

# GROW VEGETABLES WITH THE BEST OF MOTHER NATURE, a GREENHOUSE and a NETHOUSE using RETRACTABLE ROOF GREENHOUSES!

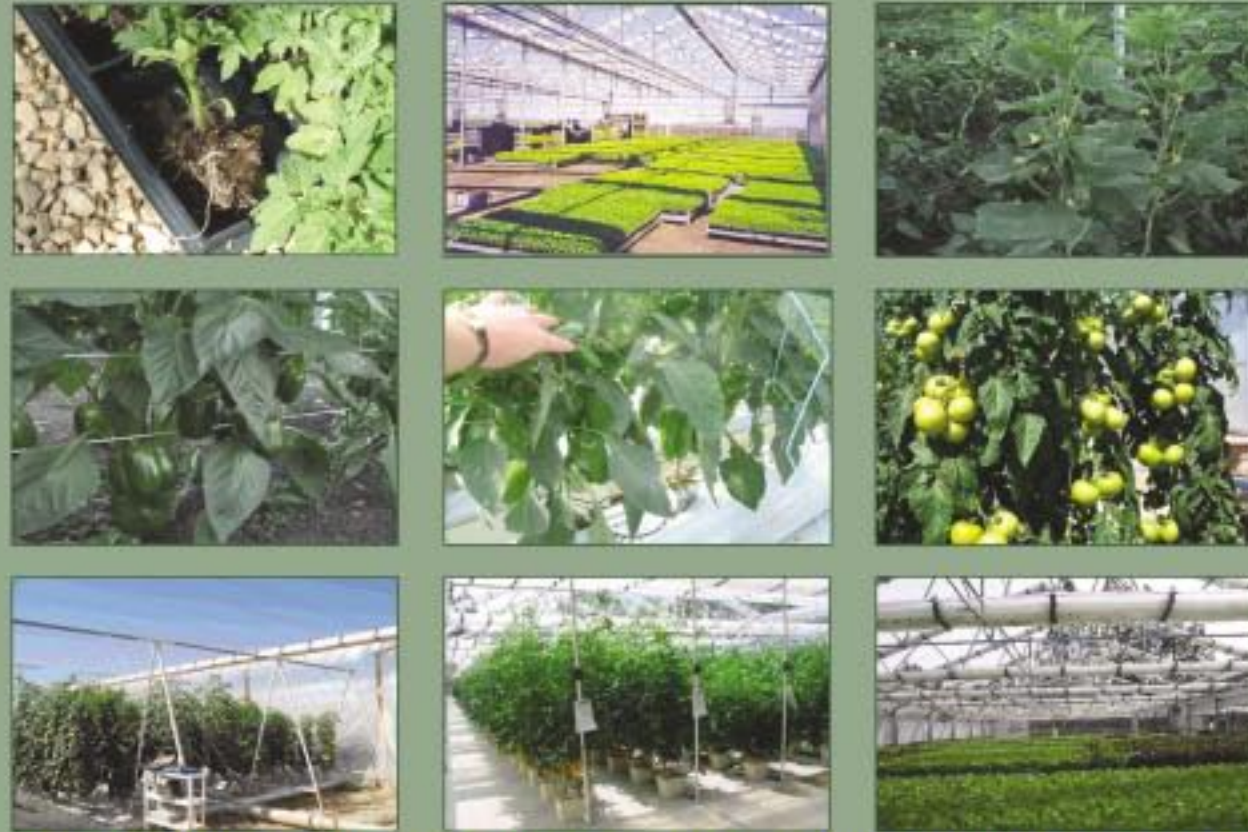
When the outside temperature is below 16C (61F) or when it is raining or windy, protect the plants by closing the roof.



## BENEFITS

- Minimum plant temperatures are maintained to maintain plant growth
- Damage from excessive wind is prevented
- Damage from excessive rain is prevented
- Roof could be left open during rain to assist in leaching of salt build up in the soil media
- Curtain system provides extra energy efficiency during cold conditions

When the outside temperature is between 17C (62F) and 32C (90F), take advantage of the natural outdoor conditions by retracting the roof.



**Fixed or retractable insect net increases crop management options!!!**  
Protect from pests while still getting the benefits of the outdoor environment.  
Retracting the net when pest pressures are low increases yields!



