



23rd Session
INTERNATIONAL POPLAR
COMMISSION



Beijing, China, 27- 30 October 2008

POPLARS, WILLOWS AND PEOPLE'S WELLBING

“ENDOPHYTIC FUNGI IN NURSERY POPLAR PLANTS”

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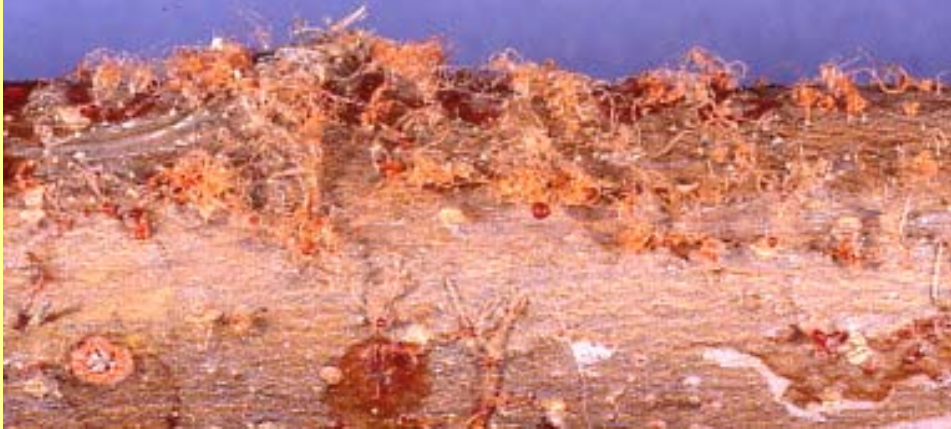
Poplar “transplant crisis”

- The poplar plantations are established with 1-year and (mainly) two-years-old saplings from nurseries.

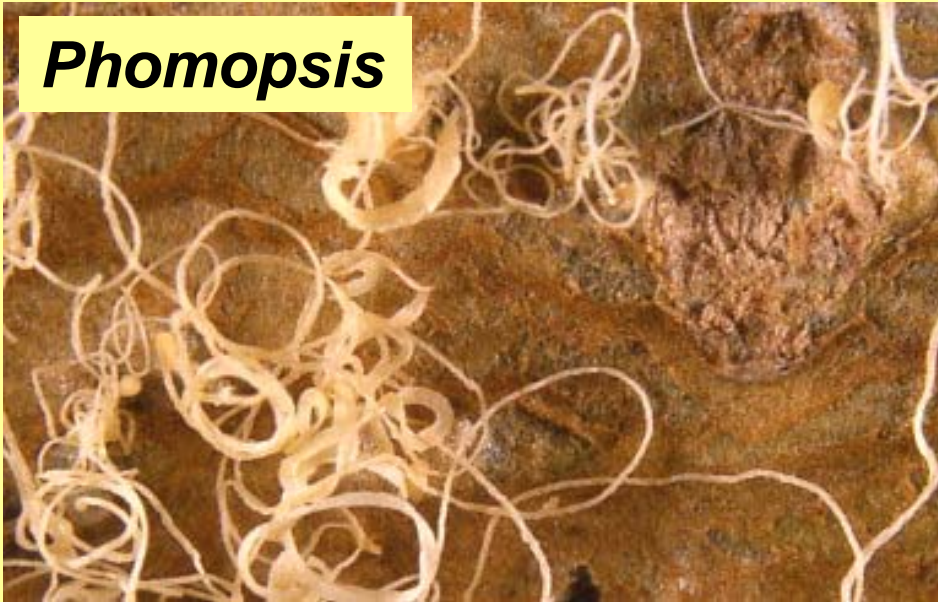
Often the new poplar plantations present **transplant crisis** (death of the plants) that:

- **can affect several plants** (even more than 50% of the transplanted saplings, with average losses of about 2% in Italy);
- **is frequently promoted by the plant dehydration**
- **is usually linked to fungal weakness pathogens, bark necrosis agents, mainly belonging to *Discosporium* (=Dothichiza), *Phomopsis*, *Cytospora* and *Fusarium* genera.**

Cytospora



Phomopsis



Bark necrotic agents
mostly related to
transplant crisis.



Discosporium



Dead or infected plants
by *Discosporium*
populeum attacks

Bark necrosis attacks



The attack generally occurs at the insertion point of the branch and / or at the separation "ring" between the one-year-old and two-years-old sapling tissues.

- Previous studies demonstrated that some of the above cited **pathogens** are present also in the tissues of **healthy plants**, **asymptotically**, as **endophytes** (so called “**endophytic pathogens**”).

- However, there is a little knowledge about the role of these **endophytic fungi** in the symptomatic attacks during the **transplant crisis**.

Our researches were mainly focused on assessing:

- ***IN NURSERY***

- 1. the distribution of the *pathogenic fungal endophytes* in the wood stem tissues of the plants;**
- 2. their incidence and association evolution during the nursery life;**
- 3. their possible relationships with**
 - the site**
 - the species and the clones of *Populus***
 - the irrigations carried out in the nursery.**

- ***DURING THE TRANSPLANT PHASE***

- 4. the influence of the rehydration or dehydration of the young plants on (after the transplant) :**
 - changing of the endophytic fungi in pathogenic one;**
 - bark necrosis attacks;**
 - transplant crisis.**

