UNIVERSITÄT HOHENHEIM

# Agrivoltaics: Chance to tackle climate change in agriculture?

**ISES Webinar on AgriPV**
10.02.2022


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GEFÖRDERT VOM Bundesministerium für Bildung und Forschung

FONA Ressource Land BMBF

Deutschland Land der Ideen Ausgezeichneter Ort 2016

Projektlaufzeit: März 2015 bis Juni 2019

**Modellprojekt APV-Resola**

**Funding: German Federal Ministry of Education and Research (BMBF)**

# Background

tagesschau

Sendung verpasst?

Inland ▸ Erneuerbare Energien: Regierung will mehr Solaranlagen auf Äckern

German government wants more agrivoltaics (AV) on fields used for agricultural production

Erneuerbare Energien

## Regierung will mehr Solaranlagen auf Äckern

*Stand: 10.02.2022 08:01 Uhr*

**Die Bundesregierung will Solaranlagen auf Ackerflächen stark ausbauen. Die Felder sollen gleichzeitig für die Landwirtschaft und zur Stromerzeugung genutzt werden und so helfen, die Klimaziele zu erreichen.**

# Background

## Agriculture: What are the benefits of AV?

- Simultaneous production of food/feed and electricity
  → Increases land use efficiency
  → Eases conflicts between food and energy production
- Diversifies renewable energies provided by agriculture
- Reduced radiation is most likely negative for certain crops, however, there might also be some positive effects on harvestable yields
- Can provide shadow for grazing animals as well

## Objectives of the project:

- Test the suitability of field crops for the cultivation under AV
- Measure the impact of solar panels on development, harvestable yield and yield quality of crops
- Analyse the effects of AV on micro-climatic conditions, soil and biodiversity
- Develop recommendations for the practical implementation of AV*.

*https://www.ise.fraunhofer.de/content/dam/ise/en/documents/publications/studies/APV-Guideline.pdf

# Field experiment

## Site:

Hofgemeinschaft Heggelbach, Herdwangen-Schönach (Germany)

Organic farm („Demeter“)


## Crops:

- Winter wheat
- Potato
- Clovergrass
- Celeriac

→ Part of an organic crop rotation

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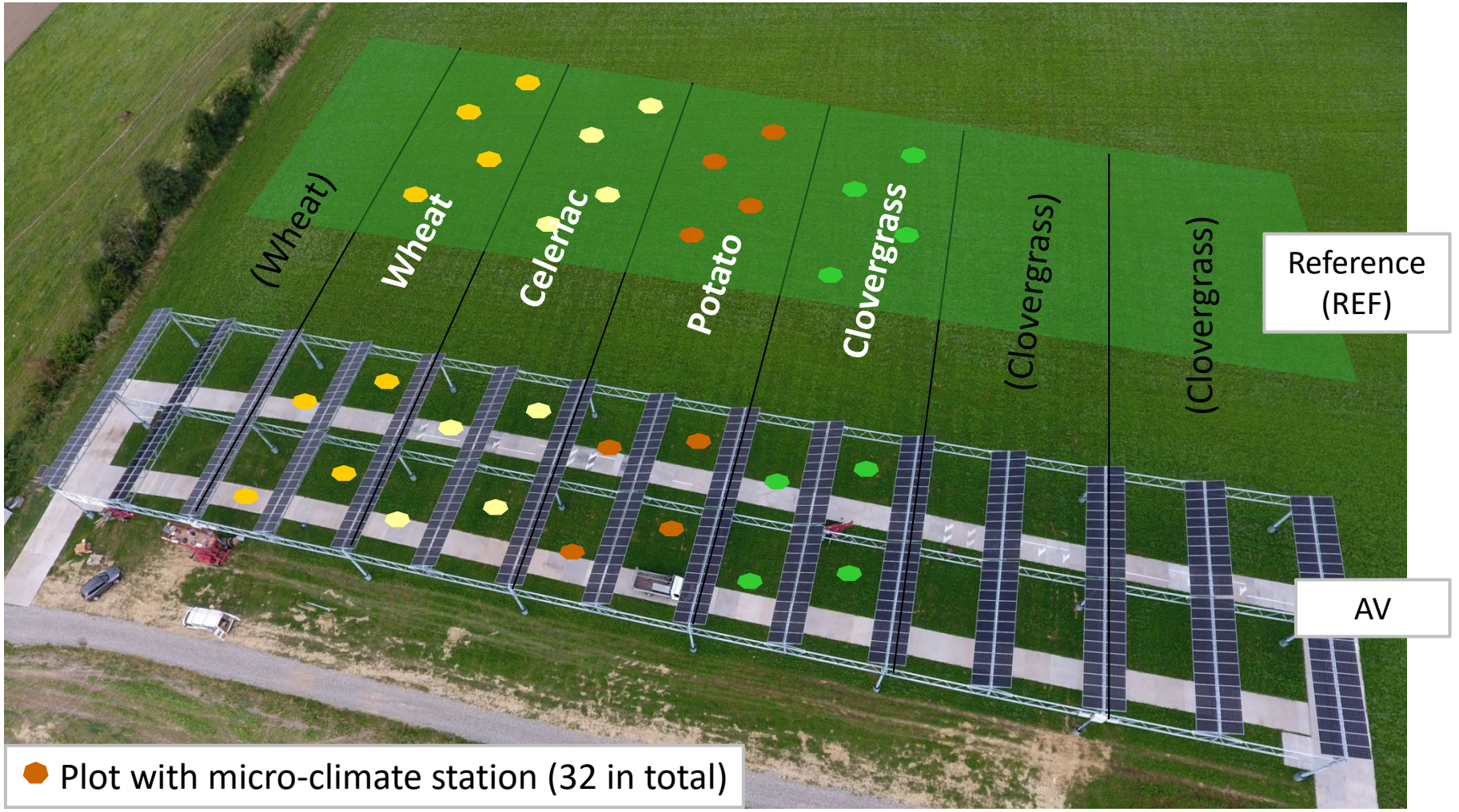
# Field plan: 1st year




