Agam Greenhouse Energy Systems Ltd.

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Test of Agam's VLHC (Ventilated Latent Heat Converter) machine in Arava R&D center Nov. 2008 – Feb. 2009

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Background

Arava valley is the largest export oriented center for winter growing crops with 1400 Hectare of pepper greenhouses and 600 Hectare of tomatoes and other vegetable.

Agam VLHC dehumidifier was introduced to a 1000 square meter Pepper greenhouse No. 3 (GH3) at the R&D Arava tests center (see Picture in page 1) Water heater provided the heat to Agam unit.

Identical 1000 square meter of pepper greenhouse No 9 (GH9) (orange in the graph) used as a reference to Agam's. The reference GH was heated by hot water pipes with separate hot water heater. The tests run from Nov. 2008.

In Feb. 14 2009 two calorimeter introduced into the two GH where hot water temperature and flow rate recorded in a 10 minutes intervals (see Excel table Heating profile.)

Temperature and humidity probes were located at the center of each GH at a 2m height. The climate conditions recorded at 20 minutes intervals (see Excel table below). Ambient temperature and humidity conditions were measured in a meteorological station near the tested greenhouses.

Additional greenhouse (GH 5) kept without heating and without screen (colored yellow In the graphs)

The walls in greenhouses 3, 9, and 5 were ventilated due to gaps left between the moving curtains and the stationary walls.

Tests procedure

At mid Feb., two calorimeters recorded the heat introduces into GH 3 and GH 9 in 10 minutes intervals. In the table bellow, we compared 5 nights where the thermal screens and wall curtains (see picture above) where closed in the two greenhouses from 17:00 in the evening to 07:00 in the next mornings. Temperature and humidity recorded in 20 min. intervals at GH 3 (Agam), GH 9 (Hot water pipes) and ambient meteorological units.

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Humidity

The average and maximum humidity are given in the two charts + tables bellow.

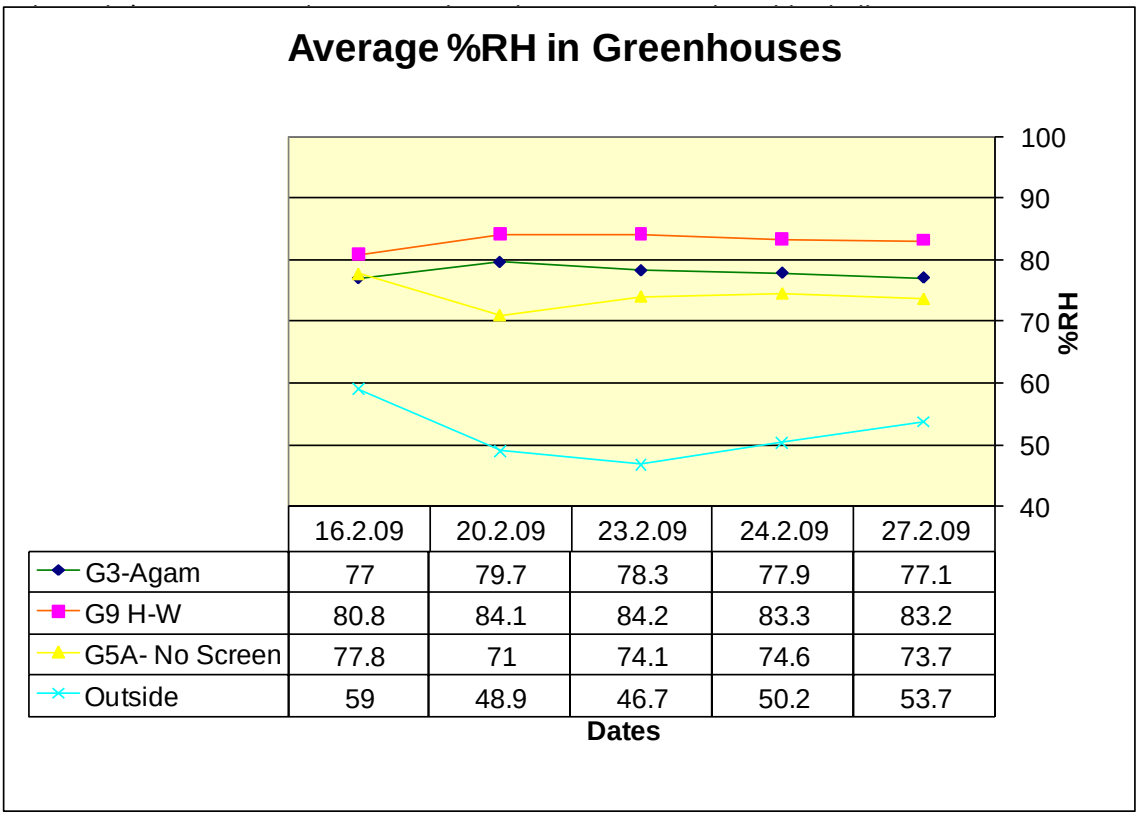
In greenhouse 3- average humidity in the 5 nights was 78% and maximum humidity was 82%.

