جامعة جنوب الوادى
كلية العلوم بقنا
قسم علم النبات

KEY

For Identification OF Aspergillus& Penicillium And Other Genera

BY
Mycological Laboratory
Qena Univ. Faculty

Identification

K E Y T O GROUPS
Based primarily on morphology

I. sterigmata strictly uniseriate

A - C onidial heads clavate with spore masses splitting at maturity, in blue-green shades; vesicles strongly clavate ..... A- clavatus group

B. Conidial heads radiate to columnar, variable in color; vesicles variable, from globose or nearly so to subclavate or turbinate

1. Conidial heads radiate, variable in size, in bluish green or olive green shades (brown in one species); osmophilic bright yellow cleistothecia abundant in most species .. .. A. glaucus group

2. C onidial heads radiate to very loosely columnar, comparatively large, in grayish or yellowish green to olive-br shades; white to purplish or olive cleistothecia produced in three species ..... A. ornatus group

3. C onidial heads radiate (short columns in one species), small, in pinkish fawn shades; cleistothecia lacking ..... A. cervinus group

4. Conidial heads loosely to definitely columnar, often long, thin and twisted, in green shades; conidia cylindrical when young; osmophilic; cleistothecia lacking ..... A. restrictus group

5. conidial heads compactly columnar, in pale gray-green to dark blue-green shades; conidial not cylindrical when young; not osmophilic ..... A. fumigatus group

A. Cleistothecia lacking ..... A fumigatus series

B. Cleistothecia present, white to yellowish.. fisheri series

II. Sterigmata biseriate, or uniseriate(the former predominat) or with both conditions in the same head

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II. Sterigmata biseriate, or uniseriate(the former predominat) or with both conditions in the same head

A. conidial heads usually globose when young, radiate or splitting in age, rarely losely columnar; vesicles globose to subglobose ..... or somewhat elongate; conidio-phores not constricted below the vesicle; sclerottia produced in many species

I. Conidial heads globose when young, sometimes remaining so but usually splitting into more or less well-defined columns at maturity

a. Conidial heads in yellow, buff, or ochraceous shades; conidiophores commonly roughened and often pigmented; cleistothecia in one species .....A. ochraceus group

b. Conidial heads in shades of black; conidiophores usually smooth and colorless or becoming pigmented below the vesicle ..... A. niger group

C. Conidial heads white or cream colored; conidiophores smooth and colorless .....A. candidus group

2- Conidial heads typically radiate with spore chains usually separate, sometimes forming poorly defined columns

A. Conidial heads in yellow-green to deep olive-brown shades; conidiophores usually roughened, colorless A. flavas group

B. Conidial heads in yellow-brown to dull buff shades; Condidiophores smooth or delicately

A. wentii Group

roughened, coloyless or lightly pigmented ..A. wenti group

B. conidial heads large, radiate; vesicles strictly globose; conidiophores definitely constricted below the vesicles; sclerotia lacking

I. Conidial heads of one type, buff-brown, pale yellow-green or blue-green; conidiophores usually colorless smooth; o-smophilic; cleistothecia produced in two species

A. cremeus group

2- conidial sttructures of two types; large heads light gray, green , or olive-buff with conidiophores usually in brown shades and encrusted; fragmentary structures borne near or beneath the agar surgace .....A. sparsus group

III . Sterigmata strictly biseriate

A. Conidial heads typically in definite green shades; hulle cells usually globose but sometimes irregularly ovate to pyriform

I. Conidial heads typically radiate; becoming loosely columnar in some species: conidiophores colorless or light brown. commonly exceeding 300 u in length; vesicles variable elongate, subglobse, hemispherical, or only slightly expanded hulle cells sometimes abundant, more often limited or lacking .....A. versicolor group

a. Conidial heads uniformly pigmented, small or fragmentary structures sometimes present; hyphal masses or sclerotia occasionally produced .....A. versicolor series

b. Conidial heads not uniformly pigmented, both white and green heads present (at least on some substrates) .....A. janus series

2. Conidial heads typically columnar, usually dark yellow-green but occasionally gray blue-green or brownish; conidiophores brown walled, commonly less than 300 u long; vesicles supglobose, hemispherical, or terminally fattened; hulle cells typically, produced, usually abundant, clustered, forming crusts, or enveloping ascocarbs; cleistothecia common, purplish at maturity; ascospores in orange-red to blue-violet shades ....A. nidulans group

B. Conidial heads in shades other than true green, hulle cells when present, elongate to strongly curved and twisted

I. Conidial heads radiate to broadly columnar, in drab, olive, or dull brown shades; conidiophores typically brown-walled; vesicles variable from globose to elongate or hemispherical; hulle cells elongate, often strongly curved or twisted .....A. ustus group

2. Conidial heads broadly to irregularly columnar white to avellaneous or vinaceous; conidiophores with walls brown or uncolored; vesicles subglucose to elongate; elongate hulle cells or heavy-walled hyphal elements prelent .A. flavipes group

3. Conidial heads compactly columnar, typically in cinnamon to orange - brown or pale buff shades ; conidiophores colorless; vesicles hemispherical ....A. terreus group

KEY TO GROUPS

Based primarily on color

A. Conidial heads showing some shade of green during development .....B.

AA. Conidial heads in some other color .....L.

