

มหาวิทยาลัยเชียงใหม่
Chiang Mai University

ภาคผนวก

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Fusarium Interactive Key

Colony

Conidial Mass on PDA, SNA or

CLA:

- blank
- cream coloured
- orange
- yellow
- tan or brown
- reddish brown
- with bluish tones
- yeast-like

Reverse on PDA:

- blank
- colourless to cream
- tan to brown
- orange
- red
- purple

Colony diameter after 10 days

PDA:

- blank
- < 3 cm
- 3-7 cm
- > 7 cm

Aerial mycelium on PDA:

- blank
- present or abundant
- absent or sparse

Odour

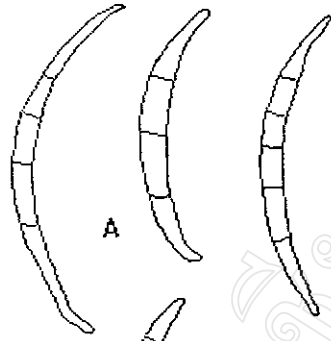
- blank
- fruity
- like lilac
- musky



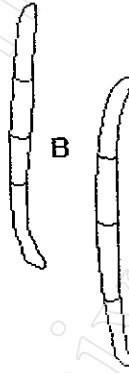
Macronidia

Macroconidia shape

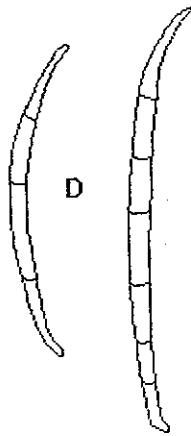
• A



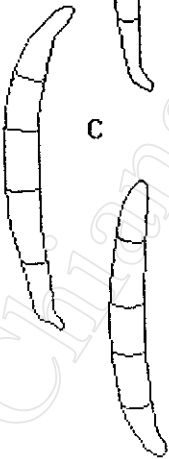
• B



• D



• C



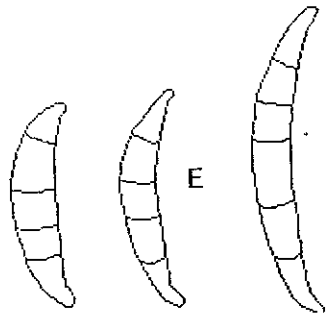
• C



• D

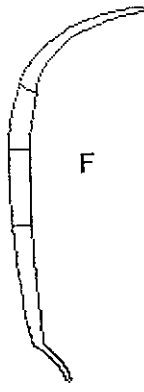


• E

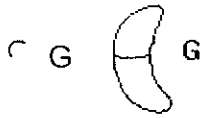


• E

• F



• F



Average length of macroconidia (μm):

40 - 60

Average width of macroconidia (μm):

< 3 μm

Average number of septa:

3-7

Widest part of

macroconidia:

- at or near centre
- above centre
- below centre

Apical/Basal cell

Apical cell length

- < penultimate cell
- = penultimate cell
- 1.5 - 2x longer than penultimate cell
- >2x longer than penultimate cell

Apical cell shape

- conical
- hooked
- blunt
- nipple-like

Basal cell shape

- Notched or foot shaped
- No foot
- Basal cell with extension > 2 μm
- with papilla

Microconidia

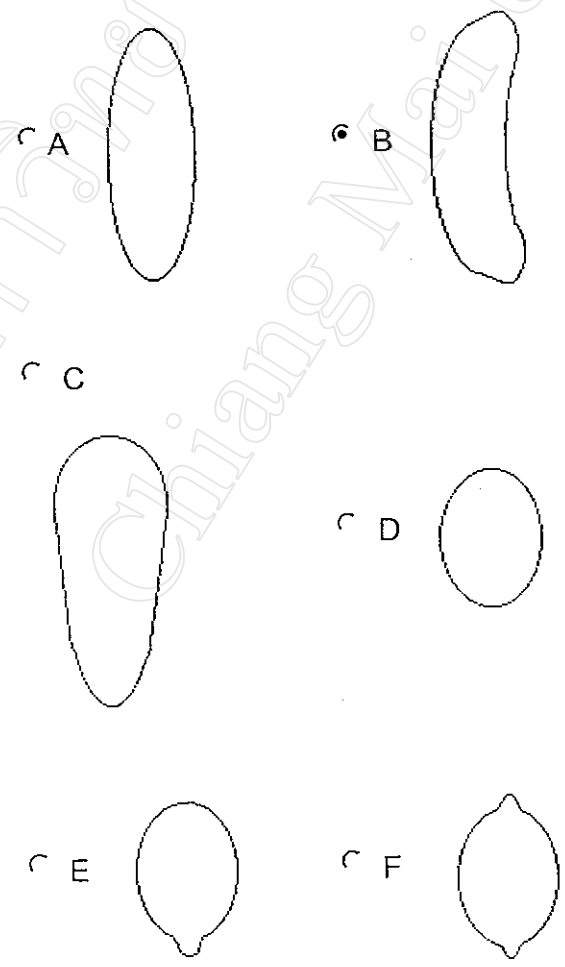
Microconidia in aerial mycelium

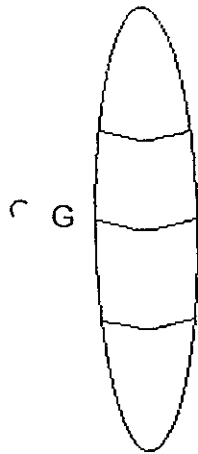
- absent or sparse
- present or abundant

Conidiophores

- microconidiophores monophialidic
- microconidiophores long and narrow mycelium
- microconidiophores mono- and polyphialidic
- phialides with wavy apex
- macroconidia produced with polyphialides

Shape





Chlamydospores

Known from

- absent
- present

- formed in chains
- not formed in chains
- single/paired
- chained
- in macroconidia

