



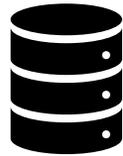
HOW BIG DATA WILL CHANGE SUGAR BEET BREEDING

Hendrik Tschoep, Juan Vegas, David Boehm & Gerhard Steinruecken

“Data is the new oil”

“Machine Learning”

“Artificial Intelligence”



Big Data

“Artificial Intelligence is the
new electricity”

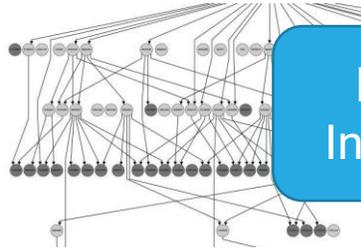
“Digitilisation”

“Algorithms”

“Big data vs big
understanding”



Breeding in the old times...



Pedigree
Information



Yield and
Quality Data



Disease
Nursery Data



The BREEDER

"Knows and decides everything!"

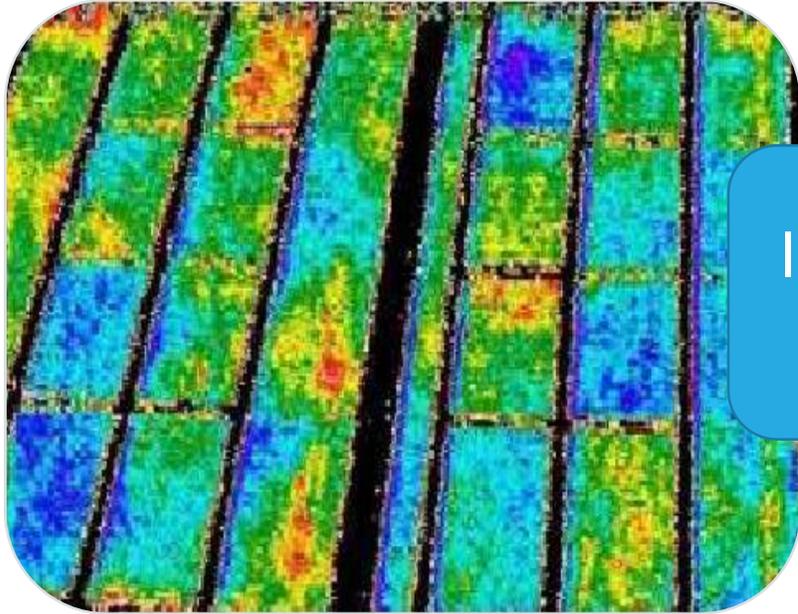


Molecular
Markers

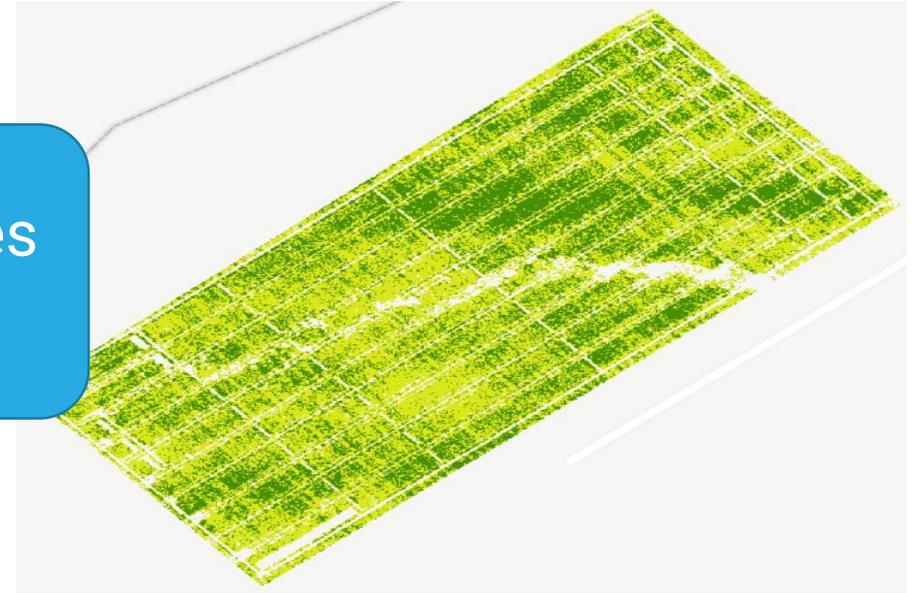