RESULTS

1. Inoculation of the endophytes

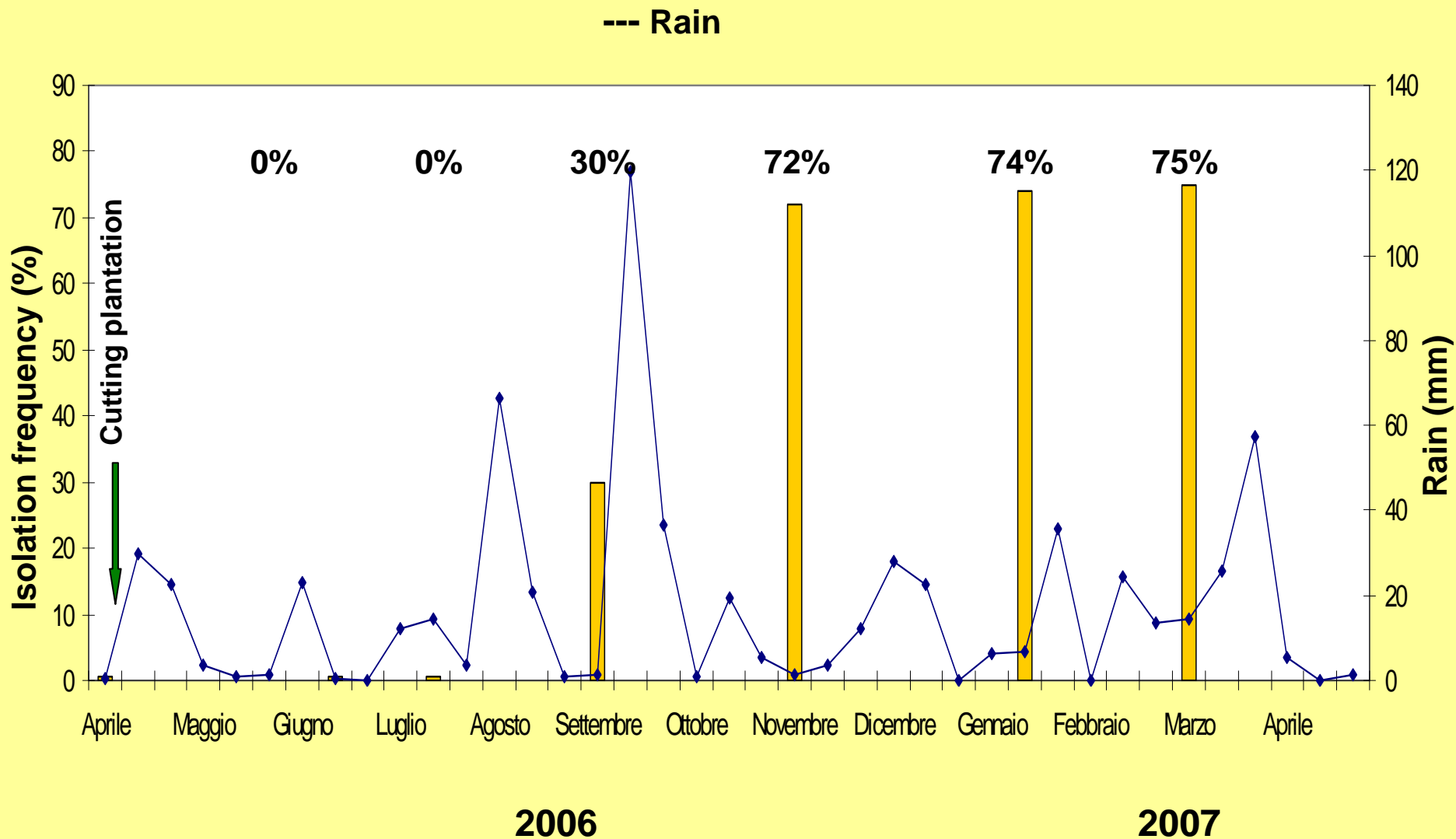
- The cuttings used for nursery were rich of endophytes: *Phomopsis*, *Cytospora*, *Discosporium*, etc.
- Nevertheless, in the young sprouts from cuttings fungal endophytes were absent;
- The first fungal endophytic presence in the bark tissues was detected after the first abundant rains.

REMARKS

In the new nursery:

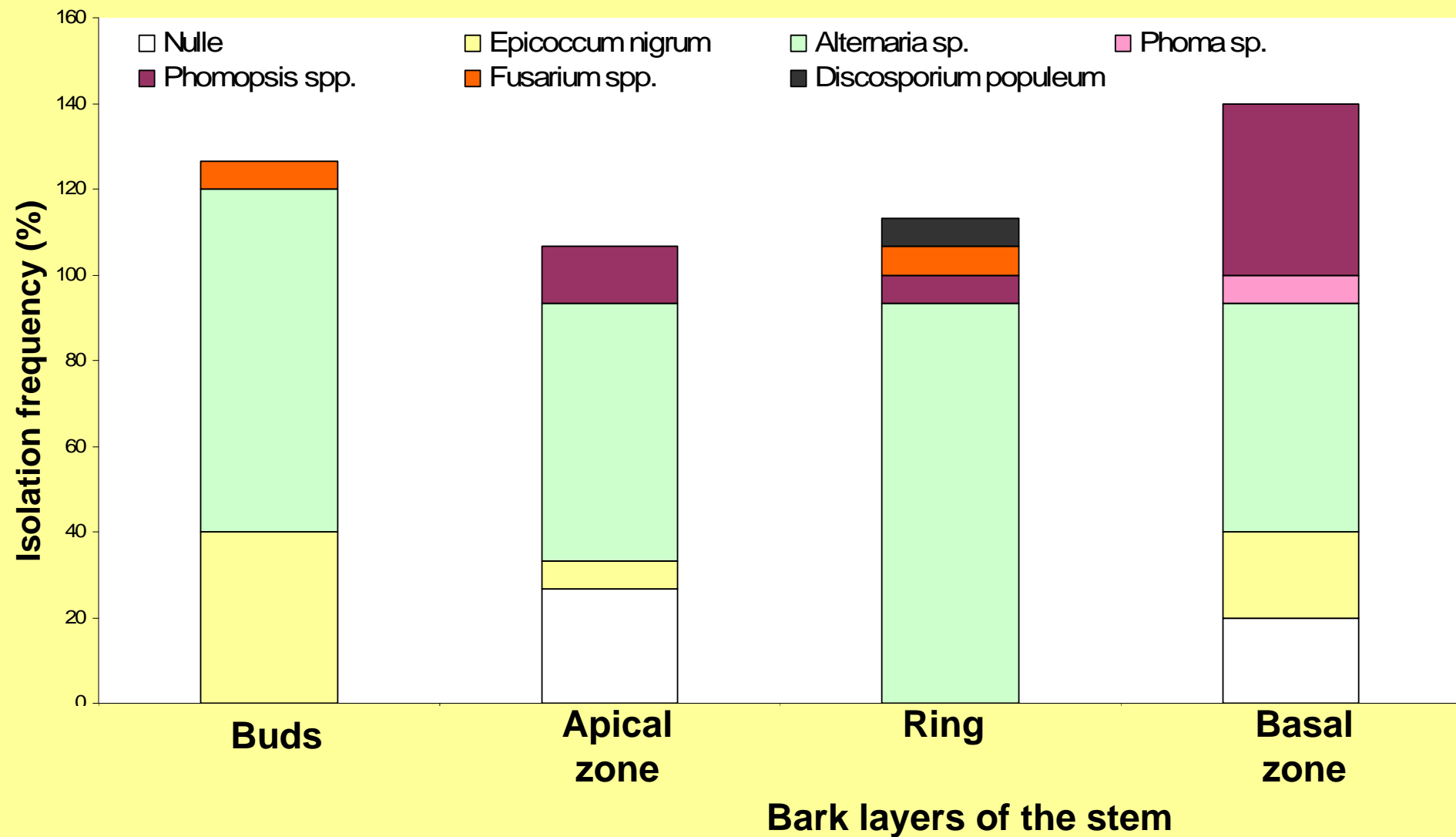
- The fungal endophytes do not arrive from cuttings (absence of organotropic diffusion);
- Main endophyte inoculum occurs with the rain.