- corn
- wheat
- soil
- roots
- scale insects
- trees or bark
- other grains

Origin

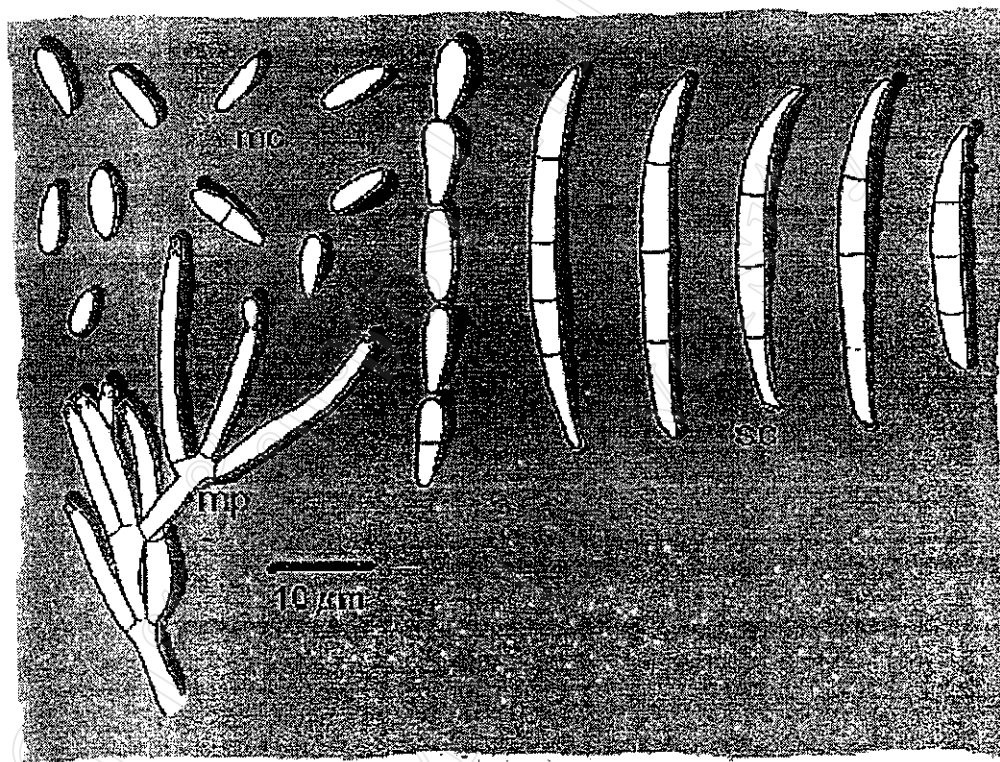
- Temperate
- Tropical

Identify

Identify new isolate

Genus species	% matches										
<i>F. moniliforme</i>	88.2%	(15/17)	<i>F. poae</i>	76.5%	(13/17)	<i>F. lateritium</i>	52.9%	(9/17)	<i>F. camptoceras</i>	64.7%	(11/17)
<i>F. sporotrichoides</i>	82.4%	(14/17)	<i>F. oxysporum</i>	76.5%	(13/17)	<i>F. reliculatum</i>	52.9%	(9/17)	<i>F. diamini</i>	64.7%	(11/17)
<i>F. subglutinans</i>	82.4%	(14/17)	<i>F. nygamai</i>	76.5%	(13/17)	<i>F. coccophitum</i>	52.9%	(9/17)	<i>F. solani</i>	64.7%	(11/17)
<i>F. avenaceum</i>	82.4%	(14/17)	<i>F. anthophilum</i>	76.5%	(13/17)	<i>F. longipes</i>	52.9%	(9/17)	<i>F. nivale</i>	64.7%	(11/17)
<i>F. equiseti</i>	76.5%	(13/17)	<i>F. chlamydosporum</i>	70.6%	(12/17)	<i>F. xylarioides</i>	52.9%	(9/17)	<i>F. tumidum</i>	58.8%	(10/17)
<i>F. scirpi</i>	76.5%	(13/17)	<i>F. semitectum</i>	70.6%	(12/17)	<i>F. crookwellense</i>	52.9%	(9/17)	<i>F. decemcellulare</i>	58.8%	(10/17)
<i>F. iricinatum</i>	76.5%	(13/17)	<i>F. heterosporum</i>	70.6%	(12/17)	<i>F. lanarum</i>	47.1%	(8/17)	<i>F. napiforme</i>	58.8%	(10/17)
<i>F. graminearum</i>	76.5%	(13/17)	<i>F. graminum</i>	70.6%	(12/17)	<i>F. aquaeductuum</i>	47.1%	(8/17)	<i>F. polyphialidicum</i>	58.8%	(10/17)
<i>F. sambucinum</i>	76.5%	(13/17)	<i>F. acuminatum</i>	64.7%	(11/17)	<i>F. merismoides</i>	41.2%	(7/17)	<i>F. beoforme</i>	58.8%	(10/17)
<i>F. proliferatum</i>	76.5%	(13/17)	<i>F. culmorum</i>	64.7%	(11/17)	<i>F. dimerum</i>	41.2%	(7/17)	<i>F. compactum</i>	52.9%	(9/17)

NOTES ON THE SPECIES

*Fusarium moniliforme* Sheldon

Alternate name: *F. verticillioides* (Sacc.) Nirenberg

Section: *Liseola*

Teleomorph: *Gibberella fujikuroi* (Sawada) Wollenw. or *G. moniliformis* Wineland.

Diagnostic characters

Microconidia produced in chains from monophialides in the aerial mycelium. Macroconidia are usually sparsely produced and are of type B, narrow and straight.

Notes

Macroconidia production may require UV. Distinguished from *F. proliferatum* by the absence of polyphialides in the aerial mycelium. Two apparently reproductively isolated mating populations are known with anamorphs assignable to *F. moniliforme*.

References

Nelson, Toussoun and Marasas. 1983. p. 128.

Booth. 1971. p. 123.

Gerlach and Nirenberg. 1982. p. 301.

Burgess, Liddell and Summerell, 1988, p. 86.

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Fusarium Interactive Key



Colony

Conidial Mass on PDA, SNA or
CLA:

- blank
- cream coloured
- orange
- yellow
- tan or brown
- reddish brown
- with bluish tones
- yeast-like

Reverse on PDA:

- blank
- colourless to cream
- tan to brown
- orange
- red
- purple

Colony diameter after 10 days
PDA:

- blank
- < 3 cm
- 3-7 cm
- > 7 cm

Aerial mycelium on PDA:

- blank
- present or abundant
- absent or sparse

Odour

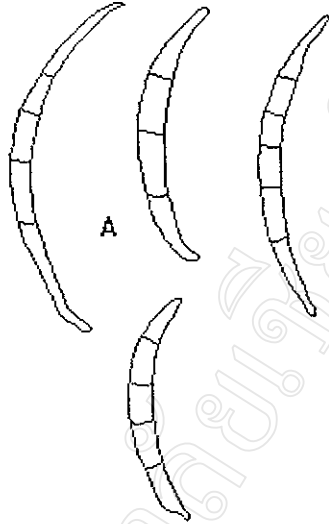
- blank
- fruity
- like lilac
- musky



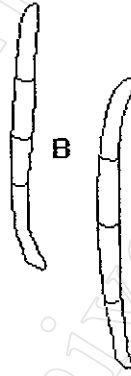
Macronidia

Macroconidia shape

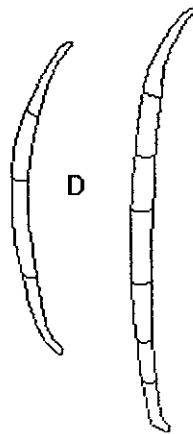
A



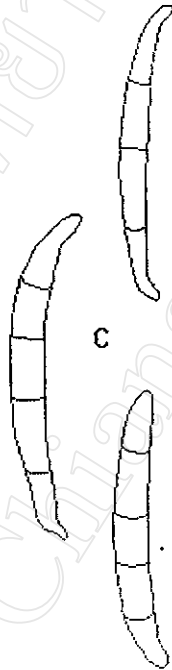
B



D

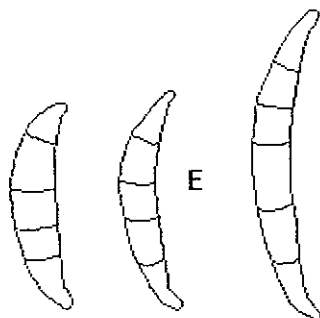


C



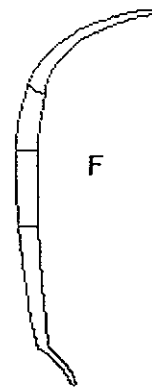
D

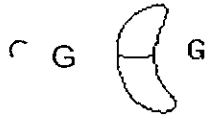
E



F

F





Average length of macroconidia (um):

Average width of macroconidia (um):

Average number of septa:

Widest part of macroconidia:

- at or near centre
- above centre
- below centre

 Apical/Basal cell

Apical cell length

- < penultimate cell
- = penultimate cell
- 1.5 - 2x longer than penultimate cell
- >2x longer than penultimate cell

Apical cell shape

- conical
- hooked
- blunt
- nipple-like

Basal cell shape

- Notched or foot shaped
- No foot
- Basal cell with extension > 2 um
- with papilla

