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VANKYA VAILLANTII (USTILAGINOMYCETES) ON *SCILLA* IN CENTRAL EUROPE

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Abstract. The paper describes and illustrates *Vankya vaillantii* (Tul. & C. Tul.) Ershad on *Scilla vindobonensis* Speta subsp. *vindobonensis*, *Scilla vindobonensis* subsp. *borhidiana* Z. Kereszty and a hexaploid population of *S. bifolia* agg. from Austria, Hungary and Slovakia. Some information on spore characters of *Vankya vaillantii* from different host plants is provided. The taxonomy and distribution of this smut fungus in Central Europe are discussed.

Key words: *Vankya*, Urocystaceae, smut fungi, *Scilla bifolia* agg., Central Europe

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INTRODUCTION

Vankya vaillantii (Tul. & C. Tul.) Ershad (Urocystales, Ustilaginomycetes) is a parasitic fungus affecting members of the genera *Albuca*, *Bellevalia*, *Chionodoxa*, *Eucomis*, *Hyacinthus*, *Muscari*, *Puschkinia*, *Scilla*, *Urginea* and *Ornithogalum pyrenaicum* L. worldwide (Vánky 1994). The fungus systemically infects anthers of host plants. The anthers are enlarged, olivaceous-brown, with sori producing a dark olive brown powdery mass of spores. Recent taxonomical studies on *Scilla bifolia* agg. populations in Slovakia and surrounding countries revealed the occurrence of many infected flowers of *Scilla* with symptoms of the smut fungus *Vankya vaillantii*. Thus, *Scilla vindobonensis* Speta subsp. *vindobonensis* and *S. vindobonensis* subsp. *borhidiana* Z. Kereszty appeared to be new host plants for *Vankya vaillantii*. In this paper, the anatomy and morphology of this fungus in populations of *Scilla bifolia* agg. were studied in order to confirm the occurrence of *Vankya vaillantii* in these new fungus/host combinations. The taxonomy and distribution of this smut fungus in Central Europe are briefly reviewed.

MATERIAL AND METHODS

Plants of *Scilla* spp. infected by *Vankya vaillantii* were collected by the authors and co-workers, and are listed in the 'Specimens examined' section. All the studied specimens are deposited in the Mycological Herbarium of the Institute of Botany, Slovak Academy of Sciences, Bratislava (SAV). For comparison, specimen no. 768 from *Flora Exsiccata Austro-Hungarica* housed in KRAM has been included in scanning electron microscopy (SEM) studies. The smut fungus was identified according to Vánky (1985, 1994) and Ershad (2000), and host plants according to Kereszty *et al.* (1986) and Kochjarová *et al.* (2004).

The method described earlier by Bacigálová (1992) was used for identification of the anatomical and morphological characters of *Vankya vaillantii*. For observations, a Zeiss light microscope with a microphotographic

attachment was employed. For spores from sori, 100 spores were measured. In the text the following abbreviations are used: LM – mean spore length (arithmetical mean of all spores, μm), WM – mean spore width (arithmetical mean of all spores, μm), Q – quotient of mean spore length and mean spore width (LM/WM ratio), ($n = x/y$) x measurements of spores from y specimens (after Niemelä 1998).

For SEM studies, dry spores were mounted on clean glass and affixed to an aluminum stub with double-sided transparent tape. The stubs were sputter-coated with carbon using a CRESSINGTON sputter-coater and viewed with a Hitachi S-4700 scanning electron microscope at a working distance of 12–13 mm.

Results and discussion

Vankya vaillantii (Tul. & C. Tul.) Ershad

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= *Ustilago vaillantii* Tul. & C. Tul., Ann. Sci. Nat. Bot. III **7**: 90. 1847.

Smut fungus symptoms. The fungus infection is systemic. The symptoms are not readily visible before plant flowering. During March, in infected plants the anthers are enlarged and covered with silvery epidermis. The sori are in the anthers, replacing them with a dark olive-brown powdery spore mass.

