

Teraviljafoorum 7.12.2021

# Käes on aeg hakata armastama GM-taimi?

*Hannes Kollist*

[www.plantsignalresearch.com](http://www.plantsignalresearch.com)

[www.plantinvent.com](http://www.plantinvent.com)



PLANT SIGNAL  
RESEARCH GROUP



Plant Invent



Euroopa Maaelu Arengu  
Põllumajandusfond:  
Euroopa investeeringud  
maapiirkondadesse



1632

# INARI™

# SEEDesign™ platform.

Satisfying demand.  
Enriching the environment.

## PRODUCTIVITY GOALS

UP TO

# +20%

YIELD IN CORN AND SOY

Compared to historical  
yield improvements of ~1% per year

## WATER USAGE GOALS

# -40%

WATER NEEDED FOR CORN

Equivalent to approximately 2.1 years of US  
total water consumption from domestic  
and public supply

## CLIMATE CHANGE GOALS

# -40%

NITROGEN NEEDED FOR CORN

Equalling a reduction of half a metric ton of  
CO2 per acre of corn



A collection of petri dishes containing various bacterial cultures, including streaked plates, confluent lawns, and discrete colonies, set against a dark background.

BIOTECH

# Wall Street wins signal the start of a synthetic biology revolution

By James Thorne & Marina Temkin

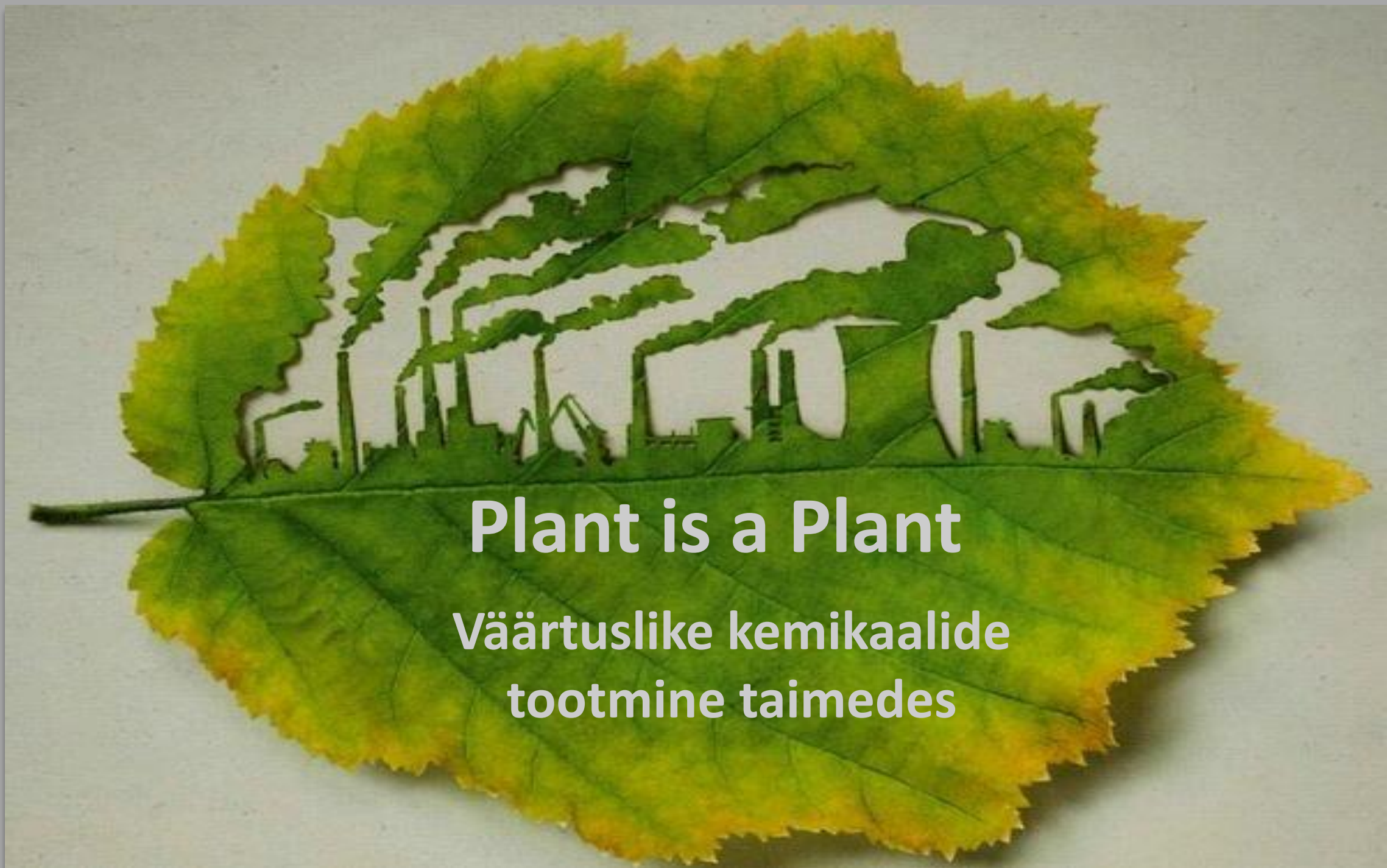
June 7, 2021 [View comments \(2\)](#)

<https://pitchbook.com/news/articles/wall-street-wins-signal-the-start-of-a-synthetic-biology-revolution>

# Biology by design.

Biology is the most advanced manufacturing technology on the planet. We program cells to make everything from food to materials to therapeutics.

The Boston-based company's patience recently paid off: Last month, Ginkgo landed a blank-check deal that **valued the company at \$15 billion**, more than triple what it was worth last year, according to PitchBook data. Its rival [Zymergen](#) also took a platform-first approach to biomanufacturing and rode it to an IPO in April at a roughly \$3 billion valuation.



**Plant is a Plant**

**Väärtuslike kemikaalide  
tootmine taimedes**



# Health is in our nature

Medicago develops vaccines and treatments to help fight emerging global health challenges, today and in the future.

Discover our business



## COVID-19

Do you have a question about our COVID-19 vaccine candidate?



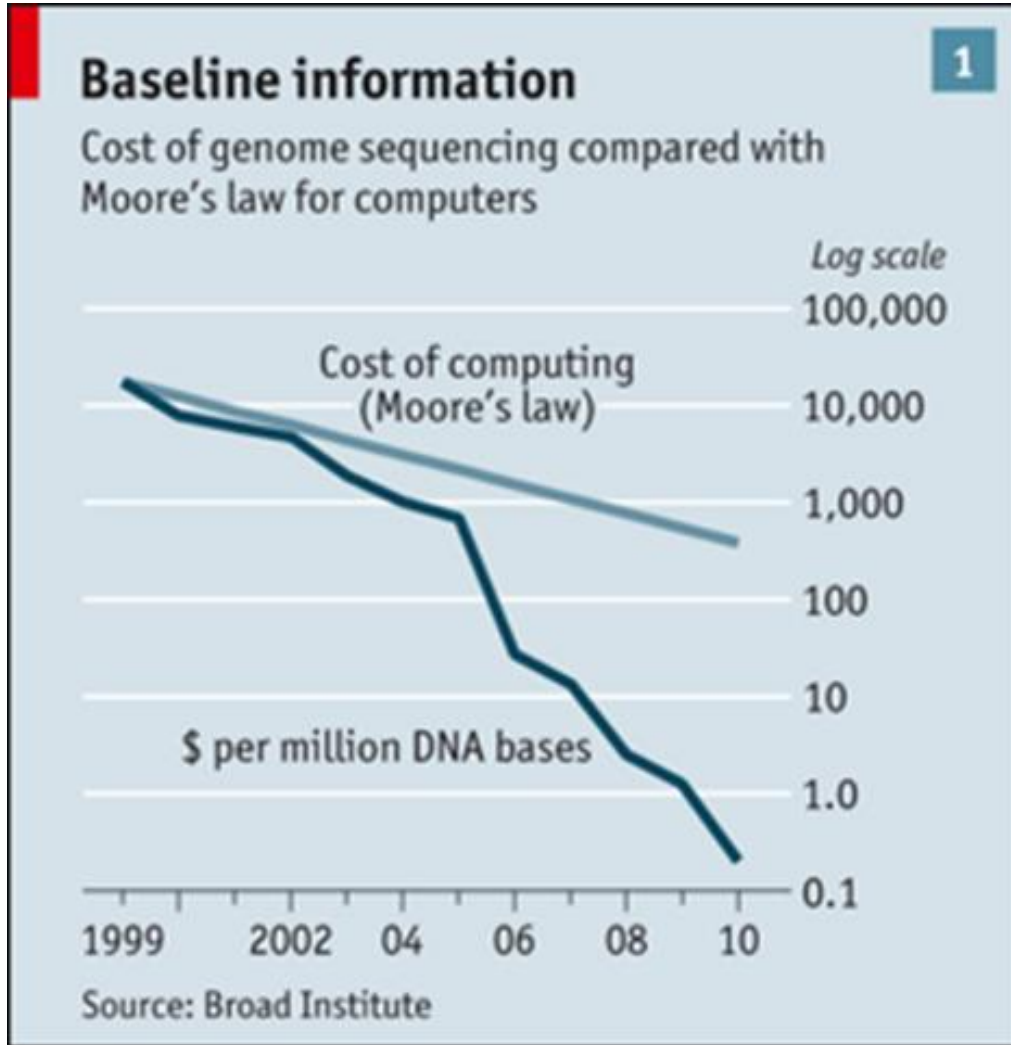
**We translate your ideas into proteins**

