REPORT 2013

EFFECT OF LIQUISOL SOLAR ON PLANT DEVELOPMENT AND GREENHOUSE TEMPERATURES

Trial 2013

BY ORDER OF THE SPONSOR :
TOM HUYSMANS
LIQUISOL
LINDBERG 52
2520 OELEGEM

REALIZED BY :
IR. TOM DECKERS, LIC. WIM VERJANS
PROEFCENTRUM FRUITTEELT V.Z.W. (PCFRUIT)
FRUITTUINWEG 1
B-3800 SINT-TRUIDEN

2013 OCTOBER 25TH

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1. TRIAL INFORMATION

1.1. GREENHOUSE

The greenhouse is located at pcfruit vzw (Kerkom, Sint-Truiden). It was constructed in 2008.

Properties

Single glass
Heating/cooling : with heated/cooled air with a flow rate between 525 m³ and 1575 m³/hour per compartment.

Dimensions : compartment

Ground surface : 6x3 meter
Height : 4 meter (without roof)
: 4.8 meter (with roof)

Glass surface

Facade and rear glass (between outside and compartment) : 2 x 13.2 m²
Sidewall glass (between 2 compartments) : 2 x 24 m²
Roof area (treated area in compartment 5) : 20.4 m²

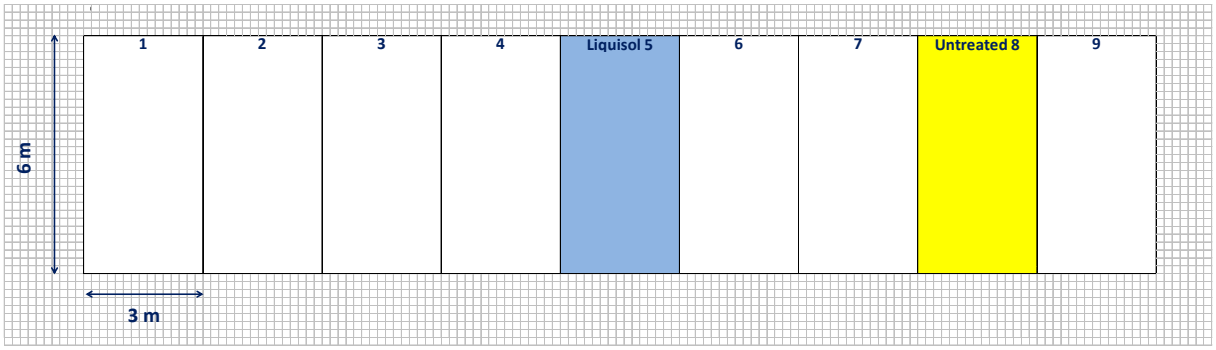

Figure 1 . The greenhouse exists out of 9 identical individual compartments. Two compartments are used in the trial where compartment 5 (blue) is Liquisol treated and compartment 8 (yellow) is untreated

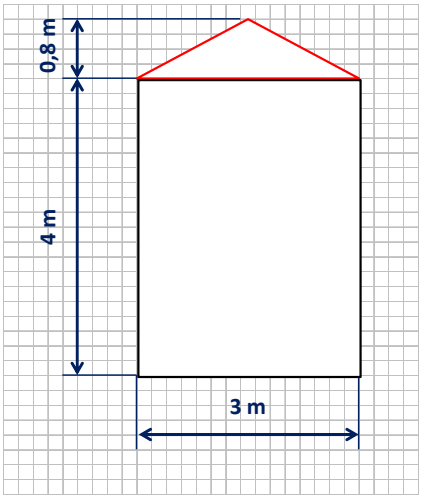

Figure 2 : Front view of a single compartment. The Liquisol treated glass is marked in red.

1.2. LIQUISOL APPLICATION

The Liquisol application of compartment 5 was done by Tom Huysmans of Liquisol on 19/02/2013. It was one layer of Liquisol 4 EVERgreen that was applied on the glass of the roof.

