Heron Pond Farm

Amazing Winter Tunnel Weed Control

Heron Pond Farm

South Hampton, NH

42.8809° N, 70.9626° W

Winter weeds start out slow

- We farmed the first few years of winter growing weed free
- Then some brassica and rouge weeds started to come in nothing that could not be handled with a hoe
- Then the chickweed started coming in (as you see here) at this stage still nothing to get to upset about.

Chickweed begins to expand it’s turf

Manageable weed pressure with hand tools.

Finding it hard to keep up even with frequent cultivations.

God Help Us…What do we do now!

Bring in the chickens! At least we will get some fertilizer out of this.

Turns out chickens are a bad idea

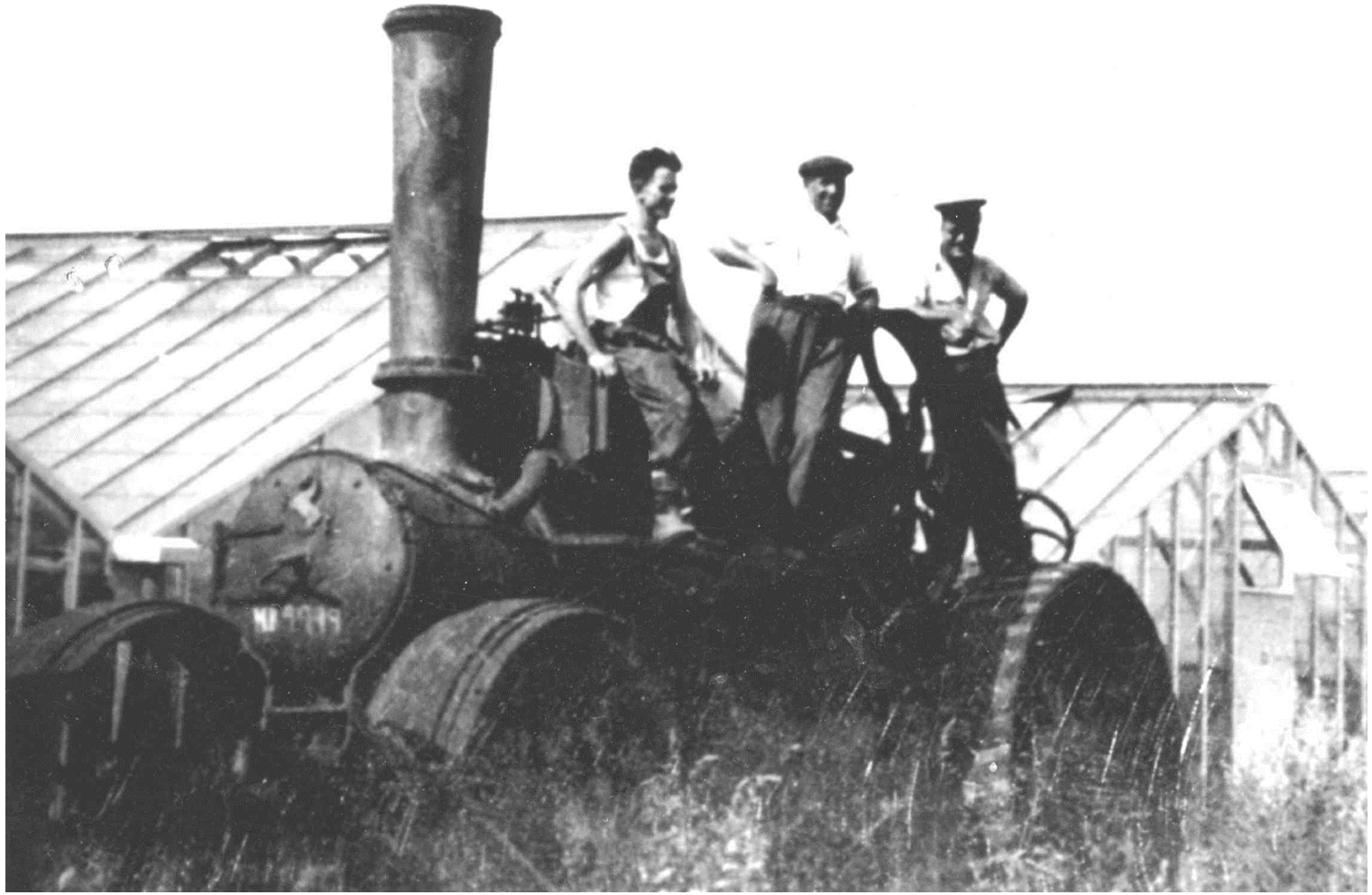
- Chickens don’t eat that much chickweed. They tend to go after any crop first and fill up on that
- Compact the soil
- Create hot spots
- Food safety nightmare

