Summary:
The purpose of this project was to identify winter and summer vegetables to be grown in unheated, unlit field hoophouses and develop an efficient organic production method for those crops. A new 20’x 48’ hoophouse was purchased and erected at Orchard Farm to provide additional growing space for this project and future use. In addition to the new hoophouse the original smaller house at Orchard Farm and an existing house at the WSU Organic Farm were used in this project. Winter crops were grown and assessed in the 2006-2007 season and successful harvests were made from the WSU hoophouse. Summer crops were all grown in 2007 in the new hoophouse and successfully harvested and marketed by Orchard Farm.

Successful production methods including appropriate variety selection for both winter and summer seasons were developed throughout this project. No significant income was made with the winter trials due to the high number of small plantings but the summer crops were very profitable. Two field days were held at the WSU Organic Farm in Pullman, WA, where visitors were able to tour the hoophouses and learn about the project. This report is now posted on the WSU Organic Farm website at: http://css.wsu.edu/organicfarm/Research.htm.

Objectives:
This project will attempt to identify a diversity of winter and summer vegetables to be grown in unheated, unlit field hoophouses and develop an efficient organic method of production for those vegetables. A 20’ x 48’ movable hoophouse will be added to Orchard Farm to help increase profits on the ½ acre garden site. In the winter we till trial 20 different cold hardy crops and another six will be trialed in the summer growing season. Once the project is completed the results will be posted on a farm webpage. Carol Miles will be the technical advisor and the Moscow Food Coop and Rural Roots will assist with a marketability assessment and advertisement for field days.

Results:
The first step of the project was to purchase a new hoophouse for Orchard Farm. I settled on a 20’wide x 12’high x 48’long Premium Round Style High Tunnel from Tek Supply which came as a complete kit except for the necessary lumber. I originally planned to erect the hoophouse in the fall of 2006 but had difficulty starting a new project at the end of our major growing season and thus postponed building until the next spring. This was actually a blessing when two enormous windstorms came through our farm in November and again in December. In the project proposal I had planned to build the hoophouse as a movable structure to allow for greater crop rotation in our system. This would have involved anchoring the hoophouse with screw-in type ground anchors that I believe now would have been insufficient in the 90 mile-per-hour wind gusts the farm experienced last fall.

Once the weather allowed spring construction began on the hoophouse in a permanent location in the garden. To reduce the overall height of the structure, one section on each side of each hoop was omitted to bring the overall height to 10 feet, thus
reducing the exposure to high winds. Each hoop, spaced four feet apart, was also set in concrete to provide maximum stability in wind and snow conditions. Many farms in our area suffered major damage to their hoophouses during the fall storms including a neighbors' which is pictured in the photo section. The new hoophouse was completed and covered with plastic on June 2.

Also in the fall of 2006 I met with the produce manager at the Moscow Food Coop to do a marketability assessment for the crops I was interested in trialing. The manager was able to provide me with quantities for each crop as well as some different marketing approaches he was interested in trying. The “spring lettuce mix” is by far the most consistent seller at 36 pounds per week sold either in pre-packaged bags or bulk. Baby spinach was the second at 26 pounds per week sold as bags and in bulk. Bunched carrots, beets, green onions, arugula, and cilantro were also identified as being higher demand crops. My interest was mostly in developing a good winter salad mix that would include lettuce, spinach, and Asian greens and we agreed to work towards marketing the mix as a bulk product.

Because the new hoophouse was not ready for the winter trials a similar sized house was available at the WSU Organic Farm where I am currently the manager. There are actually two 20’x 48’ hoophouses at the site and one was occupied with another winter greens research project conducted by a WSU graduate student. The available house was planted to spinach, salad mix (lettuce only), and an Asian greens mix. Four 42” beds were laid out after a one inch layer of WSU compost was applied and tilled in. Each bed was then planted to 15 feet of each of the three crops with an Earthway push-seeder at one week intervals starting the second week of November. These beds were then hand-watered with a normal garden spray nozzle throughout the season as needed. This was a difficult job because there was no winter water access and all had to be transported in 50 gallon drums and then gravity fed to a garden hose.

Every three weeks these crops were fertilized with a water soluble fish and kelp mixture applied by backpack sprayer. When temperatures inside the hoophouse dropped below 32 degrees Fahrenheit a single layer of fabric row-cover was stretched over thin wire hoops spaced every ten feet down each bed. These hoops kept the fabric from coming in contact with the plants which tends to cause major frost damage under freezing conditions. Even with the added fabric protection, all plants experienced freezing but were always able to continue their growth after each freeze/ thaw cycle.

