

Final Report

**Development of an Innovative Production and Marketing System
for Specialty Vegetables**

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Impact Evaluation

Sixteen Indiana farm families connected with this value-added project funded by the Office of Commissioner of Agriculture (OCA) are now increasing their specialty crop production using plasticulture technology for season extension. Four growers in West Central Indiana and 12 in Southeastern Indiana are adapting various concepts brought forth in this project. The project is in contact with three other growers now working with these same season extension concepts. In the past two years, we have promoted season extension and “Four Season Harvest” concepts at the Indiana Horticulture Congress to growers from across the state. We anticipate that the future impact of this project will increase over the next two or three years.

The logo (Hoosier Fresh) developed for this project is now being considered by Indiana Farm Bureau as a contender for a new state logo for Indiana’s produce. We have collaborated with Indiana Farm Bureau, the Indiana WIC program and MCL Cafeteria to promote the health benefits of mixed greens and lettuces in salads year round. We have also promoted the concept of locally grown produce to the Jennings County School System, the State Board of Health, and regional representatives of the Department of Defense Food Procurement Group.

The experience and capacity gained from the “Hoosier Fresh” project has greatly strengthened the efforts of the USDA-funded Specialty Growers’ Education and Marketing Initiative. We have gathered information resources from across the country that will support extension efforts to encourage adoption of low-cost season extension technologies across the state.

This project has influenced various members of the Farmers Market Cooperatives in Jennings and Ripley Counties and the Amish community in Parke County. In Jennings County it has led to developing a demand for various cool season salad greens which did not exist prior to this project. Other local growers are starting to invest in their own hoopouses and high tunnels for early season produce production, not only of vegetables, but also cut flowers and berries.

Achievements of the project include:

1. Practical experience for growers demonstrating low-cost season extension techniques.
2. Introduction of new sources of information, new crops, new varieties and new promotional techniques.
3. Demonstration and development of local demand for cool season salad greens grown under plastic.
4. Acknowledgement of profit potential for Hoosier growers by producing early season tomatoes, berries and flowers using unheated hoopouses.

Review of Project Objectives

Preparations and Adjustments:

This project was initiated in late spring 2001, prior to the funding year beginning September 1, to avoid losing a season of production. All initial effort was focused on the single pilot site with the first cold house structure located in Parke County southwest of Rockville. The following spring two additional cooperators in western Indiana were added. The second structure at Rockville had been put in place and was in use, when a series of events, including a severe injury to the grower at the pilot project, caused him to cease operations and move to another state where his wife entered teacher's training and he changed career objectives. In response, we switched from a single, fully integrated organic pilot operation to a series of efforts to introduce key components of the system to conventional growers who could use them to augment their current production.

An alternative plan was developed within six weeks. The other two growers in west central Indiana continued production and each was provided a pair of small experimental structures by the project. However, the hub of the project, including all structures and equipment at the Rockville location, was moved to the North Vernon area in conjunction with the Jennings County Growers Co-op and the Southeast Purdue Ag Center. The two full-size 96' semi-permanent production cold houses were divided into six smaller 32' mobile demonstration plastic houses. Two were reconstructed at SEPAC and the other four were distributed to grower members of the marketing co-op. Rather than establishing our own commercial learning site as planned, we teamed with a Kentucky grower, Paul Wiediger of Au Naturel Farm who already had several years of success and was providing training workshops. We sponsored growers traveling and attending a full day workshop near Smiths Grove, Kentucky and brought Paul Wiediger to consult with Jennings County growers on their farms and to speak at the Indiana Horticultural Congress.

Comments on Project Objectives:

- A. Establish a pilot program for an efficient production system for a mix of specialty vegetables that incorporates: (1) a consumer and farmer friendly production system; (2) season extension through irrigation and controlled environments with plastic covers; and (3) quality standards for freshness.*

Although cool season production under plastic did not require pesticides, fertilization was not consistently organic. With winter fast approaching by the time the structures were moved to Jennings County, primary emphasis was on plastic covering. Irrigation was not needed on the tight moist soils of that area during the cool season. Plastic mulch, shade-cloth and drip irrigation techniques are just now being implemented. Irrigation had been in use at the Parke County site when it closed.

With three market days a week in Jennings County, it was easy to move the produce in less than 48 hours. Information on postharvest handling and quality standards for each crop is currently being assembled by the Jennings County Growers Cooperative (JCGC).

The original mix of specialty vegetables was primarily Italian for the restaurants and catering, but we found the demand for Asian greens to be stronger in the farmers' markets. Also interest has been high for using the portable plastic covered hoops for producing mesclun mix

through the winter, early tomatoes in spring, bedding plants when greens production decreased, winter starting of tall-stature cut flowers, and high tunnel production of brambles.

The associated effort by Jules Janick and Mario Morales to screen for slow-bolting arugula cultivars was successful and the first potential release is now in field trials with a commercial seed company.

B. Organize an efficient marketing system through three major channels: (1) bi-weekly delivery to restaurateurs in up-scale markets, (2) weekly presence at two large farmers' markets, and (3) delivery to specialty food supermarkets. This will be coordinated with brand recognition of Hoosier-Fresh label through marketing collaborators and state and local publicity.

During the period before the grant was activated, marketing followed this pattern, but demand was more sporadic than hoped. The following season, the first under OCA project funding, success was limited due to an on-farm injury and suddenly increased family demands. This second season under a project extension met with continuous weather problems, but marketing improved. The North Vernon Market with its strong Women, Infants and Children (WIC) assistance program has absorbed the available produce to date. Some other products from Jennings County have been taken to the Carmel Market. The new Parke Produce Auction west of Bellmore should provide an outlet on the western side of the state.