1.3. PLANT INFORMATION

1.3.1. Strawberry

On 31/01/2013 we planted 40 strawberry plants in small pots. All the plants were placed in compartment 8 of the greenhouse.
Pot dim. : 11 x 10 x 10 cm. (760 ml)
Plant : Strawberry plants cv. Elsanta (refrigerated plants)
On 19/02/2013 the plants were divided over 2 compartments.
Compartment 5 (treated with Liquisol)
Compartment 8 (untreated)
The strawberry plants had 2 general treatments with insecticides.
1/4/2013 : Calypso (against leaf aphids)
8/4/2013 : Masai + Vertimec (against spider mites)

1.3.2. Bean

On 31/01/2013 Beans were sowed in 50 small pots. 2 Beans per pot were sowed, when both seeds germinated 1 plant was removed.
Pot dim. : 10 x 9 x 9 cm.
Plant : Bean seed cv. Prelude
On 19/02/2013 the plants were divided over 2 compartments.
Compartment 5 (treated with Liquisol)
Compartment 8 (untreated)
Because no pests were observed on the plants there were no general treatments on the bean plants.

1.4. COUNTING METHODS FOR PLANT DEVELOPMENT AND CHLOROPHYLL CONTENT

1.4.1. Strawberry

Yield	:	weight and number of fruits per picking date
Vegetative growth	:	plant height (average)
		Average number of runners per plant
		Average number of daughter plants per plant
Chlorofyll content	:	Measurement with Hydro N tester.
		Young leaf : 2 x x30 measurements
		Old leaf : 2 x 30 measurements

1.4.2. Bean

Yield	:	weight per picking date
Vegetative growth	:	plant weight (without beans)
Chlorofyll content	:	Measurement with Hydro N tester.
		2 x 30 measurements ON each assessment date

1.4.2.1. Chlorophyll content measurement Hydro N tester

Measuring transmittance (T) of leaf at two wave lengths
* $T = I/I_0$
* Red 650 nm : absorption from chlorophyll
* IR 940 nm : reference, adjusting for non-specific interactions of samples (leaf thickness)

Calculation of a relative Hydro N value from the two transmittance values
* This value is proportional to the chlorophyll content in the leaf
* Hydro N and SPAD meter are the same devices and the obtained values can be converted exactly. SPAD = (N-tester + 90)/15

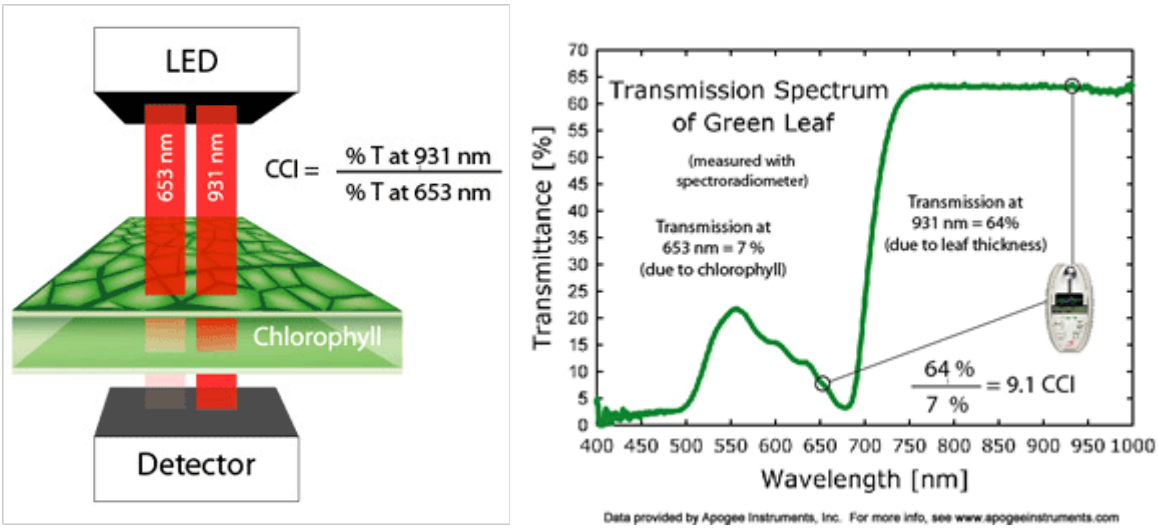

Figure 3 : Chlorophyll content meter from Opti-sciences. Principle is the same but wave lenghts and CCI calculation are different from Hydro N and SPAD.

2. INFLUENCE OF LIQUISOL SOLAR CONTROL DURING WINTER AND EARLY SPRING ON PLANT DEVELOPMENT

In figures 4 and 5 the climate conditions outside during the trial period are shown. It was a dark, rainy spring in 2013. This was very good in terms of the trial. Partially blocking the sunlight will have the most effect on plant development when the natural conditions are already low on radiation.