Experience/
Gut Feeling



New Technologies – Drone Phenotyping



Inhomogeneities
on field trials

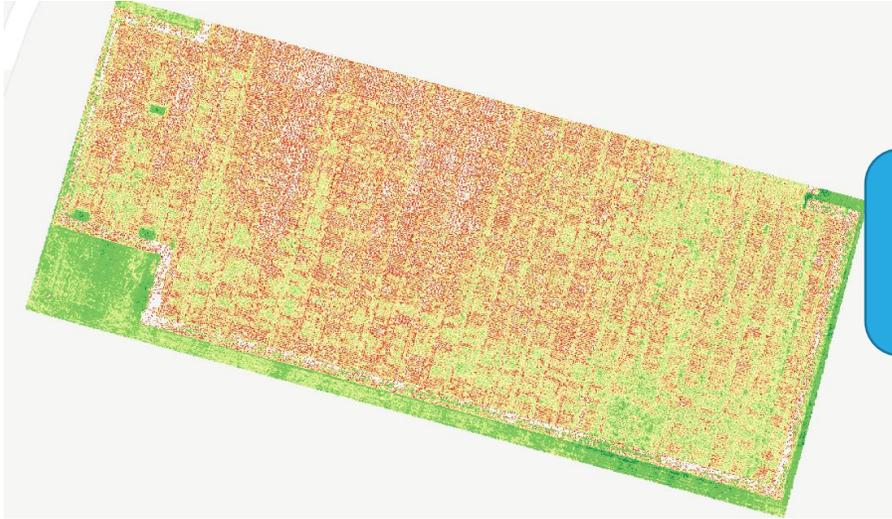


- Inhomogene fertilizer application
 - Soil quality inhomogeneities
 - Drought spots
 - Spots with diseases

Correction on plot level possible using adequate statistical models



New Technologies – Drone Phenotyping



Disease Nurseries

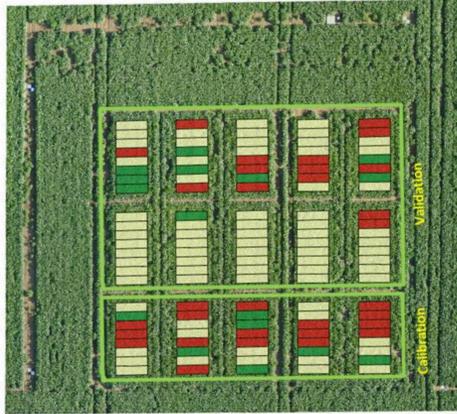


- Cercospora beticola
- Powdery Mildew
- Uromyces beticola
- Fusarium oxysporum

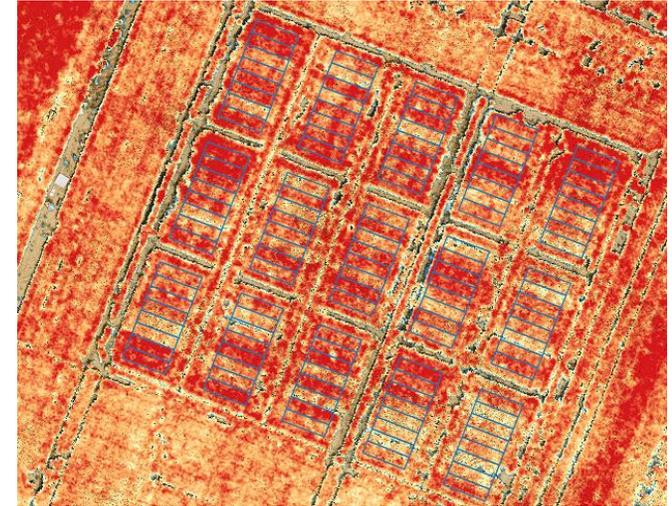
High-Throughput spatio-temporal assessment of disease on plot level



