

# b-riik & t-riik

*Hannes Kollist*

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PLANT SIGNAL  
RESEARCH GROUP



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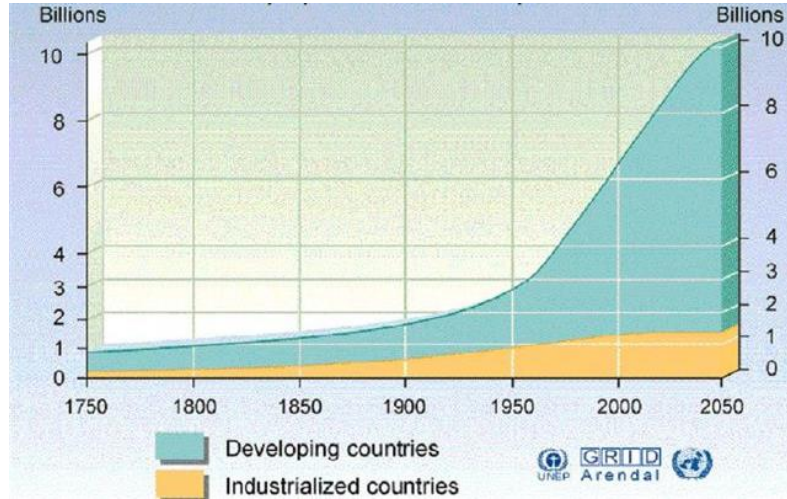
Euroopa Maaelu Arengu  
Põllumajandusfond:  
Euroopa investeeringud  
maapiirkondadesse



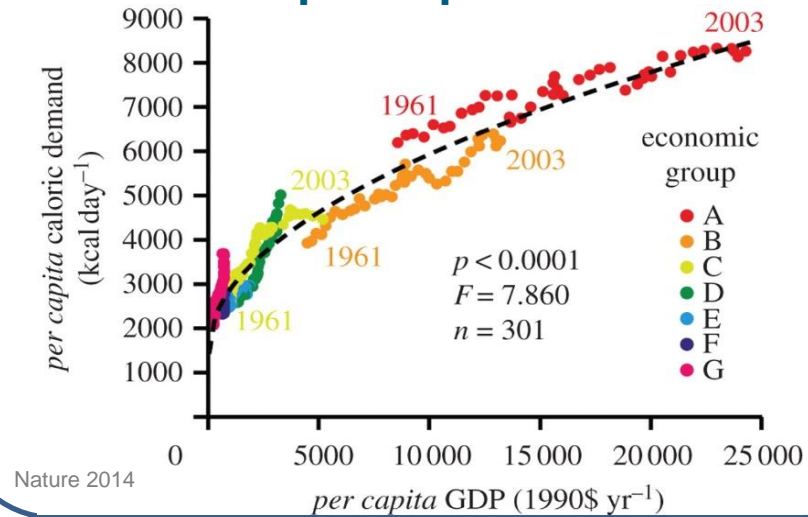
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# Nutikas taimede kasutamise on jätkusuutliku arengu võtmeküsimus

