

# Why is *Dickeya* spp. (syn. *Erwinia chrysanthemi*) taking over?

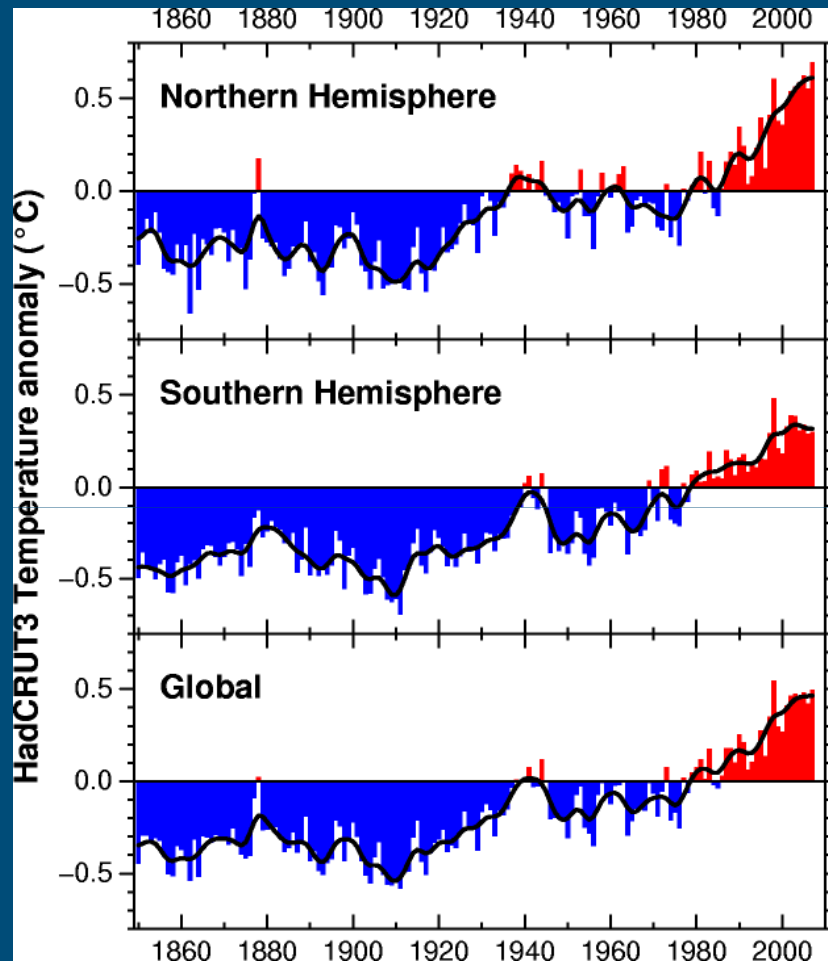
## The ecology of a blackleg pathogen

Robert Czajkowski, Henk Velvis & Jan van der Wolf



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# Climate change results in higher temperatures ..



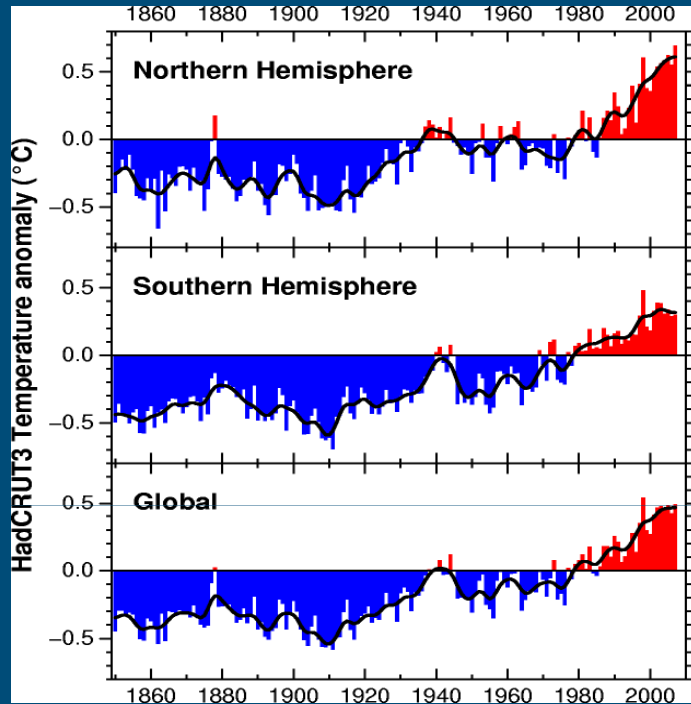
<http://www.cru.uea.ac.uk>



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# Climate change results in higher temperatures ..



Growth of most plant pathogenic bacteria is favored by higher temperatures → more disease problems



# .... and more rainfall

October 2008 - Noord Holland,  $\leq 116$  mm



T. Douma, Agrico



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- Spread of pathogens from surface water (brown rot)
- Spread of soil-borne pathogens
- Low oxygen conditions → impaired plant defense
- Dissemination via splashing water and aerosols
- Smearing during harvest