Anatomical and morphological characters of the fungus. Spores vary considerably in size and shape: globose, ovoid, elongated and irregular, pyriform, curved or subpolyhedral (Figs 1 & 3). Globose and subglobose spores 6–15 μm, ovoid to elongated spores 6–15 μm long, 6–10 μm wide (average 7.8 × 9.3 μm in diam.) (Tables 1 & 2). Spores olive-brown, spore wall 0.5 μm thick, finely and densely verruculose (Figs 1 & 3).

Germination. Spores germinated in four-celled basidia (uppermost three-celled part separating from the basal cell) and apically elongated basidiospores that budded (Fig. 2).

Specimens examined. On *Scilla vindobonensis* Speta subsp. *vindobonensis*: AUSTRIA. Maria–Lanzendorf village, mixed forest S of village, near road to Himberg village, 22 Mar. 2004, *leg. J. Vlčko & J. Kochjarová*; HUNGARY. Dunaalmás village, 19 Mar. 2003, *leg. J. Kochjarová & J. Vlčko*; SLOVAKIA. Podunajská nížina lowland: Chynorany village, Chynoriansky luh Nature Reserve, 26 Mar. 2004, *leg. J. Kochjarová*; Čičov village, in park near manor house, 12 Mar. 2003, *leg. R. Hrivnák, J. Kochjarová & J. Vlčko*; Gabčíkovo village, near research station of Forest Research Institute, 12 Mar. 2003, *leg. J. Kochjarová*; Jarovce/Kittsee villages, *leg. J. Vlčko, R. Hrivnák, I. Ondrášek, M. Ujházyová & K. Ujházy*; Rusovce village, in park near manor house, 13 Apr. 2003, *leg. K. Bacigálová*; on *Scilla vindobonensis* subsp. *borhidiana* Z. Kereszty: HUNGARY. Mecsek Mts, Pécs, Misina hill, 10 Mar. 2002, *leg. J. Vlčko, R. Hrivnák & K. Ujházy*; On hexaploid population of *Scilla bifolia* agg.: SLOVAKIA. Malé Karpaty Mts: Dubová village, oak wood near calvary, NW of village, 29 Mar. 2004, *leg. J. Vlčko, R. Hrivnák & J. Kochjarová*; On *Scilla bifolia* agg.: AUSTRIA. Salisburgia, in dumetis ad Juvaviam, *leg. Eysn*, in *Flora Exsiccata Austro-Hungarica* no. 768.

Vankya vaillantii belongs to the recently described genus *Vankya* Ershad, which also includes two other species parasitizing Liliaceae, namely *V. heufleri* (Fuckel) Ershad and *V. ornithogali* (J. C. Schmidt & Kunze) Ershad. The new taxonomic position for these fungi has been defined by Ershad (2000), who transferred them from the genus *Ustilago* (Pers.) Roussel, based on the fungus/host plant physiological specialization on Liliaceae and their anatomical and morphological characteristics (Ershad 2000). Much earlier, Blanz and Gottschalk (1984) used molecular methods to compare 5S rRNA nucleotide sequences of different basidiomycetous fungi, and demonstrated differences between species parasitizing monocots and dicots, as was done in later studies of Bauer *et al.* (1997) and Begerow *et al.* (1998). In consequence the heterogeneous genus *Ustilago* was split into new, more natural genera (Vánky 2002,