Viterbo, April 2006-March 2007. Nursery of L. Avanzo clone (*Populus x canadensis*): Isolation frequency of endophytic fungi in poplar plants during the first year related to rain occurrence.



2) DISTRIBUTION OF ENDOPHYTES IN 2-YEARS-OLD NURSERY PLANTS

- The isolation frequency increase from apical to basal zone
- Presence of *Discosporium* and *Phomopsis* in the “ring”.



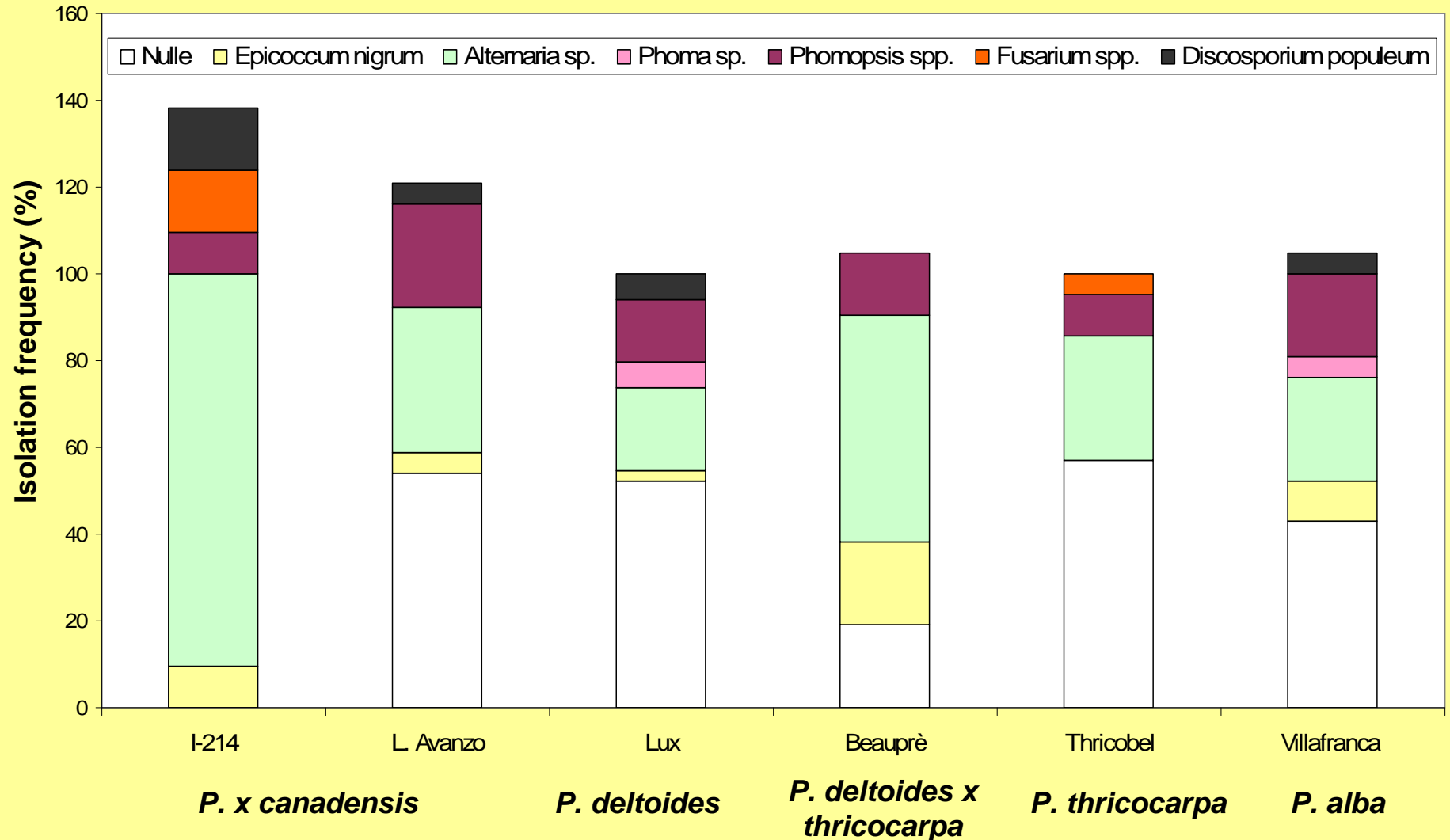
2. Distribution of endophytes in 2-years-old saplings

REMARKS

- There is an endophyte accumulation during the time, particularly of *Phomopsis*.
- The presence of *Discosporium* and *Phomopsis* in the “ring” could explain the prevalent location of its symptomatic attack at the border zone between 1-year and 2-years-old tissues.

3. COMPARISON BETWEEN VARIOUS SPECIES AND CLONES

- *Discosporium* is not present in *P. trichocarpa* or its hybrids
- *P. x euramericana* and *P. alba* have abundant presence of endophytic pathogens.

