Manure Amendment Applications, What is Enough?

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Outline

- Introduction
- Statement of Problem
- Study Goal and Objectives
- Study Locations
- Materials & Methods
- Results & Discussion
- Conclusions

Introduction

- Demands on Hawaii's water resources are increasing

-more cycles of drought and

-urban areas continue to expand.

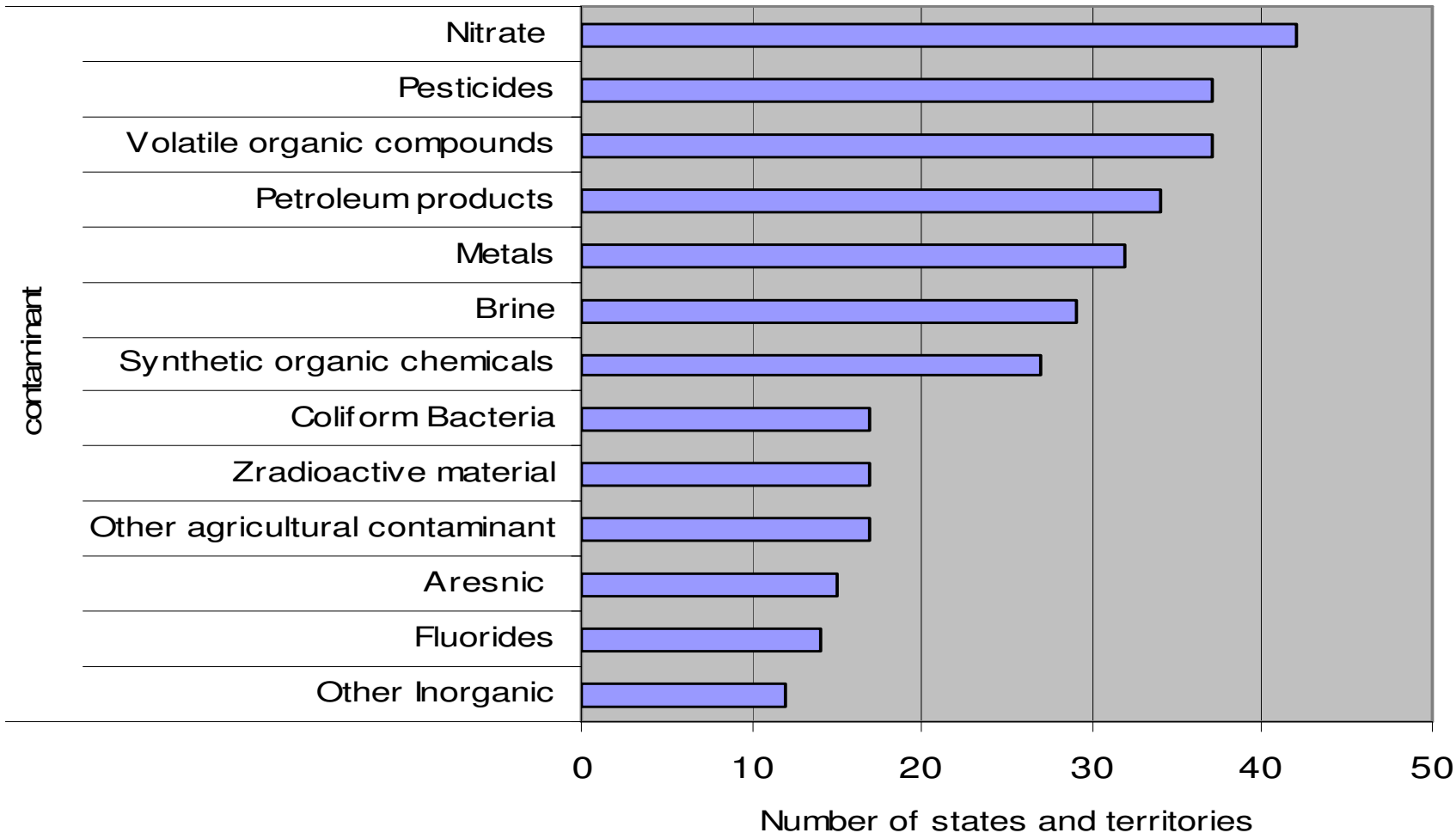
Introduction

- Nitrate (NO_3-N) pollution problem

-is a widespread problem, and

-well linked between production and surface and ground water pollution.

Introduction cont.



Frequency of various contaminants in the US. Reprint from Ling, G. (1996).

Introduction cont.

- High level of NO_3-N in drinking water (> 10ppm)

-Methemoglobinemia (Blue Baby Syndrome) in infants.

