

Sustainability Field Studies 2000/2001

Developing An Environmental Management Systems Framework For Processing Tomatoes

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A Global View of Sustainability

This 2-Phase project is funded by a partnership between Unilever Australasia & Horticulture Australia Ltd.

Phase 1 of the project (July 2000-August 2002) involves monitoring the processing tomato field environment for 2 growing seasons (no treatments applied) on 5 tomato farms in Australia.

The aim of phase 1:

Evaluate a range of field-measurable variables for their sensitivity as indicators of sustainable agriculture,

Assess the impact of standard crop management practices upon the environment, and

Develop an Environmental Management Systems Framework to facilitate adoption of Best Management Practices



130 Sustainability Indicators Under Review

Soil Fertility & Health

Indicators, including earthworm density and biomass, microbial biomass, microbial fauna & flora, mycorrhiza (Figure 1), bulk density, slaking, dispersion, soil pH, soil salinity, organic matter levels, phosphorus, nitrogen, cation exchange capacity and heavy metals were monitored to assist a better understanding of soil health and its link to environmental sustainability.

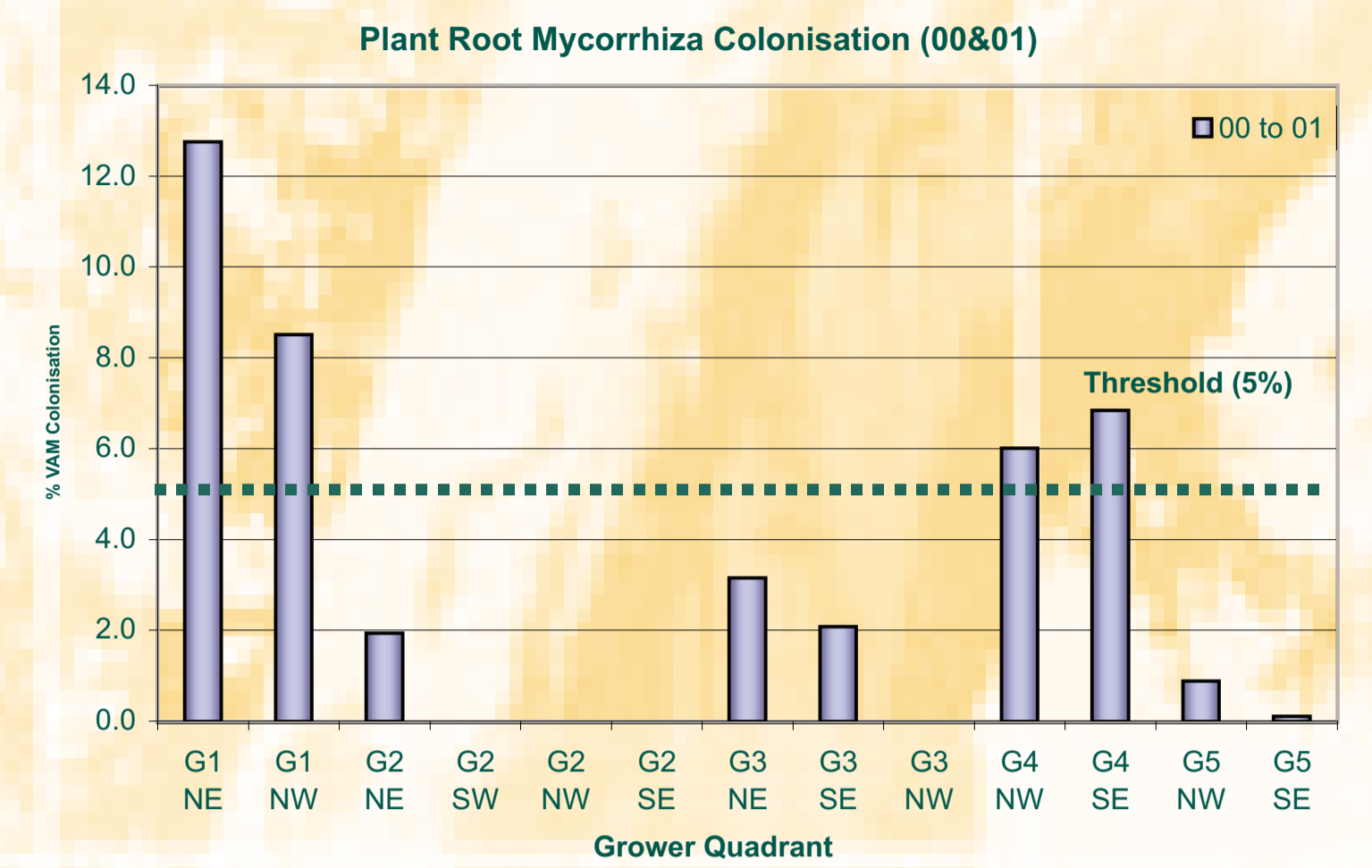


Figure 1: Plant Root Vesicular Arbuscular (VAM) Mycorrhiza Colonisation of Tomato Root Samples

Soil Loss

Indicators including number & type of cultivations, vehicle traffic movements and tonnes of soil exported to factory are under review. Figure 2 provides an example of the soil loss and yields for the 2000/2001 season.

