On-farm Organic Strawberry Trials in Santa Cruz and Monterey Counties

Organic Strawberry Production Grower Meeting

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Outline

I. A 5-year organic strawberry/vegetable rotation trial in Monterey County

II. N fertility trials in organic strawberries in Santa Cruz County

Challenge 1: Fertility Management to Optimize Fertility Input Use.

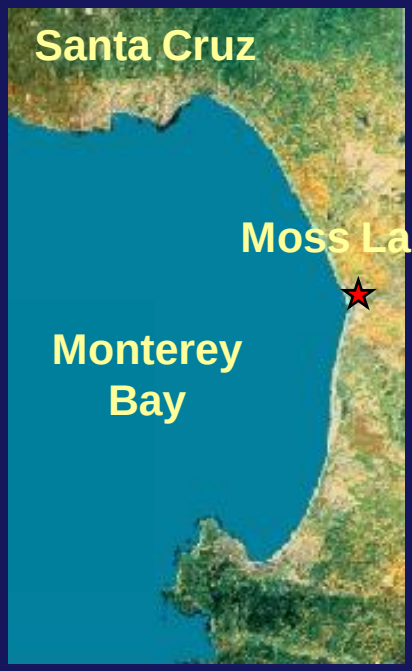
- Lack of information equivalent to best management practices developed for conventional systems.
- Compost and cover crops are often inadequate to fulfill the late N demand of long-season crops.
- Many organic strawberry and vegetable growers have intensified their use of relatively soluble organic fertilizers-"High input organic agriculture" (ATTRA*, 2003). * USDA supported program for sustainable agriculture.
- Few studies on nutrient budget and nitrate leaching from organic row crop farms.

Challenge 2: Soil-Borne Disease Management without Use of Chemical Fumigants.

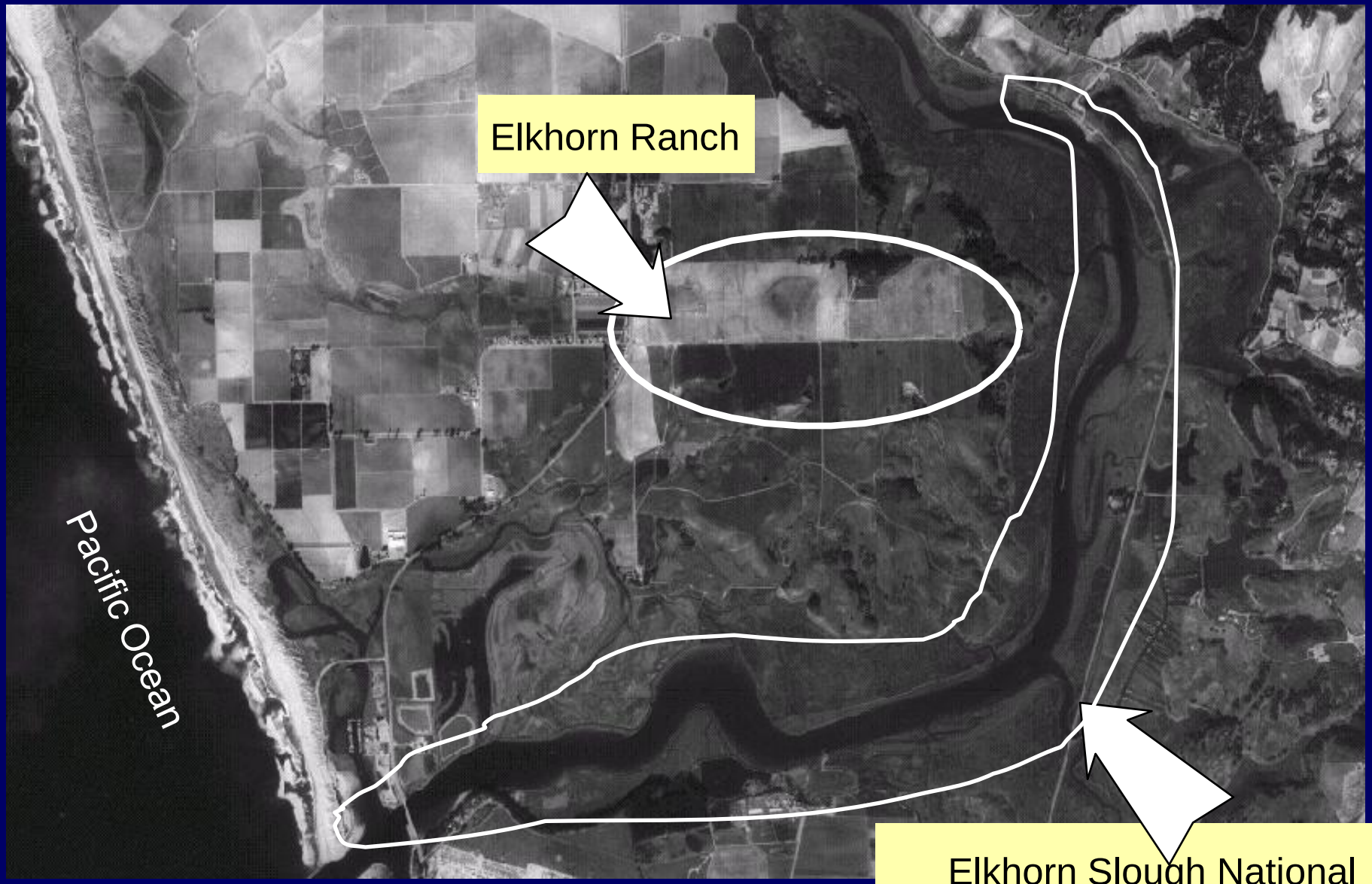
- **Verticillium wilt caused by *Verticillium dahliae*.**
  - A wide range of host crops including lettuce, tomatoes, potatoes, cauliflower, artichokes, apple, cotton, and strawberries.

  - **Resilient overwintering structures**
  - can survive for several years without host plants.
  - **Requires rotating land out of host crops for 5 years or more.**

Elkhorn Ranch Project

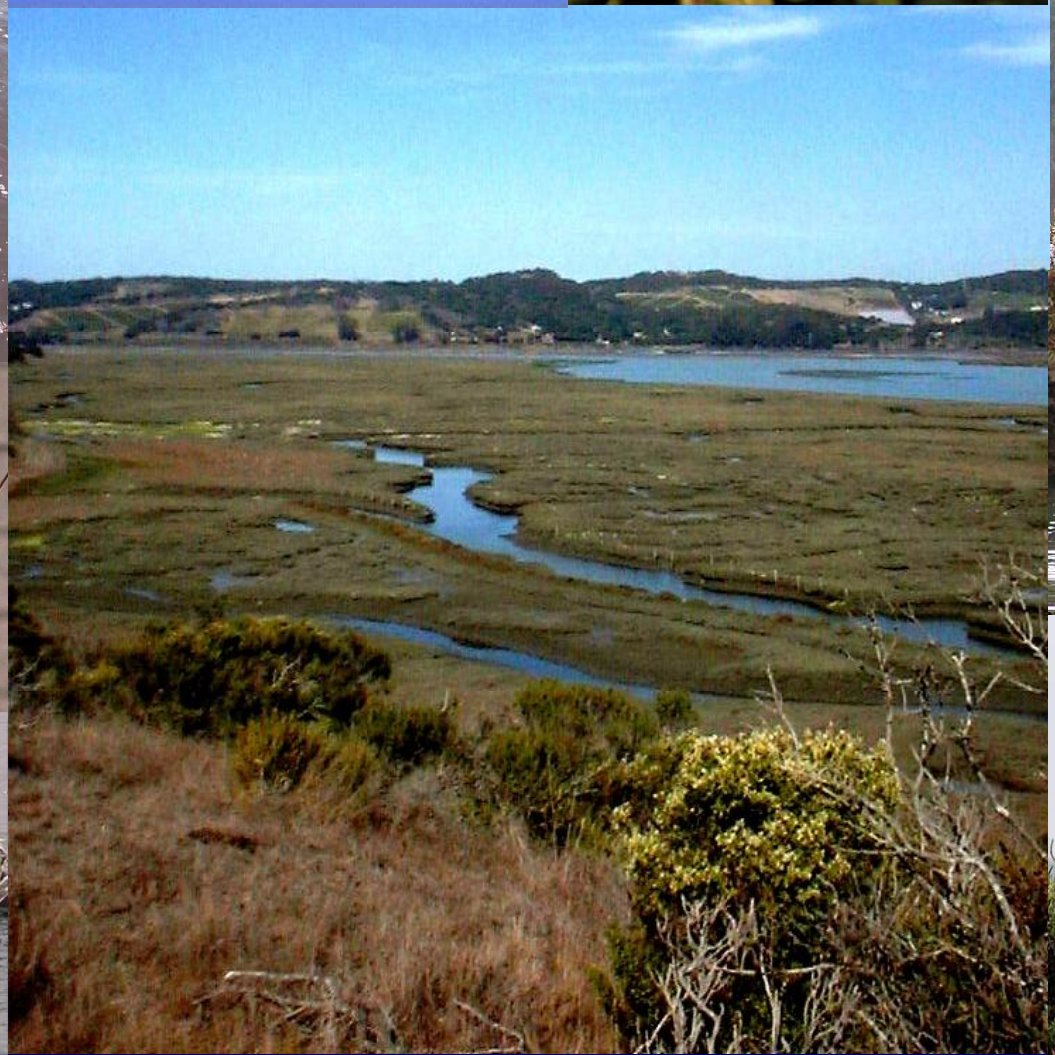


- Elkhorn Ranch.
  - Moss Landing, CA.
  - 120 acres of certified organic fields.
  - Adjacent to Elkhorn slough national estuarine research reserve.
- Grower & the landowner proposed the project and instigated the collaboration.
- A systems approach by multi-disciplinary researchers.
  - Agroecologists, plant pathologists, soil scientist, entomologist, ag-economist


Elkhorn Ranch
Pacific Ocean
Elkhorn Slough National
Estuarine Research Reserve
1 km







Goal

To demonstrate effects of diverse organic strawberry/vegetable rotations and integrated ecological practices on agroecosystem health.

