

**STUDIES ON RUSSULA CLAVIPES AND RELATED TAXA OF  
RUSSULA SECTION XERAMPELINAE  
WITH A PREDOMINANTLY OLIVACEOUS PILEUS**

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Original material of taxa of *Russula* sect. *Xerampelinae* with a mainly olivaceous pileus are compared with selected specimens. It is demonstrated that *Russula clavipes*, thought to be associated exclusively with conifers, may also occur with deciduous trees and grows from the temperate lowlands to arctic areas. Nomenclature and taxonomic status of other names used for similar taxa in this group are discussed. *Russula xerampelina* var. *elaeodes* and *R. nuoljae* are treated as the only validly published synonyms of *R. clavipes*.

Kärcher & Seibt (1994) and Kärcher (1996, 1997, 2000a, 2000b) published the most comprehensive recent studies on *R. sect. Xerampelinae* (Singer) Jul. Schäff., including observations on type material. Kärcher (2000b) accepted five taxa with a predominantly olivaceous pileus, viz. *R. clavipes* Velen., *R. cicatricata* Romagn. ex Bon, *R. fuscoochracea* R. Schulz, nom. illeg., *R. schaefferi* Kärcher and '*R. xerampelina* var. *olivascens* (Fr.) Melzer & Zvára'. According to Kärcher, *R. clavipes* and *R. fuscoochracea* grow only in coniferous woods and the other three taxa exclusively in deciduous woods. The abundance of inflated terminal elements in the pileipellis of *R. cicatricata*, which are more rare in *R. clavipes* and *R. fuscoochracea*, and lack of these structures in *R. schaefferi* are considered the most distinctive characters to delimit species in this group (the micro-morphological characters of *R. xerampelina* var. *olivascens* were not given). In addition spore-ornamentation is considered important, *R. clavipes* and *R. fuscoochracea* having short spines frequently connected by lines, *R. cicatricata* short and more isolated spines, and *R. schaefferi* having longer and frequently connected spines.

In other recent literature very different taxonomic concepts of *R. clavipes* and related taxa have been presented, including rather different ecological amplitudes of the treated taxa. Reumaux et al. (1996) treat two similar species with an olivaceous, ochraceous or brown pileus from coniferous forests and three from deciduous forests. Bon (1988) gives one taxon with an olivaceous pileus from coniferous and five from deciduous forests. Keizer & Arnolds (1995) considered all observed fruit-bodies with olivaceous pilei as forms of *R. graveolens* Romell, but they studied only collections from roadsides with deciduous trees. Knudsen & Stordal (1992) treat only one species with an olivaceous pileus from the Nordic countries, viz. *R. elaeodes* (Bres.) Bon, which grows in both coniferous and deciduous forests. Einhellinger (1987) did not have olivaceous taxa from coniferous forests, but only two species from deciduous forests.

Numerous collections, made by the present author, of members of the *xerampelina*-group with an olivaceous pileus from both coniferous and deciduous forests on moist soil urged a critical emendation of the current concept of *R. clavipes* adding a contribution to a further disentanglement of this difficult species complex.

#### MATERIAL AND METHODS

The material observed consists of several personal collections and a selection of specimens from the herbaria BRA, C, M, PRM and W (including type specimens). The description of character states and morphometry is extensively given in Adamčík & Marhold (2000) in which traditionally used characters are precisely defined or modified, especially micro-morphological characters of spores and pileipellis. Single elements of spore-ornamentation were observed in a circle of 3  $\mu\text{m}$  diameter on the spore-surface in the upper plane of focus. Terminal elements of the pileipellis were observed at the margin and centre of pileus respectively. All micro-morphological characters were observed under oil-immersion lens at a magnification of 1600  $\times$ . Basidia and pleurocystidia were observed in a solution of ammonia and Congo Red (according to Fábry, 1979), spores were observed in Melzers reagent (Melzer, 1945), and the hyphae of the pileipellis were observed in a solution of sulphovanillin (1 g of vanillin dissolved in 6 ml of distilled water and 5 ml of concentrated vitriol acid).

#### DELIMITATION OF RUSSULA CLAVIPES

Fruit-bodies with a predominantly olivaceous pileus have been collected in *Picea* forest (Slovakia and Italy) as well as under *Betula* and *Alnus glutinosa* (Slovakia). All collections were made on moist soil. The macro-morphology of these collections and characters observed on the hyphal termination of the pileipellis are similar to those of the neotype of *R. clavipes*. The terminal elements of generative hyphae on the margin of the pileipellis are subulate, attenuate or subcylindrical, relatively long (on average longer than 25  $\mu\text{m}$  and mostly exceeding 30  $\mu\text{m}$ ) and only rarely inflated to 6  $\mu\text{m}$  or more. Conversely the centre of pileipellis usually contains more than 20% of inflated elements (6  $\mu\text{m}$  thick or more). Pileocystidia are numerous, but in dried herbarium specimens they contain only inconspicuous granules or heteromorphous elements, for which reason they are sometimes very difficult to distinguish from the generative hyphae. The sporal characters of all collections are similar to those of the neotype of *R. clavipes* and clearly differ from those found in *R. schaefferi*, *R. cicatricata* or any other similar taxa from deciduous forests. Spores of the type specimen of *R. clavipes* and the specimens collected by the present author are small (their length rarely exceeds 9  $\mu\text{m}$ ); narrow (on average  $Q = 1.25\text{--}1.35$ ); with short and fine spines (length not exceeding 1.1  $\mu\text{m}$ ) which are numerous (6.5–11 spines in a circle of 3  $\mu\text{m}$  diameter on the spore-surface) and which have occasional line connections. All the characters mentioned above are considered sufficient for the delimitation of *R. clavipes* as a species of its own right, and this combination of characters were not observed in the type material of other similar taxa of sect. *Xerampelinae* with a mainly green pileipellis.

A large variability in the spores and some characters of the terminal elements of the hyphae in the pileipellis have been observed. Some fruit-bodies (including the type

specimen) have shorter spines ( $0.6\ \mu\text{m}$ ) or more numerous line connections (1.5–2 line connections in a circle of  $3\ \mu\text{m}$  diameter on the spore-surface) than the majority of other collections. A few of the fruit-bodies studied had occasional inflated elements in the generative hyphae on the margin of the pileipellis, though the majority lacked them. The proportion of inflated elements at the centre was also very variable, ranging from 15% to 60%. However, fruit-bodies with these atypical characters could occur within a single collection or within collections of one ecological type (see habitat of *R. clavipes* described in text following description of the species). These variable characters were therefore not considered reliable for the delimitation of infraspecific taxa. The spores of the collections from arctic areas of Greenland are usually somewhat larger than spores of collections from the European temperate zone. This difference was observed also in the related species *R. subrubens* (J.E. Lange) Bon and *R. pascua* (F.H. Møller & Jul. Schäff.) Kühner, but the difference is only gradual (for both ecological types). The larger spores of the arctic collections may be considered a climatic adaptation in relation to the longer hibernation period.

Similar taxa with a green pileus from deciduous forests related to *R. graveolens* do not have inflated elements of the generative hyphae at the centre of the pileipellis or any such elements are very sparse and do not exceed 10% of the total number of terminal elements. Inflated elements at the centre of pileipellis were only observed in material of *R. faginea* Romagn. ex Adamčík (2003), *R. cicatricata* and *R. pascua*. *Russula faginea*, *R. pascua* and related taxa differ from *R. clavipes* in having shorter and often inflated (up to  $6\ \mu\text{m}$  or more) terminal elements of the generative hyphae at the margin of the pileipellis. *Russula faginea* differs also in having spores with sparse spines (usually on average not more than 6 spines in a circle of  $3\ \mu\text{m}$  diameter on the spore-surface). In addition, in this group of taxa the pileus is mainly red with a discoloured, ochraceous centre. *Russula cicatricata* (4 collections examined including the type) differs also in often having the terminal elements of the generative hyphae on the margin of the pileipellis, which are very long and mostly thicker than  $6\ \mu\text{m}$ , with a specific shape (inflated in the upper part and constricted at the base and the tip).