Picture: Edgar Gimbel (modified)

# Measurements

**Agriculture**

Crop development

Crop yield

Crop quality

Soil

**Micro-climate**

Photosynthetically active radiation (PAR)

Air temperature ($T_{air}$) & Humidity ($RH_{air}$)

Soil temperature ($T_{soil}$) & Humidity ($RH_{soil}$)

**Environment**

Rain distribution

Erosion risk

Water logging

Potential nitrate leaching

**Biodiversity**

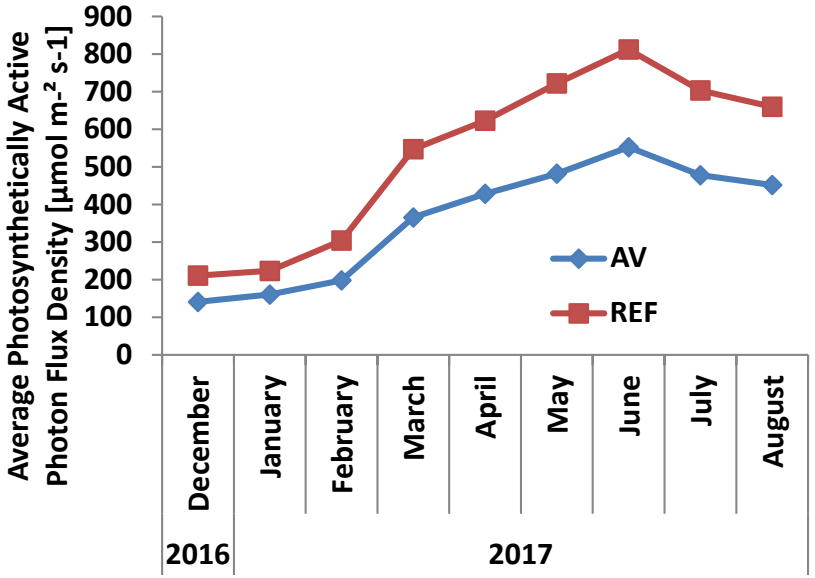
Monitoring

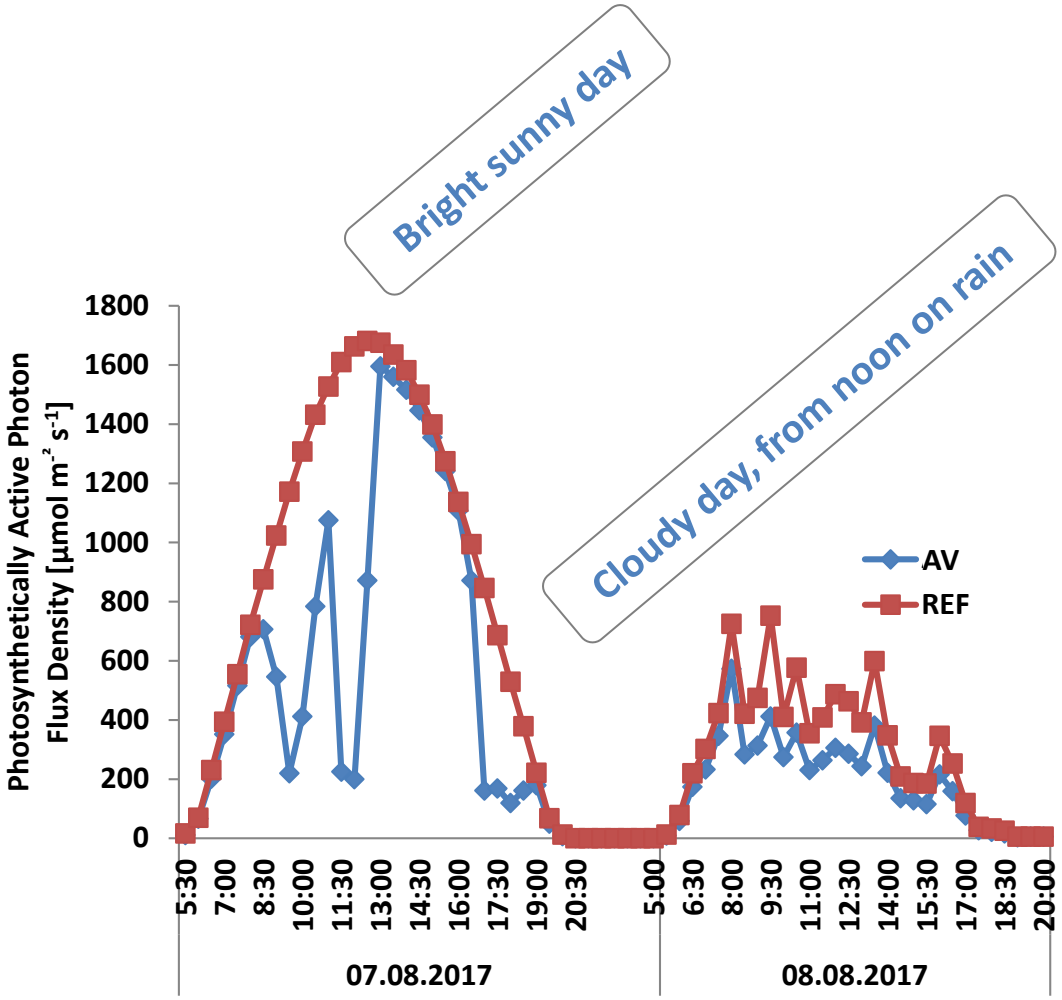
Accompanying vegetation (weeds)

Accompanying fauna (ground beetles, spiders, etc.)