Terapeutiliste valkude tootmine taimedes



# Kust on tulnud areng?

## DNA sekveneerimine ja süntees

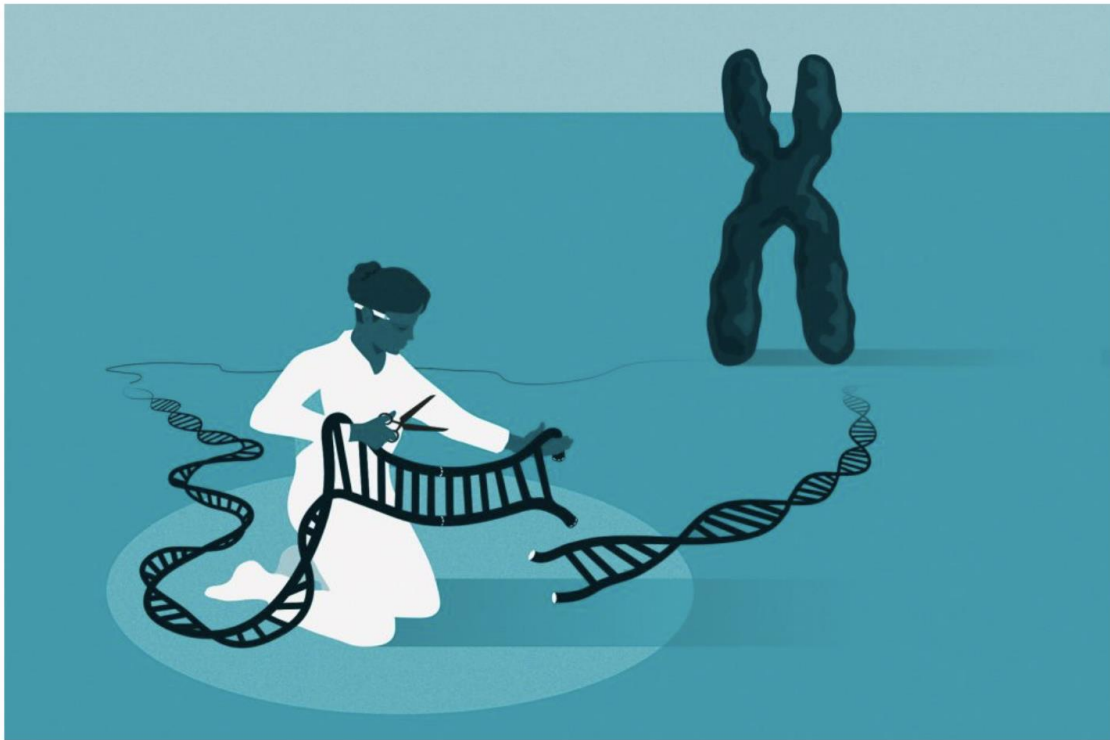




# Kust on tulnud areng?

- CRISPR/Cas9 tehnoloogia

Genetic scissors: a tool for rewriting the code of life



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## The Nobel Prize in Chemistry 2020



© Nobel Prize Outreach. Photo: Bernhard Ludewig

**Emmanuelle Charpentier**

Prize share: 1/2



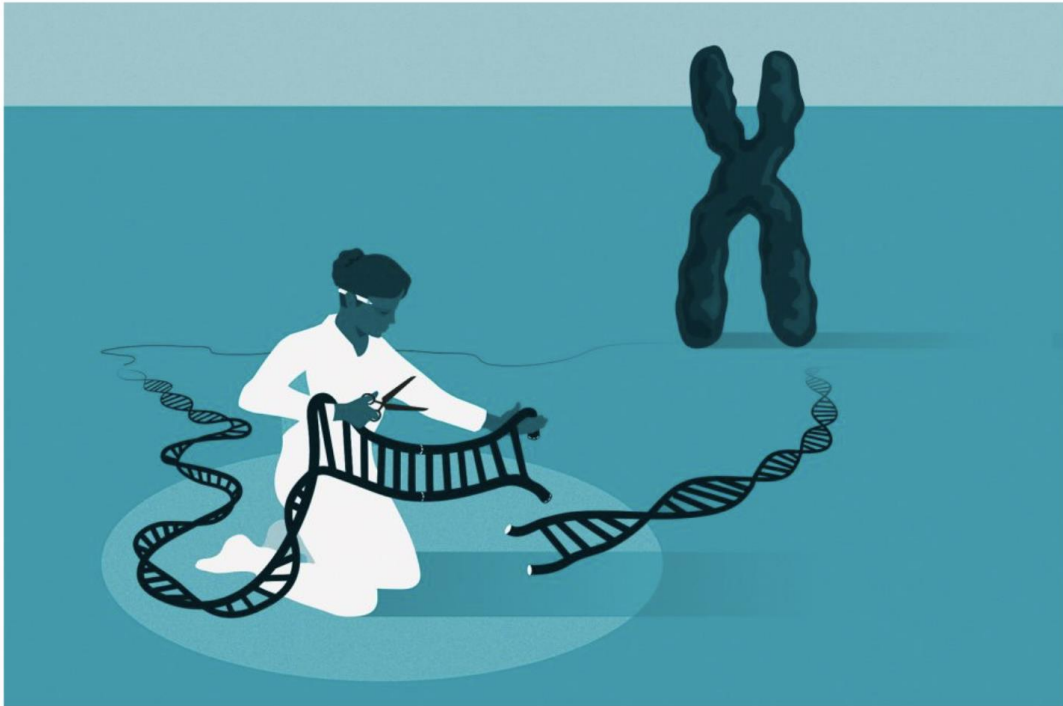
© Nobel Prize Outreach. Photo: Brittany Hosea-Small