The Jennings Growers through Indiana Farm Bureau have initiated a working relationship with MCL Cafeterias. The Marshall-based cooperator has connected with Wild Oats and the Georgetown Market and has provided some produce for the Eagles Nest at the Downtown Hyatt in Indianapolis.

Publicity efforts have increased via the Hoosier Fresh bags (Fig. 1) which have been popular with growers and customers at the Farmer's Market. Indiana Farm Bureau is interested in making it a state logo.

C. Develop the Hoosier Fresh Growers Alliance by expanding the prototype project into a network of collaborative growers. Key components include: (1) quality assurance; (2) marketing assistance; and (3) educational programming.

Quality assurance standards are currently being developed by the JCGC team. In regard to sustainable production priorities, no pesticides are needed for cool season production under plastic. Adding compost to production beds and experimenting with biological controls are both promoted. More focus is needed on non-chemical weed-control strategies.

Postharvest handling systems included washing, drying, and refrigeration. Produce grading and packing standards from the Kentucky Organic Growers were included. The Table of contents from the Postharvest Reference Notebook is included as Appendix A. The growers' cooperative was provided with an assembled reference notebook of the North Carolina guidelines.

Freshness standards were achieved by delivery within 30 hours of harvest. Using variety recommendations from Paul Wiediger and from Johnny's Seeds new crop, variety demonstrations were carried out at SEPAC and with select growers. Seed costs were covered by a complementary grant from USDA.

Our *marketing assistance* program was based on the development of a logo entitled Hoosier Fresh and using it to imprint plastic bags (9 × 12"). Five thousand bags were imprinted and distributed to grower cooperatives for test programs. The plastic bags were enthusiastically

received by growers and consumers and the Indianapolis Farm Bureau is investigating a continuation of this program (Fig. 1 and attachment A).

Education programming included special sessions at the Indiana Horticulture Congress at Indianapolis carried out in 2002 and 2003. These programs were very successful (Appendix B). Field training was carried out in October 2002 (Appendix C). The project sponsored growers' participation in a full day of training with Paul Wiediger in South Central Kentucky. Paul was then invited to Jennings County to meet with select individual growers on their farms. Each grower was provided with Wiediger's *Winter Growers* resource folder.

Outreach

David Swaim, project coordinator spoke at both Ripley County and Jennings County Growers' Banquets. Cooperator Richard (Bud) Beesley hosted a Jennings County FFA tour in May 2003, which included the mobile cold house demonstration site at SEPAC and adjacent plastic mulch demonstration. Jennings County Growers Cooperative agreed to assist Roy Ballard in purchasing a used cold house to demonstrate season extension techniques at Joe Huber's Farm and Restaurant for a fall program in the greater Louisville Area.

"Hoosier Fresh" has its own website (www.hort.purdue.edu/newcrop/hfresh) describing the project and containing pictures of growers and experimental structures.

Copies of the *Hoophouse Handbook* published by "Growing for Profit" were distributed to growers during a project review tour conducted by project coordinators J. Janick and D. Swaim in May 2003.

An article on Blue Moon Farm, the original cooperator, was published in Indianapolis Monthly in Summer 2001.

Collaboration

The Purdue Center for New Crops and Plant Products and the Purdue Extension Service worked with the JCGC, Historic Hoosier Hills RC&D, Indiana Farm Bureau and WIC. In addition the project worked with a number of commercial markets including several Farmer's Markets, MCL Cafeterias, Jennings County Schools, and food producers of the US Department of Defense.

Future Plans

The JCGC plans to expand the program and network with other current cooperators across the state. The Indiana Farm Bureau has expressed interest in promoting the concept among their members in the various counties and are negotiating with the project for use of the logo.

Plans for Continuation

This project is placing more than a dozen demonstration units in the hands of growers, most of whom belong to the JCGC. The officers of the Jennings Coop have a commitment to expanding from this base. As experienced growers expand to larger structures, the smaller mobile ones can be provided to beginning growers. The coop intends to:

1. Share experiences from this year with the rest of the growers' cooperative.
2. Increase the number of season extension structures as growers buy their own.
3. Encourage continuing improvement in management now that several growers have initial experience and a broader vision.

4. Continue to experiment with varieties and cultural techniques under plasticulture at SEPAC with special emphasis on site selection and development.
5. Increase the quantity and variety of cool season crops as well as producing more for the early and late season markets.
6. Expand current marketing relationships to serve more Indianapolis restaurateurs.
7. Expand production into flowers and berries.
8. Work with Indiana Farm Bureau and Purdue University to determine potential for further developing packaging with the Hoosier Fresh logo.
9. Continue working with WIC to promote fresh produce and provide recipe cards.

Continuing Activities Include:

- Complete and copy the harvest and storage guide by August 1.
- Encourage cooperators to have sites prepared and structures in place by September 15.
- Plan farm tours for late summer or fall.
- Complete summer and winter variety demonstrations at SEPAC.
- Continue range of market tests.
- Step up publicity efforts.
- Plan for grower roundtable learning sessions during the winter.

Summation of Grower Experience

Site Preparation

Site preparation is critical. Profitability requires: (1) perfect surface drainage, (2) improved internal drainage, (3) high residual fertility and tilth of soil, (4) exhausting soil reservoir of weed seeds or installing plastic mulch, and (5) the house must be in place ahead of time so untimely rains don't saturate the site prior to planting or windy conditions keep the house from being covered properly.

To get good surface drainage the site must be chosen or built up to be at least 4" higher than surrounding areas or if on a slope an 8" berm needs to be constructed up hill to divert surface flow in rainstorms. Ideally, plastic will be flanged out about 2' along the length of the house from the base of the sides. This is needed so the runoff from the plastic cover does not soak back into the growing beds and aisles. High traffic areas particularly in front of the door need to be covered with sawdust, old plywood, plastic, gravel, crushed stone, flat stone, or brick. Thermal mass and drainage are the considerations in making this choice.

