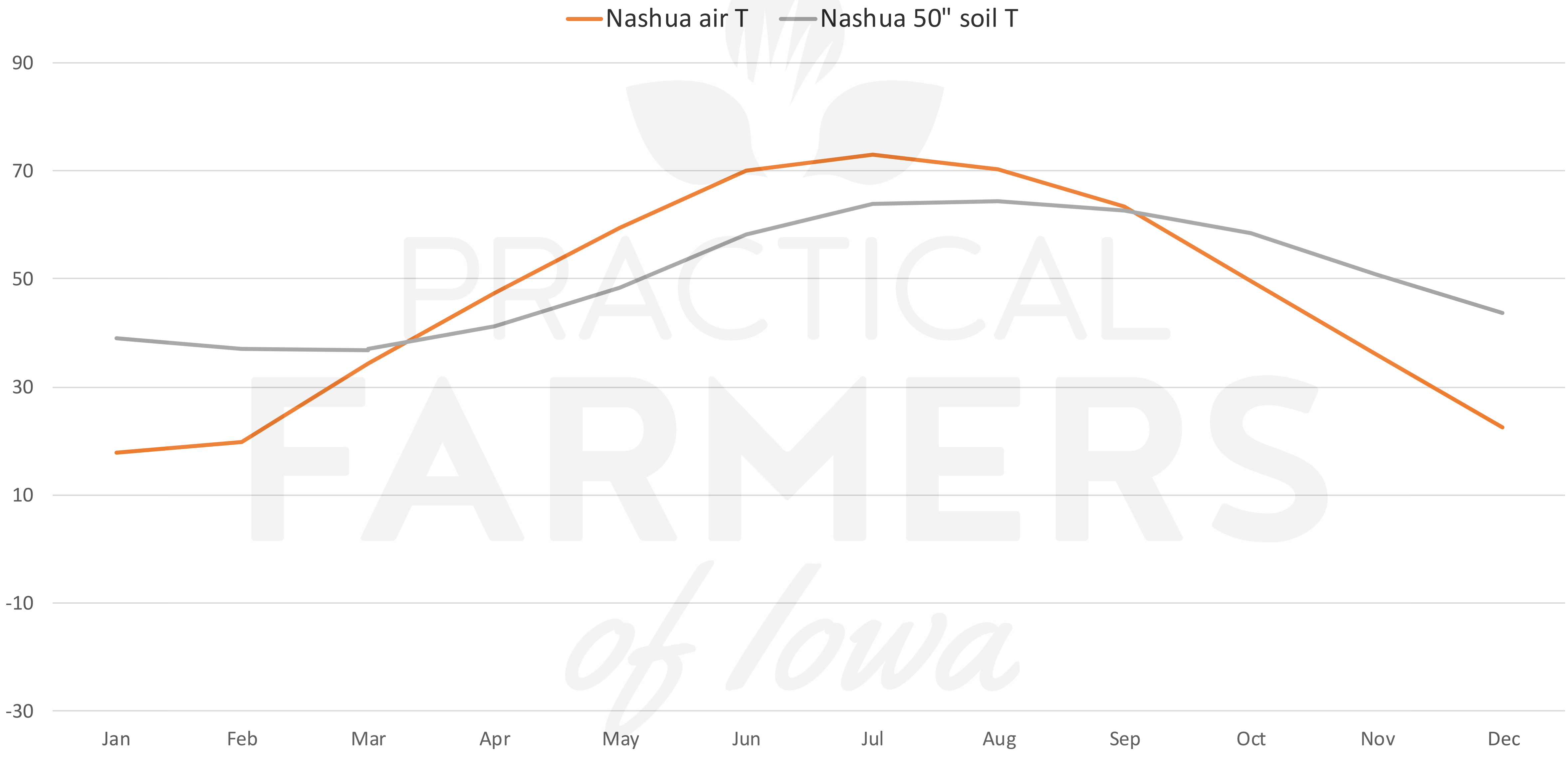
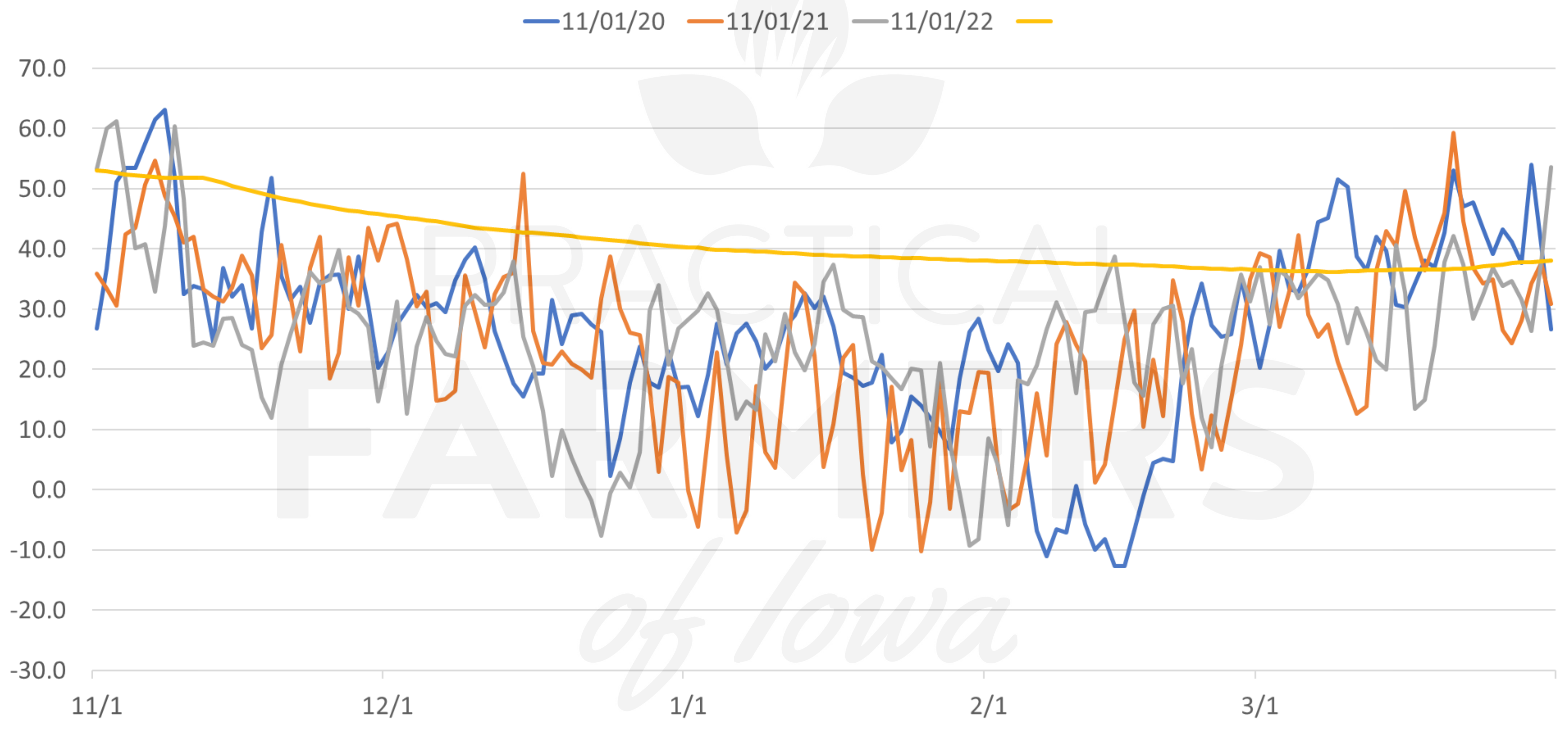