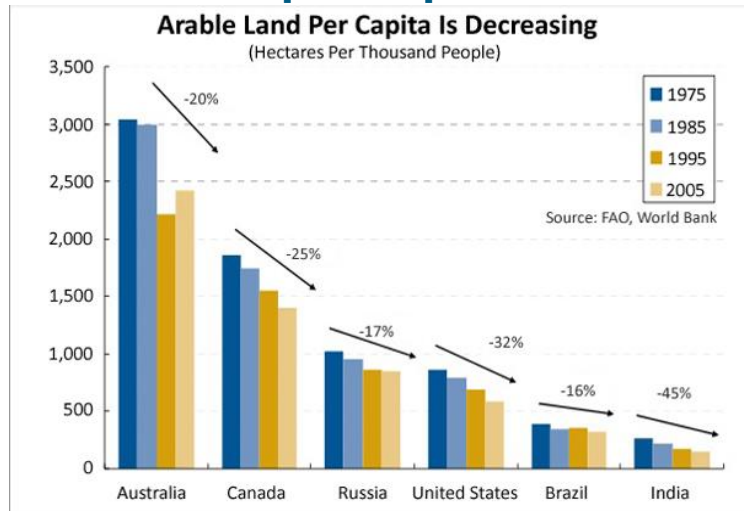
## Rahvastiku kasv



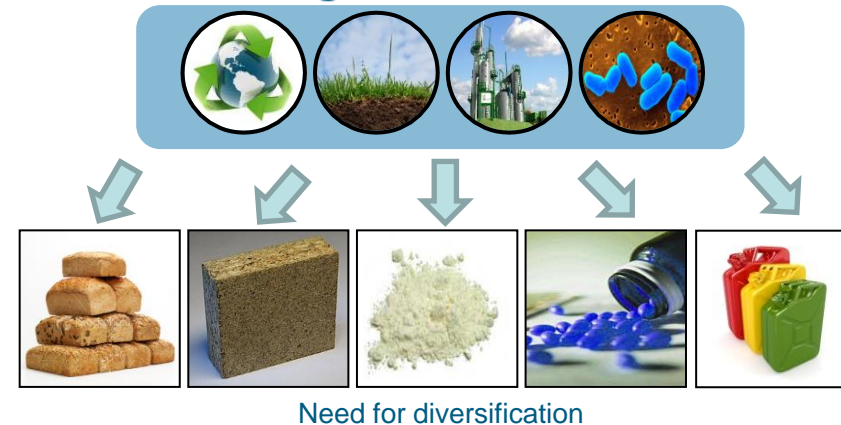
## Kasvav per capita tarbimine

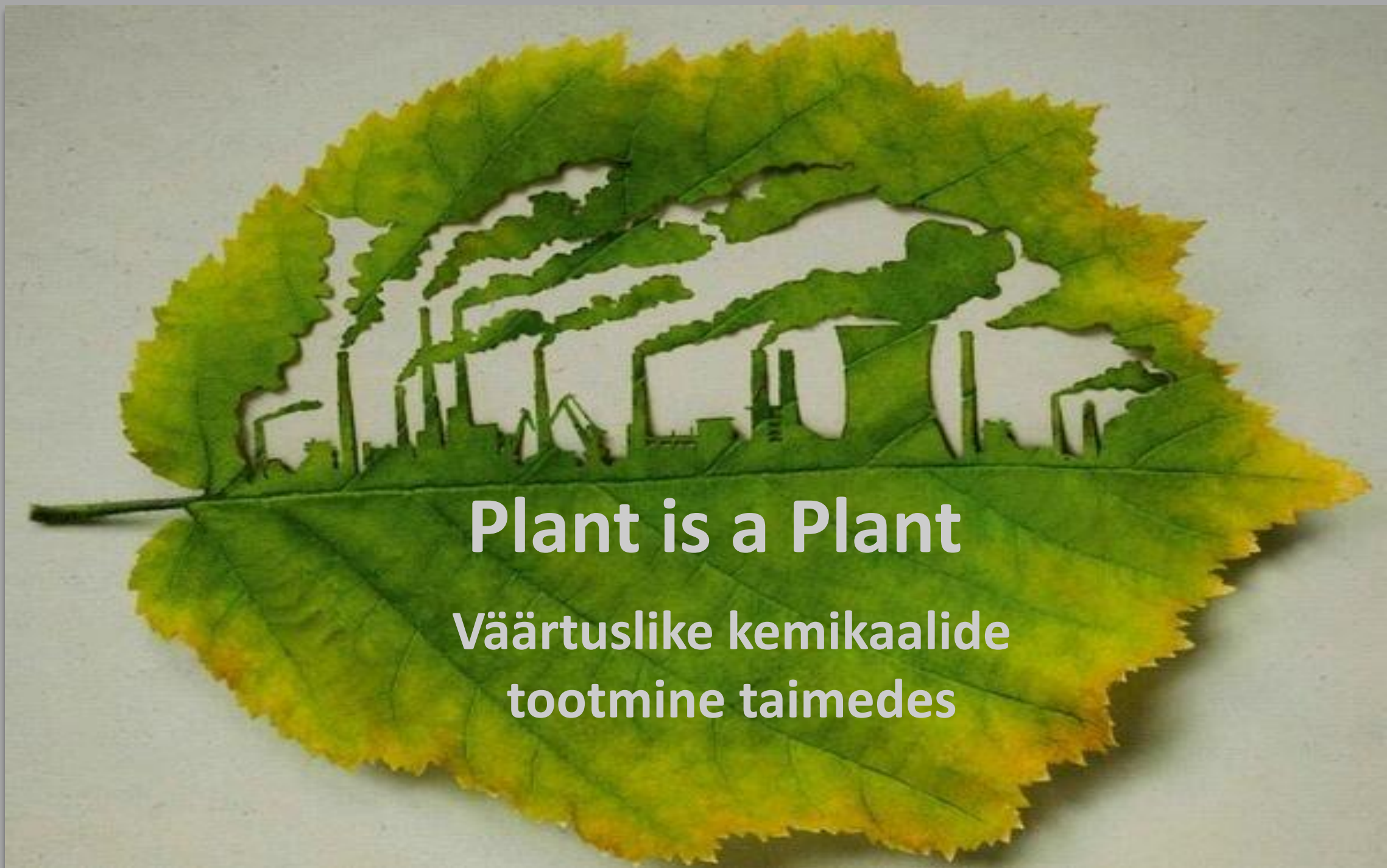


## Haritava maa per capita kahanemine



## Kasvav vajadus taimede mitmekülgses rakendamiseks





**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](#) →



**We translate your ideas into proteins**

Terapeutiliste valkude tootmine taimedes



# Põud Eestis, 2021

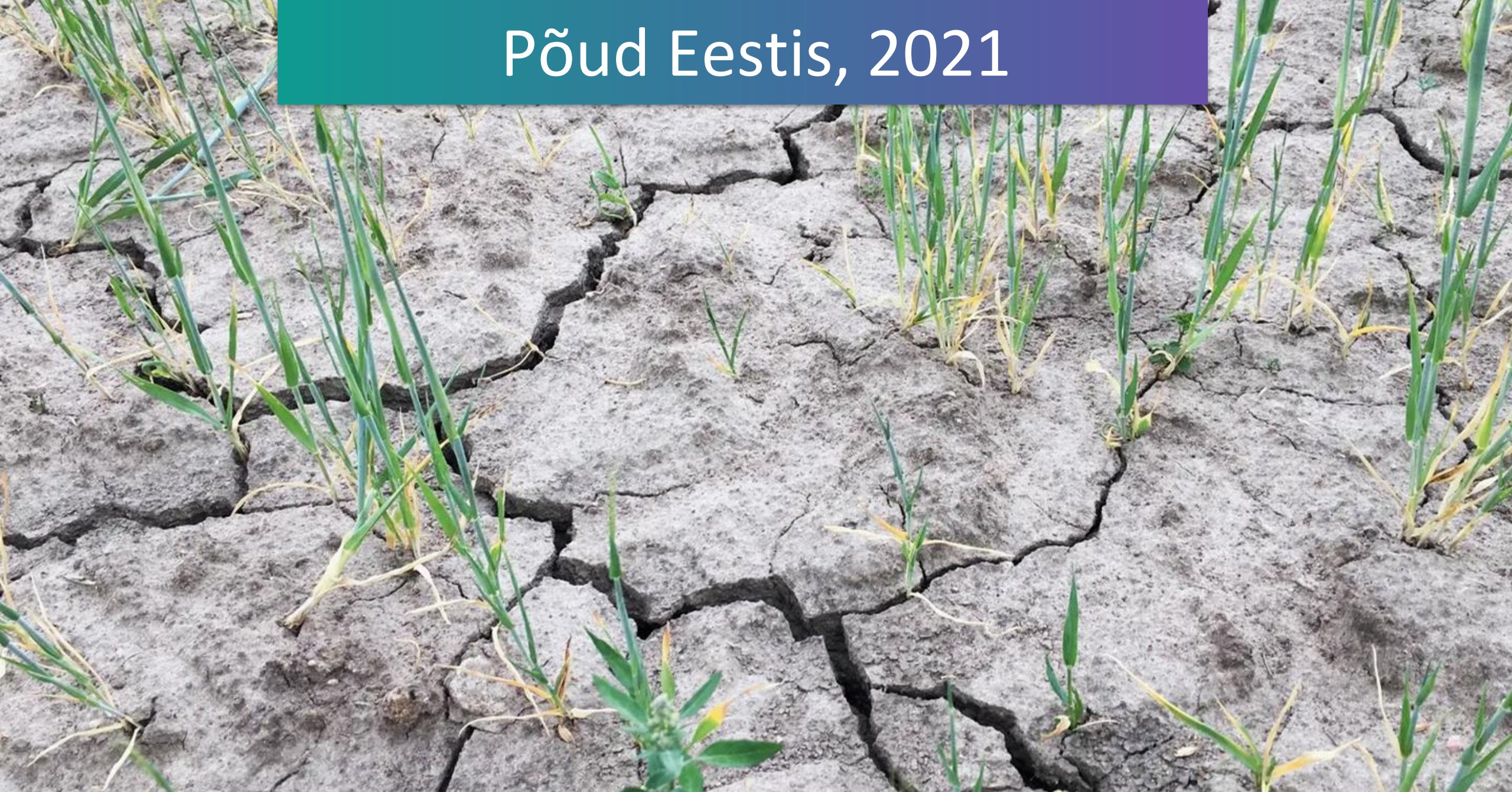
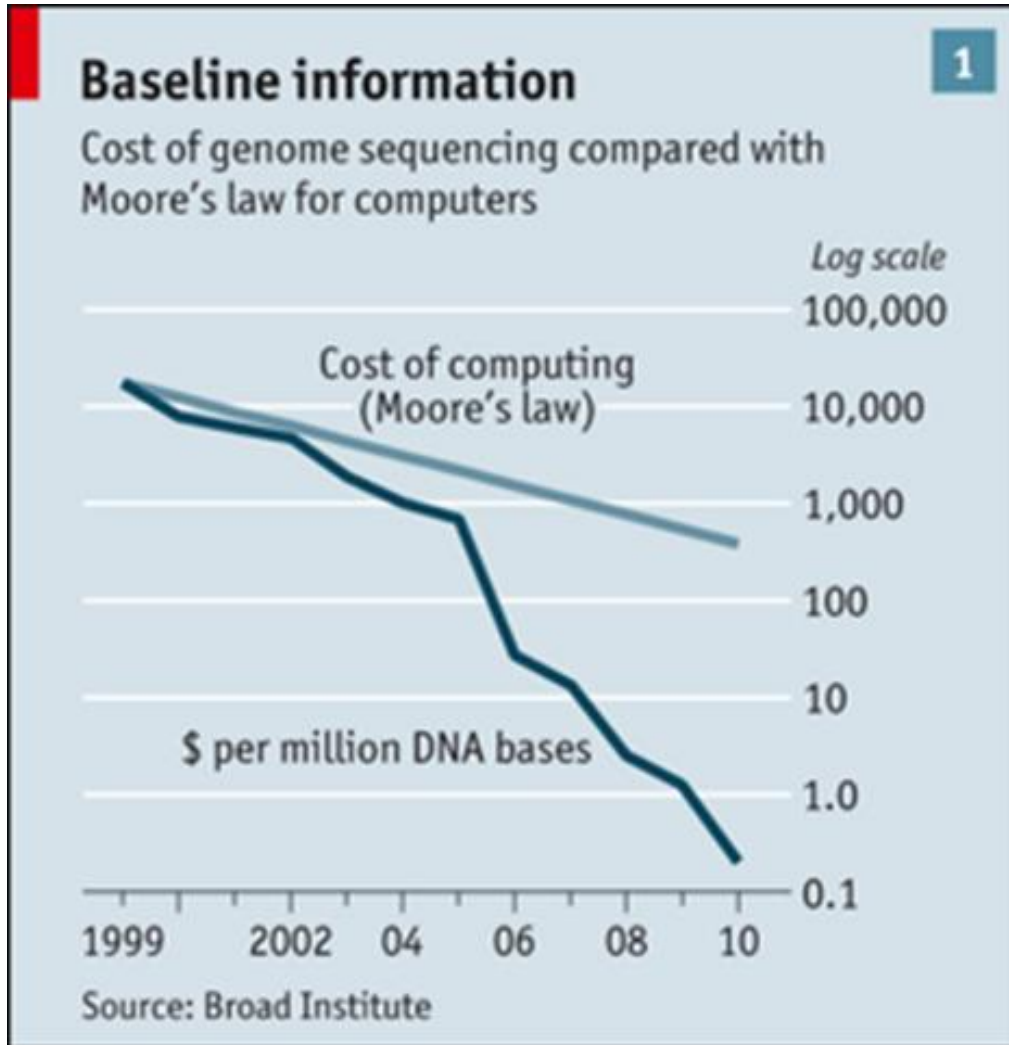