For better internal drainage, choose sandier soils or reddish slopes whenever possible. If grey silt fragipans are the only option, buildup the soil with organic matter, make raised planting beds and experiment with scrap plastic drainage tile or a narrow channel of gravel or wood chips under some of the beds.

Structures

The chosen management/marketing system should decide the type and size of structures. Many growers are more comfortable with larger semi-permanent houses, though the smaller mobile units can be cost effective and allow for more crops per year while providing the disease control benefits of "field" rotation. The smaller units require a very different management mindset. Timeliness is "everything." Management is substituted for capital. A full-time commercial

grower may find that a mix of the two types of houses is most effective if the management does not become too complicated.

If the hoophouse does not have fans, it **must** be built so the sides can roll up from the ground 2 to 3 feet for cross ventilation. Figure 2 shows the basic structural features of a small high tunnel or hoophouse. Note the details of the modifications made to allow the sides to be rolled up on sunny days. The top of each end should also be able to vent accumulated heat. Ideally in late spring the ends will be able to open completely or have large screened windows that can be opened before it is hot enough to roll the sides. **Overheating** can cause more loss than freezing on cold tolerant plants and it may hasten bitterness and bolting. The rule of thumb for end-ventilated houses is that they be no longer than twice the width. If the house is longer, as spring approaches, consider planting warm season crops in the middle while finishing the cool season crops near the ends. The exception would be high tunnels for berry production which are typically 12 to 14' wide and 96' long with roll-up sides.

The larger semi-permanent structures should be covered with a double layer of poly plastic and the space between layers kept inflated. One end might be curtained off with a plastic drape during the coldest months and electricity run to the house for lights. A portable propane heater can be used to reduce the chill.

The smaller mobile structures usually have only one layer of poly, but additional row covers can increase temperature in the row by 8°F during coldest months. After each move the poly will need to be restretched. A major challenge in this project is for new growers to recognize the difference in management needed for the smaller mobile units versus what they have experienced or observed with the larger stationary structures.

Growers using either type of lower-cost non-electric hoophouses should not expect to grow warm season crops in winter or cool season crops in summer. Even the warm season crops will be short lived during the heat of August. And the cool season crops will not grow rapidly during the low light intensity of winter here in the Great Lakes States.

Advantages of cool season growing (and early season starting) under plastic include reduction of rain splattering that splashes grit onto leaves and spreads disease. Wind blasting of seedlings and leaf crops on sandy soils is reduced and tall-growing flowers can be given the wind protection they need. Also during winter there is very little insect pressure, especially in the unheated houses, which is of great benefit on leaf crops.

The base of the house will need to be weighted, staked, or tied down to screw-in tent stakes to insure that it is not overturned in a windstorm. The system should provide stability without hindering the regular progression of site change. The smaller hoophouses are designed to be moved every few weeks to increase growth rate on a sequence of crops, starting with cold hardy, then cool season, and then early planting of warm season crops. That same structure can also be used to cover to two fall plantings, first the warm season crops and then the cool season crops. That strategy adds value to up to five crops per year.

The mobile house is typically pulled by tractor attached to the rear of house. It is pulled to a site directly behind the original site. The trailing end will need to be raised or opened to leave growing crops undisturbed. The hoophouse can be built with side boards for stability and weight with temporary bracing added while pulling. If a solid wood base with metal reinforced corners is used, a front-end loader can be used to raise the house onto cement blocks, at least one per 8 feet of house length. As the frame slides on the blocks less than a foot off the ground, another block is placed in front of each side. The frame actually does slide easily from block to block. Care should be taken to minimize stretching the frame and the plastic while moving.

Crops and Varieties

Obviously, thoroughly understanding the growth patterns and physiological needs of each individual crop is essential. Each crop has an optimum spacing depending on soil fertility, weed control method, size when harvested, moisture, and ventilation. Some can be direct seeded into cold soil while the others are best flatted, heated, and transplanted.

Both crop and variety selection should take into account market strategy as well as reliability and ease of production. A limited number of “novelty crops” may be needed to attract interest at the marketplace. The higher cost production of early crops under plastic can be justified if the grower can establish strong customer relationships while the number of competing growers is relatively small and customer flow is still light.

This project has emphasized to both growers and customers how many months of harvest can be gained by incorporating relatively low cost plasticulture techniques. Table 1 shows which crops can be grown through the winter and which other crops can be started early in spring or continued late into the fall without incurring fuel costs.

The project coordinator has introduced the cooperating growers to several new or less common crops that fit cool season production. Special emphasis has been on mesclun which is a term French market gardeners coined for various combinations of young leaf lettuce, baby greens and edible flowers, which are increasingly popular for salads. Such combinations are much more nutritious per pound than iceberg lettuce and sells at gourmet prices. The mesclun mix is ready for harvest within a month after planting and provides multiple harvest cuttings. The production of Asian “braising greens” such as mizuna and tatsoi as well as spinach, arugula and red kale has also been encouraged. Tables 2 and 3 show popular varieties and mixes.

A range of new crops and varieties were chosen for planting at the demonstration area at SEPAC and extra seed was distributed among several cooperating growers for planting on their farms. The varieties used in the spring 2003 trials plus those to be tried in 2004 are listed in Table 4.

Seeding Techniques and Spacing

The purchase of specialized hand tools to speed seeding and transplanting can be an important investment. In other cases the seed can be spread on the ground and covered with a thin later of peat and then watered. The dark peat will absorb more heat than light grey silt, will not crust but will hold moisture and is exactly the soil conditioner that soil will need for future productivity once the bed is tilled for the next crop. This is particularly important for early planting on soils too moist to till.

The grower can refer to charts of germination times and optimum temperatures to help decide which crops to direct seed. Some seeds may need to be pre-soaked or planted later on soil prewarmed with plastic. Other seeds are best grown in heated flats and transplanted.

