Plant Protection in Potato

Julius Kühn-Institut

Effect of bioactive substances from potato peel against soil-borne pathogens of potato - results from preliminary experiments

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The Julius Kühn Institute, in short …

- Federal Research Centre for Cultivated Plants in Germany
- Major fields of research are:
  - plant protection and plant health
  - plant genetics, breeding research
  - plant nutrition, agronomy and soil science

- 7 Research Facilities at Braunschweig
- Institute for Plant Protection in Field Crops and Grassland
  - Department of Mykologie
    - Plant Protection in Potato

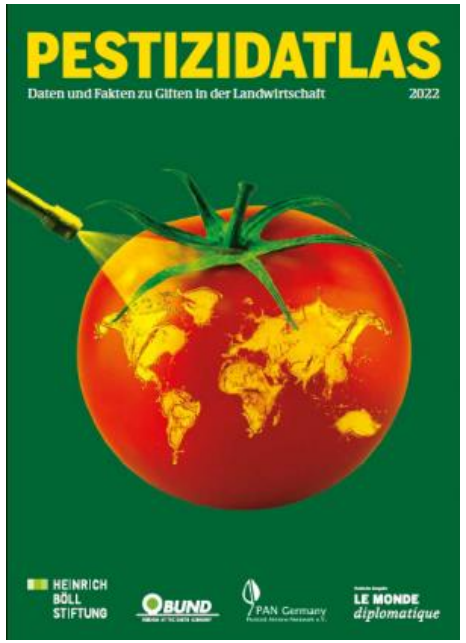
Annual screening of potato varieties for resistance against *Phytopthora infestans*

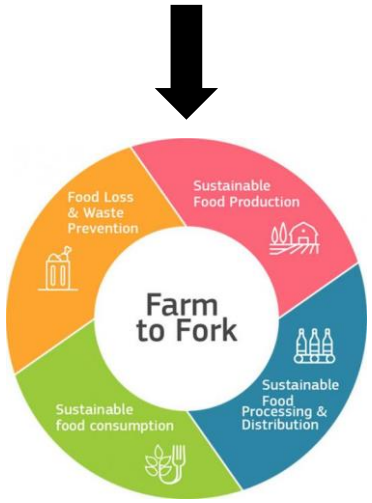
Introduction

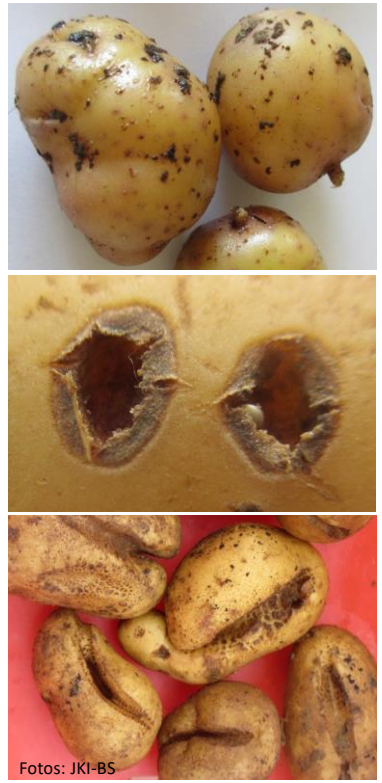
- Decline in approved plant protection products
- Demand for biological alternatives
- Soil-borne and air-borne fungi : *R. solani, P. infestans, A. solani,* (...)

Research into natural defense mechanisms to develop alternative methods

- Characteristics of the potato skin and chemical diversity
- Information on peel constituents (‘peel metabolome‘) and interaction with pathogens incomplete







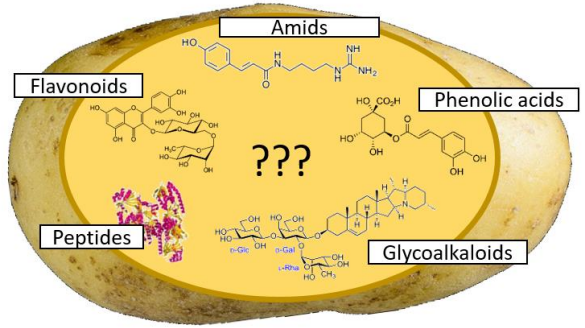
Disease symptoms induced by *Rhizoctonia solani*