B. Vesicles clavate or subclavate; sterigmata uniseriate ..C.

BB. Vesicles not clavate; sterigmata uniseriate or biseriate.D

C. Vesicles strongly clavate; conidial heads blue-green, becoming gray in age .....A. clavatus group

CC. Vesicles subclavate; sterigmata uniseriate; conidial heads yellow-green gray-green, or blue-green when youngdarkening in most species .....A. ornatus group

D. Conidial heads bright yellow-green when young, sometimes becoming brown in age, loosely radiate; sterigmata biseriate in most species. .....A. flavus group

DD. Conidial heads in other green shades; sterigmata uniseriate or biseriate .....E.

E.

E. Colonies mostly showing naked yellow cleistothecia and yellow or red encrusted hyphae .....A. glaucus group

EE. Colonies lacking naked yellow cleistothecia and yellow and red encrusted hyphae .....F.

F. Conidial heads definitely columnar.....G.

FF. Conidial heads globose, radiate, or loosely columnar.I.

G. Sterigmata uniseriate .....H.

GG. Sterigmata biseriate; globose to subglobose hulle cells common; cleistothecia in some species; ascospores orange red to violet.....A. nidulans group

H. Conidial heads columnar, long, narrow(often twisted) to irregular; conidia usually formed as cylindrical segments from the sterigmata; cleistothecia lacking; typically osmophilic.....A. restrictus group

HH. Conidial heads columnar, compact and typically uniform in diameter throughout; conidia not formed ar cylindrical segments; cleistothecia in some species; not typically osmophilic.....A. fumigatus group

I. Vesicles small, variable in shape.....J.

II. Vesicles large, strictly globose; conidiophores constricted below the vesicle.....K.

J. conidial heads blue-green, dull yellow-green, or gray blue-green, radiate to loosely columnar; hulle cells globose to subglobose .....A.versicolor group

JJ. Conidial heads olive, olive-gray, dark to light brown; radiate to broadly columnar; hulle cells elongate to twisted.....A.ustus group

K. Conidial heads graying in age from blue-green or olive-buff shades .....A. sparsus group

KK. Conidial heads pale yellow-green, blue-green, or buff-brown.....A. cremeus group see also A.wentii group)

L. Growth very sparse and sporulation poor on Czapek's agar .....

LL. growth and sporulation usually abundant on CZ pek agar

ager .....M.

M. Heads loosely to compactly columnar.....N.

MM. Heads globose to radiate.....O.

N. Heads loosely columnar, white, flesh colored, or cream-buff.....A. flavipes group

NN. Heads compactly columnar, avellaneous to cinnamon.....

A. terreus group

O. Heads persistently white; larger heads definitely globose or radiate.....A. candidus group

OO. Heads not white.....p

P. Heads in yellow, ochraceous or light brownish shades .Q.

PP. Heads in black or dark brown shades ..A.niger group

Q. Heads in sulphur yellow to ochraceous shades A. ochraceus group

QQ. Heads in yellow-brown to dull buff shades .....

.....A.wentii group (alsoA.cremeus group in part)

Aspergillus clavatus Group

clavatus

group key

C onidial structures often I to 5 or more cm.in length....

.....A. giganteus Wehmer

Conidial structures not exceeding 4.0mm. in length .....

...A. clavatus Desm.

Conidial structures less than I.O MM In length .....

.....A. clavato-nanica Batista, Maia,& Alecrim

Aspergillus glaucus Group

Group Key

A. Asc ospores lenticular 6u or less in long axis, including ridges or crestg

I. Ascospores with convex surfaces smooth or nearly so

a. Equatorial ridges lacking, furrow absent or showing, only as a trace

(I) Conldial heads large, radiate to loosely columnar, borne above the surface layer of cleistothecia and enveloping hyphae ...A. repens DeBary. *

(2) Conidial heads small, enmeshed with the cleistothecia in a felt of sterile hyphae ..A. peseudoglaucus Blochwitz

b. Equatorial ridges lacking but with furiow definite, appearing asa a narrow shallow depression; colonies yellow, not developing red pigmentation ..A. tonophilus ohtsuki

c. Equatorial ridges low and roundded, furrow broad and shallow colonies developing a strong red or orangered pigmentation ..A. rub er (Konig, spieckeimann Bremer) thom church .

d. Equetorial ridges thin and flexuous, crestlike (ascospore resemblingapulley) ..A. chevalieri (Mangin Thom& Church

2. Ascospores with convex surfaces rough

a. Conidia smali, smooth walled; ascospoies with definite crests .. A. chevalieri Ver. intermedius Thom & Raper

b. Conidia small, echinulate; ascospores without crests but with prominent V-shaped furrow flanked by irregularr ridges.

