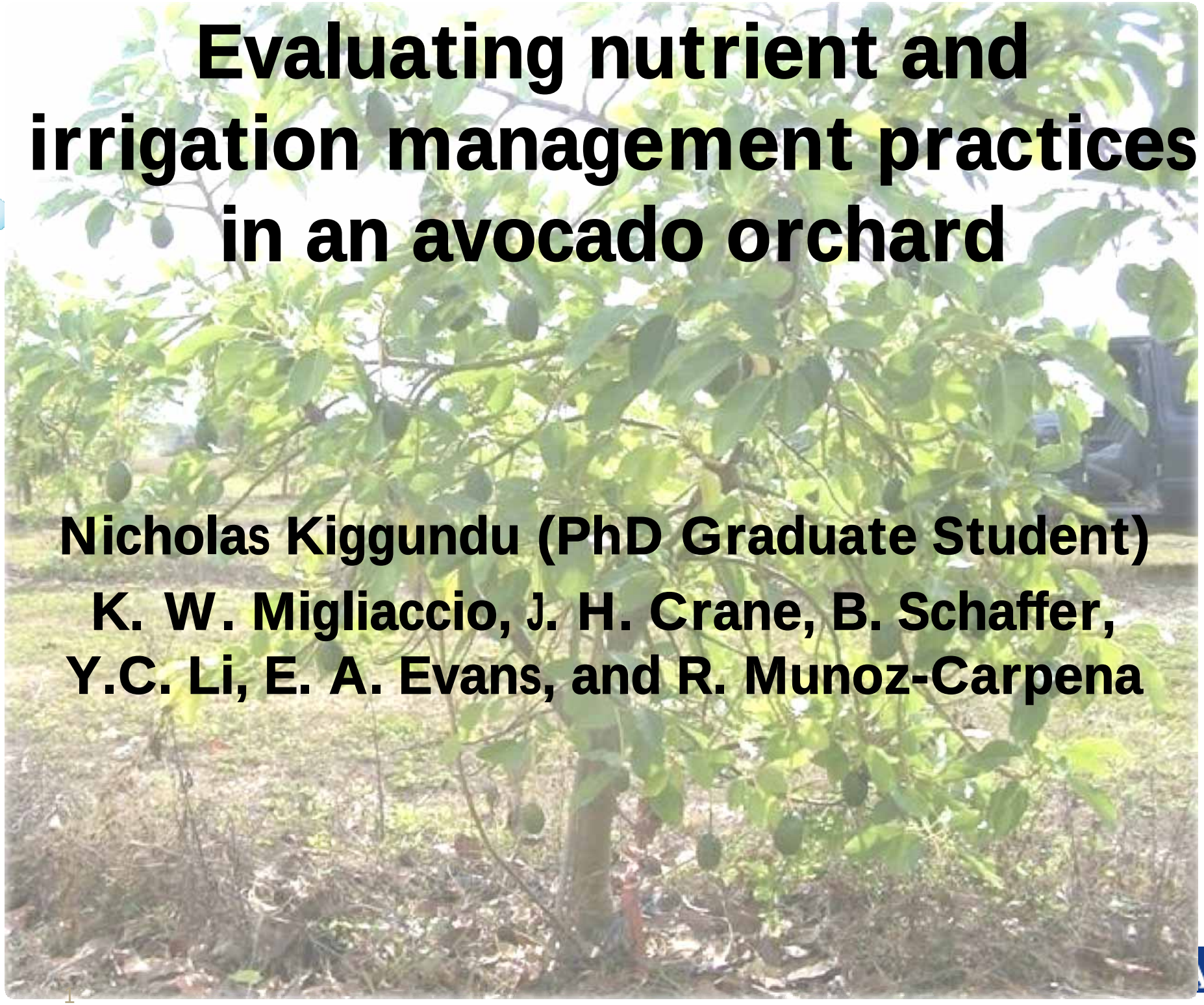
Evaluating nutrient and irrigation management practices in an avocado orchard



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Introduction

- There is a growing international concern to protect water sources in order to sustain their designated uses of domestic supply, irrigation, ecosystems services, etc.
- One water quality concern of particular interest is the degradation of water due to nutrient loading of nitrogen (N) and phosphorus (P).
- High levels of N and P lead to increased eutrophication.

