



KEYGENE THE TECHNOLOGY ENGINE FOR CROP IMPROVEMENT

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START PRESENTATION



KEYGENE INTRODUCTION

[KeyGene About us](#) link to company movie on YouTube

OUR LOCATIONS AND STRENGTH

**DEDICATED AND INNOVATION DRIVEN, INTERNATIONAL,
150 EMPLOYEES ON THREE CONTINENTS**

- > Molecular Geneticists & Plant Breeders
- > Data Scientists & Bio-informaticians
- > Phytopathologists
- > Patent & legal specialists
- > Commercial & business personnel

Wageningen, the Netherlands



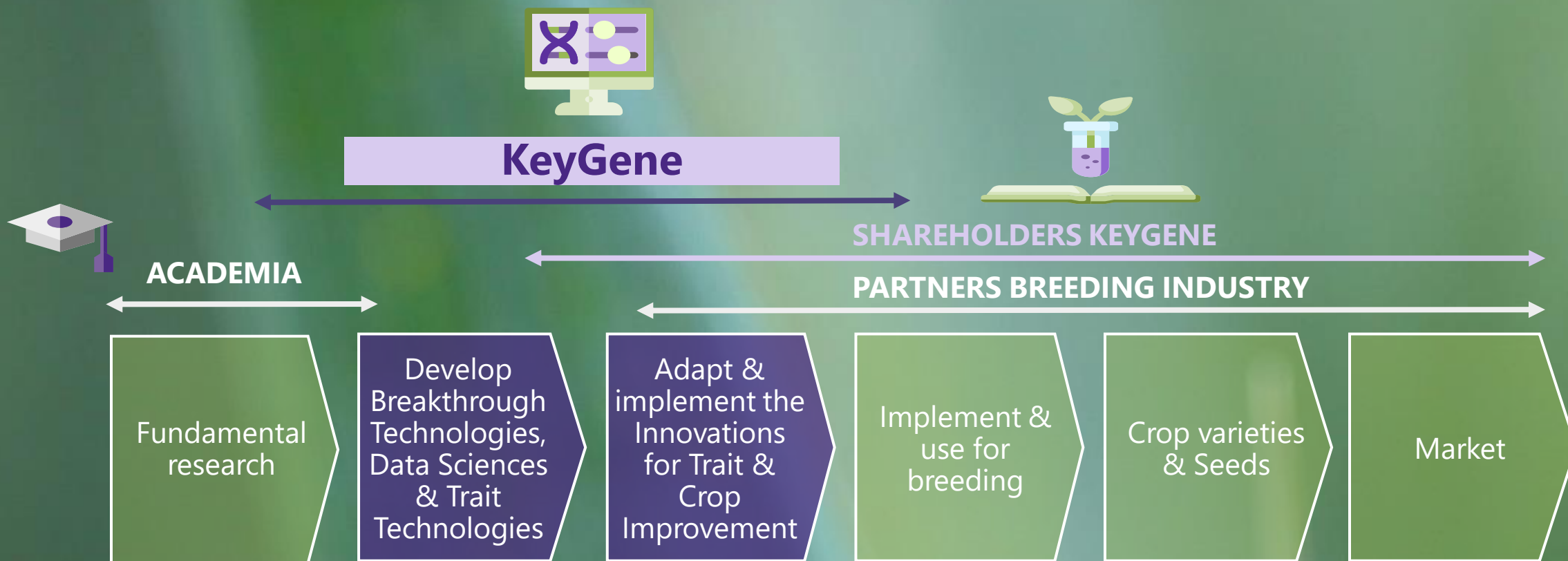
Rockville, USA



Hyderabad, India

**70 DIFFERENT PATENT FAMILIES,
500 PATENTS & PATENT
APPLICATIONS WORLD WIDE**

POSITIONING



SELECTED KEYGENE CONTRIBUTIONS AND SUCCESSES

- **BREAKTHROUGH TECHNOLOGIES**
- **BETTER TRAITS**
