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THE RECORDS OF THE DISCOMYCETES OF THE GENERA *ASCOBOLUS* AND *SACCOBOLUS* FROM ESTONIA

At present there are very few reports on the species of coprophilous fungi in our country. The fungi of various taxonomic and ecological groups of discomycetes of Estonia have been studied, but coprophilous species have practically been omitted. It should be mentioned that according to L. Järva and E. Parmasto (Eesti seente koondnimestik, 1980) only 11 coprophilous species of discomycetes have been recorded in Estonia.

This paper is a contribution to the investigation of the genera *Ascobolus* and *Saccobolus* found on the dung of different herbivorous animals or on soil. The coprophilous species of other genera and families will be published in succeeding papers.

In the course of those investigations the samples deposited in the herbarium of the Institute of Zoology and Botany (TAA), Academy of Sciences of the Estonian SSR in Tartu, collected by A. Raitviir, M. Saar, B. Kullman, A. Kollom, P. Põldmaa, K. Kalamees and L. Pihlik as well as personal collections were examined.

The dried material was examined in 5% KOH. Melzer reagent was used for the staining of the apical structure of the asci. A certain part of the samples was incubated in Petri dishes with wet paper filters under laboratory conditions.

This paper presents a list of the species of the genera *Ascobolus* and *Saccobolus* which were found on the territory of Estonia from 1959 to 1987. In this paper complete descriptions and illustrations are presented for the species which are rare and those which are interesting, while the common species are accompanied by short data only.

Ascobolus albidus Crouan. Pärnu district, Kilingi-Nõmme, on dung of hare, Apr. 1, 1986, coll. M. Saar; Tartu district, Kaagvere, on dung of deer, March 28, 1986, coll. M. Saar.

Apothecia solitary or in groups, sessile, cylindrical-ovoid or urceolate, yellow-brownish, 0.6–0.75 mm in diameter. Ectal excipulum of *textura angularis*. Asci cylindrical-clavate, blueing in Melzer reagent, (200.1-)263.6-276.5×29.8-37.6 μm. Spores biseriate, elongate-ellipsoid, violet, with longitudinal, quite broad and irregularly thickened, sometimes anastomosing cracks or with short, right or curved fissures, 25.7-30.5×12.8 μm, with unilateral cap of slime. Paraphyses filamentous, septate, branched, at the tips often lobed and curved, slightly enlarged, 4.8-8.0 μm in diameter, embedded in colourless slime (Fig. 1, a).

Note: *A. albidus* is known from different countries of Europe and North America. It is found from various regions of the USSR, too. The fruit bodies were obtained under laboratory conditions.

Ascobolus brassicae Crouan. Tartu district, Variku, on dung of hare, Apr. 10, 1980, coll. V. Prokhorov.

Apothecia solitary or in small groups, spherical or almost so, superficial, sessile, smooth, white or almost translucent, with numerous asci protruding above excipulum, 0.6–0.7 mm in diameter. Ectal excipulum of *textura angularis*. Asci cylindrical-clavate with rounded or slightly

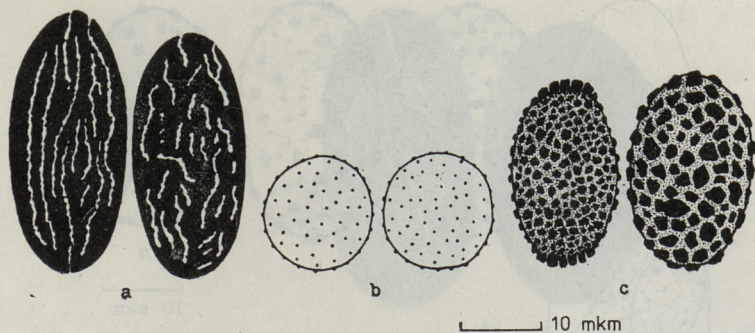


Fig. 1. Spores of the *Ascobolus* species: a — *A. albidus*; b — *A. brassicae*; c — *A. carbonarius*. ($\times 1000$).

flattened apex, diffusely blueing in Melzer reagent, gradually tapering into stalk, $155.0-189.0 \times 23.2 \mu\text{m}$. Spores uniseriate, spherical, pale violet, minutely warted, $11.6-13.0 \mu\text{m}$ in diameter. Paraphyses simple or branched, filamentous, septate, hyaline, $4.0 \mu\text{m}$ in diameter at the tips, embedded in colourless slime (Fig. 1, b).

