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VARIABILITY OF HYPHODERMA SETIGERUM (CORTICIACEAE S.L., BASIDIOMYCETES) IN BELARUS AND NORTHWEST RUSSIA

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Abstract: The general morphology and spore variability of *Hyphoderma setigerum* are discussed. The herbarium material from Belarus and northwest Russia (Leningrad region) has been involved in the study to build a generalized morphological description of the species.

Key words: Corticioid fungi, Basidioma morphology, Cystidia forms, Spore size, Spore quotient.

The corticioid fungus *Hyphoderma setigerum* (Fr. : Fr.) Donk is a widespread polytrophic saprobe, associated presumably with deciduous wood. The species is characterized by remarkable fruitbody variability (Eriksson, Ryvarden, 1975; Jülich, 1984; Domański, 1988; Hansen, Knudsen, 1997), and its morphological concept is sufficiently complex issue. As neutral "type" of the species some authors (Nikolayeva, 1961) consider an abstract setigerous grandinioid fungus, however in many cases such concept will be not applicable. In our opinion, the principal diagnostic characters are an association of clamped cystidia with diversely shaped hymenial warts, while the limits of basidioma variability are principally extensive. The purpose of this work is to describe the variability in *H. setigerum* as known from the north-central Europe.

The material from Belarus and northwest Russia (mainly Leningrad region) was studied. The vouchers taken in account are kept in the herbaria of V.F. Kuprevich Institute of Experimental Botany, Minsk (MSK, Fungi) and V.L. Komarov Botanical Institute, St. Petersburg (LE). Specimens from Belarus (MSK) have mainly been collected by E.O. Yurchenko. Collections from Russia were deposited by T.L. Nikolayeva and I.V. Zmitrovich.

The data on geography and hosts of the species in Belarus are presented in Table 1. When the substrate was not reliably identified the host name is enclosed in brackets.

Table 1. Substrates and spore variability in *H. setigerum* (Belarusian material studied). Spore sizes are given as means of 30 measured spores and SD is given in parenthesis.

			Spore size and shape:	
MSK no.	**District of Belarus**	**Substrate (host)**	**Length × width (µm)**	**Length /width**
3812a	Minsk	(*Fraxinus pennsylvanica*)	7.7 (1.6) × 3.3 (0.3)	2.4
3812b	Minsk	(*Fraxinus pennsylvanica*)	7.5 (1.6) × 3.0 (0.4)	2.5
3870	Pruzhany	(*Quercus robur*)	7.5 (1.0) × 2.8 (0.4)	2.7
3871	Mazyr	*Alnus glutinosa*	8.9 (1.6) × 3.1 (0.3)	2.9
3872	Mazyr	*Alnus glutinosa*	10.55(1.3) × 3.55 (0.4)	3.0
4095	Svislach	*Quercus robur*	10.2 (1.1) × 3.3 (0.4)	3.1
4131	Lepel'	*Salix pentandra*	8.8 (1.4) × 3.3 (0.4)	2.7
4321	Lepel'	*Alnus glutinosa*	8.5 (1.6) × 2.9 (0.5)	3.0
4426	Lahoisk	*Sorbus aucuparia*	10.6 (1.5) × 3.7 (0.5)	2.9
4431a	Hlubokaye	*Sorbus aucuparia*	8.2 (1.4) × 3.25 (0.4)	2.6
4431b	Hlubokaye	*Sorbus aucuparia*	8.0 (1.4) × 3.2 (0.4)	2.5
4576	Petrykau	*Pinus sylvestris*	8.1 (1.4) × 3.7 (0.6)	2.2
4675	Pukhavichy	*Sorbus aucuparia*	8.7 (1.5) × 3.4 (0.5)	2.6
4700	Minsk	*Pinus sylvestris*	8.7 (1.8) × 3.8 (1.0)	2.3
4733	Lepel'	*Betula pubescens*	8.3 (1.6) × 3.0 (0.4)	2.8
4843	Lepel'	*Alnus glutinosa*	8.3 (1.2) × 2.8 (0.4)	3.0
4866	Lepel'	*Alnus glutinosa*	9.2 (1.6) × 3.0 (0.4)	3.1
4975	Rechytsa	*Malus sylvestris*	8.1 (1.3) × 2.9 (0.4)	2.8
4976	Minsk	*Cerasus vulgaris*	8.8 (1.2) × 3.2 (0.4)	2.8
4977	Minsk	(*Quercus robur*)	8.7 (1.4) × 3.0 (0.4)	2.9
4978	Minsk	*Alnus glutinosa*	7.7 (1.2) × 3.6 (0.8)	2.2
4979	Minsk	*Cerasus vulgaris*	10.0 (1.3) × 3.5 (0.2)	2.9
4980	Khoiniki	*Malus domestica*	7.8 (1.2) × 3.3 (0.4)	2.4
4981a	Hrodna	*Betula pendula*	7.3 (0.9) × 2.7 (0.2)	2.7
4981b	Hrodna	*Betula pendula*	8.8 (1.8) × 2.8 (0.3)	3.2
4983	Lahoisk	*Malus sylvestris*	8.4 (1.6) × 3.0 (0.5)	2.8
4984	Minsk	*Malus sylvestris*	11.1 (1.8) × 3.8 (0.3)	3.0