- **NEW AND IMPROVED CROPS**



DNA: CARRIER OF GENETIC INFORMATION

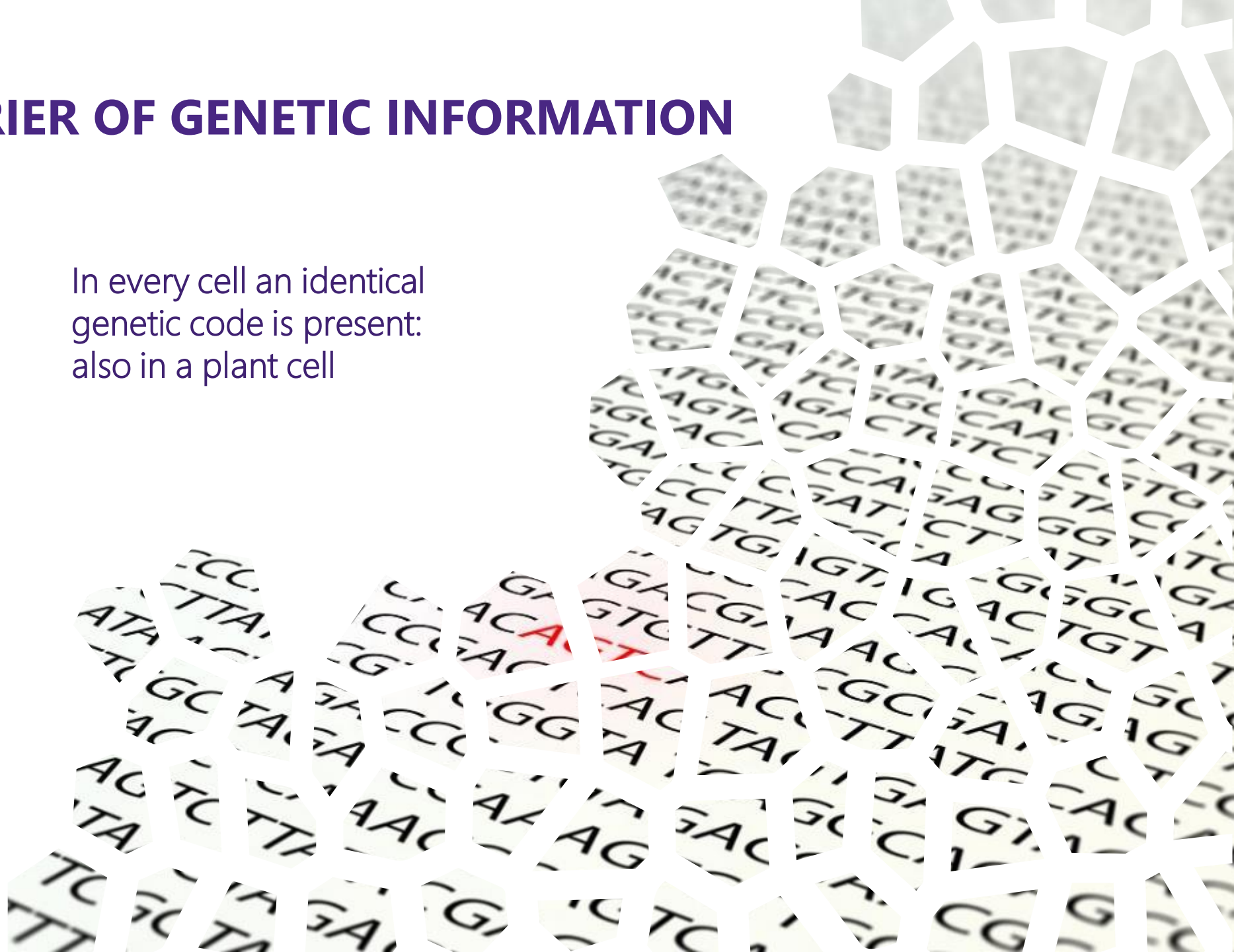


Franklin



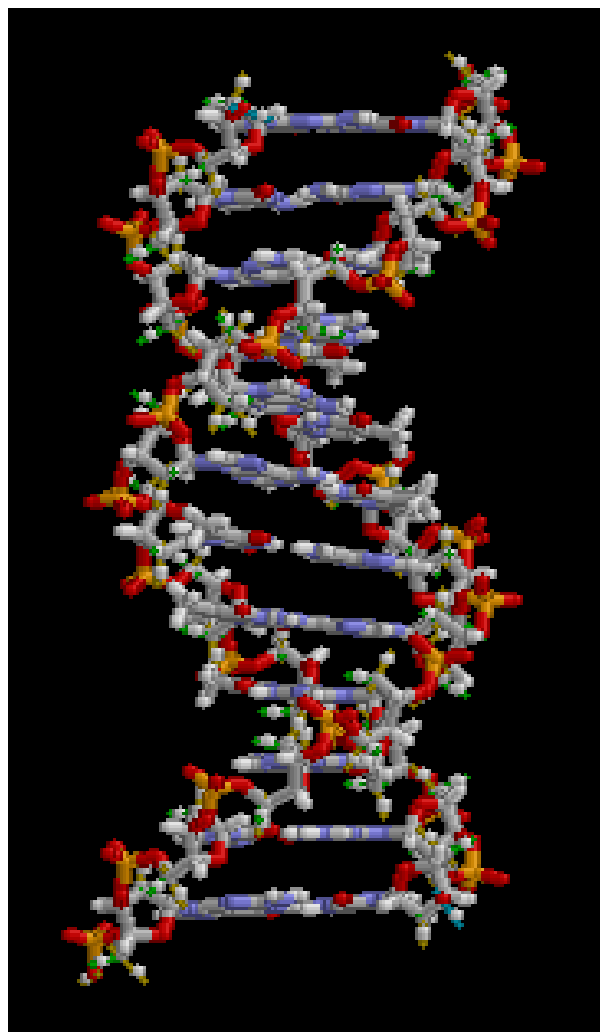
Watson & Crick

In every cell an identical genetic code is present:
also in a plant cell



DNA: SOURCE OF GENETIC INFORMATION

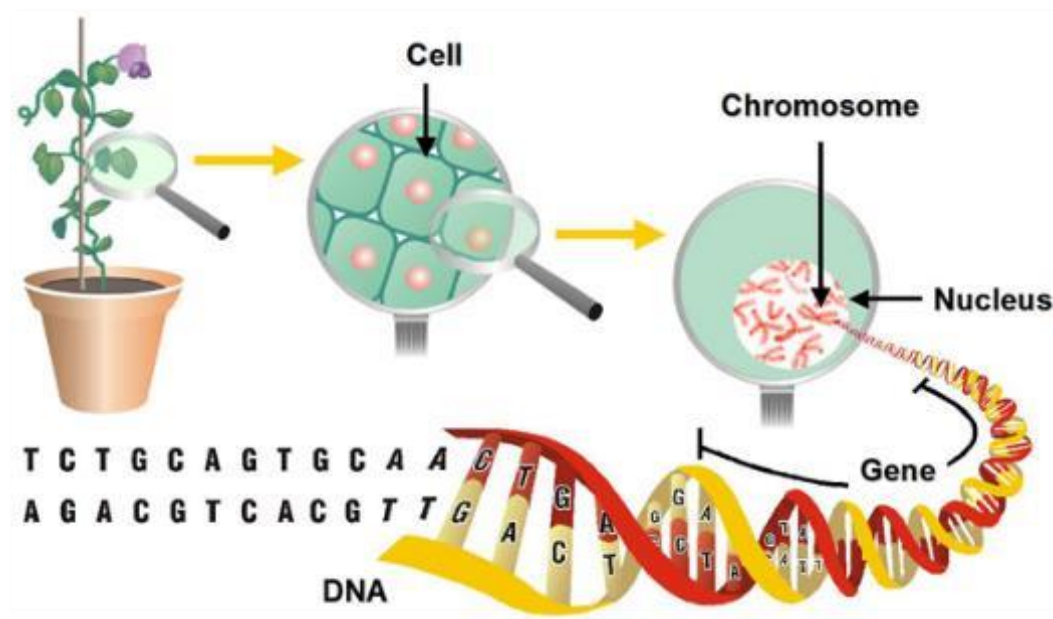
DNA the basis for breeding: since 1953



DNA has 4 building blocks (GATC)

