Solarization and use of compost in vegetable crops

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Manure is recognized:

- Source of complex nutrients
- Slow release of nutrients
- Improve soil physical properties: soil structure aeration, infiltration, bulk density
- High value of nutrient when applied close to planting date (N)
- Open market for organic production

Raw manure

Use of Animal waste

- Use of raw manure
- Compost and co-compost
- Solarization of manured soils

Manure production

- Total annual livestock waste in the US is about 2.2 billion tons of manure
- 7.5 million tons of N and 2.3 million tons of P.
- Synthetic fertilizer used annually in the US contains 10 million tons of N and 2 million tons of P (ElAhraf and Willis, 1996). If all collected and utilized, manure would provide 112, 100 LB/A N and P, respectively (Eghball and Power, 1994).
- Nutrients from manure could potentially supply an equivalent of 461 million dollars if purchased as synthetic fertilizer (ElAhraf and Willis, 1996; Eghball and Power, 1994).

Why manure is a problem today but was not 50 years ago

?

Manure problems today

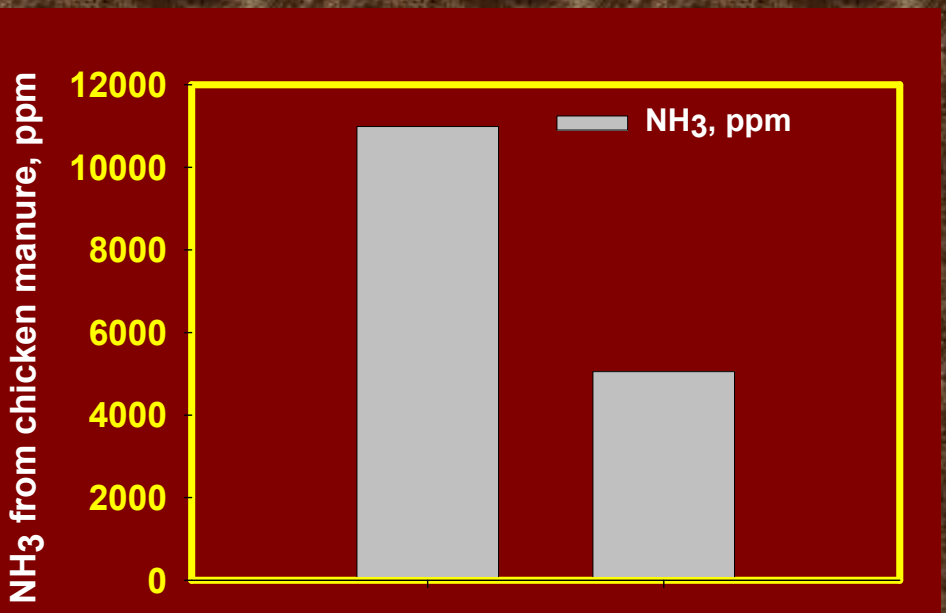
- Increasing farm and CAFO size
- while decreasing in number
- Industrialized grain and livestock operation: Without integration
  - Producers rely on commercial fertilizer: decline in soil quality
  - Feedlot operators see manure as waste management problems.: Increasing distance between CAFO and field crops:. High cost of hauling