In greenhouse 9- average humidity was 83.2% and maximum humidity 88%.

In GH 5 yellow charts (no heating) humidity follow the outside humidity, which farther indicate the roll of ventilation in reducing humidity.

Agam units keep the humidity level 5% bellow greenhouse 9 with hot water heating. The maximum humidity in greenhouse 9 is close to the limit above which humidity prompted condensation and plant disease. Therefore the ventilation in greenhouse 9 is important to keep humidity at the design value.

The basic data collection of humidity is given in the attached excel table Humidity profiles.



	16.2.09	20.2.09	23.2.09	24.2.09	27.2.09
G3-Agam	77	79.7	78.3	77.9	77.1
G9 H-W	80.8	84.1	84.2	83.3	83.2
G5A- No Screen	77.8	71	74.1	74.6	73.7
Outside	59	48.9	46.7	50.2	53.7

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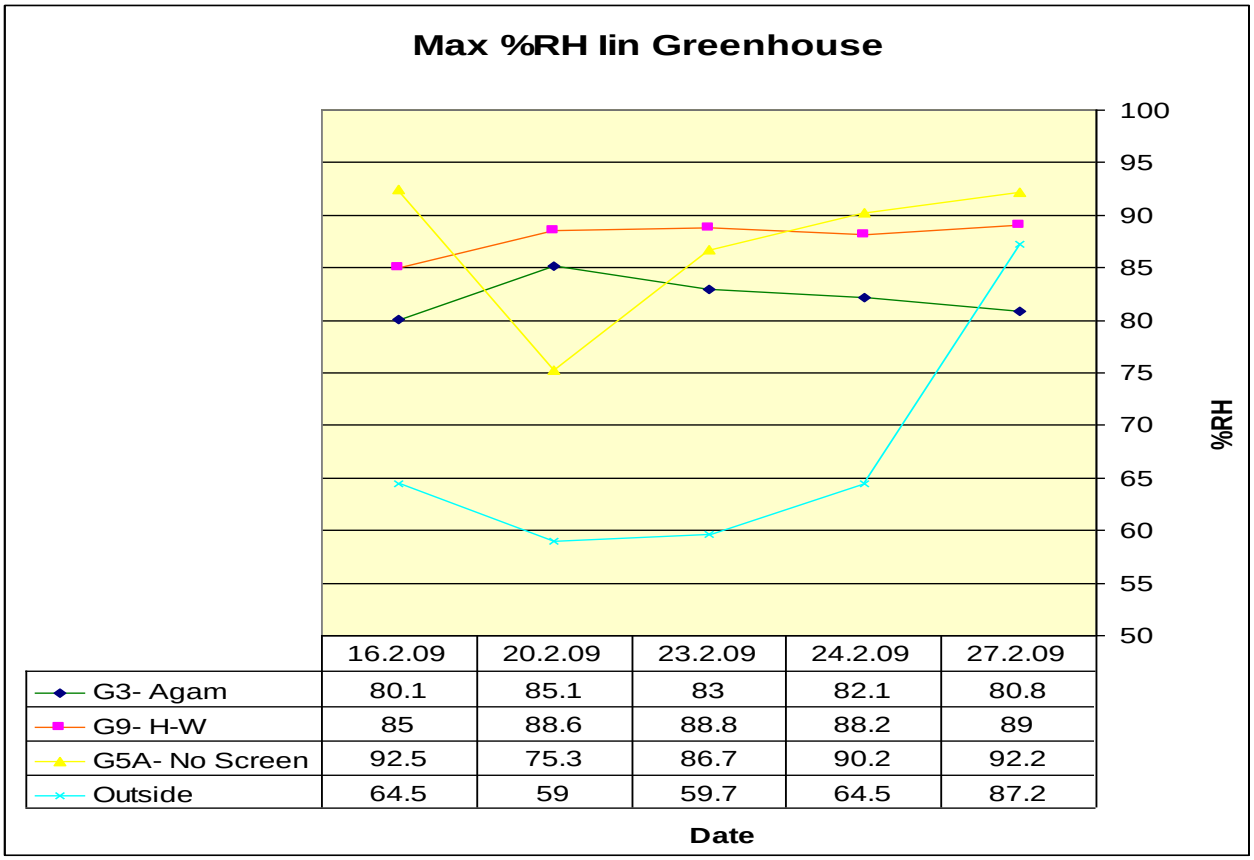