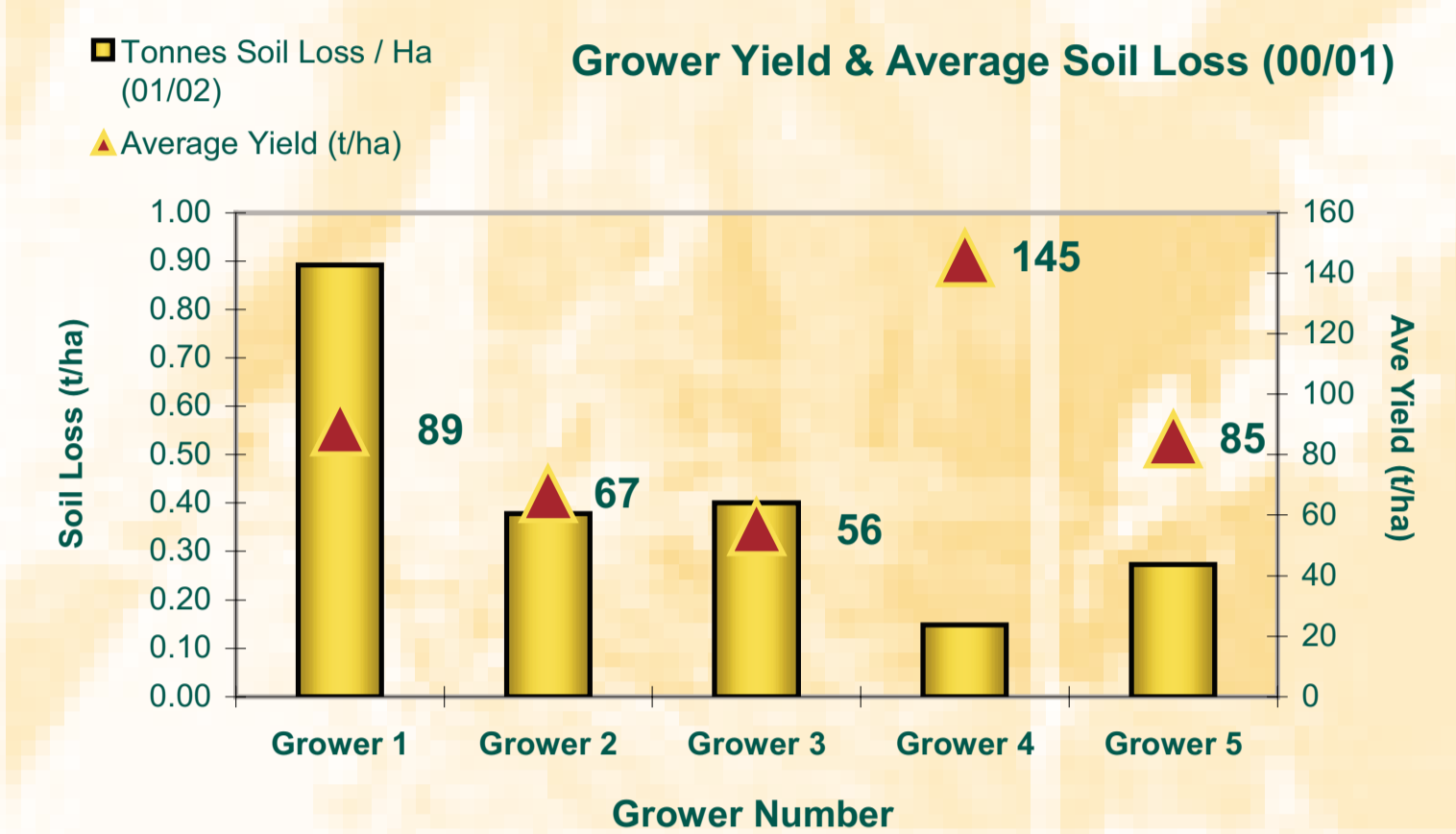


Figure 2: Grower Yield Vs Soil Loss (2000/2001)

Nutrients

Figure 3 provides an example of the nitrogen inputs for season 1. A range of nutrient indicators are monitored and a nutrient budget was developed for season-1 for each farm. The type and rates of fertilizer, frequency, timing and application methods were studied. Several techniques were evaluated to consider the potential losses of nutrients to the environment including deep soil testing, ceramic cups and ground water test well assessments.