not digital but quatro-code

in all plant cells





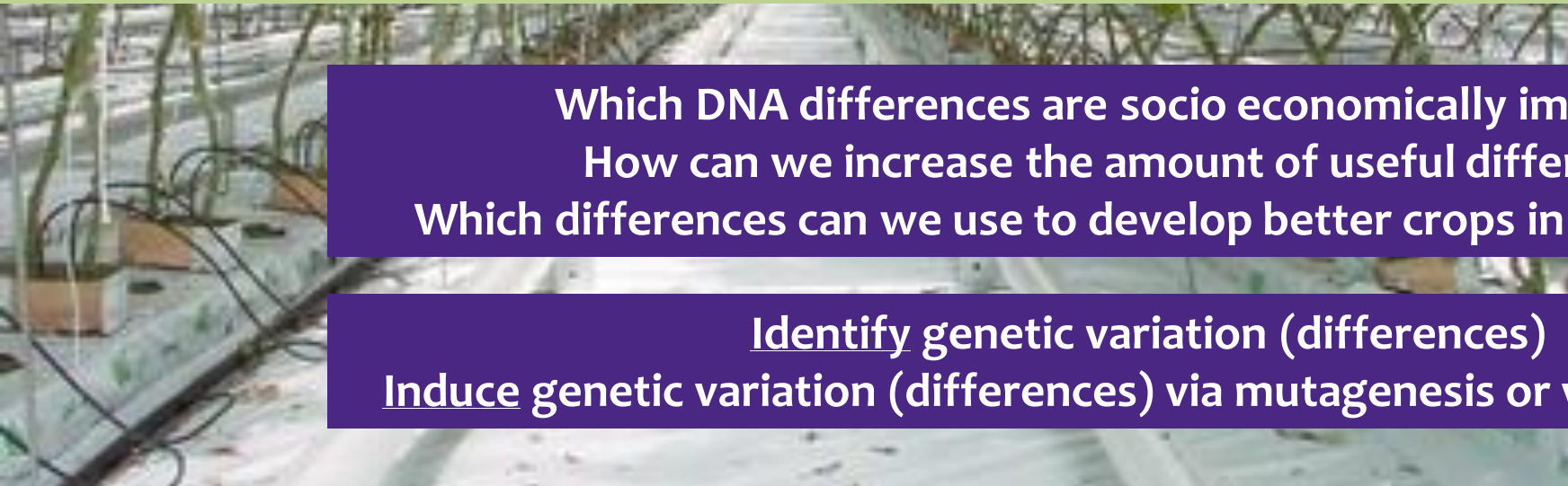
BREAKTHROUGH TECHNOLOGIES: DNA THE SOURCE OF GENETIC INFORMATION



Tomato DNA consists of 1.000.000.000 code letters (human: 3 x more)
In DNA of 2 different commercial tomato varieties: ~ 500.000 differences
In 100 different commercial tomato varieties: ~ 10 million differences
Between commercial and wild tomato species: ~ 100 million differences



Molecular Plant Breeding



Which DNA differences are socio economically important?
How can we increase the amount of useful differences?
Which differences can we use to develop better crops in a non GM way?

