

Record of rust diseases of the Chrysanthemum, Gladiolus and Limonio in the Cochabamba Valley, Bolivia

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ABSTRACT

Flower production is an important economic activity in the Cochabamba Valley, Bolivia. Species and varieties of Roses (*Rosa* sp.), Chrysanthemums (*Chrysantemum* sp.), Carnations (*Dianthus carophyllus*), Gladiolus (*Gladiolus communis*), Saticias (*Limonium* sp.), Liliiums (*Liliums* sp.) etc. are grown. Rusts affect a variety of crops, including flowers. The aim of this study, was identify the rust diseases that is affecting to three important flower species. Stems and leaves of samples with characteristic rust symptoms of smallholder farmer parcels were collected between 2016 and 2018 of the *Chrysantemum grandiflorum*, *G. communis* and *Limonium* sp. Based on morphometric studies the causal agent of rust diseases was identify as the first record to *Puccinia horiana* on chrysanthemum, *Uromyces transversalis* on Gladiolus and *Uromyces limonii* on Limonio in the Cochabamba Valley, Bolivia.

Keywords: Fungi; Rust; Uredinales

INTRODUCTION

The Bolivian Inter Andean Valleys (2000 - 3000 meters above sea level), due to its favorable weather, soil conditions and water availability, are suitable for the vegetables and flowers production. Currently, in the Central and Lower Cochabamba Valley of department, Bolivia, flower production is an important economic activity. Species and varieties of Roses (*Rosa* sp.), Chrysanthemums (*Chrysantemum* sp.), Carnations (*Dianthus carophyllus*), Gladiolus (*Gladiolus communis*), Saticias (*Limonium* sp.), Liliiums (*Liliums* sp.) etc. are grown for the local market and a small part for export. Smallholder farmers mostly grown in the "open field" and for export are grown under cover [1].

One of the limiting factors in the flowers production are the fungal diseases. Fungi, like rust disease, are destructive. Globally they are considered one of the most serious threats to agriculture [2]. Rusts affect a variety of crops, including flowers. According to Buritica et al, [3] in Colombia, rusts affect different flowers species and some such as Gladiolus rust is considered of plant quarantine in Europe and the United States [4]. At present rust affects several flowers species, they have widespread distribution and cause production losses in the Cochabamba Valley. However, there are only isolated reports of rust disease for

Bolivia. Otazu et al. in the "Plant diseases in Bolivia" reported only to carnation rust caused by *Uromyces caryophyllinus* [5]. The aim of this study, was identify the rust diseases that is affecting to three flower species by morphological details of urediniospores and teliospores collected from natural infections in the farmers' field in the Cochabamba Valley, Bolivia.

MATERIALS AND METHODS

Stems and leaves of samples with characteristic rust symptoms of smallholder farmer parcels were collected between 2016 and 2018 of the *Chrysantemum grandiflorum*, *G. communis* and *Limonium* sp. of the Cochabamba Valley (Municipalities of Tirani, Tiquipaya, Quillacollo, Vinto y Sipe Sipe). This valley, is delimited approximately by the following UTM-coordinates Latitude 8083000 - 8070000 N and Longitude 780000 - 800000 W, to 2550 msnm altitude, 450 to 550 mm of rain and average annual temperature 17°C, with a minimum of 5°C and maximum of 34 oC. The fungi causing rusts were identified examining pustules under a Stereomicroscope and urediniospores and teliospores formed in the pustules was examined Under Light Microscopic staining with lactophenol

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methylene blue using the taxonomic keys and indicators of different authors as indicated below.

