Soil Carbon and Nitrogen Management in Mangoes.

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Australian Government

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Australian Mango Soils

Soil features

- Light – medium textured
- Low water holding capacity
- Low organic carbon (<1.0%)
- Low nutrient holding capacity

Management features

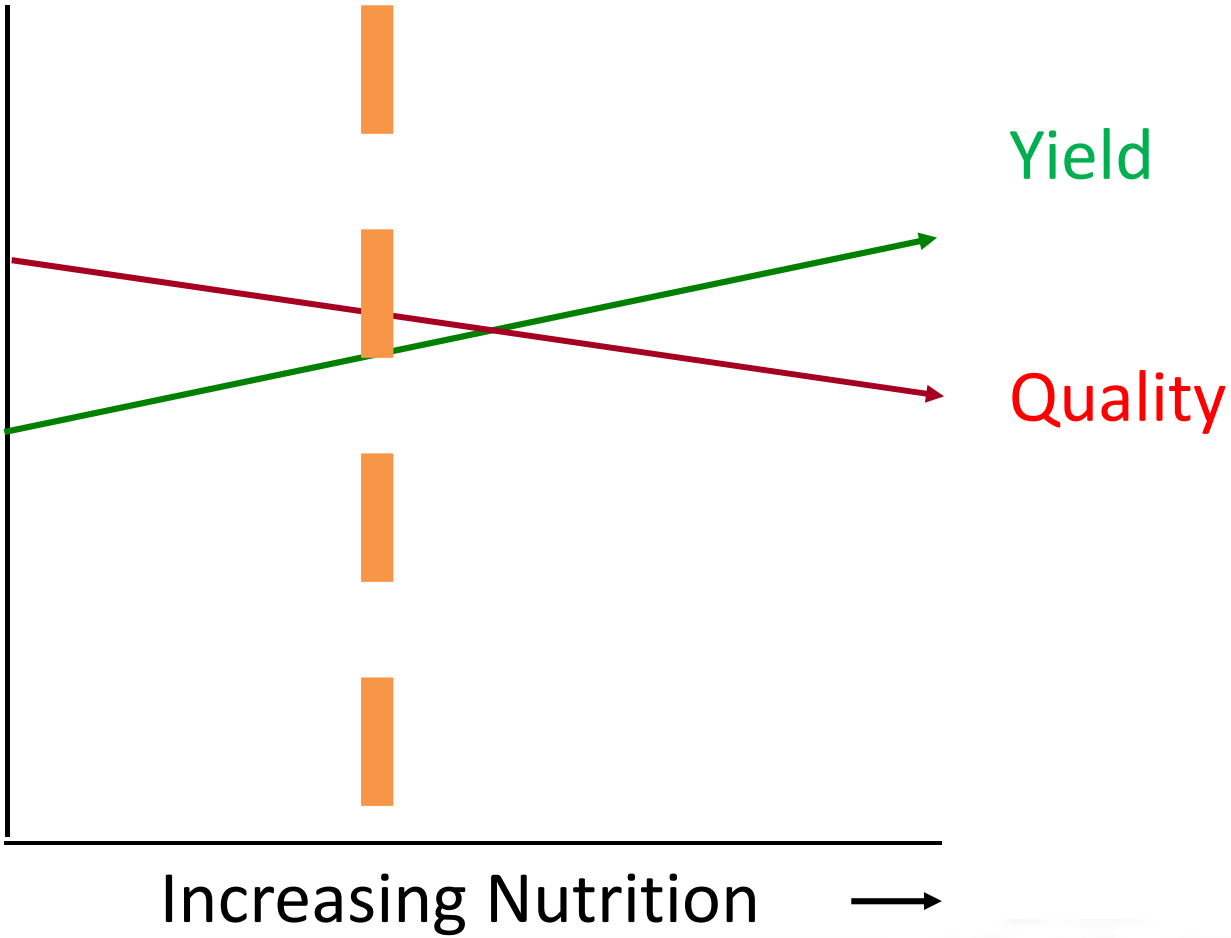
- Easy to manipulate nutrient and water
- Water stress to induce dormancy and stimulate flowering
- Low N levels = less fruit defects

