RUTGERS
New Jersey Agricultural Experiment Station

The Biology of Turfgrass Anthracnose

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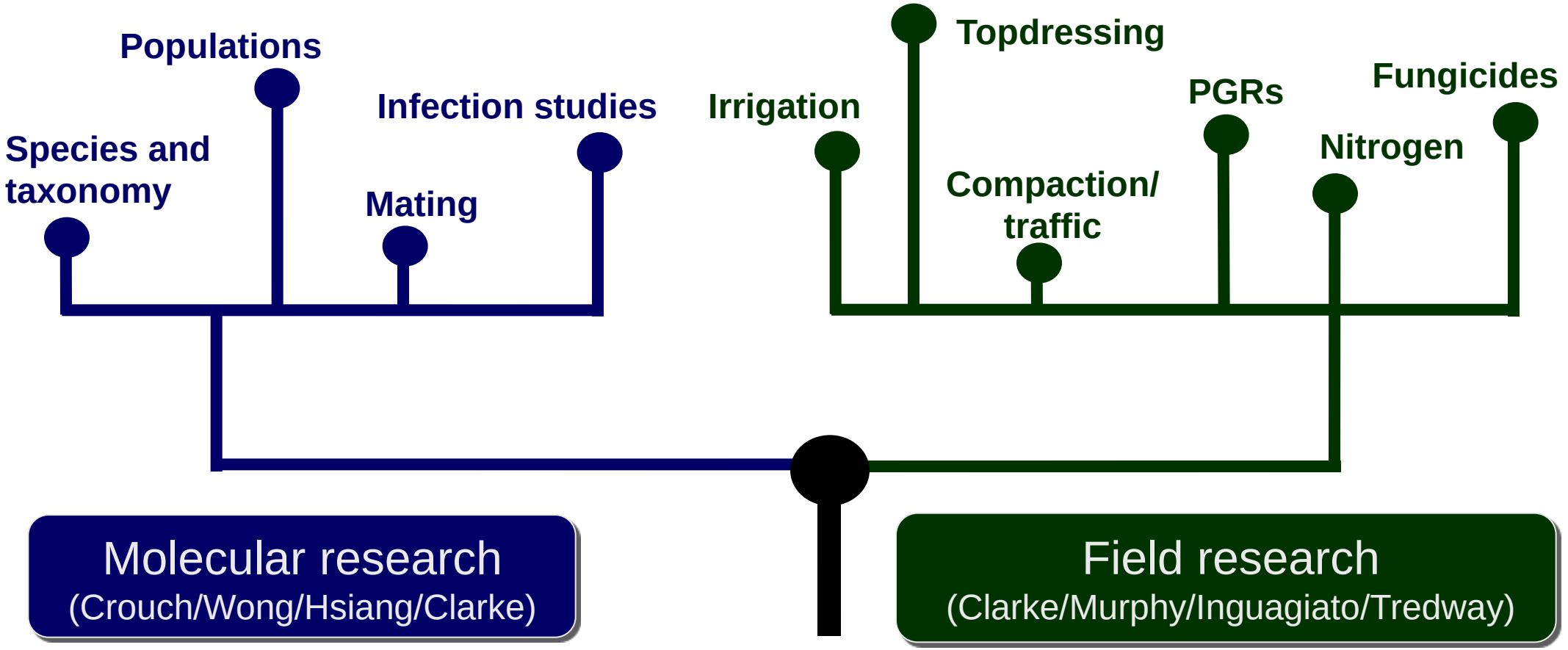
Anthracnose Becomes a Major Problem on Golf Courses in the US

- We saw a definite increase in the incidence and severity of anthracnose in the late 1990s on putting greens in the US.
- It was suggested that changes in *Management Practices* contributed to this phenomenon by increasing abiotic stress and thus predisposing turf to anthracnose
- *Over the past decade, scientists working on the NE-1025 Project have conducted research to better understand the biology and management of this* destructive disease.

Anthracnose Disease Research 2002 to Present

Population studies using DNA fingerprinting to understand the biology of the fungus

Best management practices for golf course superintendents



Molecular research
(Crouch/Wong/Hsiang/Clarke)

Field research
(Clarke/Murphy/Inguagiato/Tredway)

The Biology of Turfgrass Anthracnose

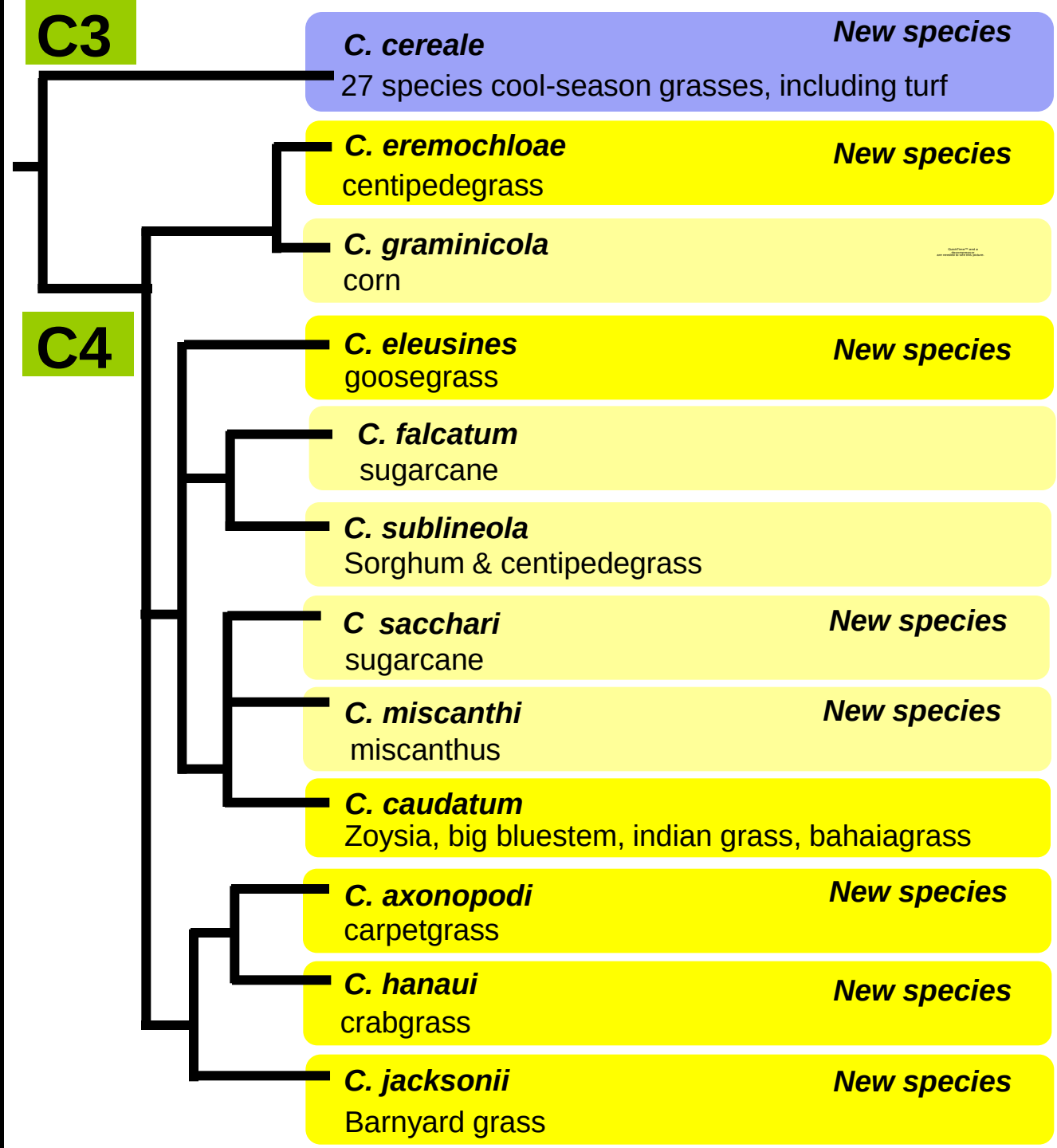
Overview

- Causal Agents of Anthracnose
- Host and Geographic Range
  - Anthracnose of cool-season turf
  - Anthracnose of warm-season turf
- Symptomology
  - Foliar blight vs basal rot anthracnose
- How the Anthracnose Fungus Infects Turf
- Factors Impacting Disease Severity

We used DNA fingerprinting to determine:

