Management of invasive forest pathogens in Switzerland

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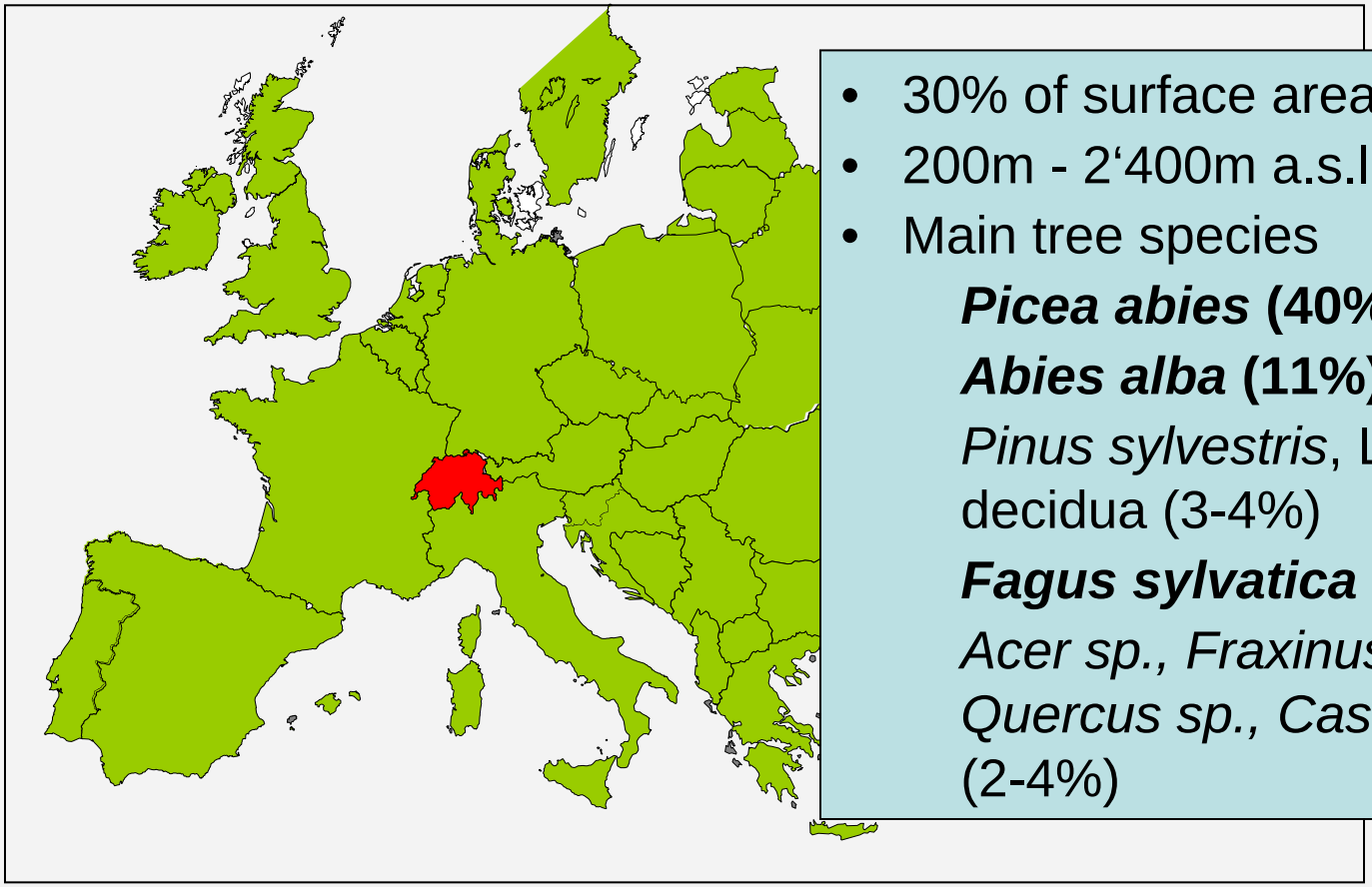
Forests in Switzerland



- 30% of surface area
- 200m - 2‘400m a.s.l
- Main tree species
  - ***Picea abies* (40%)**
  - ***Abies alba* (11%)**
  - *Pinus sylvestris*, Larix decidua (3-4%)
  - ***Fagus sylvatica* (18%)**
  - *Acer sp., Fraxinus, Quercus sp., Castanea sativa* (2-4%)

ca. 1920	*Phytophthora cinnamomi* **Ink disease of chestnut**	*Castanea sativa*	+
ca. 1989	*Mycosphaerella pini* **Red band needle blight**	*Pinus sp.*	(+)
1995	*Mycosphaerella dearnessii* **Brown spot needle blight**	*Pinus sp.*	(+)
	Phytophthora ramorum **Sudden oak death**	*Rhododendron* *Viburnum*	?

Dutch elm disease

Ophiostoma ulmi
Ophiostoma novo-ulmi

- Probably introduced by natural means (spore dispersal by vector)
- Scattered distribution of elm trees (*U. glabra, U. minor*) in the forest, often in locations difficult to access
- No or little disease management

=> 30% reduction of elm trees (BHD > 12cm) in ten years (1985-1995)*

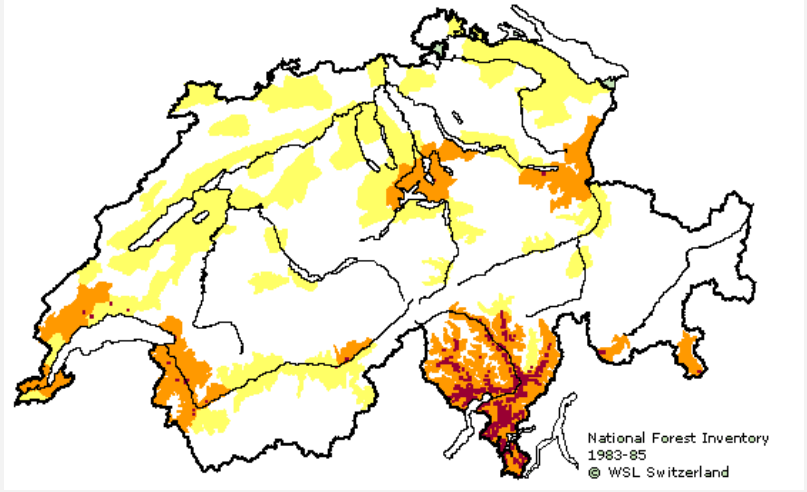
=> only tree species in Switzerland with a significant reduction

