USTILAGO TRICHOPHORA (H.F. LINK) F. KÖRNICKE, 
A FUNGUS NEWLY FOUND IN POLAND

Tadeusz Madej, Janusz Błaszkowski, Mariusz Tadych
Department of Plant Pathology, University of Agriculture,
Slowackiego 17, 71-434 Szczecin, Poland
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ABSTRACT

_Ustilago trichophora_, a smut fungus found for the first time in Poland, is characterized and illustrated. _Ustilago trichophora_ affected _Echinocloa crus-galli_ growing in the Lower Silesia voivodeship. In laboratory investigations, the germinability of teliospores, the morphological properties of promycelium, sporidia and colonies produced on potato dextrose agar, Sabouraud-glucose agar, and in water were determined. Attempts to infect seeds and seedling of _E. crus-galli_ in a greenhouse pot experiment failed.

KEY WORDS: _Echinocloa crus-galli_, _Ustilago trichophora_.

INTRODUCTION

In Poland, the genus _Echinocloa_ P. Beauv. of the family Poaceae is represented only by _E. crus-galli_ (L.) Beauv. This plant is an annual spring weed growing in fertile, humid, sand-leamy or sand-humous soils of a low content of calcium. It needs a high temperature for germination and warm days at maturation (Mowszowicz 1976).

Literature data indicate that two species of the order Ustilaginales, i.e., _Moesziomyces bullatus_ (J. Schrötl.) K. Vánky and _Ustilago trichophora_ (H.F. Link) F. Körnicke, are among the fungi associated with above-ground parts of _E. crus-galli_ (Farr et al. 1989; Vánky 1994).

_Moesziomyces bullatus_ has been found in Poland to parasitize on _E. crus-galli_ growing in many sites (Kochman and Majewski 1973). According to Harr et al. (1989), other hosts of _M. bullatus_ are species of the genera _Pennisetum_ Rich. ex Pers., _Leersia_ Sw., and _Paspalum_ L. However, in Europe, this fungus affects only _Echinocloa_ spp. (Vánky 1994).

_Ustilago trichophora_ has been recorded in North America, south Europe, Africa, Asia, and Australia (Vánky 1994). The European host of this fungus is _E. crus-galli_ (Vánky 1994).

During collection of diseased plants, _E. crus-galli_ affected by a smut fungus was found. Laboratory examination revealed the pathogen to be _U. trichophora_, a fungus found for the first time in Poland.

The aim of this paper is to characterize and illustrate _U. trichophora_ based on its structures associated with the plants affected and investigations conducted in a laboratory and a greenhouse.

MATERIALS AND METHODS

The morphology of _U. trichophora_, its development in the host plant, and the properties of the infections formed were examined with a naked eye and under a light microscope using sections cut from the diseased tissues.

The _in vitro_ development of _U. trichophora_ was observed on potato-dextrose agar (PDA; Difco), Sabouraud-glucose agar (Sabra), and in water. Color names are from Komerup and Wanscher (1983). Specimens are deposited in the Department of Plant Pathology (DPP), University of Agriculture, Szczecin, Poland.

To examine the development of the fungus in a plant, inoculation experiments were conducted in pot cultures. The inoculation was performed twice. At first, seeds of _E. crus-galli_ were mixed with teliospores of _U. trichophora_ coming from diseased plants and seeded. The inoculum of the second inoculation was a water suspension of sporidia produced on PDA. This suspension was sprinkled on 18-day-old seedlings of _E. crus-galli_. The plants grew at 23±2°C and a day light for 34 days.

RESULTS AND DISCUSSION

Symptoms

Olive yellow (2D8) to yellowish brown (5F8), 8-14×16-23 mm, knobby outgrowths of a rouged surface, covered with a dense tomentum of the host plant are present on stems, especially directly above nodes (Figs 1, 2).

Development of sori

The development of sori begins with a local condensation of mycelium in the outer parenchymal cells. At these sites, the hyphal mycelium converts into a gel (Fig. 3) that then develops into sori with teliospores (Figs 4-6). The teliospores are subglobose; 6.1-9.6 μm diam; sometimes elliptic, 4.4-6.9×8.1-12.7 μm, of a greyish orange (5B3) to brownish yellow (5C7) colour (Fig. 9). The spore wall is ornamented with warts of a different size.
The properties of the teliospores correspond with those given by Brandenburger (1985), Blumer (1963), and Vánky (1994).

