

# BLACKLEG AND SOFT ROT OF POTATO IN FINLAND: MORE THAN A DECADE OF MONITORING AND CHARACTERIZATIONS OF THE ETIOLOGY AND DISEASE OUTBREAKS

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## Outline

- Blackleg and soft rot of potato in Finland- past and present
- *Dickeya* and *Pectobacterium* species- old and new
- Research enabled by tools and resources of genomics (the genomic era)
- Characterization of disease outbreaks
- Diagnosis and detection, opportunities and challenges
- Achievements, prospects and Conclusions

## Blackleg and soft rot of potato – Symptoms and damage





# Disease could occur on field, during transit and in storage



Field outbreak



Packing, Transit and storage



Shop



## Blackleg and soft rot bacteria in Finland- A brief HISTORY

- Present since many decades under different names
- Problem increased rapidly in 1960-1970
- A decreased in the 1970s due to developments in disease certification schemes
- Once again the disease has become a considerable threat since early 2000.

## The focus of the work during the last decade

- Monitoring and surveillance
- In seed health testing method

## Blackleg Aetiology in Finland

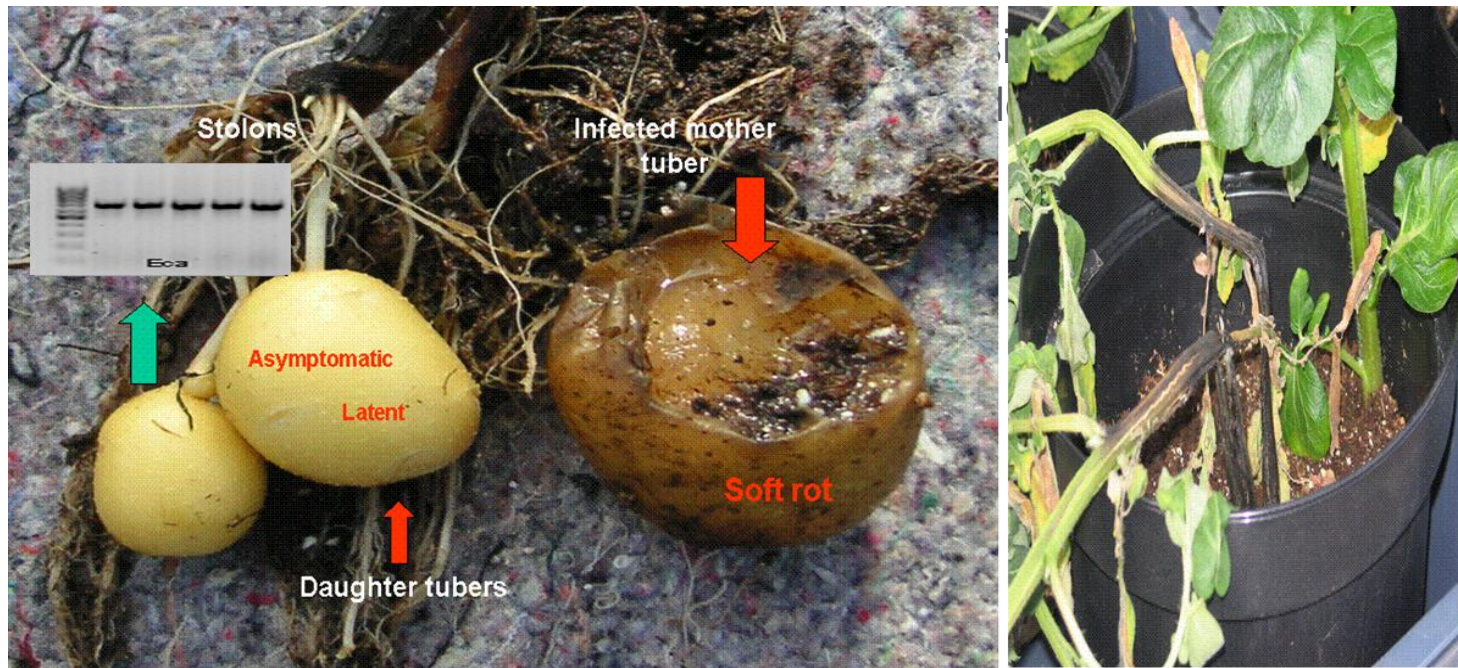
Shift from a serotype one species  
(*Pectobacterium atrosepticum*) (Harju &  
Kankila, 1993 to multiple taxa ( Degefu *et al.*  
2009, 2013, Laurila *et al.* 2010)  
..... Methodological issues!!!