Research idea

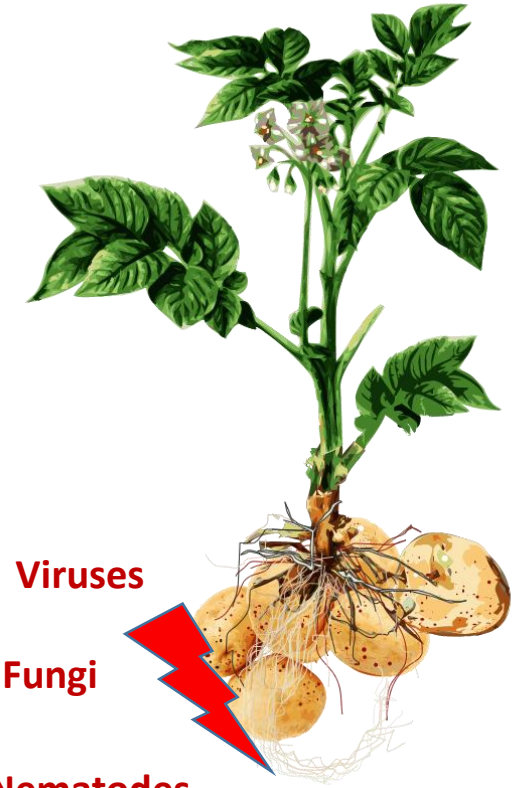
- Working hypothesis: Secondary metabolites with a regulating effect on soil-borne pathogens are present in the potato peel

- Aim: Identification of bioactive substances in (wild) potato varieties that inhibit soilbrone phytopathogenic fungi

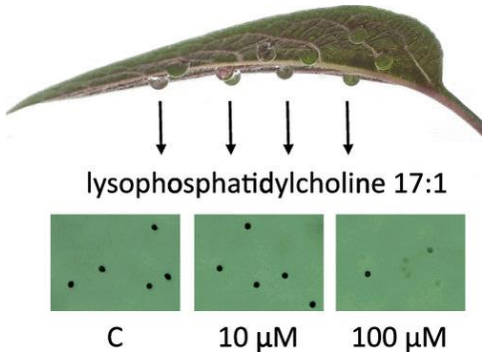
- Motivation:
  - Compensation for chemical fungicides that are withdrawn from registration
  - Reduction of synthetic plant protection products
  - Low risk for humans, animals and environment



Bioactive substances from potato

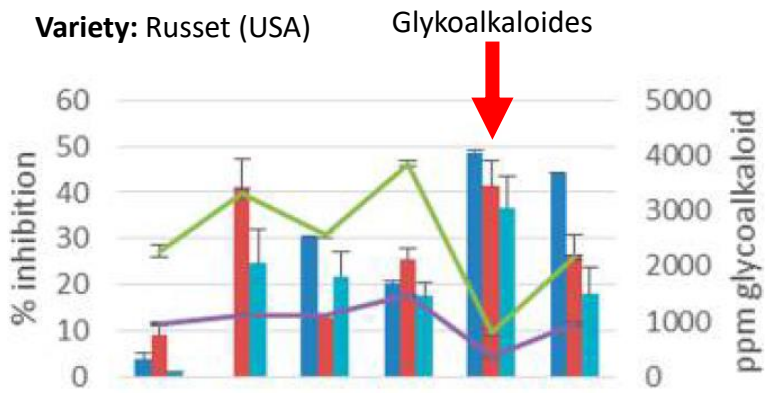


Wild variety: *Solanum bulbocastanum – P. infestans*



J. Agric. Food Chem. 2021, 69, 20, 5607–5617 (Karin Gorzolka)

Variety: Russet (USA)



J. Agric. Food Chem. 2018, 66, 7942−7947

Phytochemicals

- Phenolic acids
- Flavonoids
- Anthocyanins
- **Glycoalkaloids**

Bioaktive substances

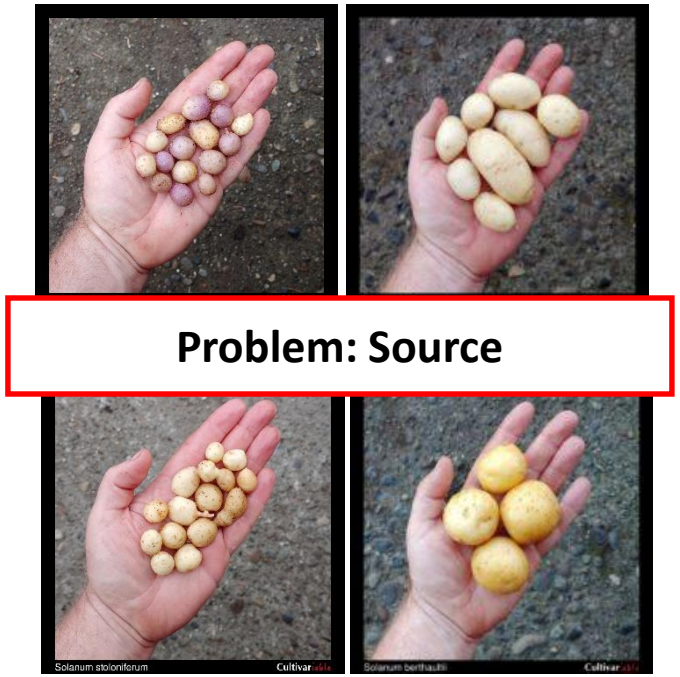
- Antioxidants
- Antimicrobial substances