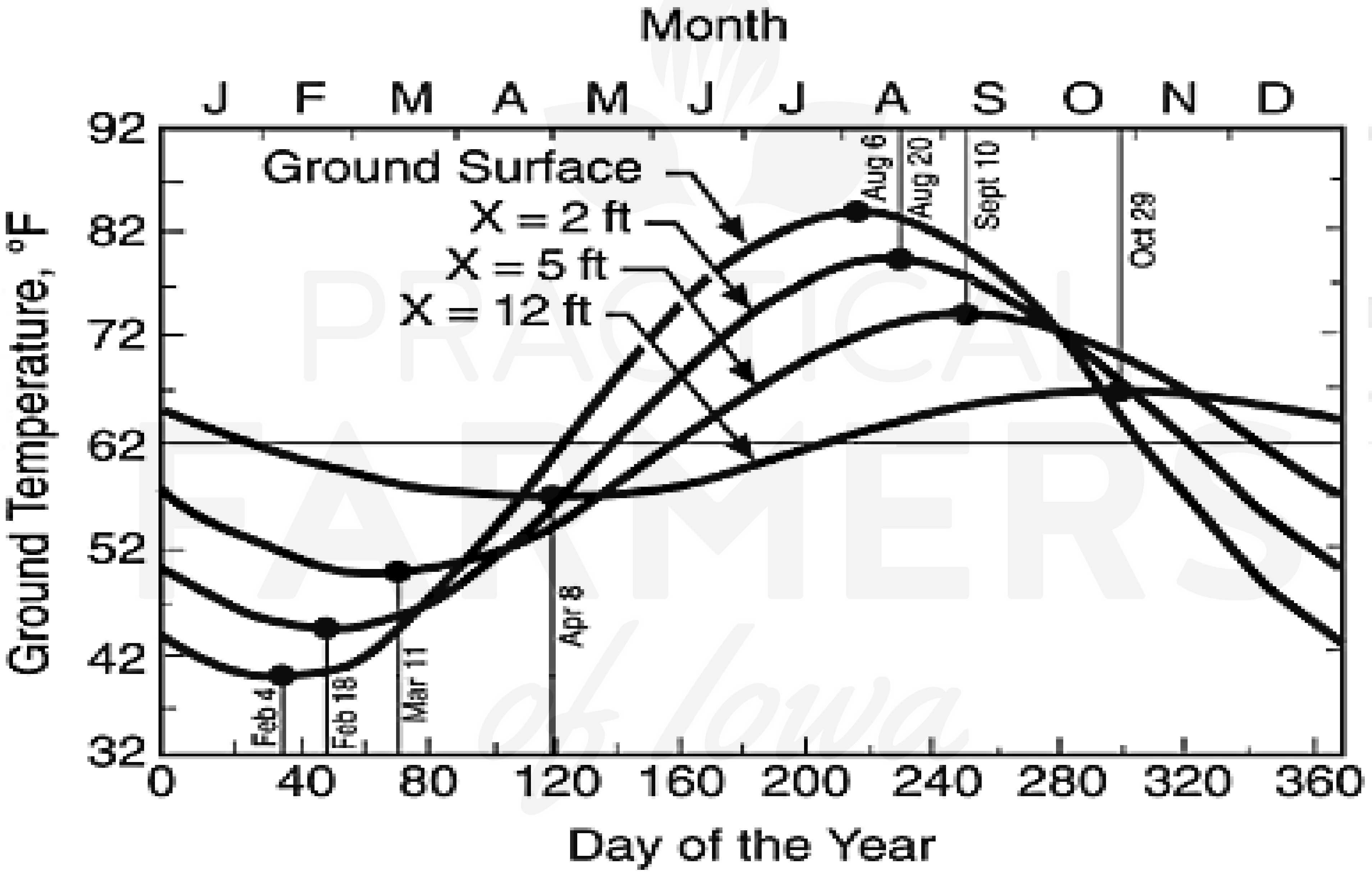
Nashua, IA long-term average air T and 3-year average 50” soil T



