Raising Livestock and Crops Simultaneously in Unheated Greenhouses

John Socolofsky (Colorado – Farmer/Rancher Grant)

Project Number: FW07-031

Title: Raising Livestock and Crops Simultaneously in Unheated Greenhouses

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The east hoophouse, at left, housed the pigs in the project, conducted at Antelope Creek Ranch near Larkspur at 7,250 feet elevation.

Inside the east hoophouse with a view of two pigpens.

Situation:

Raising vegetables on Colorado's front range is beset with many challenges:

- a short growing season (around 120 days) at elevations of 6,000-8,000 feet
- wide temperature swings
- extremely low humidity
- hailstorms and desiccating winds

Hoophouse cultivation could overcome some of these challenges and extend the growing season. But the need for supplemental heat using costly fossil fuels would likely negate profits, as locally grown greenhouse vegetables must compete with vegetables trucked in from warmer climates.

Animals produce heat from their bodies and composting manure. Harnessing this heat by raising animals inside a hoophouse, along with protective row covers, may keep the temperature high enough to sustain production of winter-hardy crops.

Objectives:

1. Assess whether greenhouse crops can be raised and harvested through the winter months on the Front Range of Colorado in hoop structures without added artificial heat
2. Determine whether heat energy produced by livestock as body heat and through composting manure will keep the temperature above freezing at the crop level in an unheated hoop structure
3. Design and construct a small-farm-size in-vessel composter to convert animal waste to compost for vegetable production inside the hoophouses
4. Publish the test methodology and results on a website and participate in a short course at Colorado State University during which the methods and results can be discussed

Actions:

The test is being conducted in two existing unheated greenhouses, each 34 feet by 72 feet. One structure has been divided lengthwise with temporary fencing, one side for growing vegetables, the other side for finishing hogs. The second structure is being used for growing vegetables.

The project team has purchased and installed two swine pens, feeders and waterers in the experimental greenhouse and moved 15 feeder pigs into the new pens. The hog pens have been deep-bedded with straw over a dirt floor.

During the warm months, a selection of market vegetables has been grown in both greenhouses. During the colder months, cold-tolerant crops – salad greens and root vegetables – will be grown.

Data acquisition equipment was installed inside both hoophouses, each with a humidity sensor and temperature sensors at five locations. An outdoor weather station – Davis Vantage Pro – with sensors was also installed. Data from all sensors is logged on a computer set up in the farmhouse via a wireless LAN.

Weather data have been gathered since January 2008, and temperature and humidity data since February 2008.

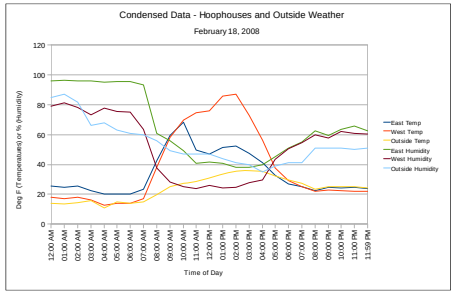
Particular attention will be paid to eliminating the potential for manure contamination for growing crops, following guidelines from EPA and Colorado State University. Materials for an in-vessel composter were purchased and a design developed to facilitate proper, controlled composting.

To address potential animal and crop overheating on sunny days, the team has installed rollup sides that will be opened for ventilation as required.

Results:

Results and final data will be compiled and analyzed at the end of 2008.

Some consistent results were observed during last winter. The chart below shows selected data for a typical day – February 18. East Temp and East Humidity refer to conditions in the East hoophouse, which housed the pigs. West Temp and West Humidity refer to conditions in the control hoophouse without animals.



Feeder pig growth was observed through the winter, with no discernible performance difference between pigs raised outdoors compared with pigs raised in the hoophouse.

Potential Benefits:

Ambient temperatures at the project site rarely fall below 10° F. If animals in a hoophouse raise the temperature by 7° F, and floating row covers add another 2-4° F, that could maintain the temperature at plant level above 20° F, high enough for many cold weather crops.

The data indicate that raising livestock in concert with vegetables in an otherwise unheated hoophouse during winter is feasible, allowing producers to:

- Raise crops during winter without fossil fuels for heat
- Increase income through winter months
- Improve farm links with the community
- Provide local, fresh, nutritious food year round
- Optimize on-farm resources in a biological cycle that benefits plants and livestock

However, pigs proved to be a difficult species because:

- Using a skid loader to clean manure, the farm's typical approach outdoors, is not feasible indoors.
- Dust from rooting pigs, if it contain manure particles, could be a concern on vegetable crops.
- Rooting pigs dig deep holes, a problem for leveling ground for spring crops.
- Pigs tend to defecate and urinate in the same spot, concentrating nitrogen.
- Wheat seeds and corn kernels in bedding create weed problems.

While the project hypothesis appears valid, a species other than pigs (rabbits, for example) may present fewer challenges.

Composting manure pile and pigpens.

Socolofsky Farms raises half- or purebred Berkshires, a breed selected for outstanding meat quality.