* Swiss National Forestry Inventories

Chestnut blight

Cryphonectria parasitica

- First record 1948
- introduction into southern Switzerland probably by natural means (spore dispersal) from Italy
- Rapid spread in almost pure chestnut stands, many new infection sites
- Spread to northern Switzerland in the 1980s
- Management
  - Resistance breeding
  - Alternative forest tree species
  - Biological control with hypovirulence (since 1980s)



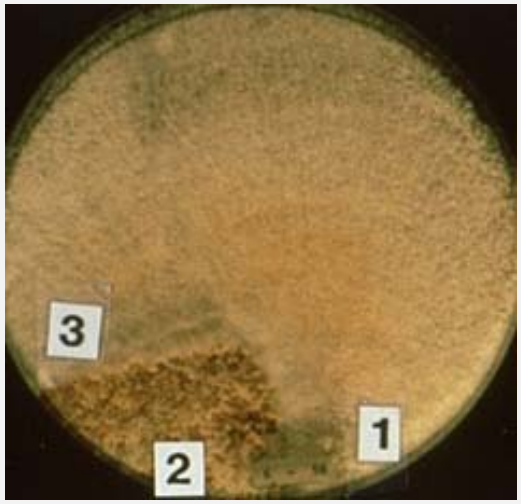
Distribution of chestnut in Switzerland

Biological control with hypovirulence

- Post-epidemic recovery of infected chestnut stands associated with non-lethal superficial cankers (healed cankers).
- White dsRNA-infected *C. parasitica* strains with reduced virulence and sporulation
- Hypovirulence = viral disease of *C. parasitica* caused by Cryphonectria hypovirus 1 (CHV-1)
- Natural biological control in southern Switzerland

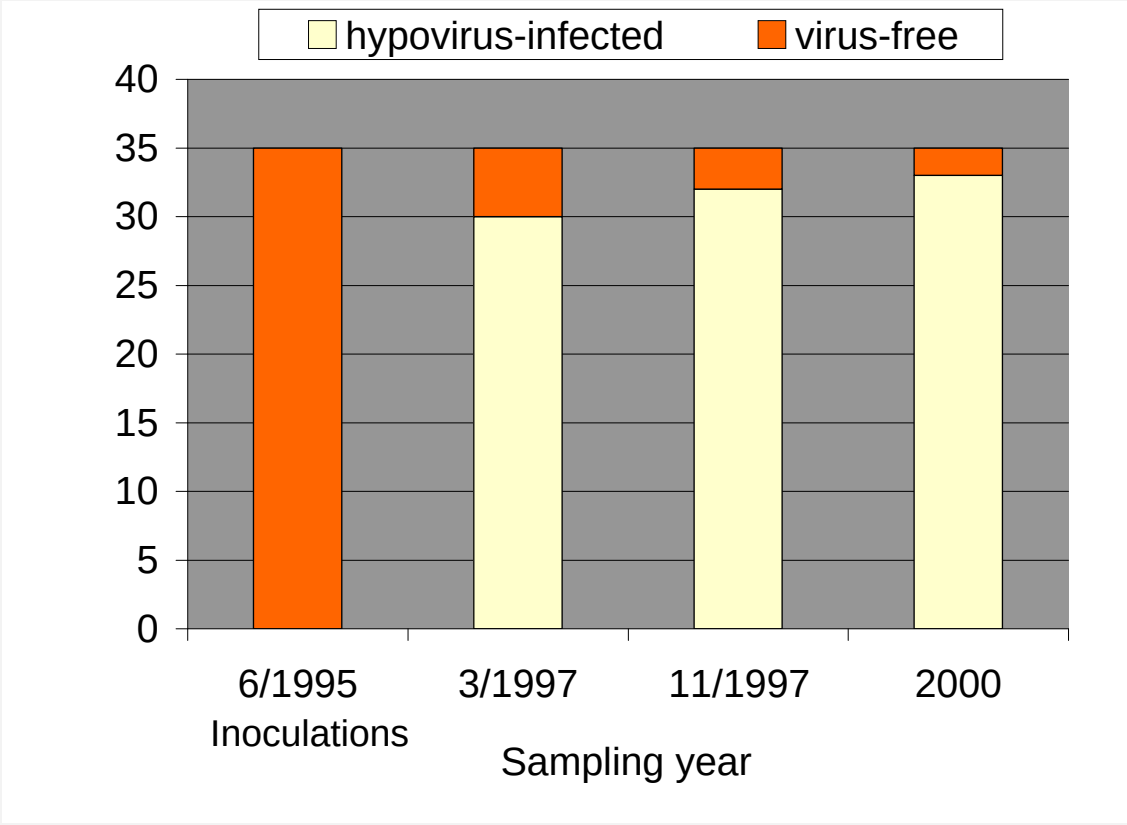
Success of natural biological control

1. Efficient dissemination of hypovirus-infected progagules
2. Low vegetative incompatibililty barriers
3. Production of hypovirulent inoculum on dead chestnut wood
4. Ecological fitness of the biological control agent
5. *C. sativa* considered less susceptible than *C. dentata*.



Hypovirus transmission *in vitro*

Natural Hypovirulence: Virus-infection of artifically induced cankers



⇒Efficient dissemination of the hypovirus to virulent cankers
(mode of dissemination not known, probably vectors involved)