Average daily temperature at Nashua, IA from November through March for three consecutive years, degrees F, and the average 50” soil temperature



Seasonal soil temperature change as a function of depth below ground surface for an average moist soil.



- A geothermal heat pump system for a building consists of a ground loop for collecting ground stored heat coupled with a heat pump that uses a refrigeration cycle to elevate or depress temperatures for our comfort

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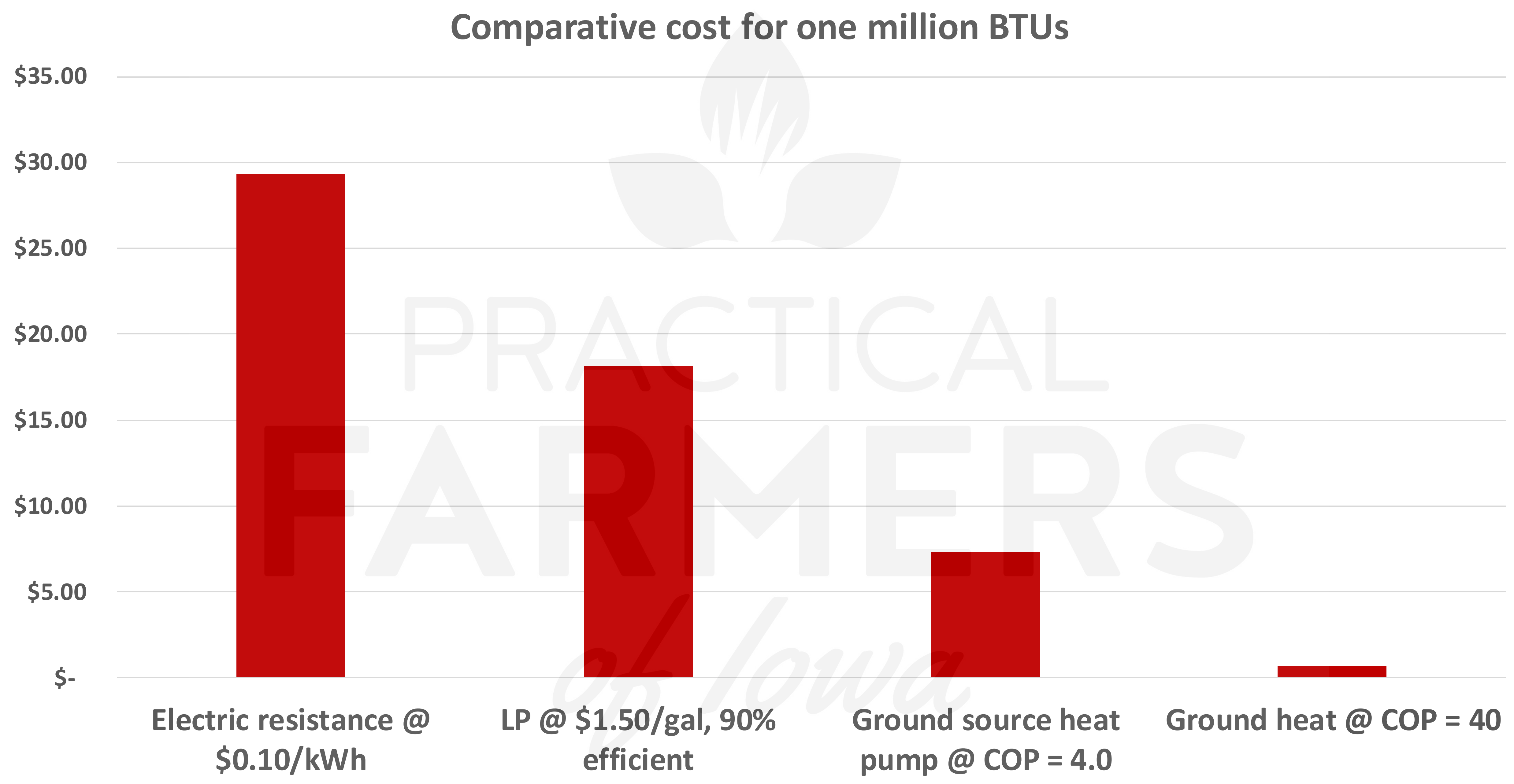
- **Heating or cooling applications that don't require our comfort don't necessarily need the heat pump, which is a very expensive part of the system. Then, although the ground heat collection system installation can be expensive up front, we can have a very inexpensive geothermal heat source for years to come.**


Comparative cost for one million BTUs
$35.00
$30.00
$25.00
$20.00
$15.00
$10.00
$5.00
$-
Electric resistance @ $0.10/kWh
LP @ $1.50/gal, 90% efficient
Ground source heat pump @ COP = 4.0
Ground heat @ COP = 40

Decreasing Energy Use and Cost of Grain Drying by Extending the Drying Period Using Ground-Stored Heat

- Eric Jellum, project coordinator
- Funded by USDA-Sustainable Agriculture Research and Education: Farmer/Rancher Grant Program
- Project number FNC17-1080

