

# Moveable High Tunnel

## Final Report for FNC03-449

Project Type: Farmer/Rancher

Funds awarded in 2003: \$5,874.00

Projected End Date: 12/31/2005

Matching Non-Federal Funds: \$9,296.00

Region: North Central

State: Kansas

Project Coordinator:

[Karen Rains](#)

## Project Information

### Summary:

#### PROJECT BACKGROUND

My experience as a bedding plant grower for 20 years has provided me with basic growing skills. The linkage between human health and food has been known for a long time. The tremendous variation that exists between low-grade produce and quality produce interested me to research the reason behind this problem. The importance of chemical-free foods, and the well being of my family and community, has greatly influenced my new direction regarding organic food production. The reduction of chemical inputs into our food, soil, and water is part of my change in growing practices. I was educated in the traditional chemically dependent philosophy of greenhouse growing and market gardening. Some lessons along the way made me question the practices and research different ways of growing. The change has been gradual and has been strengthened with each new bit of knowledge. My emphasis now focuses on human health and wellness more than profitability, but my 20 years of garden center management never lets me forget that improving quality and nutrition can be very valuable to those people who are looking for healthy food.

**DESCRIPTION:** The objective was to evaluate productivity and profitability of selected crops in protected microclimates (high tunnels. Kansas is traditionally not known for an abundance of locally grown produce and specialty crops. It relies on importing these types of crops from outside the state. Utilizing high tunnels, these crops will flourish and this situation could change.

The challenge is to control adverse natural conditions while using little, if any, supplemental heating. These conditions include high light intensity in the summer, untimely rainfall at harvest, early and late uncertain frost dates, wind, heat, weeds, disease and insect infestation. Protected microclimates with drip irrigation and a movable foot print will help control these conditions, and allow intense production of four or more crop turns each year. This intense production (profitability), will make moveable tunnels part of a sustainable small farm program. The final objective is to create conditions, through the use of high tunnels, for growers to improve income and reduce production risks.

## Goals:

- Biodiversity in the soil
- Respectable and consistent income
- Food security
- New crops for community
- Reduce fossil fuel inputs
- Workable moveable high tunnel
- Endwalls open up to drive tractor through
- Pull the tunnel over a crop of caged tomatoes or other tall crop
- Move at least four times a year for maximum crop turns and soil rest and regeneration
- Not allow pest and disease buildup by cover cropping sections not in production
- Allow for rain leaching of the soil to avoid nutrient or salt buildup
- Test the theory of optimum nutrients and soil flora: plants can resist pests, diseases, and weather stress with higher brix levels
- Marketing all of my produce at a profitable price
- Grow chemical-free crops
- Grow crops that have higher brix levels than my competition
- Obtain off-season crop in Kansas with minimum fuel inputs

Process: I researched the high tunnel topic on line, obtained four books on the subject, attended The Great Plains Vegetable Growers Conference, the Kansas State Vegetable and Fruit Growers meetings, and the Herb Growers meetings. I visited the Olathe and Wichita, and Kansas State University Extension test farms, as well as other tunnel growers. I also phoned two other growers outside the state with moveable tunnels, and talked to five greenhouse manufacturer engineers about what I was planning to do and listened to their suggestions.

After visiting Olathe's high tunnels, it was obvious that a raised bed was the way to grow, even though I had not planned on this expense.

## RESULTS

I achieved my goal of \$1.50 or more a foot, 9 of the 12 months. The summer crop and a month of transition in November did not hit the goal. My customers were restaurants, a health food store, and a farmers market. Their purchases kept increasing throughout the season and they were asking for other produce items, encouraging me to grow more. I increased prices with little or no resistance.