-undesirable growth of an algae and aquatic plants which deplete oxygen and kill fish and other aquatic life.

Introduction cont.

-popular and an economically important vegetable.

-in Hawaii is expected to increase during the coming years.

Statement of Problem

Ground water contamination

- Soils rarely supply sufficient nutrients.
- N amendments application are the key factor.

Ground water contamination

- Organic amendments (OA) improves soil fertility and structure.
- Improper use of OA.

Objectives

Evaluate the effect of OA

-types (chicken and dairy),

-rates (0, 150, 300, 600 kg ha^{-1} total N equivalent) and

Frequency (one and two time application) on:

(a) Macro- and micro nutrients concentration in soil solution within and below plants root zone,

(b) Nitrate concentration within and below the root zone and its relationship with relative chlorophyll content in sweet corn leaves.

Study Locations

Study Sites:

1. UHM, Poamoho-leeward conditions.

2. UHM, Waimanalo-windward conditions.

Materials & Methods

An Ongoing Study

- This research was part of an ongoing project funded by NRCS.
- The experiment included 33 plots each 1.8 x 18 m.
- Experimental Design was Randomized Complete Block Design (RCBD)

Overview of experimental plots

Moisture probe

Suction Cup at 60cm

Suction Cup at 30cm

Soil Solution Sampling (Waimanalo)

Soil Solution Sampling (Poamoho)

Real-Time Soil water content monitoring

-Using moisture capacitance probes (MCP) to monitor soil water dynamics within and below root zone.

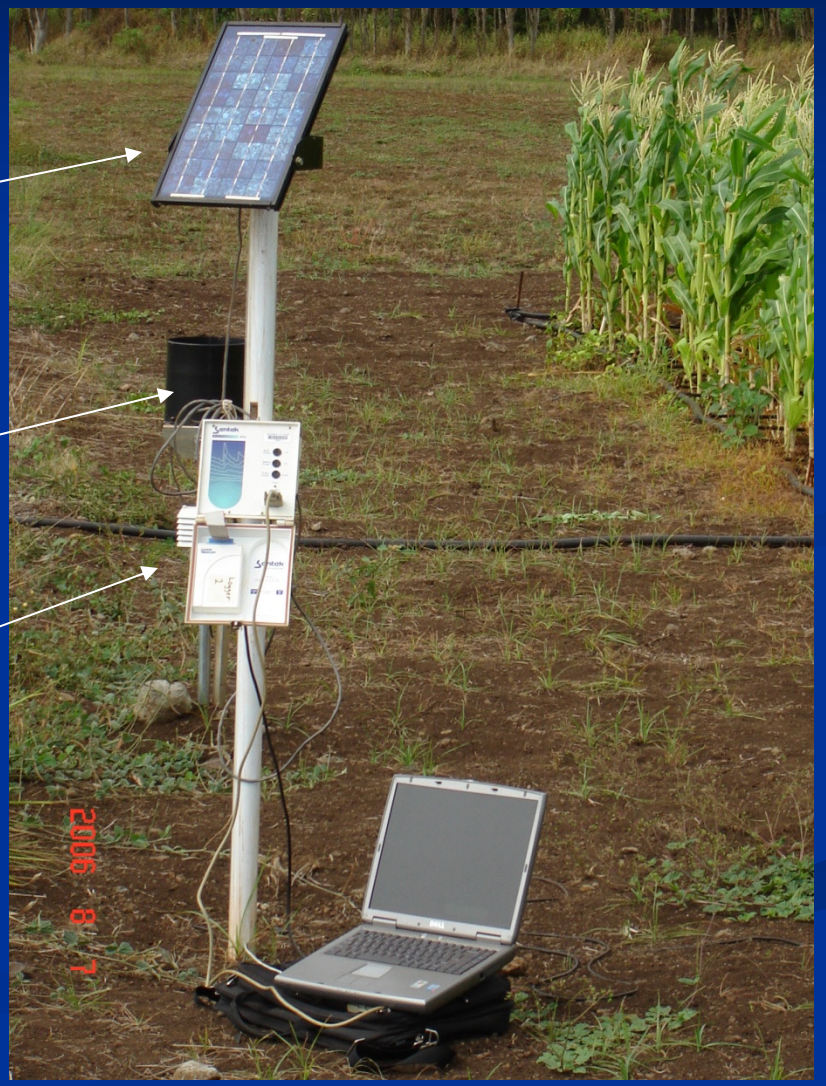
-MCP sensors monitored the water content at 10, 20, 30, and 50 cm depths.

