

A taxonomic study of Phragmidiaceae (Uredinales) in Bulgaria

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Abstract. A taxonomic revision of Phragmidiaceae in Bulgaria was carried out. The study yielded distribution of 5 genera, among which *Frommeëlla* (*F. tormentillae*) is a new Bulgarian genus record, and 16 species on 46 hosts from Rosaceae, making 61 rust-host combinations. *Trachyspora pentaphylleae* is reported for the first time from Bulgaria and the Balkan Peninsula. Twenty-two rust-host combinations are new records for Bulgaria, viz. *Phragmidium bulbosum* on *Rubus canescens* and *R. praecox*; *Ph. mucronatum* on *Rosa canina* var. *andegavensis*, *R. dumalis*, and *R. pendulina*; *Ph. potentillae* on *Potentilla bornmuelleri* and *P. pedata*; *Ph. sanguisorbae* on *Sanguisorba minor* subsp. *muricata*; *Ph. tuberculatum* on *Rosa centifolia*, *R. chinensis*, *R. damascena*, *R. dumalis*, *R. pendulina*, and *R. turcica*; *Ph. violaceum* on *Rubus canescens* var. *glabratus*, *R. geniculatus*, and *R. radula*; *Trachyspora intrusa* on *Alchemilla catachnoa*, *A. connivens*, *A. gorcensis*, *A. incisa*, and *A. jumrukczalica*. Twenty-six rust-host combinations, previously recorded for Bulgaria, are treated here as doubtful or wrong records, viz. *Phragmidium bulbosum* on *Fragaria vesca*, *Rubus corylifolius*, *R. fruticosus*, *R. glandulosus*, *R. nemorosus*, *R. thyrsanthus*, and *Rubus thyrsoides*; *Ph. fragariae* on *Fragaria vesca* and *Potentilla patula*; *Ph. fusiforme* on *Rosa gallica* and *R. pulverulenta* (*R. glutinosa*); *Ph. mucronatum* on *Rosa micrantha*; *Ph. potentillae* on *Potentilla crantzii*; *Ph. tuberculatum* on *Rosa arvensis*, *R. myriacantha*, *R. sepium*, *R. spinosissima*, and *R. vosagiaca*; *Ph. violaceum* on *Rubus fruticosus*, *R. macrostachys*, and *R. nemorosus*; *Kuehneola uredinis* on *Rubus caesius* and *R. glandulosus*; *Trachyspora intrusa* on *Alchemilla gracilima*, *A. heterophylla*, and *A. pubescens*.

Key words: Bulgaria, *Kuehneola*, *Phragmidium*, Rosaceae, taxonomy, *Trachyspora*

Introduction

A taxonomic investigation of Phragmidiaceae (Uredinales) in Bulgaria has not been carried out yet. Four genera of that family were known in Bulgaria, viz. *Kuehneola*, *Phragmidium*, *Trachyspora*, and *Xenodochus* (Denchev 1995). Eleven species of *Phragmidium* and one species for each of the other three genera have been previously reported (Bubák 1903, 1908; Malkoff 1905, 1906, 1908, 1910; Bernkopf 1910; Ivanov 1912, 1919, 1922a, b, 1928; Radoslavov 1914, 1915, 1921, 1923, 1934, 1936, 1939, 1943; Constantineanu 1920; Savov 1923, 1924; Ivanov & Patev 1925, 1927, 1930a, b; Klika 1926; Georgiev 1928; Atanasov *et al.* 1931, 1932; Hruby 1931; Nannizzi 1938; Vanchikov 1946; Anonymous 1955, 1956, 1957; Gospodinov 1957; Buhr 1958; Hinkova 1959, 1960, 1961, 1962, 1966, 1968, 1978, 1981; Kreisel 1959;

Markov 1962; Krousheva 1963, 1964, Negrean & Denchev 2002). The known published articles have been focused on phytopathological investigations of *Phragmidium* on roses or have contained data only on rust-host combinations and their localities. The available Bulgarian records of that family have been listed by Denchev (op. cit.).

A taxonomic revision of the available specimens of Phragmidiaceae in Bulgaria was made. That revision yielded distribution of 5 genera, among which *Frommeëlla* (*F. tormentillae*) is a new Bulgarian genus record, and 16 species on 46 hosts from Rosaceae. The morphological characteristics, host plants, and distribution of the members of *Frommeëlla*, *Kuehneola*, *Phragmidium*, *Trachyspora*, and *Xenodochus* are reported herein.

These five genera are characterized by forming spermogonia Group IV, erumpent telia, and pedicellate teliospores with several cells (seldom with one) by transverse septa (Cummins & Hiratsuka 2003).

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The molecular phylogenetic analysis of Maier *et al.* (2003) shows that *Triphragmium*, represented in Bulgaria with two species (Denchev 1995), is also a member of Phragmidiaceae but in the present study we have followed the family taxonomic scheme of Cummins & Hiratsuka (2003).

Materials and Methods

In the course of this investigation, 332 specimens of *Frommeëlla*, *Kuehneola*, *Phragmidium*, *Trachyspora*, and *Xenodochnus* from Bulgaria were studied. Among them, 299 specimens are kept in the Mycological Collection of the Institute of Botany, Bulgarian Academy of Sciences (SOMF). The acronym of that herbarium is not cited throughout the rubric '*Specimens examined*'. The specimens from SOMF are cited just with their collecting numbers. The other 33 specimens were obtained on loan from the Mycological Herbarium of the Institute of Biology, Bucharest (BUCM).

Aeciospores, urediniospores, and teliospores from dried specimens were examined under a light microscope after mounting in lactophenol solution, gently heating to the boiling point, and then cooling. The measurements of spores are given in the form: min-max (mean $\pm$ 1 standard deviation). In the species descriptions, a symbol ' $n_{(x)}$ ' is used to indicate the total number of measured spores (n) from all collections (x).

Identification of the rusts and clarification of their distribution were made with the aid of some classical and modern works by Sydow & Sydow (1912), Arthur (1934), Tranzschel (1939), Săvulescu (1953), Găumann (1959), Wilson & Henderson (1966), Gjaerum (1974), Kuprevich & Ulyanishchev (1975), Majewski (1977), Henderson & Bennell (1979), Gjaerum & Cummins (1982), Wei (1988), Hiratsuka *et al.* (1992), Ono *et al.* (1995), Poelt & Zwetko (1997), Zwetko (2000), Wahyuno *et al.* (2001, 2002), Tănase & Negrean (2002).

The taxonomic problems in *Rosa* L. and *Rubus* L. are well known. The main problem in the course of that study was the unsuccessful treatment of these genera in *Flora of Bulgaria* (Dimitrov 1973; Markova 1973) and *Guide to the vascular plants of Bulgaria* (Markova 1992). Another problem was that a part of the host material was inadequate in lacking some plant parts which supply important characters. Such specimens were omitted from the present revision. On the other hand, some old literature records were not accepted here, because of potential misidentifications of the hosts.

In the rubric '*Specimens examined*', the floristic regions of Bulgaria are put between parentheses and numbered as follows: [1] Black Sea Coast, [2] Northeast Bulgaria, [3] Danubian Plain, [4] Forebalkan, [5] Balkan Range, [6] Sofia region, [7] Znepole region, [8] Vitosha region, [9] West Frontier Mts, [10] Valley of River Strouma, [11] Mt Belasitsa, [12] Mt Slavyanka, [13] Valley of River

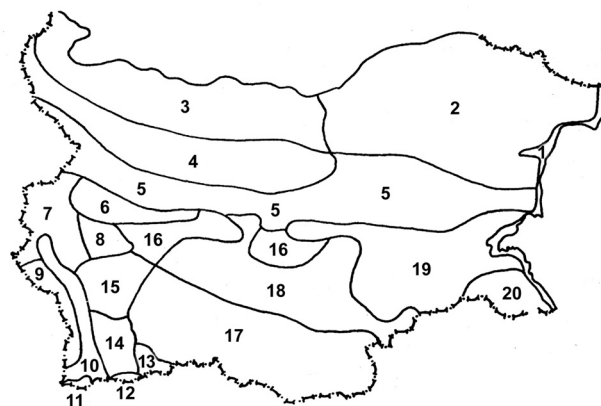


Fig. 1. Map of the floristic regions of Bulgaria

Mesta, [14] Pirin Mts, [15] Rila Mts, [16] Mt Sredna Gora, [17] the Rhodopes, [18] Thracian Lowland, [19] Toundzha Hilly Country, and [20] Mt Strandzha (Fig. 1). The following abbreviations are used for the subregions of Balkan Range and the Rhodopes: [oc] – occidentales (western), [c] – centrales (central), [or] – orientales (eastern). The following abbreviations of collectors' names are used: [BI] – B. Ivanov, [CD] – C.M. Denchev, [CH] – Ts.H. Hinkova, [GN] – G. Negrean, and [RP] – R.D. Petrova. An abbreviation 'specim. n.v.' is used for records without a herbarium voucher.

Taxonomy

The genera of Phragmidiaceae are distinguished in their aecial, uredo-, and telial stages (Cummins & Hiratsuka 2003) as following. The aecia and uredinia of *Frommeëlla* are *Uredo*-type with spores borne singly on pedicels; paraphyses few or lacking; teliospores on short pedicels, 3- to several celled with 1 apical germ pore in each cell, wall pigmented, smooth. The species of *Kuehneola* have also *Uredo*-type aecia and uredinia, teliospores cylindrical formed on short pedicels, 2- to several-celled, with 1 germ pore per cell, and pale or colourless, smooth wall; teliospores formed in clavate or elongate and slightly incurved chains. The aecia of *Phragmidium* are usually *Caeoma*-type, with catenulate spores or less often *Uredo*-type; teliospores borne singly on often hygroscopic pedicels, 1- to several-celled with 2-3 pores in each cell, and pigmented, smooth or more often verrucose wall. The species of *Trachyspora* have *Petersonia*-type aecia, with catenulate aeciospores but without intercalary cells and with spinose wall structure; usually without uredinia but sometimes with urediniospores in the telia; teliospores 1-celled, with obscure germ pores and pigmented wall. The aecia of *Xenodochnus* are *Caeoma*-type; teliospores borne singly on short pedicels, 2- to many-celled, with 1 germ pore in apical cell and 2 pores in the others, and smooth, pigmented wall.

Frommeëlla Cummins & Y. Hirats., Illustr. Genera Rust Fungi, Rev. edn, p. 120, 1983.

Typus: *Frommeëlla tormentillae* (Fuckel) Cummins & Y. Hirats.

Frommeëlla tormentillae (Fuckel) Cummins & Y. Hirats., Illustr. Genera Rust Fungi, Rev. edn, p. 147, 1983. — *Phragmidium tormentillae* Fuckel, Jahrb. Nassauischen Vereins Naturk. 23-24: 46, 1870. — *Xenodochus tormentillae* (Fuckel) Magnus, Ber. Deutsch. Bot. Ges. 17: 179, 1899. — *Kuehneola tormentillae* (Fuckel) Arthur, Rés. Sci. Congr. Int. Bot. Vienne 1905, p. 342, 1906. — *Uredo obtusa* F. Strauss, Ann. Wetterauischen Ges. Gesamte Naturk. 2: 107, 1810. — *Frommea obtusa* (F. Strauss) Arthur, Bull. Torrey Bot. Club 44: 503, 1917.

[**Spermogonia** epiphyllous, in small groups, intraepidermal, type 10. **Aecia** epiphyllous, surrounding the spermogonia, *Uredo*-type, without peridium and paraphyses, orange-yellow when fresh; **aeciospores** obovoid, 18-22 × 12-18 µm, wall 1-1.5 µm thick, echinulate, pores equatorial, obscure]. **Uredinia** hypophyllous, scattered or in small groups, at first covered by epidermis then ruptured the epidermis and naked, pulverulent, often covered the whole leaf surface, pale yellow; **paraphyses** lacking; **urediniospores** globose or obovoid, 18.5-25.5 × 16.5-21 (22.0 ± 1.5 × 18.3 ± 0.9) µm [$n_{(3)} = 150$], wall up to 1.5 µm thick, echinulate. [**Telia** hypophyllous, subepidermal in origin then ruptured the epidermis and naked; **teliospores** borne singly on short pedicels, cylindrical or fusoid, 3- to several celled (mostly 5-celled), thickened at the apex, slightly constricted at the septa and tapering below, 52-140 × 18-24 µm, wall pigmented, smooth, germ pore one per cell; pedicel persistent].

Life cycle, host range, and distribution: 0, I, II, III (Auto-eu form) on *Potentilla* spp. — Europa, Asia (Armenia, Azerbaijan, Georgia), North America.

Host range and distribution in Bulgaria:

On *Potentilla neglecta* Baumg.: Rila Mts. On *P. recta* gr.: Forebalkan. On *P. ternata* C. Koch (*P. chrysocraspeda* Lehm.): Pirin Mts.

Specimens examined:

On *Potentilla neglecta*: [15]: distr. Blagoevgrad, supra oppidum Razlog, 18 Jul 1966, M. Markova, fungus comm. CH (sub *P. argentea*) (14 964).

On *P. recta* gr.: [4]: inter oppid. Veliko Tarnovo et oppid. Drjanovo, Jul 1898, leg. I. Urumov, fungus comm. CH (sub *P. recta*) (14 968).

On *P. ternata*: [14]: ad lacum Vasilaschko Ezero, alt. 1800 m, 8 Aug 1965, CH (sub *P. chrysocraspeda*) (12 815).

Kuehneola Magnus, Bot. Centralbl. 74: 169, 1898.

Typus: *Kuehneola uredinis* (Link) Arthur

Kuehneola uredinis (Link) Arthur, Rés. Sci. Congr. Int. Bot. Vienne 1905, p. 342, 1906. — *Oidium uredinis* Link, Sp. Pl. 6: 123, 1824. — *Chrysomyxa albida* J.G. Kühn, Bot. Centralbl. 16: 154, 1883. — *Phragmidium albidum* (J.G. Kühn) F. Ludw., Centralbl. Bakteriell. Parasitenk. 3: 762, 1887. —

Kuehneola albida (J.G. Kühn) Magnus, Bot. Centralbl. 74: 169, 1898. (Fig. 5)

[**Spermogonia** epiphyllous, in redish spots, 150-200 µm diam, subcuticular, type 11. **Aecia** uredinoid, epiphyllous, formed pale yellow spots around the spermogonia, irregularly elongated and often confluent in ring-shaped structures, orange-yellow; **aeciospores** globose or obovoid, 19-23 × 18-20 µm, wall 2-2.5 µm thick, colourless, densely verrucose, with scattered pores.] **Uredinia** hypophyllous, sometimes on petioles and stems, scattered, pulverulent, at first covered by epidermis then ruptured the epidermis and naked, formed small rounded spots on the leaves ca 0.1-0.3 cm diam, often covered the whole leaf surface, pale yellow, on the stems linear or irregularly elongated to 1 cm long and 1-1.5 mm wide, on the petioles similar but smaller; **paraphyses** lacking; **urediniospores** globose or obovoid, 19-25 × 18-21.5 (22.3 ± 1.3 × 19.9 ± 0.9) µm [$n_{(3)} = 150$], wall nearly colourless, 1.5-2 (-2.5) µm thick, finely and closely echinulate, with indistinct pores. **Telia** hypophyllous, scattered or grouped but never confluent, 0.2-0.8 mm diam, soon naked and pulverulent, yellowish to whitish; **teliospores** formed in clavate or elongate and slightly incurved chains of 2-5 (3.1 ± 0.8) spores [$n_{(1)} = 50$], each one blunted at both ends, ovoid-ellipsoidal or trapezoidal, 19.5-31 × 15-21.5 (25.3 ± 3.1 × 17.6 ± 1.5) µm [$n_{(1)} = 50$], wall smooth, colourless, about 5.5 µm thick at the top of the apical cell and 1.5-2.5 µm thick in the lower cells, with 1 pore in the upper part of each cell, chains on short and thin-walled basal cells.

Life cycle, host range, and distribution: 0, I, II, III (Auto-eu form) on *Rubus* spp. — world-wide.

Host range and distribution in Bulgaria:

On *Rubus hirtus* Waldst. & Kit.: Balkan Range (Central), Pirin Mts, Rila Mts.

Specimens examined:

On *Rubus hirtus*: [5c]: distr. Gabrovo, supra vicum Stokite, 26 Jul 1965, CH (5036); [14]: distr. Blagoevgrad, supra oppidum Bansko, alt. 1500 m, 17 Sept 1957, leg. M. Markova, det. CH (14 882); [15]: distr. Sofia, in loco dicto 'Borovetz', 16 Oct 1979, CH (14 830); [15]: ad ripam rivuli Ibar, alt. 1200 m, 13 Sept 1956, CH (620 & 621).

Note. For lack of herbarium vouchers, the records of *Kuehneola uredinis* on *Rubus caesius* from Sofia region (Ivanov 1912) and *R. glandulosus* Bellardi from Balkan Range and Rila Mts (Klika 1926) are treated here as uncertain rust-host combination records.