I was surprised and impressed with the growth of the plants in the tunnel especially during the winter months. I was under the impression that plants would not grow after they were frozen, but the cool crop plants continued to grow and mature. Even though the growth was slow, it was profitable because there was no heating expense. The salad mix was the most profitable midwinter crop. It included five varieties of lettuce, spinach, Russian kale, sorrel, arugula, beet tops, dill, pea greens, ornamental kale (grown in the cool weather, the leaves were mild and colorful), savoy cabbage, endive, and celery leaves. In the center of the tunnel was a three-foot-high tunnel for extra temperature protection for broccoli, cauliflower, cabbage, celery, and flowering kale. The broccoli and cauliflower were enormous, worm free, and the leaves were so mild that they were sold like collard greens. The large flowering kale leaves were sold as decorative foliage and later the center stem produced small leaves that were perfect for the salad mix. After several cuttings of the pea foliage, the plants started to get tough and fibrous but then started producing beautiful pinkish-purple flowers that were added to the salad mix.

Other crops grown were radishes, carrots, and potted strawberries. Radishes were the first thing harvested but not worth planting as a money making crop. The carrots were very sweet and good, but the soil did not have enough organic matter

in it to keep the clay from sticking to the roots and it took too long to clean them for them to be a profitable crop. The strawberries were pulled into the tunnel after the proper amount of cold temperatures. Pollination was a problem but the early strawberries were a treat.

In March, the tunnel was moved and the tomatoes were planted with the extra protection of a clear plastic bag over each stake (300 plants on four-foot centers). No supplemental heat was needed this year. Harvest started in the end of May and an estimate of over 3,000 lbs. was taken off the plants.

The tunnel was moved again in late May over the lisianthus. The production was not what I expected because the shade cloth has not been purchased yet.

In July, the tomatoes were cut back to about a foot high, a layer of compost was applied and they were allowed to regrow. The idea behind this was to avoid the glut of field grown tomatoes and take advantage of the regrowth and heavy set of the plants in the late fall. This is when most field tomatoes have been affected by diseases, and hurricanes have reduced production in southern field-grown tomatoes, and prices are usually starting to go up.

The area for the winter greens was planted as soon as the temperature started to cool off, which was in September. The tunnel was pulled over the area when the temperature was too cold for good tomato production, which was the first part of November.

Compared to a stationary high tunnel, I will be able to prepare soil, and in some cases plant the crop, before I move the structure over the growing area. By using this procedure, I will be getting the best use of the structure, eliminating down time when changing crops, and improving the soil between crops. Another benefit is that after I move the structure from over a crop, it can still remain growing as long as temperatures are favorable. I did this with my first planted crops: after I moved the structure, the lettuce, broccoli, kale, spinach, beets, and dill remained growing with some row cover fabric.

One thing I had not planned on was the camber that was built into the high tunnel for structural support. Since the end walls were flexible and put on last, it worked out all right. Instead of a structure 28 feet x 48 feet I ended up with a structure 33 feet x 48 feet

Determining the frame the high tunnel should be built on took several months of research and at least five different designs:

1. Wood on wood skid type system
2. Ski type rail pulled on top of soil
3. Stationary permanent rail with wheels that roll on top of rail
4. Angle iron with casters that roll in it
5. Welded frame with wheels tied down with mobile home anchors and cables.

I chose design 5 because it was one of the two least expensive. The first was the least expensive to build, so I asked two other growers who used this design if they liked it and if not what would they do different. They both said they wished they did not have the permanent rail on the ground because of the repair it requires when it is run over with equipment.

The wheel and frame structure I chose was a type of design produced by a local manufacturer of hog houses. It sits above the ground by about six inches with the option of taking the wheels out and setting the frame on the ground. For now, I decided to keep the wheels on the inside wall along the bottom. They act as a heat retainer and block wind under the frame, and the organic matter will later be tilled into the soil beds when needed. Another design change came to us when we were welding the wheel attachments on. Instead of putting the wheels on the outside, we

attached them to the inside where there was more sun protection for the rubber. This also made it easier to line and insulate the outside edge with hay bales. I thought it would be necessary to take up the anchors every time we moved the structure, but it has turned out to be quite a job that requires several people to get it done in a timely fashion. I might buy more anchors and leave them in permanently at the four locations and paint them red so I can see them and don't mow or till over them.

