

A checklist of smut fungi of Croatia

DARIO IVIĆ^{1*}, ZDRAVKA SEVER², CHRISTIAN SCHEUER³
& MATTHIAS LUTZ⁴

¹Plant Protection Institute, Croatian Centre for Agriculture, Food and Rural Affairs
Svetošimunska cesta 25, 10000 Zagreb, Croatia

²Department for Plant Pathology, University of Zagreb
Svetošimunska cesta 25, 10000 Zagreb, Croatia

³Institut für Pflanzenwissenschaften, Karl-Franzens-Universität Graz
Holteigasse 6, 8010, Graz, Austria

⁴Evolutionäre Ökologie der Pflanzen, Institut für Evolution und Ökologie,
Universität Tübingen, Auf der Morgenstelle 1, 72076 Tübingen, Germany

CORRESPONDENCE TO*: dario.ivic@hcphs.hr

ABSTRACT - A list of smut fungi (*Ustilaginomycotina* p.p. and *Pucciniomycotina: Microbotryales*) recorded in Croatia from 1897 to 2011 is given. In total, 41 smut species belonging to 13 genera found on 41 host plant species have been recorded in Croatia. Additionally, four smut specimens were reported that could not be determined to species level. Five species are newly reported for Croatia: *Macalpinomyces neglectus*, *Sphacelotheca hydropiperis*, *Urocystis poae*, *Ustilago striiformis*, and *Ustilago trichophora*.

KEY WORDS – *Microbotryales*, *Ustilaginomycotina*, diversity, taxonomy

Introduction

The study of smut fungi (*Ustilaginomycotina* p.p. and *Pucciniomycotina: Microbotryales*) in Croatia was influenced by changing socio-economic conditions that impacted scientific mycology and plant pathology. Scientific mycology in Croatia developed during the late 19th century when Croatia was a part of the Austro-Hungarian Empire, and lasted until the end of World War I. In this period, German, Austrian, Hungarian and Czech botanists and mycologists collected and described a relatively high number of fungi from areas they visited during their studies, and which are a part of the current Croatia. Unfortunately, most of the materials collected by Beck (1897), Jaap (1916) or Moesz (1938) has either been lost or deposited in herbaria outside Croatia.

Between 1919 and 1945, the Croatian Škorić (1928) and the Czech Picbauer (1928) studied smut fungi and described several species found in the territory of today's Croatia.

Following World War II, Croatia became a federal republic of socialistic Yugoslavia. In 1950, Vojtech Lindtner published the "Smuts of Yugoslavia", a capital work that summarized the research on smut fungi in all parts of the former Yugoslavia. In Lindtner's work, a list of all Croatian smut species was recorded. Lindtner's (1950) "Smuts of Yugoslavia" is often cited in lists of smut fungi occurring in Europe, but without precisely quoting the republic from which a certain species was recorded. For that reason, most of the records are designated as from "former Yugoslavia".

After Lindtner (1950), the work on plant pathogenic fungi focused on economically important smuts on cereals, with very few mycological papers dealing with the smut fungi. This continued after 1991, when Croatia became an independent state.

Many of the smut fungi found in Croatia are recorded under older names not consistent with current taxonomy. The aim of this study was to provide the first checklist of smut fungi recorded to this date in Croatia, with some new records and newly collected specimens preserved in the national fungal herbarium (CNF).

Materials and methods

The following list of smut fungi recorded in Croatia is primarily based on literature. Lindtner (1950) and Vasiljević (1991) provided the main source of data on smut fungi recorded from 1888 to 1989, while records between 1990 and 2011 were based on a comprehensive study of published sources dealing with mycology or plant pathology. Names of fungal and plant species were corrected according to current taxonomy. Fungal taxa were named following Bauer et al. (2008), Denchev et al. (2009) and Vánky (1994, 2001, 2005). Taxonomy is also consistent with the recently published world monograph of smut fungi (Vánky 2012). In addition to literature studies, specimens of nine smut species have been collected between 2007 and 2011 and deposited in the Croatian National Fungarium (CNF) and the Herbarium Tubingense (TUB). These species were identified according to Vánky (1994), based on their host plants and the morphology of teliospores. To confirm identification, morphology of teliospores was compared to the following reference specimens of the herbarium of the Karl Franzens University of Graz (GZU): *Macalpinomyces neglectus* 289729, *Sphacelotheca hydropiperis* 289727, *Sporisorium andropogonis* 289725, *Urocystis anemones* 289724, *Urocystis poae* 289728, *Ustilago cynodontis* 289730, *Ustilago striiformis* 289723, and *Ustilago trichophora* 289726.