Conventional management
"Bare-earth strategy"

- Regular weed control
  - Herbicide to rows
  - Regular inter-row slashing
- Disease management
  - Removal of leaf and branch litter under trees
- Inorganic fertilisers
  - Broadcast, fertigation, foliar
- Loss of top-soil
- Depletion of soil organic matter
- Low nutrient & water-holding holding capacity

Mango industry issues

Under – productive **Irregular bearing**



Action-on-the-Ground Project

Improved Soil Health of Mangoes

1. Increased Soil Organic Carbon by mulching

- Nutrient holding capacity
- Water holding capacity
- Biological diversity
- Porosity and aeration
- Soil stability (less erosion)
- Buffer against climatic extremes
- Fruit yield and consistency

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QUEENSLAND GOVERNMENT

Action-on-the-Ground Project

Improved Soil Health of Mangoes

2. Controlled-Release Nitrogen Products

- Reduce N losses
- Increase N availability
- Improve N efficiency
- Increase fruit yield and consistency

Two Mango Orchard Trials

- **Demonstration site**
- **Intensive experiment**

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QUEENSLAND GOVERNMENT

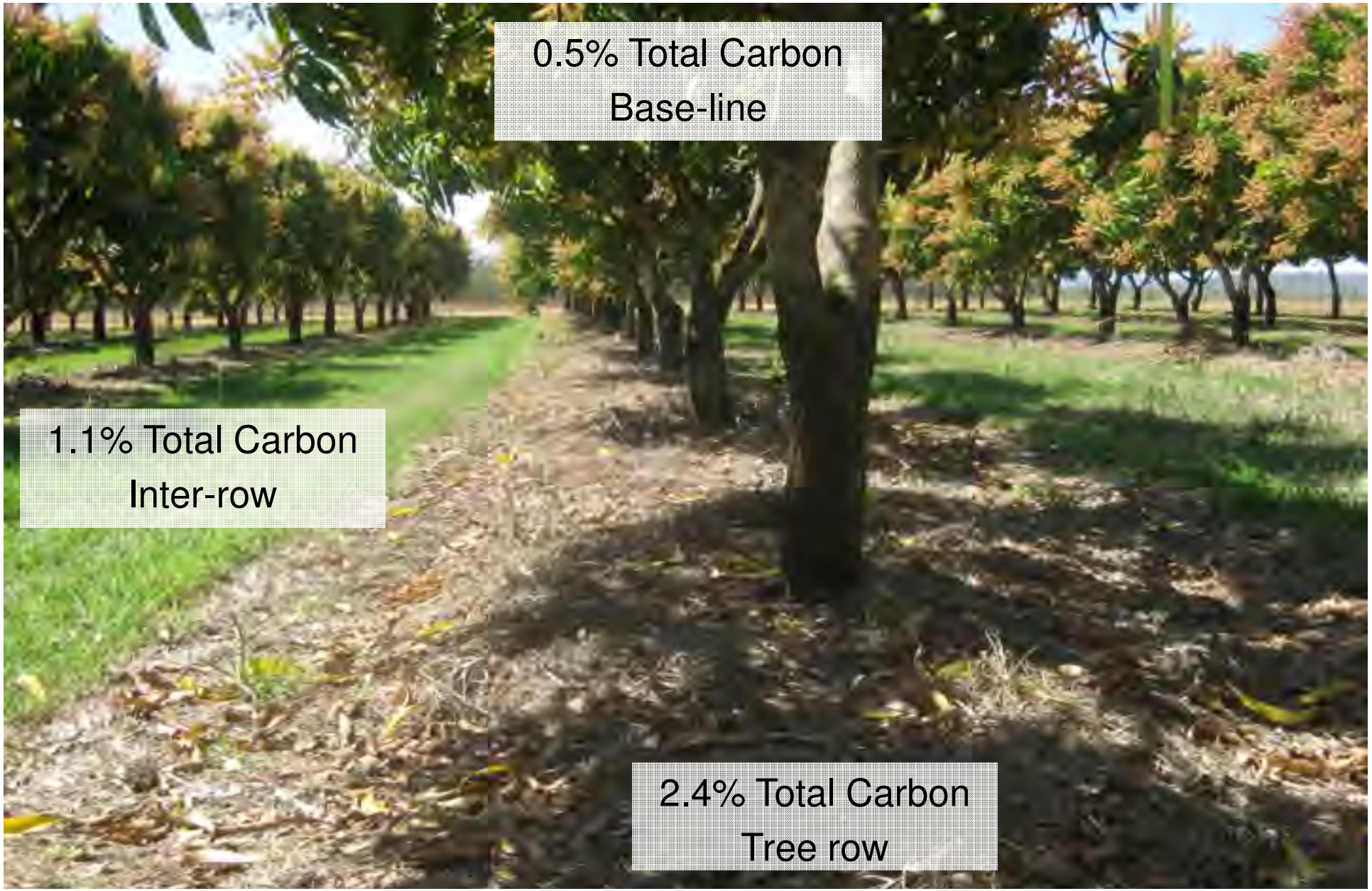
Site 1. Blushing Acres – Sam & Kylie Collins, Dimbulah