4985	Pukhavichy	*Malus domestica*	9.6 (1.5) × 3.3 (0.4)	2.9
4986	Lahoisk	*Malus sylvestris*	8.7 (1.7) × 3.5 (0.3)	2.5
4987	Minsk	*Sorbus aucuparia*	9.8 (1.9) × 3.6 (0.3)	2.7
4988	Minsk	*Cerasus vulgaris*	9.0 (1.6) × 3.6 (0.4)	2.5
4989	Hrodna	*Tilia cordata*	11.2 (1.6) × 3.6 (0.5)	3.1
4991	Asipovichy	*Alnus glutinosa*	8.9 (1.8) × 2.9 (0.5)	3.2
4992	Asipovichy	*Alnus glutinosa*	9.0 (1.9) × 3.1 (0.3)	3.0
5076	Lepel'	*Alnus glutinosa*	9.2 (1.7) × 3.4 (0.4)	2.7
5077	Lepel'	*Populus tremula*	9.9 (1.4) × 3.6 (0.5)	2.8
5103	Dzyarzhynsk	*Betula pendula*	7.6 (1.3) × 2.9 (0.3)	2.7

Substrate. The fungus develops both on bark and wood periphery of different deciduous trees, rarely on conifers (*Picea abies*, *Pinus sylvestris*). Less frequent substrates recorded from the area are dead lichen thalli (*Hypogymnia physodes*, MSK 4417, LE 201726; *Parmelia omphalodes*, LE 202182), pyrenomycete stromata (*Daldinia concentrica*, LE 206856), small plant debris, and burnt wood (conifer twigs, LE 206729), whereas the commonest one is *Alnus* wood. The dispersal of the species from nemoral to taiga vegetation zones is probably associated with alder rich vegetation.

Macromorphology. The fungus forms resupinate fructifications of diverse morphology, and its field identification in many cases is problematic. Young basidiomata are as a rule arachnoid-farinaceous, then continuous, on decorticating wood typically effused. When found on the bark, basidiomata may arise from lenticells as initial warts, then orbicular and confluent, repeating or not the relief of substrate, reaching 5 × 15 cm and more in extent, becoming deeply and densely cracked with age. Consistency mainly soft ceraceous to slightly cartilaginous, in some cases floccose and reminding of *Hyphodontia* species. Thickness varies from 0.07 - 0.3 to 1 - 5 mm, sometimes even thicker (see below). Thicker parts as a rule occupy depressions in the substrate and include particles from the bark. Thickening of orbicular fruitbodies sometimes lead to semiglobose formation. Hymenial surface is initially farinaceous to granulose but becomes tuberculate, warted, or toothed with age (teeth mostly 0.25 - 1.5 mm diam and 0.2 - 1 mm high). Parmasto (1969) mentioned, that teeth in some specimens may be furnished by dendroid outgrowths (in our collections this phenomenon was observed too, e.g. LE 209772). Color varies from pure white to cream, yellow, isabelline or even ochraceous, in some cases a weak pinkish tinge was present. Margin thinning out or bolster-like, arachnoid to continuous and thickening, abrupt, in most cases adnate, but in some old fructifications loosely attached.