DEFENSE

https://www.pflanzenforschung.de/de/pflanzenwissen/pflanzensteckbriefe/kartoffel

Natural Resources

- Numerous resistances detected in wild species, but "difficult to access".
- Significance of shell metabolites for resistance not clarified



S. stoloniferum (sto) *S. Berthaultii (ber)*

Cultivariable www.cultivariable.com

- Bioactive, natural active ingredients have been detected in the potato peel
- Of great value for medical research and food industry

Problem: Concentration

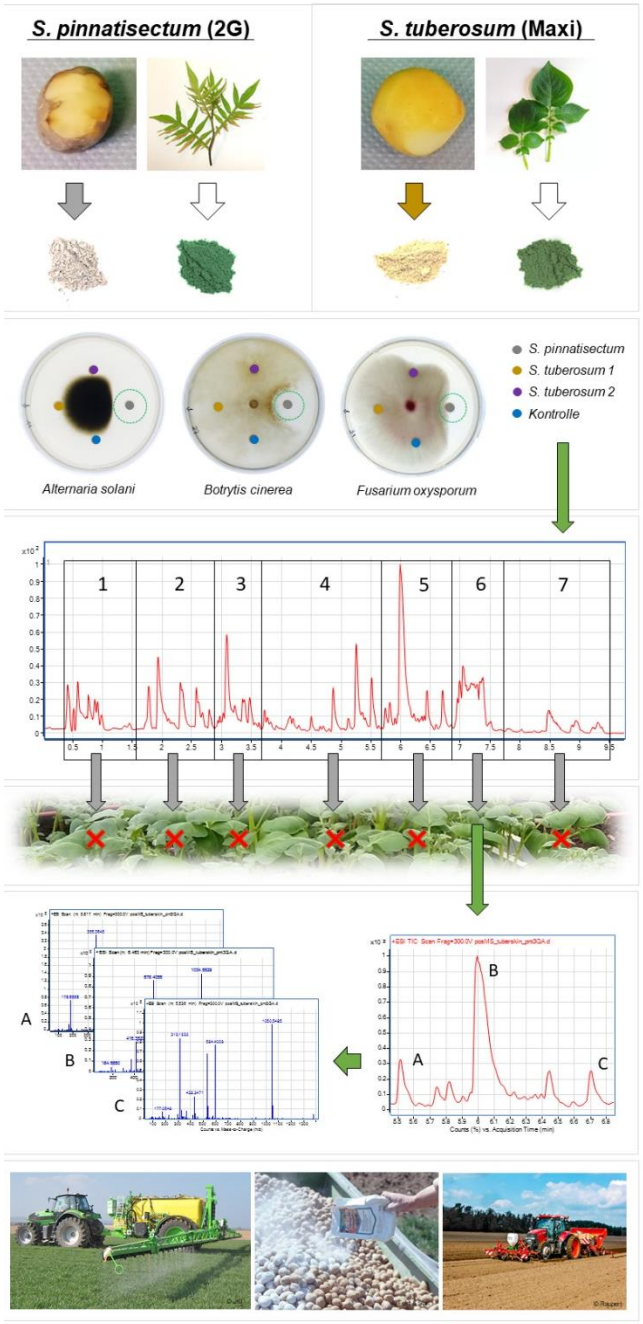
Industrial potato waste residues (chips, fries, …)

Laboratory work - efficacy studies

- Investigation of inhibitory effects from whole extracts
  - Commercial varieties: Annabelle, Bamberger Hörnchen, Belana, Blaue Anneliese, Granola, Laura, Linda, Nandina, Princess
  - Industrial samples: no information on varieties
  - Wild varieties: *S. pinnatisectum*, *S. chacoense*, *S. demissum*, *S. berthaultii*
  - Pathogens: *R. solani, A. solani, P. infestans, C. coccodes, F. coeruleum, F. suphureum, B. cinerea, F. oxysporum, V. dahliae, V. albo-atrum*

