Winter 2003-2004
Farrowing in Greenhouse
Project Results and Data Summary

Submitted by:
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Background & Project Objectives

The initiation of alternative and organic style swine production systems has led to a limited and variable supply of organic pork in the market place. Market stability will not occur unless a more steady supply of meat becomes available. One of the chief challenges in creating a year-long stable meat supply is the difficulty of procuring hogs in the summer months because of winter farrowing difficulty. Many organic pig farmers have poor results from crushing, scouring, and other problems that create high mortality rates during the winter months.

Some attempts have been made to alleviate this by deep-bedded farrowing systems with traditional LP heating. These attempts have met with limited results. Becker’s personal need for a solution to this problem is urgent, so a new idea has been attempted on his farm. His travel in Scandinavia in 2003 with the VCPSA sponsored Sweden and Denmark study tour provided a positive experience in terms of witnessing the environment needed for winter farrowing. Dry, airy, and well-lit farrowing areas were used universally. The traditional wood and steel building was nearly abandoned for farrowing. The importance of this type of environment for the small pig in its early days of life is apparent. The production experience Becker had with his organic sow herd has led him to believe in the superiority of pasture farrowing due to many of the same environmental conditions listed above. An attempt to recreate the pasture environment inside, during winter, would be desirable.

A greenhouse would be the desired structure. Many regional firms produce greenhouses and Becker purchased one in a kit form. The heating system for this building is heated water pipes laid under the concrete floor. Wood A-frame pasture farrowing huts were used for sow segregation during farrowing.

Primary objectives of this project:

- Document the design and construction of a greenhouse with floor water heating system with emphasis on cost of structure, reasoning and theory for structure aspects, and actual construction events cataloged pictorially.

- Observe and record the placing of sows into building for farrowing in winter, and document the results of farrowing in terms of pig health, environment of building, and worker atmosphere.

- Observe and record economic performance of building through one winter season with regard to energy costs.
Project Summary

From August 2003 to October 2003 a greenhouse for farrowing in winter months was constructed. Concrete foundation and floor heating with hot water from a wood powered boiler were used. Wooden farrowing huts were placed in two rows facing away from each other inside the building. Two groups of sows were put through the building in November and December. Temperature probes were used for recording the daily temp inside and outside of the building. Sow performance was noted. Cost was recorded. Health of animals was also noted.

Construction

*Foundation and Walls* - The first step was to level the site and begin pouring concrete walls. Following this, insulation to keep heat from moving down was placed on the ground, and then a grid of piping was laid out to construct the desired zones. Concrete was poured over this grid to create the floor.

![Placing wall forms.](image)

Following wall erection, pipes for greenhouse rafters are in place in the wall.

![Following wall erection, pipes for greenhouse rafters are in place in the wall.](image)
Completed walls.

After insulation is laid.

Zonal grid is laid.
Floor is poured over the grid.

Zones are identified by pipe color.

_Erection of Greenhouse_ - Following the completion of the foundation, the greenhouse frame and cover was constructed.

Rafters arrive.
Placing Rafters.

Rafters connected with purlins.

Use of scissors lift is recommended.
After the main frame is complete, it is time for placing of the covering. Calm weather is a must. The first step is to lay the inner layer of plastic over the rafters. Several people will be necessary for this. Two-by-four boards were attached to the plastic to allow for an area to pull over top of frame. After that, main cover is unrolled and again pulled over the inner cover. Then both are secured to end rafters only. Next the roof space is inflated by hooking up and turning on the blower. This will run continuously and keep the roof inflated with air at all times. Small relief holes were cut to relieve some air pressure after over inflation problems were experienced. The building was then wired for two interior and one exterior light, and several outlets inside.

Following placement of outer cover.

Start of framing end walls.
West end wall framing complete.

Placing steel siding over end frame.

Inside view of completed greenhouse.
Preparation for farrowing - After the completion of the greenhouse, preparation for introduction of sows was necessary. Since one of the goals of the building was to be versatile for alternative uses in the future, the floor space was left barren and flat with no permanent encumbrance. To allow for two separate sow groups, huts from the pasture were brought inside in early November. They were placed in two rows in the center aisle of the building facing away from each other. This accomplished two things. It provided a natural barrier to separate the sow groups, and placed the eventual litters of piglets in the center and warmest part of the building.
Sows were introduced and huts strewed with straw and farrowing began. Difficulty in keeping sows segregated was experienced. Straw in huts was kept at lower levels to allow for floor heating to take full effect on piglets.
The heating of the building was now necessary as temperatures dropped with onset of winter. The boiler had been placed on concrete pad to north of building earlier in autumn. The boiler was now covered with a wood framed steel sided shed.