Overall goal of the project

The overall goal of this study is evaluate irrigation and fertilization management practices that would save water and reduce nutrient leaching while maintaining economical yields, with application to avocado.

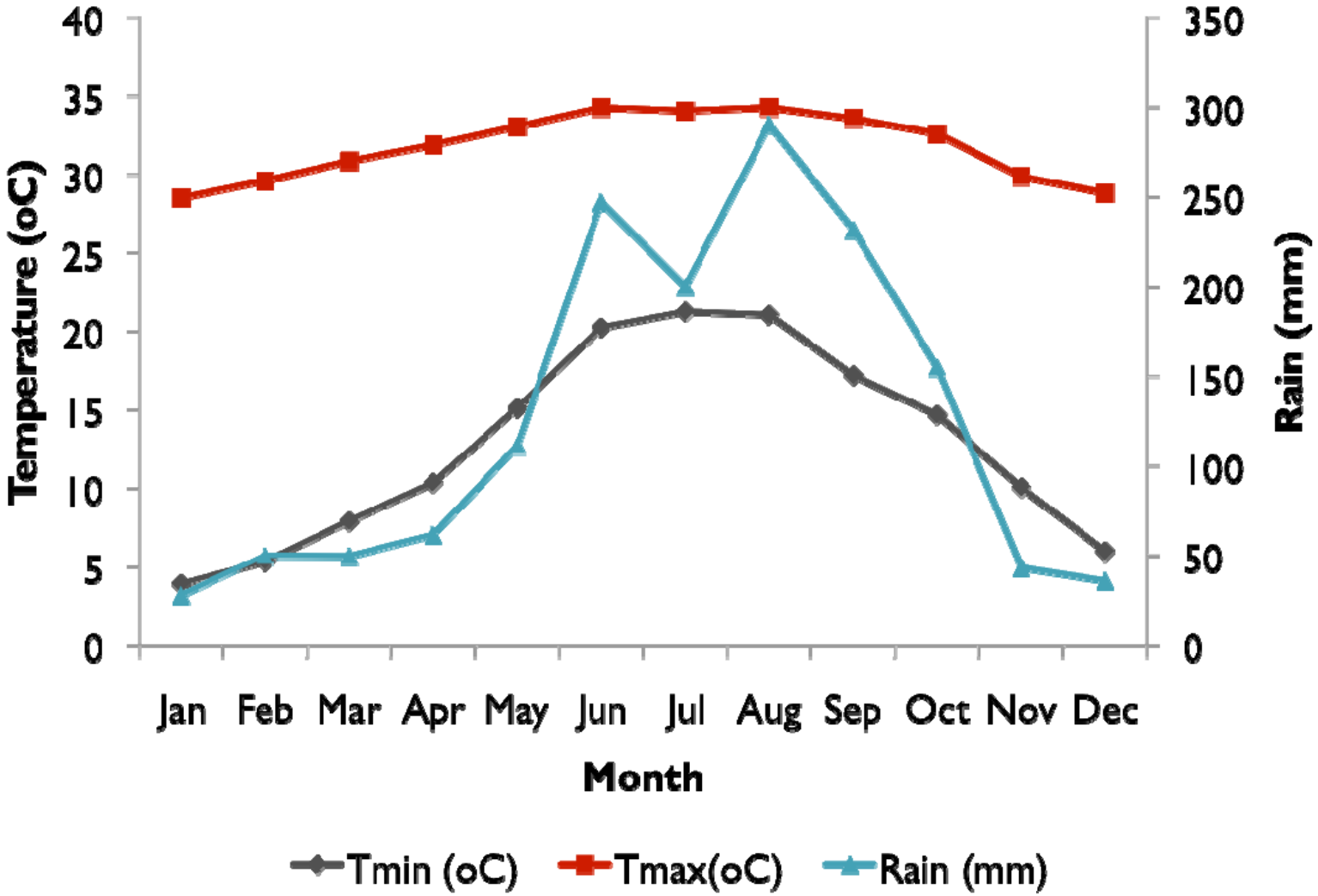
Objectives

1. To determine the effect of irrigation volume and nutrient load on nutrient leaching in Krome soils.
2. To determine effect of irrigation volume and nutrient load on crop yield.