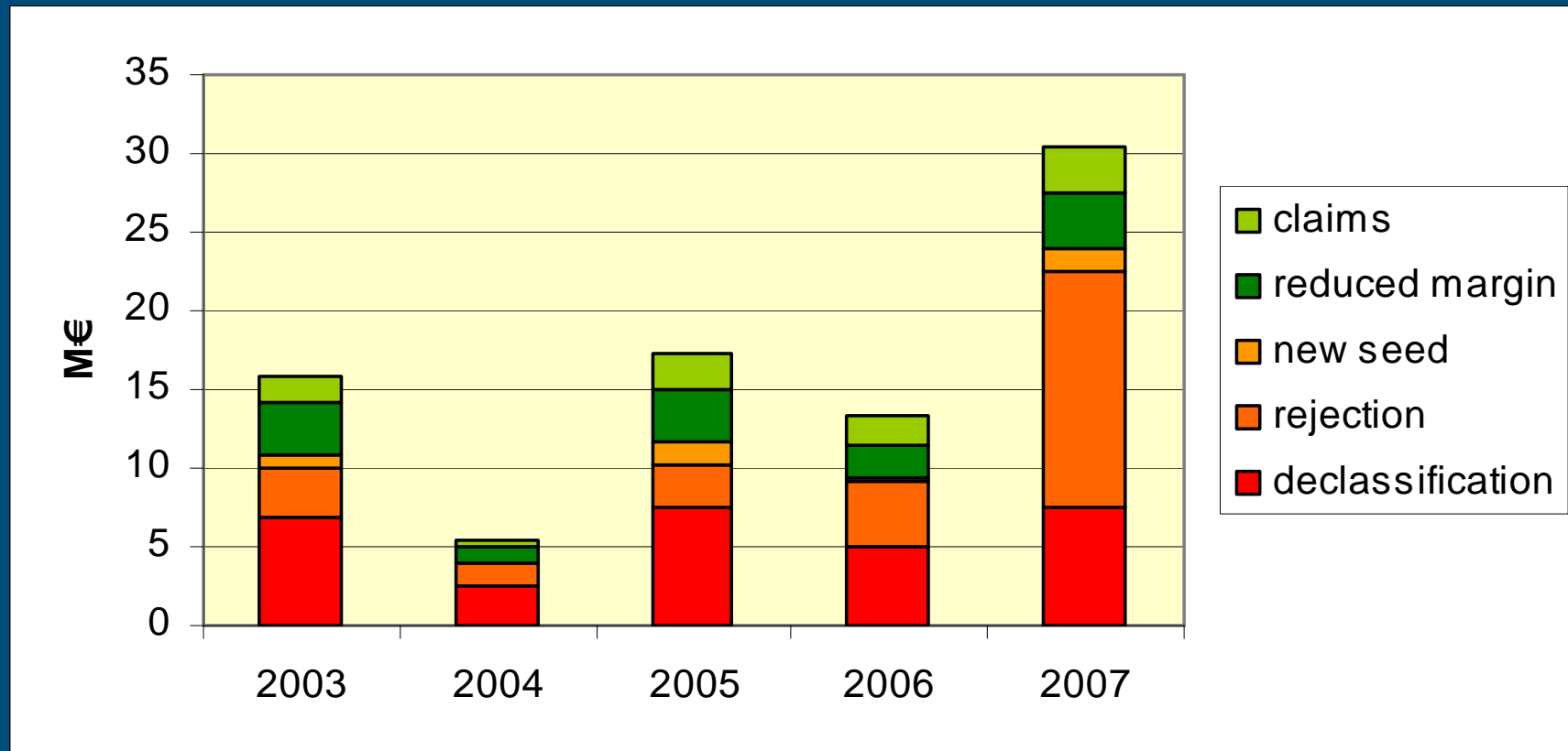
# Climate change favors potato blackleg pathogens..

## ■ Potato blackleg pathogens

- *Pectobacterium atrosepticum* (syn. *Erwinia carotovora* subsp. *atroseptica*)
- *Pectobacterium carotovorum* subsp. *carotovorum* (syn. *E. c.* subsp. *carotovora*)
- *Dickeya* spp. (syn. *E. chrysanthemi*): *D. c.*



.. and cause a lot of direct economic damage



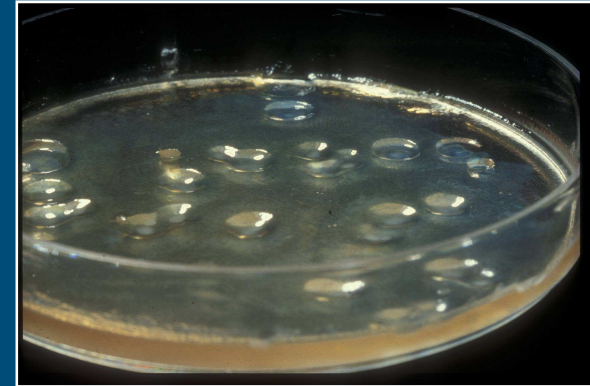
Source LEI, 2008

(Erwinia damage in flower bulbs: c. 10 M€/yr)



# Blackleg is hard to control

- Seed borne (potato vegetatively propagated)
- Often latent infections
- Introductions seem to be difficult to avoid
- No control agents
- No resistant varieties
- Instruments for (classical) resistance breeding are lacking
- Diverse group of pathogens → *Dickeya* and *Pcc* broad host range
- Pectinolytic → rotting tissue → infectious
- Facultative anaerobes
- Motile