Canker lesion 1997

15 x 7cm

18 x 10 cm

33 x 17 cm

Canker lesions 2004

14 x 10 cm

Callused

22 x 13 cm

Callused

16 x 10 cm

Callusing

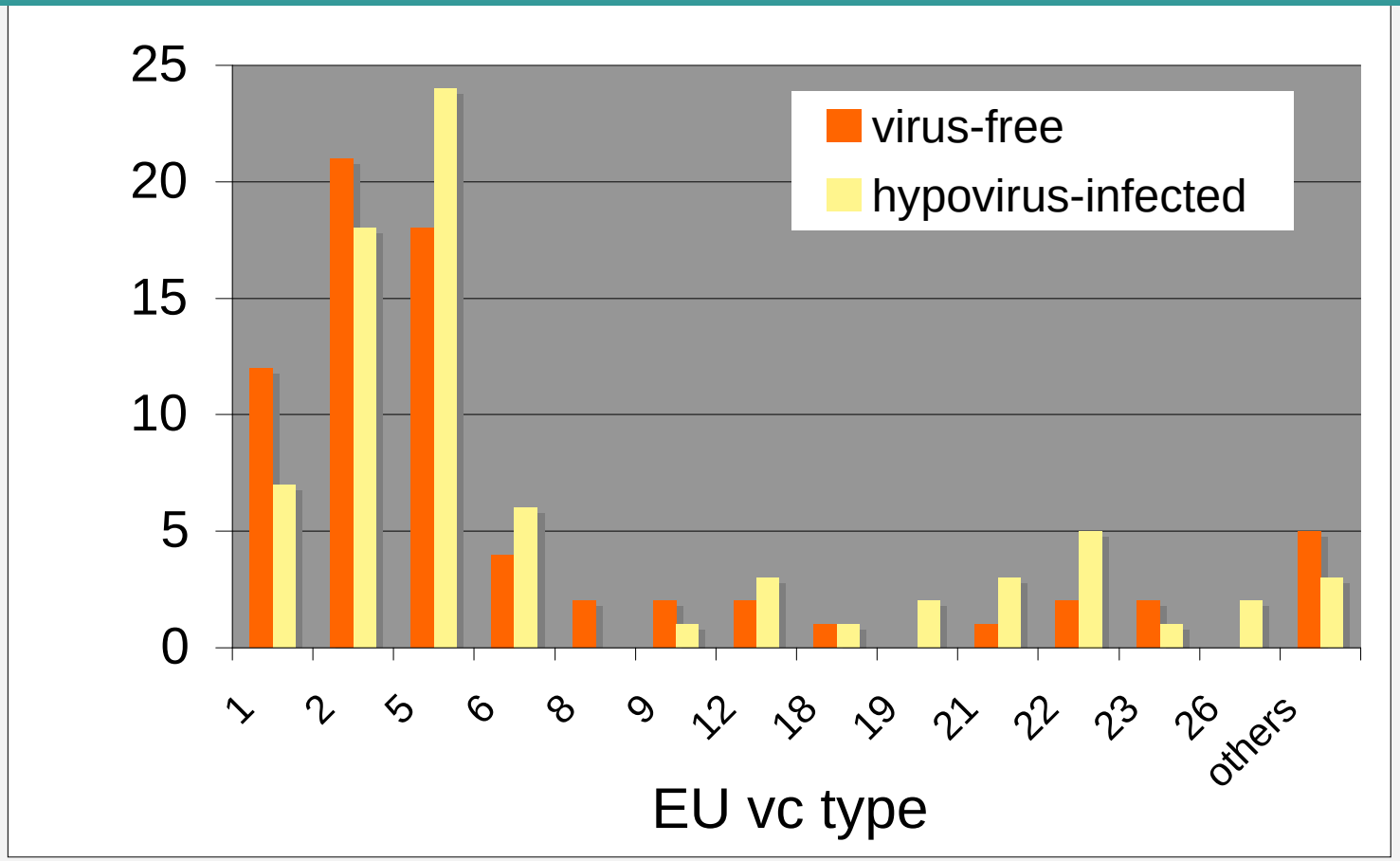
Vegetative incompatibility

- Limits spread of hypovirus between *C. parasitica* strains with different vc types.
- Success of hypovirulence associated with low vc type diversity (Europe vs USA)
- Leaky vegetative incompatibility system

VC type diversity and hypovirulence

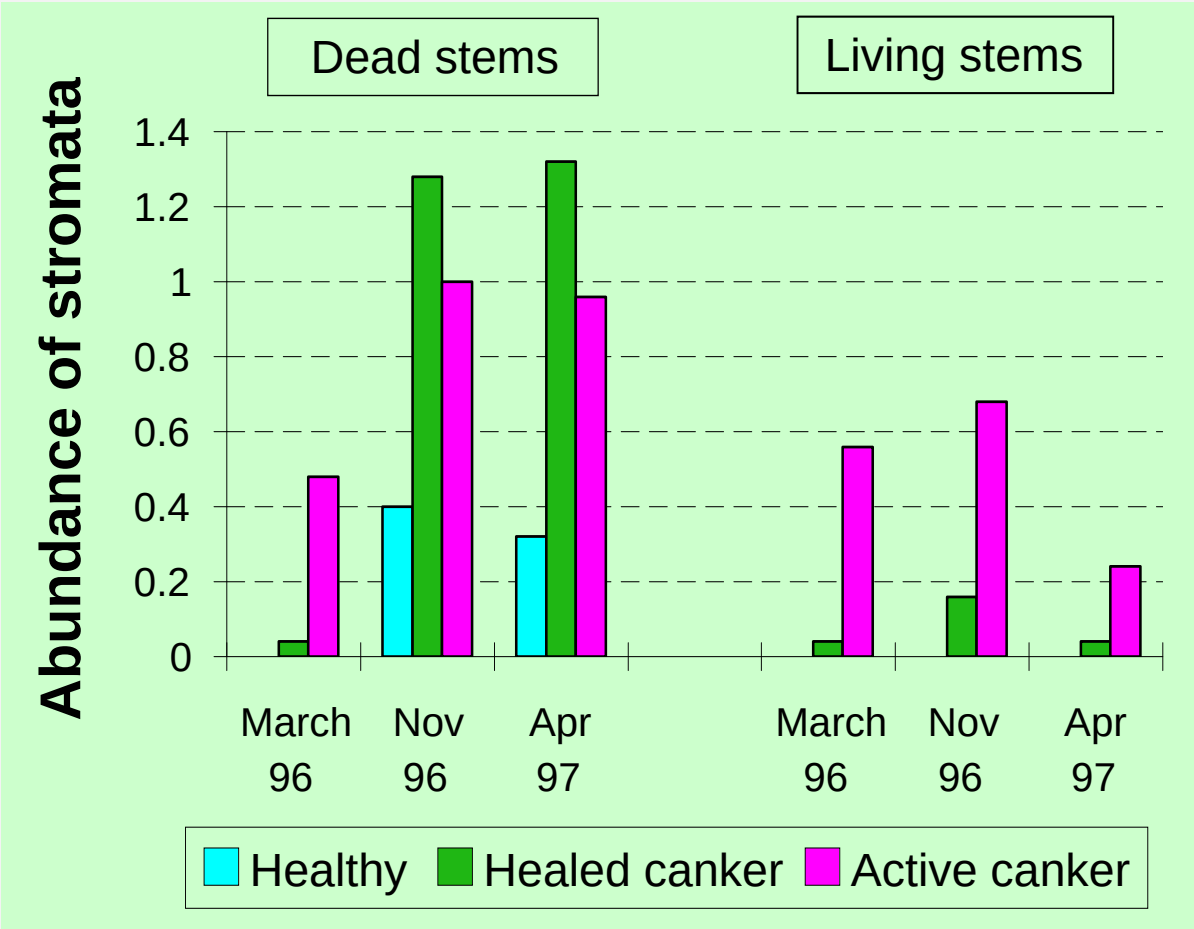
Country	No. vc Types in local populations	Total No. of vc types	Hypovirulence established
Italy	2 - 16	20	Yes (partially)
France	3 - 10	35	Yes (partially)
Switzerland (S)	4 - 16	26	Yes
USA	26 - 34	> 100	No
China/Japan	>30	> 100	No