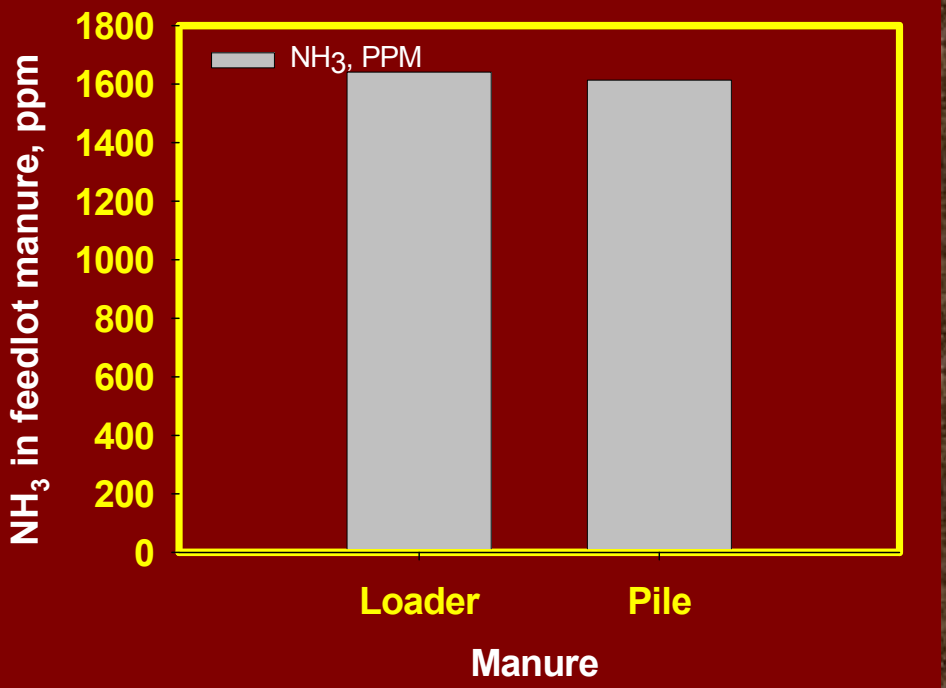
Disadvantage of manure

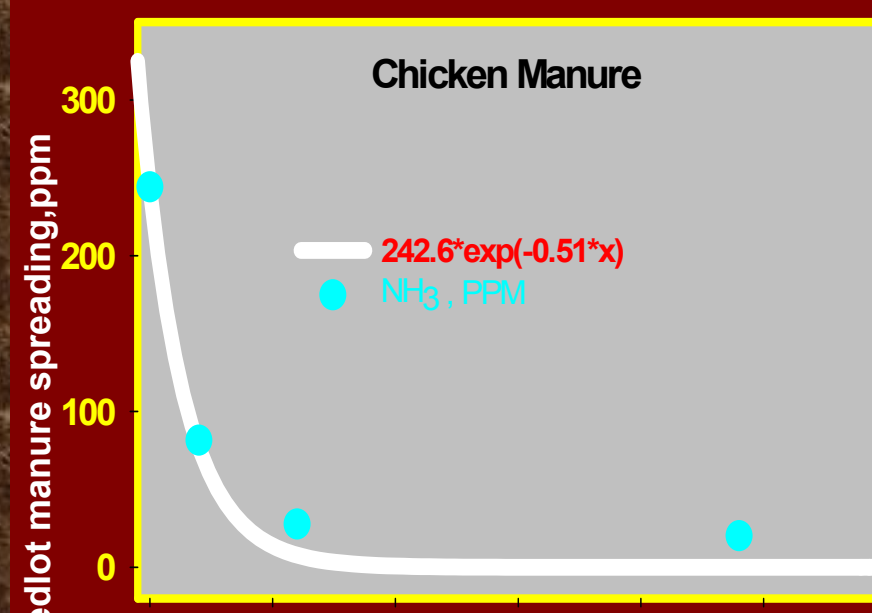
- High salt content
- High water content: (dairy), cost of hauling
- Disposed on fields near CAFO: Pollution problems
- Application uniformity: difficult to achieve
- Weed infestation
- Plant and human pathogens

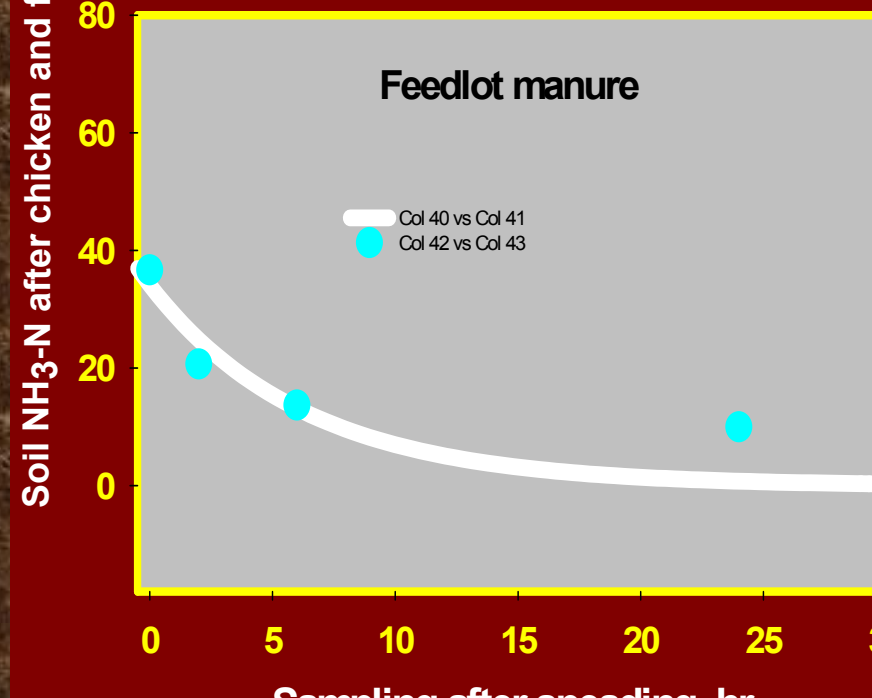
Disadvantage of raw manure (contin'd)

