Occurrence of Rust Disease Caused by *Puccinia thaliae* on *Canna indica* in Mexico

*Cedas de Jesús M, 1Leyva-Mir SG, 2Solano-Báez AR, 3Camacho-Tapia M, 1Tovar-Pedraza JM*

1Departamento de Parasitología Agrícola, Universidad Autónoma Chapingo, Chapingo, Texcoco, Estado de México, Mexico  
2Fitopatología, Campus Montecillo, Colegio de Postgraduados, Montecillo, Texcoco, Estado de México, Mexico  
3Laboratorio Nacional de Investigación y Servicio Agroalimentario y Forestal, Universidad Autónoma Chapingo, Texcoco, Estado de México, Mexico

**Abstract**
During the spring and fall of 2017, typical symptoms of rust were observed on canna lily (*Canna indica* L.) plants at an ornamental nursery in Cuautla, Morelos, Mexico. Based on morphological characteristics of uredinial stage, the causal agent was identified as *Puccinia thaliae*. In addition, pathogenicity tests were conducted and Koch’s postulates were fulfilled. To our knowledge, this is the first report of *Puccinia thaliae* causing rust on *Canna indica* in Mexico.

**Keywords**
*Puccinia thaliae*; *Canna indica*; Fungi; Pucciniales; Morphology; Pathogenicity

**Introduction**
Canna lily (*Canna indica* L.), belonging to the family Cannaceae, is a popular landscape ornamental herb that grows wild in disturbed sites and along roadsides throughout the Neotropics, from the southern states of the USA to northern Argentina, and on the West Indian Islands. This plant is an herbaceous perennial that has been extensively cultivated for decoration and as an ornamental, and it even became a weed in gardens in tropical America. The species has also been used in hybridization [1, 2].

*Canna* spp. are susceptible to several fungal diseases, including a rust, caused by *Puccinia thaliae*. This pathogen has been reported worldwide causing rust symptoms on several species belonging to the families Cannaceae and Marantaceae [3], but it has not been registered on *Canna* spp. in Mexico. During the spring and fall of 2017, symptoms of rust were observed on canna lily plants at an ornamental nursery in Cuautla, Morelos, Mexico. Therefore, the present study was carried out to identify the causal agent of rust symptoms on canna Lily based on morphology, as well as verify their pathogenicity on canna lily plants.

**Material and Methods**

**Sample Collection**
Canna lily plants showing typical symptoms and signs of rust (Figure 1) were collected at an ornamental nursery in Morelos, Mexico. The symptoms consisted of orange-yellow erumpent pustules that can occur on both leaf surfaces but mostly develop on the lower surface, as

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*Corresponding author: Cedas de Jesús M, Departamento de Parasitología Agrícola, Universidad Autónoma Chapingo, Chapingo, Texcoco, Estado de México, Mexico. E-mail: jmtovarp91@gmail.com

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well as on leaf sheaths. In severe infections, the lesions coalesced to form larger necrotic lesions and finally the infected tissues become dry. A voucher specimen (UACH–H188) was deposited in the Herbarium of the Department of Agricultural Parasitology at the Chapingo Autonomous University.

**Figure 1:** Symptoms of Rust on *Canna indica* (A–B) Uredinia on Lower Surface of Leaves, (C) Signs on Leaf Sheaths

### Morphology

For the morphological characterization in light microscopy, glass slides with lactic acid were made with longitudinal sections of the fungal structures (uredinial stage) present on surface of the leaves (Figure 2A). Slides were examined using an Eclipse Ni-U compound microscope (Nikon Corporation, Japan) with differential interference contrast illumination and equipped with a Moticam 580 camera (Motic, China). Twenty-five uredinia and 100 turgid urediniospores were measured for their length and width.

**Figure 2:** Morphology of *Puccinia thaliae* on *Canna indica* Seen in Light Microscopy. (A) Close-Up View of Uredinium, (B) Longitudinal Section of An Uredinium (10×), (C–D) Urediniospores (40×) – Bars = E = 200 μm, F–G = 30 μm

### Pathogenicity Test

Pathogenicity of the fungus was verified through inoculation by rubbing an infected leaf segment onto 10 leaves from 1-month-old canna lily plants. Five noninoculated plants served as controls. Plants were incubated in a moist chamber under darkness for 36 h, and then maintained in a glasshouse at temperatures ranging from 20 to 30°C. The pathogenicity test was performed twice.

### Results and Discussion

Microscopic observations revealed subepidermal uredinia, erumpent, and measuring 595–994 × 235–669 μm (Figure 2B). Urediniospores were obovoid, ellipsoidal to pyriform, unicellular, and measuring 23.8–38.8 × 18.5–26.1 μm (Figures 2C–D). The wall was thin (1.3–1.6 μm), hyaline, and echinulate. Germ pores were obscure and equatorial. Telia were not observed. The morphological characteristics of uredinia and urediniospores agree with those described for *Puccinia thaliae* [4, 5, 6, 7].

Uredinia on inoculated plants were observed 11 to 14 days after inoculation, whereas leaves from control plants remained disease-free. The period for the reproduction of symptoms on inoculated plants was similar to that recorded by van Jaarsveld [8], Neo and Tham [9], and Brito and Garrido [10]. Symptoms and the morphology of urediniospores on inoculated plants were similar to those observed in natural infections.

*Puccinia thaliae* has been reported infecting several *Canna* spp. in American countries, including USA [11, 12], Panama [13], Venezuela [10], Colombia [14], and Ecuador [15]. The pathogen also occurs widespread on other genera of the families Cannaceae and Marantaceae [3]. In Mexico, this fungus was previously recorded on *Maranta arundinacea* [5]. However, this is the first report of *P. thaliae* causing rust on *Canna indica* in Mexico. This pathogen represents a serious threat to the health of *Canna* spp. in gardens and parks located in different cities of Mexico where this ornamental plant is commonly found.

### Conclusion

Based on morphological characterization and the fulfilment of Koch’s postulates, we identified *Puccinia thaliae* as the causal agent of rust on canna lily plants at an ornamental nursery in Cuautla, Morelos, Mexico. To our knowledge, this is the first report of rust caused by *Puccinia thaliae* on *Canna indica* in Mexico.
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