Natural hypovirulence: Incidence of hypovirus among vc types

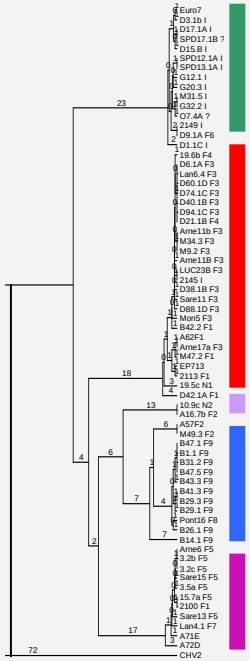


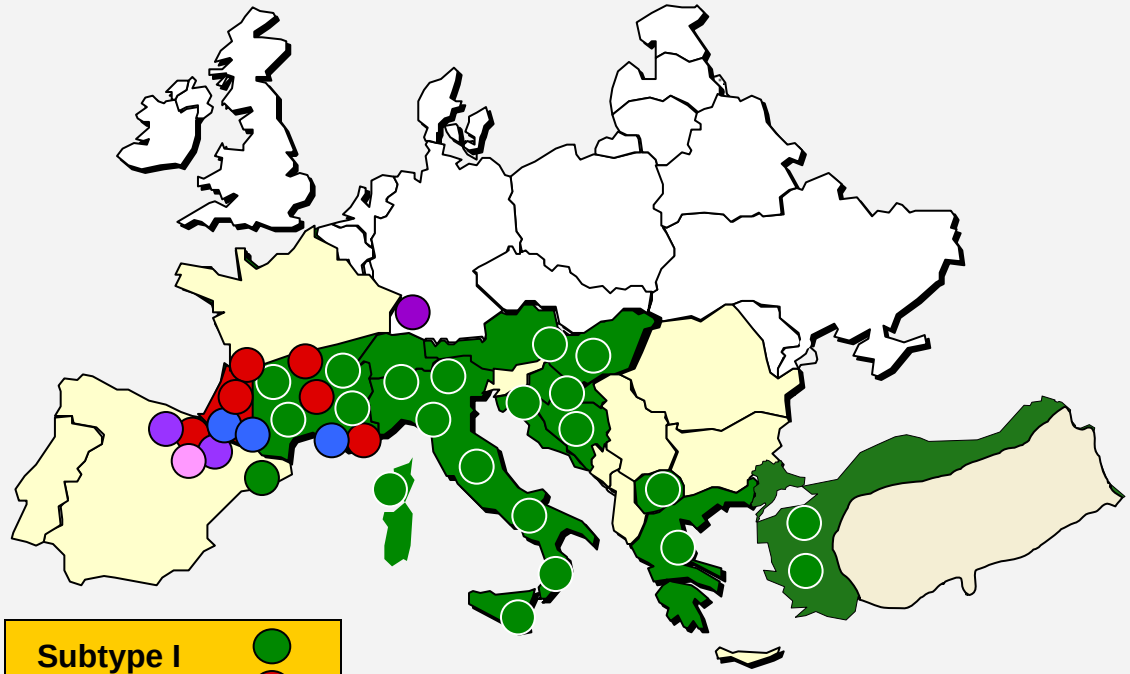
=> efficient hypovirus transmission to common and rare vc types

