubra* grown in greenhouses in Alberta, Canada (Traquair and Kokko, 1980).

Although this recent and sudden spread of *Plumeria Rust* in the Pacific is now confirmed, its cause is still unclear. From now on, it is predicted to spread to Southeast Asia and neighboring countries. Considering the severe damage it can cause on the widely cultivated *P. rubra* due to defoliation and eventual death, issuance of a warning and the development of precautionary measures against its spread are therefore deemed necessary. Particularly it is considered necessary to take precaution in transport of infection seedlings and of wreath made from *Plumeria* flowers.

ACKNOWLEDGMENTS

This work was financially supported by the Hitachi Scholarship Foundation, the Thailand Research Fund (PDF/47/2542), JICA (ATRACT), and a grant-in-Aid for Scientific Research (No. 14255004) from Ministry of Education, Science and Culture of Japan.

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Received: 20 May 2004

Accepted: 23 August 2004