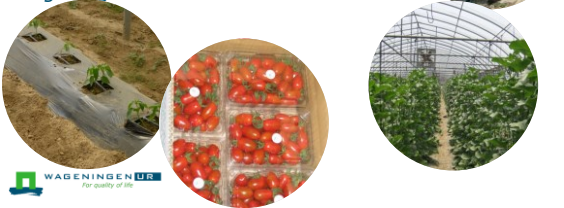


Prospects of hydroponics and protected cultivation in semi-arid regions piloted in Algeria

Erik van Os, Marc Ruijs, Bas Speetjens
Athanasios Sapounas, Margreet Bruins

Wageningen UR Greenhouse Horticulture



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Introduction

- Protected cultivation
 - Improved food production
 - Extended growing season
 - Higher water and nutrient efficiency
- Study to find the best greenhouse for Algeria
 - Development aid and trade
 - Tailor-made
 - Technology level

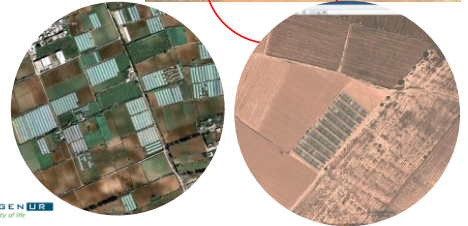


→ Greenhouse with cultivation system



Algeria

- 10th country in the world
- 40 million people
- 90% along coast
- 8000 ha tunnels

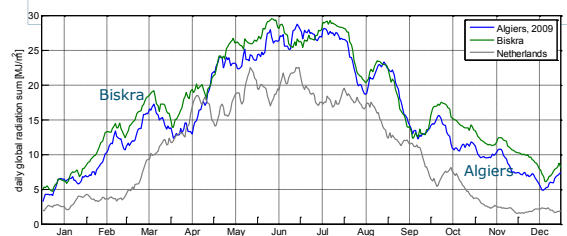


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Algerian climate – global radiation

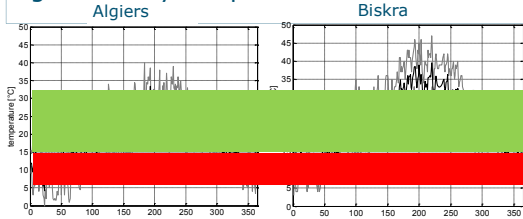


- Radiation in Algeria is much higher than in The Netherlands (6000 vs 3800 MJ): higher yield

- In winter all light is needed inside the greenhouse



Algerian daily temperatures



- Typical:
- Heating demand in winter (red)
 - Cooling demand in Biskra (white)
- Challenge:
- High temperatures: efficient ventilation
 - Extra cooling measures needed in summer



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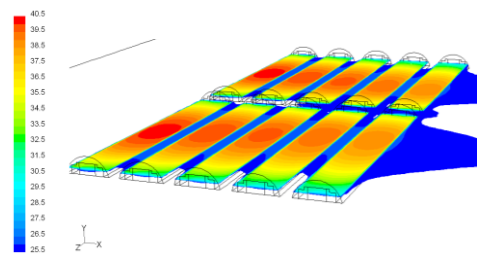
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Single tunnels



Temperature in single span tunnels



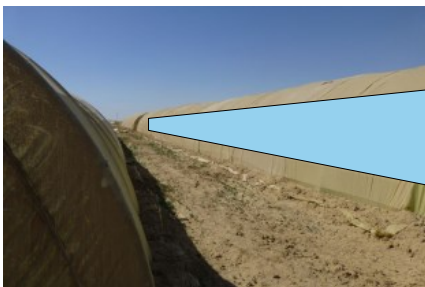
Current situation



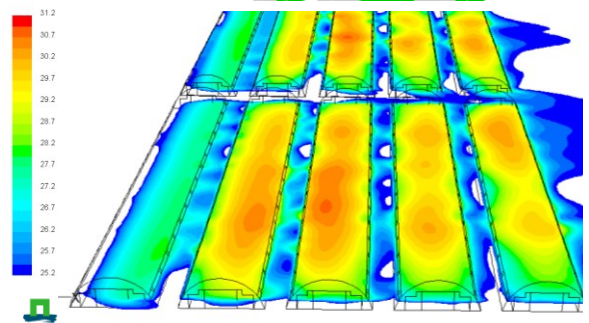
$T_{\text{outside}} = 25^{\circ}\text{C}$, $T_{\text{inside}} = 40^{\circ}\text{C}$

Ventilation and cooling

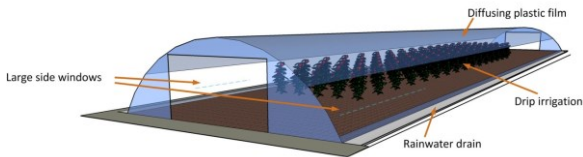
30% window opening = $\text{m}^2 \text{ window} / \text{m}^2 \text{ greenhouse} = 0.3$



Open sides (window fraction 30%)
 $T_{\text{outside}} = 25^{\circ}\text{C}$, $T_{\text{inside}} = 30^{\circ}\text{C}$



Single tunnel: future design



Multispan tunnels



Greenhouse type

- Present greenhouses:
 - Single tunnels: 8x50x 3.2 m
 - 3-4% ventilation rate, top end
 - 30% required, 50% production increase
 - Pad & fan cooling: Biskra area, 10 oC lower T
 - Diffuse film with high light transmission
 - Canarian and multispan greenhouse
 - 30% ventilation rate required
 - Insect nets (Tuta absoluta)
 - Fogging system in high grh
 - Heat?
 - Heat storage?



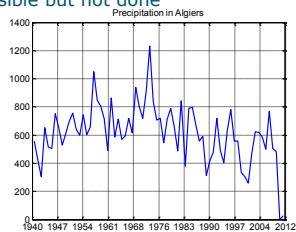
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Rainwater collection

- Precipitation: 500-600 mm in coastal area
- 75% of water need
- 1000 m3/ha
- Adapted single tunnel design
- Multispan collection is possible but not done



Hydroponic cultivation

- Soil borne diseases
 - Solar radiation insufficient
 - Change to hydroponics: 20% more yield
- Technology adapted system
- Open system
 - Reuse of surplus in other soil cultures
- Closed: disinfection required
 - Slow sand filtration as cheap reliable option
- Local substrate



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Improvements single tunnel

Single tunnel Compared to reference single tunnel	Algiers		Biskra	
	Large windows	Large windows + pad&fan	Large windows	Large windows + pad&fan
Extra yield (kg/m ²)	10.0	15.0	8.0	17.0
Extra revenues (€/m ²)	0.4	0.6	0.3	0.7
Payback period (yr)	< 1	3.9	< 1	3



Improvements multispan

Multispan tunnel Compared to reference multispan tunnel	Algiers		Biskra	
	Large windows	Large windows + pad&fan	Large windows	large windows + pad&fan
Extra yield (kg/m ²)	9.0	13.0	7.0	16.0
Extra revenues (€/m ²)	0.4	0.5	0.3	0.7
Payback period (yr)	.	3.8	.	2.7



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Conclusions

- Improvements in design:
 - Increase ventilation rate from 3 to 30%
 - Lower temperature, longer season, more yield
 - Side openings should be movable; closed at night/open during day
 - Coast: rainwater collection
 - Hydroponics: adapted to technology level
 - Open system to start
 - Experience: recirculation



Thank you for
your attention



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