New Technologies – Drone Phenotyping



Abiotic
Stress

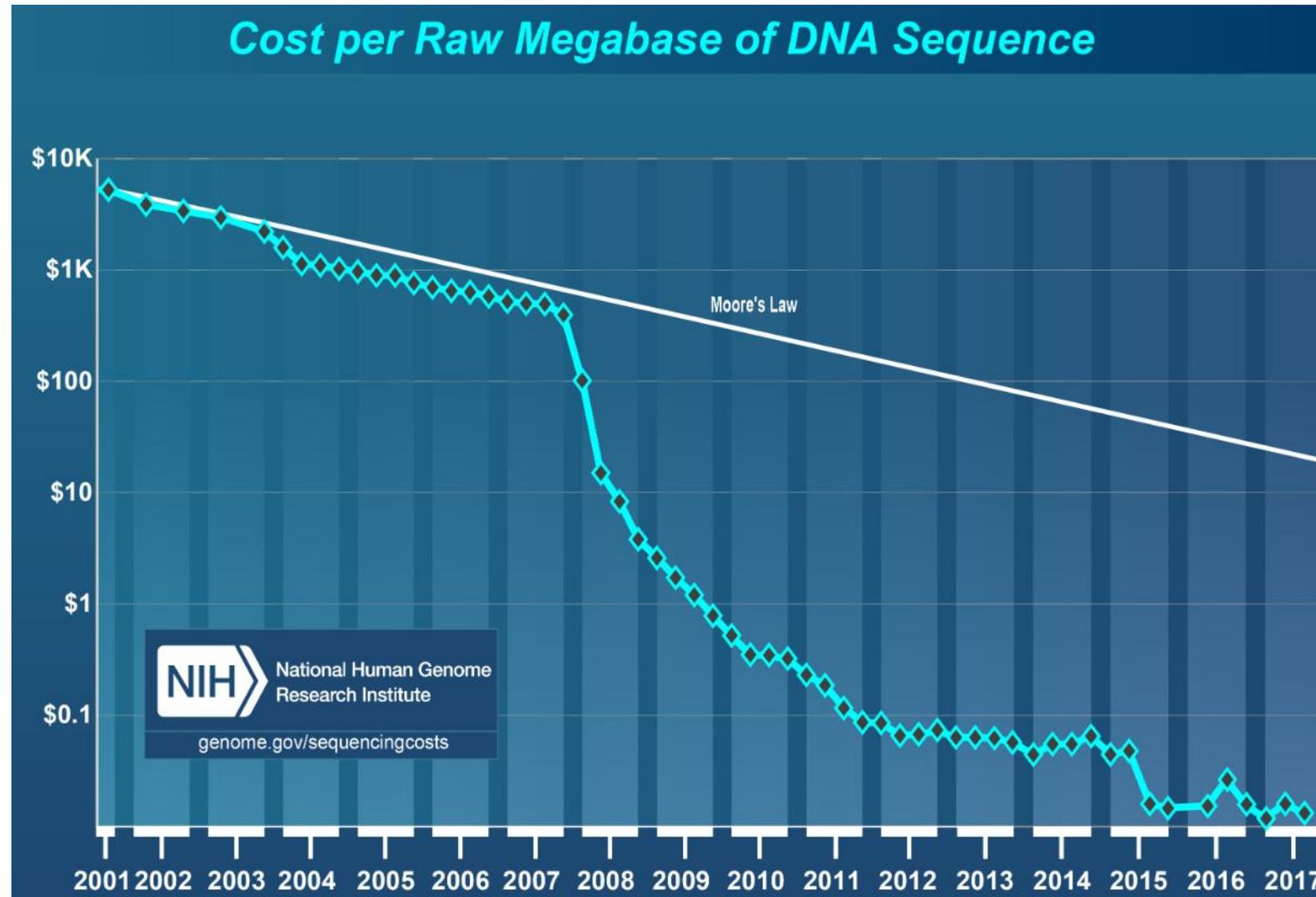


- Drought Stress
- Heat Stress

Identification of genotypes with improved stress tolerance



New Technologies – Sequencing/Genotyping



Source: NCBI: <https://www.genome.gov/27541954/dna-sequencing-costs-data/>



New Technologies – Genomic Selection

Historic Data - Training Set