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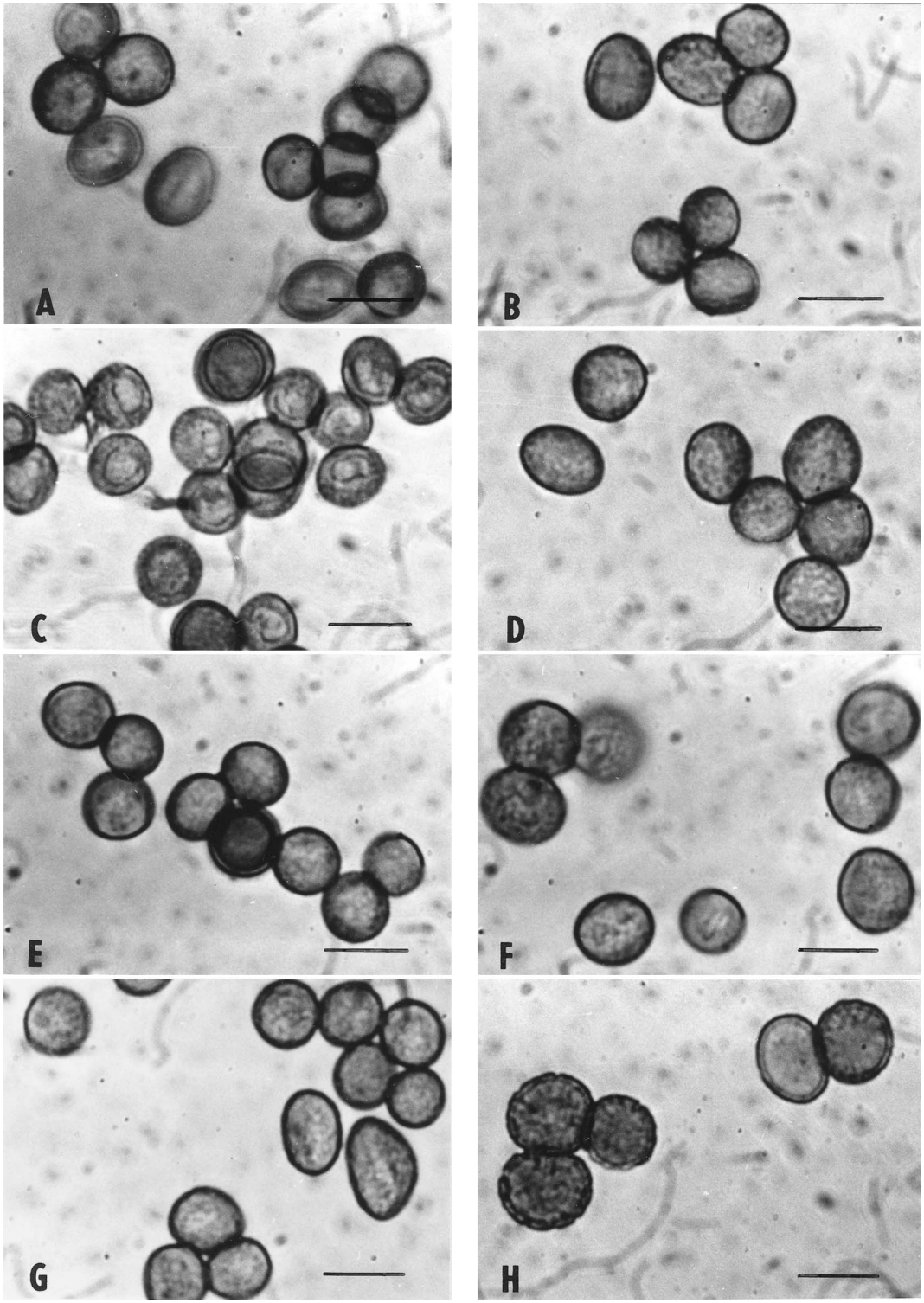
Fig. 1. LM micrographs of spores of *Vankya vaillantii* (Tul. & C. Tul.) Ershad on *Scilla* spp.: A – on *S. vindobonensis* s. str. (Dunaalmás collection), B – on *S. vindobonensis* s. str. (Čičov collection), C – on *S. vindobonensis* s. str. (Gabčíkovo collection), D – on *S. vindobonensis* (Jarovce collection), E – on *S. vindobonensis* s. str. (Maria–Lanzendorf collection), F – *S. vindobonensis* s. str. (Chynorany collection), G – *S. bifolia* agg. (Dubová collection), H – *S. vindobonensis* subsp. *borhidiana* (Mecsek Mts collection). Scale bars = 10 μm.