Frozen Ground Conference 2014

Eliot Coleman

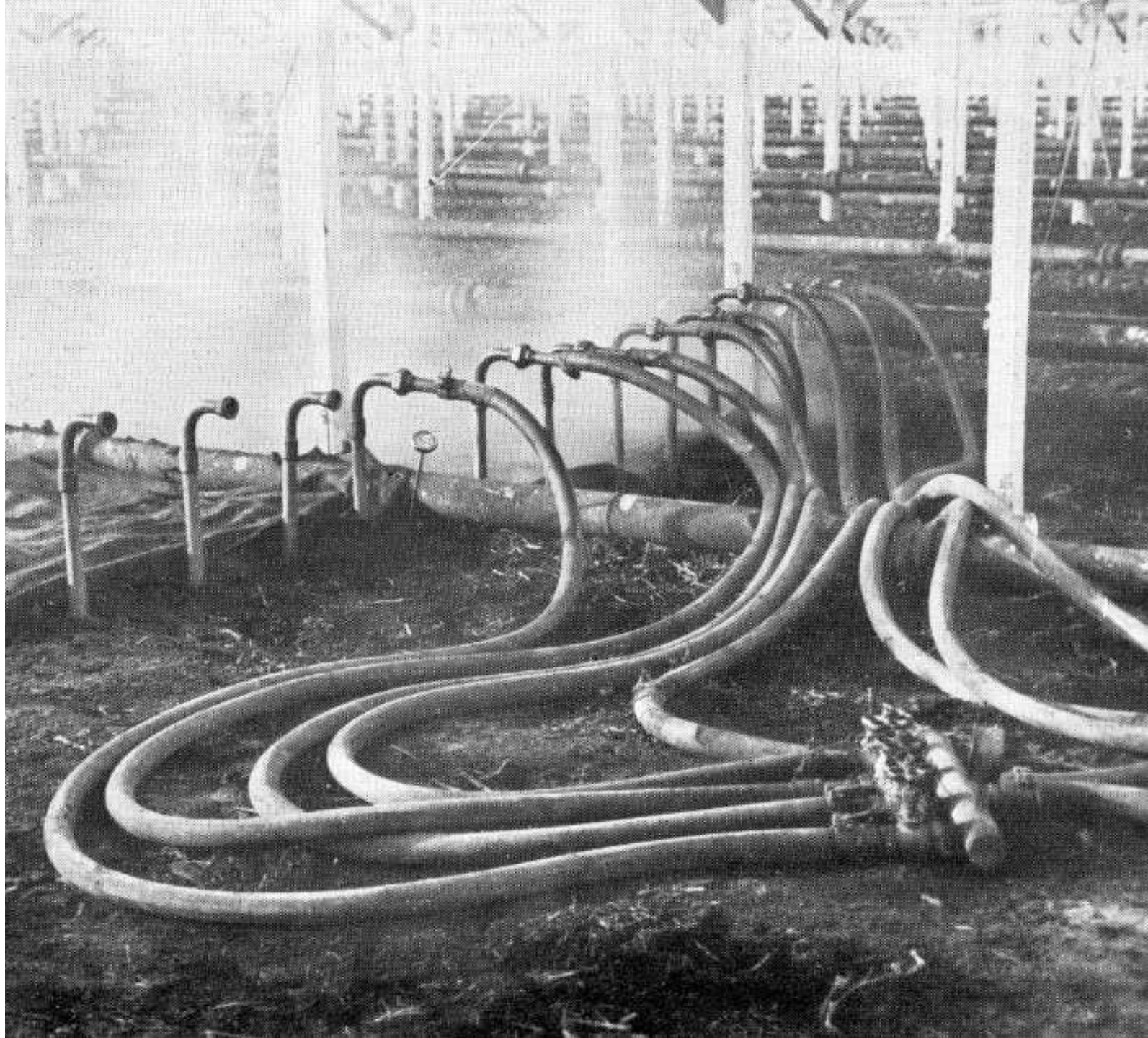
- Presented proposal for the group to try two methods
- Soil Solarization, using black plastic in closed house mid summer
- Soil Steaming, done with low pressure, high volume steamer just prior to planting the crop.
- Eliot chose the soil solarization but had tons of martial on bed steaming and got me started out.

These guys drove this steam engine from the rail yard to their greenhouse opporation.

