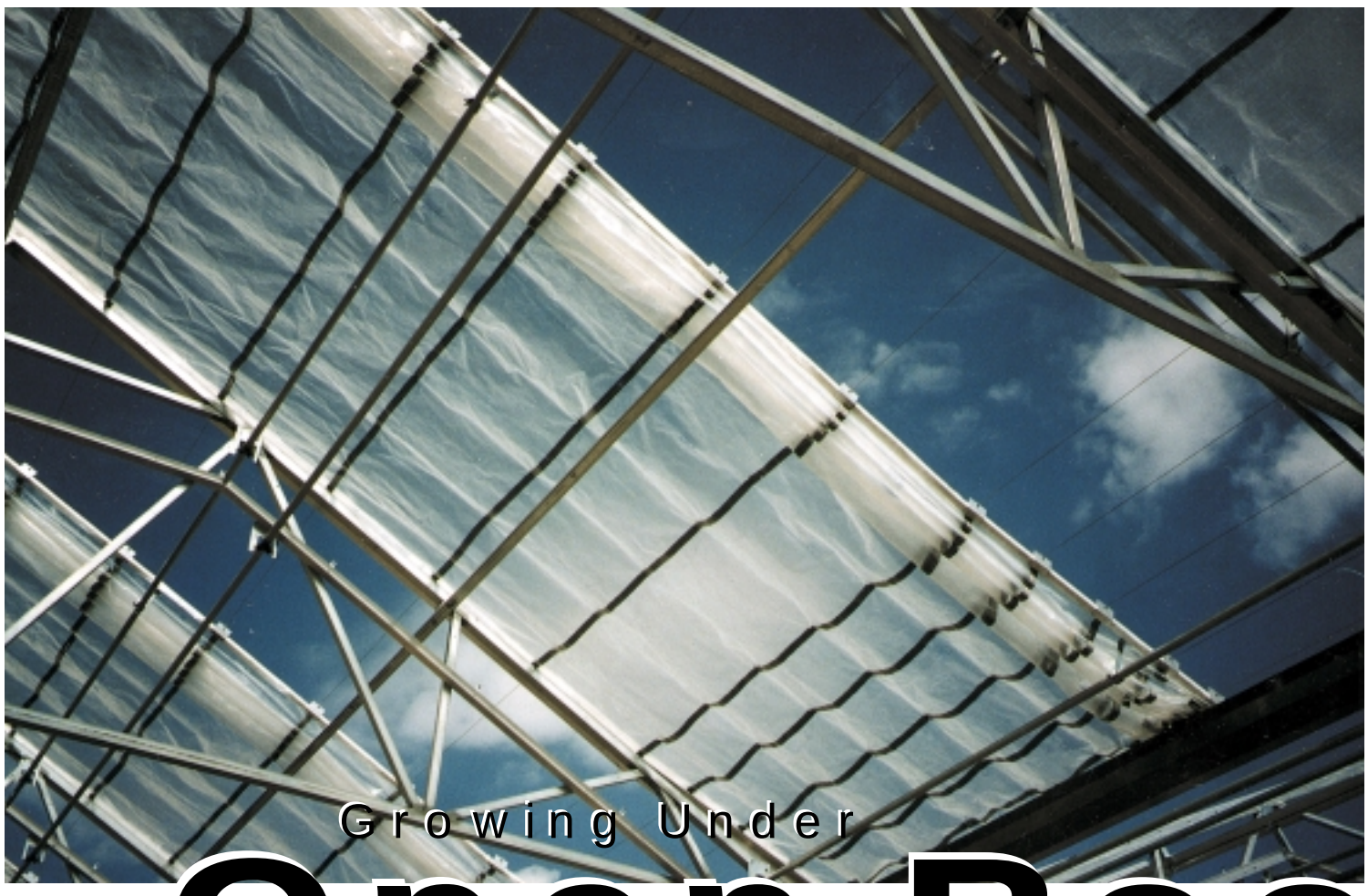


Growing Under

# Open Roofs

If someone told you that you could take advantage of optimal light, ventilation and natural DIF, saving on chemical and labor costs, what would you say? All it takes to get started is an investment in an open-roof greenhouse system.

**By Sven E. Svenson**

What is the function of a growing structure? To control the environment or to assist the grower with manipulating healthy plant growth? Should the grower and the plants be forced to adapt to the environment the greenhouse provides, or should the greenhouse provide adaptable environments the grower needs to force the crop? Open-roof structures provide more environmental flexibility compared to traditional greenhouse designs.