During the period we used the system of heating/cooling to get a constant temperature of 20°C. It was important to keep the same temperature in both compartments, so that differences in plant development were due to radiation which is different in both compartments. During the period 19/02 till the beginning of March the temperature was appr. 3°C lower in compartment 5 than in compartment 8. From 5 March the temperatures in both compartments stayed the same till the end of the experiment (11/05/2013).

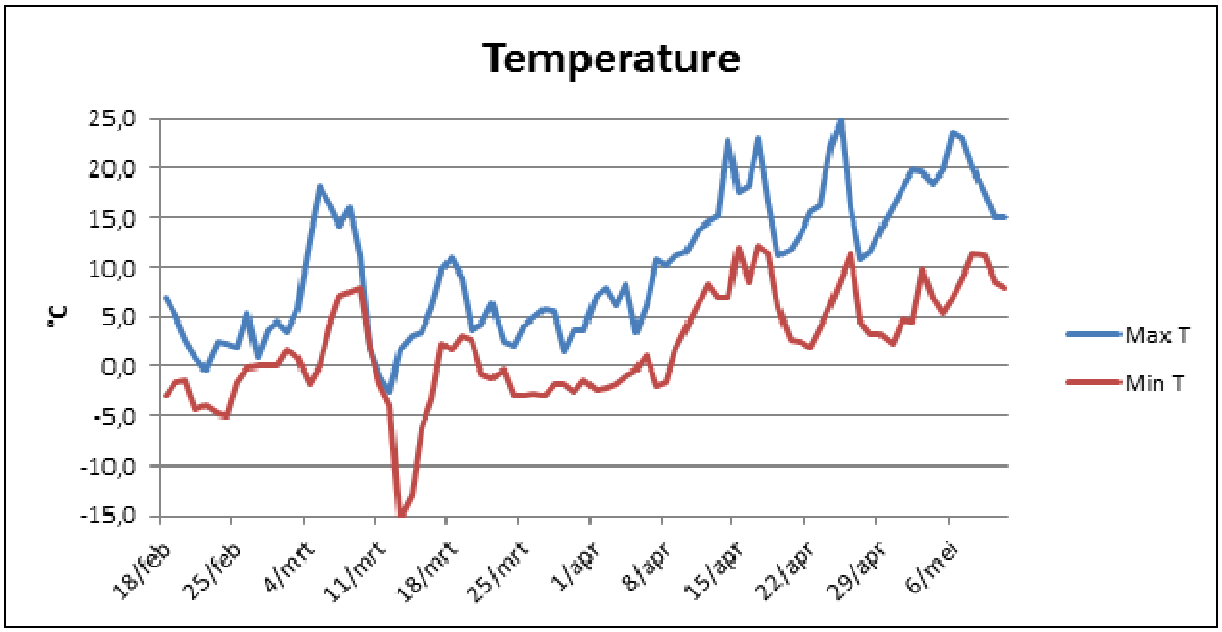

Figure 4 : Ambient minimum and maximum temperature.