Note: The fruit bodies were obtained during the incubation of the pellets of hare in a wet chamber. This species has been found in Estonia for the first time, but the first published record for the USSR is from Moscow district (Пproxopов, 1987). It is known from nine countries of Europe and from the USA. *A. brassicae* is probably not a rare species, but its minute dimensions and rare occurrence in natural conditions make its detection quite difficult.

Ascobolus carbonarius P. Karst. Tartu district, Variku, Nov. 13, 1959; Pärnu district, Vilukare, Aug. 2, 1960; Kingissepa district, Käesla, Aug. 24, 1960; Viidu, Aug. 23, 25, 1960; Rakvere district, Palmse, July 4, 1974. All records were found on burnt soil by A. Raitviir.

Spores ellipsoid, violet or dark violet, brownish, coarsely warted, warts larger on polar ends, $19.9-20.8 \times 11.6-12.5 \mu\text{m}$ (Fig. 1, c).

Note: It should be noted that the asci of *A. carbonarius* maintain sometimes a few abortive spores or 2—4 spores larger than normal ones — $27.7-30.0 \times 16.7-16.9 \mu\text{m}$. It is a common species.

Ascobolus degluptus Brumm. Põlva district, Mõtsküla, on dung of hen, Oct. 10, 1986, coll. L. Pihlik.

Apothecia solitary or gregarious, at first almost spherical, then ovoid, superficial or submersed, with 1—4 matured asci erumpent through exipular tissue, white-yellowish-grayish, 0.2—0.25 mm in diameter. Ectal excipulum of textura angularis with a tendency of becoming textura epidermoidea, in the latter case it is formed by horizontally orientated cells. Asci clavate-cylindrical, 8-spored, with rounded apex, tapering into short stalk, becoming deeply blue in Melzer reagent, $289.3-353.6 \times 41.8-51.4 \mu\text{m}$. Spores broadly ellipsoid, irregularly biseriata in upper part of ascus, violet, ornamented by large and smaller globules of pigment, the central part of spores usually with a large disruption of pigment layer, $27.3-28.9 \times 16.1 \mu\text{m}$, enveloped by a sheath of slime. Paraphyses filamentous, simple, hyaline, $3.2-3.7 \mu\text{m}$ in diameter, at the tips almost not enlarged, embedded in colourless slime (Fig. 2).

Note: *A. degluptus* is reported for the first time from the USSR and it is the fifth report in the world. The species is hitherto known only from the Netherlands, Poland, Great Britain (Brummelen, 1967), France (Caillet, Moyne, 1980). The characters of fruit bodies are very similar to the original description excluding the length of asci — $380.0-500.0 \times$

