



# Effect of clear and deffuse glass covering materials on fruit yield and energy efficiency of greenhouse cucumber grown in hot climate

Abdulaziz Alharbi, Jouke Campen, Mohamed Sharaf, Feije de Zwart, Wim Voogt, Kess Scheffers, Ilias Tsafaras, Mohamed E. Abdelaziz, Omer Babiker, Nazim Gruda, Muien Qaryouti, Khalid Al-Assaf

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## Background

The climate condition in Saudi Arabia demands greenhouses for year-round production cycle for the most needed vegetable crops. Plant production in the greenhouses might be affected by high solar radiation, resulting increase cooling load, leading to higher energy and water consumption. A proper greenhouse design and convenient covering materials would both exploit the external climatic conditions and create an effective indoor microclimate.

## Objective

This study was designed to evaluate the effect of clear glass, diffuse glass, and polycarbonate covering materials on greenhouse climate condition for, cucumber production, water and energy efficiency at the national research and development center for sustainable agriculture (Estidamah), KSA.

## Methods

Seeds of cucumber cv. Alfrid were sown in 15<sup>th</sup> and 8<sup>th</sup> of March and September 2017 and 2018, respectively. Seedlings were transplanted into rockwool slabs after 15 days to the main greenhouses.

## Greenhouse type

- Three different greenhouse compartments with a length of 40 m from pad to fan and 12 m width, gutters of 37 m length, 19 cm wide and 70 cm height above the ground, were used.
- The HortiMax computer system was used to operate fertilizers and drip irrigation applications.
- All greenhouse compartments were equipped with an automatically moving shading screen with a shading rate of 30 % and an evaporative cooling system.

## Covering materials

- The first compartment was covered by conventional tempered clear glass (4 mm) with the following properties: direct light %90, hemispherical %82, haze %0.
- The second was covered by a double layer of polycarbonate (16mm), with hemispherical %56.
- The third was covered with modern diffuse tempered diffuse glass (4mm) with the following properties: direct light %91, hemispherical %80, haze %75.

## Results

Table 1. Effect of different cover materials on total yield of cucumber cv. Alfrid

Greenhouse cover	Total yield (kg/m <sup>2</sup> )
Polycarbonate	4.8
Diffuse glass	7.5
Clear glass	7.3