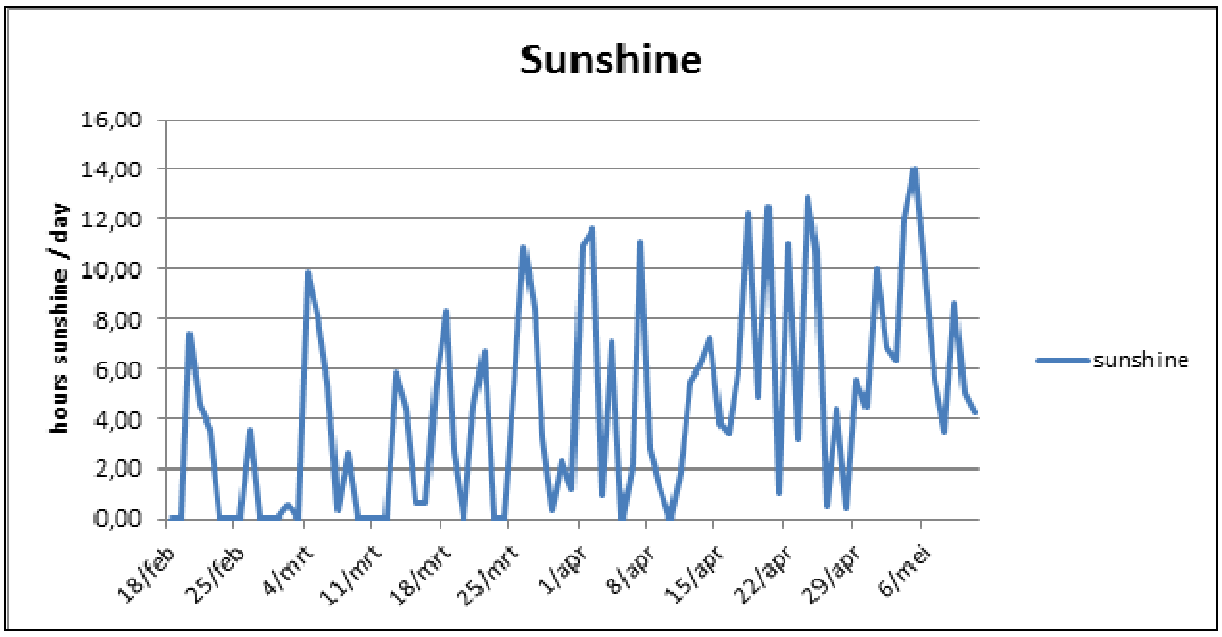

Figure 5 : Hours of sunshine per day from 18 February till 11 May.

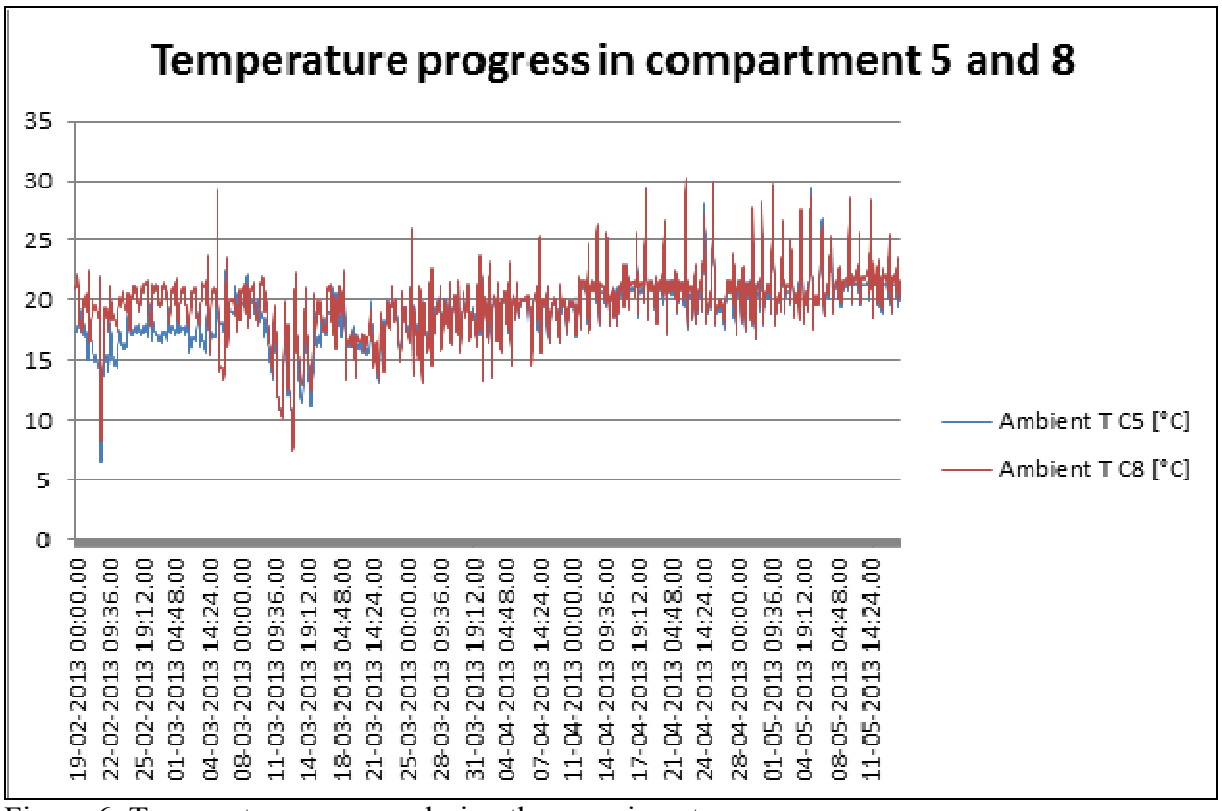

Figure 6 :Temperature progress during the experiment.