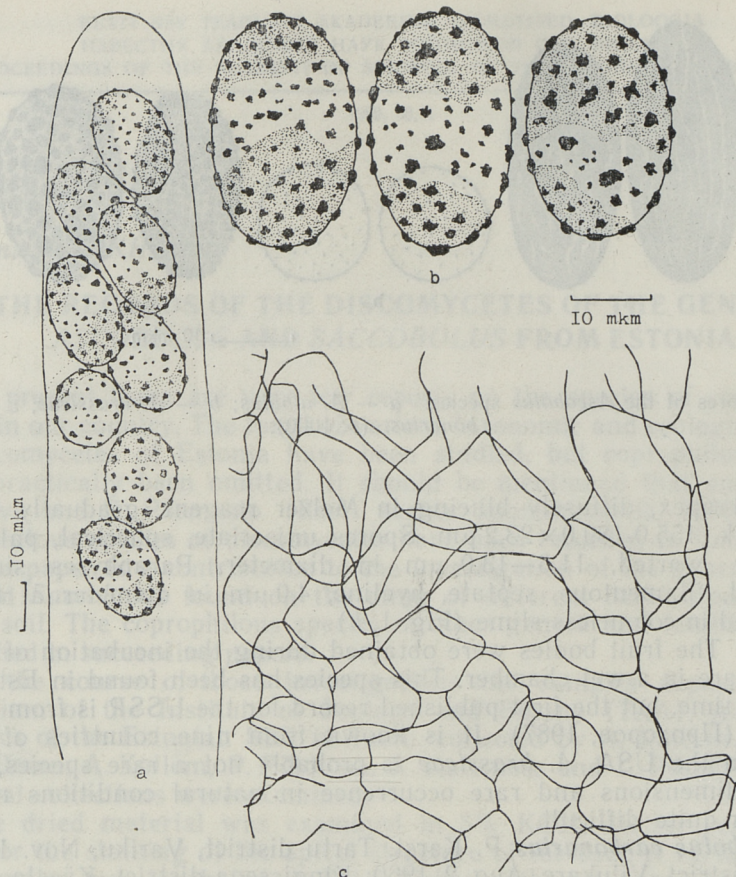


Fig. 2. *Ascobolus degluptus*: a — ascus with spores ($\times 500$); b — spores covered by partial layer of pigment; c — ectal excipulum. ($\times 1000$).

$\times 49.0$ — $56.0 \mu\text{m}$ according to J. van Brummelen. The species is evidently rare and not widely distributed.

Ascobolus furfuraceus Pers. per Hook. Pärnu district, Nigula, on dung of elk, Aug. 13, 1963, coll. A. Raitviir; Pärnu district, Kolbergi, on dung of cow, Aug. 18, 1963, coll. K. Kalamees; Rakvere district, Väike-Maarja, on dung of cow, July 30, 1964, coll. A. Raitviir; Haapsalu district, on dung of cow, Sept. 9, 1977, coll. A. Raitviir; Valga district, Lüllemäe, on dung of cow, Sept. 9, 1986, coll. V. Prokhorov; Põlva district, Mõtsküla, on dung of horse, cow and sheep, Oct. 10, 1986, coll. L. Pihlik.

Asci — 149.4 — 165.0×23.3 — $24.9 \mu\text{m}$; spores 22.2 — 27.8×9.7 — $10.5 \mu\text{m}$ (Fig. 3, a).

Note: In Estonia this species was recorded by Dietrich (Eesti seente..., 1980) as far back as 1856. This is one of the commonest, worldspread species of coprophilous discomycetes occurring on various types of dung in 31 countries at least.

Ascobolus immersus Pers. per Pers. Tartu district, on dung of cow, Apr. 7, 1980, coll. V. Prokhorov; Põlva district, Mõtsküla, on dung of horse, Oct. 10, 1986, coll. L. Pihlik; Valga district, Lüllemäe, on dung of cow, Sept. 9, 1986, coll. V. Prokhorov; Tartu district, Variku, on dung of horse, Feb. 20, 1987, coll. A. Raitviir. In all cases the fruit bodies were obtained under laboratory conditions.

Asci broadly clavate to almost saccate with a short stalk, 501.5 — 707.3×80.4 — $101.0 \mu\text{m}$, spores ellipsoid 53.0 — 66.2×32.1 — $38.5 \mu\text{m}$, en-

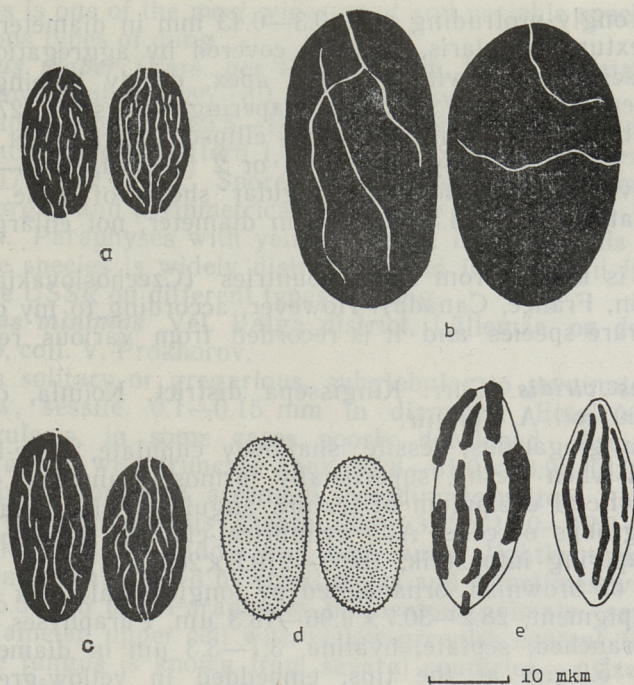


Fig. 3. Spores of the *Ascobolus* species: a — *A. jurjuraceus*; b — *A. immersus*; c — *A. sacchariferus*; d — *A. stictoideus*; e — *A. viridis*. ($\times 1000$).

veloped by a thick sheath of slime. The asci maintain sometimes 1 or 2 very small colourless abortive spores. This is one of the most widespread species (Fig. 3, b).

