Application of Animal Manure/Compost in an Irrigated Alfalfa Production System

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The Problem

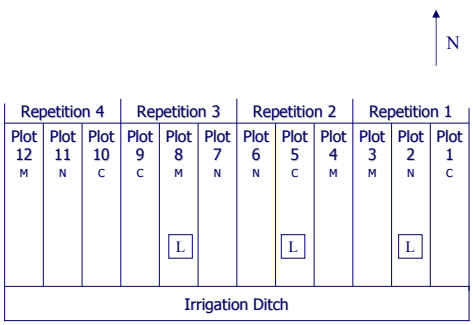
- The recently enacted ruling (Unified National Animal Feeding Operation Strategy) set restrictions on the application of animal waste on agricultural lands by CAFOs.
- The ruling calls for a balance between the amount of nutrients added by the manure and the amount used by the plants and held by the soil.

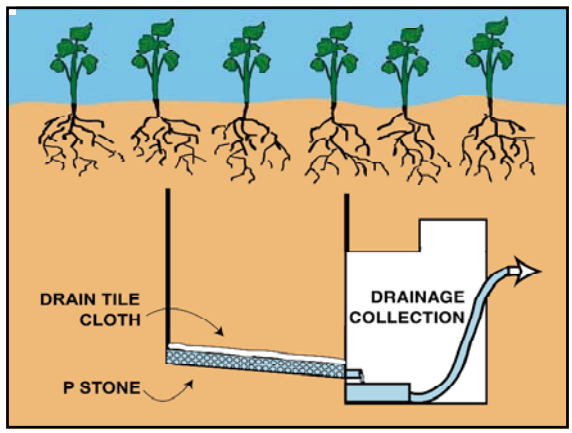
The Problem

- In essence, a CAFO owner cannot apply animal waste in excess of the expected plant uptake and the soil's ability to hold the nutrients in the animal waste applied.
  - The nutrients chosen for limiting animal waste applications were nitrogen and phosphorus – each state could determine which nutrient would be the limiting nutrient.

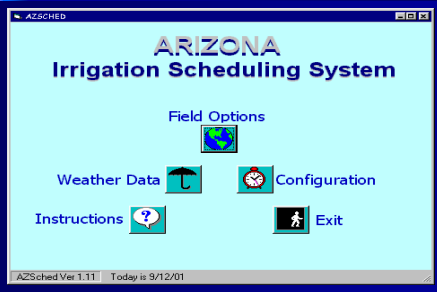
The Objective

- In Arizona, nitrogen was considered to be the limiting nutrient since surface water is not prevalent.
- The objective was to use manure/compost in an alfalfa production system and assess whether there was nitrogen build-up in the soil.

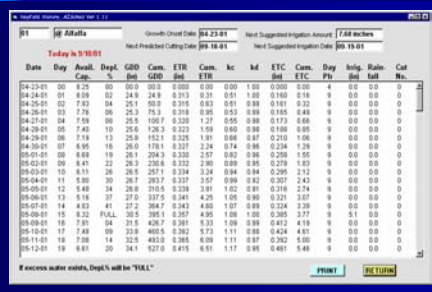




Irrigation - AZSCHED



AZSCHED



Procedures

- Alfalfa was harvested
- Yield was determined
- Harvest was analyzed for nitrogen removed
- Manure and compost were analyzed for nitrogen
- Manure and compost were added in an amount equal to the nitrogen removed by the cutting

Digestion

Total nitrogen in the alfalfa was determined from a Kjeldahl digestion that converted the organic nitrogen to ammonium.

Addition of Manure and Compost

- Manure and compost were added, using a spreader, in the amount determined to be removed in the harvest.
- Nitrogen concentration was determined by Kjeldahl digestion and KCl extract.