Phragmidium Link, Ges. Naturf. Freunde Berlin Mag. Neuesten Entdeck. Gesammten Naturk. 7: 30, 1816.

Typus: *Phragmidium mucronatum* (Pers. : Pers.) Schltdl.

Spermogonia subcuticular, type 11 or intraepidermal, type 10. **Aecia** usually on the leaves, often in fruits, pedicels or stems, subepidermal in origin but soon ruptured the epidermis and naked, caematoid with catenulate spores or less often uredinoid with spores born singly on pedicels, pulverulent, surrounded by paraphyses; **aeciospores** verrucose or echinulate, pores scattered. **Uredinia** on the leaves, at

first covered by the epidermis, then naked, surrounded by paraphyses, pulverulent; **urediniospores** born singly on the pedicels, mostly echinulate, with scattered, indistinct pores. **Telia** usually on the leaves, seldom on the calix, stems or pedicels, at first covered by the epidermis, then naked; **teliospores** born singly on pedicels, 1- to several-celled by a horizontal septa, wall pigmented, usually verrucose less often

smooth, often obviously bilaminate, with 2-3 germ pores per cell.

Host range: on **Rosaceae**. About 60 to 65 species.

Sect. *Earlea* (Arthur) Arthur, Manual Rusts U.S. & Canada, p. 78, 1934. — *Earlea* Arthur, Rés. Sci. Congr. Int. Bot. Vienne 1905, p. 341, 1906.

Key to *Phragmidium* species in Bulgaria

- 1 Teliospore wall smooth or verrucose, pedicel non-hygroscopic Sect. *Earlea* 2
- 1* Teliospore wall verrucose, pedicel hygroscopic (swelling at the base) Sect. *Phragmidium* 4
- 2 Teliospores 2-7-celled, mostly 5-celled, wall smooth often with a well developed papilla up to 7 µm long; pedicel 86-180 µm long, smooth. On *Potentilla* *Ph. potentillae*
- 2* Teliospores 2-5-celled, mostly 4-celled, wall verrucose or smooth, less often papillate; pedicel up to 70 µm long, smooth or verrucose 3
- 3 Teliospore wall with irregularly scattered warts, sometimes with colourless, up to 3 µm long papilla; pedicel verrucose. Uredospores echinulate. On *Sanguisorba* *Ph. sanguisorbae*
- 3* Teliospore wall laterally verrucose, apically verrucose, sometimes smooth, papilla lacking; pedicel smooth. Uredospores verrucose. On *Potentilla*. *Ph. fragariae*
- 4 On *Rosa*. 5
- 4* On *Rubus* 8
- 5 Teliospores 8-13-celled, mostly 10-celled, fusiform, densely and coarsely tuberculate. Aeciospores echinate *Ph. fusiforme*
- 5* Teliospores up to 9-celled, cylindrical or ellipsoidal, verrucose. Aeciospores verrucose 6
- 6 Teliospores mostly 7-celled, densely verrucose; wall 5-7 µm thick. Aeciospores verrucose, wall 3-4 µm thick *Ph. mucronatum*
- 6* Teliospores mostly 6-celled, with scattered warts; wall up to 6 µm thick. Aeciospores verrucose, wall up to 3.5 µm thick 7
- 7 Teliospore wall uniformly verrucose; wall 4-6 µm thick. Urediniospores densely verrucose; wall 2-2.5 µm thick. *Ph. tuberculatum*
- 7* Teliospores apically verrucose, at the base nearly smooth; wall 3-5 µm thick. Urediniospores densely echinate; wall 1-1.5 µm thick. *Ph. rosae-pimpinellifoliae*
- 8 Teliospores 5-9-celled, mostly 7-celled, tuberculate. Urediniospores verrucose. *Ph. rubi-idaei*
- 8* Teliospores up to 7-celled, densely verrucose. Urediniospores echinate. 9
- 9 Teliospores 2-5-celled, mostly 4-celled; wall 5-6 µm thick, with a papilla up to 7 µm long. Aeciospores echinate; wall 3.5-4 µm thick *Ph. violaceum*
- 9* Teliospores 3-7-celled, mostly 6-celled; wall to 5 µm thick, with a papilla up to 16 µm long. Aeciospores echinate or verrucose, wall 1-2 µm thick 10
- 10 Aeciospores verrucose, urediniospores echinate. In swelling both of them formed cameras around the pores. Teliospore wall 4-5 µm thick. *Ph. bulbosum*
- 10* Aeciospores and urediniospores echinate. In swelling not formed cameras around the pores. Teliospore wall 3-4 µm thick *Ph. acuminatum*

Typus: *E. speciosum* (Fr.) Arthur (= *Phragmidium speciosum* (Fr.) Cooke)

Teliospores smooth or verrucose; pedicel non-hygroscopic. The known in Bulgaria species, *Ph. potentillae*, *Ph. fragariae*, and *Ph. sanguisorbae*, are members of *Ph. potentillae* gr. on *Potentilla* spp. (Potentilleae) and *Sanguisorba* spp. (Sanguisorbeae).

1. *Phragmidium fragariae* (DC.) Rabenh., Herb. Mycol., no. 1987, 1855. — *Puccinia fragariae* DC. in Lam., Encycl. Méth. Bot. 8: 244, 1808. — *Phragmidium fragariae* (DC.) G. Winter in Rabenh., Kryptog.-Fl. Deutschl. 1(1): 288, 1884. — *Puccinia fragariastris* DC., Fl. Franç. 6: 55, 1815. — *Phragmidium fragariastris* (DC.) J. Schröt. in Cohn, Kryptog.-Fl. Schles. 3(1): 351, 1887. — *Ph. granulatum* Fuckel, Jahrb. Nassauischen Vereins Naturk. 23-24: 46, 1870. (Fig. 6)

Spermogonia epiphyllous, in small groups, subcuticular, usually surrounded by aecia, pale yellow. **Aecia** amphigenous, often on the veins and petioles, ruptured the epidermis conspicuous, scattered or aggregated around the spermogonia, elongated or rounded, 0.5-2 mm diam, orange, surrounded by clavate or capitate paraphyses with pale yellow, smooth wall; **aeciospores** globose, subglobose, broadly ellipsoid or ovoid, sometimes angular, $20.5-28.5 \times 17.5-23 \mu\text{m}$ ($23.8 \pm 2.0 \times 20.0 \pm 1.5$) [$n_{(8)} = 400$], contents bright yellow, wall ca 1.5-2.5 μm thick, minutely, densely verrucose, with indistinct pores. **Uredinia** hypophyllous, on small yellow spots, at first covered by the epidermis, then naked, scattered or grouped, sometimes confluent, pulverulent, rounded, ca 0.3-1 mm diam, orange-yellow; **paraphyses** numerous, clavate or capitate, $29-62 \times 11.5-20 \mu\text{m}$, erect or slightly incurved, wall of unequal thickness (1 μm and about 2 μm at the apex), smooth, pale yellow; **urediniospores** globose, subglobose, ovoid or ellipsoid, $17.5-24 \times 16.5-21.5$ ($21.0 \pm 1.4 \times 19.2 \pm 1.2$) μm [$n_{(9)} = 450$], contents orange-yellow, wall ca 1.5-2.5 μm thick, densely verrucose, pale yellow, with indistinct pores. **Telia** hypophyllous, often on the petioles, sometimes on the calix, scattered or grouped, pulverulent, rounded or broadly elliptical, ca 0.5-1 mm diam, brown; **paraphyses** similar to those in uredinia; **teliospores** cylindrical or oblong, 2-5-celled (3.7 ± 0.6) [$n_{(10)} = 500$], rounded at both ends, very slightly constricted at the septa, $46.5-77.5 \times 24-34.5$ ($60.2 \pm 7.0 \times 28.1 \pm 1.8$) μm [$n_{(10)} = 500$], wall 1-2 μm thick, never papillate, usually smooth but sometimes verrucose and then laterally with a few fine warts and apically with more and larger warts, pale brown, with usually 3 pores per cell; pedicel persistent, colourless, $24.5-57 \times 8-13 \mu\text{m}$, of equal thickness (non-hygroscopic).

Life cycle, host range, and distribution: 0, I, II, III (Auto-eu form) on *Potentilla* spp. (mostly on *P. micrantha*) – Europe, Asia, N. Africa, N. America.

Host range and distribution in Bulgaria:

On *Potentilla alba* L.: Sofia region. On *P. micrantha* DC.: Northeast Bulgaria, Danubian Plain, Forebalkan (Klika 1926 – specim. n.v.), Balkan Range, Znepole region, Vitosha region, Valley of River Strouma, Mt Belasitsa,

Pirin Mts, Rila Mts, Mt Sredna Gora, the Rhodopes, Mt Strandzha.

Specimens examined:

On *Potentilla alba*: [6]: Sofia, Knjazhevo, 1 Jul 1932, BI (sub *Ph. fragariastris* – *) (18 219).

On *P. micrantha*: [2]: distr. Schumen, in vicinitatibus oppidi Preslav, 8 Maj 1958, CH (sub *) (11 483); [3]: distr. Vidin, in loco dicto 'Sokolitza' prope pagum Gramada, alt. 60 m, 26 Maj 1963, CH (sub *) (11 479); [5oc]: in loco dicto 'Goljama Mogila', 27 Jul 1962 CH (sub *) (2851); [5oc]: distr. Sofia, mons Ponor, ad pagum Iskretz, 29 Apr 1998, leg. D. Stojanov, det. RP (25 201); [5c]: distr. Lovetsch, mons Zlatishko-Tetevenska Planina, in valle rivi Zavodna supra pagum Ribaritz, alt. 940 m, 14 Oct 1962, CH (sub *) (11 492); [5c]: distr. Lovetsch, mons Trojanska Planina, supra refugium turisticum 'Lovno-Ribarska Hizha', prope oppidum Trojan, alt. 740 m, 12 Maj 1963, CH (sub *) (3419); [5c]: distr. Plovdiv, mons Kaloferska Planina, supra refugium turisticum 'Vasil Levski', alt. ca 1700 m, 23 Aug 1997, CD (25 202); [5or]: distr. Sliven, in vicinitatibus oppidi Kotel, in loco dicto 'Zelenitsch', 9 Jul 1963, CH (sub *) (11 491); [7]: distr. Pernik, prope pagum Potzarnenci, alt. 700 m, 17 Maj 1960, leg. B. Kuzmanov, fungus comm. CH (sub *) (10 207); [7]: distr. Pernik, mons Golo Bardo, 8 Jun 1957, CH (sub *) (9588); [7]: distr. Pernik, mons Konjavka Planina supra oppidum Zemen, 12 Apr 1959, CH (sub *) (11 487); [8]: mons Ljulin, 7 Apr 1960, CH (sub *) (11 478); [8]: mons Vitoscha, in loco dicto 'Balabanovetz' supra Vladaja, 25 Apr 1962, CH (sub *) (11 481); [8]: mons Vitoscha, supra refugium turisticum 'Selimitza', alt. 1350 m, 1 Jan 1961, CH (sub *) (2275); [8]: mons Vitoscha, 6 Sep 1953, CH (sub *) (12 825); [9]: mons Vlahina Planina, 13 Jul 1964, leg. D. Jordanov, fungus comm. CH (sub *) (4500); [10]: distr. Blagoevgrad, supra oppidum Sandanski, 30 Mar 1959, CH (sub *) (8729); [11]: distr. Blagoevgrad, supra oppidum Petritsch, 28 Jul 1963, CH (sub *) (2926); [11]: distr. Blagoevgrad, prope pagum Gabrene, alt. 580 m, 26 Mar 1959, CH (sub *) (2878); [14]: distr. Blagoevgrad, supra pagum Pirin, alt. 1350 m, 25 Jun 1965, CH (sub *) (11 493); [15]: distr. Kjustendil, supra oppidum Sapareva Banja, alt. 1050 m, 7 Jul 1960, CH (sub *) (8783); [15]: distr. Sofia, ad ripam rivi Slivnitsa infra Borovetz, 12 Jul 1929, leg. A. Valkanov, fungus comm. CH (sub *) (12 826); [15]: distr. Sofia, supra oppidum Kostenetz, alt. 910 m, 30 Sep 1953, CH (sub *) (1042); [15]: distr. Sofia, ad ripam rivuli Ibar supra pagum Raduil, alt. 1240 m, 7 Jul 1960, CH (sub *) (1046); [15]: distr. Pazardzhik, supra pagum Sestrimo, alt. 960 m, 10 Maj 1956, CH (sub *) (1045); [15]: ibidem, alt. 1220 m, 28 Jun 1955, CH (sub *) (1043); [15]: ibidem, ad ripam rivuli Kriva Reka, alt. 1040 m, 28 Sep 1953, CH (sub *) (1041); [15]: ad ripas rivi Ilijna Reka, alt. 1040 m, 12 Aug 1963, CH (sub *) (2961); [16]: infra cacum. Bratija, 21 Aug 1933, leg. A. Radoslavov, det. CH (sub *) (11 470); [17c]: distr. Plovdiv, in loco dicto 'Tschervinata Stena' supra pagum Batschkovo, 12 Maj 1962, CH (sub *) (11 486); [17or]: distr. Kardzhali, supra pagum Belopoljane, 17 Jun 1963, CH (sub *) (11 490); [17or]: distr. Haskovo, supra pagum Mandritza, 6 Nov 1959, CH (sub *) (1047); [20]: distr. Burgas, in loco dicto 'Kerezovija Dol' prope pagum Kosti, 23 Jun 1961, CH (sub *) (11 489); [20]: distr. Burgas, ad ripam rivi Veleka prope oppidum Malko Tarnovo, 6 Jul 1963, CH (sub *) (11 488).

On *Potentilla* sp.:

[6]: Sofia, Sep 1930, leg. A. Valkanov, det. A. Radoslavov (sub * on *Potentilla alba*) (12 824); [8]: mons Ljulin, 2 Jul 1932, BI (sub *) (18 220).

Note. *Fragaria vesca* L. (Atanasov *et al.* 1932) and *Potentilla patula* Waldst. & Kit. (Ivanov 1919) are treated here as erroneous host records.

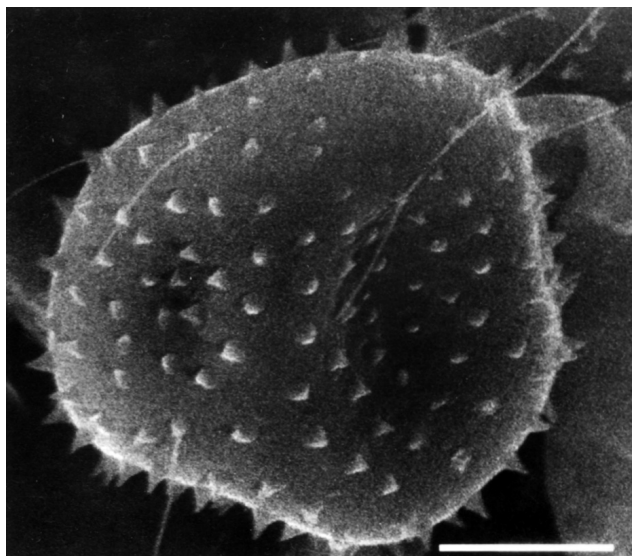


Fig 2. An urediniospore of *Phragmidium potentillae* in SEM (SOMF 9990). Bar = 5 μ m

2. *Phragmidium potentillae* (Pers. : Pers.) P. Karsten, Bidrag Kännedom Finlands Natur Folk 31: 49, 1879. — *Puccinia potentillae* Pers. : Pers., Syn. Meth. Fungorum, p. 229, 1801. (Figs 2, 3 & 7)

[**Spermogonia** amphigenous or on petioles, few, aggregated in small groups, often confluent, subcuticular, usually surrounded by the aecia, yellow]. **Aecia** amphigenous or on petioles, ruptured epidermis conspicuous, scattered or grouped, rounded, ovate, elongate or irregular in shape, 0.5–2 mm diam, pulverulent, orange; **paraphyses** cylindrical or clavate, 53.5–92.5 $\times$ 14–21.5 μ m, wall thin, nearly colourless, smooth; **aeciospores** globose, subglobose, broadly ellipsoid or obovate, 17.5–27.5 $\times$ 16–24 (22.1 $\pm$ 1.9 $\times$ 19.5 $\pm$ 1.9) μ m [$n_{(4)} = 200$], wall 1–1.5 μ m thick, nearly colourless, with fine, scattered warts, contents orange-yellow. **Uredinia** hypophyllous, at first covered by epidermis and surrounded by paraphyses, then naked (but not as conspicuous as aecia), scattered or aggregated, sometimes confluent, pulverulent, rounded, ca 0.5–1 mm diam, orange-yellow; **paraphyses** numerous, broadly clavate or capitate, 30–79 $\times$ 8.5–22.5 μ m, usually erect or slightly incurved, wall of unequal thickness (1 μ m or less), nearly colourless, smooth; **urediniospores** globose, subglobose, obovate or ellipsoid, 16.5–26.5 $\times$ 14–22 (20.9 $\pm$ 1.9 $\times$ 17.3 $\pm$ 1.5) μ m [$n_{(26)} = 1300$], pale yellow or colourless, with scattered, obscure pores, wall 1–1.6 (–2) μ m thick, finely echinulate. **Telia** mostly hypophyllous or on petioles, sometimes on the calix, scattered or grouped, pulverulent, rounded or broadly elliptical, ca 0.5–1 mm diam, black; **teliospores** cylindrical, 2–7-celled (4.8 $\pm$ 0.7) [$n_{(30)} = 1500$], 44.5–97.5 $\times$ 23–31.5 (70.0 $\pm$ 9.6 $\times$ 27.0 $\pm$ 1.6) μ m [$n_{(30)} = 1500$], rounded or acute above, sometimes papillate, usually slightly constricted at the septa, rounded at the base, with 2–3 germ pores in the upper part of each cell, wall smooth, bilaminate, outer layer brown-yellow, inner layer darker,

brown; pedicel persistent, 86.5–178 $\times$ 6–10.5 μ m, non-hygroscopic, of equal thickness but usually a little more wider at the base of the spore, colourless, somewhat rugose especially at the lower part.