Materials and methods

Experiment site

Tropical Research and Education Center, Homestead, FL.



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Soil at experiment site

- Primarily of calcium carbonate rock ploughed soils
- Classified as Krome very gravelly loam
- 51% coarse material
- Typical porosity: 0.45
- Bulk density: 1.42 g/cm^3
- Soil pH of 7.4-8.4

Irrigation and nutrient management treatments

Seven treatments:

1. ET irrigation with standard fertilizer rate (SFR);
2. ET irrigation with 50% SFR;
3. ET irrigation with 200% SFR;
4. Soil water moisture at 15 cbar with SFR;
5. Standard irrigation rate with SFR;
6. Soil moisture at 15 cbar with 50% SFR; and
7. Soil moisture at 15 cbar with 200% SFR.

Treatments

- Maxi jet micro sprinklers with an application rate of 21 gallons/ hour
- 4 replications of each treatment
- 4 trees per rep
- Each replicate has 1 Beta and 3 Simmonds (different varieties of avocado)

Avocado planting

N

Water meter and solenoid valve setup

Quantifying nutrient leaching

- Zero-tension lysimeters were used to evaluate nutrient leaching for this study.

Migliaccio et al., 2006. Edis publication

ET based Irrigation

- Evapontransipiration (ET)

  - Penman-Monteith equation
  - Input weather values were obtained from FAWN
  - Historic ET adjusted monthly
  - Trees irrigated 3 times a week

Soil moisture based irrigation

- Switching tensiometer set at 15 cbar.
- Irrigation control sends signal twice a day and irrigation occurs depending on the soil suction reading.

Standard irrigation rate

- Irrigated twice a week
- Each irrigation event is 2 hour

Fertilizer used for orchard establishment

The fertilizer used is granular diammonium phosphate (DAP) 6-6-6

Treatment	Amount applied (kg/ha/yr) Feb 06- Feb 08
1, 4 and 5	325
2 and 6	162
3 and 7	650

Fertilizer used for production

The fertilizer used is granular diammonium phosphate (DAP) 8-3-9

Treatment	Amount applied (kg/ha/yr) Mar- Aug 08	Amount applied (kg/ha/yr) Sept 08- Jan 09
1, 4 and 5	325	650
2 and 6	162	325
3 and 7	650	1300