Integrating Ecological Practices

- Compost application.
- Biofumigation with mustard cover crop and broccoli residues.
- Crop rotation with vegetables that do not host *Verticillium dahliae.*
- Use of relatively resistant strawberry cultivar.

Integrated

On-Farm Rotation Experiment

- Randomized block design with four replicates.
  - 5 year rotation study (2001-2006).
  - Main plot (n=5): number of years between strawberry crops.
  - Split plot (n=2): strawberry cultivar.
  - Plot size: 91.3m^2 x 20 plots.
  - Total area: 0.19 ha.

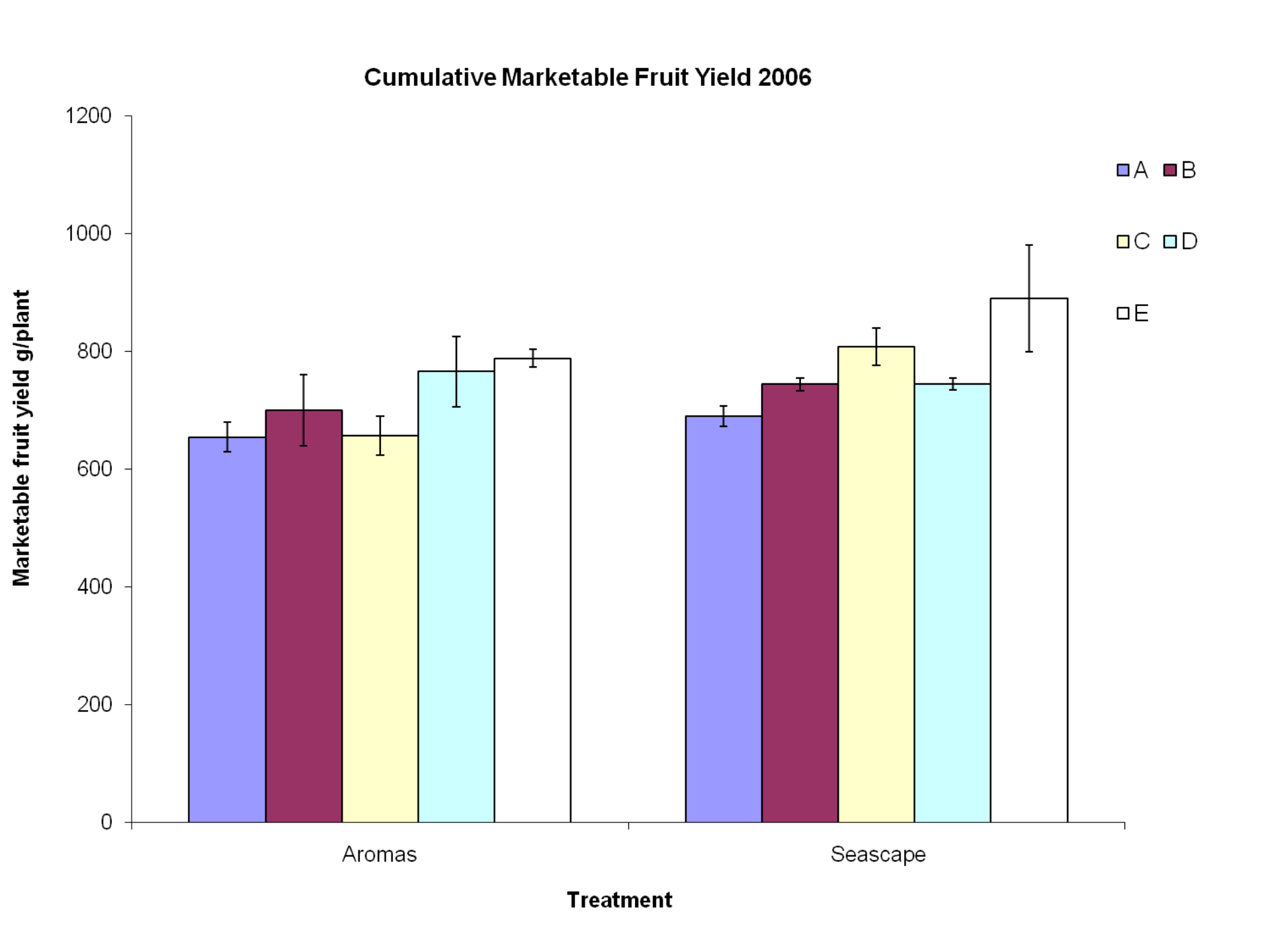
Main Treatment of the Rotation Experiment

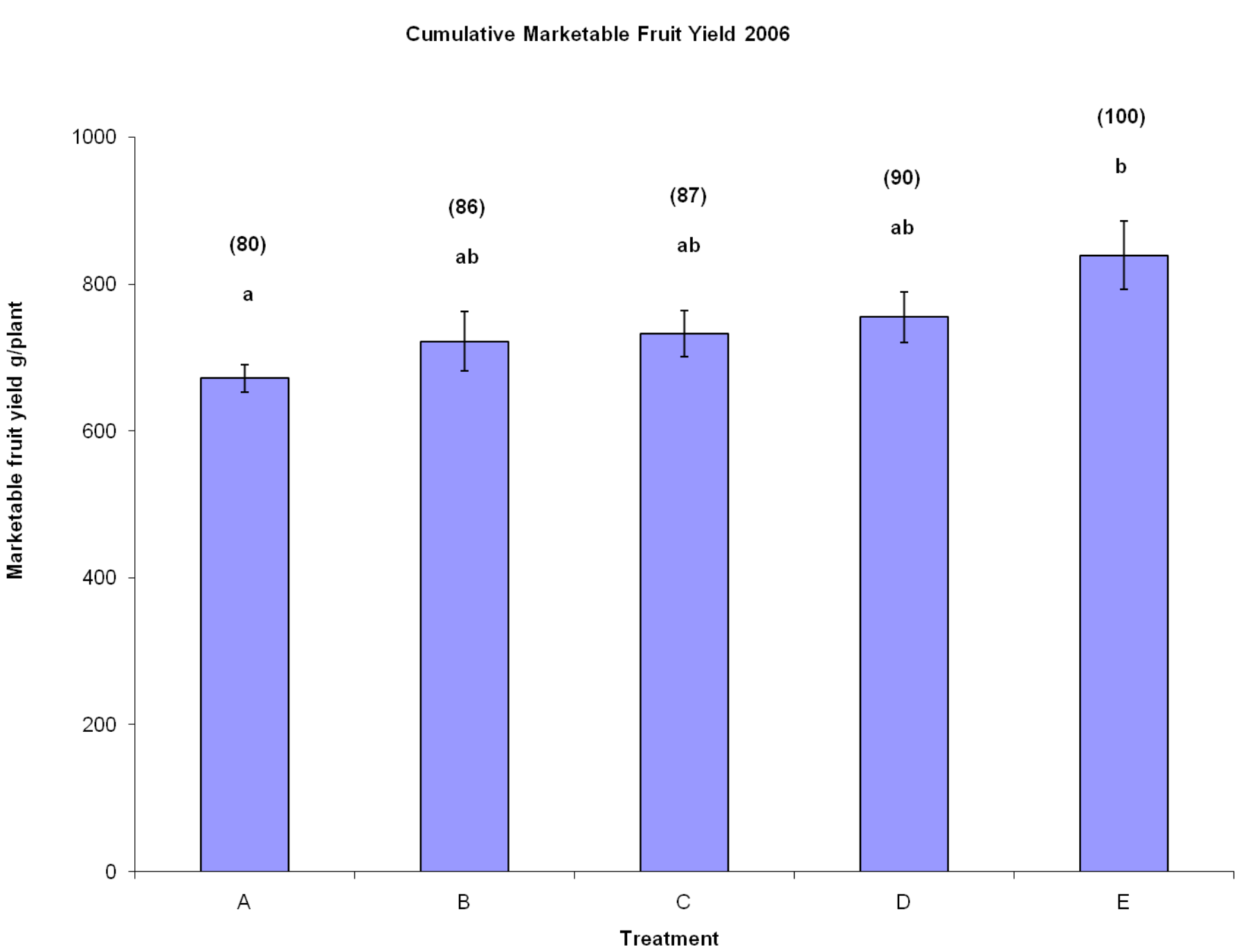
Treatment	Year 1	Year 2	Year 3	Year 4	Year 5
A (0 yr.*+ br.res.)	**st**	**st**	**st**	**st**	**st**
B (1 yr.*)	**st**	cc-vegs	**st**	cc-vegs	**st**
C (2 yrs.*)	cc-vegs	**st**	cc-vegs	cc-vegs	**st**
D (3 yrs.*)	**st**	cc-vegs	cc-vegs	cc-vegs	**st**
E (Control)	cc-vegs	cc-vegs	cc-vegs	cc-vegs	**st**

Number of years between strawberry crops.
br.res.: applying broccoli residues before planting strawberries.
cc-vegs: cover crops and vegetables (spinach and broccoli).
st: strawberries.