Life cycle, host range, and distribution: 0, I, II, III (Autoeu form) on *Potentilla* spp. — Europe, Asia, N. America.

Host range and distribution in Bulgaria:

On *Potentilla argentea* L.: Forebalkan, Balkan Range (Central), Znepole region, Rila Mts, the Rhodopes (West), Mt Strandzha. On *P. argentea* gr.: Northeast Bulgaria, Danubian Plain, Balkan Range (East), Vitosha region, Mt Slavyanka, Pirin Mts (Krousheva 1964 – specim. n.v.), Mt Sredna Gora (Radoslavov 1936 – specim. n.v.), Toundzha Hilly Country (Krousheva 1964 – specim. n.v.). On *P. bornmuelleri* Borb.: Black Sea Coast. A new host record for Bulgaria. On *P. cinerea* Vill. (*P. arenaria* Borkh., *P. tommasiniana* Schultz): Black Sea Coast, Northeast Bulgaria, Forebalkan (Hruby 1931 – specim. n.v.), Balkan Range (West, Central), Sofia region, Znepole region, Mt Sredna Gora (Radoslavov 1914 – specim. n.v.). On *P. inclinata* Vill. (*P. canescens* Besser): Black Sea Coast, Balkan Range (East), Sofia region, Mt Slavyanka, Pirin Mts, Thracian Lowland (Bubák 1903 – specim. n.v.), Mt Strandzha. On *P. laciniata* Nestler (*P. hirta* auct. bulg. non L.): Rila Mts, Thracian Lowland. On *P. neglecta* Baumg.: Black Sea Coast, Balkan Range (Central), Sofia region, Mt Sredna Gora, the Rhodopes (Central). On *P. pedata* Nestler: Pirin Mts. A new host record for Bulgaria. On *P. recta* L. s. str.: Northeast Bulgaria, Forebalkan, Toundzha Hilly Country. On *P. recta* gr. (*P. laciniata* vel *P. pedata*): the Rhodopes (West). On *P. recta* gr.: Black Sea Coast, Northeast Bulgaria, Danubian Plain, Forebalkan, Balkan Range (East), Sofia region, Znepole region, Pirin Mts, the Rhodopes (West, Central), Toundzha Hilly Country. On *P. ternata* C. Koch (*P. chrysocraspeda* Lehm.): Balkan Range (Central), Pirin Mts, Rila Mts (Kreisel 1959 – specim. n.v.).

Specimens examined:

On *Potentilla argentea*: [4]: distr. Vidin, in vicinitatibus oppidi Belogradtschik, 24 Maj 1963, CH (11 786); [4]: ibidem, 11 Jul 1967, CH (9683); [4]: ibidem, in loco dicto 'Venetza', 10 Nov 1961, CH (1709); [4]: distr. Montana, prope oppidum Georgi Damjanovo, 9 Nov 1961, CH (1109); [5c]: in declivibus cacum. Tschavdar, alt. 1400 m, 20 Jul 1962, CH (12 842); [7]: distr. Kjustendil, supra vicum Tzarven Dol, alt. ca 900 m, 22 Jul 1992, CD (25 208); [15]: distr. Sofia, prope oppidum Samokov, 1 Oct 1910, leg. B. Davidov, fungus comm. CH (14 963); [16oc]: distr. Pazardzhik, in loco dicto 'Stenata', ad aquationem 'Goljam Beglik', 17 Jul 2001, CD & RP (25 209); [16oc]: distr. Smoljan, prope oppidum Dospat, 17 Jul 2001, CD & RP (25 210); [20]: distr. Burgas, in loco dicto 'Kerezovija Dol' prope pagum Kosti, 23 Jun 1961, CH (specim. mixta, *P. argentea* + *P. inclinata*) (12 841).

On *P. argentea* gr.: [2]: distr. Schumen, in loco dicto 'Schumenska Trapeza' supra oppidum Schumen, 26 Jun 1894, leg. B. Davidov, fungus comm. CH (sub *Potentilla argentea* – *) (14 961); [3]: distr. Pleven, in valle fluvii Tschernelka infra Karschin, 14 Aug 1973, leg. N. Vihodcevsy, fungus comm. CH (sub *) (9388); [5o]: distr. Sliven, ad viam Sliven-Kotel, 7 Sep 1973, CH & M. Drumeva (sub *) (9391); [8]: mons Vitoscha, supra Dragalevtzi, 24 Oct 1956, CH (sub *) (1051); [12]: distr. Blagoevgrad, supra pagum Paril, alt. 850 m, 22 Oct 1964, CH (sub *) (4660).

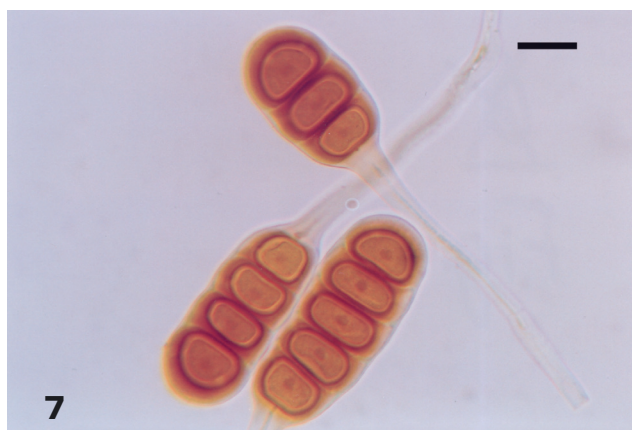
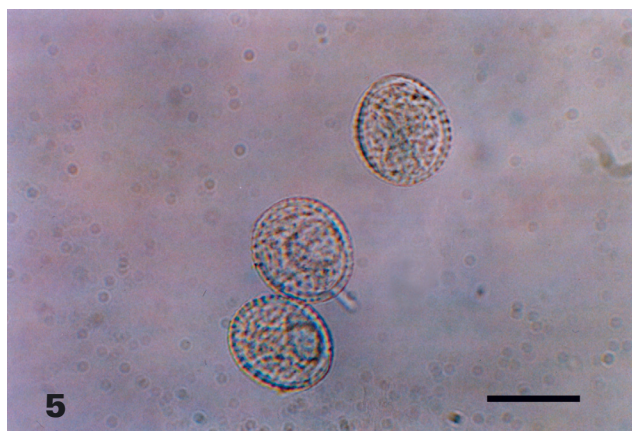


Fig. 3. Uredosori of *Phragmidium potentillae* on leaves of *Potentilla argentea* (SOMF 25 210). Fig. 4. Uredosori of *Phragmidium mucronatum* on fruit of *Rosa canina* (SOMF 25 471). Fig. 5. Urediniospores of *Kuehneola uredinis* on *Rubus hirtus* (SOMF 14 882). Fig. 6. Teliospores of *Phragmidium fragariae* on *Potentilla micrantha* (SOMF 9588). Fig. 7. Teliospores of *Phragmidium potentillae* on *Potentilla laciniosa* (SOMF 12 828). Fig. 8. Teliospores of *Phragmidium sanguisorbae* on *Sanguisorba minor* s. lat. (SOMF 4584). Figs 5-8. Bars = 20 μ m

On *P. bornmuelleri*: [1]: distr. Varna, prope urbem Varna, 2 Jun 1902, B. Davidov, fungus comm. CH (sub *Potentilla taurica*) (14 972).

On *P. cinerea*: [1]: distr. Varna, prope urbem Varna, 29 Jul 1929, B. Davidov, fungus comm. CH (14 971); [2]: distr. Razgrad, in oppido Razgrad, Jul 1885, leg. A. Javachev, fungus comm. CH (14 969); [5c]: in loco dicto 'Golyama Mogila' prope Petrohan, 27 Jul 1962, CH (sub *P. tommasiniana* – *) (2801); [5c]: distr. Lovetsch, mons Trojanska Planina, in loco dicto 'Kozjata Stena', Aug 1964, CH (sub *) (4711); [5c]: ibidem, alt. 1500 m, 22 Jul 1965, CH (12 816); [5c]: mons Schiptschenska Planina, cacum. Maluscha, alt. 1320 m, 15 Oct 1963, CH (sub *) (5906); [6]: distr. Sofia, in loco dicto 'Kutlove' prope pagum Ponor, 7 Aug 1956, leg. N. Vihodcevsy, fungus comm. CH (sub *P. arenaria*) (8770); [7]: distr. Sofia, prope oppidum Dragoman, 26 Jun 1894, leg. I. Urumov, fungus comm. CH (14 967); [7]: distr. Pernik, mons Paramunska Planina, alt. 800 m, 4 Aug 1961, CH (sub *) (2400); [7]: distr. Kjustendil, mons Rudina Planina, prope oppidum Trekljano, 13 Maj 1939, leg. K. Stoitschkov, fungus comm. CH (14 970).

On *P. inclinata*: [1]: distr. Varna, in loco dicto 'Longoza' prope pagum Novo Orjahovo, 20 Oct 1995, leg. D. Stojanov, det. CD (25 207); [5or]: distr. Sliven, in colle Bajraka prope oppidum Sliven, alt. 280 m, 19 Jun 1964, CH (sub *P. canescens*) (12 819); [5or]: distr. Sliven, in vicinitatibus oppidi Sliven, in loco dicto 'Bakadzhitze' supra pagum Gavrailovo, 23 Jun 1964, CH (sub *P. canescens*) (12 818); [6]: distr. Sofia, prope pagum Pantscharevo, 25 Aug 1959, leg. N. Vihodcevsy, fungus comm. CH (sub *P. argentea*) (2826); [12]: distr. Blagoevgrad, supra pagum Goleschovo, alt. 920 m, 28 Oct 1964, CH (sub *P. argentea*) (4780); [14]: distr. Blagoevgrad, supra loc. dict. 'Papaz-Tschair', alt. 1550 m, 24 Oct 1964, CH (sub *P. argentea*) (4659); [20]: distr. Burgas, in loco dicto 'Kerezovija Dol' prope pagum Kostî, 23 Jun 1961, CH (sub *P. argentea*; specim. mixta, *P. inclinata* + *P. argentea*) (12 841).

On *P. laciniosa*: [15]: distr. Blagoevgrad, ad ripam rivuli Blagoevgradska Bistriza, 11 Jul 1959, CH (sub *P. hirta*) (1050 & 1052); [18]: distr. Haskovo, in colle Kajrjaka prope pagum Sladun, 16 Jun 1963, CH (sub *P. hirta*) (12 827); [18]: distr. Jambol, in colle ad pagum Lesovo, 4 Jul 1963, CH (sub *P. hirta*) (12 828).

On *P. neglecta*: [1]: distr. Varna, prope urbem Varna, 1884, leg. A. Javachev, fungus comm. CH (sub *Potentilla argentea* – *) (9474); [1]: ibidem, Aug 1884, leg. A. Javachev, fungus comm. CH (sub *) (14 960); [5c]: distr. Plovdiv, mons Kaloferska Planina, supra oppidum Kalofer, 15 Jun 1967, leg. M. Markova, fungus comm. CH (sub *) (14 959); [6]: distr. Sofia, in loco dicto 'Belediehan', 19 Maj 1961, CH (sub *) (11 694); [16]: distr. Pazardzhik, in loco dicto 'Koloniite' supra oppidum Panagjurischte, 19 Aug 1934, A. Radoslavov (sub *) (12 840); [17c]: distr. Plovdiv, supra coenobium 'Batschkovski Manastir', 8 Sep 1957, CH (sub *) (2873).

On *P. pedata*: [14]: distr. Blagoevgrad, infra pagum Pirin, alt. 760 m, 25 Jun 1965, CH (sub *Potentilla hirta*) (12 829).

On *P. recta* s. str.: [2]: distr. Schumen, inter pagum Osmar et Kotschovo, 16 Jun 1960, CH (sub *Potentilla recta* – *) (12 837); [2]: distr. Schumen, ad oppidum Preslav, 28 Apr 1960, CH (sub *) (12 838); [4]: distr. Lovetsch, in colle Baschbunar ad oppidum Lovetsch, 8 Jul 1964, CH (sub *) (4540); [19]: distr. Jambol, in colle Strazhata prope pagum Goljam Dervent, 5 Jul 1963, CH (sub *) (4320); [19]: distr. Jambol, mons Sakar Planina, in loco dicto 'Dervishka Mogila', 18 Jun 1963, CH (sub *) (12 839).

On *P. recta* gr. (*P. laciniosa* vel *P. pedata*): [17oc]: distr. Pazardzhik, ad ripas rivi Stara Reka infra oppidum Batak, alt. 880 m, 11 Aug 1966, CH (sub *P. recta*) (5443).

On *P. recta* gr.: [1]: distr. Dobritsch, in collib. ad oppidum Baltschik, GN (sub *P. recta*), 18 Maj 1999 (BUCM 136 560), 23 Maj 1999 (BUCM 136 747) & 26 Maj 1999 (BUCM 136 846); [1]: distr. Varna, prope urbem Varna, Sep 1967, leg. B. Zhelyazova, fungus comm. CH (sub *P. hirta*) (9990); [2]: distr. Silistra, in loco dicto 'Suhata Reka' prope pagum Kranovo, Jul 1980, leg. G. Gantshev, fungus comm. CH (sub *P. recta*) (14 835); [2]: distr. Schumen, prope oppidum Preslav, 30 Apr 1960, CH (sub *P. hirta*) (10 292); [3]: distr. Veliko Tarnovo, in agris prope oppidum Pavlikeni, 24 Jun 1956, M. Markov (sub *P. villosa* Zimm.) (25 215); [4]: distr. Gabrovo, in colle Rjadkata Tschuka prope pagum Idilevo, 8 Jul 1964, CH (sub *P. recta*) (4772); [4]: distr. Lovetsch, in vicinitatibus oppidi Lovetsch, 1 Aug 1960, CH (sub *P. recta*) (12 831); [5or]: distr. Sliven, mons Slivenska Planina, in declivibus cacum. Karandila, alt. 900 m, 28 Jul 1965, CH (sub *P. recta*) (12 832); [5or]: distr. Schumen, supra pagum Varbitza, Sep 1960, CH (sub *P. recta*) (8747); [6]: Sofia, 25 Jul 1931, BI (sub *P. recta*) (BUCM 9265); [7]: distr. Pernik, mons Golo Bardo supra oppidum Radomir, 7 Jun 1963, CH (sub *P. recta*) (4287); [14]: distr. Blagoevgrad, supra pagum Gorno Spantschevo, alt. 650 m, 27 Oct 1964, CH (sub *P. recta*) (4615); [17c]: distr. Smoljan, ad loc. dict. 'Pamporovo', 11 Aug 1962, leg. B. Zhelyazova, fungus comm. CH (sub *P. recta*) (12 830); [19]: distr. Jambol, prope pagum Goljam Dervent, 5 Jul 1963, CH (sub *P. recta*) (4311).

On *P. ternata*: [5c]: distr. Lovetsch, mons Zlatishko-Tetevenska Planina, infra cacum. Vezhen, alt. 1900 m, 15 Oct 1962, CH (sub *Potentilla chrysocraspeda* – *) (12 814); [5c]: ibidem, alt. 2000 m, 13 Aug 1994, leg. D. Stojanov, det. CD & RP (25 211); [5c]: mons Kaloferska Planina, in loco dicto 'Peeschite Skali', alt. 1880 m, 18 Oct 1963, CH (sub *) (5909); [5c]: mons Kaloferska Planina, in declivibus cacum. Korubaschitza ad refugium turisticum 'Mazalat', alt. 1650 m, 17 Oct 1963, CH (sub *) (5908); [14]: infra cacum. Dontschovi Karauli, alt. 2200 m, 31 Aug 1961, CH (sub *) (2399); [14]: in declivibus cacum. Muratov Vrah, alt. 2180 m, 27 Apr 1962, CH (sub *) (2759).

Note. *Potentilla crantzii* (Crantz) Fritsch (Markov 1962, as *P. villosa* (Crantz) Zimm.) omitted as a host record. This host plant, SOMF 25 215, is a member of *Potentilla recta* gr.