Water sampling

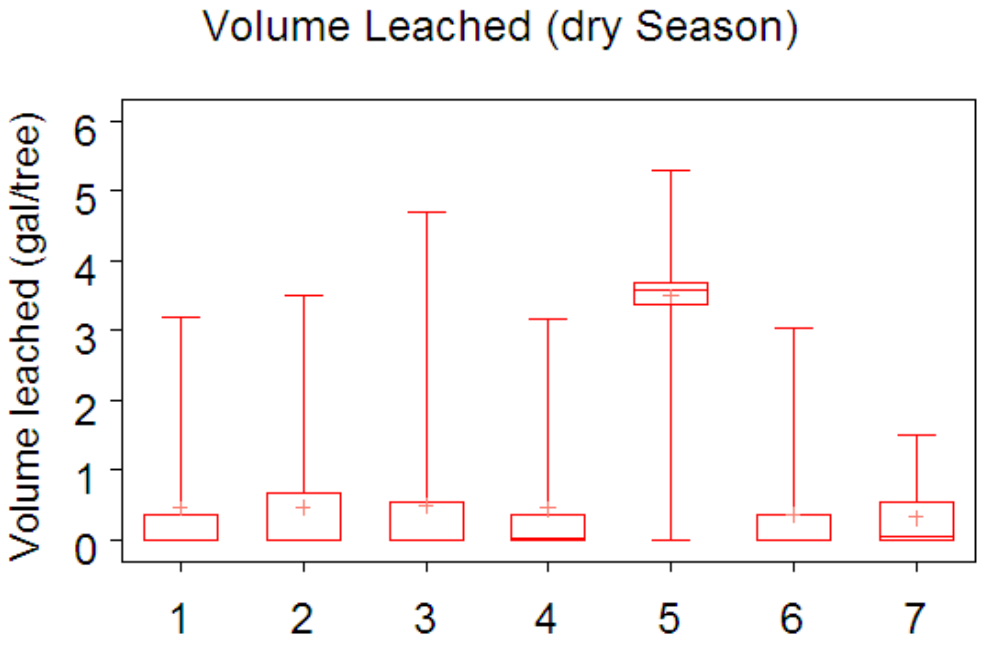
Field measurements/activities

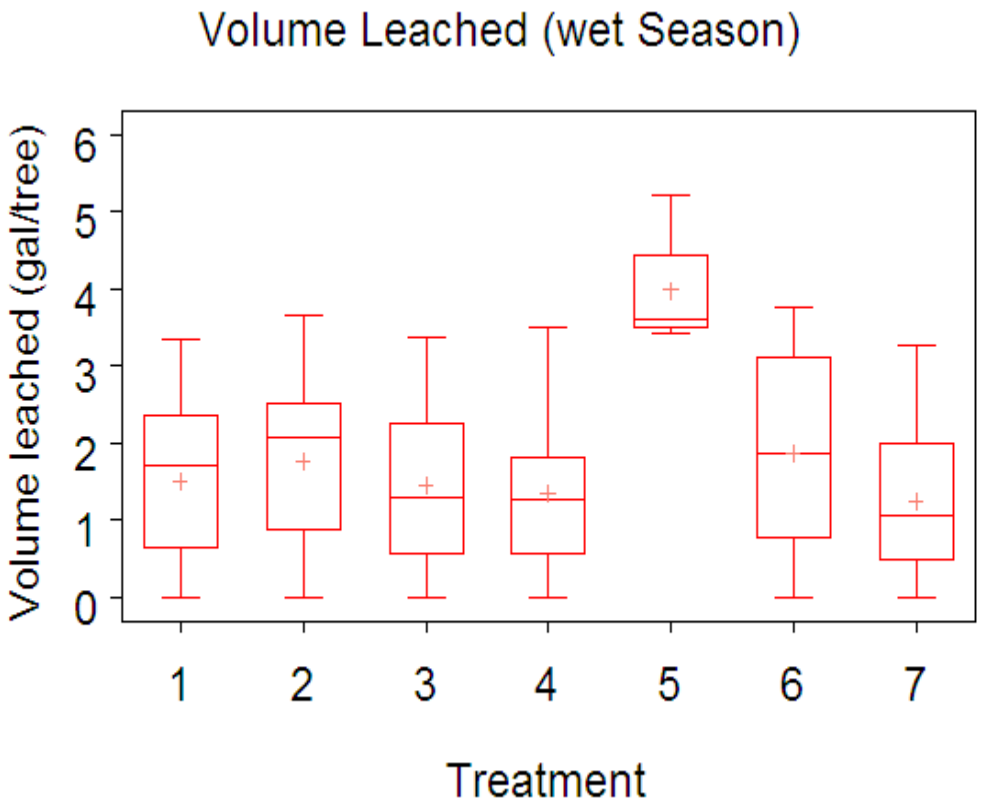
Item	Activity	Occurrence	Analysis	Purpose
1	Record irrigation water applied per treatment and soil moisture.	Every week	Statistical	Compute Averages for water use and soil suction per treatment
2	Collect of leachate from bucket lysimeters	Every month.	NH_4^+, NO_3-N, and PO_4-P and TP	Leaching assessment.
3	Apply fertilizers (8-3-9) four times a year.	Four times in a year (during fruiting period)		Support growth
4	Collect soil samples	Three times in a year	NH_4^+, NO_3-N, and PO_4-P and TP	Nutrient mass balance.
5	Record tree diameter	Once a year		Compute yields kg/diameter
6	Avocado harvest	June-Sept	Statistical	Difference among treatments