RESULTS AND DISCUSSION

Chrysanthemum rust

The pustules were formed mostly on the lower side of the leaves (Figure 1A,B,C). On the leaves or stems were not found other

spore state of the rust fungi. According to Hernandez et al. Spermogonia, aecia and uredinia unknown [6]. Telia hypophyllous, compact, yellowish, 2-3 mm diameter, often clustered in irregular pattern. The teliospores were thin walled, bicelled, pedicellate, pale yellow, oblong to oblong-clavate, $30-50 \times 10-16 \mu\text{m}$, slightly constricted at the septum, smooth; pedicel hyaline persistent, up to $45 \mu\text{m}$ long (Figure 1D). According to Hernandez et al [4] and based on this morphometric studies the causal agent is *Puccinia horiana* Henn.

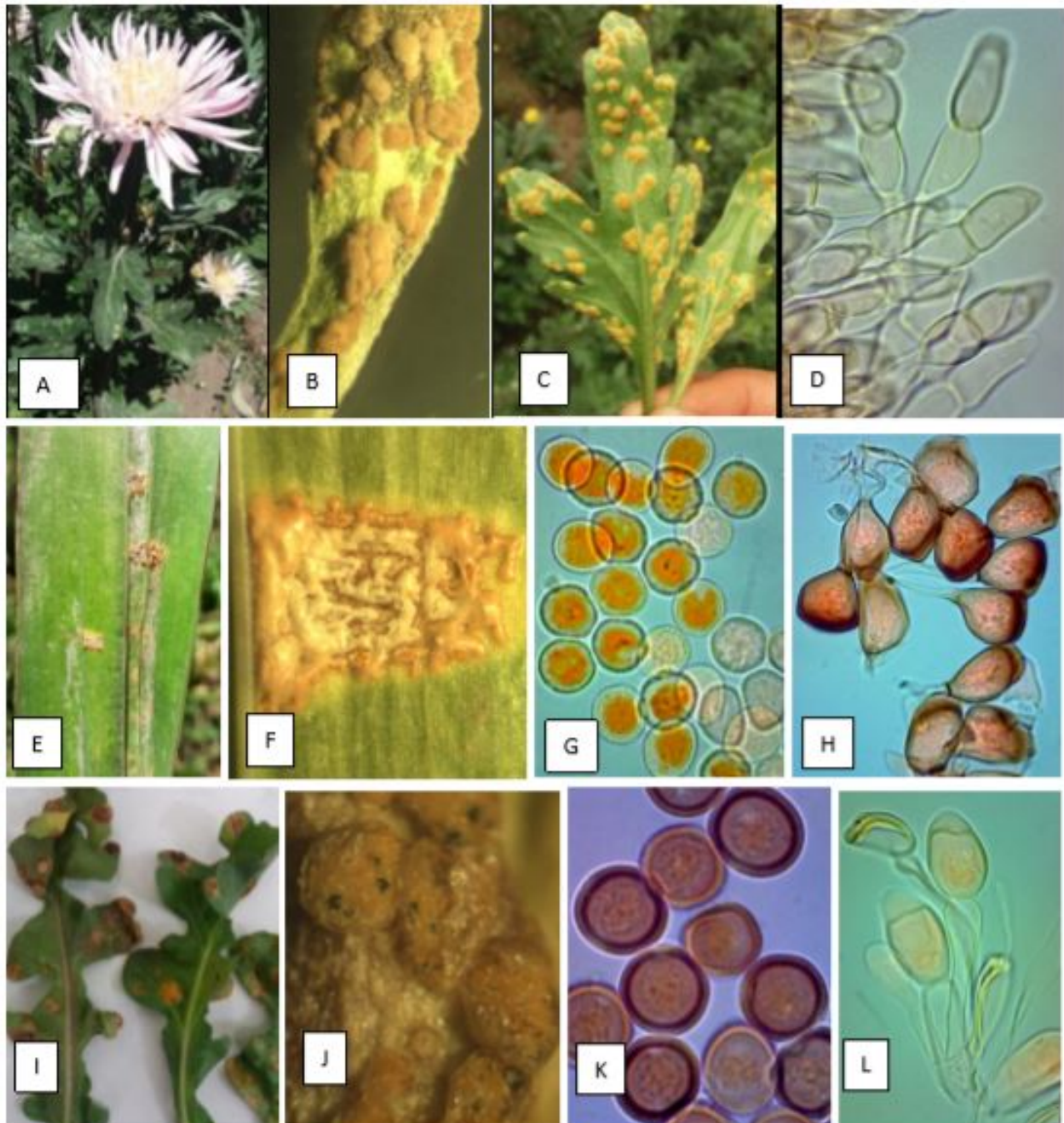


Figure 1: A: *Chrysanthemum rust* pustules (*Ch. grandiflorum*) caused by *P. horiana*; B: Telia pustules deforming leaf; C: Pustules on leaf; D: Hyaline and bicelled teliospores (400X); E: *Gladiolus rust* pustules caused by *U. transversalis*; F: Uredinia and telia Pustule; H: Unicellular urediniospores (400X); I: Unicellular teliospores (400X); I: *Limonium rust* (*Limonium sp.*) caused by *Uromyces limonii*; J: Uredinia pustules; K: Unicellular urediniospores (400X); L: Unicellular teliospores with pedicels (400X).

Gladiolus rust

The pustules are formed on the leaves, yellowish-orange, typically transverse (Figure 1E). Uredinia amphigenous, 0.5-3.5 mm long and 0.5-2 mm broad, sori at first covered by the blistered epidermis which finally splits (Figure 1F); urediniospores variable in form and size, globose, ovate, or oblong, 18-22 × 15-23 μm, sub hyaline to yellowish-pale, cell wall hyaline, typically 1.3-2.5 μm thick, closely and minutely verruculose; germ pores obscure scattered (Figure 1G). Telia amphigenous, minute, black in small or larger lineal groups, remaining covered by the epidermis, which may be scattered, often grouped and loculate, separated by a zone of golden-brown, palisade-like