Results

A total of 41 species of smut fungi were recorded in Croatia from 1897 to 2011. Five of these were recorded and collected for the first time during the present study: *Macalpinomyces neglectus*, *Sphacelotheca hydropiperis*, *Urocystis poae*, *Ustilago striiformis*, and *Ustilago trichophora*. Among the smuts recorded, *Ustilago* species are the most numerous (nine species), followed by *Entyloma* (six species), *Urocystis* (six species), and *Tilletia* (five species). Additionally, four smut specimens were reported which could not be determined to species level because of the lack of the original material. The list of species follows.

Antherospora vaillantii (Tul. & C. Tul.) R. Bauer, M. Lutz, Begerow, Piątek & Vánky
 (Jaap, 1916, on *Muscari comosum* (L.) Mill. and *Muscari racemosum* (L.) Mill. = *Muscari neglectum* Guss. ex Ten., as *Ustilago vaillantii* Tul. & C. Tul.;
 Škorić, 1928; Moesz, 1938, on *Muscari comosum* (L.) Mill., as *Ustilago vaillantii* Tul. & C. Tul.)

Anthracoidea humilis Vánky
 (Picbauer, 1928, on *Carex humilis* Leyss., as *Cintractia caricis* (Pers.) Magnus)

Anthracoidea sempervirentis Vánky
 (Beck, 1897, on *Carex laevis* Kit. = *Carex kitaibeliana* Degen ex Bech., as *Cintractia caricis* (Pers.) Magnus)

Entyloma crepidis-rubrae (Jaap) Liro
 (Jaap, 1916, on *Crepis rubra* L., as *Entyloma crepidicola* Trotter var. *crepidis-rubrae* Jaap)

Entyloma ficariae A.A. Fisch. Waldh.
 (Jaap, 1916, on *Ficaria verna* Huds. = *Ranunculus ficaria* L., as *Entyloma ranunculi* (Bonord.) J. Schröt.)

Entyloma fuscum J. Schröt.
 (Picbauer, 1928, on *Glaucium flavum* Crantz)

Entyloma henningsianum Syd. & P. Syd.
 (Jaap, 1916, on *Samolus valerandi* L.)

Entyloma mediterraneum Syd. & P. Syd. ex Cif.
 (Jaap, 1916, on *Pallenis spinosa* (L.) Cass., as *Entyloma calendulae* (Oudem.) de Bary)

Entyloma rhagadioli Pass.
 (Jaap, 1916, on *Rhagadiolus stellatus* (L.) Gaertn.)

Farysia jaapii Syd. & P. Syd.
 (Jaap, 1916, on *Carex caryophyllea* Latourr., as *Stilbella olivacea* Jaap)
 NOTE: *F. jaapii* is only known from this type collection (e.g. Vánky, 2012).

Macalpinomyces neglectus (Niessl) Vánky
 MATERIAL EXAMINED: On *Setaria viridis* (L.) P. Beauv., Croatia, Zagreb, 27.10.2009, leg. et det.: D. Ivić (CNF 7/23)
 NOTE: New to Croatia.

Microbotryum lychnidis-dioicae (DC. ex Liro) G. Deml & Oberw.

MATERIAL EXAMINED: On *Silene latifolia* ssp. *alba* (Mill.) Greut. & Burdet, Croatia, Pula, 23.08.2007, leg. et det.: M. Lutz (TUB 019003)
(Previous records: Jaap, 1916, on *Silene latifolia* ssp. *alba*, as *Ustilago violacea* (Pers.) Roussel)

Microbotryum shykoffianum T. Giraud, Denchev & M.E. Hood

(Picbauer, 1928; Jaap, 1916, on *Dianthus sylvestris* Wulfen, as *Ustilago violacea* (Pers.) Roussel)

Microbotryum silenes-inflatae (DC. ex Liro) G. Deml & Oberw.

(Jaap, 1916, on *Silene vulgaris* (Moench) Garcke, as *Ustilago violacea* (Pers.) Roussel)

***Microbotryum* sp.**

(Beck, 1897, on *Silene multicaulis* Guss., as *Ustilago violacea* (Pers.) Roussel;
Liro, 1924, on *Silene waldsteinii* Griseb., as *Ustilago violacea* (Pers.) Roussel;
Liro, 1924, on *Silene italica* (L.) Pers., as *Ustilago violacea* (Pers.) Roussel)

Schizonella melanogramma (DC.) J. Schröt.