Costs and return analysis

No.	Item
1	**Operating costs** - Fertilizer - Fungicide - Insecticide - Interest on operating capital - Other
2	**Fixed costs** - Land rent - Supervision- Overhead - Other
3	**Harvest and marketing costs** - Sell (brokerage) - Pick, pack, and haul - Other
4	**Miscellaneous** -Site preparation - Set trees - Irrigation -Labor -Grower Association Fees - Top, head prune - Mow middles – Tree replacement

Results





TREATMENTS

1-ET+SFR

2-ET+0.5 SFR

3-ET+2 SFR

4-SM15cbar+ SFR

5-SIR+SFR

6-SM15cbar+ 0.5 SFR

7-SM15cbar+ 2 SFR

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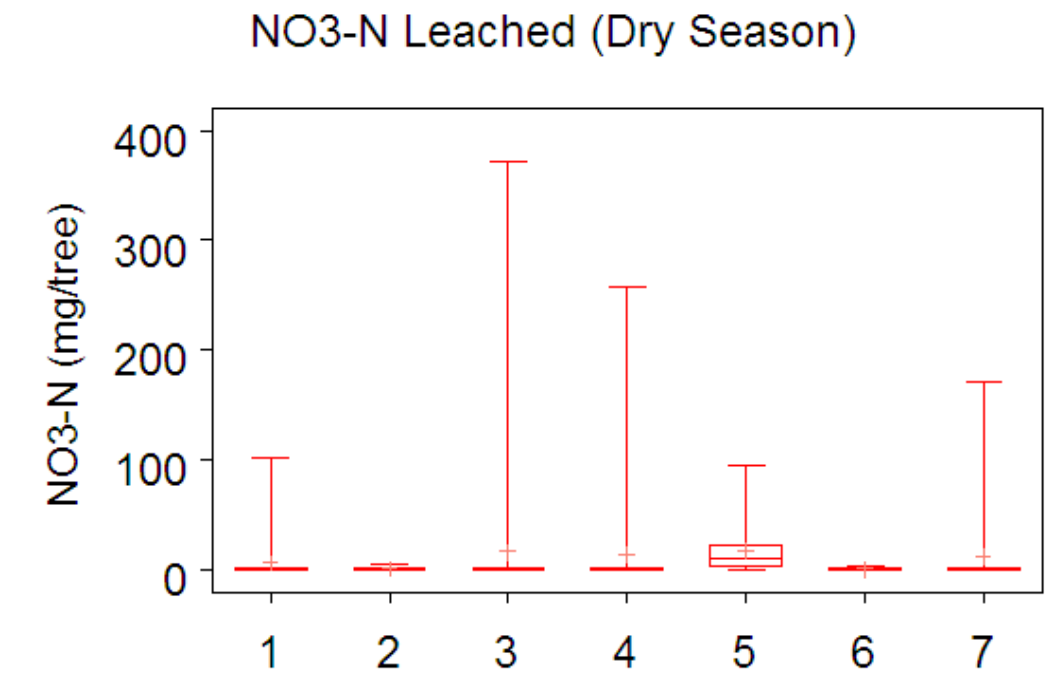