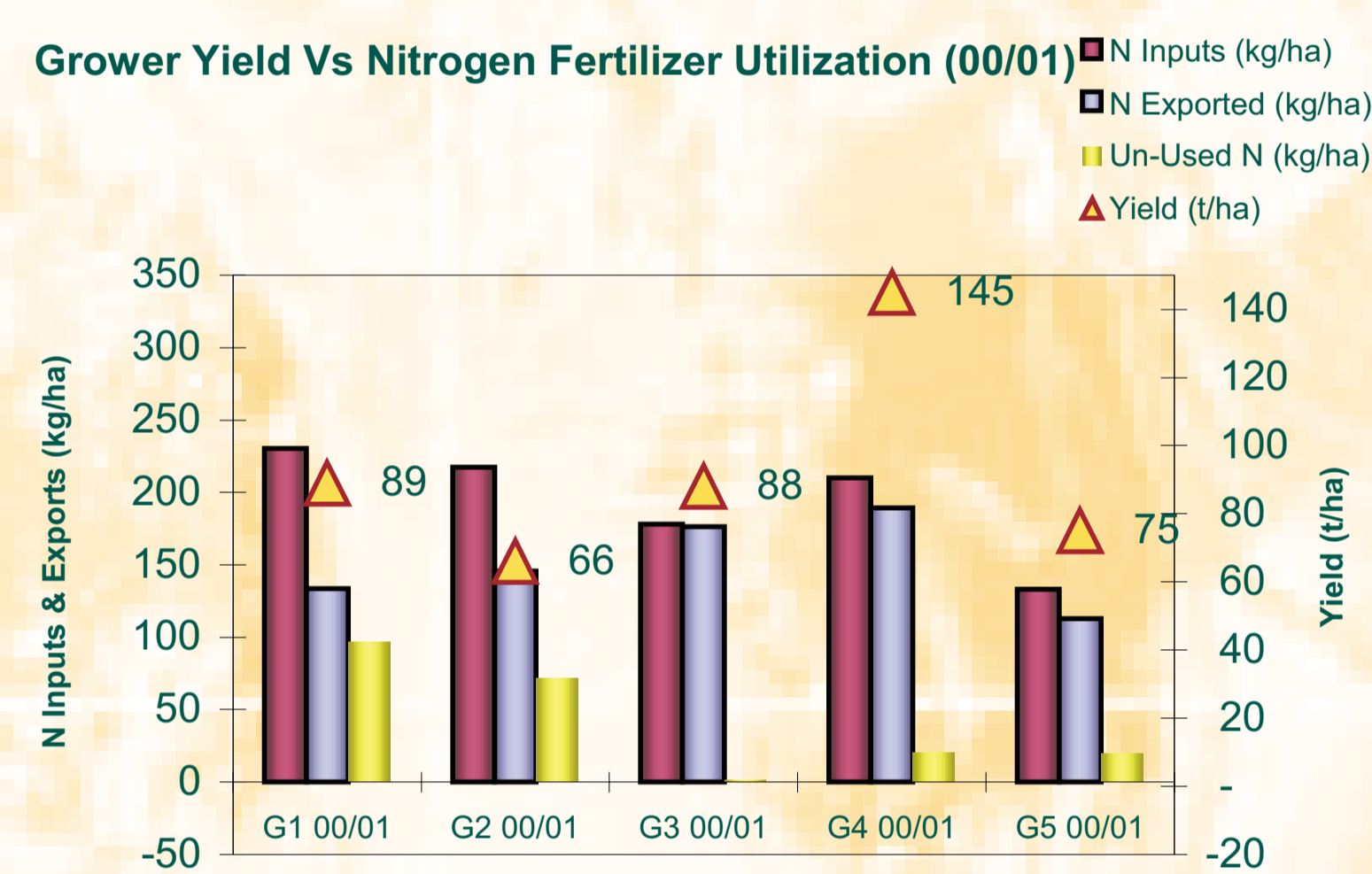


Figure 3: Grower Yield vs Nitrogen Fertilizer Utilization (2000/2001)