Anthracnose of cool-season turf is caused by *Colletotrichum cereale*

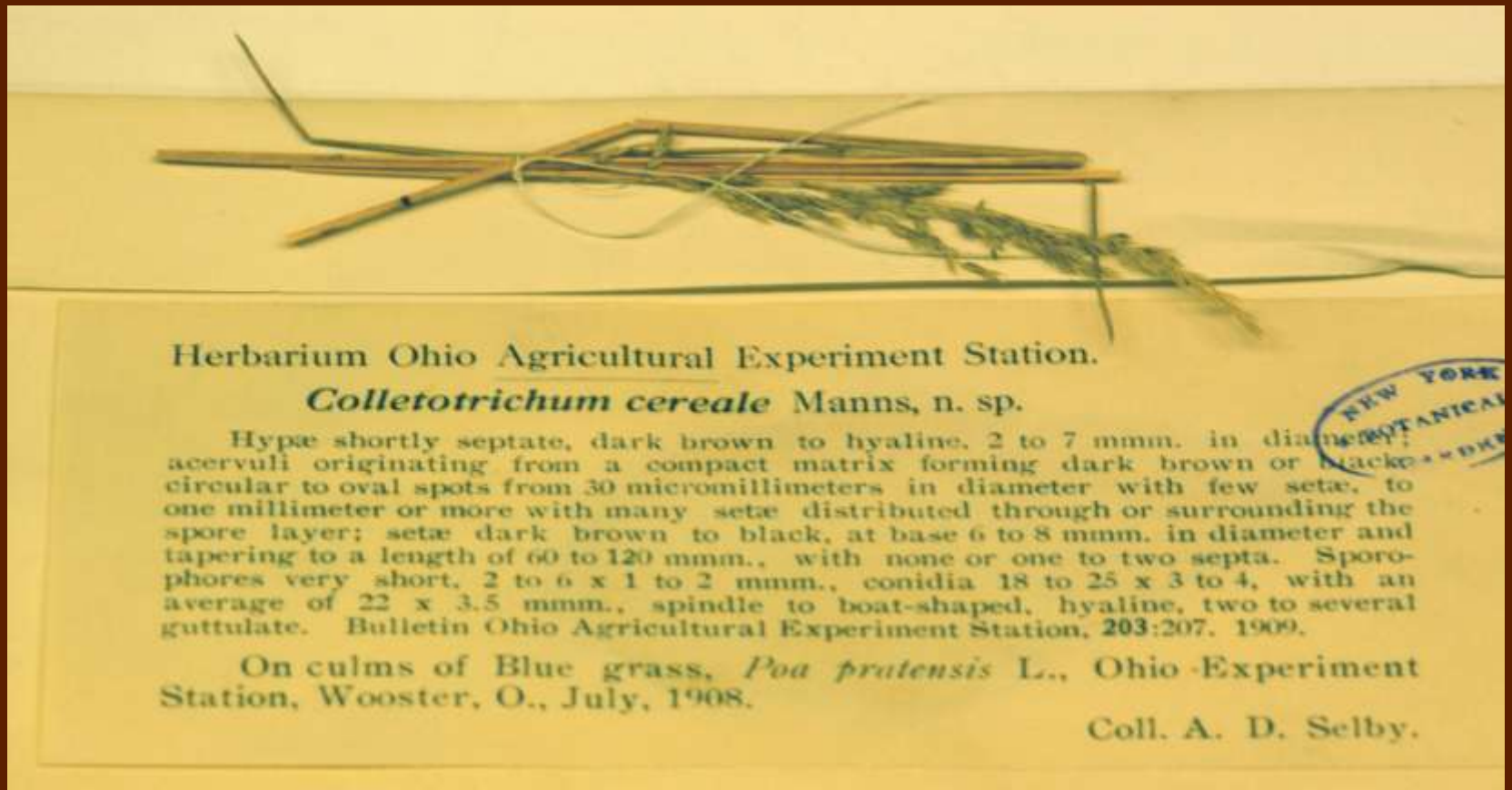
Anthracnose of warm-season grasses (turf, weeds and agronomic crops caused by other *Colletotrichum* species)



Anthracnose of Cool-Season Turfgrass

Colletotrichum cereale (2006 Crouch, Hillman, Clarke) (formerly known as *Colletotrichum graminicola*)

- Species name *C. cereale* first described in 1909 by Selby & Manns on several hosts including Kentucky Bluegrass and creeping bentgrass



Herbarium Ohio Agricultural Experiment Station.

Colletotrichum cereale Manns, n. sp.

Hypæ shortly septate, dark brown to hyaline, 2 to 7 mmm. in diameter; acervuli originating from a compact matrix forming dark brown or black circular to oval spots from 30 microniillimeters in diameter with few setæ, to one millimeter or more with many setæ distributed through or surrounding the spore layer; setæ dark brown to black, at base 6 to 8 mmm. in diameter and tapering to a length of 60 to 120 mmm., with none or one to two septa. Sporophores very short, 2 to 6 x 1 to 2 mmm., conidia 18 to 25 x 3 to 4, with an average of 22 x 3.5 mmm., spindle to boat-shaped, hyaline, two to several guttulate. Bulletin Ohio Agricultural Experiment Station, **203**:207. 1909.

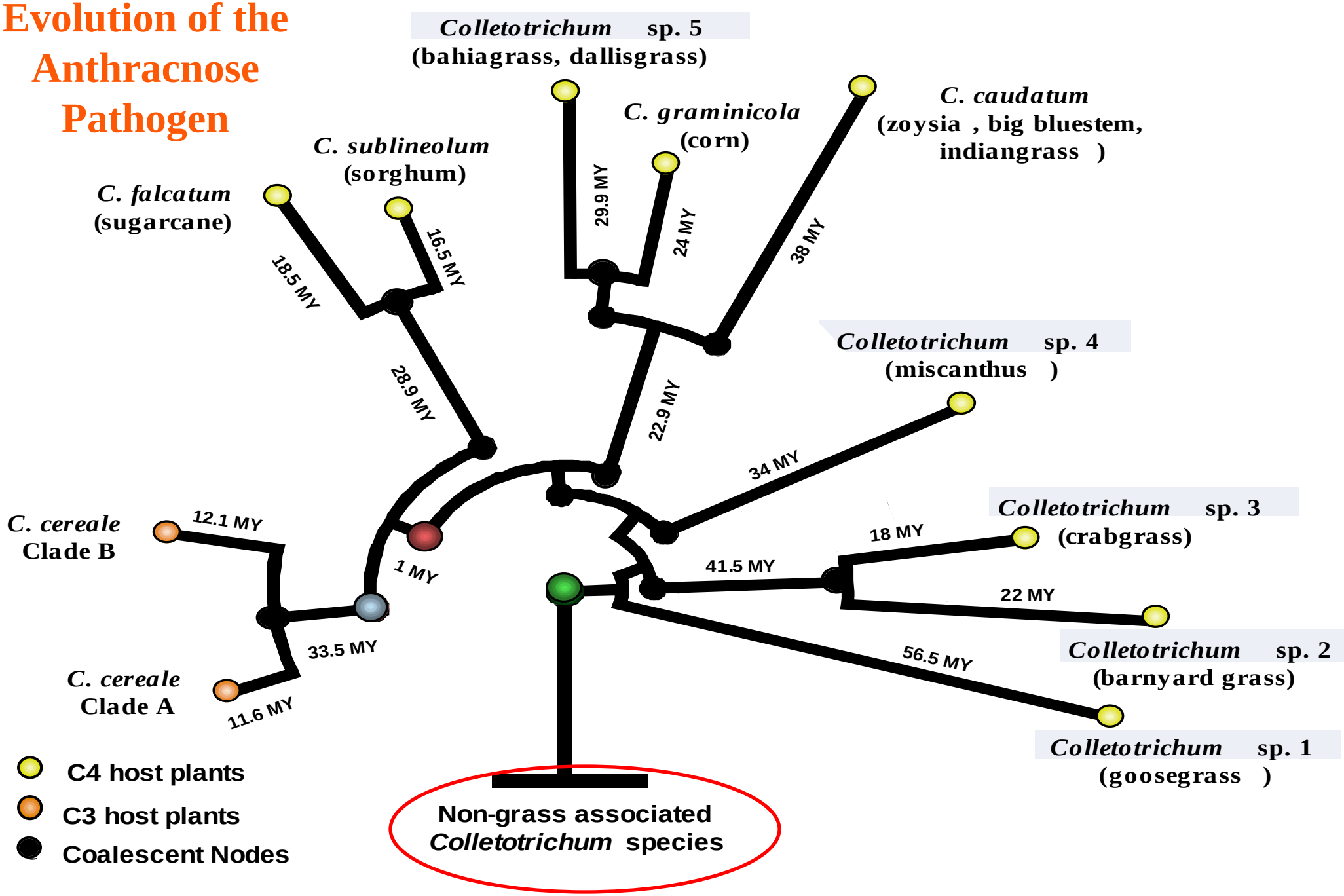
On culms of Blue grass, *Poa pratensis* L., Ohio Experiment Station, Wooster, O., July, 1908.

Coll. A. D. Selby.