Photo: Olev Kenk/ERR



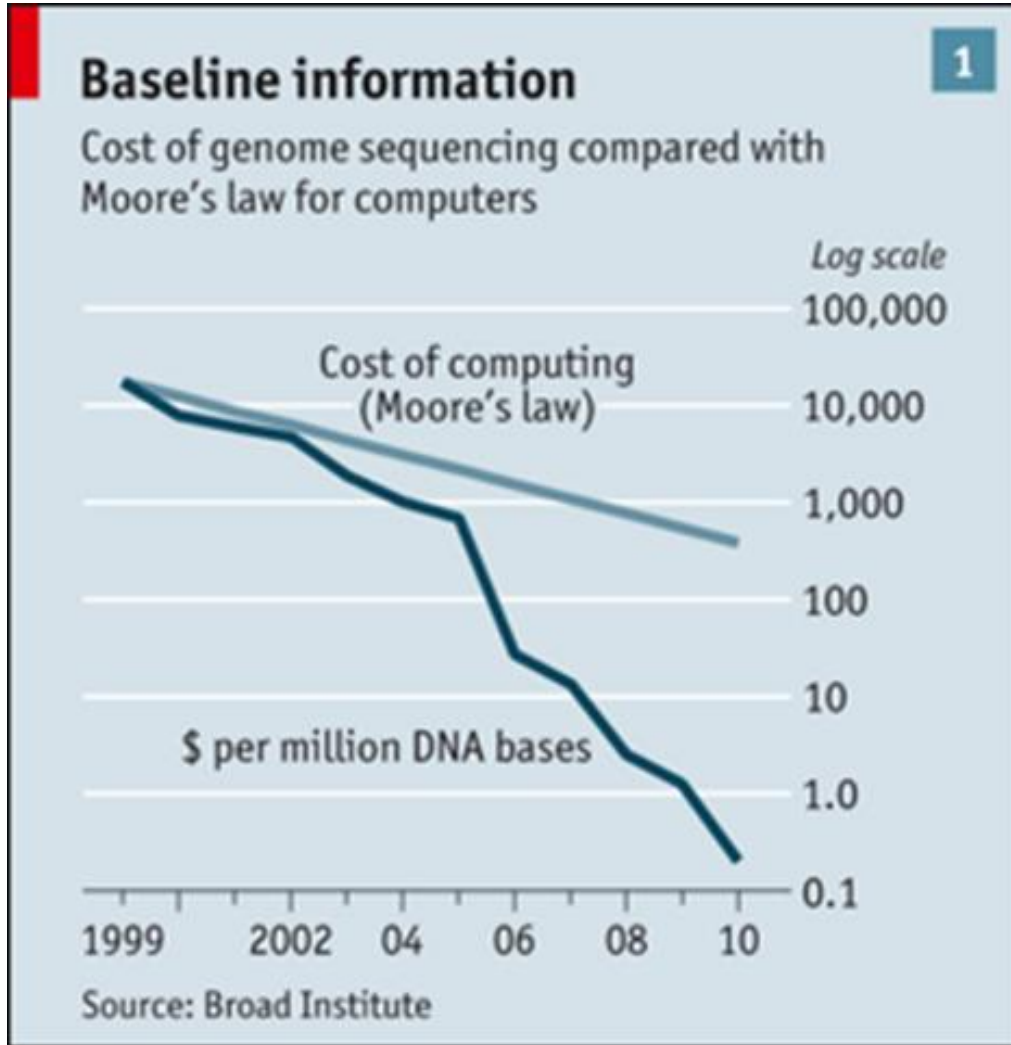
# Kust on tulnud areng?

## - DNA sekveneerimine



# Kust on tulnud areng?

- DNA sekveneerimine



# Mis on kujunenud pudelikaelaks?

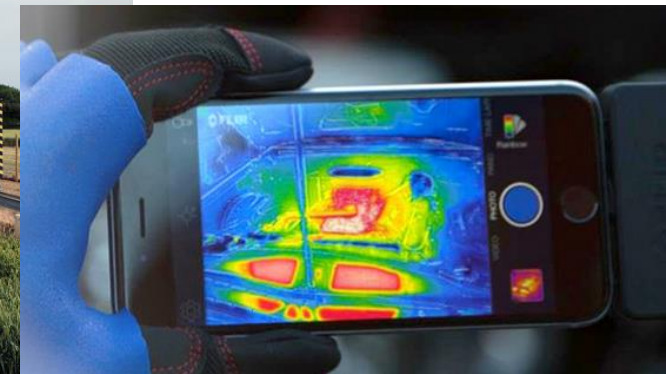
- Fenotüpiseerimine



Flying platforms



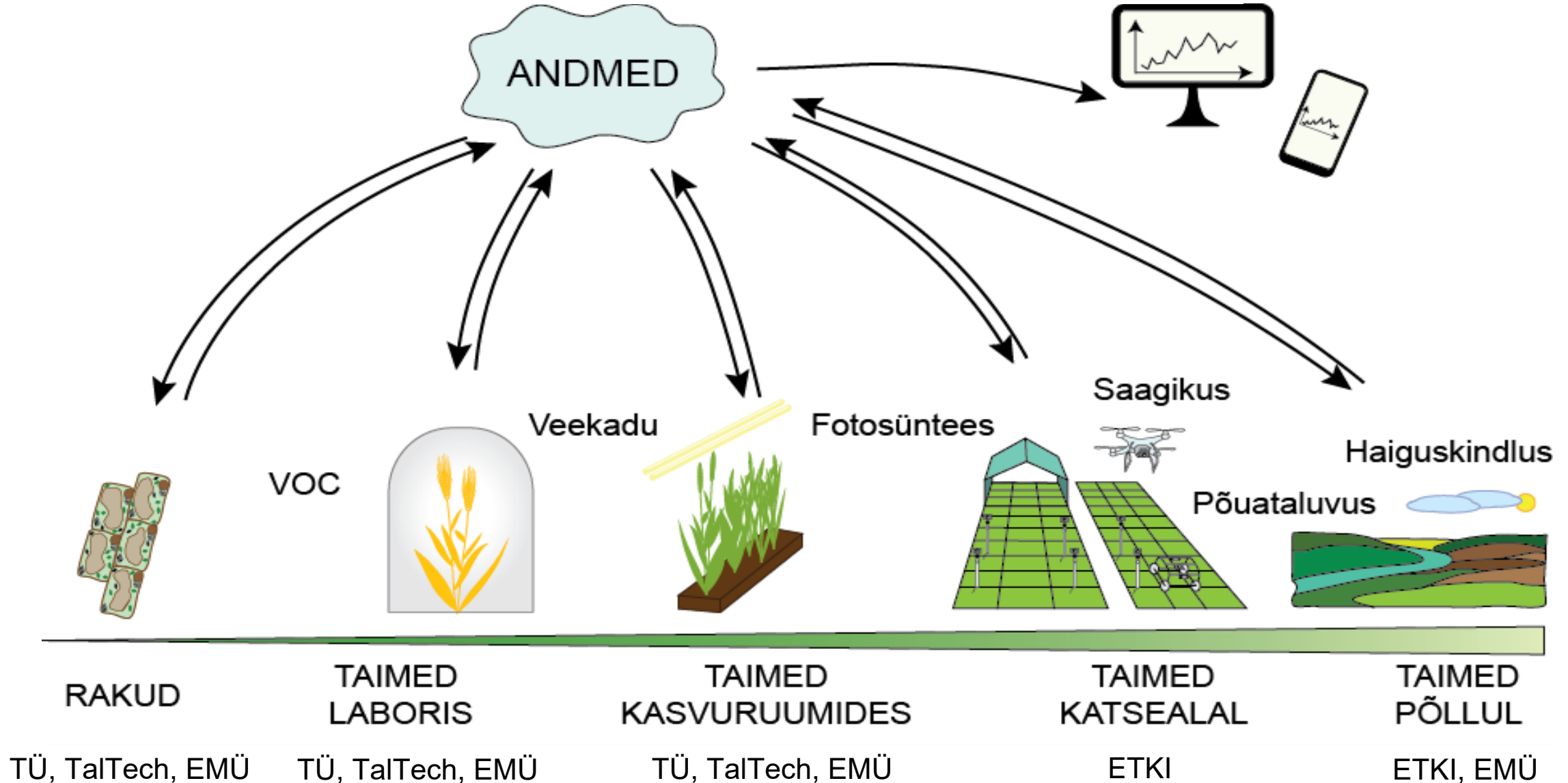
Portable sensors („cheap“)







# Taimebioloogia Infrastruktuur





Euroopa Liit  
Euroopa  
Regionaalarengu Fond



Eesti  
tuleviku heaks

# TAIM

Taimebioloogia infrastruktuur

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



# Taimebioloogia Infrastruktuur

## TEENUSED

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TAIMEBIOTEHNOLOOGIA



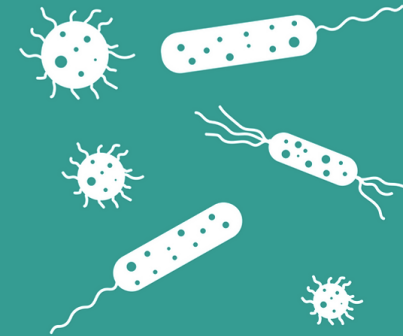
BIOINFORMAATIKA



FOTOSÜNTEES JA VEEKASUTUS



LENDUVATE ÜHENDITE ANALÜÜS



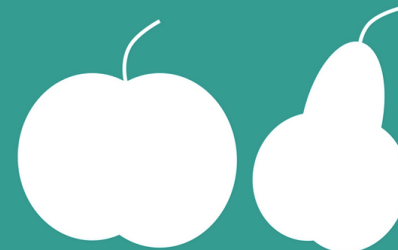
MULLA MIKROBIOLOOGIA



PÕLDKATSED



PÕLLUKULTUURIDE SAAGI ANALÜÜSID

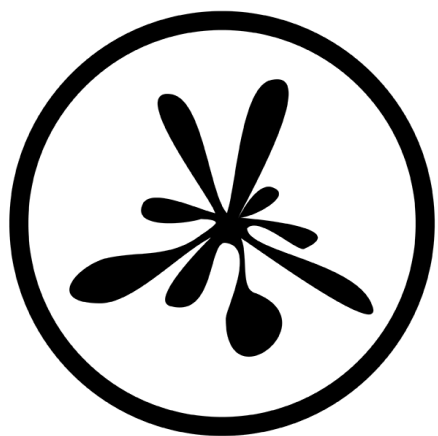


AIAKULTUURIDE SAAGI ANALÜÜSID



TAIMEDIAGNOSTIKA SEADMED

# Tehnoloogiad taimede fenotüpiseerimiseks



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# Taimediagnostika instrumentid

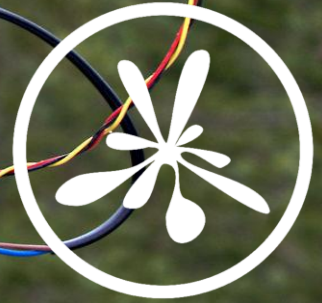


Photo by: Kaspar Koolmeister





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# REINVENTING GAS EXCHANGE ANALYSIS

## OUR MISSION

To provide whole plant gas exchange analysis that provides researchers with the ability to measure plant photosynthesis and transpiration in a non-destructive manner.

