



First appearance of smut disease on woodland tulip, *Tulipa sylvestris*, in Iran

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Abstract

Tulips (*Tulipa* spp.) are popular species of bulbous plant belonging to the family Liliaceae. Tulips are ornamental plants commonly used as cut flowers, potted plants, and a garden favourite. During late April 2015, signs and symptoms of a smut disease were observed for the first time on wild grown woodland tulip, *T. sylvestris*, in the campus of the University of Tabriz (East Azarbaijan Province, Iran). Based on morphological characteristics, the pathogen was identified as *Vankya heufleri*. This study provides the first report on the occurrence of this fungus on *T. sylvestris* in Iran.

Key words – leaf smut – Liliaceae – teliospores – *Tulipa sylvestris* – *Vankya heufleri*

Introduction

Tulipa L. (tulips) is a genus of bulbous plants belonging to the family Liliaceae. Tulips are a popular ornamental plant commonly used as cut flowers, potted plants, and garden favourite (Christenhusz et al. 2013). Members of this genus occur in Eurasian and North African regions ranging from south-western Europe and North Africa to Asia, from Anatolia and Iran to northeast China and Japan and North Africa. About 75 wild species are known in this genus (Christenhusz et al. 2013). In a survey of foliar disease of tulips in north-western Iran, smut disease symptoms and signs were observed on woodland tulips in the campus of the University of Tabriz, Iran. Symptoms appeared as elongate pustules on the leaves, initially covered by a thin, translucent membrane, which later ruptured and exposed blackish brown, dusty spore mass. We describe the causal agent and provide an update on smut diseases of *Tulipa* spp. in Iran.

Materials & Methods

Isolates and morphology

During late April 2015, signs and symptoms of a smut disease were observed for the first time on wild grown woodland tulip, *T. sylvestris* L., in the campus of the University of Tabriz (East Azarbaijan Province, Iran). Infected leaves were collected in paper bags and taken to the laboratory. Fungal structures were mounted in distilled water and examined at 1000× magnification. Microscopic observations were made using an Olympus-BX41 light microscope. Thirty measurements were made for each microscopic structure and 95% confidence intervals were

calculated for the measurements with the extremes given in parentheses. High-resolution photographs of microscopic fungal structures were captured using an Olympus digital camera system (DP 25) and software to analyze photographs.

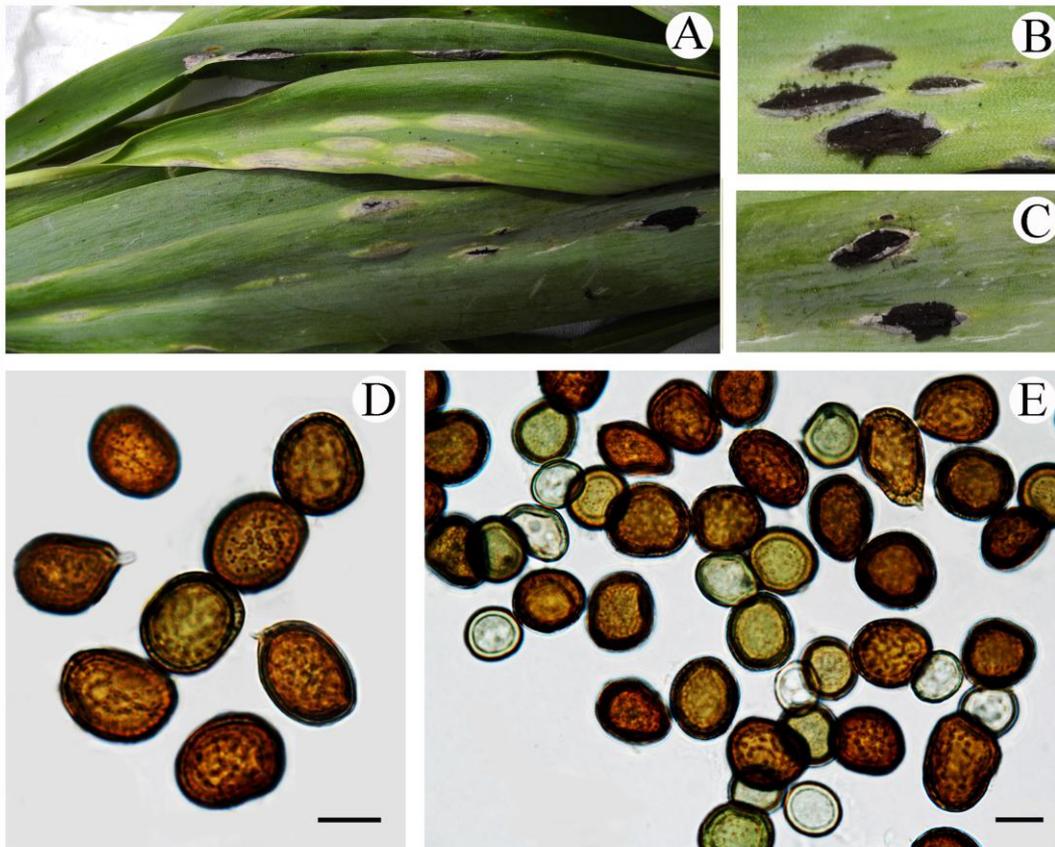


Fig 1 – *Vankya heufleri*: A–C Sori on adaxial leaf surface as elongate pustules, D–E Teliospores and sterile cells. – Scale bars (D–E) = 50 μ m.

