

Red fruited *Cladonias* + few more species with pale apothecia



Cladonia coccifera

Cocciferae (Red fruited plus pale fruited Cladonias):

- ca. 80 species worldwide, 22 (23) species in Europe, (20 in Sweden, 19 in Austria, 16 in the Czech Republic)
- traditionally characterized by red hymenia
- recently: species with pale apothecia included !
- monophyletic, defined by diagnostic chemical characters



1) red fruited: ***Cladonia alpina***

C. bellidiflora

C. borealis

C. coccifera

C. deformis

C. digitata

C. diversa

C. floerkeana

(*C. granulans*)

C. incrassata

C. luteoalba

C. macilenta

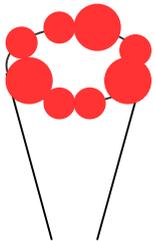
C. pleurota

C. polydactyla

C. straminea

C. sulphurina

C. vulcani



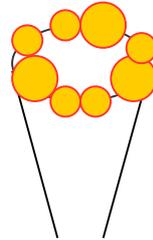
2) with pale apothecia: ***C. bacilliformis***

C. botrytes

C. carneola

C. cyanipes

C. norvegica



How to follow the key?

- Podetia usually grey to brown, more rarely yellowish, **often sorediate or squamulose**, unbranched to richly branched, surface smoothly corticate or not. PD+ red or PD-

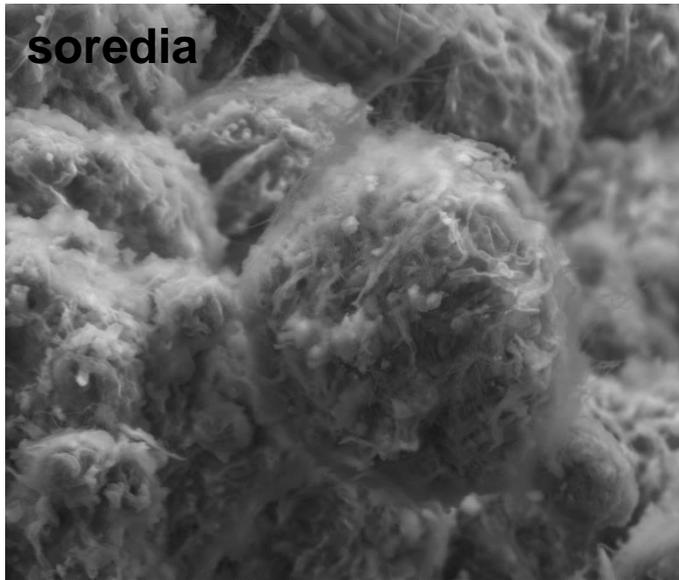
red colour caused by presence of **rhodocladonic acid** – this substance is usually present in hymenial discs or in pycnidia, but it can be produced also after mite infection in *Cladonia norvegica* (which has pale apothecia)

- **Apothecia** (hymenial discs) and slime in pycnidia **red** (occasionally visible in osciolum). **Necrotic bases often turning orange**. PD – or rarely PD+yellow, never red

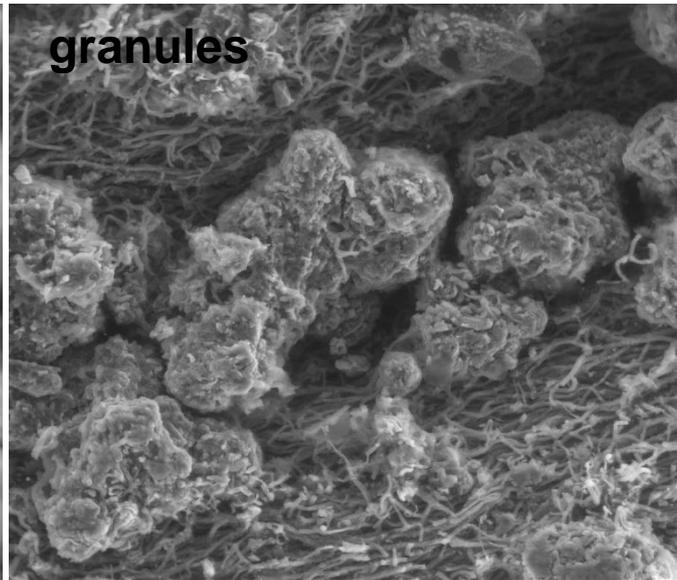
- **Apothecia brown** to ochraceous, slime in pycnidia usually hyaline (never red). **Necrotic bases grey, brown or melanotic**. PD+ red (commonly), PD+ yellow or PD-