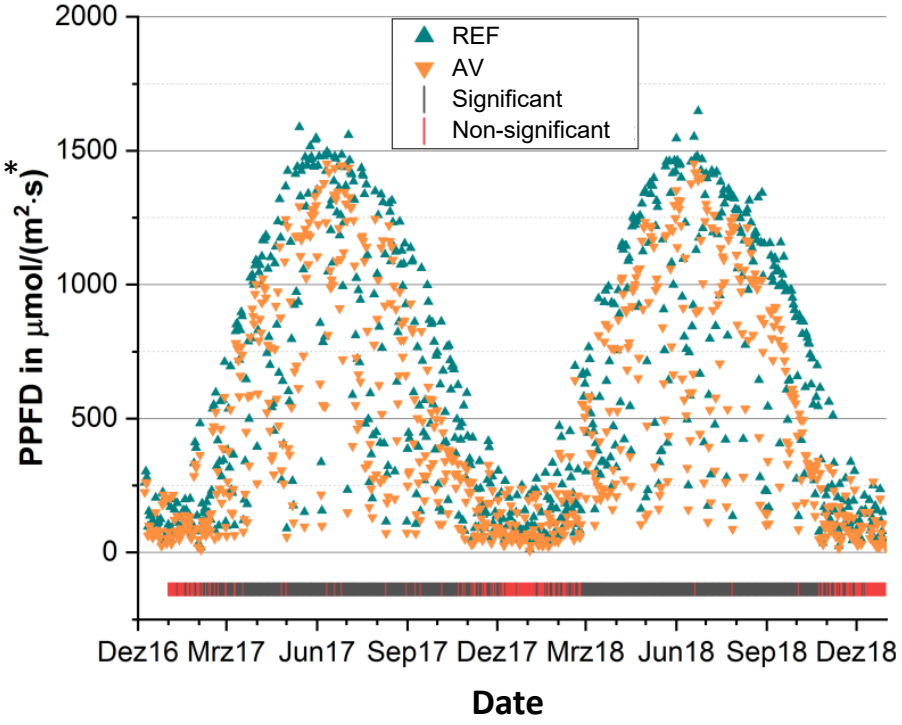

# Micro-climate: Solar radiation

## Winter wheat



# Micro-climate: Solar radiation



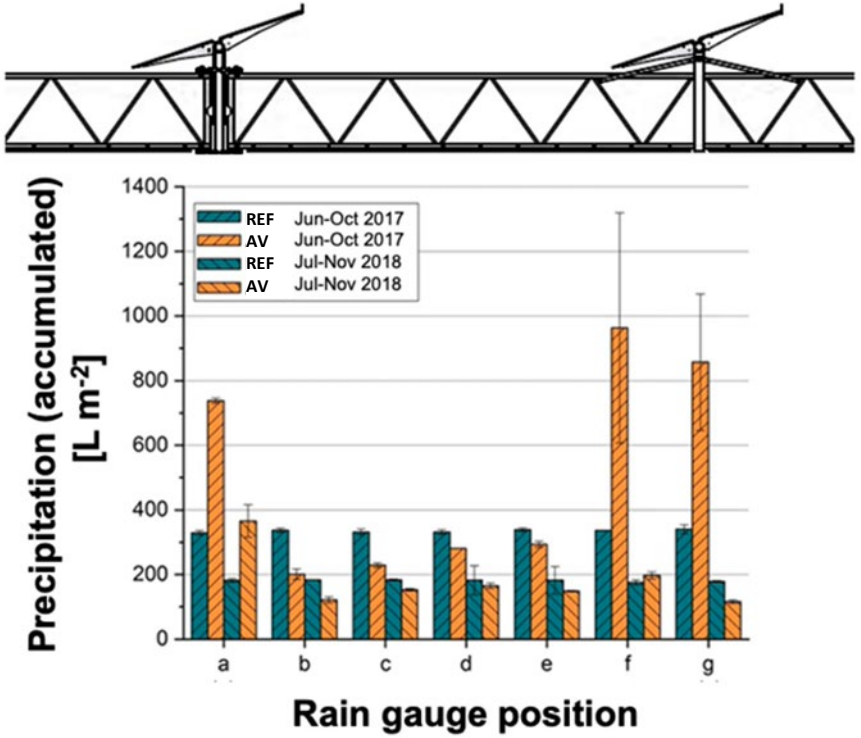

- Reduced solar radiation under AV
- Significant differences in terms of solar radiation from spring to late autumn.



