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SOME SPECIES OF *ASPERGILLUS* FROM YUGOSLAVIA. I.

In this paper, the first of a series on molds from Yugoslavia, we describe 15 species of *Aspergillus*, one of them new to science. These have been isolated from the air, from soil, from decaying products and as contaminants of established cultures. Although many of these species have a world wide distribution and some of them have been studied in Yugoslavia (Stević 1952, Blinc & Koželj 1954, Blinc & Johanides 1956), their variability, which is worthy of note and which can cause confusion in identification, has led us to publish this study. We have described the morphological characteristics of the forms isolated here and the most outstanding properties of these molds which are of such a great importance in industry, economic botany, physiology and biochemistry, clinical microbiology, genetics and many other biological branches.

We propose a new species, **Aspergillus aureolatus,** Munt. — Cvet. & Bata, which was isolated from the air in Belgrade, and which belongs to the non-ascosporic members of the *A. nidulans* group.

The following list present the species here studied, the number of isolates of each one, and their source.

MATERIAL AND METHODS

Three culture media have been used in our study:
Czapek's solution agar + 30% sucrose
Potato Dextrose Agar (PDA)
White's solution agar
All the cultures have been incubated at 25° C.

When grouping the species encountered, we have followed Thom & Church (1945). As for the colors, we have used the Pavlovsky's »Dezimal-Buntskala« (Paclt, 1958) for the description of all the known species, and the »Dictionary of Color« by Maerz & Paul (1950) for the description of the new species *Aspergillus aureolatus* Munt.-Cvet. & Bata.

Group	Species	№ isolates	Source
Clavatus	*A. clavatus* Desm.	1	air
Glaucus	*A. repens* (Cda.) D By	9	air
		1	cartoon
		3	cork
		1	jam
		1	stewed cherries
	A. amstelodami (Mang.) Thom & Church	1	air
	A. umbrosus Bain & Sart.	2	air
		1	cork
	A. echinulatus (Delacr.) Thom & Church	4	air
Fumigatus	*A. fumigatus* Fres.	2	culture contaminant
		1	water chesnut fruit *(Trapa)*
		1	soil
Nidulans	*A. nidulans* (Eidam) Wint.	1	air
		1	cork
		1	iris leaf *(Iris)*
		1	stewed cherries
		1	water chesnut fruit *(Trapa)*
Versicolor	**A. aureolatus** n. sp.	1	air
	A. versicolor (Vuill.) Tirab.	10	air
		1	cork
		3	soil
		1	water chesnut fruit *(Trapa)*
Terreus	*A. terreus* Thom	1	air
		1	soil
Niger	*A. niger* van Tiegh.	2	air
		1	animal cage
		1	ivy leaf *(Hedera)*
		1	lèmons
		1	onion bulbs
		1	stewed cherries
		2	soil
Wentii	*A. wentii* Wehmer	2	maize grains
		2	soil
Flavus-oryzae	*A. oryzae* (Ahlb.) Cohn	1	air
	A. flavus Link	2	air
		1	pea seeds
		1	soil
		1	iris leaf
Ochraceus	*A. sulphureus* (Fres.) Thom & Church	3	air

ASPERGILLUS CLAVATUS Desm.

COLONIES

— On Czapek's solution agar + 30% sucrose: plane, with or without some floccose patches, characterised by the abundant erect conidiophores up to 3 mm in length bearing conidial heads pale olive when young, then grayish blue-green; reverse colorless or dull drab; odor foetid.

— On PDA: They follow the general pattern of those on Czapek's solution agar but the conidiophores are generally greater in length.

MICROSCOPICAL CHARACTERS

Conidial heads clavte, large, in age splitting into 2—3 or more divergent columns of compacted conidial chains. Conidiophores 1,5 — 3 mm in length, smooth, colorless, 20μ in diameter at the base, gradually enlarging up to 35μ at the entrance of the vesicle; vesicle clavate, up to 70μ wide by 220μ long; sterigmata in a single series, varying in size from 3,5——4,5 × 2—3μ at the base of the vesicle to 8—10μ and occasionally 12μ by 2,5—3μ at its apex; conidia elliptical, smooth, 3—4,5μ by 2,5—3μ.

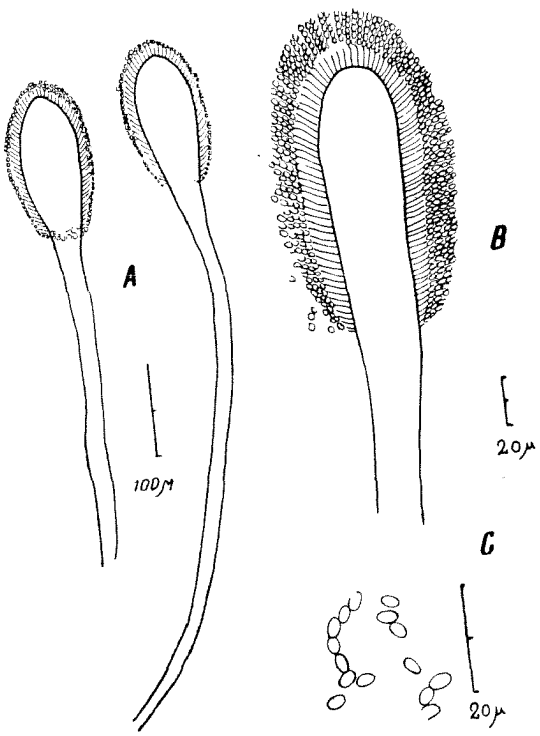

Fig. 1. *A. clavatus.* A: conidiophores; B: detail of the apex of a conidiophore; C. conidia. (From our culture N⁰ KO-UN-1).

SOURCE

Represented in our collection by cultures № KO-UN--1, isolated from the air, in Belgrade, in May 1963.

ECONOMIC IMPORTANCE

A. clavatus is capable of producing clavatin, a bactericidal substance which has been studied by W a k s m a n and coworkers (1942, 1943), and identified by H o o p e r and associates (1944) with patulin, a substance obtained from *Penicillium patulum.*

Wilson & Porter (1958), who studied the behaviour of the soil invader and plant pathogen *Verticillium albo-atrum*, reported that *A. clavatus* enhanced the expression of the disease caused by V. *albo-atrum* to Bonny Best tomatos.

ASPERGILLUS REPENS (Cda.) DBy

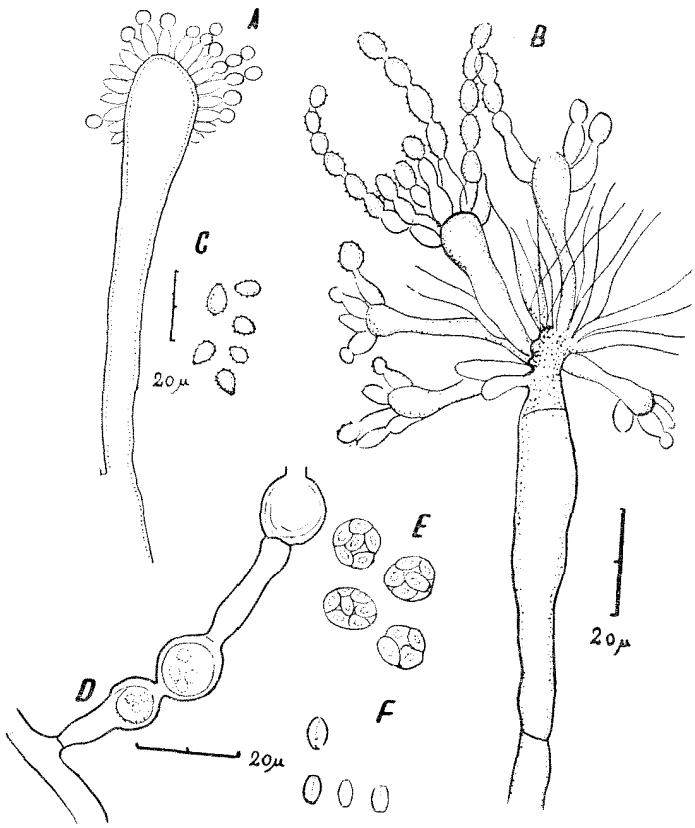

Fig. 2. *A. repens*. A: apical end of normal conidiophore showing the size and shape of the vesicle; B: proliferating head of a conidiophore, bearing small secondary heads; C. conidia; D: hyaline, inflated, intercalary cells, not rare in some preparations; E: asci; F. ascospores. (From our cultures N° 5W and 14W).

COLONIES

— On Czapek's solution agar + 30% sucrose: 20—25 mm diam. after two weeks of incubation at 25° C, plane, consisting of loosely woven hyphae enmeshing abundant yellow cleistothecia which can be seen with the naked eye, and abundant conidial heads in yellow-green shades (dark yellow-green, greenish olivaceous, etc.); reverse at first in yellow-green

shades (dark yellow-green and dark greenish), then olivaceous, olivaceous grey, brown olivaceous and sooty; substratum discolored in brown shades.