Promote inter-row growth for use as mulch

Site 1. Blushing Acres – Sam & Kylie Collins, Dimbulah

Side-throw slash 3-4 times, 5 tonnes mulch/year

Site 1. Sam & Kylie Collins



Site 1. Sam & Kylie Collins

Site 1. Sam & Kylie Collins

Inter-row groundcover – a haven for beneficials

- Bees
- Flies
- Lacewings
- Mantids
- Parasitic wasps
- Predatory Bugs
- Spiders

Site 1. Sam & Kylie Collins

Anecdotal benefits of mulch

- Reduced herbicide use
- Reduced irrigation
- Reduced fertilisation
- Refuge for beneficial insects

High yields (Honey Gold)

- 17 T/Ha – 3 year average

No fruit quality issues

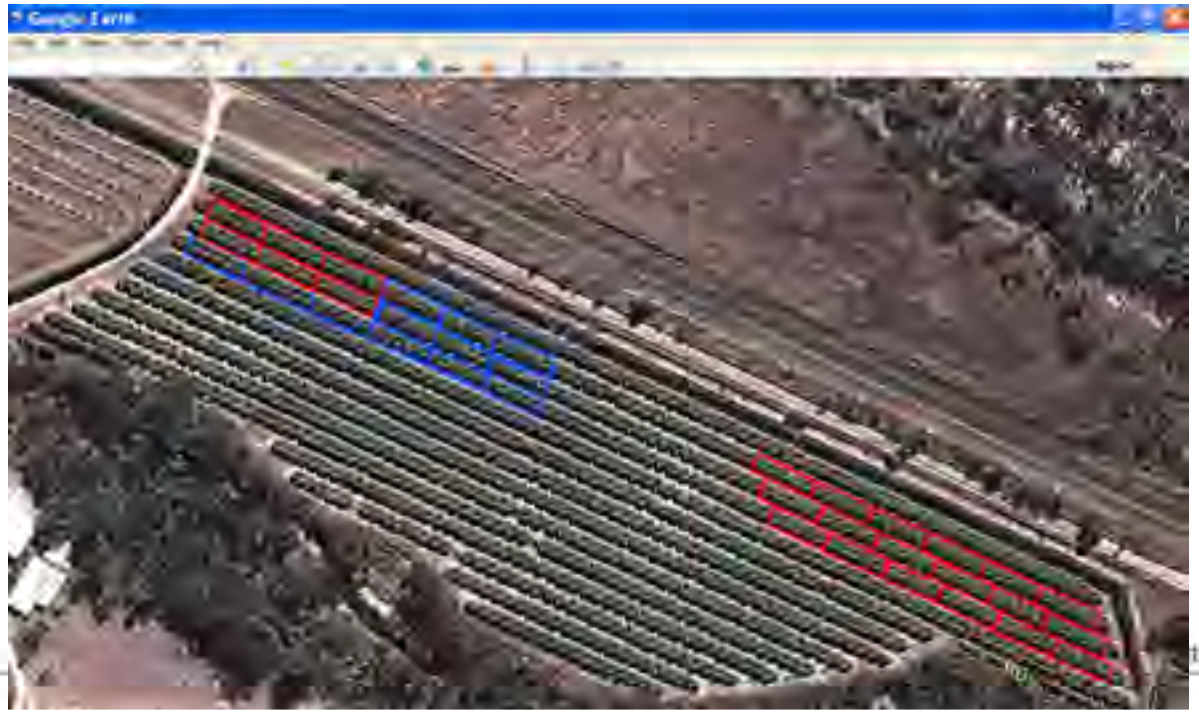
Site 2. “Samdara” – Adrian & Alfina Zugno, Mutchilba