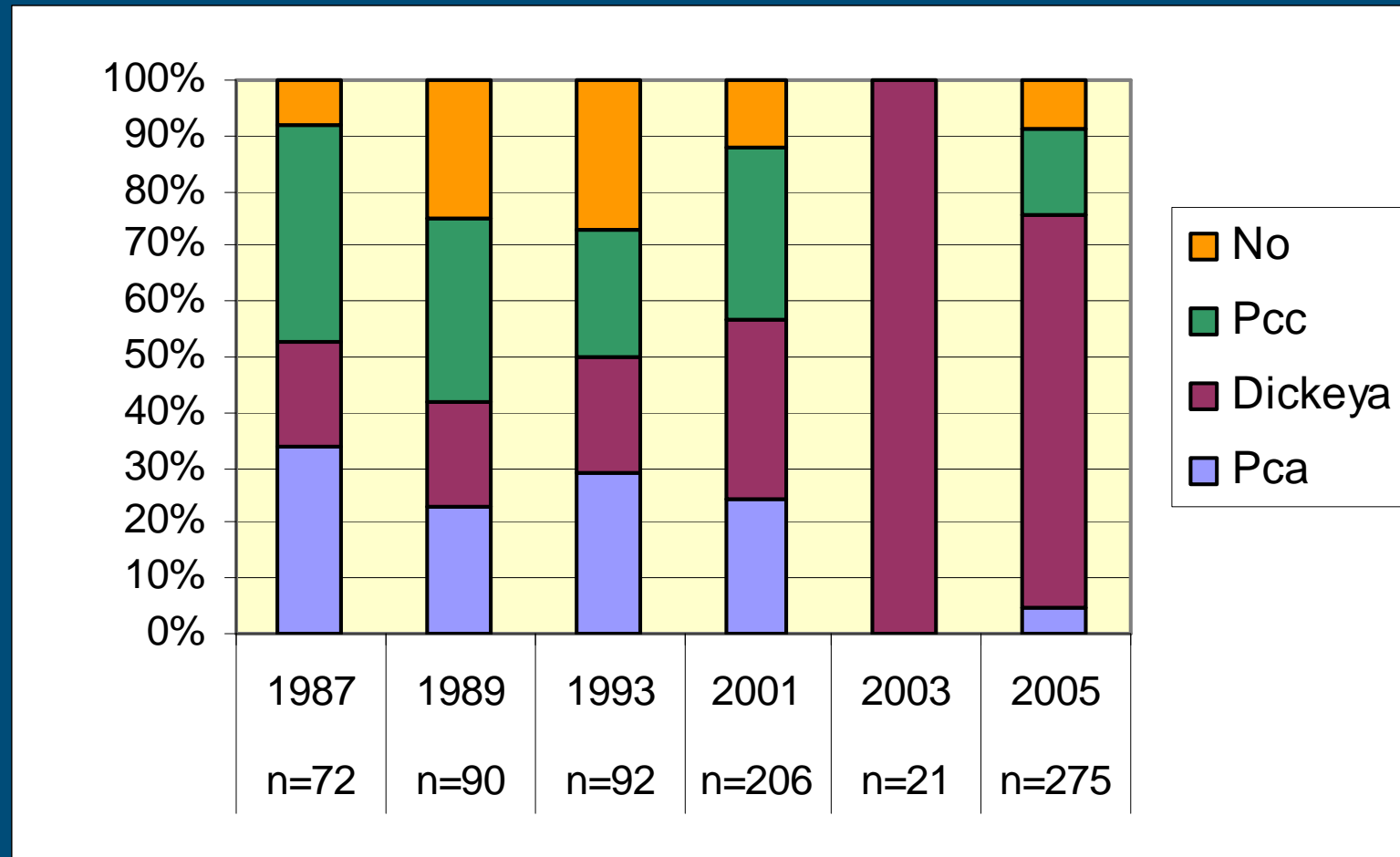




# Temperature



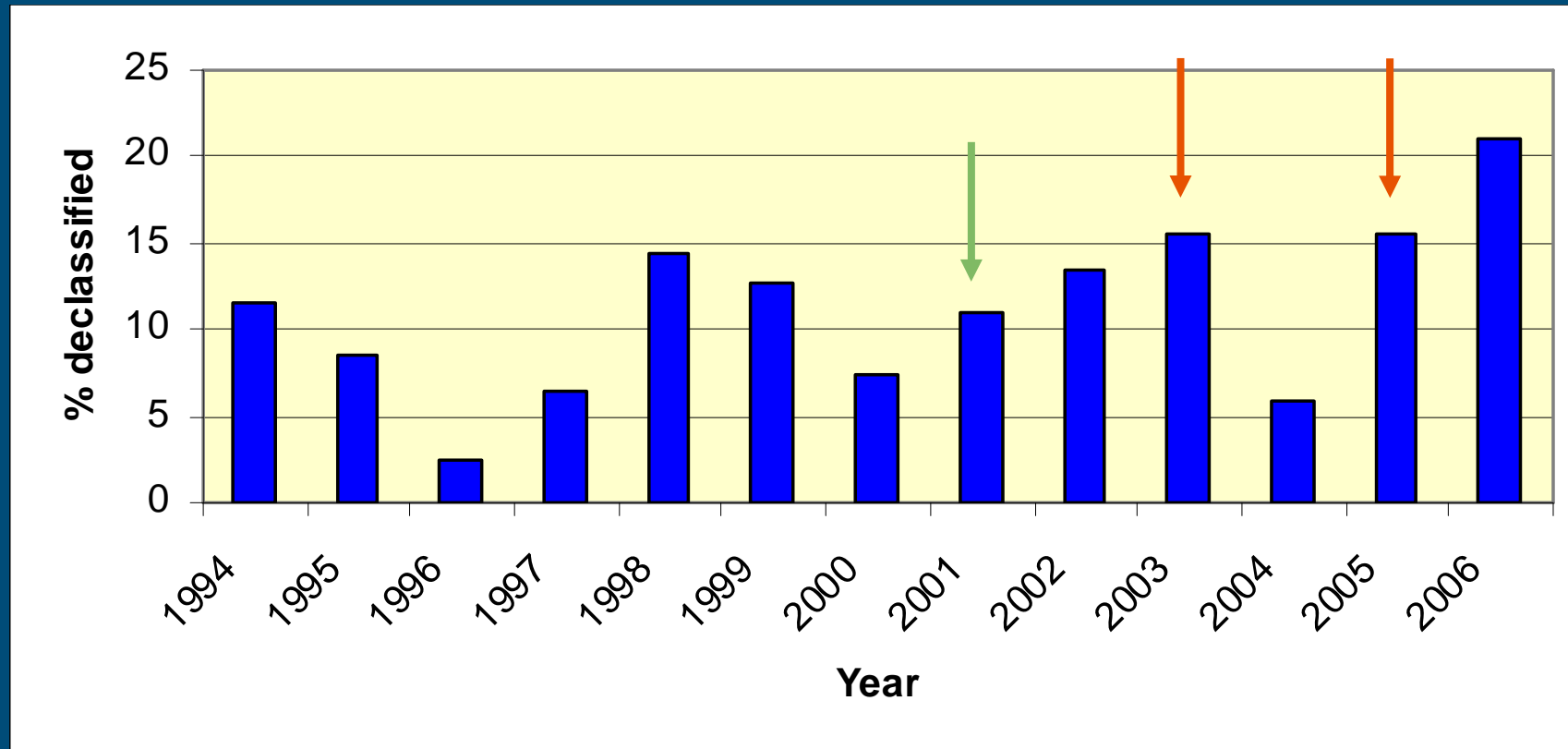
# Survey Erwinia in blackleg-diseased plants (NL)



Source: NAK



# Declassified + rejected seed lots in the Netherlands



Source: NAK



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# *Dickeya* spp. have a high growth optimum