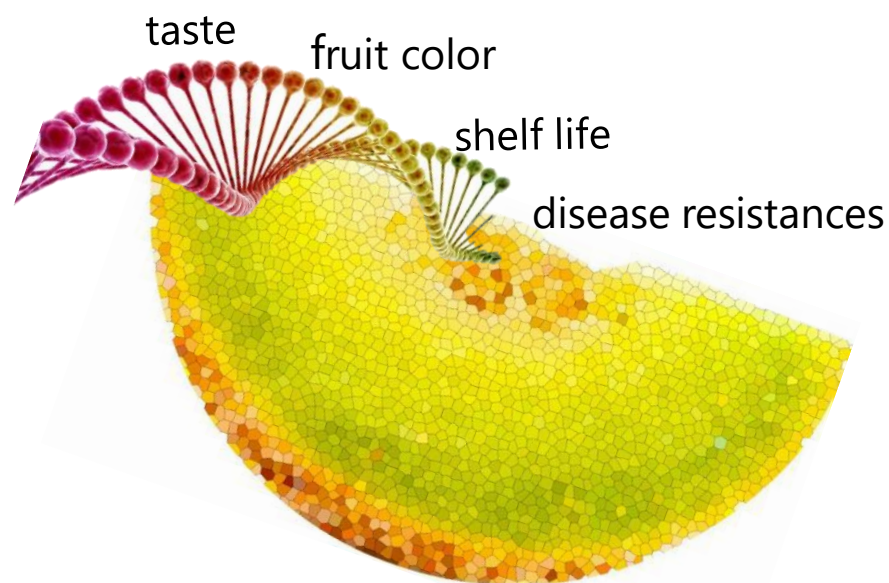
Identify genetic variation (differences)
Induce genetic variation (differences) via mutagenesis or with CRISPR (GE)



BREAKTHROUGH DNA TECHNOLOGIES: PROGRESS IN GENOME SEQUENCING

KeyGene successfully applied 'Nanopore DNA sequencing' in plants by combining:

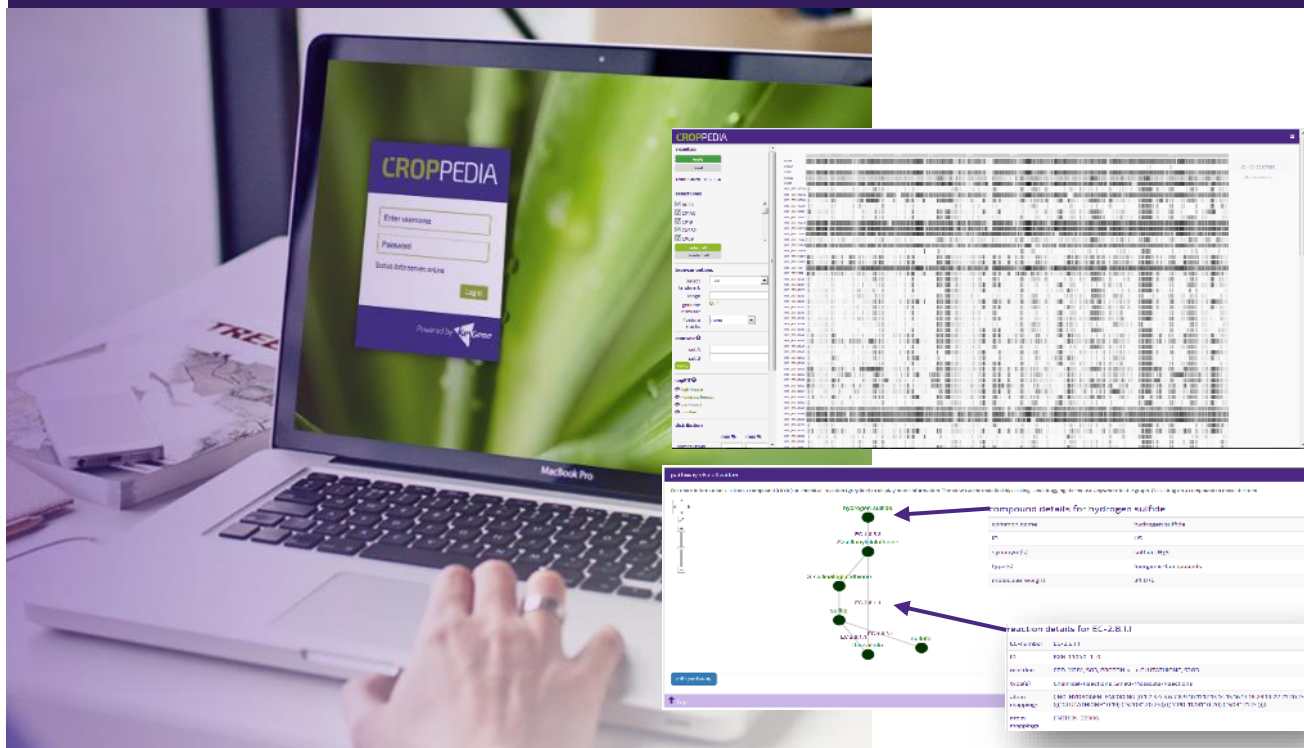
- Isolation and enrichment of HMW DNA
- *de novo* long read sequencing on a.o. the ONT PromethION