Unlike, standard gas exchange systems, which require the use of a leaf chamber, our system allows for the measurement of whole plant gas exchange in a non-destructive manner. This allows for the measurement of gas exchange in a wide range of plant species and growth stages, including seedlings, mature plants, and trees.



## WE MEASURE

CO<sub>2</sub> assimilation rate (A), transpiration rate (E), stomatal conductance (gs), and leaf temperature (T<sub>leaf</sub>).

- CO<sub>2</sub> assimilation rate (A)
- Transpiration rate (E)
- Stomatal conductance (gs)
- Leaf temperature (T<sub>leaf</sub>)

All measurements are made in real-time and are available via a web interface.

## WE PROVIDE DATA FOR

- Photosynthesis rate
- Transpiration rate
- Stomatal conductance
- Leaf temperature

## GAS EXCHANGE ANALYSIS AS A SERVICE

**What:** Measure the whole plant gas exchange of a plant.

**How:** Using a non-destructive, whole plant gas exchange analysis system.

**Why:** To provide researchers with the ability to measure plant photosynthesis and transpiration in a non-destructive manner.

**Who:** Researchers, growers, and plant breeders.

**Where:** In a laboratory or greenhouse setting.

**When:** Anytime during the plant's life cycle.

info@plantinvent.com  
www.plantinvent.com



Plant Invent



# Eesti tingimustes hästi kasvava odra ja nisu aretamine



**BRACE** – põuakindel oder,  
*odra genoomi editeerimine*  
2021-2024

**NOBAL**  
wheat  
2021-2023



Horizon 2020  
European Union Funding  
for Research & Innovation



MAAELUMINISTEERIUM



Eesti  
Taimekasvatuse  
Instituut



# The BARISTA Consortium (13 partners, 8 countries)



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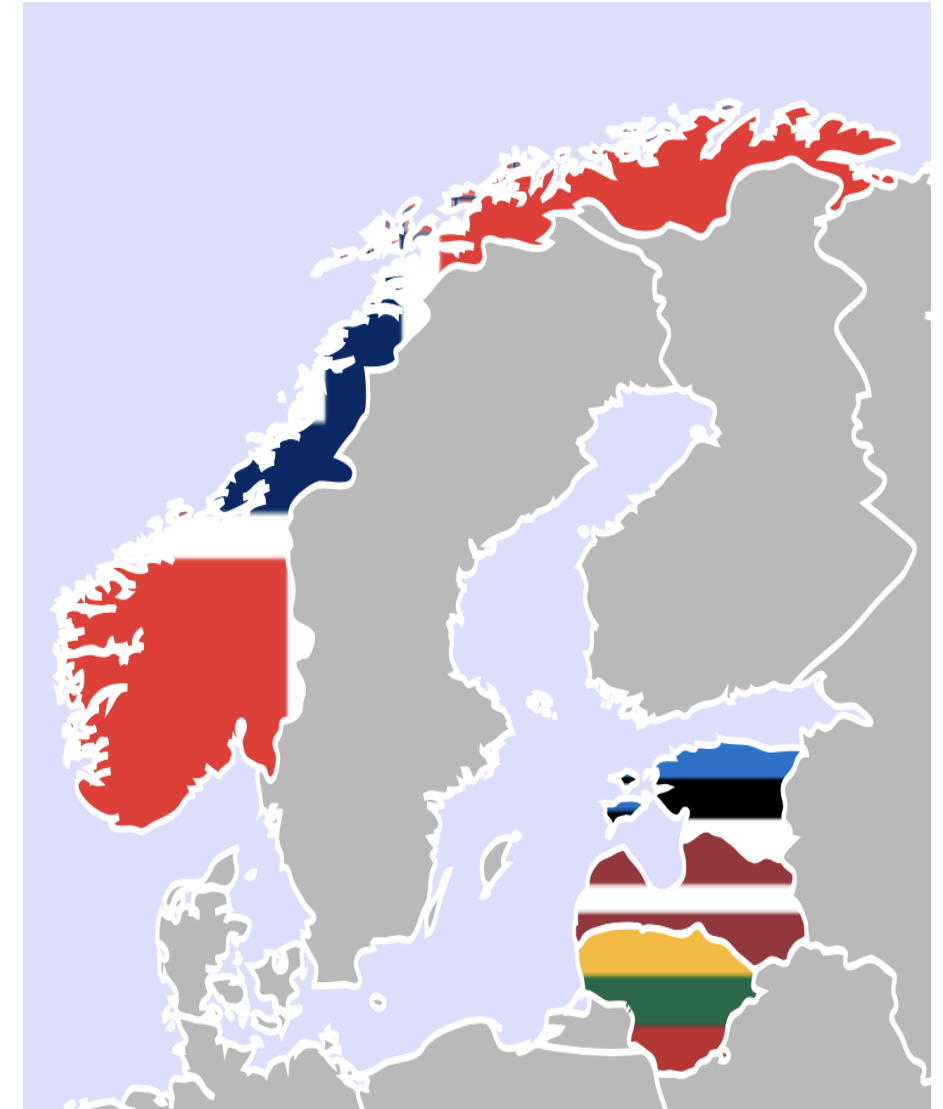


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# Breeding toolbox for sustainable food system of the Nordic-Baltic region



Norwegian University  
of Life Sciences









# 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 nususortide 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





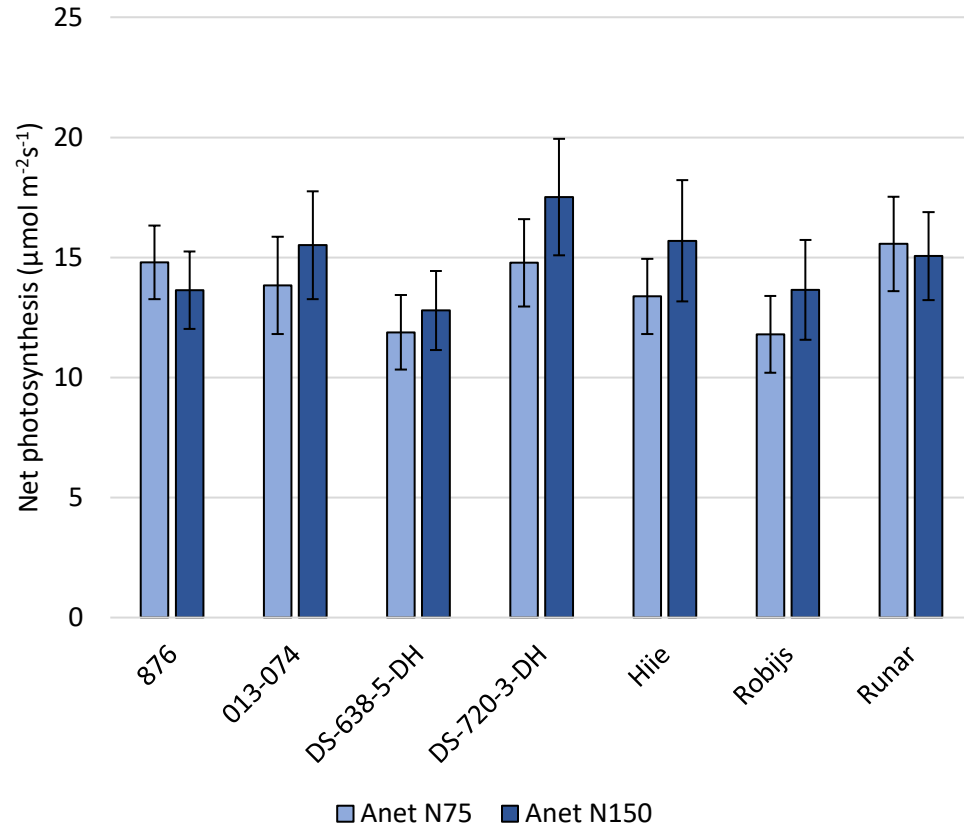


|                 |         |
|-----------------|---------|
| CO2             | 399.22  |
| H2O             | 19.81   |
| Air temperature | 39.01   |
| Radiation       | 2080.85 |
| CO2 exch        |         |