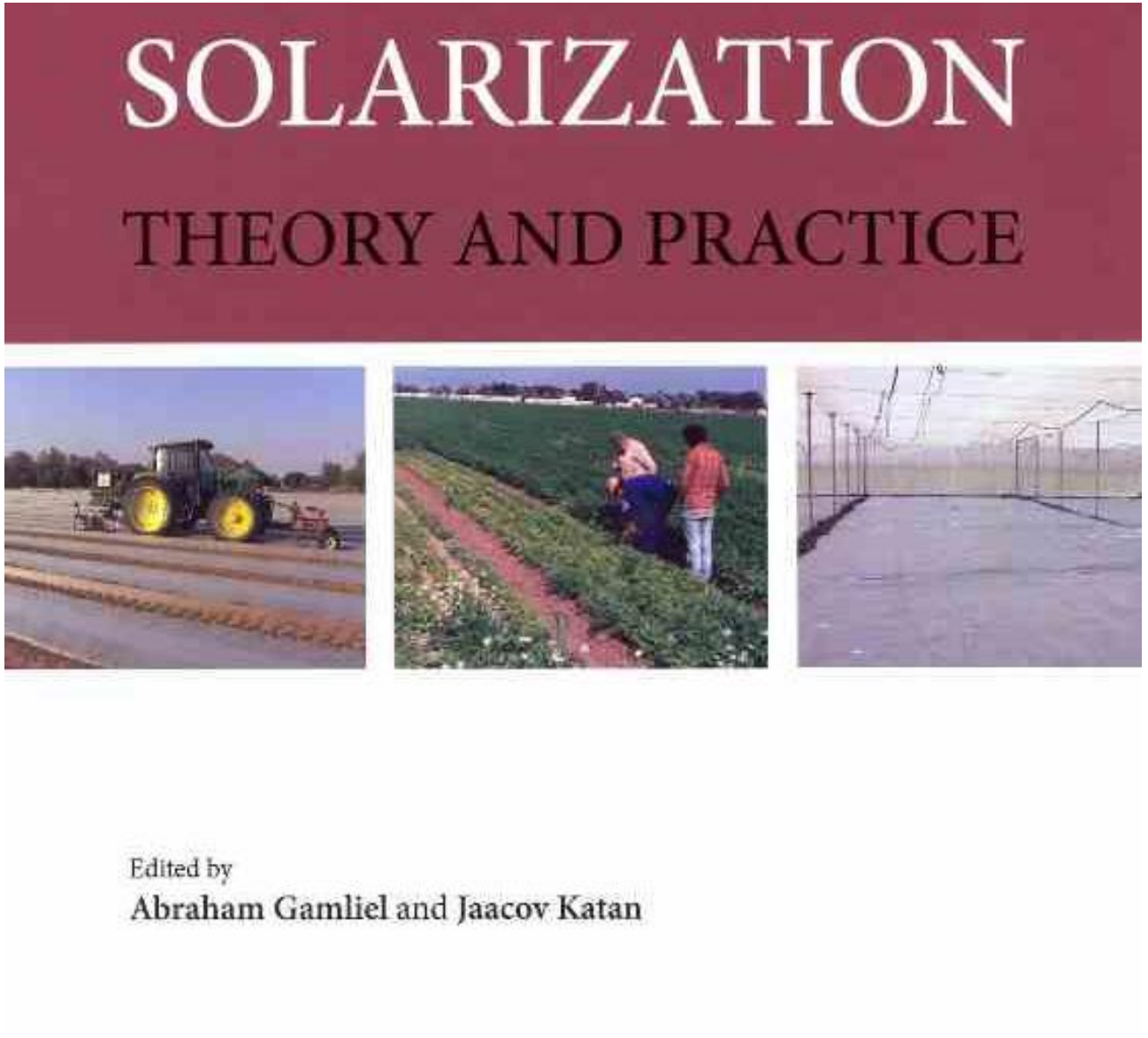


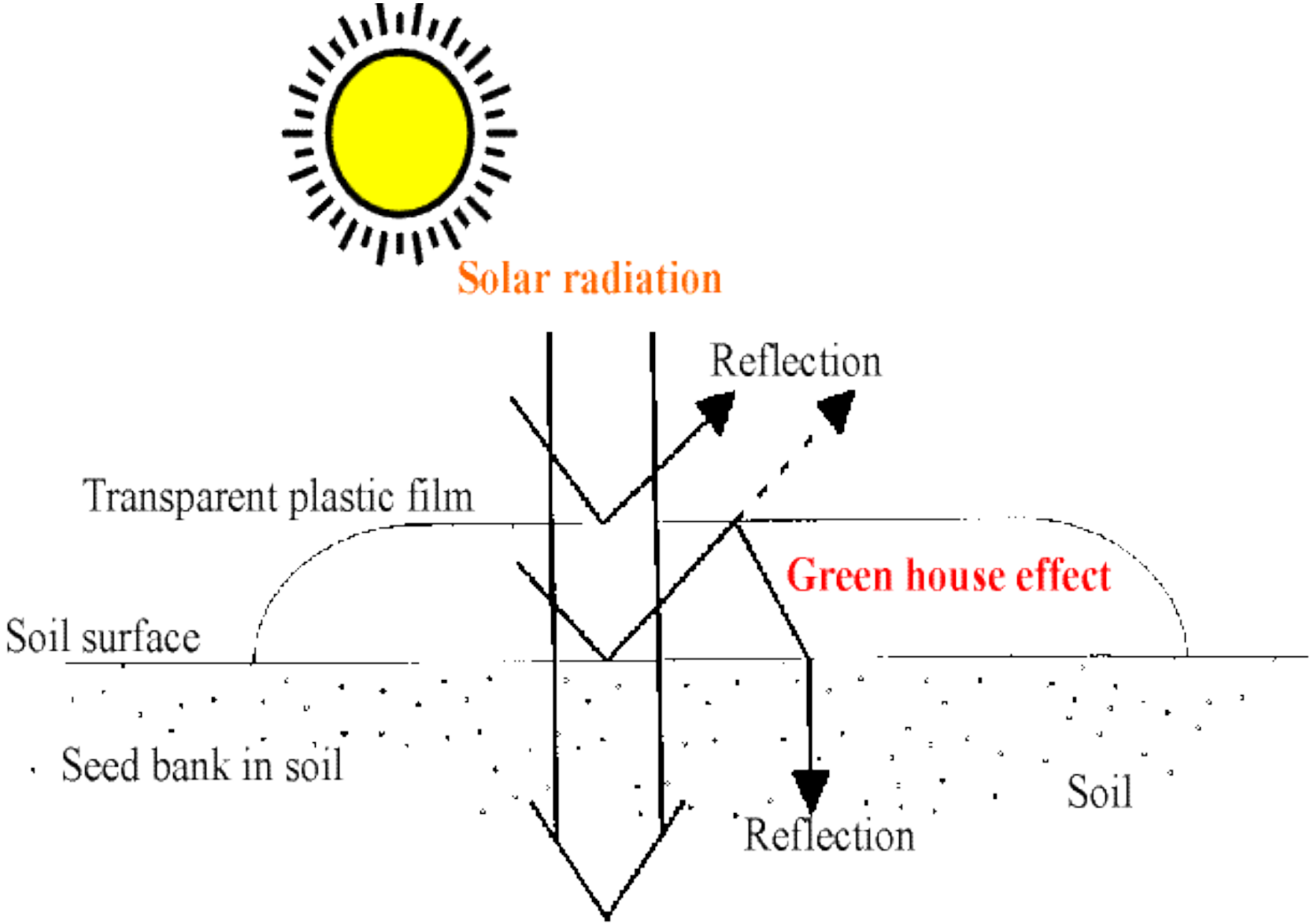
Steaming soil is not a new idea

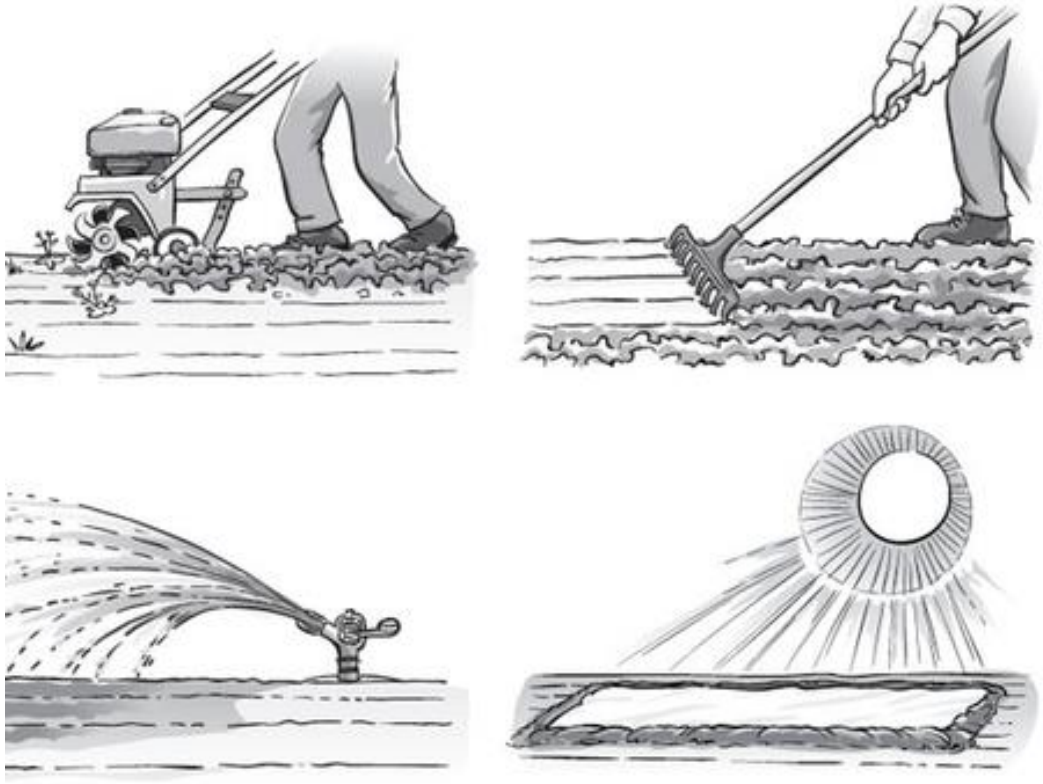
- Steam from a locomotive is pumped into the soil through underground permanent pipes.
- Thick canvas covers are used to hold the steam in the soil.
- Currently there is a flush of new research going on in regards to steaming, but not much new has been published since the 50’s.



Everything you ever wanted to know about solarization




Solar radiation
Reflection
Transparent plastic film
Green house effect
Soil surface
Seed bank in soil
Soil
Reflection



Bed prep is done prior to treatment.

- Deep and/or finish tillage will bring up viable weed seed.
- Smoothing off will allow not only for a better seed bed but for more consistent heating of soil bed.
- Watering for heat conductivity and retention. Soil must still be friable. Over saturation leads to uneven heat and unobtainable BTU load. Soil moister should be 25%.
- Use of a power harrow post watering will aid in optimal treatment conditions.

How Long? The longer the better.