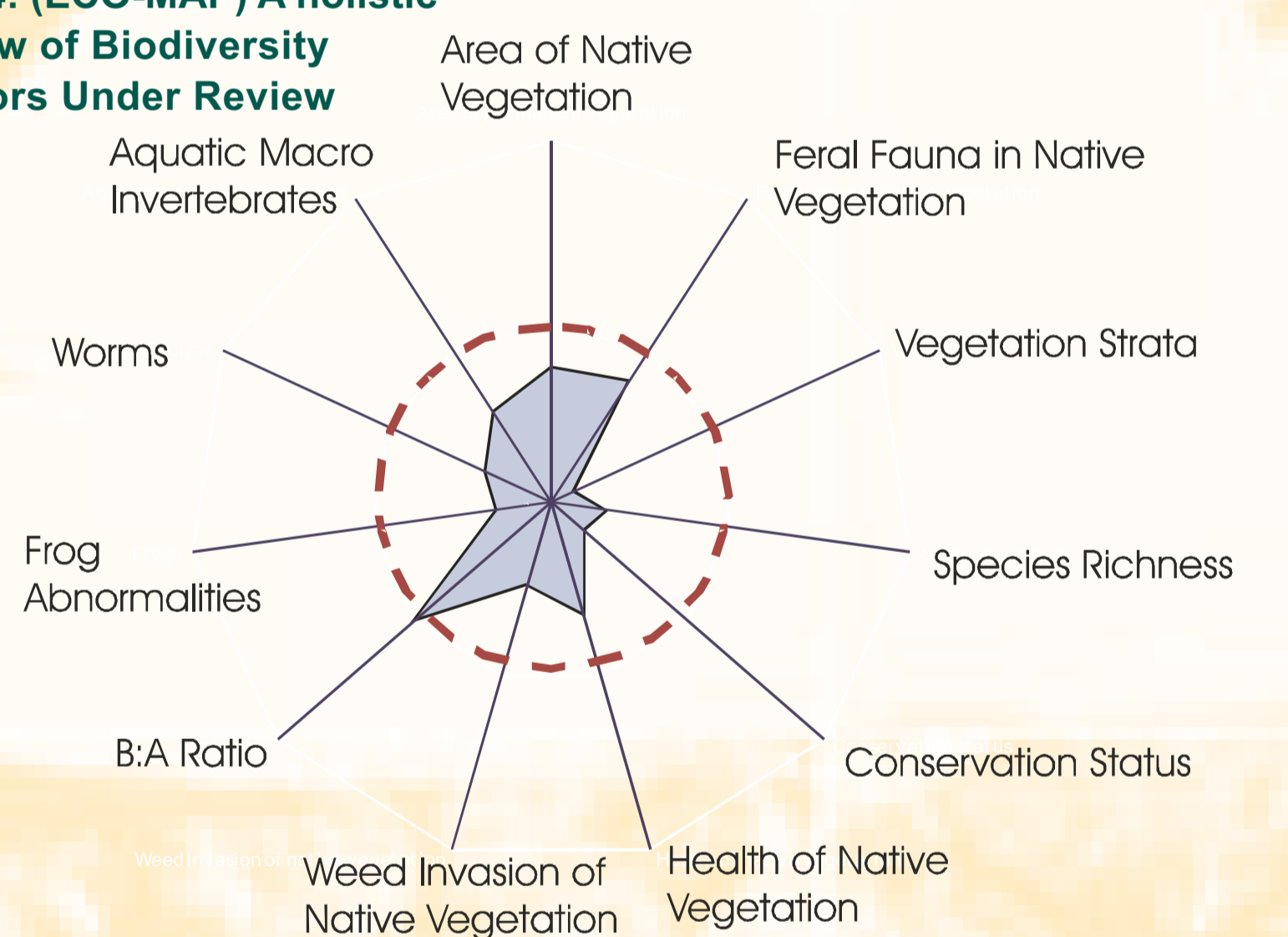
Pest Management

Pest profiles and the presence of beneficial insects were monitored along with the chemicals used, their eco-toxicity and fate. Insect traps, soil and ground water sampling were used to help assess current pest management practices and off-target contamination.



Heliophilus Grub

Figure 4: (ECO-MAP) A holistic overview of Biodiversity Indicators Under Review



Biodiversity

Biodiversity indicators ranged from size and shape of native vegetation to macro invertebrates and frog abnormalities. In addition, biodiversity management plans for each farm were developed. From Figure 4 it is seen that several key indicators perform below the threshold deemed appropriate for a sustainable agricultural system.

Water Management

Figure 5 provides a comparison of Profile Soil Moisture for Drip and Furrow Irrigation for 2000/2001 season. Irrigation system method, application uniformity, frequency and timing, water quality and water table depth (Figure 6) provided the basis for water indicator assessments. Water use for season 1 on tomatoes ranged from 3.6 to 7.1 mega litres per hectare. Irrigation system distribution uniformities ranged from 60 to 92%.