A
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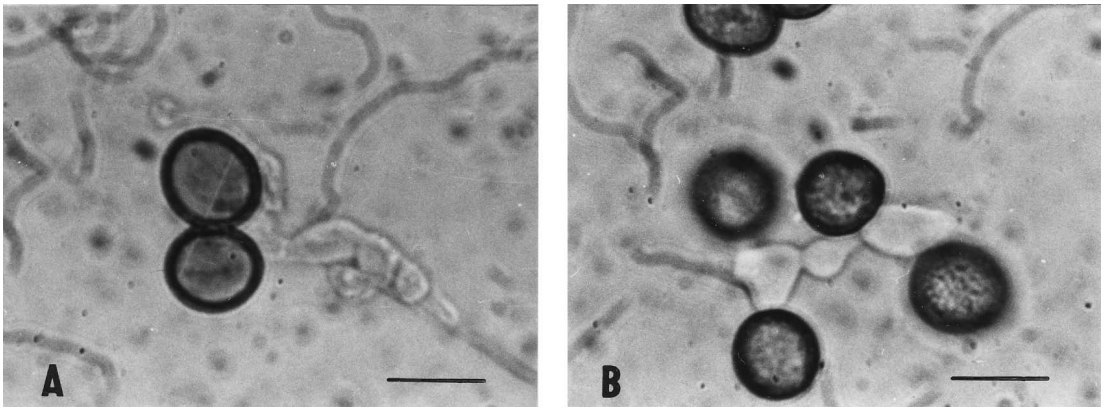

Fig. 2. *Vankya vaillantii* (Tul. & C. Tul.) Ershad on *Scilla vindobonensis* – germinating spores with septate basidium and terminal basidiospores: A – on *S. vindobonensis* subsp. *borhidiana* (Mecsek Mts collection), B – on *S. vindobonensis* s. str. (Rusovce collection). Scale bars = 10 μm.

and literature therein). The smut fungi belonging to the genus *Vankya* are identified on the basis of characters of the sori and the anatomical and morphological features of spores. No molecular methods have been used in taxonomic studies of *Vankya* species until now.

In Central Europe, *Scilla bifolia* agg. includes *S. bifolia* L., *S. drunensis* (Speta) Speta, *S. kladnii* Schur, *S. spetana* Z. Kereszty and *S. vindobonensis* Speta, which had not been differentiated before the 1970s. Therefore, some older data about the occurrence of *Vankya vaillantii* on host plants of

Table 1. Comparison of spore length and width (μm) of *Vankya vaillantii* (Tul. & C. Tul.) Ershad on *Scilla vindobonensis* Speta subsp. *vindobonensis*, *S. vindobonensis* subsp. *borhidiana* Z. Kereszty and *S. bifolia* agg. at various locations: A – Austria, H – Hungary, SR – Slovakia; L – length, W – width. Numbers in rows indicate the number of spores with particular dimensions.

Location of the fungus	Host plant	Measured magnitude of length and width of 100 spores in μm								
			6	7	8	9	10	11	12	15
Maria–Lanzendorf (A)	*S. vindobonensis*	L	1	36	35	20	2	5	1	
		W	4	77	17	2				
Dunaalmás (H)	*S. vindobonensis*	L		38	26	30	3	1	2	
		W	1	85	12	2				
Jarovce (SR)	*S. vindobonensis*	L		18	13	48	12	7	2	
		W	1	49	20	30				
Čičov (SR)	*S. vindobonensis*	L		22	25	34	3	14	1	1
		W		75	17	8				
Gabčíkovo (SR)	*S. vindobonensis*	L		22	31	32	10	3	2	
		W	1	65	22	10	2			
Rusovce (SR)	*S. vindobonensis*	L		21	16	43	14	6		
		W		64	18	18				
Chynorany (SR)	*S. vindobonensis*	L		14	20	52	8	5	1	
		W		40	31	29				
Mecsek Mts (H)	*S. vindobonensis* subsp. *borhidiana*	L		15	18	42	7	12	4	2
		W		55	13	20	12			
Dubová (SR)	*S. bifolia* agg.	L		46	20	28	3	3		
		W	2	79	14	5				