On PDA: they follow the general pattern of those on Czapek's solution agar but the growth is more abundant and floccose and very often has a narrow margin, whitish at the beginning then turning to yellowish or green-yellowish (pale yellow-greenish and pale lemon yellow); substratum discolored in orange-brown shades (sienna). Some strains (15-A-58) when growing on PDA always present, at the beginning, a blue-green color rather than the yellow-green one above mentioned.

MICROSCOPICAL CHARACTERS

Cleistothecia globose, 70-121 μ diam., subhyaline or very pale olivaceous when young, then olivaceous, finally brown-olivaceous; asci 10—11μ diam.; ascospores hyaline, like a double convex lens, 5—5,5 × 4 μ, smooth-walled, equatorial area rounded or somewhat flattened, without crests or ridges. Conidial heads abundant, consisting of diverging chains of conidia radiating from a hemispherical vesicular apex of the conidiophore; conidiophores 230—700 μ long, 3,5—6,5 μ wide at the foot, enlarging to 13 μ at the base of the vesicle, smooth-walled, subhyaline at the foot, increasing color upwards and being medium olivaceous at the apex (orange-brown or brown-olivaceous in one month old cultures on White's solution agar), sparsely septate; vesicle subglobose but wery often not well differentiated, mere broadening of the end of the conidiophore, up to 22 μ in diam., subhyaline when young, then gray-olivaceous, branching frequently especially in some strains (14-W and 5-W) and then bearing several small heads; sterigmata in one series, 6,5—10 × 4 μ, not crowded; conidia elliptical, strawberry-like or subglobose, 5,5—8 × 5——6,5 μ, spinulose, greenish.

REMARKS

Thom & Raper (1945) give as synonyms of *A. repens* (Cda.) D By., *A. glaucus var. repens* Cda. 1842, *A. scheelei* Bain. & Sart. 1912, and *A. B* var. *scheelei* Bain. & Sart. 1912. Gilman (1959) give *A. proliferans* G. Smith 1943 as another synonym of *A. repens*.

As for the color of the colonies, the forms isolated here have the same color as described by Bainier & Sartory (1912) for *A. scheelei* (»couleur verte qui brunit un peu à la fin de la culture«); the orange-yellow color repeatedly described in *A. repens* and *A. proliferans* by Thom & Raper (1945), G. Smith (1943), and Gilman (1959) has never been observed in our colonies.

As for the conidiophores, which are described as colorless in *A. repens*, they have been repeatedly observed pigmented (orange-brown and brown-olivaceous) in our cultures.

The zonate arrangement of conidial heads, which is given as a character for typical cultures of *A. repens* (Thom & Raper, 1945), has

never been seen in our isolates, nor have we seen such long conidiophores (up to 1000 μ) described for this species. Vesicles have been reported 25–40 μ wide, but in our cultures they are up to 22 μ in diam. In this respect our specimens are more like *A. dierckxii* Biourge, which produces colonies showing no zonate arrangement of conidial heads, shorter conidiophores than in typical *A. repens*, and little or no red color in the colonies or in reverse, and which Thom & Raper (1945) consider to be a strain of *A. repens*.

The proliferating character has been observed in almost all the isolates, and it is especially remarkable in some (14-W, 5-W, 6-W). This character and the shape of the vesicles make our cultures very similar to *A. proliferans* G. Smith 1943, given by Gilman (1959) as a synonym of *A. repens*. Our cultures ressemble *A. proliferans* in yet another character: on Czapek's solution agar + 30% sucrose they grow rather slowly (colonies of *A. repens* on this media are described as spreading broadly and rapidly). The characters of »sporing tardily« and »perithecia not found« described by G. Smith in *A. proliferans* do not agree with the forms studied here.

SOURCE

Represented in our collection by cultures N⁰ 5-W, 6-W, 7-W, 14-W, 20-P, 105-W, 15-A-58 isolated from the air (Oct. 1962); 3-F-3 from a jam made from figs (Mart 1963); ZAP-25 and ZAP-92 from cork (April 1963); TER-1 from a cartoon (May 1963); VIS-7 from stewed cherries (Nov. 1963).

ECONOMIC IMPORTANCE

This species is extremely abundant in nature and lives under all sorts of conditions. As all the members of this group, heralds incipient spoilage, and its presence is evidence of the earliest stages of decomposition. It can be found in sweetened and salted products, dried foods and other concentrated substrata; upon manufactured leather, clothing and textiles, soft wood, cork, etc., stored in moist atmospheres.

Papavizas & Christensen (1957) have studied the effect of invasion by *A. repens* upon germination of wheat seed and upon development of sick wheat.

A. repens has also been occasionally reported as fruiting in the external canal of the human ear.

ASPERGILLUS AMSTELODAMI (Mangin) Thom & Church

COLONIES

— On Czapek's solution agar + 30% sucrose: plane, bright yellow in color from abundant cleistothecia, and dark green due to conidial production which appears abundant in the center of the colonies or unevenly

scattered over some sections; reverse repeating of the colors on the srface; substratum discolored in brownish shades, greenish-yellow and even pinkish.

— On PDA they follow the general pattern of those on Czapek's solution agar with some minor differences: conidial areas light bluegreen in color during the first days, intermingled with the lemon-yellow of the perithecial stage, turning dull in age; reverse yellow or greenish at the beginning, purplish-brown in old cultures.

— On White's solution agar they mantain their characteristic yellow color with an occhraceus tinge after two months culture; the deep green conidial sections are very few and small; reverse and substratum purplish-brown.

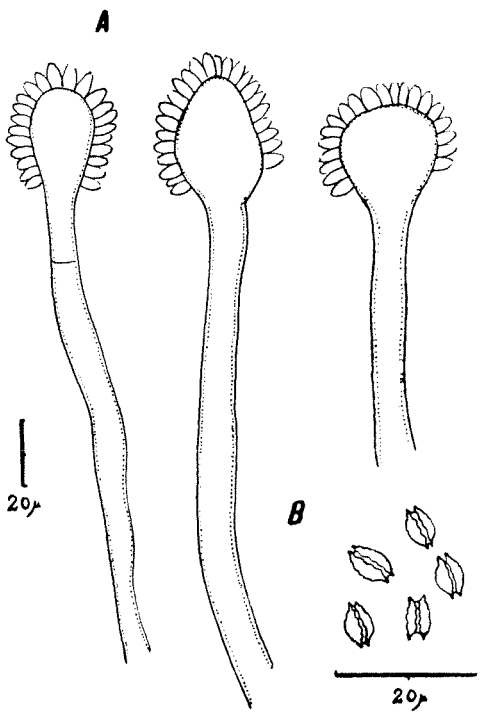

Fig. 3. *A. amstelodami.* A: apical end of the conidiophores showing different forms of vesicle and the disposition of sterigmata; B: ascospores. (From our strain 4W).

MICROSCOPICAL CHARACTERS

Cleistothecia very abundant and clustered in masses giving a characteristic appearance to the colony, globose to subglobose, 125—150 μ in diam., olivaceous, the outer layer brown-olivaceous when ripe; asci 10—12 μ, 8-spored; ascospores hyaline, 5—5,5 × 4—4,5 μ, like a double convex lens, with a V-shaped longitudinal furrow and broad irregular ridges, walls roughened over the entire surfaces. Conidial heads radiate-columnar; conidiophores 250—350 μ long, colorless to pale yel'ow-green and 5—8 μ wide at the base, increasing color and diameter upwards up to 10—12 μ below the vesicle, smooth-walled, sparsely septate; vesicle subglobose, 18—25 μ in diam.; sterigmata in one series, about 6 × 2,5 — 3,5 μ; conidia subglobose, 3,5—5 μ in diam., finely spinulose.

SOURCE

Represented in our collection by cultures № 4W, isolated as contaminants in the series of tests with *Acer sp.* tissue cultures on Whites's solution agar made in this Institute.

ECONOMIC IMPORTANCE

A. amstelodami occurs in different materials stored in moist atmospheres. Among the studies concerning to this problem we will refer those of Papavizas & Christensen (1960), who have investigated the damages caused in stored grains by the invasion of *A. amstelodami* and other species of the *A. glaucus* group, damages evaluated by reduction in germination and increase in discolored germs in wheat.

In the field of medical microbiology, *A. amstelodami* has been reported by Fonseca (1930) in Brazil from a case of mycetoma of the foot.

ASPERGILLUS UMBROSUS Bain. & Sart.