Ascobolus sacchariferus Brumm. Paide district, on dung of elk, May 21, 1982, coll. B. Kullman; Tartu district, Kaagvere, on dung of deer and horse, March 28, 1986, coll. M. Saar; Pärnu district, Kilingi-Nõmme, on dung of elk, Apr. 1, 1986, coll. M. Saar; Võru district, Vastseliina, on dung of sheep and roe, Apr. 2, 1986, coll. M. Saar.

Apothecia hemispherical, cylindrical to barrel-shaped, sessile on narrowed base, solitary or in small groups, superficially granulose with agglomerations of hyaline, almost spherical cells, white, 0.42–1.15 mm in diameter. Ectal excipulum of *textura angularis* or formed by elongate cells with rounded angles. Asci cylindrical-clavate with slightly truncated apex, the wall becoming blue in Melzer reagent, $144.2\text{--}188.3 \times 15.7\text{--}22.5 \mu\text{m}$. Spores biseriate, ellipsoid, with rounded ends, violet, ornamented by longitudinal, anastomosing, sinuous fissures, $16.1\text{--}17.7 \times 8.0\text{--}9.6 \mu\text{m}$, with a lateral cap of slime. Paraphyses filamentous, septate, hyaline, simple or irregularly and shortly branched (forked) at the apex, $3.2\text{--}3.7 \mu\text{m}$ in diameter, embedded in colourless slime (Fig. 3, c).

Note: *A. sacchariferus* was described originally by J. van Brummelen (1967) from the Netherlands on dung of deer only. This is evidently quite a rare species and it is known now from Czechoslovakia (Moravec, 1970), Denmark (Paulsen, Dissing, 1979) and Japan (Minoura et al., 1978). According to my observations it should be a common fungus developing on various types of dung. The fruitbodies often develop on samples of dung in a wet chamber.

Ascobolus stictoideus Speg. Tartu district, Variku, on dung of hare, Apr. 10, 1980, coll. V. Prokhorov.

Apothecia at first immersed, then subimmersed or almost superficial, subglobose or obconical, solitary or gregarious, dingy white-yellowish,

with few strongly protruding asci, 0.3–0.43 mm in diameter. Ectal excipulum of *textura angularis*, sparsely covered by aggregations of violet pigment. Asci clavate, with rounded apex, deeply blueing in Melzer reagent when immature, gradually tapering into stalk, $270.7\text{--}330.0 \times 48.9\text{--}50.0 \mu\text{m}$. Spores biseriate, broadly ellipsoid, dark violet, ornamented by multiple warts, usually present 1 or 2 fissures, $26.5\text{--}27.4 \times 16.6\text{--}18.3 \mu\text{m}$, enveloped by a total or irregular sheath of slime. Paraphyses simple, septate, hyaline, $4.5\text{--}5.5 \mu\text{m}$ in diameter, not enlarged upwards (Fig. 3, *d*).

Note: It is known from some countries (Czechoslovakia, Denmark, Great Britain, France, Canada). However, according to my observations, it is not a rare species and it is recorded from various regions of the USSR.

Ascobolus viridis Curr. Kingissepa district, Koimla, on wet soil, Aug. 24, 1960, coll. A. Raitviir.