## WORKING WITH NATURE

Greenhouses create a growing environment in response to the outdoor environment. Heating systems are needed when the outdoor environment makes the greenhouse too cold. Fans and cooling systems are needed when the outdoor environment makes the greenhouse too hot (or perhaps the greenhouse design provides insufficient ventilation). Shading systems are needed when the outdoor environment provides too much radiation (too much light or heat). Irrigation systems are needed since the greenhouse roof prevents natural rainfall from watering the crop. Horizontal airflow fans are needed to circulate the air because the greenhouse prevents exposure to natural breezes. Supplemental lighting systems are needed when the outdoor environment provides insufficient light (or perhaps the greenhouse glazing does not provide sufficient light transmission). All of this technology is expensive and requires energy and maintenance to operate.

Many cultivars that are healthy when grown outdoors may stretch and become infested with pests and diseases when forced in a greenhouse. Growers are forced to use chemical growth regulators and pesticides to regulate height and control pests. If growers could use the outdoor conditions that support the growth of healthy, high-quality plants when those outdoor conditions are available, then growers might be able to reduce the use of growth regulators and pesticides.

Just as there are beneficial insects useful for ➧

biological manipulation of pests, there are “beneficial” environmental conditions useful for manipulation of plant growth. Both are helpful tools when used properly; both are a waste of money when not properly used.

The list of useful environmental conditions (see sidebar on page 30) that are not available when growing in traditional greenhouse designs is also the list of the advantages of growing under “open” roofs. In open-roof structures, growers have more control over the development of stem caliper, insect resistance, disease resistance, transplanting-stress resistance and root growth development because they have more control of exposure to natural breezes, exposure to natural UV light, exposure to full natural sunlight and exposure to cooler daylight temperatures.

An often-repeated statement is: “Growers understand that 80 percent of problems in a greenhouse can usually be traced to poor environmental conditions.” By working with the natural environment as much as possible, growers using open-roof structures can expose the crop to the best available environment for a longer period of time.

During any crop-growing cycle, the best environmental conditions often occur outside a traditional greenhouse. Open-roof structures allow the grower to expose the crop to beneficial outdoor environments while retaining the ability to protect the crop from sub-optimal outdoor environments (without having to move the crop). The grower


*Top: The variety of drive systems now available for opening and closing open-roof greenhouses has resulted in faster-opening, more responsive systems. Bottom: Growing in open-roof greenhouses allows you to take advantage of full, natural sunlight and UV light.*

has greater control of crop development than can be obtained by growing in traditional greenhouses or outdoor compounds alone (or in combination). The risks associated with greenhouse-only or outdoor-only growing are nearly eliminated.

## USING THE NATURAL BREEZE

In traditional greenhouses, the solid roof and side walls protect the plant from exposure to damaging winds. Stationary coverings also prevent exposure to gentle, natural breezes. If the grower can expose the crop to natural breezes, the crop develops a compact appearance with stronger stems. The response is similar to the use of "brushing" or "mechanical conditioning" for height control. Proper operation of open roofs and roll-up side walls lets growers capture natural breezes as a growing tool to develop crops with strong stems and a compact appearance.

Exposure to gentle breezes has also been shown to help the plant develop its own natural resistance to insects and diseases. It also encourages proper development of waxy surfaces on leaves and stems, which help reduce water loss and provide some protection against insect feeding and invasion by germinating disease spores. When the plant's own defenses are stimulated, the effectiveness of biological predators is improved. So, compared to structures with stationary coverings, plants grown in open-roof structures often require fewer applications of pesticides. Natural breezes are free, but you need a structure that lets you take advantage of them.

> Growers understand that 80 percent of problems in a greenhouse can usually be traced to poor environmental conditions.

Naturally compact plants with strong stems and improved resistance to pests let the grower reduce or eliminate the applications of chemical growth regulators and pesticides. This reduces all costs and risks associated with chemical applications, including: cost of chemicals, application labor, application equipment maintenance, application record-keeping, possible phytotoxicity damage to the crop, and possible worker exposure to chemicals (including possible litigation costs). When your records prove you have reduced your use of chemicals, you can also request a lower premium on your liability insurance.

For crops like bedding plants or perennials that will eventually be used outdoors where they will be exposed to natural breezes, plants properly grown in open-roof structures are already acclimated to wind. This eliminates the labor costs and growing space needed to relocate the plants to a "hardening-off" area before shipping.