Nitrogen Analysis

- Ammonium – KCl extract
- Nitrate – KCl extract
- Organic Nitrogen – TKN minus ammonium
- Total Nitrogen – TKN plus nitrate

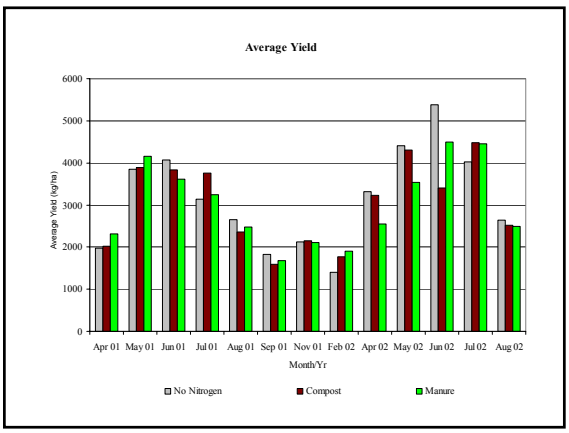
Procedures

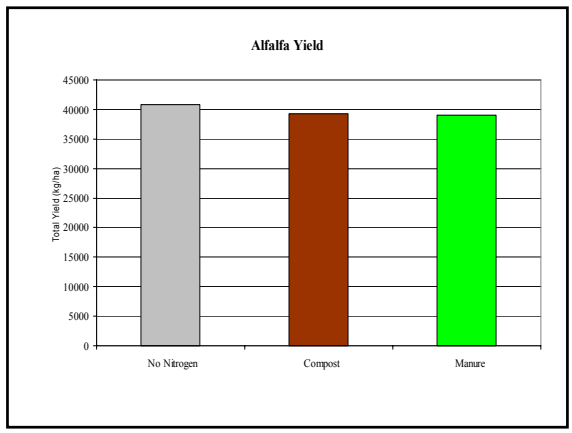
- Drainage was analyzed for nitrogen and phosphorous.
- Soil samples were analyzed for nitrogen, phosphorous, and electrical conductivity.

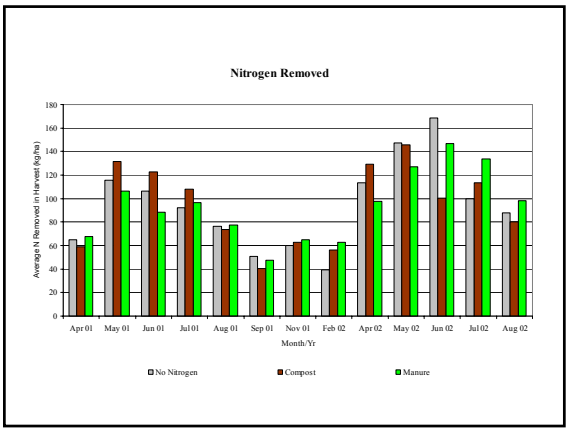
RESULTS

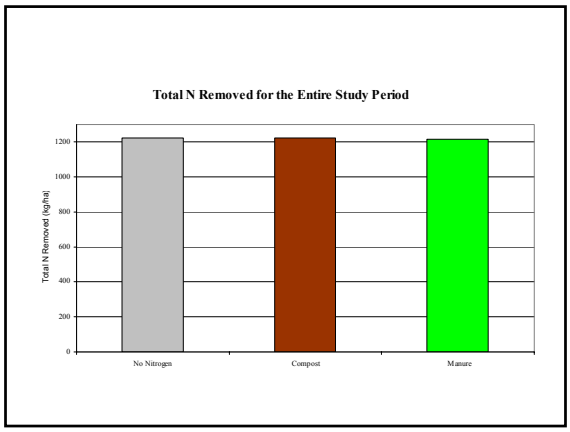
Alfalfa Yield and Nitrogen Composition

- Total yield did not vary between treatments.
- Nitrogen removed in alfalfa harvest did not vary between treatments.