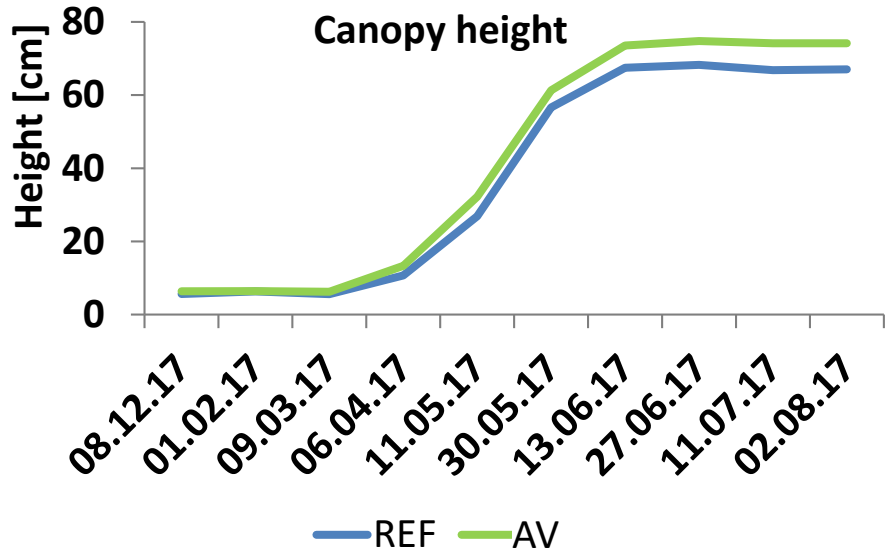
*Photosynthetic photon flux density

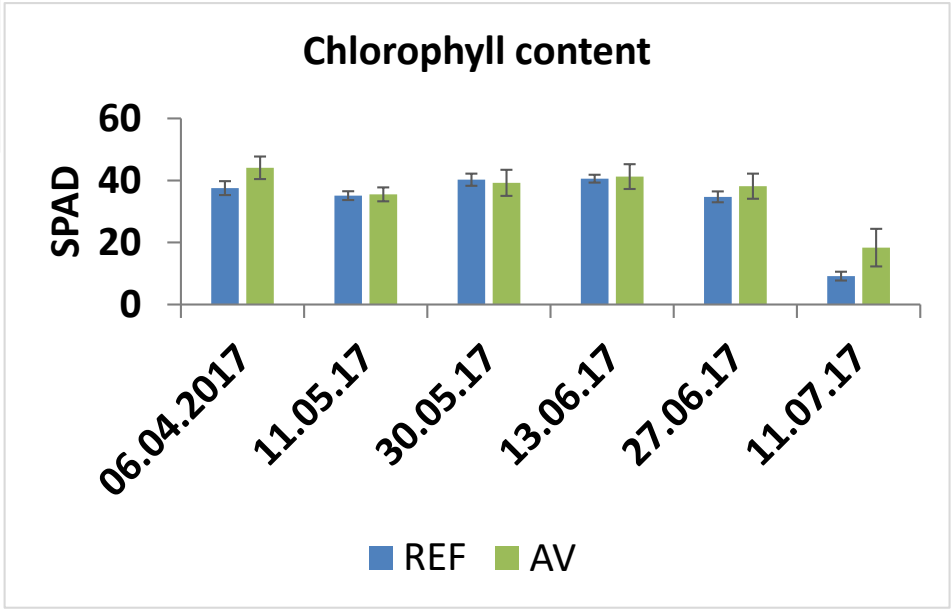
# Micro-climate: Temperature, humidity and precipitation

- Reduced soil temperature under AV
- Significant difference with regards to soil temperature from late spring until autumn
- No significant differences in terms of air temperature, air humidity and soil humidity.