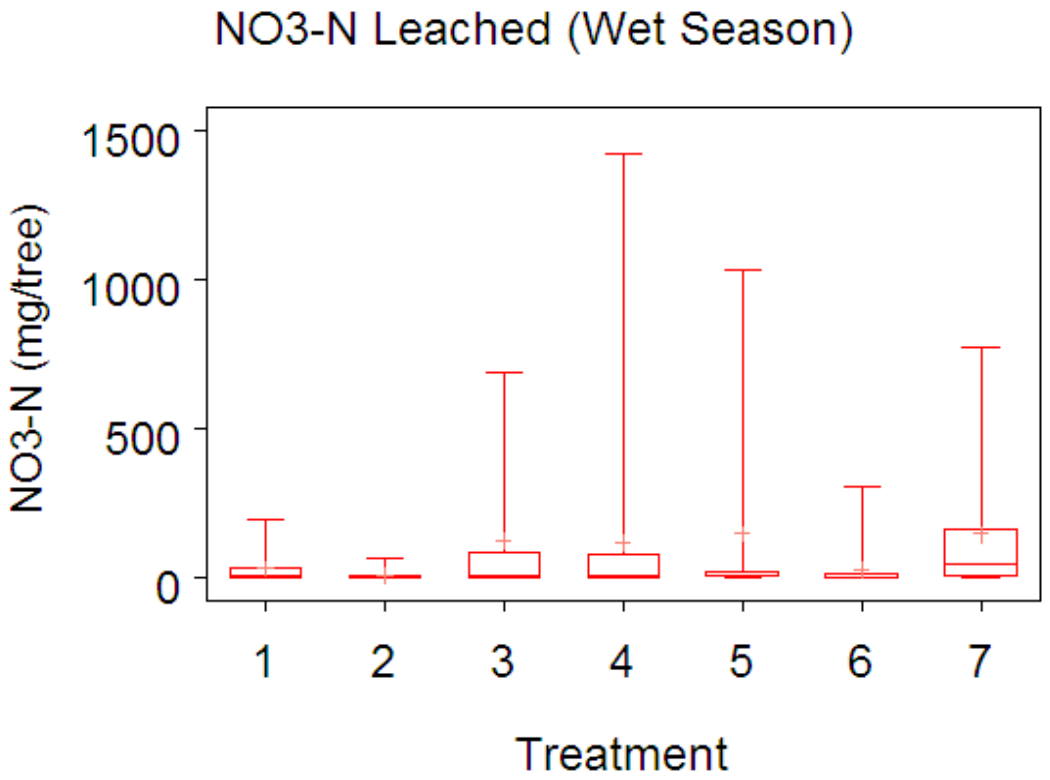

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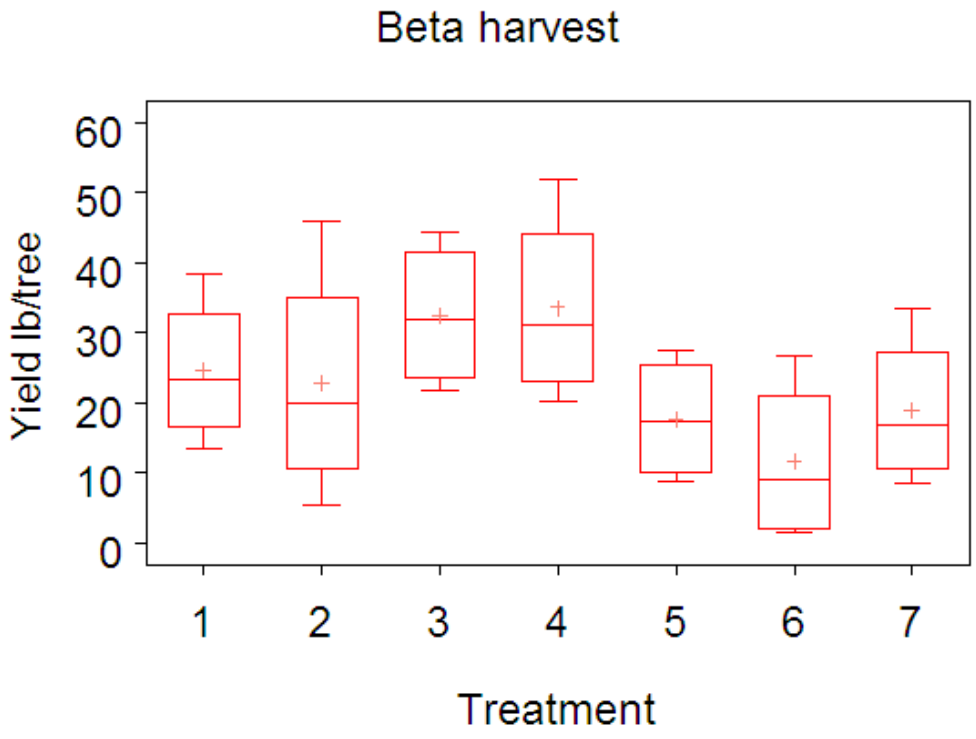
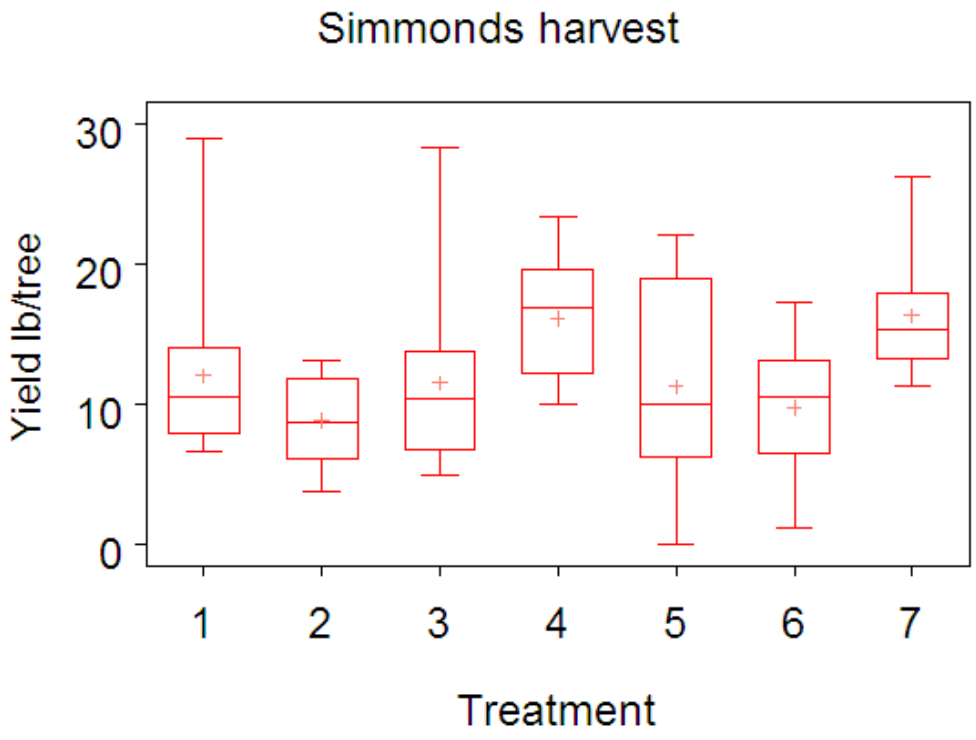
Harvest and weighing Simmonds avocado