Corticioid and grandinioid (with granulose hymenium) forms dominate in the investigated area, whereas odontioid and raduloid ones are less frequently met with (in North America the situation seems to be reverse - see Miller and Boyle, 1943). The data on some forms with rather deviating hymenial configuration are given in Table 2.

Table 2. Substrates and spore variability in some deviating growth forms of *H. setigerum* (Russian material studied)

Growth form of basidiomata	LE No.	Substrate	Spore size and shape: Length × width (µm)	Spore quotient
Odontioid				
« semiglobose	206586	*Alnus incana*	7.5-12.0x2.8-4.5	2.4
« with dendroid hyphae in teeth	209772	*Alnus incana*	7.5-12.5x3-4	2.8
« effused with a striking central wart	206847	*Betula* sp.	7.0-11.2x2.8-3.5	2.6
Raduloid	209704	*Alnus incana*	7.5-12.5x3.2-4.5	2.8
« with bolster-like sterile margin	202106	*Alnus incana*	7.5-10x2.5-4.3	2.5

Concerning the thickness of fruiting bodies we made surprising observations. We found specimens with conspicuous cushion-like basidiomata, up to 7-10 mm thick. Such findings seem to have been observed earlier, because Fries (1838, 1874) mentions that basidiomata in *Kneiffia setigera* may be very thick, «... *in statu perfectissimo hemisphaericas*...» and also «*Specimina maxima Pomi magnitudie*...» (dimensions were not indicated). Regardless that there are no principal limits for basidiomata growth in fungi, such thickened fruitbodies are certainly rare in nature.

The specimen with thickened basidiomata from Belarus (MSK 4431b, Fig. 1) was found on a fallen decayed trunk of *Sorbus aucuparia*, and thickened basidiomata grown jointly with a typical, thin one (MSK 4431a). They are resupinate, cushion-like, 2.5-5 mm thick in average, up to 7 mm thick, 5-7 cm in extent, pale coloured, with rather loose, but elastic (when fresh) consistency. Hymenial surface seems not to be quite mature, uneven, lacunose-tuberculate with minute ridges formed by hyphal fascicles or even and partly powdery due to crystalline masses. The specimen collected in St. Petersburg growing on the stump of *Alnus incana* (LE 206586, Fig. 2) reach a thickness of 10 mm. Its cross-section is clearly semiglobose, whereas the hymenophore is oblong, with thin, sterile margin (Fig. 2 A). Surface, like the Belarusian specimen, is in most parts uneven, lacunose, but so far as basidioma is mature, the odontioid processes are more expressed. In living state aculei in the specimen reached 4 mm.

Thus, we have a rare growth form being revealed from time by time by independent investigators (see Fries, 1838; Scheremeteva, 1908). The possible reason stimulating such forms could be breakings of the normal growth conditions (change of substrate orientation), or simply interpreted as an age