- Nutrient N loss when applied far from planting
- Imbalance of nutrient loading: nitrogen vs phosphorus
- Variable and unstable nutrient content
- High transport cost
- Odors: near urban areas


NH3 from chicken manure, ppm
12000
10000
8000
6000
4000
2000
0
NH3, ppm


NH3 in feedlot manure, ppm
1800
1600
1400
1200
1000
800
600
400
200
0
NH3, PPM
Loader
Pile
Manure


Chicken Manure
Soil NH3-N after chicken and feedlot manure spreading,ppm
300
200
100
0
242.6*exp(-0.51*x)
NH3 , PPM


Feedlot manure
80
60
40
20
0
Col 40 vs Col 41
Col 42 vs Col 43
0
5
10
15
20
25

Composting

Composting

- Hot and arid climate and manure handling practices in Southwest are adequate to control the risks from pathogens and weed seed that may be in manure
- Although composting manure induces additional handling cost, thermophilic composting improves manure stability, suppresses pathogen and weed seed viability
- Agronomic benefits of fresh or composted manure application on crop yield, and on soil quality as measured by physical and chemical properties, are significant.

Composting and Co-composting

- Pathogen and weed destruction
- Easier to apply
- Nutrient stability
- Increase C:N ratio: adding C source
  - C: fuel to microorganisms
  - N: protein for microorganism to thrive
  - Reduction of salt: dilution with residue