Boiler shed complete, 12 by 12’.

Interior of boiler shed.
Boiler operation was successfully achieved after lengthy learning process. A professional plumber with extensive experience in boiler installation was contracted for this job. Doing it any other way is highly risky following the observation of the installation. Many complex factors such as sophisticated plumbing and electronic switches make this a job for only professionals.

Initially, wood from on farm was used, but this job became unrealistic after the volume of wood needed for adequate heat was realized. A nearby sawmill provided offal from logs at a very reasonable price. This course of action will be followed in the future.

_Farrowing results_ - The first group of sows to farrow preformed barely adequate, but not any better than other prior winter farrowings. Difficulties noted were continued crushing, sows going two to a hut, and sows trying to jump or wedge between huts. Makeshift barriers were erected to prevent that behavior.
For the second farrowing, doors and fronts were built onto huts, and sows were let in and out manually each day for eating, and drinking.

Following the first group of sows completing farrowing, pigs were weaned at six weeks of age. Huts were removed from one side of the building and pigs were left. Sows were removed for rebreeding. With the huts gone, the building can be easily cleaned and strewed with straw. A
self-feeder was added and pigs were started on full feed and gotten to approximately 50 lbs. in weight before being removed to hoops and reintroduction of the next group of pregnant sows into the greenhouse.

Pigs after weaning.

Ready to move to hoop.
Performance Data

Sow performance

Farrowing Event #1-

9 of 12 sows bred and introduced into greenhouse (farrowing listed chronologically)

<table>
<thead>
<tr>
<th>Date</th>
<th>born live</th>
<th>stillborn</th>
<th>survive 24 hr.</th>
<th>survive 3 day</th>
<th>wean</th>
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<tbody>
<tr>
<td>11-13</td>
<td>11</td>
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<tr>
<td>11-15</td>
<td>11</td>
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<td>8</td>
<td>7</td>
<td>4</td>
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<td>11-17</td>
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<td>0</td>
<td>9</td>
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<td>5</td>
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</table>

Comments: High Crushing and weak piglet problems noted. Yellow scouring of pigs at three weeks of age. Pigs weaned per sow farrowed = 4.7

Farrowing Event # 2

12 of 12 sows bred and introduced into greenhouse (farrowing listed chronologically)

<table>
<thead>
<tr>
<th>Date</th>
<th>born live</th>
<th>stillborn</th>
<th>survive 24 hr.</th>
<th>survive 3 day</th>
<th>wean</th>
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<tbody>
<tr>
<td>12-15</td>
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<td>2</td>
<td>1</td>
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<tr>
<td>12-20</td>
<td>9</td>
<td>4</td>
<td>6</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

Comments: High crushing but death from scouring at three weeks plus significant factor in mortality. Pigs weaned per sow = 2.1

Supplemental Floor Heating Data - Wood powered boiler was installed and started on 11-1. Initially wood from farm was cut, but labor was found to be excessive and a nearby sawmill that had offal from logs was contracted to provide pre-cut wood.
Costs are as follows:

<table>
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<th>Date</th>
<th>Amount ($)</th>
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<tr>
<td>November 28, 2003</td>
<td>$63</td>
</tr>
<tr>
<td>December 20, 2003</td>
<td>$63</td>
</tr>
<tr>
<td>January 15, 2004</td>
<td>$63</td>
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<tr>
<td>February 14, 2004</td>
<td>$165</td>
</tr>
<tr>
<td>February 28, 2004</td>
<td>$65</td>
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<tr>
<td><strong>Total wood cost</strong></td>
<td><strong>$419</strong></td>
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</table>

Electricity cost was noted for the building but was not recorded exactly. A substantial decrease compared to a wooden farrowing house with pens was noted due to elimination of heat lamps.

Temperature probes were placed to collect exact data for the project. Three probes were placed altogether in the following locations: inside farrowing hut, inside greenhouse, and inside nearby barn for control comparison. Probes ran for the entire winter and the data is displayed on the following graph.
Cost of Construction

Greenhouse kit 34’ by 60’ $4789
Delivery $300
Site Excavation $1640
Concrete Pad and Foundation $4,600
Labor on Concrete $2686
Floor Heating Materials $2900
Labor on Floor Heating $1400
End Wall Materials $2100
Labor on End Walls $2000
Boiler $5100
Boiler Shed $1100
Gates $225
Exhaust Fan $250
Wiring $325
T Walls $740
Nursery Feeders $400
Automatic Feed System $3445

Total Construction Cost $34,000

Discussion

The preceding data is critical in any serious analysis of this project but incomplete alone. It cannot supplant the observations of a herdsperson gathered on a daily basis over the time allotted for the project.