 Microconidia

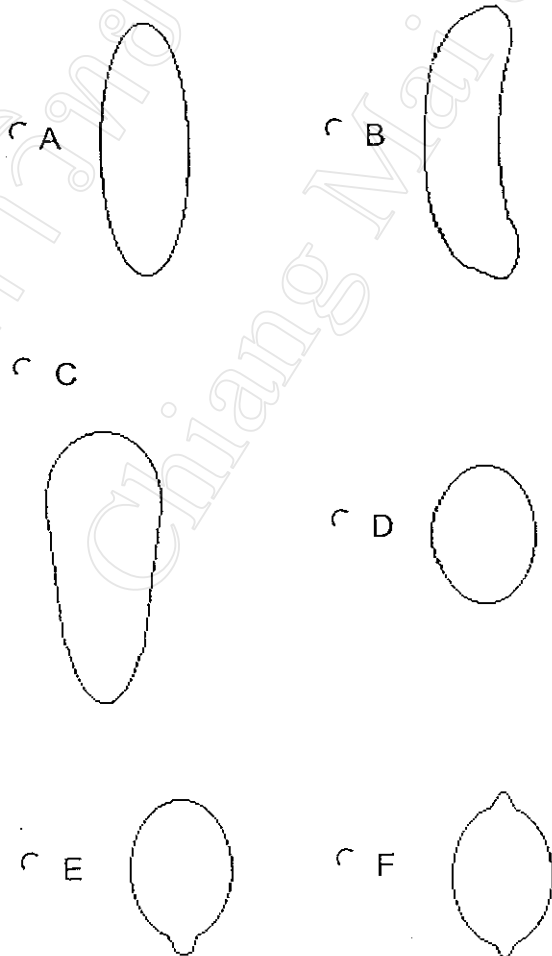
Microconidia in aerial mycelium

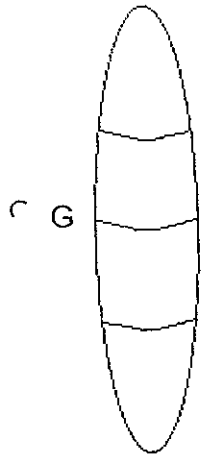
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Conidiophores

- microconidiophores monophialidic
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- microconidiophores mono- and polyphialidic
- phialides with wavy apex
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Chlamydospores

Known from

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- corn
- wheat
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- trees or bark
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Origin

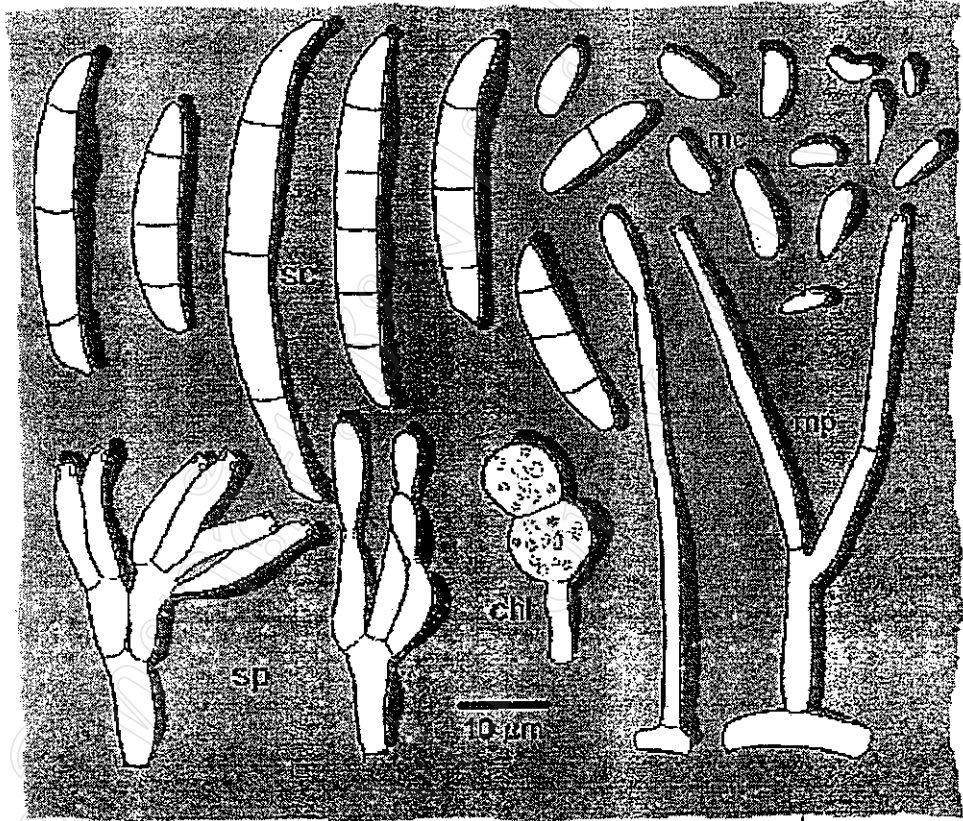
- Temperate
- Tropical

Identify

Identify new isolate

Genus species	% matches											
<u>F. solani</u>	77.8%	(14/18)	<u>F. tumidum</u>	(12/18)	<u>F. diamini</u>	55.6%	(10/18)	<u>F. merismoides</u>	50.0%	(9/18)		
<u>F. oxysporum</u>	72.2%	(13/18)	<u>F. scirpi</u>	(12/18)	<u>F. lateritium</u>	55.6%	(10/18)	<u>F. proliferatum</u>	50.0%	(9/18)		
<u>F. sambucinum</u>	72.2%	(13/18)	<u>F. heterosporum</u>	(11/18)	<u>F. semitectum</u>	55.6%	(10/18)	<u>F. decemcellulare</u>	44.4%	(8/18)		
<u>F. avenaceum</u>	72.2%	(13/18)	<u>F. sporotrichioides</u>	(11/18)	<u>F. napiforme</u>	55.6%	(10/18)	<u>F. coccophinum</u>	44.4%	(8/18)		
<u>F. culmorum</u>	72.2%	(13/18)	<u>F. beoforme</u>	(11/18)	<u>F. nivale</u>	55.6%	(10/18)	<u>F. xylarioides</u>	38.9%	(7/18)		
<u>F. graminearum</u>	72.2%	(13/18)	<u>F. moniliforme</u>	(11/18)	<u>F. anthophilum</u>	55.6%	(10/18)	<u>F. aquaeductuum</u>	38.9%	(7/18)		
<u>F. equiseti</u>	72.2%	(13/18)	<u>F. poae</u>	(11/18)	<u>F. compactum</u>	55.6%	(10/18)	<u>F. larvarum</u>	33.3%	(6/18)		
<u>F. acuminatum</u>	66.7%	(12/18)	<u>F. nygamai</u>	(11/18)	<u>F. crookwellense</u>	55.6%	(10/18)	<u>F. tabacinum</u>	27.8%	(5/18)		
<u>F. camptoceras</u>	66.7%	(12/18)	<u>F. reticulatum</u>	(10/18)	<u>F. polyphialidicum</u>	50.0%	(9/18)					
<u>F. graminum</u>	66.7%	(12/18)	<u>F. trinctum</u>	(10/18)	<u>F. dimerum</u>	50.0%	(9/18)					
<u>F. longipes</u>	66.7%	(12/18)	<u>F. subglutinans</u>	(10/18)	<u>F. chlamydosporum</u>	50.0%	(9/18)					

NOTES ON THE SPECIES

*Fusarium solani* (Mart.) Appel & Wollenw.Section: *Martiella*Teleomorph: *Nectria haematococca* Berk. & Br.

Diagnostic characters

Macroconidia of type C, straight, of medium or robust stature, often with rather blunt basal and apical cells. Microconidia ellipsoidal, produced from long monophialides in the aerial mycelium. Chlamydospores usually produced singly or in pairs.