Soil water content monitoring

Solar panel

Rain gauge

Data logger



Total N, NH_4-N, NO_3-N macro-, micro-nutrient, pH and EC measurements

Soil solution samples were submitted to the CTAHR's-ADSC

Relative Chlorophyll Content in Sweet Corn Leaves

SPAD 502

-Is one of the nondestructive diagnostic techniques

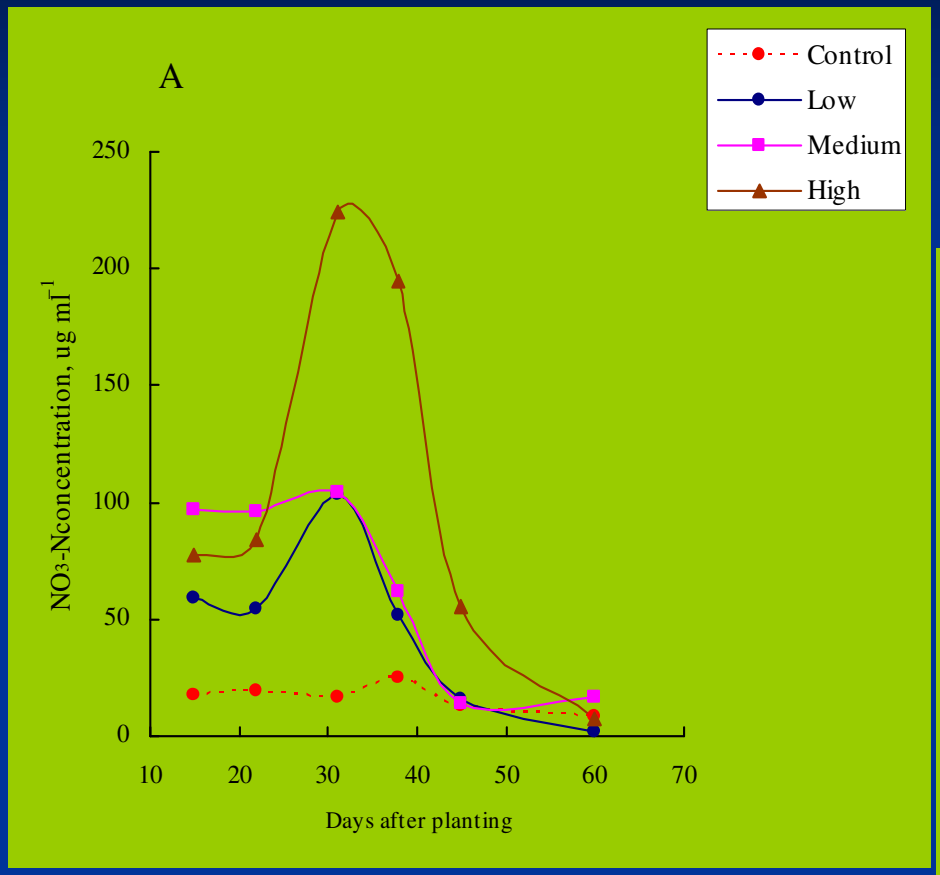
-Used as a diagnostic tool to predict N status of crops.

-Related to N in soil but not yet with NO3–N in soil solution.