**Jennifer A. Doudna**

Prize share: 1/2

# Kust on tulnud areng? - Molekulaarbioloogia

Genetic scissors: a tool  
for rewriting the code  
of life



© Johan Jarnestad/The Royal Swedish Academy of Sciences

# Mis on kujunenud pudelikaelaks? - Fenotüpiseerimine

# Kust on tulnud areng?

## -Molekulaarbioloogia

Genetic scissors: a tool for rewriting the code of life



© Johan Jarnestad/The Royal Swedish Academy of Sciences

# Mis on kujunenud pudelikaelaks?

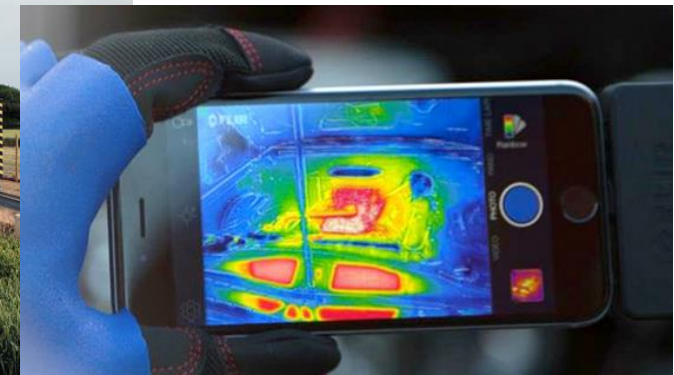
## - Fenotüpiseerimine



Flying platforms

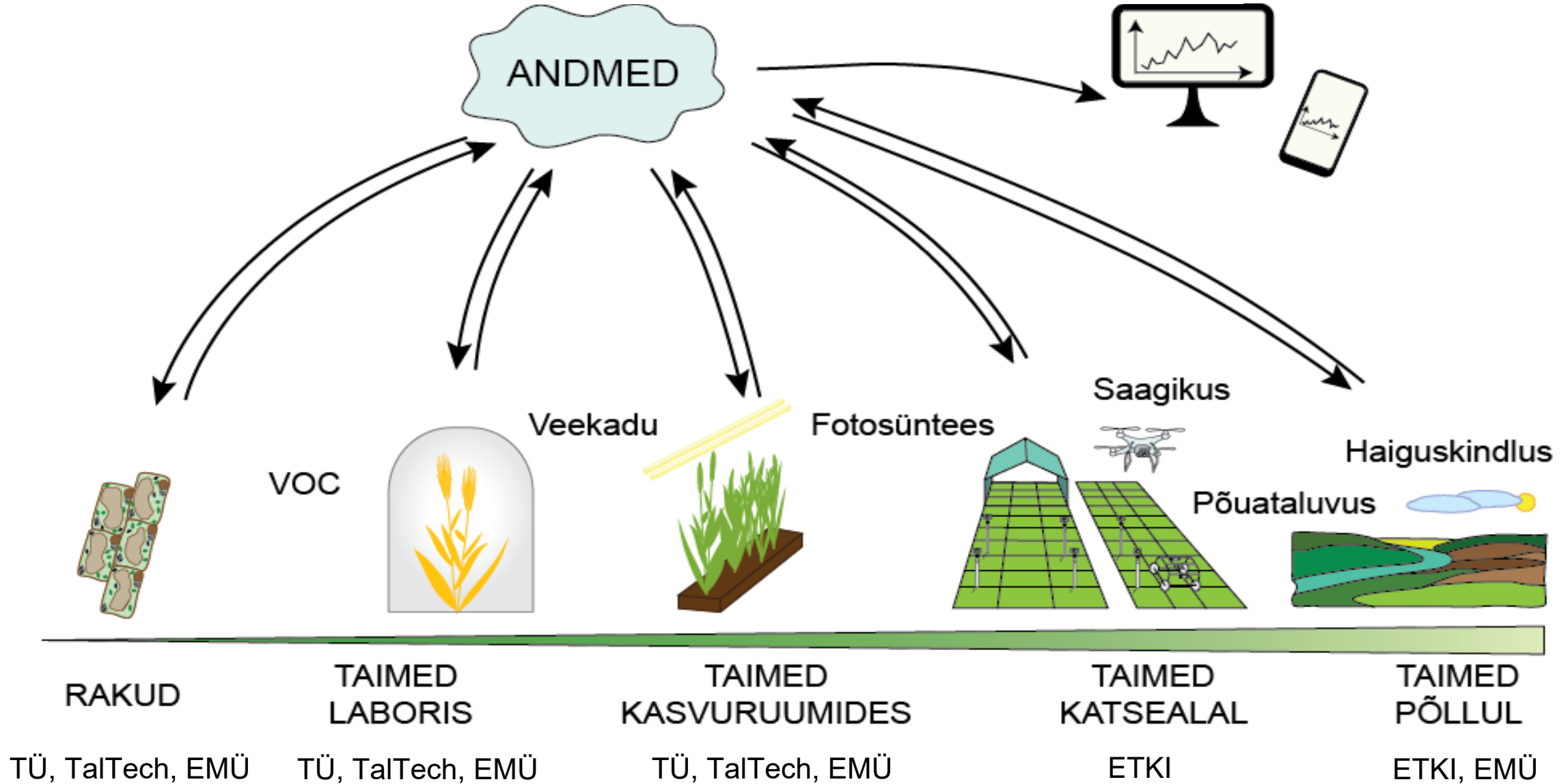


Portable sensors („cheap“)





# Taimebioloogia Infrastruktuur





Euroopa Liit  
Euroopa  
Regionaalarengu Fond



Eesti  
tuleviku heaks

# TAIM

Taimebioloogia infrastruktuur

[www.taimebioloogia.ee](http://www.taimebioloogia.ee)



# Taimebioloogia Infrastruktuur

## TEENUSED

[www.taimebioloogia.ee](http://www.taimebioloogia.ee)



TAIMEBIOTEHNOLOOGIA



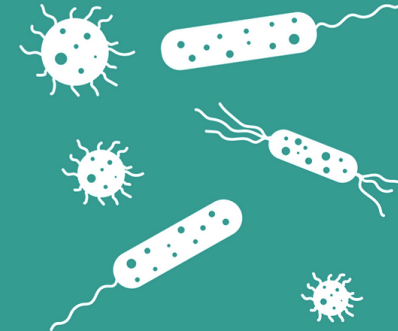
BIOINFORMAATIKA



FOTOSÜNTEES JA VEEKASUTUS



LENDUVATE ÜHENDITE ANALÜÜS



MULLA MIKROBIOLOOGIA



PÕLDKATSED



PÕLLUKULTUURIDE SAAGI ANALÜÜSID

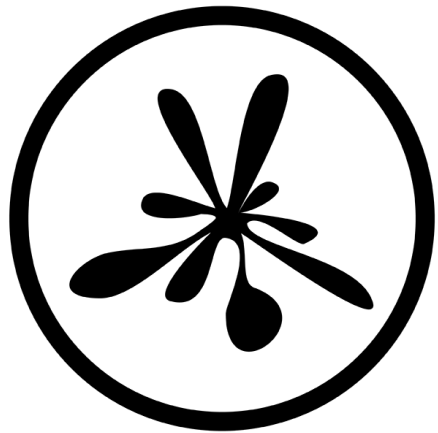


AIAKULTUURIDE SAAGI ANALÜÜSID



TAIMEDIAGNOSTIKA SEADMED

# Tartu Ülikool taimediagnostika tehnoloogiad



**Plant Invent**



Photos by: Kaspar Koolmeister





Plant Invent

# Taimediagnostika instrumentid



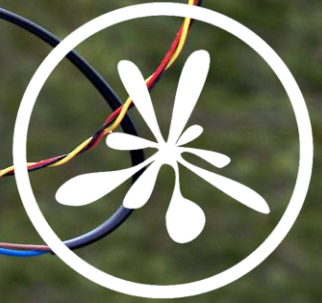
Photos by: Kaspar Koolmeister







Plant Invent



Plant Invent



Plant Invent

# REINVENTING GAS EXCHANGE ANALYSIS

## OUR MISSION

To provide whole plant gas exchange analysis that provides researchers with detailed information on plant and ability to assess and optimize plant performance.

Unlike, standard gas exchange systems, our system is designed to measure the whole plant, not just the leaves. This allows us to measure the whole plant, including the roots, stems, and leaves. This provides a more comprehensive view of plant performance, including the ability to assess and optimize plant performance.



## WE MEASURE

Whole plant gas exchange, including photosynthesis, respiration, and transpiration.

- CO<sub>2</sub> exchange
- H<sub>2</sub>O exchange
- O<sub>2</sub> exchange
- Leaf area
- Plant growth

Whole plant gas exchange, including photosynthesis, respiration, and transpiration.

## WE PROVIDE DATA FOR

- Plant growth
- Plant health
- Plant stress
- Plant yield

## GAS EXCHANGE ANALYSIS AS A SERVICE

**What:** Measure the whole plant gas exchange of your plant.  
**How:** Using our whole plant gas exchange system.  
**Why:** To assess and optimize plant performance, including the ability to assess and optimize plant performance.



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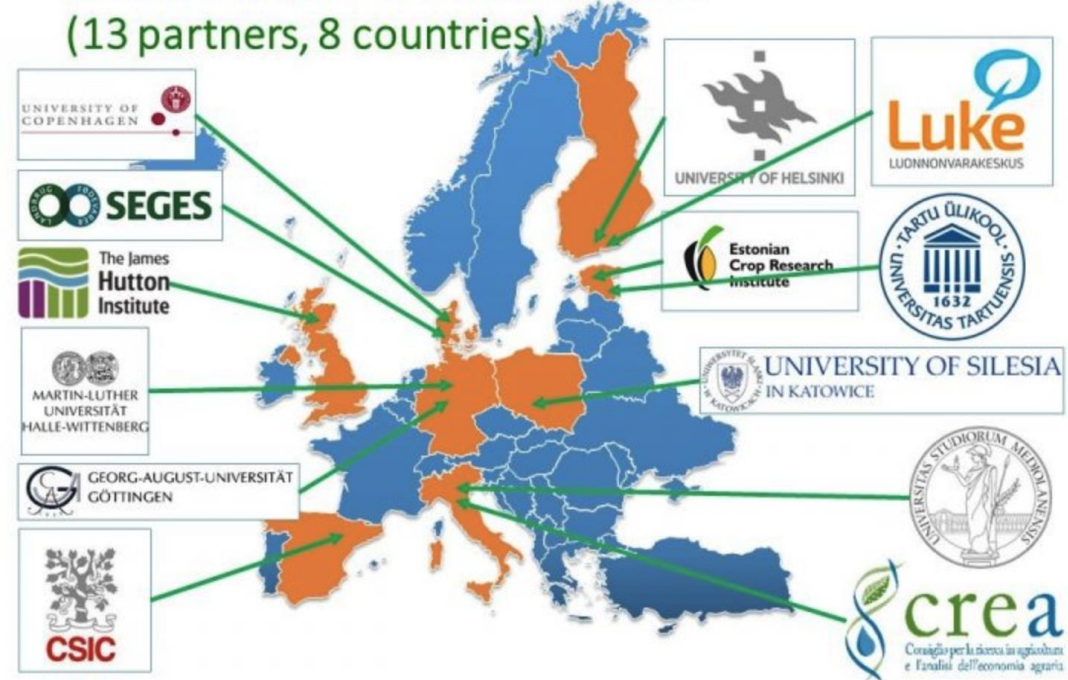
# Rahvusvahelised projektid – kliimakindel & ressursisäästlik oder ja nisu



**BRACE** – põuakindel oder,  
odra genoomi editeerimine



The BARISTA Consortium  
(13 partners, 8 countries)