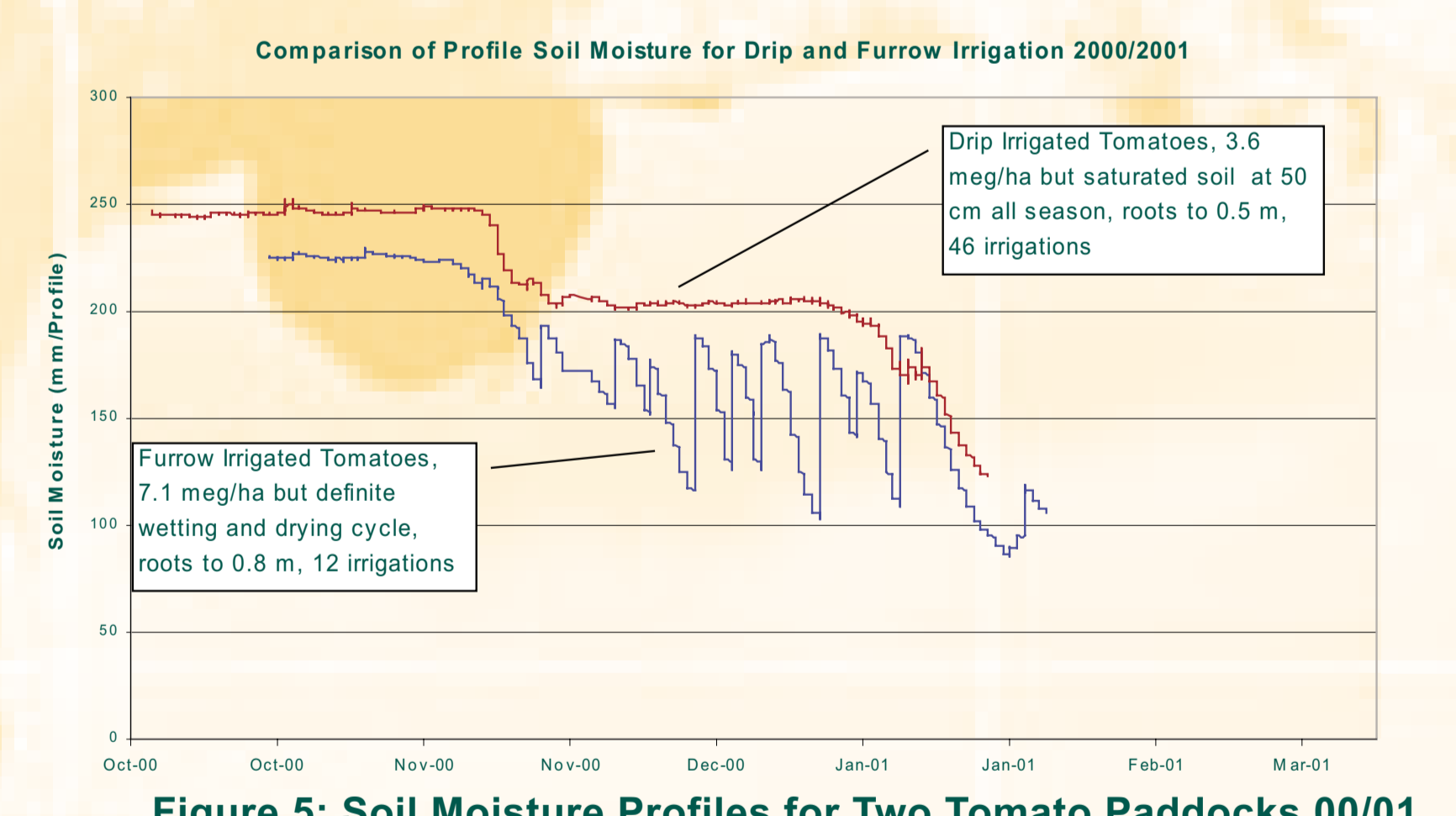


Figure 5: Soil Moisture Profiles for Two Tomato Paddocks 00/01

Energy & Greenhouse Emissions

In collaboration with the Australian Greenhouse Office, several energy indicators were reviewed. Fuel and electricity use, soil disturbance, tomato trash management and presence of native vegetation on the farm were considered.

Product Value

A range of indicators including yield, soluble solids, nutrient value and chemical residues are under review. Grower yields for season one ranged from 49 to 154 t/ha.



The Perfect Crop



Unilever Australasia

Horticulture Australia

Project funded by: Unilever Australasia Limited & Horticulture Australia Limited.

Results Of 2000-2001 Monitoring Season

Study Of The Natural Resource Base

The natural resource base study consisted of:

- A study of existing soil and geology records,
- A detailed grid soil survey for each production and native monitoring site,
- Developing a series of natural resource and environment maps,