Phenotypic Data



Regression Model



Genotypic Data



New Data - Predictive Data Set



Predicted Phenotypic Data

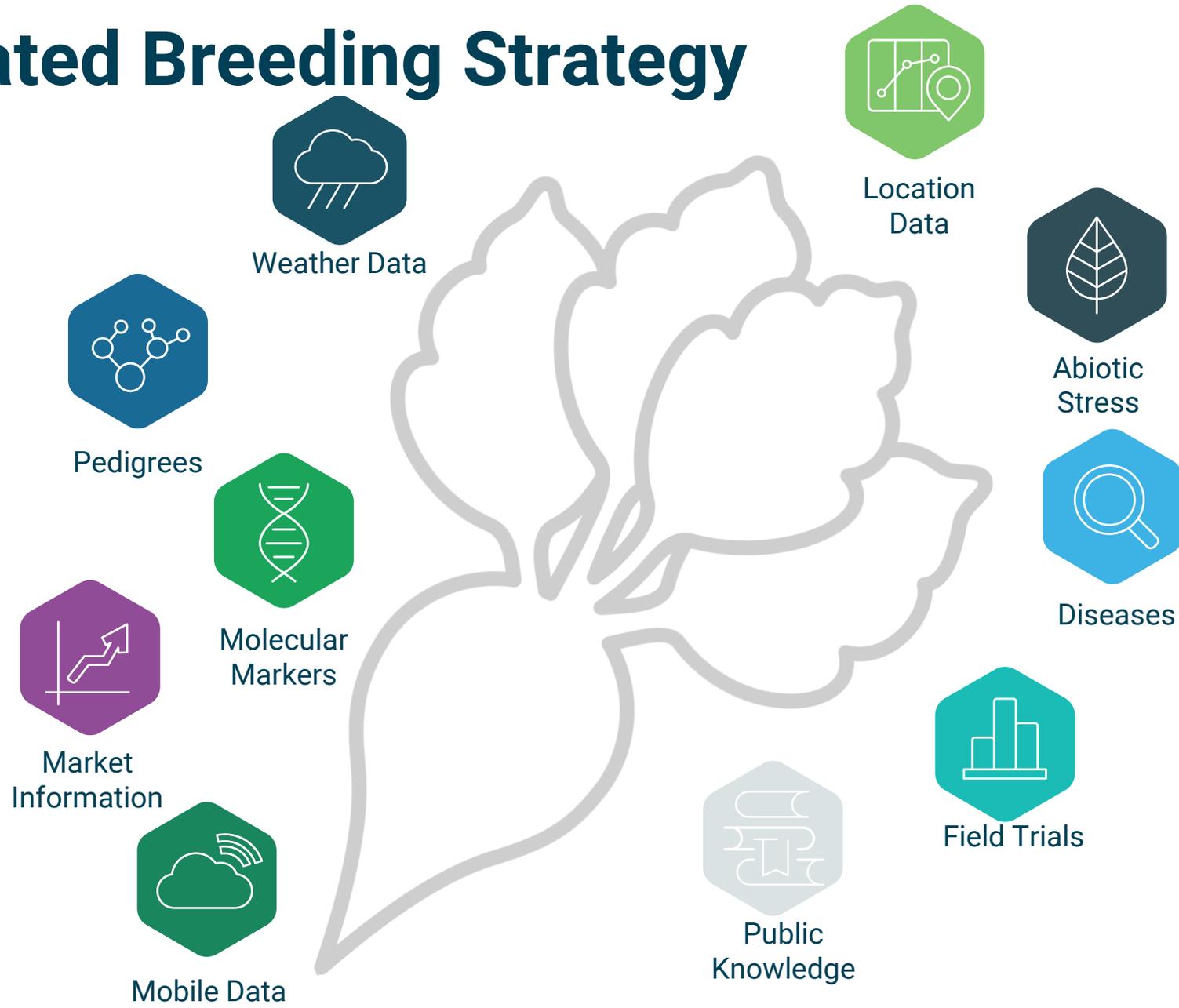
Regression Model



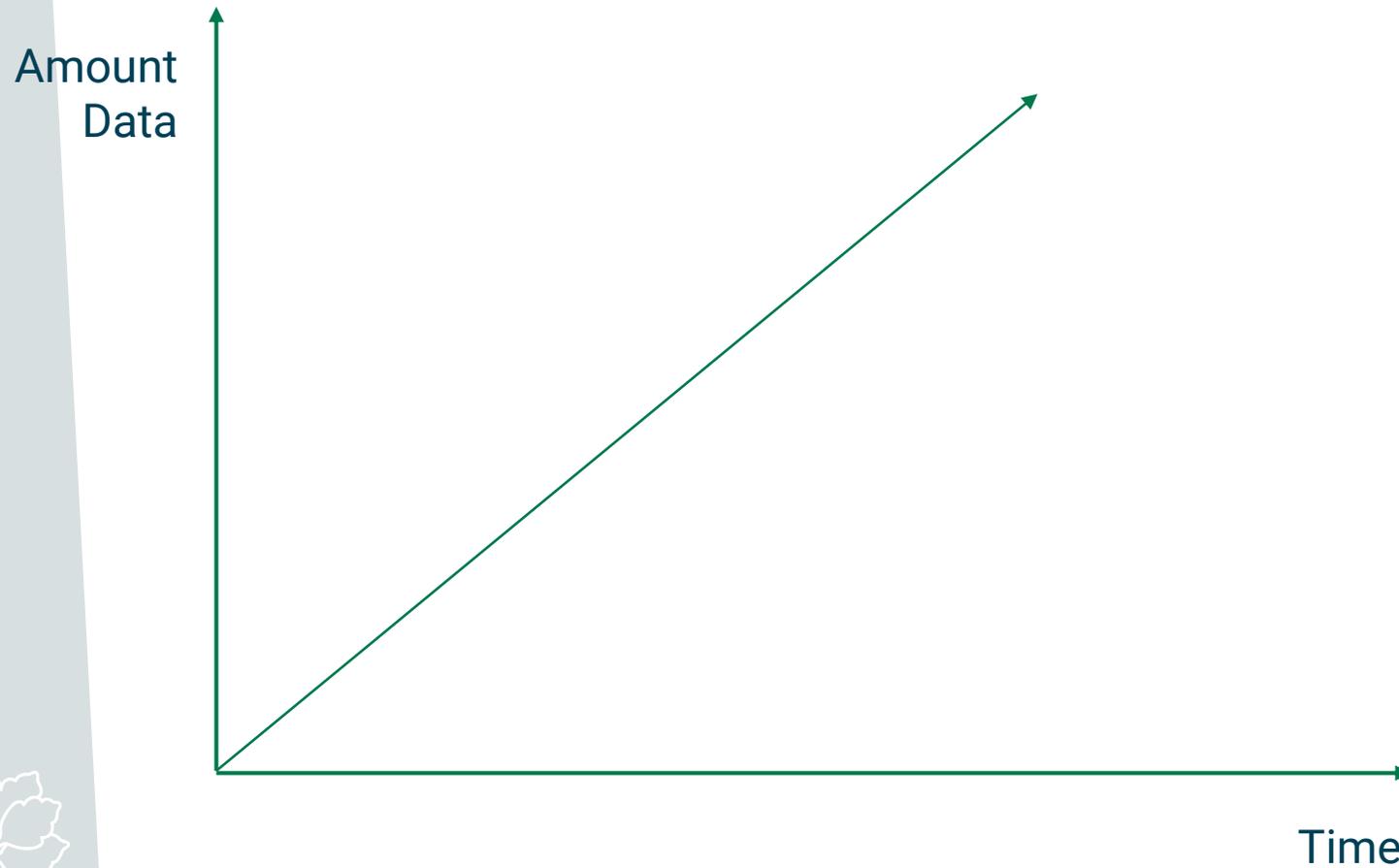
Genotypic Data



Integrated Breeding Strategy



Data Challenges



Data is getting cheaper



Data is more noisy



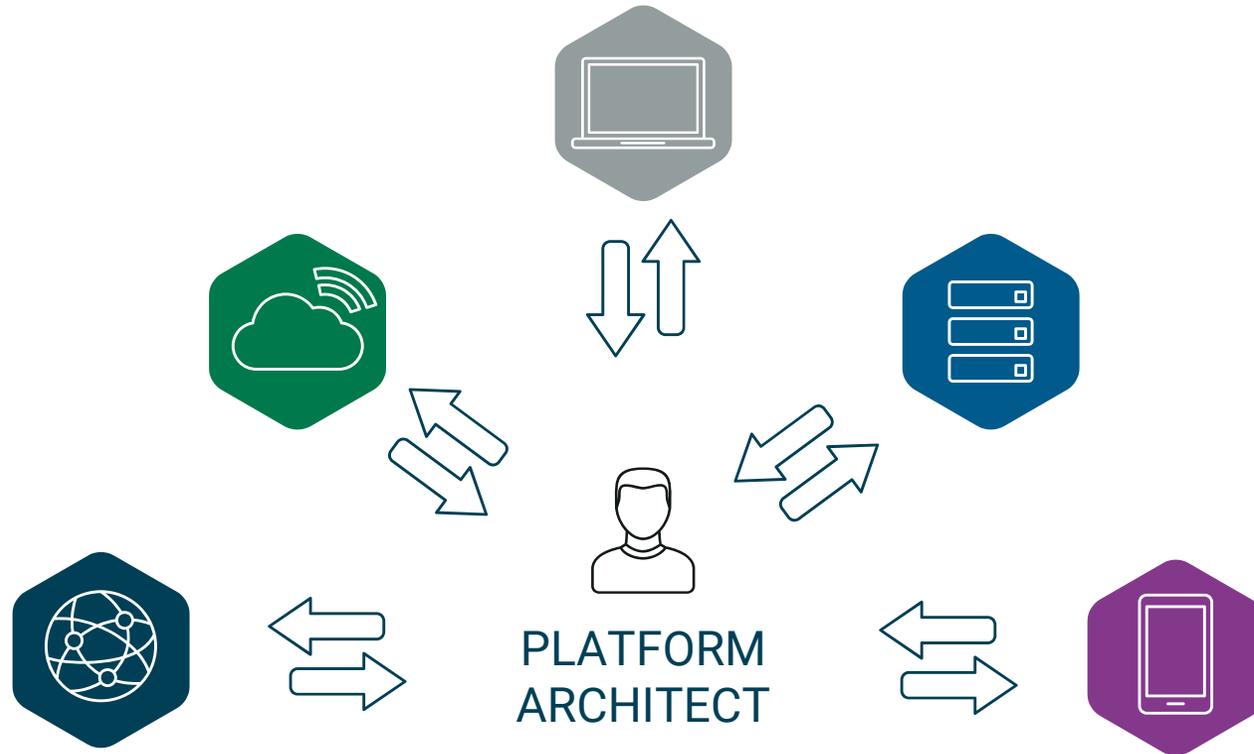
More useless data