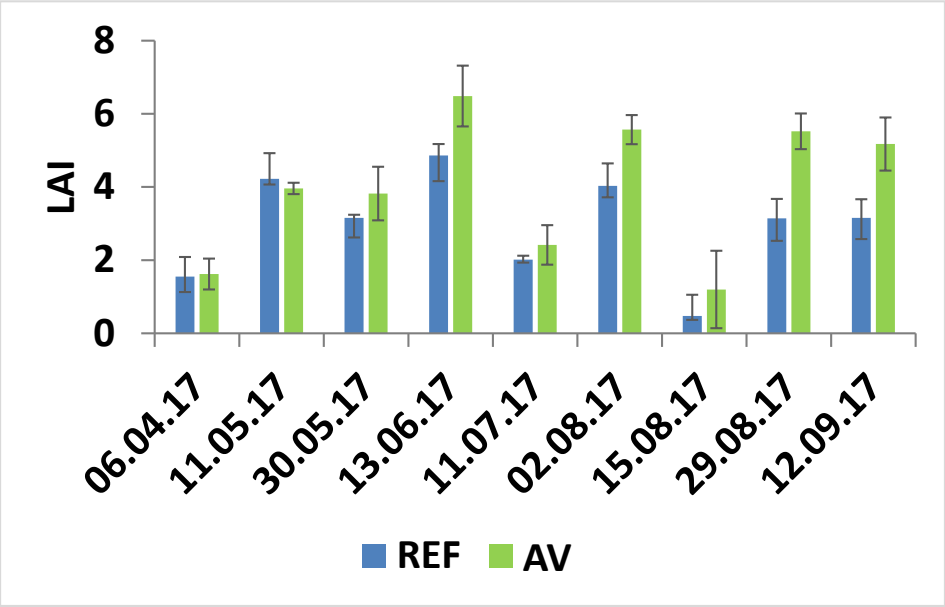


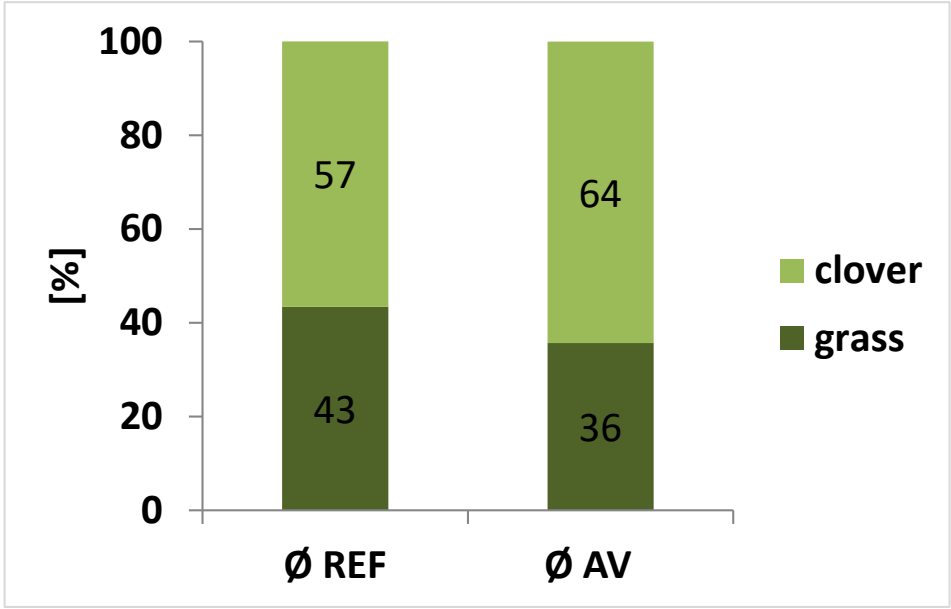
# Crop development: Winter wheat



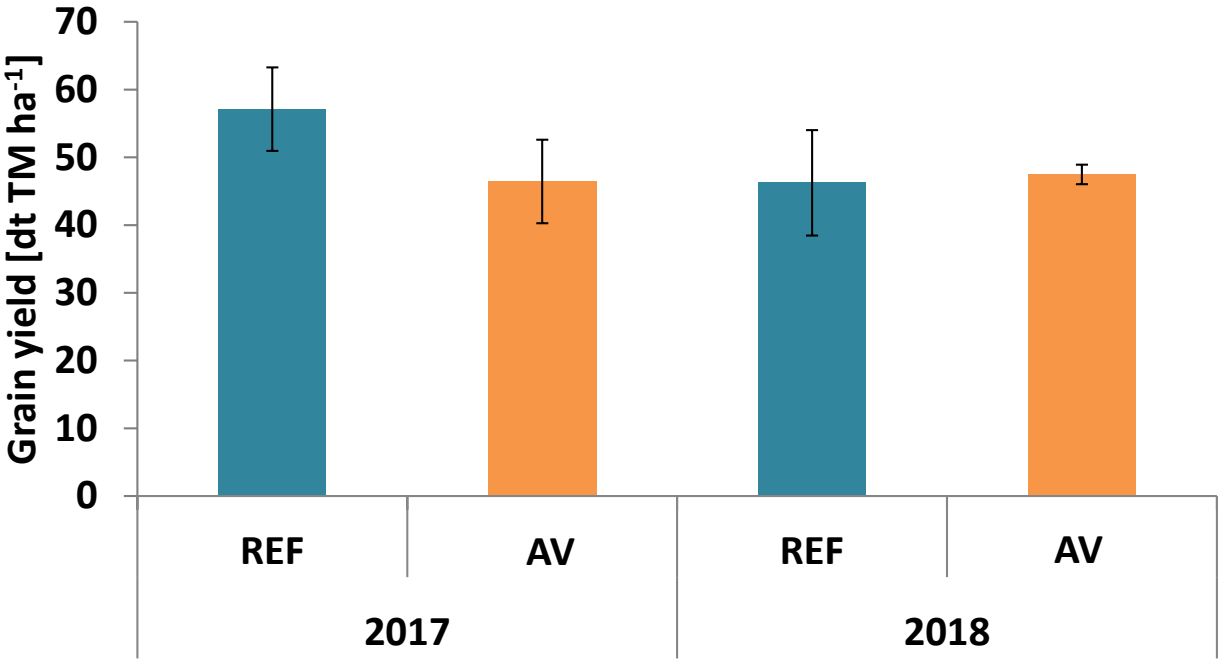



# Crop development: Clovergrass