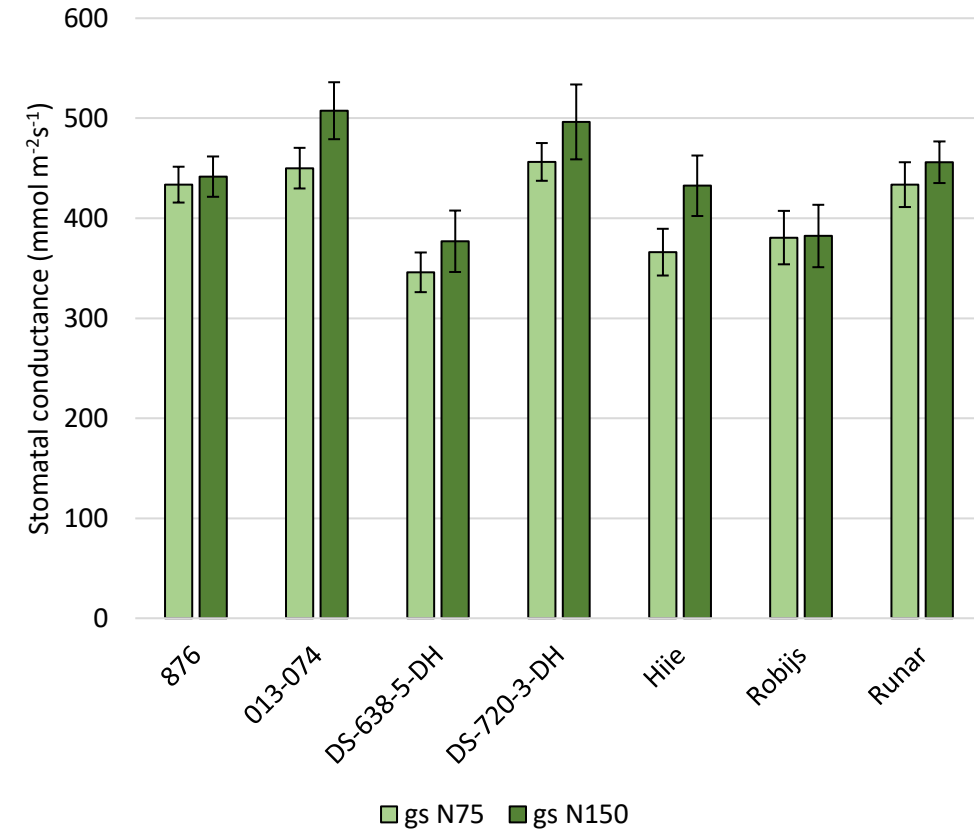


# Nisu gaasivahetuse tulemused – enne õitsemist

Pre-anthesis net photosynthesis of N75 and N150 plots

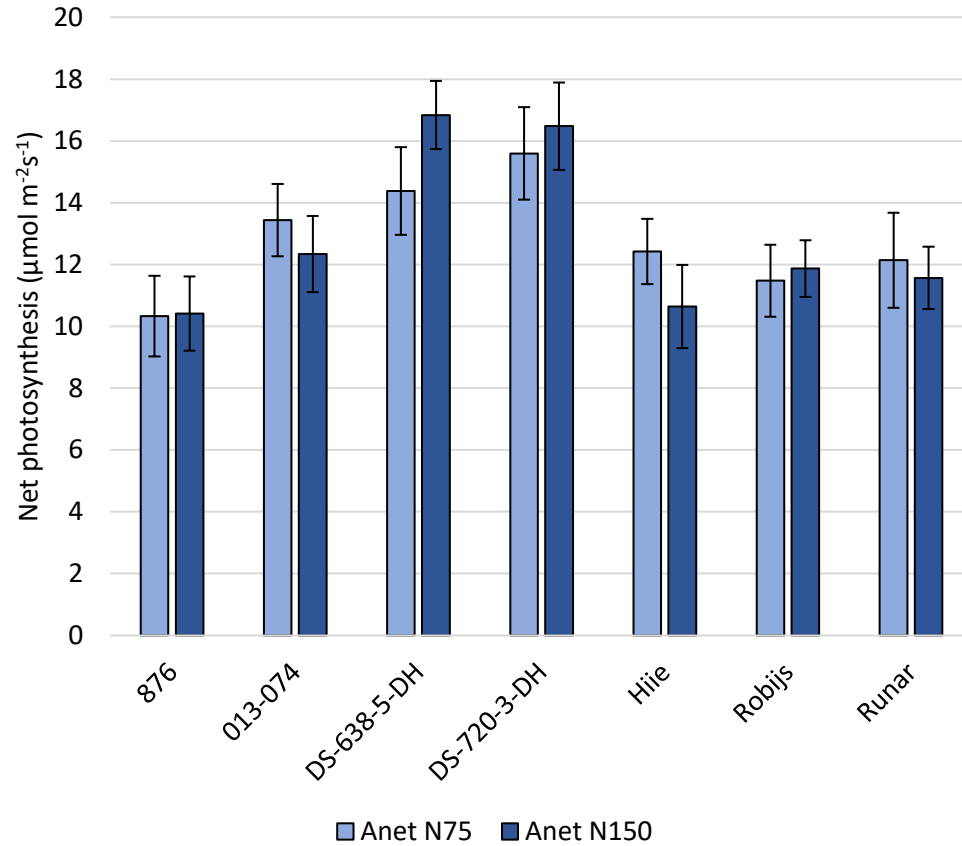


Pre-anthesis stomatal conductance of N75 and N150 plots

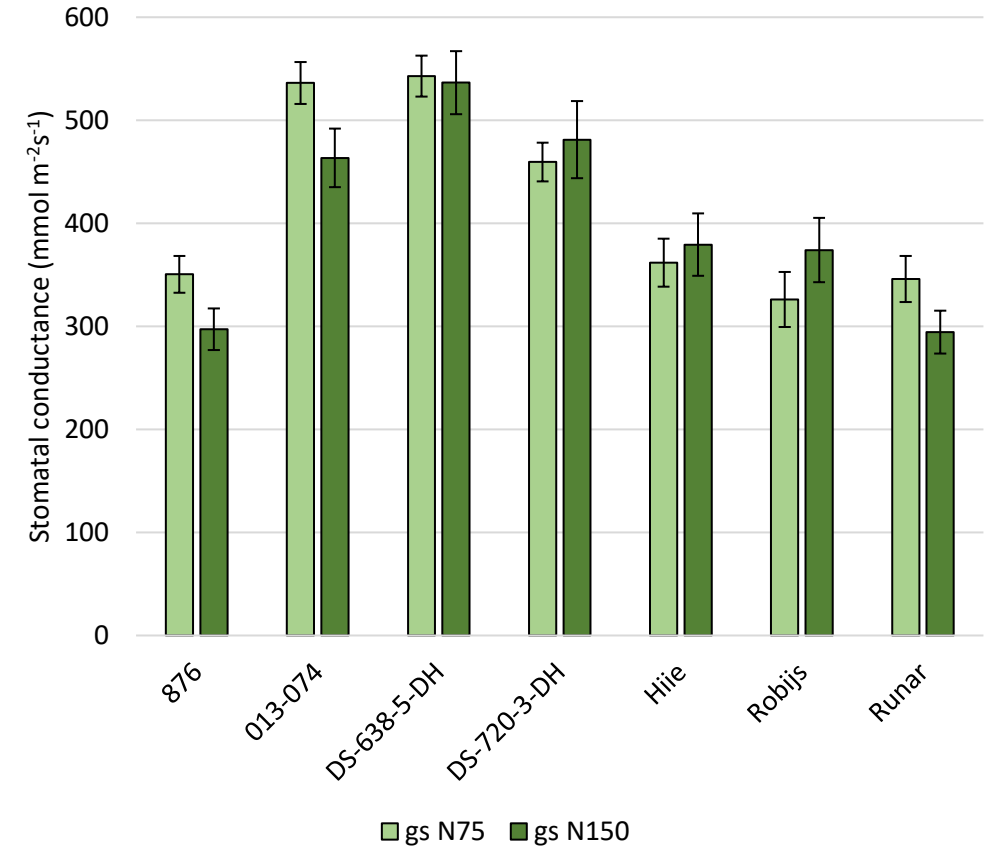


# Nisu gaasivahetuse tulemused – peale õitsemist

Post-anthesis net photosynthesis of N75 and N150 plots

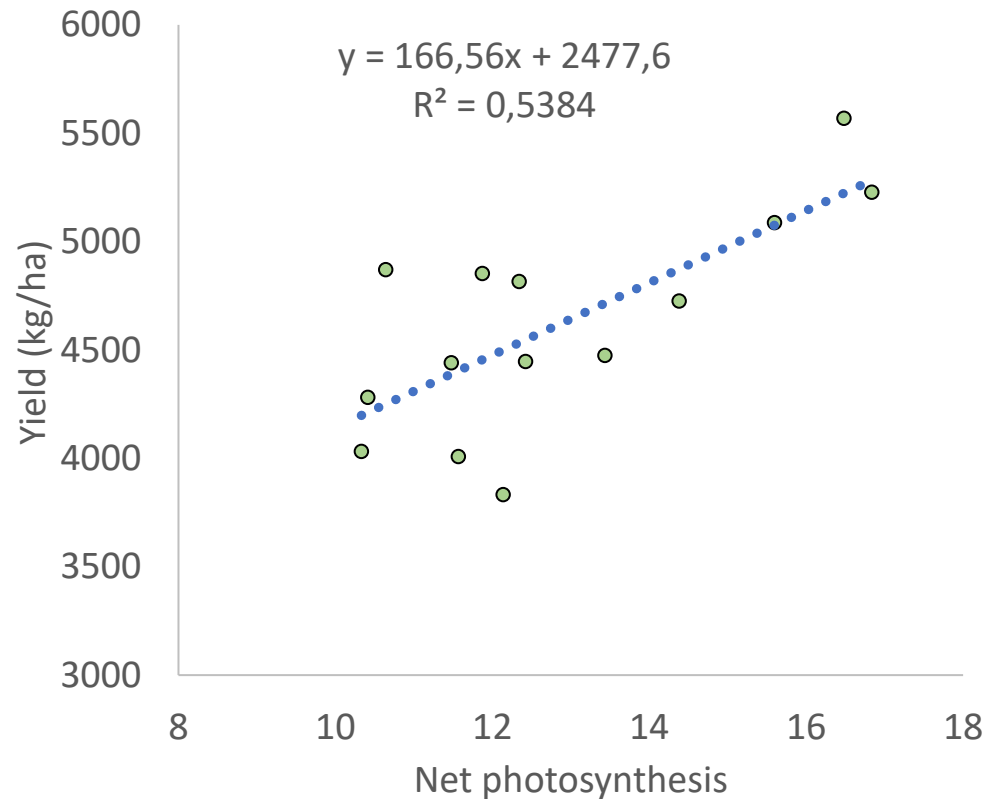


Post-anthesis stomatal conductance of N75 and N150 plots