Soil Characteristics

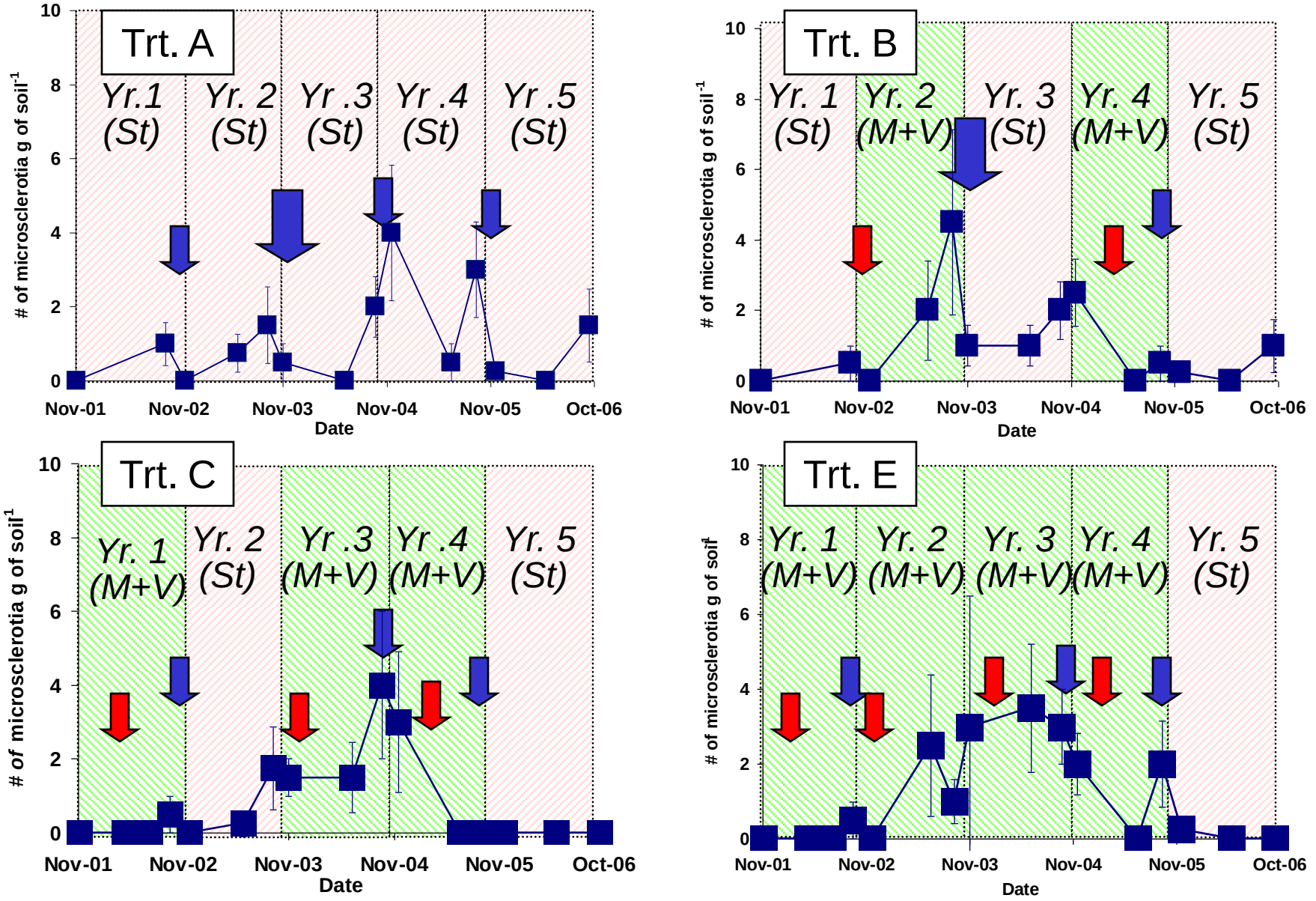
- Soil type: *Santa Ynez fine sandy loam, 2 to 9 percent slopes (fine, montmorillonitic, thermic Ultic Palexerolls)* with low SOM content (~1 %) in the topsoil.
- Thick claypan below ~40cm from the surface. – Low leaching potential.
- Very few *Verticillium dahliae* propagules in the topsoil….residual effect of fumigation?


Cumulative Marketable Fruit Yield 2006
1200
1000
800
600
400
200
0
Marketable fruit yield g/plant
A
B
C
D
E
Aromas
Seascape
Treatment


Cumulative Marketable Fruit Yield 2006
Marketable fruit yield g/plant
1000
800
600
400
200
0
(80)
a
(86)
ab
(87)
ab
(90)
ab
(100)
b
A
B
C
D
E
Treatment

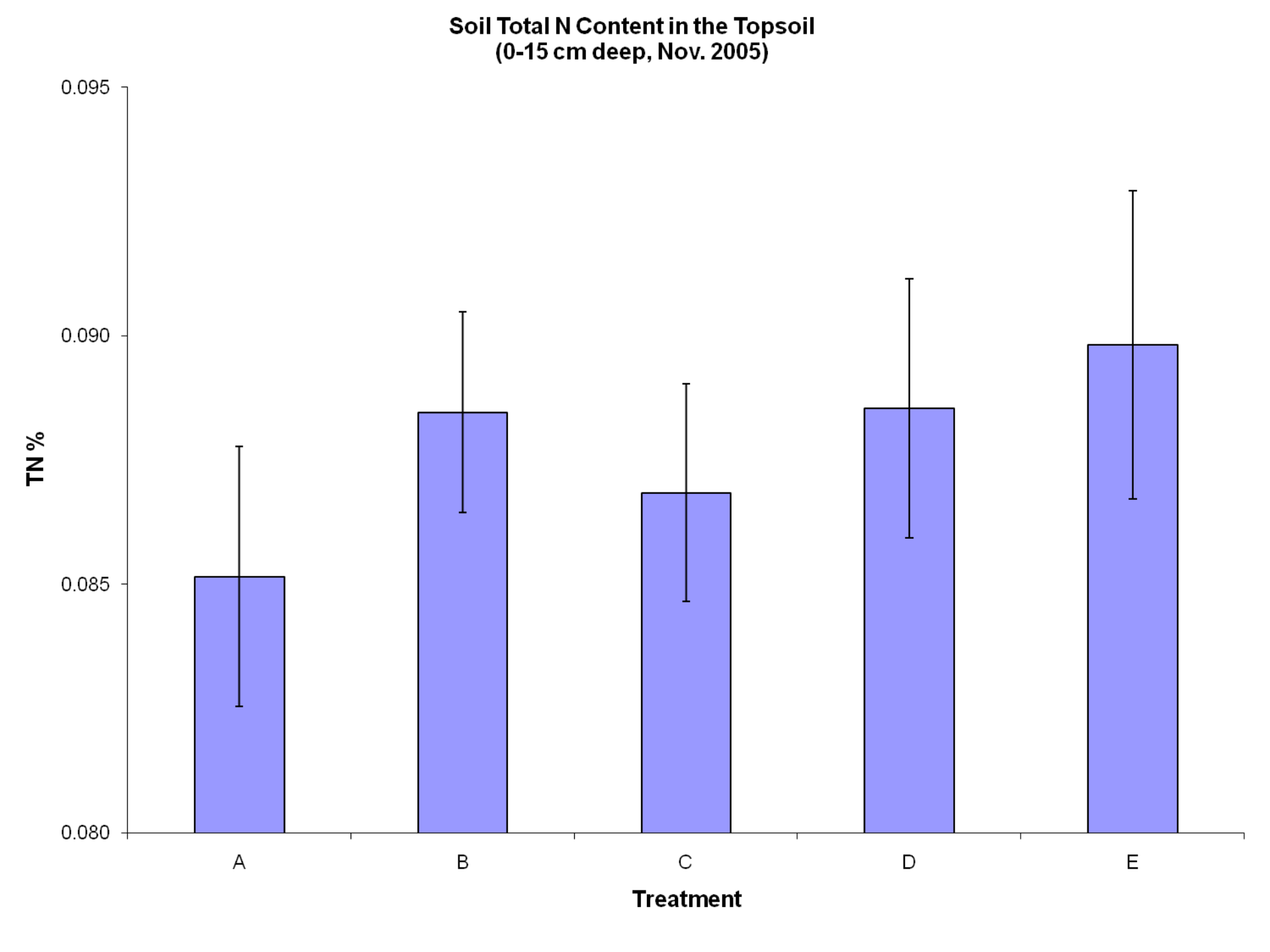
Plant Pathological Diagnosis at the End of the Fifth Year

- Regardless of treatment, no major strawberry pathogens (Phytophthora, Verticillium, Colletotrichum) were recovered from any of the samples.
- A few plants had the following fungi (all from cv. Aromas): Cylindrocarpon, Pythium, Fusarium (secondary type) --- “Sub-lethal” pathogens?
- Soil analysis by PLFA and molecular biological methods are in progress --- Difference in soil microbial communities?