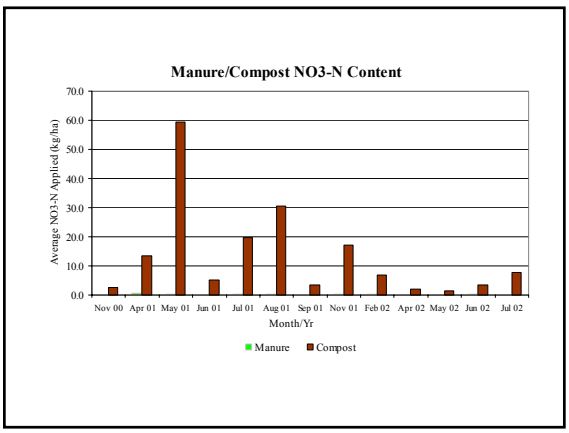


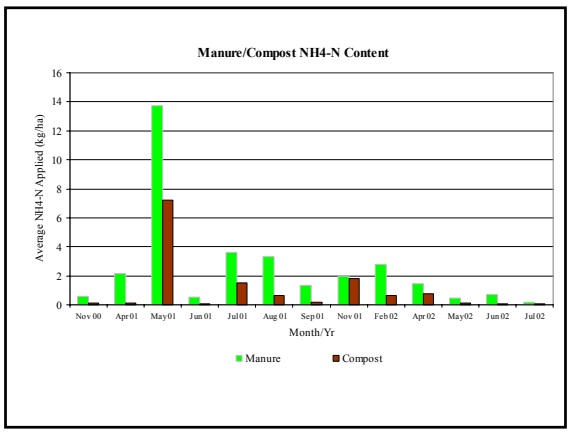
Manure and Compost Composition

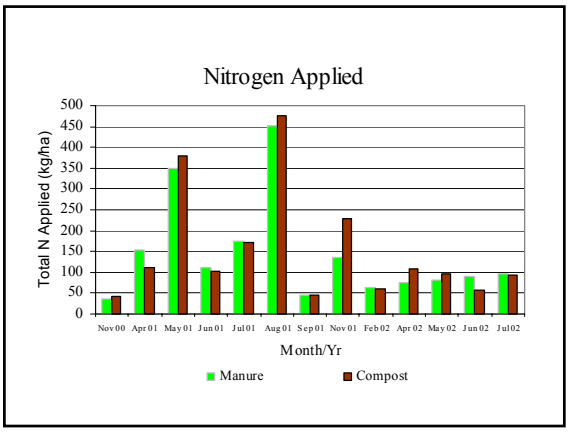
- More ammonium was applied to the manure plots.
- More nitrate was applied to the compost plots.
- About equal amounts of total nitrogen was applied to all treatment plots.

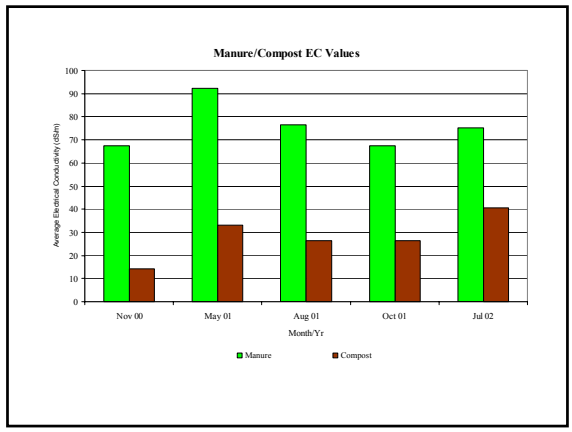
Manure and Compost Composition

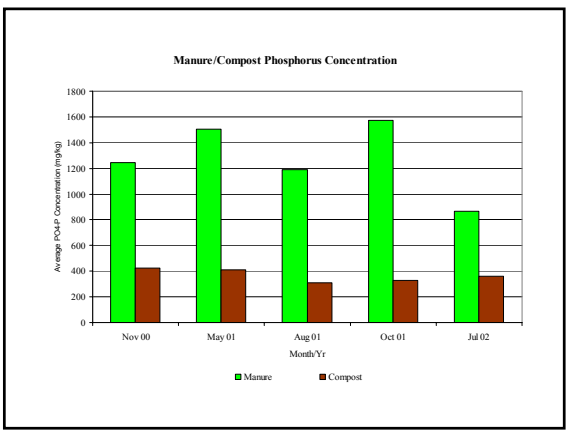
- More phosphorous was applied to manure plots.
- More total dissolved solids were applied to manure plots.