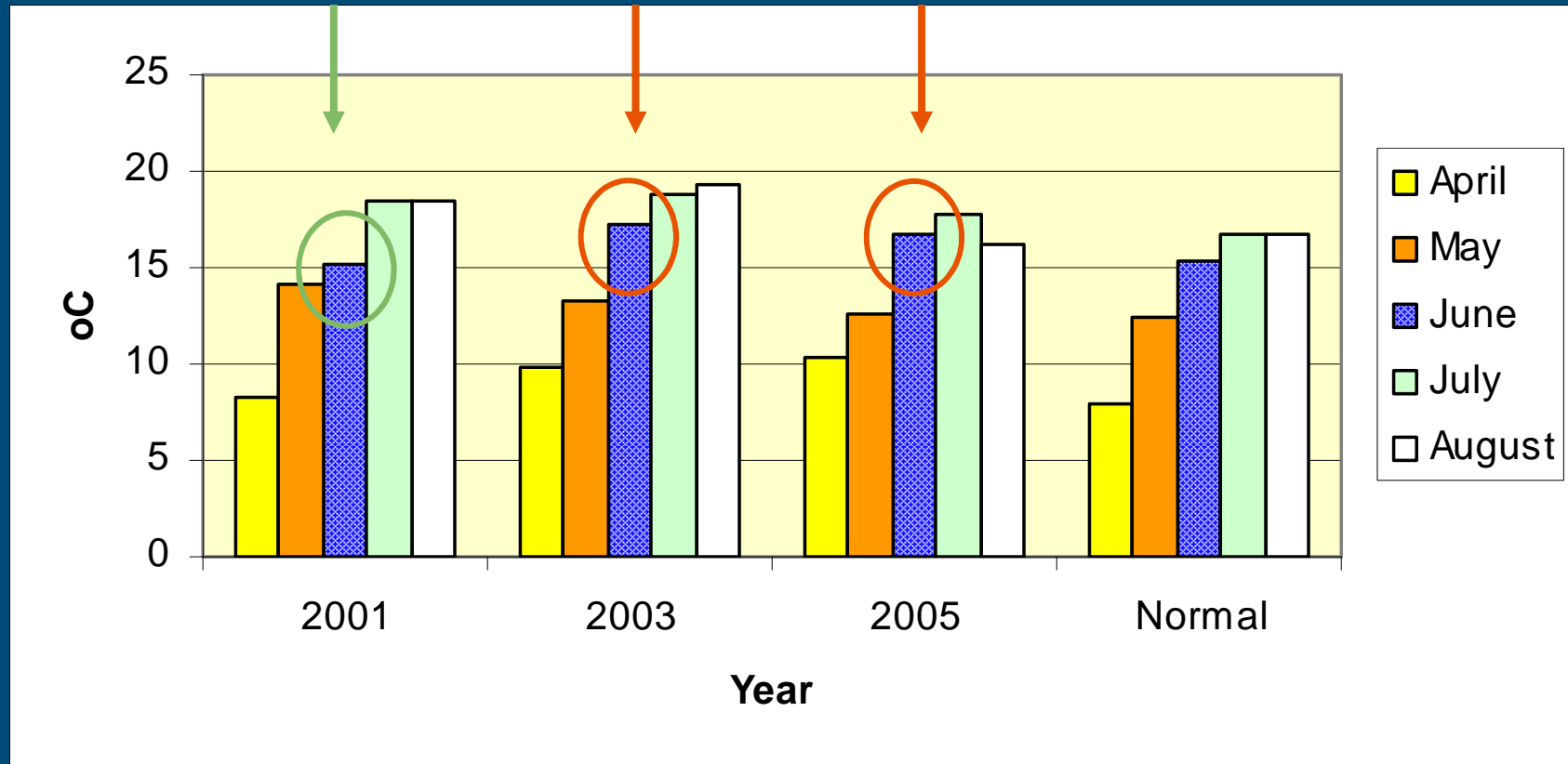
Growth temperature (in °C)	<i>P. atrosepticum</i>	<i>P. carotovorum</i> <i>spp. carotovorum</i>	<i>Dickeya</i> spp.
Minimum	3	6	6
<b>Optimum</b>	<b>27</b>	<b>29</b>	<b>34</b>
Maximum	35	≥ 37	≥ 37

Revised after Pérombelon & Kelman, 1980





# High temperatures in June associated with *Dickeya* spp. infections?

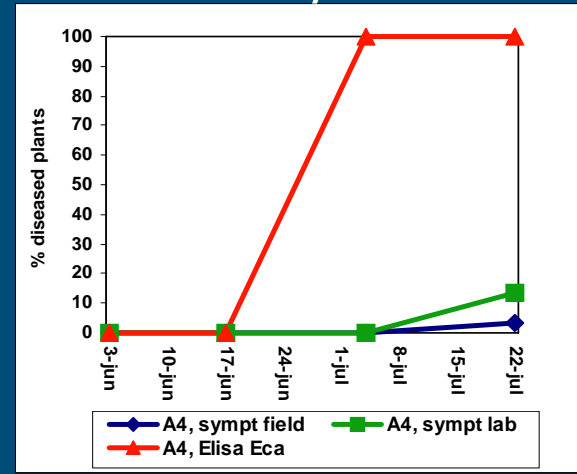
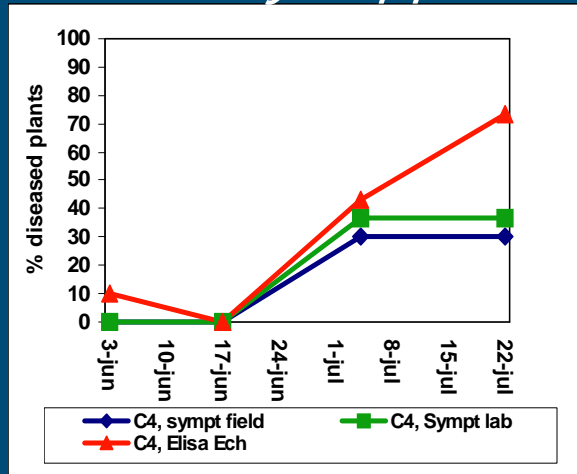