Results and Discussions

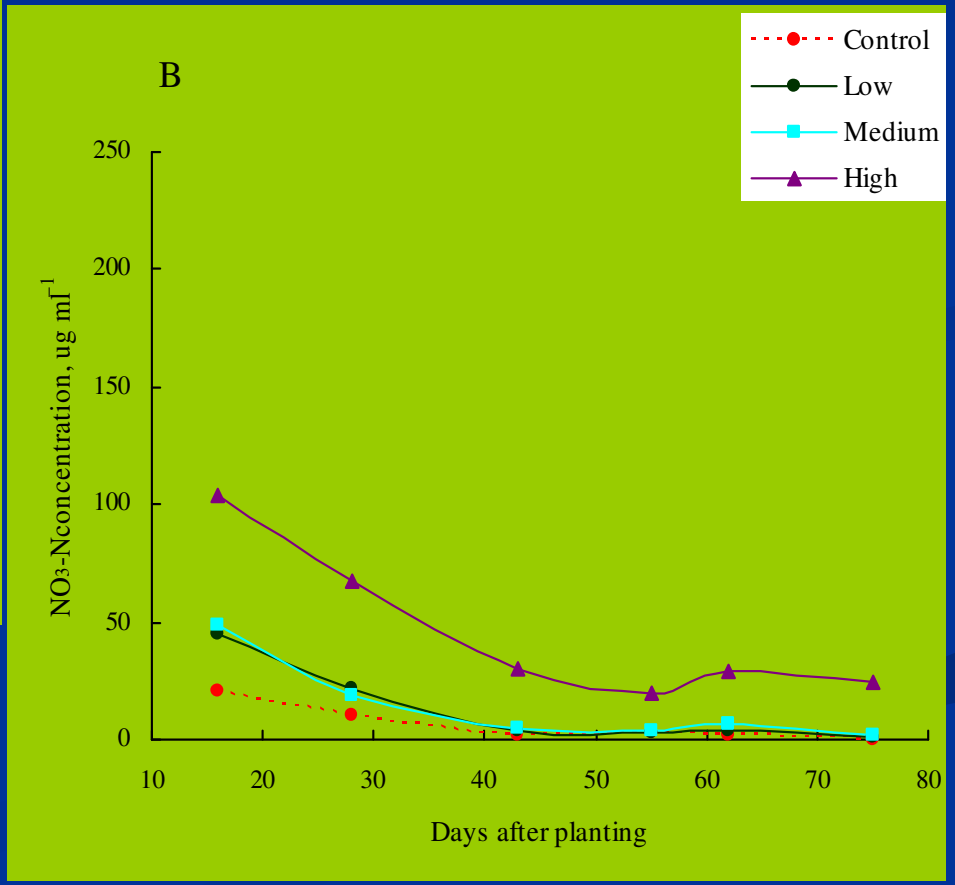
Nutrient Concentration Within and Below Root Zone from Applied Manure Amendments

-Nitrate-N concentration within the root zone-

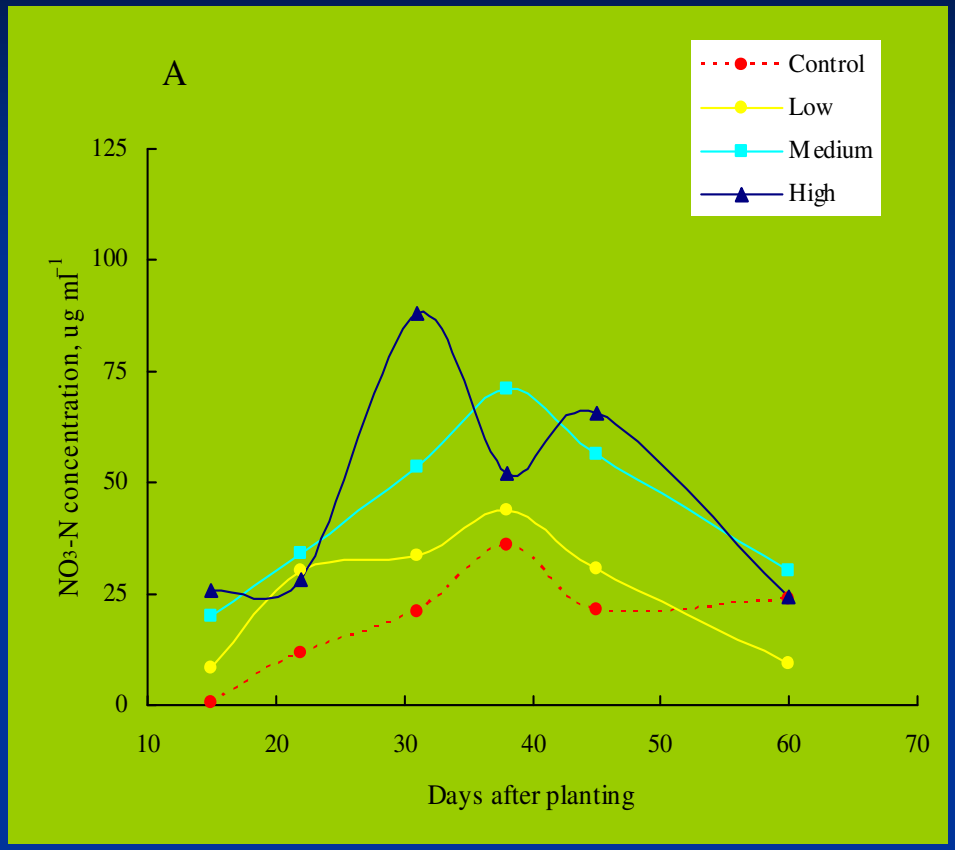


A-NO_3–N concentration (ug ml^{-1}) within the root zone at Poamoho.

B-NO_3–N concentration (ug ml^{-1}) within the root zone at Waimanalo.