Apothecia gregarious, sessile, shallowly cupulate, olive-brown (pale yellow-green when fresh), superficially farinose-granulose, 4.0–6.0 mm in diameter. Ectal excipulum of *textura angularis* with pyramidal warts formed by groups of cells. Asci cylindrical-clavate, with rounded apex, gradually tapering into stalk, $180.0\text{--}219.8 \times 20.0\text{--}21.6 \mu\text{m}$. Spores fusiform, violet or brownish, ornamented by longitudinal thick ribs or with globules of pigment, $28.2\text{--}30.7 \times 9.96\text{--}13.3 \mu\text{m}$. Paraphyses filamentous, simple or branched, septate, hyaline, $3.1\text{--}3.3 \mu\text{m}$ in diameter, slightly enlarged to $5.0 \mu\text{m}$ at the tips, embedded in yellow-greenish slime (Fig. 3, *e*).

Note: The species is widely distributed, but it is not easily noticeable. It is recorded from eight countries at least.

Saccobolus depauperatus (Berk. et Br.) E. C. Hansen. Rakvere district, Viitna, on dung of elk, Sept. 10, 1974, coll. B. Kullman; Haapsalu district, Vormsi Island, on dung of horse, Sept. 19, 1980, coll. A. Raitviir; Pärnu district, Varbla, on dung of elk, Sept. 12, 1980, coll. A. Raitviir; Tartu district, Kaagvere, on dung of sheep, March 28, 1986, coll. M. Saar; Võru district, Vastseliina, on dung of deer, Apr. 2, 1986, coll. M. Saar.

Asci clavate or cylindrical-clavate, becoming blue in Melzer reagent, $75.5\text{--}94.8 \times 16.9\text{--}19.3 \mu\text{m}$. Spore-clusters compact, arranged according to pattern II or sometimes III, $14.1\text{--}30.8 \times 10.1\text{--}11.2 \mu\text{m}$. Spores ellipsoid-fusiform, smooth or occasionally with 1–2 cracks, $12.8\text{--}14.4 \times 10.1\text{--}11.2 \mu\text{m}$ (Fig. 4, *a*).

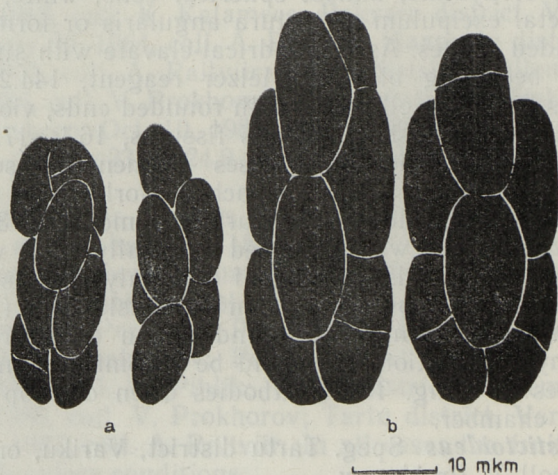


Fig. 4. Spore-clusters of the *Saccobolus* species: *a* — *S. depauperatus*; *b* — *S. glaber*. ($\times 1000$).

Note: This is one of the most widespread and variable species, developing on various types of dung.

Saccobolus glaber (Pers. per Pers.) Lamb. Valga district, Lüllemäe, on dung of cow, Sept. 9, 1986, coll. V. Prokhorov.

Asci broadly clavate, $125.5-141.2 \times 34.5 \mu\text{m}$. Spore-clusters compact, aggregated according to pattern I, enveloped by an entire sheath of slime, $45.0-53.1 \times 17.7-19.4 \mu\text{m}$. Spores fusiform-ellipsoid, sometimes unilaterally enlarged and asymmetrical, smooth or with 1 crack, $19.3-22.2 \times 9.0-10.4 \mu\text{m}$. Paraphyses with yellow content in upper cells (Fig. 4, b).

Note: The species is widely distributed and it is known from various regions of the USSR on different types of dung.

Saccobolus minimus Vel. Valga district, Lüllemäe, on dung of cow, Sept. 9, 1986, coll. V. Prokhorov.

Apothecia solitary or gregarious, subglobose to pulvinate, yellow or golden-yellow, sessile, 0.1-0.15 mm in diameter. Ectal excipulum of textura angularis, in some cases poorly developed. Asci clavate or cylindrical-clavate, with truncate apex, $57.8-61.0 \times 16.9-18.0 \mu\text{m}$. Spore-clusters compact, elongated, arranged according to pattern I or sometimes III, covered by mucilaginous sheath, $20.9-32.2 \times 11.0-12.9 \mu\text{m}$. Spores ellipsoid, inflated in the middle part and with slightly truncated ends, violet, uniformly ornamented by small warts and sometimes with 1 fissure, $12.2-12.5 \times 5.3-5.6 \mu\text{m}$. Paraphyses filamentous, simple, septate, $3.2-3.4 \mu\text{m}$ in diameter, upper cell with yellow-greenish content (Fig. 5).