(Picbauer, 1928, on *Carex pilulifera* L.)

Sphacelotheca hydropiperis (Schumach.) De Bary

MATERIAL EXAMINED: On *Polygonum minus* Hudson, Croatia, Zagreb, 01.10.2009, leg. et det.: D. Ivić (CNF 7/24)
NOTE: New to Croatia.

Sporisorium andropogonis (Opiz) Vánky

MATERIAL EXAMINED: On *Dichanthium ischaemum* (L.) Roberty, Croatia, Pag, 02.09.2009, leg. et det.: D. Ivić (CNF 7/25)
(Previous records: Jaap, 1916, on *Andropogon ischaemum* L. = *Dichanthium ischaemum* (L.) Roberty, as *Ustilago ischaemi* Fuckel)

Sporisorium destruens (Schltdl.) Vánky

(Škorić, 1928, on *Panicum miliaceum* L., as *Sphacelotheca panicum-miliacei* (Pers.) Bubák)

Sporisorium reilianum (J.G. Kühn) Langdon & Full.

(Kišpatić, 1948b, on *Zea mays* L., as *Sorosporium reilianum* (J.G. Kühn) McAlpine;
Jurković et al., 2001, on *Sorghum halepense* Pers., as *Sorosporium reilianum* (J.G. Kühn) McAlpine)

***Sporisorium* sp.**

(Jaap, 1916, on *Cymbopogon hirtus* (L.) Thomson = *Hyparrhenia hirta* (L.) Stapf, as *Ustilago ischaemi* Fuckel)

***Thecaphora affinis* W.G. Schneid. ex A.A. Fisch. Waldh.**

(Moesz, 1938, on *Astragalus glycyphyllos* L.)

***Thecaphora melandrii* (Syd.) Vánky & M. Lutz**

(Jaap, 1916, on *Silene vulgaris* (Moench) Garcke, as *Sorosporium saponariae* Rud.)

***Tilletia brachypodii-ramosi* H. Zogg**

(Jaap, 1916, on *Brachypodium ramosum* (L.) Roem. & Schult., as *Tilletia olida* (Riess) G. Winter)

***Tilletia caries* (DC.) Tul. & C. Tul.**

(common on cultivated wheat; recorded by Škorić, 1928; Borjan, 1938; Potočanac, 1948; Minev, 1951, as *Tilletia triticoidea* Sävul.; Milohnić, 1958; Cvjetković, 1987; Cvjetković et al., 1999; Čizmić et al., 2003; on *Triticum aestivum* L.)

***Tilletia contraversa* J.G. Kühn s. lato**

(Kišpatić, 1948a, on *Hordeum hexastichon* L. = *Hordeum vulgare* L., as *Tilletia pancicii* Bubák & Ranoj.;

Lušin, 1954, on *Triticum aestivum* L., as *Tilletia brevifaciens* G.W. Fisch.;

Moesz, 1938, on *Agropyron intermedium* (Host) P. Beauv. = *Elymus hispidus* (Opiz) Melderis)

***Tilletia laevis* J.G. Kühn**

(Minev, 1951; Cvjetković, 1987; on *Triticum aestivum* L.)

Tilletia laevis* × *Tilletia caries

(Minev, 1951, on *Triticum aestivum* L., as *Tilletia intermedia* (Gassner) Sävul.)

***Urocystis anemones* (Pers.) G. Winter**

MATERIAL EXAMINED: On *Anemone nemorosa* L., Croatia, Vrbovsko, 21.05.2010, leg. et det.: D. Ivić (CNF 7/26)

(Previous records: Škorić, 1928, on *Anemone nemorosa* L., as *Tubercinia anemones* (Pers.) Liro)

***Urocystis ficariae* (Liro) Moesz**

(Moesz, 1938, on *Ficaria verna* Huds. = *Ranunculus ficaria* L., as *Tubercinia ficariae* (Unger) Liro)

Urocystis floccosa (Wallr.) D.M. Hend.
(Picbauer, 1928, on *Helleborus viridis* L., as *Tubercinia hellebori-viridis*
(DC.) Liro)

Urocystis muscaridis (Niessl) Moesz
(Jaap, 1916, on *Muscari comosum* (L.) Mill. and *Muscari racemosum*
(L.) Mill. = *Muscari neglectum* Guss. ex Ten., as *Urocystis colchici*
(Schltld.) Rabenh.)