Results

Based on a combination of morphological features and host-plant association the causal agent was identified as *Vankya heufleri* (Vánky & Abbasi 2013).

Vankya heufleri (Fuckel) Ershad, Rostaniha 1: 68, 2000.

\equiv *Ustilago heufleri* Fuckel, Jahrbücher des Nassauischen Vereins für Naturkunde 23–24: 39, 1870.

Sori on adaxial leaf surface as elongate pustules (2–)6–9.5(–15) mm long, initially covered by a thin translucent membrane, the membrane later split irregularly and blackish brown, dusty spore mass exposed (Fig. 1A–C). The spore mass contains teliospores and sterile cells. Teliospores olive-brown, globose, subglobose to ovoid or slightly irregular, (12–)14–15(–17) \times (15–)16.5–18(–23) μ m, occasionally with a short pedicel; spore wall composed of two layers: a dark brown inner layer approximately 0.5 μ m thick, and yellowish outer layer 1–2.5 μ m thick, the inner layer contains sparse, unevenly dispersed 1–2 μ m high spines, embedded in the outer layer (Fig. 1D). The spines are often arranged in irregular rows or groups and sometimes reach the spore surface. Sterile cells often solitary, indistinct, subglobose, ellipsoidal, to somewhat irregular, (11–)12–13(–15) \times (10–)11–12(–13) μ m, yellowish to pale olivaceous brown, wall one-layered, evenly or somewhat unevenly thickened, 1.5–3 μ m wide, smooth (Fig. 1E). Spore germination was not observed. The host range of *Vankya* species is presented in Table 1.

Table 1 Hosts and origin of *Vankya* species (retrieved from <http://nt.ars-grin.gov/fungaldatabases>)

Species	Hosts	Origin
<i>Vankya heufleri</i>	<i>Erythronium albidum</i>	USA
	<i>E. americanum</i>	USA
	<i>Tulipa biebersteiniana</i>	Russia, Iran
	<i>T. biflora</i>	Iran
	<i>T. humilis</i>	Iran
	<i>T. montana</i>	Iran
	<i>T. montana</i> var. <i>chrysantha</i>	Iran
	<i>T. polychroma</i>	Iran
	<i>T. schrenkii</i>	Russia
	<i>Tulipa</i> sp.	Iran, Russia
	<i>T. sylvestris</i>	Austria, Russia
<i>Vankya lloydiae</i>	<i>Lloydia triflora</i>	Russia
<i>Vankya ornithogali</i>	<i>Gagea arvensis</i>	Sweden
	<i>G. bohemica</i>	Czech Republic
	<i>G. confusa</i>	Iran
	<i>G. dubia</i>	Iran
	<i>G. fistulosa</i>	Iran
	<i>G. gageoides</i>	Iran
	<i>G. lutea</i>	Finland, Poland
	<i>G. minima</i>	Germany, Poland
	<i>G. pratensis</i>	Germany, Poland
	<i>G. pusilla</i>	Hungary
	<i>G. reticularis</i>	Israel
	<i>Gagea</i> sp.	Iran, Israel
	<i>G. spathacea</i>	Poland
<i>Ornithogalum pratense</i>	Germany	

Discussion

The causal agent was identified as *Vankya heufleri* based on morphology and host-plant association. The morphology, as well as the host, is in agreement with published descriptions (Ershad 2000, Vánky & Abbasi 2013). The genus *Vankya* was erected by Ershad (2000) to accommodate fungi that cause smut diseases on Liliaceae s. lat.; the species had been previously treated as *Ustilago* (Pers.) Roussel. The genus *Ustilago* is now restricted to species infecting plants in the family Poaceae (Vánky 2009). Ershad (2000) transferred three species into *Vankya* viz., *V. heufleri*, *V. ornithogali* (J.C. Schmidt & Kunze) Ershad and *V. vaillantii* (Tul. & C. Tul.) Ershad, while Vánky (2009) described a fourth species, *V. lloydiae* Vánky, on *Lloydia triflora* (Ledeb.) Baker. The concept of the genus *Vankya* was later narrowed to restrict it to species on leaves and stems of liliaceous plants. *Vankya vaillantii*, which infects flowers, was transferred to a new genus *Antherospora* R. Bauer et al. (Bauer et al. 2008).

To the best of our knowledge, this is the first report on the occurrence of smut disease caused by *V. heufleri* on *T. sylvestris* in Iran, although *V. heufleri* has been reported on other species of *Tulipa* in Iran. *Vankya heufleri* has been previously reported on *T. sylvestris* from Austria (Vánky 2009) and European part of Russia (Karatygin 2012), but our study is the first report on the occurrence of *V. heufleri* on *T. sylvestris* in Asia.

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