#### RUSSULA CLAVIPES IN PUBLISHED LITERATURE

After its publication by Velenovský (1920), the name *Russula clavipes* has hardly been used. Only 7 authors have been encountered who actually used the name, viz.: Svrček et al. (1984), Kärcher (1996) and Reumaux et al. (1996). According to the studies of Kärcher & Seibt (1994), Kärcher (1996) and the author's own observations, *R. clavipes* has been described in literature under various names, including *R. xerampelina* var. *olivascens* sensu Melzer & Zvára, *R. xerampelina* var. *fusca* sensu Melzer & Zvára (see also misapplied names), and the valid but later *R. xerampelina* var. *elaeodes* Bres. (Bresadola, 1929).

In his original description Velenovský (1920) noted only one locality for *R. clavipes*: "in *Picea* and *Abies* forests near Babice, October 1918". Svrček, Erhart & Erhartová (1984), who reintroduced the name, indicated that this species grows also in association with *Betula* and *Populus tremula*.

Kärcher (2000a) and Reumaux et al. (1996) treated *R. clavipes* as a species associated exclusively with coniferous trees, and moreover, they distinguished additional species

of coniferous forests with an olivaceous pileus: *R. fuscochracea* (nom. illeg.) and *R. elaeodes* (accepted only by Reumaux et al., 1996). Delimitation of these species is based mainly on coloration of the pileus cuticle, which is disputed below.

*Russula elaeodes* is a synonym of *R. clavipes*. The basionym *R. xerampelina* var. *elaodes* is the correct name on the rank of variety (following Art. 11.3 of the International Code of Botanical Nomenclature (ICBN, Greuter et al., 2000)). No herbarium material collected or determined by Bresadola and labelled as *R. xerampelina* var. *elaodes* is known and the only available material for designating the type noted in the protologue is pl. 420 (Bresadola, 1929) as iconotype. Following the original concept of *R. xerampelina* var. *elaodes*, it applies to a taxon with a mainly olivaceous pileus associated with coniferous trees by several mycologists (such as Singer, 1932; Kühner & Romagnesi, 1953; Knudsen & Stordal, 1992; Galli, 1996; Reumaux et al., 1996).

Romagnesi (1967), however, applied the name *R. elaeodes* to a different species, followed by Bon (1983) and Einhellinger (1987). Kärcher (1996) described *R. schaefferi* based on the specimens of *R. elaeodes* in the Romagnesi herbarium.

Keizer & Arnolds (1995) treated the epithet *elaodes* at the rank of a form of *R. graveolens*. According to their description it is similar to *R. graveolens* in all micro-morphological characters. They have observed only specimens collected on sandy soil under *Quercus*, which probably relates to the variability of *R. graveolens* or similar taxa, but surely differs from the original concept of *R. xerampelina* var. *elaodes*.

Another validly published synonym of *R. clavipes* is *R. nuoljae* Kühner. Kühner (1975) delimited *R. nuoljae* on the absence of pileocystidia. According to our observations on the type material (deposited in herbarium G), this taxon has indistinct (deformed) pileocystidia, typical for *R. clavipes* (with very weak granulation in sulphovanillin). Other micro-morphological characters are also similar to *R. clavipes*: terminal elements on the margin of pileipellis are mostly attenuated or subulate, terminal elements at the centre are frequently inflated and spores have an ornamentation composed of fine isolated spines. Kühner described *R. nuoljae* only from one fruit-body collected under dwarf *Betula* in an arctic area of Sweden. He described predominantly red colours of the pileus, which does not fit well with the current concept of *R. clavipes*. Judging from the type study, however, *R. nuoljae* is considered conspecific with *R. clavipes* and the more red colouration of the pileus may be caused by longer exposure to sunlight.

## DESCRIPTIVE PART

### *Russula clavipes* Velen. — Figs. 1, 2

*Russula clavipes* Velen., Česká houby 1 (1920) 143. — *Russula nuoljae* Kühner, Bull. Soc. Mycol. France 91 (1975) 388–389. — *Russula xerampelina* var. *elaodes* Bres., Icon. Mycol. 9 (1929) pl. 420; *Russula elaeodes* (Bres.) Bon, Doc. Mycol. 13 (50) (1983) 27.

Neotypus: “sub *Picea*, Jirny ad Pragam, X.1932, Zvára” (PRM, 770649, *R. xerampelina* var. *fusca*) [designated by Kärcher, 1996].

*Misapplied names.* *Russula barlae* sensu Reumaux et al., Russules rares ou méconnues (1996) 177, 178, 218, 242; *Russula cicatricata* sensu Einhellinger, Die Gattung *Russula* in Bayern (1987) 49–50; *Russula xerampelina* var. *fusca* sensu Melzer & Zvára, České holubinky (1927) 60; *Russula fusca* sensu Reumaux et al., Russules rares ou méconnues (1996) 177, 178, 218, 242; *Russula fuscochracea* sensu

Reumaux et al., *Russules rares ou méconnues* (1996) 176, 216, 241, 1996, sensu Kärcher, *Micologia* 2000 (2000) 275–277; *Russula xerampelina* var. *fuscoochracea* sensu Galli, *Le Russule* (1996) 373; *Russula xerampelina* var. *ochracea* sensu Galli, *Le Russule* (1996) 372; *Russula xerampelina* var. *olivascens* sensu Singer, *Z. Pilzk.* 2 (1923) 173, sensu Melzer & Zvára, *České holubinky* (1927) 60, sensu Bon, *Doc. Mycol.* 18 (70–71) (1988) 83.

Locality indicated in the protologue: “V smrkových a jedlových lesích u Babice.” [Czech Republic, in *Picea* and *Abies* forests near Babice village.]

Pileus 4.9–8.5 cm wide, mostly regularly shaped, convex when young, expanding to plane and slightly depressed at centre or funnel-shaped, with acute to subobtuse margin, striate at margin for (0–)2–8 mm, cuticle separable to 1/3–2/3 of pileus radius from the margin; predominately olivaceous, at margin sometimes incarnate to pinkish brown or more often greyish olivaceous to olivaceous brown, in the middle zone olivaceous with darker spots (lens), variegated with dark-olivaceous, dark-brown, tobacco-brown, hazel-brown, or yellow-olivaceous colours, rarely with almost dark-brown centre; sometimes the middle zone and centre uniformly yellow-olivaceous; surface smooth, almost matt except for the slightly shining centre. Lamellae, L = 154–215, lamellulae numerous, frequently forked, adnexed to adnate; 5–8 mm wide, light cream, with yellow tinge in frontal view. Stipe 4.2–6.8 × 1.2–1.8 (upper part) × 1.5(–3.2) (base) cm, mostly distinctly clavate, rarely cylindrical, white and often tinged pink on one side, then entire brownish ochraceous, after bruising turning rusty to brown, densely and strongly striate; with 1.5–2 mm thick cortex. Flesh compact but not firm, then fragile in the pileus, 2–4.5 mm thick halfway radius, white, in the cortex of stipe slightly yellowing, in the medulla of stipe turning brown, in the pileus almost not changing colour. Smell almost absent in fresh condition, then sweetish, crab-like when drying or damping off. Spore-print ochraceous (IIIb according to Romagnesi, 1967).

FeSO<sub>4</sub> reaction grey-green to blue-green when young, then less intensive and with a more ochraceous tint.