Solanum pinnatisectum

Wild species propagation and tuber production



Laboratory workflow

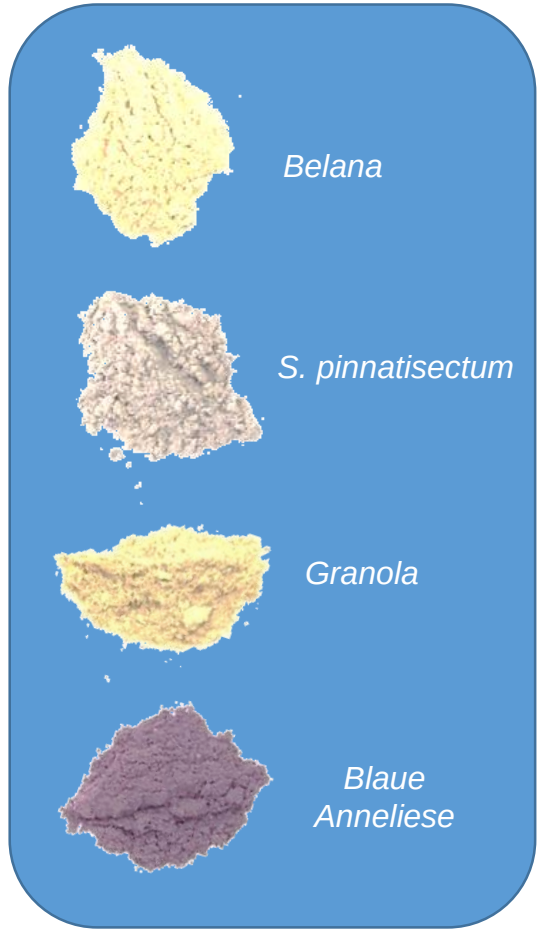
- Resources: JKI-ZL – propagation and tubers
- Biotest – Investigation of efficacy *in vitro* (small scale)
- Screening and comparison of complete peel extracts and fractionation
- Biotest – Investigation of efficacy *in vitro* (small scale)
- Screening and comparison of complete peel extracts and fractionation
- Biotest – Investigation of efficacy in the field (…)