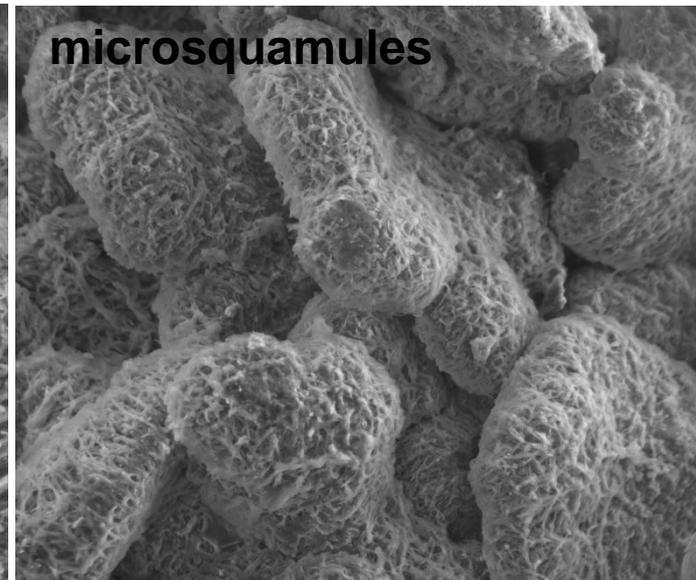
Vegetative propagules: soredia, granules, plates, microsquamules



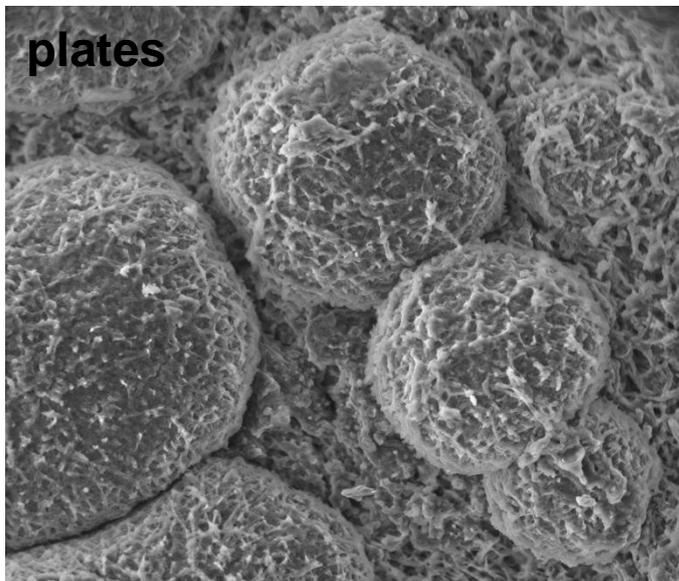
7/29/2009 Mag WD HV HFW Pressure Spot 50.0µm
4:08:40 PM 1200x 10.2 mm 20.0 kV 0.23 mm 230.0 Pa 3.5 Cladonia pleurota (T. -12°C)



8/5/2009 Mag WD HV HFW Pressure Spot 100.0µm
7:52:39 PM 500x 11.4 mm 20.0 kV 0.54 mm 230.0 Pa 3.5 Cladonia diversa (T. -12°C)



7/29/2009 Mag WD HV HFW Pressure Spot 100.0µm
6:41:16 PM 550x 9.2 mm 20.0 kV 0.49 mm 230.0 Pa 3.5 Clad. metacorallifera (-12°C)



6/18/2009 Mag WD HV HFW Pressure Spot 100.0µm
4:59:08 PM 550x 8.3 mm 20.0 kV 0.49 mm 230.0 Pa 3.5 Cladonia borealis (T. -12°C)

soredia:

- usually easy to recognise
- often smaller compared to other vegetative propagules
- usually without cortex (in contrast to other veg. propagules)
- but when not small and with cortex then hard to distinguish

- Podetia with **yellowish tint**. **Usnic acid present**



- Podetia **brownish** or **greenish grey**. **Usnic acid absent**



Usnic acid – present in cortex

!! content of usnic acid might vary (longitudinally, altitudinally, sun-exposed vs. shadowed habitats...) – yellowish tint not always clearly visible!!

Podetia with **yellowish tint. Usnic acid present**

- Podetia **brownish or greenish grey. Usnic acid absent**

1) red fruited: *Cladonia alpina*
C. bellidiflora
C. borealis
C. coccifera
C. deformis
C. digitata
C. diversa
C. floerkeana
(*C. granulans*)
C. incrassata
C. luteoalba
C. macilenta
C. pleurota
C. polydactyla
C. straminea
C. sulphurina
C. vulcani

2) with pale apothecia: *C. bacilliformis*
C. botrytes
C. carneola
C. cyanipes
C. norvegica

C. sulphurina

- podetia tall (up to 8 cm), farinose soresdiate (squamulose at base), yellow, scyphose – much deformed
- **contains usnic and squamatic acids (UV+ white)**
- peatlands, rotten wood, alpine and arctic heaths, rock outcrops, boulder screens



similar species: *Cladonia deformis*

- *C. deformis* is UV negative (does not contain squamatic acid) and produces crystal needles (zeorin? - in herbarium material)
- *C. sulphurina* is usually (not always!) more deformed

