UPOV

International Union for the Protection of New Varieties of Plants

E

Technical Working Party on Testing Methods and Techniques **TWM/3/16**

Third Session
Beijing, China, April 28 to May 1, 2025

Original: English
Date: March 26, 2025

DATA SCIENCE ACTIVITIES AT NAKTUINBOUW TOWARDS GENOTYPING AND PHENOTYPING: AN UPDATE

Document prepared by an expert from the Netherlands (Kingdom of)

Disclaimer: this document does not represent UPOV policies or guidance

1. The Bioinformatics facility at Naktuinbouw has been instrumental in supporting variety identification and research. Our work includes identifying molecular markers using next-generation sequencing, developing algorithms for optimization and automation, and conducting statistical analysis and reporting. This has driven us to create uniform data platforms that enable meaningful comparisons.

2. Building on this foundation, our next step is to standardize image analysis and phenotyping at Naktuinbouw. This presentation will offer a sneak peek into our upcoming projects on image analysis, workflow developments, AI and other collaborative efforts

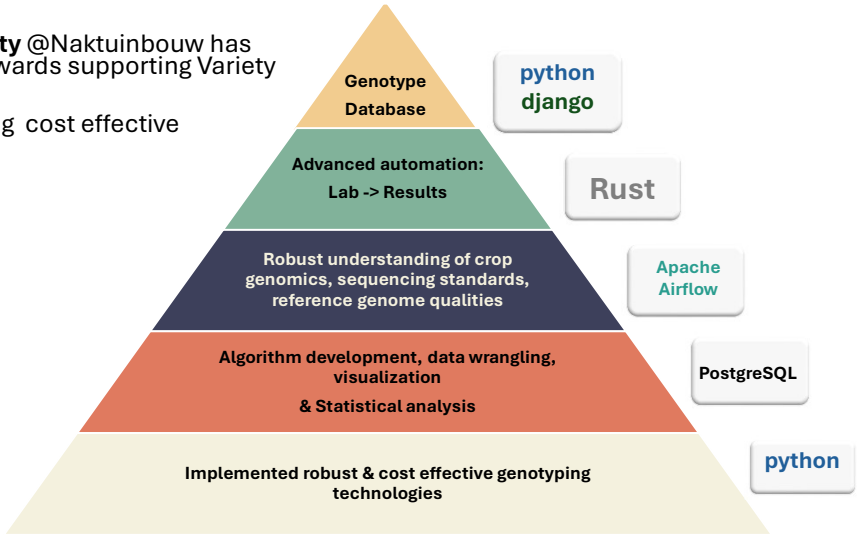
3. The annex to this document contains a copy of a presentation “Data Science activities at Naktuinbouw towards Genotyping and Phenotyping: An Update”, to be made by an expert from the Netherlands (Kingdom of), at the third session of the TWM.

[Annex follows]

1

Data Science @Naktuinbouw

- The **Bioinformatics facility** @Naktuinbouw has been working for years towards supporting Variety Testing
- **Milestones**: Implementing cost effective genotyping technologies