Worflow I: Sample preparation

Peeling

Freeze drying

Homogenization



Extraction
MeOH/H2O/ACN

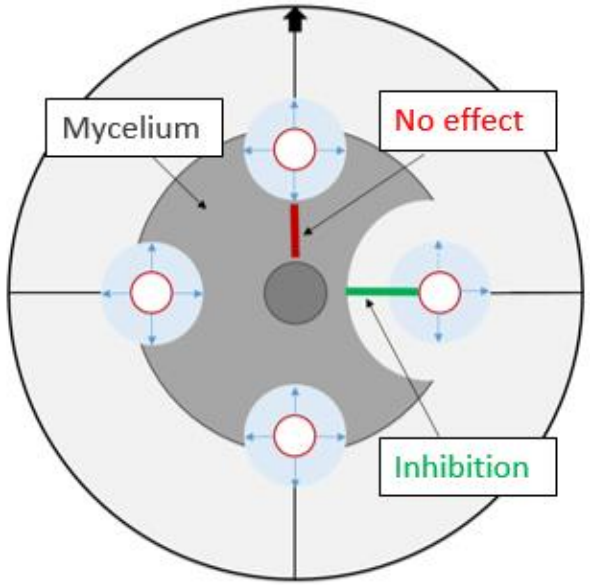
Concentration

Biotest

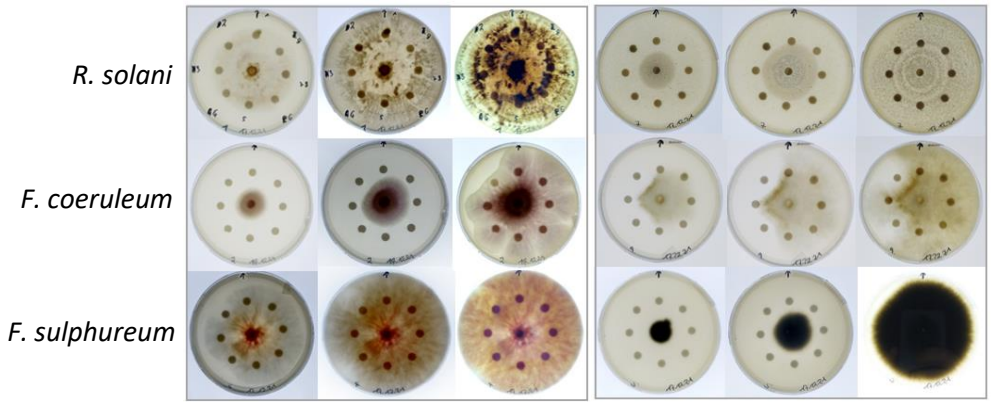
Chemistry

Workflow II - Phytopathology

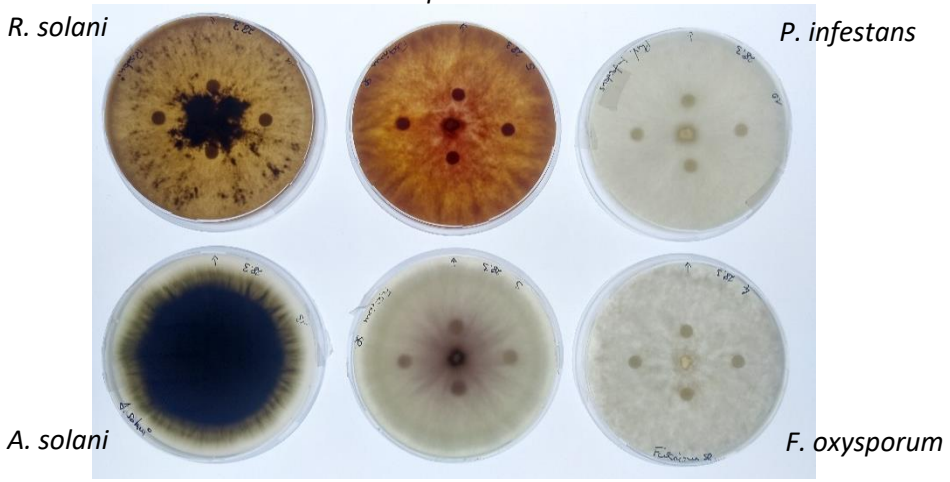
Disk assay



Commercial and wild varieties

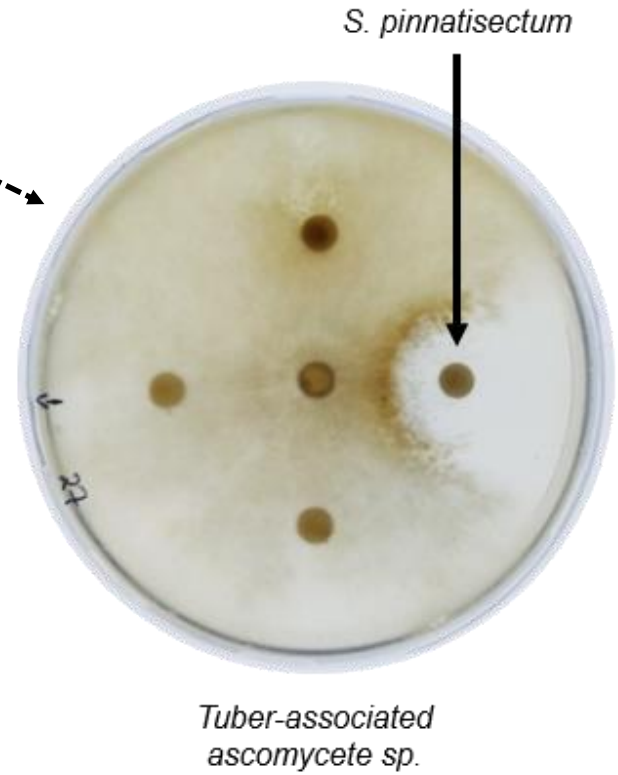


F. sulphureum