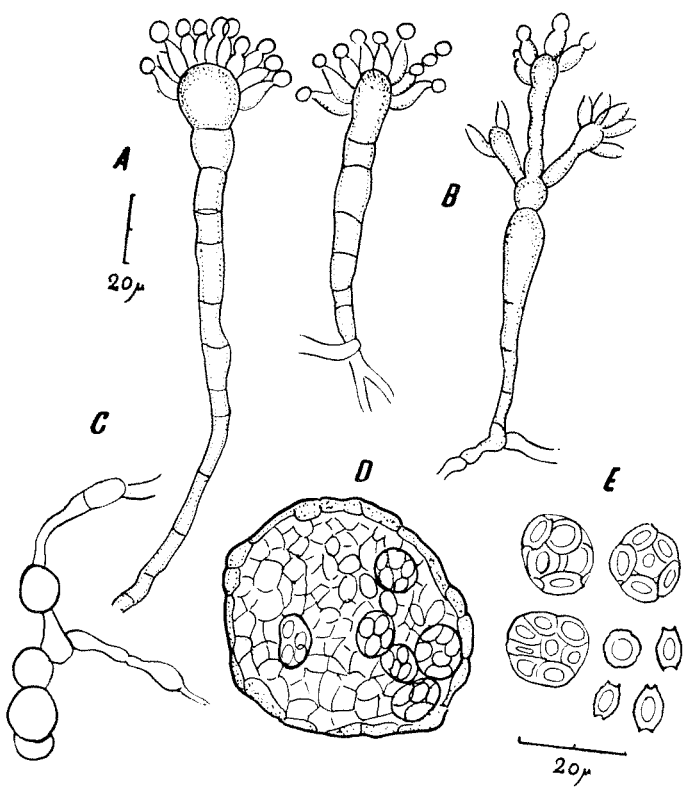

Fig. 4. *A. umbrosus*. A and B: conidiophores; C: hyaline, inflated, intercalary cells seen in some preparations; D: cleistothecia; E: asci and ascospores (From our strain 9W).

COLONIES

— On Czapek's solution agar + 30% sucrose: very restricted, plane, spreading irregularly, predominantly vinaceous-red to orange-brown in

color, with some green conidial areas and a flesh-colored margin finally brown; reverse in red-brown shades.

— On PDA: restricted, greenish during the first 8 days, then turning to flesh color and to orange, finally brown.

MICROSCOPICAL CHARACTERS

Cleistothecia globose, embedded in a felt of sterile red-encrusted hyphae on the agar surface, orange or orange-yellow in color (saffron yellow), 80—180 μ but mostly 100 μ in diam.; asci 12—16,5 μ in diam., 8-spored; ascospores double lens-shaped, 7,5—8 × 5—5,2 μ, with a shallow longitudinal furrow, finely roughened to smooth, very hard to get out of the ascus. Conidial heads radiate, compact; conidiophores commonly short, 100—200 μ long, by 3—4 μ wide at the base and gradually broadening to a vesicular apex of up to 18 μ wide, colorless to olivaceous, sometimes orange-brown with the pigment irregularly distributed (in old cultures on White's solution agar), closely septate, septae conspicuous, 8—30 μ between septae; vesicle in general not well differentiated from the stalk; sterigmata in one series, 10—12 × 3—4—(5) μ, commonly continuous but sometimes 1—2 septate or developping into secondary stalks bearing little heads; conidia elliptical, elliptical-truncate or subglobose, 6,5—7,5 × 5—5,5 μ, finely spinulose.

SOURCE

Represented in our collection by cultures № 9W and 96, isolated as contaminants in the series of tests with *Acer sp.* tissue cultures on White's solution agar made in this Institute, and № ZAP-21 isolated from cork.

ASPERGILLUS ECHINULATUS (Delacr.) Thom & Church

COLONIES

— On Czapek's solution agar + 30% sucrose: slow growing, plane, spreading irregularly, at the beginning white, then bluish-green (turquoise and bluish greenish) turning to bottle green (dark greenish olivaceous) in 8 days; after 10 days the green color disappears and is replaced by rusty and maroon shades (rusty and chesnut) which fade toward the margins of the colony; finally the whole growth becomes very deep brown, almost black; reverse brown or very deep brown (sienna and sepia); substratum discolored in cinnamon and brown shades, finally very dark.

— On PDA: they follow the general pattern of those on Czapek's solution agar, but growing better and often presenting in 12 days a striking zonate appearance: orange in the center (saffron yellow), then a deep olivaceous (dark greenish and iron gray) ring, followed by another one orange-yellow (apricot) in color, the whole colony surrounded by a white margin.

PDA agar-slant cultures present in 21 days the top of the slope covered with a deep olivaceous-green production of conidia, and with yellow cleistothecia which can be seen with the naked eye.

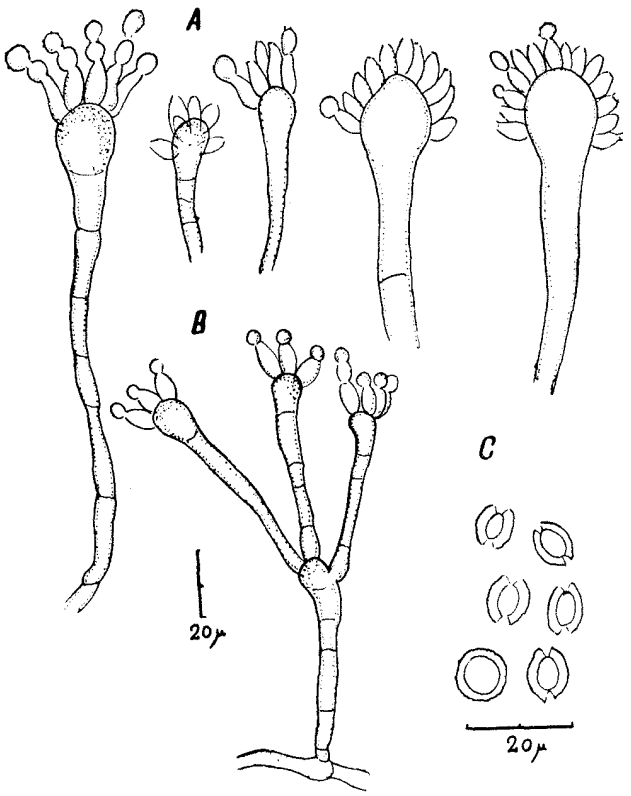

Fig. 5. *A. echinulatus.* A: apical end of conidiophores showing different size and shape of vesicles and the disposition of sterigmata; B: a proliferating head; C: ascospores. (From our strain 10W).

MICROSCOPICAL CHARACTERS

Cleistothecia globose, 77—115 μ diam., yellow, olivaceous or brick-colored, abundant, beginning its formation in 8 days; asci 18—20 μ in diam., in 15 days old cultures on PDA completely formed in some cleistothecia but not yet free, not yet formed in others, ripening in 20 days; ascospores like a double convex lens, with a broad longitudinal furrow, ridges prominent and irregular, slightly rough when observed under oil immersion, 8—10 × 6,5 μ. Conidial heads radiate, consisting of relatively few, divergent chains of conidia; conidiophores up to 250 μ long in our cultures (reported 700—800 μ in length), 5—7,5 μ wide at the base, enlarging gra-

dually upwards up to 12,5 μ below the vesicular apex, or up to 17,5 μ and bearing the sterigmata at the top without forming a real vesicle, smooth-walled, subhyaline or greenish when young then olivaceous or brownish with the pigment irregularly distributed in old cultures, continuous or septate, the septa being sometimes very close (10—15 μ between septa) in the whole length of the conidiophore or in some sections only; vesicle obconical—truncate with a hemispherical apex, very often indistinguishable from the conidiophore, up to 25 μ wide (reported 25—35 μ in diam.); sterigmata in one series, mostly 10 × 5 μ but varying from 7—17 × 3,5—5 μ, not crowded, hyaline when young, then pigmented like the vesicle; conidia globose, subelliptical or strawberry-like, with the base truncate and the disjunctor plainly visible, 6—11 × 5—6 μ but most frequently 7,5 × 5,5 μ, membrane thick and conspicuously spinulose, greenish or pale olivaceous.

REMARKS

By the characters of their ascospores the cultures above mentioned belong to the »large-spored« series of the *Aspergillus glaucus* group (Thom & Raper, 1945). By their characters in general (ornamentation of the ascospores, dimension of conidiophores, vesicle, etc.) they are close to *Eurotium verruculosum* Vuill. 1918. This species and *A. brunneus* Vuill. 1918 have been considered by Thom & Raper (1945) synonyms of *A. echinulatus* (Delacr.) Thom & Church (= *Eurotium echinulatum* Delacr. 1893). Although the forms isolated in this Laboratory differ in many respects from *A. echinulatus* (for instance, the ascospores of our strains are not »conspicuously roughened in the equatorial area« as stated in *A. echinulatus),* considering the variability of the group and assuming the authority of Thom & Raper we refer our material to this species.

SOURCE

Represented in our collection by cultures № 10-W1, 10-W2, 10-W3, and 10-W0, isolated as contaminants in the series of tests with *Acer sp.* tissue cultures on White's solution agar made in this Institute (October 1962).

ASPERGILLUS FUMIGATUS Fres.

COLONIES

— On Czapek's solution agar + 30% sucrose: spreading broadly over the substratum, from velvety to more or less floccose with varying amounts of tufted aerial mycelium, grayish-green; reverse dark green or dark bluish-green; substratum discolored in greenish-yellow and salmoneus shades.