More storage space required



IT Infrastructure



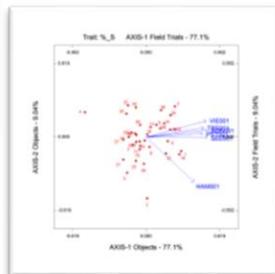
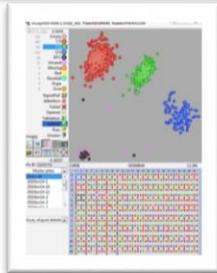
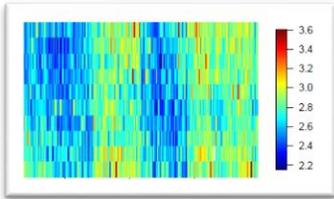
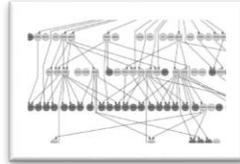
Data Analysis



STATISTICIAN



QUANTITATIVE
GENETICIST



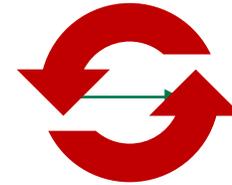
Storage



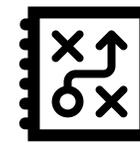
Cleaning



Modelling



Implementation in
Breeding Process



Variety
Release

- Contant re-adjustment of the models
- Selection will be based on probabilities rather than on intuition





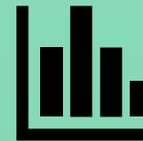
IT
Infrastructure

Data
Science

Breeding
Strategy



Statistics



Requirement for new capabilities



PLATFORM
ARCHITECT



IMAGE
ANALYST



The BREEDER

Knows and decides everything!"