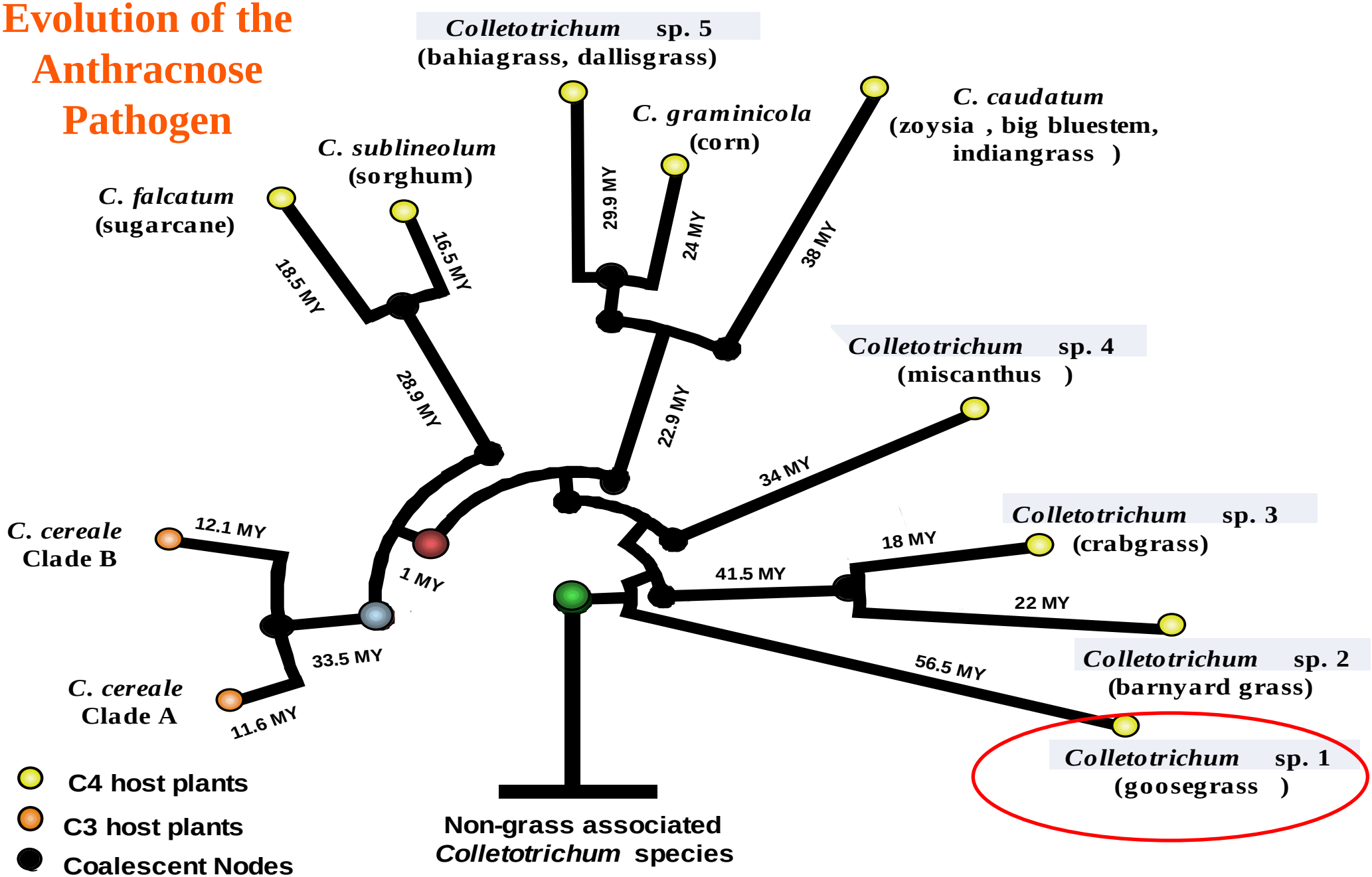
J. Crouch

Where Did Turfgrass Anthracnose Come From and When Did It First Appear ?

Evolution of the Anthracnose Pathogen



Evolution of the Anthracnose Pathogen



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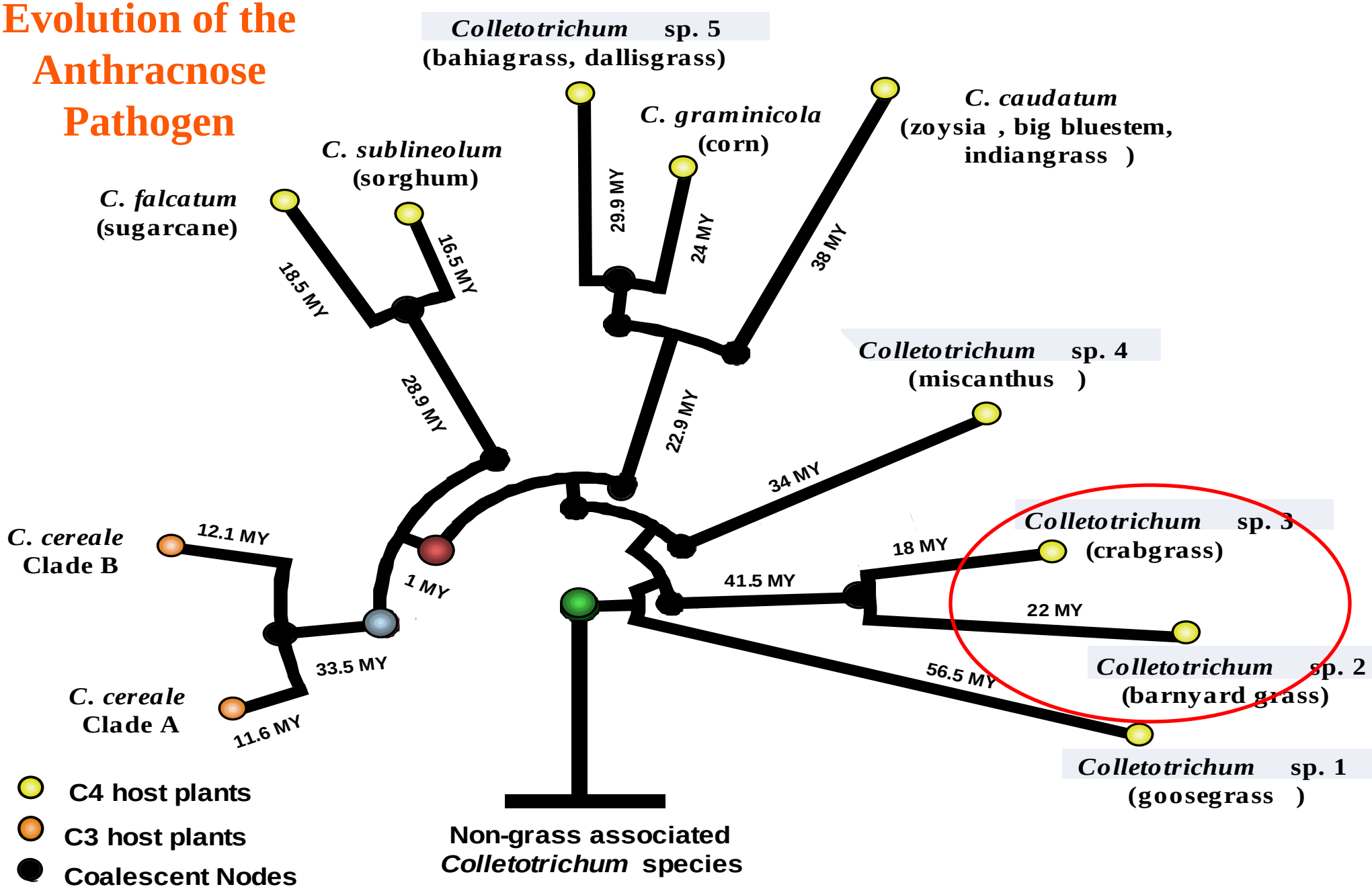

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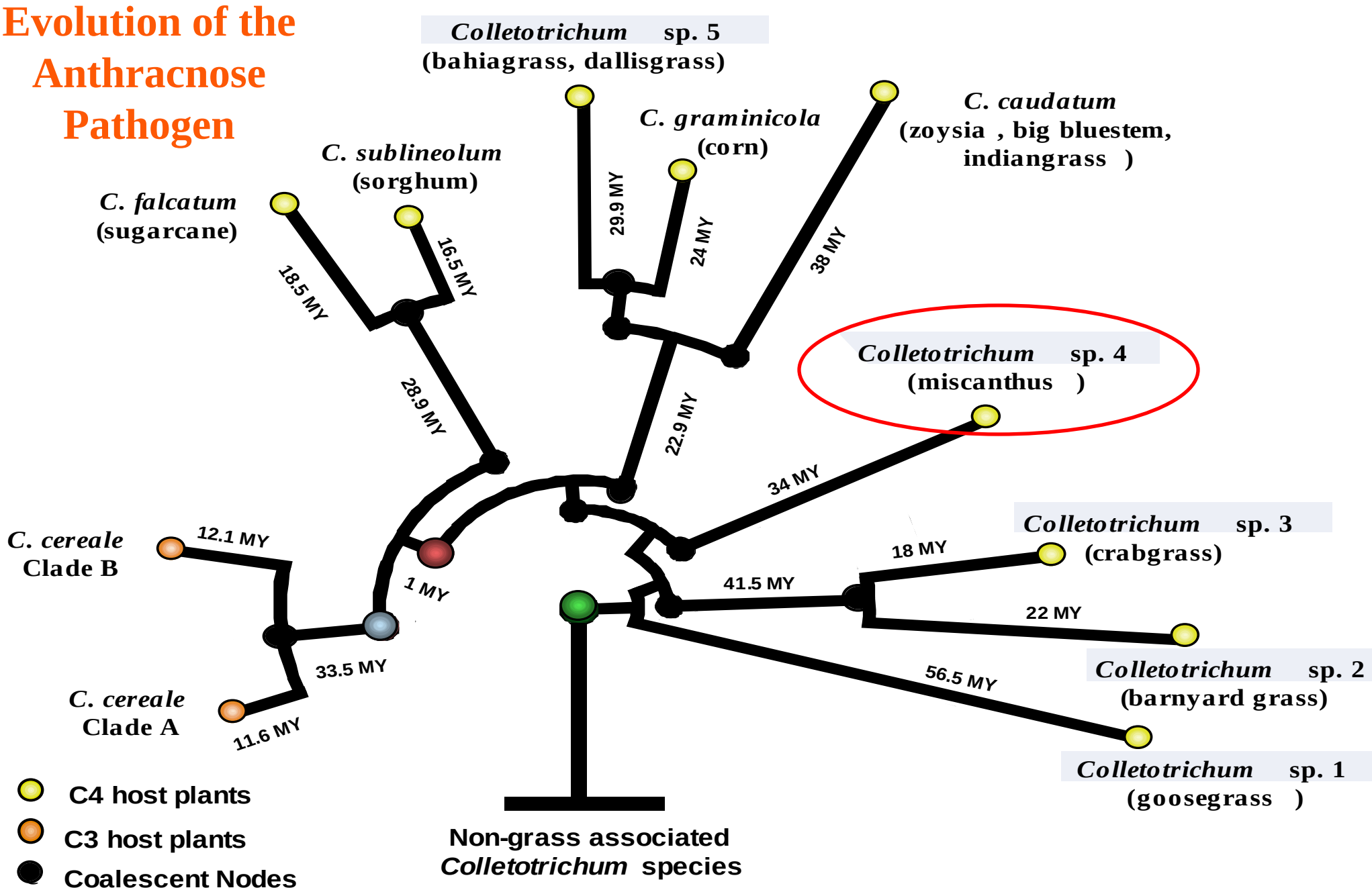