Harvests began by the end of January and continued into March for the first two beds that were planted in November. Crops were cut with scissors, washed, spun, and then bagged for sale. Each of these beds was cut three times before bolting and yielded an average of 8 pounds per harvest. Because the Asian greens were seeded at the same time as the lettuces and spinach they were always ahead in their growth which lead to crops of unequal size at the times of harvest. The last two beds seeded in this house in early December were not able to produce a harvestable crop by the beginning of March when the beds were needed for early carrot seeding.

At the same time the WSU hoophouse was being prepped for seeding the smaller 16’x 48’ hoophouse at Orchard Farm was getting ready for its winter trials. It also received a one inch layer of WSU compost, was tilled, and then laid out in three 42 inch wide beds. On November 4, 23 different crops were planted in the first two beds with each crop receiving four feet of bed length. These included green onions, carrots, beets,
rutabaga, parsnip, turnip, radish, cilantro, parsley, dill, fennel, arugula, lettuce mix, spinach, Asian green mix, sorrel, mizuna, orach, endive, tatsoi, kale, bok choi, and chard. By November 26 the following varieties had germinated: turnip, radish, green onion, arugula, salad mix, spinach, Asian green mix, mizuna, tatsoi, and bok choi. These ten crops were the only ones out of the first planting to grow to a harvestable size by late winter.

On December 12 the following 10 crops were seeded in the remaining bed: Asian green mix, watercress, minutina, radicchio, claytonia, broccoli raab, spinach, beet, lettuce mix, and arugula. By January 21 the following varieties had germinated: watercress, claytonia, spinach, and lettuce mix. Again these crops were the only ones to continue to any harvestable size. As at the WSU site this hoophouse received regular fertilizer and similar row cover treatment.

Summer

Beginning in February six summer hoophouse crops were seeded in a lit and heated greenhouse space which included peppers, tomatoes, eggplants, cucumbers, tomatillos, and melons. I am much more familiar with the production methods and timing for these crops and was very happy with their results. The one challenge with this phase was a delay in transplanting to the hoophouse while I waited for an appropriate day to stretch the plastic. It’s important to choose a sunny warm day without much wind and those are hard to come by on the Palouse in the spring. We were able to transplant the day after the plastic went on and the plants were happy to get out of their plastic temporary homes! In this 20 foot wide house I was able to create four 42” beds that were prepped with WSU compost and then tilled before planting. Each bed was irrigated with two lines of drip tape. All harvested crops were either sold at a weekly farmer’s market or to the Moscow Food Coop.

Planted in Bed #1 was ten Valley Girl tomatoes, ten Matchbox peppers, twelve New Ace peppers, and 46 Anaheim peppers. These all produced very well and the one crop that we could have used less of was the Matchbox pepper which is a small chili type that did not sell well at the Farmer’s Market. The Anaheims are our biggest pepper producer and was sold at our farmer’s market and Moscow Food Coop.

Bed #2 contained all tomatoes: twelve Celebrity, eleven Double Rich, eleven Black Plum, and eleven Moskvitch. The Celebrities were the best all-round tomato producing well though the entire season. Moskvitch did well early and Black Plum was a good producer of paste tomatoes but was not a good seller at our farmer’s market. Double Rich had problems with splitting.

Bed #3 was planted to 26 San Marzano paste tomatoes, twelve Shoyu Long cucumbers and five Tasty Jade cucumbers. We were trying the paste tomatoes for the Moscow Food Coop but were not very happy with this variety due to the high amount of splits. Both cucumber varieties did great and were heavy producers. The Shoyu Long was the preferred variety at the farmer’s market.

Bed #4 was planted to fourteen purple tomatillos, fourteen Black Beauty eggplants, fourteen Purple Long eggplants, and eight Charentais melons. The tomatillos were very heavy producers but a challenge to keep pruned. They sold well both at the coop and the farmer’s market. The eggplants never seemed to get it together to produce a good crop. Of the two varieties trialed the Purple Long showed more promise but they
performed very poorly under our conditions. The melons did great with each plant producing an average of seven fruits. These were not marketed but devoured by the family and crew at Orchard Farm.

