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ROME • ITALY 2020

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Mitochondrial genomes as phylogenetic backbone

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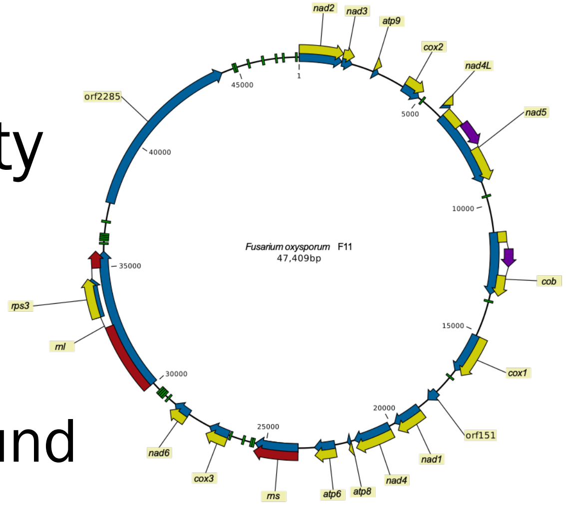
Overview

- Mitochondrial genome
  - Advantages of mitochondrial genomes
  - Mitochondrial vs. nuclear genome
- *Fusarium asiaticum* in China
- Mitochondrial genome analysis
- Whole genome analysis
- Conclusions
- Future perspectives

Advantages of mitochondrial genomes

- High copy number per cell
  - Easily accessible (PCR or WGS)
- Relatively small size and low complexity
  - Can be studied in its entirety
- Usually circular
  - We know when the whole sequence is found
- Simple organization
  - Easy to identify homologous sites



Mitochondrial vs. nuclear genome

- **Mitogenome** is involved only in housekeeping functions
- **Nuclear genome** is important in adaptation to the environment
- Recombination is well regulated and coordinated for the **nuclear genome**
  - ➢ Genetic isolation originates from the **nuclear genome**

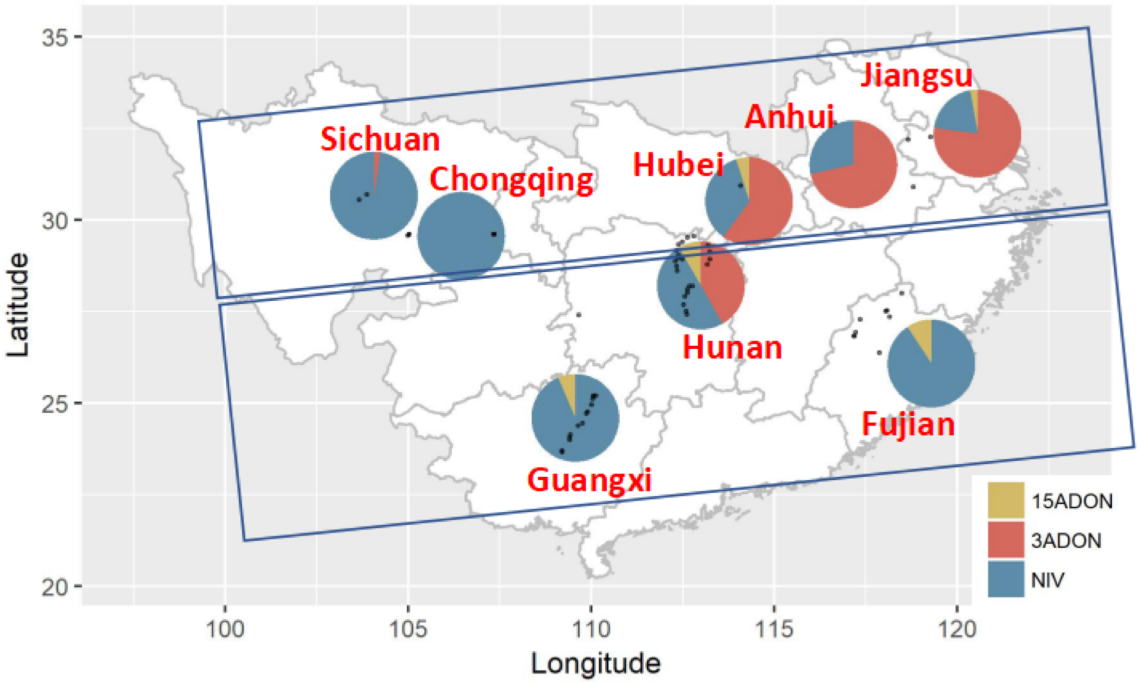
Fusarium asiaticum

- Important pathogen in China especially recently
- Hosts:
  - Wheat
  - Rice

- Produces mycotoxins: trichothecenes
  - Nivalenol (**NIV**) → associated with rice
  - Deoxynivalenol (**DON**): 3ADON or 15ADON
    → 3ADON is more virulent on wheat than NIV