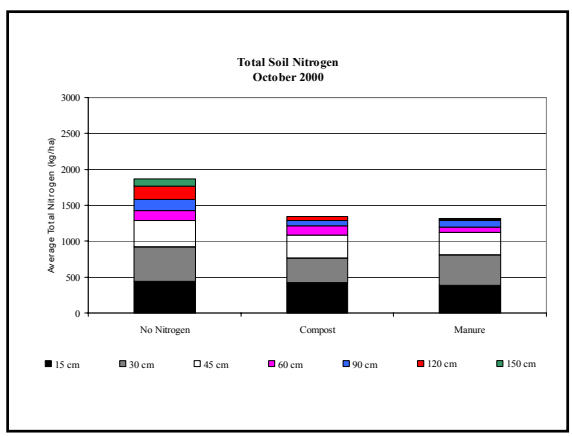


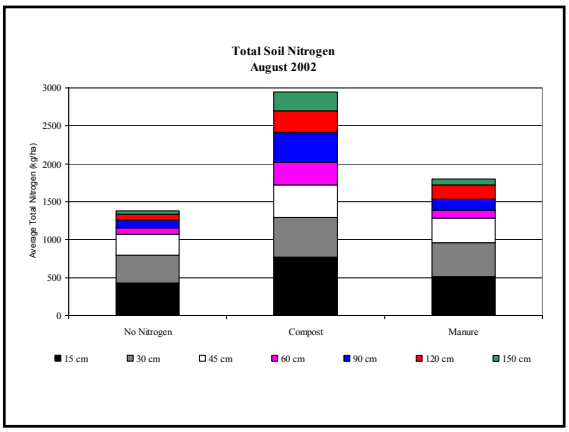
Soil Composition

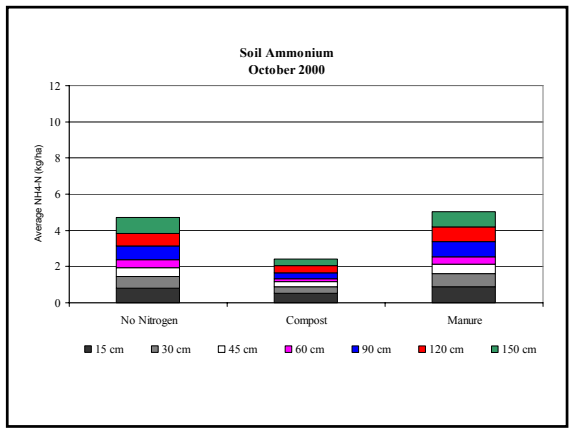
- Compost plots were higher in total nitrogen.
- All plots were similar in ammonium.
- Manure and compost plots were higher in nitrate.

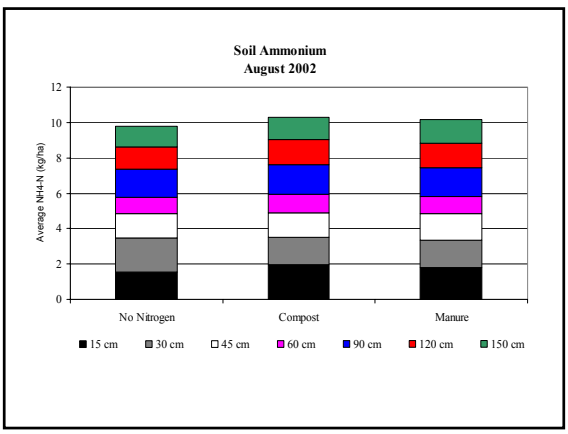
Soil Composition

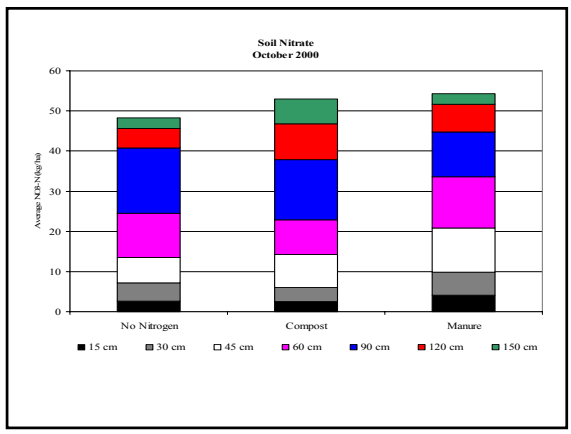
- Manure and compost plots were higher in phosphorus.
- All plots were similar in electrical conductivity.