## BENEFITS

- Plant growth is increased due to increase in light, CO2 and transpiration
- Increased transpiration increases fruit production, improves nutrient absorption and distribution preventing blossom end rot
- It is easier to manage the plant since irrigation intervals will be increased compared to when the roof is closed
- Higher transpiration increases development of wax on leaves, growth of roots, increases oxygen availability to roots
- Plants develop more wax on leaves providing greater insect resistance. Diseases like botrytis and powdery mildew are reduced due to increased UV sunlight, reduced humidity and rapid drying of leaves
- Plants can be easily cooled to slow down growth or increase fruit sweetness.
- Labour costs are reduced due to shorter internode lengths and reduced need for leaf pruning.

When the outside temperature is greater than 33C (92F), protect the plants by closing the roof 85%



## BENEFITS

- Sunlight is diffused reducing overheating of upper leaves, and distributing light to lower leaves
- Closing roof and curtain in opposite direction maximizes air exchange to maintain best possible air temperatures
- Helps prevent overheating of leaves, fruits and soil media when roots are in a container
- Transpiration rate is reduced preventing sunburn, reducing water usage
- Fog or mist systems can help reduce air temperatures and transpiration

## OVERALL BENEFITS

- Faster return on investment
- Increases fruit size, sugar content and shelf life
- Improves effectiveness of biological controls
- Easier to grow organically
- Easier to time crop to realize best prices
- Roofs are resistant to high winds, and hail
- Can choose to grow in warmer climates to minimize heating costs



2036 Nevada City Hwy. #214  
Grass Valley, CA 95945  
www.foreverflowering.net  
1-888-78-G-HOUSE



# Tomato yields were 140% higher in a Retractable Roof Greenhouse though the capital investment was 56% less!

## Open Field



Plants develop naturally as the seasons change. Quality and yield is reduced by excessive cold, wind, rain, heat and insects.

When exposed to the natural outdoor conditions plants experience normal transpiration rates causing plants to develop a natural balance between roots, leaves and fruit. The optimal transpiration rates on a sunny day cause plants to develop thick wax cuticles which in turn helps plants defend themselves against insects and disease.

However, excessive leaf and fruit temperatures resulting from direct sunlight on hot days causes plants to experience excessive transpiration rates and fruit temperatures causing plants to stay smaller and fruits to be sun-burned.

+/- 8 kg / \$ invested

## Conventional Greenhouse



Tomato yields are higher in a conventional greenhouse than open field since plants are protected from excessive cold, wind, rain and heat.

However, transpiration rates are very low compared to the natural outdoor environment. A low transpiration rate naturally causes a reduction in plant activity, excessive vegetative growth, nutritional deficiencies (ie blossom end rot), and a reduced resistance to insects and disease. Excessive vegetative growth necessitates leaf pruning.

Photosynthesis is also limited since the roof covering blocks up to 50% of the light, reduces available CO2, prevents soil temperature from warming up in the winter/spring, and prevents rain from leaching salts out of the soil.

+/- 0.8 kg / \$ invested

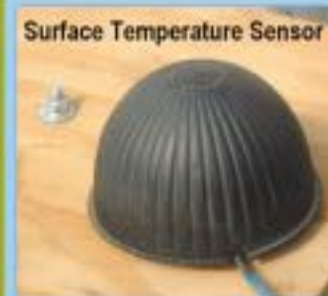
## Retractable Roof Greenhouse



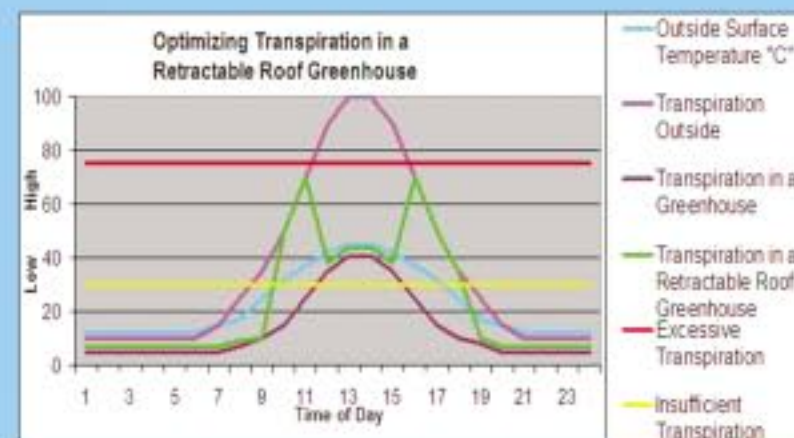
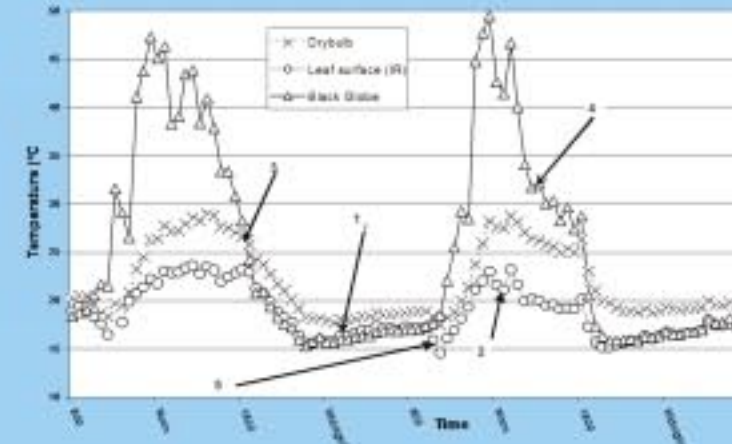
UNIVERSITY OF ARIZONA achieved 140% more tomatoes that were 38% larger with 10% more sugar and plants that were 30% shorter in the lowest cost retractable roof greenhouse compared to those in a high technology conventional greenhouse. The ability to close and retract the roof allowed the to take advantage of both the greenhouse and the natural outdoor growing conditions to better manage plant growth and development. The plants produced more fruit and fewer leaves compared to the conventional greenhouse. They did not fruit prune, did minimal leaf pruning and no manual pollination. These results were mostly due to the optimization of the transpiration rate causing the plants to develop fewer leaves and more fruit. Higher transpiration allows growers to better manage the plants since they can irrigate more often and modify nutrition rates.