2.1. STRAWBERRY PLANTS

- Hydro N measurement (chlorophyll content) on young leaves : 2 x 30 measurements

	5/03/2013	14/03/2013	22/03/2013	11/04/2013
GC 5 : Liquisol	422.7	432.5	434.5	436
GC 8 : Untreated	424	427	426.5	441.5

GC = Greenhouse Compartment

- Hydro N measurement (chlorophyll content) on old leaves : 2 x 30 measurements

	5/03/2013	14/03/2013	22/03/2013	11/04/2013
GC 5 : Liquisol	682.3	672	679.5	693
GC 8 : Untreated	683.7	677.5	654.5	691.5

- Mean plant height

	4/04/2013
GC 5 : Liquisol	27.6 cm
GC 8 : Untreated	23.8 cm

- Mean runners (daughter plants) per plant

	15/05/2013
GC 5 : Liquisol	2.43 (3.05)
GC 8 : Untreated	1.89 (2.79)

- Yield (weight and number of fruits)

	weight (gram)							
	26/04	**29/04**	**3/05**	**6/05**	**11/05**	**15/05**	**21/05**	**Total**
GC 5	0	14	141	350	872	529	789	2695
GC 8	150	158	260	365	554	820	670	2977

	Number of fruits							
	26/04	**29/04**	**3/05**	**6/05**	**11/05**	**15/05**	**21/05**	**Total**
GC 5	0	1	9	19	66	34	68	197
GC 8	14	19	20	21	34	61	42	211

During the Hydro-N measurements, a difference was made between old and young leaves. At the 4 observation dates, no differences were observed for the old nor for the young leaves. This indicates that there is no influence on the amount of chlorophyll which is present in the leaves. The strawberry plants in the treated compartment show more vegetative growth. Here the vegetative growth was assessed by means of 2 parameters. In the first place the number of runners and daughter plants was counted. One can clearly see that there are more runners on the plants in compartment 5. The plant height too was on average higher in compartment 5 than in compartment 8.
In compartment 8 flowering was a few days earlier than in compartment 5. Also at harvest this advance remained and more fruits were harvested in compartment 8 during the first 2 pickings. At all later picking dates about the same amount of fruits was picked and there is hardly a difference in total yield. On 21/5 the plants were removed.

2.2. BEAN SEEDLINGS

- Hydro N measurements : chlorophyll content (2 x 30 measurements)

	5/03/2013	14/03/2013	22/03/2013
GC 5 : Liquisol	272	330	359
GC 8 : Untreated	262	313	386

- Total plant weight (on the ground)

	22/04/2013
GC 5 : Liquisol	1280 gram
GC 8 : Untreated	1075 gram

- Yield (weight of beans)

	5/04	11/04	16/04	19/04	22/04	Totaal
GC 5	24 g	202 g	381 g	295 g	395 g	1297 g
GC 8	448 g	308 g	255 g	137 g	100 g	1248 g

No clear differences were observed in the chorophyll content of the leaf between the bean plants in compartments 5 and 8. The plants in compartment 5 showed more vegetative growth than the plants in compartment 8. This is also observed in the total plant weight which is clearly higher in compartment 5. Total yield was equal in both compartments but the first harvest was bigger in compartment 8. Flowering too was one week earlier, possibly caused by the slightly higher temperature in compartment 8 during the first 10 days.

2.3. CONCLUSION

There were no differences in production or chlorophyll content of the leaves. There is no influence of the Liquisol treatment on these parameters, even not during the cloudy spring period.
There is a small effect on the vegetative growth in both the strawberries and the beans. This was more in the Liquisol treated compartment.

3. INFLUENCE OF LIQUISOL SOLAR CONTROL DURING LATE SPRING – SUMMER ON GREENHOUSE TEMPERATURE.

3.1. RESULTS

During the period from 3rd June 2013 till 19th June 2013 the evolution of temperature was followed in compartment 5 (Liquisol) and compartment 8 (untreated) of the greenhouse without any kind of heating or refrigerating.
In this period there was sunshine in two warm periods (from 5/6 till 8/6 and from 17/6 till 19/6).