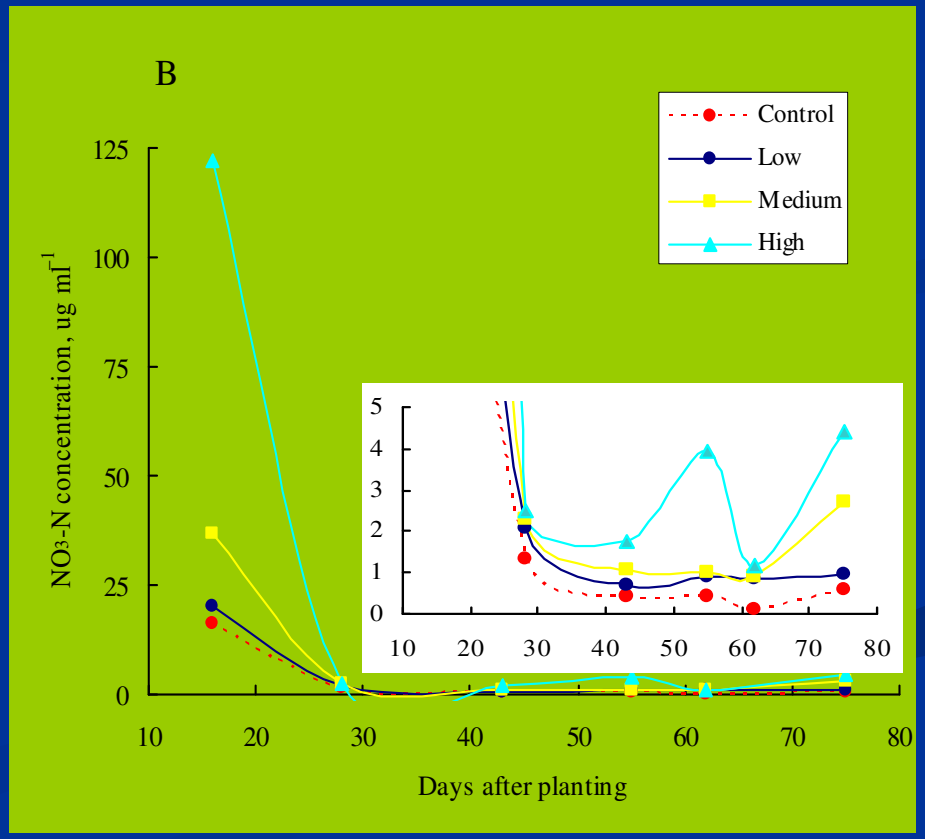


-Nitrate-N concentration below the root zone-



A-NO_3–N concentration (ug ml^{-1}) below the root zone at Poamoho.

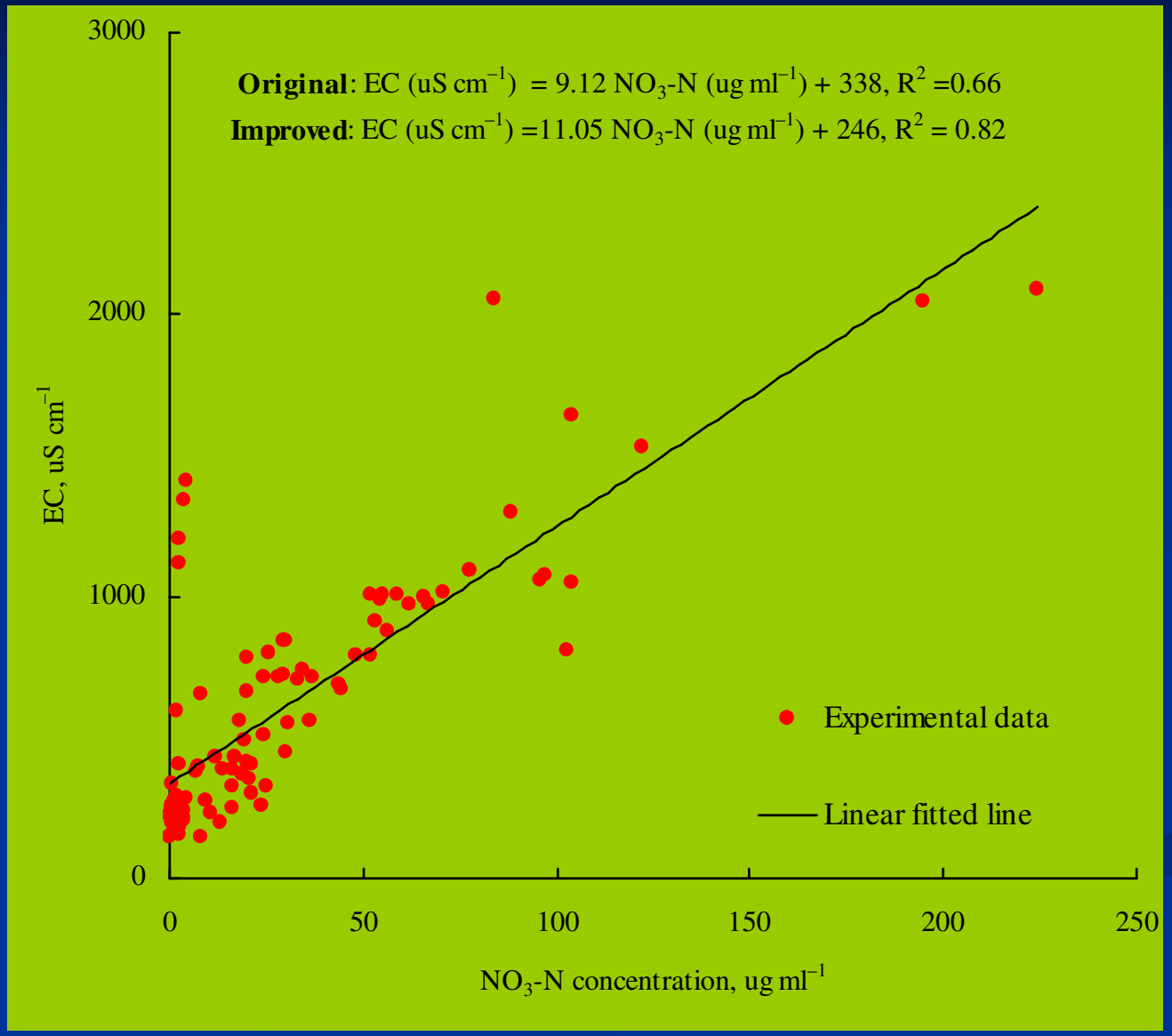
B-NO_3–N concentration (ug ml^{-1}) below the root zone at Waimanalo.