Notes

The interpretation of the limits of this species varies from author to author. It is clear from genetic and molecular results presented at recent conferences that there are many biological species currently included under this one name. *F. solani*, in this broad sense, is easily distinguished from *F. oxysporum* by the long phialides in the aerial mycelium, and the macroconidia usually with blunt apical and basal cells.

References

Nelson, Toussoun and Marasas. 1983. p. 146.

Booth. 1971. p. 46.

Gerlach and Nirenberg. 1982. p. 364.

Burgess, Liddell and Summerell. 1988. p. 98.

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Fusarium Interactive Key



Colony

Conidial Mass on PDA, SNA or
CLA:

- blank
- cream coloured
- orange
- yellow
- tan or brown
- reddish brown
- with bluish tones
- yeast-like

Reverse on PDA:

- blank
- colourless to cream
- tan to brown
- orange
- red
- purple

Colony diameter after 10 days
PDA:

- blank
- < 3 cm
- 3-7 cm
- > 7 cm

Aerial mycelium on PDA:

- blank
- present or abundant
- absent or sparse

Odour

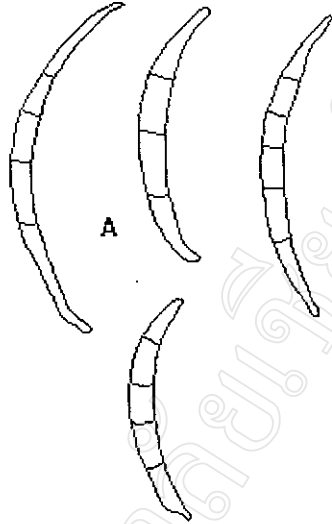
- blank
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- like lilac
- musky



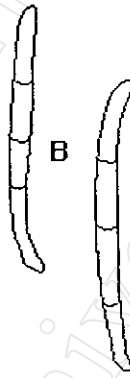
Macronidia

Macroconidia shape

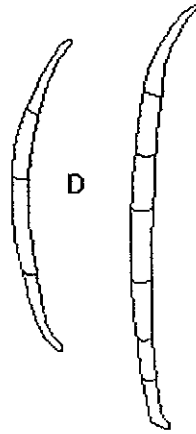
A



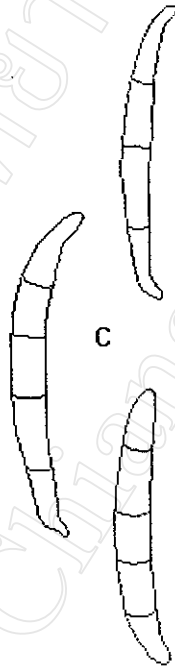
B



D

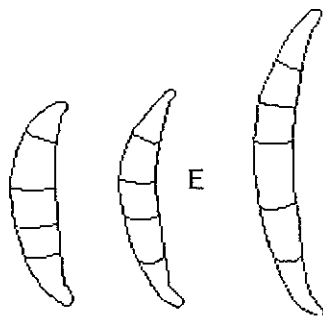


C

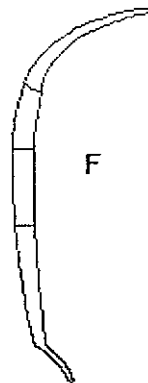


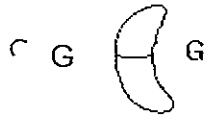
D

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F





Average length of macroconidia (um):

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Apical cell length

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- = penultimate cell
- 1.5 - 2x longer than penultimate cell
- >2x longer than penultimate cell

Apical cell shape

- conical
- hooked
- blunt
- nipple-like

Basal cell shape

- Notched or foot shaped
- No foot
- Basal cell with extension > 2 um
- with papilla



Microconidia

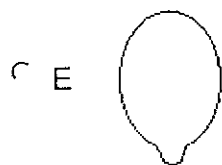
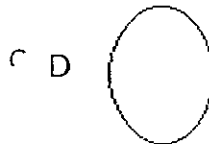
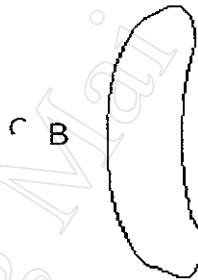
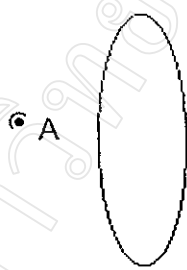
Microconidia in aerial mycelium

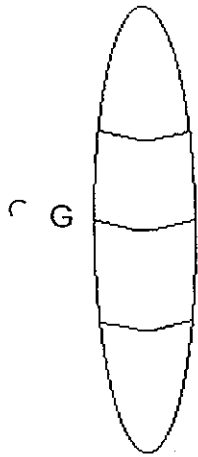
Conidiophores

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- microconidiophores mono- and polyphialidic
- phialides with wavy apex
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Shape





Chlamydo-spores

Known from

- absent
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- formed in chains
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- single/paired
- chained
- in macroconidia

- corn
- wheat
- soil
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- trees or bark
- other grains