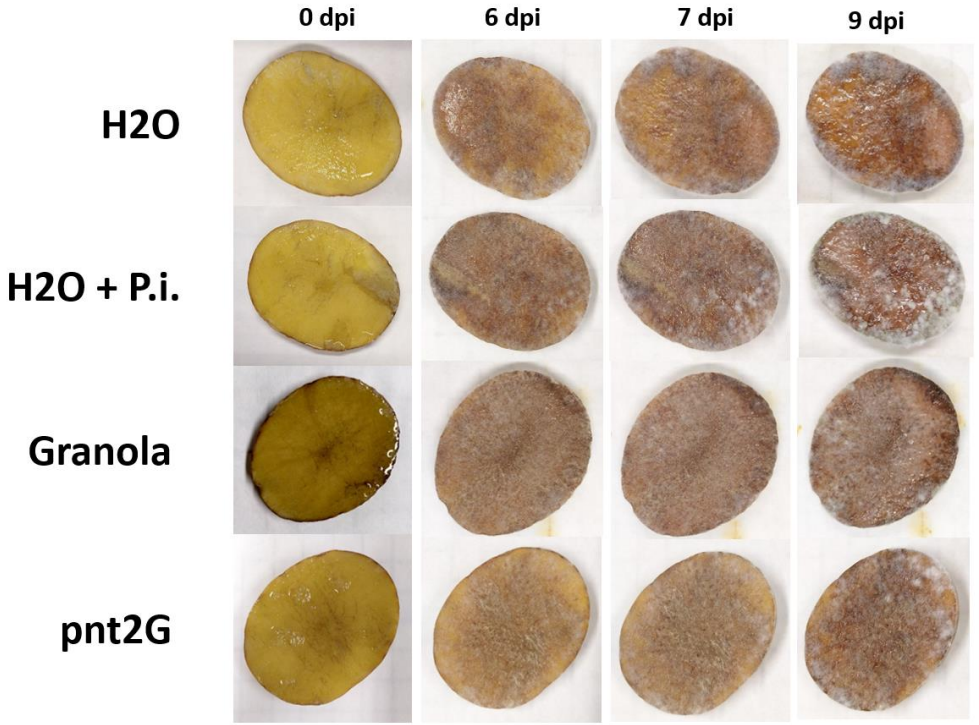
F. coeruleum

Industrial peel waste



Workflow II - Phytopathology

Phytophthora infestans



Workflow III – Analytical chemistry

- Investigation of the peel Metabolom (*Metabolite-Profiling*) - Dr. Karin Gorzolka, JKI-ÖPV

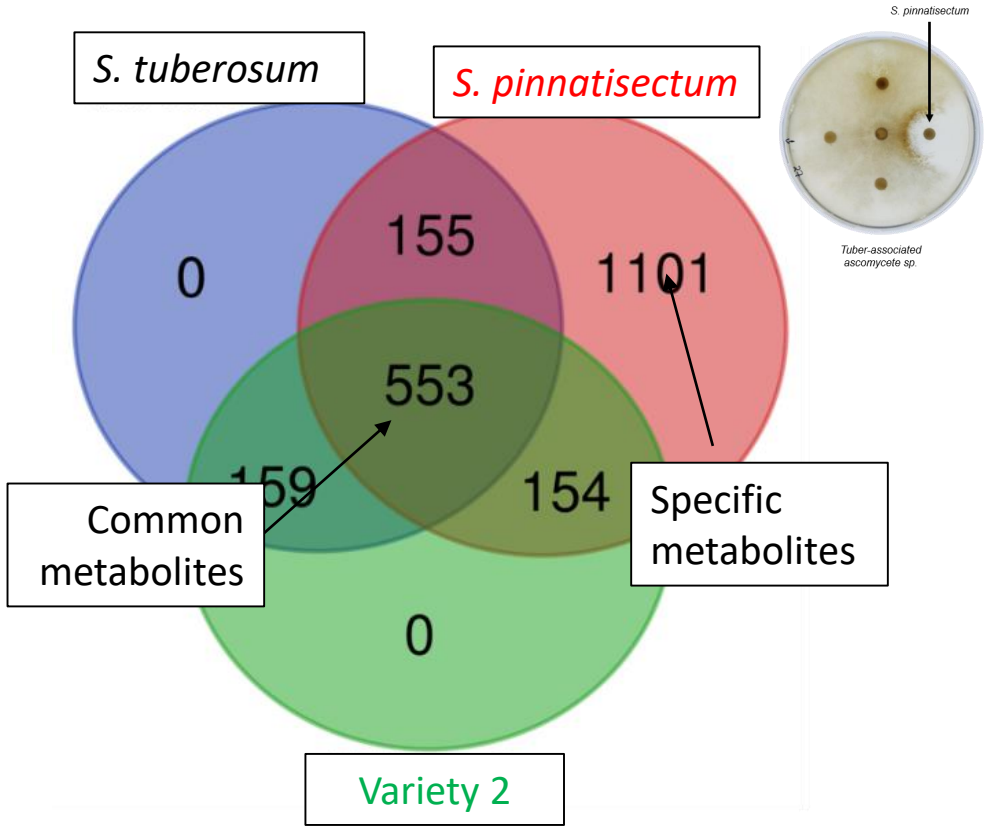
  - Variety: Maxi
  - Wild varieties: *S. pinnatisectum*, *S. chacoense*, *S. berthaultii*