-Electrical Conductivity-Nitrate-N relationship-

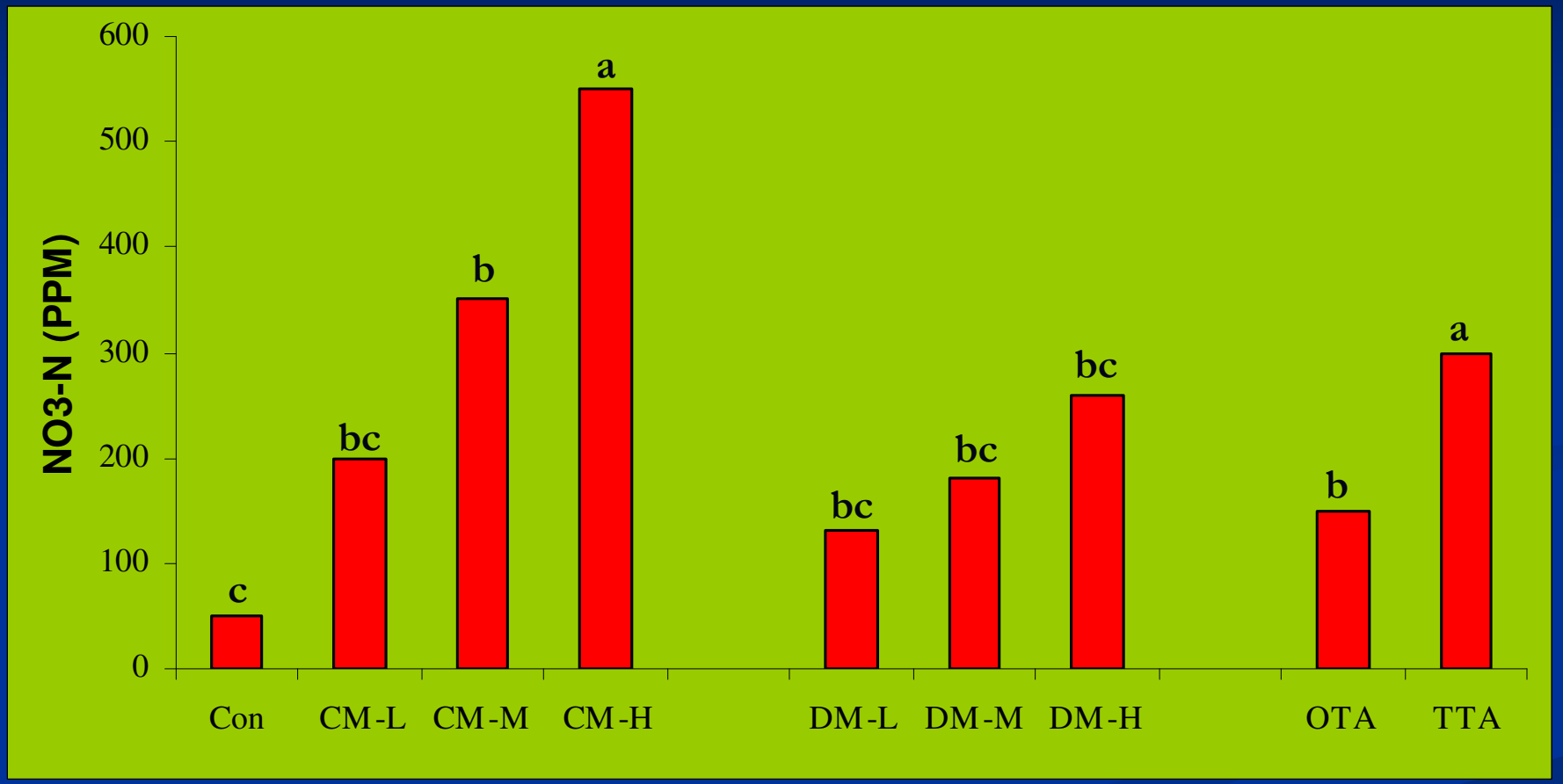
Correlation coefficient (R^2) between NO_3–N (ug ml^{-1}) and EC (us cm^{-1}).