Harvest and weighing Beta avocado





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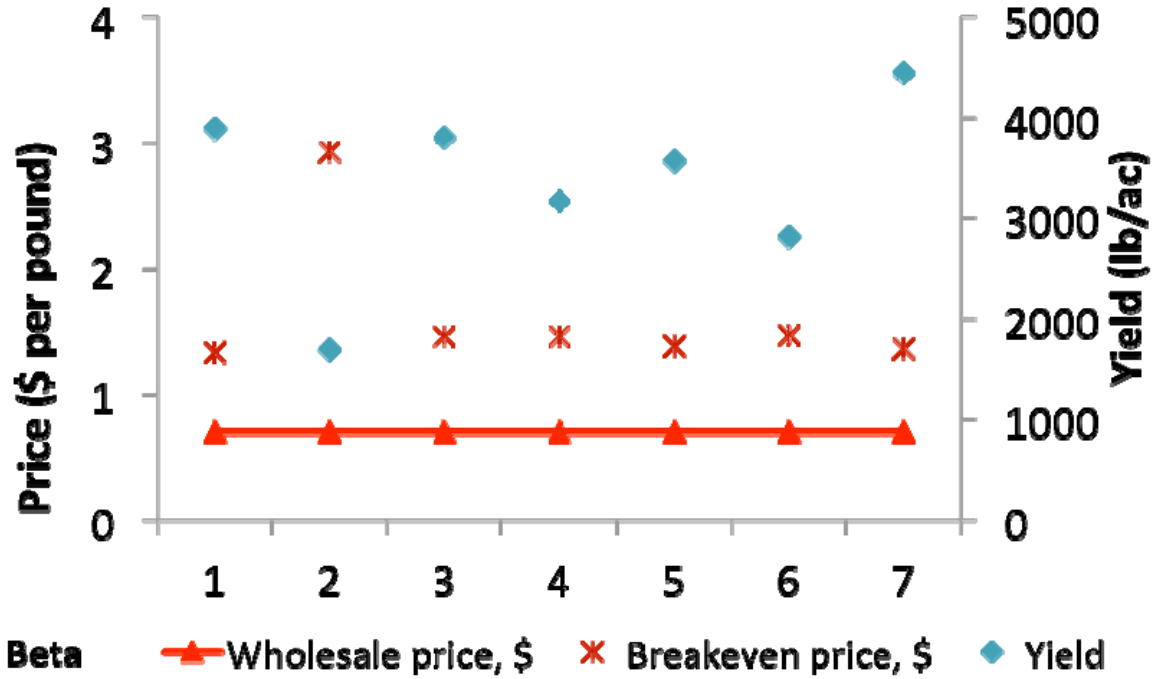