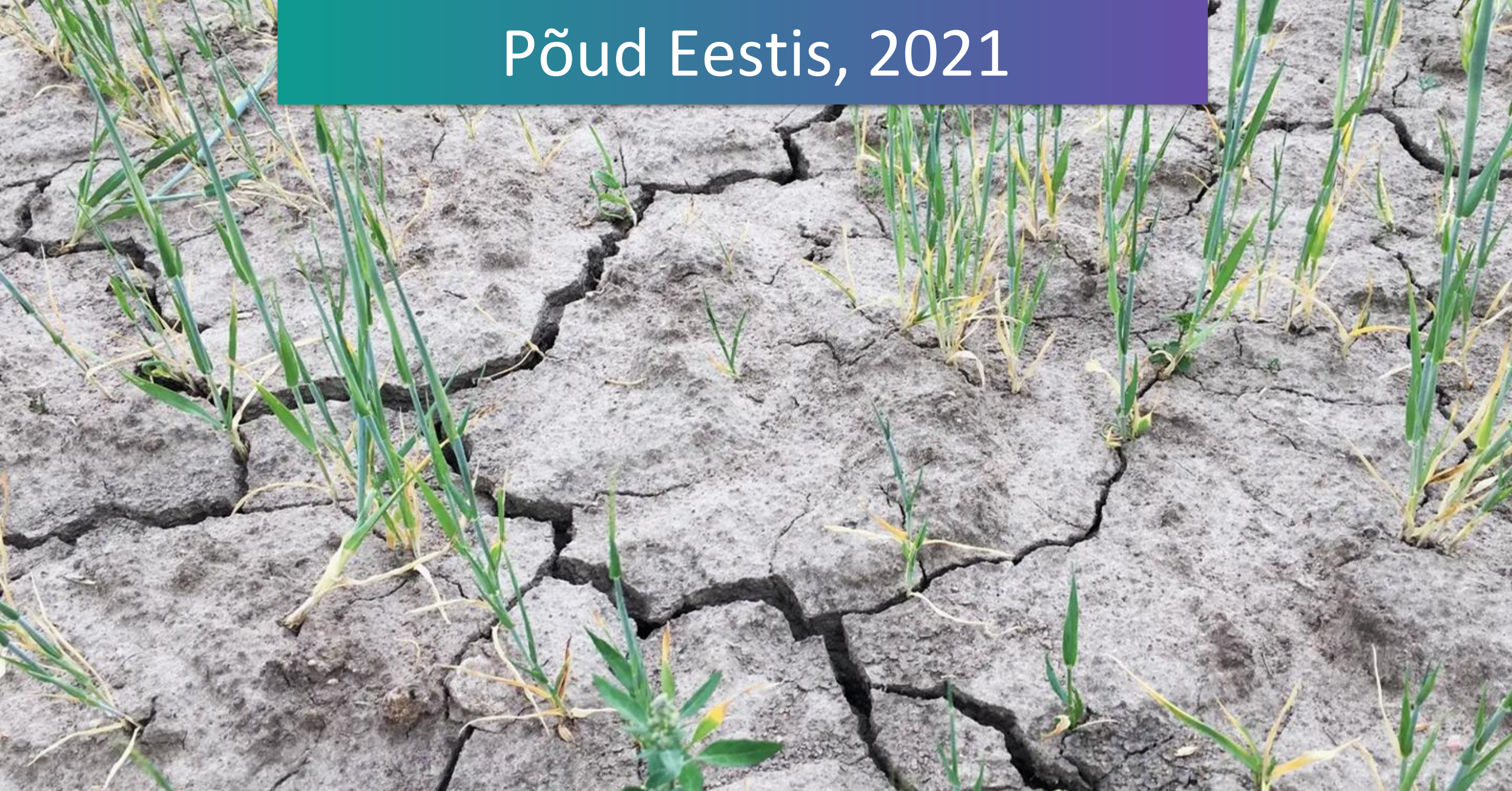
MAAELUMINISTEERIUM



Horizon 2020  
European Union Funding  
for Research & Innovation



# Põud Eestis, 2021



# Põldkatsete prototüüp - KaRaL

Mõõdab taime transpiratsiooni, õhulõhede juhtivust ja CO<sub>2</sub> omastamist fotosünteesis

Lisaks mõõdab instrument lehe temperatuuri, valguse intensiivsust ja valideerib jooksvalt tulemuste kvaliteeti

1 taimelehe mõõtmiseks kulub – 8 sekundit.

1 katselapi mõõtmiseks (20-30 taimelehte) kulub 7-8 min



# NOBALWheat – Norra, Läti, Leedu, Eesti nisusortide aretusprojekt

- ~75 nisu sorti kõigist osalevatest riikidest
- põldkatsed 300 sordiga, 3 aastat kõigis riikides
- erinevad analüüsid, TÜ teeb vee kasutuse ja fotosünteesi analüüse
  - 7 sorti
    - N75 and N150
    - 2 korduses

20 lehte igast katselapist, 8 minutid 1 lapi mõõtmiseks

Mõõtepäevadel uuriti 1000+ lehte



Jaanika Unt





Helen Parik

Egon Meigas

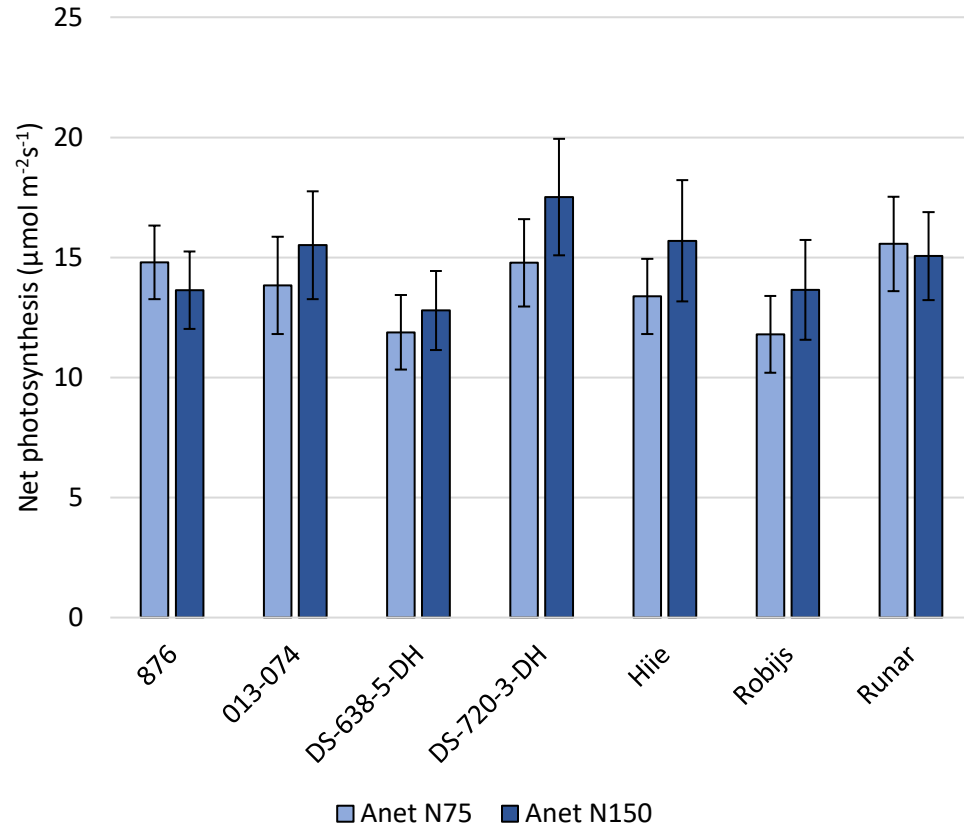
CO2	399.22
H2O	19.81
Air temperature	39.01
Radiation	2080.85
CO2 exch	