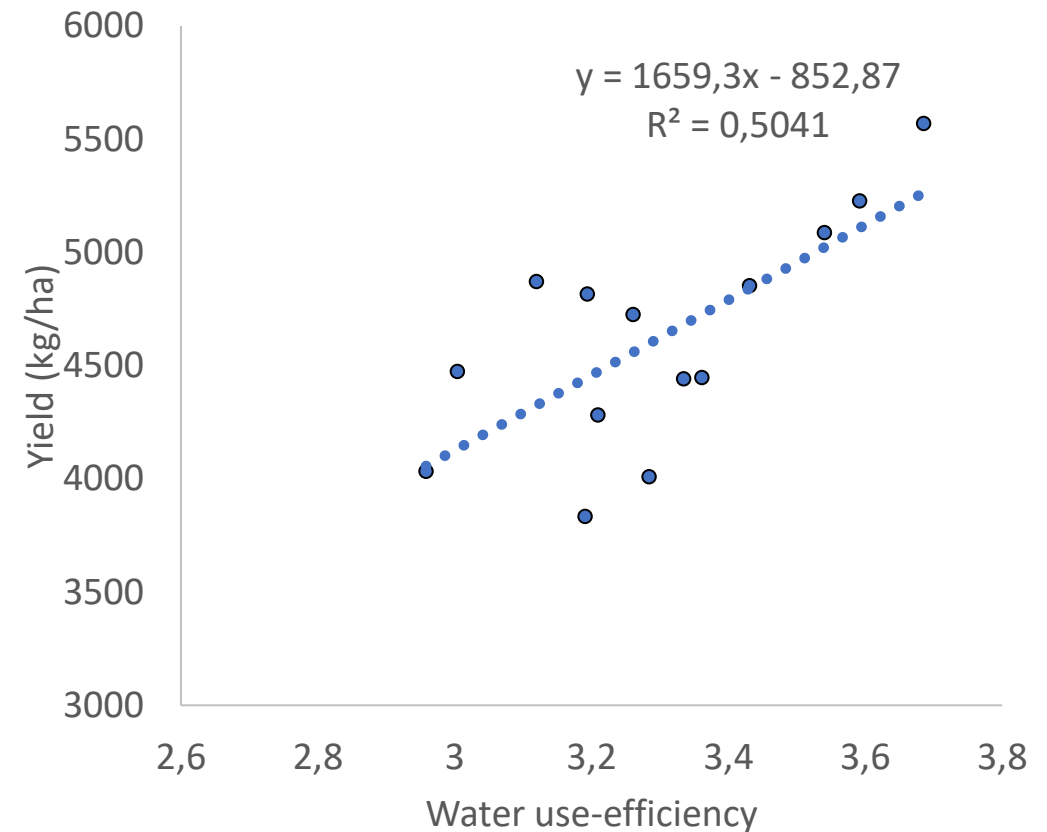


# Nisu gaasivahetuse tulemuste korrelatsioon saagiga

Yield vs net photosynthesis in wheat  
(post-anthesis)



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



# BARISTA Field gas exchange experiments

Egon Meigas, Ebe Merilo, Hannes Kollist, Tartu 2021



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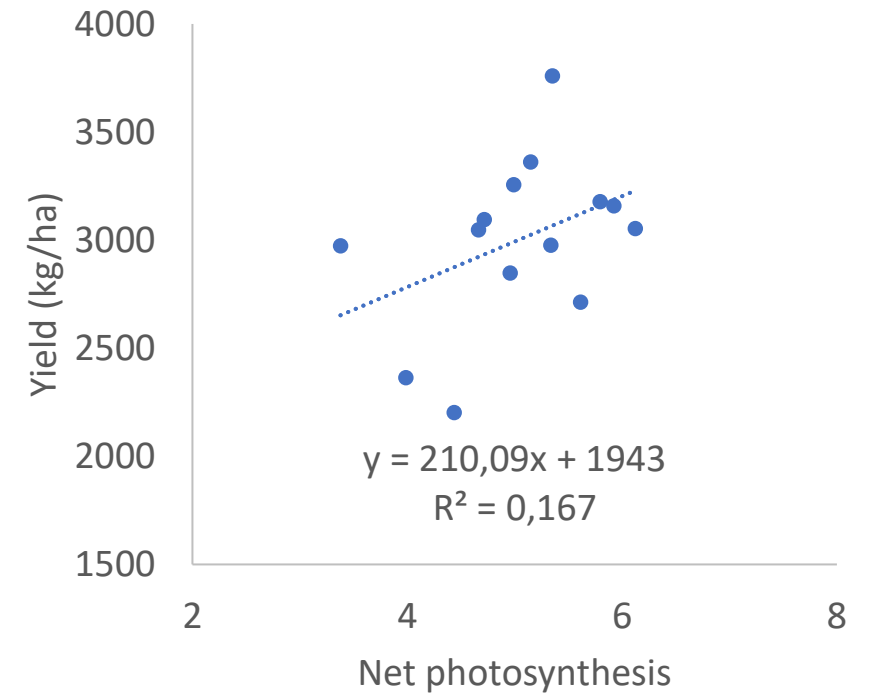
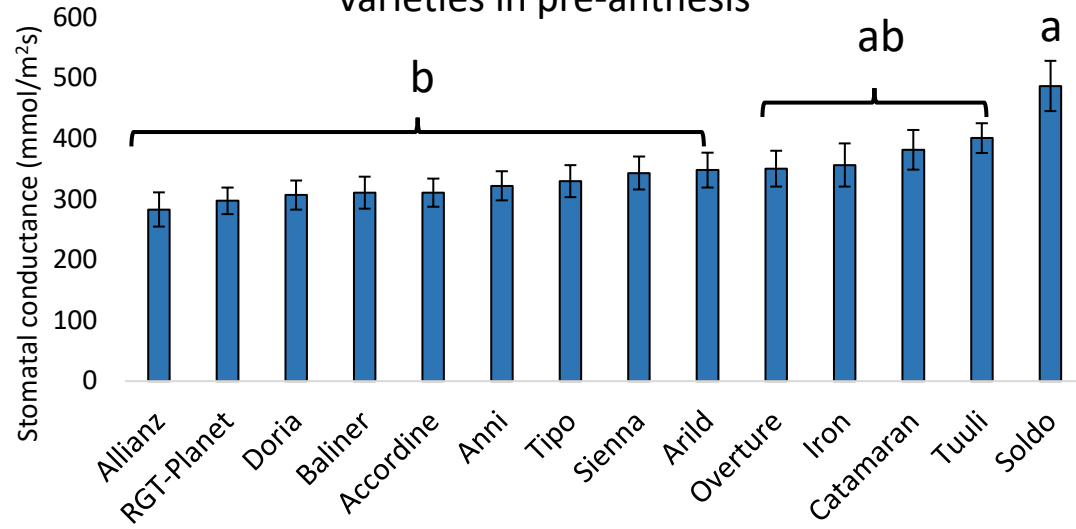