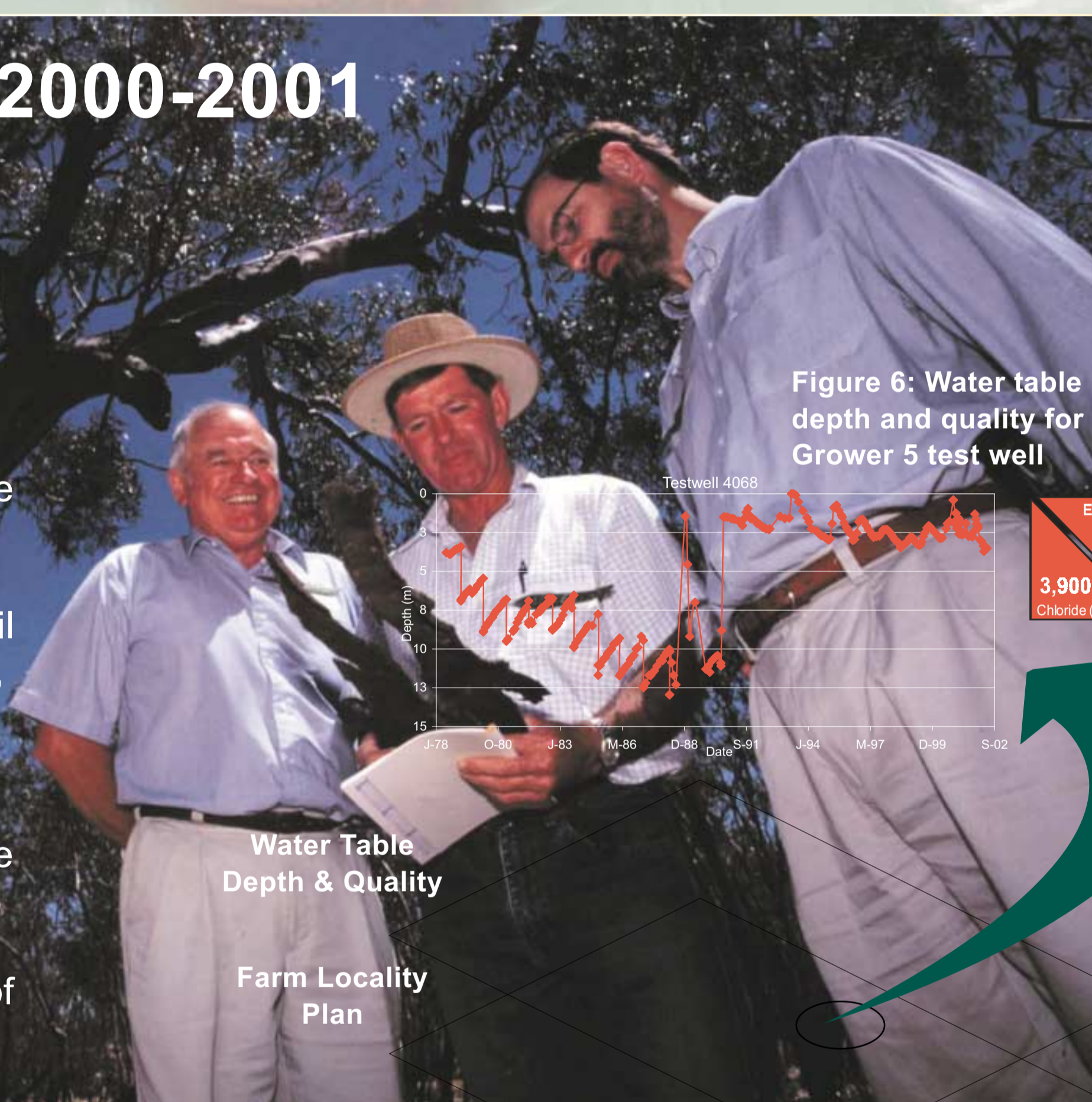
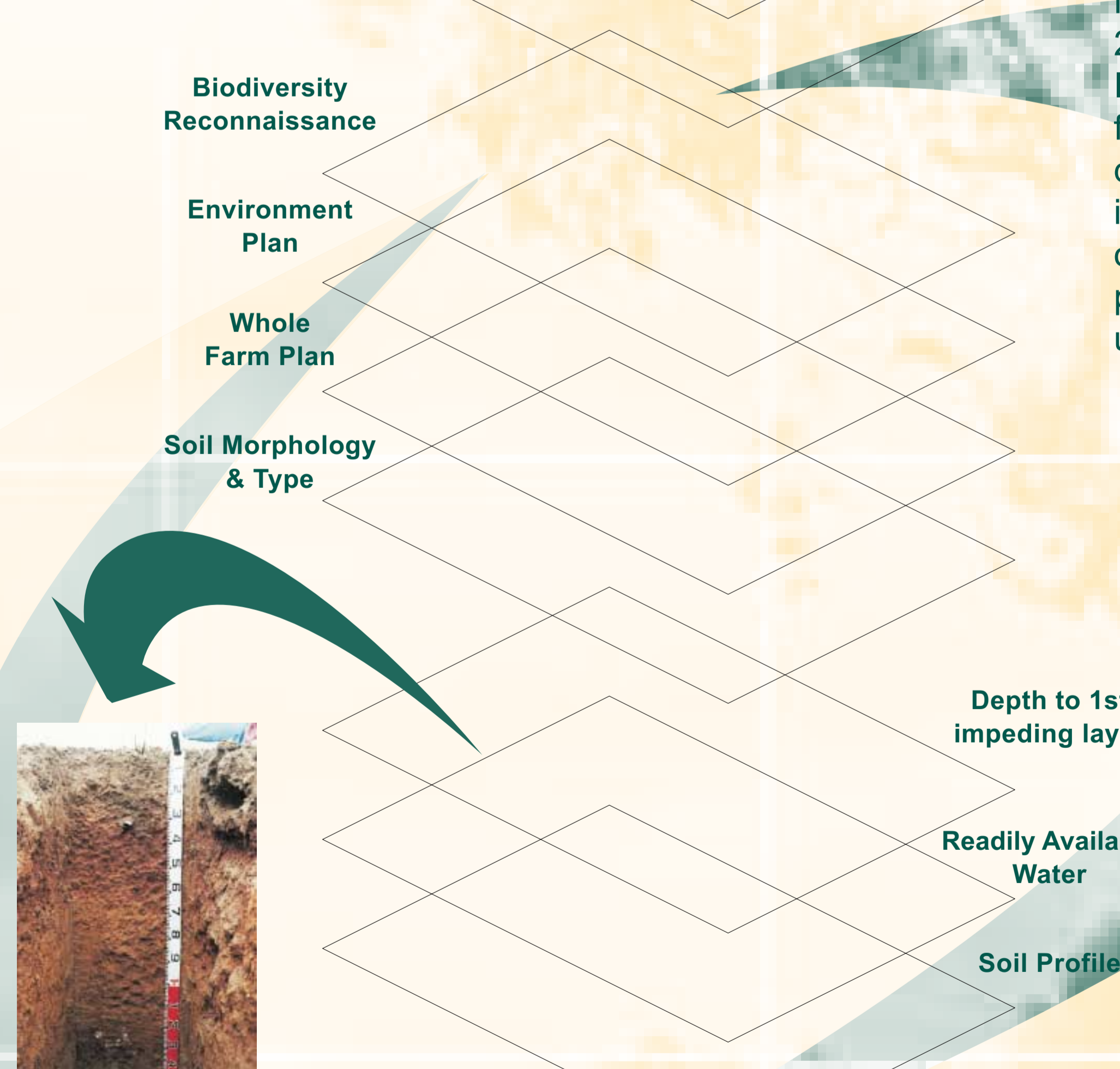


Figure 6: Water table depth and quality for Grower 5 test well

- Detailed soil-pit assessment and analysis for dominant soil types associated with each property,
- Reconnaissance biodiversity assessment for each farm and surrounding areas,
- Identify native monitoring sites for benchmarking purposes,
- Construction of a Graphic Information System (GIS) of the natural resource base.



Conclusions (Season 2000/2001)

Monitoring indicators of environmental sustainability in processing tomato crops in 5 Australian growing environments in the season 2000-2001 showed:

- Some standard management practices have adverse effects upon the environment (e.g. Soil loss, Inefficient Use of Nutrients & Water)
- There is a need for further screening of indicators to confirm those most suited as Sustainability Indicators for the Australian processing tomato field environment
- The ECO-MAP method of displaying the overall state of the field environment in a holistic way, helps identify crop management challenges
- Some of the effects of management upon the environment are quantifiable

See our Web Site: www.outsourcedenvironmental.com.au for further information about this project.