(I) Colonies predominantly cleistothecial ...A. amstelodomi (hangin Thomy chueck

(2) coloniespredominankly conieial ..A. monteyidensis Talice machkinnon

(I) Conidia small, not exceeding 5.5 u in diameter .....
.....A. cristatus n. sp.

(2) Conidia large, exceeding 5.5 u in diameter.

(a) Ascospores 6.5 to 7.5 u in long axis. A. mangini Thom & Kaper

(b) Ascospores 7.5 to 8.5 u in long axis .....
.A. umbrosus Bainier & Sartory

(c) Ascospores 9.0 to I0.0 u in long axis.....
.....A. echinulatus (Delacr.) Thom & Church

B. Asci ripening more slowly, colonies favored by media containing 40 per cent sugar or more.

(I) Ascospores roughened in equatorial area with ridges and furrow.

(a) Ascospores 8.8 to 9.6 u by 6.0 to 6.8 u with ridges ~~relatively~~ thin and irregular; colonies developing brick red pigmentation on M 40y agar .A. medius to 7. 5u Meissner

(b) Ascspores5.5 u by 4.0 to 5.0 u (up to 9.0 by 7.0 u), with ridges low; colonies maize to buff yellow on Czapek agar with ca. 70 per cent sucrose.....
...A. halophilicus chistensen, papavizas,& Benjamin

(2) Ascospores usually without equatorial ridges and furrow...A. carnoyi (Biourge) Thom & Kaper

-- [illegible] DESCRIPTIONS

2. Conidial heads white.....A. niveo-glaucus Thom & raper

II. Cleistothecia absent, but coiled ascogonia abundant

A. Ascogonia producing naked clustered asci; conidial heads light brown .....A. athecius n. sp.

B. Ascogonia never producing asci; conidial heads green pro

ASPERGILLUS ORNATUS GROUP

GROUP KEY

I. Conidial heads yellow-green to brownish green. radiate; conidia citriform to elliptical; cleistothecia tyically produced.

A. Cleistothecia at first white and parenchymatous throughout, becoming purplish at maturity; produced in dark incubated cultures.

1. Ascospores with multiple thin flexuous crests.....
.....A. ornatus Raper, Fennell & Tresner

2. Ascospores with a single equatorial ridge(two adherent crests?) ....A. citrisporus (Von Hohnel) Raper, Fennell Tresner

B. Cleistothecia white to olive, lacking a definite wall, surrounded by loosely interwoven fine hyphae; ascospores large, spiny, without equatorial furrow or ridges .....
.....A. spinulosus Warcup n. sp.

II. Conidial heads light grayish blue-green, loosely columnar or radiate; conidia elliptical; sclerotia or compact sclerotium-like masses of hulle cells typically present and produced more abundantly in dark-incubated cultures.

A. Sclerotia present; heads columnar; conidiophores and conidia delicately roughened..A. paradorus Fennell & Raper

B. Hulle cell masses present; heads usually radiate; conidiophores and conidia smooth ..A. raperi Stolk

III. Conidial heads at first dark blue-green then brownish black, radiate; conidia globose, strongly spinulose to irregularly warty.....A. brunneo-uniseriatus Singh & Bakshi

Aspergillus ceruinus Group

GROUP KEY

I. Heads radiate

A. Conidiophores exceeding IOO, erect to terminally recurved

I. Conidiophores usually IOO to 300 ,in length, walls very thick, I.5 to 2.0 ,; heads erect.....
....A. cervinus (Massee) emend. Neill

2. Conidiophores extremely variable, IOO to 800 u, in length; large heads usually erect, smaller heads often nodding ...A. kanagawaensis Nehira

B. Conidiophores not exceeding IOO in length; vesicles upright or borne at an angle ..A. parvulus Smith

II. Heads columnar

A. Conidiophores and vesicles strongly pigmented, vesicles borne at acute angles.....
.....A. nutans Mclennan & Ducker

Aspergillus restrictus Group

GROUP KEY

I. Heads columnar; vesicles small, flask shaped. domelike or only gradual enlargements of the conidiophore apices fertile on the upper surface only

A. Conlonies 4 to 5 cm. in diameter in 3 weeks at 26 C on standard Czapek'S agar ..A. caesiellus saito

KEYS AND SPECIES DESCRIPTIONS

B. Colonies less than I.5 cm. at 3 weeks on Czapek's agar

I Rapidly growing on M 40 y agar, dark olive green; columns long, often twisted, adherent in fluid mounts .....
...A. restrictus smith

