Actuele stand kasdekmaterialen

Silke Hemming,
Wageningen UR Greenhouse Horticulture

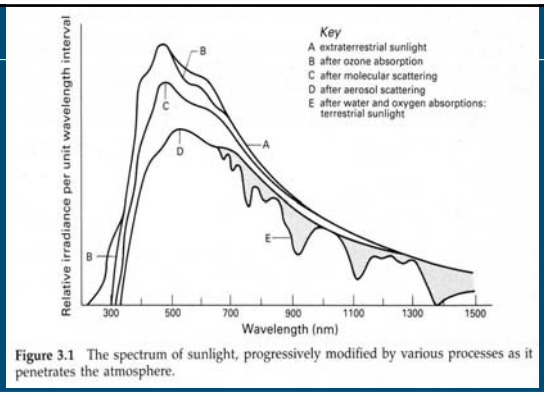


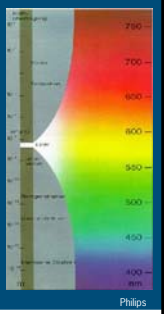
Figure 3.1 The spectrum of sunlight, progressively modified by various processes as it penetrates the atmosphere.

General

Solar radiation (300-2500nm), energy input greenhouse

Relevant for horitcultural applications

UV	300-400 nm	morphogenesis
PAR	400-700 nm	photosynthesis, morphogensis
FR	700-800 nm	morphogenesis
NIR	800-2500 nm	*increasing greenhouse temperature*
FIR	2.5-100 µm	*heat radiation*

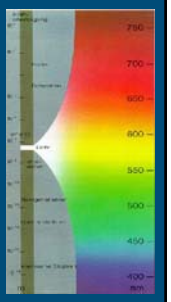


Heat radiation, energy loss greenhouse

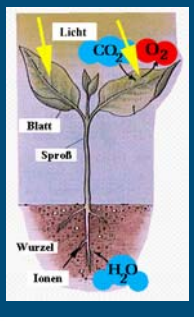
Light transmission

PAR light

- 400 – 700 nm = **PAR light**
- **PAR** = **P**hotosynthetic **A**ctive **R**adiation

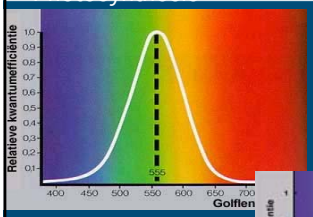


Photosynthesis



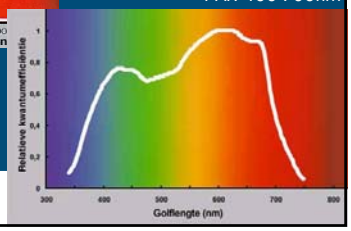
- CO_2 + water + light → sugar + O_2
- Lightreaction: absorption of lightenergy, transfromation into usable energy
- Darkreaction: energy is transformed into sugar
- Sugars are used for growth

Photosynthesis



Sensitivity of
'all' plants
= PAR 400-700nm

Sensitivity of
human eye
= visible light 380-780nm



Greenhouse coverings

- Glass
  - Floatglass – Greenhouse glass
  - White glass – Low-iron, Crystal Clear, Optiwhite, Clear glass, Ultrawhite, Diamantglas
  - AR glass – Coating or surface treatment, Sunarc AR glass, Centrosol HiT, GroGlass AR
  - Diffuse glass – surface treatment with different structures, Vetrasol, V&V diffuus, Centrosol Struktur

Light quantity

Light transmission >75%

The Netherlands

Spain

More light

More light by…

- Advanced covering material
  - White glass (+1-2%)
  - AR glass (+5-7%)
  - ETFE (+3%)
- Lighter construction (max +1-5%)
- Roof angle (<1%)
- Greenhouse orientation (+1-2% yeararound)
- Cleaning (up to 10%)
- Less installations (+1-3%)

Light transmission

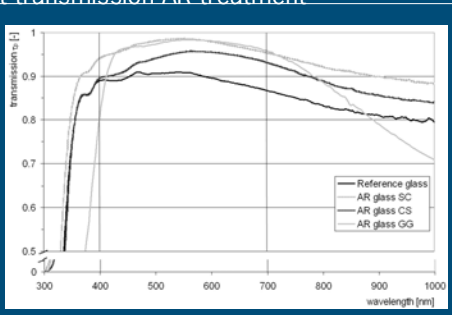
Material	thickness	light transmission	
		perpendicular	hemispherical
Floatglass	4 mm	89-90%	82%
White glass	4 mm	90-91%	83%
AR glass	4 mm	95-97%	89-90%
Diffuse glass	4 mm	90-91%	76-82%
PE / EVA films	200 µm	85-90%	78-82%
ETFE (F-Clean)	100 µm	93%	86%
PC sheet	12 mm	80%	61%
PMMA sheet	16 mm	89%	76%