DEVELOPING AN ENVIRONMENTAL MANAGEMENT SYSTEMS FRAMEWORK FOR PROCESSING TOMATOES

Field Studies 2000/2001

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Keywords: Tomato, sustainability, environment, indicators, monitoring, holistic, methodology

Abstract:

A 2-season field monitoring trial to assess the environmental impact of growing processing tomatoes in Australia is reported. The results from the first season's monitoring data are outlined and illustrated. The current phase of this project formally concludes at the end of August 2002, at which time a formal report will be available via the Internet. A wide range of information about the project is available from www.outsourcedenvironmental.com.au

INTRODUCTION

A Sustainable Agriculture Project for processing tomatoes (SAP) commenced in July 2000 as a result of a research partnership led by Unilever Australasia and Horticulture Australia. The aim of SAP is to identify issues affecting the environmental sustainability of growing processing tomatoes and so lay a foundation for developing a more sustainable production system for the future. An Environmental Management Systems (EMS) framework is under development and it is envisaged that this system will combine best management practices into a tool for on-farm use and supply chain assurance.

METHODS:

Variables believed linked to sustainability were specified by Unilever as a result of field research with vegetable crops; the variables were classified into ten "clusters", eight of which are the focus of this project, namely - Soil Fertility/health, Soil loss, Nutrients, Pest Management, Biodiversity, Water management, Energy and Product Value. Growers were selected to represent the range of environments and management practices encountered within the processing tomato industry. Conventional scientific rigour was applied to the acquisition of field data.

Following a Literature review, a set of field-assessable variables that collectively offer a holistic description of the natural resource base involved in growing processing tomatoes, were selected for monitoring over 2 growing seasons on 5 farm properties representing the diversity of industry management practices & field environments in Northern Victoria and Southern New South Wales. Monitoring data was evaluated for linkages, which might - assist the resolution a Grower Audit System of Sustainability Indicators; contribute to Industry Best Practice Guidelines for the sustainable production of processing tomatoes; offer a holistic statement of the agri-ecosystem on a growers property; assist in developing of both field methods and indicators for their relevance to monitoring the processing tomato field environment, and provide base-line or interpretive/reference values for further work with the processing tomato industry.

No treatments were applied and no direct influence upon grower management practice was made, the aim being to observe and measure the variables during the normal seasonal cycle of tomato cropping under standard management in an unobtrusive way.

RESULTS & DISCUSSION:

Phase 1 of this project involved a *Ramp-up* stage and a *2-year-field-monitoring* stage spanning July 2000 – August 2002. Key learning's from the first monitoring season include;

Initial Environmental Review

This detailed review was conducted in August 2000 and involved the five Farmers, their families and employees over a two-day period per farm. The review examined - current management practices, current or potential environmental impacts, sensitive neighbouring environments, grower and community concerns etc. Detailed information was collected to help the SAP project team establish priorities to select environmental indicators and focus the field research for the monitoring stage. Each farmer received a detailed report plus initial risk-aversion recommendations, many of which were implemented immediately. A review of all 10 Unilever Sustainable Indicators occurred. **Key Learning's include;**

- Up to 17 different tillage activities were noted for a tomato crop
- Up to 44 individual vehicle traffic movements occurred per season
- 8 to 20 months of year the paddock soil had <50% ground cover
- Biodiversity health was evaluated, but limited native vegetation was found
- 3.3 to 5 litres of diesel fuel is consumed /tonne of tomato crop produced
- Processing tomato yields ranged from 49 to 106 Tonne/ha.
- Both furrow & trickle irrigation methods were used
- Water use efficiency ranged from 4.1 to 9.1 mega litres / ha., or 0.032 to 0.075 Mega Litres/Tonne of tomatoes

Study of the Natural Resource Base

The natural resource base study consisted of;

- a study of existing soil and geology records,
 - conducting a detailed grid soil survey for each production and native monitoring site,
 - developing of a series of natural resource and environment maps,
 - detailed soil pit assessment and analysis for dominant soil types associated with each property,
 - reconnaissance biodiversity assessment for each farm and surrounding areas,
 - identification of native vegetation sites to monitor and for benchmarking purposes.
- The results of this study were compiled into a Graphic Information System for each farm

130 SUSTAINABILITY INDICATORS UNDER REVIEW

In this current phase of the project a range of indicators and methods of assessment were reviewed. The data from season-1 is currently being processed to generate an environmental map (ECO-MAP) for each indicator cluster monitored, together with a summary ECO- MAP for each farm. While season-1 data is inadequate to evaluate the usefulness and sensitivity of sustainability indicators, the following information offers an insight and initial reference point for further investigation.

Soil Fertility & Health

Indicators, including *earthworm density* and *biomass*, *microbial biomass*, *microbial fauna & flora* and *mycorrhiza*, are under review for paddock and native reference soil site; insight is thereby sought into the factors influencing the living component of soil fertility. Soil properties including *bulk density*, *slaking* and *dispersion* also help to evaluate soil physical properties.

Indicators including *soil pH*, *soil salinity*, *organic matter levels*, *phosphorus*, *nitrogen*, *cation exchange capacity* and *heavy metals* were monitored to assist a better

understanding of soil chemical properties and their link to environmental sustainability.

Soil Loss

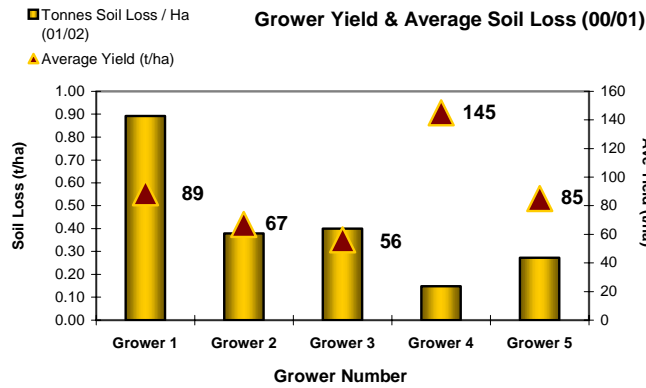


Figure 1: Grower Yield Vs Soil Loss (2000/2001)

Figure 1 provides an example of the soil loss and yields for the 2000/2001 season. Indicators including number & type of cultivations, vehicle traffic movements and tonnes of soil exported to factory are under review.