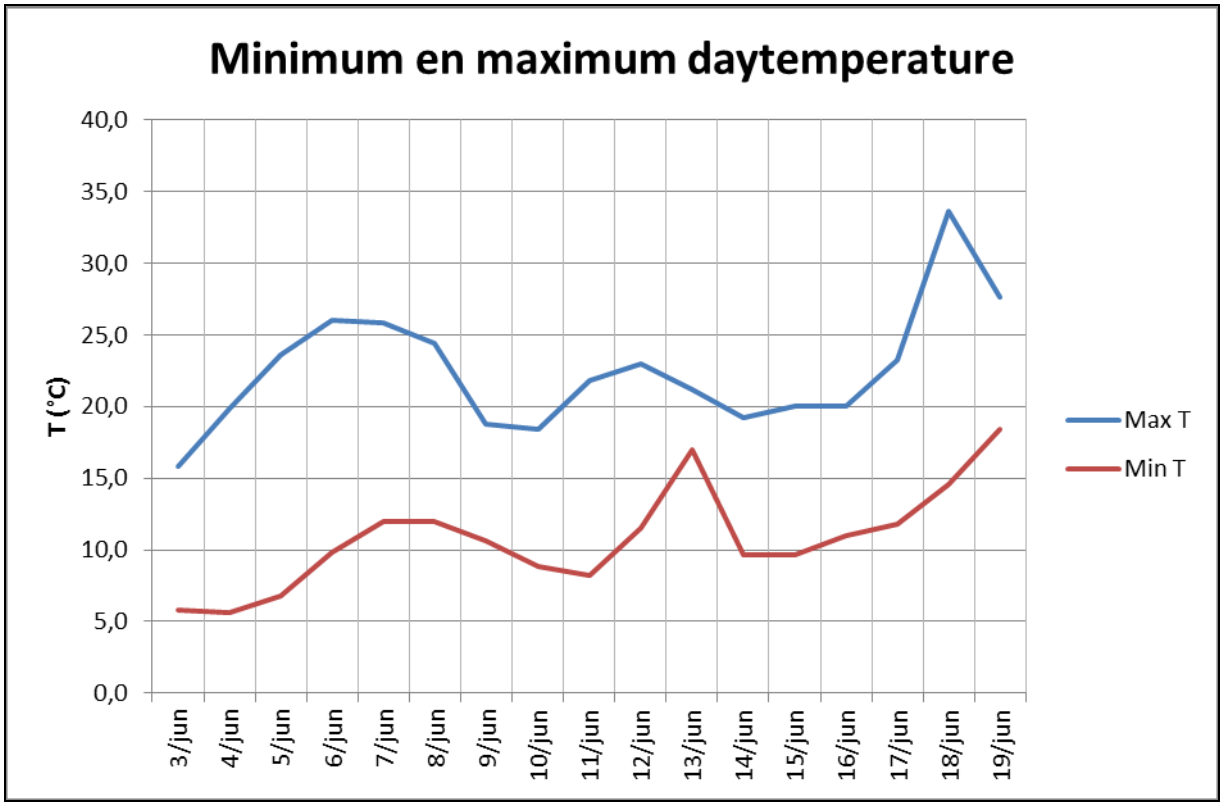

Figure 7 : Minimum and maximum ambient temperature in the period in which temperature was followed in the greenhouse.

In this period temperature was registered every 32 minutes in both compartments 5 and 8. The table beneath shows the evolution of temperature in both greenhouse compartments. This figure clearly illustrates that the maximum temperature in compartment 8 is always a few degrees higher than in compartment 5, the roof surface of which was treated with Liquisol. Table 1 shows that the maximum temperature measured is 3.5°C lower in the compartment with the Liquisol treated roof surface (compartment 5). It was also observed that the average maximum day temperature was almost 2.5°C lower than in compartment 5. The average minimum temperature is one degree higher in compartment 5. This results in an average difference between both compartments of more than 3.5°C in maximum and minimum temperature.