Light transmission AR treatment

	Type glass	Type coating	Transmission perpendicular $\tau_{PAR,n}$ [-]	Transmission hemispherical $\tau_{PAR,h}$ [-]
CS	greenhouse glass basic single	no	0,893	0,824
CS	greenhouse glass basic single	AR-AR	0,942	0,893
CS	greenhouse glass basic double	no	0,808	0,716
CS	greenhouse glass basic double	AR-AR-AR-AR	0,897	0,822
CS	greenhouse glass low-iron single	no	0,910	0,844
CS	greenhouse glass low-iron single	AR-AR	0,969	0,911
CS	greenhouse glass low-iron double	no	0,840	0,751
CS	greenhouse glass low-iron double	AR-AR-AR-AR	0,929	0,860
SA	greenhouse glass 90+ single	no	0,903	0,832
SA	greenhouse glass 90+ single	AR-AR	0,970	0,906
SA	greenhouse glass 90+ double	no	0,824	0,732
SA	greenhouse glass 90+ double	AR-AR-AR-AR	0,942	0,836
GG	greenhouse glass 90+ single	no	0,903	0,832
GG	greenhouse glass 90+ single	AR-AR	0,966	0,906
GG	greenhouse glass 90+ double	no	0,829	0,732
GG	greenhouse glass 90+ double	AR-AR-AR-AR	0,934	0,850

Dubbel glas → -10% **AR → +3.5 – 7.0%**
Dubbel AR → = enkel glas

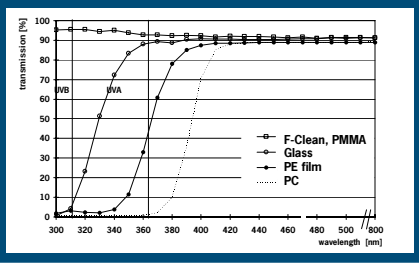
Light transmission AR treatment



UV in the greenhouse

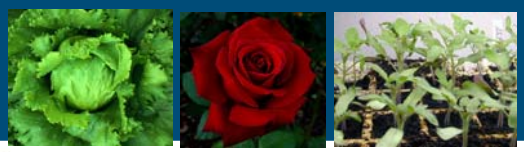
Light quality

- UV transmission of different materials



Light quality

- Use UV-block materials:
  - Dark red roses
  - Young plants
  - Leaf vegetable crops (salad etc.) – faster growth



Light quality

- Use UV-transparent materials for
  - plants which need hardening;
  - plants, which need UV for their colour (salad “lollo rosso”, aubergines, some flowers or flowering potplants);
  - plants, who need to grow compact (bedding plants, some potplants)
  - greenhouses where (bumble-) bees are needed!

Diffuse light

Light diffusion

Greenhouse covering materials are able to scatter light rays, transforming direct light into diffuse light

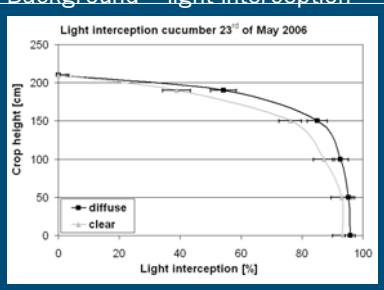
50% 0%

Haze

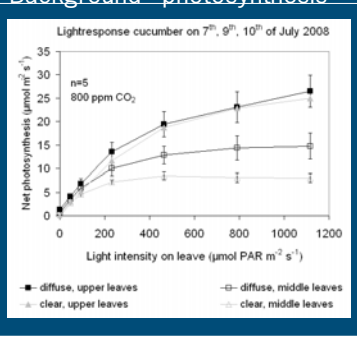
Light diffusion

- Vertical light distribution
  - Most light intercepted by upper leaves
  - Lower leaves contribute less to photosynthesis

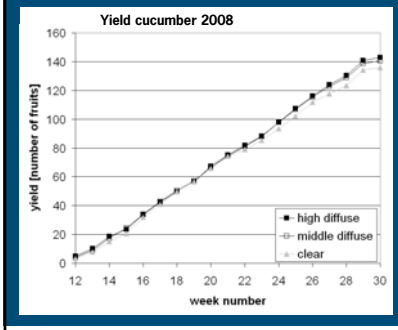
Background – light interception



Background - photosynthesis

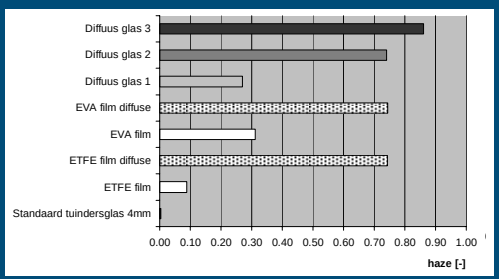


Background - yield



	more fruits
74% haze	9.2%
27% haze	6.5%
0% haze	-

Materials – haze and light transmission



Be careful with light losses at high haze factors

Questions?