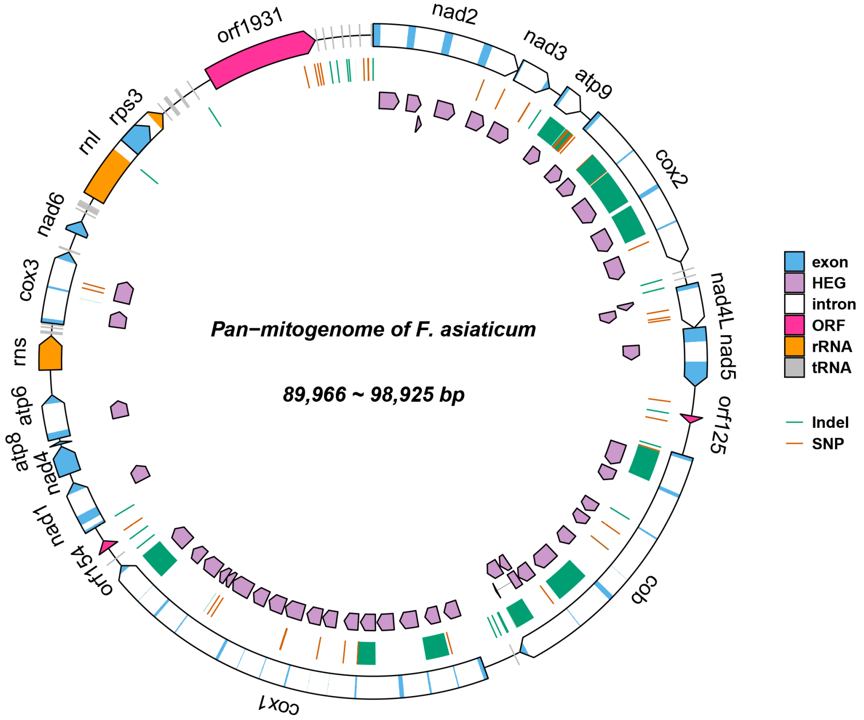
F. asiaticum sampling in Southern China

Province	Crop	Toxin	N
Sichuan	Wheat	NIV	30
	Rice		30
Hubei, Anhui, Jiangsu	Wheat	3ADON	30
	Rice		30
Hunan	Rice	NIV	30
		3ADON	30
Fujian	Rice	NIV	30

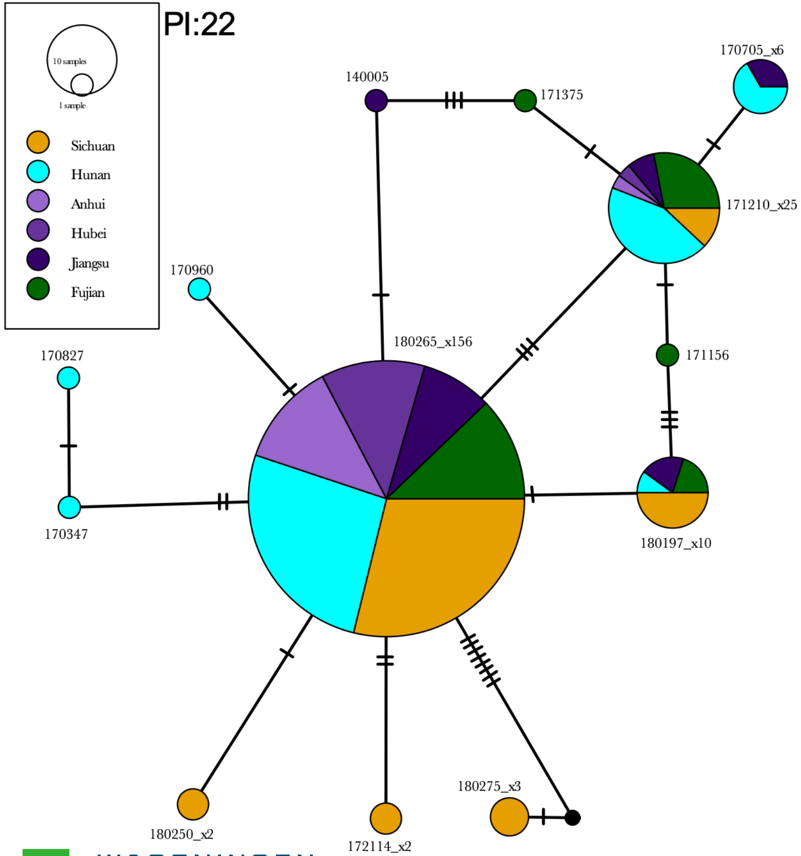


Mitochondrial genome analysis

1. *De novo* assembly
2. Annotation
3. Remove intron regions
4. Align sequences
5. Median joining network analysis (PopArt)