2.less rapidly growingon M40y agar, light gray green,columns more delicate

a. conidia elliptical when first formed, often remaining so,mostly 4,5uby3,0to 3.5uchains adherent in fluid mounts.....A. conicus Blochwitz

b. conidia subglobose to pyriform, mostly 3.0 to 3.5u in diameter, chains not adherent in fluid mounts.....
....A. gracilis Bainier

II. Heads radiate when young, tardily becoming loosely or irregularly columnar; vesicles subglobose to pear-shaped, fertile over the upper half to two-thirds.....
.....A. penicilloides spegazzini

Aspergillus Fumigatus Group

GROUP KEY

Cleistothecia absant .....A. fumigatus series

A. Conidial heads erect, compart, and strongly columnar; vesicles commonly 20to 30u in diameter, upright on the conidiophore

I. conidiophores 0.5 mm.or less; conidial heads dark green; conidia globose echinulate .....A. fumigatus Fresenius

2. Conidiophores exceeding 0.5 mm.; heads light yellow-green; conidia elliptical, smooth or nearly so.....
.....A. fumigatus varellipticus, n.var.

B. Conidial heads often presenting a nodding appearance. smaller than the preceding and not consistently columnar; vesicles less than 20u in diameter

I. Vesicles upright but with sterigmata often borne in lateral or basal clusters to give a pseudonodding appearance..... ....A. unilateralis Thrower

2. V esicles often borne at an angle to the conidiophore

a. Conidiophores thin walled, sinuous; vesicles uncolored and often strongly nodded, conidia in pale blue green shades.....A. viridi-nutans Ducker& Thrower

b. Conidiophores heavy walled; vesicles and sterigmata colored ; conidia in dark blue- green shades

(I) Conidia conspicuously echinulate; colony reverse uncolored or nearly so ....A. duricaulis, n.sp.

(2) Conidia finely spinulose; colony reverse in reddish brown to deep rose shades ...A. brevipes Smith

II. Cleistothecia present .....A. fischeri series

A. Cleistothecia and enveloping hybhae white to cream in color

I. Ascospores showing two distinct equatorial crests

a. Convex surfaces bearing anastomosing ridges.....

.....A. ficheri wehmer

b. Convex surfaces smooth (ornearly so) .....

..... A. ficheri var.glaber Fennell & raper

C. Convex surfaces spinulose or echinulate .....

....A. Ficheri var. spinosus, n. var.

2. Ascospores showing more than two equatorial crests

a. ascospores showing 4equatorial crests.....

.....A. Quadricinctus Guill

B. cleistothecia and enveloping hyphae in yellow, golden or orange shades

I. Colonies loose textured, growing rapidly on all media, cleistothecia large

a. Ascospores with prominent equatorial crests and

Cconvex surfaces conspicuously echinulate .....
.....A. aureolus Fennell & raper

2. Ccolonies close textured , growing very restrictedly on czapek's agar, cleistothecia small

a. ascospores with prominent equatorial crests and convex surfaces delicately echinulate.....
..... A. stramenius Novak & kaper, n. sp.

Bb. Ascospores with low equatorial crests and convex surfaces finely reticulate or spinulose..A. auratus Warcup. n. sp.

Aspergillus Ochraceus Group

Ochraceus group

GROUP KEY

I. CConidial heads in pale pure yellow shades

A. Sclerotia cream to pale yellow, produced in a dense layer, 300 to 450 u in diameter; conidial heads loosely radiate, spore chains adherent into narrow divergent columns.....A. sulphureus(Fres.) Thom & Church

B. Sclerotia white to cream to pale pink, produced singly, I.0 to I.5 mm. in diameter; conidial heads hemispherical to loosely columnar, or split into two or more compact .....
.. columns..A. sclerotiorum Huber

II. CConidial heads in bright golden yellow shades

A. Sclerotia black at maturity, vertically elongate,I to 3mm. high (at several months containing multiple cleistothecia); conidia smooth, oval to subglobose,2.5 to 4.0 bu 2.0 to 3.5u; c... ...h, conedial heads changing to cinnamon buff in age...A. alliaceus Thom & C hurch

B. Sclerotia orange to rufous, globose to subglobose, 500 to 700 u in diameter, conidia heavy walled, smooth , elliptical or ovate, 3.3 to 4.4 u by 2.5 to 3.0u;

Conidial heads remaining bright in age ...A. auricomus (Guéguen) saito

III. Conidial heads in dull yellowish cream, buff, or ochraceous shades

A. Sclerotia produced in most strains

I. Sclerotia abundant, small, commonly 400 to 500u

a. Sclerotia pure yellow then brown; conidia globose, subglobose or elliptical, 2.75 to 3.5 u or 3.0 to 3.3 u by 2.5 to 2.8 u .....A. melleus Yukawa