• The EC of soil solution can be a good indicator for NO_3–N concentration in the soil solution under the study conditions.



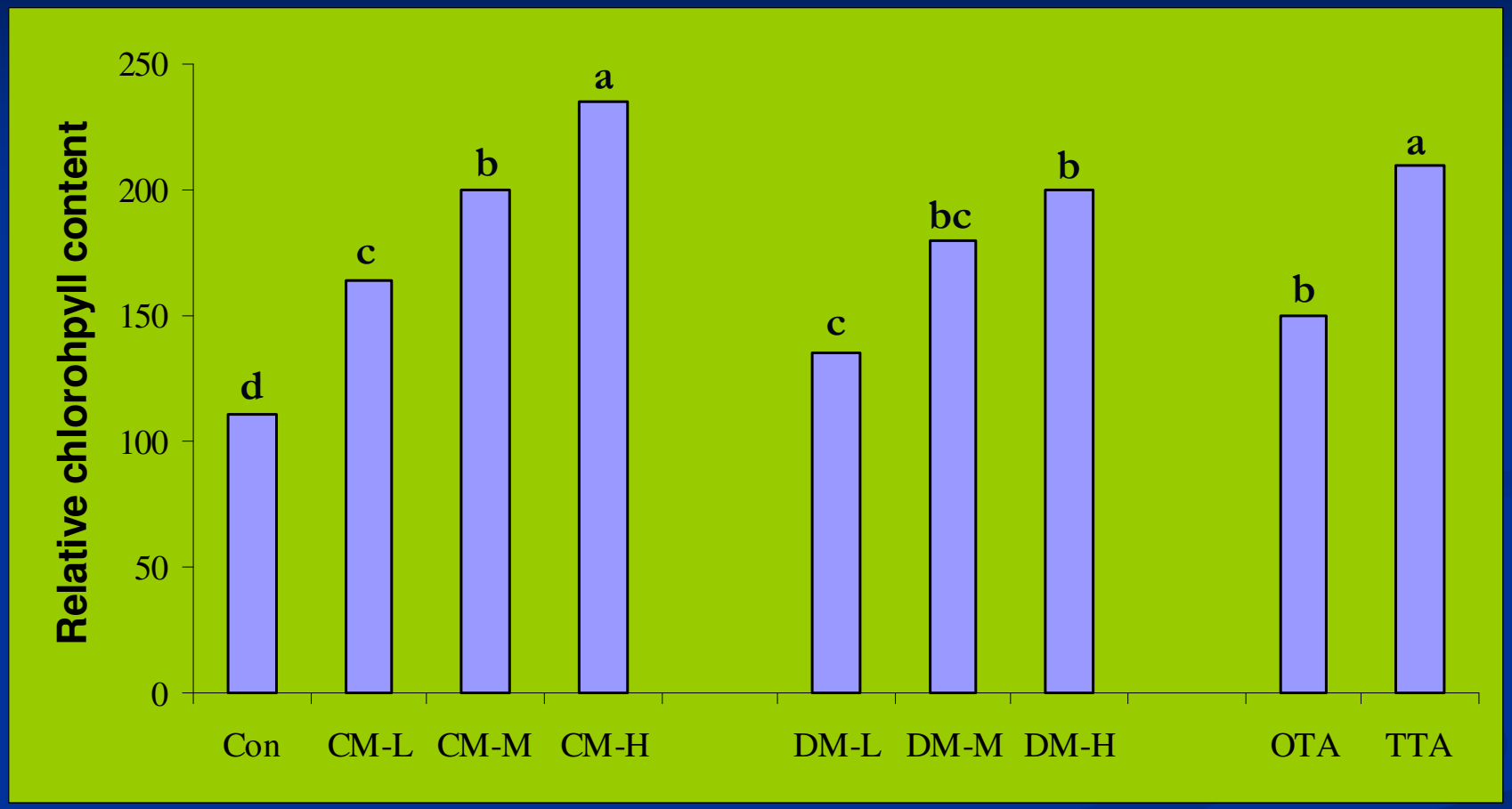
Relating Relative Chlorophyll Content of Plant Leaves with Root Zone Nitrate Concentration