FOR SUSTAINABLE BARLEY

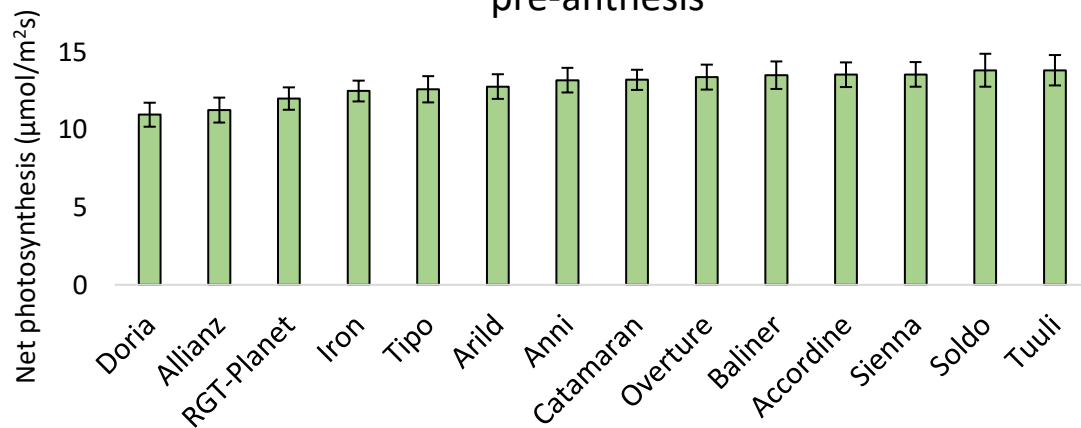


# Preliminary results 2021

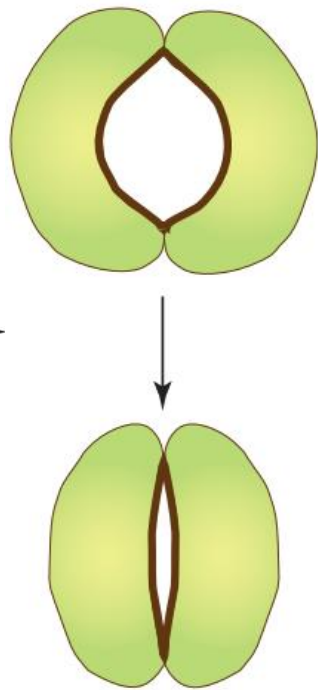
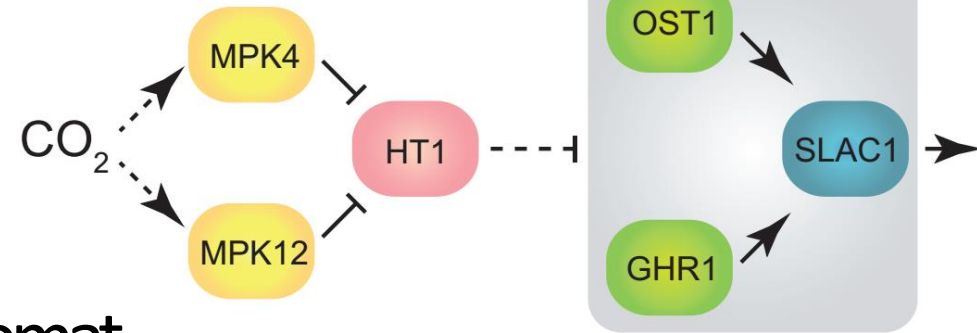
Average stomatal conductance of 14 barley varieties in pre-anthesis



Average net photosynthesis of 14 barley varieties in pre-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*



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



# Finally! A way to return flavor to bland tomatoes

J ÜLIKOOL

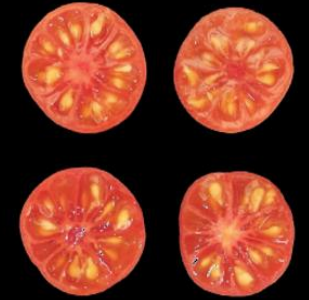
Scientists have discovered a rare gene that could help "make tomatoes great again"... or at least taste less bland.



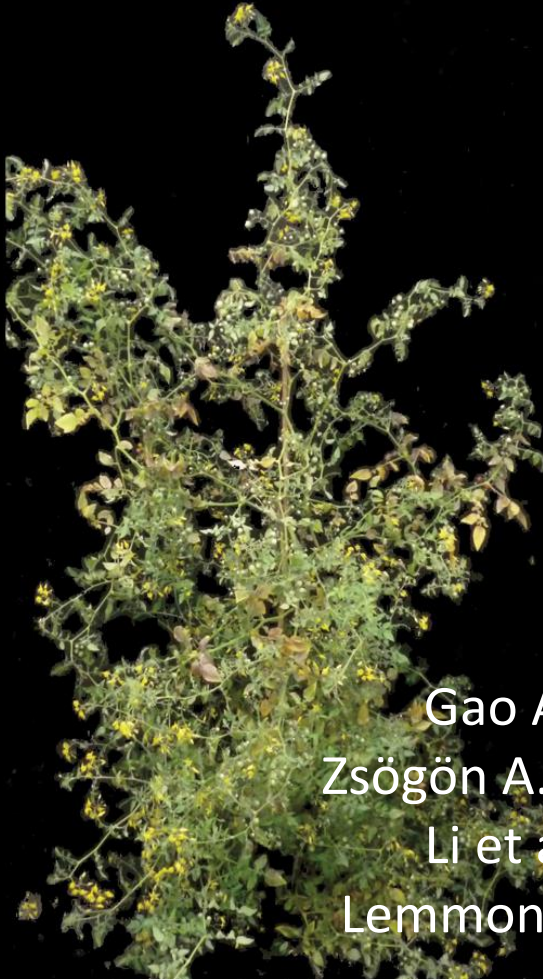
<https://www.dw.com/en/finally-a-way-to-return-flavor-to-bland-tomatoes/a-48732899>