## Advances in Methodology: Diagnostics in the genomic era

Progress in the availability of genomic data made in the past decade (genomic era) contributed to wide spread transformation into research enabled by tools and resources of genomics – Molecular diagnostics



# Pathogen Detection and diagnosis : Empowered by advances in Molecular Biology



Degefu Y. Unpublished

## Blackleg Aetiology- Current knowledge

A serotype of one species  
*P. atrosepticum*  
(Harju & Kankila, 1993)

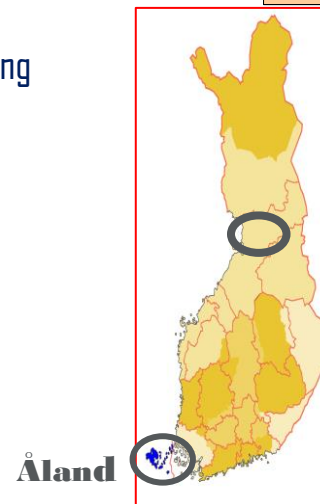
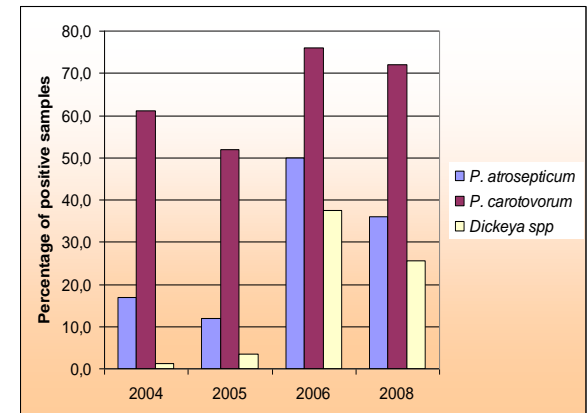
### Current list

- *Pectobacterium atrosepticum*
- *Pectobacterium brasiliensis*
- *Pectobacterium carotovorum*
- *Pectobacterium wasabiae*
- *Dickeya solani*. Perhaps some *unknowns???*
- Degefu *et al.*, 2009, 2013, Laurila *et al.* 2010)

-Emerging & re.-emerging  
-(pathogen dynamics)

## Incidence of *Dickeya* and *Pectobacterium i* in Finnish seed potato

- *Dickeya solani* was first detected from the autonomous island, Åland, in the South West region between Finland and Sweden where most of the production of industrial potato and potato chips manufacturing is concentrated.
- Soon spread to other potato and seed potato growing regions including the High Grade (HG) zone.
- Became the predominant species causing blackleg during warm seasons (Degefu *et al.* 2013, Annals of Applied Biology)



(Degefu *et al.* 2009, J. Phytopathology 157:370-378)

**Oulu region**

# Implication of diversity of causal agents

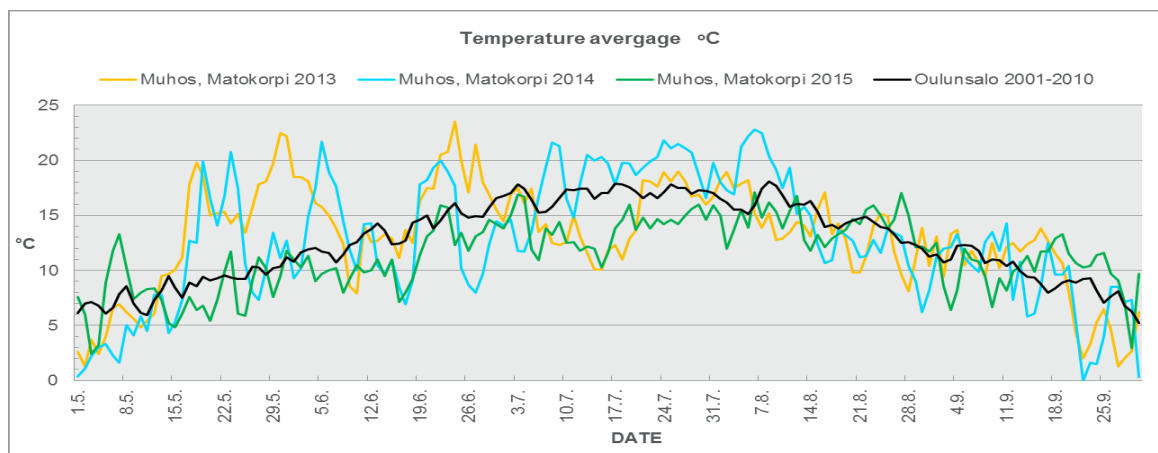
- **Blackleg /soft rot - a diseases complex**
- **Diagnostic costs and complexity**
- **Disease occurrence, a likely phenomenon (Irrespective of the type of summer warm or cool )**
- **Blackleg and soft rot- consistent threats**
- **Possible complications in disease management**