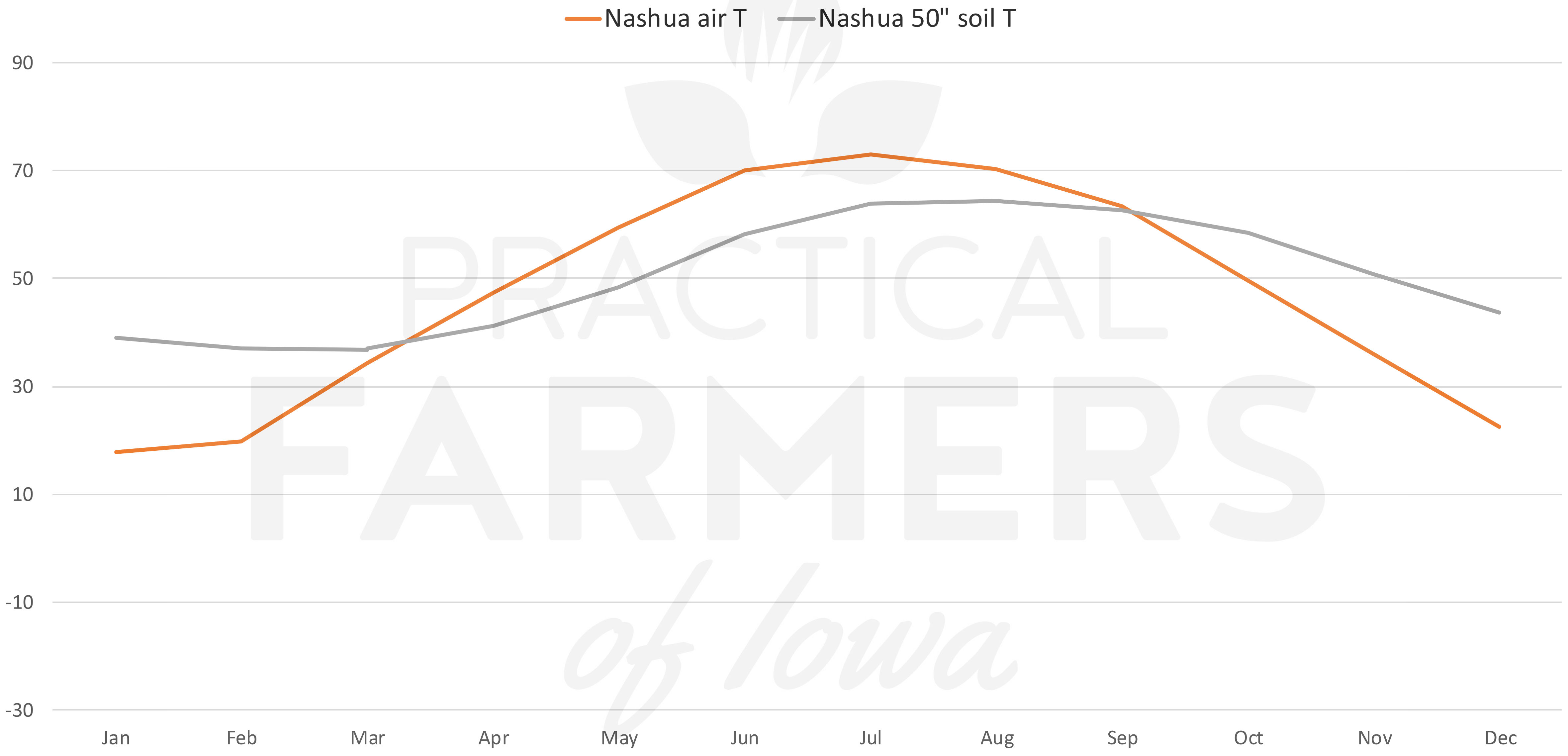

PRACTICAL FARMERS
Webstone
ASTM D1785 PPFA
HT


GRUNDFOS
NONSUBMERSIBLE CIRCULATION PUMP
Type UPS 15 58 FC
P/N: 59896341 P1
115 V 1 PH
PC 0839
60 Hz
10 uF
US
WITH CHECK VALVE
I1/1(A) P1(W)
.55 60
.66 80
.75 87
Class F
IMPEDANCE PROTECTED
FOR INDOOR USE ONLY
MAX FLUID TEMP. 230 F
99K4
c UL us

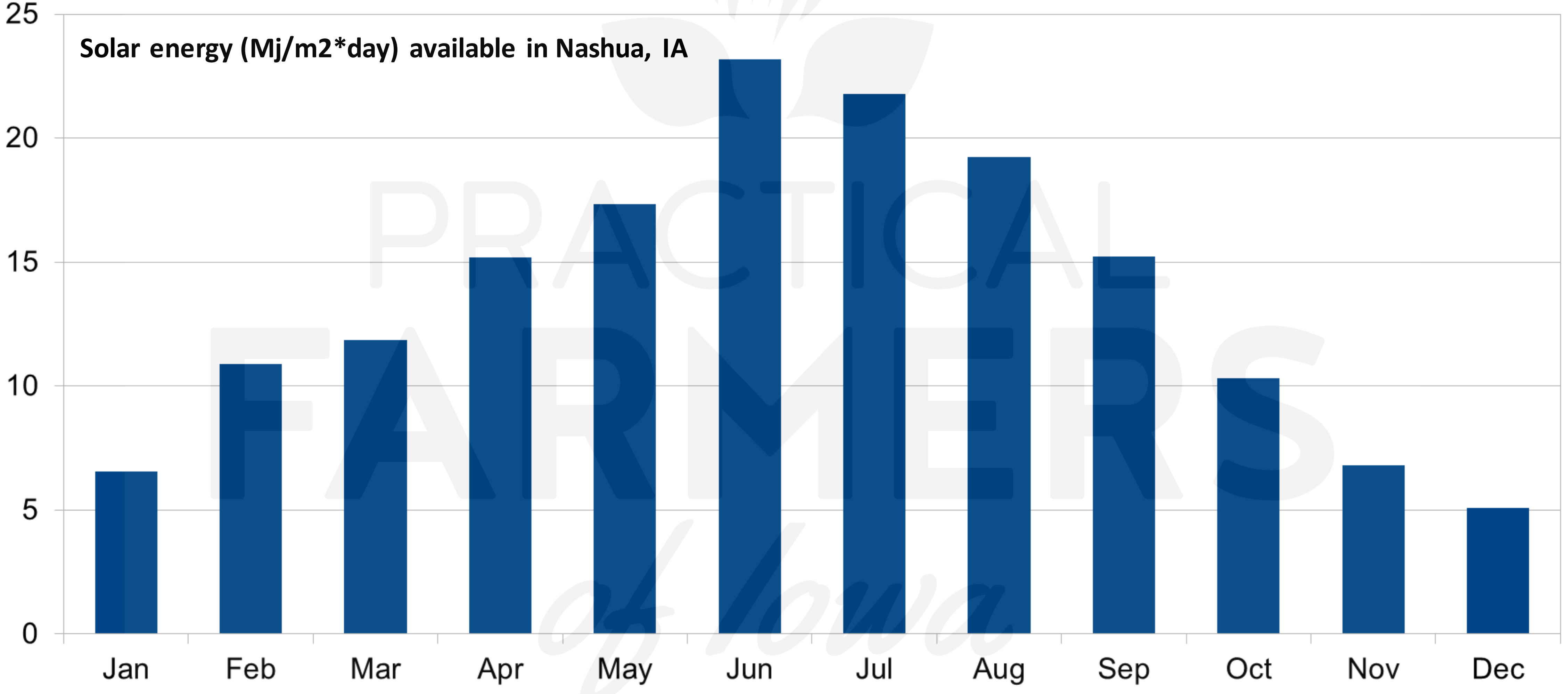
Establishing a Temperature Gradient to Enhance Geothermal Heating and Cooling of a High Tunnel

- Eric Jellum, project coordinator, and Steve Strasheim (Twisted River Farm)
- Funded by USDA-Sustainable Agriculture Research and Education: Farmer/Rancher Grant Program
- Project number FNC21-1278