2. Sclerotia scattered, developing late, large, commonly 500 to I000 u

a. Sclerotia pink to vinaceous purple when mature, globose, ovate to cylindrical; conidia globose to subglobose, mostly 2.5 to 3.0 u ...A. ochraceus Wilhelm

b. Sclerotia cream to buff or clay colored, globose to ovate; conidia elliptical to pyriform 4.0 to 5.0 u by 3.0 to 3.5 u .....A. ostianus Wehmer

c. Scmerptoa wjote tp cream, ovate to discoid; conidia ovate to elliptical, mostly 3.2 to 4.0 u by 2.8 to 3.2 u.....A. elegans Gasperini

B. Sclerotia unknown

I. Colonies [illegible] close textured, sporulating slowly conidial heads pinkish buff; conidia subglobose ovate or elliptical, mostly 3.0 to 4.0 u by 2.5 to 3.0 u..... .....A. petrakii Voros

Aspergillus niger Group

GROUP KEY

I. Sterigmata in two series

A. Colonies (conidial heads) on Czapek's agar appearing carbon black to the naked eye

I. Conidia 6 to IO u in diameter at maturity ..A. carbonarius (Bainier) thom

2. Conidia 5.0 u or less in diameter at maturity

a. Conidiophores not exceeding 4.0 mm. in length

(I). Colonies spreading rapidly on Czapek's agar.....A. ficuum (Reich.) Hennings

(2). Colonies growing mores slowly on Czapek's agar

(a). Conidia at maturity horizontally flattened, mostly 3.0 to 3.5 u in diameter, with longitudinal color bars or striations ....A. phoenicis (Cda.) Thom

(b). Conidia at maturity globose, mostly 4.0 to 5.0 u irregularly roughened with conspicuous ridges and echinulations not arranged as longitudinal striations.....A. niger V. Tiegh .

b. Conidiophores commonly exceeding 5 mm. and reaching I cm. but also commonly with shorter stalk bearing diminutive heads .....A. pulverulentus (Mcalp.) Thom

B. Colonies (Conidial heads) grayish olive brown or deep olive brown when young; usually becoming reddish brown to brownish black, but with olive or grayish colors often persistent.

(I). Heads quickly dark black-brown or reddish brown a.

a. Conidia under 5.0 u in diameter, horizontally flattened, and appearing striate at maturity

(I) Heads quickly dark black- brown; colony reverse uncolored; conidiophores mostly 2 to 3 mm. but up to 5.0 mm. long; conidia mostly 3.0 to 3.5 u in diameter.....A. tubingensis(Schober) Moss.

(2) Heads quickly reddish brown; colony reverse in similar shades; conidiophores mostly I.0 to 1.5 mm. long; conidia mostly 4.0 to 4.5 u in diameter..... .....A. awamori Nakazawa

b. Conidia 6.0 to 8.0 u in diameter, globose to subglobose, coarsely tuberculate ....A. flavo-furcatis Batista and Maia (see A. flavus group)

2. Heads persistently dark grayish brown or olive-brown

a. Conidia at maturity elliptical, conspicuously echinulate, 5.0 to 5.5 u by 3.3 to 3.8 u.....A. ellipticus, sp . nov.

b. Conidia at maturity globose or nearly so, sometimes elliptical when young

(I) Conidia at maturity conspicuously spinulose..... .....A. heteromorphus Batista and Maia

(2) Conidia at maturity irregularly and finely roughened

(a) Conidial heads generally small, in age on malt agar splitting into fairly numerous compact divergent columns....A. foetidus (Naka.) Thom and Raper

(b) Conidial heads large, columns few and poorly defined on malt agar

(I) Basal mycelium on malt agar uncolored or only faintly yellow..A. foetidus(Naka.) T. & R. var. N ., S.,&W.

(2) basal mycelium on malt agar bright golden yellow .....A. foetidus (Naka.) T.& R.var.acidus .N S.,& W.

II. Sterigmata uniseriate

A. Conidia globose to subglobose, conspicuously echinulate; vesicles commonly 20 to 35 u but ranging from I5 to 45 u .....A. japonicus saito

B. Conidia subglobose to definitely elliptical, conspicuously echinulate; vesicles commonly 60 to 80 u ranging from 35 to 100 u ...A. A. aculeatus Iizuka

Aspergillus flavus Group

GROUP KEY

I. Conidial heads in pale to intense yellow or yellow-green shades when young

A. Colonies not shifting to brown on Czapek's agar; conidia definitely echinulate

1. Sterigmata either single or double with the latter predominant; heads radiate or very loosely columnar ..... .A. flavus Link

2. Sterigmata typically in a single series

a. Heads colunar; sterigmata usually uniseriate.....A. flavus var. columnaris, N. var.

b. Heads radiate; sterigmata uniseriate.....A. parasiticus Speare

B. Colonies shifting to light brownish green in age on Czapek's agar; conidia irregularly roughened or smooth

1. Conidia large, mostly 4.5 to 7.0 u but up to 8.0 u or 10.0 elliptical at first, then globose to subglobose, smooth to irregularly roughened

a. Conidiophores borne primarily from the substrate .....A. oryzae(Ahib.) Cohn

b. Conidiophores borne primarily as short branches from aerial hyphae....A. oryzae(Ahlb.) Cohn Var. effusus (Tiraboschi) Ohara