3. *Phragmidium sanguisorbae* (DC.) J. Schröt. in Cohn, Kryptog.-Fl. Schles. 3(1): 352, 1887. — *Puccinia sanguisorbae* DC., Fl. Franç. 6: 54, 1815. — *Caecoma poterii* Schltdl., Fl. Berol. 2: 125, 1824 (l.). — *Phragmidium poterii* Fuckel, Jahrb. Nassauischen Vereins Naturk. 23-24: 46, 1870. (Fig. 8)

[*Spermogonia* amphigenous, in small rounded groups, flat, yellowish, formed purple spots]. *Aecia* amphigenous or on petioles, caeomatoid, rounded, 0.2-0.3 mm diam, surrounded the spermogonia but on the opposite side of the leaves, or larger and elongate up to 3 mm due to their longitudinal confluence on the petioles and veins, usually orange; *paraphyses* incurved, clavate, 39-74 × 8.5-14.5 µm, wall of unequal thickness, about 1 µm and up to 2 µm at the apex, pale yellow, smooth; *aeciospores* globose, subglobose, broadly ellipsoid or polyhedral, 17-24 × 15-20.5 (20.5±1.6 × 17.5±1.2) µm [$n_{(7)} = 350$], contents yellow, with 6-8 pores, wall 1-1.8 (–2) µm thick, densely verrucose, warts scattered irregularly. *Uredinia* hypophyllous, formed russet spots on the upper leaf surface, at first covered by epidermis and surrounded by paraphyses, then ruptured epidermis conspicuous, scattered, pulverulent, rounded, ca 0.25-1 mm

diam, orange-yellow; **paraphyses** incurved, clavate or capitate, $29-60 \times 9-15.5 \mu\text{m}$, wall about $1 \mu\text{m}$ thick, at the apex thicker up to $2 \mu\text{m}$, pale yellow, smooth; **urediniospores** globose, subglobose, ovoid or ellipsoid, $16.5-23 \times 14.5-19 (19.3 \pm 1.6 \times 17.0 \pm 1.4) \mu\text{m}$ [$n_{(7)} = 350$], contents orange-yellow, with 6-8 scattered pores, wall $ca 1 \mu\text{m}$ thick, finely echinate. **Telia** hypophyllous, scattered, pulverulent, rounded, $ca 0.25-1 \text{ mm}$ diam, black; **paraphyses** incurved, clavate, $27.5-57.5 \times 9-16.5 \mu\text{m}$, wall $ca 1 \mu\text{m}$ thick, at the apex up to $2 \mu\text{m}$, nearly colourless, finely verrucose; **teliospores** ellipsoidal or broadly cylindrical, $(3-4) 4 \pm 0.5 (-5)$ -celled [$n_{(5)} = 250$], $49-78 \times 24.5-31 (63.5 \pm 6.3 \times 28.0 \pm 1.5) \mu\text{m}$ [$n_{(5)} = 250$], rounded above, with a hyaline papilla up to $5 \mu\text{m}$ long, slightly constricted at the septa, rounded at the base, with 2-3 pores in the upper part of each cell, wall bilaminar, $2-3 \mu\text{m}$ thick, the outer layer brown-yellow, the inner layer darker, brown, verrucose, warts scattered irregularly; pedicel fragile, $36.5-67 \times 9-13.5 \mu\text{m}$, non-hygroscopic, of equal thickness, colourless, with fine, scattered warts, somewhat rugose at the lower part.

Life cycle, host range, and distribution: 0, I, II, III (Auto-eu form) on *Sanguisorba* spp. – Europe, Asia, N. Africa.

Host range and distribution in Bulgaria:

On *Sanguisorba minor* Scop. subsp. *minor*: Northeast Bulgaria, Forebalkan, the Rhodopes (Central, East). On *S. minor* subsp. *muricata* (Rouy & Cam.) Briq.: Black Sea Coast, Northeast Bulgaria. A new host record for Bulgaria. On *S. minor* s. lat.: Black Sea Coast, Danubian Plain, Forebalkan, Balkan Range, Sofia region, Znepole region, Vitosha region, Mt Belasitsa, Mt Slavyanka, Pirin Mts, Mt Sredna Gora, the Rhodopes (East), Toundzha Hilly Country, Mt Strandzha.

Specimens examined:

On *Sanguisorba minor* subsp. *minor*: [2]: distr. Dobritsch, General Toshevo, 26 Jun 1962, M. Markov (25 204); [2]: distr. Varna, prope pagum General-Kantardzhievo, 17 Jun 1966, CH (11 472); [4]: distr. Lovetsch, in vicinitatibus oppidi Lovetsch, 2 Aug 1960, CH (11 473); [17c]: distr. Plovdiv, prope pagum Batschkovo, 10 Sep 1956, CH (11 469); [17or]: distr. Haskovo, prope pagum Mezek, 16 Maj 1960, CH (11 468).

On *S. minor* subsp. *muricata*: [1]: distr. Dobritsch, in oppido Baltschik, 21 Maj 1999, GN (BUCM 136 653); [1]: ad oppidum Baltschik, 21 Maj 1999, GN (BUCM 136 663), 24 Maj 1999 (BUCM 136 776), 25 Maj 1999 (BUCM 136 801) & 1 Oct 1998 (BUCM 136 363); [2]: distr. Dobritsch, in oppido Dobritsch, 26 Maj 1999, GN (BUCM 136 839).

On *S. minor* s. lat.: [1]: distr. Burgas, in vicinitatibus oppidi Tzarevo, 13 Nov 1962, CH (2893); [3]: distr. Veliko Tarnovo, in vicinitatibus oppidi Pavlikeni, 26 Apr 1963, leg. M. Markov, det. CH (4443); [3]: ibidem, 25 Nov 1964, CH (4584); [4]: destr. Veliko Tarnovo, prope pagum Bjala Tscherkva, 22 Apr 1956, M. Markov (25 203); [5oc]: distr. Sofia, prope pagum Komschitza, alt. 1150 m, 11 Maj 1969, CH (13 470); [5c]: distr. Lovetsch, mons Zlatishko-Tetevenska Planina, supra pagum Ribaritz, Jun 1977, G. Bakalova (25 205); [5c]: distr. Lovetsch, prope pagum Neschkovtzi, alt. 750 m, 11 Maj 1963, CH (3442); [5o]: distr. Sliven, prope pagum Avramovo, 7 Sep 1973, CH & M. Drumeva (9380); [5o]: distr. Schumen, supra oppidum Varbitza, 1960, CH (11 466); [6]: Sofia, prope Vladaja, 8 Maj 1935, leg. B. Kitanov, fungus comm. CH (11 716); [6]: in vicinitatibus urbis Sofia prope pagum Katina, 26 Mar 1967, leg. N. Vihodcevsy, fungus comm. CH (11 471); [7]: distr. Pernik, mons Golo Bardo, 8 Jun 1957, CH

(11 463); [8]: Sofia, mons Vitoscha supra Bistrizta, alt. $ca 1000 \text{ m}$, 2 Sep 1963, CH (11 475); [11]: distr. Blagoevgrad, supra oppidum Petritsch, 20 Mar 1960, CH (11 465); [14]: distr. Blagoevgrad, prope oppidum Melnik, 10 Jul 1959, CH (11 477); [14]: distr. Blagoevgrad, prope pagum Pirin, 25 Jun 1965, (11 474); [16]: distr. Sofia, mons Lozenska Planina, prope pagum Kokaljane, 9 Apr 1971, CH (10 508); [17or]: distr. Kardzhali, ad viam inter pagum Odrintzi et pagum Sviratschi, 6 Nov 1959, CH (1067); [19]: distr. Haskovo, in vicinitatibus oppidi Topolovgrad, 24 Mar 1961, CH (11 467); [20]: distr. Burgas, inter oppidum Malko Tarnovo et pagum Zvezdetz, alt. 200 m, 14 Maj 1970, CH (9175).

Sect. *Phragmidium*

Teliospores verrucose; pedicel hygroscopic. The known in Bulgaria species are members of *Ph. mucronatum* gr. (*Ph. mucronatum*, *Ph. fusiforme*, *Ph. rosae-pimpinellifoliae*, and *Ph. tuberculatum*) on *Rosa* spp. (Roseae) and *Ph. violaceum* gr. (*Ph. violaceum*, *Ph. acuminatum*, *Ph. bulbosum*, and *Ph. rubidaei*) on *Rubus* spp. (Rubeae).

4. *Phragmidium acuminatum* (Fr.) Cooke, Handb. Brit. Fungi, p. 490, 1871. — *Aregma acuminata* Fr., Observ. Mycol. 1: 226, 1815; — *Phragmidium rubi-saxatilis* Liro, Bidrag Kännedom Finlands Natur Folk 65: 421, 1908. (Fig. 9)

[*Spermogonia* unknown]. **Aecia** hypophyllous, ruptured epidermis conspicuous, scattered, rounded in shape, $0.2-0.3 \text{ mm}$ diam, pulverulent, yellow; **paraphyses** few, cylindrical, clavate or capitate, $37.5-85.5 \times 8-15 \mu\text{m}$, erect or slightly incurved, wall of equal thickness, $ca 1 \mu\text{m}$, pale yellow, smooth; **aeciospores** subglobose, globose or broadly ellipsoid, $20.5-26 \times 18-23 (23.3 \pm 1.4 \times 20.7 \pm 1.5) \mu\text{m}$ [$n_{(1)} = 50$], contents yellow, with indistinct pores, wall $1-2 \mu\text{m}$ thick, pale yellow, sparsely echinulate. **Uredinia** hypophyllous, at first covered by epidermis and surrounded by paraphyses, then ruptured the epidermis and naked, scattered or aggregated, pulverulent, rounded, $ca 0.2-0.5 \text{ mm}$ diam, yellow; **paraphyses** few, clavate or capitate, $33-65.5 \times 9-16.5 \mu\text{m}$, incurved, wall of equal thickness, $ca 1 \mu\text{m}$, pale yellow, smooth; **urediniospores** broadly ellipsoid, ellipsoid or subglobose, $17-25.5 \times 16.5-20.5 (21.2 \pm 1.7 \times 18.4 \pm 1.0) \mu\text{m}$ [$n_{(1)} = 50$], contents yellow, with indistinct pores, wall $1-1.2 \mu\text{m}$ thick, densely and finely echinulate. **Telia** hypophyllous, scattered, $ca 0.3-1 \text{ mm}$ diam, or grouped, pulverulent, rounded or broadly elliptical, black; **paraphyses** cylindrical or capitate, $42-68.5 \times 7.5-16 \mu\text{m}$, slightly incurved, wall of equal thickness, $ca 1 \mu\text{m}$, pale yellow, smooth; **teliospores** cylindrical, 4-7-celled $(5.8 \pm 0.7) [n_{(3)} = 150]$, $68-108 \times 29-36.5 (88.4 \pm 9.1 \times 32.6 \pm 1.9) \mu\text{m}$ [$n_{(3)} = 150$], with 2-3 pores in each cell, not constricted at the septa, rounded at both ends but with a developed papilla above, up to $16 \mu\text{m}$ long, wall chestnut-brown, $2.5-4 \mu\text{m}$ thick, densely verrucose; pedicel persistent, $73.5-125 \mu\text{m}$ long, $8-12 \mu\text{m}$ wide, yellowish in the upper part, hygroscopic, dilated to $20 \mu\text{m}$ and nearly colourless in the lower part.

Life cycle, host range, and distribution: 0(?), I, II, III (Auto-eu form) on *Rubus saxatilis* L. – Europe, Asia.

Host range and distribution in Bulgaria:

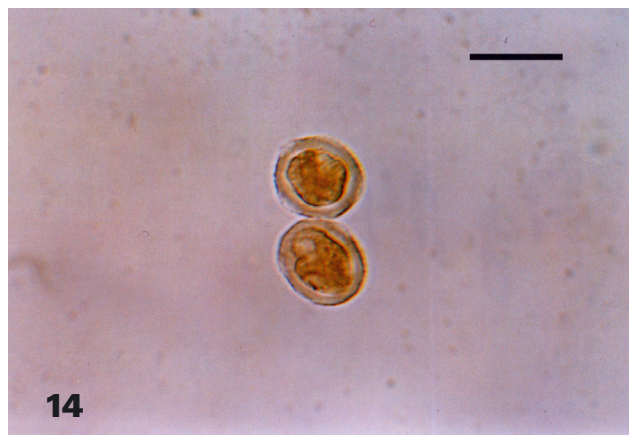
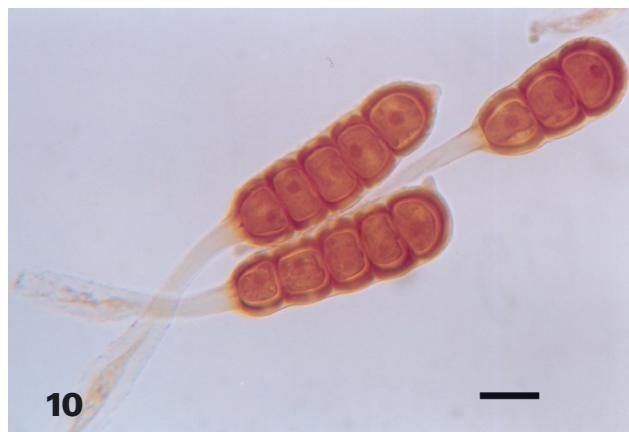


Fig. 9. Teliospores and urediniospores of *Phragmidium acuminatum* on *Rubus saxatilis* (SOMF 5219). Fig. 10. Teliospores of *Phragmidium bulbosum* on *Rubus caesius* (SOMF 9607). Fig. 11. Teliospores of *Phragmidium fusiforme* on *Rosa pendulina* (SOMF 3253). Fig. 12. Teliospores and urediniospores of *Phragmidium mucronatum* on *Rosa canina* (SOMF 10 204). Fig. 13. Aeciospores of *Phragmidium* aff. *rosae-pimpinellifoliae* on *Rosa spinosissima* (SOMF 8742). Fig. 14. Urediniospores of *Phragmidium* aff. *rosae-pimpinellifoliae* on *Rosa spinosissima* (14 834). Figs 9-14. Bars = 20 μ m

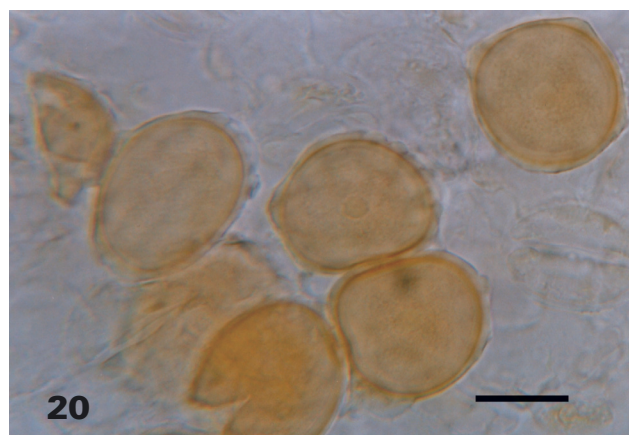
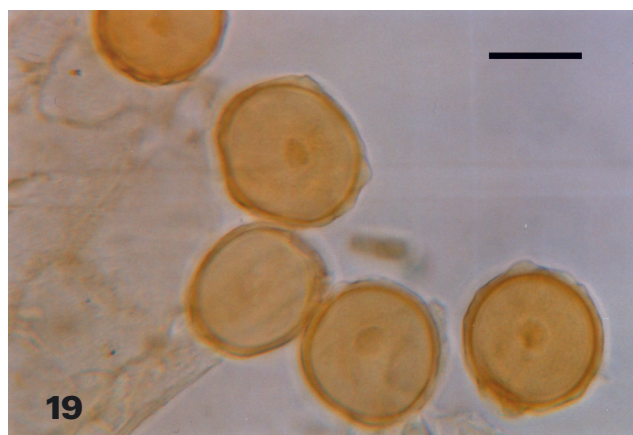


Fig. 15. Teliospores of *Phragmidium rubi-idaei* on *Rubus idaeus* (SOMF 12 775). Fig. 16. Teliospores of *Phragmidium tuberculatum* on *Rosa turcica* (SOMF 1039). Fig. 17. Teliospores of *Phragmidium violaceum* on *Rubus praecox* (SOMF 25 224). Fig. 18. Teliospores of *Xenodochus carbonarius* on *Sanguisorba officinalis* (SOMF 25 206). Fig. 19. Teliospores of *Trachyspora intrusa* on *Alchemilla incisa* (SOMF 25 544). Fig. 20. Teliospores of *Trachyspora* aff. *pentaphylleae* on *Alchemilla viridiflora* (SOMF 9694). Figs 15-20. Bars = 20 μ m

On *Rubus saxatilis* L.: Pirin Mts, the Rhodopes (Central).

Specimens examined:

On *Rubus saxatilis*: [14]: supra refugium turisticum 'Javorov', in loco dicto 'Hajduschkata Tšeschma', alt. ca 1800 m, 7 Sep 1961, CH (5219); [14]: in declivibus cacum. Razlozhki Suhodol, alt. ca 2000 m, 22 Sep 1957, CH (sub *Ph. rubi-saxatilis*) (1064); [17c]: distr. Smoljan, supra pagum Trigrad, alt. 1200 m, 16 Aug 1966, CH (sub *Ph. rubi-saxatilis*) (5479).

