Healthy Food, Diverse Farms, Vibrant Communities

Subsoil Heat in a Greenhouse

Cooperators

Ann and Eric Franzenburg

Project Timeline

March-December 2009

Web Link

practicalfarmers.org/resources

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Funding

The Ceres Foundation

Abstract

Eric and Ann Franzenburg of Pheasant Run Farm near Van Horne constructed three greenhouses on their farm in 2008. In 2009 they took data on crops grown in these greenhouse to determine if heating the soil was cost effective, and to determine if they could gain a longer period of production profitably. Results of this data collection indicate bottom growing over a longer season does make sense for this farm, and season extension is lucrative for their operation. They learned information from recording data over 2009 that will help them tailor their growing plan to maximize profit potential.

Background

Many fruit and vegetable farmers are interested in increasing revenue on their farms through season extension. There are many ways to increase the season on fruit and vegetable farms. A common practice is to install high tunnels or greenhouses that modify the environment to create more favorable growing conditions for plants. Structures like these are an investment, so it is important that farmers generate enough revenue from a high tunnel or greenhouse to justify its expense.

Eric and Ann Franzenburg have constructed three greenhouses on their farm near Van Horne. When they built their greenhouses, they installed a sub soil heating system to help increase the season in Iowa's cold climate. Eric and Ann's objectives were:

- Longer period of production and income
- High quality production
- First to market or only one in the market

Method

Eric and Ann have three connected side by side greenhouses. Two measure 20 by 100 feet, and one measures 22 by 100 feet. The walls are insulated into the ground 18 inches, and there is also insulation in between the houses. Ventilation and circulation fans are installed for temperature control and air flow. A water heater from a corn boiler is hooked to in-ground tubing to heat the soil. Insulation is buried 18 inches under ground. Water tubing lies on top of the insulation, with soil on top of the tubing in the growing area. They have a supplemental air heater connected to the corn boiler that they can use in case of a hard freeze that will put their crops in jeopardy.

Eric and Ann have an additional greenhouse (30 by 96 feet) that uses LP as supplemental heat when temperatures reach 20 degrees F or below. They grew grape tomatoes in this structure that they covered with small hoops on evenings when the temperature dipped to near freezing.

The Franzenburgs grew a variety of crops and kept data on their performance to see if it makes sense to heat the soil to help promote early season growth.

Data was collected on: planting date, transplant date, varieties, location of crop, plant spacing, plant progress, yield, harvest dates, labor, market price, amount of marketable product sold, and corn usage. Dataloggers recorded temperature and humidity in each greenhouse as well as outside.

Crops cultivated were: slicing tomatoes, grape tomatoes, greens, spinach, and flowers.

Farm Cooperators

Eric and Ann Franzenburg started farming in 1993. They grow 130 acres of medicinal herbs. 2009 was the third year of tomato production on the farm, and the second year for flower production. Ann and Eric market their horticulture crops mainly to grocery stores, institutions, and through Cedar Rapid's and Iowa City's farmer's markets. The Franzenburgs also raise corn, soybeans, and