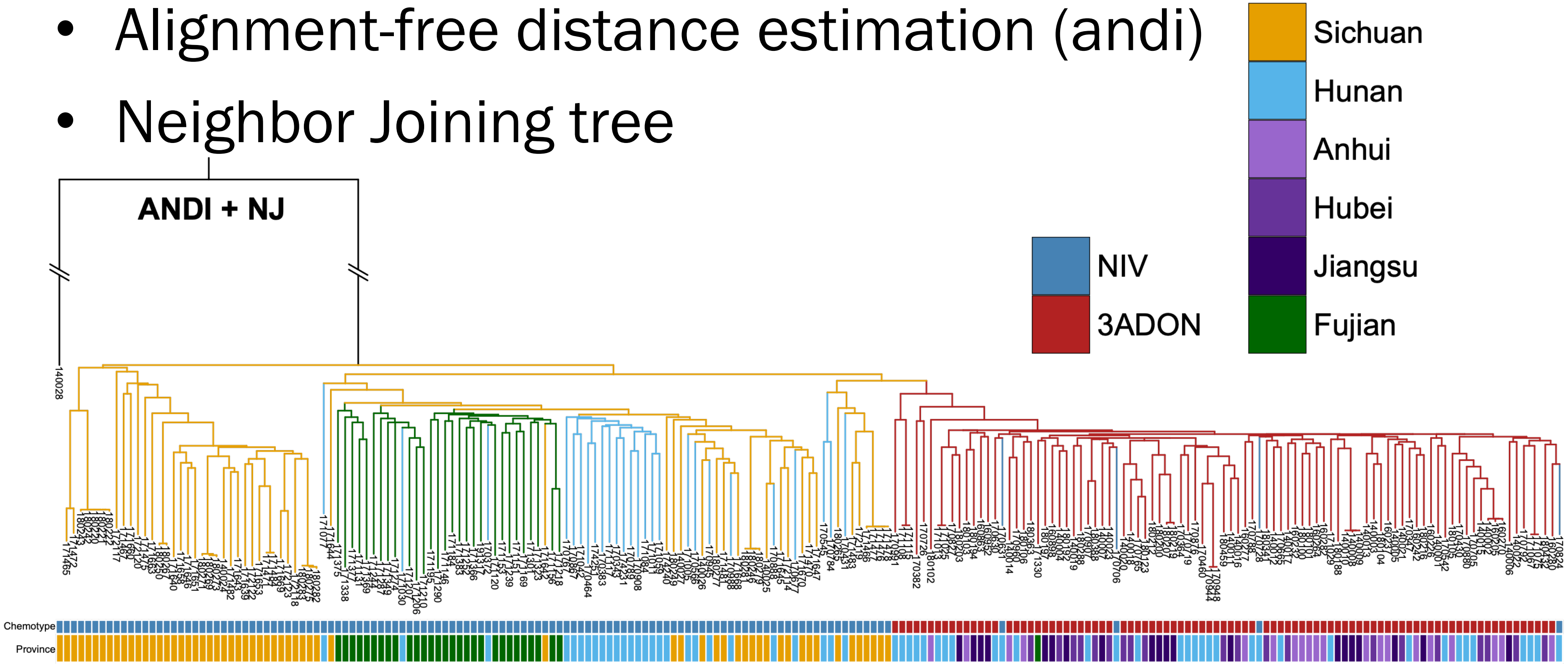
Median joining network analysis (mtDNA)