Origin

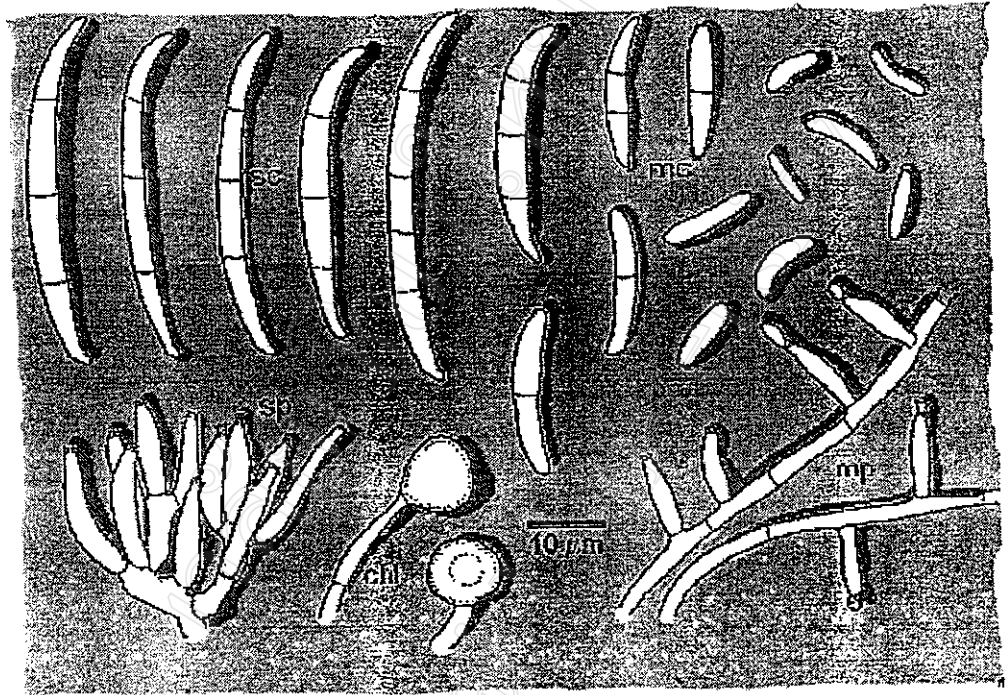
- Temperate
- Tropical

Identify

Identify new isolate

Genus species	% matches										
<u>F. oxysporum</u>	90.0%	(18/20)	<u>F. napiforme</u>	70.0%	(14/20)	<u>F. lateritium</u>	60.0%	(12/20)	<u>F. longipes</u>	50.0%	(10/20)
<u>F. solani</u>	85.0%	(17/20)	<u>F. moniliforme</u>	70.0%	(14/20)	<u>F. acuminatum</u>	60.0%	(12/20)	<u>F. crookwellense</u>	45.0%	(9/20)
<u>F. tumidum</u>	80.0%	(16/20)	<u>F. avenaceum</u>	70.0%	(14/20)	<u>F. xyloarioides</u>	60.0%	(12/20)	<u>F. reticulatum</u>	45.0%	(9/20)
<u>F. sambucinum</u>	80.0%	(16/20)	<u>F. scirpi</u>	70.0%	(14/20)	<u>F. chlamydosporum</u>	60.0%	(12/20)	<u>F. larvarum</u>	40.0%	(8/20)
<u>F. beoforme</u>	80.0%	(16/20)	<u>F. anthophilum</u>	65.0%	(13/20)	<u>F. heterosporum</u>	60.0%	(12/20)	<u>F. dimerum</u>	40.0%	(8/20)
<u>F. sporotrichioides</u>	75.0%	(15/20)	<u>F. graminearum</u>	65.0%	(13/20)	<u>F. proliferatum</u>	60.0%	(12/20)	<u>F. merismoides</u>	35.0%	(7/20)
<u>F. dlamini</u>	75.0%	(15/20)	<u>F. iricinatum</u>	65.0%	(13/20)	<u>F. camploeras</u>	60.0%	(12/20)	<u>F. aquaeductuum</u>	35.0%	(7/20)
<u>F. equiseti</u>	75.0%	(15/20)	<u>F. semitectum</u>	65.0%	(13/20)	<u>F. nivale</u>	55.0%	(11/20)	<u>F. tabacinum</u>	30.0%	(6/20)
<u>F. polyphialidicum</u>	70.0%	(14/20)	<u>F. subglutinans</u>	65.0%	(13/20)	<u>F. graminum</u>	55.0%	(11/20)			
<u>F. poae</u>	70.0%	(14/20)	<u>F. decencellulare</u>	60.0%	(12/20)	<u>F. compactum</u>	55.0%	(11/20)			
<u>F. nygamai</u>	70.0%	(14/20)	<u>F. culmorum</u>	60.0%	(12/20)	<u>F. coccophilum</u>	55.0%	(11/20)			

NOTES ON THE SPECIES

*Fusarium oxysporum* Schlecht.Section: *Elegans*

Diagnostic characters

Macroconidia of type C, straight. Microconidia usually comma shaped or ellipsoidal. Chlamydospores usually produced singly or in pairs.

Notes

This species is divided into many *formae speciales* that cannot be distinguished using morphological criteria. It is distinguished easily from *F. solani* by the shorter phialides in the aerial mycelium.

References

- Nelson, Toussoun and Marasas. 1983. p. 142.
Booth. 1971. p. 130.
Gerlach and Nirenberg. 1982. p. 345.
Burgess, Liddell and Summerell. 1988. p. 100.

Fusarium Interactive Key



Colony

Conidial Mass on PDA, SNA or
CLA:

- blank
- cream coloured
- orange
- yellow
- tan or brown
- reddish brown
- with bluish tones
- yeast-like

Reverse on PDA:

- blank
- colourless to cream
- tan to brown
- orange
- red
- purple

Colony diameter after 10 days
PDA:

- blank
- < 3 cm
- 3-7 cm
- > 7 cm

Aerial mycelium on PDA:

- blank
- present or abundant
- absent or sparse

Odour

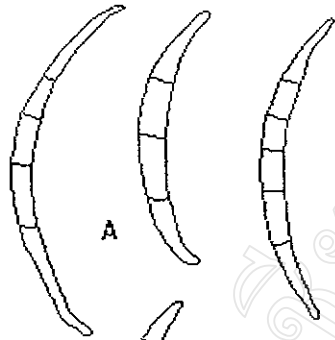
- blank
- fruity
- like lilac
- musky



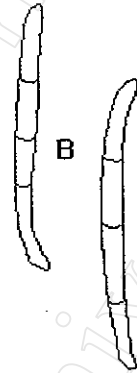
Macronidia

Macroconidia shape

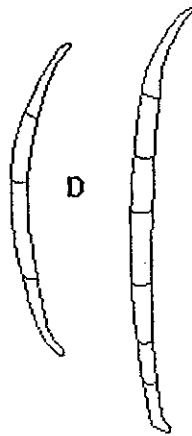
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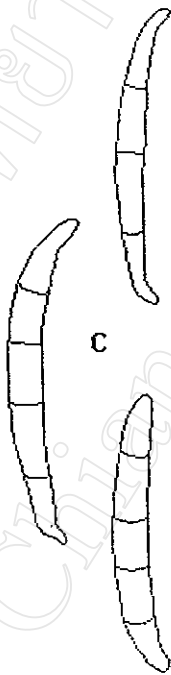
B



D

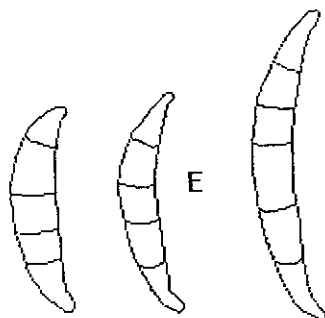


C

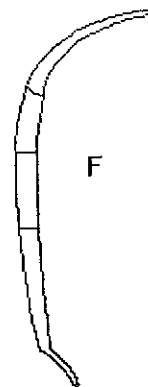


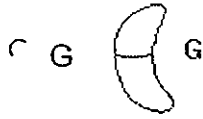
D

E



F





Average length of macroconidia (um):

Average width of macroconidia (um):

Average number of septa:

Widest part of macroconidia:

- at or near centre
- above centre
- below centre



Apical/Basal cell

Apical cell length

- < penultimate cell
- = penultimate cell
- 1.5 - 2x longer than penultimate cell
- >2x longer than penultimate cell

Apical cell shape

- conical
- hooked
- blunt
- nipple-like

Basal cell shape

- Notched or foot shaped
- No foot
- Basal cell with extension > 2 um
- with papilla



Microconidia

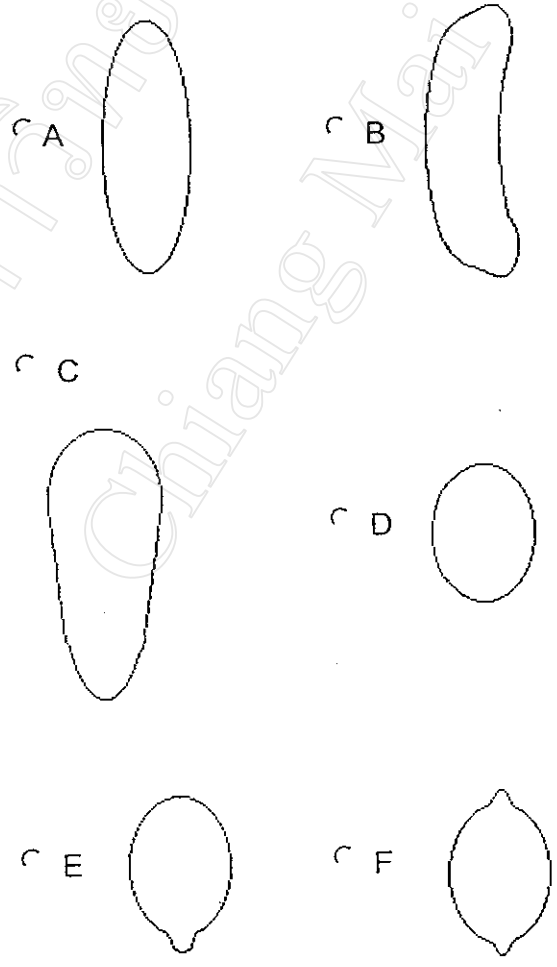
Microconidia in aerial mycelium

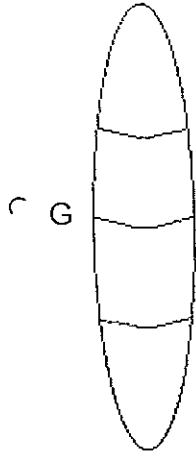
- absent or sparse
- present or abundant