	16.2.09	20.2.09	23.2.09	24.2.09	27.2.09
G3- Agam	80.1	85.1	83	82.1	80.8
G9- H-W	85	88.6	88.8	88.2	89
G5A- No Screen	92.5	75.3	86.7	90.2	92.2
Outside	64.5	59	59.7	64.5	87.2

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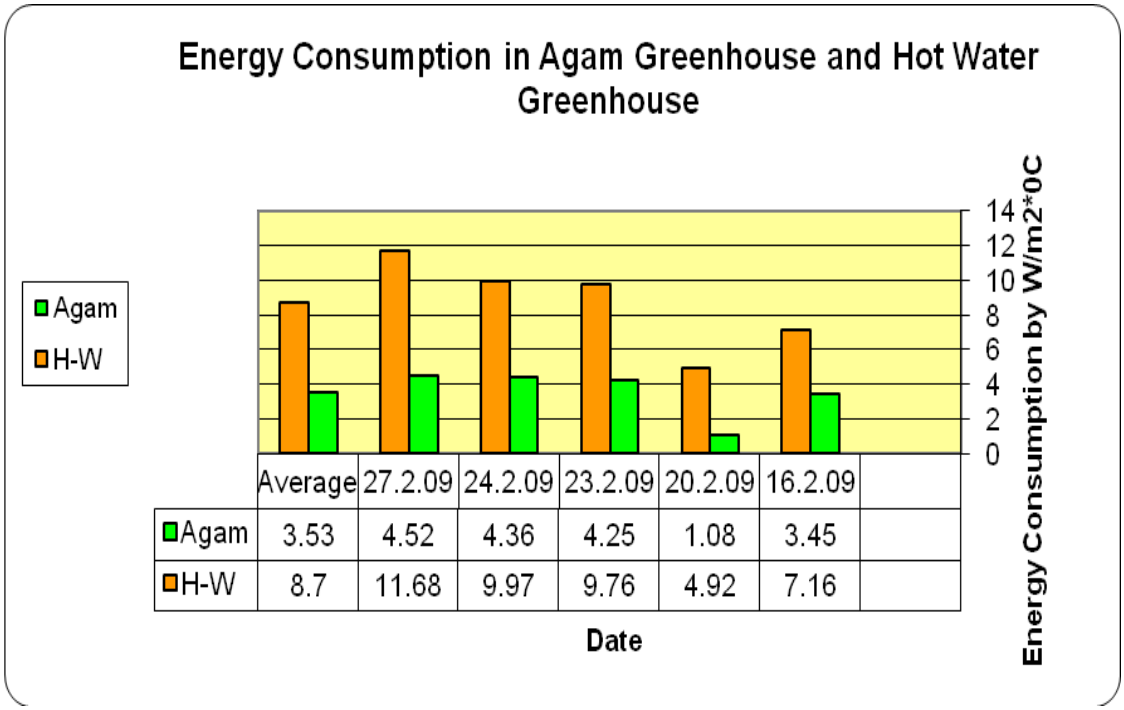
Energy used

The inside air temperature tables are given in the attached excel table "Temperature profiles" in greenhouses 3 (Agam), 9 (Hot water) and ambient. The calorimeter data is given in Excel table "Heating profiles".