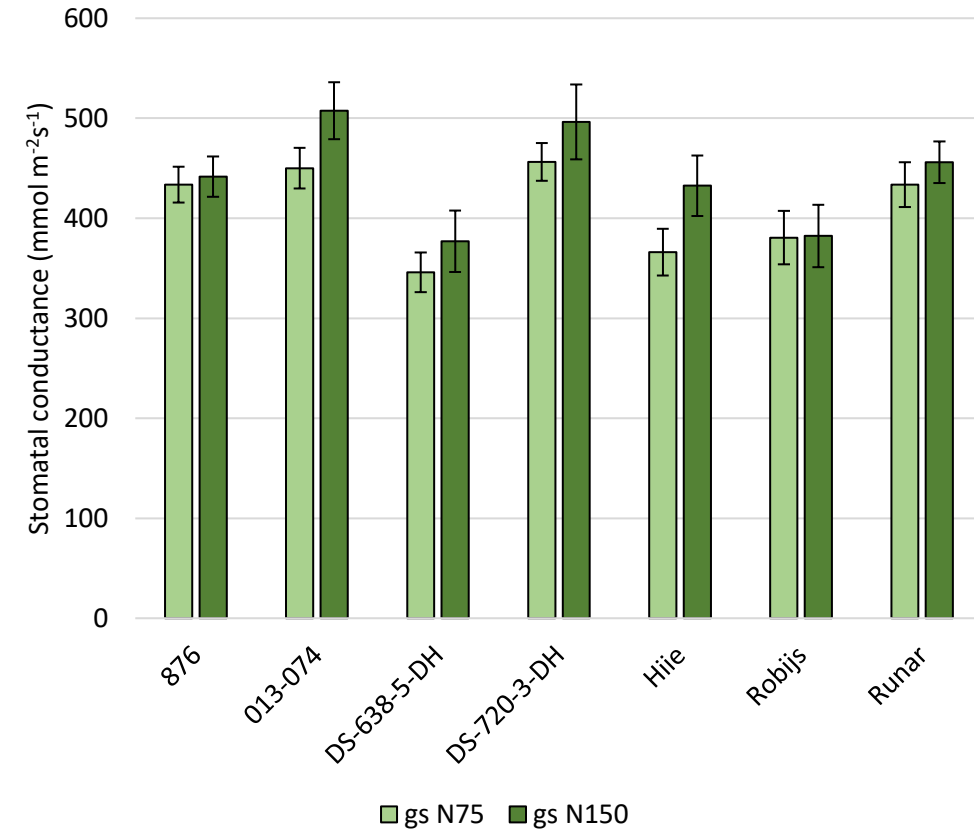


# Nisu gaasivahetuse tulemused – enne õitsemist

Pre-anthesis net photosynthesis of N75 and N150 plots

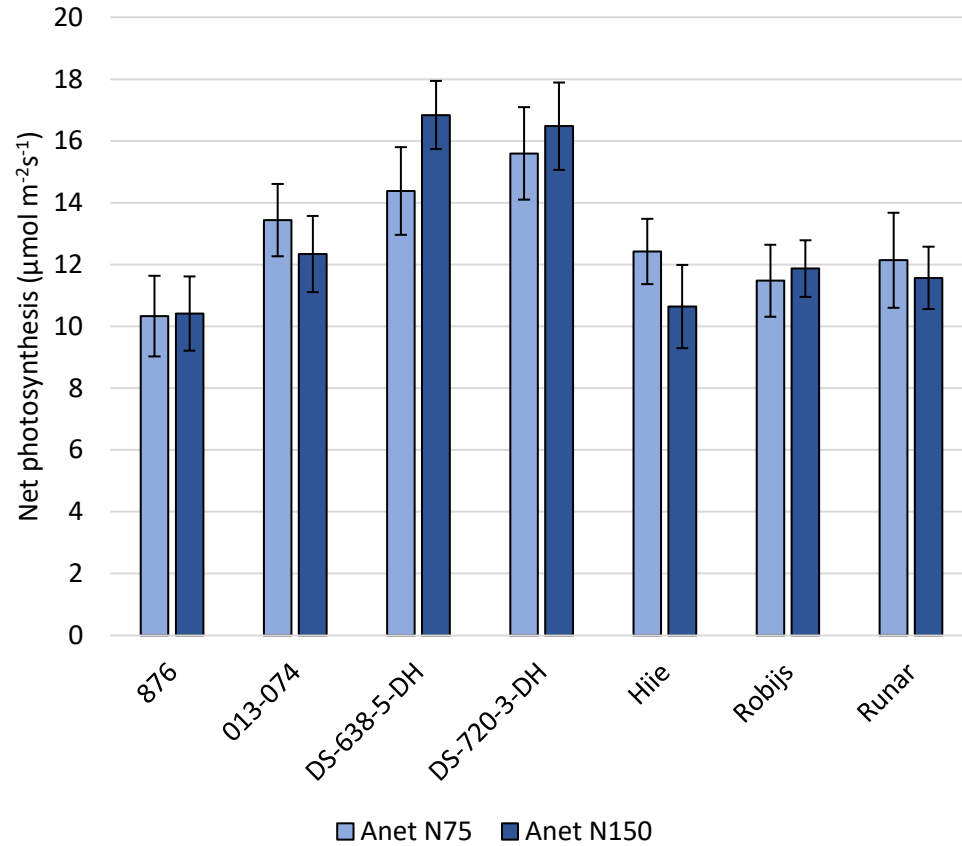


Pre-anthesis stomatal conductance of N75 and N150 plots

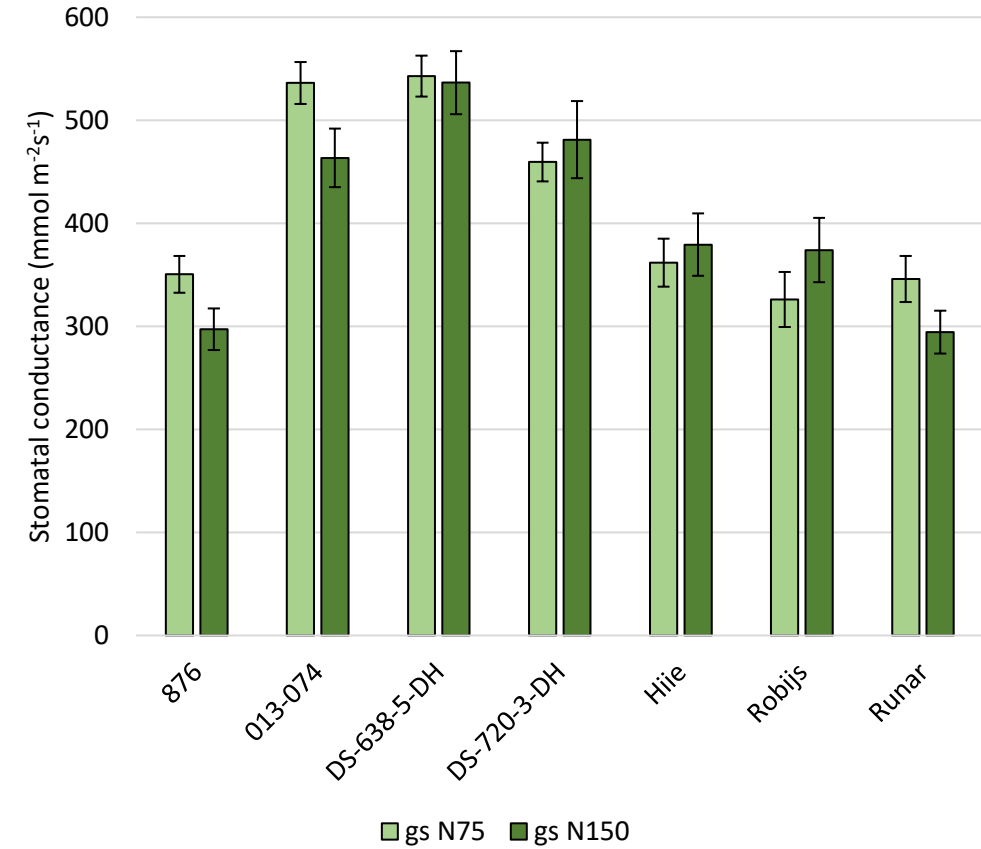


# Nisu gaasivahetuse tulemused – peale õitsemist

Post-anthesis net photosynthesis of N75 and N150 plots

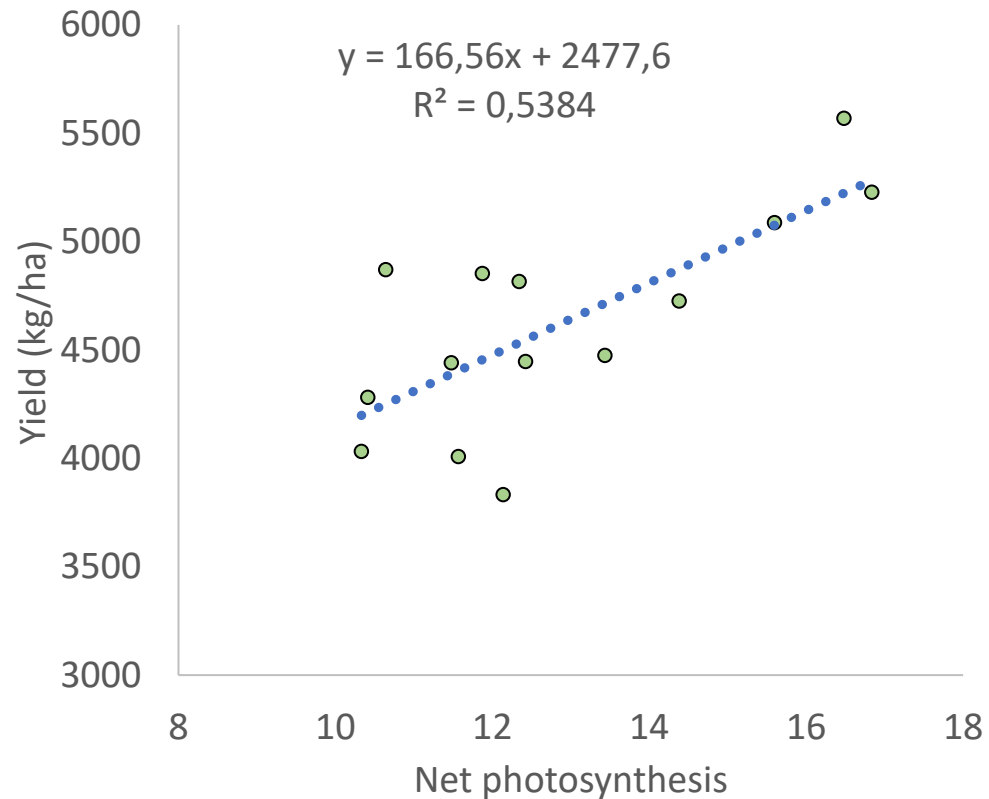


Post-anthesis stomatal conductance of N75 and N150 plots

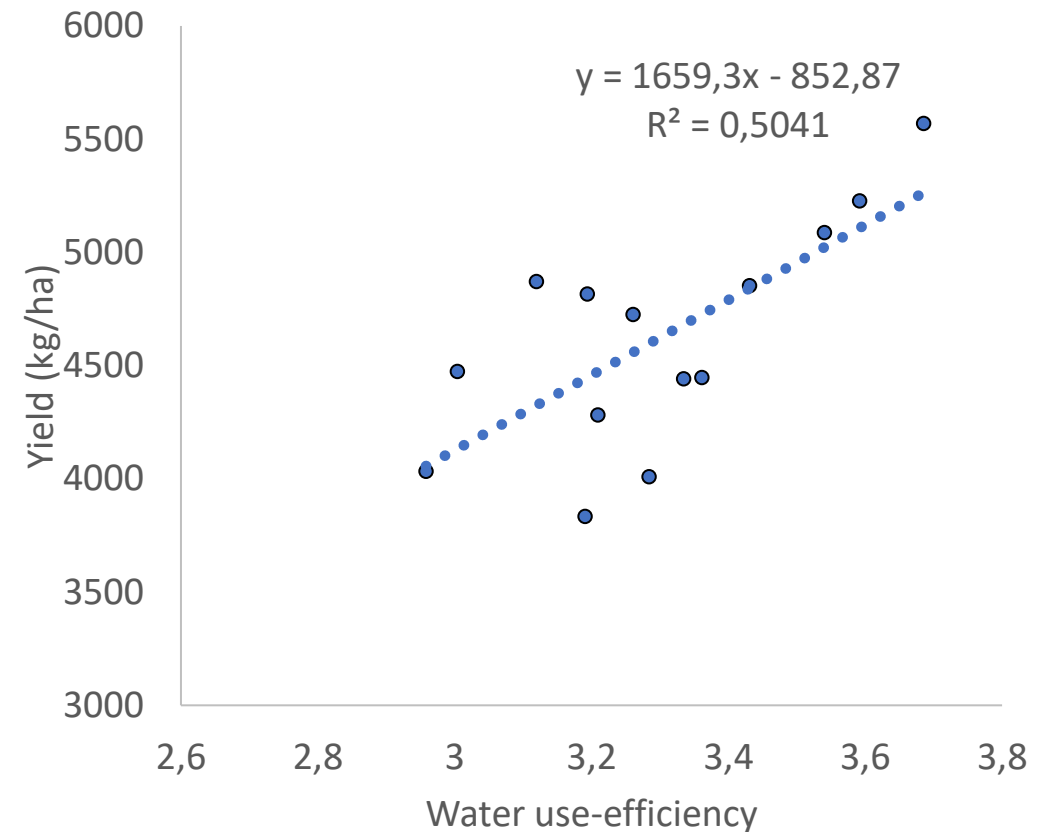


# Nisu gaasivahetuse tulemuste korrelatsioon saagiga

Yield vs net photosynthesis in wheat  
(post-anthesis)



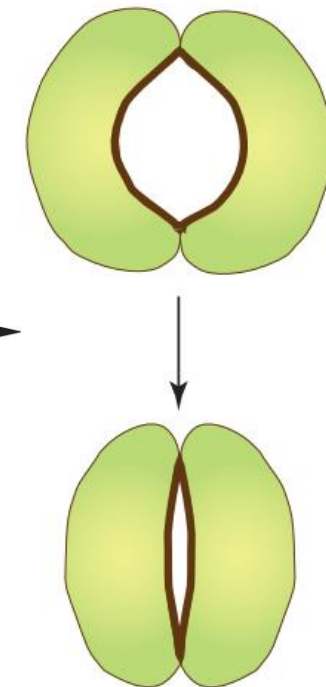
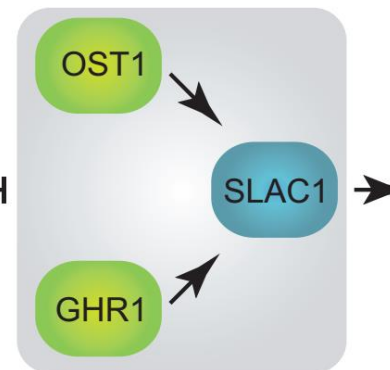
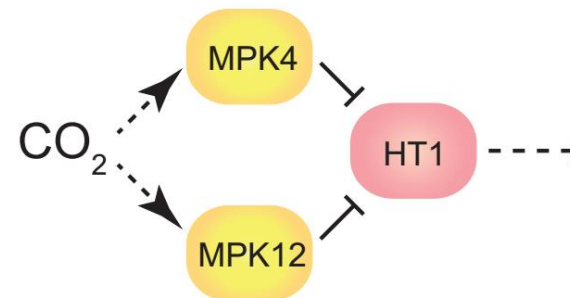
Yield vs water use efficiency (A<sub>net</sub>/E) in wheat  
(post-anthesis)







# Tomatitaimed, mis tarbivad 2 korda vähem vett



Tavaline tomat