— On PDA: they follow the general pattern of those on Czapek's solution agar, but the reverse of the colonies is colorless, and no pigments have been seen diffusing into the substratum.

MICROSCOPICAL CHARACTERS

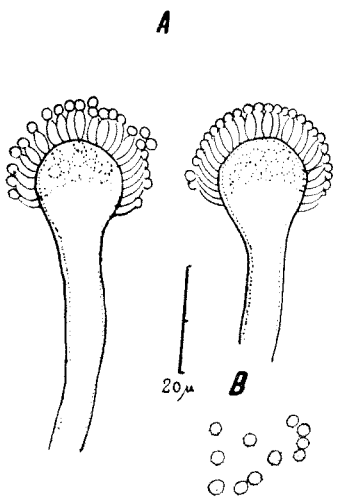

Fig. 6. *A. fumigatus*. A: apical end of conidiophores, showing the size and shape of the vesicle and the disposition of sterigmata; B: conidia. (From our strain HIG 1).

Conidial heads short columnar, compact; conidiophores short, smooth, smoky or pale gray-olivaceous in color, especially in the upper part, 2—3 μ wide at the base, gradually enlarging upward to 8 μ and passing almost imperceptibly into the apical flask-shaped vesicle; vesicle up to 20 μ in diam. in our material (Thom & Raper, 1945, report 20—30 μ), fertile on the upper half only; sterigmata in one series, crowded, closely packed, usually about 5—7 × 2,5 μ, with axes roughly parallel to the axis of the conidiophore; conidia dark green in mass, globose, echinulate, sometimes 2 μ but usually 2,5 μ in diameter.

SOURCE

Represented in our collection by cultures № TRA-28 isolated from a fruit of *Trapa* (June 1963); № HIG-1 and HIG-2 isolated in this Laboratory (April 1963) as persistent contaminants of special cultures in medical laboratories, and hence causing great losses and constituting a major problem; № 445 isolated from soil by Dr. Aleksandar Gelineo (Galenika Laboratories, Belgrade).

ECONOMIC IMPORTANCE

A. fumigatus is an important agent in many decomposition process, particularly at temperatures above 37° C. Growing successfully at 45—50° C, it is able to operate within a range where most fungi are excluded.

— It has been isolated from soil in many countries (Gilman, 1959).

— As a phytopathological mold, together with other microorganisms it has been found responsible for the destruction of the fibers of *Musa textilis* and of the cotton bolls during the storing period.

— In the field of clinical microbiology, an extensive literature indicates that *A. fumigatus* is pathogenic to man and animals, causing allergia,

asthma, characteristic lesions in the cornea, etc., and it is not therefore surprising that, isolated from different sources, it had been described under different names (*A. pulmonum hominis* Welcker 1857, *A. bronchialis* Blument. 1909, etc.).

Among the recent researchs and reports on medical pathology we will only mention those of Smith (1961) reporting the intracellular localization of conidia of *A. fumigatus* in bronchial washings; those of Goving & Hamlin (1960) reporting 5 cases of aspergillosis due to *A. fumigatus,* complicating Hogdkin's disease and leukaemia and involving lungs, stomach, brain and meninges, heart, kidneys, spleen, thyroid, and liver, and stating that *A. fumigatus* can produce toxic metabolites which are able to cause tissue necrosis and vascular damage. In Yugoslavia, Cestnik (1958) reported two cases suspected of tuberculosis which revealed, when operated, gray cystic masses, from which *A. fumigatus* was isolated.

In the field of veterinary we will refer some recent works: those of Sawamura (1960) demonstrating the formation of acute inflamatory or chronic lesions in the lungs of rabbits inoculated with living cultures of pathogenic strains of *A. fumigatus;* those of Herman et al. (1958) prooving the pathogenicity of *A. fumigatus* on chickens and ducklings; of Webb & Lionnet (1958) reporting a mortality of 19,3% and 75% in two breeding units of birds at the Maurice Isle; of Wright et al. (1962) stating an average of 9,8% dead embryos following the dusting of spores of *A. fumigatus* onto eggs at the eleventh day of incubation, etc.

— From *A. fumigatus* three substances have been isolated, named fumigatin, fumigacin and spinulosin, the two formers proved as powerful agents against various pathogenic bacteria (*Bacillus anthracis, Escherichia coli, Salmonella typhi-murinum Staphylococcus albus, S. aureus, Streptococcus viridans, Vibrio cholerae,* etc.). Both fumigatin and fumigacin have been found toxic to experimental animals. Tilden et al. (1961) reported the toxin of *A. fumigatus* as a powerful nephrotoxin causing characteristic necrosis of the kidney cortex in mice, and the fumigatus extracts having strong hemolytic and mild dermonecrotic properties.

In Yugoslavia, the antibiotic behaviour of *A. fumigatus* has been studied by Blinc & Johanides (1956), and recently by Todorović (1963), who has tested the antibiotic power of *A. fumigatus* against 30 different species of bacteria, fungi and actinomycetes isolated from soil, many of them being involved in the process of decomposing organic manures. As the result of this study Todorović states that in 43,3% of cases *A. fumigatus* demonstrate an antagonistic power against these organisms, but never against the root-nodule bacteria.

ASPERGILLUS NIDULANS (Eidam) Wint.

COLONIES

— On Czapek's solution agar + 30% sucrose: plane, spreading broadly, with a white or dirty white mycelial floccosity at the center, surrounded by a yellow-green area and a white spreading margin which

later on turns purely deep yellow or purely dark green; reverse dull drab or dull purple.

On Czapek's solution agar slants it is very evident an intense purplish pigment diffusing into the substratum, and a reddish or orange-red exudation collecting in big drops on the surface.

— On PDA: plane, dark yellowish green; reverse pale greenish-gray.

On PDA slants: reddish-orange pigment diffusing into the agar; minute yellowish drops on the surface.

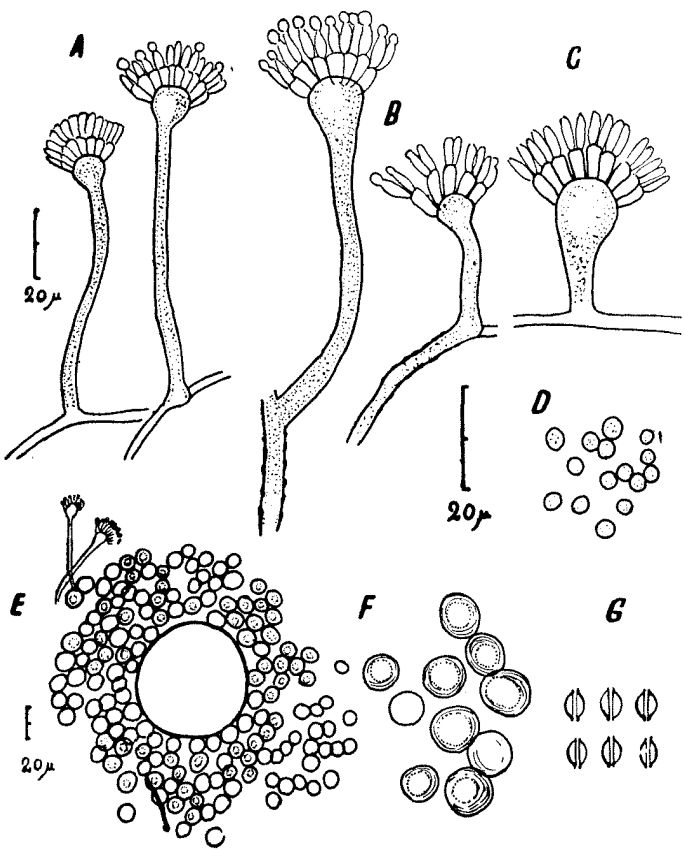

Fig. 7. *A. nidulans.* A: general aspect of the conidiophores; B: conidiophores under higher magnification showing some hyphae and the base of some conidiophores irregularly roughened; C: a very short conidiophore, not rare in some colonies; D: conidia; E: cleistothecia enveloped by a thick covering of hülle cells; F: hülle cells under higher magnification; G: ascospores. (From our culture SPR).

MICROSCOPICAL CHARACTERS

Conidial heads short columnar, yellow in their whole length or yellow at their basal half and yellow green at the apical one; conidiophores short, commonly 55—80 μ in length by 4 μ wide at the foot and 6 μ at the entrance of the vesicle, cinnamon or brownish in color, smooth-walled; vesicle hemispherical or globose and fertile at the upper half only, 9—14 μ in diam.; sterigmata in two series, greenish yellow, primary series 5—6 × 2—3 μ, secondary 5—6 × 2—2,5 μ; conidia globose, rugulose, 3—3,5 μ in diam., green in mass.