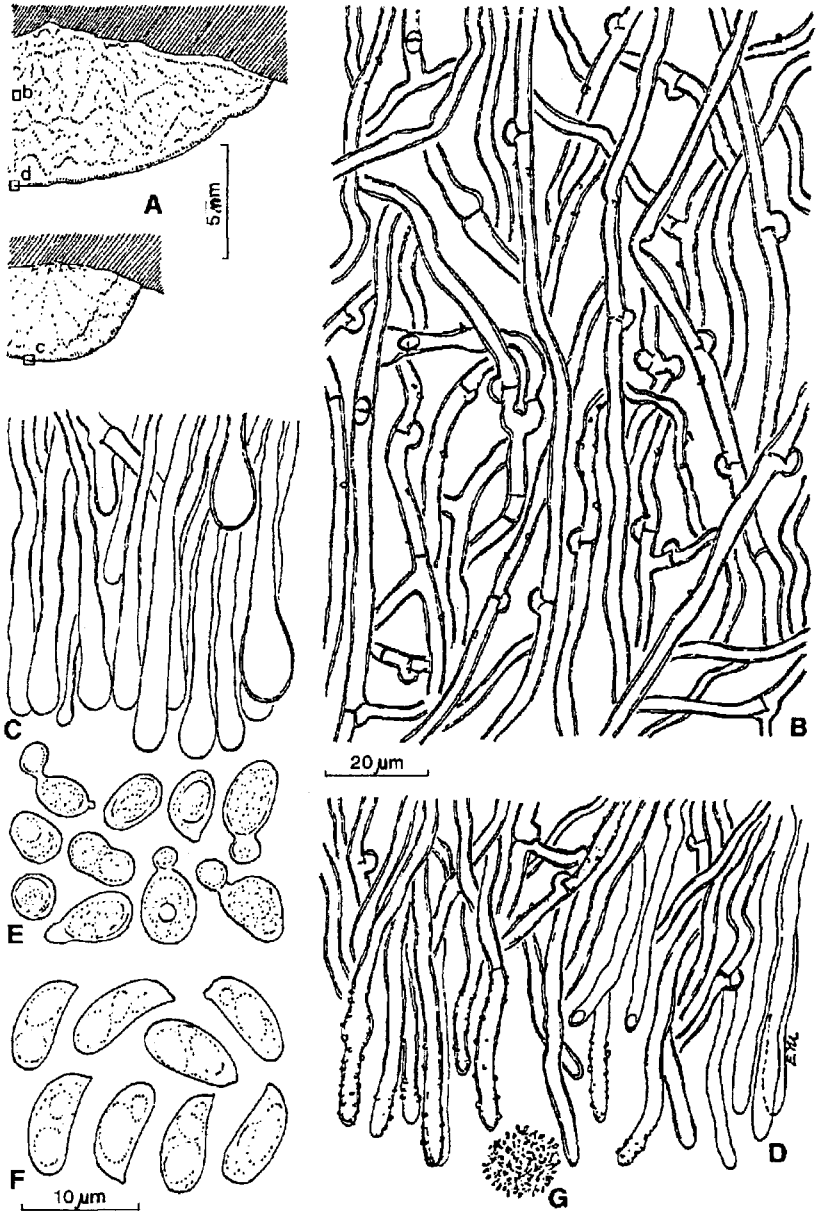

Figure 1. *Hyphoderma setigerum* (MSK 4431b). A-D, sections through basidiomata. E, budding bodies. F, basidiospores. G, crystalline mass. Drawings by E.O. Yurchenko.

state. Specimens with unusually thickened fruitbodies recorded by the authors were mainly collected at the end of the vegetation period (October - November).

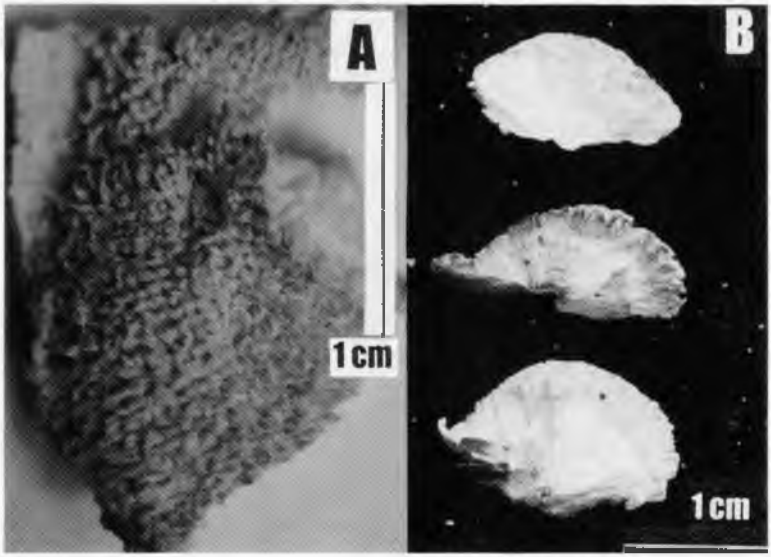

Figure 2. Thickened basidiomata of *Hyphoderma setigerum* (LE 206586), collected in St. Petersburg (05.10.1997, Piskaryovskii forest park) from decayed stump of *Alnus incana*. A, odontioid basidioma with sterile edging, B, basidioma in cross-sections (photo I.V. Zmitrovich).