CRISPR tomat



- Vahisalu et al. 2008 *Nature*
- Jakobson et al. 2016, *PLOS Biology*
- Hõrak et al. 2016, *Plant Cell*
- Tõldsepp et al. 2018, *Plant Journal*
- Merilo et al. 2018 *Plant Phys*
- Hsu et al. 2018 *PNAS*
- Zhang et al. 2018, *Current Biology*
- Sun et al. 2019 *PNAS*
- Kollist et al. 2020 *Trends in Plant Science*
- Dittrich et al. 2020, *Nature Plants*



# Katsed Helmholtz keskuses Münhhenis WT & HT1 tomattitaimed kõrgema juures CO<sub>2</sub> juures



# tHT1 tomatitaimed kasvavad hästi...



**WT**

***tHT1***



***tHT1***

**WT**



... ja maitsevad ka hästi...

Triinu Arjus, Kaspar Koolmeister & Collaboration prof Jörg-Peter Schnitzler

# Finally! A way to return flavor to bland tomatoes

J ÜLIKOOL

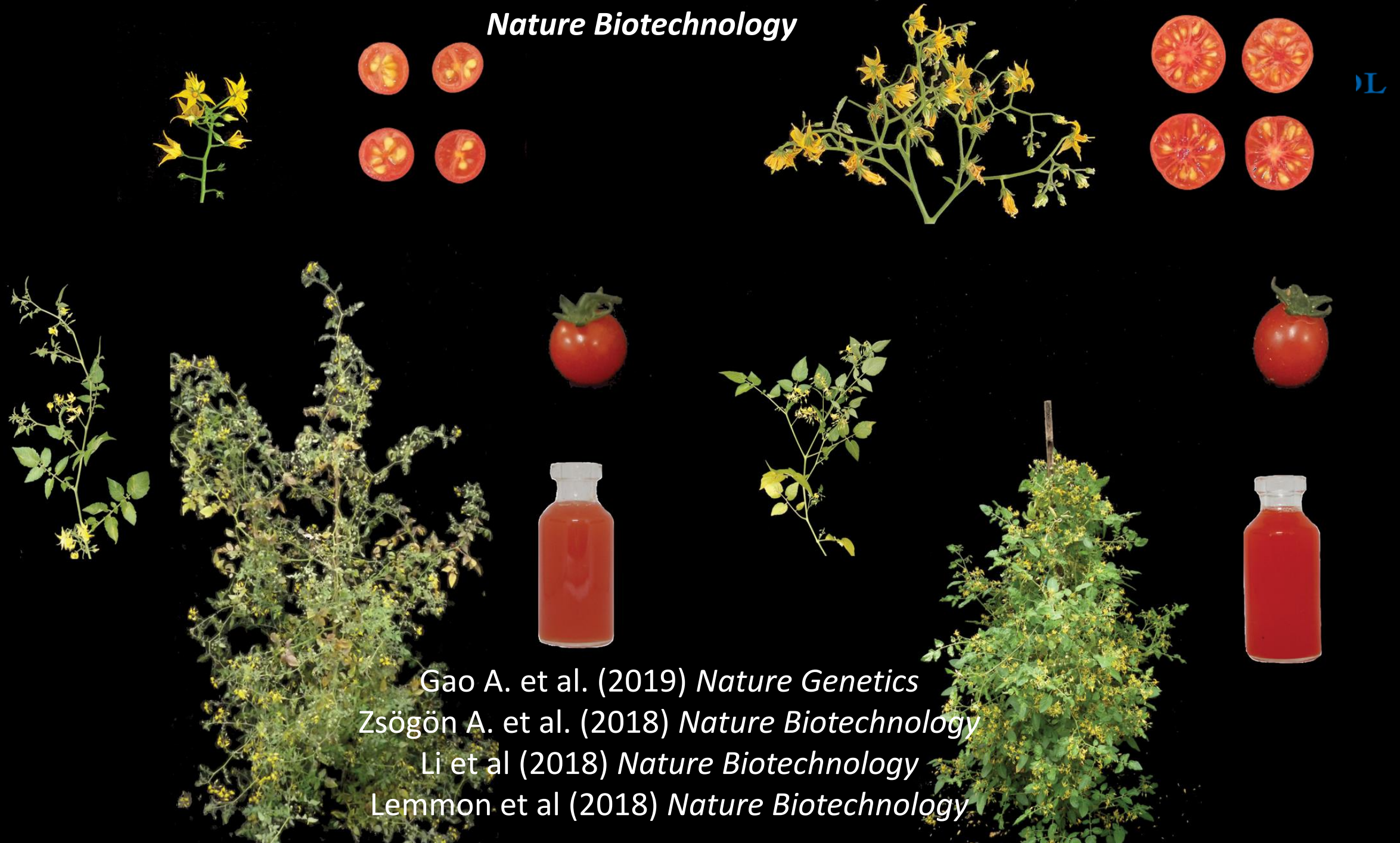
Scientists have discovered a rare gene that could help "make tomatoes great again"... or at least taste less bland.