Pepper, eggplant, and tomatillos all sold for $3.00 per pound. Cucumbers sold for $2.00 per pound. Tomatoes were $1.89/# to the Coop and $2.00/# at the farmer’s market. Winter salad mix was sold at $10.00/#

**Benefits on Agriculture:**

The greatest impact from this project will be on our local food supply. Growers like me are increasing their production to meet a growing demand for locally produced organic crops in our area. Many of these growers have already invested in hoophouses for their operations and are eager to maximize their potential for growing year-round fruits and vegetables. This project has clearly identified the crops that would be most suitable to marketing to the community but there is also the direct benefit to the farmer and their family by being able to produce more of the food they need themselves. It will be difficult to grow large quantities of winter crops without a large increase in hoophouses. It is probably more efficient for a small farm to have two or three houses that produce smaller quantities in the winter but enough in the summer months to cover the bulk of operating expenses. These hoophouses are easy to operate, require no additional heat or lighting, and easily extend the growing season for many crops already grown in our area.

**Producer Adoption and Reactions:**

As I mentioned before there are producers in our area that are utilizing hoophouses to enhance their farm systems. For example, Affinity Farm, also located in Moscow, has been increasing their winter production after seeing our success just from last season. It’s very exciting to have another grower experimenting with different crops and planting dates so as to aid in improving our local knowledge. They were successful in seeder transplants in July for planting to their hoophouses by the fall.

This fall I’ve already planted out two hoophouses just to winter greens. I’m focusing on lettuce mix, spinach, and Asian greens direct seeded with a high-density precision seeder purchased from Johnny’s Seed. This seeder will hopefully allow a high density of plants to be grown in the same amount of space, thus, increasing winter production. In order to correctly use the seeder, more care must be made in seed bed preparation by first removing any debris or large dirt clods from the planting surface. I’ve achieved this by first making sure the soil has adequate moisture, applying compost, and then tilling. After marking out beds I then use a rigid garden rake to first smooth the bed with the teeth and then by flipping over the rake to remove debris and large clods. This will ensure even operation of the seeder. After seeding it has proved beneficial to directly lay fabric row-cover on the bed to help retain soil moisture during seed germination.

The other important part of this process is timing. To ensure a good production in winter crops, seeding must take place early in the season. As soon as there is a decline in production of summer crops we began pulling out those crops and preparing for winter seeding. I would recommend that there be no seeding after November if the houses were to be used for spring and summer crops the following season. Affinity farm has also
been successfully trialing different crops for early spring production including peas, bok
choi, and beets as well as transitioning to summer crops such as pole beans and basil.
Another exciting crop that I have trialed the last two seasons is sweet potato planted after
my spring carrots come out in early June.

**Recommendations:**

I have already offered some suggestions in the previous section but would highly
encourage others to trial the recommended crops at multiple seeding dates. This seems to
be one of the most important factors in producing successful harvests. Another
interesting line of research would be to develop a low-tech efficient means to add heat to
a hoophouse during the coldest periods of winter.

**Outreach:**

The two largest means of communicating this project to others was at events held
at the WSU Organic Farm. The first was the farm’s annual field day held July 26 with
approximately 60 attendees. Visitors were able to tour the two hoophouses at the farm as
well as hearing about the winter production that took place last season. The second event
was the farm’s annual Harvest Party which brought in roughly 500 attendees. This is
more of an open-house where visitors can tour the farm on their own and get to harvest
pumpkins in a u-pick area. Visitors were able to converse with staff about the different
farm operations including the hoophouse systems.

As mentioned before this report will also be available on the WSU Organic Farm
website at: [http://css.wsu.edu/organicfarm/Research.htm](http://css.wsu.edu/organicfarm/Research.htm).
16’x48’ hoophouse getting ready for seeding  (#3)

4’ trials of 30 winter vegetables  (#4)

WSU Hoophouse with lettuce, spinach, Asian greens  (#6)
WSU Hoophouse in spring 2007 (#7)

New Hoophouse in summer production (#10)

Cucumber trellising (#11)
Summer time at Orchard Farm    (#12)

Bell Pepper    (#13)

High-Density Precision Seeder
Fall 2007   (#14)

Second pass with seeder   (#15)
2007 Fall seeded lettuce mix and spinach (#16)

2007 Fall transplanted broccoli (#17)

“The Next Generation” (#18)