# Low densities of *Dickeya* spp. can give blackleg

## *Dickeya* spp.

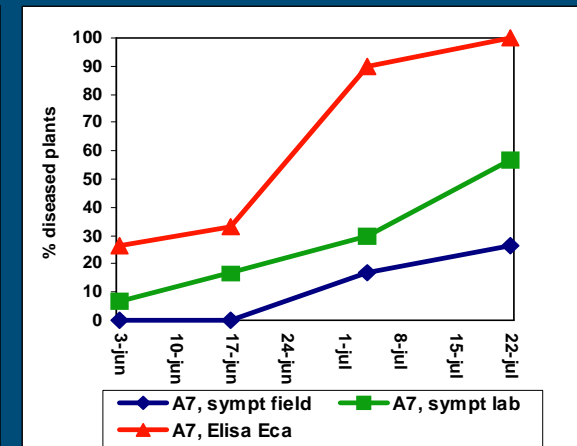
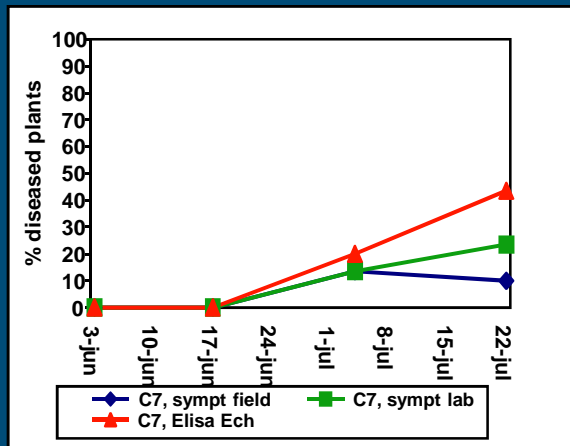
## *P. atrosepticum*

low,  $10^4$  cells/ml



low,  $10^4$  cells/ml

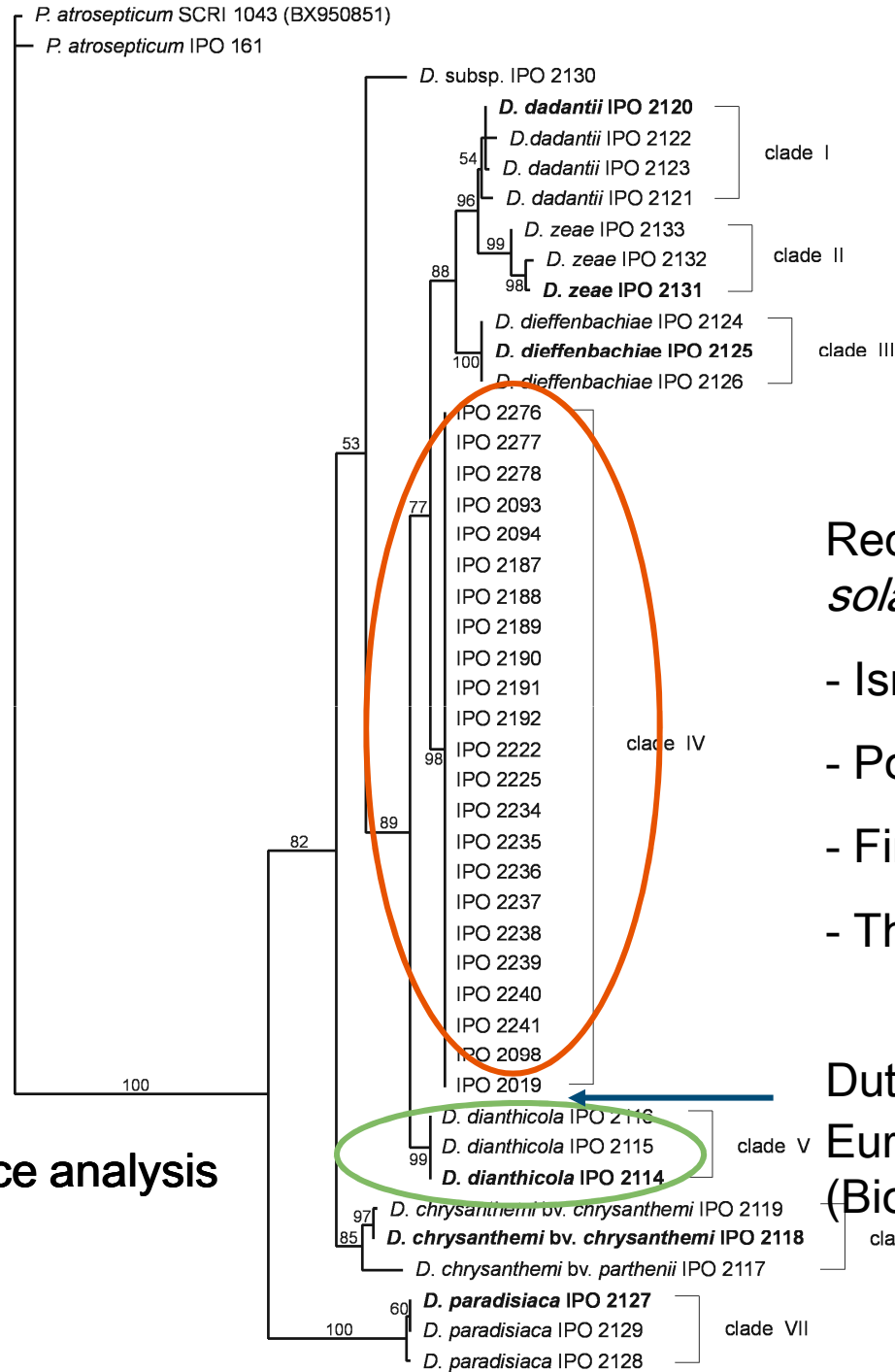
high,  $10^7$  cells/ml



high,  $10^7$  cells/ml



**DnaX-sequence analysis**



Recent potato strains "*D. solani*" (Biovar 3):

- Israel
- Poland
- Finland
- The Netherlands

Dutch Hyacinth strain  
European potato strains ≤ 1995 (Biovar 1 and 7)

— 5 changes

## *D. solani* seems to be more virulent than *D. dianthicola*

Feature	<i>D. solani</i>	<i>D. dianthicola</i>
Maximum growth temp.	39 °C	37 °C
Symptom expression	62% (n=3)	36% (n=2)
Tuber tissue maceration	Strong	Weak
Plant colonization		
from roots	Yes	No
from stems	Strong	Weak
Survival on tuber tissue	Long	Short