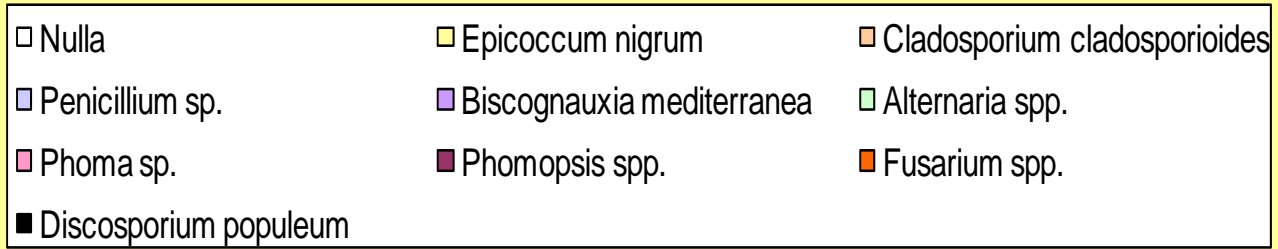


3. COMPARISON AMONG SPECIES AND CLONES

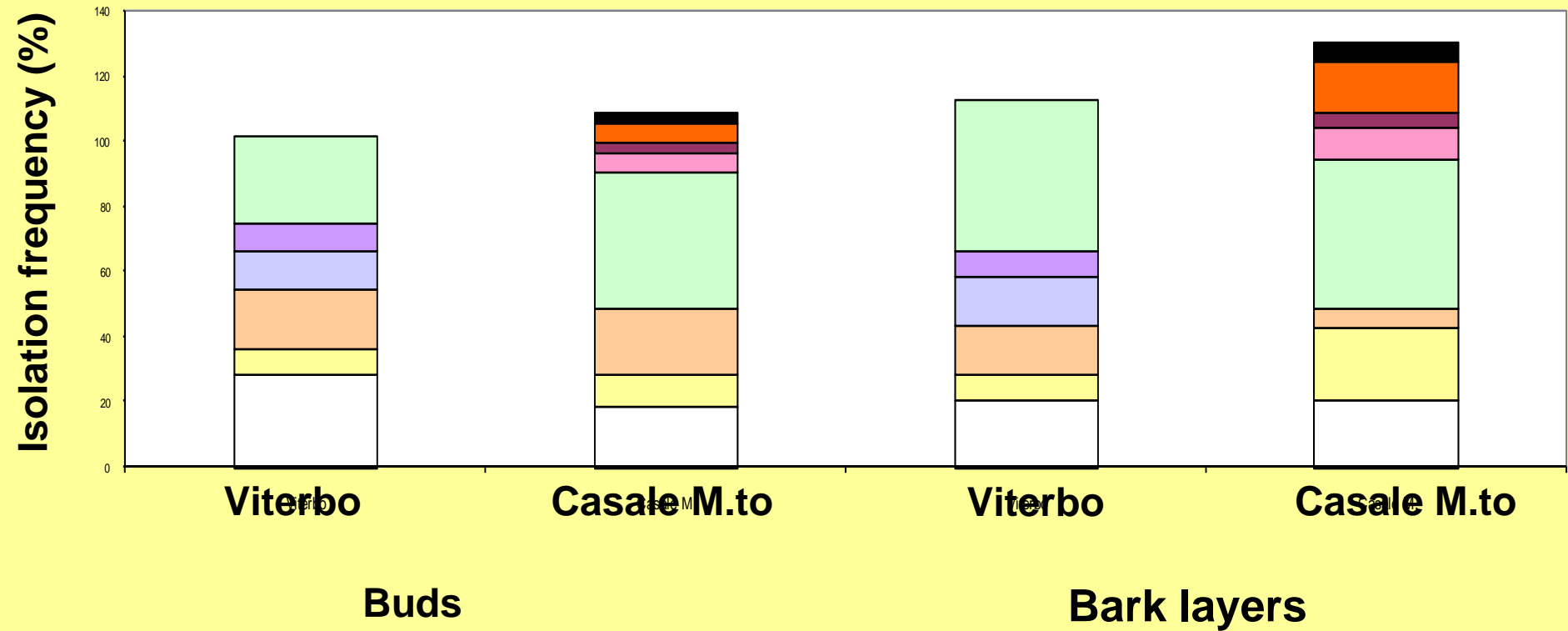
REMARKS

- ***Discosporium* is not present in *P. trichocarpa* or its hybrids.**
 - * ***P. trichocarpa* clones are resistant to *Discosporium* in field!**
- ***P. x euramericana* and *P. alba* have abundant presence of endophytic pathogens.**
 - * **They easily suffer transplant crisis!.**

4. INFLUENCE OF THE SITE



The incidence of necrotic agents is higher in Casale M.to (Northern Italy) than Viterbo (Central Italy)!



4. INFLUENCE OF THE SITE

REMARKS

In the site of Viterbo (Central Italy), warmer, dryer and with scarce presence of poplars (lower inoculum pressure) than Casale Monferrato (Northern Italy) :

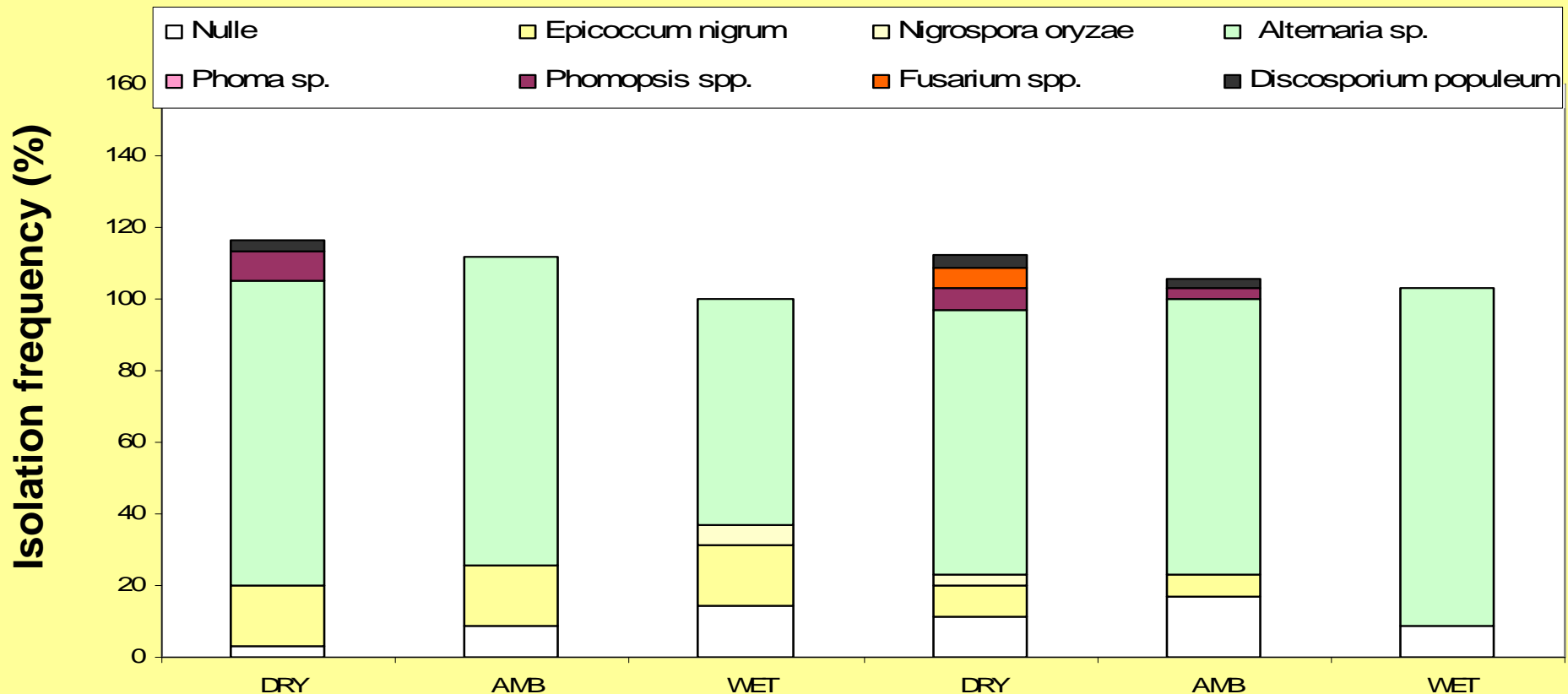
- the endophytic incidence of necrotic agents reported in the “transplant crisis” is low;
- *Discosporium*, particularly dangerous in the Northern areas, is absolutely absent;