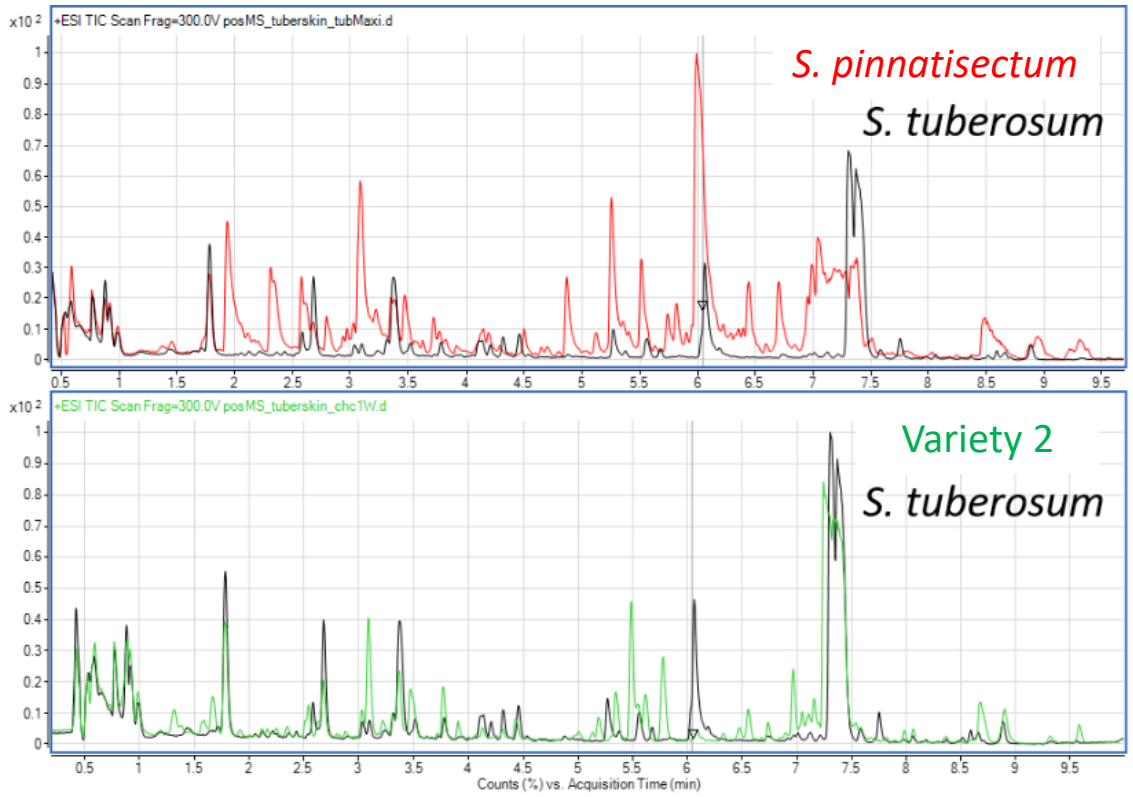
pnt2G pnt3GA pnt71-13 berG chc1W tub Maxi

HPLC-MS/MS: JKI-ÖPV Berlin

Strong differences in skins of wild potato varieties compared to conventional varieties