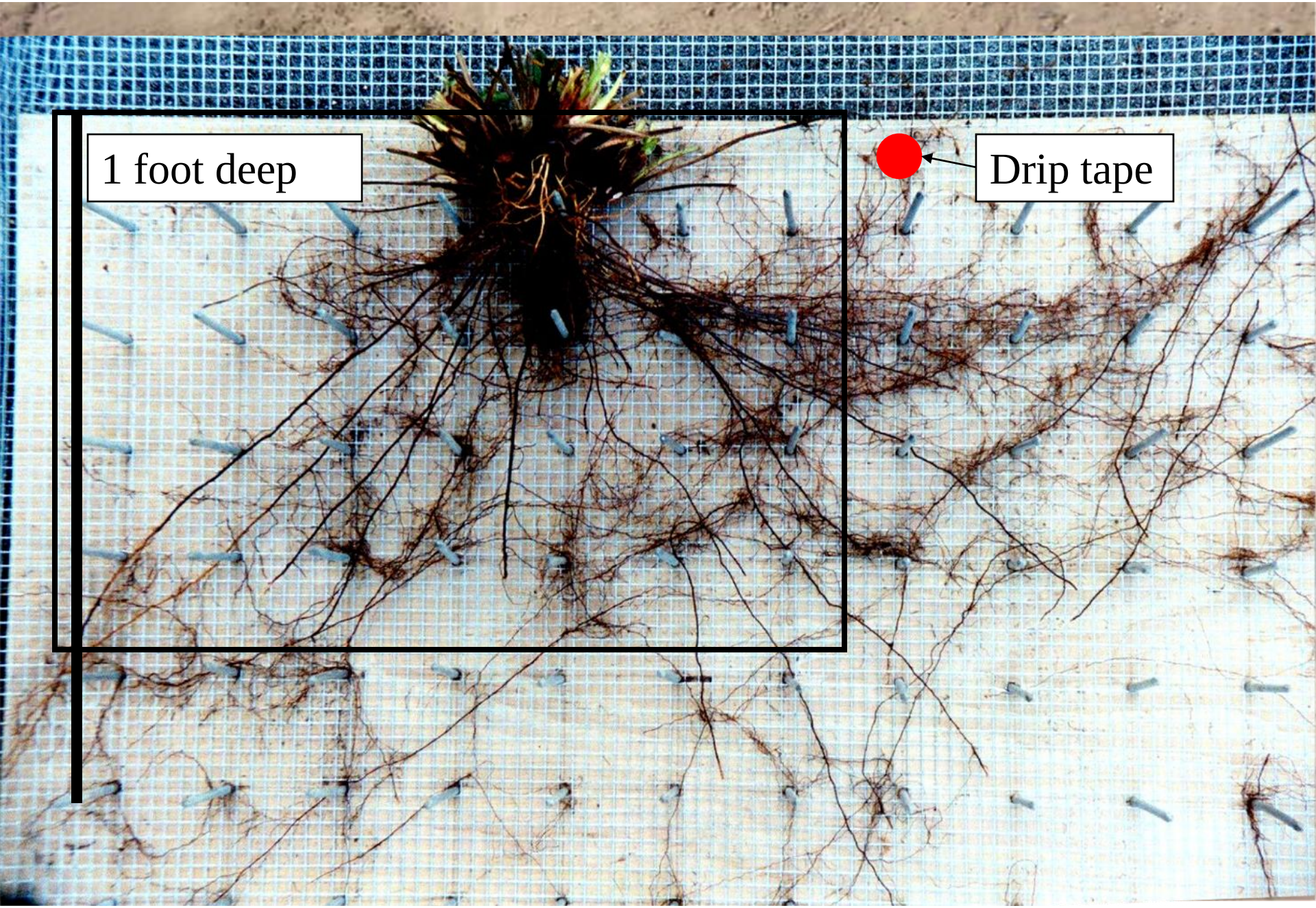


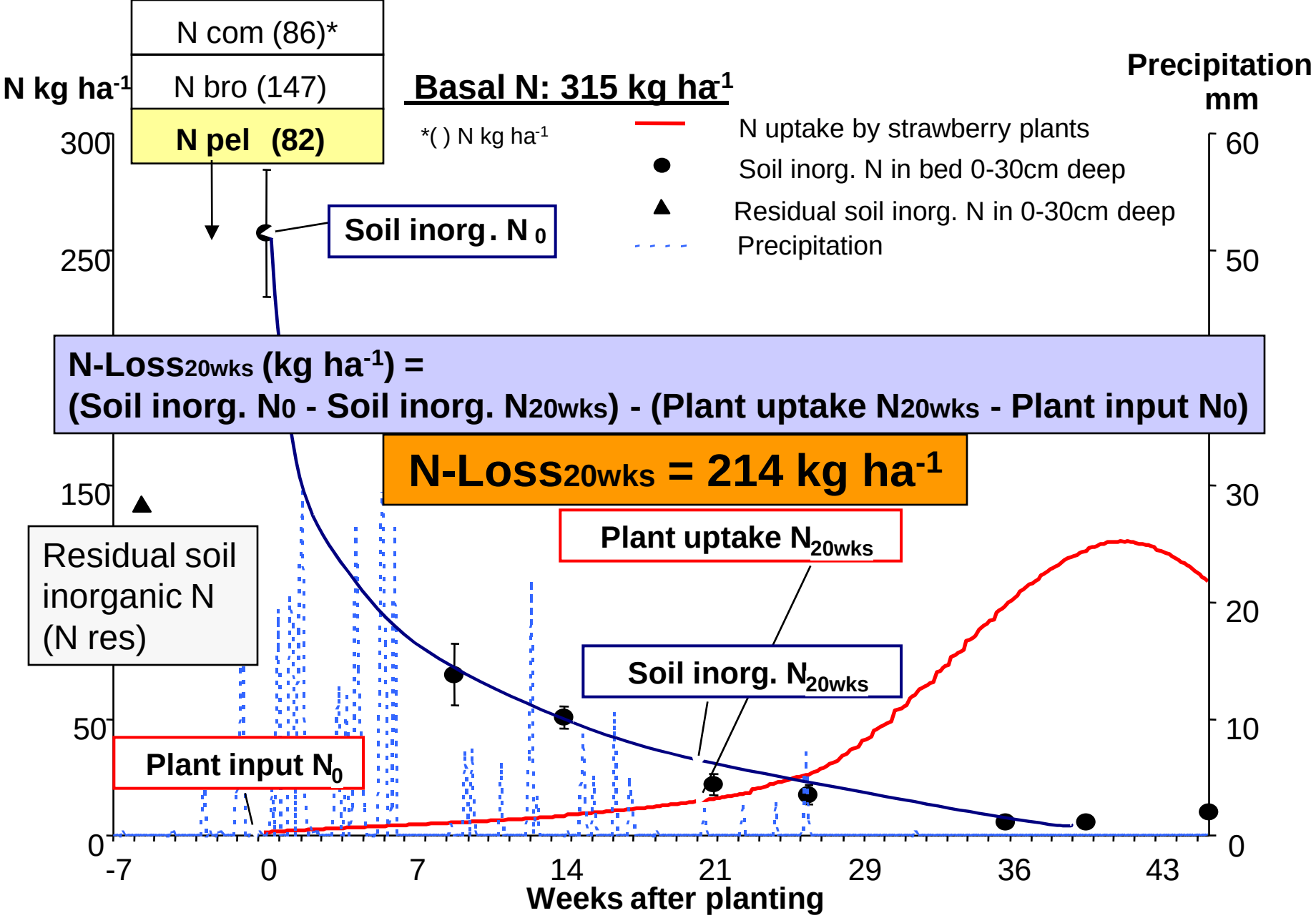
St: strawberries. *M:* mustard. *V:* vegetables.

Changes in Numbers of *Verticillium dahliae* Microsclerotia in Soils in Different Treatments. The mean ± SEM. ↓Broccoli residues or ↓mustard incorporation.