<https://www.dw.com/en/finally-a-way-to-return-flavor-to-bland-tomatoes/a-48732899>



*Nature Biotechnology*



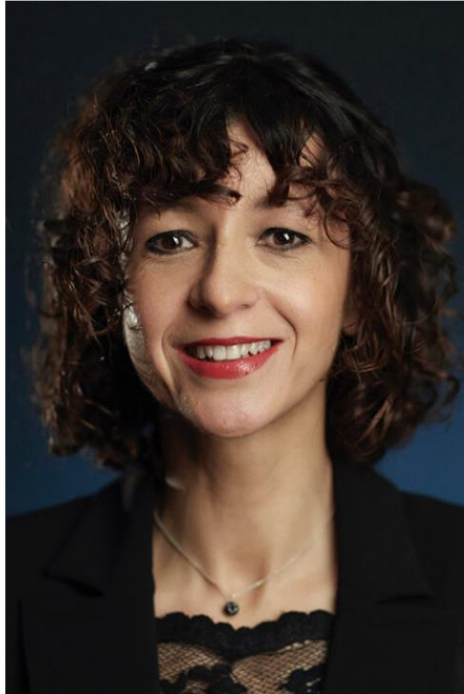
Gao A. et al. (2019) *Nature Genetics*

Zsögön A. et al. (2018) *Nature Biotechnology*

Li et al (2018) *Nature Biotechnology*

Lemmon et al (2018) *Nature Biotechnology*

# The Nobel Prize in Chemistry 2020



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Bernhard Ludewig

**Emmanuelle  
Charpentier**

Prize share: 1/2



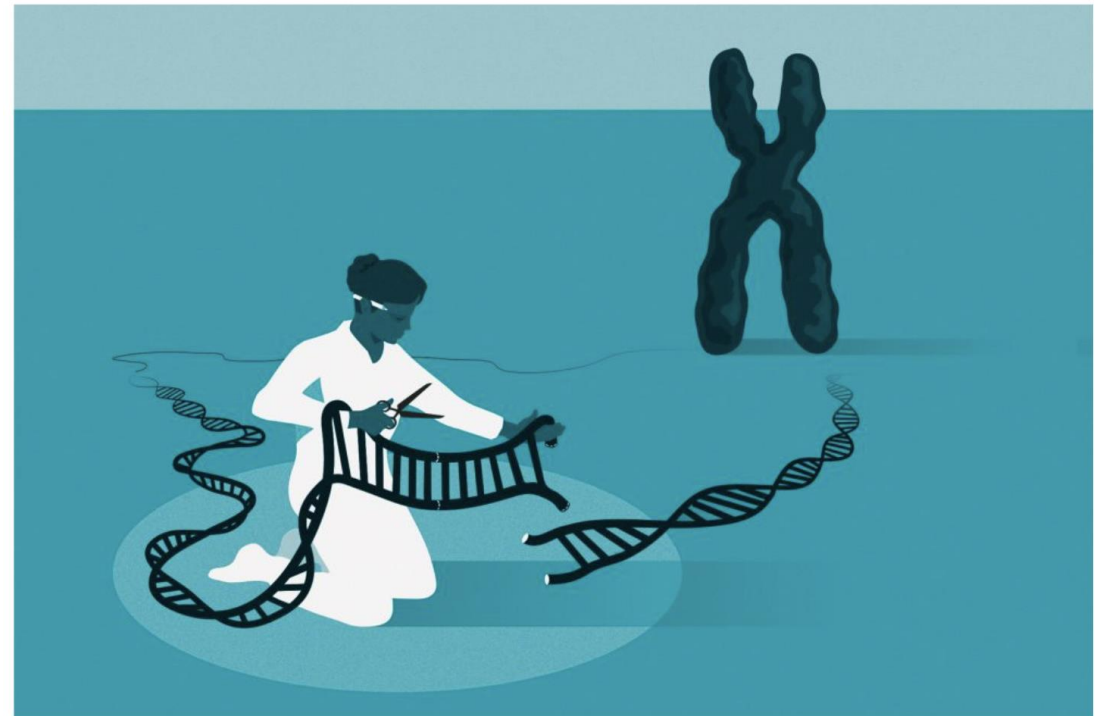
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Brittany Hosea-Small

**Jennifer A. Doudna**

Prize share: 1/2

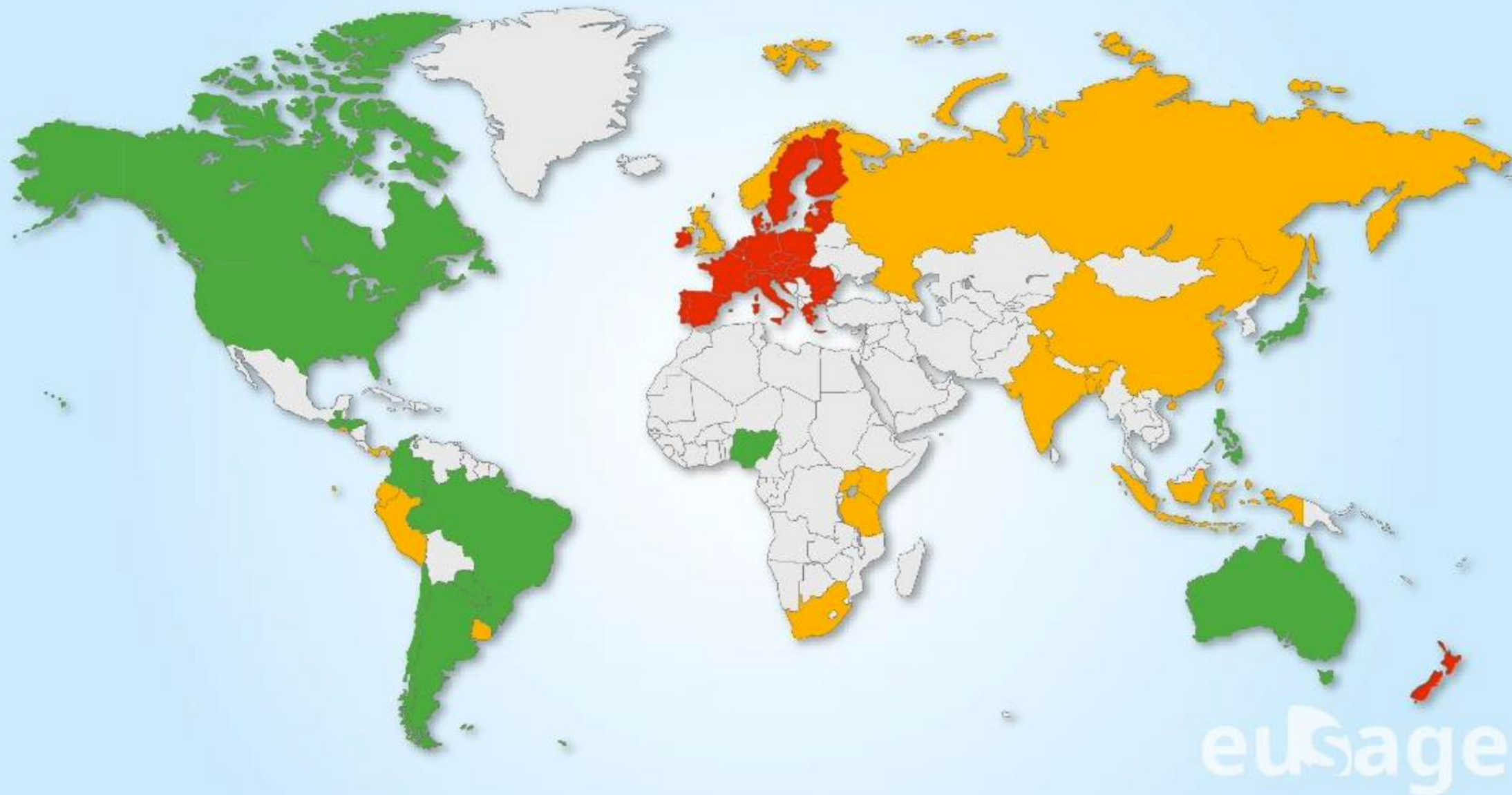
## Genetic scissors: a tool for rewriting the code of life