5. Influence of water stress in the nursery

(Bark layers control in November)

Plots with water interception under foliage (DRY); environmental conditions (AMB); large irrigations (WET).

The water stress seems to increase the number of endophytic species!



5. INFLUENCE OF WATER STRESS IN THE NURSERY

REMARKS

The water stress seems to:

- **Increase the number of endophytic species;**
- **Promote the inoculation of *Discosporium*.**

6. INFLUENCE OF HYDRATION OR DEHYDRATION OF THE SAPLINGS DURING THE TRANSPLANT PHASE

REMARKS

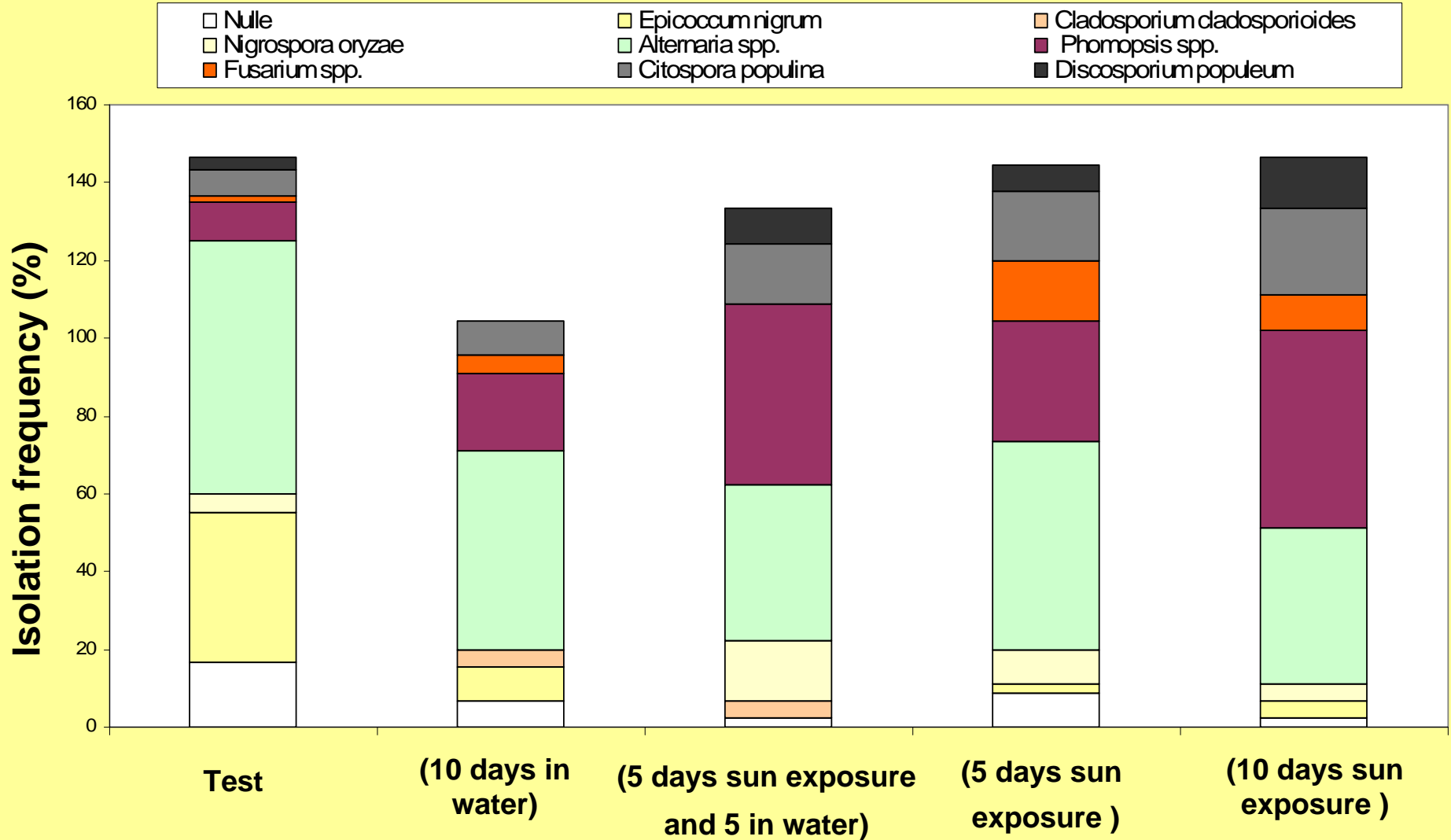
The dehydration of the sapling at the transplant:

- increase the isolability of pathogenic endophytic fungi;**
- promotes their attacks on the bark;**
- increase the death in transplanted plants.**

