



# Evaluation of pedigree relationships in apfel:gut apple breeding

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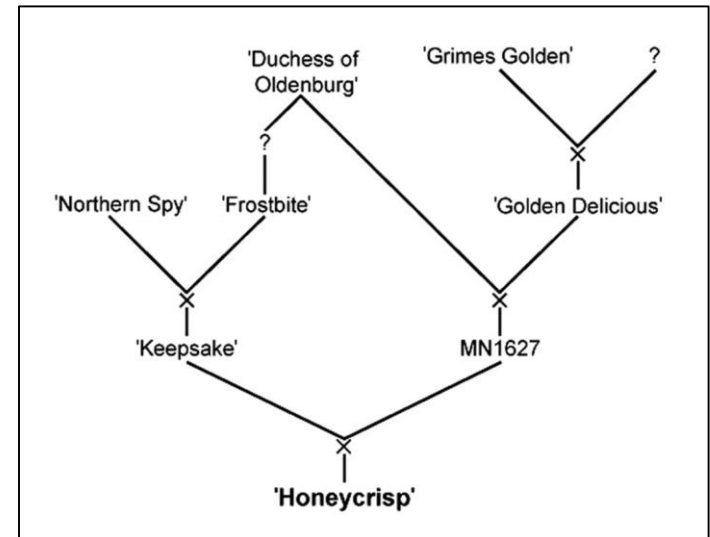
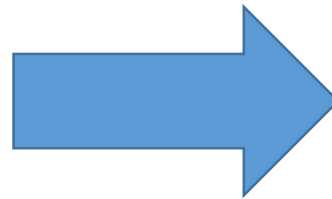
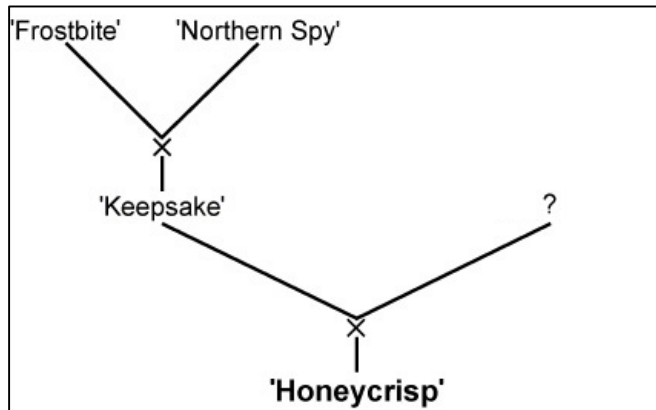
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# Presentation outline

1. Research description
2. (Brief) Project methods
3. Results of apfel:gut material

# Background

- Pedigree information of fundamental importance in breeding programs
- Apple cultivars are interrelated by recent and distant common ancestors
- Many old cultivars still exist in germplasm collections
- SNP arrays have been used to identify pedigree relationships with precision:



- Howard et al. 2017. Elucidation of the 'Honeycrisp' pedigree through haplotype analysis with a multi-family integrated SNP linkage map and a large apple (*Malus × domestica*) pedigree-connected SNP data set. *Horticulture research*, 4, 17003.

- These new pedigree findings have been successfully implemented in breeding programs and QTL studies

# Collaborative project to identify direct and distant pedigree relationships in apple

- Research goal:
  - Connect pedigrees of a very large diverse set of historically and economically important cultivars
- Purposes:
  - To be useful in development of new apple cultivars
  - To help us better understand genetics of important traits
  - To benefit germplasm collections
    - Connecting material between germplasm collections
    - Assessing true-to-typeness
  - To provide historical information about apple cultivars to appeal to people's cultural connection to apples

# Germplasm

- >30 different germplasm collections
- Currently >5400 cultivars
  - Soon to be >6000
- apfel:gut breeding selections and likely ancestors from collections were included

Group	Country	Accessions
INRA	France	596
National Fruit Collection	UK	548
Plant and Food Research	New Zealand	528
USDA	USA	502
Fondazione Edmund Mach	Italy	483
University of Copenhagen	Denmark	384
Ökowerk	Germany	380
Sveriges lantbruksuniversitet	Sweden	378
CRA-W	Belgium	215
UNIBO	Italy	180
Seed Savers Exchange	USA	161
Julius Kühn Institute	Germany	146
RBIPH	Czech Republic	146
Universidad Publica de Navarra	Spain	141
NIAB EMR	UK	81
University of Minnesota	USA	63
Wageningen University and Research	The Netherlands	58
VNIISPK	Russia	57
NARO	Japan	56
Hans-Joachim Bannier (private orchard)	Germany	50
Temperate Orchard Conservancy	USA	49
Agroscope	Switzerland	30
Warsaw University of Life Sciences	Poland	27
Canadian Clonal Genebank	Canada	25
Das Apfel Schiff	Germany	17
Laimbourg	Italy	15
IFG	Belarus	13
Research Institute of Horticulture	Poland	12
Other	Various	62
	Total	5403

# Research methods brief overview

- Collect leaf samples of culturally, historically, and economically important cultivars
- Analyze leaf samples on SNP arrays
  - I.e. obtain genetic information from samples
- Highly curate SNP data
  - I.e. clean the data
- Identify pedigree relationships using various old and new methods
  - Three papers on this topic are being written