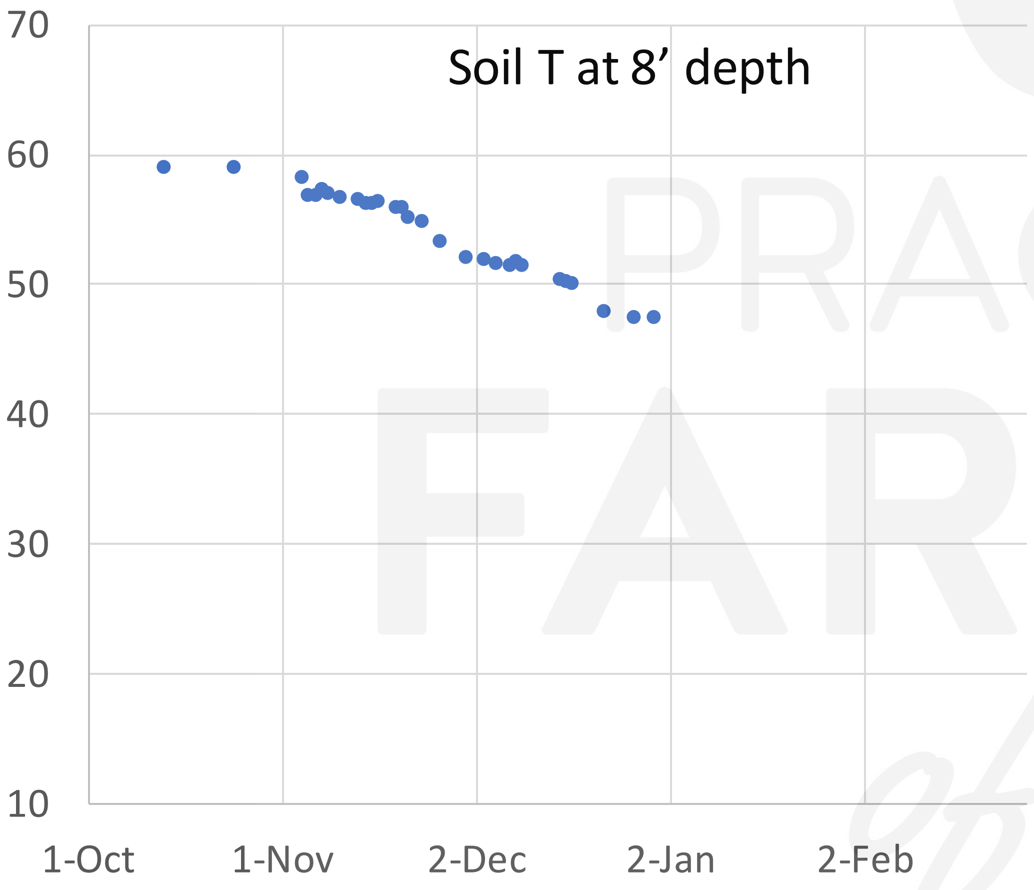
Nashua, IA long-term average air T and 3-year average 50” soil T

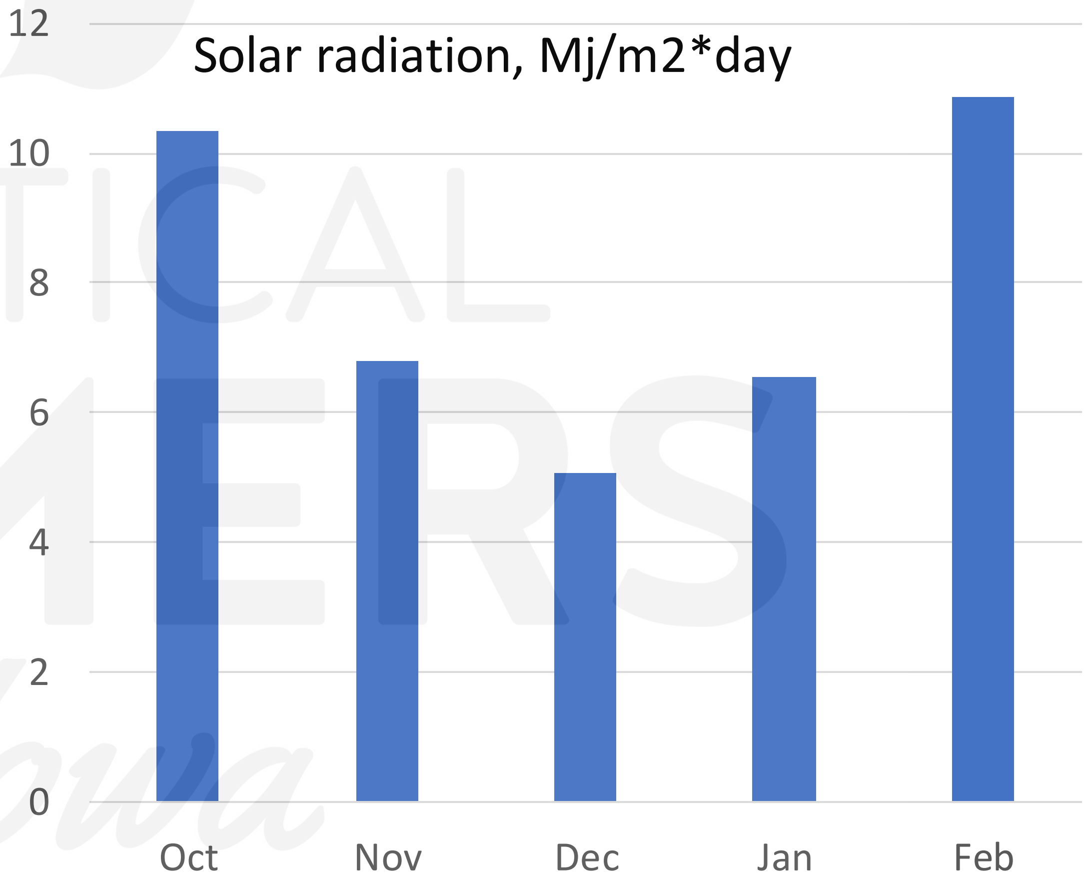


Since a greenhouse or high tunnel is also a solar collector, solar heat should also be considered in the design of the heating system



Through the most demanding part of the heating season, December through February, soil T will continue to decline. Solar radiation bottoms out in December and increases through February. A geothermal loop beneath the footprint of the greenhouse could function as both a heat source at night and a heat sink during the day to store excess solar heat and increase soil temperatures.