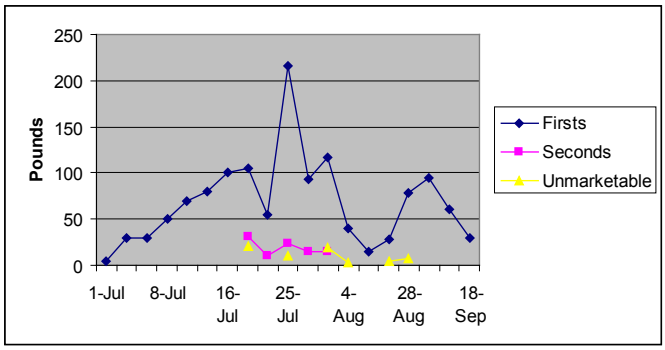

Chart 1. Celebrity tomato harvest on 60% of greenhouse

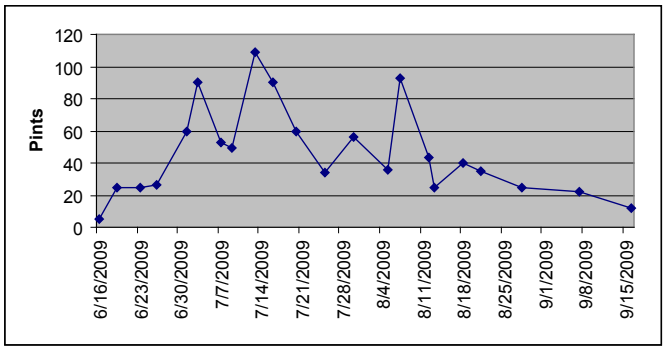

Chart 2. Grape tomato harvest on 65% of greenhouse

pork.

Results

Grape and slicing tomatoes (Celebrity) were both transplanted into the greenhouses on March 23 as six-week-old transplants. Celebrities were planted in two-row beds with two foot spacing between the plants, and took up 60% of one 20X100 greenhouse. Chart 1 illustrates Celebrity tomato harvest. Total harvest for Celebrity was 1291.5 pounds of firsts, 95 pounds seconds, and 64.5 pounds unmarketable tomatoes. Table 1 shows expenses for Celebrity tomatoes and table 2 shows income.

Grape tomatoes were planted at one and a half foot spacing and took up 65% of a 20X100 foot greenhouse. Chart 2 illustrates grape tomato harvest. Total harvest was 1008 pints. More grape tomatoes were harvested after September 16, but quantity was minimal and not recorded.

Table 3 shows expenses for grape tomatoes and table 4 shows income.

Grape tomatoes were more labor intensive than slicing tomatoes, but net profit was greater for grape tomatoes. Grape tomatoes were planted in a smaller area than slicing tomatoes, so net profit would be even greater if calculated for an area with same square footage.

Eric and Ann planted three Johnny's greens mixes in their greenhouse in October. One consisted of all Greenleaf lettuces, one was a mix of green and red leaf lettuces, and one was a mix of greens like arugula, tatsoi, and more. After harvest they sold all three mixes bagged together. They started to harvest in early November, and went until early December. They were only able to get one cutting off of the greens and feel that the plant date was a bit late. Table 5 shows their expenses for greens and table 6 shows their income.

Ann and Eric planted spinach too late for a good harvest, but hope to get a spring harvest from the plants.

Ann grew tulips, lilies, gladiolas, snapdragons, asters, celosia, sunflowers, and lisianthus in the greenhouse.

The prechilled tulip bulbs were planted in the greenhouse in late February. Temperatures were too warm for them, and they didn't bloom.

All other flowers were planted mid to late March. Harvest began in mid-June for snapdragons, lisianthus, and celosia. These flowers were harvested throughout the summer. The gladiolas, lilies, asters, and sunflowers were all one-time cuts.

Lisianthus grew better in the greenhouse, even though it is a

Table 1. Expenses for slicing tomatoes (full greenhouse)

Labor	7.5 hours planting tomatoes 7.5 hours weeding & trellising 15 hours total at $10/hour	$150
Heat	78 bu corn @ $3.50/bu	$273
Seed (includes soil and flats)	Celebrity tomato seed	$27
Harvesting/Packing	80 pounds/hr (picking & packing) 1451 pounds 27 hours at $10/hour	$270
Supplies	Bees--$65 Twine for trellising--$10 REC--$350 (for running ventilation fans and corn furnace)	$425
	Total Expenses	**$1,145**

Table 2. Income for slicing tomatoes (full greenhouse)

Gross sales	2218 lb x $2/lb	$4436
Expenses		$1,145
Net (minus capital investment)		$3,291

Table 3. Expenses for Grape Tomatoes (full greenhouse)