## USING UV LIGHT

Greenhouse glazing greatly reduces or nearly eliminates exposure of the crop to UV light. The materials that protect the glazing from damage by UV light also prevent exposure of the crop to UV light.

Exposure to excessive UV radiation can slow growth or directly damage many crops. However, exposure to sufficient UV light is needed to encourage the plant to protect itself from radiation. The stronger cell walls, changes in physiology and thicker, waxy cuticles that plants develop to protect themselves from exposure to UV light also help protect them from pests and diseases. Many plants also grow more compact when exposed to UV light. So, just like grower-controlled exposure to natural breezes, careful exposure to UV ➧

light can improve crop quality, reduce the use of chemicals and reduce costs. Natural UV light is free, but you need a structure that lets you take advantage of it.

For crops like bedding plants or perennials that will eventually be used outdoors where they will be exposed to UV light, plants properly grown in open-roof structures are always acclimated to UV light. This eliminates labor costs and growing space needed to relocate crops to a "hardening-off" area before shipping.

## USING FULL SUNLIGHT

All greenhouse glazings reduce the total amount of light available to the crop. Stationary coverings reduce the amount of light all the time, even when a reduction (shading) is not needed. Under cloudy conditions or in the early morning and late afternoon hours, shading is usually not needed. Open-roof structures provide growers with the option to expose the crop to all of the available light whenever shading is not needed. The extra light can influence crop scheduling.

Compared to the taller, softer growth with weak stems that some plants develop when grown in traditional greenhouses, careful exposure to full-sun conditions when grown in open-roof structures encourages plants to develop stronger stems, waxy surfaces and a compact growth habit. So, just like grower-controlled exposure to natural breezes and UV-light, careful exposure to full sunlight can improve crop quality, reduce the use of chemicals and reduce costs. Natural, full sunlight is also free, but you need a structure that allows you take advantage of it.

As is the case with UV light, for crops that will eventually be used outdoors where they will be exposed to full sunlight, plants properly grown in open-roof structures are already acclimated to full-sun conditions. This eliminates labor costs and growing space needed to relocate crops to a "hardening-off" area before shipping.

## OPTIMIZING NATURAL DIF

Growers have been using DIF to manipulate plant growth for many years. Reducing the difference between the day and night temperatures helps many crops develop a compact growth habit. Open-roof structures can be easily operated to keep temperatures warm at night and cool during the day without the energy and maintenance expense of a cooling system, thereby reducing the difference between the day and night temperature. The natural, outdoor air temperature is free, but you need to have a structure that can take advantage of it.

When open-roof structures are operated to reduce DIF (maintaining cool daylight ➧

### *Advantages of Growing in* Open-Roof Structures

**Grower-controlled exposure to natural breezes.**
- assists in development of stem caliper and compact growth
- assists in development of insect resistance
- assists in development of disease resistance
- assists in development of transplanting-stress resistance

**Grower-controlled exposure to natural UV light.**
- assists in development of stem caliper and compact growth
- assists in development of insect resistance
- assists in development of disease resistance
- assists in development of transplanting-stress resistance

**Grower-controlled exposure to full, natural sunlight.**
- assists in development of stem caliper and compact growth
- assists in development of insect resistance
- assists in development of disease resistance
- assists in development of transplanting stress resistance

**Grower-controlled exposure to cooler daylight temperatures.**
- assists in development of stem caliper and root growth
- assists in development of insect resistance
- assists in development of transplanting stress resistance
- exposes plants to more light without more heat, which means improved photo:thermal ratio

**Reduced exposure to chemicals.**
- less risk of visible or hidden phytotoxicity
- less risk of worker injury and costly litigation

**Reduced expenses.**
- reduced chemical application labor
- reduced equipment maintenance expenses
- fewer chemicals purchased
- reduced chemical-use record-keeping costs
- reduced handling labor

temperatures), the relationship between the amount of light the plant is exposed to each day (daily light integral) and the average daily temperature is altered. In traditional greenhouse systems, the temperature is controlled by the cooling system, but light levels remain unchanged. In open-roof structures, crops receive more light when the roof is kept open to release heat. When this "photo:thermal ratio" is increased, plants accumulate more dry weight (more carbon) on a daily basis, which can lead to faster growth or development. So, one way to obtain compact plants using DIF and faster crop development at the same time is to operate the open-roof structure to optimize the photo:thermal ratio.