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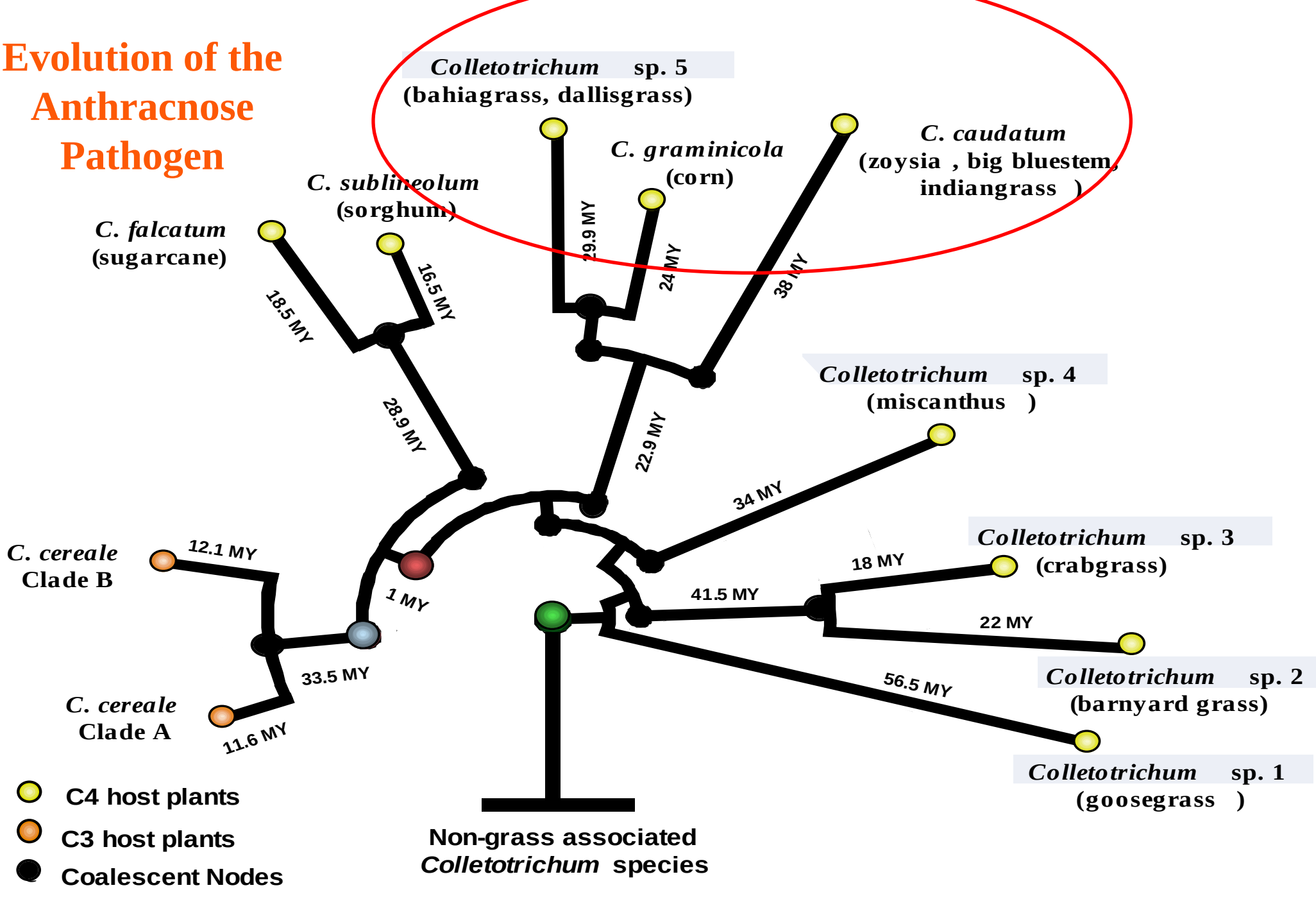
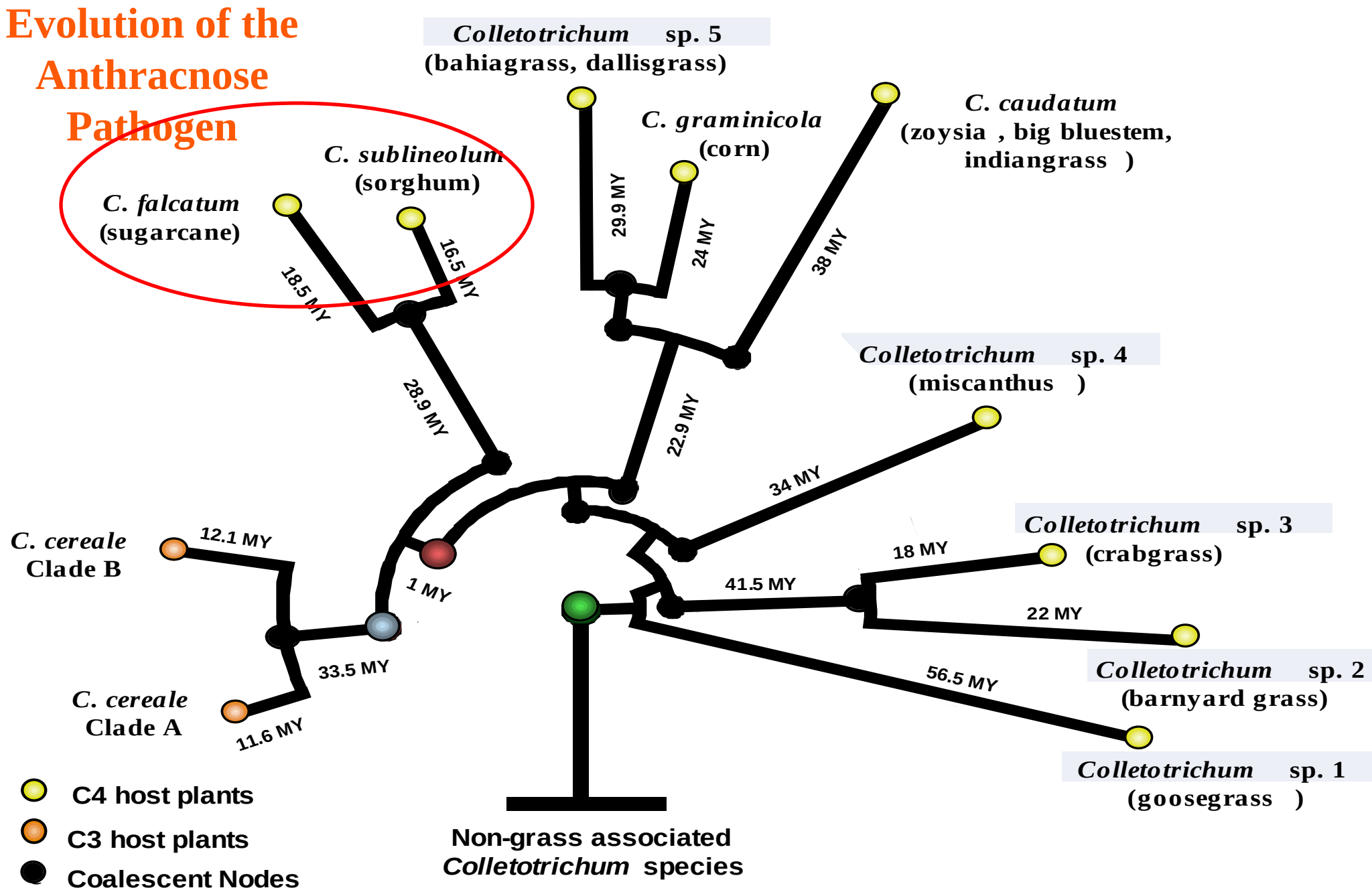
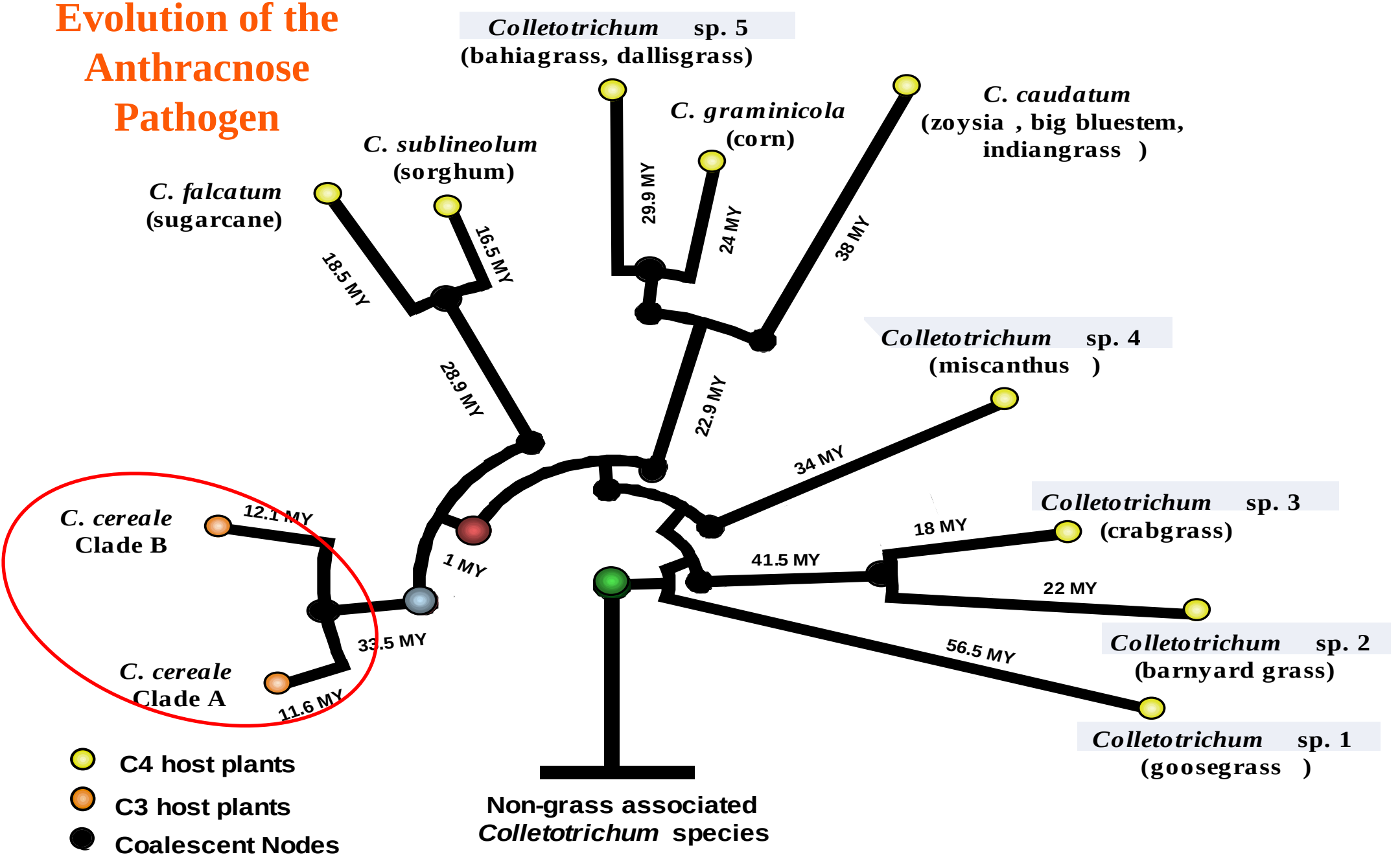
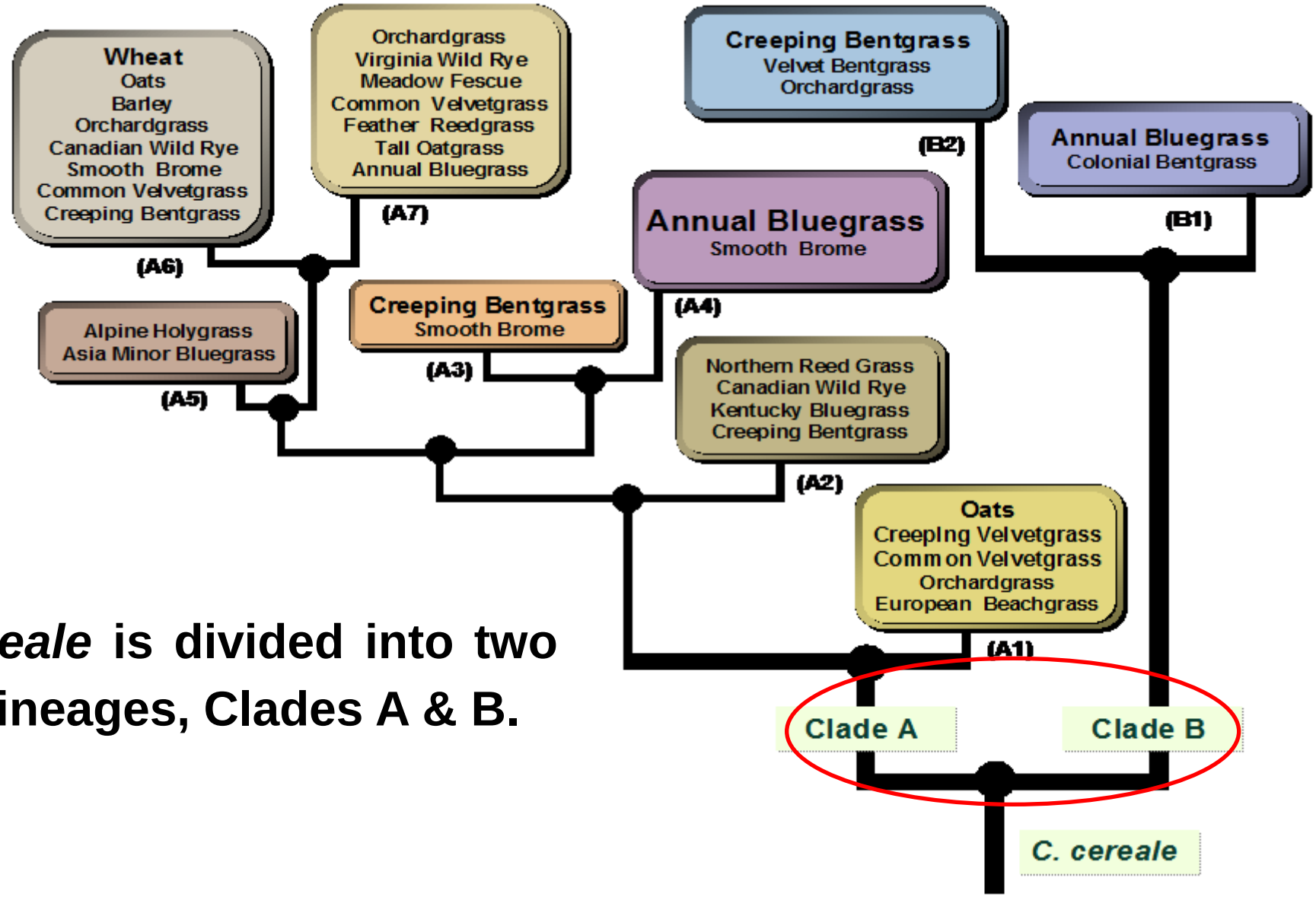