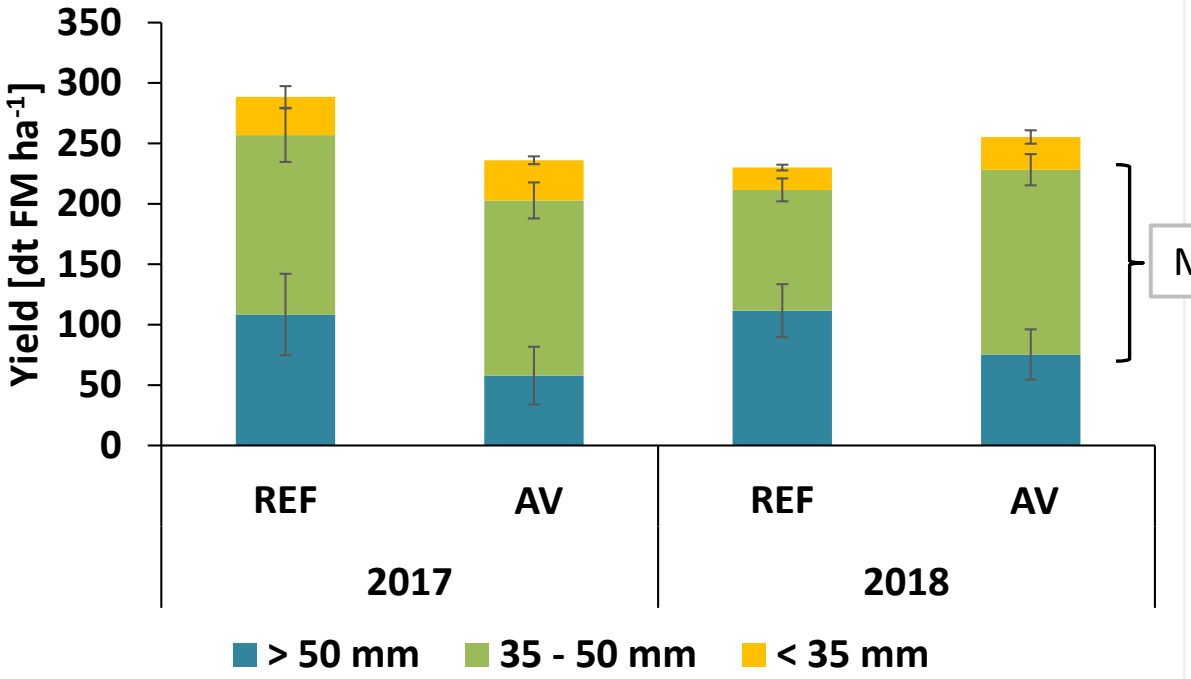
# Harvestable yield: Winter wheat




Hot summer 2018

- 2017: Decrease in grain yield by - 19 % under AV
- 2018: Increase in grain yield by + 3 % under AV.