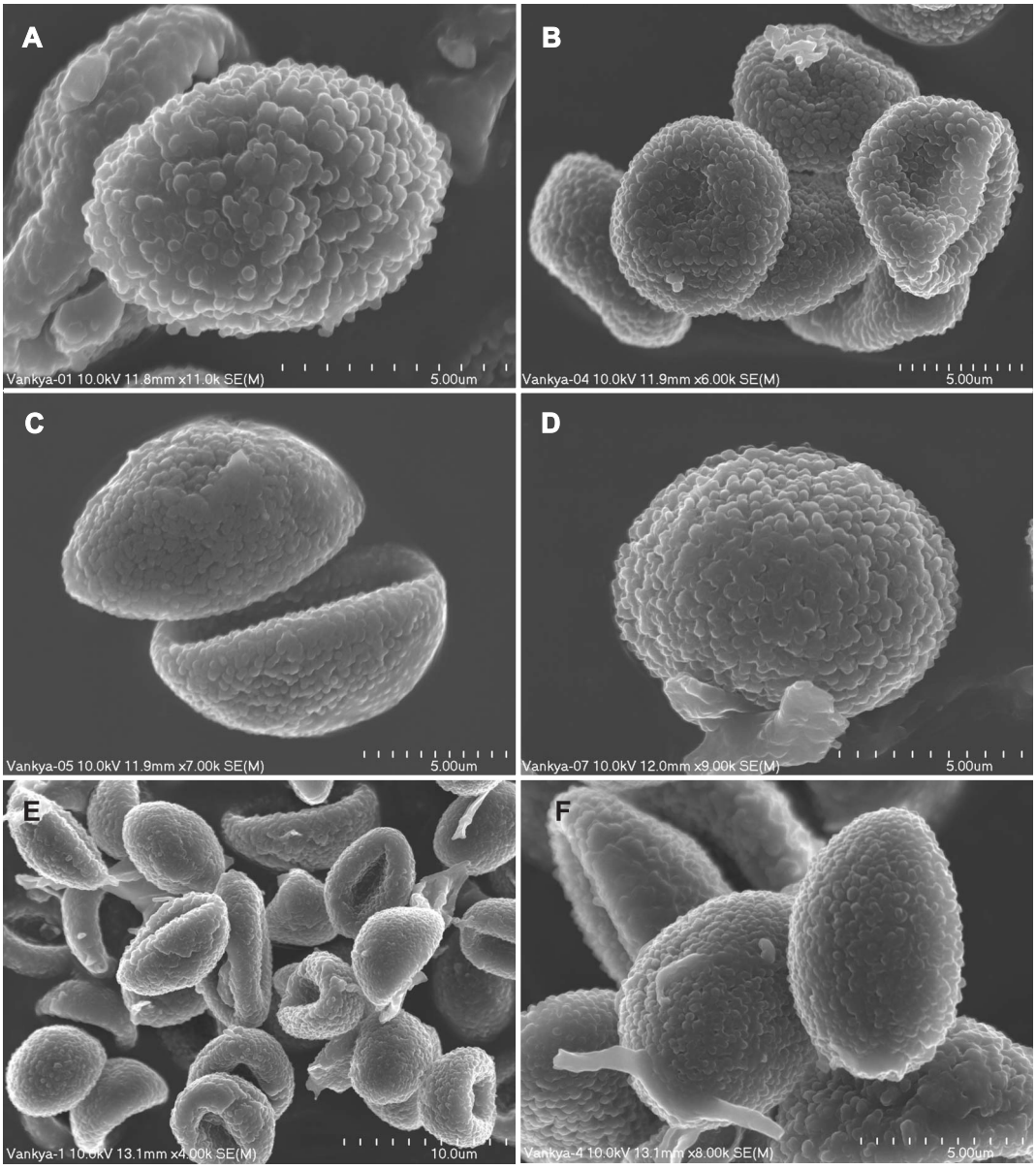

Fig 3. SEM micrographs of spores of *Vankya vaillantii* (Tul. & C. Tul.) Ershad on *Scilla* spp.: A–B – on *S. vindobonensis* s. str. (Dunaalmás collection), C–D – on S. *vindobonensis* subsp. *borhidiana* (Mecsek Mts collection), E–F – on *S. bifolia* agg. (Juvaviam collection, in *Flora Exsiccata Austro-Hungarica* no. 768).