5. *Phragmidium bulbosum* (F. Strauss) Schltdl., Fl. Berol. 2: 156, 1824. — *Uredo bulbosum* F. Strauss, Ann. Wetter. Ges. 2: 108, 1810 (III). — *Puccinia mucronata* Pers. β *rubi* Pers., Disp. Meth. Fungorum 1: 38, 1797. — *P. mucronata* Pers.: Pers. β *rubi* Pers.: Pers., Syn. Meth. Fungorum, p. 230, 1801 (pro parte). — *Phragmidium rubi* (Pers.): Pers. G. Winter in Rabenh., Kryptog.-Fl. Deutschl. 1(1): 230, 1881 (pro parte) (Fig. 10)

Spermogonia epiphyllous, aggregated in small groups, subcuticular, brown, hemispherical or conical, 0.2–0.8 mm diam. **Aecia** mostly hypophyllous, ruptured epidermis conspicuous, rounded, oval, elongate or irregular in shape, 0.2–0.5 mm diam, scattered or in small ring-shaped groups, up to 1.5 mm diam, surrounded the spermogonia or situated on the opposite side of the leaf surface, confluent and elongate around the veins, pulverulent, orange; **paraphyses** broadly capitate or clavate, $36.5\text{--}83.5 \times 7.5\text{--}17.5 \mu\text{m}$, usually incurved, sometimes erect, hyaline, wall thin, slightly or not thickened at the apex, pale yellow, smooth; **aeciospores** subglobose, broadly ellipsoid or ovoid, $18\text{--}24 \times 16.5\text{--}21.5$ ($20.9 \pm 1.5 \times 18.9 \pm 1.2$) μm [$n_{(3)} = 150$], with 2–4 pores, formed globular cameras in swelling, contents yellowish, wall 1.2–2 μm thick, covered by rough and irregular warts. **Uredinia** hypophyllous, at first covered by epidermis and surrounded by paraphyses, then ruptured the epidermis and naked, scattered or confluent in groups, pulverulent, rounded, ca 0.2–0.3 mm diam, orange-yellow, formed yellowish spots on the upper leaf surface; **paraphyses** cylindrical or capitate, $36.5\text{--}72 \times 10\text{--}16.5 \mu\text{m}$, incurved, wall thin, slightly thickened at the apex, smooth; **urediniospores** globose, subglobose, ovoid or ellipsoid, $19.5\text{--}24.5 \times 17\text{--}21.5$ ($21.2 \pm 1.3 \times 18.7 \pm 1.0$) μm [$n_{(2)} = 100$], contents yellow, with 4 scattered pores formed globular cameras in swelling, wall 1–1.5 μm thick, rather distantly echinulate. **Telia** hypophyllous, scattered or aggregated, pulverulent, rounded or broadly elliptical, ca 0.2–1 mm long, black; **paraphyses** similar to those in uredinia; **teliospores** cylindrical, 3–7-celled (5.9 ± 0.7) [$n_{(6)} = 300$], $72\text{--}109.5 \times 28\text{--}35.5$ ($90.1 \pm 8.5 \times 32.1 \pm 1.8$) μm [$n_{(6)} = 300$], rounded at both ends, usually with developed hyaline papilla above, up to 14.5 μm long, sometimes papilla verrucose, less often papilla absent, not constricted at the septa, with 2–4 pores in each cell, wall 3.5–5 μm thick, brown, densely and finely verrucose; pedicel persistent, hygroscopic, 75.5–125 μm long, dilated to 20 μm in the lower part, 9–11 μm wide in non-hygroscopic part, colourless, smooth.

Life cycle, host range, and distribution: 0, I, II, III (Autoeu form) on *Rubus* spp. — Europe, Asia, N. Africa.

Host range and distribution in Bulgaria:

On *Rubus caesius* L.: Black Sea Coast, Northeast Bulgaria (Savov 1923 – specim. n.v.), Forebalkan, Balkan Range (West, Radoslavov 1915 – specim. n.v.; East), Sofia region (Radoslavov 1914 – specim. n.v.), Vitosha region (Radoslavov 1914 – specim. n.v.), Mt Belasitsa (Ivanov 1919 – specim. n.v.), Mt Sredna Gora (Radoslavov 1923 – specim. n.v.), the Rhodopes (Central), Thracian Lowland, Mt Strandzha. On *R. canescens* DC. (Syn. *R. tomentosus* Borkh.): Balkan Range (East), the Rhodopes (Central). A new host record for Bulgaria. On *R. hirtus* agg.: Forebalkan, Rila Mts, Mt Strandzha. On *R. praecox* Bertol. (Syn. *R. discolor* Weihe & Nees, *R. procerus* P.J. Mueller, *R. macrostemon* Focke, *R. hedyocarpus* Focke): Sofia region, Rila Mts, Mt Strandzha. A new host record for Bulgaria.

Specimens examined:

On *Rubus caesius*: [1]: distr. Dobritsch, prope pagum Durankulak, $43^{\circ}44'12''\text{N } 28^{\circ}33'35''\text{E}$, 21 Sep 1998, GN (BUCM 135 985); [1]: distr. Dobritsch, in oppido Kavarna, 1 Sep 1914, I. C. Constantineanu (BUCM 8904); [1]: distr. Dobritsch, in loco dicto 'Albena', 27 Sep 1998, GN (BUCM 136 275); [1]: distr. Varna, in loco dicto 'Zlatni Pyasaci', 27 Sep 1998, GN (BUCM 136 201); [4]: distr. Gabrovo, prope pagum Sennik, 20 Oct 1963, CH (sub *Ph. rubi* – *) (5971); [4]: distr. Vidin, Vraschka Tschuka, alt. 400 m, 28 Maj 1963, CH (sub *) (11 401); [5or]: distr. Schumen, in loco dicto 'Patlejna', prope oppidum Preslav, 9 Nov 1957, CH (sub *) (9607); [5or]: distr. Schumen, in loco dicto 'Dervischa', prope oppidum Preslav, 29 Apr 1960, CH (sub *) (9606); [17c]: distr. Smoljan, ad viam Devin-Bedenski Bani, 14 Jun 1969, CH (13 446); [18]: distr. Plovdiv, prope urbem Plovdiv, 20 Jun 1929, leg. A. Valkanov, det. CH (12 522); [20]: ad distr. Burgas, ripam rivi Veleka inter pagum Zvezdetz et oppidum Malko Tarnovo, 11 Nov 1962, CH (sub *) (2838).

On *R. canescens*: [5or]: distr. Sliven, prope oppidum Kotel, 28 Oct 1975, CH (sub *R. tomentosus*) (9222); [17c]: distr. Blagoevgrad, prope pagum Kovatschevitza, 21 Aug 1980, CH (sub *R. tomentosus*) (14 914).

On *R. hirtus* agg.: [4]: distr. Gabrovo, in loco dicto 'Rosischko Gorsko Stopanstvo' supra pagum Batoschevo, 26 Jul 1965, CH (sub *Ph. rubi* on *R. serpens*) (9604); [15]: distr. Sofia, supra oppidum Kostenetz, alt. 1000 m, 28 Jun 1960, leg. M. Markova, fungus comm. CD & RP (25 226); [20]: distr. Burgas, in loco dicto 'Uzunbudzhak' supra pagum Kosti, alt. 180 m, 13 Maj 1965, CH (sub *Ph. violaceum* on *R. hirtus* Waldst. & Kit.) (9609).

On *R. praecox*: [6]: Sofia, Bojana, 30 Jul 1928, leg. I. Urumov, fungus comm. CD & RP (25 217); [15]: distr. Sofia, supra oppidum Kostenetz, alt. 690 m, 18 Sep 1955, CH (sub *Ph. rubi* on *R. nemorosus*) (1057); [15]: ibidem, alt. 680 m, 18 Sep 1955, CH (sub *Ph. rubi* on *R. thyrsoides*) (1056); [20]: distr. Burgas, in loco dicto 'Bogoroditschnia Dol', prope pagum Kosti, 15 Maj 1965, CH (sub *Ph. rubi* on *R. procerus*) (9602).

Notes. (i) For lack of vouchers and because of potential misidentifications of the hosts, the following host records are omitted here: *Fragaria vesca* L. (Radoslavov 1934), *R. corylifolius*, *R. glandulosus*, and *R. nemorosus* (Klika 1926), and *Rubus fruticosus* (Savov 1923). (ii) The host records of *Rubus nemorosus* (Hinkova 1959) and *R. thyrsoides* Wimm. (Hinkova 1959, 1960, non *R. thyrsanthus* Focke, as it was cited in Denchev 1995), are related to *Rubus praecox*.

6. *Phragmidium fusiforme* J. Schröt. var. *fusiforme*, Abhandl. Schles. Ges. Vaterl. Cult., Nat. Abth. 1869–72: 24, 1870. — *Uredo pinguis* DC. var. *rosae-alpinae* DC., Fl. Franç.

2: 235, 1805 (I). — *Phragmidium rosae-alpinae* G. Winter in Rabenh., Kryptog.-Fl. Deutschl. 1(1): 227, 1881. (Fig. 11)

Spermogonia mostly hypophyllous, subcuticular, hardly conspicuous, in small groups, pale yellow, formed minute yellowish spots. **Aecia** hypophyllous or on fruits, sometimes on petioles, pedicels and stems, ruptured epidermis conspicuous, scattered, 0.2–1 mm diam, or in small ring-shaped groups, 1–1.2 mm diam, elongate or irregular in shape around the veins, on pedicels and stems, irregular and larger, up to 15 mm, on fruits, pulverulent, orange-yellow; **paraphyses** numerous, capitate or clavate, less often cylindrical; **aeciospores** broadly ellipsoid, subglobose or polyhedral, 19.26×17.23 ($23.1 \pm 1.7 \times 19.7 \pm 1.1$) μm [$n_{(1)} = 50$], wall 1.5–2.5 μm thick, yellowish, distantly echinulate. **Uredinia** hypophyllous, at first covered by epidermis and surrounded by paraphyses, then ruptured the epidermis and naked, scattered or confluent in groups, pulverulent, rounded or irregular in shape, ca 0.1–0.3 mm diam, yellow, formed pink-yellowish or brownish spots on the upper leaf surface; **paraphyses** numerous, cylindrical, less often capitate, $30.5\text{--}62.5 \times 7.5\text{--}14.5$ μm , usually incurved, sometimes erect, wall thin, ca 1 μm , slightly thickened at the apex, smooth; **urediniospores** subglobose, globose, ovoid or ellipsoid, $17.5\text{--}23 \times 15.5\text{--}20$ ($19.8 \pm 1.3 \times 17.6 \pm 1.1$) μm [$n_{(3)} = 150$], contents yellow, pores formed globular cameras in swelling, wall ca 1.5 μm thick, densely and finely echinulate. **Telia** mostly hypophyllous or on petioles, scattered or grouped, pulverulent, rounded or broadly elliptical, 0.3–0.5 mm long, black; **paraphyses** similar to those in uredinia; **teliospores** cylindrical or fusiform, 8–12-celled (10.1 ± 0.9) [$n_{(3)} = 150$], $69.5\text{--}98 \times 27\text{--}34.5$ ($83.8 \pm 6.8 \times 30.5 \pm 1.7$) μm [$n_{(3)} = 150$], central cells low, 5.5–7 μm , upper cell, 10–13 μm high, basal cell, 9–10.5 μm high, rounded at both ends, with developed, smooth or slightly verrucose papilla, up to 12 μm long, not constricted at the septa, with 3–4 pores per cell, wall 3.5–5 μm thick, blackish brown or chestnut, closely verrucose with hyaline tubercles; pedicel persistent, 94–140 μm long, up to 6–8 μm wide in the upper part, hygroscopic and dilated up to 18.5 μm in the lower part, colourless, smooth.

Life cycle, host range, and distribution: 0, I, II, III (Auto-form) on *Rosa* spp. — Europe, Asia, N. America.

Host range and distribution in Bulgaria:

On *Rosa pendulina* L.: Balkan Range (Central), Vitosha region, Mt Slavyanka, Pirin Mts, Rila Mts, the Rhodopes (West).

Specimens examined:

On *Rosa pendulina*: [5c]: in declivibus cacum. Kademlija, alt 2000 m, 6 Aug 1942, leg. Jurkovski, fungus comm. CH (14 909); [5c]: in declivibus cacum. Botev, 1920, leg. I. Urumov, fungus comm. CH (14 900); [5c]: in declivibus cacum. Rusalka, 22 Jul 1885, leg. I. Urumov, fungus comm. CH (14 958); [8]: mons Vitoscha, Sofia supra Bistriza, alt. 1200 m, 6 Jul 1958, leg. B. Zheljazova, fungus comm. CH (9576); [8]: mons Vitoscha, infra refugium turisticum 'Kumata', alt. 1600 m, 26 Jul 1962, CH (9577); [8]: mons Vitoscha, prope refugium turisticum 'Bor', 7 Aug 1961, leg. B. Zheljazova, fungus comm. CH (8786); [14]: infra refugium turisticum 'Javorov', 17 Jun 2002, CD & RP (25 243); [15]: in loco dicto 'Sokoletz', alt. 1600 m, 6 Sep 1909, leg. B. Davidov, fungus comm. CH (14 951); [15]:

ad ripas rivi Ilijna Reka, 12 Aug 1963, CH (sub *R. alpina* L.) (3253); [17oc]: distr. Pazardzhik, supra pagum Sarnitza, 27 Jun 1979 (14 833); [12]: distr. Blagoevgrad, in declivibus cacum. Tzarev Vrach supra pagum Paril, alt. 2300 m, 31 Jul 1963, CH (sub *R. alpina*) (4470).

Notes. (i) Hiratsuka *et al.* (1992) include as an additional synonyme of that species *Ph. rosae-acicularis* Liro while Savile (1974, Fungi Canad., no. 54 in Parmelee & Corlett 1996) treat the latter as a separate taxon, viz. *Ph. fusiforme* J. Schröt. var. *rosae-acicularis* (Liro) Savile. (ii) Hinkova (1966) reported *Ph. fusiforme* on *Rosa pulverulenta* Bieb. (as *R. glutinosa* Sibth. & Sm.) from Mt Belasitsa (SOMF 4291) but it was impossible to revise the host plant of that specimen. (iii) Because of potential misidentifications both of the rust species and host, a record of *Ph. fusiforme* on *Rosa gallica* L. (Radoslavov 1923) is omitted here.

7. *Phragmidium mucronatum* (Pers. : Pers.) Schltdl., Fl. Berol. 2: 156, 1824. — *Puccinia mucronata* Pers. α *Puccinia rosae* Pers., Neues Mag. Bot. 1: 118, 1794. — *P. mucronata* Pers. : Pers. α *Puccinia rosae* Pers. : Pers., Syn. Meth. Fungorum, p. 230, 1801. — *Aegma mucronata* Fr., Observ. Mycol. 1: 225, 1815. — *Ascophora disciflora* Tode α *solida* Tode, Fungi Mecklenb. 1: 16, 1790. — *Phragmidium disciflorum* (Tode) J. James, Contr. U.S. Natl. Herb. 3: 276, 1895. — *Lycoperdon subcorticium* Schrank, Bot. Taschenb. Hoppe 1793: 68, 1793. — *Phragmidium subcorticium* (Schrank) G. Winter in Rabenh., Kryptog.-Fl. Deutschl. 1(1): 228, 1881. — *Uredo rosae-centifoliae* Pers. : Pers., Syn. Meth. Fungorum, p. 215, 1801. (Figs 4 & 12)

Spermogonia mostly epiphyllous, few, aggregated in small groups, often confluent, subcuticular, yellowish, hardly conspicuous. **Aecia** hypophyllous or on petioles, stems, pedicels and fruits, ruptured epidermis conspicuous, scattered or grouped, usually rounded, ca 0.2–0.8 mm diam, less often elongate up to 1–2.5 mm, pulverulent, yellow; **paraphyses** capitate or clavate, $42\text{--}78 \times 8.5\text{--}18$ μm , incurved or slightly erect, wall nearly colourless, smooth; **aeciospores** subglobose, broadly ellipsoid or obovate, $22\text{--}31 \times 19.5\text{--}26.5$ ($25.4 \pm 2.1 \times 22.5 \pm 1.7$) μm [$n_{(2)} = 100$], with 6–8 pores, wall 2.5–3.5 μm thick, nearly colourless, distinctly verrucose. **Uredinia** hypophyllous, at first covered by epidermis and surrounded by paraphyses, then ruptured the epidermis (but not as conspicuous as aecia) and naked, usually scattered over the whole leaf surface, sometimes grouped or confluent, pulverulent, rounded, ca 0.2–0.5 mm diam, yellow; **paraphyses** numerous, broadly clavate, cylindrical or capitate, $34.5\text{--}65.5 \times 8\text{--}15$ μm , strongly incurved, wall of unequal thickness ca 1.5 μm , thickened up to 3.5 μm at the apex, nearly colourless, smooth; **urediniospores** subglobose, broadly ellipsoid or obovate, $20\text{--}25 \times 16.5\text{--}21.5$ ($23.1 \pm 1.5 \times 18.9 \pm 1.1$) μm [$n_{(4)} = 200$], contents yellow, with about 8 scattered pores, wall 1.5–2.5 μm thick, closely echinulate. **Telia** hypophyllous, usually scattered over the whole surface of the leaves, sometimes in groups, pulverulent, rounded, ca 0.3–0.8 mm long, black; **paraphyses** present; **teliospores** cylindrical or narrowly ellipsoid, 5–9-celled (7.0 ± 0.7) [$n_{(5)} = 250$], $67.5\text{--}103.5 \times 33.5\text{--}40$ ($83.8 \pm 8.1 \times 36.5 \pm 1.7$) μm [$n_{(5)} = 250$], rounded at both ends, somewhat acute above and always with a well developed

papilla, up to 13.5 µm long, not constricted at the septa, with 3–4 pores per cell, wall 5–6.5 µm thick, closely verrucose, dark brown; pedicel persistent, 101–149 µm long, 8–11 µm wide in the upper part, hygroscopic and dilated up to 24.5 µm in the lower part, pale yellow.