Natural hypovirulence:
Sporulation on the bark of dead chestnut wood



=> 18% of asexual conidia were hypovirus-infected

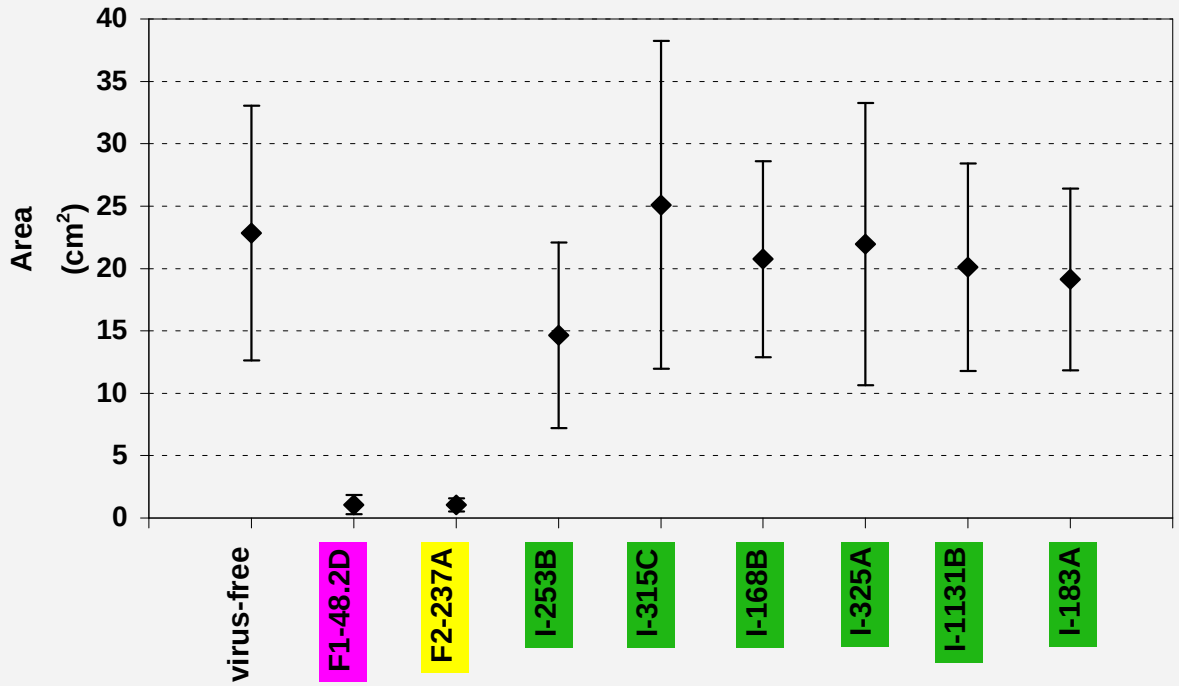


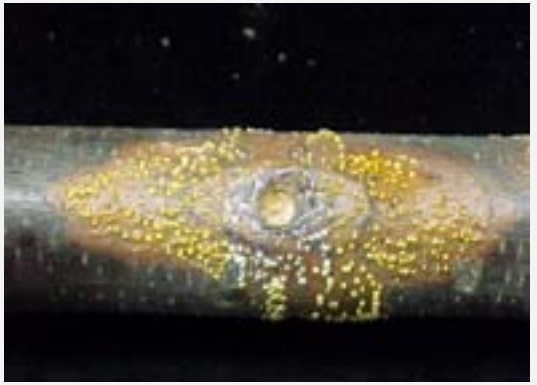


Subtype I
Subtype F1
Subtype F2
Subtype E1/D
Subtype E2