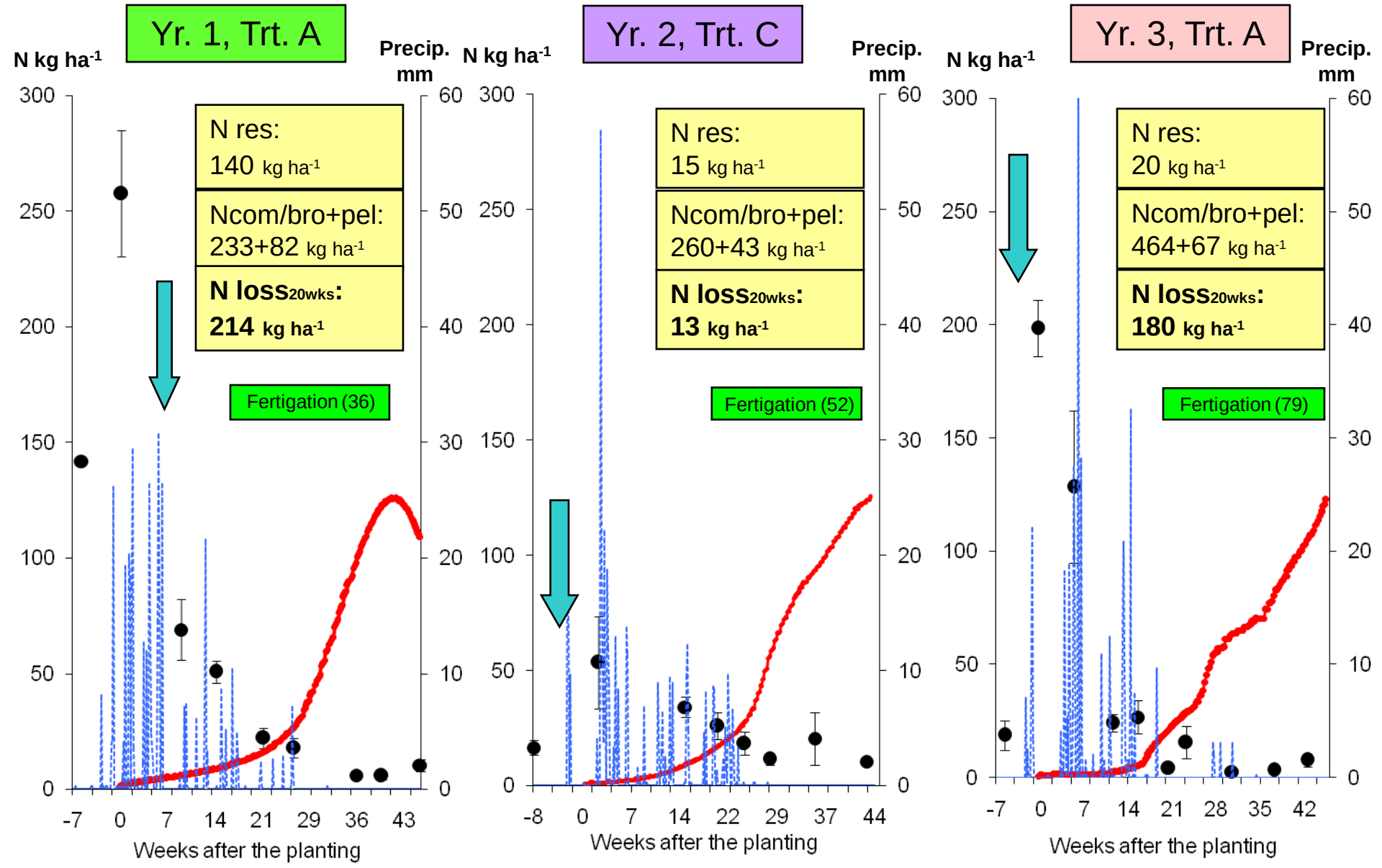

Soil Total N Content in the Topsoil
(0-15 cm deep, Nov. 2005)
0.095
0.090
0.085
0.080
TN %
A
B
C
D
E
Treatment

Strawberry Root Profile Survey

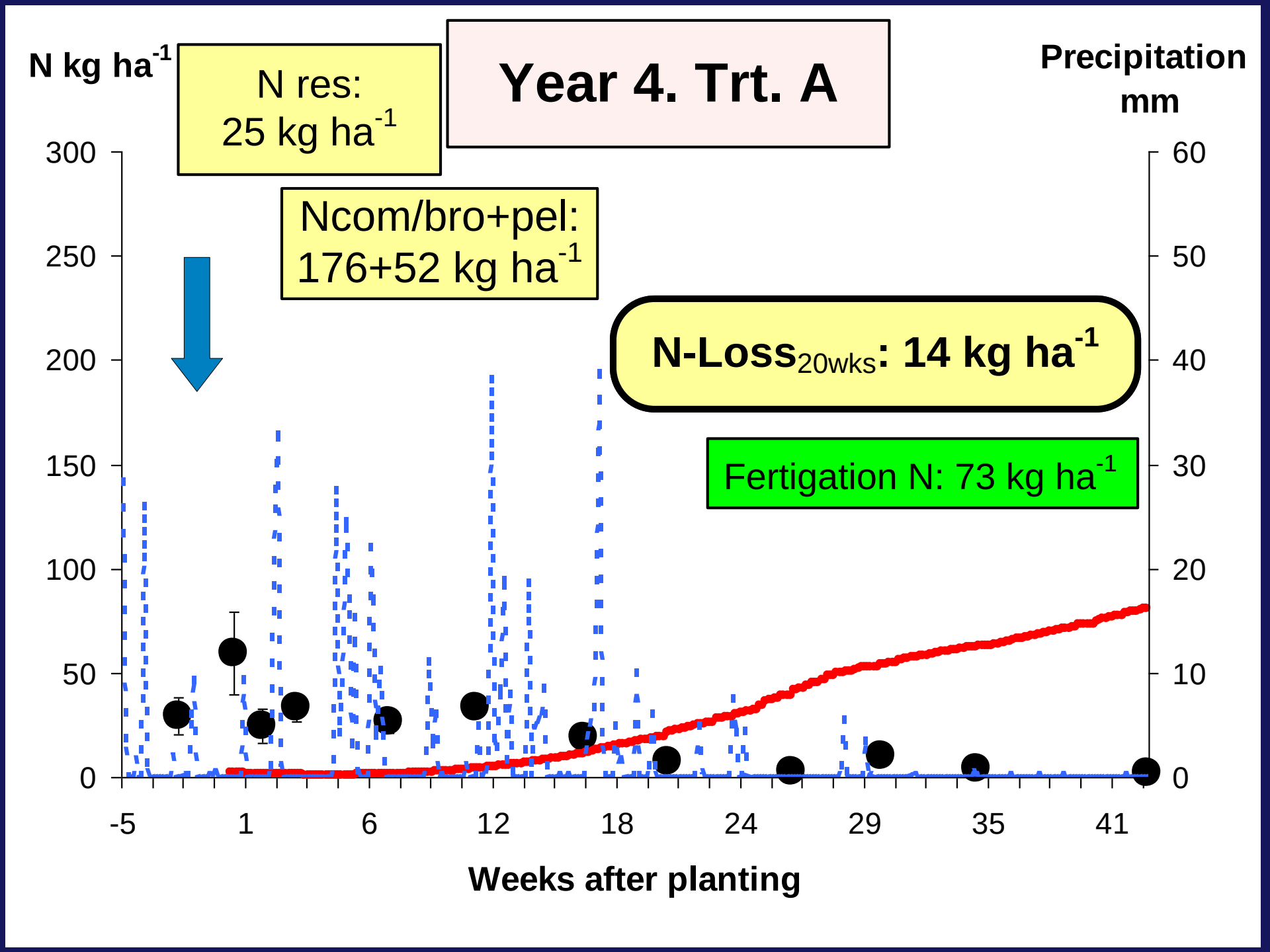

1 foot deep
Drip tape



N Dynamics and N Loss During the Rainy Season in a Strawberry Plot (year 1, treatment A).



Nitrogen Dynamics in Strawberry Plots During the First Three Years.


N kg ha-1
Precipitation mm
Year 4. Trt. A
N res:
25 kg ha-1
Ncom/bro+pel:
176+52 kg ha-1
N-Loss20wks: 14 kg ha-1
Fertigation N: 73 kg ha-1
300
250
200
150
100
50
0
60
50
40
30
20
10
0
-5
1
6
12
18
24
29
35
41
Weeks after planting

Conclusions

- In organic production systems, **under low Verticillium pressure** and by using the integrated ecological practices, strawberry cultivar Aromas and Seascape can be grown in 1 to 3 year-break rotation without statistically significant yield difference from 7 year-break rotation.
- Fruit yield difference observed among different rotations in the final year appears to be attributed not to *Verticillium dahliae* but to other factors such as "none-lethal" pathogens that were not monitored in the experiment and/or improved soil N fertility in longer rotation plots.

Conclusions

- Analysis of the effect of different rotations on soil microbial diversity by PLFA and molecular biological methods are in progress.
- “High input organic farming” can have significant environmental N load.
- Pre-plant N rate + residual inorganic N level seem to affect most to the amount of N loss during the winter.
- How much is too much?

N Fertility Trial for Organic Strawberries

- Two sites in Watsonville
- Two years in each site
- Different N rates (pre-plant and supplement)
- Split –plot design
- Monitor soil inorganic N (0-30, and 30-60 cm. Monthly), mite population, tissue N, petiole NO_3

Site 1: Redman Farm, Watsonville, Yr 1 (2005-06)