The grower should also review charts on optimum spacing and then modify to allow for tilth conditions, fertility, ventilation, moisture availability, size at harvest, and weed control strategy.

Temperature and Moisture Control

A soil thermometer placed in the growing bed and a max-min thermometer placed at canopy height are needed for monitoring temperature extremes.

Many cool season crops can endure amazingly low temperatures, even down to 10°F for short periods of time, especially when the leaves are somewhat flaccid from delayed watering. Water during warmer spells but reduce water during periods of freezing weather. The greater

problem is overheating on clear days. Houses must have some daily air circulation on clear days even in winter. As spring nears, the sides of the hoophouse **must** be designed to be rolled up from 1 to 3 feet above the ground or dropped to ground. There are several mechanisms for raising and lowering the plastic on the sides of the house. Also the heat in the top of the house should escape through vents on the ends. There are many designs to choose from.

A major problem in cold houses is condensation which decreases penetration of sunlight into the house and then drops from the plastic onto the plants. The condensation virtually pulls moisture up through the ground. This is a particular problem on the wet fragipanic soils on the flatlands north of the Ohio Valley like those at SEPAC. Even in winter the cold houses need to have the end windows opened during the day for ventilation to reduce condensation. Using the double layer of poly helps this problem to some extent.

If warm season crops are to be grown in hoophouses they will need plastic hose for drip irrigation put in place before planting. Fertigation is recommended on soils with low organic matter. It is important to develop a method for monitoring soil moisture which is somewhat difficult when using plastic mulch. Overwatering should be avoided because it hastens root rot and interferes with nutrient uptake,

Pest Control: Weeds, Disease, Insect and Vertebrates

Control of cool season broadleaf weeds like chickweed, henbit, shepherds purse, and curly dock can be a major challenge in greens and lettuce. In early spring, annual bluegrass can become a major problem. With the warm season crops or summer salad plantings or even fall seedlings, all the warm season broadleaves and grasses become competitive.

Because the high-value winter leaf crops are harvested small and can be planted in narrow rows, mechanical weeding is difficult and plastic mulch is not practical. Beds for leaf crops should ideally be prepared months in advance with frequent tillage to sprout most of the weed seed. Adding two or three inches of weed free compost or peat on top of the beds is also practiced. When the crop seedlings are an inch or so tall, the bed can be quickly and shallowly “run” with a stirrup-shaped hoe. Long handed diamond-shaped hoes are used a couple of weeks later. Never let beds grow up in weeds that are left to reseed after the crop is harvested!

For slower maturing, transplanted crops the use of plastic mulch is recommended for weed control. For early tomatoes, the entire floor of the hoophouse can be covered with black plastic with soaker hose placed underneath near the location of future rows.

As long as raindrop splashing is controlled, the crops are relatively free of disease as well as grit. Also wind dissemination of spores is curtailed.

During the winter there is relatively little insect problem on most crops grown in unheated frames. In spring insect problems start nearest the windows. In the fall, much more effort will be needed to guard against severe insect damage.

If the fertigation system is not distributing water and nutrients uniformly, there can be more disease and physiological damage. If the sides are left open during a severe windstorm the windward rows may suffer desiccation and stunting.

Using plastic-covered hoophouses greatly reduces the risk of bird damage, especially to berries. Occasionally meadow voles can dig up seeds in unmulched soil. If the hoophouse is left open at night, deer will enter and feed.

Tools and Equipment

Having the right tools for assembling the hoop structures and fastening down the plastic makes the job more efficient. Quality hand tools, particularly specialized weeding hoes, are

essential to effective production management of smaller scale operations. Hand tools or garden tractor tools for rapid seeding and transplanting can be helpful and are cost effective for larger scale operations. Access to a combined bedder and plastic layer is important again for larger scale operations where spaced transplants are grown.

For direct seeding of mesclun mixes and Asian braising greens, the manager of our pilot project at Blue Moon Farm followed the Coleman method of bed preparation using the broadfork, three-tined cultivator, and the metal-toothed grading rake. He finished the beds with a 30-inch mesh-surfaced roller. The beds were then planted with a “Four-Row Pinpoint Seeder” purchased from Johnny’s Seeds of Albion, ME. For more information on purchasing this equipment consult “The Winter-Harvest Manual” by Eliot Coleman.

Thermometers for monitoring soil and air temperature are important. Since the extremes are the problem, a max-min thermometer is recommended. Supplemental heaters and portable grow lights can also help keep small sections of the house on production schedule even during a cloudy cold winter like this past one.

Some crops may do best with trellising. Extra poles, wires and string will be needed. Raised beds make planting, tending, and harvesting greens much easier. While raised beds are colder than “flat ground” plantings in mid winter, they work well in houses receiving minimal supplemental heat. One innovative technique has been to buy children’s wading pools, punch holes in bottom for drainage, fill with potting soil, and place on used livestock gates laid on concrete blocks placed under the corners and midway. Wooden boxes can also be raised on blocks for easier access.

Standardized harvest containers are needed to provide a professional image at the market. Cleaning the leaf crops can be terribly time consuming, so investing in an organized wash station and a spin drier should be considered. Commercial spin dryers are expensive, but some growers have adapted old washing machines which do an adequate job.

Scheduling and Harvesting Techniques

A key to profitability is the scheduling of plantings and controlling the growing conditions so that harvests fit the market opportunities. Microgreens are harvestable in 7–10 days after planting. Asian greens for salads are ready in a little over two weeks. Radishes are ready in 3 to 5 weeks. The green leaf lettuces are ready to be harvested for mesclun about 4 weeks after planting but the red leaf lettuces may require an extra week or two. Loose heads of lettuce will require several weeks more. Some of the warm season crops will require 60 to 80 days from transplanting to be in full production (Table 5).

