

Crop response to APV in soft fruit production

Experiences with raspberry and strawberry under solar panels in the Netherlands






Herman Helsen, 4. November 2022, Martigny, CH







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Agri-PV

Netherlands 51 °N






- Combining production agriculture and production of energy.
- No magic: light energy can only be used once. Increasing yield with APV? Or minimizing yield reduction?
- Business case: -> Search for synergy, and optimizing the total system.
- Fruit crops may be good candidates for agrivoltaics
- SunBiore project: pilots in pear, red currant, raspberry, strawberry






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Agrivoltaics in soft fruit production



- Potential synergy:
 - Alternative to plastic cover
 - Wind resistance
 - Construction may serve as physical crop support
 - Protection against sunburn, rain, (hail?)
 - Better microclimate
 - Better conditions for workers
- Application of APV in fruit does not have the potential constraints of APV in some other crops (cf. arable crops)
 - Small machinery is used
 - No crop rotation
 - Crop rows at the same position over years, growers are used to fixed support systems
 - Irrigated crops
 - Growers have experience with production under protection

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Two case studies in this presentation

Raspberry: Comparing a large-scale conventional production system under plastic rain cover with a large-scale (multi-hectare) system with solar panels.



Strawberry: small scale experimental units in commercial plantation. Panels with 2 levels of transparency vs open air (reference).



Graphs show 2021 results. The 2022 results not yet completely analysed. Some preliminary comments added.




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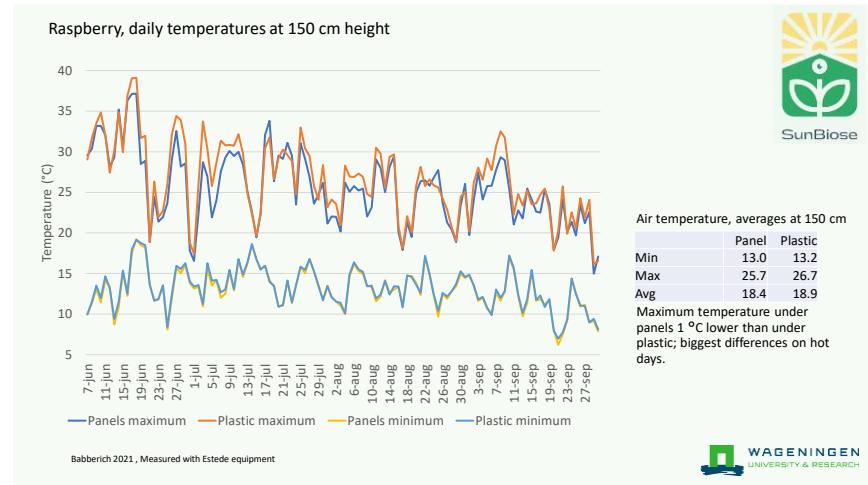


Raspberry pilot 2021

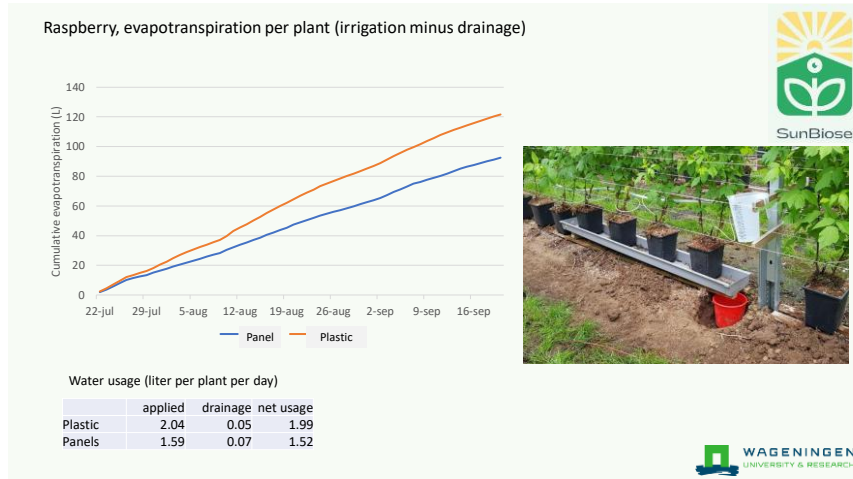
- Comparing two commercial-scale systems
- Solar panels
 - Rows ~ north - south
 - Alternately tilted east and west
 - 40% transparency -> ~40-50% of natural light (earlier pilot with 25% transparency: too dark)
- Plastic cover = commercial standard
 - With net to prevent sunburn
 - ~50-60% of natural light, (highly variable in practice: age plastic, construction, nets yes/no)
- Raspberry cv. Lagorai
 - Long canes, 2 canes per pot, 2 pots per m
 - Cool storage during winter, planted in week of 14 June 2021 ("late planting")
 - Harvest end August – end September