Note: The fungus is known from several countries — Czechoslovakia

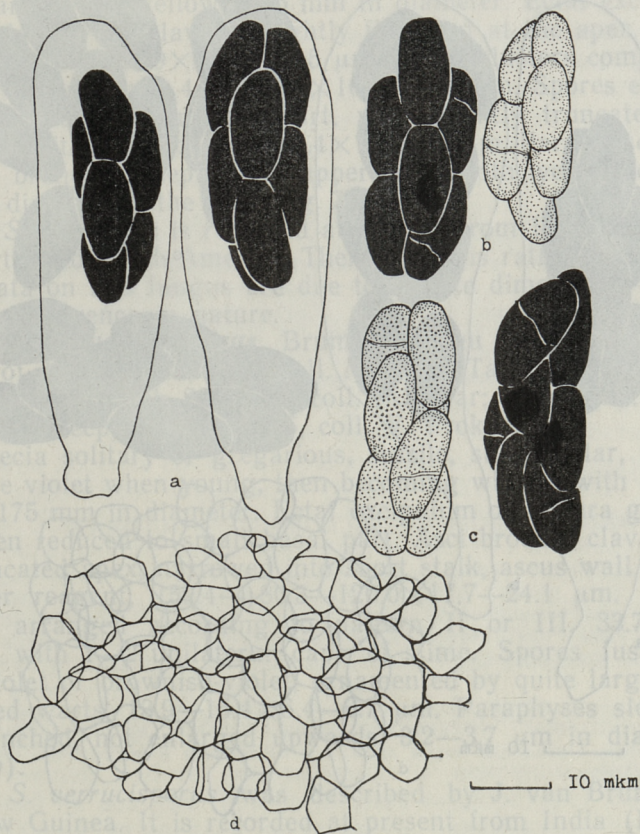


Fig. 5. *Saccobolus minimus*: a — asci; b — spore-clusters arranged according to pattern I; c — spore-clusters arranged according to pattern II; d — ectal excipulum. ($\times 1000$).

(Svrček, 1981), Venezuela (Jeng, Krug, 1977), Spain (Guarro, 1983), Iraq (Abdullah, 1982), Japan (Minoura, Yamada, 1976), Austria, Thailand, Hawaii, Canada, USA, Ecuador (Brummelen, 1967). It is reported for the first time in the USSR.

Saccobolus saccoboloides (Seaver apud Dodge et Seaver) Brumm. Võru district, Vastseliina, on dung of sheep, Apr. 2, 1986, coll. M. Saar.

Apothecia sessile, pulvinate, yellow, yellow-amber, 0.2–0.375 mm in diameter. Ectal excipulum of textura globulosa-angularis, scarcely developed and present mostly at basal part of fruit body. Asci clavate, gradually tapering into short stalk, with rounded apex, $80.3\text{--}104.4 \times 21.7\text{--}22.5 \mu\text{m}$, the ascus wall becoming blue in Melzer reagent. Spores in young asci arranged into clusters according to pattern I or sometimes II, $33.7\text{--}38.5 \times 12.8\text{--}13.8 \mu\text{m}$, which soon disintegrate, releasing the spores. Individual spores violet, smooth, ellipsoid, often enlarged in the middle part, $14.4\text{--}16.1 \times 7.4 \mu\text{m}$, enveloped by a sheath of slime. Paraphyses filamentous, simple, $2.7\text{--}3.0 \mu\text{m}$ in diameter at the tips, upper cells with yellow-greenish contents (Fig. 6).