PRECISION
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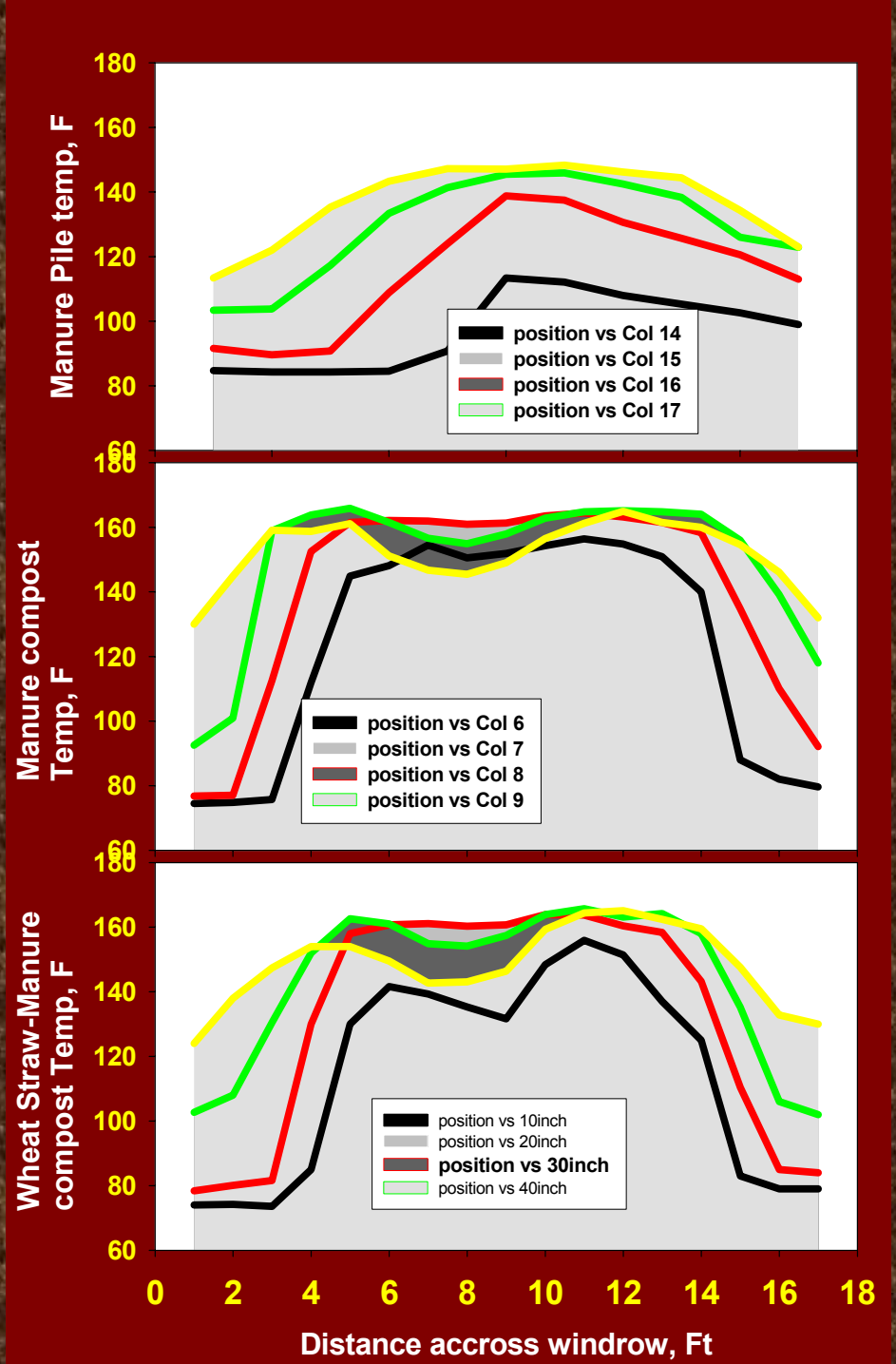
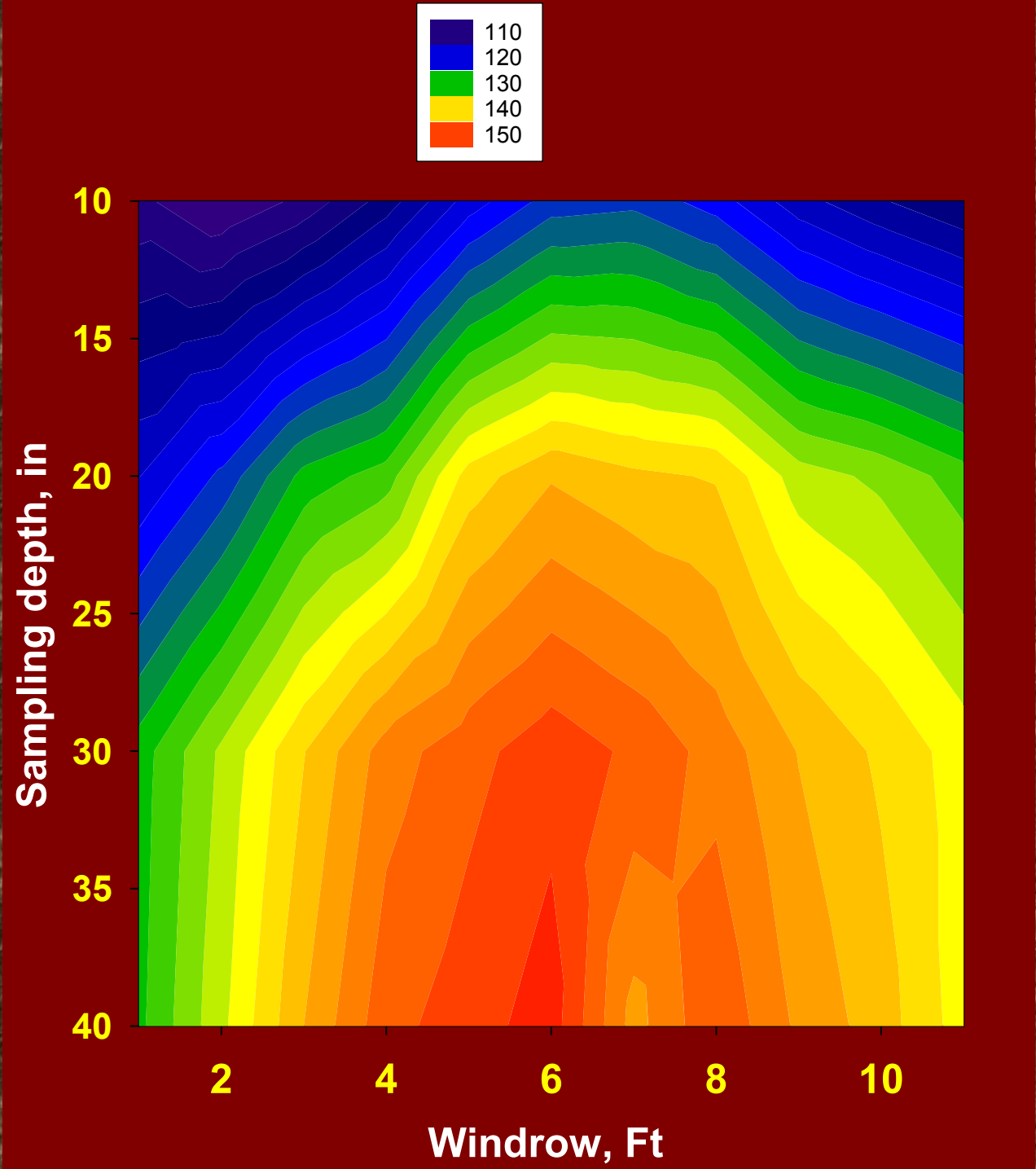
Mixing: NH_3 volatilization