Scilla bifolia agg. probably refer to some of those species, but we have no herbarium specimens for exact determination. For this reason, *S. vindobonensis* subsp. *vindobonensis* and *S. vindobonensis* subsp. *borhidiana* can be considered new host plants for *Vankya vaillantii*. Our comparison of the infection symptoms and anatomical and morphological characters of spores of *V. vaillantii* on *Scilla vindobonensis* subsp. *vindobonensis*, *S. vindobonensis* subsp. *borhidiana* and a hexa-

Table 2. Comparison of spores of *Vankya vaillantii* (Tul. & C. Tul.) Ershad associated with *Scilla* species from various locations: ML – arithmetical mean of length; MW – arithmetical mean of width; Q – quotient of mean spore length and mean spore width (ML/MW), n = 100/1, A – Austria, H – Hungary, SR – Slovakia.

Location of fungus	Host plant	ML	MW	Q
Maria–Lanzendorf (A)	*Scilla vindobonensis*	8.6	7.8	1.10
Dunaalmás (H)	*S. vindobonensis*	8.6	7.8	1.10
Jarovce (SR)	*S. vindobonensis*	9.3	8.4	1.10
Čičov (SR)	*S. vindobonensis*	9.2	8.0	1.14
Gabčíkovo (SR)	*S. vindobonensis*	8.9	8.2	1.08
Rusovce (SR)	*S. vindobonensis*	9.1	8.1	1.12
Chynorany (SR)	*S. vindobonensis*	9.2	8.5	1.08
Mecsek Mts (H)	*S. vindobonensis* subsp. *borhidiana*	9.3	8.5	1.09
Dubová (SR)	*S. bifolia* agg.	8.5	7.8	1.08

ploid population of *S. bifolia* agg. confirms the occurrence of *Vankya vaillantii* in association with these new taxa of host plants in the studied habitat conditions. The observations of anatomical and morphological characters are similar to those of Vánky (1985, 1994) and Ershad (2000). Comparison of the collections of *Vankya vaillantii* on *Scilla vindobonensis* s. str., *S. vindobonensis* subsp. *borhidiana* and *S. bifolia* agg. by SEM revealed that spore morphology and ornamentation essentially do not differ between particular fungus/host combinations.

In Central Europe, *Vankya vaillantii* is known from the lowland to submontane vegetative belts. It was recorded on *Scilla bifolia* L. by Vánky (1985) near Mosonmagyaróvár in Hungary, as well as in Romania and Yugoslavia. The rare occurrence of *Vankya vaillantii* on *Scilla* species in southern Austria was documented by Speta (1974, as *Ustilago scillae* Cif.) and recently in detail by Zwetko and Blanz (2004) in the whole of Austria. In Central Europe, *Vankya vaillantii* on *Scilla bifolia* was also reported as relatively rare from Germany (Scholz & Scholz 1988), while in Poland it was so far found only on *Muscari* species (Kochman & Majewski 1973). In Slovakia, *Vankya vaillantii* was first found on *Scilla bifolia* near a path on the right bank of the Danube in Ovsište (Habern; Bratislava, part Petržalka) and on *Muscari comosum* (L.) Mill. at a mountain location (Gebirg) near Bratislava (Bäumler 1890). Later, Součková (1952) found this fungus/host combination near Moravský Sv. Ján (Záhorská nížina lowland) and the Kováčovské kopce hills near Štúrovo. The fungus was also found by Maglocký on *Scilla bifolia* near Vinosady village, on Holubyho lúka meadow in the Malé Karpaty Mts (Paulech & Maglocký 1997). All the locations of *Vankya vaillantii* reported here have similar habitat conditions: areas with generally warm climate in the floodplain woods along the Danube basin, permanently supplied by soil moisture with a balanced water regime, to the foreland meadows of the Carpathians in southern Slovakia and Hungary and the Pannonian region in Austria. Further studies, possibly also in other regions of Europe, could establish whether these habitat conditions are most suitable for the occurrence of *V. vaillantii*.