Note: The description given by J. van Brummelen (1967) is incomplete. However, the characters of fruit-body studied here are very similar to those described by J. van Brummelen, but the spore-clusters become disintegrated within the ascus in an early stage of maturation, though the pattern of spore arrangement remains. This species is evidently closely related

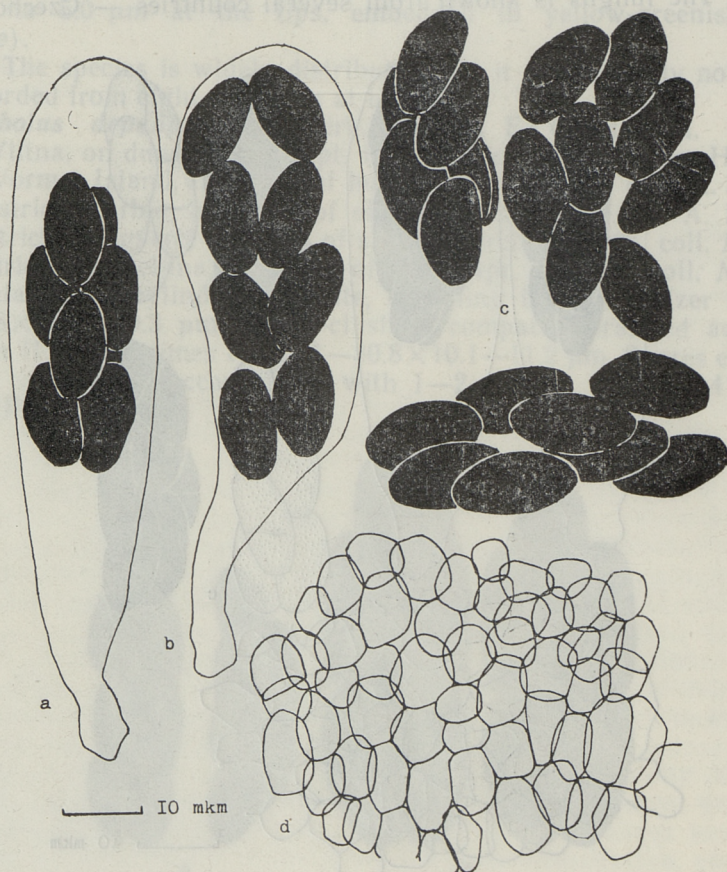


Fig. 6. *Saccobolus saccoboloides*: a — ascus with spore-cluster arranged according to pattern I; b — ascus with disintegrated spore-cluster; c — different types of changes and disintegrations of spore-clusters; d — ectal excipulum. ($\times 1000$).

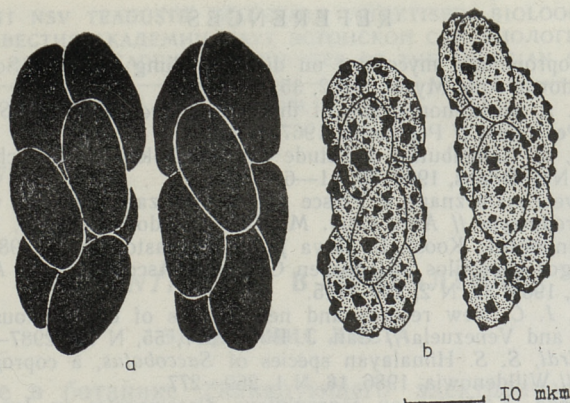


Fig. 7. Spore-clusters of the *Saccobolus* species: a — *S. truncatus*; b — *S. verrucisporus*. ($\times 1000$).

with *S. depauperatus* and *S. truncatus* which are characterized by compact spore clusters. Probably it is a scantily distributed species. At present it is recorded from Indonesia, New Guinea (Brummelen, 1967) and from India (Kaushal, Viridi, 1986). This is the first report from the USSR.

Saccobolus truncatus Vel. Tartu district, on dung of horse, Feb. 20, 1987, coll. A. Raitviir.

Apothecia solitary or gregarious, sessile, shortly obconical, smooth, yellow, dark golden-yellow, 0.25 mm in diameter. Ectal excipulum of textura angularis. Asci clavate, slightly flattened at the apex and narrowed downwards, $73.9\text{--}81.9 \times 20.9\text{--}22.5 \mu\text{m}$. Spore clusters compact, arranged according to pattern I, $41.8\text{--}43.4 \times 16.1\text{--}17.7 \mu\text{m}$. Spores ellipsoid, sometimes enlarged in the middle part, with slightly truncate ends, violet, smooth, or with 1 crack, $16.1\text{--}16.4 \times 7.2\text{--}8.0 \mu\text{m}$. Paraphyses filamentous, simple or branched, septate, in upper part with yellow contents, $2.8\text{--}3.2 \mu\text{m}$ in diameter at the tips (Fig. 7, a).