Impact: after DNA sequencing selected regions in crop DNA encoding crucial traits can be identified, breeders can better understand genetic variation for development of new varieties.

BREAKTHROUGH DATA HANDLING TECHNOLOGIES: THE WORLD'S FAMOUS "CROPPEDIA" INTERACTIVE DATA BASE

KeyGene's powerful data analysis & visualization platform to handle proprietary & public data for any crop



Impact: interactive & easy to use in-house software for improved decision making



advanced compute



data integration



data storage



public & proprietary data sources



automated input quality control



system integration



data security



available as SaaS



advanced user management

BREAKTHROUGH MUTAGENESIS TECHNOLOGY: KEYPOINT® BREEDING

Sequence based mutagenesis breeding system



Tomato

Operational in many crops

Vegetables

Tomato, Sweet & Hot Pepper, Cabbage, Cucumber, Melon, etc.

Field Crops

Potato, Rye, Wheat, Sugar Beet, Tobacco, Dandelion, Soybean, Corn, Canola, Sorghum, Rice, Barley, Cassava, Sunflower, etc.

In-house industrialized procedure in one go

- typically 4,000 – 25,000 mutagenized plants
- up to 20 genes simultaneously screened, number still growing
- patentable induced variations
- combined with CropPedia® & KeySeeQ® gene discovery system
- many mutants phenotyped and introduced in breeding programs

Risotto rice

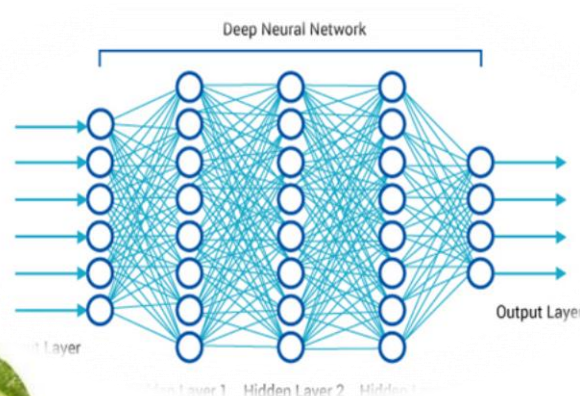
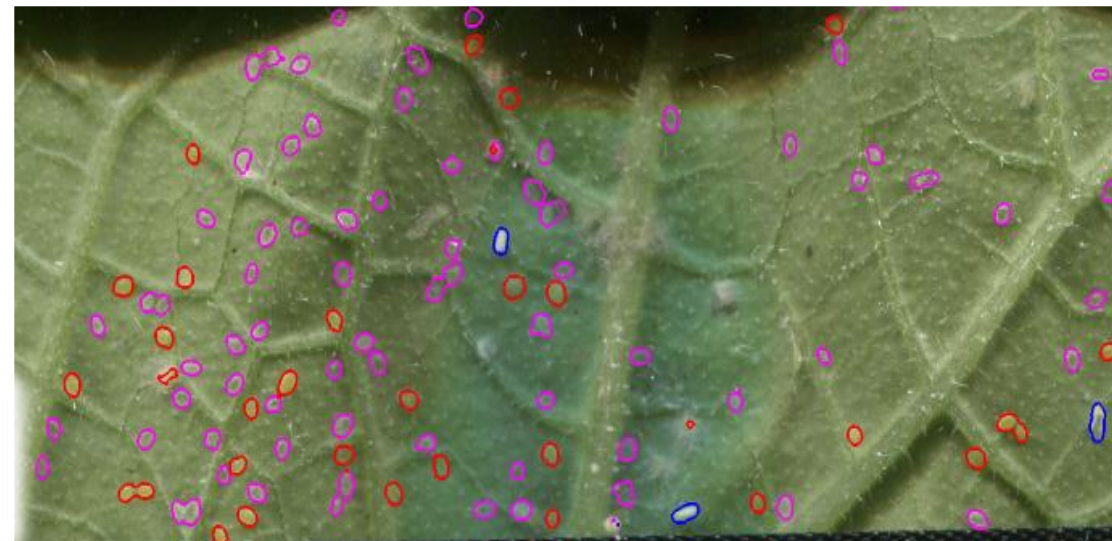