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REFERENCES

BACIGÁLOVÁ K. 1992. *Taphrina potentillae* (Farl.) Johanson on *Parageum montanum* (L.) Hara – a new species in Slovakia. *Česka Mykol*. **46**(1–2): 138–142.

BAUER R., OBERWINKLER F. & VÁNKY K. 1997. Ultrastructural markers and systematics in smut fungi and allied taxa. *Canad. J. Bot.* **75**: 1273–1314.

BÄUMLER J. A. 1890. Beiträge zur Cryptogamen-Flora des Pressburger Comitates. *Verh. Vereins Natur-Heilk. Pressburg.*, *N. S.*, **2**: 62–126.

BEGEROW D., BAUER R. & OBERWINKLER F. 1998. Phylogenetic studies on nuclear large subunit ribosomal DNA sequences of smut fungi and related taxa. *Canad. J. Bot.* **75**(1997): 2045–2056.

BLANZ P. A. & GOTTSCHALK M. 1984. A comparison of 5S ribosomal RNA nucleotide sequences from smut fungi. *System. Appl. Microbiol.* **5**: 518–526.

ERSHAD D. 2000. *Vankya*, a new genus of smut fungi. *Rostaniha* **1**: 65–72.

KERESZTY Z., SZILÁGYI L. & BORHIDI A. 1986. Biosystematic studies of the *Scilla bifolia* complex in Hungary. *Uppsala Univ. Arsskr.* **27**: 107–112.

KOCHJAROVÁ J., VLČKO J. & HRIVNÁK R. 2004. Diploidné populácie *Scilla bifolia* agg. v Západných Karpatoch a priľahlej časti Panónskej nížiny. *Bull. Slov. Bot. Spoločn.*, *Bratislava*, *Suppl.* **10**: 171–175.

KOCHMAN J. & MAJEWSKI T. 1973. Basidiomycetes, Ustilaginales. In: J. KOCHMAN & A. SKIRGIEŁŁO (eds), *Flora Polska. Rośliny zarodnikowe Polski i ziem ościennych. Grzyby.* **5**. Państwowe Wydawnictwo Naukowe, Warszawa–Kraków.

NIEMELÄ T. 1998. The *Skeletocutis subincarnata* complex (Basidiomycetes), a revision. *Acta Bot. Fennica* **161**: 1–35.

PAULECH P. & MAGLOCKÝ Š. 1997. Huba *Ustilago vaillantii* Tul. et C. Tul. na *Scilla bifolia* L. *Bull. Slov. Bot. Spoločn.*, *Bratislava* **19**: 65–68.

SCHOLZ H. & SCHOLZ I. 1988. Die Brandpilze Deutschlands (Ustilaginales). *Englera* **8**: 1–691.

SOUČKOVÁ M. 1952. Příspěvek k poznání rzi a snětí v Československu II. *Čas. Morav. Musea, Brno* **37**: 88–101.

SPETA F. 1974. Cytotaxonomische und arealkundliche Untersuchungen an der *Scilla bifolia*-Gruppe in Oberösterreich, Niederösterreich und Wien. *Naturk. Jahrb. Stadt Linz* **19**(1973): 9–54.

VÁNKY K. 1985. Carpathian Ustilaginales. *Symb. Bot. Upsal.* **24**(2): 1–309.

VÁNKY K. 1994. European smut fungi. G. Fischer Verlag, Stuttgart–Jena–New York.

VÁNKY K. 2002. Illustrated Genera of Smut Fungi. Ed. 2. APS Press, St. Paul, Minnesota.

ZWETKO P. & BLANZ P. 2004. Die Brandpilze Österreichs. Catalogus Florae Austriae III/3. Österreichische Academie der Wissenschaften, Wien.

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