Spores (6.8–)7.2–8.7(–10.4) × (5.3–)5.8–7(–7.5) μm, Q = (1.12–)1.18–1.34(–1.4); spines (0.6–)0.7–1.1 μm long; dense, (6–)7.5–11(–12) in a circle of 3 μm diameter on spore-surface; line connections rare or occasional, 0–2(–6) in the circle. Basidia 35.5–56 × 9–12.5(–14) μm, slender. Pleurocystidia 58–82.5 × (10–)10.5–14(–14.5) μm, short, with 4–16.5 μm long appendage, almost all without constriction in the terminal part and acute. Terminal elements of generative hyphae of the pileipellis at margin (17.5–)20–51(–59.5) × 3–7(–9.5) μm, often subulate, attenuate to subcylindrical, sometimes also lageniform or fusoid, only rarely thicker than 6 μm, the terminal part mostly 3 μm thick or thinner; second element of the hyphae often inflated and wider. In some fruit-bodies, clusters of hyphae are present with terminal elements similar to pileocystidia and larger than other generative hyphae (× 5–9 μm). Terminal elements at centre of pileus (7.5–)9.5–45.5(–48.5) × 3–12(–15.5) μm, narrowly cylindrical, mixed with inflated ampullaceous, pear-shaped or rarely ovate or elliptical elements, which are mainly 3 μm or narrower in the terminal part; terminal elements often very short, ovate, ellipsoid or cylindrical and then with wider secondary elements. Pileocystidia with (19.5–)25–67 × 4–7.5 μm wide, cylindrical or fusoid, rarely conversely clavate or clavate terminal elements with rounded or acute terminal part, content with very weak granulation in sulphovanillin.

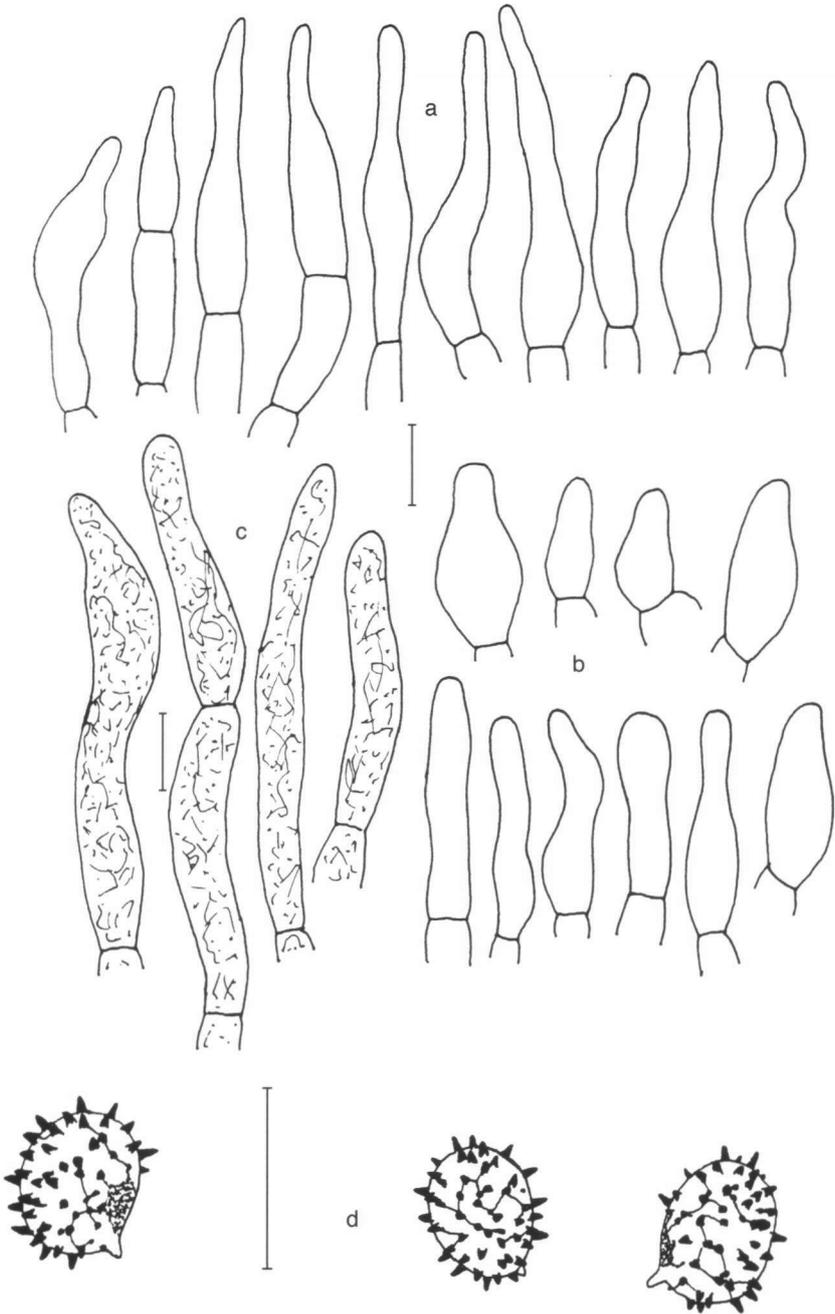


Fig. 1. Microscopic structure of the type specimen of *Russula clavipes* (PRM, 770649). a. Generative hyphae on the margin of the pileus; b. generative hyphae in the centre of the pileus; c. pileocystidia; d. spores (bar = 10 µm).

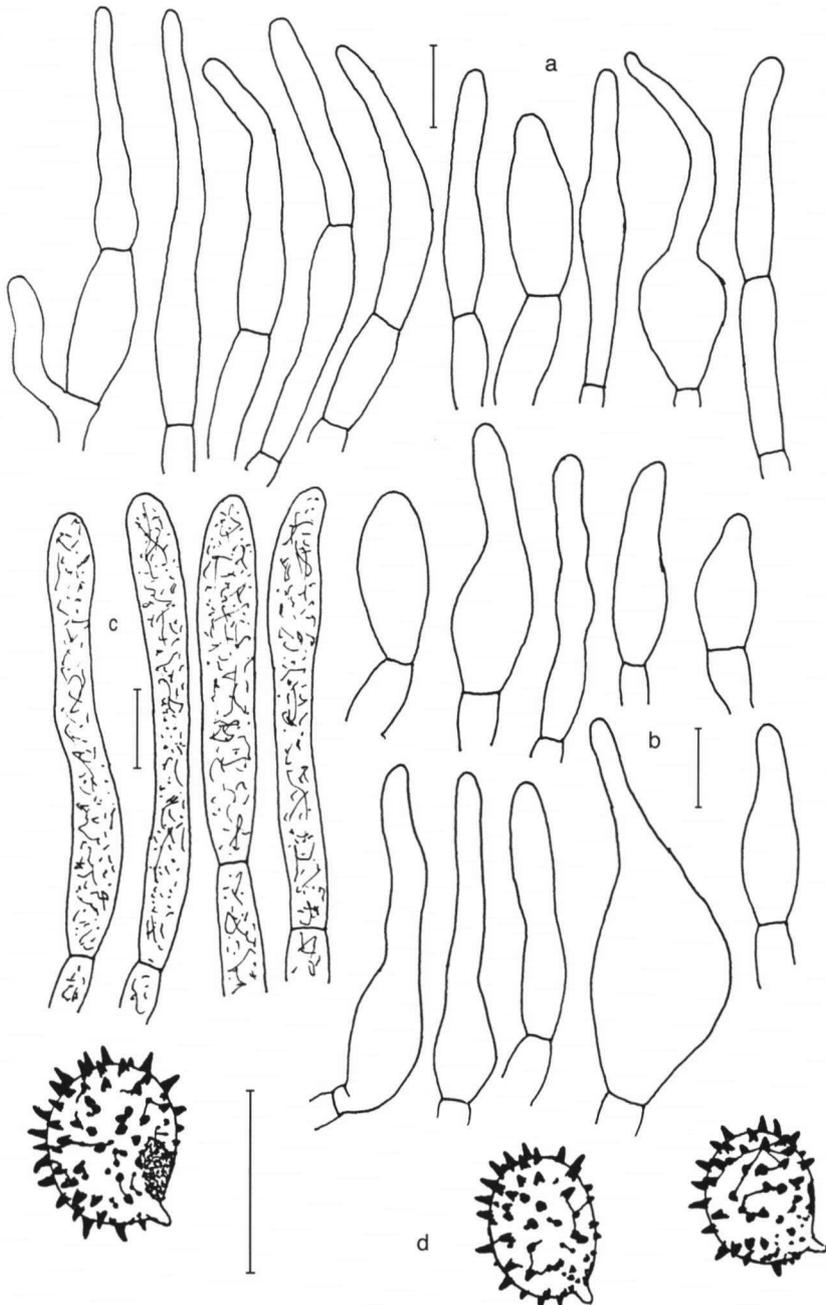


Fig. 2. Microscopic structure of the specimen of *Russula clavipes* collected under *Betula* and *Alnus* in Slovakia (Adamčík, SAV). a. Generative hyphae on the margin of the pileus; b. generative hyphae in the centre of the pileus; c. pileocystidia; d. spores (bar = 10  $\mu$ m).