Urocystis poae (Liro) Padwick & A. Khan
MATERIAL EXAMINED: On *Poa nemoralis* L., Croatia, Zagreb,
25.08.2009, leg. et det.: D. Ivić (CNF 7/27)
NOTE: New to Croatia.

Urocystis ranunculi (Lib.) Moesz
(Picbauer, 1930, on *Ranunculus sardous* Crantz, as *Tubercinia ranunculi*
(Lib.) Liro)

Ustilago avenae (Pers.) Rostr.
(Jaap, 1916, "in anthers of *Avena sativa*";
Milatović, 1967, on *Hordeum vulgare* L., as *Ustilago nigra* Tapke)

Ustilago bromivora (Tul. & C. Tul.) A.A. Fisch. Waldh.
(Jaap, 1916; Moesz, 1938, on *Bromus madritensis* L.)

Ustilago cynodontis (Henn.) Henn.
MATERIAL EXAMINED: On *Cynodon dactylon* (L.) Pers., Croatia, Pag,
01.09.2009, leg. et det.: D. Ivić (CNF 7/28)
(Previous records: Sydow & Sydow, 1903, on *Cynodon dactylon* (L.)
Pers.)

Ustilago hordei (Pers.) Lagerh.
(Jaap, 1916; Milatović, 1967; on *Hordeum vulgare* L.;
Potočanac, 1948, on *Avena sativa* L., as *Ustilago levis* (Kellerm. &
Swingle) Magnus)

Ustilago maydis (DC.) Corda
(common on maize; recorded by Škorić, 1928; Moesz, 1938; Potočanac,
1948; Milatović, 1948; Kišpatić, 1984; Palaveršić, 1985; Kišpatić,
1988; on *Zea mays* L.)

Ustilago nuda (J.L. Jensen) Kellerm. & Swingle
(Škorić, 1928; Milatović, 1967; on *Hordeum vulgare* L.)

Ustilago strüiformis (Westend.) Niessl
MATERIAL EXAMINED: On *Lolium perenne* L., Croatia, Ivanić-Grad,
08.05.2008, leg. et det.: D. Ivić (CNF 7/29); on *Holcus lanatus* L.,

Croatia, Ivanić-Grad, 08.05.2008, leg. et det.: D. Ivić (CNF 7/30); on *Arrhenatherum elatius* (L.) P. Beauv. ex J. Presl & C. Presl, Croatia, Ivanić-Grad, 08.05.2008, leg. et det.: D. Ivić (CNF 7/31)

NOTE: New to Croatia.

Ustilago trichophora (Link) Körn.

MATERIAL EXAMINED: On *Echinochloa crus-galli* (L.) Beauv., Croatia, Čakovec, 22.09.2007, leg. et det.: D. Ivić (CNF 7/32)

NOTE: New to Croatia.

Ustilago tritici (Pers.) Rostr.

(Jaap, 1916, on *Triticum* sp.;

Potočanac, 1948; Milohnić, 1958; Kišpatić, 1980; on *Triticum aestivum* L.)

Discussion

Considering the Croatian flora, which comprises about 5600 plant species and subspecies (Nikolić, 2001), it could be concluded that the number of 41 smut species recorded so far is relatively small. In comparison, in the much smaller Slovenia with about 3200 plant species, Lutz & Vánky (2009) recently reported 72 smut species. Without taking into account the five new records, it can be seen that as few as 32 smut species were recorded in Croatia between 1897 and 1950. From Lindtner's publication (1950) until 2011, only three smuts new to Croatia have been determined: *Tilletia laevis*, *T. laevis* × *T. caries*, and *Ustilago avenae* (Minev, 1951; Milatović, 1967; Cvjetković, 1987). Such results clearly show that research on smut fungi was stifled in the former Yugoslavia. In a socialistic society, the work on smuts was focused only on economically important pathogens of cultivated cereals, with the main focus on their control. During this period, relatively numerous records of *Tilletia* and *Ustilago* species in Croatia can be found, but generally without further investigation.

Once discontinued, it is obvious that research on smut fungi was hard to re-establish. From 1991, when Croatia became an independent state, to 2011, there has not been any record of smut species new to Croatia, and no relevant mycological papers dealing with this group of fungi were published.

It is clear that smut fungi in Croatia have been considerably under-recorded and remain inadequately known. The establishment of the Croatian National Fungarium, a central herbarium where fungal specimens can be deposited, should result in more smuts recorded and collected in Croatia in the future.