paraphyses, 50-112.5 μm diam., 55-75 μm deep with spores in 3-4 closely packed rows (Figure 1F). Teliospores ovate, ellipsoid or pyriform, less frequently globose, often irregular or angular through mutual pressure, light brown, darker (often chestnut brown) near the apex, apex rounded, truncate or broadly conical, base usually attenuate, less frequently rounded; (17.5-) 20-25 (-34) × (14-) 15-17.5 (-21) μm, cell wall smooth, usually 2 μm thick, 4-6 (-8) μm at the apex; pedicel semipersistent, hyaline or tinted at the apex, 45 μm long and 3 μm thick (Figure 1H). According to symptoms and uredinia and telia description is *Uromyces transversalis* (Thüm.). Spermogonia and aecia not was observed and according Hernandez et al. [4], this spore states are unknown.

Limonium rust

The pustules are formed on the leaves and stems, are yellowish and reddish-brown and irregular form (Figure 1I,J). Uredinia amphigenous, pulverulent and orange, mm, sori at first covered by the blistered epidermis which finally burst (Fig. 1K). Urediniospores variable in form and size, ellipsoide or globose and minutely echinulate. Telia amphigenous similar to uredinia, black-brown (Figure 1K). Teliospores (22-28 μm length and 20-24 μm in wide) oblong to ellipsoid, unicellular, rarely ovate, color yellow-orange to light brown. the wall is light brown,

smooth and thick or thicker at the top. The pedicel is hyaline (50 μm) (Figure 1L). Spermogonia and Aecial phase not was observed and according Garcia-Hernandez et al. [7] this spore state are unknown. Therefore, based on this description and according to Garcia-Hernandez et al. [2] the causal agent is *Uromyces limonii* (D.C.) Lev. 1849.

CONCLUSION

These are the first record of the following rust disease affecting several species flowers, *P. horiana* on chrysanthemum, *U. transversalis* on Gladiolus, *U. limonii* on *Limonium* sp. in the Cochabamba Valley, Bolivia.

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