Hyphae (Fig. 1 B). Hyphae are distinct, 2 - 5.5 (6) μm wide, thin- to somewhat thick-walled, fibulate, with characteristic hyphodermoid ramifications, vertically arranged in subhymenium and more horizontal in subicular part; smooth or encrusted, hyaline or subhyaline, even, rarely with ampullate (MSK 4976) or irregular swellings up to 8.5 - 10 μm in diam; sometimes with adventitious septa. Walls up to 0.8 - 1 μm thick, although sometimes reaching 2 μm (MSK 4983). As a rule in young or weakly developed basidiomata all the hyphae are thin-walled. Subiculum loose or tightly packed.

Septocystidia (Fig. 3 A - C, F - H, J - N). The most peculiar and characteristic element of high diagnostic value. They are pronounced, rare in young basidiomata, as a rule well developed and abundant in mature ones, associated mainly with apices of warts, teeth or other protuberances, 55 - 185 (280) × 5.5 - 12 (14) μm, immersed or protruding to 55 - 170 μm, walls up to 2 - 2.5 μm thick, sometimes seemingly layered (MSK 4131). Typical cystidia

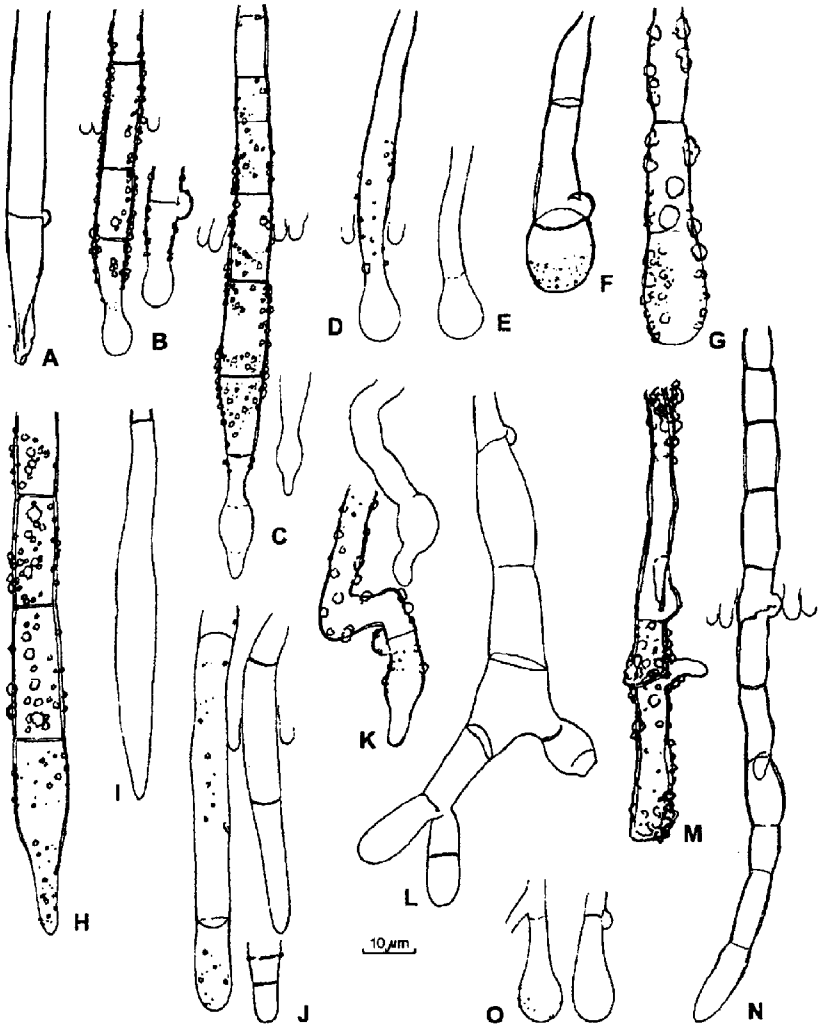

Figure 3. Cystidia (A-N) and basidioles (O) of *Hyphoderma setigerum*. A, cylindrical with wrinkled tip (MSK 4986). B, capitate (MSK 3872). C, clampless capitate, with spout-like tip (MSK 3872). D and E, capitate aseptate (D - MSK 4985, E - MSK 4988). F and G, with widened apical part (F - MSK 4131, G - MSK 4843). H, clampless, narrowed at the tip (MSK 4866). I, fusiform smooth (MSK 4866). J, with adventitious septa (MSK 3870). K, distorted (MSK 4843). L, branched (MSK 3870). M, branched at clamp (MSK 4984). N, with many short-celled segments (MSK 4991). O, clavate basidioles (MSK 4988).