Cleistothecia are reported developing after the first few days, and asci breaking down quickly leaving the ascospores free. In our cultures cleistothecia began their formation after 15—20 days and ripened very slowly, giving the ascospores free after 20—40 days of cultivation on Czapek's solution agar + 30% sucrose. In many colonies cleistothecia were not abundant, appearing irregularly in the center of the colonies or in marginal areas. They developed within or upon the conidial layer, being globose, comonly 85—95 μ in diam. (reported 100—175 μ), yellowish to cinnamon colored, each one surrounded by a thick covering of hülle cells 10—15 μ in diam.; ascospores purple-red, lenticular, smooth-walled, with two equatorial crests, spore bodies about 4,5—5 × 3,5 μ, equatorial crests from 0,5—1,0 μ in width.

SOURCE

Represented in our collection by cultures №. SPR isolated from the air (April 1963); ZAP-12 from cork (April 1963); TRA-283 from a fruit of water chesnut (*Trapa*) (April 1963); GI-20 from an iris leaf (Sept. 1963).

ECONOMIC IMPORTANCE

A. nidulans has a significant role in decomposition processes. Some strains are pathogen to man producing onychomycosis and other diseases.

In biochemical and physiological studies, *A. nidulans* has been largely employed by several scientific workers, and recently by Loginova (1961), Nakumura (1961), Agnihotri (1961, 1962), Agnihotri & Mehrotra (1961), and many others.

A. nidulans has also been the object of ample researches in cytology and genetics (Elliot 1960, Garber et al. 1961, Apirion 1962, Leal & Villanueva 1962, Siddiqi 1962, Tector & Kafer 1962, etc., among the new published ones), an 8-chromosome map of *A. nidulans* having been given by Kafer (1958).

ASPERGILLUS AUREOLATUS n. s p.

During the course of our work in this Laboratory we have encountered a form, isolated from the air and labeled № 5-BKZ, which belongs to the *A. nidulans* group but whose characters do not coincide with any one of the species described in this group.

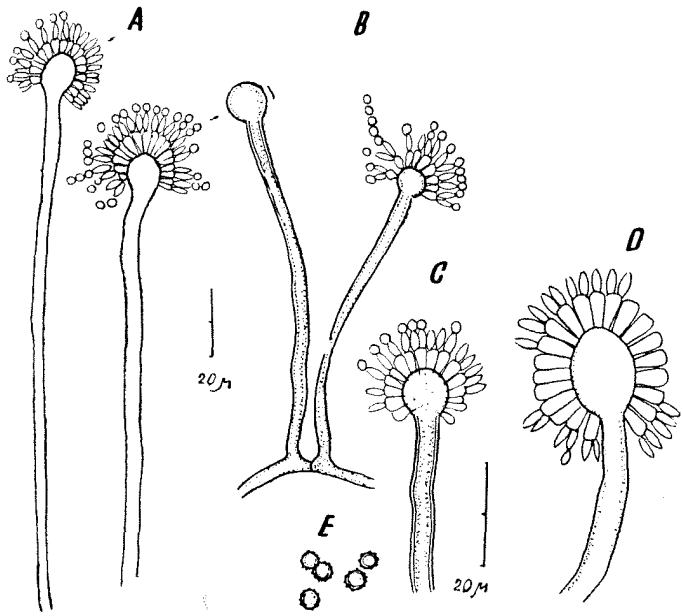

Fig. 8. *A. aureolatus.* A, B, C and D: conidiophores, vesicles and sterigmata; E: conidia. (From our culture 5-BKZ).

As *A. unguis* (Emile-Weil & Gaudin) Thom & Raper (1939), cultures № 5-BKZ do not produce cleistothecia nor hülle cells. But our cultures № 5-BKZ differ from *A. unguis* in some characters, the most outstanding of which are:

1) the color of the colonies, which in *A. unguis* becomes brown in age and in cultures № 5-BKZ remains grayish-green in all the mediums studied;

2) in the preparations of cultures № 5-BKZ we have never seen the »striking sterile, thick-walled hyphae with walls in brown shades, irregularly roughened, tapering to a blunt point, often up to 1.000 μ or more in length, slanting upwards or rising only slightly above the conidial area« which are characteristic for *A. unguis.*

Dr. Raper, who had the kindness to examine our cultures, agree with us in that our cultures №-BKZ have to be described as a new species. For this new species we propose the name of:

ASPERGILLUS AUREOLATUS Munt. Cvet & Bata

Coloniae in agaro Czapekii lente crescentes, planae, velutinae, viridogrisae, deinde saepe partim lutae vel ochraceae factae, cum margine indefinita vel lobata, aliquando circundata corona crocea; mycelium vegetati-

vum saepissime submersum, facie obversa virido-grisea tum lutea, tum crocea vel ferruginea.

Capitula conidialia juvenilia radiata, matura in columnarum formis, saepe in columnas divergentia, virido-grisea vel ochracea; conidiophoris erectis, brevibus, plerumque 100—137 × 5—6 μ, glabris, castaneis; vesiculis globosis 9—12,5μ in diametro, vel ovatis 12,5 × 16μ, totis fertilibus; sterigmatibus in series duas crescentibus, primariis 4,5—8 × 2—4μ, secundariis 4—6 × 2μ; conidiis globosis vel subglobosis, plerumque 3—4μ in diametro, virido-griseis vel flavo-virentibus, spinulosis.

COLONIES

— On Czapek's solution agar + 30% sucrose: slow growing, surface plane, mostly consisting of conidiophores which arise directly from the substratum and support conidial head grayish-green (»Fir« green to »Yew« or »Brewster green«*) in color; when the colonies get older, the conidial heads instead of being grayish-green may be yellow or ochraceous (»Yellow ochre« to »Orange rufous«), this color occupying only some parts of the colonies, specially the margins; margins thin and indefinite to lobate, not rarely, in a complet developped colony, separated from the central part (of about 7 mm in diam.) by a ring up to 1 mm wide; the whole coiony commonly surrounded by a more or less intense halo of immersed hyphae, »Saffron yellow«, »Orange rufous« to »Orange peel« in color; reverse of the colonies colorless or pale greenish-gray at first, with a narrow or an incomplete yellow margin which later on becomes orange-yellow, orange, and russet brown.

— On PDA: compact, more or less convex, or with the central area more prominent and with a tendency to split, tendency which is very strong when the medium is abundant; grayish yellow-green (»Yew green« to »Cedar green«) in color; margin white, cobweby, very deep and even arborescent in age; surrounded by an striking and irregular zone orange or reddish-orange (»Orange peel« to »Chrome orange«) in color; reverse reddish-orange, becoming darker and almost brown in age. In six weeks old cultures on PDA slants abundant exudate amber to purplish-brown (near »Nomad brown« and »Leaf mold«) in color.

— On Malt agar: plane to more or less convex and more or less furrowed, in several shades of grayish green and grayish yellow-green (»Fir«, »Yew green«, Holly green«, »Reseda«), commonly showing a zonate aspect, with a tendency to split in central areas and even radially near the margins when grown on abundant medium; margins lobate and even arborescent, surrounded by an irregular zone orange or reddish-orange in color of immersed hyphae; reverse dark dull green and dull orange.

The epithet *aureolatus* has been chosen on account of the striking orange halo which commonly surrounds the colonies, specially when grown on abundant substratum.

*) Maerz & Paul (1950), »A Dictionary of Color«.

MICROSCOPICAL CHARACTERS

Conidial heads radiate when young, becoming columnar (short columnar, but in old agar slant cultures the conidial chains may be rather long and may even split); conidiophores short, 100—137 × 5—6 μ, cylindrical, brown, walls firm, thick, smooth; vesicle globose 9—12,5 μ in diameter, to ovate 12,5 × 16 μ, brownish or cinnamon in color, fertile over the entire surface, sterigmata in two series, primary 4,5—8 × 2—4 μ, secondary 4—6 × 2 μ; conidia globose to subglobose, spinulose, intensely yellow-green in the green areas, yellowish in the yellow ones, mostly 3—4 μ in diameter.

SOURCE

Represented in our collection by cultures № 5-BKZ isolated from the air in Belgrade, in January 1963. Type deposited at this Institute.

ASPERGILLUS VERSICOLOR (Vuill.) Tirab

COLONIES

— On Czapek's solution agar + 30% sucrose: rather slow growing, compact or velvety, at first white, passing through shades of yellow, orange-yellow, tan, to yellowish-green shades, some strains with the green colors almost or completely lacking; reverse and substratum rarely colorless, mostly passing through shades of yellow to orange, rose, purple-red or red, in some strains particularly intense.

On Czapek's solution agar slants: abundant guttulation pinkish or amber in color.

— On PDA: they follow the general pattern of those on Czapek's solution agar but they are slightly more floccose, larger and convex; reverse terra-cotta, rusty and sienna; substratum discolored in the same shades.