## *Dickeya solani*: the game changer

Severity of blackleg outbreak, direct loss of harvest and losses from down grading of seed lots have increased significantly since the introduction and establishment of *Dickeya solani*

# Dickeya solani is aggressive and spread rapidly within potato fields

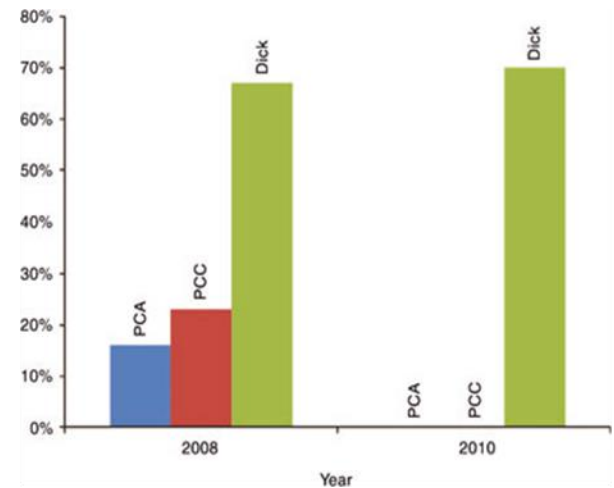
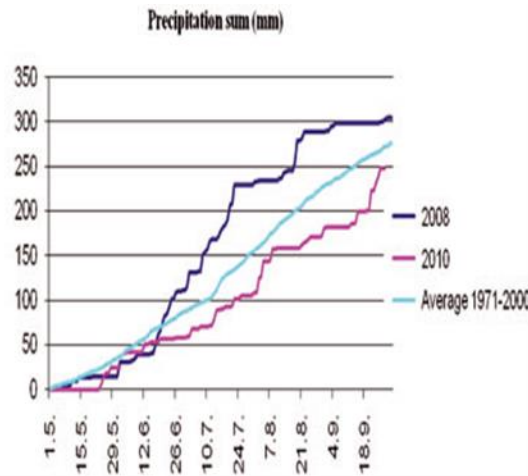
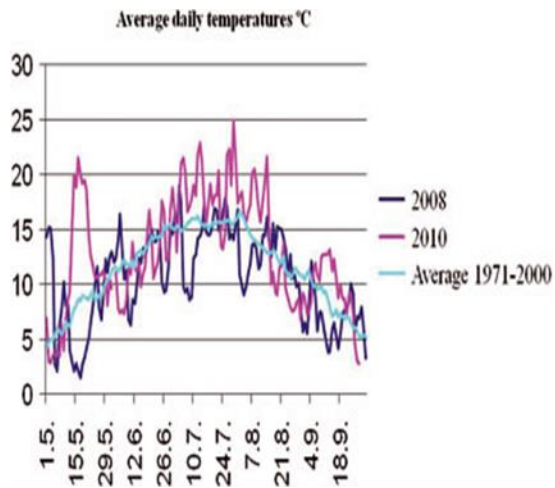
The lesson from the Finnish summer of 2015 indicated that 5-7 days with temperatures of about 25°C resulted in heavy infection from symptom free condition, thereby rejection of the fields.



(Degefu Y. Unpublished)