are cylindrical and unbranched with truncate apices and clamped septa, but variation occur, namely: 1) with clampless septa, 2) aseptate, 3) with capitate thin-walled tip, 4) apically widened or swollen (MSK 3872), 5) with inflations in other parts, 6) tapering to the apex, 7) with many short-celled segments, 8) branched (MSK 3870).

The content is hyaline to yellowish or slightly greenish, refractive or not, homogeneous or granular.

The encrustation if present varies from poor to abundant, consists of minute or big double-pyramidal crystals (0.3 - 7 pm long, Fig. 3 F, G). Cystidial apices as a rule smooth or less encrusted.

Basidia and basidioles. Basidia in the fungus are of typical hyphodermoid appearance, subclavate, with characteristic median constriction and 4 long sterigmata, 25 - 35 (45) × 5 - 6 (7) µm (sterigmata reaching 9.5 µm length), arranged in a palisade or sometimes a more loose structure. Hyaline to yellowish ovoid or short-clavate structures 7 - 9 µm wide and *ca* 20 µm long present in some specimens (Fig. 3 O), which probably are young stages of either basidia or cystidia.

Spores (Figs. 1 F, 4). Spore shape varies from ovoid to ellipsoid and cylindrical, adaxially flattened and often slightly curved. Apiculus short to prominent, sometimes not visible. Surface smooth, in one specimen (MSK 4989) with adhered granules.

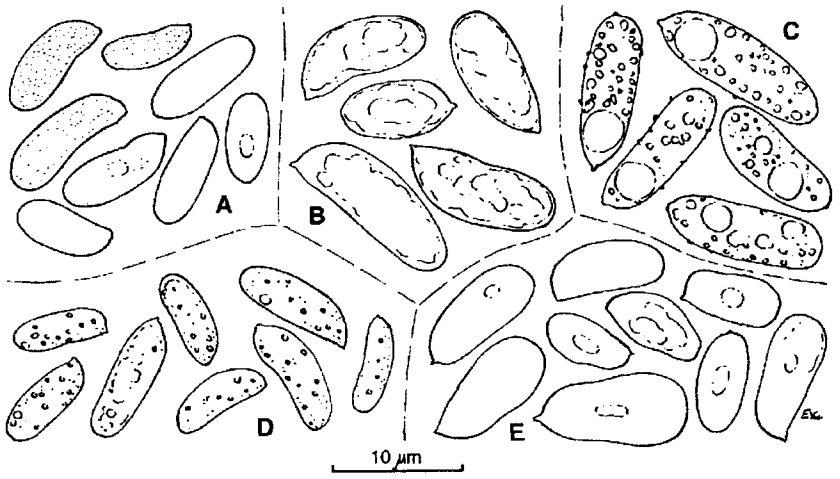

Figure 4. Spores of *Hyphoderma setigerum*. A, MSK 4870. B, MSK 4987. C, MSK 4989. D, MSK 4733. E, MSK 4700.

