The market for greenhouses with retractable roofs is booming. The reason: These structures enable nurseries to grow hardier plants faster.

HOT Houses

by JASON BRAMWELL

The demand for greenhouses with retractable roofs is growing just as fast as the plants they shelter.

"They are becoming very popular, especially in the last five to six years," says John Bartok Jr., extension professor emeritus and extension agricultural engineer for the University of Connecticut Cooperative Extension System, Storrs. "Some growers in some parts of the US use [greenhouses with retractable roofs] to extend the [growing] season, while others use them [for] environment modification."

According to Richard Vollebregt, president of Cravo Equipment Ltd., Brantford, Ontario, Canada, a greenhouse with a retractable roof "helps protect plants against excessive cold, heat, wind and rain, while allowing growers to take advantage of outdoor conditions when they are optimal."

He says Cravo has seen its sales benefit from the structures' increase in popularity.

"This has been our best year to date in the last five because we've focused our business totally on greenhouses [with retractable roofs]. It's a growing market," Vollebregt says. "Look at some of the megatrends facing growers right now: land is more expensive, labor is more expensive and harder to find, chemicals are more expensive, water is becoming a major limiting factor for some growers, the responsibility of crop quality is being put back on the growers, and hurricanes. Retractables offer the best protection against hurricanes of any greenhouse on the market because you can choose to retract the roof. A hinged, open-roof house doesn't give you that flexibility. If you open the roof so it's vertical, it will be damaged because of the wind.

"In the past, growers who bought retractables didn't really know how to use them to get the best results," he adds. "We have put together documentation on best practices to help growers use their greenhouses to their best advantage."

Meeting a growing need. Retractable greenhouses, which first became available approximately 15 years ago, meet the two basic needs of a commercial grower, according to Vollebregt: to grow plants fast and to grow hardier plants.

"In the spring, you have people trying to push stuff into color or hit a certain target window if you put a plant in a conventional greenhouse, it won't be grown in the cold, but it will be soft because it is not getting the stressors from the outside environment to become hardy," he says. "With a retractable house, plants are grown faster because you are closing the roof when it's cold outside, and you retract the roof when it's nice outside so the plants will grow hardier."

Vollebregt adds growers achieve additional benefits by closing the greenhouse roof in the summer.

"If you protect the roots from overheating, you will have fewer root diseases. You also will prevent summer dormancy, you will prevent excessive release of controlled-release fertilizers, and you will reduce water consumption by almost 50 percent. Any container plant will perform better because there won't be fluctuating root temperatures, which is the biggest problem for a container-grown plant," he says.

Open and shut cases

...to John Bartok Jr., extension professor emeritus and extension agricultural engineer for the University of Connecticut Cooperative Extension System, Storrs, there are four types of greenhouses that feature retractable tops: Open roof, roll-up roof, folding roof and retractable roof.

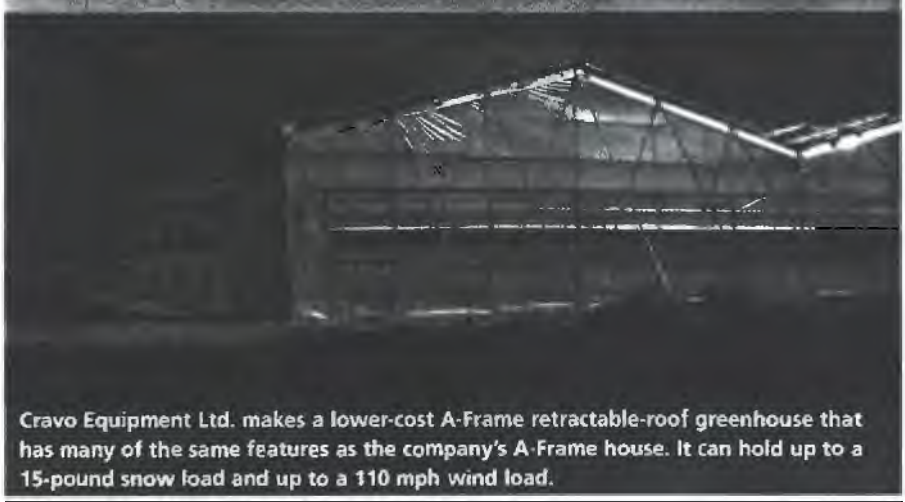
Open roof: These greenhouses provide a natural environment for plant growth when the weather is suitable and an artificial environment when it is too hot or cold. Opening the roof over the plants increases light intensity, which can help to control the growth habit, flowering and crop timing. It also reduces electricity costs as expensive fan cooling is not needed.