Habitat — In lowland to submountainous forests associated with *Picea*, *Betula*, *Pinus* (perhaps also *Alnus*) species, on moist soil, often near mires, from July–October. Also grows in association with *Betula* in arctic areas.

*Specimens examined.* AUSTRIA: Wiener Wald bei Heitzawinkel, unter *Betula* im Fichtenwald, IX.1933, *Cernohorsky* (W, *R. xerampleina* var. *olivascens*, det. Singer). — BELGIUM: Zedelgem, Vloethemveld, in group among litter under *Salix* / *Populus tremula* / *Betula*, 20.X.2002, *Walley* (GENT 2785). — CZECH REPUBLIC: Mašov, osada Pelešany, distr. Turnov, sub arce 'Valštein', *Picea exc.*, *Fraxinus excelsior*, *Acer pseudoplatanus*, *Alnus glutinosa*, *Quercus* sp., *Frangula alnus*, ad terram humos., *Herink* (PRM, 609826, *R. xerampelina* var. *elaeodes*); Vodňany, VIII.1936, *Herink* (PRM, 770661, *R. xerampelina* var. *fusca*); Praha, Divoká Šárka, in pic.-querquetis, 22.IX.1939, *Herink* (PRM, 138798, *R. xerampelina* var. *fusca*); Golčův Jeníkov, in pic., 18.VII.1940, *Herink* (PRM, 770698, *R. xerampelina* var. *fusca*); Hřebečnický (distr. Rakovník), in pineto-piceetis, 16.IX.1940, *Herink* (PRM, 770664, *R. xerampelina* var. *fusca*); světlá nad Sáz., in silva mix., praecipue *Betula*, 6.VIII.1942, *Herink* (PRM, 770699, *R. xerampelina* var. *olivascens*); in Silva Bedrník haud procul ab oppido Týn nad Vltavou, alt. c. 349 m, *Karlásová* (PRM, 622159, *R. xerampelina*); Valdštejn pr. Turnov, in silva (*Picea*, *Bet.*), 19.VIII.1945, *Herink* (PRM, 770713, *R. xerampelina* var. *olivascens*); Mašov, osada Pelešany (pr. Turnov), sub arce Valdštejn, picetum (cum *Robo* sp.), ad terram humosam, 18.VIII.1948, *Herink* (PRM, 609815, *R. xerampelina* var. *elaeodes*); ad vicum Kyjov haud procul ab oppido Krásná lípa, 21.VIII.1961, *Svrček* (PRM, 616776, *R. xerampelina* var. *fusca*); Kytín, in silva mixta (*Betula*, *Picea*, *Pinus*), 14.VII.1965, *Svrček* (PRM, 610819, *R. xerampelina* var. *putorina*); haud procul ab oppido Týn nad Vltavou, in silva Děkanství, sub *Piceae*, alt. c. 349 m, 26.VII.1965, *Karlásová* (PRM, 622160, *R. xerampelina* var. *olivascens*); Todeň pr. Trhové Sviny, in monte Todeňská hora, in sphagno vivo sub *Alnus viridis* et *Pinus silv.*, 28.X.1965, *Svrček* (PRM, 610459, *R. xerampelina* f.); Montes Brdské hřebený, Dobříchovice, in decliv. collis Hvízdinec, in piceto nudo, 7.VIII.1996, *Svrček* (PRM, 889857, *R. xerampelina*); Moravsko-slezské Beskydy: Radh. Besk., distr. Vsetín, Horní Bečva, na S svahu Vysoká (1024 m) asi 1.5 km od vrcholku, na J okraji smíšeného smrkového lesa s modřínem pod *Betula pendula* [on the margin of mixed forest of *Picea* and *Larix* under *Betula pendula* trees], alt. c. 690 m, 23.VIII.1999, *Vašutová* (OL); Moravsko-slezské Beskydy: Radh. Besk., distr. Vsetín, Horní Bečva, louka asi 1.5 km SZ od vrcholku Grapy (892 m) [on the meadow 1.5 km NNW from Grapy hill], pod *Alnus incana*, *Populus tremula*, alt. c. 660 m, 23.VII.2000, *Vašutová* (OL). — DENMARK: M – Tyll. Vinklund, under *Picea* & *Betula*, 21.IX.1985, *Vesterholt* (C); WJ: Hoverdal Plantage NE of Ringkøbing, 3.IX.1988, *Christensen* (C47447, *R. cicatricata*); WJ: Hoverdal Plantage NE of Ringkøbing, under *Larix* & *Populus tremula*, 7.IX.1988, *Christensen* & *Vesterholt* (C15431, *R. cicatricata*); WJ: Båstlund Krat N of Billund, under *Quercus*, 7.X.1989, *Vesterholt* (C15451, *R. cicatricata*); EJ: Skanderbord Dyrehave, in mixed deciduous forest (*Betula*, *Alnus*, etc.) along seashore, 13.X.1990, *Mårbjerg* & *Vesterholt* (C15521, *R. cicatricata*); EJ: Skanderbord Dyrehave, under *Betula*, 2.IX.1992, *Mårbjerg* (C25755, *R. cicatricata*); NEJ: Rubjerg, Rævevej, under *Abies*, etc., 17.IX.1992, *Vesterholt* (C14423, *R. cicatricata*); EJ: Linå Vesterskov E of Silkeborg, under *Pinus*, *Picea* & *Betula*, *Larsen* (C15393, *R. cicatricata*). — GERMANY: Täuhausen, bei Eichen, 21.VII.1919, *Killermann*, (M, 41-99/11, *R. xerampelina* var. *elaeodes*); Fürstenfeldbruck, Wildmoos zw. Moorenweis und Jesenwang, MTB 7832/2, 21.IX.1969, *Bresinsky* (M, 30-99/3, *R. xerampelina*); Bayern, Bevurieder Holz bei Rottenried unweit Giedring (Ammerseegebiet), Mischwald mit Fichte, Kiefer, Buche und Birke [mixed forest with *Picea*, *Pinus*, *Fagus* and *Betula*], 15.VIII.1966, 12.VIII.1971, *Einhellinger* (M, *R. cicatricata*); Bayern, Ascholding, i. Ldkr. Wolfratshausen, in Nadelwald mit Fichte und Kiefern? [in coniferous forest with *Picea* and *Pinus*?], 19.VII.1970, *Kleylein* (M 345-2002/4, *R. cicatricata*); Bayern, Ysarbäl bei Grünwald südl. von München, im mit Birken gemischt; Fichtenwald [in *Picea* forest mixed with *Betula*], 30.VII.1973, *Einhellinger* (M 35-2002/7, *R. cicatricata*); Waldkraiburg, im Hart, Fi.-Wald, 9.VIII.1973, *Marschner* (M, 30-99/13, *R. xerampelina*); Ysarhochuter c. 1.5 km südl. von Grünwald, c. 14 km südl. von München, anmoorige Stelle bei Birke, Espe, Fichte [marshy place with *Betula*, *Populus tremula*, *Picea*], 10.VII.1974, 13.VII.1974, *Einhellinger* (M 35-2002/9, *R. cicatricata*); Bayern: Isarbäl bei Straßlach unweit Grünwald, c. 17 km südl. v. München, Mischwald [mixed forest], 22.VII.1974, 12.IX.1974, *Einhellinger* (M 35-2002/10, *R. cicatricata*); Bayern: Ysarhochuter westl. Straßlach, c. 16 km südl. von München, Fichte, Birke