2. Conidia small, oval to elliptical, mostly 3.0 to 3.5u by 2.4 to 3.0 u smooth or nearly so

a. Growth negligible on Czapek's agar; conidial structures abundant, zonately arranged on ~~mall agar coni~~ diophores smooth or nearly so ...A. zonatus Kwon & Fennell, n. sp .

b. Growth spreading on both Czapek's and malt agars; conidial structures often forming coremiform clusters; conidiophores conspicuously roughened.....A. clavato-
.... flavus, N. sp

II. Conidial heads in deep yellow-green to olive-brown shades when young; conidia conspicuously verruculose

A. Conidial heads at first deep yellow-green, shifting to brownish green or brown on czapek's agar .....
.....A. tamarii Kita

B. Conidial heads quickly olive'brown then dark brown..
....A. furcatis Batista& Maia

III. Conidial heads in pale yellowish olive or grayish olive shades; conidia smooth or nearly so

A. Conidiophores conspicuously échinulate...A. subolivaceus,n.sp.

B. Conidiophores smooth or nearly so..A.avenaceus smith

Aspergillus wentii Group

GROUP KEY

I. Conidiophores smooth or granulose

A. Conidial heads large, up to 500 u or more in diameter, on smooth or slightly granular stalks which may reach several millimeters in length...A. wentii Wehmer

B. Conidial heads smaller and borne on shorter stalks

I. Sterigmata mostly double, few single; both single and double sterigmata often observed in the same head

a. Conidia mostly 5.5 to 6.5 u coarsely echinulate...
.....A. terricola Marchal

b. Conidia mostly 4.5 to 5.5 by 3.8 to 5.0 u, rugulose.
.....A. terricola var. americana Marchal

2. Sterigmata almost entirely single, rarely double, and then at the base of the vesicle in otherwise uniseriate heads ....A. terricola var. indicus(Mehrotra&Agnihotri) n. comb .

II. Conidiophores conspicuously echinulate.....
.....A. thomii Smith

Aspergillus cremeus Group

GROUP KEY

I. Conidial heads in light green shades
A. Sterigmata biseriate; cleistothecia present .....
....A. cremeus Kwon & Fennell,n. sp.
B. Sterigmata initially uniseriate. becoming biseriate progressively from the base of the vesicle upward; dark stroma'like hyphal masses present..... ...
.....A. stromatoides, n. sp.
C. Sterigmata uniseriate; dark hyphal masses and cleistothecia lacking...A. itaconicus Kinoshita

II. Conidial heads in light brown shades
A. Sterigmata biseriate; cleistothecia present .....
.....A. chrysellus Kwon & Fennell, n. sp .
B. Sterigmata mostly uniseriate, occasionally biseriate; cleistothecia absent...A.flaschentraegeri Stolk

Aspergillus sparsus Group

GROUP KEY

I. Sterigmata in two series
A. Conidia usually of one type
1. Conidia in large heads light yellow'green to olive-buff, subglobose to elliptical, delicately roughened.....A. sparsus Raper & Thom

2. Conidia in large heads darker green, globose, conspicuously echinulate; similar conidia produced from fragmentary structures at agar surface ..A.biplanus, spnov .

B. Conidia of two types

I. Conidia in large heads gray , slightly elliptical, smooth or nearly so; conidia from low level fragmentary structures, green,globose, conspicuously roughened .....A. diversus, sp. nov.

II. Sterigmata in a single series

A. Conidia in heads borne on long stalks at first elliptical and smooth, those subsequently formed subglobose to globose, brown and coarsely roughened as are the conidia of short stalked and fragmentary heads ....A. funiculosus Smith

Aspergillus versicolor Group

GROUP KEY

I. conidial heads of one color....A.versicolor series

A. Vesicles globose to somewhat elongate, fertile over most of the vesicular surface; globose to subglobose hullecells often present; compact hyphal masses and sclerotia lacking

I. Mature conidia not exceeding 4.0 u consistently globose to subglobose

a. Conidiophores uncolored to faintly yellowish

(1) Conidial heads variable in color, light yellow-green, buff to orange'yellow, or occasionally flesh colored..... A. versicolor(Vuill. tiraboschi

(2) Cnidial heads always blue'green when young.....
....A. sydowi(Bain.&Sart.) Thom and Church

b. Conidiophores definitely brown

(I) Conidial heads radiate, very dark yellow-green; conidiophore walls smooth; Hulle cell masses conspicuous.....A. silvaticus Fennell & Raper

(2) Conidial heads radiate; very dark blue-green; conidiophore walls definitely rough; hulle cells lacking..... .A. pulvinus Kwon & Fennell. n. sp.

