

In this post I share my experience with the semi-closed glasshouse. There is much confusion on how best to grow crops in a semi closed glasshouse, and this series of articles tries to clear up confusion, inspire new discussion and educate.

Keeping the Semi-Closed Glasshouse Cool

In the previous post we saw that a high fan speed has a negative effect on climate. But if air-exchange is our main means of cooling a glasshouse, how does a grower keep the semi-closed glasshouse cool? Besides fan speed and evaporative cooling there is one other important tool to keep the temperature low.

Excess Sunlight

The answer is shading. In a conventional glasshouse, shading is the least preferred method for cooling. It is easy to understand why. In cool climates the general perception is that 1% light equals 1% production. Shading takes away light and reduces yield. But what if you receive more than 3000 Joules of light in a desert or subtropical climate? Is the plant able to convert all those joules into grams of fruit? In general, growers now accept that a tomato plant needs 1700-2000 joules per day to achieve maximum production. Similar levels are true for peppers and lettuce. In fact, in the Dutch summers, the average light sum has a similar range. Growers in Australia receive almost twice as much light compared to growers in the Netherlands. But they struggle to achieve the Dutch yields. Still, they are reluctant to use shading because, because in a conventional glasshouse, the air exchange is impeded. The air underneath the screen becomes stagnant creating a poor climate for plants. In a semi closed glasshouse the air enters the glasshouse from below. When a shade screen is closed, the air is pushed through the screen (or a gap, see insert), to the vents and leaves the glasshouse. There is no staleness of the air, as the fans keep pushing the air up towards the vents. In fact, a shade screen acts as a membrane, distributing the air more evenly as it passes through the screen, creating a more even temperature. In a semi-closed glasshouse, air is always moving and activating transpiration.

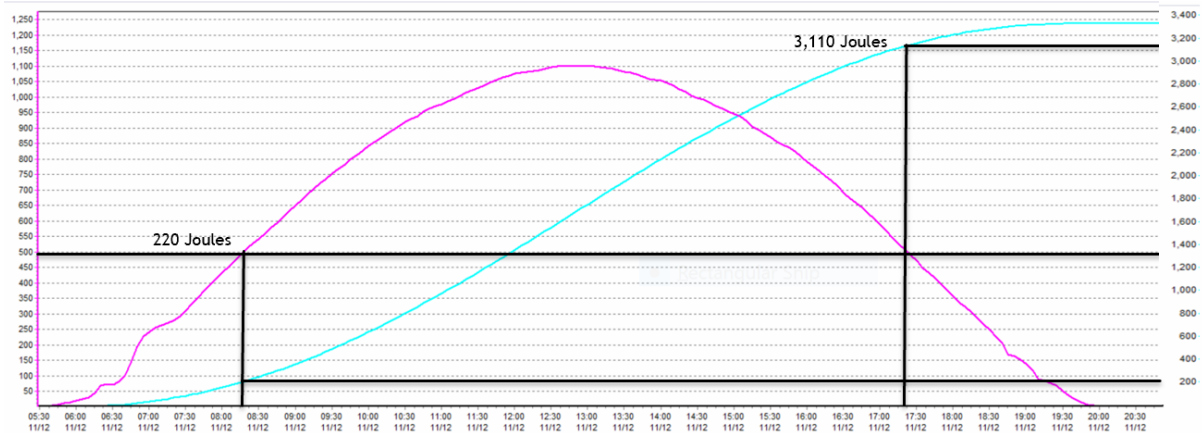
If we accept that 1800 joules are needed to achieve maximum production, shading is an excellent way to reduce the heat in the semi-closed glasshouse. Less heat coming into the glasshouse means less fan speed.

Can we reduce light and heat without losing yield?

GROWER TIP

Depending on the openness of the screen and the fan speed, a gap may need to be left in the screen so that the screen does not become a restriction to the airflow. If the screen is lifted against the top wires, this indicates that the screen restricts the flow and the gap needs to be increased.

To answer that question, let's consider a 3300 Joule day. This is very unusual in cool climates, but a frequent occurrence in warmer climates. The graph below shows a perfectly sunny day, reaching a maximum of 1100 watts light intensity (pink line, left hand scale) and a total light sum of more than 3300 joules (blue line, right hand scale).



The glasshouse already has 25% whitewash on the roof to reduce radiation and the grower has access to a 25% shade screen. The grower decides to close the screen at 500 watts. This might seem too aggressive, but let's try to calculate the amount of light that is shaded away. From sunrise to 500 watts, 25% of the accumulated is stopped from reaching the plants. The light sum at that stage is 220 joules, so 55 joules are blocked, and 165 joules reach the crop. At 500 watts the screens close and 50% of the light is blocked. In the table underneath the calculations are presented for the full day.

Light Period	Joules	Whitewash 25 % Shading	Screen 25% Shading	Light Transmission Total
Sunrise - 8.15 am	220	Yes	No	$220 \times 75\% =$ 165 Joules
8.15 am - 5.25 pm	$3,110 - 220 =$ 2,890 Joules	Yes	Yes	$2890 \times 75\% \times 75\% =$ 1,625 Joules
5.25pm - Sunset	$3,300 - 3,110 =$ 190 Joules	Yes	No	$190 \times 75\% =$ 142 Joules
Daily Total				1,932 Joules

It turns out that from the 3300 Joules of total light, the combined shading and screen blocks almost 1400 joules letting a respectable 1932 joules through for the plants. Experience has shown that this is enough for optimum production. More importantly, it allows the grower to stop the heat from the sun entering the glasshouse. A lower fan-speed can be maintained in combination with shading without yield loss and without making sacrifices to the climate.

When Should a Shade Screen be Used?

The key for the grower is that he needs to calculate when to use the screen. Gone are the days when we can set the screen to close at a certain light intensity. On a partly cloudy day he may need to close the screens at 600 or 700 watt, in order to still achieve 1800 Joules. A calculator in the

computer that automatically calculates the reduced Joules based on shading would be a welcome addition to any climate computer. Looking at the weather forecast is another important aspect to consider when to use screens. If, after a sunny morning a cloudy afternoon is expected, use of the screen may be better left until later in the morning (600-700 watts of radiation) to accumulate 1800 Joules.

Second Screen

In the semi-closed glasshouse, there is a distinct advantage in using a second screen. If in the example above a second screen was used instead of whitewash. More light can enter the glasshouse in the early morning and late afternoon. This allows for first shading at an even lower light intensity than 500 watts, further reducing the need to cool. Depending on location, the accumulated amount of shading can be as high as 60%, but with smart usage by the grower, this doesn't have to lead to production losses.

An interesting discussion point that follows from the use of screens is that if we use shade screens that diffuse light for most of the day, is there really any benefit in using diffuse glass in a semi closed glasshouse?

Previous Post

Thank you for all your comments and questions regarding the last post. There are still quite a few misconceptions about how the semi-closed glasshouse works and in my next post I will shed some more light (pardon the pun) on this.

If you like to be copied in on future articles or would like to know more and have questions, follow me on LinkedIn Godfrey Dol, or email Godfrey@glasshouse-consultancy.com.