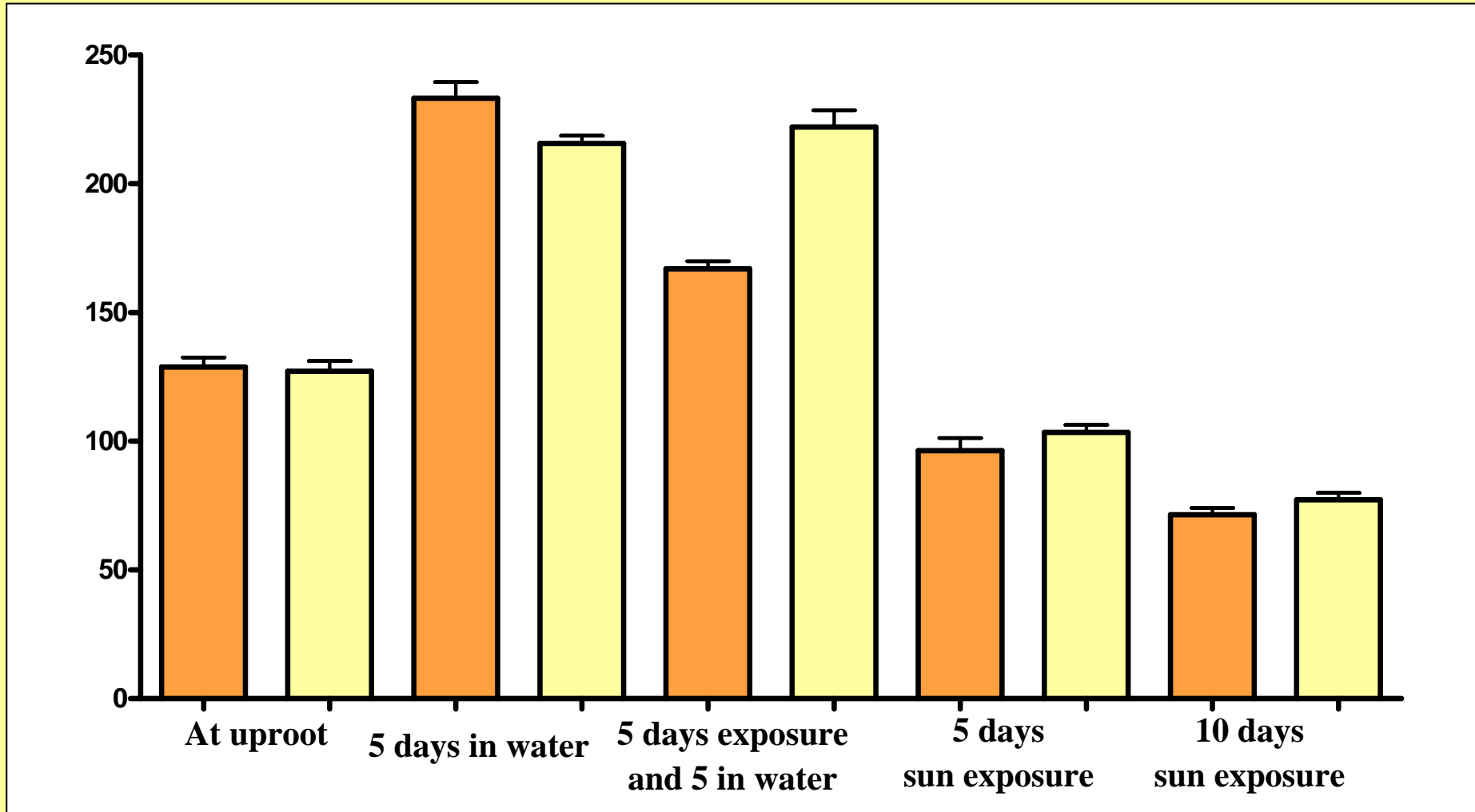
The rehydration of the sapling reduce them.

6. EFFECTS OF THE PRE-TRANSPLANT HYDRATION OF THE PLANTS

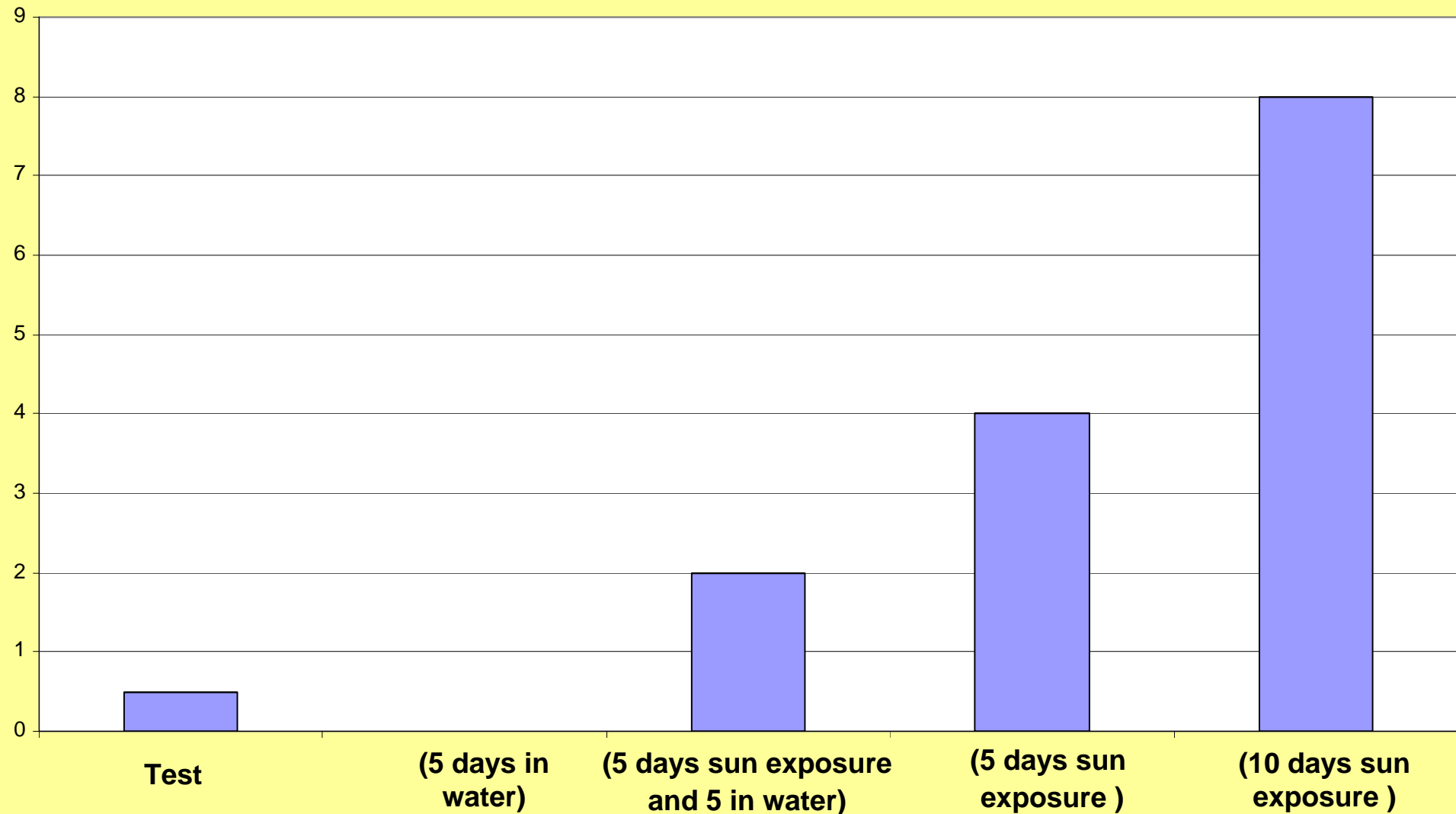
(Bark layers control at the beginning of sprouting after the transplant)