After visiting the test fields in Olathe and Wichita, I changed my high tunnel design and did not include raised sidewalls for ventilation. I believe there will be enough airflow for a 48-foot-long tunnel without side vents since the end walls will open completely. It would be different if it was 100-foot-long tunnel. Because the wind very rarely stops blowing here in Kansas, I believe we have more wind stress on our crops than other areas which reduces plant growth and yields.

All of the greenhouse engineers I talk to about the project advised me to reinforce the structure with extra wind bracing because I live in Kansas, and because of the lack of a good wind break, and the fact I would be moving the structure so often.

## DISCUSSION

The research I did to prepare for this project led me to articles about the soil food web, the way it works, how easily it can be lost, and the effect on brix and nutrient levels. The soil flora also reduces plant disease, insect infestation, and increases stress resistance. Micro nutrients and/or trace elements can play an important part in plant and human health – applying and retaining both the flora and nutrients can be a challenge. I understand now why some of the California strawberries and hydroponic tomatoes are tasteless. Soil flora has a great effect on the flavor of our foods. When I operated my garden center, my customers would ask for a tomato that tasted like their grandmothers' tomatoes. We tried the old non-hybrid varieties, but they (the customers) complained about lack of disease resistance in the old varieties. I believe now it was due to lack of soil flora and micronutrients due to overlapping crops and using inorganic fertilizers.

The equipment needed to move the structure was a concern. If I used a tractor or truck it would pack the soil bed down and a cable system could be in the way or get tangled. We opted for large wheels and more than we needed to support and move the tunnel. We found that on dry level soil two people could push the tunnel to the new location.

With the raised ridge I knew there would be settling of the soil and did not go to the expense of laser leveling as of yet. As of this report, soil settling has not been a problem because of the adjustable allowance in the end walls and the frame side edge not sitting on the ground.

The project turned out to be more expensive than anticipated because of the raised bed, added wind bracing, and the welded frame and wheel. From initial results, the production from this structure looks to be profitable. Because the tunnel is moveable, I can be flexible with the choice of crops, planting and harvest times while avoiding most of the drawbacks of a stationary high tunnel. I can envision permanently planted perennial crops such as strawberries, raspberries, cherries, lilacs, hydrangeas, bulb type flowers, etc.

Regrowth of certain plants was a pleasant surprise, some loose leaf lettuce varieties were recut 3 to 4 times and broccoli produced very large heads, then continued to produce side shoots for several months longer than field grown plants.

Project impacts included, improving nutrition in local communities, adding an alternative winter crop option to growers in a slow time of the year, and providing a local alternative to the high fossil fuel cost of transporting greens and other fresh

vegetables and flowers from California, Mexico, Florida, or further. These higher quality, higher value crops can be marketed to local restaurants or retail markets offering organic produce.

In addition to the commercial opportunities, the incredible importance of being able to sustain a family with fresh, clean, healthy produce with active beneficial flora, enzymes, and minerals in our uncertain times might be of more value than money.

#### OUTREACH

I invited my county agent to see the tunnel after a night of near 0 degree F temperatures - he assumed that without heat there would be nothing left except black wilted foliage. He was surprised that it was still alive and growing. The first garden club presentation is scheduled in February 2006. Pictures will be submitted to the high tunnel website. 4-H groups will be scheduled after the first of the year. I volunteered to be a part of a pest control study with Sorkel Kadir, Assistant Professor of Fruit Crops at Kansas State University.

## Research

### Participation Summary

Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture or SARE.



Sustainable Agriculture  
Research & Education [US Department of Agriculture](#)



This site is maintained by SARE Outreach for the SARE program and is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award No. 2019-38640-29881. SARE Outreach operates under cooperative agreements with the University of Maryland to develop and disseminate information about sustainable agriculture. [USDA is an equal opportunity provider and employer.](#)