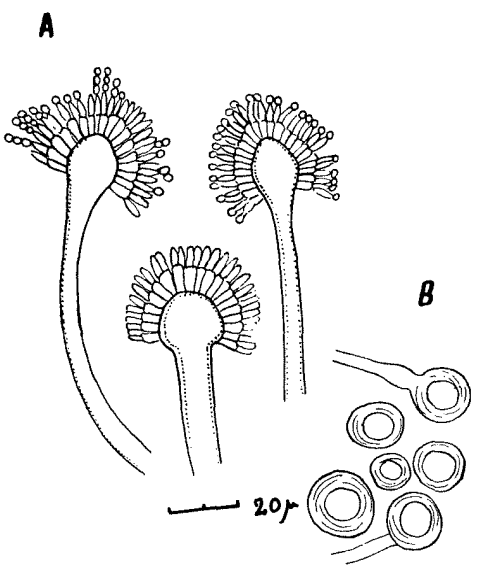

Fig. 9. *A. versicolor*. A: apical end of the conidiophores; B: hülle cells. (From our culture ZAP 9).

MICROSCOPICAL CHARACTERS

Conidial heads roughly hemispherical, radiate; conidiophores mostly 300—400 μ long, 4,5—6 μ wide, cylindrical, walls smooth, thick (1,2—1,5 μ), colorless; vesicle globose, 13—17,5 μ in diam., fertile area hemispherical passing almost imperceptibly into the funnel-like enlar-

ged apex of the conidiophore; sterigmata crowded, in two series, primary 5—6,6 μ long (reported comonly 8—10 μ), secondary 4,8—5 μ long (reported 5—10 μ); conidia globose, greenish, delicately echinulate, mostly 3 μ in diam.

SOURCE

This species has appeared, together with *A. repens,* as the most frequent air-borne contaminant of different cultures in several laboratories, and as a mold isolated from various sources. Represented in our collection by cultures № 11 W, 13 W, 192, 15 M 57, 2311, 11 OR, PO 28, SP, BL 34 isolated from the air; № ZAP 9 from cork, and which do not produces any pigment in the reverse of the colony neither diffusing into the agar; № TRA 281 from a fruit of *Trapa;* 2 D—E 4, 660 and 706 isolated from soil by Dr. Aleksandar Gelineo (Galenika Laboratories).

ECONOMIC IMPORTANCE

Widely distributed in soil, spoiling and drying food stuffs, cereals, dried meats, vegetable products, etc. Reported as capable of decomposing certain paraffins (Hopkins & Chibnall, 1932), and effective in its aggregating influence in soils (Martin, Ervin & Shepherd, 1959).

ASPERGILLUS TERREUS Thom

COLONIES

On Czapek's solution agar + 30% sucrose: plane, velvety, showing tendency toward white floccosity in central colony areas, sporing throughout or in the marginal areas only in chestnut shades; pale amber exudate present or not; reverse in dull orange-yellow to orange-brown.

— On PDA: growing and sporulating more abudantly than on Czapek's solution agar.

MICROSCOPICAL CHARACTERS

Conidial heads long columnar, compact, chestnut or sepia in color; conidiophores about 200—250 μ in length by 4,5—6 μ in diam., more or less flexuous, smooth, colorless; vesicles hemispherical, mostly 12 μ wide, fertile in the upper half only; sterigmata in two series, roughly parallel to the main axis of the conidiophore, primaries crowded, 6 × 2 μ, secondaries 5,5 × 1,5 μ; conidia globose, 2 μ in diam.

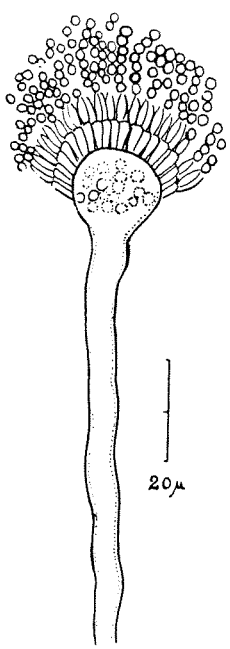

Fig. 10. *A. terreus.*

REMARKS

A culture obtained through the kindness of Dr. Aleksandar Gelineo (Galenika Laboratories of Belgrade), isolated from the soil and labelled № ZOK-2, has shown colonies and conidial apparatus which differ from the species in some particulars:

— The mycelium is white, yellowish to dull yellow and hence presents an intermediate character between typical. *A. terreus* and *A. terreus* var. *aureus*.

— Substratum is strongly discolored in deep yellow or orange-yellow shades.

— Conidial structures are produced after 8—10 days of incubation, and they are paler in color than in typical species of *A. terreus*.

— Conidiophores are longer (100—250 μ in *A. terreus*, 280—380 μ in the strain here discussed), and vesicles somewhat larger (10—16 μ in *A. terreus*, 14—18 μ in this strain).

SOURCE

Represented in our collection by cultures № ZOK-2 isolated from soil, № NO-4241 from the air, and by cultures № 4219 obtained from the Institut für Mikrobiologie of Göttingen.

ECONOMIC IMPORTANCE

A. terreus occurs on a great variety of materials useful to man not adequately protected from excessive moisture. It can be found widespread in warm arable soils, less commonly in forest, rarely in acid forest soils from the colder temperate zone (Thom & Raper, 1945).

As a pathological agent, *A. terreus* has been reported by Tandon & Bhatnagar (1958) producing a storage rot of apples, infections taking place through injury or through calyx and stem end of fruits.

— In the field of biochemistry, *A. terreus* has been the object of many investigations on account of the ability of certain strains to produce itaconic acid from sugars.

Studies of terreic acid produced by *A. terreus* and its activity as an anti-HeLa substance were published two years ago by Takahashi and collaborators (1961).

— In the field of antibiotism, Blinc & Johanides (1956), in Yugoslavia, found a strain of *A. terreus* producing citrinin.

On account of the interesting activity of this mold, analysis of the chemical composition of its mycelium have been attempted, and related to this subject we will mention the works of Lahoz & Rodriguez (1961).

ASPERGILLUS NIGER van Tieghem

COLONIES

— On Czapek's solution agar + 30% sucrose: rapidly growing, mycelium scanty to abudant and from colorless to yellow or with an ochraceous tinge, in some strains the aerial mycelium is very compact giving a characteristic aspect to the colony during the first days, in some other strains very scantily produced; conidial heads large, fuscous, deep olive, olivaceous-brown to blackish-brown; reverse white, yellowish, greenish-yellow or brownish-yellow, with yellow pigment sometimes very intense and diffusing into the agar.

— On PDA: they follow the general pattern of those on Czapek's solution agar.

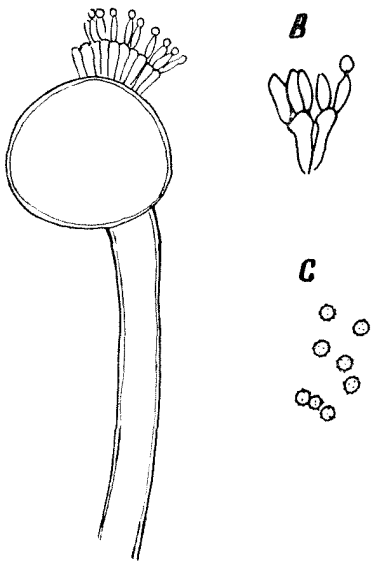

Fig. 11. *A. niger.* A: apical end of conidiophore; B: detail of the sterigmata; C: conidia. (From our strain N° VAZ 1).

MICROSCOPICAL CHARACTERS

Conidial heads typically globose, radiate; conidiophores mostly arising directly from the substratum, uncolored or yellow to brown near the vesicle only, smooth and thick-walled, unseptate or with occasional thin septa, varying greatly in length and diameter in different cultures and even in sections of the same colony (450—750×8—11 μ in most of our isolates); vesicle globose, thick-walled, up to 50 μ in diam., colorless or more or less intensely yellow-brown; sterigmata in one series in young colonies, but typically in two series, usually brownish, primary closely packed, covering the vesicle, usually 12—13 μ in length and 4,5—5 μ in diam., at the outer end (reported for this species 20—30 × 6—8 μ); secondary sterigmata usually 8—2, 5—3 μ (reported 6—10 × 2—3 μ); conidia globose, rough, mostly 4,5—5 μ in diam. (reported 2,5—4 μ, occasionally up to 5 μ).

Sclerotia not found in some strains; present in two isolates from soil: globose, superficial, at first white or buff, then pale buff salmon.

REMARKS

Among the isolates made in this Laboratory some variability has been observed in the aspect of the colonies, intensity of mycelial production, intensity of pigment in the hyphae, in the substratum and in the co-

nidial heads (sparse, crowded or in concentric zones), etc., but all this variations fall into the description of *A. niger*. What is more strikingly different in some of our isolates is the measurements of the primary sterigmata, much smaller than in van Tieghem's species. Because of the great variability of the group and the short time that we have been studying this isolates we have not desired to separate them from the main species.

SOURCE

Represented in our collection by cultures N⁰ VAZ-1 and ZE-26 isolated from the air (April and July 1963); STA-1 from an animal cage (Sept. 1963); HE-1 N from ivy leaves ((*Hedera*) (August 1963); LIAN-1 from lemons (Mart 1963); LUK-1 from onion bulbs (April 1963); VIS-1 from stewed cherries (Sept. 1963); 230 and 778 isolated from soil by Dr. Aleksandar Gelineo (Galenika Laboratories, Belgrade); № 4217 obtained from the Microbiological Institute of Göttingen.