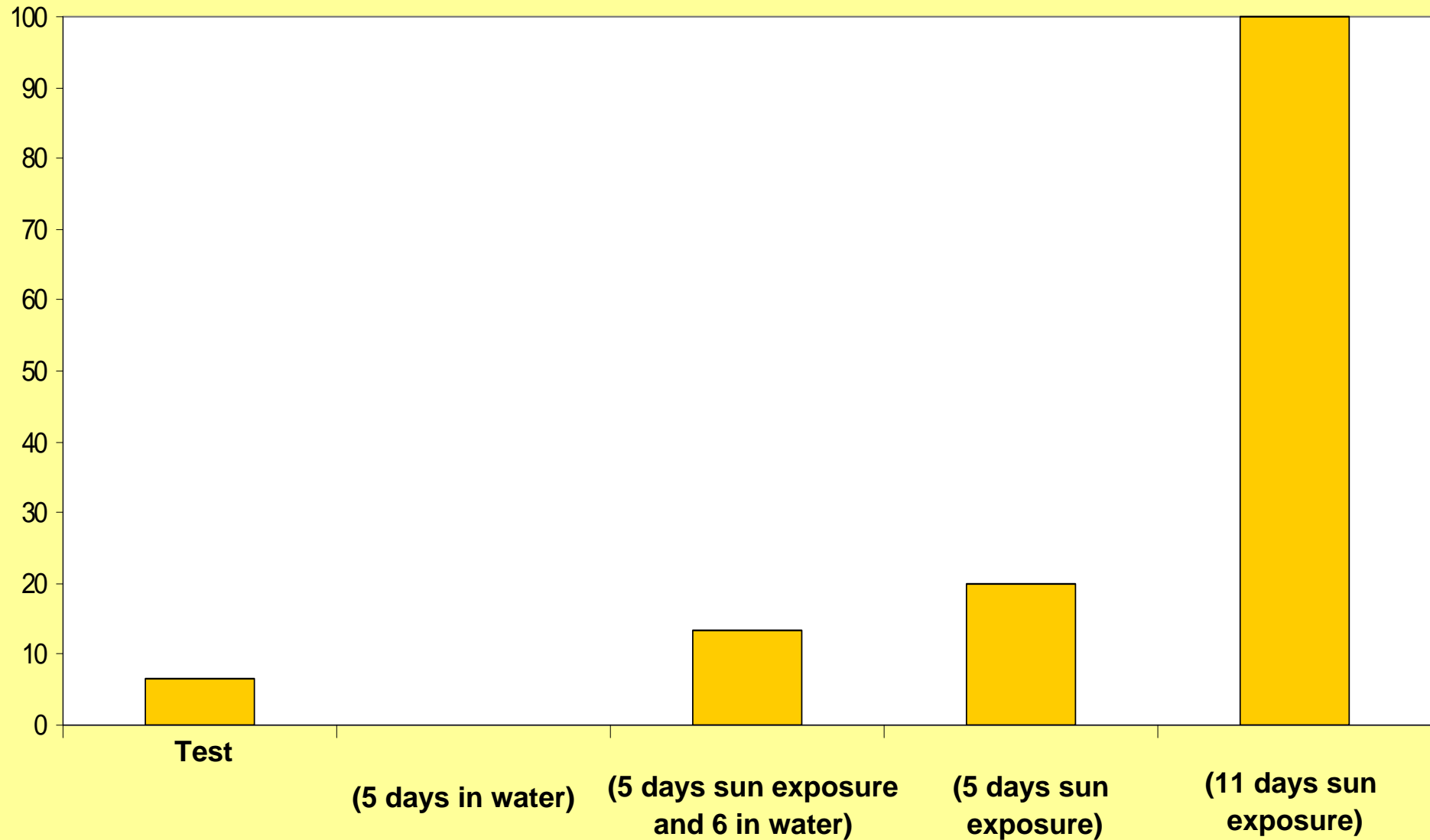
WATER CONTENT VS DRY WEIGHT (%) OF THE SAPPLINGS



Number of fruiting bodies per plant: *Phomopsis* spp. (~65%); *Cytospora* spp. (~30%); *Discosporium* (~5%)