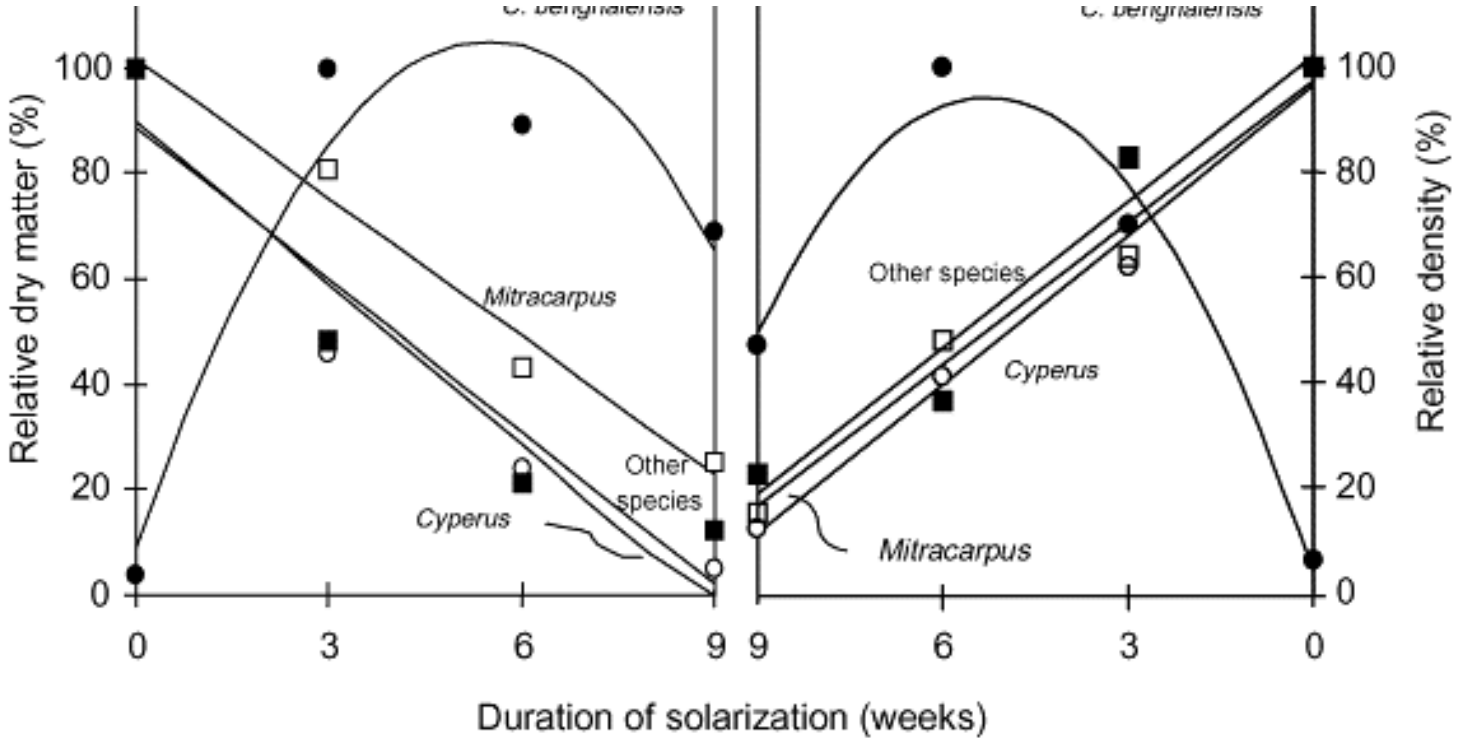


FIG. 1. **Relative weed dry matter and relative density at 30 days after film removal. Relative weed dry matter: *Cyperus* spp. (-O-), $y_r = 89.80 - 10.23t$, $R^2 = 0.92$; *C. benghalensis* (-●-), $y_r = 8.90 + 35.13t - 3.2t^2$, $R^2 = 0.91$; *Mitracarpus* sp. (- -), $y_r = 101.70 - 8.77t$, $R^2 = 0.98$; other species, (-■-), $y_r = 88.82 - 9.64t$; $R^2 = 0.90$; relative density: *Cyperus* spp. (-O-), $y_r = 96.50 - 9.50t$, $R^2 = 0.99$; *C. benghalensis* (-●-), $y_r = 3.55 + 34.35t - 3.27t^2$, $R^2 = 0.97$; *Mitracarpus* sp. (- -), $y_r = 97.40 - 9.03t$, $R^2 = 0.98$; other species (-■-), $y_r = 102.25 - 9.3t$, $R^2 = 0.95$. Where t is the duration of solarization (weeks). The group classified as other species included: *C. nictans* var. *paraguariensis*, *M. chamaedrys*, *M. verticillata*, *S. corniculata*, *S. anthelmia*. Each value, mean of the two film tickness, 100 and 150 µm (n = 8).**