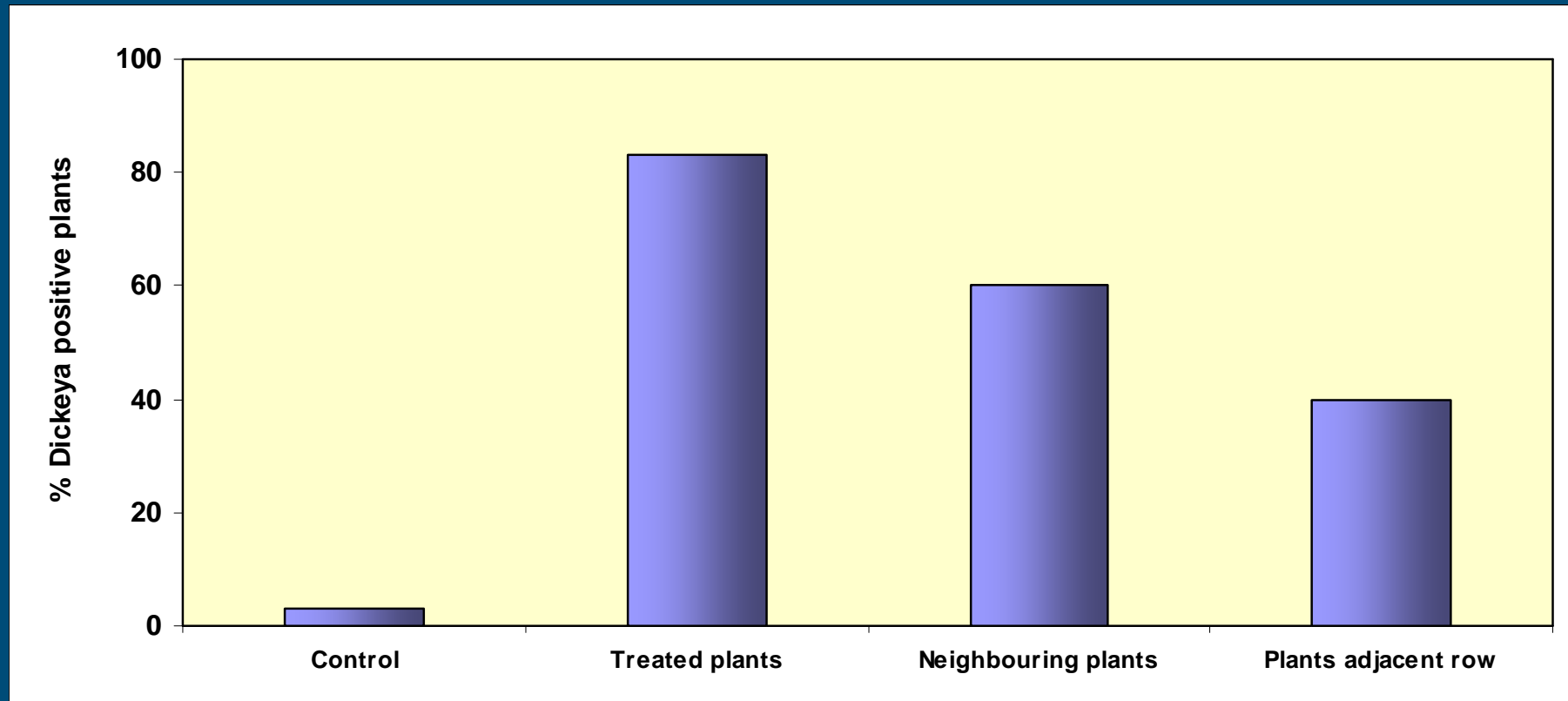
# Precipitation



“Your umbrella or your life!”



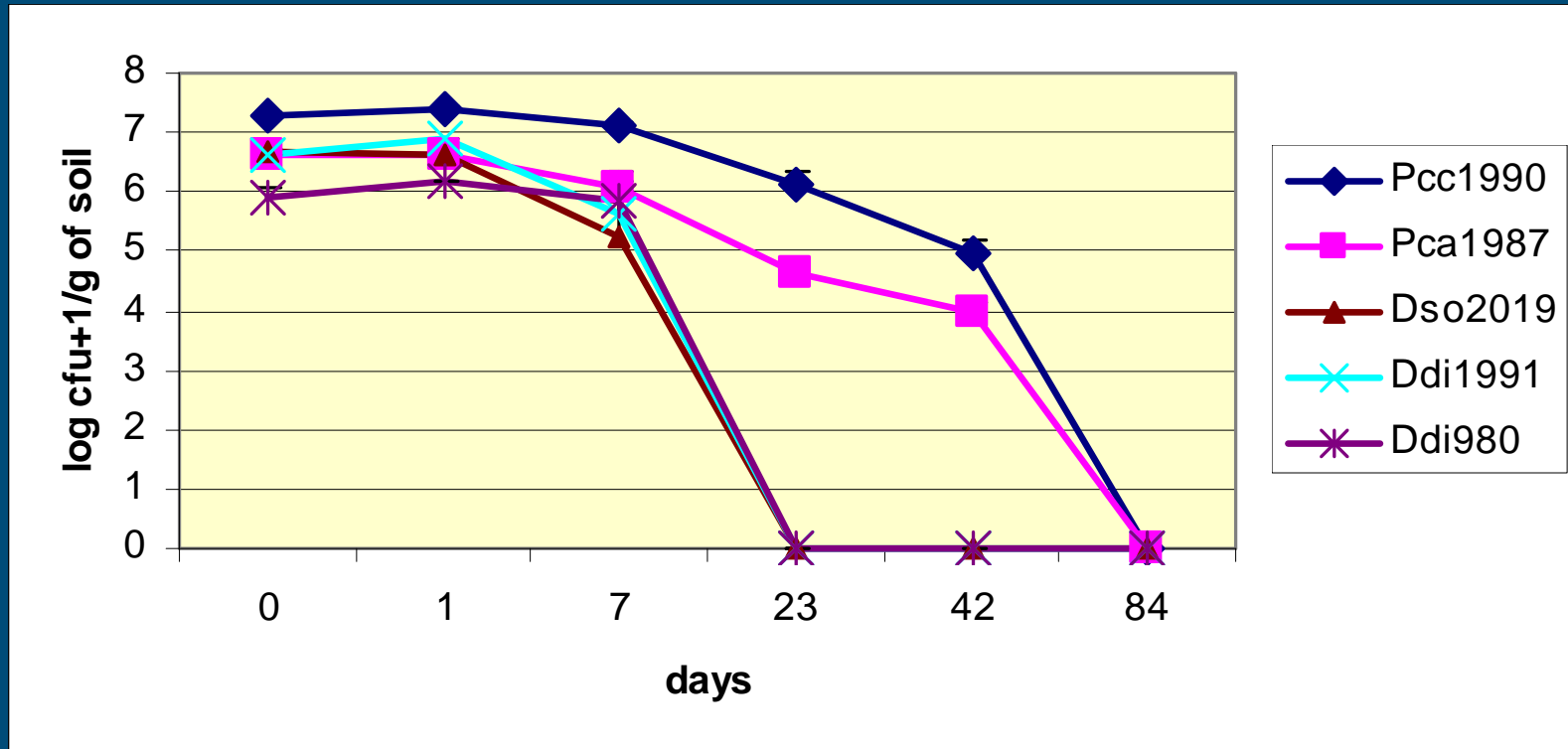
# *Dickeya* spp. is spread by free water in soil