Labor	7.5 hours planting tomatoes 7.5 hours weeding & trellising 15 hours total at $10/hour	$150
Heat	78 bu corn @ $3.50/bu	$273
Seed (includes soil and flats)	Grape tomato seed	$57
Harvesting/Packing	20 pints/hr (picking & packing) 1680 pints total 84 hours at $10/hour	$840
Supplies	Bees--$65 Pint containers--$.11/clamshell Twine for trellising--$10 REC--$350 (for running ventilation fans and corn furnace)	$610
	Total Expenses	**$1,930**

Table 4. Income for Grape Tomatoes (full greenhouse)

Gross Sales	1680 pints x $2 =	$3,360
Expenses		$1,930
Net (minus capital investment)		$1,430

Table 5. Expenses for Greens (full greenhouse)

Labor	6 hours planting 1t $10/hour	$60
Heat	No heat used	
Seed	Seed for spinach, mixed greens	$149
Harvesting/Packing	4 hours harvesting at $10/hour	$40
	23 hours bagging at $10/hour	$230
Supplies	$.11/2ml poly bag + $.04/label=$.15/package 1152 packages at $.15	$173
	REC--$70 (for running ventilation fans)	$70
	Total Expenses	**$722**

Table 6. Income for Greens (full greenhouse)

Gross Sales	1152 packages x $2	$2,304
Expenses		$722
Net (minus capital investment)		$1,582

cool weather crop. Ann believes it likes the diffused sunlight that comes through the plastic. "Stem length is always longer on a GH lisianthus," said Ann. The celosia also loved the GH environment. In the field, it grows to a height of about 2 ½ to 3 feet. It was about 5 feet high in the greenhouse. "I lost a crop of lisianthuss that I planted next to the celosia because it shaded it out," said Ann.

Gladiolas also grew quite tall in the GH. "Other flower producers do not like to grow these indoors the greenhouse because they get leggy, but I liked the quality of the gladiolas and it was nice to have an early crop in late June. I only planted the first crop of gladiolas in the greenhouse—the other successions were sown outside.

Ann chose sunflower varieties specifically for the greenhouse. They took almost 2.5 months to produce a flower.

The bulbs were planted directly into the greenhouse soil, as well as the sunflower seeds. The other flowers were started in plug trays or purchased as plugs.

Conclusions

Ann and Eric see great potential for their greenhouses. The big questions are: what to grow and how much? "Do you grow small scale and sell direct? Or do you construct more greenhouses so you can fulfill larger markets?" wonders Ann. "If we put a greenhouse full of grape tomatoes, we don't have enough to supply New Pioneer (Iowa City grocery store)," says Ann. For next season, they plan to have one home greenhouse full of grape tomatoes, and one greenhouse at Eric's parents filled with grape tomatoes as well.

Grape tomatoes are more labor intensive, but they fill a niche in the market. "Everyone is growing slicing tomatoes," said Ann. "Grape tomatoes are kind of a pain, so nobody else is growing them in large amounts."

Space is valuable in a greenhouse structure, so Ann and Eric think seriously about what and when to plant crops to maximize potential.

Eric: "The 'payback' on these structures will be longer due to the added expense of the heating system. But the heating provides much more stability in production at both ends of the season. Based on this year's results, it appears that if you look for 10% return on investment annually the facilities can be paid for in four to five years. I believe we can do better than that with proper crop selection, better production, and timing. We have a lot to learn about tomato production.

"One cost that can be difficult to deal with is distribution costs Our approach is to have at least two to three items going to any buyer at one time and to work with current distribution systems."

Ann: "This trial helped us be able to better plan for next year. It will be easier to rip out our grape tomatoes to make way for an earlier greens crop because our outdoor grapes will be in full production by early September and we have documentation that shows we need to plant our greens earlier."

Grape tomatoes in greenhouses summer 2009

Corn boiler used to heat subsoil in greenhouses

Franzenburg greenhouses