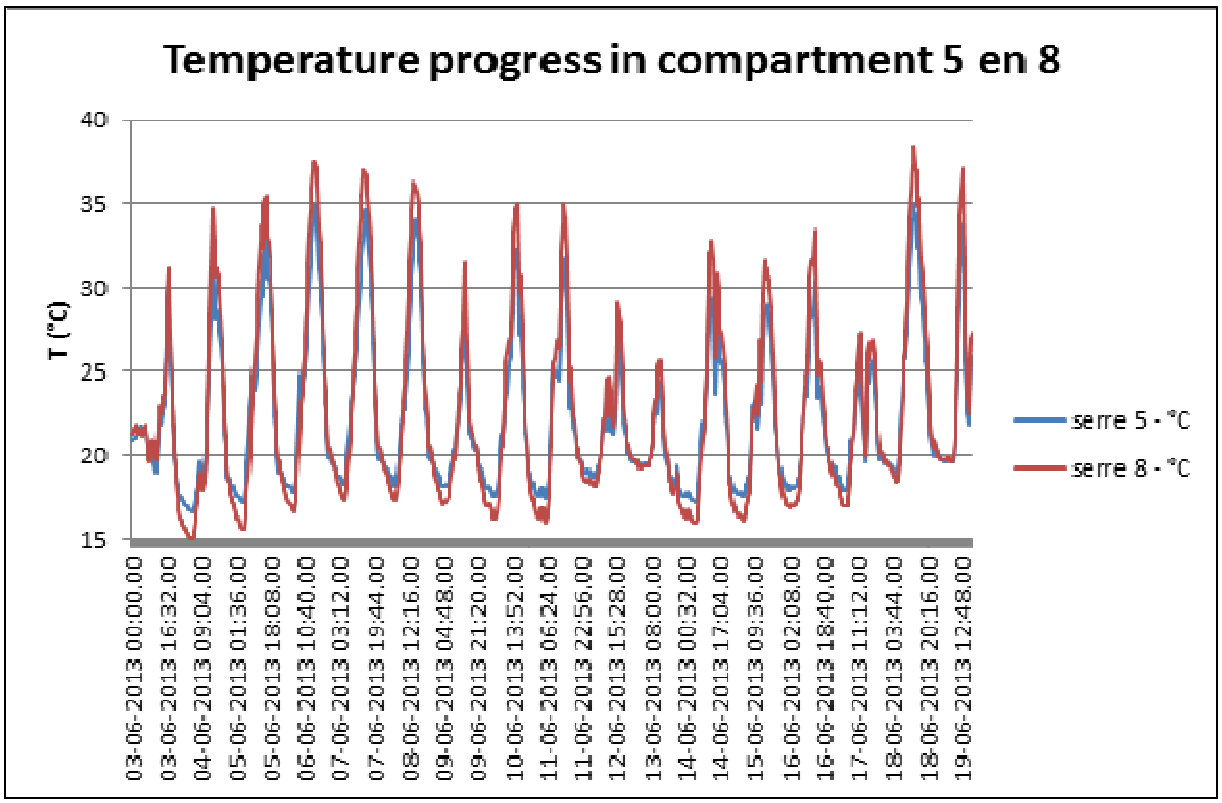

Figure 8 : The temperature in compartments 5 and 8 during the period from 03/06/2013 till 19/06/2013

Table 1

	Compartment 5 (Liquisol)	Compartment 8 (Untreated)
Average T (°C)	22.35 °C	22.83°C
Maximum measured T (°C)	35 °C	38.5 °C
Average minimum day T (°C)	17.88 °C	16.81 °C
Average maximum day T (°C)	31.12 °C	33.59 °C
Average difference between max. day T and min. day T. (°C)	13.24 °C	16.77 °C

3.2. CONCLUSION

The data above indicate that the maximum peaks on sunny days are 3.5 °C lower in a greenhouse compartment where the roof surface is treated with Liquisol. On (partly) cloudy days this difference is smaller.
Despite the fact that the maximum temperature is situated considerably lower in compartment 5, this certainly isn't the case for the minimum temperature at night. The treatments with Liquisol don't give lower but rather higher night temperatures in this trial (1 °C higher on average).
Due to both effects there are smaller temperature changes in compartment 5 in comparison with compartment 8.
The average temperature in compartment 5 decreases only a little bit when compared with compartment 8 (about 0.5°C).
As the treated roof surface of these compartments is relatively small in comparison with the untreated side walls, this means a considerable decrease of the peak temperatures. When treating a greenhouse with a large roof surface the effect of this treatment will be even bigger because the relative share of the glass surface in the side walls decreases. Also in case of a treatment of the total greenhouse (roof + side walls) the effect will be even more considerable.