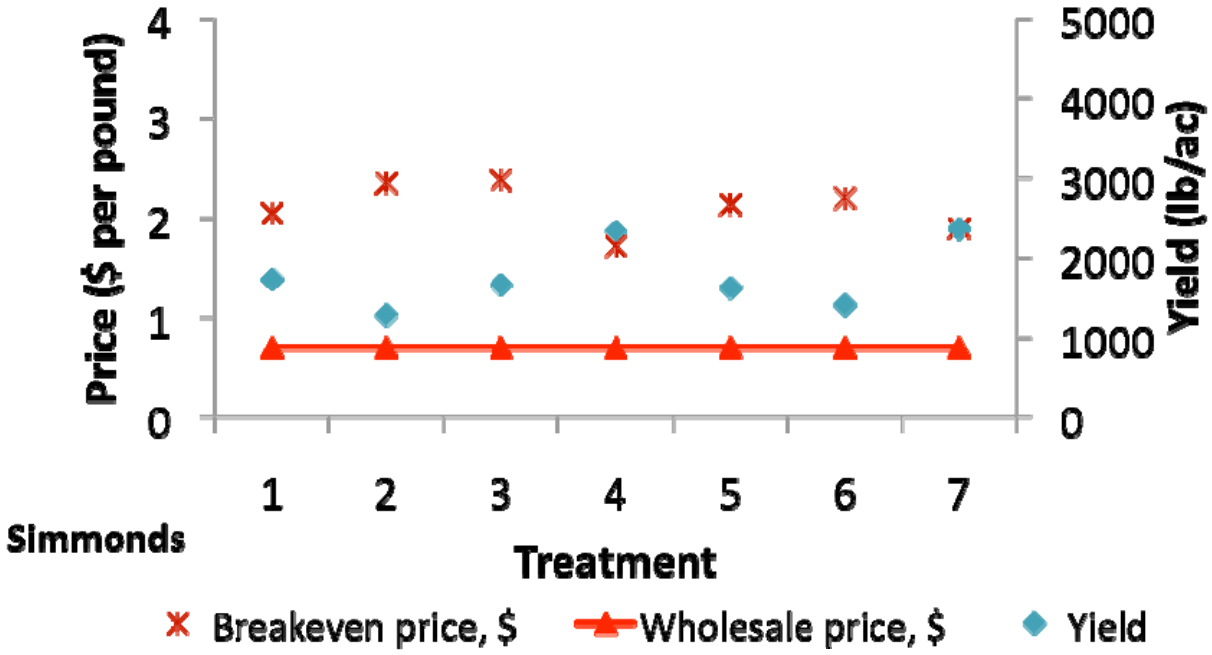

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Conclusion

- The amount of N leached depended on the amount of fertilizers applied and irrigation water volume. While P leached depended on volume of water applied.
- P leaching can be reduced by about 30% in wet season and 85% in dry season by implementing soil moisture or ET based irrigation.
- Water savings of 90% or more can achieved by implementing Soil moisture or ET based irrigation.
- The most economically viable BMPs, were Treatment 1 for Beta and Treatment 4 for Simmonds.

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Thank You

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