Conidiophores

- microconidiophores monophialidic
- microconidiophores long and narrow mycelium
- microconidiophores mono- and polyphialidic
- phialides with wavy apex
- macroconidia produced with polyphialides

Shape





Chlamydospores

Known from

- absent
- present

- formed in chains
- not formed in chains
- single/paired
- chained
- in macroconidia

- corn
- wheat
- soil
- roots
- scale insects
- trees or bark
- other grains

Origin

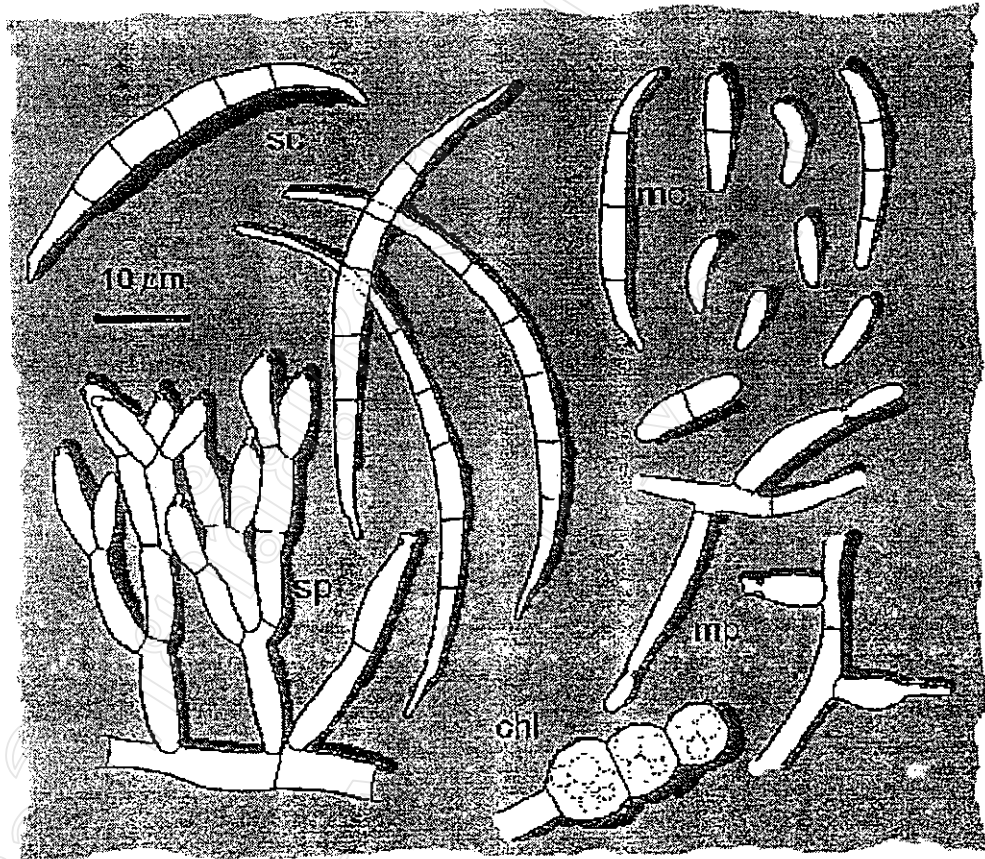
- Temperate
- Tropical

Identify

Identify new isolate

Genus species	% matches										
<i>F. equiseti</i>	77.8%	(14/18)	<i>F. moniliforme</i>	61.1%	(11/18)	<i>F. chlamydosporum</i>	50.0%	(9/18)	<i>F. decemcellulare</i>	38.9%	(7/18)
<i>F. acuminatum</i>	72.2%	(13/18)	<i>F. campoceras</i>	61.1%	(11/18)	<i>F. lateritium</i>	50.0%	(9/18)	<i>F. reticulatum</i>	38.9%	(7/18)
<i>F. solani</i>	72.2%	(13/18)	<i>F. beoforme</i>	61.1%	(11/18)	<i>F. compactum</i>	50.0%	(9/18)	<i>F. crookwellense</i>	38.9%	(7/18)
<i>F. sambucinum</i>	72.2%	(13/18)	<i>F. longipes</i>	61.1%	(11/18)	<i>F. nivale</i>	50.0%	(9/18)	<i>F. coccophitum</i>	33.3%	(6/18)
<i>F. oxysporum</i>	72.2%	(13/18)	<i>F. semitectum</i>	61.1%	(11/18)	<i>F. graminum</i>	50.0%	(9/18)	<i>F. dinnerum</i>	33.3%	(6/18)
<i>F. avenaceum</i>	66.7%	(12/18)	<i>F. graminearum</i>	55.6%	(10/18)	<i>F. anthophilum</i>	50.0%	(9/18)	<i>F. aquaeductuum</i>	27.8%	(5/18)
<i>F. tumidum</i>	66.7%	(12/18)	<i>F. tricinatum</i>	55.6%	(10/18)	<i>F. polyphialidicum</i>	44.4%	(8/18)	<i>F. tabacinum</i>	27.8%	(5/18)
<i>F. poae</i>	66.7%	(12/18)	<i>F. dlamini</i>	55.6%	(10/18)	<i>F. xylarioides</i>	44.4%	(8/18)	<i>F. larvarum</i>	22.2%	(4/18)
<i>F. scirpi</i>	66.7%	(12/18)	<i>F. napiforme</i>	55.6%	(10/18)	<i>F. proliferatum</i>	44.4%	(8/18)			
<i>F. culmorum</i>	61.1%	(11/18)	<i>F. sporotrichioides</i>	55.6%	(10/18)	<i>F. merismoides</i>	44.4%	(8/18)			
<i>F. nygamai</i>	61.1%	(11/18)	<i>F. subglutinans</i>	50.0%	(9/18)	<i>F. heterosporum</i>	44.4%	(8/18)			

NOTES ON THE SPECIES

*Fusarium equiseti* (Corda) Sacc.Section: *Gibbosum*Teleomorph: *Gibberella intricans* Wollenw.

Notes

Chlamydospores form better without UV light. Main difference from *F. acuminatum* - colonies red on PDA.
Macroconidia in aerial mycelium extremely variable.

References

- Nelson, Toussoun and Marasas. 1983. p. 89.
Booth. 1971. p. 157.
Gerlach and Nirenberg. 1982. p. 177.
Burgess, Liddell and Summerell. 1988. p. 140.