Results and applications  
in apfel:gut breeding material

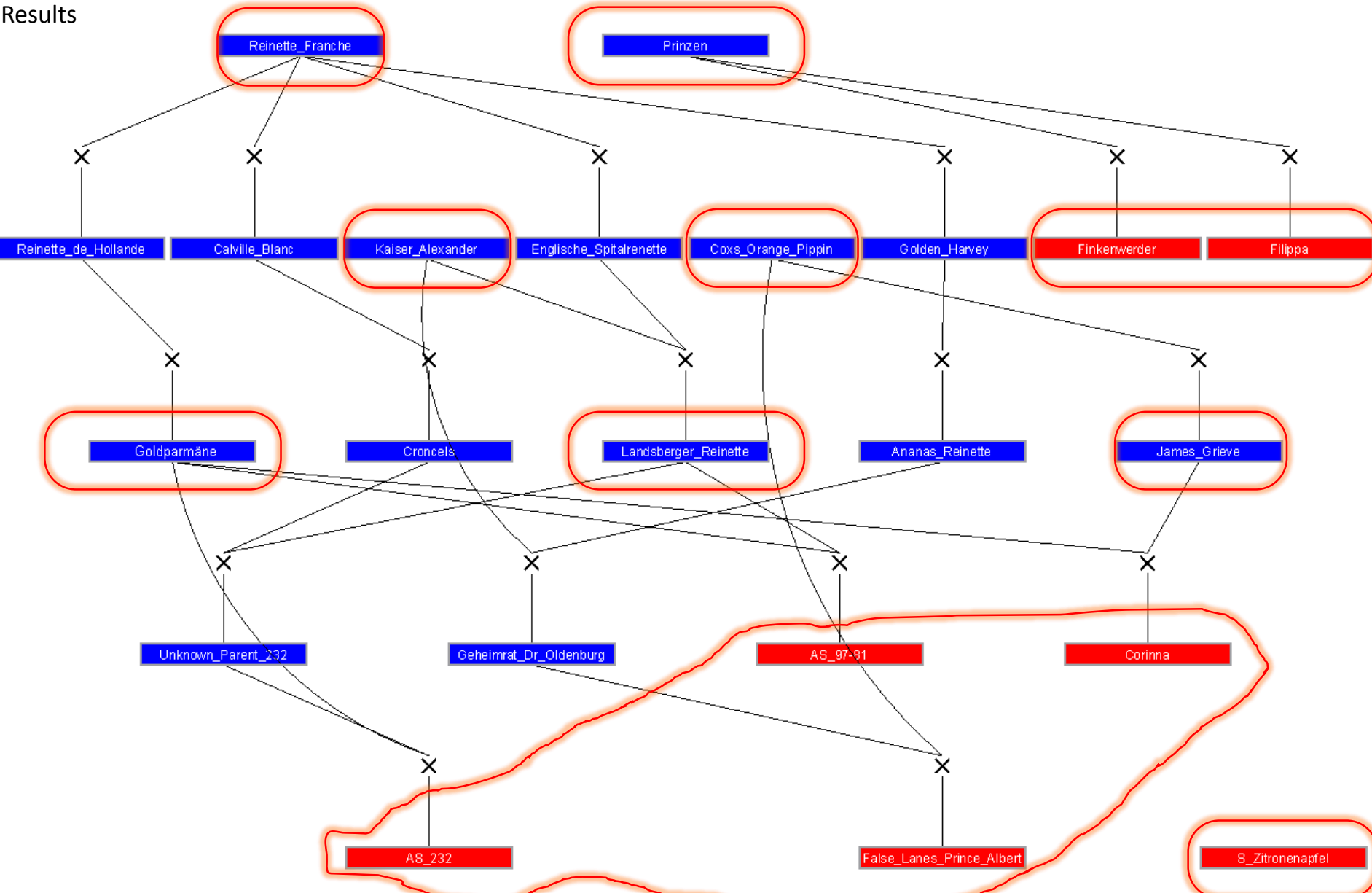
# apfel:gut material genotyped

- Breeding selections
  - 97-81
  - 232
  - 06-09-06
- Breeding parents
  - Corinna
  - (False) Lanes Prinz Albert
  - Seestermüher Zitronenapfel
  - Filippa
  - Finkenwerder Herbstprinz
  - Karmina
    - (pedigree matches records, American/English derived)







Results



**Key**

-  Apfel:gut selection or breeding parent
-  Pedigree ancestor

# Key extended project collaborator affiliations

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# Germplasm contributors



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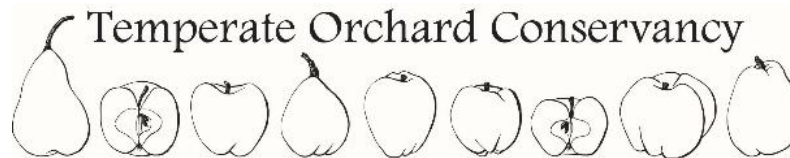
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# Funding sources



Funding provided by the Niedersächsisches Ministerium für Wissenschaft und Kultur through the EGON project: “Research for a sustainable agricultural production: Development of organically bred fruit cultivars in creative commons initiatives.”



Niedersächsisches Ministerium für Wissenschaft und Kultur



Some data and resources come from the RosBREED project: “Combining disease resistance with horticultural quality in new rosaceous cultivars”. Funding provided by the Specialty Crop Research Initiative Competitive Grant 2014-51181-22378 of the USDA’s National Institute of Food and Agriculture



Some data comes from the EU seventh Framework Programme funded project FruitBreedomics: “Bridging the gap between genomics and fruit breeding” (Project ID #265582)