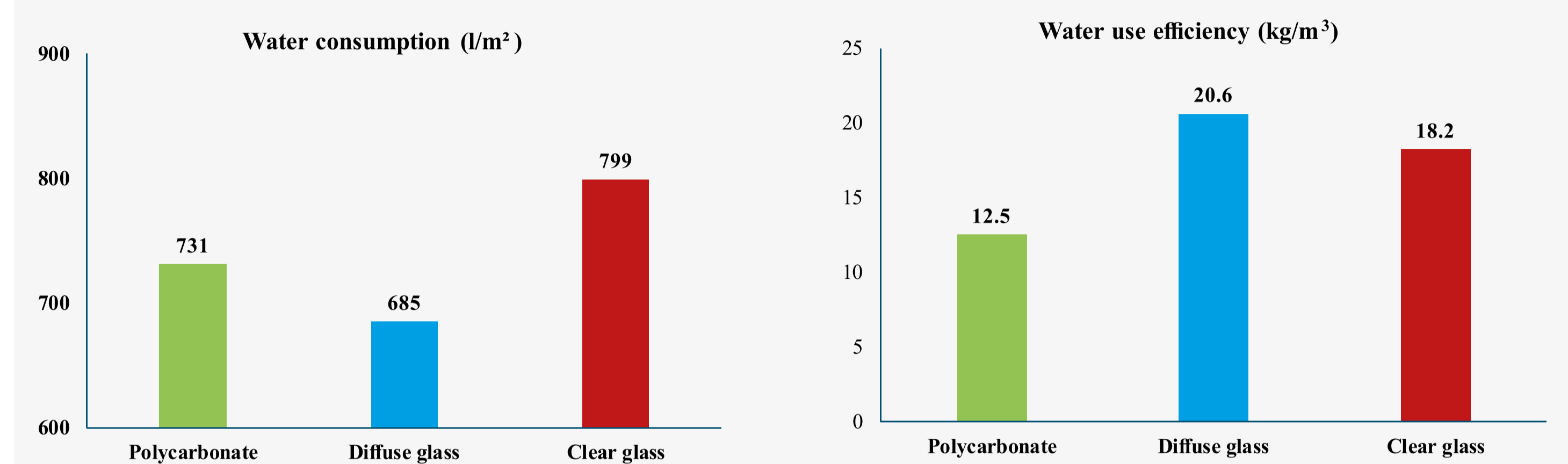


Figure 1. Water consumption and water use efficiency of cucumber plants grown under different three greenhouse covering materials during the two growing cycles.

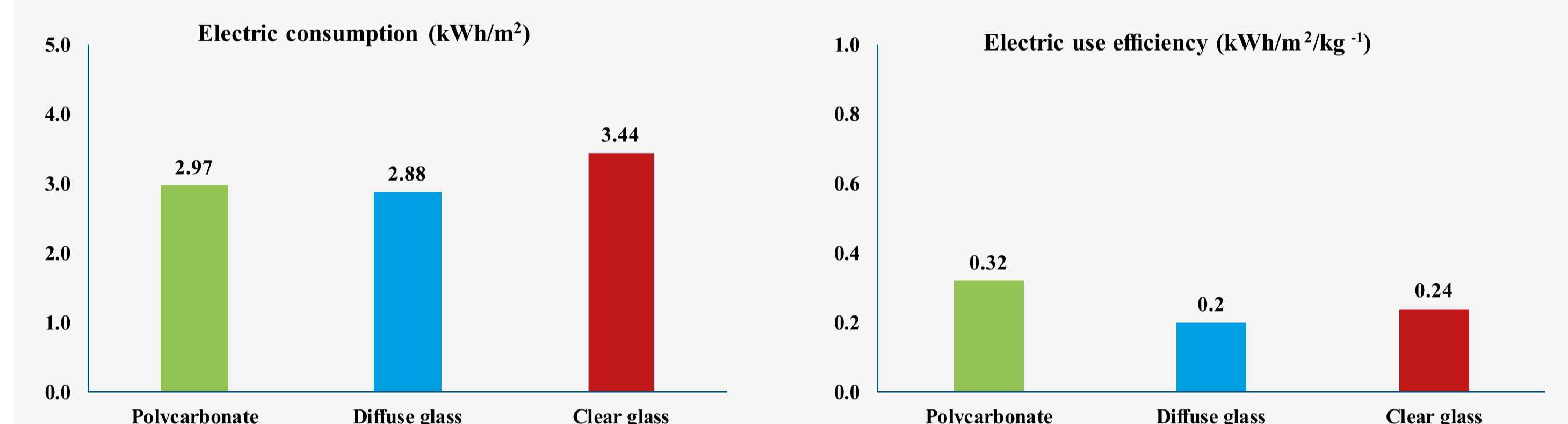


Figure 2. Electric consumption and electric use efficiency of cucumber plants grown under different three greenhouse covering materials during the two growing cycles

## Discussion

Fruit yield of cucumber (kg/m<sup>2</sup>) was significantly higher (%58) in clear and diffuse glass greenhouses as opposed to polycarbonate greenhouse.

Either water or light use efficiency was higher in compartments covered with diffused or clear glass than polycarbonate compartment.

Less light was transmitted through polycarbonate cover than clear or diffuse glass. The electricity consumption was 3.44, 2.97, and 2.88 kWh under polycarbonate, clear glass, and diffuse glass, respectively.

Diffuse glass compartment revealed %16 lower of water consumption than other covering materials.

## Conclusion

- High light transmissivity caused by diffuse and clear glass cover materials increased cucumber fruit yield up to %50 more than polycarbonate cover material.

Due to the high light intensity in Saudi Arabia, light does not limit photosynthesis.

Water and energy usage are more efficient when the greenhouse is covered by a material with higher transmissivity, either diffuse or glass cover materials.