=> Success of hypovirulence associated to CHV-1 subtype I

Effect of CHV-1 subtypes on *C. parasitica*





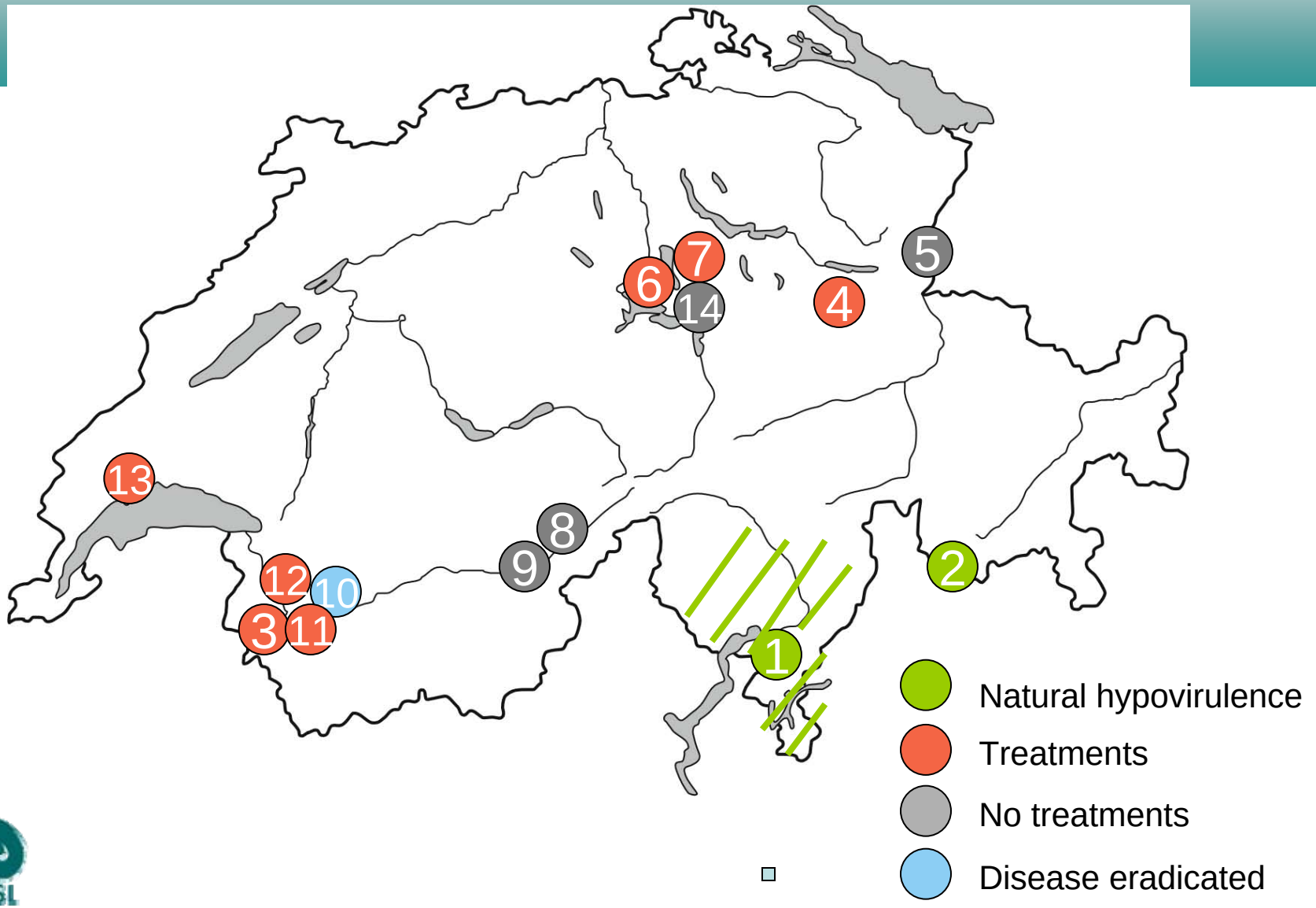
CHV-1 subtype I

CHV-1 subtypes F1, F2

Subtype I: mild effect on fungus

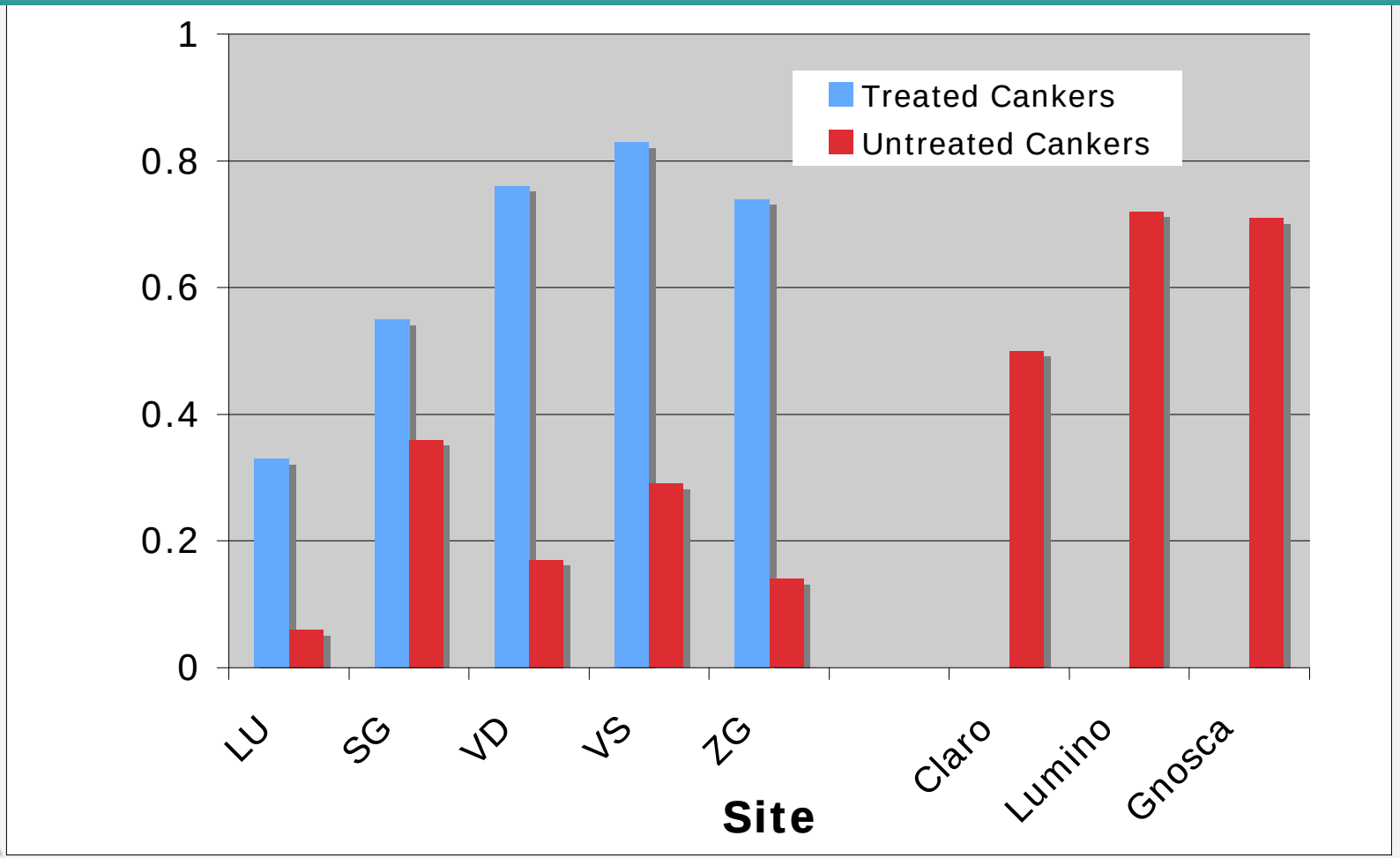
Subtypes F1 and F2: severe effect on fungus