During the cold temperatures and low light intensity of January and February, growth can be slowed from 2 to 4 extra weeks. Also the higher-value red lettuces and kales may not take on full color without supplemental light, so they should be planted earlier and grown separate from the green during mid winter. Experienced growers bunch up lettuce plantings in late November and early December planning to space out the harvesting over a ten week period of very slow growth. Direct seeding of late December and early January plantings can be a waste of effort. Better to seed into heated flats for early February transplanting or into deep soil trays for growth under lights and direct harvest.

Several of the cool season crops can be harvested up to four times from the same plant. Growers need to compare the results from replanting with harvesting regrowth for each type of green. Some prefer two cuttings and then replant.

Processing and Packaging

In winter, cleaning and packaging is minimal. Once the mobile hoop house is moved and the leaf crops experience direct rainfall, the cleaning of splashed grit becomes consumptive. While greens are often best direct seeded while under plastic, they are better transplanted into plastic mulch when field grown.

In summer “field heat” needs to be quickly removed with refrigeration or a cold water bath. Insulated and iced coolers will be needed to keep salad green fresh. Large shallow “tupperware” type containers are available at Wal-Mart. Waxed cardboard boxes can also be purchased wholesale.

Restaurateurs simply wanted ease of handling volume while maintaining freshness. At the farmers’ market, the use of zip-loc bags with the bright Hoosier Fresh logo created interest and were quite popular. Also the brightly colored six-pac carton for Hoosier Botanicals has attracted extra attention at the Louisville market as well as at Jennings County.

With warm season crops the emphasis is on careful grading and the use of harvest and shipping containers that minimize scraping or other damage that may hasten deterioration.

Market Demand

Demand at the local market was surprisingly good for all crops if produce was good quality: ideal size, clean and trimmed and very fresh. The demand for greens was surprisingly good. Explanations on use are helpful. The WIC certificate program has greatly stimulated interest in fresh vegetables and fruit among those with fixed or very limited income.

Servicing the restaurant trade has proven challenging due to sudden changes in orders and the sporadic nature of customer preferences. Communication requirements can be difficult to fulfill. Also liability insurance costs can be prohibitive.

There is interest in some schools and defense facilities for “locally-grown” produce but a cooperative effort of several growers is required to meet the demands of these markets.

This project has just begun to explore the potential for internet marketing of produce. It probably has its greatest potential in maintaining contact with potential wholesale buyers. Message groups that notify regular market customers of the coming availability of particular crops or varieties may be used to build interest, particularly mid week. Growers using cold houses through the winter can confirm orders over the internet for home deliveries much as the Wiedigers of Au Naturel Farm do in the Glasgow and Bowling Green, Kentucky areas.

Profitability

Profitability depended heavily on site selection and preparation. Waterlogging and weed pressure were major problems. Building tilth and fertility to support close spacing was needed for better utilization of limited growing area. Some crops could be direct seeded and result in good stands but several needed to be germinated in heated flats with access to grow lights and then transplanted. Row covers inside a single layer of poly covering appeared to be less cost but more trouble than inflated double layers of plastic film.

Production needs to be carefully timed to meet the established market and space needs to be used efficiently. Avoid wasting heat too early in the season on warm season crops. Color, shape, freedom from blemishes and cleanness are necessary for appeal, along with earliness, freshness, variety of selection, and presentation. Obviously all are related to profit potential.

Individual Cooperators

A list of cooperators with the season extension structures is presented in Table 6.

Project Documentation

Photographs of cooperators, marketing progress, and season extension tunnels and greenhouses are shown in Appendix D. Comparison of hoophouses with other season extension techniques is shown in Appendix E. Checklist of cold house startup are shown in Appendix F. Results from winter-growing demonstration at SEPAC are included in Appendix G.

Logo and Packaging Development

Hoosier Fresh Logo

One purpose of the project was to develop and promote a marketing logo for Indiana specialty crop growers. Jules Janick, assisted by Anna Whipkey, located and adapted the artwork for the ***Hoosier Fresh*** logo. Participating growers reacted favorably toward the logo.

The Plastic Bags

Dave Swaim checked prices for test market volumes of plastic bags with several companies including Putnam Plastics of West Carrollton, Ohio and Rockford Packaging of Rockford, Michigan, both of which are regular exhibitors at the Indiana Horticulture Congress, and the Bag Barn at 1337 W. JPG Woodfill Road, Madison, Indiana 47250 (www.bagbarn.com phone 877-616-5238). Bag Barn was an in-state business and the owner-manager Barry Storner worked with us using our graphics and was willing to print smaller lots. He printed an initial run of 5,000 Zip-Loc 9"×12" Clear Plastic Bags printed with the Hoosier Fresh logo (see attachment). The 3-color line art printing on a white background cost \$970 for the lot of 5000 which was \$0.19 per bag after initial set-up fees. (Total cost was \$1,241.00.) That quality of bag would cost \$0.14 each if printed in half-tones or in much larger quantities. The rolls of produce bags used at the grocery store are much thinner and not reusable at home but are much cheaper.

If these bags were to be distributed through stores nutrition facts would have to be added, ingredients, weight, serving size, expiration date, name and address of processor, UPC, and possibly lot number. Mesclun mixes and specialty salad greens from California and Mexico typically come in a three-color 9" × 11" sealed acetate bag.

The bags were distributed among growers in the three areas, with the majority used by several growers in Jennings County. The size was just right for leafy greens. The growers at the Farmers' Market were impressed with the quality bags and appreciated the sense of professionalism and identity the bags provided. They believe the bags will be kept by most buyers and will continue to provide advertising.

Plastic Transport Containers

The commercial users like MCL did not want several bags to empty. They preferred either disposable waxed paperboard boxes or returnable containers. We could have used waxed paperboard boxes but wanted something distinctive and would be able to pick them up regularly.