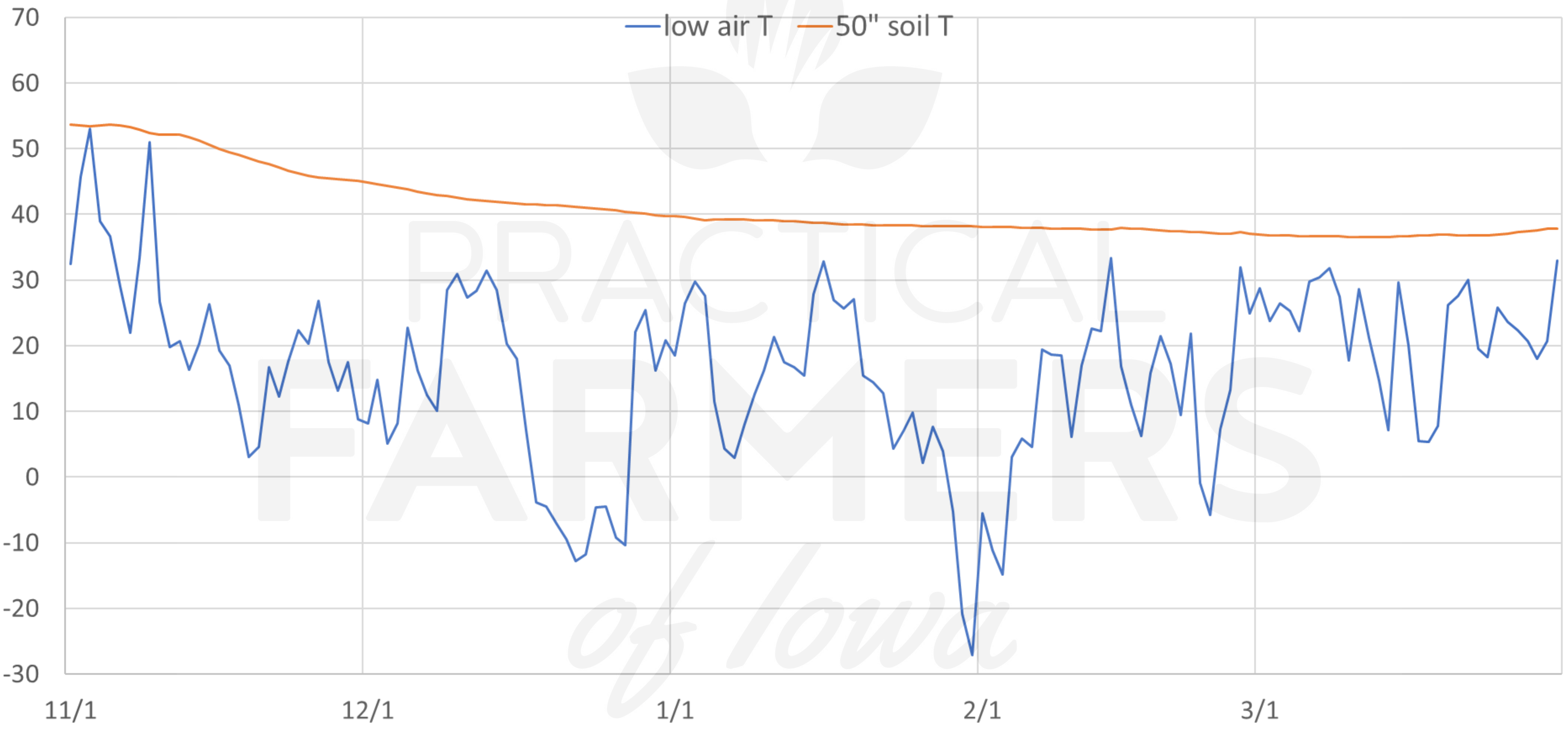

ALLIED
DEERE

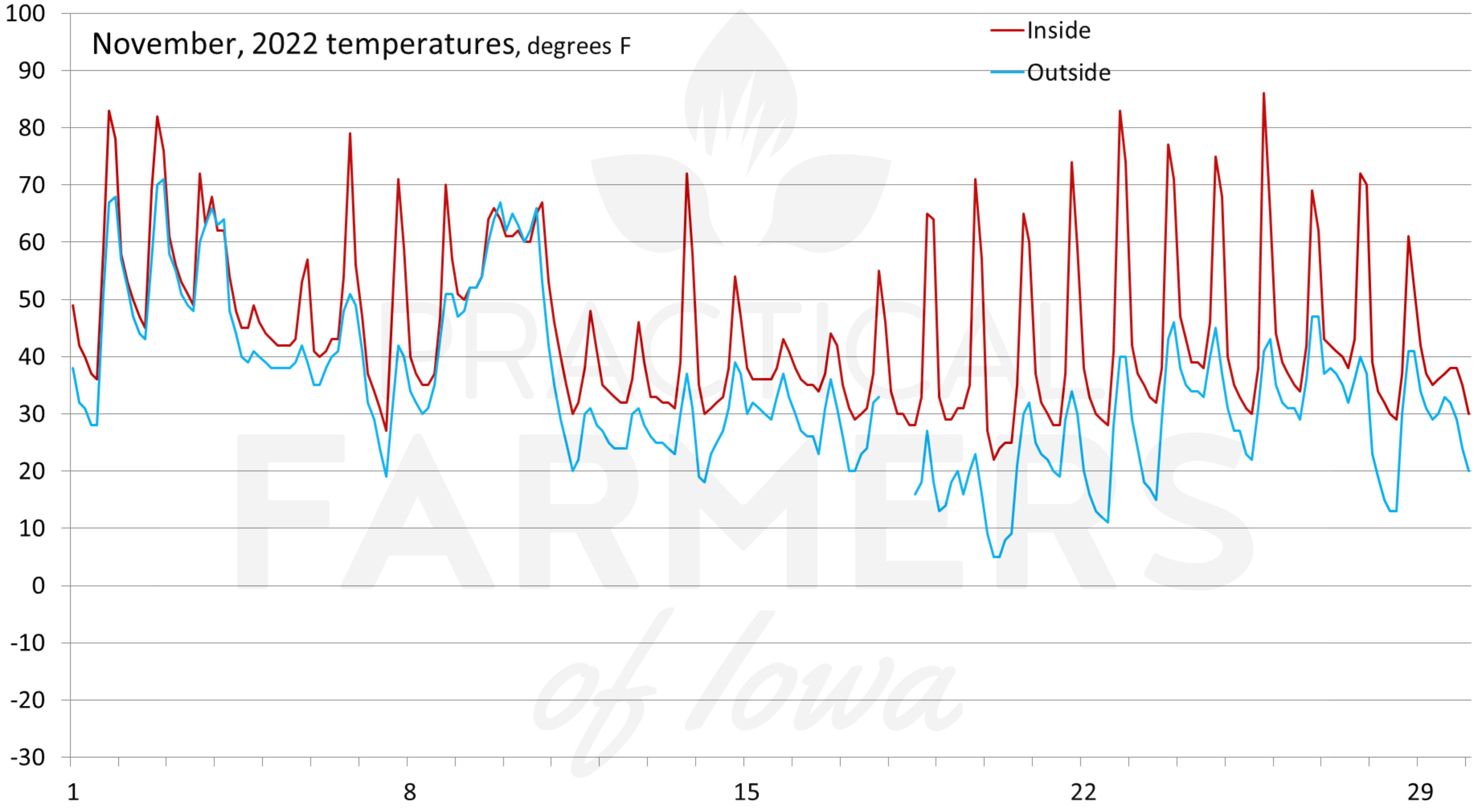

CHARLOTTE PIPE

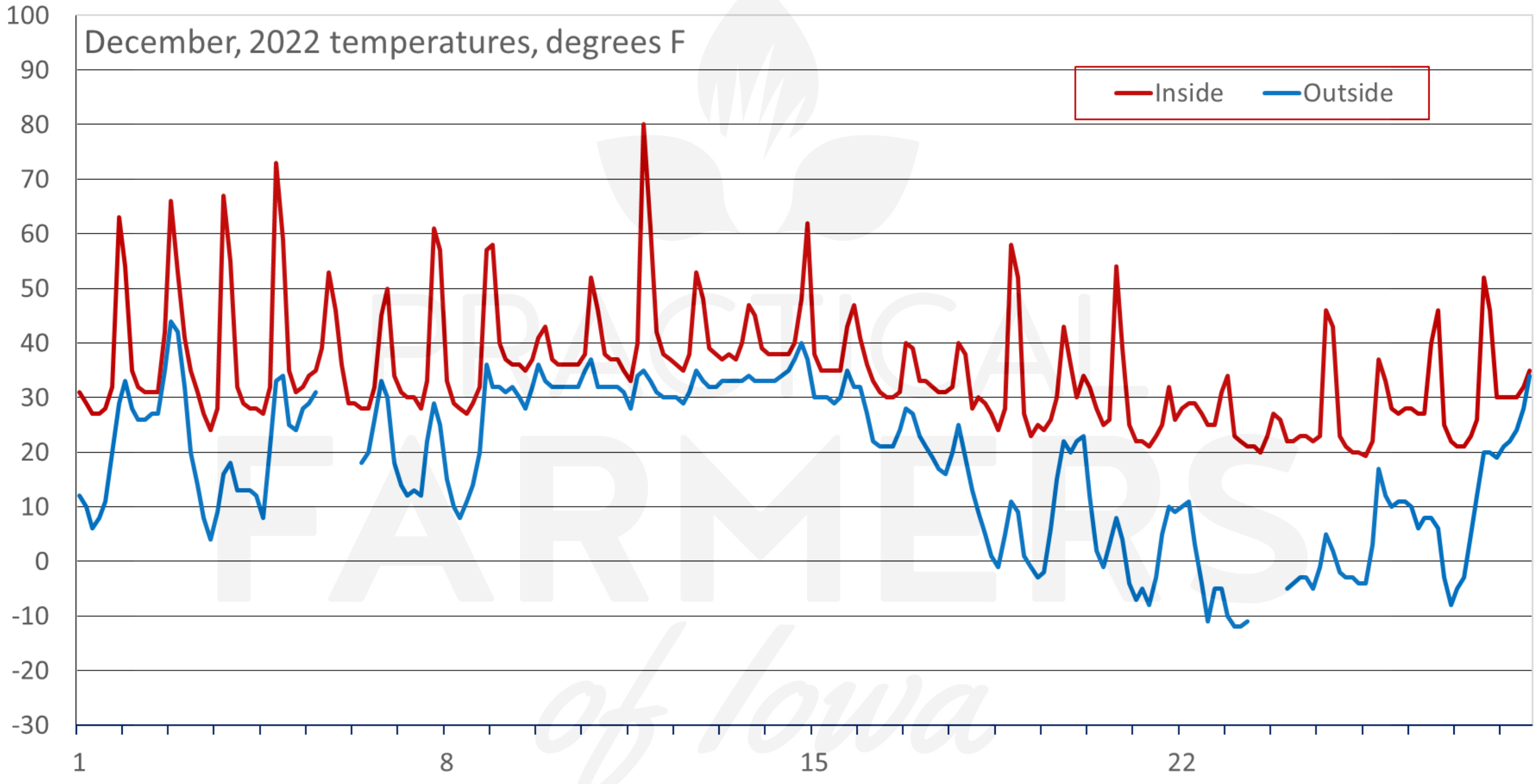
of Iowa

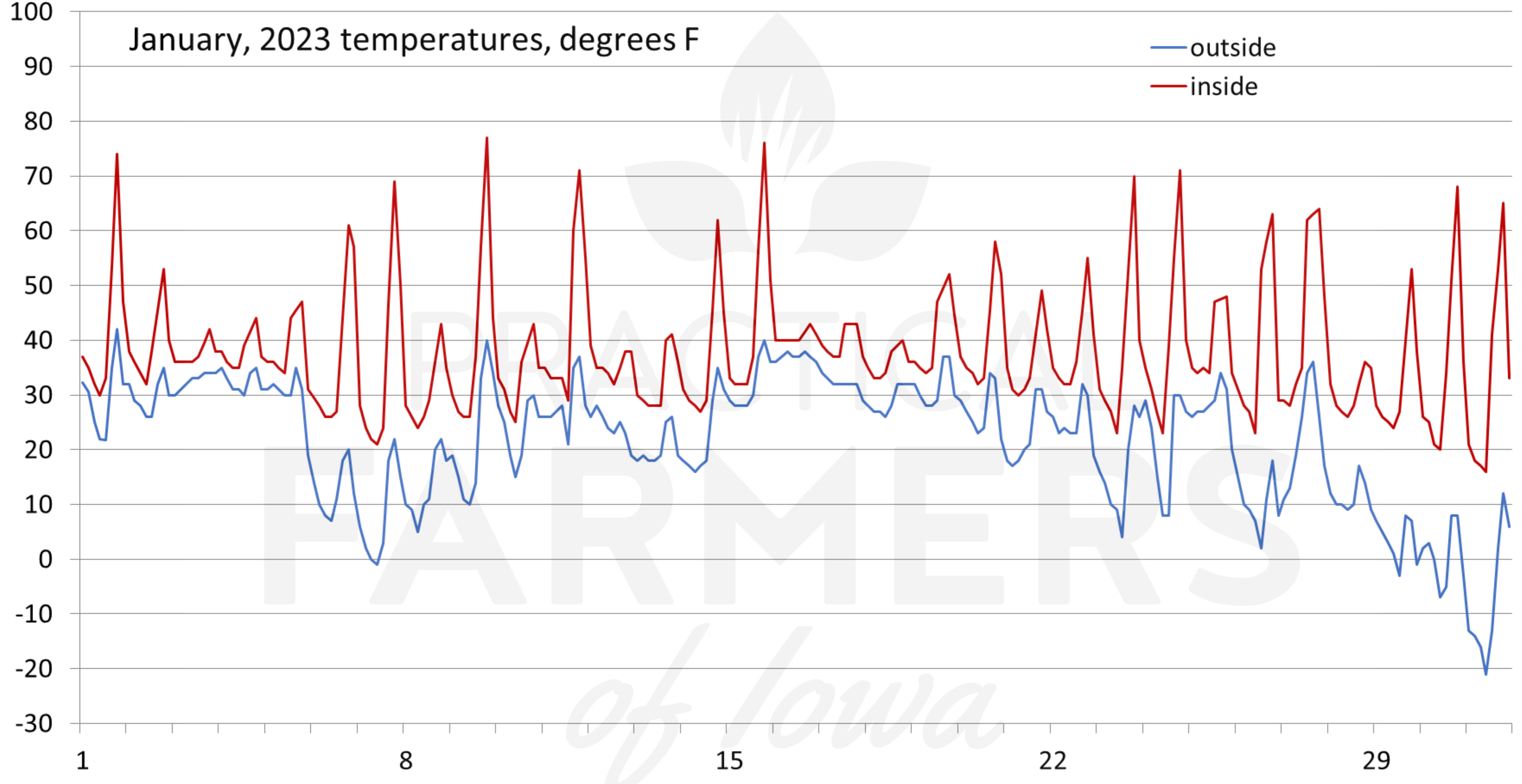

PRACTICAL
FARMERS
of Iowa

Nashua, IA low air T and 50” soil T for November, 2022 through March, 2023

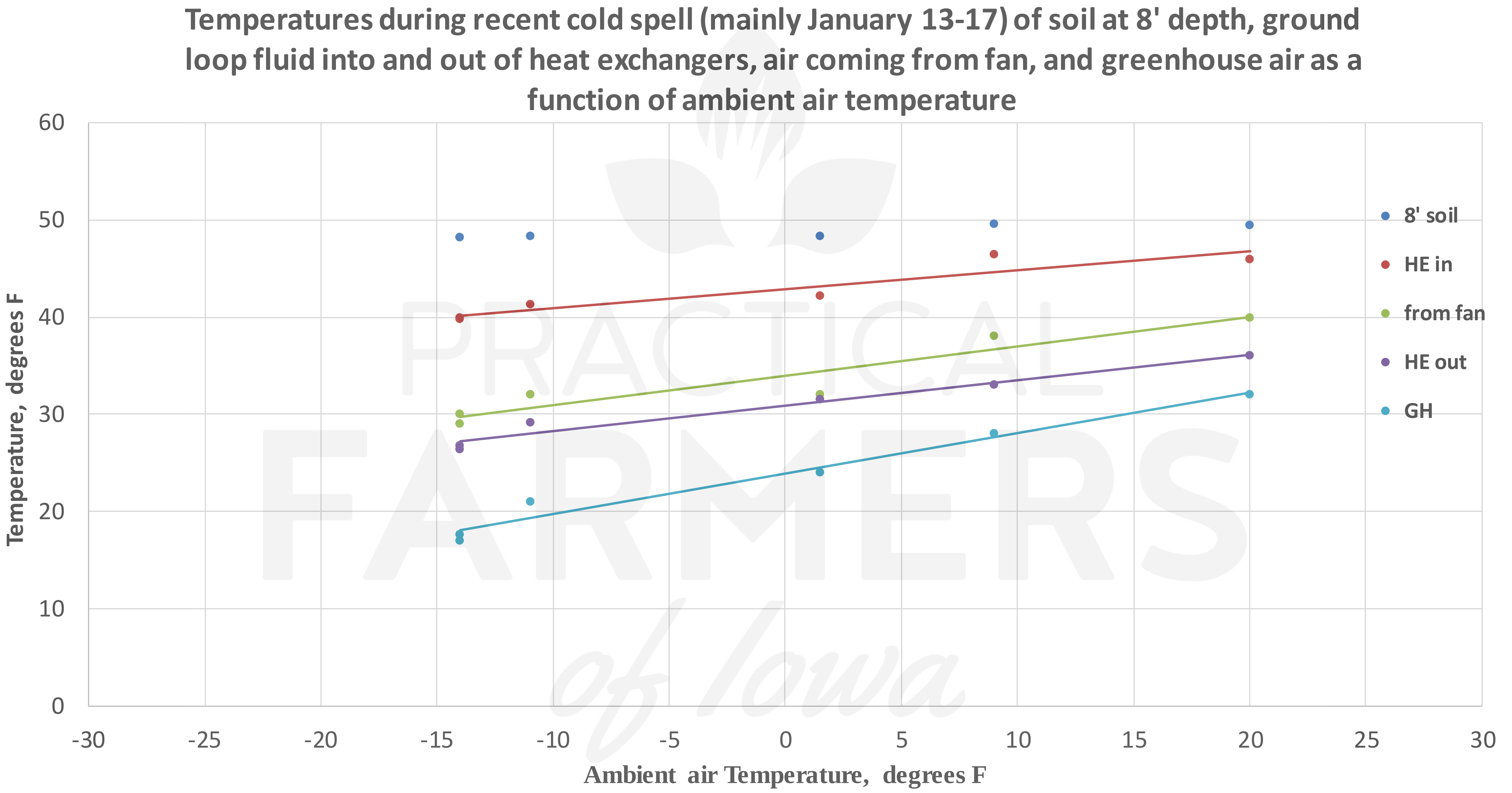



November, 2022 temperatures, degrees F
Inside
Outside
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
1
8
15
22
29
PRACTICAL FARMERS of Iowa


December, 2022 temperatures, degrees F
Inside
Outside
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
1
8
15
22


January, 2023 temperatures, degrees F
outside
inside
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
1
8
15
22
29
PRACTICAL FARMERS of Iowa

PRACTICAL FARMERS *of Iowa*



Temperatures during recent cold spell (mainly January 13-17) of soil at 8' depth, ground loop fluid into and out of heat exchangers, air coming from fan, and greenhouse air as a function of ambient air temperature
Temperature, degrees F
Ambient air Temperature, degrees F
60
50
40
30
20
10
0
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
30
8' soil
HE in
from fan
HE out
GH

Summary

Low-temperature geothermal applications like corn drying and greenhouse heating are ideal and inexpensive uses of ground-stored heat and involve very little use of fossil energy. The intended project to evaluate a geothermal heating system under the footprint of the greenhouse that could operate as a diurnal heat source at night and heat sink for excess solar gain during the day was not accomplished. Instead, a deeper ground loop external to the greenhouse was successfully evaluated. The original design for the heating system has merit and should still be tested.

Questions, suggestions, and discussion

Eric Jellum jellumfm@gmail.com