[*Picea*, *Betula*], 28.VIII.1975, *Einhellinger* (M 35-2002/8, *R. cicatricata*); Waldkraiburg, auf dem Friedhof im Gras bei Birken, 25.IX.1975, *Marschner* (M, 30-99/15, *R. xerampelina*); Bayern: Mooshamer Weihermoor bei Ascholding, MTB 8035/3, bei Birke, 15.VIII.1977, *Einhellinger* (M 35-2002/3, *R. cicatricata*); Bayern, unter Birke, Espe, etc. auf sehr sauren, anmoosigen Oberboden zus. mit *R. claroflava*, *aquosa*, etc. [under *Betula*, *Populus tremula*, etc., on very acid soil, among mosses, associated with *R. claroflava*, *aquosa*, etc.], bei Straßlach-Nord, MTB 7934, 16.VII.1981, 24.IX.1981, *Einhellinger* (M 35-2002/1, *R. cicatricata*). — GREENLAND: Søndre Strømfjord-area, Ringsødal, coord. 67°01'N, 50°53'W, 10.VIII.1973, *Petersen* (C, *R. chamitae*); Søndre Strømfjord-area, Store Salsø, coord. 66°59'N, 50°36'W, 12.VIII.1973, *Petersen* (C, *R. chamitae*); Narssarsuaq, under *Betula pubescens*, coord. 61°10'N, 45°25'W, 18.VIII.1981, *Læssøe & Elborne* (C6554, *R. sp.*); Narssarsuaq, under *Betula pubescens*, coord. 61°10'N, 50°25'W, 27.VII.1983, *Knudsen, Borgen & Petersen* (C6549, *R. sp.*); Quinqua-valley at Tasersuaq Lake, under *Betula pubescens*, dry location, coord. 60°16'N, 44°33'W, 27.VII.1983, *Knudsen, Borgen & Petersen* (C6545, *R. sp.*); Narssarsuaq, under *Betula pubescens*, coord. 61°10'N, 45°25'W, 27.VII.1983, *Knudsen, Borgen & Petersen* (C6542, *R. sp.*); Paamiut, Frederikshåb, Kangilineq, Kvanøen, in heath with *Betula glandulosa*, alt. 30 m, coord. 67°57'N, 50°28'W, 28.VIII.1984, *Borgen* (C6578, *R. sp.*); Grønødal, Kangilinnugit, on heath with *Betula glandulosa*, alt. 50 m, coord. 61°41'N, 48°05'W, 12.VIII.1985, *Borgen* (C6582, *R. sp.*). — ITALY: Pine, in pineti, VIII.1926, *Bresadola* (FH, *R. graveolens*); Trento region, Langhestel near Pine, on moist acid soil under *Pinus silvestris*, alt. 900 m, 25.IX.1997, *Adamčík & Floriani* (SAV). — RUSSIA: Siberia, Buriyatia, Ust Barguzin village, E side of Lake Bajkal, under *Pinus sibirica* and *Betula pendula*, alt. 300 m, 13.VIII.1994, *Adamčík* (SAV). — SLOVAKIA: Montes Nízke Tatry, prope Maluziná, ad terram sub Piceis, alt. 850 m, 13.VIII.1982, *Kuthan* (BRA, *R. olivascens*); Convexo Podtatranská kotl., prope Važec, in valle rivi Solisková voda, ad terram sub Betulis (+ *Picea*), alt. 850 m, 14.IX.1985, *Kuthan* (BRA, *R. elaeodes*); Podtatranská kotlina, Tatranská štrba, okraj rašelinska 1 km východne od obce, pod brezami [on the edge of peat bog, under *Betula*], 6.VII.1994, *Škubla* (BRA, *R. elaeodes*); Podtatranská kotlina, Tatranská Štrba, na okraji smrečiny pod brezami [on the margin of *Picea* forest under *Betula*], 1 km od obce, 7.VII.1994, *Škubla* (BRA, *R. elaeodes*); Záhorská nížina lowland, 2.5 km SW from Lakšárska Nová Ves village, near Jasenecký rybník lake, on moist soil on the margin of moor, under *Betula* and *Alnus* trees, alt. 200 m, 22.X.1998, *Adamčík & Kosorinová* (SAV); Oravské Beskydy hills, peat bog 1 km E from Hviezdoslavova alej alley, 3 km from Oravská Polhora village, under *Picea* on moist soil among *Sphagnum*, alt. c. 850 m., 29.IX.2000, *Adamčík* (SAV). — SWEDEN: Laponie suédoise, Environs d'Abisco, vers la station sup. du tétépherique du Nuolja, alt. 850 m, 14.VIII.1967, *Kühner* (G, holotype of *R. nuoljae*).

#### NOTES ON OTHER SIMILAR TAXA IN LITERATURE

For the taxa of *Russula* sect. *Xerampelinae* with a predominantly olivaceous pileus several epithets have been used, viz. *barlae*, *cicatricata*, *citrinocincta*, *clavipes*, *cookeiana*, *duportii*, *elaodes*, *fusca*, *fuscochracea*, *ochracea*, *olivascens* and *schaefleri* (with the exception of forms of *R. graveolens* with an olivaceous pileus cuticle, as discussed above). No types have been designated for *R. barlae*, *R. elaeodes*, *R. fusca*, *R. fuscochracea*, *R. ochracea* and *R. olivascens* and the only available elements for typification are the original descriptions and illustrations. Often the names have been variously interpreted, leading to great confusion. The following species are briefly discussed.

***Russula barlae* Quél., Compt.-Rend. Assoc. Franc. Avancem Sci. 12 (1884) 504.**

Quélet (1884) described this as a species with firm, mild, whitish flesh; sweetish smell; apricot-yellow to red-orange and then pale yellow pileus; white stipe, and pale yellow spores. Although the original description does not include one of the characters

typical for *Russula* sect. *Xerampelinae* (flesh turning rusty-brown and with crab-like smell when drying or damping off, reaction to  $\text{FeSO}_4$  green), many authors applied it to taxa of this section.

Melzer & Zvára (1927) treated it as variety of *R. xerampelina* (like other taxa of the section) but their short description does not allow a secure interpretation. Schaeffer (1933) also accepted the name *R. xerampelina* var. *barlae* (Quél.) Melzer & Zvára. Original material of Schaeffer's preserved in Kew proves that this is identical with *R. faginea* (terminal elements of generative hyphae at centre of pileipellis frequently inflated and spore-ornamentation with numerous line connections). Also Blum (1961, 1962) noted in his description of *R. xerampelina* var. *barlae* characters typical for *R. faginea*: pileus cuticle reddish on the margin and ochraceous at centre, spore-ornamentation with 'fine reticulation' and pileus cuticle with numerous inflated hyphae. According to observations on the original material of Blum's deposited in herbarium PC, *R. barlae* sensu Blum is a species belonging to the group of *R. brevis* Romagn. ex Bon.

Romagnesi (1967) suggested that *R. barlae* is only a form of *R. cicatricata* with a more orange or reddish pileus and paler spore-print. The specimen from his herbarium has inflated terminal elements at margin and centre of the pileus, fitting well with the original concept of *R. cicatricata*. However, the spores are different from *R. cicatricata*: line connections are more frequent, spines are shorter and spores are narrower ( $Q = 1.19\text{--}1.45$ ). Einhellinger (1987) and Bon (1988) distinguished *R. barlae* from related species (*R. cicatricata* and *R. faginea*) on the base of similar characters.