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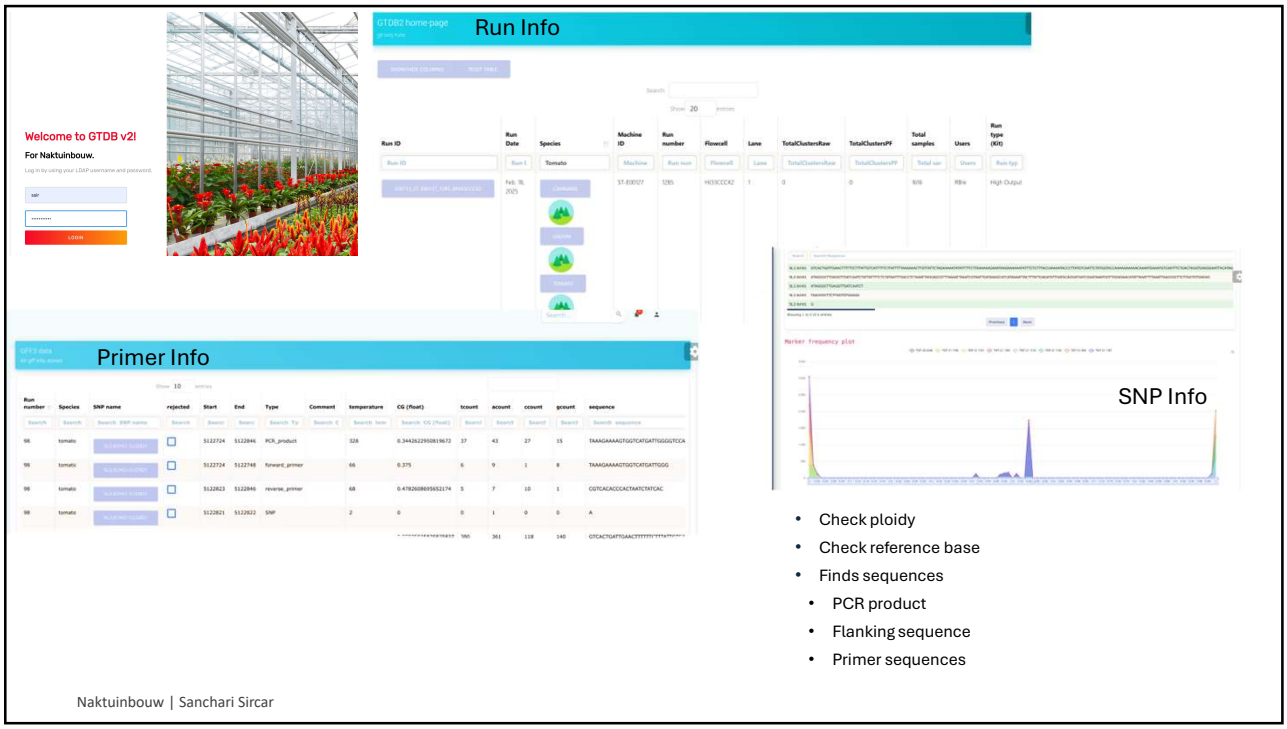
Welcome to GTDB v2!
For Naktuinbouw.
Run Info
Primer Info
SNP Info
Check ploidy
Check reference base
Finds sequences
PCR product
Flanking sequence
Primer sequences
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Run statistics
Optimization
Merker team
Flowcell info
Fastp reports
Raw data filtering info
Read lengths
Read quality
Summaries of read data
Base distributions
Flowcell distributions
And much more.
25 March 2025
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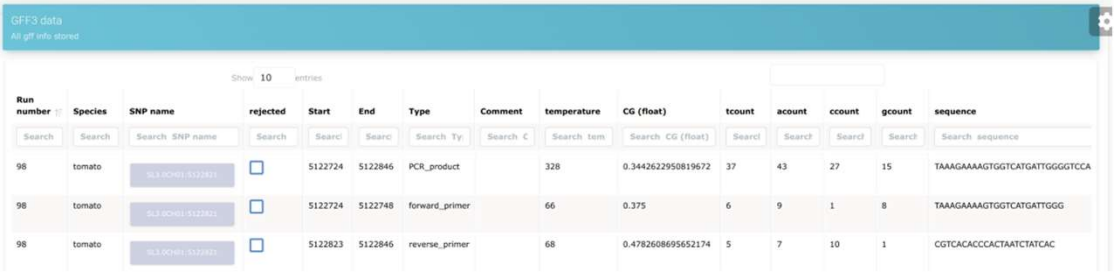
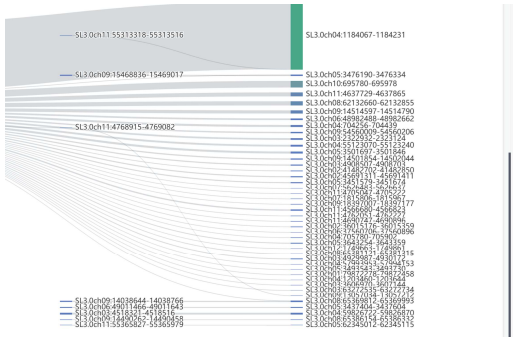


- Primer Optimization
  - SNP Discovery -> SNP Validation
  - SNPs thrown out
  - Rerun
  - Repetitive process
- Interactions between
  - Primers for this run
  - Visualizes bindings with Sankey Plots



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Dendrogram

- For a given species, compare within and between runs
- Dynamic dendrogram and heatmap
  - Collapsible nodes
  - Clickable names (and searchable)
  - Lots of filtering
    - Depth
  - Individual sample selection
  - Heathmap hovertool, showing haplotypes or depth.