Steve Pedersen @ High Ground Organics

- Soil type: Clear lake clay
- Variety: Seascape

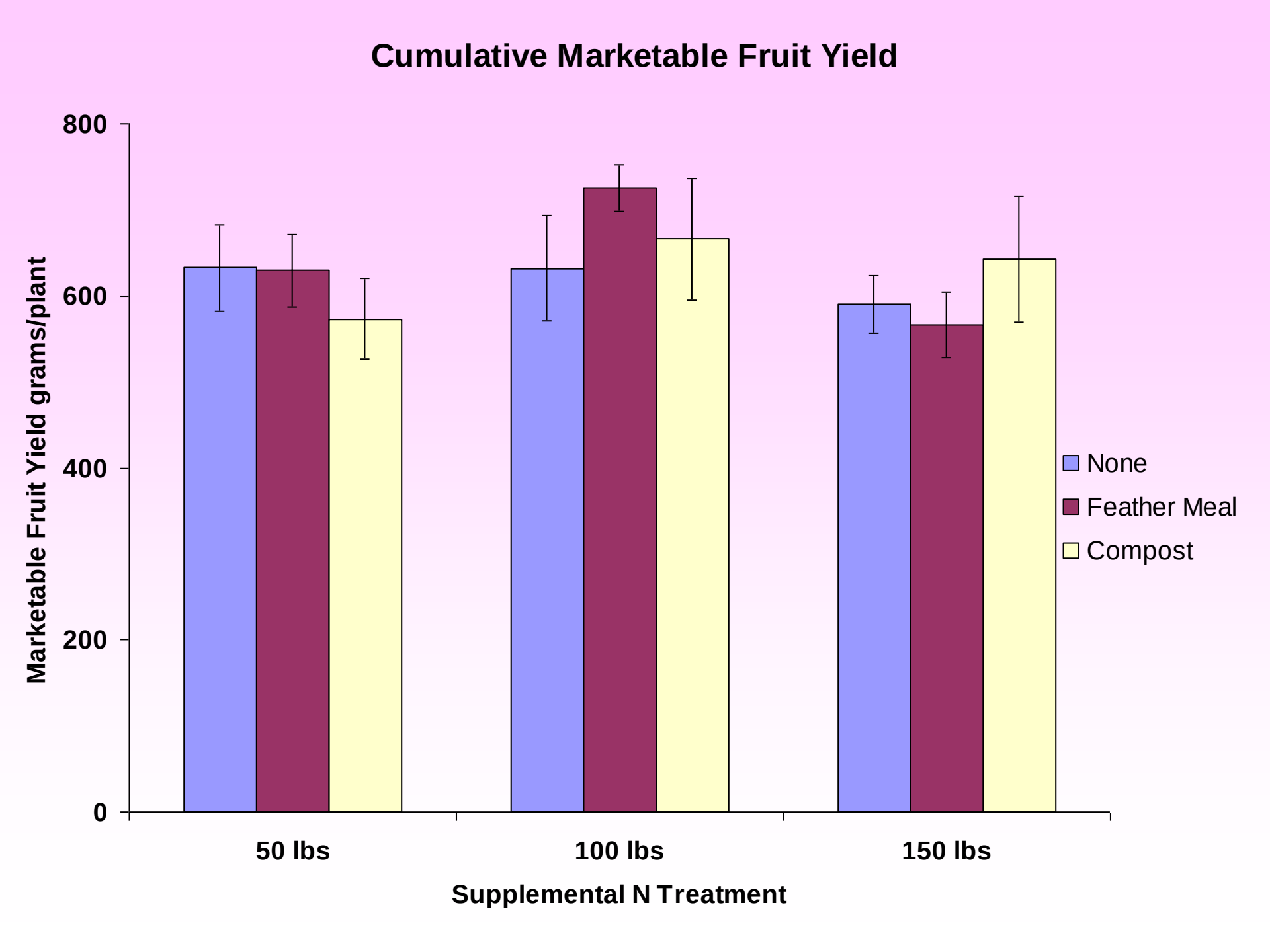
Main plots (3 levels):

- Supplemental N application; **50, 100, or 150 lbs-N/acre** during **January and August** through fertigation

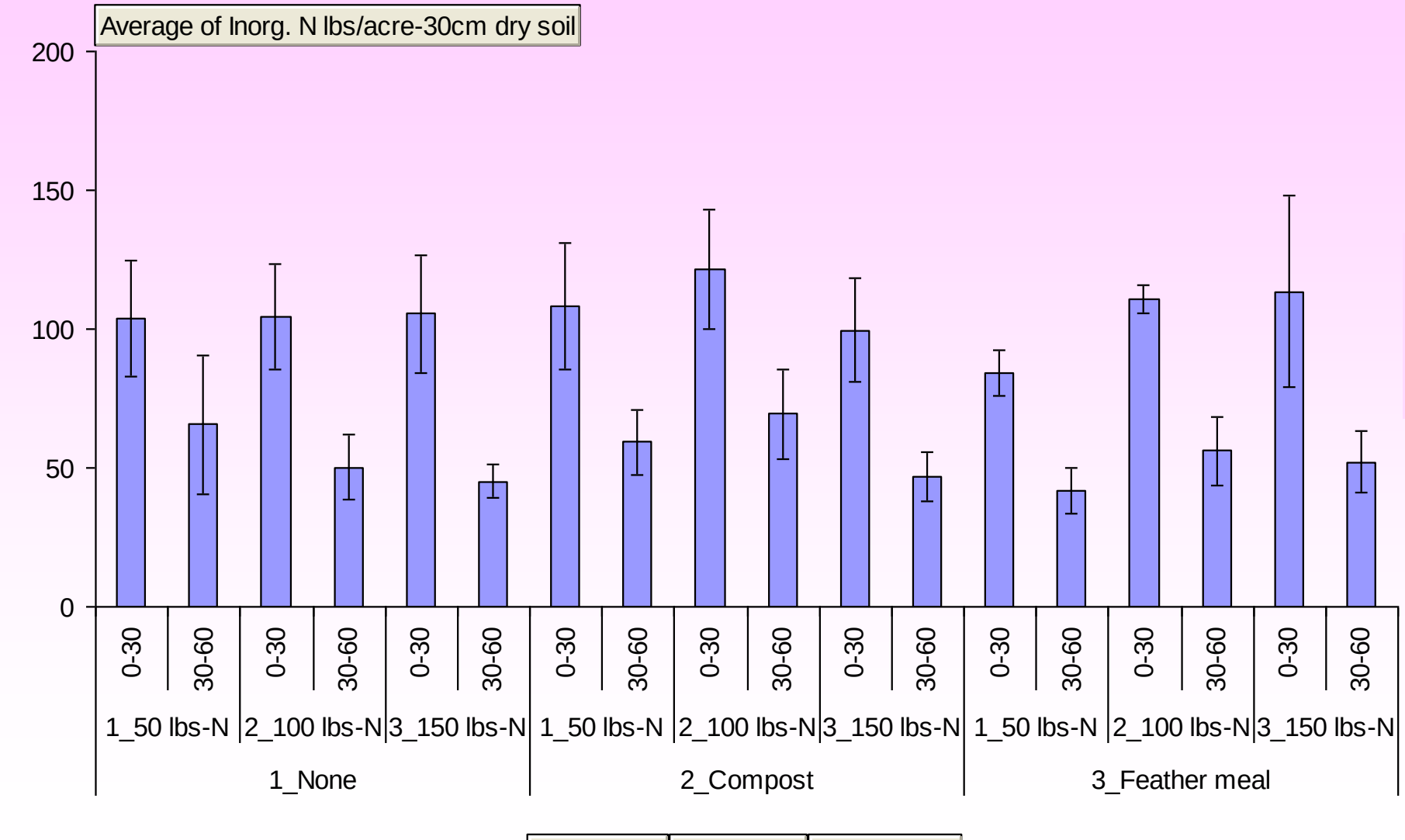
Subplots (3 levels):

- Basal fertilizer; **none, compost 5 tons/acre, or feather meal 50 lbs-N/acre**

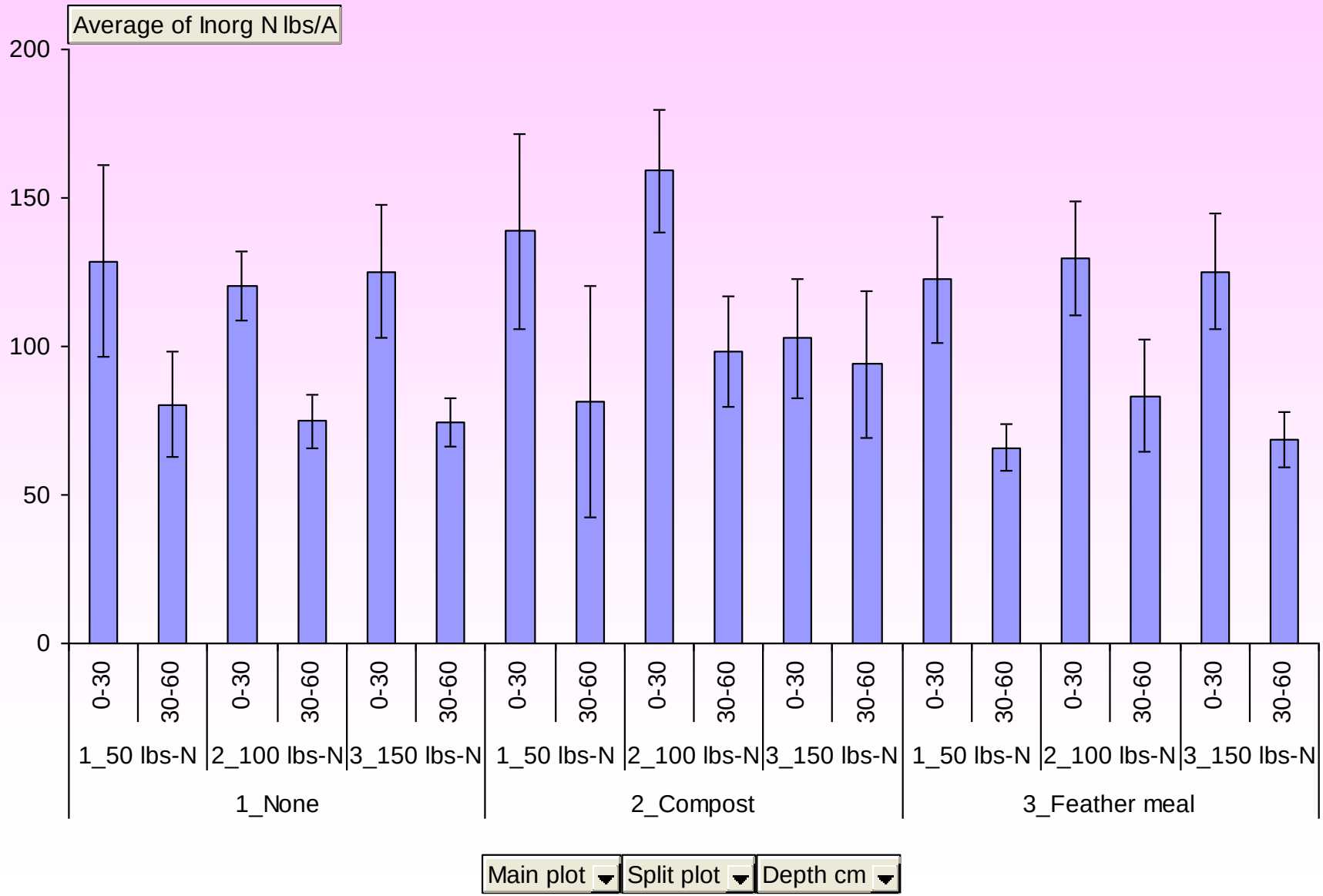
Reps: 4, Total plots: 36


Cumulative Marketable Fruit Yield
800
600
400
200
0
Marketable Fruit Yield grams/plant
None
Feather Meal
Compost
50 lbs
100 lbs
150 lbs
Supplemental N Treatment