# Weather determines the species prevalence- species of the year!



**NOTE:** *Dickeya* takeover in warm season

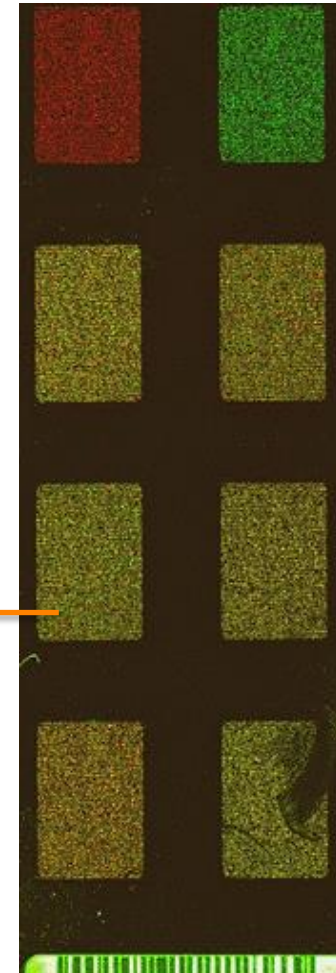
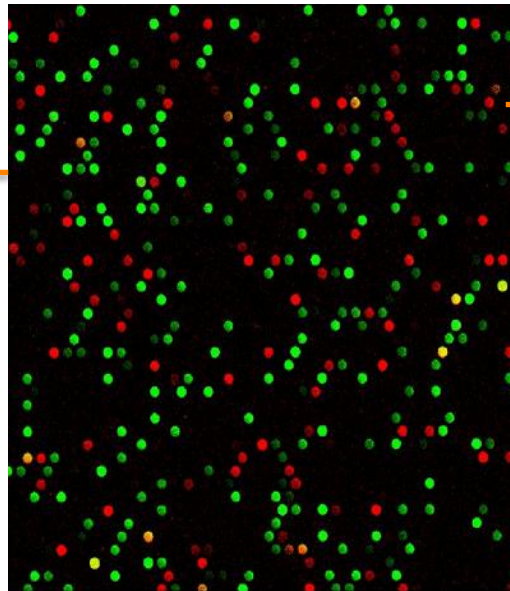
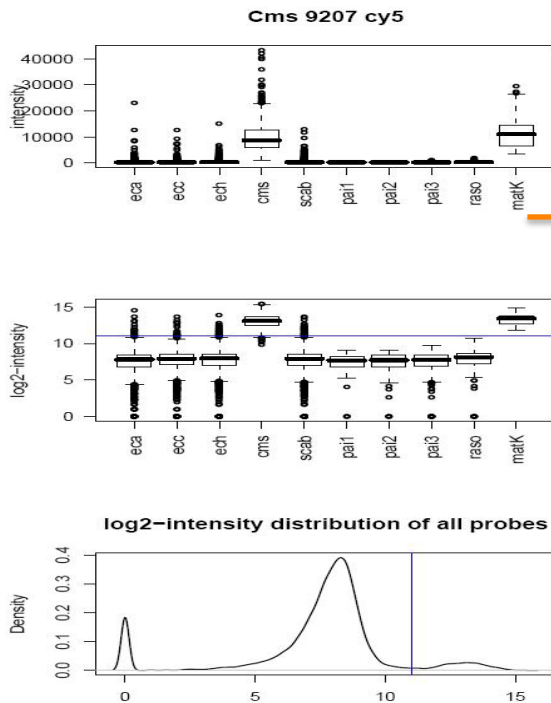
Degefu et al. 2013. Ann. Appl. Biol. 162:231-241

# Advances in disease diagnostic technology and species characterizations

- Methods for parallel detection of potato pathogens  
**MICROARRAYS** in theory a method with unlimited multiplexing capability

# DETECTION MICROARRAY

Degefu *et al.* (2016). Evaluation of microarray in the detection of major bacterial pathogens of potato from tubers. **EPPO Bulletin 46:103-111.**



# For investigations on Specificity and sensitivity of the Microarrays!

**Degefu *et al.* (2016). Evaluation of microarrays in the detection of major bacterial pathogens of potato from tubers. EPPO Bulletin 46:103-111.**

# Species Characterization- Genome Comparison

Degefu *et al.* 2013. *Ann Appl Biol*  
162:231-241

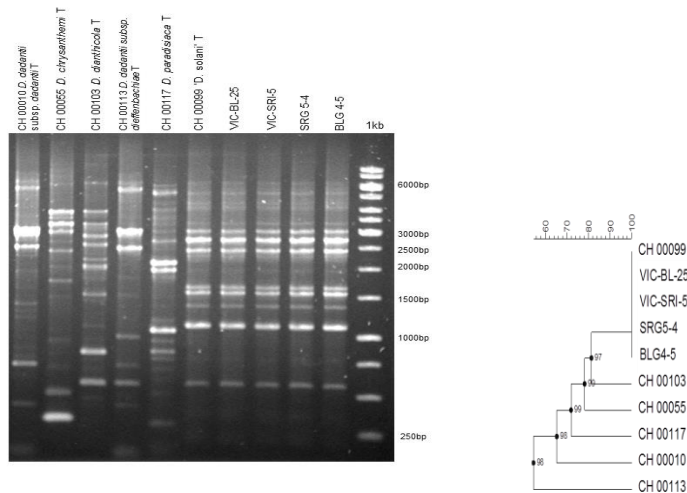


Fig.5. REP-PCR analysis. Patterns of *Dickeya* reference species and selected strains of a new clade of *Dickeya* isolated in Finland (A). Phylogenetic analysis based on REP-PCR electrophoregram made in BioNumerics Software, (B). Method of cluster analysis: UPGMA, Branch quality: Cophenetic correlation