+/- 1.5 - 3 kg / \$ invested

An outdoor surface temperature is the best way to open and close the roof to optimize the light levels, transpiration, and plant and soil temperatures



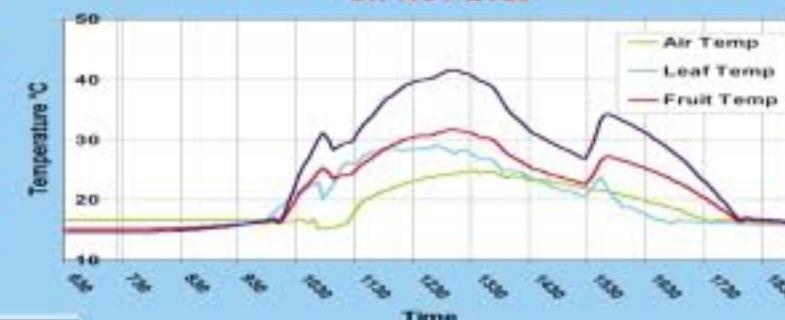
Open the roof based on an exposed sensor which incorporates the heating effects of direct sunlight. This sensor gives a more accurate picture of what a plant would be exposed to. Notice how surface temperatures are 22C greater than air temperatures due to the radiation.



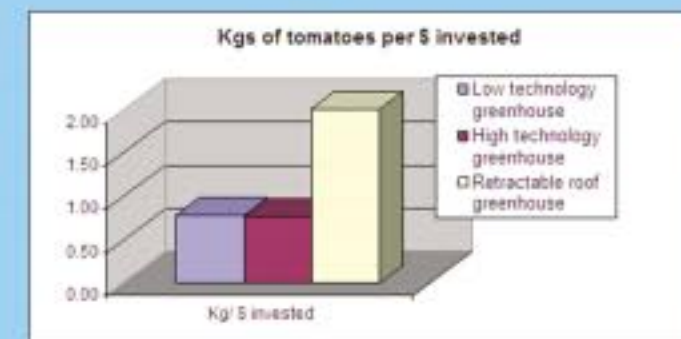
Transpiration is optimized in the retractable roof compared to crops only being outside or in a conventional greenhouse by retracting the roof when the outdoor temperatures are optimal.

Notice how leaf and fruit temperatures increased faster than air temperatures during the late morning (10:00am - 11:00) and late afternoon (3:30-6:00pm) when the roof was retracted. Also notice how leaf and fruit temperatures dropped when the roof was closed 85% midday but air temperatures remained lower.

Temperatures taken at the Univ. of Arizona on Nov 21st



TOMATOES			
	Conv Gh	RRG	% increase/decrease
Grams harvested per plant (#1's)	1475	2309	57%
% of total harvest that were #1's	0.76	0.498	
% of total harvest that were #2's	0.24	0.489	
Total yield ( gms per plant)	1933	4637	140%
% increase in March			140%
Actual annual yield (40-45kg)	45		
Expected annual yield		84	
% increase in yield			87%
Commercial investment per sq m	\$ 60.00	\$ 25.00	-58%
Kg /per \$ invested	0.75	3.36	348%



# 348% more tomatoes per dollar invested!!