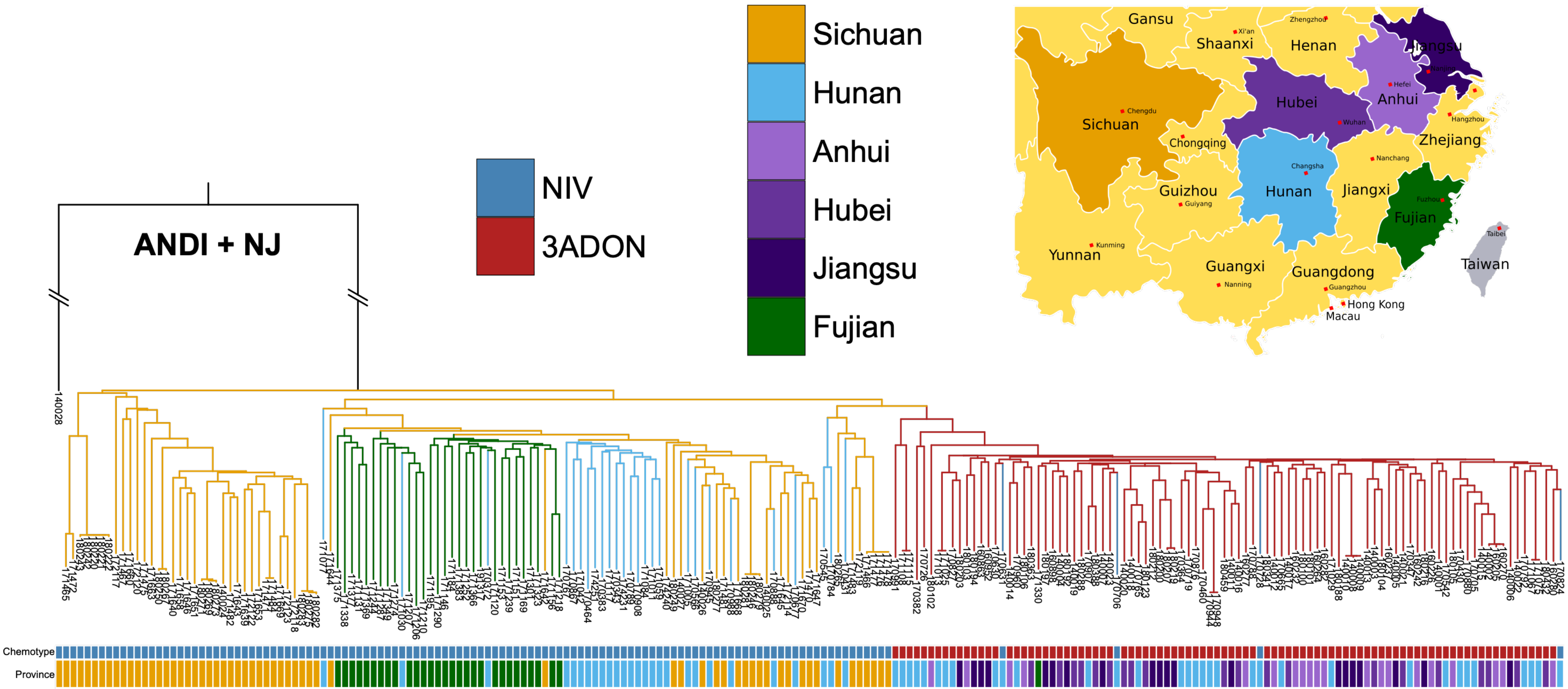
- Extremely low variation
- No clear grouping
- Recombination
- Sichuan most similar to outgroup

Whole genome analysis

- *De novo* assembly
- Alignment-free distance estimation (andi)
- Neighbor Joining tree



Whole genome analysis

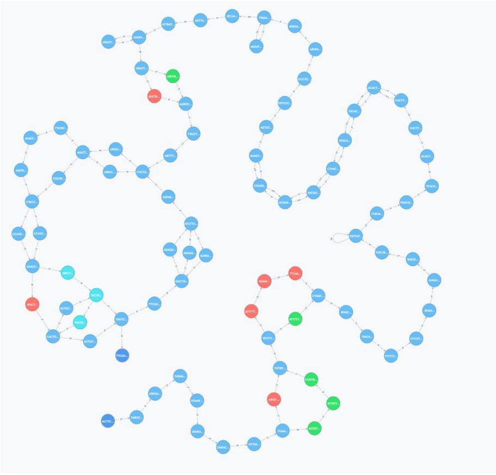


Conclusions

- Low amount of variation in mitochondrial genomes indicates recent origin/spread
- Sichuan is probably the center of origin of *F. asiaticum*
- *F. asiaticum* radiated all over China relatively recently
- From the first radiation wave a second radiation emerged
  - Linked to the acquisition of 3ADON chemotype

Future perspectives

- Expanding the analysis to a worldwide collection of *F. asiaticum*
- Construct a pangenome of the nuclear genomes using PanTools
- Identify genes specific to radiation events
  - E.g. biosynthetic gene clusters



Thank you for your attention!

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Special Issue: **The Significance of Mitogenomics in Mycology**

Yang, M., Zhang, H., van der Lee, T.A.J., Waalwijk, C., van Diepeningen, A.D., Feng, J., Brankovics, B., Chen, W. Population genomic analysis reveals a highly conserved mitochondrial genome in *Fusarium asiaticum*. *Frontiers in Microbiology* (submitted)