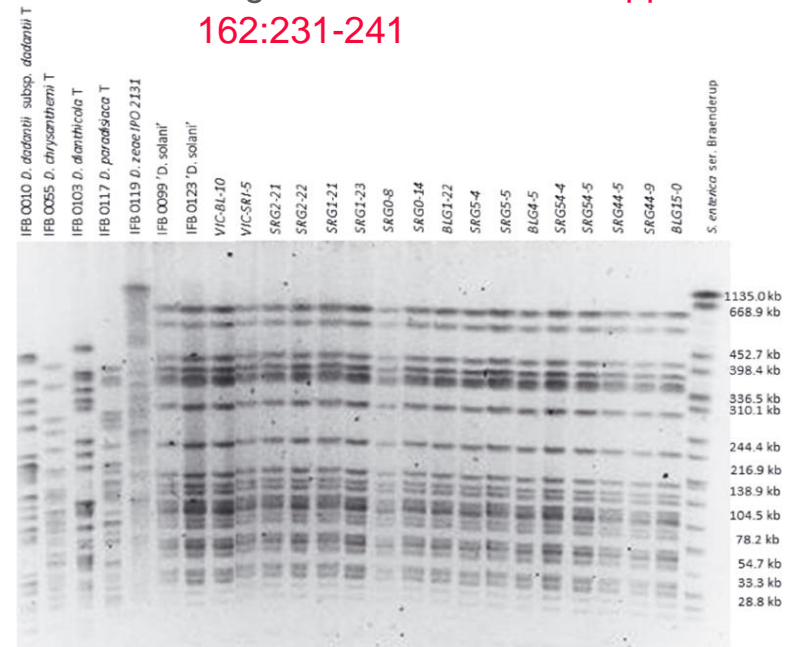


Figure 6. Comparison of the PFGE patterns of six strains of *Dickeya* spp. and tested *Dickeya* strains isolated in Finland. As a standard *Salmonella enterica* serotype Braenderup (strain H9812, ATCC) was used.

## A decade of monitoring *Dickeya* and *Pectobacterium* species in the HG area

### SUMMARY

1. A functional end user diagnostic laboratory in place for effective monitoring
2. Methods for specific and sensitive detection of *Dickeya* and *Pectobacterium* spp. optimized and validated
3. Diagnostic services to seed companies, producers etc at home and abroad provided
4. A checklist of old and new *Dickeya* and *Pectobacterium* species found in Finland made available
5. Characterization of outbreaks, role and incidence of the different species conducted, large collection of Finnish strains maintained and genome comparisons and species characterization of Finnish collections of *D. solani* carried out
6. Dissemination of knowledge through publications in international journals, professional news letters, lectures, both in national and international workshops and conferences, field days, etc. And consultations to producers and agricultural advisory services (ProAgria) etc.
7. Increased *Dickeya* and *Pectobacterium* awareness among producers, risk evaluation and informed decision support system created.
8. Active participation in European joint partnerships
9. Problem areas for future investigations identified.



## Take home message

- Start Healthy- Test for latent infection and use Disease free seeds
- Remain Healthy (Vigilant)- monitoring and disease surveillance

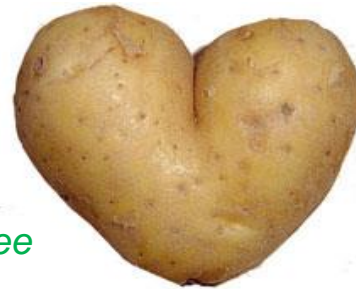
# Acknowledgements

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Ewa Lojkowska, Marta Potrykus, Małgorzata Golanowska, University of Gdansk and my own Team at the Natural Resources Institute Finland ( Luke) Oulu

# Why potato matters?

MANY REASONS TO



POTATOES

*More potassium than three bananas!!!*



100 g



Three glasses of red wine

400 g of strawberries

*Thank you for your attention*