-Nitrate concentration within the root zone-



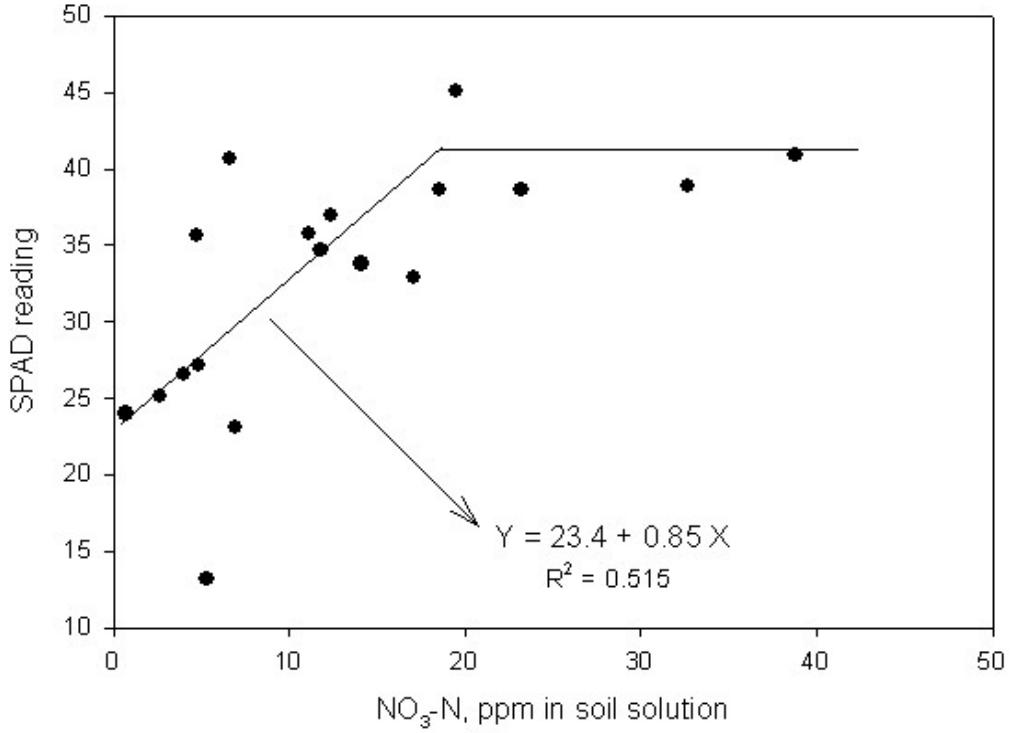
The effects of manure amendment Type, Rate, and Frequency of application on NO3-N within root zone

-Relative chlorophyll content in plant leaves-



The effects of manure amendment Type, Rate, and Frequency of application on RCC in plant leaves.

-Relationship between NO_3–N and RCC-



Regressing SPAD readings against soil-solution NO3-N

-NO3-N concentration of 20 ppm was obtained as the break point, below which SPAD readings was linearly correlated with NO3-N concentration.

-Above 20 ppm NO3-N, SPAD reading was leveled off at 40, suggesting healthy green leaves.

Conclusions

- The increasing trend in the studied variables was as below:

- TYPE: Control < DM < CM.
- Rate: Control < low < Medium < High.
- Frequency of application: OTA < TTA.

Conclusions

- OA should be applied as recommended. Over-application results in loss of nutrients due to leaching.
- Event of high rainfall and excess irrigation may increase nutrient leaching below the root zone.
- To avoid loss of nutrient and potential ground water contamination, irrigation should be scheduled according to soil moisture conditions and plant requirement.

Question … ???