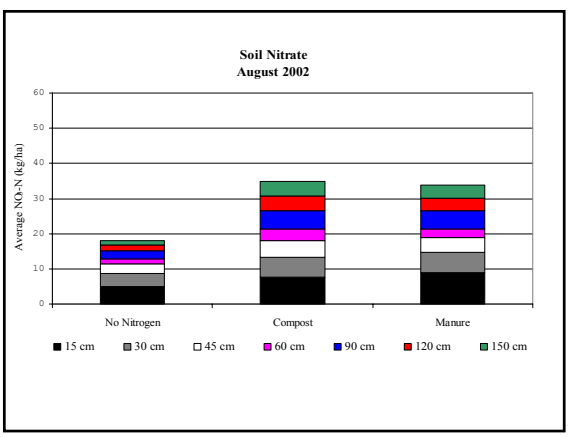


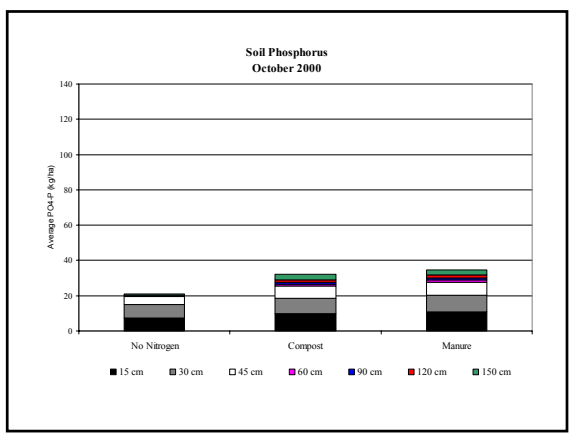

Total Soil Nitrogen
August 2002
Average Total Nitrogen (kg/ha)
3000
2500
2000
1500
1000
500
0
No Nitrogen
Compost
Manure
15 cm
30 cm
45 cm
60 cm
90 cm
120 cm
150 cm

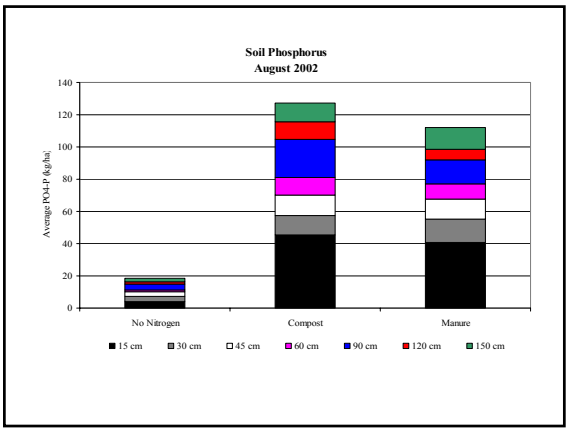

Soil Ammonium
October 2000
Average NH4-N (kg/ha)
12
10
8
6
4
2
0
No Nitrogen
Compost
Manure
15 cm
30 cm
45 cm
60 cm
90 cm
120 cm
150 cm

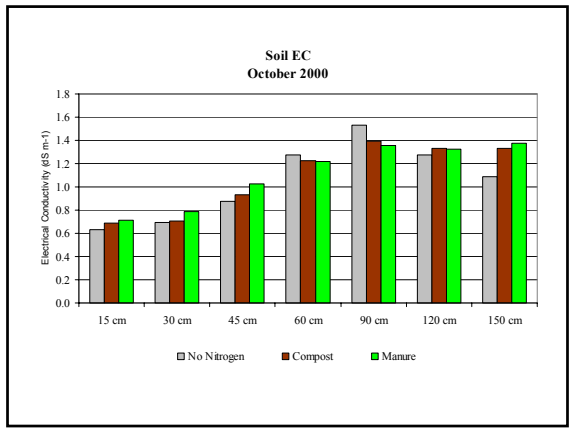

Soil Ammonium
August 2002
Average NH4-N (kg/ha)
12
10
8
6
4
2
0
No Nitrogen
Compost
Manure
15 cm
30 cm
45 cm
60 cm
90 cm
120 cm
150 cm

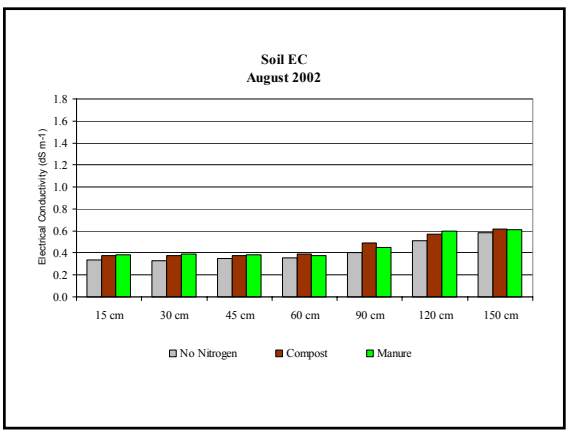

Soil Nitrate
October 2000
60
50
40
30
20
10
0
No Nitrogen
Compost
Manure
15 cm
30 cm
45 cm
60 cm
90 cm
120 cm
150 cm