Note: *S. truncatus* is recorded at present from 10 countries of Europe, Asia, North and South America. Therefore, it is rather a common species. Scanty data on this fungus are due to minute dimensions of fruit bodies and rare occurrence in nature.

Saccobolus verrucisporus Brumm. Pärnu district, Kilingi-Nõmme, on dung of deer, Apr. 1, 1986, coll. M. Saar; Tartu district, Kaagvere, on dung of sheep; March 28, 1986, coll. M. Saar; Valga district, Lüllemäe, on dung of sheep, Sept. 9, 1986, coll. V. Prokhorov.

Apothecia solitary or gregarious, sessile, subglobular, shortly cylindrical, pale violet when young, then becoming whitish with a violet shade, 0.075–0.175 mm in diameter. Ectal excipulum of textura globulosa-angularis, often reduced to small basal part. Asci broadly clavate, generally with truncated apex, narrowed into short stalk, ascus wall becoming blue in Melzer reagent, $(59.4\text{--})80.3\text{--}120.0 \times 17.7\text{--}24.1 \mu\text{m}$. Spore clusters compact, arranged according to pattern II or III, $33.7\text{--}40.2 \times 12.8\text{--}14.8 \mu\text{m}$, with 1–2 unilateral caps of slime. Spores fusiform-ellipsoid, deeply violet or brownish-violet, ornamented by quite large and coarsely distributed warts, $13.9\text{--}15.4 \times 6.4\text{--}6.7 \mu\text{m}$. Paraphyses slender, filamentous, branched, not enlarged upwards, $3.2\text{--}3.7 \mu\text{m}$ in diameter, hyaline (Fig. 7, b).

Note: *S. verrucisporus* was described by J. van Brummelen (1967) from New Guinea. It is recorded at present from India (Kaushal, Viridi, 1986), Japan (Minoura, Yamada, 1976), Venezuela (Jeng, Krug, 1977) and Czechoslovakia (Svrček, 1981) and Poland (Chmiel, 1981). This species is probably more widely distributed than it is reported.

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PEREKONNAD ASCOBOLUS JA SACCOBOLUS EESTIS

Aastail 1959—1987 Eesti eri osadest kogutud rohusööjate loomade väljaheidete proovides, mida hoitakse ENSV TA Zooloogia ja Botaanika Instituudi herbaariumis ja samuti autori poolt kogutud ja laboratooriumis inkubeeritud proovides määrati kokku 15 liiki koprotroofseid liudseeni sugukonnast *Ascobolaceae*, nendest 9 liiki perekonnast *Ascobolus* ja 6 liiki perekonnast *Saccobolus*. Liigid *Ascobolus degluptus*, *Saccobolus minimus* ja *S. saccoboloides* on leitud esmakordselt Nõukogude Liidus. 7 liiki — *Ascobolus albidus*, *A. brassicae*, *A. sacchariferus*, *A. stictoides*, *A. viridis*, *Saccobolus truncatus*, *S. verrucisporus* on esmasleitud Eestis.

Владимир ПРОХОРОВ

РОДЫ ASCOBOLUS И SACCOBOLUS В ЭСТОНИИ

Исследование образцов помета травоядных животных, собранных в период с 1959 по 1987 г. в разных районах Эстонии (хранятся в гербарии ИЗБ АН ЭССР), позволило идентифицировать 15 видов копротрофных дискомицетов семейства *Ascobolaceae*. Среди них 9 видов относятся к роду *Ascobolus* и 6 видов — к роду *Saccobolus*. Впервые найдены в СССР такие виды как *A. degluptus*, *S. minimus*, *S. saccoboloides*.

Другие 7 видов — *A. albidus*, *A. brassicae*, *A. sacchariferus*, *A. stictoides*, *A. viridis*, *S. truncatus*, *S. verrucisporus* описаны для Эстонии впервые, но для других регионов страны — уже ранее. Остальные виды являются обычными и достаточно широко распространенными в мире.