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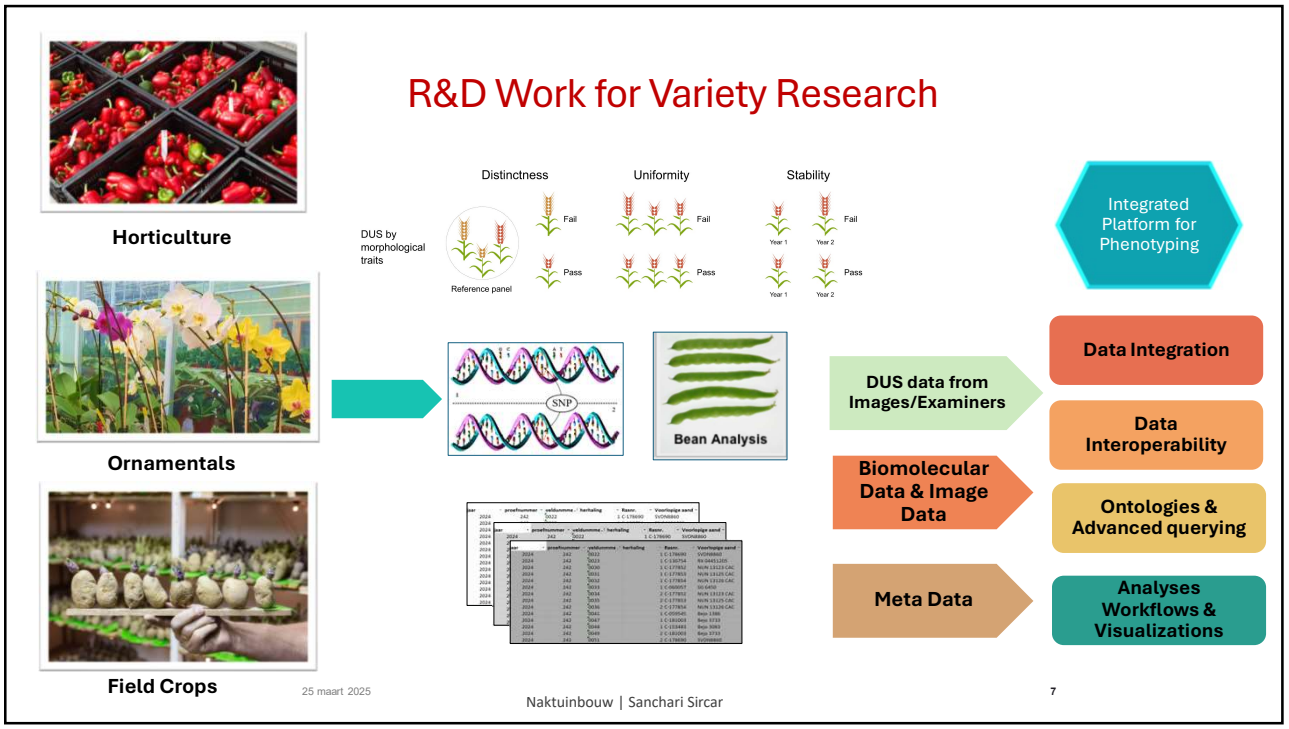
R&D Work for Variety Research
Horticulture
Ornamentals
Field Crops
DUS by morphological traits
Distinctness
Uniformity
Stability
Fail
Pass
Reference panel
Year 1
Year 2
SNP
Bean Analysis
Integrated Platform for Phenotyping
DUS data from Images/Examiners
Biomolecular Data & Image Data
Meta Data
Data Integration
Data Interoperability
Ontologies & Advanced querying
Analyses Workflows & Visualizations