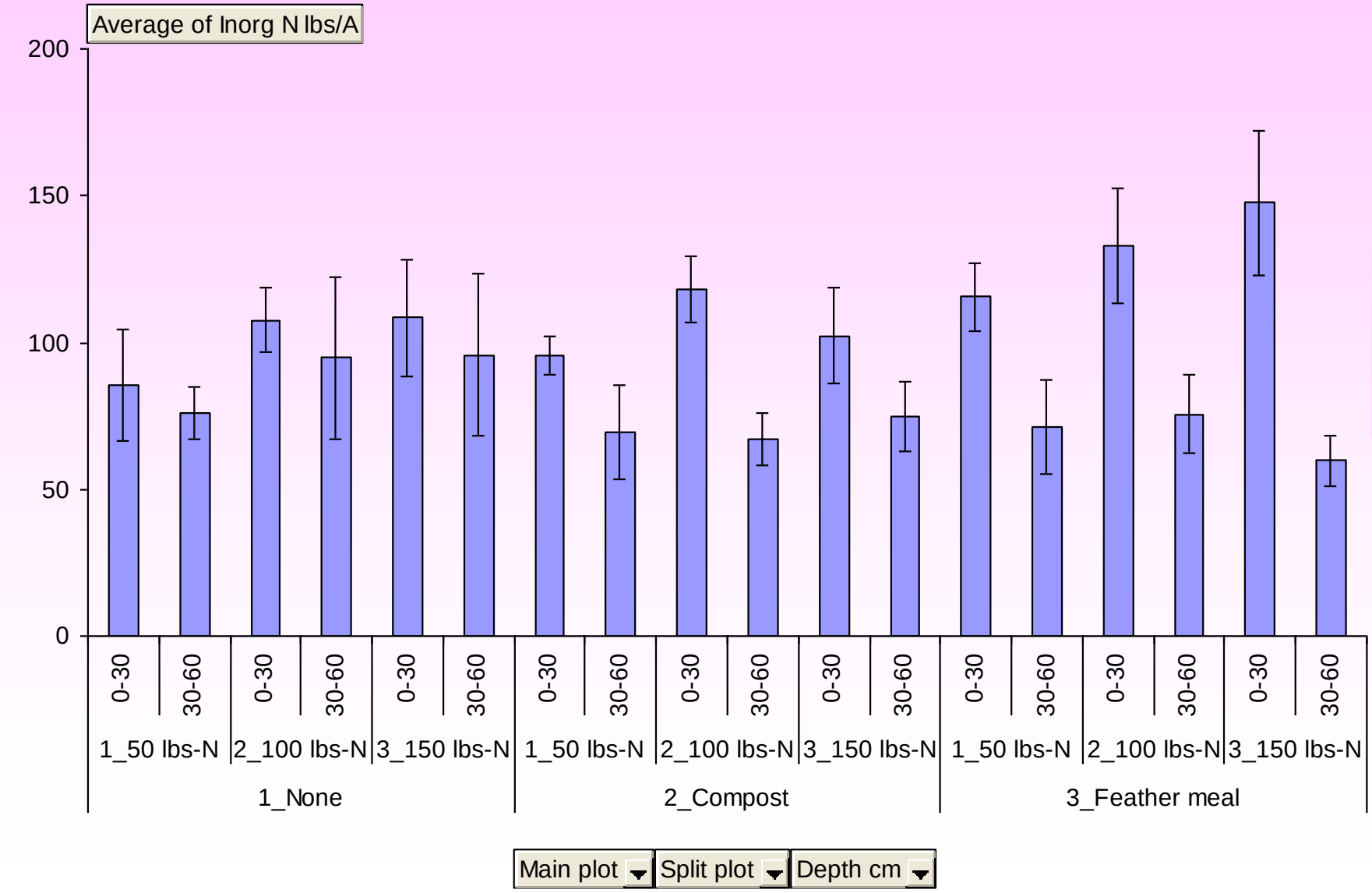
Soil Inorganic N: 10/11/05
[Pre-fertilizer application]



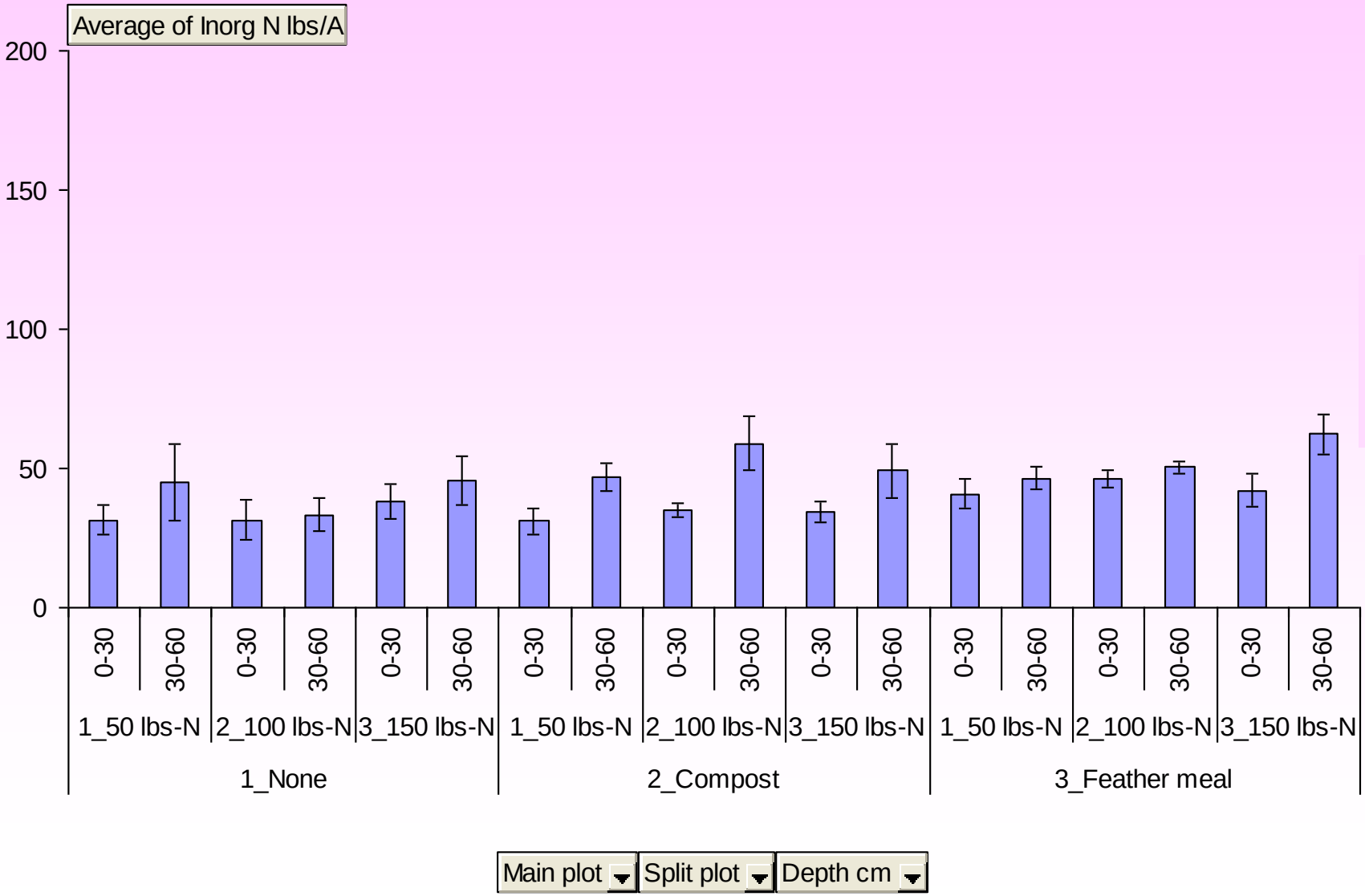
Soil Inorganic N: 11/04/05
[At Planting]