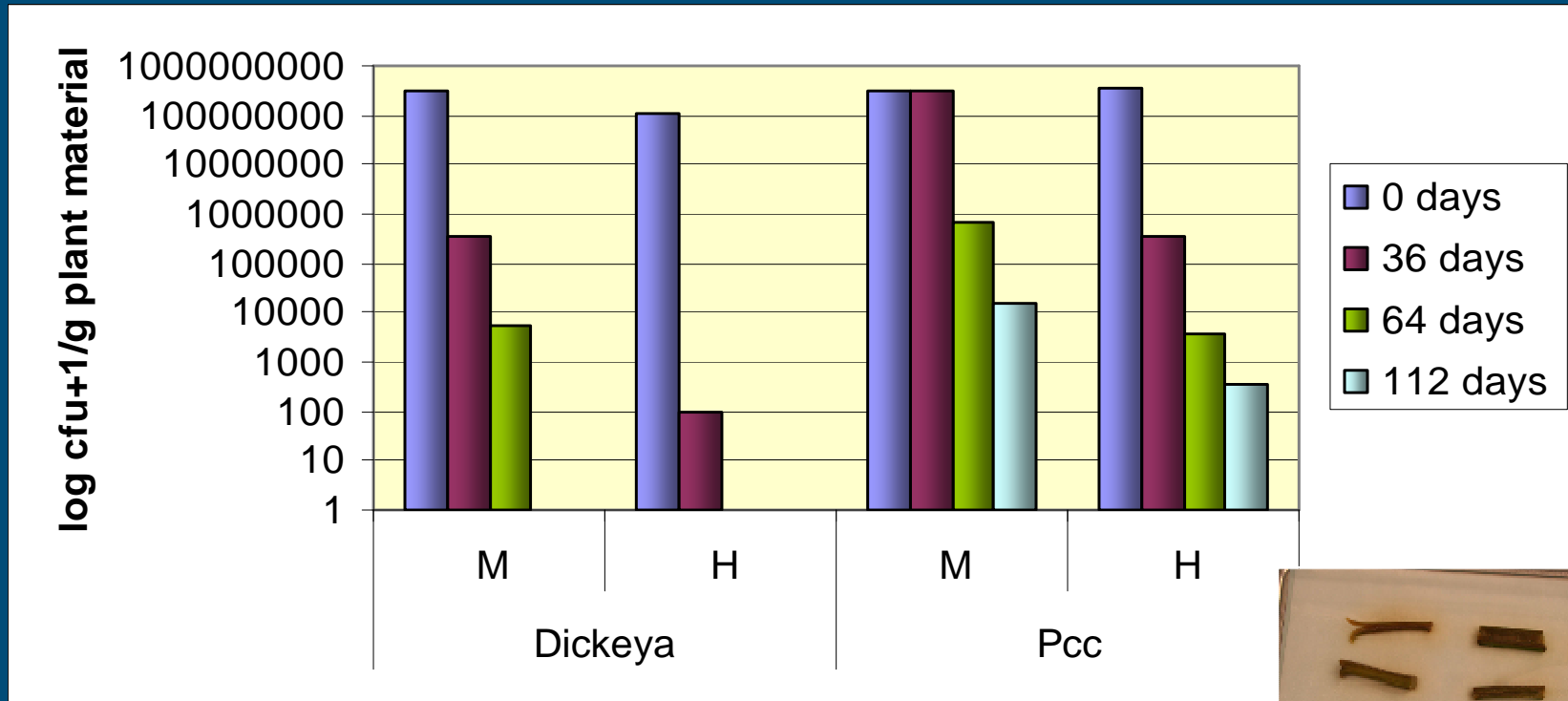
six weeks after irrigation



# *Dickeya* and *Pectobacterium* cannot overwinter in soil ...



... even not in crop debris



Stem fragments were still present at day 112

Soil M = peaty soil, Soil H = sandy soil

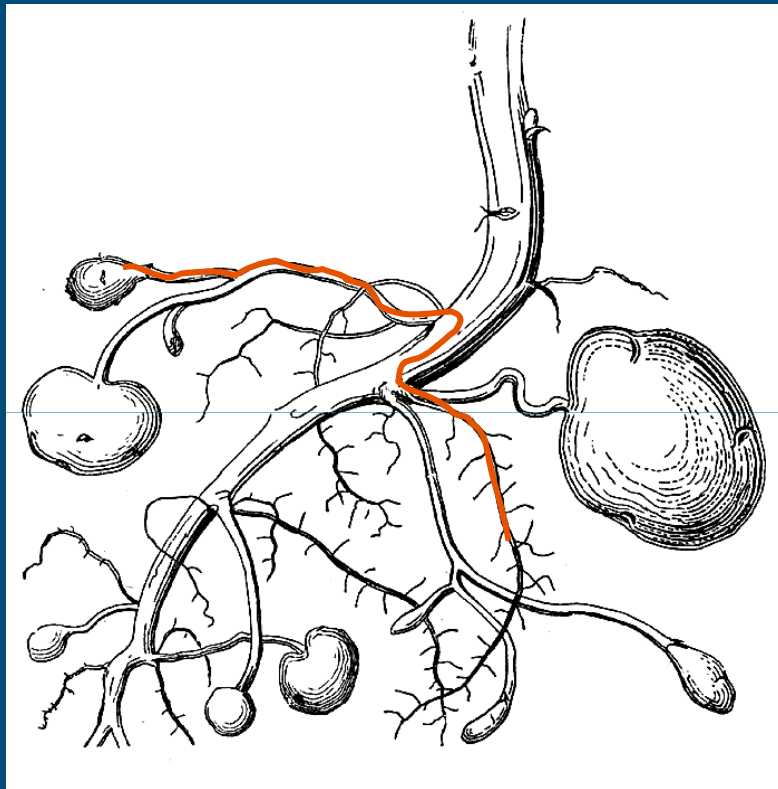




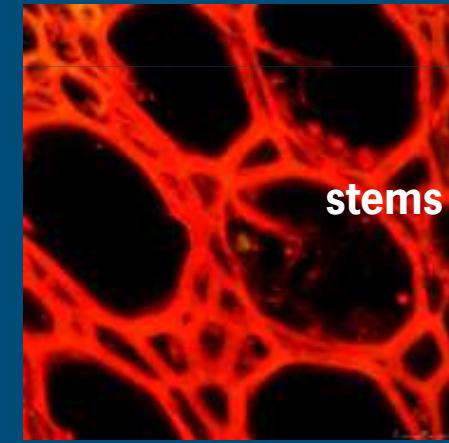
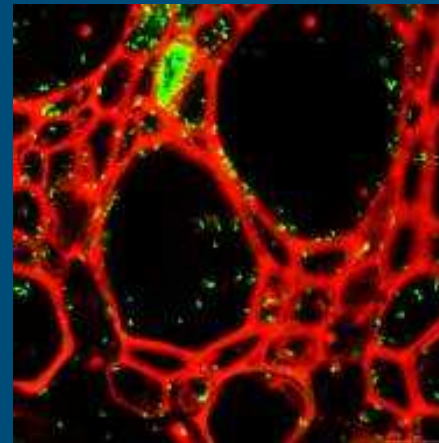
# ..colonize roots and cause systemic infections

GFP-tagged *Dickeya*

control



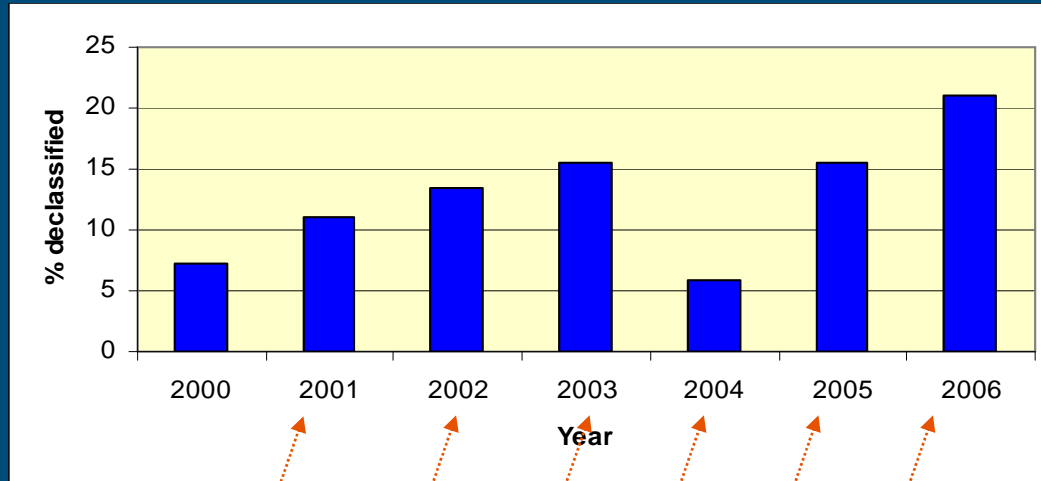
roots



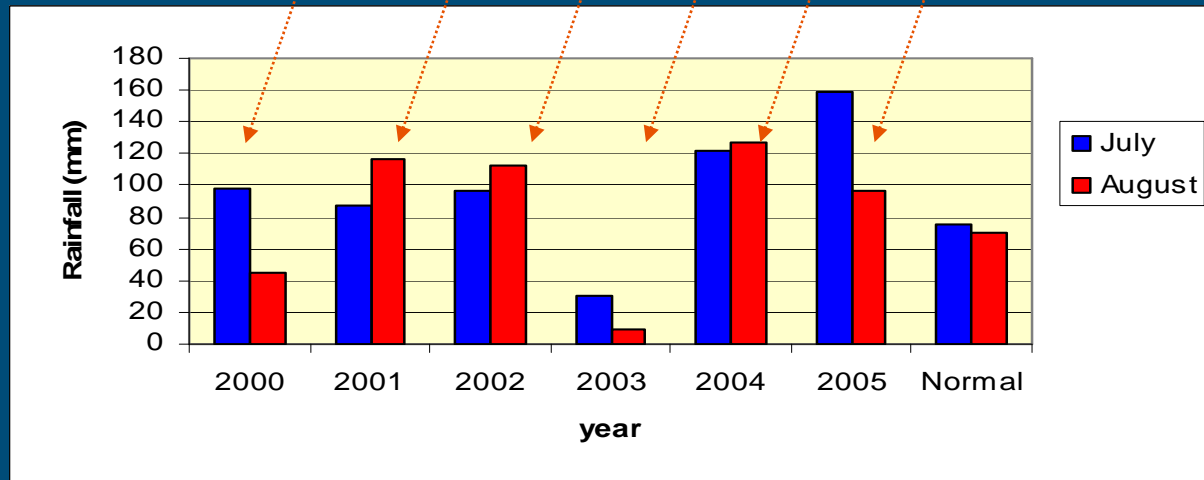
stems



# Wet weather conditions result in smearing during harvest



Declassification



Rainfall



# Concluding remarks

- Blackleg incidences fluctuate largely, but last five years more problems are encountered
- Incidences are connected to increasing *Dickeya* infections, a high temperature pathogen
- A new *Dickeya* 'high temperature' species ("*D. solani*") seems to take over from *D. dianthicola*
- *Dickeya* spp. can induce symptoms at low densities
- *Dickeya* spp. are spread via free water in soil
- *D. solani* can invade progeny tubers via roots from soil borne inoculum



# Contributors

- HZPC Research
  - Doretta Boomsma
- Applied Plant Research
  - Joop van Doorn
- NAK
  - Gé van de Bovenkamp
  - Eisse de Haan
- Plant Research International
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  - José van Beckhoven
  - Monika Slawiak

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