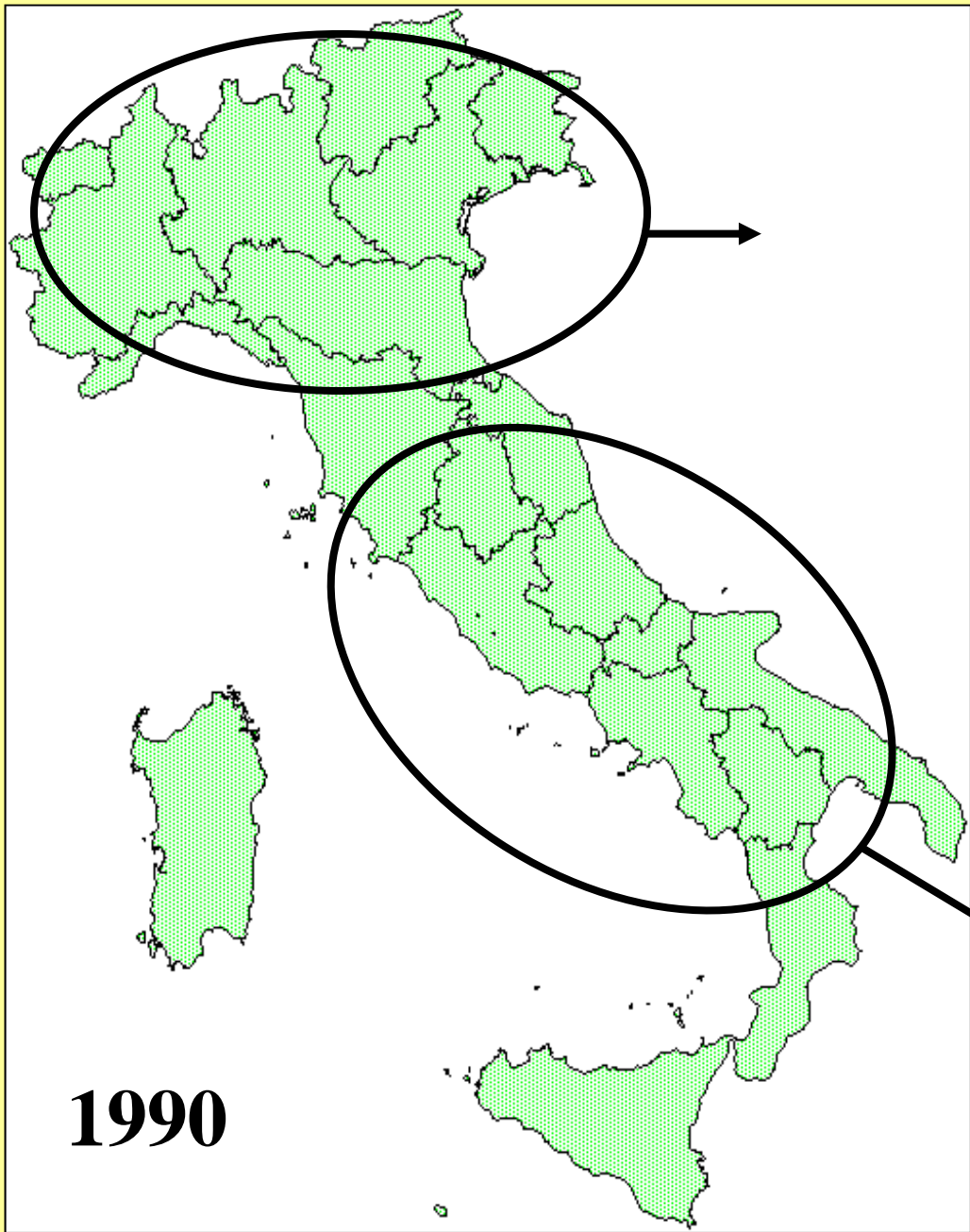


Death rate (%) in transplant phase



CONCLUSIONS

- **Fungal endophytes bark pathogens were always isolated in the poplar nursery.**
- **Main endophyte inoculum occurs with the rain.**
- **The endophytic incidence of necrotic agents is related with inoculum pressure of the site.**
- **The water stress seems to increase the endophytic fungi.**
- **The dehydration of the plants during seems to stimulate the endophytic pathogens to evolve in their pathogenic status**
- **In opposition to what reported in the past, now *Phomopsis* and *Cytospora* prevailed on *Discosporium* (known to be more micro-thermic).**
- **Could it be linked to the *Global Change* effect?**



85 %

10 %

5 %



Discosporium *Cytospora* *Phomopsis*

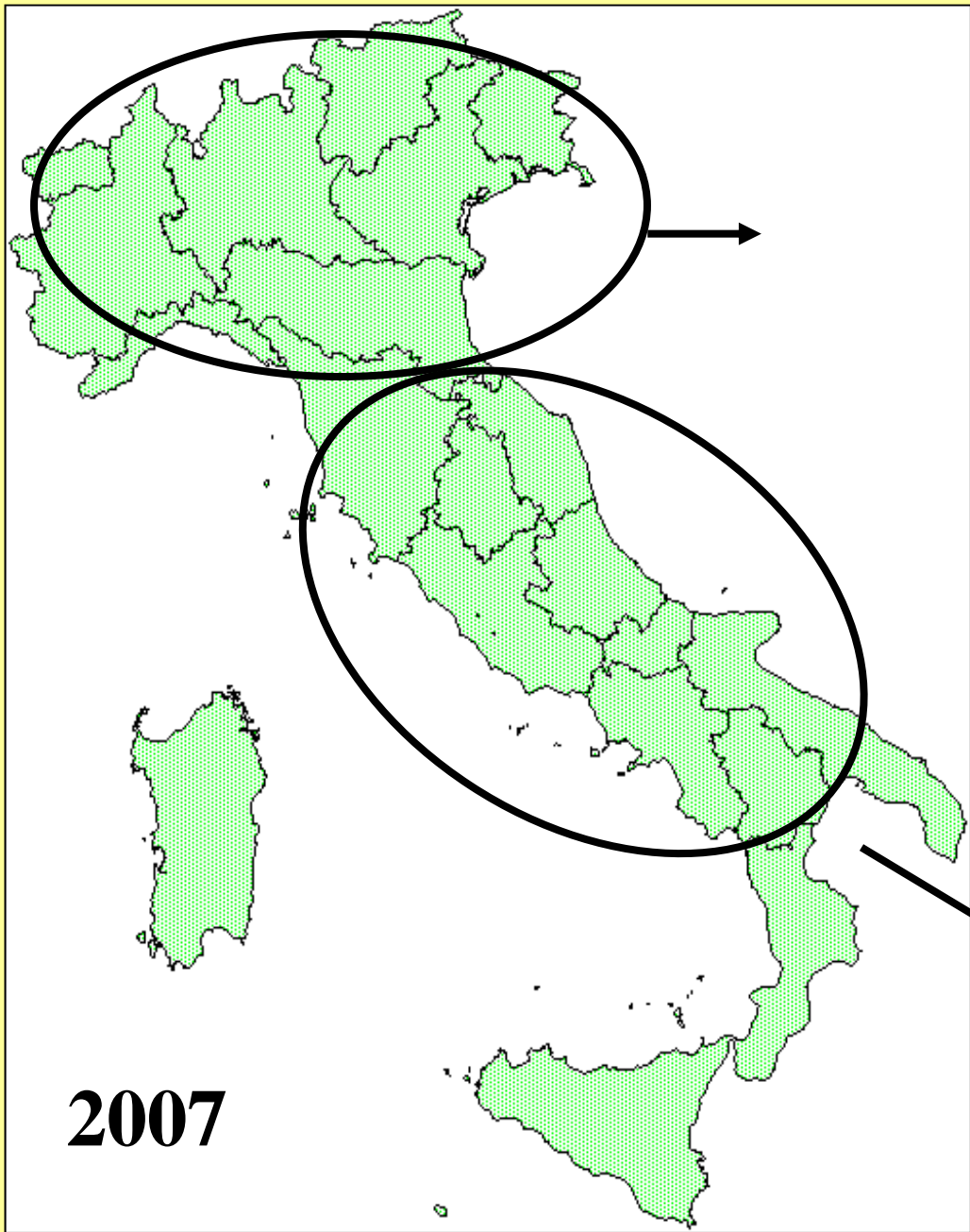
5 %

50 %

45 %



Discosporium *Cytospora* *Phomopsis*



5 %

40 %

55 %



Discosporium Cytospora Phomopsis

0

30 %

70%



Discosporium Cytospora Phomopsis