Applying the calorimeters recorded data for the 2 greenhouses we obtain heating energy in kWh . Thermal gradient (Degree-Hours) was calculated for each greenhouse and each night. The energy dissipation was calculated by divided the heating energy by the greenhouse area (1000 square meter) and by degree-hours to yield the heat conductivity ($W/m^{2}*^{0}C$).

The results are given bellow:



	Average	27.2.09	24.2.09	23.2.09	20.2.09	16.2.09
Agam	3.53	4.52	4.36	4.25	1.08	3.45
H-W	8.7	11.68	9.97	9.76	4.92	7.16

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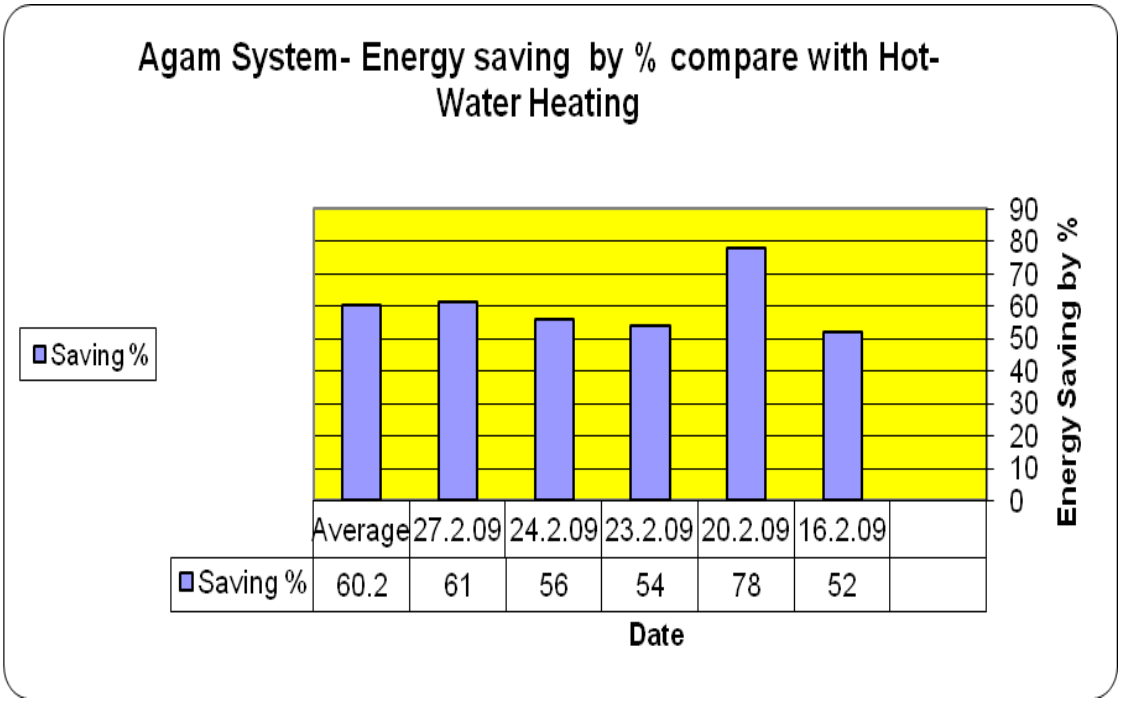
The energy saving of Agam systems is given bellow:



Summary

Agam unit kept the average greenhouse humidity at 78% compared with 82% in the greenhouse heated by hot water pipes. The maximum humidity was 83% in Agam's green house as compared with 88% at the hot water heating greenhouse.

The average energy saving in Agam's greenhouse was 60%.

Thus Agam's unit keeps plant diseases induces by humidity away, and reduces fuel consumption to 40% of its present use.

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