Evolution of the Anthracnose Pathogen
Colletotrichum sp. 5
(bahiagrass, dallisgrass)
C. graminicola
(corn)
C. caudatum
(zoysia , big bluestem, indiangrass)
C. sublineolum
(sorghum)
C. falcatum
(sugarcane)
29.9 MY
24 MY
38 MY
18.5 MY
16.5 MY
28.9 MY
22.9 MY
Colletotrichum sp. 4
(miscanthus)
34 MY
C. cereale
Clade B
12.1 MY
1 MY
Colletotrichum sp. 3
(crabgrass)
18 MY
41.5 MY
22 MY
33.5 MY
C. cereale
Clade A
11.6 MY
56.5 MY
Colletotrichum sp. 2
(barnyard grass)
Colletotrichum sp. 1
(goosegrass)
C4 host plants
C3 host plants
Coalescent Nodes
Non-grass associated
Colletotrichum species

Evolution of the Anthracnose Pathogen



How are turfgrass isolates of *C. cereale* related to the isolates of *C. cereale* that inhabit cereal crops and natural grasslands?



C. cereale **is divided into two main lineages, Clades A & B.**

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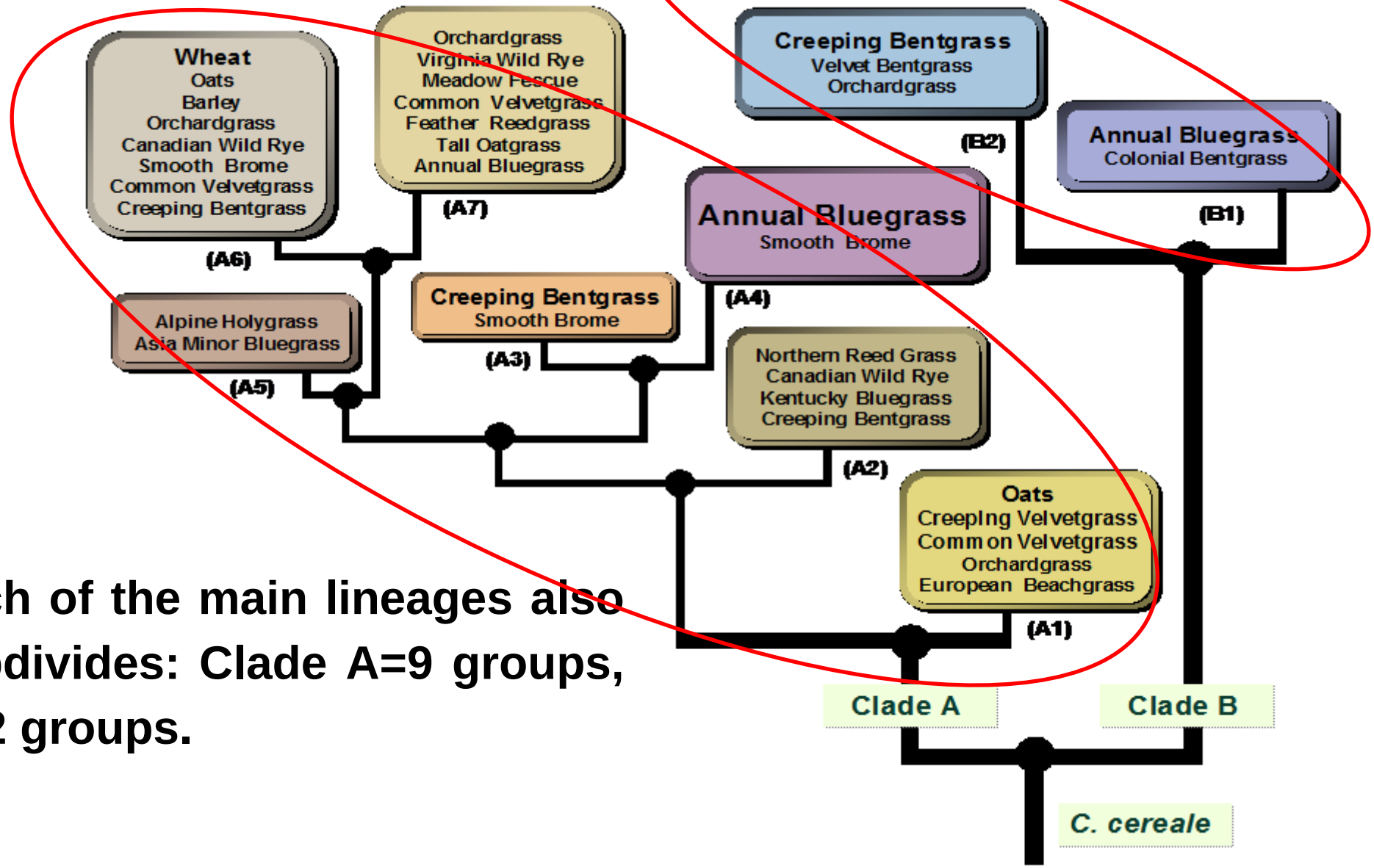

Each of the main lineages also subdivides: Clade A=9 groups, B=2 groups.