Fusarium Interactive Key



Colony

Conidial Mass on PDA, SNA or

CLA:

- blank
- cream coloured
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- yellow
- tan or brown
- reddish brown
- with bluish tones
- yeast-like

Reverse on PDA:

- blank
- colourless to cream
- tan to brown
- orange
- red
- purple

Colony diameter after 10 days

PDA:

- blank
- < 3 cm
- 3-7 cm
- > 7 cm

Aerial mycelium on PDA:

- blank
- present or abundant
- absent or sparse

Odour

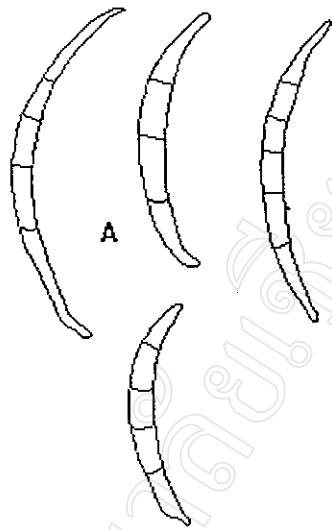
- blank
- fruity
- like lilac
- musky



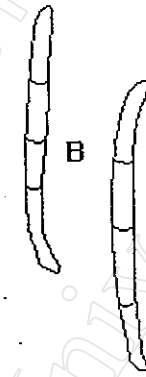
Macronidia

Macroconidia shape

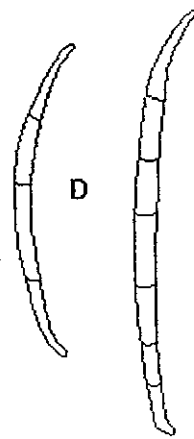
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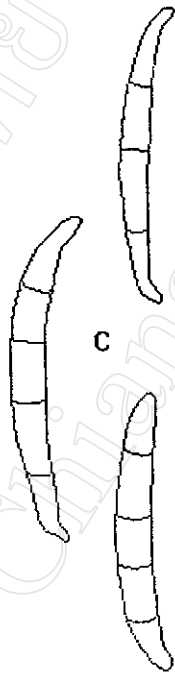
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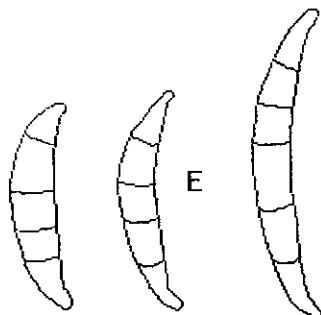
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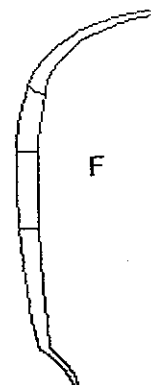
C

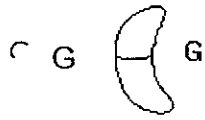


E



F





Average length of macroconidia (μm):

Average width of macroconidia (μm):

Average number of septa:

Widest part of macroconidia:

- at or near centre
- above centre
- below centre

 Apical/Basal cell

Apical cell length

- < penultimate cell
- = penultimate cell
- 1.5 - 2x longer than penultimate cell
- >2x longer than penultimate cell

Apical cell shape

- conical
- hooked
- blunt
- nipple-like

Basal cell shape

- Notched or foot shaped
- No foot
- Basal cell with extension > 2 μm
- with papilla

 Microconidia

Microconidia in aerial mycelium

Conidiophores

- absent or sparse
- present or abundant

- microconidiophores monophialidic
- microconidiophores long and narrow

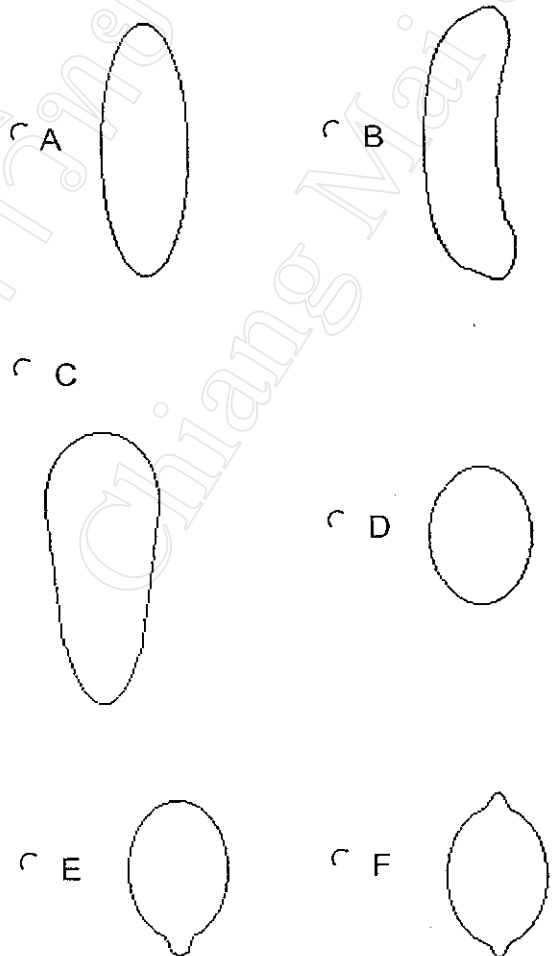
mycelium

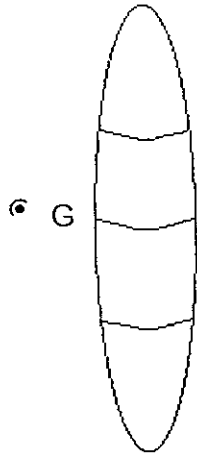
- microconidiophores mono- and polyphialidic

- phialides with wavy apex

- macroconidia produced with polyphialides

Shape





Chlamydospores

Known from

- absent
- present

- formed in chains
- not formed in chains
- single/paired
- chained
- in macroconidia

- corn
- wheat
- soil
- roots
- scale insects
- trees or bark
- other grains

Origin

- Temperate
- Tropical

Identify

Identify new isolate

Genus species	% matches										
<u>F. semitectum</u>	73.7%	(14/19)	<u>F. nivale</u>	63.2%	(12/19)	<u>F. graminum</u>	52.6%	(10/19)	<u>F. reticulatum</u>	42.1%	(8/19)
<u>F. camptoceras</u>	68.4%	(13/19)	<u>F. tumidum</u>	63.2%	(12/19)	<u>F. anthropitum</u>	52.6%	(10/19)	<u>F. decemcellulare</u>	42.1%	(8/19)
<u>F. sporotrichioides</u>	68.4%	(13/19)	<u>F. proliferatum</u>	57.9%	(11/19)	<u>F. heterosporum</u>	47.4%	(9/19)	<u>F. lateritium</u>	42.1%	(8/19)
<u>F. nygamai</u>	68.4%	(13/19)	<u>F. equiseti</u>	57.9%	(11/19)	<u>F. crookwellense</u>	47.4%	(9/19)	<u>F. coccophillum</u>	36.8%	(7/19)
<u>F. sambucinum</u>	68.4%	(13/19)	<u>F. subglutinans</u>	57.9%	(11/19)	<u>F. compactum</u>	47.4%	(9/19)	<u>F. aquaeductuum</u>	36.8%	(7/19)
<u>F. solani</u>	63.2%	(12/19)	<u>F. moniliforme</u>	57.9%	(11/19)	<u>F. acuminatum</u>	47.4%	(9/19)	<u>F. larvarum</u>	36.8%	(7/19)
<u>F. scirpi</u>	63.2%	(12/19)	<u>F. chlamyosporum</u>	57.9%	(11/19)	<u>F. longipes</u>	47.4%	(9/19)	<u>F. merismoides</u>	36.8%	(7/19)
<u>F. oxysporum</u>	63.2%	(12/19)	<u>F. beoforme</u>	57.9%	(11/19)	<u>F. polyphialidicum</u>	47.4%	(9/19)	<u>F. tabacinum</u>	31.6%	(6/19)
<u>F. avenaceum</u>	63.2%	(12/19)	<u>F. xylerioides</u>	57.9%	(11/19)	<u>F. tricinclum</u>	47.4%	(9/19)			
<u>F. culmorum</u>	63.2%	(12/19)	<u>F. graminearum</u>	57.9%	(11/19)	<u>F. diamini</u>	47.4%	(9/19)			
<u>F. napiforme</u>	63.2%	(12/19)	<u>F. poae</u>	57.9%	(11/19)	<u>F. dipterum</u>	47.4%	(9/19)			

