

GROWERTALKS

Under an Acre

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Citrus in the Snow

Anne-Marie Hardie



Nebraska is known for its extreme temperatures, dropping well below freezing in the winter months and soaring to the mid-80s in the height of the summer. These temperatures are far from ideal for growing citrus, and yet, there's been one grower who's been consistently producing oranges for the past 25 years—Russ Finch.

For 45 years, Russ was a wheat farmer in the heart of Nebraska, and in his off hours, a mail carrier. During his agriculture career, Russ decided to build a new house and a manufacturing facility to construct riding cabs for pickups. At the time, Russ had heard about the possibilities of geothermal energy, but had yet to see it in action. He was curious if it would be possible to sustainably heat a home in the midst of a Nebraska winter.

Pictured: Local farmers and university professors were skeptical when Russ wanted to grow citrus in a greenhouse—especially during the hard Nebraska winters. But he's made a good living, experimenting with a number of different varieties over the year. This one is Tango Mandarin.

To heat the house, he used an outside unit that pumped heat from 8 ft. deep in the ground. The structure worked so well that Russ wondered what other applications geothermal energy could have. Immediately, he began to consider whether this type of energy could be harnessed to run a 12-month greenhouse. At 8 ft. deep, the Earth's temperature is a consistent 52F (11C). By tapping into this heat source, Russ could create a frost-free greenhouse environment year-round.

Russ reached out to scientists at the University of Nebraska for their insights on whether the design was feasible. The initial response was skepticism, particularly when Russ shared that his goal was to not just grow Nebraska zoned plants, but citrus. Despite the negative response, Russ was determined to move forward and see for himself whether geothermal energy could be harnessed to grow tropical produce in Nebraska.

"It was just a hobby," said Russ. "But we wanted to show that growing citrus in Nebraska could be possible without the extensive heating cost."

So he constructed a 70-ft.-long greenhouse with a 4-ft.-deep pit. The pit allowed Russ to experiment not only with off-season plants, but trees, planting them directly into the ground. A 10-in. wheel blower was used to circulate the air through seven 6-in. tubes, with a total length of 1,050 ft. It's a completely closed-loop system, continuously recycling the same air. Using low-grade geothermal energy (referred to as geo air) alone, Russ was able to successfully maintain a consistent heat of 52F from one end of the greenhouse to the other without any back-up heat.

During the day, the internal heat increased due to the prolific, bright sunlight that the high altitudes of Nebraska is known for. The roof is slanted to the south, taking advantage of the solar rays to increase the temperature from 52F to the mid-70s (at times 80s) during the sunnier winter days. Russ was able to achieve his ideal temperature.

Twenty-six years later, the tropical plants are thriving, with 12-ft.-high citrus trees that produce over 125 lbs. of produce a year. The cost to run the operation, said Russ, is approximately 85 cents a day, making it economically sustainable to operate year-round. The geothermal greenhouse that Russ designed for a local high school in Alliance, Nebraska, has averaged 96 cents a day for the past four years.

One of the factors that lends towards the low operating cost in Nebraska is the amount of sunshine.

“We have the same amount of sunshine that San Diego has,” said Russ. “In fact, our greenhouses mimic the San Diego climate, going a little higher in the summer.”

To reduce the internal climate in the summer, Russ uses the same motor that pumps the heat in the winter to power the fan. Shade cloths are also used to reduce the intensity of the sun.

When asked about shifting from growing wheat to citrus, Russ admits that the two really don’t fit together.

“We didn’t know anything growing citrus; we still know very little about growing citrus, except that they are not demanding,” said Russ. “There isn’t a steep learning curve; they grow fairly well and often produce within the first year.”

To achieve a commercial output, Russ said, it typically takes about 12 years, although some varieties—like Tango Mandarin—can produce the needed volume in about five years.

Over the years Russ has experimented with several varieties of plants. Currently, he’s growing 13 varieties of citrus, nine types of grapes, figs, kiwi, pomegranate and a selection of tropical plants. Until last summer, all the produce was sold through Little Ladybugs Farmers Market providing fresh, locally grown citrus, to the Nebraska community. The demand exceeded production, with the market often running out by the second day of the market.

Today, most of the fruit is used to promote the benefits of geothermal-heated greenhouses to northern communities. Russ has made it his mission to share the story of his greenhouse in the snow with other northern communities with the hope that they’ll incorporate geothermal heat in their own greenhouse structures. Russ is in the process of building their 39th greenhouse at Scottsbluff, Nebraska.

“This is our first government deal. It’s a state project and will be the largest structure that we have built,” said Russ. At 138-ft. long, the geothermal structure will include a 30-ft. entry room that will be used as a classroom, while the greenhouse itself will showcase plants from around the world, including citrus, cacao and a variety of tropicals.

Since the initial greenhouse, Russ has evolved the floor plan to increase efficiencies and simply be easier to build. The new structure is built at ground level, with a 4-ft. drop to accommodate the 12-ft. growing height needed for the citrus plants. From the outside, the structure is only 7.5 ft. above grade, increasing its resiliency during windy and extremely inclement weather.

The newer units also include a system that captures the intense heat at the peak of the greenhouse, flowing it back into the ground to help heat the structure during the cooler evenings.

“If the sun is out, the internal temperature can rise to 125 degrees Fahrenheit, but as soon as the sun goes down, the temperature plunges,” said Russ.

When asked about the future, Russ hopes that all the citrus sold in Nebraska will be produced locally and that this success story can then be shared with other northern communities. The commercial value for geothermal

greenhouses is unlimited, shared Russ, and having local production not only provides a fresher product, but eliminates the transportation cost, providing an economically and environmentally sustainable method to grow fresh produce, year-round. **GT**

Anne-Marie Hardie is a freelance writer/speaker from Barrie, Ontario, and part of the third generation of the family-owned garden center/wholesale business Bradford Greenhouses in Barrie/Bradford, Ontario.