Spore wall from very to moderately thin, forming distinct outline. Content hyaline or subhyaline (seemingly greenish), refractive or not, as a rule granular.

Data on spore sizes are presented in Table 1 (mean length and width, standard deviation, and mean length/width ratio). For each specimen 30 spores were measured. Spores sizes varies in limits 5.5 - 14 x 2.0 - 5.5 µm with the marginal mean values for our specimens 7.3 - 11.2 x 2.7 - 3.8 µm. Spore quotient varies considerably: from 1.2 to 5.0, its mean values are from 2.2 to 3.2. The generalized mean spore size for Belarusian material is 8.85 x 3.25 µm, and spore quotient is 2.76. We observed certain dependence of spore length and width from the type of substrate: fallen or erect branches and trunks. The basidiomata growing on vertical trunks and still-attached branches have mostly bigger spores than basidiomata on fallen wood (Fig. 5). Mean spore sizes are 9.4 x 3.4 for basidiomata in exposed position versus 8.7 x 3.2 for basidiomata in close contact with the ground.

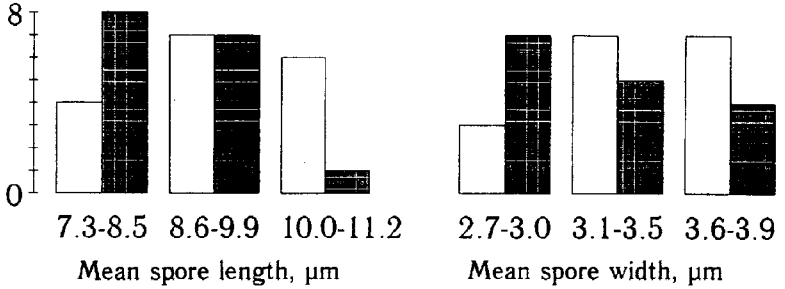

Figure 5. Number of specimens of *Hyphoderma setigerum* with mean spore length and width belonged to one of three classes, with basidiomata growing on still-attached branches and vertical trunks (white rectangles), and on fallen branches and trunks (gray rectangles).

Any dependence of spore size and shape from both the host species and the type of host tissue were not found. An exception is rather short and wide spores of specimens from *Pinus sylvestris* (length/width = 2.2 and 2.3).

A deviating form is represented by MSK 4978 (Fig. 6) with small ovoid or ellipsoid spores (7.7 x 3.5 µm in average), very few septocystidia, and well visible basal layer up to 90 µm thick. It is remarkable, that some spores of this specimen are subglobose (length/width = 1.2 - 1.3), subhymenium is richly encrusted, cystidia are weakly projecting and sparse, the hymenial palisade is very dense.

Other structures. Rounded or slightly angular bodies 3.7 - 18.5 x 3.5 - 11 µm with some oily hyaline to yellowish contents (Fig. 6 B) were observed in a number of specimens. They are dispersed or aggregated in subiculum, mainly near substrate, resembling a parasitic fungus. In one thickened specimen (cited

above) was found subhyaline yeast-like structures 3 - 9.5 (15) × 3 - 5.5 µm with contents and refraction resemble those of basidiospores (Fig. 1 E). They seem to be budding, in some places forming large assemblages. The functional value of both types of structures remains unknown for the authors.