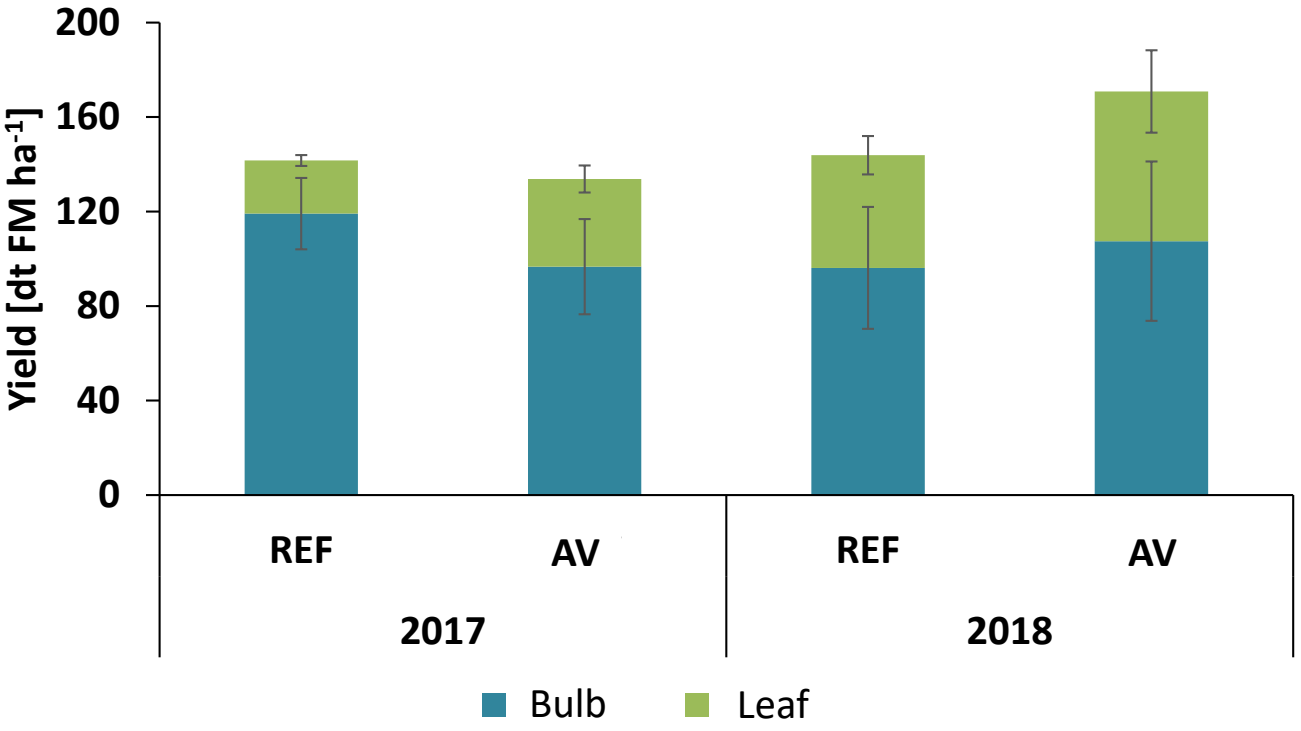
# Harvestable yield: Potato




- 2017: Tuber yield was decreased by - 18 % under AV
  Fraction of tubers >50 mm was decreased under AV
- 2018: + 11 % under AV
  Again, fraction of tubers >50 mm was decreased under AV.

Hot summer 2018

# Harvestable yield: Celeriac




- 2017: Bulb yield was reduced by - 19 % under AV
- 2018: Bulb yield was increased by + 12 % under AV
- In both years, biomass of leaves was increased under AV.

Hot summer 2018

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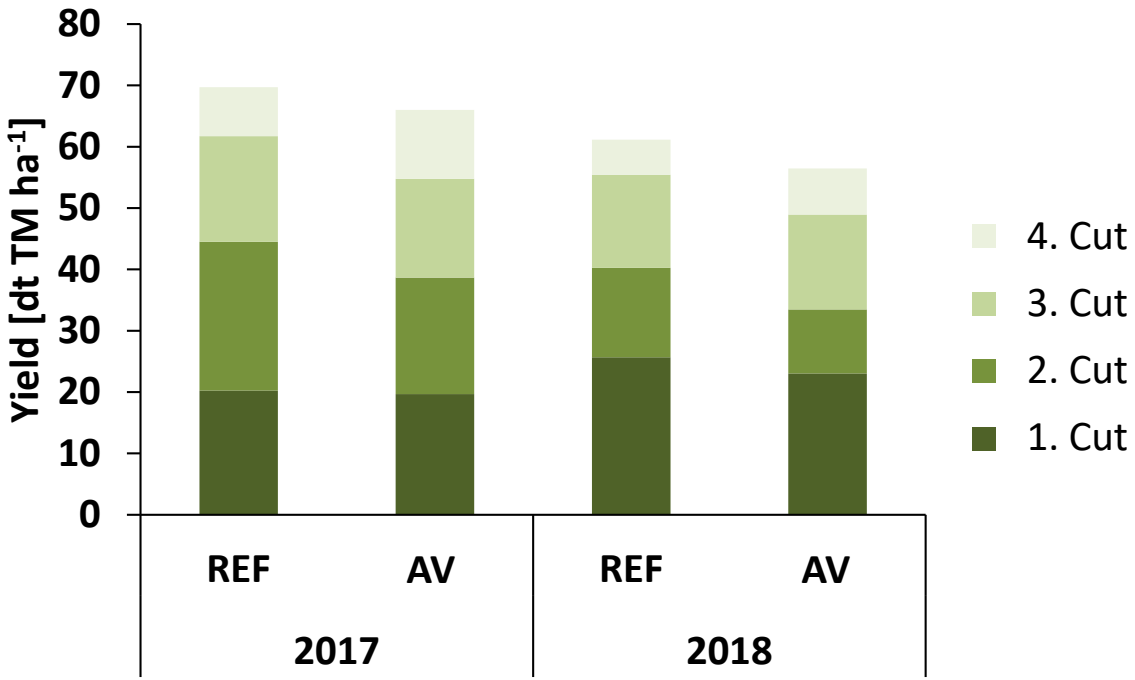
# Harvestable yield: Clovergrass




Hot summer 2018

- 2017: Total yield was decreased by - 5 % under AV (4 cuts)
- 2018: Total yield was decreased by - 8 % under AV (4 cuts).

# Outlook

- AV provides a promising opportunity

  → **Increased land use efficiency** due to production of crop yield and energy yield at the same area

- Reduced solar radiation is the limiting factor
- Decrease in crop yield was overcompensated by energy yield
- **Additional experimental years** and **test of other species** are needed in order to provide clear conclusion.

# Outlook

Shading and reduced transpiration under AV might be important in the future → **climate change**

AV is a **mitigation option** with regard to **climate change**

AV might be on option for plant production in **arid areas** with intensive solar radiation and insecure energy supply

AV is a good opportunity to produce **healthy food and renewable energy at the same field site**

**AV is a chance to tackle climate change in agriculture!**

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# Thanks for your attention!

**Project website:**
www.agrophotovoltaik.de

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Deutschland Land der Ideen
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