(3) Conidial heads variable in shape, often loosely columnar; conidiophore walls smooth but with knobby encrustments on malt agar...A. speluneus. n. sp.

2. Mature conidia usually exceeding 4.0 u globose, subglobose, or elliptical

a. Conidiophores colored in brown shades

(I) Conidia strictly globose, echinulate

(a) Conidial heads pale gray-green, globose to somewhat elongate Hulle cells in small colorless clusters .: .....A. granulosus Raper & Thom

(b) Conidial heads dark yellow-green globose to elliptical hulle cells in conspicuous hyaline to purplish masses.....A. caespitosus Raper& Thom

(2) Conidia of two types; elliptical and smooth; globose and rough .....A. asperescens Stolk

b. Conidiophores uncolored in wet mounts; conidia 4.0 to 5.0 u in long axis ...A. varians Wehmer

B. Vesicles turbinate, spathulate, or merely slight expansions of the conidiophore apices, fertile on the apex only; hulle cells lacking, or if present, pyriform to elongate; compact hyphal masses or sclerotia present

I. Soft masses of white to cream-colored, compacted, thin-walled or heavy-walled cells present, sometimes in lim-

a. Stalks long, 1 to several cm.; smooth; conidia mostly oval to elliptical, smooth or very slightly roughened; abundant sclerotium-like masses composed of globose, elongate, or pear-shaped elements resembling hulle cells ....A . malodoratus Kwon & Fennell. n. sp.

b. Stalks less than 400 u delicately roughened; conidia globose, 4 to 7 u in diameter with long echines; sclerotium-like masses sparsely produced, composed of thin-walled cells and surrounded by short sterile hyphae..... .....A. crystallinus Kwon & Fennell. n. sp.

2. True sclerotia present, cream to buff; vesicles turbinate, often borne at a slight angle to the conidiophore

a. Conidial heads dark yellow-green; conidiophores up to 600 u long; conidia globose, minutely asperulate, mostly 2.5 to 3.0 u in diameter ...A. peyronelii sappa

b. Conidial heads gray-blue-green, conidiophores up to 350u long; conidia globose to subglobose, smooth or nearly so, mostly 2.2 to 2.8 u in diameter ...A. arenarius,n.sp.

II. conidial heads of two colors; green or white ....A. JANUS series

A. Vesicles of green and white heads dissimilar

1. Vesicles of white heads conspicuously clavate, 45 to 60u by 15 to 18 u borne on conidiophores usually exceeding 2 mm. in length ....A. janus Raper& Thom

2. Vesicles of white heads not conspicuously clavate,20 to 25 u by 14 to 18 u borne on conidiophores less than 2.0 mm. in length.....A. janus var. brevis Raper& Thom

B. Vesicles of green and white heads essentially similar

I. Conidia from both white and green heads smooth walled and of similar dimensions ....A. allahabadii Mehrotra & Agnihotri

2. Conidia from green heads rugulose and larger than the smooth conidia of white heads

a. Colonies on malt agar producing cushion-like overgrowths of thick-walled hyphal elements .....
.....A. ambiguus Sappa

b. Colonies on malt agar notproducing overgrowths .....
.....A. microcysticus Sappa

Aspergillus nidulans Group

GROUP KEY

I. Ascospores present

A. Ascospores orange-red in color

I. Equatorial crests two in number, rarely lacking. not exceeding 2.0 u in width

a. Convex walls smooth

(I) Equatorial crests lacking ....A. nidulans var. acristatus Fennell& Raper
.....

(2) Equatorial crests present

(a) Conidial stage dark yellow-green, promiment on malt agar, generally arising from submerged mycelium.

(1.) Coarse, encrusted, spicular hyphae absent

(1.) Crests entire, 0.5 to I.3 u wide ...A. nidulans (Eidam) Wint

(2.) Crests entire, I.5 to 2.0 u wide

(i') Crests entire, I.5 to 2.0 u wide

(i") Cleistothecial envelope in dull shades consisting of hulle cells only .....A. nidulans var, latus Thom & Raper

(2.) Cleistothecial envelope consisting of hulle cells associated with abundant mycelium in bright yellow to

red- orange shades.....A. heterothallicus Kwon, Fennell,& Kaper, n. sp .

(c) Crest dentate.....A. nidulans var. dentatus Sandhu& Sandhu

(2) Coarse, encrusted, spicular hyphae present; cleistothecia rare .....A. unguis(Emile-weil& Gaudin) Thom & Kaper

(b) Conidial stage green , inconspicuous on malt agar, genrally arising from aerial mycelium

(1) Cleistothecia borne in mycelial tufts with few accompanying hulle cells

(a) Cleistothecia 50 to 100 u associated mycelium heavily encrusted, silvery in apperance .... A. fruticulosus n. sp.