Coop vice president and distribution coordinator, Bud Beesley, located appropriate containers at Wal-Mart at a cost of \$3 each but provided by another budget. They were semi-opaque white tupperware type plastic with lids made by Sterilite. The dimensions were 15" × 24" and depths could be either 6" and 12". More info available at www.sterilite.com. The deeper containers were handier in the field but the bottom produce got crushed. The restaurant staff preferred the shallower containers. The lettuce stayed so fluffy that the MCL staff could mix it with pressed lettuce from California and get a fresher looking salad.

Bud Beesley would deliver up to three times a week and pick up the empty plastic containers. These should have a 5–10 year lifespan. They should not be left in direct sunlight for long. Once the lid is on, these containers act like the “crisper” drawer in the refrigerator.

Marketing and Promotional Experiences

Farmers’ Markets and WIC Program

Brad Miller was able to sell products from the project at Bloomington and Carmel markets during the preparatory year. Jacob Fisher sent some of his produce to Indianapolis along with that of other Amish growers. The Trees were able to sell project produce at Noblesville farmers market but were discouraged from selling in Lafayette.

This year the Jennings County Growers have been selling primarily through the North Vernon market. The strong local WIC program that provides produce certificates for needy women, infants, and children has been a big boon to growers. Season extension techniques allow growers to service this need both earlier and later in the year. Also busloads of senior citizens have come from other counties to shop at the market. Red leaf lettuce and mizuna greens were the top sellers.

Restaurateur Relationships

Initially Brad Miller was selling products from the project to select Carmel chefs as well as through his partners’ “Rustic Gourmet” Catering Service. Jacob Fisher has been able to provide produce to the Eagles Nest Restaurant at the Indianapolis Hyatt Regency, as well as a restaurant in Champaign, Illinois.

Bud Beesley has been providing samples of produce since late march to MCL in Indianapolis. Handouts (see Appendix H) were developed to familiarize customers with the new salad mixes. Recently MCL has increased the volume and variety of products to resell fresh at their Castleton outlet on Sundays.

Institutional Marketing

The JCGC has partnered with the Jennings County School System to serve as a pilot project with the State Board of Health on incorporating locally grown produce back into the school lunch program.

A second project has been developing contacts within the food producers at the US Department of Defense that is looking for sources of local produce in Southern Indiana and Ohio.

Internet Marketing

With funding from the Jennings County Farm Bureau, a homepage was developed by SEIDATA that could eventually facilitate internet marketing once production volume is adequate. Paul Wiediger, project consultant from Smiths Grove, Kentucky, reports that most of the marketing from his cold houses when the farmers’ market is not open is over the internet with customers established during the summer and referrals.

Purdue Black Tie Dinner

The project was asked by a representative of the Purdue University Hotel and Institutional Management Department to provide produce for President Jischke’s Black Tie Dinner on Saturday evening April 5, 2003. Dave Swaim coordinated communication and

delivered mint sprigs, parsley, and kale to Stone hall two days before the dinner. Mint and small parsley sprigs came from Kent Fenley of Greensburg and the more mature parsley and kale came from Clarence Wullenweber of Commiskey. Purdue contact Brad Beeler reported back to Swaim that the products were the quantity, size, and quality that they needed and he thanked the project for participating.

Training Opportunities and Educational Materials

Project Homepage

A project homepage developed by Anna Whipkey is online (www.hort.purdue.edu/newcrop/hfresh) see Appendix I.

Eliot Coleman Books

At the onset of the project copies of Eliot Coleman's book on "Four Season Gardening" were distributed to Fisher, Trees, and Armand with illustrations shown to other growers. Brad Miller already had his own. Swaim repeatedly discussed the concept of mobile coldhouses with participants.

Indiana Horticultural Congress

One day programs for specialty crops were carried out as part of the Indiana Horticultural Congress in 2002 and 2003. The programs are presented as Appendix B.

Au Naturel Farm Workshop

On Saturday, October 25, 2002 from 8:30 to 4:00 EST, Paul Wiediger hosted a workshop at his Au Naturel Farm, located near I-65 just south of the Mamouth Cave exit. Bud Beesley, Richard Adrian, and Dan Frantz attended (See Appendix C).

Paul Wiediger On-farm Consulting

In early December, 2002, Paul Wiediger accompanied Dave Swaim on visits to the farms of the Hendrix, Wullenweber, Shatto, Armand families, and also met with cooperators Short, McCullough, Beesley, and Adrian during the day. The group also stopped at the demonstration at SEPAC to make observations and discuss possibilities.

High Tunnel Manual by Wiediger

Copies of Paul's detailed seminar folder were given to all those visited on the farm tours. This material was the basis for his booklet *Walking to Spring ... Using High Tunnels to Grow Produce 52 Weeks a Year*.

The Hoophouse Handbook by Growing for Market

Copies were given to Shatto, Armand, McCullough, Hoyt, Beesley, Beihle of SEPAC, Short, Hendrix, Wullenweber, and Dailey plus one sent to Frazier.

Jennings and Ripley County Growers Banquets

On January 9, 2003, David Swaim spoke at the Ripley Growers' Banquet at the Osgood Community Center. On January 16, 2003, Swaim spoke at the Jennings County Growers' Banquet at the Jennings County Public Library at North Vernon and explained the potential of

season extension structures and told of the experiences at SEPAC with the Jennings County Growers Project.

Extension Handouts

Project coordinator, David Swaim assembled a collection of extension materials relating to cold house, hoop house, and high tunnel culture. Copies of several booklets and reprints were sent to Lewis Frazier of Sharpsville in response to his call requesting detailed technical information. Notebooks containing the full collection of materials are being made available to the JCGC and Purdue Extension Horticulturalists. The Table of Contents of this reference notebook is included as Appendix J. Copies were provided to Lewis Frazier of Sharpsville in response to his call for printed technical information.