Roll-up roof: Several methods can be used to open the roof. Some manufacturers make a roof that opens by rolling up the single or double layer of flexible, plastic glazing that runs the length of the greenhouse bay. A small gear motor rotates a shaft that winds the plastic onto it like a window shade. A light, second framework over the structure secures the plastic from bellowing out during windy weather. Opening and closing the roof either can be manual or automatic. Each side of the roof can be controlled independently for flexibility in cooling.

Folding roof: These greenhouses work well in snowy climates, as they can be closed tightly during cold weather. Most designs use standard vent hardware. Some have panels that hinge at the gutter and open upward. There almost is a 100 percent opening. Other have panels that are hinged at the ridge and one gutter and slide sideways on Teflon bearings. Opening is approximately 85 percent. Most designs use rubber gaskets to seal the joints. Glazing can be glass, polycarbonate or film plastic. Some manufacturers provide a movable gutter to collect rainwater when the roof is open partially. Wind sensors should be installed to close the roof in stormy weather.

Movable shade frequently is used. It reduces the heat load by reflecting the sun's rays back out. The shade curtain should be of a porous design to allow heat to escape. In northern climates, an energy blanket also may be installed to reduce heat loss during winter.

Retractable roof: These structures consist of a steel frame, flexible glazing and cable support. The glazing is made of woven, ultraviolet-stabilized, polyethylene film. Depending on the cropping system, bracing of the structure can be external cables attached to internal compression braces, or trusses with cable bracing. Flat-roof designs are used where there is little rain or snow. A roof designs shed the rain and snow to an internal gutter system. Designs that will carry up to 35 pounds per square feet of snow load and up to a 100 mph wind load are available. The roof opens in sections by moving the leading edge of the curtain. One gear motor will handle up to 50,000 square feet of roof. Heating is more difficult



Cravo Equipment Ltd. makes a lower-cost A-Frame retractable-roof greenhouse that has many of the same features as the company's A-Frame house. It can hold up to a 15-pound snow load and up to a 110 mph wind load.

Leading the pack. Bartok and Vollebregt both say retractable- and open-roof greenhouses are the most popular structures on the market.

"Retractables have a roof covering that essentially disappears, On the hinged, open-roof greenhouses, you are rotating the roof [covering] into a vertical position," Vollebregt says.

The roof covering on retractable-roof greenhouses is closed either by rolling it on a tube, using cables, or by suspending it from hooks that slide on stainless steel wires. Therefore, retractable-roof coverings must be flexible and usually are made with polyethylene film or reinforced polyethylene, according to Cravo.

"Often, the roof is attached to a cable system. The roof then is pulled sideways, end to end or between the trusses when

The Dual Atrium open-roof greenhouse made by Nexus Corp. features one-piece, factory-welded trusses, and the roof opens vertically to 85 degrees, which allows for flexibility in cooling and venting.

opened," Bartok says. "lt can be either a flat roof or a slope roof. A flat roof should be used for locations where there is not heavy snow or rain. The slope roof can take a snow load or a rain load and will drain the water off, either over the edge or to a gutter."

Opening the roof allows plants to receive maximum light and infrared radiation during the early morning and late afternoon to maximize photosynthesis, Cravo states. The roof then can be closed 85 percent during the hottest time of the day to reduce infrared radiation, while still allowing plants to receive high levels of photosynthetic active radiation light. The horizontal opening helps provide good air exchange to optimize air temperatures, according to the company.

When the retractable roof is a single layer and crops are being heated through the winter, an energy curtain usually is required. The curtain system also can be used during hot conditions for cooling.