Life cycle, host range, and distribution: 0, I, II, III (Autoeu form) on *Rosa* spp. — Cosmopolitan.

Host range and distribution in Bulgaria:

On *Rosa arvensis* Hudson: the Rhodopes (East). On *R. canina* L. s. lat. (*R. corymbifera* Borkh.): Black Sea Coast, Forebalkan (Klika 1926 — specim. n.v.), Balkan Range (Central, East), Vitosha region, Rila Mts, the Rhodopes (West, Central). On *R. canina* L. var. *andegavensis* (Bast.) Desp.: the Rhodopes (West). A new host record for Bulgaria. On *R. centifolia* L. (hort.): the Rhodopes (Central), Thracian Lowland (Malkov 1906 — specim. n.v.). On *R. dumalis* Bechst. (*R. subcollina* (Christ) Vuk., *R. subcollina* (Christ) Dalla Torre & Sarnth.): Black Sea Coast, the Rhodopes (West). A new host record for Bulgaria. On *R. damascena* Mill. (*R. gallica* L. var. *damascena* (Mill.) Voss) (cult.): Thracian Lowland, Toundzha Hilly Country. On *R. pendulina* L.: Vitosha region. A new host record for Bulgaria and Europe. On *R. tomentosa* Sm.: Rila Mts, the Rhodopes (West).

Specimens examined:

On *Rosa arvensis*: [17or]: distr. Kardzhali, in loco dicto 'Soflu-Orman' prope pagum Vojnovo, 15 Jun 1966, CH (10 257).

On *R. canina*: [1]: distr. Dobritsch, in collibus 'Tschirakman' prope oppidum Kavarna, 43°24'48"N 28°20'54"E, 25 Sep 1998, GN (BUCM 136 165); [1]: distr. Dobritsch, ad declive mari expositum in loco dicto 'Tschirakman' prope oppidum Kavarna, 25 Sep 1998, leg. CD, det. CD & RP (SOMF); [1]: distr. Dobritsch, in loco dicto 'Tuzlata' prope oppidum Baltschik, 43°24'10"N 28°13'42"E, alt. 15 m, 23 Sep 1998, GN (sub *Ph. tuberculatum*) (BUCM 136 064); [1]: in oppido Baltschik, 30 Sep 1998, GN (BUCM 136 316); [1]: distr. Varna, in loco dicto 'Zlatni Pjasatzi', 27 Sep 1998, GN (BUCM 136 234); [5c]: distr. Lovetsch, in declivibus cacum. Vezhen, alt. 1900 m, 15 Oct 1962, CH (sub *Ph. disciflorum*) (10 099); [5c]: distr. Plovdiv, supra oppidum Karlovo, 4 Jul 1928, leg. I. Urumov, fungus comm. CH (14 928); [5c]: distr. Gabrovo, supra vicum Stokite, 26 Jul 1965, CH (4915); [5or]: distr. Sliven, in loco dicto 'Tscherkovischtereto' prope oppidum Kotel, 24 Jul 1964, CH (10 205); [5or]: distr. Sliven, inter oppidum Kotel et oppidum Sliven, alt. 420 m, 28 Jul 1965, (10 204); [8]: mons Vitoscha, supra pagum Zheleznitza, Jun 2001, CD & RP (25 463); [15]: distr. Blagoevgrad, supra oppidum Blagoevgrad, 1 Oct 1930, leg. N. Fenenko, fungus comm. CH (sub *Ph. disciflorum*) (9012); [15]: distr. Pazardzhik, in valle rivuli Koprivska Reka supra pagum Sestrimo, alt. 1900 m, 28 Jun 1955, CH (sub *Ph. tuberculatum*) (10 181); [17oc]: distr. Pazardzhik, supra oppidum Rakitovo, infra loc. dict. 'Paschino Bardo', 15 Jul 2001, CD & RP (25 471); [17oc]: distr. Pazardzhik, ad aquationem 'Batak', 16 Jul 2001, CD & RP (25 464); [17oc]: distr. Pazardzhik, in loco dicto 'IV Prozoretz' supra oppidum Batak, 20 Jul 2001, CD & RP (25 465); [17oc]: distr. Pazardzhik, inter loc. dict. 'Tzigov Tschark' et reservatum 'Mantaritza', alt. ca 1380 m, 4 Aug 2001, leg. CD, det. CD & RP.

On *R. canina* var. *andegavensis*: [17oc]: distr. Pazardzhik, inter oppidum Rakitovo et loc. dict. 'Paschino Bardo', 15 Jul 2001, CD & RP.

On *R. centifolia*: [17c]: distr. Pazardzhik, in pago Varvara, 30 Maj 1979, CH (14 369).

On *R. dumalis*: [1]: distr. Dobritsch, in collibus 'Tschirakman' prope oppidum Kavarna, 18 Maj 1999, GN (sub *R. subcollina*) (BUCM 136 549); [1]: distr. Dobritsch, ad oppidum Baltschik, 24 Maj 1999, GN (sub *R. subcollina*) (BUCM 136 791); [17oc]: distr. Pazardzhik, in loco dicto 'Tzigov Tschark' supra oppidum Batak, 23 Sep 2001, CD & RP (25 467 & 25 468).

On *R. damascena*: [18]: distr. Plovdiv, prope oppidum Karlovo, Aug 1930, leg. Jurkovski, fungus comm. CH (sub *R. gallica* L. var. *damascena* (Mill.) Voss) (14 924).

On *R. pendulina*: [8]: mons Vitoscha, inter loc. dict. 'Zlatnite Mostove' et 'Bjalata Voda', 2001, leg. CD, det. RP (25 466).

On *R. tomentosa*: [15]: distr. Sofia, supra oppidum Kostenetz, alt. 690 m, 18 Sep 1955, CH (sub *Ph. disciflorum* — *) (1038); [15]: distr. Pazardzhik, in loco dicto 'Furnadzhijski Kladenetz', supra pagum Sestrimo, alt. 1240 m, 21 Jul 1953, CH (sub *) (1033) & 30 Aug 1955, CH (sub *) (1035); [17oc]: distr. Pazardzhik, inter oppidum Batak et loc. dict. 'Teheran', 5 Aug 2001, leg. CD, det. CD & RP (SOMF).

Note. Because of potential misidentifications both of the rust species and host, a record of *Ph. mucronatum* on *Rosa micrantha* Sm. (Radoslavov 1939) is omitted here.

8. *Phragmidium* aff. *rosae-pimpinellifoliae* Dietel, Hedwigia 44: 339, 1905. — *Ph. rosarum* Fuckel f. *rosae-pimpinellifoliae* Rabenh., Fungi Eur., no. 1671, 1873 (nom. nud.). (Figs 13–14)

[Spermogonia epiphyllous and on stems, irregularly scattered, often in small groups, yellowish.] **Aecia** scattered, hypophyllous or on stems, confluent in groups, irregularly elongate in shape, ruptured epidermis conspicuous, pulverulent, orange-yellow; **paraphyses** few, clavate or cylindrical, 40.5–77.5 × 9.5–21 µm, erect, less often slightly incurved, wall of equal thickness, ca 1 µm, yellowish, smooth; **aeciospores** subglobose, globose, broadly ellipsoid to ellipsoid, seldom polyhedral, 18.5–28.5 × 15–21 (23.5±2.4 × 18.3±1.4) µm [$n_{(2)} = 100$], contents orange-yellow, wall 1.2–2 µm thick, pale yellow, densely and finely verrucose with scattered and indistinct pores. **Uredinia** hypophyllous, at first covered by epidermis and surrounded by paraphyses, then ruptured the epidermis and naked, scattered, rounded, orange-yellow; **paraphyses** numerous, cylindrical or clavate, 30.5–57.5 × 9–16.5 µm, less or more incurved, less often erect, wall of equal thickness, ca 2 µm, yellowish, smooth; **urediniospores** broadly ellipsoid, subglobose or globose, 17–24.5 × 14.5–20 (20.5±1.6 × 17.5±1.4) µm [$n_{(2)} = 100$], contents yellow, with indistinct pores, wall 1–1.5 µm thick, finely echinulate. [*Telia* absent in the studied specimens from Bulgaria].

Life cycle, host range, and distribution: 0, I, II, III (Autoeu form) on *Rosa spinosissima* L. and some cultivated species *Rosa* which are assumed that have been descended from *R. spinosissima* — Europe, Asia, N. America, Australia, New Zealand.

Host range and distribution in Bulgaria:

On *Rosa spinosissima* L. (*R. pimpinellifolia* L., *R. myriacantha* Lam. & DC.): Sofia region, Znepole region, Pirin Mts, Mt Sredna Gora, the Rhodopes (West, Klika 1926 — specim. n.v.).

Specimens examined:

On *Rosa spinosissima*: [6]: distr. Sofia, in loco dicto 'Belediehan', 26 Maj 1969, CH (14 834); [7]: distr. Pernik, mons Golo Bardo, 27 Maj 1936, leg. B. Achtarov, fungus comm. CH (14 936); [14]: distr. Blagoevgrad, supra oppidum Bansko, alt. 1200 m, 20 Aug 1980, CH (14 898); [14]: distr. Blagoevgrad, in loco dicto 'Papaz-Tschair' supra oppidum Gotze Deltschev, alt. 1980 m, 25 Jun 1965, CH (11 815); [16]: distr. Sofia, mons Lozenska Planina, supra pagum Kokaljane, 30 Apr 1995, leg. D. Dimitrov, det. RP (25 469) & alt. 720 m, 18 Maj 1973, CH (8742).

Note. That fungus is very close to *Ph. mucronatum* which has black telia and blackish-brown teliospores. The difference between them is that *Ph. rosae-pimpinellifoliae* has brown telia and chestnut-brown teliospores. All examined Bulgarian specimens do not contain telia and we presume that they belong to *Ph. rosae-pimpinellifoliae*.

9. *Phragmidium rubi-idaei* (DC.) P. Karsten, Bidrag Kännedom Finlands Natur Folk 31: 52, 1879. — *Puccinia rubi-idaei* DC., Fl. Franç. 6: 54, 1815. — *Uredo rubi-idaei* Pers., Observ. Mycol. 2: 24, 1799 (I). — *U. rubi-idaei* Pers.: Pers., Syn. Meth. Fungorum, p. 218, 1801. — *Puccinia gracilis* Grev., Fl. Edinb., p. 428, 1824. — *Phragmidium gracile* Cooke, Handb. Brit. Fungi, p. 491, 1871. — *Ph. imitans* Arthur, N. Amer. Fl. 7: 165, 1912. (Fig. 15)

[*Spermogonia* epiphyllous, in small groups, usually surrounded by the aecia, rounded, 45–60 µm diam, yellow]. *Aecia* epiphyllous, ruptured epidermis conspicuous, scattered or grouped, rounded in shape, 0.5–1.5 mm diam, pulverulent, orange-yellow; *paraphyses* clavate, sometimes incurved, 35.5–70 × 10–19.5 µm, wall pale yellow, slightly thickened at the apex, smooth; *aeciospores* subglobose, obovate or broadly ellipsoid, 19–25.5 × 16.5–21.5 (21.8±1.5 × 18.9±1.2) µm [$n_{(8)} = 450$], contents orange-yellow, wall 1.5–2.5 µm thick, nearly colourless, sparsely and strongly echinulate, prickles 1.2–2.5 µm high. *Uredinia* hypophyllous, at first covered by epidermis and surrounded by paraphyses, then ruptured the epidermis and naked, scattered or gregarious, pulverulent, rounded, ca 0.2–0.5 mm diam, orange-yellow; *paraphyses* numerous, cylindrical or clavate, 41–80 × 11.5–23 µm, incurved or almost erect, wall of unequal thickness, colourless, smooth; *urediniospores* subglobose, broadly ellipsoid or obovate, 18.5–24.5 × 16.5–21.5 (21.2±1.4 × 18.9±1.1) µm [$n_{(3)} = 150$], contents orange-yellow, with scattered indistinct pores, wall 1.2–2 µm thick, verrucose. *Telia* hypophyllous, covered the whole leaf surface or grouped, pulverulent, rounded or broadly elliptical, ca 0.3–1.2 mm diam, black; *paraphyses* present; *teliospores* cylindrical, 5–9-celled (7.2±0.9) [$n_{(8)} = 450$], 76–123 × 29.5–37 (99.3±11.4 × 33.0±1.8) µm [$n_{(8)} = 450$], rounded at the base, the upper part rounded or slightly tight, with a developed apical papilla up to 3–10.5 µm long, with 3 pores per cell, wall chestnut-brown to olive-brown, 3.5–5 µm thick, densely verrucose with colourless or subhyaline tubercles; pedicel persistent, 75–144 × 10–13 µm, pale yellow in the upper part, hygroscopic and nearly colourless, dilated up to 21 µm in the lower part.

Life cycle, host range, and distribution: 0, I, II, III (Autoeu form) on *Rubus* spp. — Europe, Asia, N. America.

Host range and distribution in Bulgaria:

On *Rubus idaeus* L.: Balkan Range, Vitosha region, Pirin Mts, Rila Mts, Mt Sredna Gora, the Rhodopes (Central).

Specimens examined:

On *Rubus idaeus*: [5oc]: in reservato 'Tschuprene', alt. 1500 m, 19 Jun 2003, leg. D. Dimitrov, det. RP (25 529); [5oc]: infra cacum. Todorini Kukli, alt. 1750 m, 14 Jul 1967, CH (9868); [5oc]: distr. Sofia, infra refugium turisticum 'Rudinata' supra oppidum Botevgrad, 8 Jun 1964, CH (5986); [5c]: distr. Lovetsch, mons Zlatitschko-Tetevenska Planina, in valle rivi Zavodna infra refugium turisticum 'Vezhen', alt. 1500 m, 14 Oct 1962, CH (12 773); [5or]: ad cacum. Razbojna, 31 Jul 1965, CH (8621); [8]: mons Ljulin, infra cacum. Ljulin, 17 Oct 1940, A. Radoslavov (10 741); [8]: mons Vitoscha, supra Simeonovo, 14 Aug 1960, CH (10 758); [8]: mons Vitoscha, 2 Jul 1961, CH (9623); [8]: mons Vitoscha, prope refugium turisticum 'Aleko', alt. 1800 m, 26 Jul 1962, leg. B. Zheljazova, det. CH (2850); [14]: distr. Blagoevgrad, infra refugium turisticum 'Javorov', supra oppidum Razlog, 7 Sep 1961, CH (9647); [14]: ad refugium turisticum 'Javorov', 17 Jun 2002, CD & RP (25 233); [14]: distr. Blagoevgrad, infra refugium turisticum 'Vihren', supra oppidum Bansko, alt. 1800 m, 17 Sep 1957, CH (10 743); [14]: distr. Blagoevgrad, in loco dicto 'Popina Laka', supra oppidum Sandanski, alt. 1400 m, 12 Jun 1995, leg. D. Dimitrov, det. CD & RP (25 229); [14]: distr. Blagoevgrad, in loco dicto 'Papaz-Tschair', supra oppidum Gotze Deltschev, alt. 1450 m, 25 Jun 1965, CH (12 772); [14]: ibidem, alt. 1560 m, 24 Oct 1964, CH (4626); [15]: distr. Blagoevgrad, in valle rivi Bistritza supra oppidum Blagoevgrad, 9 Jun 1964, leg. P. Hristova, fungus comm. CH (4422); [15]: distr. Sofia, in loco dicto 'Borovetz', 22 Jul 1962, leg. B. Zheljazova, det. CH (12 804); [15]: distr. Sofia, ad ripam rivuli Ibar supra pagum Raduil, alt. 1230 m, 13 Sep 1956, CH (1063); [15]: infra cacum. Maljovitz, alt. 2000 m, 15 Aug 1963, CH (3302); [15]: infra refugium turisticum 'Maljovitz', 12 Jul 1996, leg. CD, det. CD & RP (25 221); [15]: in valle rivi Ilijna Reka, alt. 2000 m, 12 Aug 1963, CH (2968); [15]: in valle rivi Kostenska Reka, 21 Jun 1962, CH (12 774); [15]: distr. Pazardzhik, supra pagum Sestrimo, alt. 1310 m, 25 Sep 1953, CH (1061); [15]: in valle rivi Rilska Reka, 8 Aug 1963, CH (12 805); [15]: prope monasterium riloense, in loco dicto 'Tschereschovo', 26 Jun 1965, leg. B. Zheljazova, det. CH (8735); [15]: in reservato 'Parangalitz', 19 Jun 1965, leg. B. Zheljazova, CH (8743); [16]: distr. Pazardzhik, in loco dicto 'Koloniite' supra oppidum Panagjurishte, 19 Aug 1934, A. Radoslavov, (12 775); [17c]: distr. Smoljan, infra pagum Bujново, alt. 1200 m, 22 Jun 1965, CH (12 776); [17c]: distr. Smoljan, supra vicum Mugla, 28 Sep 1975, CH (8979).