- Conventional ‘bare earth’ management
- 0.8% Total Soil Carbon

- Intensive nutrition and soil moisture monitoring program
- 18T/Ha average yields (KP)

Site 2. Adrian & Alfina Zugno

- Treatments commenced in Jan 2014
- Hay mulch applied annually
- Three nitrogen fertiliser products (at 66kg N/ha/Year)
  - Urea
  - Entec® Urea (+ nitrification inhibitor)
  - Agrocote® Urea (Controlled release fertiliser)



Site 2. Adrian & Alfina Zugno

Hay mulch applied at 11T/Ha/Year over 3 years

Site 2. Adrian & Alfina Zugno

Mulch nutrient inputs (11 Tonnes/Ha)

Element	Mulch	Kg/Ha
N	0.5%	**66**
P	0.2%	**20**
K	2.1%	**230**
Ca	0.2%	**20**
Cl	0.7%	**80**

Site 2. Adrian & Alfina Zugno

Mango leaf nutrients analysis

Element	No Mulch	Mulch
N	1.18%	1.21%
P	0.16%	0.16%
K	**0.86% a**	**1.03% b**
Ca	2.7%	2.6%
Cl	**0.06 a**	**0.08 b**

Site 2. Adrian & Alfina Zugno

Mango phenology

Positive effects of mulch

- Canopy leaf area increased by 10%
- Root biomass (top 10cm of soil) increased by 20%.