C. deformis

- podetia usually tall (up to 8 cm), farinose soresdiate (corticate at base), yellow, scyphose – scyphi usually regular, with dentate margins
- **contains usnic acid, zeorin (UV-, crystals in herbarium material)**
- on humus rich soil, rotten wood, boulder screes, rock outcrops, heaths



similar species: *Cladonia pleurota* – same chemistry, but shorter and with coarser soresdiate (however, *C. deformis* might also form short-podetiate forms – soresdiate size is the proper distinguishing character!!)

Cladonia sulphurina – easy to recognise by positive UV reaction

Cladonia digitata

- recognizable by large squamules, to 1,5 (3) cm long, underside and margins sorediate; podetia often defomed, surface corticate with sorediate patches
- **thamnolic acid** – UV-, K+ yellow, P+ yellow - on bases and trunks of trees, on rotten wood, on soil



similar species: *C. polydactyla* – has smaller squamules, different podetial surface

Cladonia polydactyla

- primary thallus small, podetia narrow, green, usually forming scyphi. Podetial surface granulate sorediate.
- **thamnolic acid – UV-**, K⁺ yellow, PD⁺ yellow - on bases and trunks of trees, on rotten wood, mossy rocks, on soil



similar species: *C. umbricola* – usually does not react K⁺, P⁺; *C. polydactyla* forms welldefined soralia *C. digitata* – larger squamules, soredia in patches

C. pleurota

- podetia to 3 cm tall, scyphose, usually roughly soresdiate (but sometimes also farinose soresdiate), corticate at base
- **contains usnic acid, zeorin (UV-**, crystals in herbarium material)
- wide ecological amplitude, from very lowlands to high mountains, on different substrata (even on a leather glove), rock outcrops, rotten wood, etc.
- polyphyletic taxon



The most usual taxon, very similar to *Cladonia coccifera*. *Cladonia coccifera* has similar chemistry, but it is never soresdious. It has squamules.

Cladonia coccifera

Cladonia coccifera -
podetia to 3 cm tall,
scyphose, scyphi wide;
surface in lower part
corticate, in upper part
mainly areolate, cover by
plates – usually somehow
irregular

- contains **usnic acid**,
zeorin – UV negative;
crystals in herbarium
material - rock outcrops,
soil; in Central Europe in
mountains (*C. diversa*
mostly in lowlands)



similar species: *C. borealis* – contains barbatic acid (no crystals in herbarium material); more regular plates
C. diversa – produces granules and/or microsquamules on the podetia, forms narrower podetia, different ecology

***Cladonia straminea* (syn. *C. metacorallifera*)**

- podetia yellowish green or yellowish grey, slender, necrotic parts blackening, scyphose – scyphi narrow!, surface microsquamulose
- 2 chemotypes:
 - 1) usnic, didymic, squamatic acids (common; UV+);
 - 2) usnic, didymic, thamnolic acid (rare) - on big boulders, rock outcrops, boulder screes, chionophobious, often on vertical site of the rock



similar species: *C. bellidiflora* – usually ascyphose, with bigger squamules, does not contain didymic acid *C. coccifera*, *C. diversa*, *C. borealis* – podetia not so narrow, covered with plates or granules, with different chemistry (zeorin or barbatic acid present)

Cladonia bellidiflora

- podetia yellowish green, tall, narrow, squamulose, usually ascyphose (but scyphi sometimes present)
- **usnic and squamatic acids (UV+)** - tundra, mountains, rock outcrops



similar species: if scyphose then it might be confused with *Cladonia straminea* – but *C. straminea* has smaller squamules (microsquamules) and, additionally to usnic acid, contains didymic acid (usually contains also squamatic acid)

Cladonia floerkeana a *macilenta*

- podetia to 4 cm tall, brownish grey, simple or more often branched. Podetial surface corticate, smooth to rough, not sorediate.

- 2 chemotypes:

1) barbatic acid + sometimes didymic a. (K-, P-)

2) thamnolic a. and didymic acid (K+ yellow, P+ yellow) – rare - rock outcrops, bare mineral soils (sand dunes), sometimes on rotten wood – open biotopes



similar species: *C. floerkeana* and *C. macilenta* – usually produces soredia (but when fertile gets corticate!), taxonomical problem not sort yet!

Cladonia botrytes

- podetia up to 3 cm, yellowish grey, tips always with pale apothecia. Podetial surface continuously corticate or areolate. - usnic, barbatic acids, sometimes squamatic acid - usually on wood but in N might grow on soil - ephemeral species – podetia present only 1-2 years, requires certain age of stump



similar species: no similar species!!