Host – Fungus Index

- Anemone nemorosa* – *Urocystis anemones*
Arrhenatherum elatius – *Ustilago striiformis*
Astragalus glycyphyllos – *Thecaphora affinis*
Avena sativa – *Ustilago hordei*
Brachypodium ramosum – *Tilletia brachypodii-ramosi*
Bromus madritensis – *Ustilago bromivora*
Carex caryophyllea – *Farysia jaapii*
Carex humilis – *Anthracoidea humilis*
Carex kitaibeliana – *Anthracoidea sempervirentis*
Carex pilulifera – *Schizonella melanogramma*
Crepis rubra – *Entyloma crepidis-rubrae*
Cynodon dactylon – *Ustilago cynodontis*
Dianthus sylvestris – *Microbotryum shykoffianum*
Dichanthium ischaemum – *Sporisorium andropogonis*
Echinochloa crus-galli – *Ustilago trichophora*
Elymus hispidus – *Tilletia contraversa* s. lato
Glaucium flavum – *Entyloma fuscum*
Helleborus viridis – *Urocystis floccosa*
Holcus lanatus – *Ustilago striiformis*
Hordeum vulgare – *Tilletia contraversa* s. lato, *Ustilago avenae*, *U. hordei*,
U. nuda
Hyparrhenia hirta – *Sporisorium* sp.
Lolium perenne – *Ustilago striiformis*
Muscari comosum – *Antherospora vaillantii*, *Urocystis muscaridis*
Muscari neglectum – *Antherospora vaillantii*, *Urocystis muscaridis*
Pallenis spinosa – *Entyloma mediterraneum*
Panicum miliaceum – *Sporisorium destruens*
Poa nemoralis – *Urocystis poae*
Polygonum minus – *Sphacelotheca hydropiperis*
Ranunculus ficaria – *Entyloma ficariae*, *Urocystis ficariae*
Ranunculus sardous – *Urocystis ranunculi*
Rhagadiolus stellatus – *Entyloma rhagadioli*
Samolus valerandi – *Entyloma henningsianum*
Setaria viridis – *Macalpinomyces neglectus*
Silene italica – *Microbotryum* sp.
Silene latifolia spp. *alba* – *Microbotryum lychnidis-dioicae*
Silene multicaulis – *Microbotryum* sp.
Silene vulgaris – *Microbotryum silenes-inflatae*, *Thecaphora melandrii*
Silene waldsteinii – *Microbotryum* sp.
Sorghum halepense – *Sporisorium reilianum*
Triticum aestivum – *Tilletia caries*, *T. contraversa* s. lato, *T. laevis*,
T. laevis × *T. caries*, *Ustilago tritici*
Zea mays – *Sporisorium reilianum*, *Ustilago maydis*

Acknowledgments

We thank Marcin Piątek, Alistair McTaggart and Brian Spooner for reviewing the manuscript.