Biological control of chestnut blight in Switzerland



Biological control treatments

Applied vs. Natural Hypovirulence



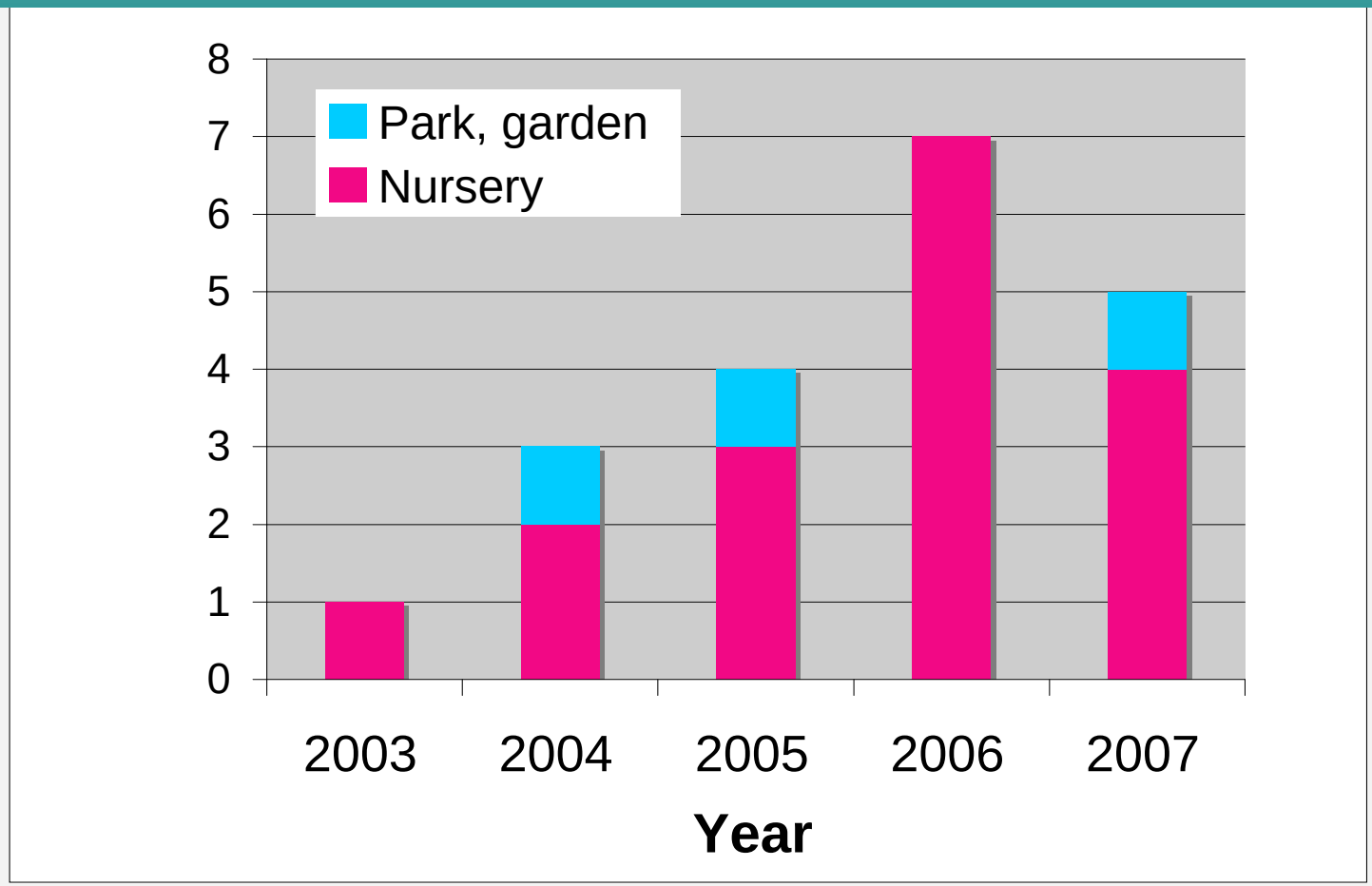
Phytophthora ramorum

Rhododendron

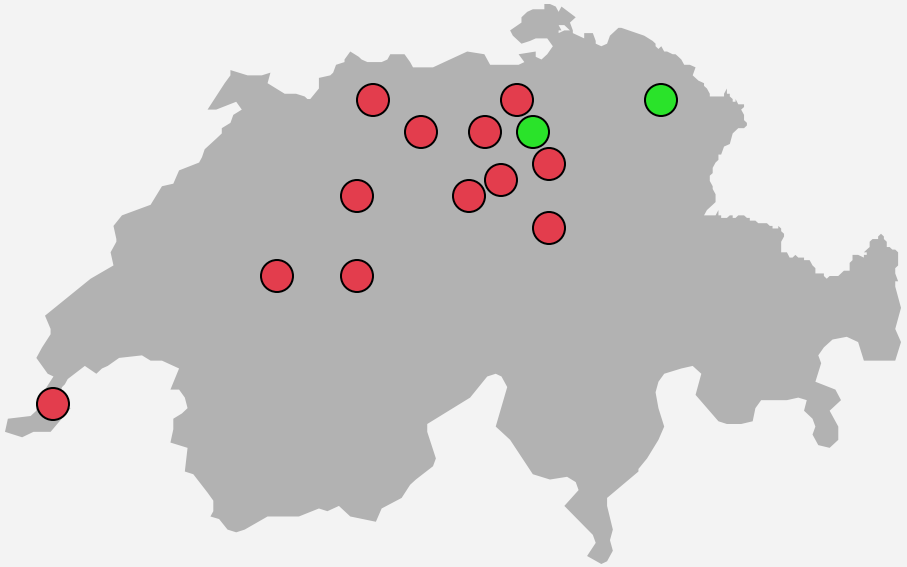
R. hirsutum

Viburnum

Incidence of *P. ramorum* in Switzerland



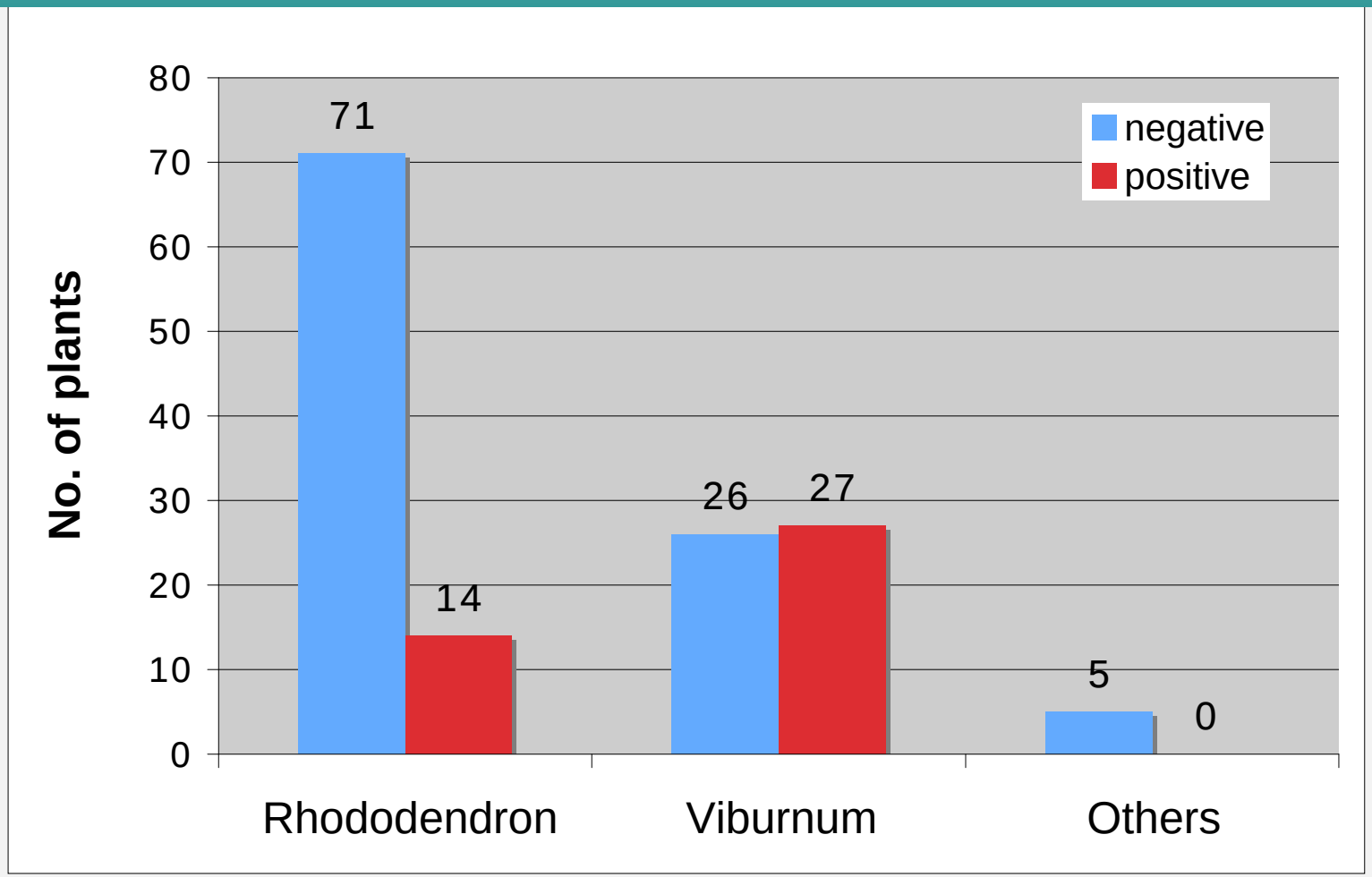
P. ramorum: Infection sites 2003 -2007



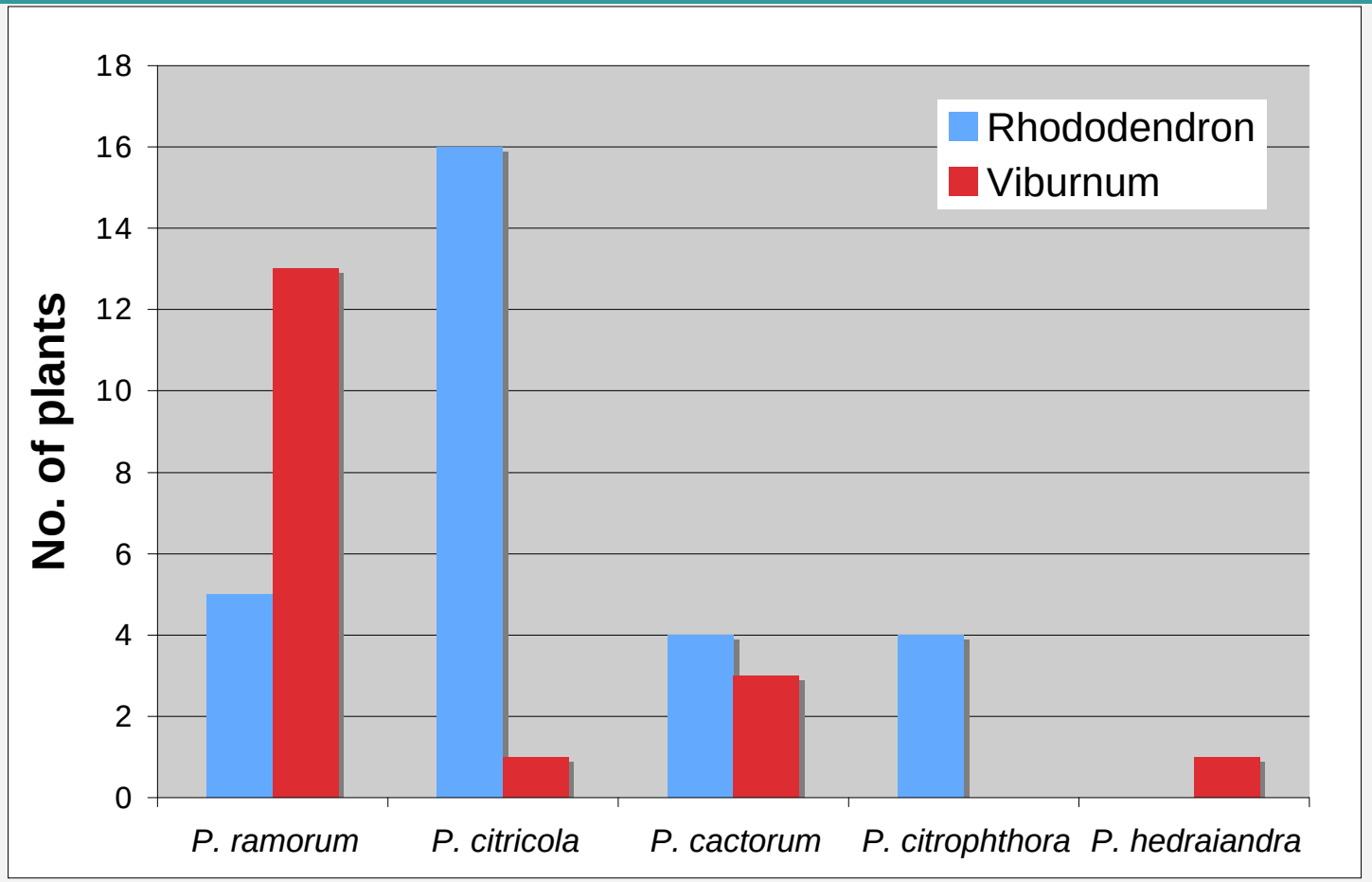
Nursery
Park/garden

14 outbreak sites

Incidence of *P. ramorum* on symptomatic host plants



Other *Phytophthora* species on symptomatic plants



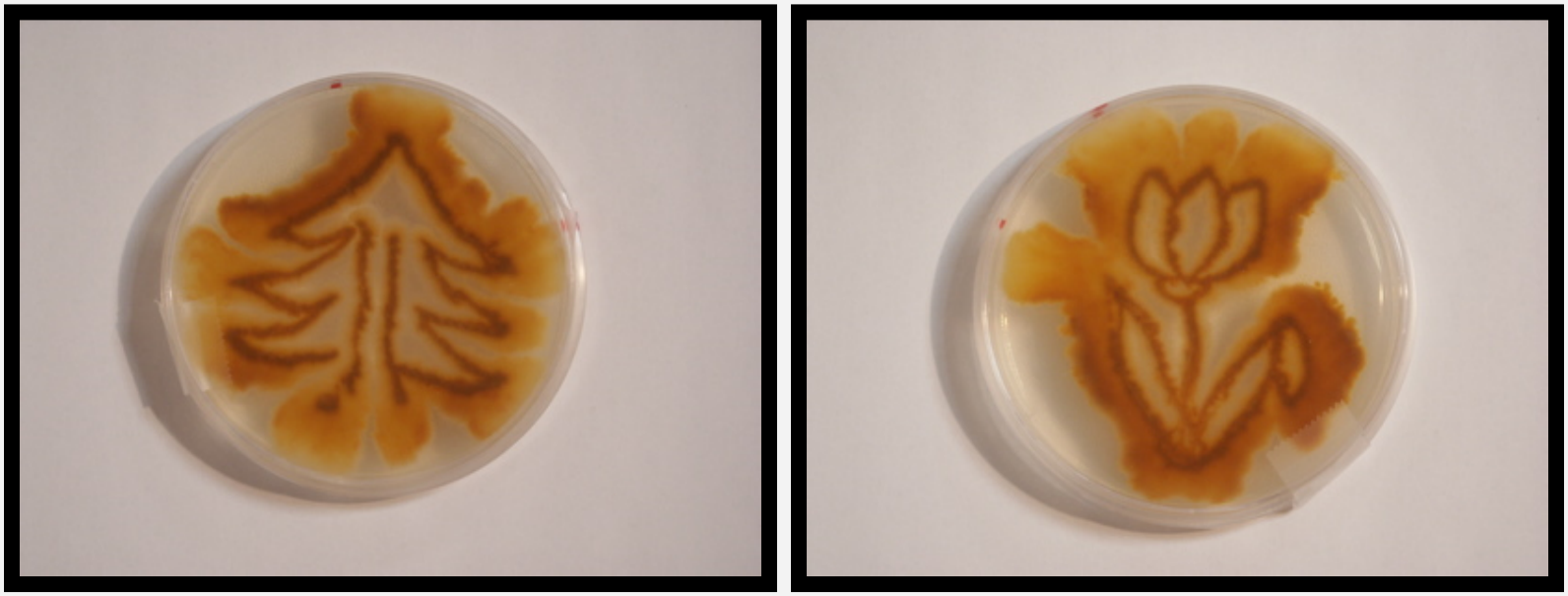
P. ramorum in Switzerland

- *P. ramorum* isolated from a total of 47 symptomatic *Rhododendron* and *Viburnum* in 14 different locations.
- *P. ramorum* on imported plants but also on locally grown plants
- Relative high incidence compared to many other European countries
- Eradication measures according to the “2,3,10” rule appear to be successful
- A few nurseries with repeated occurrence

Future:

- More intensive inspections of plant passporting nurseries (twice a year).
- More intensive monitoring of outbreak sites (including testing of soil, water, natural vegetation, streams)

Thank you for your attention!



Paintings by alien invasive species