Manure Pile temp, F
180
160
140
120
100
80
60
position vs Col 14
position vs Col 15
position vs Col 16
position vs Col 17
Manure compost Temp, F
180
160
140
120
100
80
60
position vs Col 6
position vs Col 7
position vs Col 8
position vs Col 9
Wheat Straw-Manure compost Temp, F
180
160
140
120
100
80
60
position vs 10inch
position vs 20inch
position vs 30inch
position vs 40inch
0
2
4
6
8
10
12
14
16
18
Distance accross windrow, Ft


110
120
130
140
150
10
15
20
25
30
35
40
Sampling depth, in
2
4
6
8
10
Windrow, Ft

Weeds tested

- Canary grass
- Ivy (morning glory)
- Lambsquarter
- Wild mustard
- Velvet
- Sorghum
- Ray grass

Seed viability

- After 14 days only Ivy appeared to survive the heat inside the windrow. After one months no seed remained viable in the windrow at 30 inch.
- This investigation is still in progress, Seed buried at 15 inch the wheat and manure compost and non composted manure will be tested.

Compost: an alternative to raw manure

- Better amendment quality
- Environmental sustainability
- Requires time and money
- Requires investment machinery
- Need economic study

Pathogen and weeds

- Less than 1% of weed seeds found in composted manure
- Less than 10 MPN /gram in E coli bacteria

Solarization

Solarization

- Solarization is a non chemical pre-planting soil treatment used successfully to control pathogens and weeds.
- It is a hydrothermal process combining moist soil and clear plastic tarps allowing a direct sunlight during hot summers to raise temperature enough to suppress weeds and pathogens underneath clear plastic.
- It is anticipated that temperatures under plastic tarps will be elevated as high as 150 F, enough to destroy weed seed and soil born pathogen viability.