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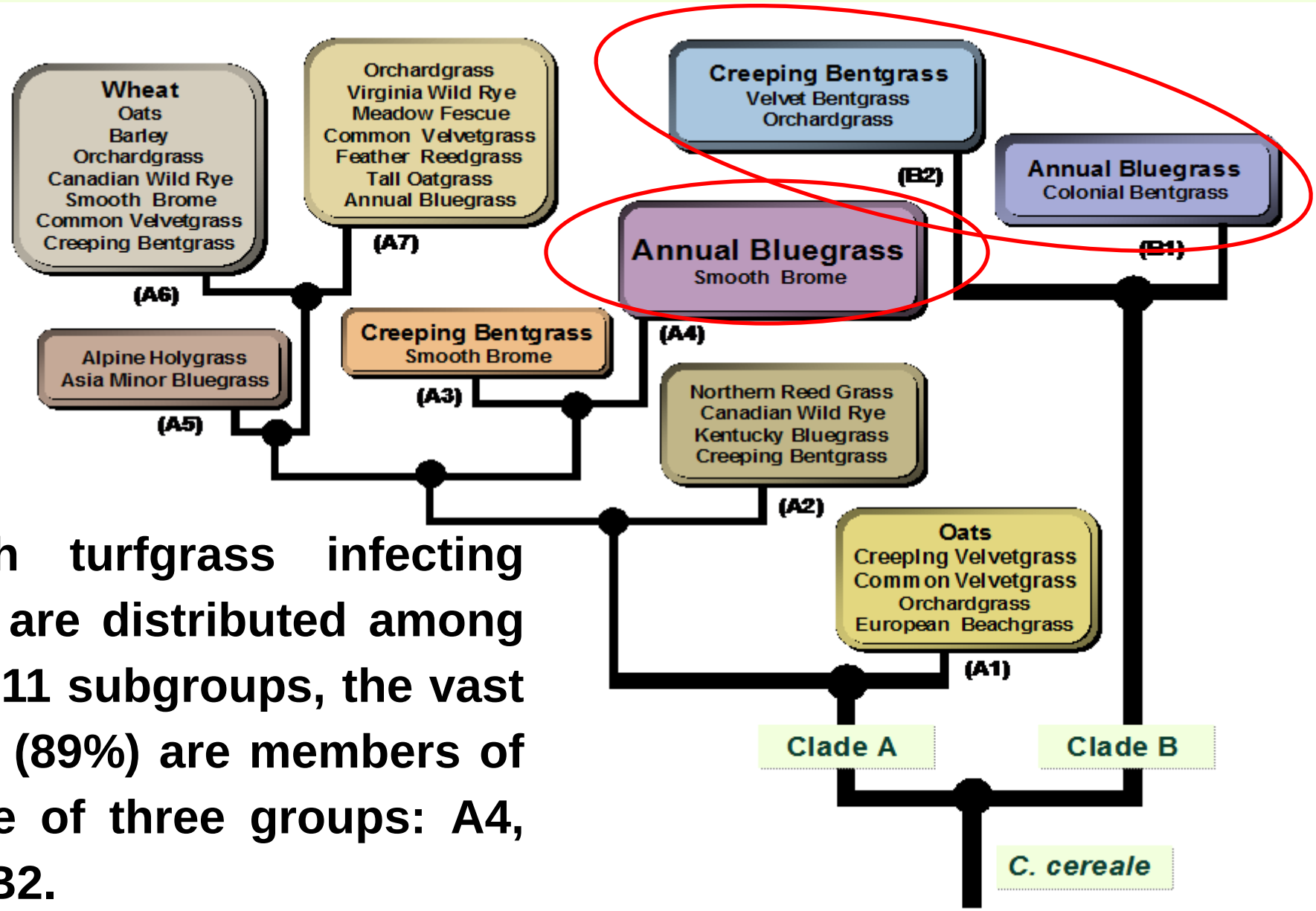

Although turfgrass infecting isolates are distributed among 7 of the 11 subgroups, the vast majority (89%) are members of only one of three groups: A4, B1 and B2.

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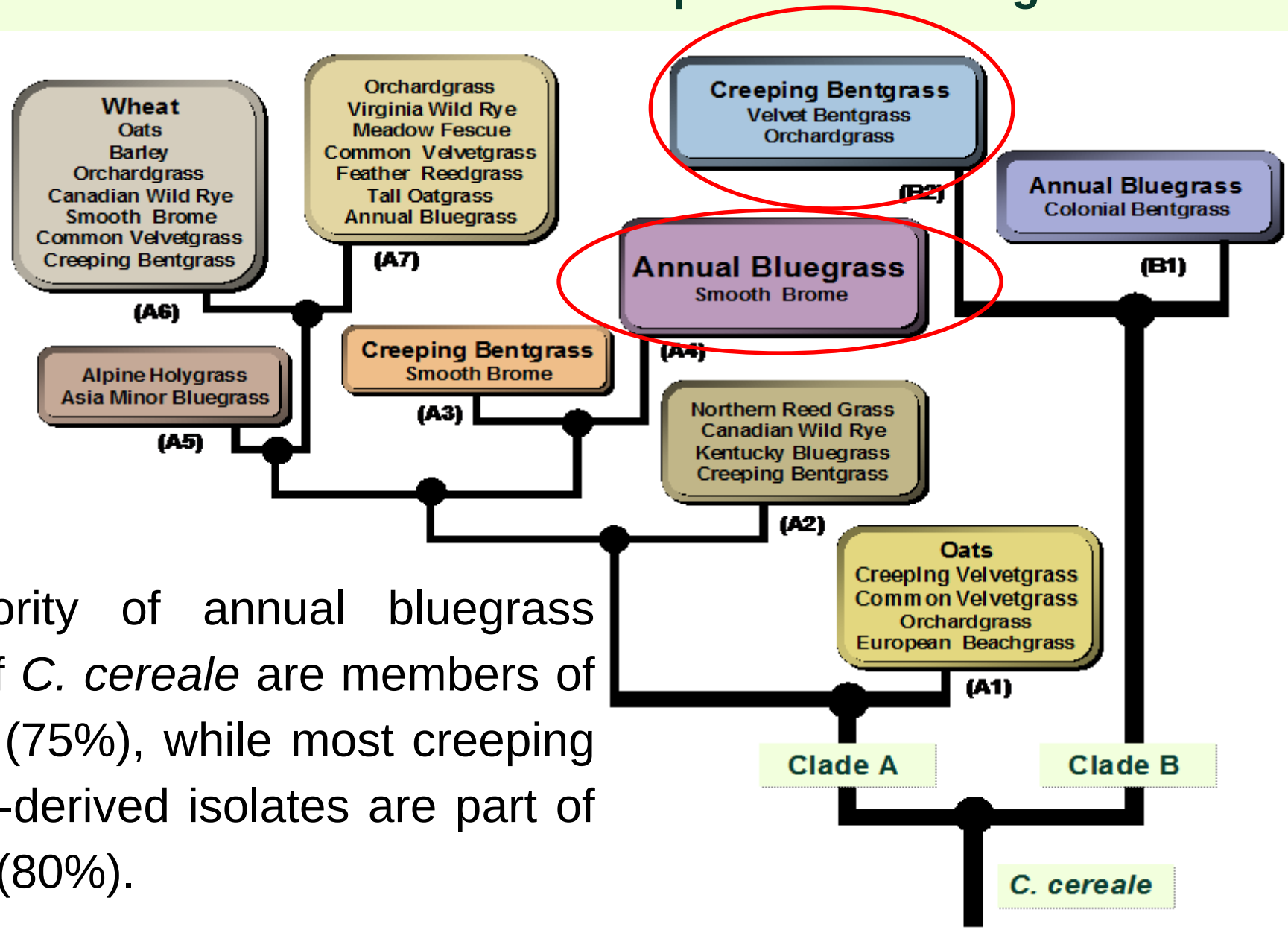

The majority of annual bluegrass isolates of *C. cereale* are members of group A4 (75%), while most creeping bentgrass-derived isolates are part of group B2 (80%).

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Anthracnose Disease of Turfgrass

- Can be found on cool- and warm-season turf in roughs, fairways and tees
- **Most destructive** on annual bluegrass maintained at putting green height of cut, although bentgrass is susceptable.

Anthracnose in Creeping Bentgrass

- Tolerant cultivars
  - Shark, Penneagle II, Runner, Penn A-1, A-2 Tyee
- Susceptible cultivars
  - Viper, Providence, Penncross, Brighton, Seaside II, Pennlinks II and Penn A-4

Anthracnose Disease of Turfgrass

- May also develop on cool-season turf such as ryegrasses, fine fescues, Kentucky bluegrass, and velvet bentgrass but is **rarely destructive** on these grasses

- Warm-season turf, such as Centipedegrass and Bermudagrass, also susceptible; **less common and less destructive**.