"Energy costs are going to double this coming winter compared to last winter. All growers are concerned with energy, and we are doing a lot with energy conservation," Bartok says. "There is a very short payback period on energy conservation measures, like energy blankets, perimeter insulation and end-wall insulation. The payback period is less than three years and, in some cases, three months."

Cravo manufactures three models of retractable-roof greenhouses: A-Frame, lower-cost A-Frame and Flat Roof, according to Vollebregt.

"The Flat Roof (photo, page 32) doesn't keep rain off; the plants still get wet. But you can protect the plants from the cold and heat," he adds. "The lower-cost A-Frame (photo, page 30) is for people to cover their crops. People liked their retractable-roof houses and liked the cost of the Flat Roof, but couldn't justify the cost of the A-Frame for certain crops. So we made a lower-cost A-Frame house that would hold up to a 15-pound snow load

The A-Frame retractable-roof greenhouse manufactured by Cravo Equipment Ltd. offers maximum light and heat when the roof is retracted and maximum cooling when the roof and energy curtain are closed in opposite directions.

and up to a 110 mph wind load. The normal A-Frame house (photo, above) has been engineered for up to a 70-pound snow load and up to a 140 mph wind load. There is a higher threshold on the normal A-Frame, but it's more expensive."

Northglenn, CO-based Nexus Corp. also manufactures a retractable-roof greenhouse called the Convertible Roof, according to vice president of engineering Craig Humphrey.

"The Convertible features a cloth-style roof, but was designed to be able to [use] a rigid-style roof covering if the owner wanted to change it because of either the environment or his business [if his crops changed]," he says.

According to Nexus, plants can be started and finished in the same location without having to be moved. The Nexus truss design allows baskets and equipment to be hung from the structure, which increases the amount of crops that can be grown in the same square footage, the company states. The Convertible Roof greenhouse can incorporate a number of energy curtain options, such as shade, heat-retention or blackout blankets. The company's NEX-CURTAINS can be installed in the side- and end walls for added ventilation, according to Nexus.

The Flat Roof retractable-roof greenhouse manufactured by Cravo Equipment Ltd. improves crop quality and reduces growing times by providing cold protection, shade and cooling using the same roof covering.

Open-roof greenhouses either are

hinged at the peak or gutter, according to Cravo. They feature tight-fitting roofs when closed, which can prevent extra moisture from entering the greenhouse area, Bartok says.

"The retractable roof with cable system is not as tight as the open-roof greenhouses. It is more difficult to seal up the joints with a flexible roof. The open-roof design with hinges tends to have rubber gaskets and seals that can close tight and won't have leakage," he adds. "Most larger nurseries are going toward open-roof designs for two reasons: cost and a better environment. You eliminate fan ventilation, which is getting more expensive as electricity costs go up. Now that we are building larger blocks of greenhouses, it makes sense to use an open-roof design where you can maintain fairly uniform temperatures anywhere in the greenhouse."

Open-roof greenhouses with hinges can be covered with double-layer or rigid-roof coverings. Double-layer coverings are the most energy-efficient in the winter, while rigid-roof coverings usually provide the highest light transmission and best condensation control, according to Cravo. If the roof covering is a single layer, like glass, an energy curtain typically is required for heating in the winter and for shade and cooling in the summer, the company states.

"When you look at the differences between the open-roof and retractable houses, open roof has a higher cost per square foot, so it's used primarily for crops that have a higher dollar value or where a glass roof is required," Vollebregt says. "If it costs more, you have to have a crop that pays for it. You have to use that greenhouse for 12 months a year, and if you're in the North, you want glass."

Humphrey says Nexus manufactures two open-roof greenhouses with rigid roofs: Clear Sky and Dual Atrium (photo, page 31).

"The rigid-covered house has become more popular because of its versatility. Sales of the cloth-style coverings on greenhouses (with retractable roofs] have declined, and the hard-covered, rigid roofs have found their niche. The rigid roofs have dominated in the bedding and pot industries," he says. "The Clear Sky and our Dual Atrium both offer the open-roof-type of vents that pivot at the base and open upward. These can use all types of rigid covering, from glass to polycarbonate. The Nexus houses are structurally built for the areas in which they are intended."

Jason Bramwell is an associate editor of AMERICAN NURSERYMAN.