Solarization

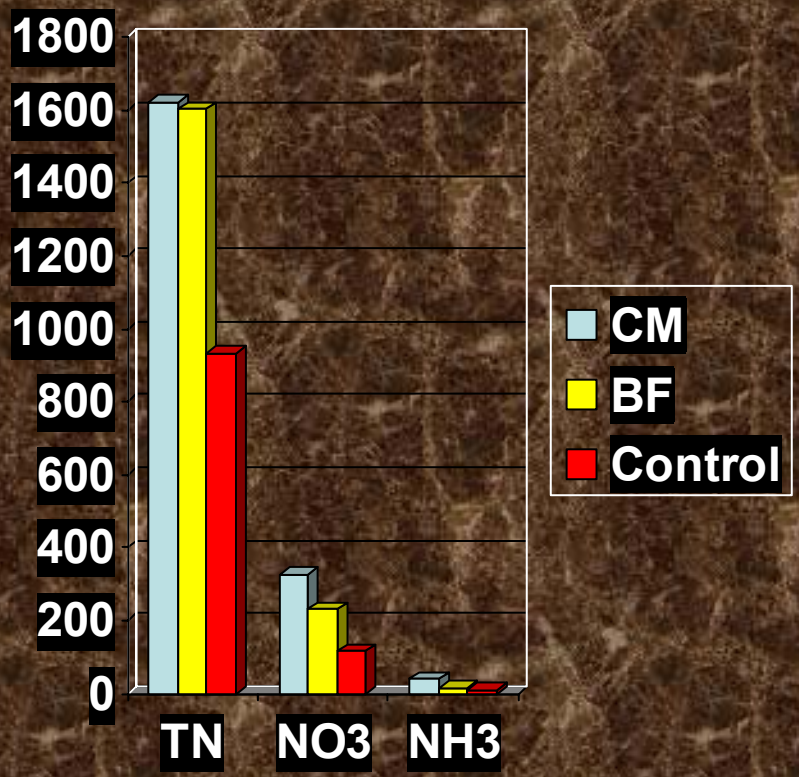
- 10 t/A beef cattle manure and 3 t/A chicken applied 10-3-03 on two 84 inch beds, mixed to 3 inch top soil and control, covered with VIF on 10-4, 03
- Subsurface irrigated (drip) until beds were sufficiently wet. No additional irrigation afterward

Materials and Methods

- Clear plastic VIF was laid prior irrigation

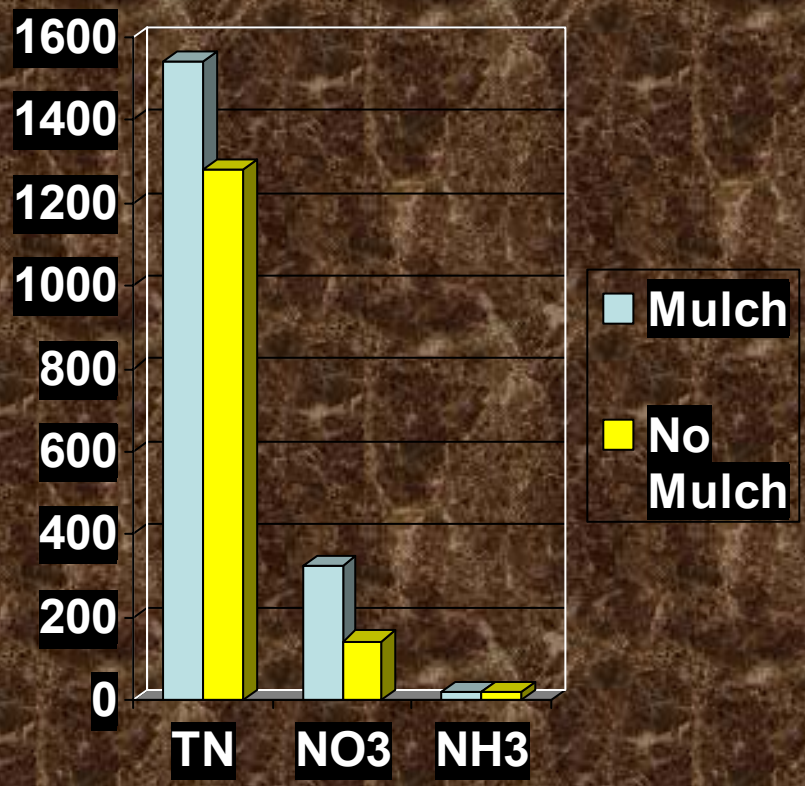
Results

- Manure treatments averaged over mulch:
  - Chicken and Beef manure trt were
  - high but equal in TN
  - High but significantly different in NO3
  - Both low in NH3