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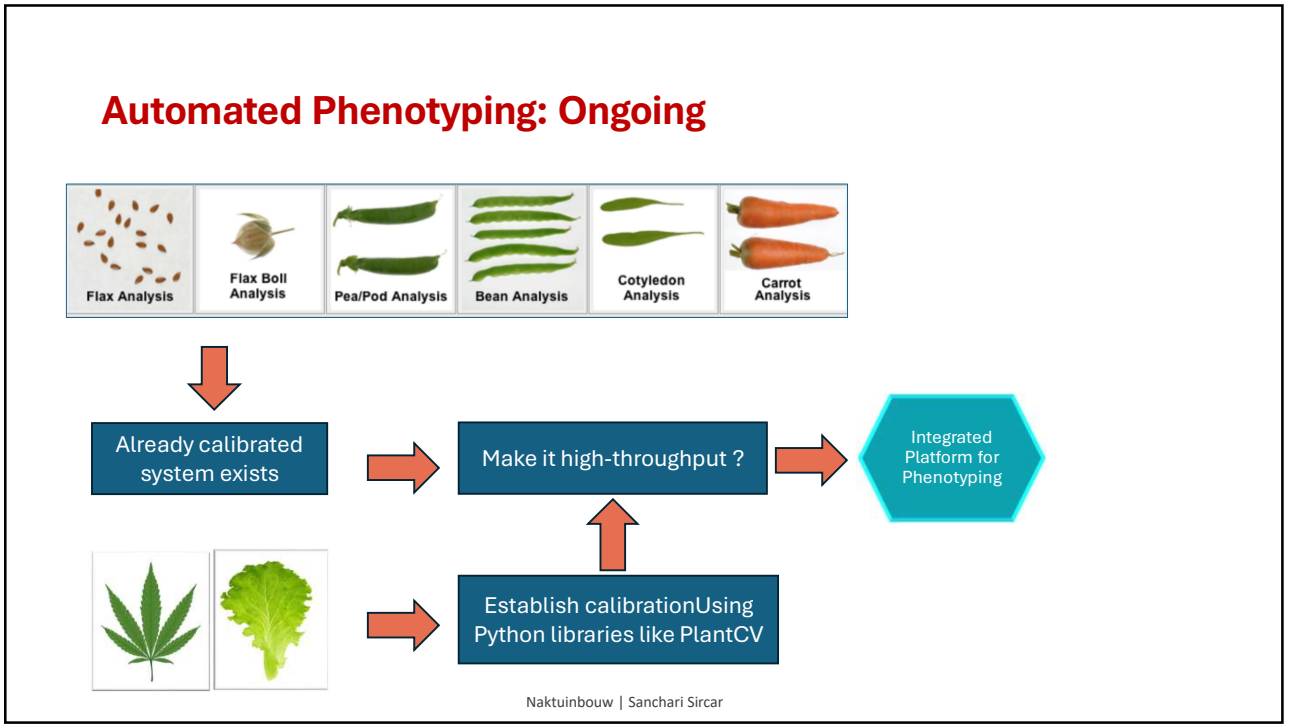
Automated Phenotyping: Ongoing
Flax Analysis
Flax Boll Analysis
Pea/Pod Analysis
Bean Analysis
Cotyledon Analysis
Carrot Analysis
Already calibrated system exists
Make it high-throughput ?
Integrated Platform for Phenotyping
Establish calibrationUsing Python libraries like PlantCV
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Managing Our PhotoDatabases: Ongoing