STATISTICIAN



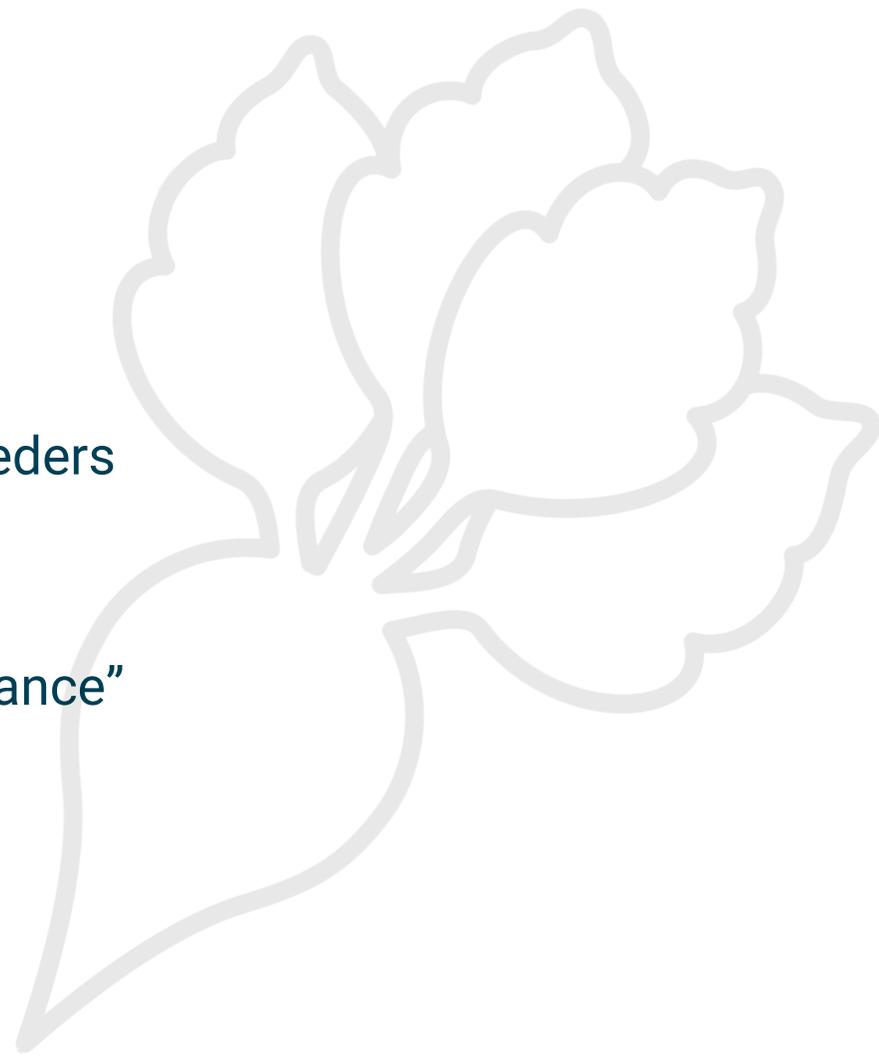
QUANTITATIVE
GENETICIST

- Breeders are part of a multifunctional team
 - Modern Project Managers
- Team players with people management skills



Big Data analysis...

- Is useless without profound analysis
- requires combined expertise from IT, statistics and breeders
- requires a team of specialists from different domains
- has to be constantly benchmarked to “on-farm performance”
- will enable the optimisation of operational activities
- will change traditional sugar beet breeding profoundly
- turns the breeder into a project and people manager
- is a challenge and an opportunity to improve and speed up variety development





SESVANDERHAVE

sugar beet seed



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