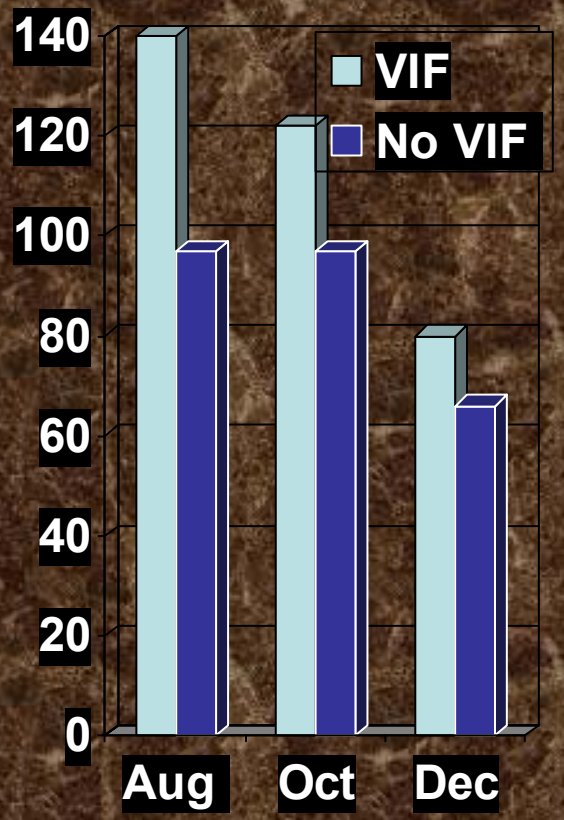
Results

- Mulch averaged over manure treatments
  - TN and NO3 were significantly higher under mulch
  - Effect of mulch on NO3 accumulation

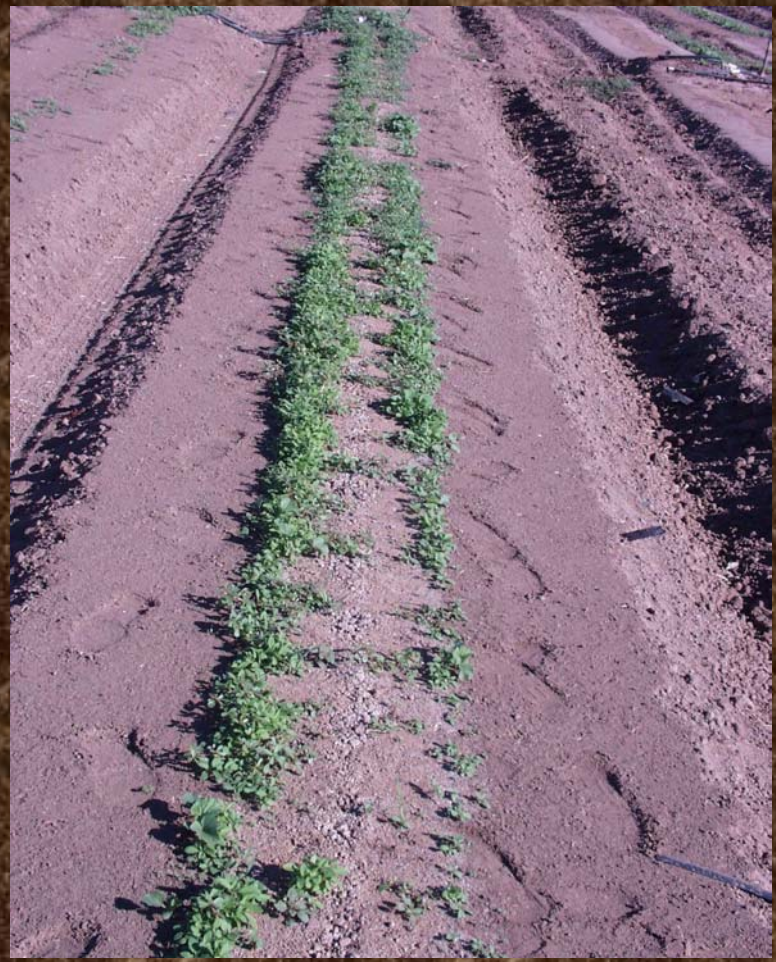


Soil moisture and temperature

- Soil moisture 6% no mulch
- Soil moisture 20% mulch
- 10-14-03:




Drip Tape Buried at
4 inc
No tarp



Materials and Methods Cont'd

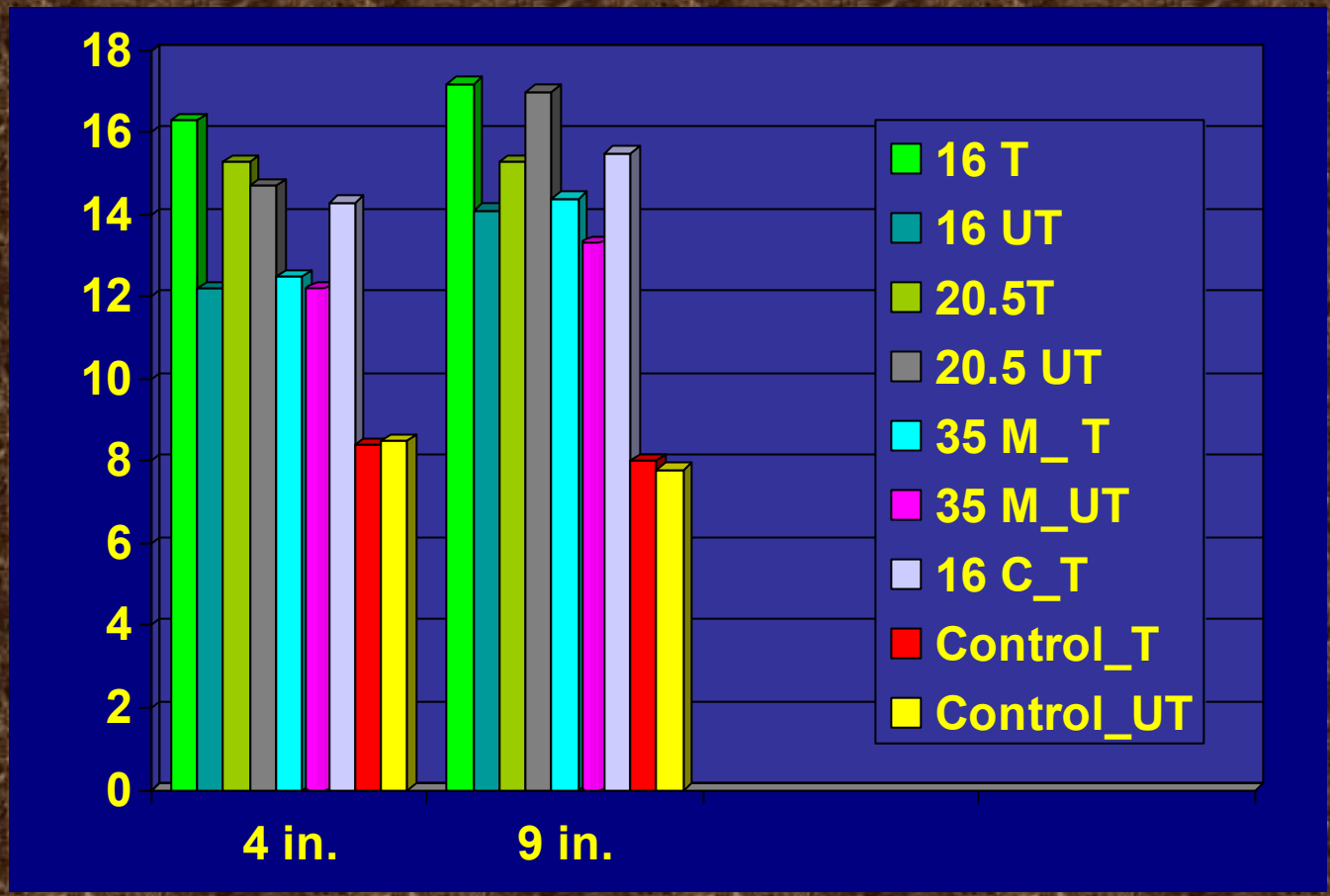
- Inline Chloropicrin applied at 16, 20.5 gal/A
  - Tarp and no tarp
- Chloropicrin applied under tarp
- Metam applied at 35 gal/A
  - under tarp and no tarp
- Control
  - tarp and no tarp

All trt applied in 35 gal. Water thru. ventury

Material and Methods

- 84 inc-bed
- Drip tape placed at 4, and 9 inch for subsurface treatment

Yield, kg


18
16
14
12
10
8
6
4
2
0
4 in.
9 in.
16 T
16 UT
20.5T
20.5 UT
35 M_ T
35 M_UT
16 C_T
Control_T
Control_UT

Conclusion

- Although composting manure induces additional handling cost, thermophilic composting improves manure stability, suppresses pathogen and weed seed viability
- Composting induces NH_3 via volatilization
- Agronomic benefits of fresh or composted manure application on crop yield, and on soil quality as measured by physical and chemical properties, are significant.

Conclusion continued

- *Significant* increase in temperature due to the use of VIF
- Significant N loss reduction when VIF is used on manured soils
- These results are preliminary, further study is needed
- Solarization is often combined with fumigation treatments to increase the efficacy
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Thank you