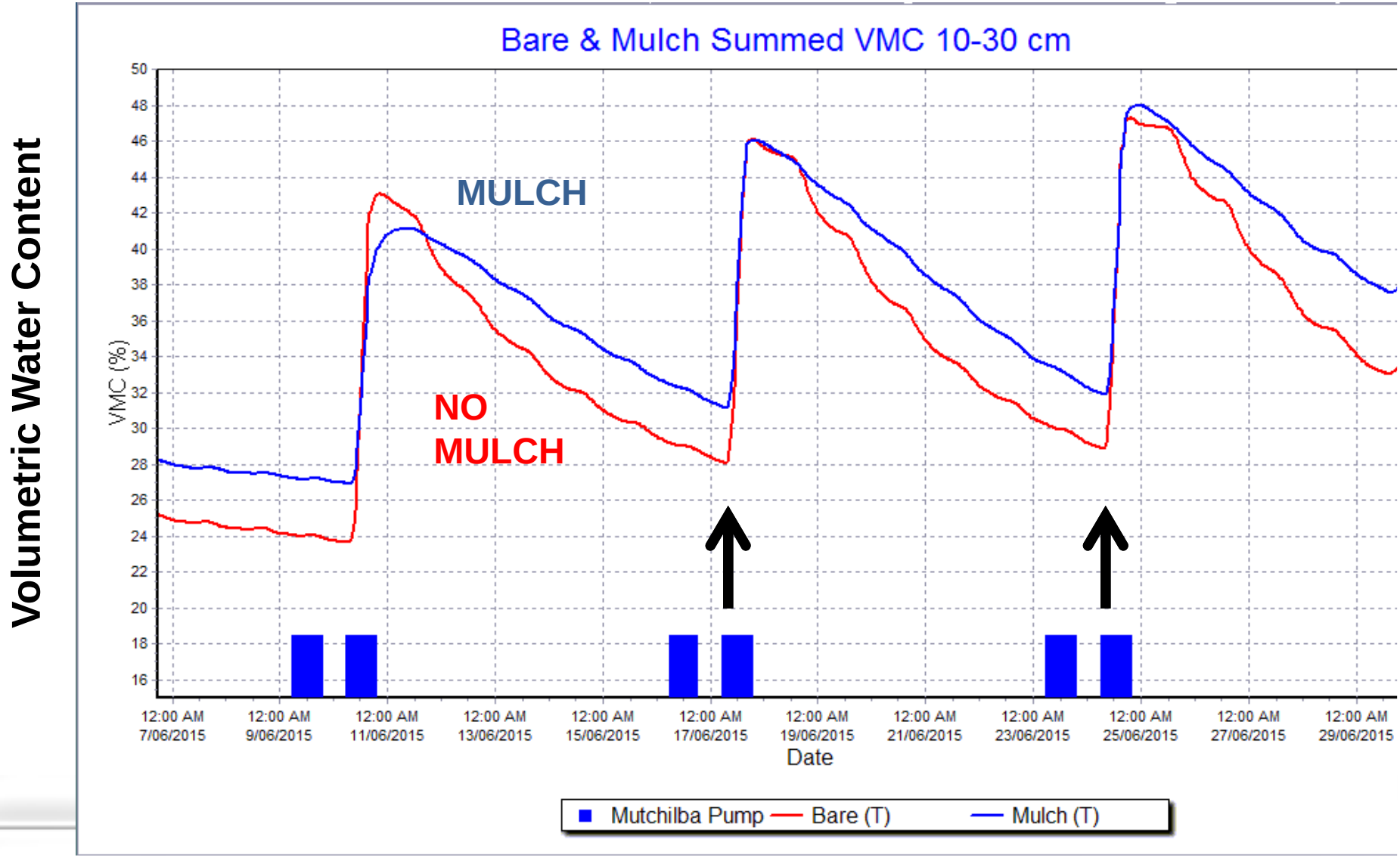
Site 2. Adrian & Alfina Zugno

Soil biology

- Changes within 12 months
- Greater microorganism diversity
- Large reduction in parasitic nematodes
- Large increase in detritus nematodes