ภาคผนวก ข

ตารางที่ 1 ผลการวิเคราะห์ประสิทธิภาพของเชื้อราที่แยกได้จากเมล็ดถั่วเหลืองในการยับยั้งการเจริญเติบโตของเชื้อรา *Colletotrichum truncatum* สาเหตุโรคแอนแทรกคโนสของถั่วเหลือง หลังจากวางเชื้อ 7, 9 และ 12 วัน

Source of variation	Degree of freedom	Mean Square
Date (A)	2	1.9131E + 04 *
Error (a)	12	97.970
Pathogen (B)	16	5600.9 *
Date + Pathogen (A x B)	32	163.64 *
Error (b)	192	6.8870
TOTAL	254	
Grand average	1	
C.V. (a) = 22.73 %	C.V. = 6.02 %	

* แสดงอย่างมีนัยสำคัญทางสถิติที่ระดับความเชื่อมั่น 95 %

ตารางที่ 2 ผลการวิเคราะห์เปอร์เซ็นต์ความงอกของเมล็ดถั่วเหลืองพันธุ์ ชม.2 ที่ปลูกด้วยเชื้อราปฏิปักษ์ *Trichoderma* sp. เปรียบเทียบกับชุดควบคุม

Source	DF	SS	MS	F	P
Germination	1	49.000	49.000	20.79	0.0004
Error	14	33.000	2.3571		
Total	15	82.000			

C.V. (%) 3.30

ตารางที่ 3 ผลการวิเคราะห์อัตราการผลิตของต้นกล้าถั่วเหลืองพันธุ์ ชม.2 ที่ปลูกด้วยเชื้อราปฏิปักษ์ *Trichoderma* sp. เปรียบเทียบกับชุดควบคุม

Source	DF	SS	MS	F	P
Growth	1	1.1902E-01	1.1902E-01	0.00	0.9699
Error	14	1127.4	80.532		
Total	15	1127.6			
C.V. (%)	8.15				

ตารางที่ 4 ผลการวิเคราะห์อัตราการผลิตใบโตของรากถั่วเหลืองพันธุ์ ชม.2 ที่ปลูกด้วยเชื้อราปฏิปักษ์ *Trichoderma* sp. เปรียบเทียบกับชุดควบคุม

Source	DF	SS	MS	F	P
Root length	1	65.975	65.975	26.38	0.0002
Error	14	35.019	2.5013		
Total	15	100.99			
C.V. (%)	9.49				

ตารางที่ 5 ผลการวิเคราะห์เปรียบเทียบผลของเชื้อราปฏิปักษ์ *Trichoderma* sp. ต่อน้ำหนักสดและน้ำหนักแห้งของต้นกล้าถั่วเหลืองพันธุ์ ชม.2

Source	DF	SS	MS	F	P
Fresh weights	1	255.49	255.49	2.09	0.1981
Error	6	732.47	122.08		
Total	7	987.97			
C.V. (%)	9.68				

Source	DF	SS	MS	F	P
Dry weights	1	4.4402	4.4402	5.87	0.0516
Error	6	4.5370	7.5617E-01		
Total	7	8.9772			
C.V. (%)	9.57				

ตารางที่ 6 ผลการวิเคราะห์ผลของเชื้อราปฏิปักษ์ *Trichoderma* sp. ต่อความงอก การตายก่อนงอก ต้นกล้าปกติ และต้นกล้าไม่ปกติ เปรียบเทียบกับ ชุดควบคุม เมื่อปลูกในโรงเรือนที่อายุ 7 วัน

Source	DF	SS	MS	F	P
Germination	1	4.9701E-29	4.9701E-29	0.00	1.0000
Error	6	15.500	2.5833		
Total	7	15.500			

C.V. (%) 1.65

Source	DF	SS	MS	F	P
Pre-emergence	1	2.7733E-32	2.7733E-32	0.00	1.0000
Error	6	15.500	2.5833		
Total	7	15.500			

C.V. (%) 58.45

Source	DF	SS	MS	F	P
Seedling normal	1	6.1250	6.1250	0.90	0.3790
Error	6	40.750	6.7917		
Total	7	46.875			
C.V. (%)	4.85				

Source	DF	SS	MS	F	P
Seedling abnormal	1	6.1250	6.1250	0.88	0.3843
Error	6	41.750	6.9583		
Total	7	47.875			
C.V. (%)	49.08				

ตารางที่ 7 ผลการวิเคราะห์เปรียบเทียบเปอร์เซ็นต์ความงอก การตายก่อนงอก-หลังงอก ต้นกล้าปกติ และต้นกล้าไม่ปกติ ของเมล็ดถั่วเหลืองพันธุ์ชม.2 ในแต่ละกรรมวิธี ภายหลังจากถั่วเหลืองในโรงเรือน

Source	DF	SS	MS	F	P
Germination	4	389.80	97.450	13.69	0.0001
Error	15	106.75	7.1167		
Total	19	496.55			
C.V. (%)	2.84				

Source	DF	SS	MS	F	P
Pre-emergence	4	92.500	23.125	5.48	0.0063
Error	15	63.250	4.2167		
Total	19	155.75			

C.V. (%) 54.76

Source	DF	SS	MS	F	P
Post-emergence	4	512.20	128.05	66.81	0.0000
Error	15	28.750	1.9167		
Total	19	540.95			

C.V. (%) 30.43

Source	DF	SS	MS	F	P
Seedling normal	4	3.1530E+04	7882.4	1176.47	0.0000
Error	15	100.50	6.7000		
Total	19	3.1630E+04			

C.V. (%) 4.04

Source	DF	SS	MS	F	P
Seedling abnormal	4	2.2266E+04	5566.4	387.45	0.0000
Error	15	215.50	14.367		
Total	19	2.2481E+04			

C.V. (%) 12.98

ตารางที่ 8 ผลการวิเคราะห์ความยาวรากและ ยอดอ่อนของต้นกล้าถั่วเหลืองพันธุ์ ชม.2
ที่อายุ 14 วัน เปรียบเทียบแต่ละกรรมวิธี

Source	DF	SS	MS	F	P
Shoot length	4	1355.3	338.83	169.58	0.0000
Error	15	29.971	1.9981		
Total	19	1385.3			
C.V. (%)	4.92				

Source	DF	SS	MS	F	P
Root length	4	161.21	40.304	31.07	0.0000
Error	15	19.455	1.2970		
Total	19	180.67			
C.V. (%)	8.30				

ตารางที่ 9 ผลการวิเคราะห์การทดสอบประสิทธิภาพของเชื้อราปฏิปักษ์
Trichoderma sp. ในการควบคุมโรคแอนแทรคโนสของถั่วเหลือง
ในระยะต้นกล้าในโรงเรือน โดยวัดผลจากน้ำหนักสดและน้ำหนักแห้ง
ของต้นกล้าในแต่ละกรรมวิธี

Source	DF	SS	MS	F	P
Fresh weighth	4	1.2999E+04	3249.7	57.26	0.0000
Error	15	851.26	56.751		
Total	19	1.3850E+04			
C.V. (%)	8.96				

Source	DF	SS	MS	F	P
Dry weighth	4	101.29	25.322	50.17	0.0000
Error	15	7.5702	5.0468E-01		
Total	19	108.86			
C.V. (%)	9.30				

ประวัติผู้เขียน

ชื่อ นายสิทธิศักดิ์ แสนไพศาล
วัน เดือน ปีเกิด 3 เมษายน 2519
ประวัติการศึกษา สำเร็จการศึกษาชั้นมัธยมศึกษาตอนปลายที่โรงเรียน
ถ้อยคำหาญวารินชำราบ จ. อุบลราชธานี ปีการศึกษา 2537
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