10. *Phragmidium tuberculatum* Jul. Müll., Ber. Deutsch. Bot. Ges. 3: 391, 1885. (Fig. 16)

Spermogonia epiphyllous, in small groups, often confluent, 1–1.8 mm long, subcuticular, usually surrounded by the aecia but on the opposite side of the leaves, yellowish. *Aecia* rounded, scattered or grouped, usually hypophyllous or on stipules, petioles, pedicels, and fruits, formed elongate or irregular structures, 0.3–1.2 mm long, ruptured epidermis conspicuous, pulverulent, orange; *paraphyses* cylindrical or clavate; *aeciospores* globose, subglobose, broadly ellipsoid, obovate or polyhedral, 21.5–29 × 17–23.5 (25.3±1.8 × 19.9±1.5) µm [$n_{(3)} = 150$], with 6–8 scattered pores, formed subglobular cameras in swelling, wall 2.5–3.5 µm thick, nearly colourless, closely

and finely verrucose. **Uredinia** hypophyllous, at first covered by epidermis and surrounded by paraphyses, then ruptured the epidermis (but not as conspicuous as aecia) and naked, scattered or grouped, sometimes covered the whole leaf surface, pulverulent, rounded, *ca* 0.2–0.8 mm diam, yellow; **paraphyses** numerous, broadly clavate or capitate, $35.5\text{--}60 \times 6.5\text{--}14\ \mu\text{m}$, mostly incurved, wall of equal thickness, nearly or quite colourless, with few scattered warts; **urediniospores** ellipsoid, globose, subglobose or ovoid, $20\text{--}30 \times 17\text{--}22\ (24.8 \pm 2.3 \times 19.0 \pm 1.1)\ \mu\text{m}$ [$n_{(6)} = 300$], with 6–8 scattered pores, formed cameras in swelling, wall $2\text{--}2.5\ \mu\text{m}$ thick, closely and finely verrucose. **Telia** hypophyllous or on petioles, scattered or aggregated, pulverulent, rounded, or broadly elliptical, *ca* 0.2–1 mm long, black; **paraphyses** present, $36\text{--}78.5 \times 6.5\text{--}9\ \mu\text{m}$; **teliospores** cylindrical or broadly ellipsoid, 5–7-celled (6.1 ± 0.5) [$n_{(5)} = 250$], $69\text{--}103.5 \times 33.5\text{--}41\ (86.1 \pm 7.7 \times 36.6 \pm 1.6)\ \mu\text{m}$ [$n_{(5)} = 250$], rounded or somewhat acuminate at the upper part, slightly tight at the base, with a well developed apical papilla, up to $18.5\ \mu\text{m}$ long and sometimes verrucose, not constricted at the septa, with 2–3 pores per cell, wall $4\text{--}5.5\ \mu\text{m}$ thick, sparsely verrucose, chestnut; pedicel persistent, $87\text{--}148\ \mu\text{m}$ long, $8.5\text{--}11.5\ \mu\text{m}$ wide in the upper part, hygroscopic and dilated up to $28\ \mu\text{m}$ in the lower part.

Life cycle, host range, and distribution: 0, I, II, III (Auto-eu form) on *Rosa* spp. and *Hulthemia berberifolia* (Pall.) Dumort. – Europe, Asia, N. Africa, N. America, New Zealand.

Host range and distribution in Bulgaria:

On *Rosa agrestis* Savi: Black Sea Coast, Balkan Range (West). On *R. canina* L. s. lat. (*R. corymbifera* Borkh.): Black Sea Coast, Danubian Plain (Hinkova 1981 – specim. n.v.), Forebalkan, Balkan Range (West, Hinkova 1981 – specim. n.v.), Mt Slavyanka, Rila Mts (Hinkova 1959 – specim. n.v.), the Rhodopes (West, Klika 1926 – specim. n.v.). On *R. centifolia* L. (hort.): Forebalkan, Balkan Range (East), West Frontier Mts. A new host record for Bulgaria. On *R. chinensis* Jacq. (cult.): Vitosha region. A new host record for Bulgaria. On *R. damascena* Mill. (*R. gallica* L. var. *damascena* (Mill.) Voss) (cult.): Toundzha Hilly Country. A new host record for Bulgaria. On *R. dumalis* Bechst. (*R. subcanina* (Christ) Vuk., *R. subcanina* (Christ) Dalla Torre & Sarnth.): Black Sea Coast. A new host record for Bulgaria. On *R. gallica* L.: Danubian Plain, Pirin Mts (Hinkova 1981 – specim. n.v.). On *R. micrantha* Sm.: Black Sea Coast, (?) Znepole region, (?) Mt Slavyanka. On *R. pendulina* L.: Vitosha region. A new host record for Bulgaria. On *R. pulverulenta* Bieb. (*R. glutinosa* Sibth. & Sm.): Mt Slavyanka, Pirin Mts. On *R. tomentosa* Sm.: Znepole region. On *R. turcica* Rouy: Pirin Mts. A new host record for Bulgaria.

Specimens examined:

On *Rosa agrestis*: [1]: distr. Dobritsch, in loco dicto 'Tuzlata' ad oppidum Baltschik, 27 Maj 1999, GN (BUCM 136 874); [5oc]: distr. Sofia, supra pagum Ogoja, 6 Sep 1975, CH (9054).

On *R. canina*: [1]: distr. Dobritsch, in collibus 'Tscherakman' prope oppidum Kavarna, 25 Sep 1998, GN (sub *Ph. mucronatum* on *R. deseglisei*) (BUCM 136 160); [1]: distr. Dobritsch, in oppido Baltschik, 30 Sep 1998,

GN (sub *Ph. mucronatum* on *R. deseglisei*) (BUCM 136 340); [1]: distr. Dobritsch, in loco dicto 'Tuzlata' ad oppidum Baltschik, 22 Maj 1999, GN (sub *Ph. mucronatum*) (BUCM 136 699); [1]: in oppido Baltschik, Hortus Botanicus, 17 Maj 1999, GN (sub *Ph. mucronatum*) (BUCM 136 521); [4]: distr. Vidin, in loco dicto 'Sokolitza' prope pagum Gramada, 26 Maj 1963, CH (10 274); [4]: distr. Vidin, infra cacum. Vraschka Tschuka, alt. 380 m, 28 Maj 1963, CH (10 265); [12]: distr. Blagoevgrad, prope pagum Goleschovo, alt. 780 m, 25 Jun 1965, CH (10 264).

On *R. centifolia*: [4]: distr. Vidin, in pago Gorni Lom, 10 Jul 1967, CH (12 853); [5or]: distr. Sliven, in oppido Kotel, 24 Jul 1964, CH (4806); [9]: distr. Kjustendil, in oppido Kjustendil, 14 Jul 1963, leg. M. Markova, fungus comm. CH (3248).

On *R. chinensis*: [8]: mons Vitoscha, Zheleznitza, Jun 2001, CD & RP (25 470).

On *R. damascena*: [19]: distr. Stara Zagora, prope oppidum Kazanlak, 13 Maj 1970, CH (sub *R. gallica* L. var. *damascena* (Mill.) Voss) (9170).

On *R. dumalis*: [1]: distr. Dobritsch, in oppido Baltschik, Hortus Botanicus, 24 Maj 1999, GN (sub *Ph. mucronatum* on *R. subcanina*) (BUCM 136 765).

On *R. gallica*: [2]: distr. Veliko Tarnovo, in oppido Pavlikeni, 25 Oct 1964, CH (sub *R. centifolia*) (4560).

On *R. micrantha*: [1]: distr. Dobritsch, in loco dicto 'Bolata Dere' prope promontorium Kaliakra, 22 Sep 1998, leg. CD, det. CD & RP (SOMF) & GN (BUCM 136 045); [1]: distr. Dobritsch, ad declive mari expositum in loco dicto 'Tschirakman' prope oppidum Kavarna, 25 Sept 1998, leg. CD, det. CD & RP (SOMF).

On *R. cf. micrantha*: [7]: distr. Pernik, mons Paramunska Planina, 4 Aug 1961, CH (5016); [12]: distr. Blagoevgrad, supra pagum Paril, alt. 950 m, 22 Oct 1964, CH (4759).

On *R. pendulina*: [8]: mons Vitoscha, supra Bistritza, alt. 1200 m, 2 Sep 1963, CH (sub *Ph. fusiforme*) (6682).

On *R. pulverulenta*: [12]: distr. Blagoevgrad, supra pagum Paril, 22 Jul 1977, leg. L. Evstatieva, det. CH (sub *R. glutinosa*) (14 192); [14]: supra refugium turisticum 'Banderitza', alt. 2160 m, 9 Aug 1965, CH (sub *R. glutinosa*) (9579); [14]: distr. Blagoevgrad, supra oppidum Gotze Deltshev, 1 Jul 1958, CH (sub *R. glutinosa*) (9580).

On *R. tomentosa*: [7]: distr. Pernik, in colle Transka Tschuka prope oppidum Tran, 4 Aug 1961, CH (5006).

On *R. turcica*: [14]: distr. Blagoevgrad, in pedes montis supra oppidum Razlog, 21 Sep 1957, CH (sub *Ph. disciflorum*) (1039).

Note. Because of potential misidentifications of the hosts and/or the fungus, some host records of *Ph. tuberculatum* without herbarium vouchers are omitted here, viz. *Rosa arvensis* Hudson (Ivanov 1922a), *R. sepium* (Klika 1926), *R. spinosissima* auct. (Malkoff 1906, 1907, 1908, a host related by Denchev 1995 to *R. myriacantha*), and *R. vosagiaca* Desportes (Radoslavov 1939).

11. *Phragmidium violaceum* (C. Schultz) G. Winter, Hedwigia 19: 54, 1880. — *Puccinia violacea* C. Schultz, Prodr. Fl. Starg., p. 459, 1806. (Fig. 17)

Spermogonia epiphyllous, formed dark red spots on the leaf surface, in small groups, often confluent, subcuticular, rounded or hemispherical, 0.2–0.5 mm diam, yellowish. **Aecia** hypophyllous or on petioles and stems, ruptured epidermis conspicuous, scattered or grouped, often confluent, rounded, elongate or irregular in shape, 0.5–2 mm long,

pulverulent, orange-yellow; **paraphyses** cylindrical or clavate, erect or slightly incurved, $48.5\text{--}81.5 \times 12.5\text{--}20.5 \mu\text{m}$, wall of equal thickness, pale yellow, smooth; **aeciospores** globose or ellipsoid, $23.5\text{--}30.5 \times 22\text{--}27.5$ ($26.9 \pm 1.6 \times 24.5 \pm 1.3$) μm [$n_{(4)} = 200$], contents yellow, with indistinct pores, wall $3.5\text{--}4 \mu\text{m}$ thick, yellow, with scattered rough warts. **Uredinia** hypophyllous, at first covered by epidermis and surrounded by paraphyses, then ruptured the epidermis and naked, scattered or grouped, sometimes confluent, pulverulent, rounded, *ca* $0.2\text{--}0.8 \text{ mm}$ diam, orange-yellow; **paraphyses** numerous, clavate, capitate or cylindrical, $43.5\text{--}80 \times 14\text{--}23.5 \mu\text{m}$, mostly incurved, wall of equal thickness, almost or quite colourless, smooth; **urediniospores** globose or ellipsoid, $23.5\text{--}30.5 \times 21\text{--}27$ ($26.6 \pm 1.7 \times 23.5 \pm 1.3$) μm [$n_{(5)} = 250$], contents yellow, with scattered indistinct pores, wall $2.5\text{--}3.5 \mu\text{m}$ thick, distantly verrucose. **Telia** hypophyllous, formed redish spots on the upper leaf surface, sometimes on peduncles, scattered or aggregated, often confluent, pulverulent, rounded or broadly elliptical, *ca* $0.3\text{--}1 \text{ mm}$ long, black; **paraphyses** similar to those in uredinia, $41\text{--}56 \times 7.5\text{--}20.5 \mu\text{m}$; **teliospores** cylindrical, 2-5-celled (3.7 ± 0.6) [$n_{(7)} = 350$], $61.5\text{--}92 \times 34\text{--}40$ ($75.8 \pm 8.2 \times 37.2 \pm 1.6$) μm [$n_{(7)} = 350$], rounded at both ends, sometimes with apical papilla, up to $6.5 \mu\text{m}$ long, usually slightly constricted at the septa, with 2-4 pores per cell, wall $4.5\text{--}5.5 \mu\text{m}$ thick, densely and finely verrucose, chestnut-brown; pedicel persistent, $83.5\text{--}141.5 \mu\text{m}$ long, dilated up to $23 \mu\text{m}$ at the base, $8\text{--}12 \mu\text{m}$ wide in non-hygroscopic part, pale yellow, smooth.

Life cycle, host range, and distribution: 0, I, II, III (Autoeu form) on *Rubus* spp. – Europe, Asia, N. Africa.

Host range and distribution in Bulgaria:

On *Rubus caesius* L.: Balkan Range (Central, Nannizzi 1938 – specim. n.v.), Pirin Mts, the Rhodopes (Central). On *R. canescens* DC. (*R. tomentosus* Borkh.): Toundzha Hilly Country. On *R. canescens* var. *glabratus* (Godron) Davis & Meikle (*R. lloydianus* Genev.): Balkan Range (Central). A new host record for Bulgaria. On *R. geniculatus* Kaltenb.: Black Sea Coast, Mt Strandzha. A new host record for Bulgaria. On (?) *R. hirtus* agg.: Pirin Mts (Hinkova 1981 – specim. n.v.), Mt Strandzha (Hinkova 1981 – specim. n.v.). On *R. praecox* Bertol. (*R. discolor* Weihe & Nees, *R. procerus* P.J. Mueller, *R. macrostemon* Focke, *R. hedycarpus* Focke): Black Sea Coast, Balkan Range (West), Sofia region, Mt Slavyanka, Pirin Mts, Rila Mts, the Rhodopes (Western, Central), Mt Strandzha. On *R. radula* Weihe ex Boenn.: Balkan Range (Central). A new host record for Bulgaria. On *R. sanctus* Schreber (*R. sanguineus* Friv.): Valley of River Strouma, Pirin Mts. On (?) *R. thyranthus* Focke: Sofia region, Balkan Range (Central, Klika 1926 – specim. n.v.).

Specimens examined:

On *Rubus caesius*: [14]: distr. Blagoevgrad, supra oppidum Gotze Deltchev, 1 Jul 1958, CH (9600); [17c]: distr. Plovdiv, supra pagum Batschkovo, 12 Maj 1962, CH (9610).

On *R. canescens*: [19]: distr. Jambol, in colle prope pagum Lesovo, 4 Jul 1963, CH (sub *Ph. rubi* on *R. tomentosus*) (11 400); [19]: distr. Jambol, prope pagum Goljam Derwent, 5 Jul 1963, CH (sub *R. tomentosus*) (4346).

On *R. canescens* var. *glabratus*: [5c]: distr. Gabrovo, in oppido Gabrovo, Jun 1899, leg. I. Neičev, fungus comm. CMD & RDP (25 225).

On *R. geniculatus*: [1]: distr. Burgas, inter oppidum Obzor et pagum Banja, 29 Jun 1961, leg. M. Markova, fungus comm. CH (9257); [1]: distr. Burgas, in loco dicto 'Otmanli' prope urbem Burgas, 26 Jun 1961, leg. M. Markova, fungus comm. CH (9256); [20]: distr. Burgas, ad ripam rivi Veleka prope pagum Gramatikovo, 6 Jul 1963, leg. M. Markova, fungus comm. CH (9068); [20]: distr. Burgas, in reservato 'Uzunbudzhak', 18 Sep 1996, leg. CD, det. RP (25 528).