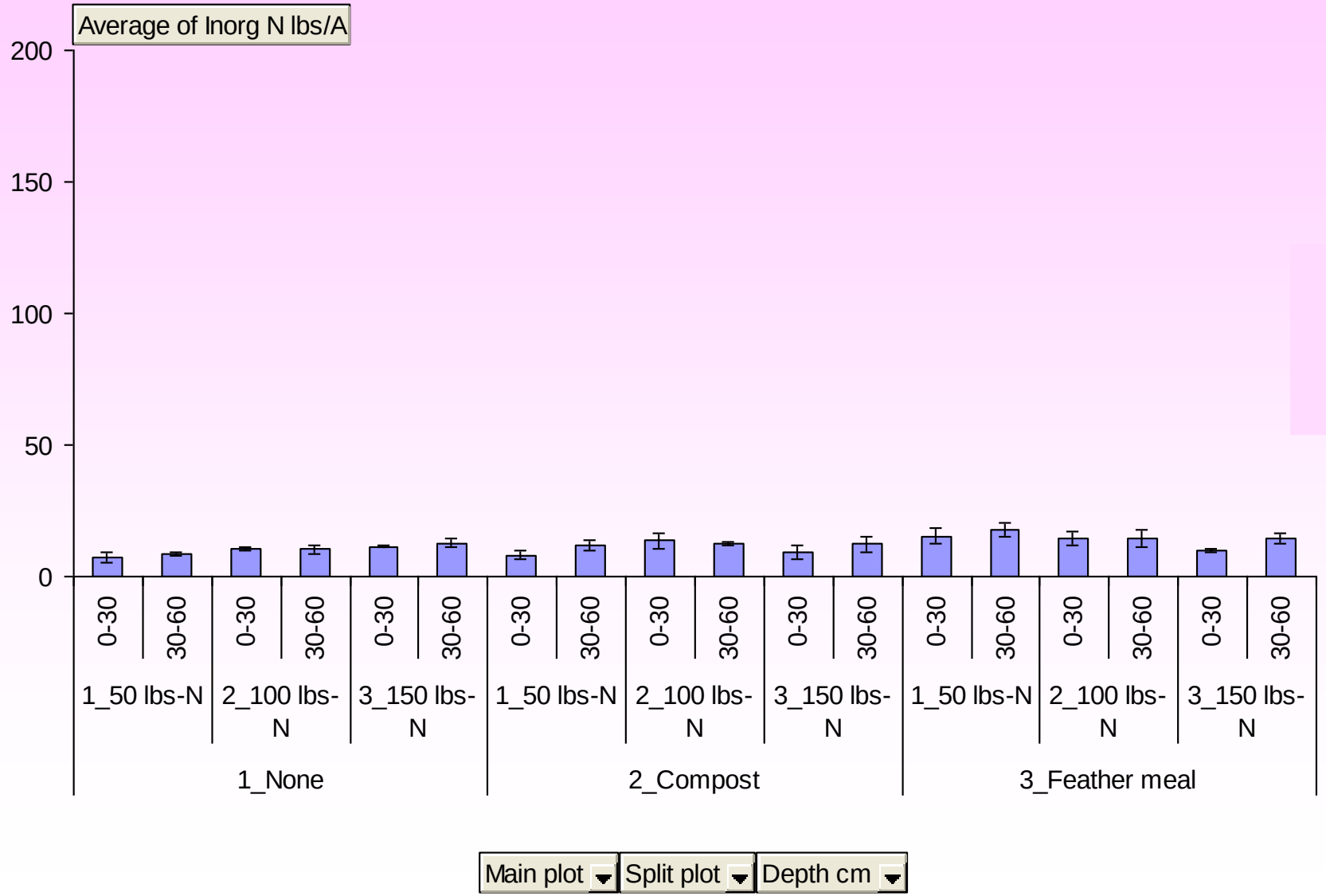
Soil Inorganic N: 12/09/05
[5 weeks after planting]



Soil Inorganic N: 01/30/06
[12 weeks after planting]



Soil Inorganic N: 03/10/06
[18 weeks after planting]



Site 1: Redman Farm, Watsonville, Yr 2 (2006-07)

- Steve Pedersen @ High Ground Organics
- Soil type: Clear lake clay
- Variety: Seascape

Main plots (3 levels):

- Supplemental N application; **75, 150, or 225 lbs-N/acre** during **March and July** through fertigation

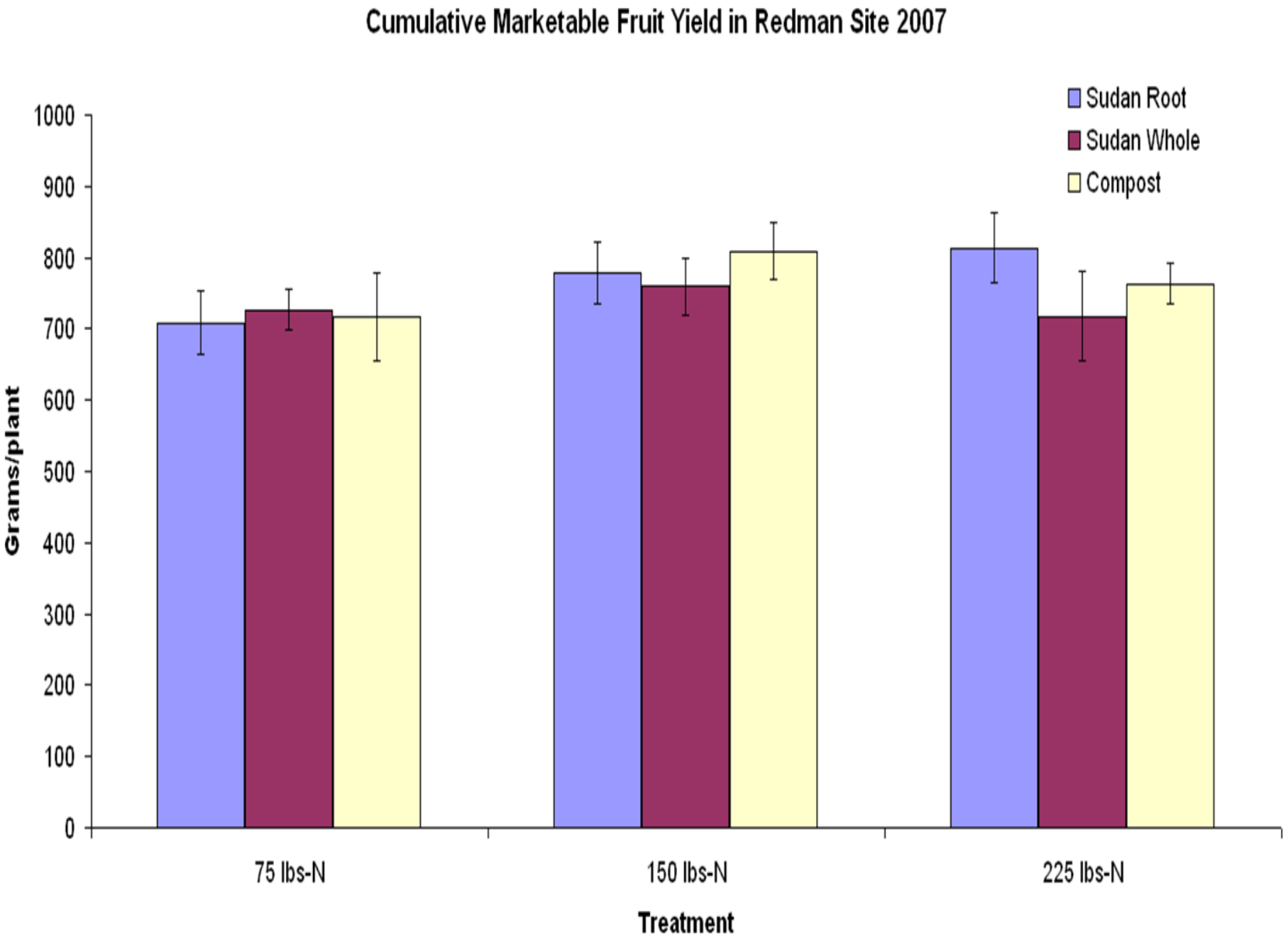
Subplots (3 levels):

- Basal fertilizer; **Sudan grass roots, Sudan grass whole plants, or compost 10 tons/acre**

Reps: 4, Total plots: 36


09 . 22 . 2006


BUCHWALDS C A STORAGE INC.
10/26/2007


Cumulative Marketable Fruit Yield in Redman Site 2007
Sudan Root
Sudan Whole
Compost
1000
900
800
700
600
500
400
300
200
100
0
Grams/plant
75 lbs-N
150 lbs-N
225 lbs-N
Treatment

Site 2: Farris Ranch, Watsonville, Yr 1 (2007-08)

- Reiter and Driscoll's. (Kevin Healy and Fred Cook)
- Soil type: Canejo loam
- Varieties: Seascape, Albion, Two Driscoll's varieties,

Main plots (3 levels):

- Supplemental N application; **0, 150, or 300 lbs-N/acre*** during **March and October*** through fertigation

(*tentative. for Seascape only)

Subplots (3 levels):

- Basal fertilizer; **None, Blood meal 75 lbs-N/acre, or Blood meal 150 lbs-N/acre**

Reps: 4, Total plots: 36


11/12/2007

Summary

- In the first site, pre-plant N (compost, cover crop, or feather meal) and supplemental N rates tested did not affect marketable fruit yield significantly during the two-year trails in an organic farm.
- Currently testing different rates of pre-plant and supplemental N in the second site.

Acknowledgements

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Questions?

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