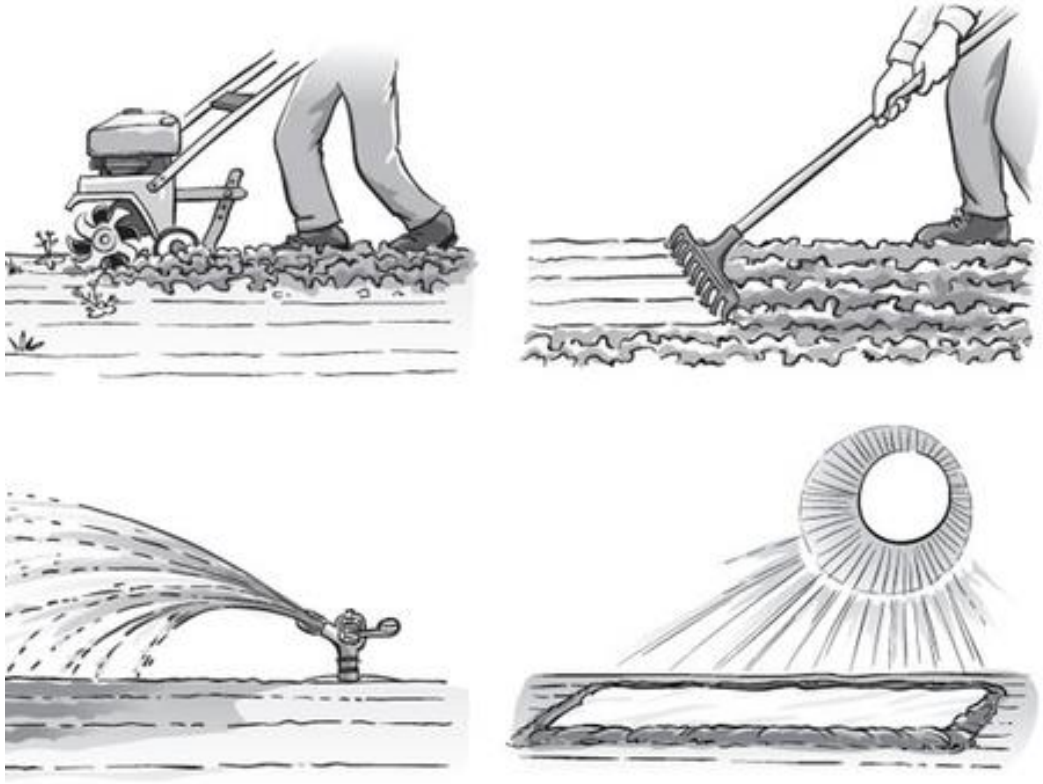
Raised beds
covered with tarps
for 10 weeks.

Weed free without cultivation

Problem with Solarization

- Recommended four week minimum for solarization
- Trying to stretch a summer crop like tomatoes to the last minute becomes impossible
- Timely planting of winter crops (always critical) may become problematic.