Wild vs established varieties

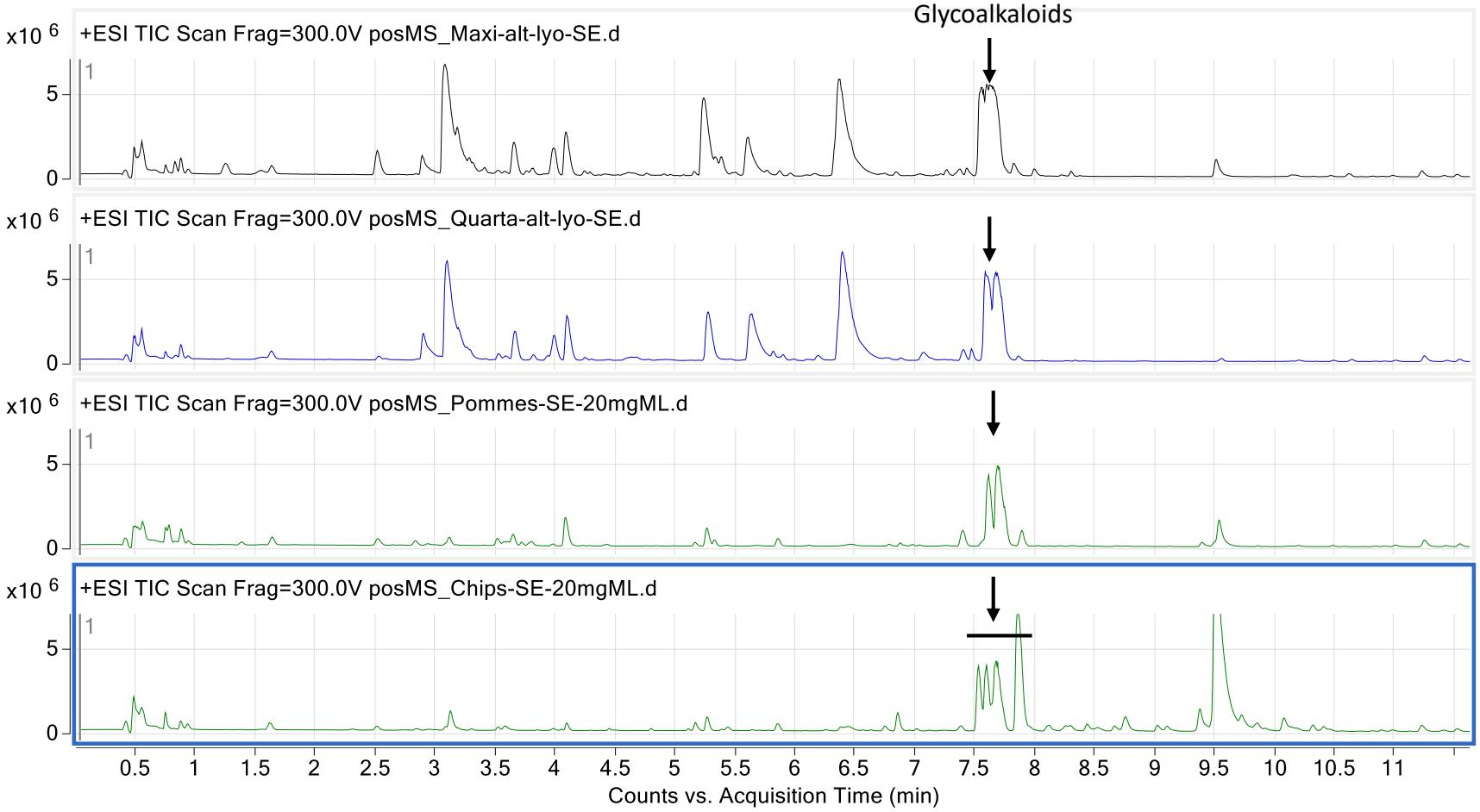




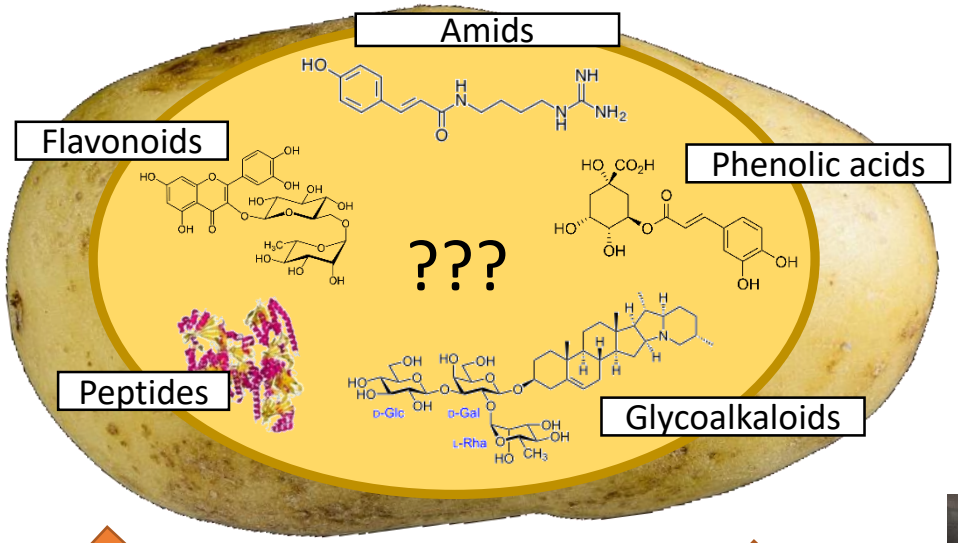
- ***S. pinnatisectum*** provides 1100 signals not found in conventional potatoes or other wild species
  - Approx.150 chemically modified alkaloids with unknown effects
  - Numerous compounds without proper characterization

Industrial potato peel waste

LC-MS Karin Gorzolka (JKI-ÖPV)



Outlook



Cultivation of wild species as a supplier of active ingredients for biological pesticides

Environmentally compatible and efficient chemical synthesis of the active ingredient and application (coating/furrow treatment)

JKI-ZL Groß Lüsewitz

Identification of synthesis genes: resistance markers for targeted breeding strategies

Dr. Karin Gorzolka Julius Kühn-Institute, Institute for Ecological Chemistry, Plant Analysis and Stored Product Protection, Berlin

Dr. Roman Gäbelein Julius Kühn-Institute, Institute for Breeding Research on Agricultural Crops, Groß Lüsewitz

Inga Hilbrich
Monika Heiderich
Regina Eggeling
Anke Kawlath

Thank you for your attention!