In terms of sow performance, the greenhouse did not appear at first glance to work much better than the wooden building that preceded it. The crushing numbers were unacceptably high and scouring of piglets pre weaning was again a significant problem. The reasons for this are still unknown, but the data may shed some light on part of the problem. The temperature of the huts was still too cold and the floor was rarely hot enough. The boiler didn’t work to desired performance levels for many reasons. These may be the lack of experience with running the boiler. There are times on the graph in which the temperature in the hut drops to freezing range. This may have been when there was no sow or litter in the hut, which was neglected to be recorded, and now proves to be very significant. The temperature of the hut inside, however, should remain above freezing, irrelevant of the presence of a sow.

Several positive results were noted, however. The goal of controlling sow behavior was achieved. The cooler temperature floor along the outer alleyways was achieved and it led sows to eat, socialize, and dung there. Huts with litters remained very clean. Handling of sows and pigs was easier than with previous systems. While sows were eating on ends of building, litters could be processed and huts re bedded. The environment inside of the greenhouse was much improved over the traditional wooden building. Light was abundant and a pleasant feeling for work was always noted. When the sun was out, humidity levels were minimal. Only at night, or
on wet or cloudy days did any buildup of moisture take place. An exhaust fan was added to the East end of the building and set to run on a timer to alleviate extra moisture.

The cost of the greenhouse ended at a point that was higher than initially desired, but when compared to the farrowing house of more traditional confinement type, it is actually still cheaper by about 10% - $1888 per sow space compared to $2000 plus for confinement. As a nursery, the capacity is estimated at 320 to 350 pigs, which equates to about $100 per pig space, or a favorable cost compared to confinement. If this number is taken into account with regard to premiums available in many niche markets, the cost of this building is likely justifiable.

Seasonality

Since the need of a winter farrowing environment was the primary goal of this building, the arrival of spring meant that the sow herd was returned to the pasture for farrowing. This creates a down time in which the greenhouse is not used, and the resulting economic burden of an empty building is undesirable. A strong incentive is therefore present to create an alternative or good weather use of the building. This will lead to quicker payoff and better utilization.

One problem that has not been addressed in the overall production system is the size of pigs at weaning and the available environments for those pigs. At six weeks of age, most pigs are too small to enter a hoop building with its’ airy and often cold microclimate. A more controlled environment would be the ideal facility to aid in adapting the small pig to weaning and full feed. This in turn would toughen the pig to the more variable climate of hoops for fattening.

The greenhouse, following the removal of huts to the pasture in early April was fitted with concrete T walls down the center and then perpendicular, thus creating quadrants that would each hold from 50 to 80 pigs of the 25 to 50lb. size. A flex auger feeding system with nursery feeders was added with bulk bin to aid in delivering starter ration. Thus far, this is working according to plan. It is foreseen that the nursery feeders can be removed and the huts added again upon the coming of cold weather in early November.
First group of pigs to be put through nursery exceeded expectations and was beyond 50 lbs in a desirable amount of time.

**Conclusion**

The pig performance in the first season of the winter farrowing greenhouse did not meet expectations. Mortality was still at unacceptable levels. Reasons for this may include boiler malfunction, and inability to control moisture in certain times that degraded the health of small pigs prior to weaning.

Efforts to alleviate these challenges were partially successful [exhaust fan] and partially failures [boiler performance]. There is now time, however, to work on this prior to the onset of the second season of farrowing.

Success was experienced with regard to overall microclimate in terms of light, and pleasant working conditions. This was not the subject of data collection but is believed to directly contribute to the well being and lowering of stress on pigs. Ease of pig handling, feeding and cleaning was also a positive result of building design.

Cost of construction was viewed to be slightly too high, but when compared to more traditional confinement counterparts, it is still favorable. Energy costs for the building were very low, and were better than expectations.

While the effort to alleviate the winter farrowing challenges faced by alternative pork producers will not end with new facility design alone, this project can be said to be a beginning to the kind of thinking and micro climate/environment creation that will aid the pig in overcoming the challenges in winter environments that is proving to be a hurdle to so many operations efforts to a more sustainable method of pig production.