Bed steaming offers timely turnaround of crops with the same weed control



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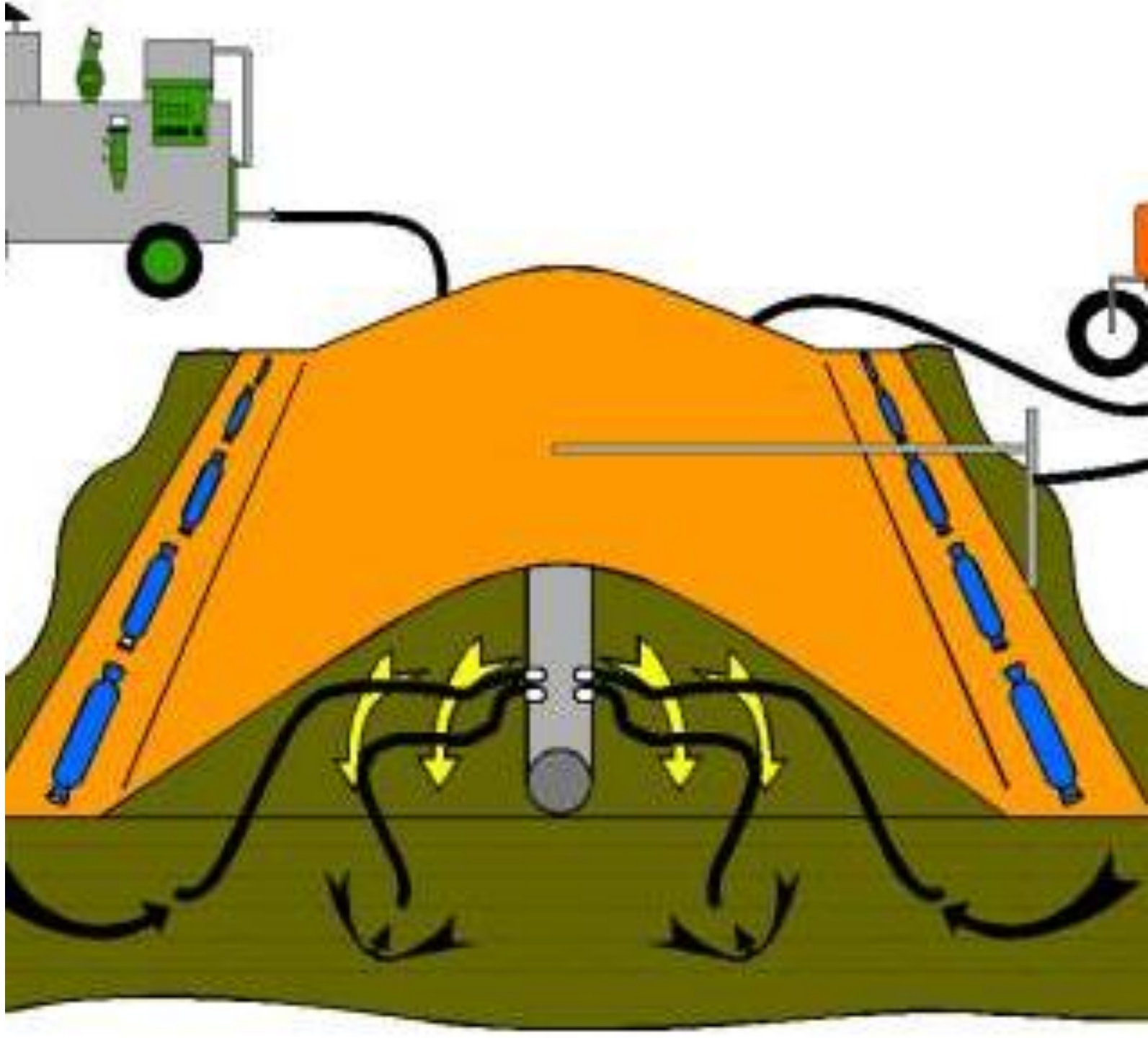
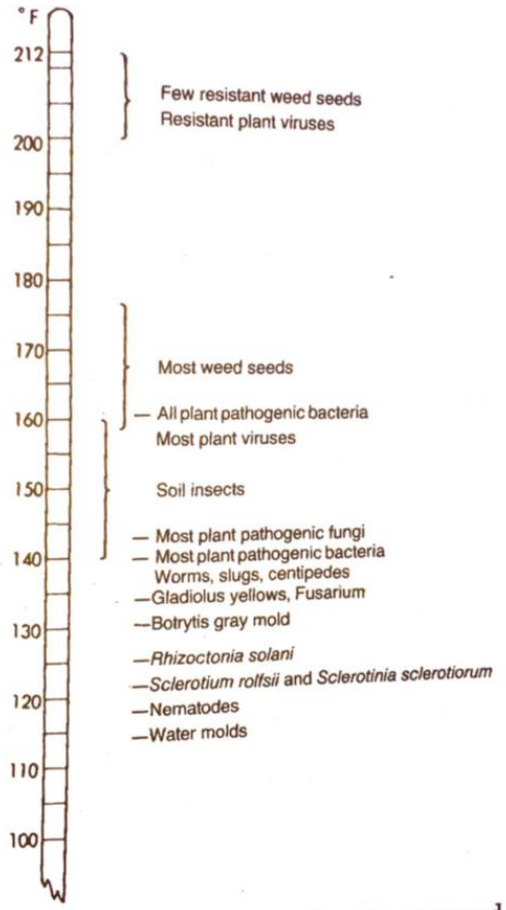
We use mini wobblers to water our prepped and leveled beds

General soil steaming set up

- Heat tube carries steam supply down entire length of treated area.
- Sides must be weighted down the entire way. No gaps. We use chain.
- Do not take test temp at beginning or end of run.
- Do not take test temp from middle or against weighted side of bed



For a guide on temperatures needed for sterilizing, see the following thermometer graph.



This graph shows temperatures necessary to kill pathogens and other organisms harmful to plants. Most of the temperatures indicated here are for 30-minute exposures under moist conditions. (From Baker, K. F., ed., "The U.C. System for Producing Healthy Container-Grown Plants," California Agriculture Experiment Station and Extension Service Manual 23, 1957.)

Temperatures needed to effect change in weed seed bank.

- 175 degrees held for 30 min will destroy most weeds in soil.
- All plant pathogenic bacteria and most plant viruses are destroyed at 160 degrees.
- A few resistant weed seeds stay viable till help to 212 degrees. Luckily chickweed is not one of them.

Understand Your BTU Load

- Length 100
- Width 4
- Depth in Inches 12
- % Moisture in soil 25%
-
- Total area (Sq. Ft) 400.0
- Total cubic yards 14.8
- Weight per cubic yard (lbs) 1000

- Total Weight (lbs) 14,815

Total weight of soil moisture (water) 3,704
Total weight of soil 11,111
Soil Specific Heat 0.21

Starting Temperature of soil F 60
Ending Temperature F 175
Delta T F 115

BTUs required to heat soil 268,333
BTUs required to heat moisture in soil 425,926
BTUs required Total 694,259