Reumaux et al. (1996) described *R. barlae* with pileus colour similar to the original description, clearly differing from Romagnesi (1967). *Russula barlae* in their concept is probably *R. clavipes*: spore-print is ochraceous (IIIa–IIIb), terminal elements subulate, often with inflated subterminal cell and spores with short spines. They referred to the ecology indicated in the original description of *R. barlae* (montane to subalpine forests of Alpes Maritimes), but they interpreted it as a species of deciduous forests in the key (*R. clavipes* grows also under *Betula*).

*Russula favrei* M.M. Moser, a species described from submountainous to subalpine forests (Adamčík, 2002), may possibly also be synonymous with *R. barlae* in its original sense. Considering the very brief protologue (Quélet, 1884) which does not allow a modern interpretation, and the different concepts in literature, the name *Russula barlae* must be considered a nomen dubium according to Art. 56.1 of the International Code of Botanical Nomenclature (ICBN, Greuter et al., 2000), as has been suggested earlier (Kriegelsteiner, 1987; Keizer & Arnolds, 1995).

### ***Russula cicatricata* Romagn. ex Bon, Doc. Mycol. 18 (69) (1987) 35.**

*Russula cicatricata* has been validly published by Bon (1987), referring to the original description by Romagnesi (1967). Romagnesi considered the firm consistence of the flesh, concentric wrinkles at margin of the pileus, olivaceous colour of the pileus and presence of numerous inflated elements in the pileipellis as the most important differentiating characters of the species. However, according to the study by Keizer & Arnolds (1995) these characters are not reliable, because they may vary greatly within one collection. Accordingly *R. cicatricata* was reduced by Keizer & Arnolds (1995) as a mere form of *R. graveolens*. The present author agrees with the opinion of Keizer &

Arnolds that macro-morphological characters cannot be used to define a specific status for *R. cicatricata*, but additional microscopic characters, in the form of the combination of numerous inflated elements with specific shape at centre and margin of the pileus clearly differentiate *R. cicatricata* from *R. graveolens* and related species. The delimitation of *R. cicatricata* from *R. clavipes* and *R. faginea* is discussed above.

Almost all specimens collected by Einhellinger (1987) and determined as *R. cicatricata* represent *R. clavipes*, according to a revision of the material deposited in herbarium M. They were found in wet places under *Betula* or *Picea* (often in mixed forests) and the spines of spores are short (according to Einhellinger, 1987). Only one collection of Einhellinger found under *Quercus* was perhaps correctly determined as *R. cicatricata*.

The descriptions of *R. cicatricata* by Kärcher & Seibt (1994) and Galli (1996) include characters observed on the type material.

Besides the type specimen of this species, similar characters were found in the specimen of *R. barlae* determined by Romagnesi (and described in Romagnesi, 1967: 700, 701) and two specimens from Greenland deposited in herbarium C. All of the collections examined were collected on silicate soil in association with *Quercus* or *Betula* species. This association may be an important factor in the occurrence of this species.

#### **Russula citrinocincta** Reumaux in Reumaux et al., *Russules rares ou méconnues* (1996) 282.

*Russula citrinocincta* is characterised by a pale spore-print (IIc according to Romagnesi, 1967) and flesh in the cortex of stipe turning lemon-greenish. It was found in wet places under *Carpinus*, mixed or not with *Betula*. According to the observations on the type specimen of *R. citrinocincta*, inflated elements of generative hyphae at the centre of the pileipellis are very sparse (approximately 10% of the total); the spores are larger (8–10.5 × 7–8 µm) with isolated, dense, short spines and the terminal elements of generative hyphae on the margin of the pileipellis are mostly subulate, attenuate or appendiculate. These characters correspond with the type specimen of *R. graveolens* (designated by Kärcher, 2000a) and are distinctly different from characters observed on the material of *R. clavipes*.

#### **Russula cookeiana** Reumaux in Reumaux et al., *Russules rares ou méconnues* (1996) 283.

*Russula cookeiana* grows in deciduous forest and is characterised by a more brown tinged pileus and relatively small spores with long spines. Reumaux et al. did not mention *R. elaeodes* in the sense of Romagnesi, in this respect, a species very similar to their description of *R. cookeiana*. According to the observations on the type material of *R. cookeiana* by Kärcher (1997) the spores are 7–8.5 × 6.5–7.5 µm, spines 1–1.5 µm long and the terminal elements of the generative hyphae in the pileipellis are cylindrical and narrow (3–4 µm wide). This points very clearly towards the microscopic details observed in the type of *R. schaefferi*. Despite this, Kärcher (1997) distinguished *R. cookeiana* from *R. schaefferi* on account of the brownish-yellow to ochraceous-yellow pileus and sparser line connections on the spores. Type studies show that *R. cookeiana*

and *R. schaefferi* have a similar structure of the pileipellis: the terminal elements of the generative hyphae at the margin of the pileipellis are never appendiculate and mostly clavate or cylindrical with obtuse tips, and the terminal elements at the centre are cylindrical and not inflated. Both names therefore probably represent one and the same species, which is different from *R. clavipes*. If further studies prove that both species are indeed conspecific, the correct name will be, according to Art. 11.3 of the Code, *Russula schaefferi*, since this was published in March 1996, and the monograph of Reumaux et al. in June of the same year.

***Russula duportii* W. Phillips in Phillips & Plowright, Grevillea 13 (1884) 48–54.**

*Russula duportii* is another poorly known taxon in the group concerned. The original description by Phillips & Plowright (1884) bears a character, which is typical for *Russula* sect. *Xerampelinae* “flesh turns reddish brown when cut and the odour is that of the common crab”. However, the position of this species in section *Xerampelinae* is uncertain, because the characters “gills white, rounded behind, broad and distant” are more typical for *R. vesca* Fr. and related taxa. Accordingly, Masee (1893) treated *R. duportii* as a variety of *R. vesca* and Singer (1926) treated *R. vesca* sensu Masee as a variety of *R. duportii*, so it seems that *R. duportii* in the sense of both authors is not a member of *Russula* sect. *Xerampelinae*. Cooke (1889a, 1889b), Smith (1908) and Rea (1922) also mention *R. duportii*, but their descriptions of this species refer to the original diagnosis.

Melzer & Zvára (1927) were the first who associated *R. duportii* clearly with *R. xerampelina*, although later Zvára (1931) synonymised *R. duportii* with *R. amoena* Quél. Singer (1932) also modified his previous concept of *R. duportii* (see above) and treated it as taxon related to *R. xerampelina*.

While Melzer & Zvára (1927) and Singer (1932) tried to classify *R. duportii* within the *Xerampelinae* on the basis of the original description, Blum (1961) described *R. duportii* on the basis of his own collections. Blum reduced it to variety of *R. xerampelina* and his description is different from the protologue: “the dominant colour of the pileus cuticle is green-yellow, becoming more reddish with age, rarely lemon-yellow with lilac spots and lamellae are pale cream”. Blum claimed that his collections ‘exactly represented’ pl. 1042A by Cooke (1889b). The Cooke illustration has greenish tones on the margin of the pileus cuticle according to my observations, but the differences from the original diagnosis (which does not mention greenish tones) could be caused by a shift of the bluish tones to greenish. The combination *R. xerampelina* var. *duportii* was invalidly published by Blum (1961, 1962), because it lacks a reference to its basionym (according to Art. 33.2 of the Code).

Reumaux et al., (1996) followed the concept of Blum and described *R. duportii* as a taxon in *R.* sect. *Xerampelinae* with olivaceous, ochraceous and reddish-brown tints on the pileus cuticle. The terminal elements of generative hyphae (Reumaux et al., 1996, fig. R114, p. 218) are described as cylindrical, the spines of spores are short and the only collection of Reumaux was found in association with *Quercus*, so this species in the sense of Reumaux et al. perhaps comes close to *R. graveolens*. Accordingly, my observation on the type of *R. duportii* f. *spinulosospora* Reumaux (new taxon published in Reumaux et al., 1996) corresponds with the type material of *R. graveolens* (see discussion on *R. citrinocincta*).