Impact: Development of unique breeding material, attractive for introduction in commercial breeding

BETTER PHENOTYPING TECHNOLOGIES: DIGITAL WHITEFLY ASSESSMENT

Whitefly bio assay data collection:

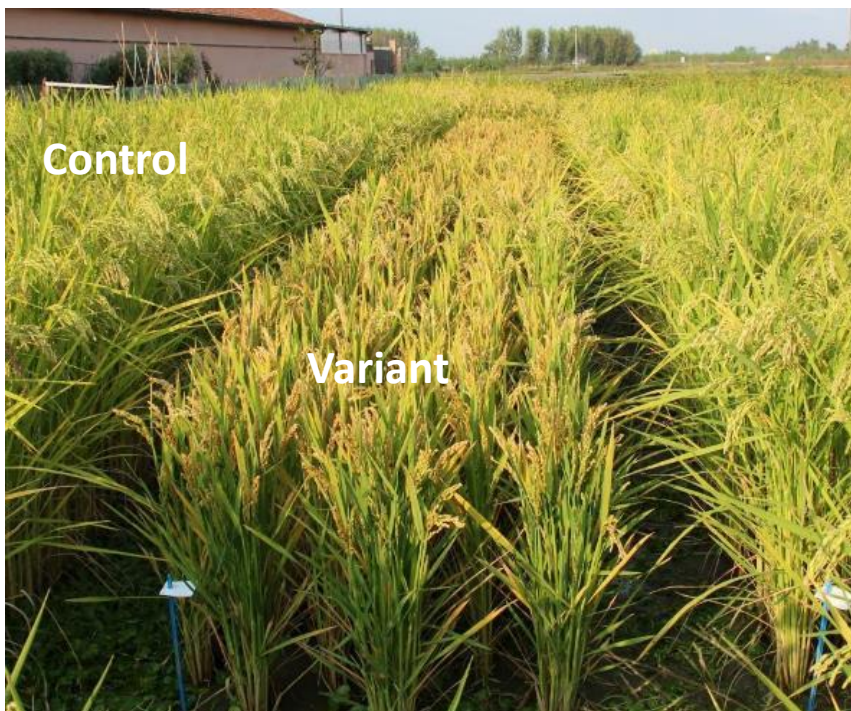
- Automatic detection of a developmental stages of whiteflies including eggs and larval stages
- Deep learning algorithm counts eggs and juveniles



Impact: digital analysis of whitefly infested leaves provide a robust, cheap, high throughput measure for insects. It replaces labor-intensive meticulous and highly trained human observations.