© Johan Jarnestad/The Royal Swedish Academy of Sciences



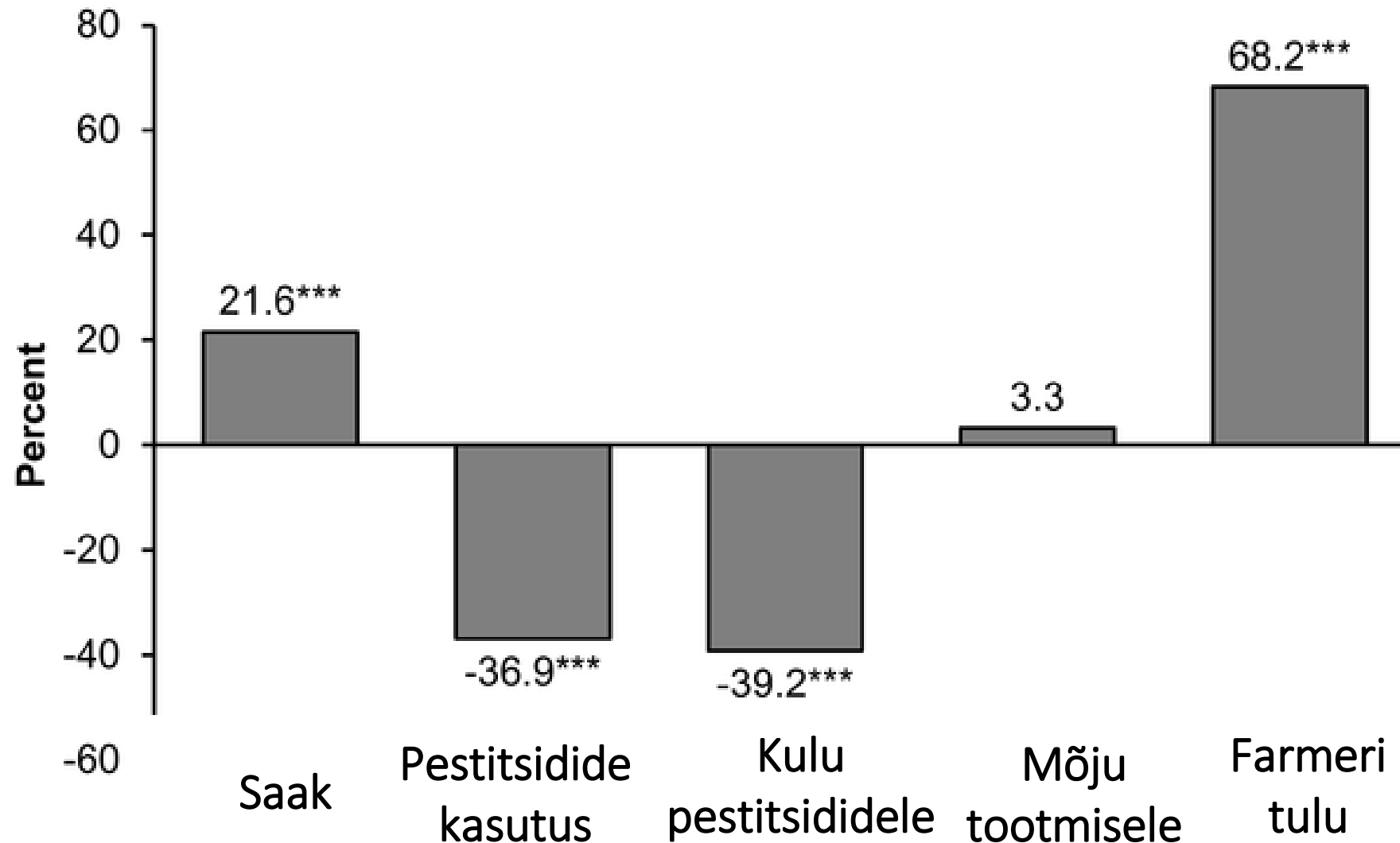
# Genoomide editeermine ja geneetiline modifitseerimine



eusage

 Genome-edited crops are not regulated as GMOs.  Discussion is ongoing.  Genome-edited crops are regulated as GMOs.

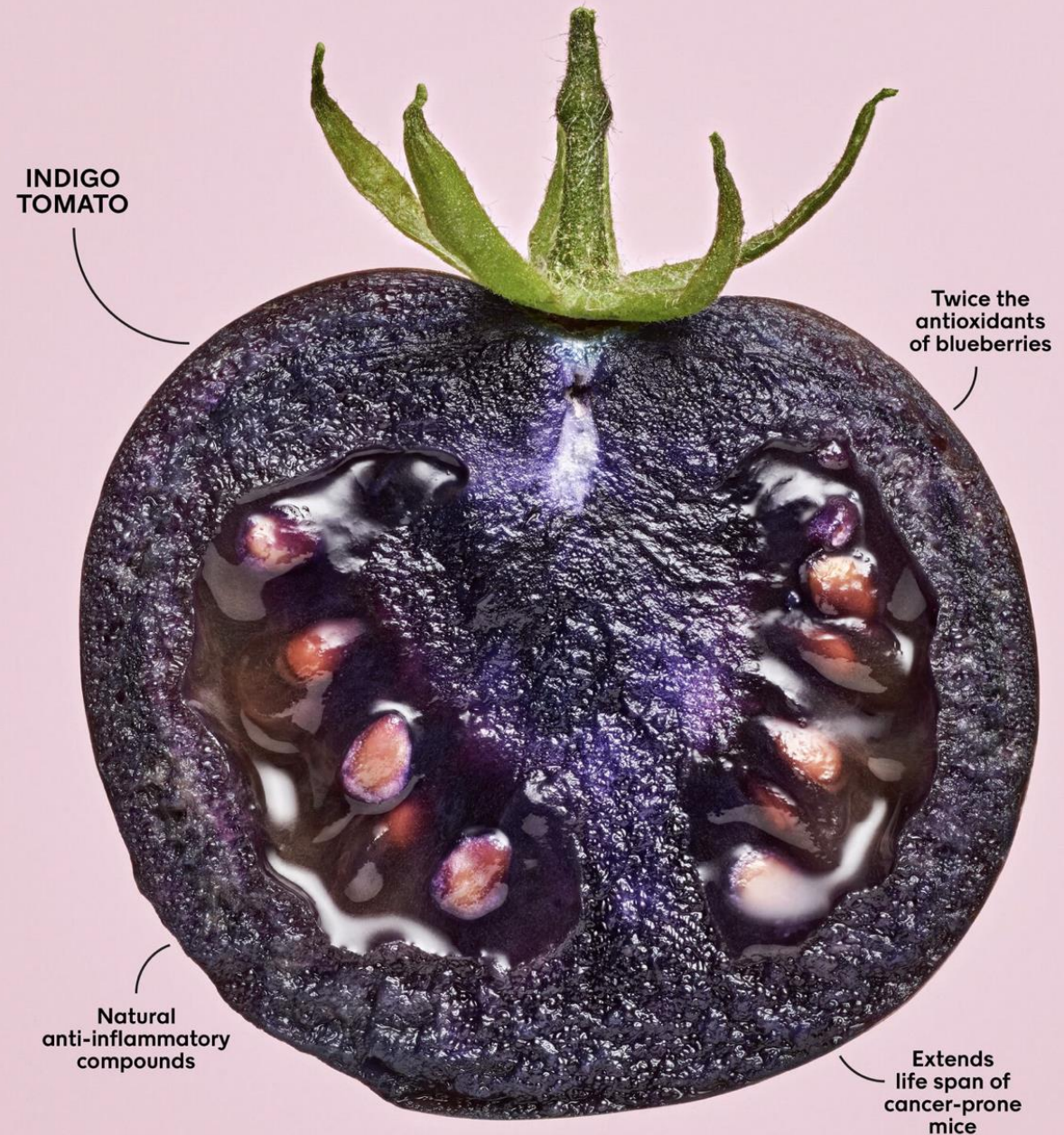
# GM-taimede kasutamise mõju – 114 uuringut koondav metaanalüüs



# Learning to Love G.M.O.s

Overblown fears have turned the public against genetically modified food. But the potential benefits have never been greater.

The New York Times 20.07.2021



# Taimsete signaalide uurimisrühm

[www.taimebiologia.ee](http://www.taimebiologia.ee)

[www.plantsignalresearch.com](http://www.plantsignalresearch.com)

[www.plantinvent.com](http://www.plantinvent.com)



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## Rakutehnoloogiate tippkeskus



Eesti Teadusagentuur  
Estonian Research Council



European Union  
Regional Development Fund



Investing in your future



Horizon 2020  
European Union Funding  
for Research & Innovation