ECONOMIC IMPORTANCE

World-wide in distribution, *A. niger* is well known in industry for its production of a variety of acids (gallic, citric, fumaric, gluconic, oxalic); in physiological studies because its production of fat materials, its nitrogen and phosphorus assimilation, the role of heavy metals in its nutrition, etc.; in genetics because its spontaneous or induced mutants; in different economical branches because it represents a common cause of mildew on exposed wood surfaces and cotton fabrics.

As a phytopathological agent it is responsable for the »black mold« of onions, very well known in some countries for the damages that it causes, and it contributes to the rotting of the citric fruits in storage. It has also been described as causing the »smut« of figs and an internal dry rot of the cotton bolls in California (Viennot-Bougin, 1949).

Although *A. niger* has been considered to be a non-cellulose-decomposing organism, Simpson & Marsh (1959) demonstrated the decomposition of the cotton fiber under certain conditions. Recently, Natour (1961) has studied a stem rotting disease of *Dracaena sanderiana* caused by a strain of *A. niger*.

A. niger has also been reported isolated from the external ear of man, from cases of otomycosis, as points of infection in the lungs, etc.

From soil it has been isolated in many countries (Gilman, 1959).

ASPERGILLUS WENTII Wehmer

COLONIES

— On Czapek's solution agar + 30% sucrose: growing rapidly, with loosely floccose aerial colorless or yellowish mycelium during the first 2—3 days, becoming then scanty and completely covered by crowded

large conidial heads, yellow, dull yellow, ochraceous to rusty and sienna in color; exudate abundant, amber or deep amber; reverse white at the beginning, becoming brownish or pinkish-brown after 12 days.

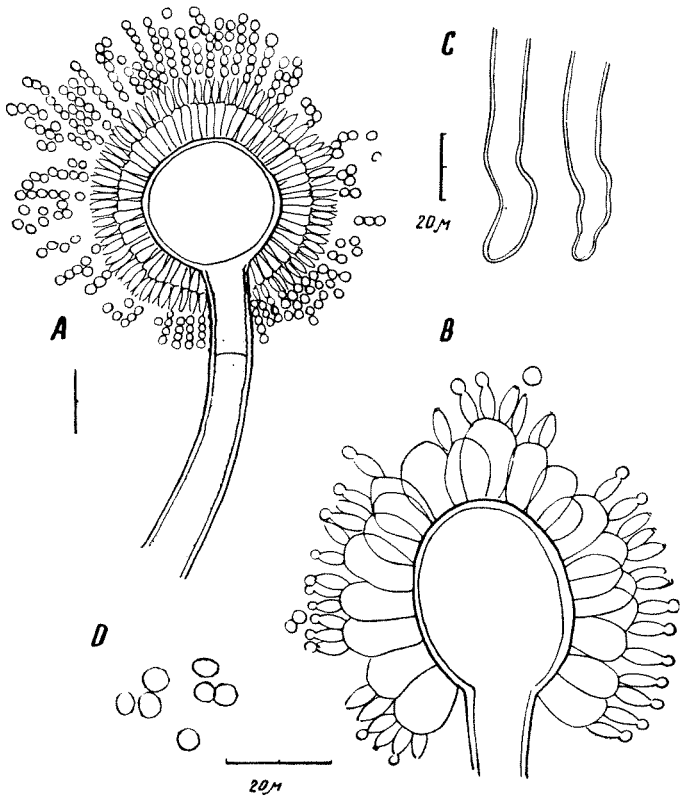

Fig. 12. *A. wentii.* A: typical conidial head; B: vesicle elliptical with primary series of sterigmata strikingly large; C. foot of conidiophores; D: conidia. (From our culture ZEA-3, 14 days on Czapek's sol. agar + 30% sucrose).

— On PDA: the color of the mycelium is more yellowish and the conidial heads olive-brown in the cultures that we have studied; substratum strongly discolored in yellow or lemon-yellow shades.

MICROSCOPICAL CHARACTERS

Conidial heads globose, radiate; conidiophores with walls thick, appearing smooth but someones showing rudimentary pits, pale, 10—13 μ in diam.; vesicle globose or somewhat elliptical, the long axis perpendicular or parallel to the axis of the conidiophore, mostly 40—45 μ in diam., or 30—50 × 40—60 μ when elliptical, fertile over the entire surface, thick-walled (2,5—3 μ in thickness); sterigamata in two series, primary

10—15 × 3—5 μ, but sometimes strikingly larger (13—15 × 8—10 μ), secondary 7 × 3—3,5 μ; conidia globose to elliptical, from smooth to very finely roughened.

Sclerotia were not found.

SOURCE

Represented in our collection by cultures N⁰ ZEA-3 and ZEA-33 isolated from grains of *Zea mays* (April 1963), and N⁰ 515 and 36—9 from soil (Dr. Aleksandar Gelineo, Galenika Laboratories, Belgrade, leg.).

ECONOMIC IMPORTANCE

Cosmopolitan and vigorous species with definite biochemical possibilities (Thom & Raper, 1945). In Orient it is used, together with some other species of *Aspergillus,* in the manufacture of various soy products. Some strains of this mold have been reported capable of producing citric and kojic acid. In Yugoslavia, Blinc & Johanides (1956) proved that in an *A. wentii* strain antibiotic activity was due to an unknown antibiotic, and not to the production of kojic acid as is usually reported for active *A. wentii* strains.

ASPERGILLUS ORYZAE (Ahlburg) Cohn

COLONIES

— On Czapek's solution agar + 30% sucrose: spreading rapidly, developing pale greenish-yellow or grayisy yellow-green colors with the production of ripening conidia, the green disappearing later and becoming olivaceous or gray-brown; reverse in the same shades and brownish at the central area.

— On PDA: following the general pattern of those on Czapek's solution agar but tending to be more floccose.

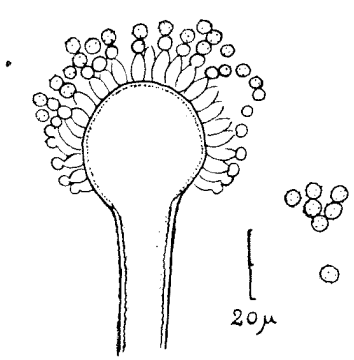

Fig. 13. *A. oryzae.*

MICROSCOPICAL CHARACTERS

Conidial heads predominantly large, abundant, globose, radiate; conidiophores about 2 mm long by 15 μ wide (reported 20—25 μ in diam.), definitely pitted or rough, colorless; vesicles globose to subglobose, 35—40 μ in diam.; sterigmata commonly in one series, 10—12 × 3—5 μ (reported up to 15—20 μ long); conidia more or less pyriform, 3—4 μ in diam., or 5—6 × 7—8 μ, rough.

No sclerotia found.

SOURCE

Isolated from time to time in this Laboratory, but at the moment represented in our collection by cultures № 4214 received from the Institut für Mikrobiologie of Göttingen.

ECONOMIC IMPORTANCE

Members of the *A. flavus-oryzae* group are interesting not only because their cosmopolitan distribution and variety of substrata upon which they are able to develop and live longtime (including soil, forage and cereals, leather, paper, textiles, human wastes, all kind of foods, dairy products, etc.), but also for a number of particulars which can be summarized as follows:

— Their capacity to produce abundantly diastatic and proteolytic enzymes, upon which are based in large measure the alcoholic and soy food industries of the Far East, as well as others in Orient and Occident, particularly the textile and tanning industries, the production of industrial alcohol, etc. This capacity being of great economic importance, genetical, physiological and biochemical studies regarding the ezymatic activity of these molds have been carried on by different investigators. Among the recent works on this field we find those of Kalashnikov & Lifshits (1961), Kalashnikov & Trainina (1961), Malkov & Deeva (1961), Tonomura et al. (1962), Searashi (1962), etc.

— Their capacity to produce kojic acid.

— Their presence in some pathogenic processes, records showing occasional infection of man by these molds being not rare. Among these records we can mention, as a very interesting one, that of Ziskind et al. (1958) reporting a case of a chronic granulomatous mass in the brain, whose material, obtained in a subsequent operation as well as from necropsy, revealed *A. oryaze.*

— The interest that they present in biochemical and genetical studies, and at this respect we can cite, among others, the works of Tatarenko et al. (1961).

ASPERGILLUS FLAVUS Link

COLONIES

— On Czapek's solution agar + 30% sucrose: spreading rapidly, with floccosity limited, greenish-olivaceous to dark greenish-olivaceous in color due to the conidial production, the green factor disappearing in age and leaving different shades of olivaceous-gray and olivaceous-brown; reverse gray-green and brown. In some strains the abudant production of dark sclerotia dominates the character of the colony and discolors the substratum in yellowish and dull pinkish or purplish-brown shades.