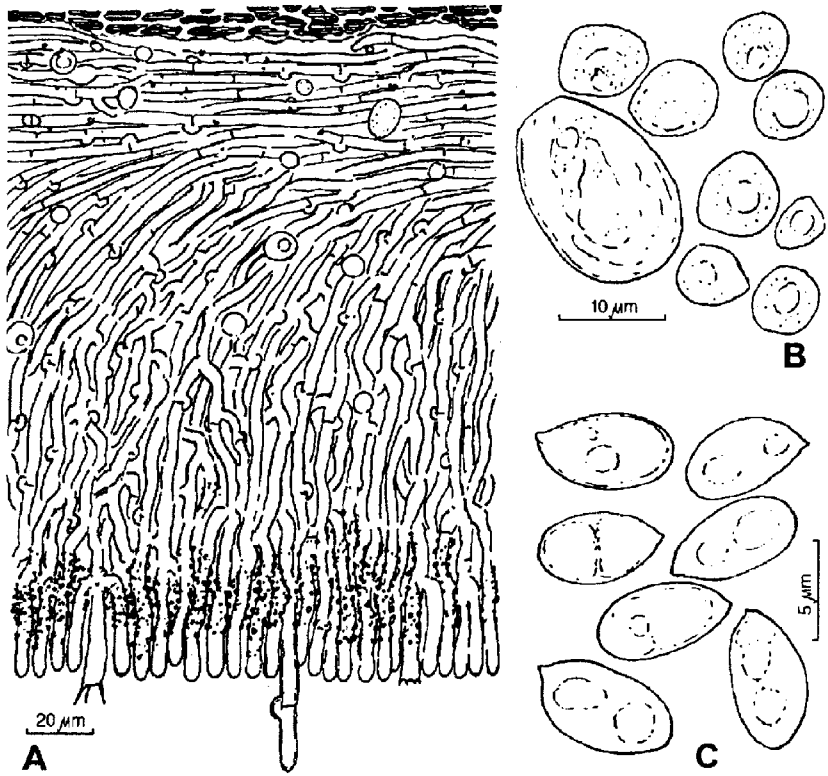

Figure 6. *Hyphoderma setigerum* (MSK 4978). A, vertical section of basidioma with basal layer. B, rounded bodies from subiculum. C, spores.

Considering the here added information on basidiome morphology the elaborated diagnosis of the species may be presented as follows.

Hyphoderma setigerum (Fr. : Fr.) Donk, Fungus 27: 15, 1957. - *Thelephora setigera* Fr. : Fr., 1828. - *Kneiffia setigera* (Fr. : Fr.) Fr., 1838. - *Peniophora setigera* (Fr. : Fr.) Höhn. et Litsch., 1906. - *Odontia setigera* (Fr.: Fr.) L.W. Mill., 1934; *Hydnum cristulatum* Fr. : Fr., 1821; *Thelephora aspera* Pers., 1822 non Fr.; *Hyphoderma spiculosum* Wallr., 1833; *Corticium myxosporum* P. Karst., 1882.; *Corticium latitans* P. Karst., 1888; *Odontia acerina* Peck, 1901; *Peniophora subtestacea* Litsch., 1928.

Basidiomata adnate, effused or orbicular with central wart, firstly arachnoid, then thickening, up to 15 - 20 cm in extent and 10 mm thick, ceraceous to floccose, often cracking, white to ochraceous. Margin sterile, arachnoid to bolster-like, white, then darkening. Hymenium smooth (farinaceous under lens) or toothed. Teeth 4 mm or less in length, conical to dendroid, blunt, sometimes crowded, hispid at the apex. Hyphae 2 - 6 (10) µm in diam, clamped, with age moderately thick-walled, smooth or with scattered encrustation, loosely arranged. Cystidia 30 - 280 × 5.5 - 14 µm, cylindrical, sometimes tapering or branched, as a rule septate with clamp connections, projecting on 10 - 170 µm mostly near the apex of hymenial warts, at first naked, becoming encrusted with coarse crystals. Basidia 25 - 45 × 5 - 7 µm, subclavate, constricted, with 4 sterigmata (reached to 9.5 µm in length), hyaline; sometimes together with ovoid or short-clavate basidioles 15 - 25 × 7 - 9 µm. Spores 5.5 - 14 × 2.0 - 5.5 µm, mostly 7 - 11 × 3 - 4 µm, ovoid to cylindrical, slightly curved or at least clearly depressed, smooth, hyaline, as a rule granular and guttulate.

On bark or wood of alder and many other deciduous, rarely coniferous trees, dead lichen thalli, old pyrenomycete stromata, plant debris and burnt pieces. Associated with a white rot. Grows from June to November. Common and widely distributed in North-Central Europe. Circumglobal species.

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