

High Tunnel Systems May Provide Earlier, Greater Yields

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crops. The tunnel produced about 2,000 pounds of fresh market tomatoes which were sold at an average price of \$1.60 a pound. The cost of the tunnel, which included all lumber, labor, transplants, mulch, trickle irrigation equipment, and other materials, was about \$977.

Sales of tomatoes from the tunnel reached about \$3,200, for a net of about \$1,423. The system paid off the costs of the tunnel in the first year.

"There are not many systems that you can get complete payback in the first year," said Wells.

Where field tomatoes will average about 1½ pounds of tomatoes at harvest per square foot, the tunnel tomatoes, with their longer growing season, average about 3.5 pounds per square foot from July through September.

"The high tunnel almost doubled the per square foot yield of tomatoes," he said.

Other crops that can be readily grown in the tunnel include summer squash, melons, cucumbers, peppers, cut flowers, strawberries, all sorts of spring and fall crops, and "niche" market items.

Wells said that tunnel systems are used extensively in such countries as South Korea (22 acres in production), Spain (10,000 acres), Israel, and southern European countries.

"We have very few high tunnels in this country," said Wells. "And I don't understand why."

"There's always someone trying to get something earlier, and better, and faster," he said. "Not necessarily trying to compete with a neighbor, but simply to have it earlier, for an earlier marketing opportunity."

According to Wells, the ideal situation for use of a tunnel would be for fresh market vegetables, but wholesale could be a possibility, depending on market demand. For farmers that can set aside a couple of acres or even less, this high-production farming could prove immensely beneficial.

The tunnel operation is similar to a greenhouse. A typical greenhouse is Quonset-shaped utilizing two 6-mil layers of plastic with a permanent heating and ventilation system. The tunnel, however, is similar in look, but utilizes only one 6-mil layer of plastic, relies on heat from the sun, and ventilation is provided by rolling up the sides.

The location of the site is important. The soil quality and drainage should be good quality, and the site needs access to water. The site should be away from other sheds and greenhouses. If growing tomatoes, the site should be far enough away from field tomatoes to prevent disease and insect crossover.

The greenhouse should be situated in a north-south direction so that westerly winds blow across the sides of the tunnel.

Good ventilation is necessary, according to Wells. "Ventilation is crucial to tomato growth," he said. "You need to open the tunnel early every morning, because the temperature and humidity are going to be factors that we cannot control any other way. You do not want excessive temperature building up."

He said he opens the tunnel at 7-7:30 each morning and closes it at the same time each night. It is important to close it regularly at night to keep the heat in.

To construct the tunnel, size is important. The wider the tunnel,



Dr. Otho Wells, extension vegetable specialist with the University of New Hampshire, spoke about the results of trials using high tunnel production on Monday at the New Holland Vegetable Day.

the higher the sides. Many growers use a 14-foot wide tunnel by 96-feet long as standard. The best system uses the following, based on results at the University of New Hampshire:

- Used galvanized metal bows for construction. PVC pipe can wear and break after a time.

- Use portable ends, to make working inside easier and to allow sufficient ventilation in the hot summer months.

- Place the clear 6-mil plastic over top of the canopy, and allow about a foot longer on each side.

- Secure the tunnel plastic with batten board and hip board. Sandwich the plastic between the two boards. Use "plenty of screws," he said, to make sure the plastic is held firmly. The plastic may tear if the screws aren't close enough together.

- Using a galvanized pipe that runs the length of the tunnel, secure this with duct tape to the ends of the cover. This will be used to roll up the sides of the tunnel. The university uses a "sliding T-angle" to use as a take-up for the sides, which allows the sides to be rolled up and down quickly.

- Incorporate proper nutrients based on soil sample. Prepare the soil as you would a field crop. Disc, till, and work until completely smooth.

- Use one row of trickle irrigation line for each row of tomatoes.

- Place down a 6-mil black plastic mulch cover over the entire area. It is important that all the soil is covered and that the area is completely smooth.

- Transplants should be about 5-6 weeks old, in 4-inch pots, ready to transplant 3-4 weeks earlier than outside. Use plenty of phosphorous starter fertilizer for good root growth. Place plants in a four-row system, 3½ feet apart, with 18 inches between plants.

- Use 4-foot stakes and place in a sequence of two plants, then stake, then two plants. Use twine and string up in a "Florida basket-weave" system to support stems. Start the basketweave system early so that plants don't start flopping and falling over, said Wells.

It is important to make sure the sides are rolled up early in the morning and down at night each day in order to keep excessive heat and humidity from building up. Also, the plants must be kept free of rain to suppress disease formation. On days with excessive heat (more than 87 degrees for two hours at a time), open doors and sides wide.

He has encountered problems with white fly. "If you see one white fly, go for it," said Wells. The university uses a bioinsecticidal soap, which he said works well.

Weeds are suppressed through the use of black plastic mulch.

But one disease that can attack the crop is early blight.

"The number one way to control diseases in a greenhouse or tunnel is sanitation," said Wells. He said that when the crop is finished, clean up all debris and "don't leave anything on the soil."

He showed slides of where, in one case, near a field with evidence of early blight, the tunnel tomatoes were not affected.

"Do not plant field tomatoes beside your high tunnel," he said.

He said the tunnel system protected plants from frost and even cold temperatures, down to 28 degrees at night.

Wells said that tomatoes should be rotated out every two years from the tunnel system.

Wells said he believes there is a home for tunnel ventilation in Pennsylvania. One New England grower produced about 3,000 pounds of tomatoes in a tunnel in the first year.

"If you can grow tomatoes in tunnels in Spain and Israel and South Korea, we can do it here or anywhere in the United States," he said.