Colletotrichum cereale is present worldwide

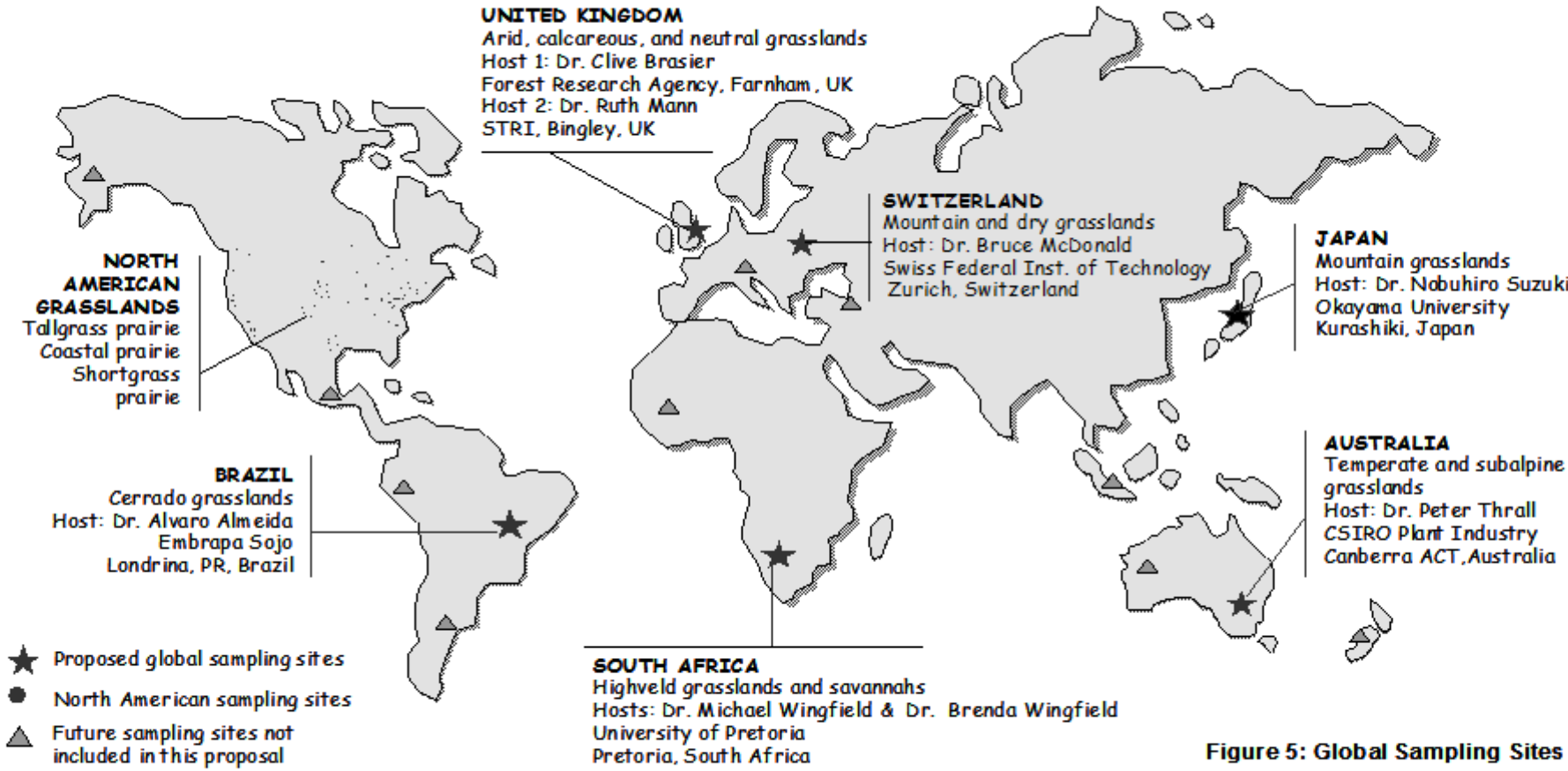

Figure 5: Global Sampling Sites

All grass communities are habitats for *C. cereale* including native grasses and agronomic crops

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Anthracnose Disease of Turfgrass

Symptoms Poa - yellow, irregular patches (0.25 to 0.5 in)

Bent - red to bronze patches (size varies)

Appearance Usually on greens

Most severe during warm weather, but outbreaks may occur throughout the year

Types or Phases Foliar blight (usually during heat stress)

Basal rot anthracnose (can occur anytime, sometimes appearing in late winter or early spring; becoming severe in summer and fall)

Initial symptoms of Anthracnose Foliar Blight

Anthracnose symptomology

Anthracnose Foliar Blight on *Poa*

Anthracnose symptomology

Anthracnose Foliar Blight on Creeping Bentgrass (Vincelli)

Anthracnose symptomology

Anthracnose Foliar Blight on *Poa (Stowell)*

Acervuli (reproductive structures), with setae (sterile hairs) protruding

Anthracnose Basal Rot Symptomology

Chlorotic Leaves

Acervuli on Infected *Poa annua* Tillers

Anthracnose symptomology

Anthracnose basal rot on *Poa*
(start 0.25-0.5 in. orange to yellow spots)

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General *Colletotrichum cereale* lifecycle

Lunate, gutulate conidia travel via wind and water to susceptible hosts

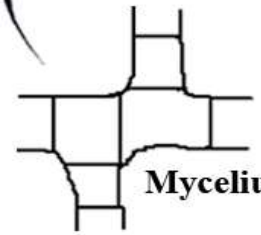
Conidia adhere, a germ tube develops, and the appresoria forms, leading to host penetration

Infection is favored by high temps (85-95° F)

Initially, a brief biotrophy phase occurs

Thin secondary hyphae form and the necrotrophic phase begins

Secondary inoculum continues to be produced



Mycelium

Acervuli with black, sterile setae produce numerous conidia

Fungus overwinters as mycelium, conidia , Sclerotia or acervuli in seeds, plant debris, or the soil

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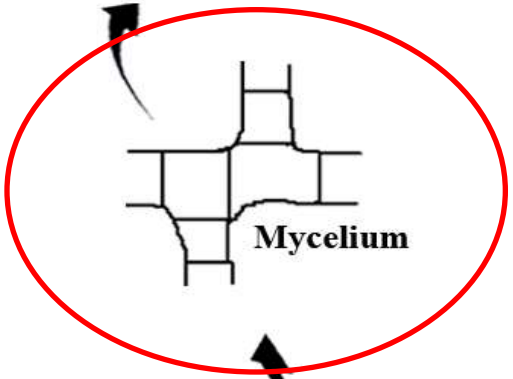

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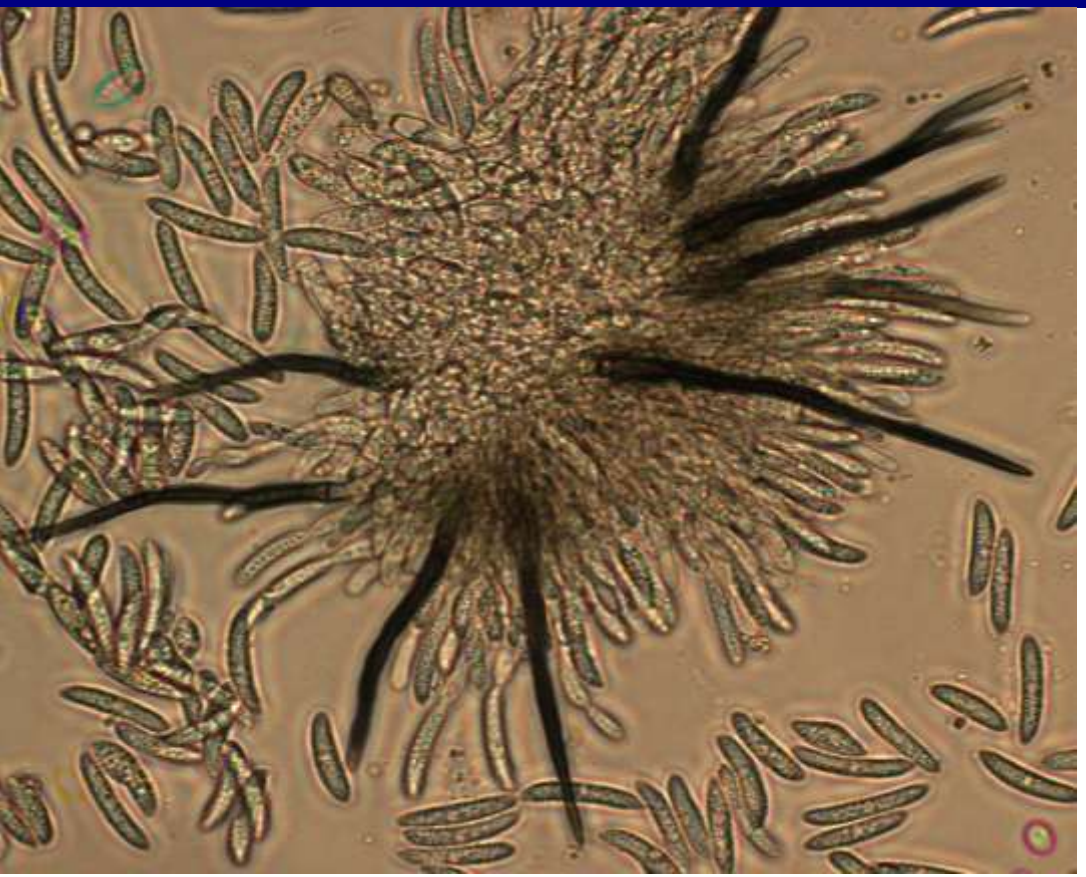
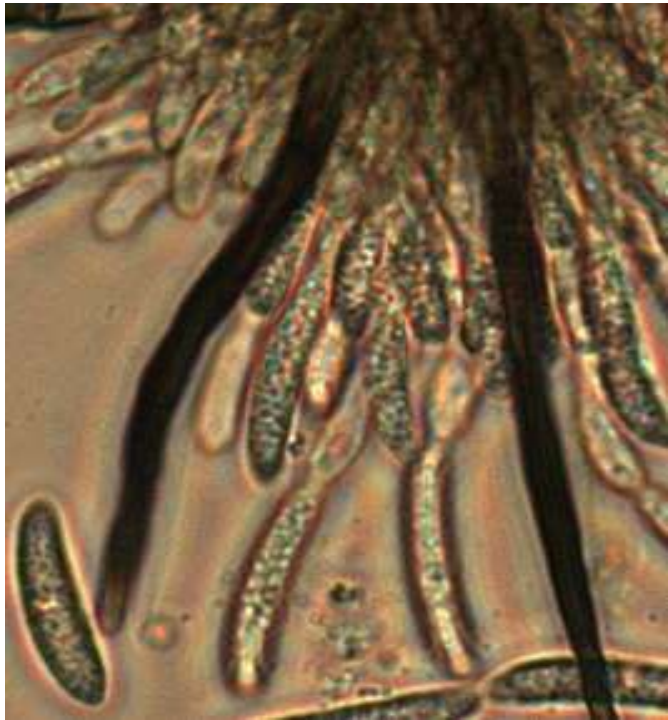