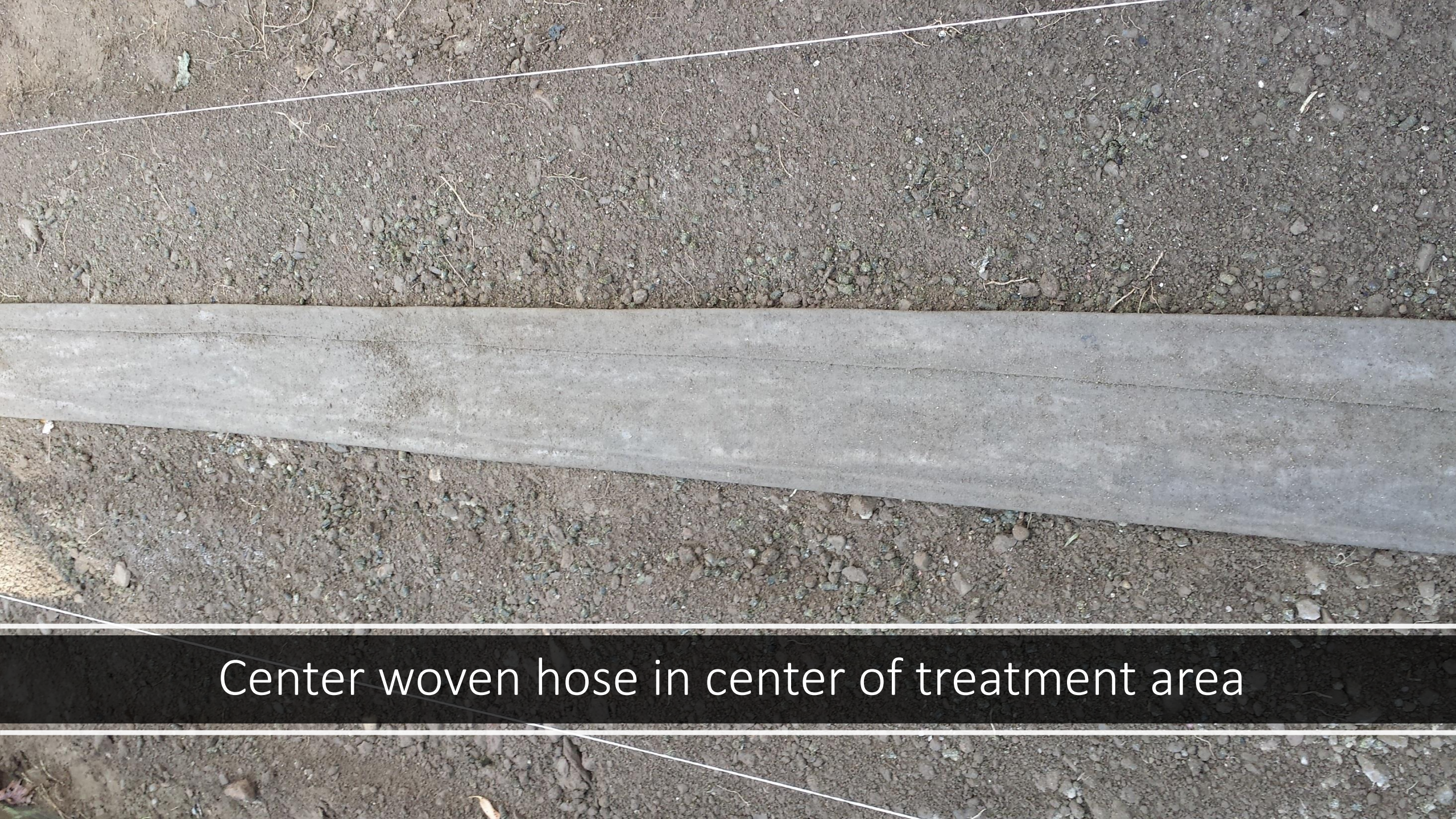
BTU Input Efficiency

					Min	Hours
• SF-11	427,000	84%	358,680	306,600	239.02	3.98
• SF-20	791,000	83%	656,530	561,202	144.19	2.40
• SF-25	1,010,000	81%	818,100	699,312	121.64	2.03

Steamer must be level in all directions

Steam leaves boiler in heater hose. Passes to woven hose in treated bed.


Grommet holes in woven house let out more steam.



Center woven hose in center of treatment area

Tarp stretched over treatment area

Post streaming tarp pulled back. Note the chain used for hold down. We use 5/8 chain that we walk on to seal before steaming.

Steam is hot. Care must be taken when removing covers.

- Chains will be very hot. Use cloves. We reel into buckets for move to next bed.
- A blast of steam will come up when you move cover, keep face away.
- Ground can get spongy in over steamed areas. Watch footing at edge of beds.

Baby greens coming up well and weed free

Same house, still weed free and ready to harvest

Steaming turned an unprofitable house from this…

To a house that looks like this and produces numbers like…

Yield and Value of Greens 30x96 Greenhouse

- 492.8 Pounds for First Cut x $14.70/Pound = $7,247
- 394.2 Pounds for Second Cut x $14.7/Pound = $5,795
- 315.4 Pounds for Third Cut x 14.7/Pound= $4,636
- **Total Yield for House is 1202.4 Pounds Valued at $17,675**

Cost of Steaming a 30x96 Greenhouse

- 3.5 Gal Fuel/Hour x 2 Hours/Set x 14 x $2.00/Gal = $196
- $4.00/Gal = $392
- Labor = .33 Hours/Set x 7 x $17.50/Hour = $122.50
- Depreciation on Steamer $140/House
- **Total Cost of Steaming in 2019 per 30x96 House = $458.5 or 16 cents a square foot.**
- **Could Go as High as $654.5 with $4.00/Gal Fuel or about 22.7 cents a square foot.**

Contact Information

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