Literature cited

- Bauer R, Lutz M, Begerow D, Piątek M, Vánky K, Bacigálová K, Oberwinkler F. 2008. Anther smut fungi on monocots. *Mycological Research* 112: 1297-1306. <http://dx.doi.org/10.1016/j.mycres.2008.06.002>
- Beck G von. 1897. Ein botanischer Ausflug auf den Troglav (1913 m) bei Livno. *Wissenschaftliche Mitteilungen aus Bosnien und der Hercegovina* 5: 480-490.
- Borjan B. 1938. Testing fungicides for control of *Tilletia tritici* on wheat. *IPOKSS – Topčider* 3, 191-193. [In Croatian]
- Cvjetković B. 1987. Yugoslav and European experiences in wheat diseases control. *Zaštita bilja* 180: 177-183. [In Croatian]
- Cvjetković B, Čizmić I, Jurković D, Zabica LJ. 1999. On the occasion of common bunt (*Tilletia caries* (D.C.) Tul.) epidemic on wheat in Croatia. *Zbornik predavanj in referatov s 4. Slovenskoga posvetovanja o varstvu rastlin, Portoroz, 03-04.03.1999, Društvo za varstvo rastlin Slovenije*: 37-40.
- Čizmić I, Tomić Z, Hrlec G, Zabica LJ. 2003. Situation with common bunt (*Tilletia caries*) occurrence in 2002. *Glasilo biljne zaštite* 6: 345-356. [In Croatian]
- Denchev CM, Giraud T, Hood ME. 2009. Three new species of anthericolous smut fungi on *Caryophyllaceae*. *Mycologia Balcanica* 6: 79-84.
- Jaap O. 1916. Beiträge zur Kenntnis der Pilze Dalmatiens. *Annales Mycologici* 14: 1-44.
- Jurković D, Čosić J, Vrandečić K. 2001. Parasite mycopopulation of some important weed species. *Zbornik sažetaka 37. Znanstvenog skupa hrvatskih agronoma, Opatija, 19-23.02. 2001., Poljoprivredni fakultet Osijek*: 341. [In Croatian]
- Kišpatić J. 1948a. Contribution to the list of parasitic fungi in Croatia. *Periodicum Biologorum* 2/3: 44-50. [In Croatian]
- Kišpatić J. 1948b. *Sorosporium reilianum* McAlpine, a new disease of maize in our country. *Arhiv za poljoprivredne nauke i tehnike* 5: 1-14. [In Croatian]
- Kišpatić J. 1980. The actual situation in control of wheat diseases in Croatia. *Glasnik zaštite bilja* 10: 337-342. [In Croatian]
- Kišpatić J. 1984. Sanitary inspection of maize. *Poljoprivredne aktualnosti* 4/5: 815-820. [In Croatian]
- Kišpatić J. 1988. Corn smut (*Ustilago maydis* D.C.). *Glasnik zaštite bilja* 5: 186-190. [In Croatian]
- Lindtner V. 1950. *Ustilaginales Jugoslaviae*. *Glasnik Prirodnjačkog muzeja Beograd* 3/4: 1-112. [In Serbian]
- Liro JI. 1924. Die Ustilagineen Finnlands. I. *Annales Academiae Scientiarum Fennicae Ser. A* 17(1): 1-636.
- Lušin V. 1954. Dwarf smut of wheat (*Tilletia brevifaciens*). *Agronomski glasnik* 7: 427-429. [In Croatian]
- Lutz M, Vánky K. 2009. An annotated checklist of smut fungi (*Basidiomycota: Ustilaginomycotina* and *Microbotryales*) in Slovenia. *Lidia* 7(2-3): 33-72.
- Milatović I. 1948. Corn smut. *Biljna proizvodnja* 4: 152-157. [In Croatian]
- Milatović I. 1967. Black loose smut of barley (*Ustilago nigra* Tapke) in Yugoslavia. *Poljoprivredna znanstvena smotra* 24: 3-7. [In Croatian]
- Milohnić J. 1958. An approbation of the Italian seed wheat. *Agronomski glasnik* 3/4: 70-78. [In Croatian]
- Minev K. 1951. The geographical distribution of *Tilletia* species on wheat in Yugoslavia. *Zaštita bilja* 5: 50-53. [In Serbian]
- Moesz G von. 1938. Aufzählung der in Flora Velebitica bisher bekannten Pilze. 281-298, in Degen A von. *Flora Velebitica* Vol. 3, *Akademiai Kiado, Budapest*.
- Nikolić T. 2001. The diversity of Croatian vascular flora based on the checklist and croflora database. *Acta Botanica Croatica* 60: 49-67.
- Palaveršić B. 1985. Phytosanitary inspection of seed maize crops. *Sjemenarstvo* 6: 166-174. [In Croatian]

- Picbauer R. 1928. Fungi croatici a dr. Ed. Baudyš collecti. Glasnik botaničkog zavoda i bašte Univerziteta u Beogradu 1: 60-74.
- Picbauer R. 1930. Additamentum ad floram Jugoslaviae mycologicam. Glasnik zemaljskog muzeja Bosne i Hercegovine 42: 133-140.
- Potočanac J. 1948. Seed production and seed treatment. Poljoprivredni nakladni zavod, Zagreb. [In Croatian]
- Škorić V. 1928. Micological contribution to the knowledge of Croatian and Slavonian flora relative to parasitic fungi. Glasnik hrvatskog prirodoslovnog društva 39/40: 97-108. [In Croatian]
- Sydow H, Sydow P. 1903. Beitrag zur Pilzflora des Litoral-Gebietes und Istriens. Annales Mycologici 1: 232-254.
- Vánky K. 1994. European smut fungi. Gustav Fischer Verlag, Stuttgart.
- Vánky K. 2001. Taxonomical studies on *Ustilaginales*. XXI. Mycotaxon 78: 265-326.
- Vánky K. 2005. European smut fungi (*Ustilaginomycetes* p.p. and *Microbotryales*) according to recent nomenclature. Mycologia Balcanica 2: 169-177.
- Vánky K. 2012. Smut Fungi of the World. APS Press, St. Paul, Minnesota.
- Vasiljević L. 1991. Bibliography of Plant Protection in Yugoslavia. Union of Plant Protection Societies of Yugoslavia, Belgrade.