Kärcher (2000a) designated a collection of Blum's as neotype of *R. duportii*. In the determination key to the species of *Russula* sect. *Xerampelinae* Kärcher (2000b) distinguished *R. duportii* from *R. cicatricata* by the colour of the pileus, which is, according to him, reddish-purple to vinaceous-purple at first with discoloured centre, and then often completely discolouring to ochraceous-yellow. Kärcher (2000a) mentioned also the resemblance of microscopic characters to *R. faginea*, but *R. duportii* differs on account of its sparser inflated terminal elements in the pileipellis, and wider and longer elements of the pileocystidia. The present author does not consider the determining characters of *R. duportii* indicated by Kärcher reliable for a specific status of this taxon, since these characters vary among fruit-bodies of one collection. According to the observations on the neotype the terminal elements of the generative hyphae at the margin of the pileipellis are often inflated and the terminal elements at the centre mostly cylindrical reaching 6  $\mu\text{m}$  only rarely (not more than 5%). Spores have relatively long and moderately distant spines. This character corresponds to the type specimen of *R. brevis*, which is probably another separate taxon similar to *R. graveolens* and distinctly different from *R. clavipes*.

***Russula fusca*** Quél., Compt.-Rend. Assoc. Franc. Avancem Sci. 15 (1887) 486.

The identity of *R. fusca* is uncertain, as in *R. barlae*: the original description is very brief and the illustration shows no specific characters. The description gives no clue either as to characters fitting sect. *Xerampelinae*.

Melzer & Zvára (1927) treated this taxon as a variety of *R. xerampelina*. According to observations on a herbarium specimen of *R. xerampelina* var. *fusca* revised by Melzer (PRM, 770664), it fits well the current concept of *R. clavipes*.

Romagnesi (1967) described *R. cicatricata* f. *fusca* (an invalidly published combination) based on one specimen. Study of the material revealed no differences with the current concept of *R. cicatricata*.

Bon (1988) treated *R. fusca* as a species with rusty brown pileus (also with olivaceous tinges at centre) growing under *Quercus* species. He described similar spores and hyphal elements in the pileipellis as in *R. cicatricata*, so the only differentiating character seems to be the browner pileus. Therefore *R. fusca* in the sense of Bon as a separate taxon is not accepted here.

***Russula fuscoochracea*** R. Schulz in Michael & R. Schulz, Führer für Pilzekunde, Vol. 2. (1926) pl. 241 [nom. illeg.].

*Russula fuscoochracea* is an illegitimate name, because it is a later homonym of *R. fuscoochracea* Velen. (Velenovský, 1920). *Russula fuscoochracea* Velen. is not a member of *Russula* sect. *Xerampelinae*. Schulz described *R. fuscoochracea* as a species with a pileus that is brown, in the centre darker chestnut-brown to black-brown, finally tinged olivaceous, and a stipe that is white to brownish often with pinkish spots, growing in mountainous forests from June–November. All these characters are similar to those of *R. clavipes*, but there is also similarity with *R. favrei* (for a detailed description of *R. favrei* see Adamčík, 2002).

Reumaux et al. (1996) and Kärcher (2000a, 2000b) treat *R. fuscoochracea* R. Schulz as a species of coniferous forest different from *R. clavipes*. The concept of *R. fuscoochracea* presented by these authors is based on characters which are considered inappropriate (see delimitation of *R. clavipes*). Also the description and photo of *R. xerampelina* var. *fuscoochracea* (R.S. Schulz) ined. by Galli (1996) represents typical *R. clavipes*.

### **Russula graveolens** Romell in Britzelm., Hymen. Südb. (1986) 68–69.

In this paper Romagnesi's concept (Romagnesi, 1967) of *R. graveolens* is accepted as a species with a typically brownish, vinaceous, purple and greenish pileus, attenuated terminal elements of the generative hyphae, and spores with low ornamentation. The concept of *R. graveolens* by Romagnesi is based on one specimen, which Kärcher (2000a) designated as epitype of this species. Some fruit-bodies of *R. graveolens* have been observed with an olivaceous pileus completely lacking red, purple or violet tinges, in association with normally coloured fruit-bodies with purple and vinaceous-brown tinges. Such aberrantly coloured fruit-bodies of *R. graveolens* could easily be wrongly determined as one of the species described above. However, *R. graveolens* and similar taxa, which have been collected under *Quercus* (or *Tilia* and *Carpinus*), have one conjunctive character, which is essentially different from *R. clavipes*, viz. the terminal elements of the generative hyphae at the centre of the pileus are almost never inflated (wider than 6  $\mu\text{m}$ ). This has been verified by the study of type material of several species from the group of *R. graveolens* described by Romagnesi (namely *R. graveolens*, *R. amoenoides* Romagn., *R. gilvescens* Romagn. ex Bon, *R. gracilipes* Romagn., nom. inval., *R. cretata* Romagn. ex Reumaux, *R. brevis*).

### **Russula ochracea** Pers., Syn. meth. fung. (1801) 443.

In its original concept, *R. ochracea* Pers. is probably not a species from sect. *Xerampelinae*, but modification of the original concept by several later authors caused, for example, Blum (1961, 1962) to treat it as variety of *R. xerampelina*. Persoon (1801) characterised it as a species with yellow pileus cuticle, ochraceous lamellae and white stipe. Von Albertini (1805) published the name '*Russula ochracea*  $\beta\beta$  *unicolor*', a new taxon at the rank of variety (according to Art. 35.4 of the Code) with ochraceous colour on all parts of the fruit-body. Fries (1838) interpreted *R. ochracea* according to the variety of Von Albertini, adding the ochraceous colour of the flesh. At the same time, Fries excluded the original concept of *R. ochracea* from his description, stating "Ag. *ochraceus* P.? potius est n. 42. Variat *stipite albo* et, *ut-omnes*, pileo sicco!" (*A. ochraceus* P. is under n. 42. – *R. chamaeleontina*, it differs by a white stipe and dry pileus). Thus, according to Art. 48.1 of the Code, Fries (1838) published a new name, *R. ochracea* Fr. which must be considered a later homonym of *R. ochracea* Pers. Later authors such as Cooke (1889a) and Blum (1961, 1962) followed Fries' concept of the species. Modification of the original concept by Fries later caused him to identify this species as a member of sect. *Xerampelinae*. The original concept of this name is dubious.

***Russula olivascens*** (Pers.) Fr., *Epicr.* (1861) 361.

Zvára (1923) introduced the combination *R. xerampelina* var. *olivascens* (Fr.) Zvára. The epithet *olivascens* does not go back to Fries, as Zvára suggested, but must be attributed to Persoon (1801). Persoon (1801) referred in the description of *Agaricus Russula olivascens* to his previous work (Persoon, 1796: 103), where he used, however, the name *R. olivacea*. Both descriptions contain exactly the same expressions. Both epithets 'olivacea' and 'olivascens' are similar names based on the same type, therefore we consider it as orthographic variants (Art. 61.2), and the correct name is *R. olivacea* Pers. (1796). Also Secretan (1833) already noticed that Persoon used both epithets 'olivascens' and 'olivacea' for the same taxon. *Russula olivacea* is not a member of sect. *Xerampelineae*, thus the name cannot be applied to any taxon of the section.

Original material named by Singer as *R. xerampelina* var. *olivascens* preserved in herbarium W, appeared to be identical with the current concept of *R. clavipes*. Singer's interpretation of *R. xerampelina* var. *olivascens* (Fr.) Zvára was accepted by Melzer & Zvára (1927), Schaeffer (1933), Galli (1996) and Kärcher (2000b), although they probably applied the names to various taxa.

***Russula schaefferi*** Kärcher, *Beitr. Kennt. der Plz. Mitteleuropas* 10 (1996) 68–69.

Kärcher created the name *R. schaefferi* for Romagnesi's misidentification of *R. elaeodes*. Besides Romagnesi (1967), who listed five collections from France, this species seems very rare (for example Einhellinger, 1987 indicated only two localities in Bavaria).