— On PDA: growing abundantly and following the general pattern of those on Czapek's solution agar.

MICROSCOPICAL CHARACTERS

Conidial heads small, with chains of conidia separate rather than adhering, from radiate to columnar; conidiophores 400—1000 μ long by 8—15 μ wide, hyaline, finely pitted to almost spiny, septate or not; vesicle dome-like to flask-shaped, 15—20 μ in diam. in small heads, 25—40 μ in the large ones; sterigmata in a single series in small heads and commonly 10 × 3 μ, or both single and double series in large vesicles; conidia globose, 3—5 μ, or elliptical to subglobose and 5—6 × 3—3,5μ, yellowish-green, from almost smooth to variously pitted or finely roughtened. Sclerotia, hen found, at first white, then brown, finally black, subglobose, 0,4—0,7 mm diam.

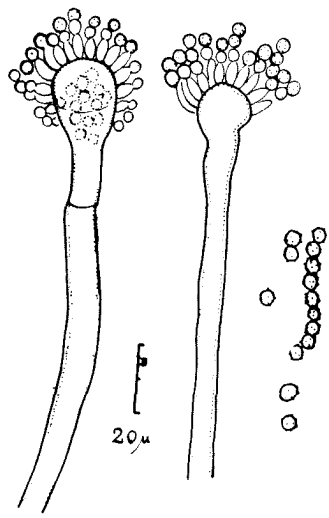

Fig. 14. *A. flavus*. A: conidiophores; B: conidies.

SOURCE

Represented in our collection by cultures № 4218 obtained from the Microbiological Institute of Göttingen; N. IR-IV isolated from an iris leaf associated with *Septoria breviuscula* (August 1963); N. 271, from pea seeds (Septem. 1963); N. 28-A isolated from soil by Dr. Aleksandar Gelineo (Galenika Laboratories, Belgrade). (Cultures N. IR-IV and 28-A develop abundant sclerotia; the other ones fail to produce these structures).

ECONOMIC IMPORTANCE

— In the field of economic botany, *A. flavus* is a component of the microflore of the soil and a heterotrophic producer of nitrate (Schmidt, 1960). An immunofluorescent staining method for detecting this mold has not long ago been stated by Schmidt & Bankole (1962).

— As a phytopathological agent, *A. flavus* has been found developping abundantly with other species on fruits of *Musa textilis* during the period of their germination, and later on causing the destruction of the fibers because of the action of the mold on the cellulose (Serrano, 1927). It also produces the destruction of the cotton fibers during the storing period of the bolls, and among the studies concerning to this problem we will mention those of Marsh & Taylor (1958). The studies by Durbin (1959) on albinism in citrus seedlings strongly indicate that *A. flavus*, under natural conditions, produces a metabolite which, when taken up by the germinating seed, inhibits chlorophyll biosynthesis.

— In the field of clinical microbiology, the presence of *A. flavus* in the human external ear, sputum, bird lungs, etc., has been reported. Kirschtein & Sidransky (1956) report a fatal mycotic endocarditis infection due to *A. flavus*. Occasional allergic reactions have been atributed to this fungus, and some fractions of *A. flavus* extracts have been shown, by the investigations of Smith & McKernan 1962), to have a hepatotoxic action.

In Yugoslavia, Liht & Vidaković (1956) while studying the allergic factors in Subotica, a region where the cases of allergy are extremely abundant, isolated from the walls of humid appatments several molds, among them *A. flavus,* and prooved through intracutaneous injections its allergic effects.

— *A. flavus* is also interesting in the field of industrial microbiology because it is capable of producing rutinase, a glycosidase that hydrolizes rutin to quercitin and rutinose (Hay, Westlake & Simpson, 1961).

— In the field of antibiosis *A. flavus* is known bacause of its ability to produce antibacterial substances: aspergillic and hydroaspergillic acid (the chemistry of this substances was investigated by Dutcher, 1958), and penicillin. In Yugoslavia, studies on the antibiotic activity of this mold have been undertaken by Blinc & Johanides (1956).

ASPERGILLUS SULPHUREUS (Fres) Thom & Church

COLONIES

— On Czapek's solution agar + 30% sucrose: growing well, plane, submerged and aerial mycelium whitish at the beginning, then salmon; conidial heads in pure yellow during the first three days, then with an ochraceous tinge and dominating the culture in 8 days; reverse colorless, pale lemon yellow and salmon. Sclerotia not found in 2 months old plate cultures, but not rare in the tube cultures.

On Czapek's solution agar slants: production of exudate amber in color; sclerotia appear in 30 days, from rare to abundant, pinkish, up

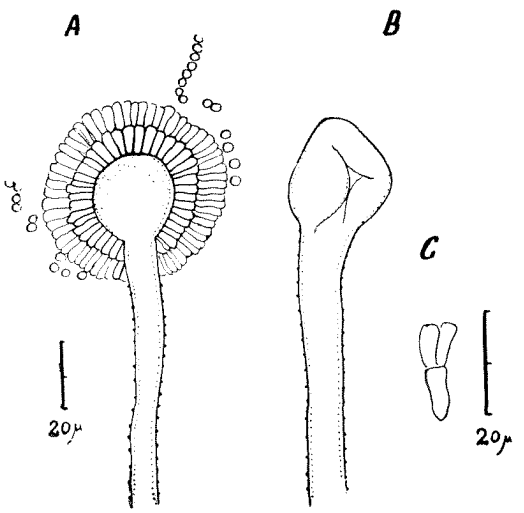

Fig. 15. *A. sulphureus.* A: apical end of a conidiophore; B: the same, showing crushed vesicle; C: detail of primary and secondary sterigmata under higher magnification. (From our strain 15 A 57).

to 1 mm in diam., not scattered over the whole growth but rather in zones, specially at the bottom of the tube, between the agar and the glass.

— On PDA: the colonies follow the general pattern of those on Czapek's solution agar, but the grow is more abundant Sclerotia present in 1 month old cultures, not abundant, as described above.

MICROSCOPICAL CHARACTERS

Conidial heads mostly globose; conidiophores 1.500—1.700 μ long by 7,5 μ at the foot, almost cylindrical but measuring nearly 9 μ at the base of the vesicle, firm walls, rough or pitted, uniformly pale yellow, sparsely septate; vesicle typically globose and fertile over the whole surface, 28 μ wide, fragile and easily crushed in mounting; sterigmata in two series, crowded, primary closely packed on the vesicular surface, 7,5—10 × 2,5 μ, secondary 6—7 × 2 μ; conidia globose, smooth, 2,5 μ, sometimes forming persistent long chains.

REMARKS

Thom & Raper (1945) report for this species »very short« conidiophores. In the isolates made in this Laboratory the conidiophores have always been observed as very long, ressembling in this respect Fressenius description of *A. sulphureus*.

SOURCE

Represented in our collection by cultures № 15A57 isolated as air-borne contaminants of different cultures in this Laboratory (November 1962); BI-16 and BI-20 isolated from the air (July 1963).

ECONOMIC IMPORTANCE

A. sulphureus is probably a common component of the microflore of decaying vegetation. It has been isolated from soil in the United States, Panama and India. It sometimes develops abundantly on the surface of fruits of *Musa textilis*.

Reports on the biochemical activity of this fungus are rare.

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All the isolates here discussed can be found at the Biological Institute of Belgrade, Plant Physiology Section (Laboratory Cultures Collection), and they are at the disposal of the laboratories interested in them.

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MARÍA MUNTAÑOLA-CVETKOVIĆ and JOVANKA BATA

Rezime

NEKE VRSTE *ASPERGILLUS* U JUGOSLAVIJI. I.

U ovom radu opisano je 15 vrsta *Aspergillus*, od kojih je jedna nova u nauci. Ove vrste su izolovane iz vazduha, zemlje, produkata koji trule i iz zagađenja postojećih kultura. Iako su mnoge od ovih vrsta veoma rasprostranjene u svetu, a neke od njih ispitivane i u Jugoslaviji (Stević 1952, Blinc & Koželj 1954, Blinc & Johanides 1956), njihova varijabilnost, na koju vredi ukazati i koja može da stvara zabunu pri identifikaciji, navela nas je da publikujemo ovu studiju. Ovde su opisane morfološke karakteristike forama izlovanih kod nas i najistaknutije osobine ovih gljiva koje imaju veliki značaj u industriji, ekonomskoj botanici, fiziologiji i biohemiji, kliničkoj mikrobiologiji, genetici i mnogim drugim biološkim granama.

Mi predlažemo novu vrstu, *Aspergillus aureolatus* Munt.-Cvet. & Bata. izolovanu iz vazduha u Beogradu, a koja pripada onim predstavnicima grupe *A. nidulans* koje ne razvijaju askospore.

Sve izolovane i ovde diskutovane forme nalaze se u Biološkom Institutu u Beogradu, Sekcija Fitofiziologija (Kolekcija laboratoriskih kultura) i stoje na raspolaganju laboratorijama koje se interesuju za njih.