Mulches

Wells also said that for growers who want to use mulches but want biodegradability, it may be possible to use the black kraft-like paper now being tested at the university.

There is a paper called Planter's

Paper made by Kinbar, out of Reading, Mass., that shows a great deal of promise in biodegradability and standability for the duration of field crops.

He said there are three types of mulches — organic, plastic, and paper — and all three work to provide the two most important things for growers: soil warming and weed control.

The mulch used by many growers is the raw plastic material called polyethylene.

When manufactured, polyethylene is a clear plastic. To obtain black plastic, a black material in bead form is added.

Clear plastic is used only when a good weed control program is put in place. While there is better warming with clear plastic, the black plastic provides better weed suppression.

Photodegradable mulches allow ultraviolet (UV) light to slowly break the molecular bonds, which causes the plastic to slowly deteriorate.

The only problem is that the edges of the photodegradable mulches, buried in the soil, don't decompose. This creates a residue management problem in the fields.

Biodegradable mulches are starch-based, which break down with bacterial action. But many vary greatly in how long they take to finally break down, depending on field and weather conditions.

The biodegradable cover with the most promise, according to Wells, is the black paper. In yield trials, it performed as well as the black plastic, but is slightly more expensive.

Wells also examined the IRT plastic mulches, which allows infrared, or warming light, to pass through while blocking UV light.

PSU, Cornell Offer Dairy Expansion Conference

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TOWANDA (Bradford Co.) —

Attention dairy farmers, extension staff, agricultural lenders, builders, equipment dealers, and veterinarians! Mark your calendars for an important regional conference, "Expansion Strategies for Dairy Farms: Facilities and Financial Planning," to be held on March 29 and 30, in Sayre.

The conference is being planned by faculty at Penn State and Cornell Universities, with assistance from the Northeast Regional Agricultural Engineering Services (NRAES).

"Many farmers are at a crossroads," said Robert E. Graves, professor in the Department of Agricultural and Biological Engineering at Penn State. "They're having to decide whether to make major changes to their facilities to stay competitive and modern into the 21st century. This conference gives them a chance to review their option."

Dairy farmers must consider the long-term effects expansion will have on their finances, the health and productivity of their cows, the efficiency and comfort of their workers, and the surrounding environment.

"Expansion Strategies for Dairy Farms" will bring together experts on these issues and more so that dairy farmers and others involved in the expansion process will be better able to make sound decisions.

Presentations will focus on incremental expansion as a strategy to ensure the debt load is reasonable when compared to anticipat-

ed cash flow.

Everyone involved in the expansion process should benefit from this educational experience. Dairy farmers and managers considering dairy farm expansion can learn about the many facets of planning and executing a successful expansion, from financing to manure management plans.

Extension agents, facilities planners, engineers, builders, and equipment suppliers will learn up-to-date techniques for selecting free stall floor plans, ventilation systems, milking center designs, and materials.

Financial and management advisors and veterinarians will improve their ability to evaluate proposed dairy facilities.

The conference will begin with a series of case studies. Several dairy farmers will detail the pros and cons of their experiences with expansion.

The remainder of the conference will consist of 25-minute presentations from specialists in dairy facilities, agricultural lending, facilities planning, manure handling, and construction.

Informal discussion periods will be interspersed with the presentations to allow participants time to talk with speakers and each other about specific concerns and issues.

Presentations are to be given by dairy facility engineers, facilities planners, animal scientists, agricultural economists, a lender, a veterinarian, and environmental engineers.

Experts from Penn State and Cornell University will share their knowledge and answer your ques-

tions concerning dairy expansions.

The conference was planned by a committee chaired by Robert E. Graves, professor, Department of Agricultural and Biological Engineering, Penn State University.

The conference will be held at the Guthrie Inn and Conference Center, located at 255 Spring Street in Sayre. Sayre is in northeastern Pennsylvania on the New York border, just off NYS Route 17. To get to the conference from the south, take Route 220 to Route 17 east. From Route 17, take Exit 61 and turn right; the hotel is on the right, about 200 feet from the exit.

A block of rooms at the Guthrie Inn and Conference Center has been reserved for conference participants. The rate is \$58 for single or double rooms. Reservations can be made by calling (800) 627-7972. Reserve your room by March 15 and mention "Expansion Strategies for Dairy Farms" to receive the special rate.

The registration fee for the conference is \$110 if postmarked by March 16 and \$130 after March 16 or for walk-ins.

The fee includes admission to the conference, two lunches, break refreshments, and a 300-plus-page notebook of information related to dairy expansions. Reduced rates are not available for groups or for single-day attendance.

For a brochure containing a complete conference agenda, a map to the conference, and a registration form, contact NRAES, Cooperative Extension, 152 Riley-Robb Hall, Ithaca, NY 14853-5701, or call (607) 255-7654.

Late blight on tomatoes may become more evident during the 1994 growing season, according to Dr. Alan MacNab, Penn State extension, who presented disease highlights at the Vegetable Day.

He said that more resistant spores of tomato late blight may show up during the 1994 growing season.

Late blight resembles early blight. Early blight starts with the older leaves toward the bottom of the tomato plant. But late blight affects leaves on all parts of the plant.

He said that Penn State will watch the disease closely and be in touch with extension offices to recommend and review control programs for growers.

He told the growers that it is important to rotate crops and follow good control programs to keep disease, insect, and weed pressures down.

In one study, he showed that when dew was reduced on tomatoes, early blight was effectively controlled.

The Vegetable Day included a variety of other sessions on greenhouse biosecurity, integrated nutrient management for tomatoes, weed management strategies, greenhouse insect ID, vegetable crop budgeting, pumpkin variety trials, greenhouse IPM, tailgate farmers markets, soil fumigation, herb production, packaging quality vegetables, pesticide container recycling, and others.