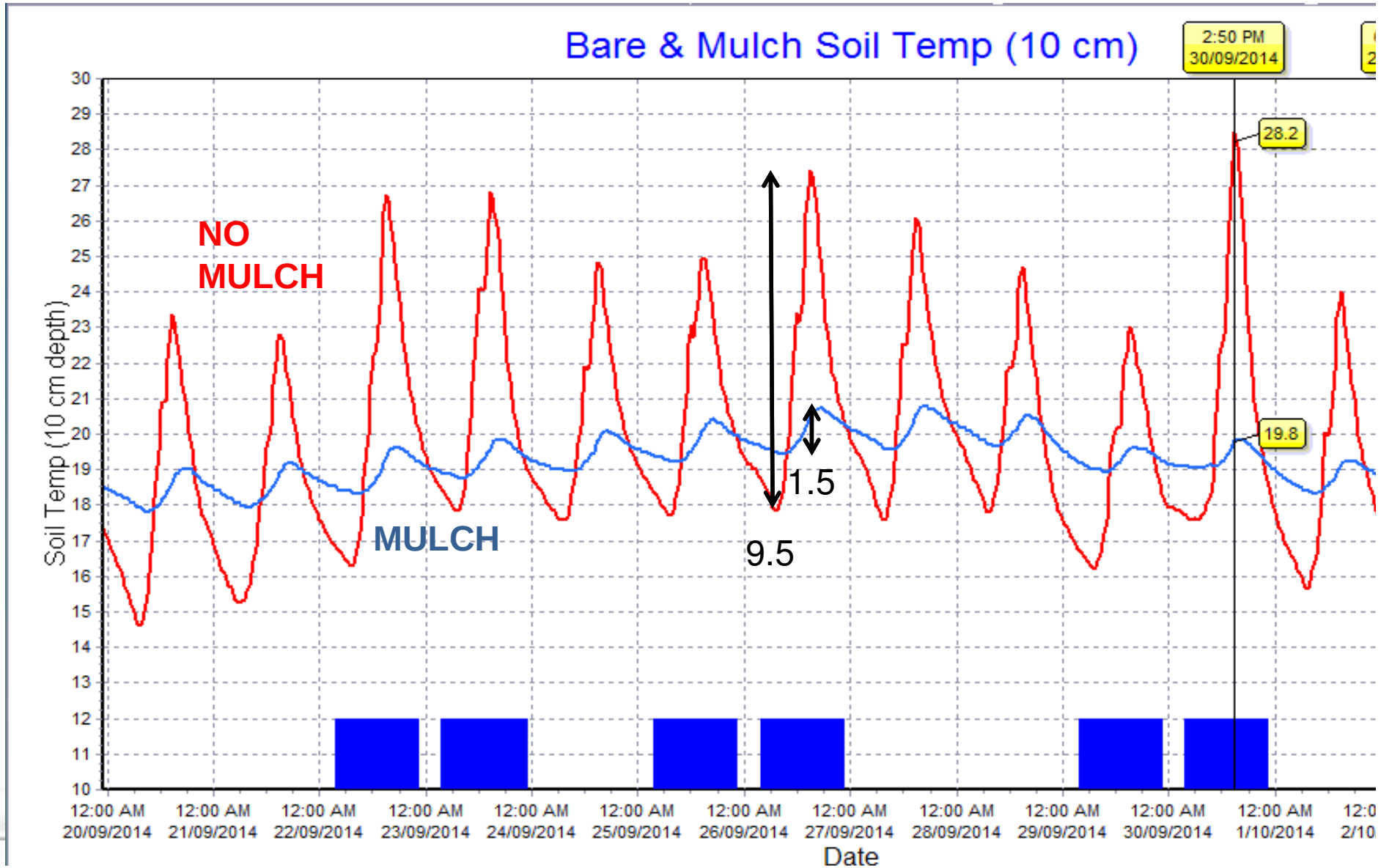
Site 2. Adrian & Alfina Zugno

Soil moisture



Site 2. Adrian & Alfina Zugno

Soil temperature



Site 2. Adrian & Alfina Zugno

Fruit yields/tree – 2016 season

	No Mulch	Mulch
Fruit Number	196	199
Fruit Weight	**329g a**	**361g b**
Fruit Yield	**64.4kg a**	**71.7kg b**

Site 2. Adrian & Alfina Zugno

Fruit quality – 2016 season

No effects on:

- Fruit blush (harvest)
- Fruit colour
- Fruit firmness
- Body rots (post harvest Scholar® hot-dip)

Small effects on:

- Body rots (non-dipped)
  - 22 days post harvest
  - Number of fruit with >5% body rots
  - 2015 season. Mulched 24%, Non-mulched 12%
  - 2016 season. Mulched 48%, Non-mulched 39%,

Effects of increasing soil organic carbon in mango orchards

Soil

- Buffering of soil temperatures
- Increased soil water holding capacity
- Increased microbial biodiversity and proportion of ‘beneficial’ microorganisms.

Plant

- Increased plant nutrient levels (Potassium)
- Increased plant canopy size
- Increased surface root biomass
- Increased fruit size and overall fruit yield
- Fruit quality unaffected (when fungicide dipped)


THANK YOU