The generative hyphae of the type specimen of *R. schaefferi* have cylindrical and narrow terminal elements at the margin as well as at the centre of the pileus (only 3–5  $\mu\text{m}$  wide), which usually have obtuse tips. The spores have longer (1.1–1.7  $\mu\text{m}$ ) and sparse spines (3–8 spines in the circle) which are densely connected by line connections (1–7 connections in a 3  $\mu\text{m}$  diameter circle). Similar terminal elements of the generative hyphae of the pileipellis are for example found in the type specimen of *R. cookeiana* (see above) or collections of *R. bruneoalba* from Belgium (Walley, Gent). Based on these observations, *R. schaefferi* is considered different from *R. clavipes*.

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## REFERENCES

- Adamčík, S. 2002. Taxonomy of the *Russula xerampelina* group. Part 2. Taxonomic and nomenclatural study of *Russula xerampelina* and *R. erythropoda*. *Mycotaxon* 82: 241–267.  
Adamčík, S. 2003. *Russula faginea* and similar taxa. *Czech mycol.* 54: 177–191.

- Adamčík, S. & K. Marhold. 2000. Taxonomy of the *Russula xerampelina* group. I. Morphometric study on fruitbodies of the *Russula xerampelina* group from Slovakia. *Mycotaxon* 76: 463–479.
- Albertini, J. B. von. 1805. *Conspectus fungorum in Lusatae superioris agro niskiensis crecentium e methodo Persooniana*. Kummerion, Leipzig.
- Blum, J. 1961. *Russules, Compléments II*. Bull. Soc. mycol. France 77: 152–183.
- Blum, J. 1962. *Les Russules*. Paul Lechevalier, Paris.
- Bon, M. 1983. Validations et taxons nouveaux. *Doc. Mycol.* 13 (50): 27.
- Bon, M. 1987. Espèces et combinaisons nouvelles (Addenda et Corrigenda). *Doc. Mycol.* 18 (69): 35–36.
- Bon, M. 1988. Clé monographique des russules d'Europe. *Doc. Mycol.* 18 (70–71): 1–120.
- Bresadola, G. 1929. *Fungi tridentini*, Vol. 1. Typis B. Monanni, Trento.
- Cooke, M. C. 1889a. *Handbook of Brithish Fungi*, Vol. 3, ed. 2. London.
- Cooke, M. C. 1889b. *Illustrations of Brithish fungi*, Vol. 7. Williams & Norgate, London.
- Einhellinger, A. 1987. Die Gattung *Russula* in Bayern, ed. 2. J. Cramer, Berlin & Stuttgart.
- Fábry, I. 1979. *Metodika štúdia vyšších húb*. Pedagogický ústav mesta Bratislavy, Bratislava.
- Fries, E. 1838. *Epicrisis systematis mycologici, seu Synopsis Hymenomycetum*. Typographia Academica, Upsaliae [Uppsala].
- Galli, R. 1996. *Le Russule*. Edinatura, Milano.
- Greuter, W. et al. (eds.). 2000. *International Code of Botanical Nomenclature (Saint Louis Code)*. Koeltz Scientific Books, Königstein/Taunus.
- Kärcher, R. 1996. Beitrag zur Kenntnis der Täublinge. *Russula-Studien*, Teil 3. Was ist *Russula elaeodes*? *Beitr. Kennt. Plz. Mitteleuropas* 10: 65–78.
- Kärcher, R. 1997. Beitrag zur Kenntnis der Täublinge. *Russula-Studien*, Teil 4. Die gelben und zu Gelb neigenden Heringstäublinge. *Beitr. Kennt. Plz. Mitteleuropas* 11: 17–28.
- Kärcher, R. 2000a. Beitrag zur Kenntnis der Täublinge. *Russula Studien*, Teil 5. Zur Taxonomie und Nomenclatur einiger Vertreter der Untergattung *Viridantula* (Melzer & Zvara) Kärcher in Krieglsteiner (1999). In: Anon. [AMB – Fondazione Centro Studi Micologici], *Mycologia* 2000: 269–284.
- Kärcher, R. 2000b. Beitrag zur Kenntnis der Täublinge. *Russula Studien*, Teil 6. Zur Taxonomie und Nomenclatur der velutierten und velutiert-bereiften Laubwald-Heringstäublinge (mit Schlüssel für die europäischen Arten der Untergattung *Viridantula* (Melzer & Zvara) Kärcher in Krieglsteiner (1999)). *Beitr. Kennt. Plz. Mitteleuropas* 13: 79–95.
- Kärcher, R. & D. Seibt. 1994. Beitrag zur Kenntnis der Täublinge. *Russula-Studien*, Teil 2. *Z. Mykol.* 60: 399–421.
- Keizer, P. J. & E. Arnolds. 1995. Taxonomical notes on macrofungi in roadside verges planted with trees in Drenthe (Netherlands) – II. *Persoonia* 16: 81–122.
- Knudsen, H. & J. Stordal. 1992. *Russula Pers.* In: L. Hansen & H. Knudsen (eds.), *Nordic Macro-mycetes*, Vol. 2. Nordsvamp, Copenhagen.
- Krieglsteiner, G. J. 1987. Aspekte zur Geschichte der *Russula*-Forschung in Europa. *Beitr. Kennt. Plz. Mitteleuropas* 12: 85–112.
- Kühner R. 1975. *Agaricales de la zone alpine: Genre Russula Pers.* Bull. Soc. Mycol. France 91: 324–345.
- Kühner, R. & H. Romagnesi. 1953. *Flore analytique des champignons supérieurs*. Paris.
- Massee, G. E. 1893. *British fungus-flora*. George Bell & Sons, London.
- Melzer, V. 1945. *Atlas holubinek*. Kropáč a Kucharský, Praha.
- Melzer, V. & J. Zvára. 1927. *České holubinky*. Praha.
- Persoon, C. H. 1796. *Observationes mycologicae*. Lipsiae et Lucernae [Luzern].
- Persoon, C. H. 1801. *Synopsis methodica fungorum*. Gottingae [Göttingen].
- Phillips, W. & B. Plowright. 1884. *New and rare British Fungi*. *Grevillea* 13: 48–54.
- Quélet, L. 1884. Quelques espèces critiques ou nouvelles de la flore mycologique de la France. *C. r. Ass. Franc. Avancem Sci.* 12: 504.
- Rea, C. 1922. *British Basidiomycetae, a handbook of the larger British fungi*. Cambridge University Press, London.

- Reumaux, P., A. Bidaud & P. Moëgne-Loccoz. 1996. Russules rares ou méconues. Editions Federation Mycologique Dauphiné-Savoy, Frangy.
- Romagnesi, H. 1967. Les Russules d'Europe et d'Afrique du Nord. Bordas, Paris.
- Schaeffer, J. 1933. *Russula* – monographie. *Annls Mycol.* 31: 305–516.
- Secretan, L. 1833. *Mycographie suisse, ou description des champignons qui croissent en Suisse*, Vol. 1. Genève.
- Singer, R. 1926. Monographie der Gattung *Russula*. *Hedwigia* 66: 163–260.
- Singer, R. 1932. Monographie der Gattung *Russula*. *Beih. bot. Zbl.* 49: 205–380.
- Smith, F.L.S. 1908. Synopsis of the British Basidiomycetes a descriptive catalogue of the drawings and specimens in the Department of Botany British museum. British Museum, London.
- Svrček, M., J. Erhart & M. Erhartová. 1984. *Holubinky*. Academia, nakladatelství ČSAV, Praha.
- Velenovský, J. 1920. *České houby*, Vol. 1. Česká botanická společnost, Praha.
- Zvára, J. 1923. *Russula olivascens, olivacea, Linnaei, roseipes*. *Z. Pilzk.* 2: 128–130.
- Zvára, J. 1931. Contribution a l'étude des Russules. *Bull. Soc. Mycol. France* 4: 266–273.