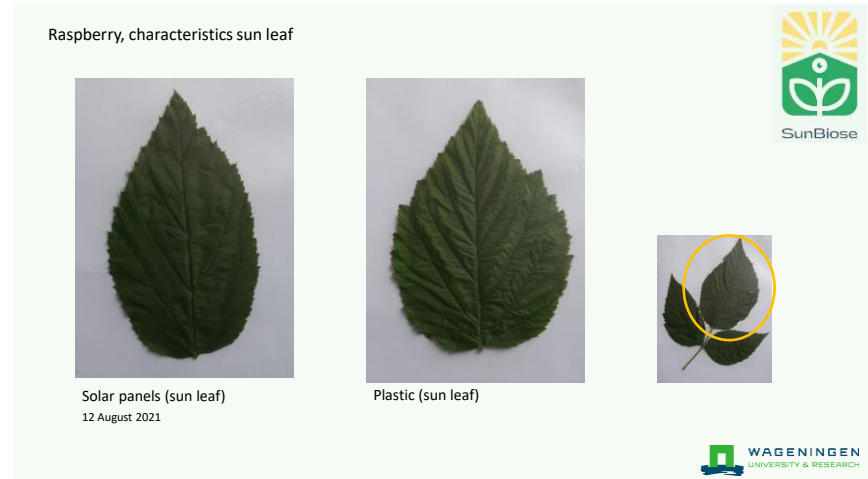
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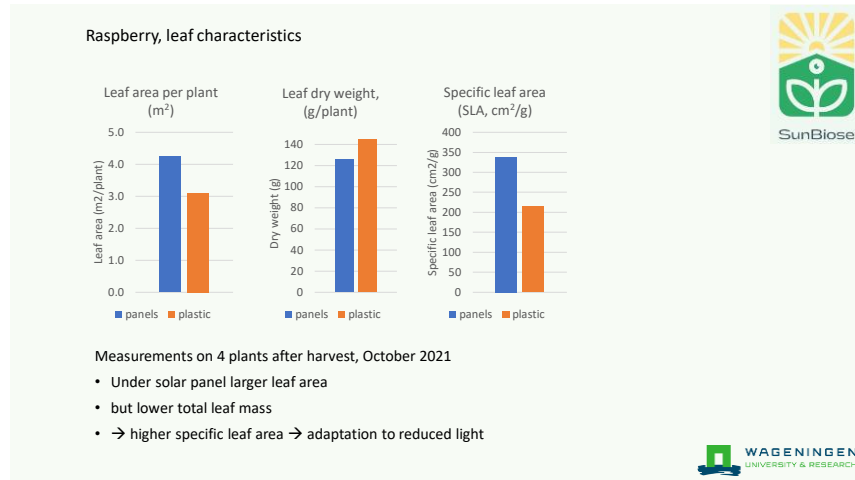
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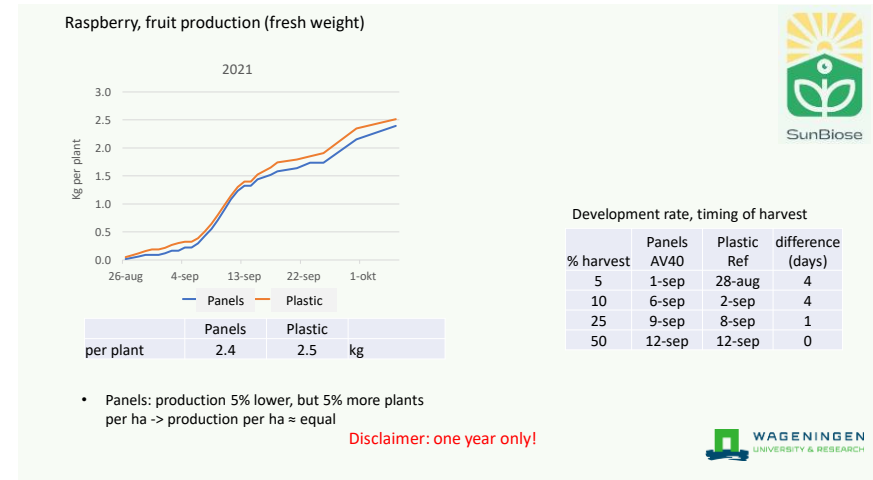
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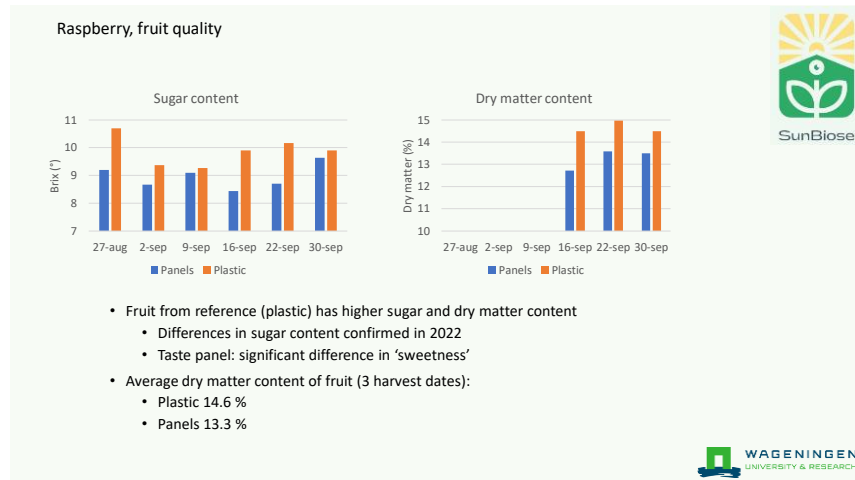
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Raspberry, use of shade nets