SEPAC exposure to FFA plus Grower Experiences

Jennings County FFA members visited the mobile cold houses at SEPAC plus the plastic-mulched raised bed comparisons for which they have been growing bell pepper transplants in their class greenhouse at school. Representatives of the Ripley County Growers Coop have requested visits to SEPAC in 2003. The Jennings County Growers will be invited at that same time, though several have already stopped by.

Huber Farms Demonstration

Jennings County Growers Coop provided resources to Roy Ballard to purchase and set up a demonstration cold house at the Joe Hubert Farm and restaurant at Starlight for the fall and winter of 2003–2004.

Related Projects

Arugula Screening

As part of this project, Jules Janick and Mario Morales, acquired several cultivars of the cold-hardy Italian salad and braising green “arugula,” which is called “roquette” by the French. They conducted extensive screening for slow bolting genotypes that could grow longer into the summer before bolting and flowering. They have found lines that are late flowering and have provided these to a commercial seed company for field trials. The results of this research was published, and is listed as Appendix K.

Microgreens on Mats

Janick and Morales have also experimented with the production of microgreens on soaker mats on tables as an alternative to float tables. They have been cooperating with Jefferson County Grower Denise Dailey of Walton Creek Farms west of Deputy. The mat system was effective but cost was not competitive.

SARE Funded Grower Project

While this project has been in progress, Ivor Chodkowski of Greenville, Indiana, in Washington County received a NCR SARE Producer’s Grant to set up a cold house production and marketing system. He can be contacted at ivorchodkowski@aol.com.

Dan Frantz who farms south of Ivor toward Corydon accepted our invitation to attend the Workshop at the Wiediger Farm and is experimenting on his own with season extension techniques in his organic production system.

Amish Community Trends

As neighbors have observed Jacob Fishers experience growing cool season crops in unheated hoopouses and starting early tomato plantings, cold houses have been purchased for several Parke County Amish Farms. This will provide more early season produce for the new Parke Producers Auction located west of Bellmore.

Appendix A

Postharvest Reference Notebook

Jennings County Growers Cooperative

Table of Contents

Packing and Grading Standards

Kentucky Organic Growers, 1995

Postharvest Handling of Crops

The JSS Advantage from Johnny's Seeds

Postharvest Cooling and Handling Guidelines

Cabbage and Leafy Greens
Green Beans and Field Peas
Peppers
Sweet Corn
Onions
Strawberries

North Carolina Cooperative Extension Service

Proper Postharvest Cooling and Handling Methods

Introduction
Hydrocooling
Crushed and Liquid Ice Cooling
Forced Air Cooling
Chlorination and Postharvest Disease Control
Design of Room Cooling Facilities:
Structure & Energy Requirements

North Carolina Cooperative Extension Service

Affordable Postharvest Handling and Cooling of Fresh Fruits, Vegetables and Flowers

Part I: Quality maintenance
Part II: Cooling
Part III: Handling
Part IV: Mixed Loads
Part V: References

North Carolina Cooperative Extension Service

Small Scale Postharvest Handling Practices

The University of California, Davis

Appendix B

Indiana Horticultural Congress

Appendix C

Au Naturel Farm Passive Solar Greenhouse Growing Workshop

Appendix D

Images of project cooperators and season extension greenhouses.

Blue Moon Farm
SEPAC
Armand
McCullough
Jacob Fisher Farm
Hendrix Greenhouses
Hoyt Blackberry Farm
Prairie Stream Produce
Shatto's Pumpkins and Poseys
Short's Produce Gardens
Walton Creek Farms
Wullenweber Produce Farm
North Vernon Farmer's Market
MCL Cafeteria Collaboration

Appendix E

Comparison of Hoophouses with Other Season Extension Techniques

The use of hoophouses provides a better working area and less temperature fluctuation than row covers and hot caps. If the ends of the structure can be opened and the sides roll up and down, then expensive heating and cooling are not needed for the adapted crops. This requires more timely management but can be economical. Conventional fully-controlled greenhouses are difficult to pay for with winter production of vegetables because the light intensity during winter is so low in this humid region and fuel costs are so high. Also insect and disease problems are often less in spring in the cold house than in either fully heated greenhouses or in the fields.

Sections of the house or growing benches in the hoophouse can be covered with additional plastic and heated for fast germination and early growth without having to heat the whole space. Larger hoophouses can even be tilled with tractors or horses. The smaller moveable ones can be moved over three to five different plantings per year and be paid for that year while optimizing rotation benefits.

Hoophouses are comparable in cost per square foot of growing area with traditional cold frames having glass or fiberglass hinged tops. The hoophouses obviously provide more comfortable working conditions in mid winter. The hoophouses are particularly well suited for fall and winter production and late winter starting of summer crops. The key is in crop selection and planting date.

Narrow high tunnels (8' high) work well for berries providing frost and bird protection and for tall stature flowers providing wind protection and earlier growth resulting in longer stems. Low tunnels (4' high) have been used effectively by the Amish for children to tend cool season greens and winter peas. Row covers (<3' high) and hot caps and even planting in old tires have all worked well to give a couple of weeks head start to field plantings.