*Nature Biotechnology*

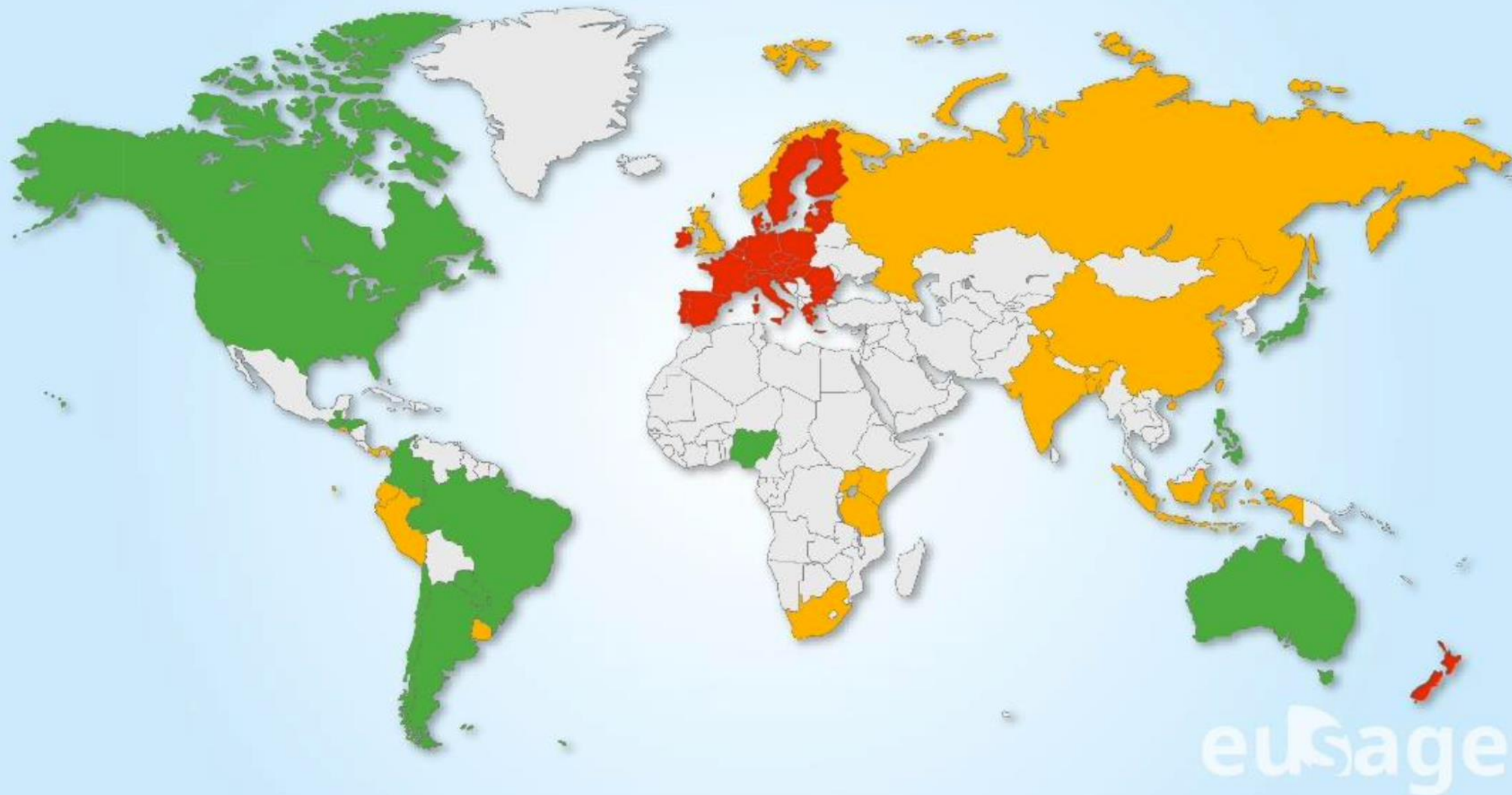


DL



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*

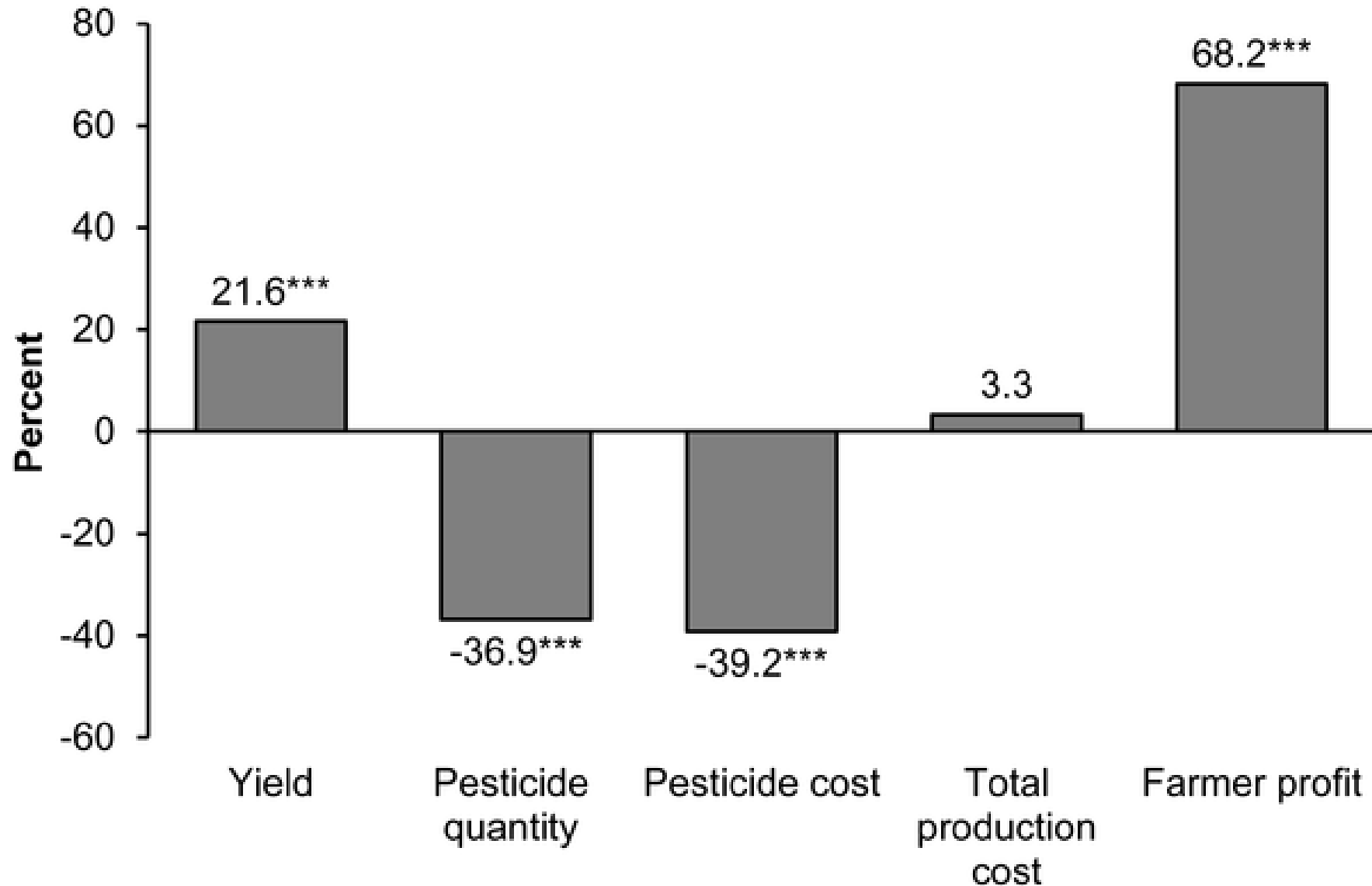
# Genoomide editeermine ja geneetiline modifitseerimine



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

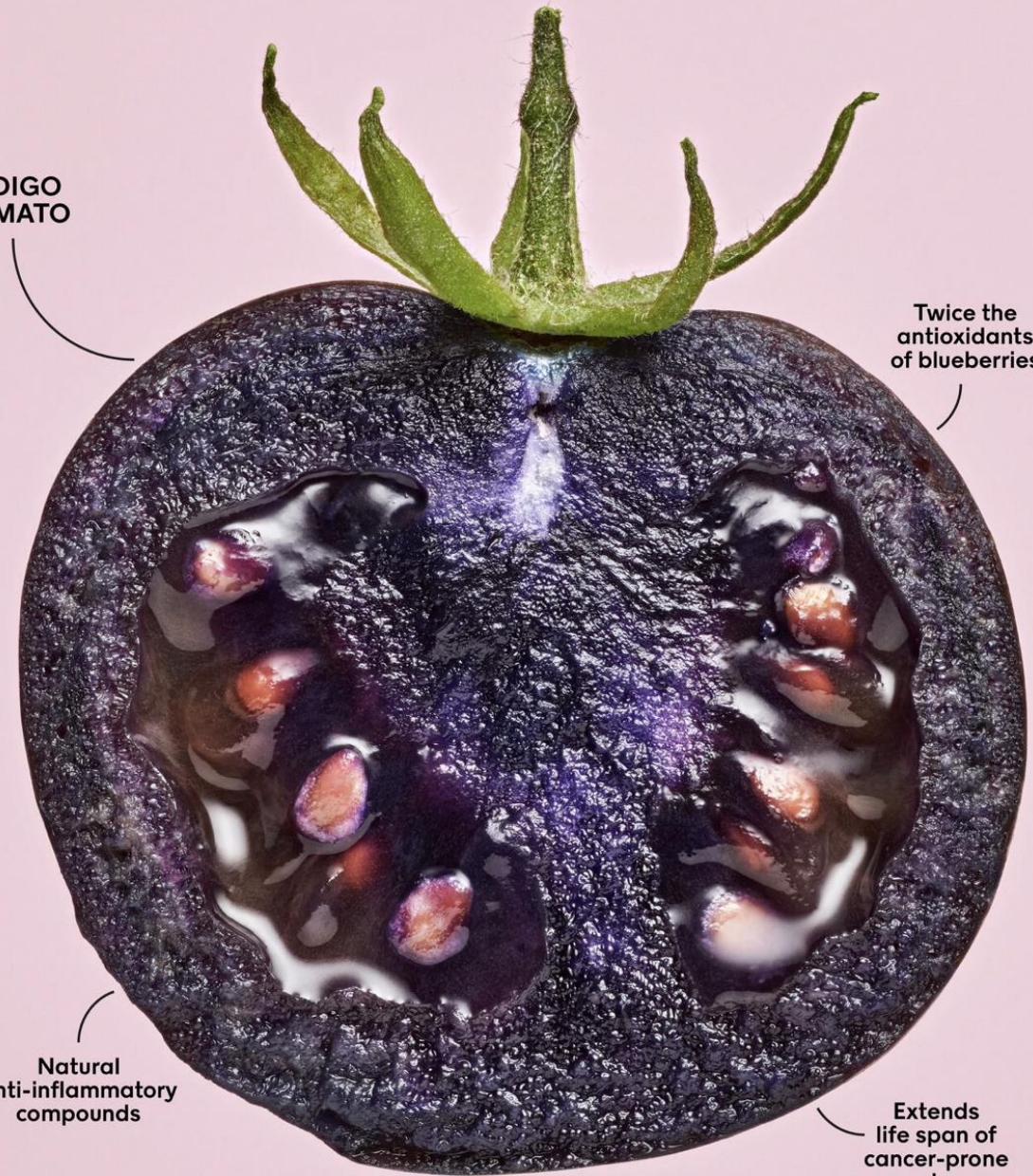
Overblown fears have turned the public against genetically modified food. But the potential benefits have never been greater.

INDIGO TOMATO

Twice the antioxidants of blueberries

Natural anti-inflammatory compounds

Extends life span of cancer-prone mice



# Taimsete signaalide uurimisrühm

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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