Shade nets to prevent sunburn of fruits in late afternoon

Better protection against rain, erosion, but less light!



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Raspberry, storm damage in reference plot



March 2022

April 2022, after storm

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Red currant
Effects of a hail storm June 2022



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Strawberry pilots 2021



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Strawberry pilots 2021

- 3 treatments:
 - Panels 25: 25% transparency, crop receives ~40% of natural light
 - Panels 40: 40% transparency, crop receives ~50% of natural light
 - Open: open air (reference)
- 3 plantings, cultivar Elsanta, plants from cool storage

Timeline: C (April to September), B (May to August), A (April to August)

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Microclimate strawberry 2021, minimum and maximum temperatures per day

Temperature at crop level, averages May 29 - July 9 2021

	Panels 25	Panels 40	Open
Avg	18.9	19.0	19.0
Min	12.6	12.5	12.2
Max	24.9	25.4	25.9

Small scale plots reduce potential differences

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Panels 25% Panels 40% Open

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Strawberry, leaf characteristics

Measurements after harvest, Elsanta planting C, September 2021

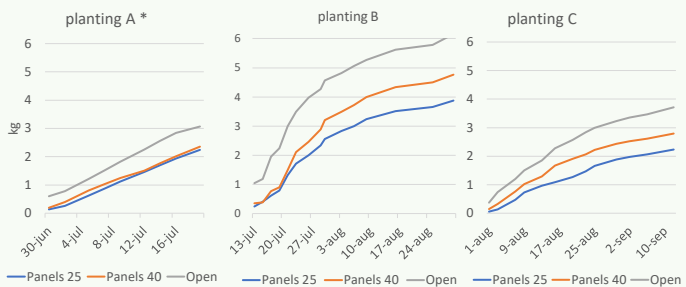
- Under solar panels smaller leaf area
- much lower total leaf mass, SLA is higher
- > some adaptation to lower light level

SunBios

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Strawberry, fruit production (kg per running meter)



Relative total production			
Planting	Panels 25	Panels 40	Open
A	0.73	0.77	1.00
B	0.63	0.77	1.00
C	0.60	0.75	1.00

Relative production class 1			
Planting	Panels 25	Panels 40	Open
A	0.70	0.79	1.00
B	0.69	0.78	1.00
C	0.62	0.78	1.00

*Incomplete measurements at start and end



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Raspberry, summarized

- Treatments compared (both with shade nets between rows)
 - panels 40% transparency <-> plastic reference (current practice)
 - ~40-50% of natural light <-> ~50-60% of natural light
- Observations
 - Plant compensates for reduced light with a strong (absolute) increase of leaf area
 - Harvest (fresh weight) under panels slightly less than under plastic.
 - Slightly less sugar, lower dry matter content under panels (2022: fruits taste significantly less 'sweet').
 - 2022 lower production under panels: effect shade nets?
- Potential improvements
 - This was a late season planting. Differences may be smaller when planted earlier (but we couldn't confirm that in 2022)
 - Rainwater drainage to be considered in design of system. Collection of water?
- Concluding
 - Further finetuning options: effect of planting time, growing season, choice of cultivars
 - Economic viability: all aspects of the system must be considered.



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Strawberry, summarized

- Treatments compared:
 - panels 25% <-> panels 40% <-> open air
 - ~40% <-> ~50% <-> 100% of natural light
- Observations
 - Plant compensates for reduced light with increase of SLA, but strong absolute reduction of total leaf area, leaf dry weight and total plant dry weight
 - Harvest (fresh weight) under panels strongly reduced
- Changed design in 2022 test (to increase light at crop level)
 - 20 cm greater distance between rows
 - 40 cm higher position of the panels
 - > preliminary results 2022: improvement insufficient
- Potential further improvements
 - Greater transparency of panels? (affects business case)
 - Other cultivars?



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Thank you for your attention.

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