The sori are covered with 6-15 layers of parenchymal cells deformed due to hypertrophy and hyperplasia. The cells are almost hyaline, lack cytoplasm, and usually contain remnants of the mycelium. The integuments, even wider than 50 μm, burst when teliospores are mature.

The living cells neighbouring the sori are colonized by hyphae developing only intracellularly. The hyphae are hyaline, 2.0-3.5 μm wide, and have many short branches ended with haustoria of different shapes (Figs 7, 8). According to Vánky (1994), U. trichophora forms intercellular hyphae with ramified haustoria.

The cells located some centimeters from the swellings lack hyphae of the parasite. Thus, U. trichophora probably colonizes locally its host plant, similarly as, e.g., U. maydis (A.P. de Candolle) A.C.I. Corda.

Collection examined: Poland, Rakowice Wielkie, the Lwówek administrative district (the Lower Silesia voivodeship), on stems of E. crus-galli growing as a weed in a culture of Beta vulgaris L.; leg.: Anna Skwarkowska, in the third decade of August of 1999. Specimens of E. crus-galli collected in the Westpomeranian voivodeship in 1999 did not harbour neither M. bullatus nor U. trichophora.

Distribution
In Poland, U. trichophora was found associated with E. crus-galli growing in Rakowice Wielkie. According to Vánky (1994), this fungus has a worldwide distribution.

In vitro development
The germinability of teliospores on PDA, SabA and in water after 6 months of storage in dry conditions ranged from 14 to

Figs 1-6. Ustilago trichophora. 1 and 2. Sori in infected stems of Echinochloa crus-galli, x2. 3-6. Stages of development of sori from a gel form (3) to differentiating teliospores (6); Fig. 3, bright field microscopy (BFM), x720. Figs 4 and 5, differential interference contrast (DIC), both x1070; Fig. 6, DIC, x1428.
35%. The percent of germination was higher when the teliospores occurred in aggregates. Single teliospores germinated infrequently. On PDA, SabA, and in water, the teliospores produced a promycelium after 16-24 h. The promycelium usually is one-celled; sometimes it is branched at the spore base (Fig. 10). Sporidia form at the tip of the promycelium by budding. Setchall and Brefeld (in Vánky 1974) informed that the promycelium of *U. trichophora* is two-celled. The promycelium subsequently developed into colonies.

On PDA, after 3 weeks of growth, *U. trichophora* produced yellowish white (4A2) to orange white (5A2), compact, surface colonies of a diameter of 3-3.5 cm (Fig. 11) with a cream (4A3) to butter yellow (4A5) reverse. The aerial mycelium of these colonies formed branched, hyaline hyphae, 2-2.5 μm wide, consisting of longitudinally ellipsoidal, hyaline cells with a granular content. With age, the colonies became leathery, and their aerial mycelium produced numerous globose to oval conglomerations due to the fragmentation of the hyphae.

On SabA, the colonies of *U. trichophora* were compact, powdery to slimy, of an orange (5B8) to yellowish brown (5D8) colour (Fig. 12); with age, their aerial mycelium also fragmented into globose, hyaline to flavus pieces.

The attempts to infect *E. crus-galli* by both the inoculation of seeds with teliospores and seedlings with a water suspension of sporidia failed.

**LITERATURE CITED**


USTILAGO TRICHOphORA (H.F. LINK) F. KÖRNICKE,
NOWY GRZYB DLA POLSKI

STRESZCZENIE

Scharakteryzowano i zilustrowano Ustilago trichophora, grzyba głównego znalezionego po raz pierwszy w Polsce. Ustilago trichophora występowała na Echinochloa crus-galli rosnącej na Dolnym Śląsku. W badaniach laboratoryjnych określono zdolność kielkowania zarodników, cechy morfologiczne promycelium, sporidiów i kolonii wyrosłych na agarze dekstrozowo ziemiaczanym, podłożu Sabourauda z glukozą i w wodzie. Próby zainfekowania nasion i siewek E. crus-galli w doświadczeniach szkolnionych nie powiodły się.

SŁOWA KLUCZOWE: Echinochloa crus-galli, Ustilago trichophora.