On *R. praecox*: [1]: distr. Dobritsch, in loco dicto 'Bolata Dere' prope promontorium Kaliakra, alt. 2 m, 22 Sept 1998, leg. CD, det. CD & RP (25 224) & GN (sub *R. discolor*) (BUCM 136 043); [1]: distr. Dobritsch, in oppido Baltschik, alt. 15 m, 23 Sept 1998, GN (sub *R. discolor*) (BUCM 136 063); [1]: distr. Dobritsch, ad oram rivuli Batova, alt. 0.5 m, 24 Sept 1998, GN (sub *R. discolor*) (BUCM 136 140); [1]: distr. Varna, in loco dicto 'Zlatni Pjasatzi', 27 Sept 1998, GN (sub *R. discolor*) (BUCM 136 209); [1]: distr. Burgas, ad oppidum Nesebar, 23 Jun 1996, CD (SOMF) & GN (sub *R. discolor*) (BUCM 133 133); [1]: distr. Burgas, in loco dicto 'Slanchev Brjag', Jul 1992, leg. T. Meshinev & A. Petrova, fungus comm. RP & CD (25 216); [1]: distr. Burgas, in oppido Ahtopol, 28 Aug 1973, CH (sub *R. thyrsoideus*) (9394); [5oc]: distr. Vidin, supra pagum Tschuprene, 11 Jul 1967, CH (sub *R. procerus*) (9603); [6]: Sofia, Bojana, 25 Aug 1960, leg. M. Markova, fungus comm. CD & RP (25 227); [6]: Sofia, 21 Sep 1991, leg. CD, det. CD & RP (25 218); [12]: distr. Blagoevgrad, supra pagum Petrovo, alt. 550 m, 28 Oct 1964, CH (sub *R. procerus*) (5089); [14]: distr. Blagoevgrad, supra pagum Pirin, alt. 1020 m, 26 Oct 1964, CH (sub *R. procerus*) (4681); [15]: distr. Pazardzhik, ad ripas rivuli Kriva Reka supra pagum Sestrimo, alt. 1080 m, 2 Sep 1955, CH (sub *R. nemorosus*) (1072); [15]: ad ripas rivuli Tschairska Reka supra pagum Sestrimo, alt. 1010 m, 28 Sep 1953, CH (sub *R. candicans* Wh. in Hinkova 1960) (1071); [15]: distr. Kjustendil, prope pagum Usojka, 8 Dec 1975, CH (sub *R. thyranthus*) (8984); [17oc]: distr. Pazardzhik, supra loc. dict. 'Tzigov Tschark', infra reservatum 'Mantaritza', 24 Sep 2001, CD & RP (25 222); [17oc]: distr. Smoljan, sub vicum Mugla, 27 Sep 1979, CH (sub *R. thyranthus*) (14 837); [17c]: distr. Plovdiv, prope pagum Batschkovo, Jul 1915, leg. V. Stribny, fungus comm. CH (sub *R. sanguineus*) (14 910); [20]: distr. Burgas, in reservato 'Silkosija', prope pagum Kosti, 25 Jun 1996, leg. CD, det. CD & RP (25 220) & GN (sub *R. discolor*) (BUCM 133 166).

On *R. radula*: [5c]: distr. Lovetsch, prope oppidum Trojan, ad monasterium, 2 Aug 1964, leg. M. Markova, fungus comm. CH (9069); [5c]: distr. Gabrovo, in loco dicto 'Lägät', 1 Aug 1964, leg. M. Markova, fungus comm. CD & RP (25 223).

On *R. sanctus*: [10]: distr. Blagoevgrad, in pedibus montis Ograzhden, prope pagum Parvomaj, 27 Jul 1963, CH (sub *R. procerus*) (4350); [14]: distr. Blagoevgrad, prope pagum Gorno Spantschevo, alt. 450 m, 27 Oct 1964, CH (4622).

On *R. (?) thyranthus*: [6]: distr. Sofia, inter Pantscherevo et Bistritza, 27 Sep 1959, leg. M. Markova, fungus comm. CH (sub *R. thyrsoideus*) (1075).

Notes. (i) The host plant of specimen no. 1075, *Rubus thyranthus*, can not be revised and that host of *Ph. violaceum* needs confirmation. (ii) For lack of herbarium vouchers and because of potential misidentifications of the hosts, the records of *Ph. violaceum* on *Rubus fruticosus* (Malkoff 1906, 1907, 1908), *R. nemorosus* (Klika 1926), and *R. macrostachys* (Hinkova 1968) are treated here as uncertain for Bulgaria.

Trachyspora Fuckel, Bot. Zeitung 19: 250, 1861.

Typus: *Trachyspora intrusa* (Grev.) Arthur

Spermogonia known only in *T. intrusa*, intraepidermal, type 10; usually not produced or not collected. **Aecia** subepidermal, erumpent, without peridium and paraphyses (*Petersonia*-type), or aecia not produced but with some supposed aeciospores singly in the telia (in *T. melospora* (Therry) Tranz. and *T. pentaphylleae* Gäum.); **aeciospores** catenulate, without intercalary cells, coarsely echinate, pores obscure. **Uredinia** not produced. **Telia** subepidermal, erumpent, produced both on systemic mycelium in the old aecia or localized; **teliospores** borne singly on pedicels, 1-celled, wall pigmented or nearly hyaline, coarsely verrucose, verruculose or smooth, pores obscure.

Host range: on *Rosaceae* (*Alchemilla*). A genus of four species.

Key to *Trachyspora* species in Bulgaria

- 1 Aperiadate aecia produced *T. intrusa*
 1* Aecia not produced but with some supposed aeciospores
 singly in the telia *T. pentaphylleae*

1. *Trachyspora intrusa* (Grev.) Arthur, Manual of Rusts, p. 97, 1934. — *Uredo intrusa* Grev., Fl. Edinb., p. 436, 1824 (III). — *Uromyces intrusus* (Grev.) Lévl., Ann. Sci. Nat. Bot., Ser. 3, 8: 376, 1847. — *Uredo alchemillae* Pers.: Pers., Syn. Meth. Fungorum, p. 215, 1801 (II). — *Trachyspora alchemillae* (Pers.: Pers.) Fuckel, Bot. Zeitung 19: 250, 1861. — *Uromyces alchemillae* (Fuckel) J. Schröt., Abh. Schles. Ges. Vaterl. Cult., Nat. Abth. 1869-72: 10, 1870. (Fig. 19)

[**Spermogonia** intraepidermal, type 10.] **Aecia** hypophyllous, covered almost the whole leaf surface, rounded or elongate, confluent, covered by large fragments of epidermis, 2-4 mm diam, pulverulent, orange to yellowish; **aeciospores** globose or ellipsoid, pedicelate or in chains, orange to yellowish, 20-25.5 × 18-22.5 (22.6 ± 1.3 × 20.2 ± 1.0) µm [$n_{(6)} = 180$], wall ca 1 µm thick, densely echinulate, with indistinct pores; **paraphyses** lacking. **Uredinia** unknown. **Telia** hypophyllous, formed by the aecial or localized mycelium, rust-brown; **paraphyses** lacking; **teliospores** globose to obovoid or oblong, 1-celled, 28-37 × 24.5-31 (32.3 ± 2.2 × 27.8 ± 1.6) µm [$n_{(8)} = 240$], L/w = 1.16, wall brown, 1.5 (-2.5) µm thick, not thickened at the apex, irregularly verrucose or smooth; pedicel fragile, colourless.

Life cycle, host range, and distribution: (0), I, III (Auto-spis form) on *Alchemilla* spp. — Europe, Asia, and Africa.

Host range and distribution in Bulgaria:

On *Alchemilla catachnoa* Rothm.: Pirin Mts. A new host record for Bulgaria. On *A. connivens* Buser: Vitosha region. A new host record for Bulgaria. On *A. erythropoda* Juz.: Balkan Range (West, Central). On *A. gorcensis* Pawł.: Vitosha region. A new host record for Bulgaria. On *A. incisa* Buser: Balkan Range (West). A new host record for Bulgaria. On

A. jumrukczalica Pawł.: Balkan Range (Central). A new host record for Bulgaria. On *A. subglabra* gr.: Rila Mts.

Specimens examined:

On *Alchemilla catachnoa*: Pirin montes: 1995, leg. CD, det. CD & RP (25 545).

On *A. connivens*: [8]: mons Vitoscha, supra refugium turisticum 'Aleko', Jul 1997, leg. D. Dimitrov, det. CD & RP (25 543).

On *A. erythropoda*: [5oc]: ad cacum. Todorini Kukli, 14 Jul 1967, CH (sub *Trachyspora alchemillae* — * on *A. vulgaris*) (11 697); [5c]: distr. Lovetsch, mons Zlatishko-Tetevenska Planina, in reservato 'Tzaritschina' supra refugium turisticum 'Vezhen', 9 Sep 1997, leg. CD, det. CD & RP (25 547).

On *A. gorcensis*: [8]: mons Vitoscha, 27 Jun 1963, CH (sub * on *A. vulgaris*) (4282).

On *A. incisa*: [5oc]: mons Tschiprovska Planina, infra cacum. Midzhur, alt. ca 1800 m, leg. CD, det. CD & RP (25 544).

On *A. jumrukczalica*: [5c]: mons Kaloferska Planina, ad loc. dict. 'Djuza' supra refugium turisticum 'Vasil Levski', 23 Aug 1997, leg. CD, det. CD & RP (25 546).

On *A. subglabra* gr. (*A. glabra* Neygenf., *A. reniformis* Buser or *A. obtusa* Buser): [15]: in loco dicto 'Tschernej', alt. 1650 m, 11 Aug 1963, CH (sub * on *A. gracillima* Rothm.) (3268).

Note. Many specimens of that fungus on *Alchemilla vulgaris* auct. bulg. or on other *Alchemilla* spp., which host plants are *specimina incompleta*, are deposited in SOME. They are omitted here. Some other Bulgarian records, e.g. *A. pubescens* Lam. and *A. heterophylla* Rothm. (Hinkova 1959; Krousheva 1964), are without herbarium vouchers and were also omitted here.

2. *Trachyspora* aff. *pentaphylleae* Gäum., Boissiera 7: 111, 1943. (Fig. 20)

Spermogonia unknown. **Aecia** unknown but **aeciospores** singly in the telia. **Uredinia** unknown. **Telia** hypophyllous, at first covered by the epidermis, then naked, scattered, rounded, rarely confluent, dark brown, pulverulent; **paraphyses** lacking; **teliospores** globose to obovoid or oblong, 1-celled, 32.5-43 × 24.5-33 (36.0 ± 2.9 × 29.1 ± 2.1) µm [$n_{(3)} = 90$], L/w = 1.24, wall brown, 1.5 (-2.5) µm thick, not thickened at the apex, irregularly verrucose or smooth; pedicel fragile, colourless.

Life cycle, host range, and distribution: III (Micro form) on *Alchemilla* spp. — Europe (Switzerland and Bulgaria).

Host range and distribution in Bulgaria:

On *Alchemilla connivens* Buser: Vitosha region. On *A. erythropoda* Juz.: Balkan Range (West). On *A. viridiflora* Rothm.: Pirin Mts.

Specimens examined:

On *Alchemilla connivens*: [8]: mons Vitoscha, infra refugium turisticum 'Vasil Kolarov', 7 Aug 1991, leg. CD, det. CD & RP (25 530).

On *A. erythropoda*: [5c]: mons Kaloferska Planina, supra refugium turisticum 'Raj', in loco dicto 'Rajskoto Praskalo', alt. ca 1650 m, 22 Sep 1997, leg. CD, det. CD & RP (25 548).

On *A. viridiflora*: [14]: in declivibus cacum. Orelova Skala, alt. ca 2000 m, 18 Jul 1936, leg. B. Achtarov, fungus comm. CH (sub *Trachyspora alchemillae* on *A. vulgaris*) (9694).

Notes. *Trachyspora pentaphylleae* was hitherto known only from Switzerland on *Alchemilla pentaphylleae* L. (Gäumann 1943; Poelt & Zwetko 1997). The location of aeciospores, as well as both the mean dimensions of the teliospore length and width and the L/w ratio coincide with the data

for that rust fungus in Gjaerum & Cummins (1982) and Gäumann (1943, 1959), respectively. That was the reason to determine the cited 3 specimens as *Trachyspora pentaphylleae*. Unfortunately, we can not compare our results with the data of Caucasian materials publishing as *T. melospora* (Ulyanishchev 1959; Ulyanishchev *et al.* 1985), because of lack of mean values of the teliospore length and width, but their ranges clearly show a species with smaller teliospores.

Xenodochus Schltdl., Linnaea 1: 237, 1826.

Typus: *Xenodochus carbonarius* Schltdl.

Xenodochus carbonarius Schltdl., Linnaea 1: 237, 1826. — *Torula carbonaria* Corda, Icon. Fg. 3: 5, 1839. — *Phragmidium carbonarium* (Schltdl.) Winter in Rabenh., Kryptog.-Fl. Deutschl. 1(1): 227, 1884. (Fig. 18)

Spermogonia intraepidermal, type 10. **Aecia** hypophyllous, formed yellow or purple spots, scattered or grouped, on the leaves rounded or elliptical, 0.2-0.5 cm diam, often on petioles and veins elongated to 1 cm, pulverulent, orange; **paraphyses** lacking; **aeciospores** globose or obovate, $19.5\text{--}26.5 \times 17.5\text{--}22.5$ ($22.2 \pm 1.5 \times 19.8 \pm 1.8$) μm [$n_{(3)} = 150$], contents yellow, wall 1.5-2.5 μm thick, densely verrucose, with indistinct pores. [**Uredinia** – caematoid, similar to the aecia.] **Telia** hypophyllous, often confluent with the aecia, pulverulent, 0.2-0.4 cm diam, black; **teliospores** cylindrical, 7-12-celled (9.6 ± 1.3) [$n_{(1)} = 50$], rounded at both ends, constricted at the septa, $107\text{--}206.5 \times 22.5\text{--}29$ ($155.1 \pm 22 \times 26.5 \pm 1.6$) μm [$n_{(1)} = 50$], with 2 pores per cell, the apical cell with 1 pore and small colourless papilla, wall smooth 1.5-2 μm thick, dark brown, the wall of basal cells often colourless; pedicel short, fragile, colourless.

Life cycle, host range, and distribution: 0, I, (II), III (Auto-eu form) on *Sanguisorba* spp. – world-wide.

Host range and distribution in Bulgaria:

On *Sanguisorba officinalis* L.: Vitosha region.

Specimens examined:

On *Sanguisorba officinalis*: [8]: mons Vitoscha, 2 Jun 1960, CH (5585); [8]: mons Vitoscha, prope refugium turisticum 'Planinetz', alt. 1350 m, 24 Jun 1960, CH (2165); [8]: mons Vitoscha, inter loc. dict. 'Zlatnite Mostove' et refugium turisticum 'Planinetz', 27 Jun 1990, leg. D. Stojanov, det. CD & RP (25 206).

Conclusions

The taxonomic revision of Phragmidiaceae in Bulgaria yielded distribution of five genera, *Frommeëla*, *Kuehneola*, *Phragmidium*, *Trachyspora*, and *Xenodochus*, and 16 species on 46 hosts from Rosaceae, making 61 rust-host combinations.

Frommeëla (*F. tormentillae*) is a new Bulgarian genus record. *Trachyspora pentaphylleae* is reported for the first time from Bulgaria and the Balkan Peninsula. Twenty-two rust-host combinations are new records for Bulgaria, viz. *Phragmidium bulbosum* on *Rubus canescens* and *R. praecox*; *Ph. mucronatum* on *Rosa canina* var. *andegavensis*, *R. dumalis*,

and *R. pendulina*; *Ph. potentillae* on *Potentilla bornmuelleri* and *P. pedata*; *Ph. sanguisorbae* on *Sanguisorba minor* subsp. *muricata*; *Ph. tuberculatum* on *Rosa centifolia*, *R. chinensis*, *R. damascena*, *R. dumalis*, *R. pendulina*, and *R. turcica*; *Ph. violaceum* on *Rubus canescens* var. *glabratus*, *R. geniculatus*, and *R. radula*; *Trachyspora intrusa* on *Alchemilla catachnoa*, *A. connivens*, *A. gorcensis*, *A. incisa*, and *A. jumrukczalica*. Twenty-six rust-host combinations, previously recorded for Bulgaria, are treated here as doubtful or wrong records, viz. *Phragmidium bulbosum* on *Fragaria vesca*, *Rubus corylifolius*, *R. fruticosus*, *R. glandulosus*, *R. nemorosus*, *R. thyranthus*, and *R. thyrsoideus*; *Ph. fragariae* on *Fragaria vesca* and *Potentilla patula*; *Ph. fusiforme* on *Rosa gallica* and *R. pulverulenta* (*R. glutinosa*); *Ph. mucronatum* on *Rosa micrantha*; *Ph. potentillae* on *Potentilla crantzii*; *Ph. tuberculatum* on *Rosa arvensis*, *R. myriacantha*, *R. sepium*, *R. spinosissima*, and *R. vosagiaca*; *Ph. violaceum* on *Rubus fruticosus*, *R. macrostachys*, and *R. nemorosus*; *Kuehneola uredinis* on *Rubus caesius* and *R. glandulosus*; *Trachyspora intrusa* on *Alchemilla gracilima*, *A. heterophylla*, and *A. pubescens*.

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