Soil Nitrate
August 2002
Average NO3-N (kg/ha)
60
50
40
30
20
10
0
No Nitrogen
Compost
Manure
15 cm
30 cm
45 cm
60 cm
90 cm
120 cm
150 cm


Soil Phosphorus
October 2000
Average PO4-P (kg/ha)
140
120
100
80
60
40
20
0
No Nitrogen
Compost
Manure
15 cm
30 cm
45 cm
60 cm
90 cm
120 cm
150 cm







Lysimeter Results

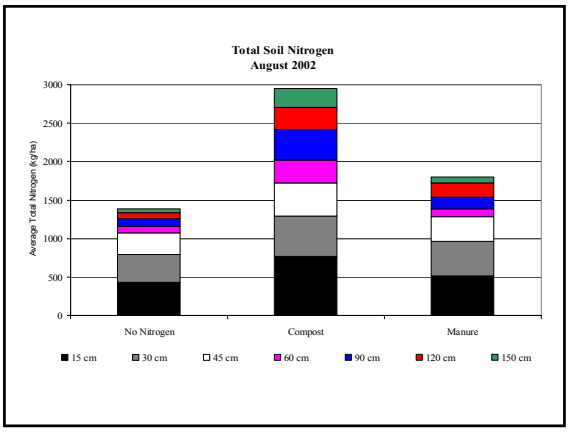
- **Little drainage was obtained during the study.**
- **No detectable nitrate or phosphate was found in the drainage water.**

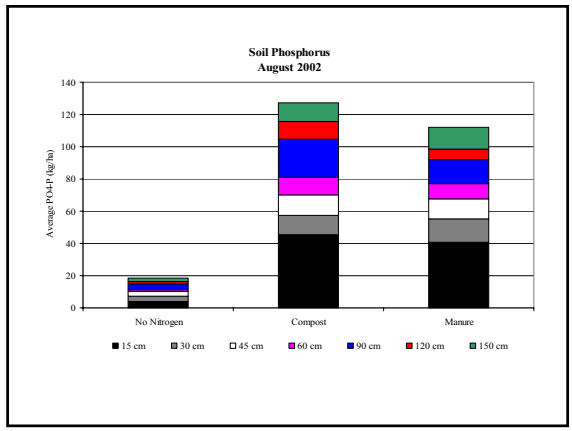
Conclusions

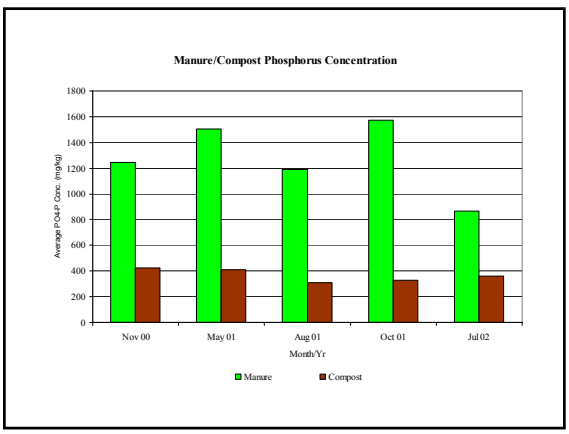
- All treatments had the same yield and N concentrations – Thus the addition of the manure/compost had no effect.
- Although not statistically significant – the no nitrogen treatment had a slightly higher yield, probably due to less surface traffic.

Conclusions

- Nitrogen mass balance showed that a substantial amount of nitrogen in the manure plots were unaccounted for.
- Even the phosphorus readings were low for the manure treatment.







Manure Discrepancies

- The low values for nitrogen and phosphorus in the soil manure plots suggests that manure was lost somehow.
- Reports from the farm manager indicated that the hay was “dirty” and “not salable” because of the manure chunks in the bales.

Manure Discrepancies

- One theory was that the manure was physically removed from the plots, thus causing lower than expected values.
- The other is that the manure is still there and sitting on the surface.

Long-term Projections

- Nitrogen increases in the treated plots may threaten groundwater quality
- Phosphorous increase may threaten environmental quality

Questions?