(b) Cleistothecia less than 50u associated mycelium mostly unbranched, not encrusted ....A. parvathecius, n.sp.

(2) Cleistothecia obscured by a nearly continuous layer of hulle cells ...A. aurantiobrunneus (A., H., & K.)n. comb.

b. Convex walls not smooth

(1) walls echinulate .... A. nidulans var. echinulatus Fennell & Kaper

(2) Walls coarsely rugulose .....A. rugulous Thom & Kaper

2. Crests two in number, 3.0 u or more in width.

a. Crests dissected, stellate.....A. variecolor(B&B.) Thom & Kaper

b. Crests entire .....A. variecolor var. astellatus Fennell & Kaper

3. Crests four or more in number,

a. Crests four in number, narrow .....A. quadrilineatus Thom & Kaper

b. Crests multiple, sometimes irregularly arranged and

A. Stellatus

giving the impression of striations .....A. striatus Kai. Tewari & Mukerji

B. Ascospores blue-violet in color, with convex surfaces echinulate .....A. violaceus Fennell& Raper

II. Ascospores not present

A. Conspicuous coarse encrusted spicular hyphae present; hulle cells lacking except in one unique strain which has been known to produce occasional cleistothecia .... .A. unguis (E.W.&.G.) Thom & Raper

B. Conspicuous spicular hyphae absent

I. Hulle cells absent or limited in number

a. Hulle cells absent, yellow mycelium prominent

(i) Conidiophores short, straight; conidial heads loosely columnar to somewhat divergent; arising from a yellow submerged mycelium .....A. aureolatus Hunt. Cvet.& Bata

(2) Conidiophores short, curved or coiled;conidial heads columnar, enmeshed in a prominent yellow aerial mycelium ....A. recurvatus, n. sp.

b. Hulle cells very limited in number, scattered, seldom exceeding IO to I2 u in diameter ...A. speluneus, n. sp. (see A. versicolor group

2. Hulle cells aggregated in scattered and irregular masses suggestive of cleistothecia; not produced on malt agar ..... A. caespitosus Raper & Thom (see A. versicolor group)

3. Hulle cells a bundant, scattered throughout the mycelial felt; conidiophores very short ...A. subsessilis, n . sp.

4. Hulle cells abundant, massed to form continuous crusts on malt agar

a. Hulle cell crust blue-gray, colonies restrictedly growing ....A. crustosus,n. sp.

b. Hulle cell crust reddish purple, colonies rapidly spreading .....A. multicolor sappa

c. Hulle cell crust bronze .....A aeneus sappa

d. Hulle cell crust golden yellow ..A. silvaticus Fennell & Raper (see A. versicolor group)

e. Hulle cell crust white to creamy white, conidial heads few in number and developing tardily ....A. eburneo-cremeus sappa

Aspergillus ustus Group

GROUP KEY

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I. Vesicles upright on the conidiophores

A. Conidial heads in olive-gray to drab or red-brown shades

1. Conidial heads variable, radiate when young to loosely or broadly columnar at maturity

a. Hulle cells typically present, scattered throughout the colonuY or forming irregular masses not associated with pigmented mycelium ...A. ustus(bain.) Thom & church

b. Hulle cells abundantly produced, forming conspicuous masses associated with brightly pigmented yellow mycelium .....A. puniceus Kwon & Fennell. n. sp.

2. Conidial heads persistently radiate

a Conidial heads reddish brown (near wood brown); hulle cells elongate, twisted, in tufts of red mycelium ....A. panamensis Raper & Thom

b. Conidial heads buffy olive; hulle cells elongate, seldom bent, associated with yellow mycelium ....A. conjunctus Kwon & Fennell, n . sp .

II. Vesicles borne at a sharp angle to the vertical axis of the conidiophore .....A. deflectus Fennell& Raper

Aspergillus flavipes Group

GROUP KEY

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I. Cnidiophores definitely pigmented in yellow to light brown shades

A. Conidial heads usually white to very pale buff, in occasional strains darker near avellaneous .....
.....A. flavipes (Bain.& sart.) Thom& church)

II. Conidiophores unpigmented or very faintly yellowed

A. Conidial heads persistently white ... A. niveus Blochwitz

B. Conidial heads at first white, becoming vinaceous fawn
.....A. carneus(V. Tiegh.) Blochwitz

Aspergillus terreus Group

GROUP KEY

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I. Colonies velvety; conidial heads long, compactly columnar, in cinnamon to orange-brown or brown shades; borne on short conidiophores

A. Sclerotium-like masses of swollen, relatively heavy-walled cells lacking on malt and agar....A. terreus Thom

B. Sclerotium-like masses present on malt agar .....
.....A. africanus Fennell & Raper

II. Colonies floccose, aerial mycelium conspicuously golden yellow; conidial heads small, compactly columnar, cream to buff; borne on conidiophores to 500 or more long.....A .....A. terreus var. aureus Thom & Raper

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