Under the Microscope:

- Distinctive dark-brown colored setae (left)
- Acervuli (asexual reproductive structures)



Clear, asexual spores (conidia) produced in acervuli with setae

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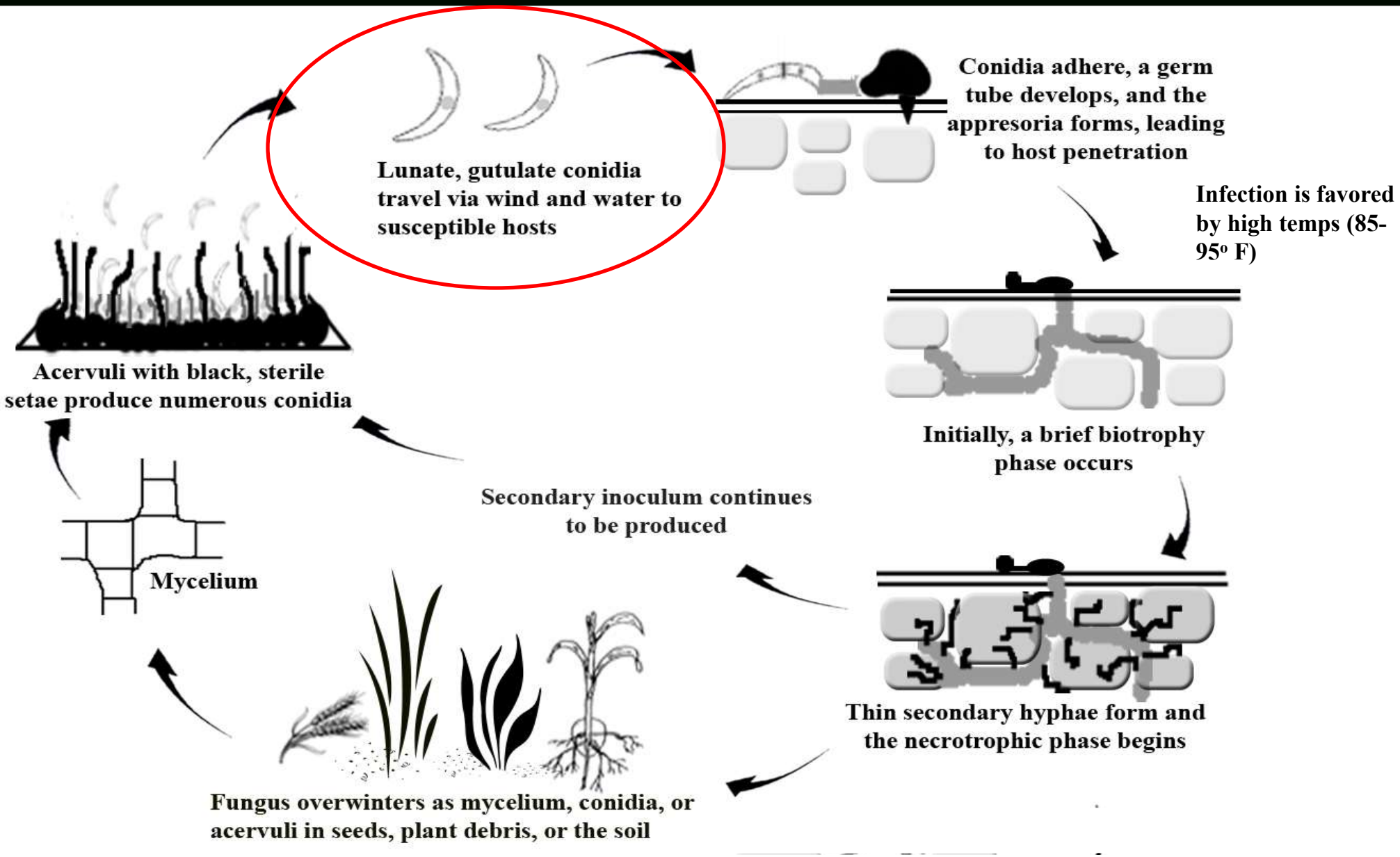

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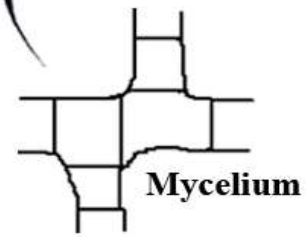

Mycelium

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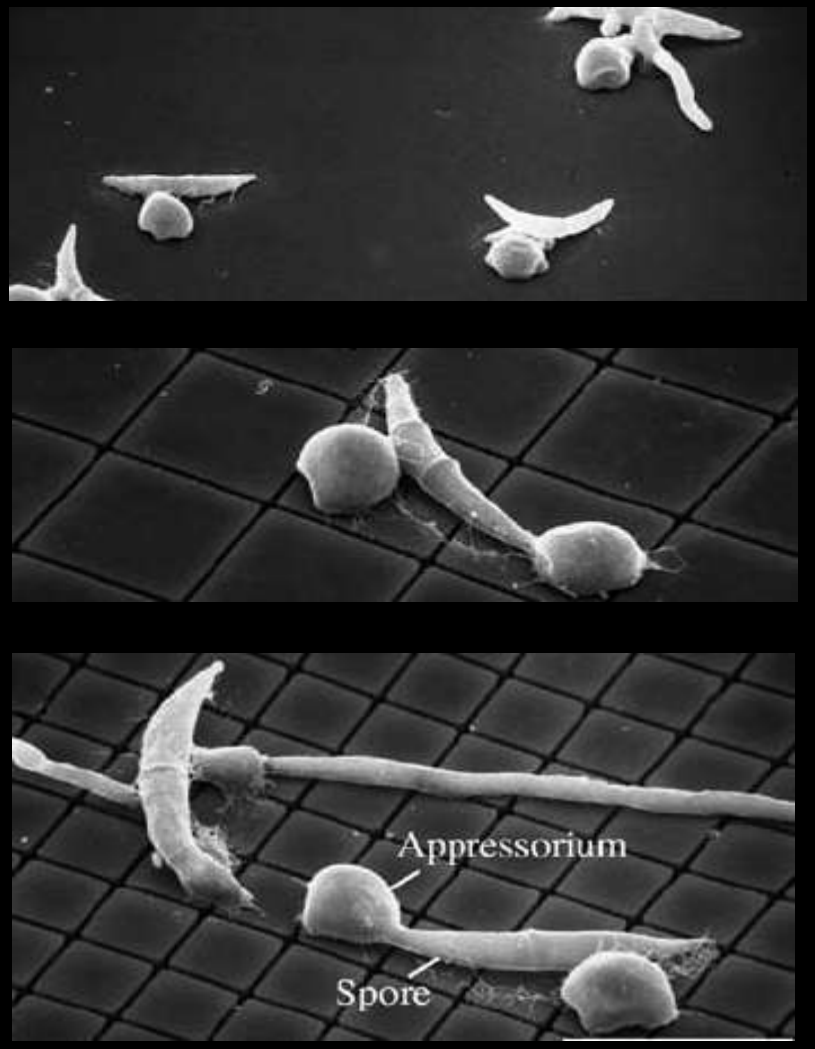
Appressorium formation & host colonization



Apoga *et al.* Fungal Genetics and Biology (2004) 41: 1-12.

- Conidia germinate in 2-6 hr
- An appressorium forms within 6 hr and acts like a suction cup allowing for the development of intensive pressures, resulting in penetration of the host cell wall within 24 hr
- Equivalent pressure exerted on the palm of ones hand would allow you to lift a 17,000 lb school bus.
- Infection is dependent on High Humidity and Prolonged Leaf Wetness (symptoms in 5-18 days)

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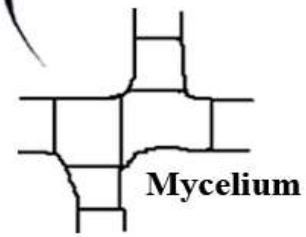

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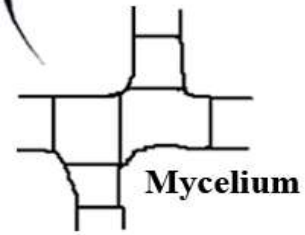

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- **Factors Impacting Disease Severity**

Factors Impacting Disease Severity

- Anthracnose most severe on weakened or senescent turf.
- Wounding does not appear to be important for infection based on field cultural management studies.
- Disease severity influenced by plant health, host susceptibility, environment (temp., humidity, wetness period), pathogenicity, and magagement practices (effect host vigor and environment)

Conclusion

- Anthracnose of cool-season grasses is caused by *C. cereale*.
  - 11 distinct populations and 2 clades (lineages)
  - Turf isolates are distinct from non-turf isolates (majority in 3 groups)
  - Poa and Bent isolates typically found in separate groups
  - Populations are independent of geography (very old).
- Other species of *Colletotrichum* cause anthracnose on warm-season turf and agronomic grasses

Conclusion

- Two types/phases of anthracnose: Foliar blight & basal rot
- Infection generally takes 24 hr; symptoms in 5-11 days in field (depending on environment).
- Need for a reliable lab inoculation method to better study:
  - Pathogenicity different isolated
  - Screening of new turf selections & cultivars
  - Infection process as affected by management (influence of fertility, pH, topdressing, environmental stress under controlled environmental conditions).