The four most requested ornamental species for DUS testing at Naktuinbouw are Phalaenopsis, Tulip, Rose, and Lily

For ornamentals, Naktuinbouw receives approximately 400 applications for DUS testing per year

Development of Image Analysis & AI tools and pipelines **in-house** is more efficient and economical towards managing our reference collections

&

Floricode

Hard Benefits	Soft Benefits
➢ Have an efficient searchable system based on "open source" tools	➢ Set up uniform data standards, i.e. quality, color charts with Floricode ➢ Parameterize and benchmark CNN algorithms ➢ Evaluate costs and compute required for scaling up

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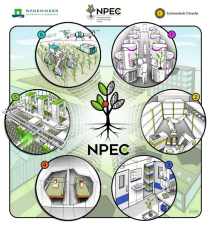
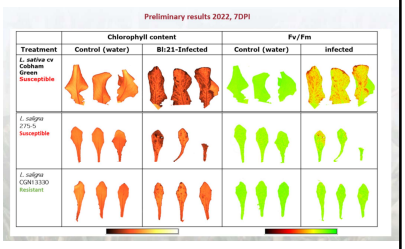
Future Collaborations

- Non-competitive Collaborations
- Comparing analyses
  - Pattern regognitions
  - Comparing data standards
  - Resources & Algorithms
  - Common controls

The Netherlands Plant Eco-phenotyping Centre: NPEC

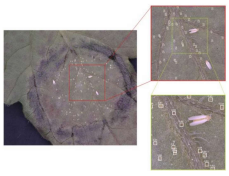


P4P: Phenotyping 4 Profit
For disease resistance in plants



Digital Phenotyping of downy mildew disease in Lettuce

PPS INSPIRE: INnovations for Smart Plant Insect Resistance Evaluation and testing



Detection of whitefly eggs from tomato & potato leaves using AI

WAGENINGEN UNIVERSITY & RESEARCH

Floricode

Registration and coding of floriculture products.
Description and photography of floriculture products

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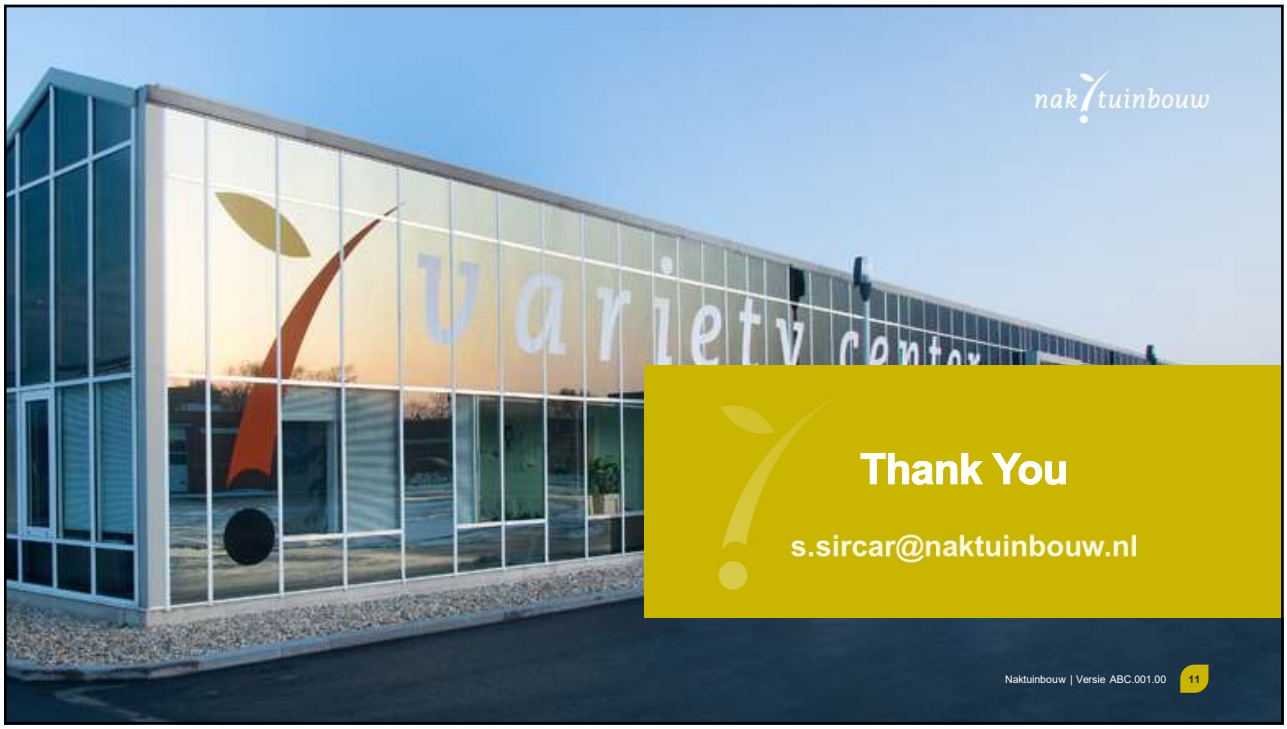

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[End of Annex and of document]