BETTER TRAITS: IMPROVED RICE YIELD AND CROP PERFORMANCE

KeySeeQ[®] followed by KeyPoint[®] Breeding has resulted in higher grain yield & more erect panicles



UNIVERSITÀ DEGLI STUDI
DI MILANO

Impact: Effective development & market introduction of high yielding rice varieties for Shriram Bioseed

KeyPoint[®] technology is protected by patents and/or patent applications owned by KeyGene

BETTER TRAITS: POWDERY MILDEW RESISTANCE IN WHEAT

Powdery Mildew fungi are a source of yield losses in wheat especially in ecological production without fungicides. KeyGene has discovered three S gene homeologs of the S gene MLO of hexaploid wheat



Impact: by combining strong loss of susceptibility alleles – created by KeyPoint® - of all relevant MLO homeologs in wheat, Powdery Mildew resistant germplasm was created. This material will enable wheat breeders to generate PM resistant crops that are less dependent on fungicides

BETTER TRAITS: RESISTANCE TO GEMINI VIRUSES IN SWEET PEPPER

Broad resistance to Gemini virus generated using the “loss of susceptibility” approach



Impact: Contribution to sustainable agriculture, breeders using resistance to Gemini virus disease in pepper breeding

NEW AND IMPROVED CROPS: BANANA BREEDING & RESEARCH

State of the art genomics tools & wild banana types for banana plants resistant to Fusarium (Panama disease) & Mycosphaerella (Black Sigatoka), and increased diversity for sustainability



Impact: International breeding collaboration started in 2022, academics & business: Yelloway

NEW CROPS: DANDELION AS A NEW SOURCE OF NATURAL RUBBER

State of the art genomic & breeding tools resulted in succesful interspecific cross of tiny Kazach rubber dandelion and robust Dutch dandelion



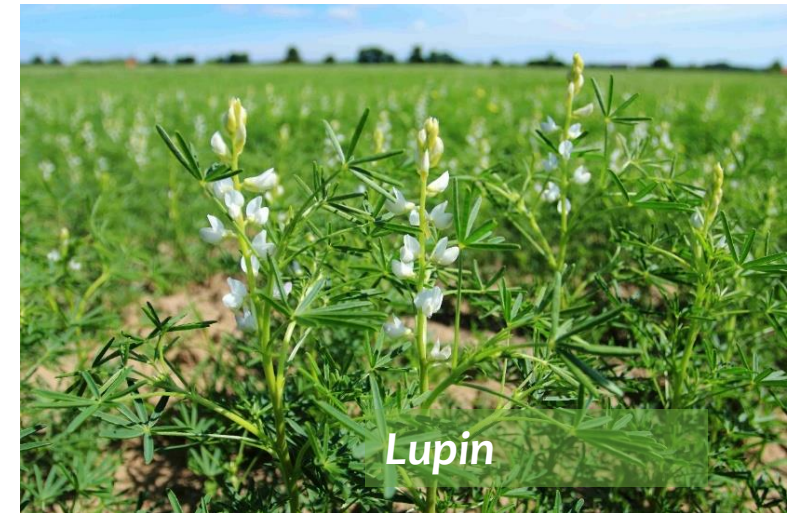
LionFlex
SUSTAINABLE NATURAL RUBBER

Impact: Flexilis[®] hybrid varieties with superior yield, foundation of LionFlex breeding company

This technology is protected by patents and/or patent applications owned by Lion-Flex B.V.

NEW AND IMPROVED CROPS: HIGH PROTEIN CROPS FOR HUMAN FOOD

Faba bean, yellow pea, lupin as new source for plant proteins:
increase yields and prevents pests and diseases by molecular breeding



Impact: developing Faba bean, yellow pea and lupin as protein crops grown in temperate climates will further enable the protein transition.

*"As a **"Technological Innovation Engine for Crop Improvement"**, KeyGene innovates not only for our strategic partners but especially with our partners. I am proud that we can bring together and collaborate with different people, ideas, projects & partners from all over the world followed by executing a solid amount of breakthrough and high quality research that generates impact and improvements."*

Arjen J. van Tunen
CEO KeyGene

THANK YOU