Season extension structures

Structure	Area	Material	Duration
Hotcap	1 plant	Paper or plastic	Brief in spring
Cloche	1 plant	Glass or plastic	Brief in spring
Solar cone	Cluster of plants	Fiberglass cone	Brief in spring
Coldframe	Small block of plants	Glass or plastic	Brief in spring
Hotbed *	Small block of plants	Glass or plastic	Brief in spring
Solar pod	Small block of plants	Insulated fiberglass	Through winter
Mobile coldhouse	Moderate block of plants	Plastic	Brief but sequential
Rowcover	1 row	Plastic	Brief in spring
Low tunnel	2 rows	Plastic	Seasonal
High tunnel	4 rows	Plastic	Seasonal
Hoophouse	4-8 rows	Plastic	Permanent
Greenhouse (supplemental heat)	Various sizes	Plastic, glass, fiberglass	Permanent

Appendix F

Checklist for Cold House Start-Up

- Is the proposed site higher than the land around it or can the site be shaped so runoff won't flow in?
- Do you have sites with reddish or sandy soils that have natural internal drainage?
- Will you ridge flat gray soils into beds for better in-row drainage?
- Has site been repeatedly tilled to germinate weed seeds and reduce weed seed reservoir?
- Have adequate amounts of lime, fertilizer, or soil amendments been incorporated into the soil?
- Was the plastic cover put on while the soil was still dry?
- If moveable, is structure stabilized on the corners and staked down against the wind?
- Is house sturdy or reinforced to withstand a heavy snowfall?
- Is double poly-plastic needed in this situation or can row covers be used under a single poly layer?
- Can the sides be either raised or lowered for clear day ventilation?
- Does it have venting in the peak of both front and back?
- Can both ends be opened?
- Was fringe of plastic left from base of frame outward 18 or 24" to divert runoff from sides?
- Can plastic mulch be used over rows or over entire floor?
- Does your all-winter house have double poly-plastic and an outside vented inflation fan?
- Do you ventilate timely to reduce condensation in winter and keep temperature below 90 in spring?
- Do you avoid over watering in winter and under watering in late spring?
- Are you starting to plant early enough?
- Are you "front loading" by planting extra by November to be harvested during slow-growing January?
- Are you planting the slower-growing red lettuces and kale two weeks earlier than the green varieties?
- Are you planting the mixed lettuce and the Asian greens densely enough?
- Do you have containers of dry soil that can be used to cover shallow seedings when soils are moist?
- Do you want to direct seed some crops and flat & transplant others?
- Do you want a portable propane heater for the coldest nights?
- Do you have a soil thermometer and also a max-min thermometer placed 1' above the ground?
- Would use of heat lamps for short periods during overcast periods pay back with certain varieties?
- Do you have a plan for monitoring and responding to disease and insect problems?
- Do you want to try shade cloth and fertigation for summer production?
- Is frame stabilized so it can be moved without stretching the plastic?
- Are side boards or extra framing or shelving or southern doors causing shade on certain rows?
- Are you planting too close to the cold sides of the house?
- Can you avoid gritty leaves by not removing cold house early or by using plastic mulch or row covers?

Appendix G

Results from SEPAC Coldhouse Demonstration 2003

Cold Tolerant Vegetable Crops

Germination and Stand Establishment

Asian Greens	Excellent under all conditions
Mixed Lettuce	Excellent under all conditions
Pac Choi	Excellent except under heavy bark
Cauliflower	Excellent except under heavy bark
Cabbage	Excellent except in very wet soils
Kale	Excellent except in very wet soils
Collards	Excellent except in very wet soils
Buttercrunch	Excellent except in very wet soils
Snap peas	Extreme variation for undetermined reason
Snow peas	Extreme variation for undetermined reason
Arugula	Good under most conditions
Broccoli	Good under most conditions
Need special treatment and especially more heat to germinate	
Spinach	Poor under cold wet conditions
Swiss Chard	Very poor until soils were drier and warmer
Iceberg Lettuce	Very poor, need to be transplanted
Brussell Sprouts	Very poor, need to be transplanted

Comparison of media used to cover seeds on wet soils

Dry Field Soil was adequate in most cases for quick germ crops

Potting Soil was variable in its results

Bark Mulch was a problem for several crops and is not recommended.

Appendix H

MCL Handouts

Appendix I

Website Homepage

Appendix J

Booklets, Reprints and Homepages on Low-cost Season Extension Techniques for Horticultural Producers

Table of Contents

Season Extension Techniques for Market Gardeners	Janet Bachmann and Richard Earles Appropriate Tech Transfer for Rural Areas Fayetteville, Arkansas
Rowcovers & High Tunnels Growth Enhancing Technology	Otho S. Wells University of New Hampshire
Winter Harvest Manual	Eliot Coleman, <i>Four Season Harvest</i> Harborside, Maine
Hoophouse Handbook <i>Growing Produce and Flowers in Hoophouses and High Tunnels</i>	Lynn Byczynski, <i>Growing for Market</i> Lawrence, Kansas
Walking to Spring <i>Using High Tunnels to Grow Produce 52 Weeks a Year</i>	Paul and Allison Wiediger, Au Naturel Farm Smiths Grove, Kentucky
Au Naturel Farm <i>High Tunnel Workshop Handouts</i>	Paul and Allison Wiediger, Au Naturel Farm Smiths Grove, Kentucky
Portable Field Hoophouse	Carol Miles and Pat Labine Washington State University Extension
Hoophouse Research www.noble.org	Steve Upson Noble Foundation Ardmore, Oklahoma
Planting Date & Pot Size for Tomatoes in Hi-Tunnel System	William H. Shoemaker St. Charles Horticulture Research Center University of Illinois
Low Technology Plastic Greenhouses <i>A Collection of News Releases</i>	Mike Orzolek and William Lamont Penn State University
Work Efficiency Tools for Berry Growers www.Hightunnels.org	Healthy Farmers, Healthy Profits Project University of Wisconsin High Tunnel Extension Team Central Great Plains States of Kansas, Nebraska, and Missouri
www.plasticulture.org	American Society for Plasticulture State College, PA 16803

Appendix K

Arugula: A Promising Specialty Leaf Vegetable

Reprinted from: **Trends in new crops and new uses. 2002. J. Janick and A. Whipkey (eds.). ASHS Press, Alexandria, VA.**

Images of arugula trials and selection results.