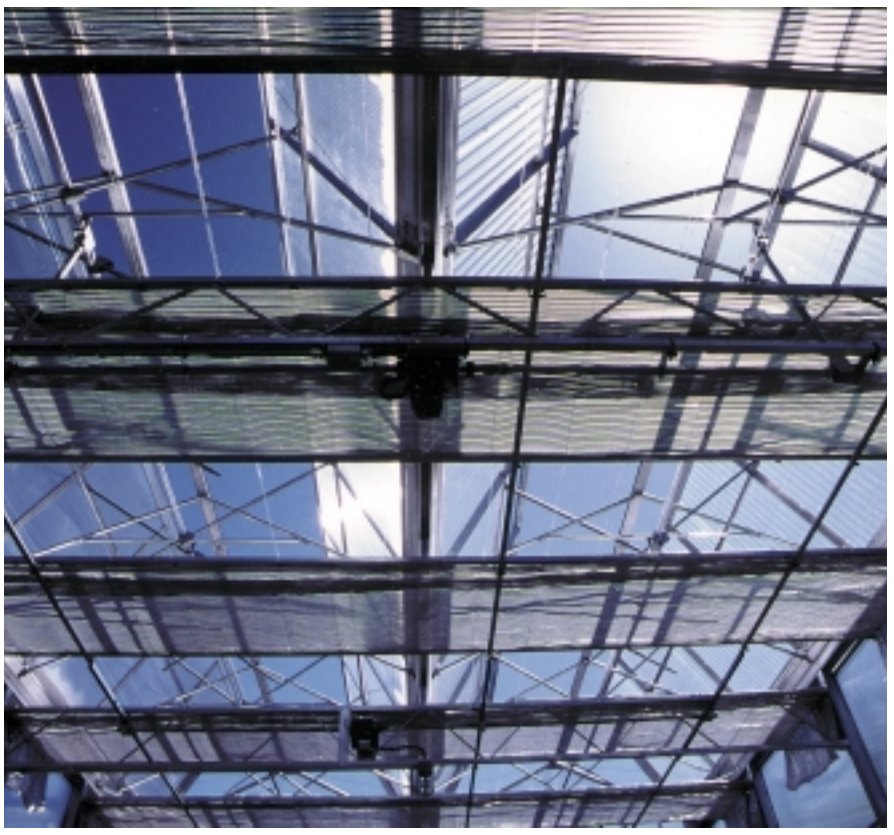
## ADAPTING TO OPEN-ROOF GROWING

When using open-roof structures, grower-regulated exposure to natural breezes, natural UV light, natural full sunlight and DIF all contribute to crops that are naturally compact, naturally more pest- and disease-resistant and continuously acclimated to outdoor conditions. These growing tools may be used all at the same time or whenever one or more is available.

Compared to traditional growing structures, the timing and concentration of growth regulators needed when growing in open-roof designs are different. In some situations, they may no longer be needed. Similarly, the timing and amounts of pesticides, fertilizers and irrigation water also differ. Temperature recipes used to schedule crops differ. When growers switch to open-roof structures, they will have to carefully reapply their skills to manipulate crops as necessary. However, they will have many more tools and alternatives available to them to help them be successful and profitable.

A computer operation system is an essential component for proper operation of an open-roof growing system. Trying to keep the roof and side walls in the correct position by hand is a full-time job, and other chores will usually cause the person in charge of the structure to "fail" on a regular basis. A one-time purchase of a good computer control system (typically about $20,000 purchased and installed) is much less expensive than a permanent, full-time worker.

No matter how sophisticated, growing structures do not operate by themselves. Remember that the computer controller does not operate the system or grow the crop for you. This is computer-assisted growing, not computer-controlled growing. You must still know your crop and its needs, and make daily, routine or seasonal adjustments to the computer settings as needed.



*With an open-roof system, you don't have to move crops to hardening-off areas, which can mean significant labor savings.*

## CONSIDER THE LABOR SAVINGS

An important reason growers are selecting open-roof structures is to reduce labor costs. There are significant labor savings from reduced crop handling. When using open-roof systems, plants need not be moved from stationary-roof systems into "acclimation areas" for hardening-off before shipping (the roof is moved instead). Useful growing space is not wasted as acclimation area.

*The grower controls exposure to natural breezes with an open-roof system.*

Seasonal greenhouse glazings need not be removed — the roof is moved instead. Eliminating each labor-handling step saves a significant amount of money.

For some crops, such as florist azaleas, open-roof structures can eliminate from 2-5 handling steps. Depending upon your crop and your current handling system, you can eliminate as much as 50 percent of your handling labor costs by growing under an open-roof system. GPN

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