For example, given the first seasons monitoring, the number of cultivations for the crop ranged from 13 to 17, while total traffic movements ranged from 33 to 44 and amount of soil exported (or kindly donated) to the Unilever Tatura Victoria factory ranged from 0.28 to 0.90 tonnes/ha. of process tomatoes cultivated.

Nutrients:

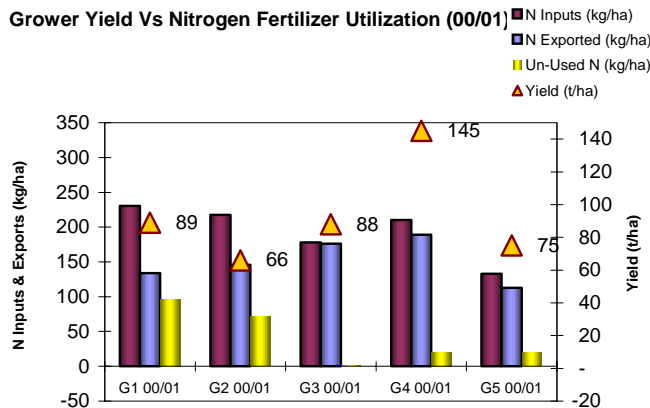


Figure 2: Grower Yield Vs Nitrogen Fertilizer Utilization (2000/2001)

nutrients to the environment including *deep soil testing*, *ceramic cups* and *ground water test well* assessments.

Pest Management

Pest profiles and the *presence of beneficial insects* were monitored along with the *chemicals used*, their *eco-toxicity* and *fate*. Insect traps, soil and ground water sampling were used to help assess current pest management practices and off-target contamination.

Biodiversity

After the initial reconnaissance survey in September 2000, an assessment system was developed and 13 biodiversity indicators were selected for field-testing. Biodiversity indicators ranged from *size and shape of native vegetation* to *macro invertebrates* and

Figure 2 provides an example of the nitrogen inputs for season 1. A range of nutrient indicators are monitored and a nutrient budget was developed for season-1 for each farm. The type and rates of fertilizer, frequency, timing and application methods were studied.

Several techniques were evaluated to consider the potential losses of

frog abnormalities. In addition, biodiversity management plans for each farm were developed.

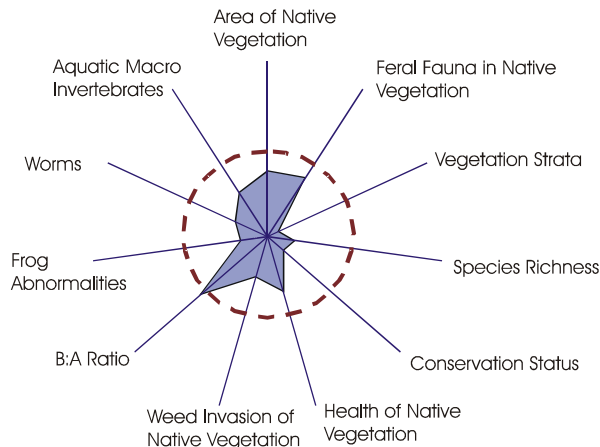


Figure 3 (ECO-MAP) A holistic overview of Biodiversity Indicators Under Review

From Figure 3 it is seen that several key indicators perform below the threshold deemed appropriate for a sustainable agricultural system.

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A range of indicators including *yield, soluble solids, nutrient value and chemical residues* are under review. Grower yields for season one ranged from 49 to 154 t/ha.

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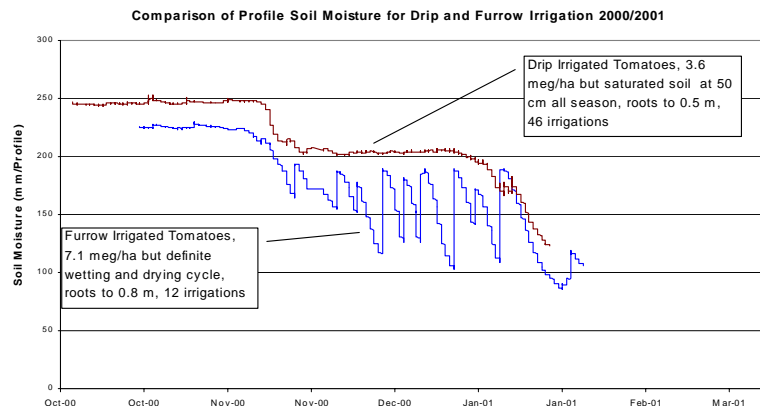
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Water Management

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Irrigation system method, application uniformity, frequency and timing, water quality and water table depth provided

the basis for water indicator assessments.



Water use for season 1 on tomatoes ranged from 3.6 to 7.1 mega litres per hectare.

CONCLUSIONS (Season 2000/2001)

Monitoring indicators of environmental sustainability in processing tomato crops in 5 Australian growing environments in the season 2000-2001 showed:

- Some standard management practices have adverse effects upon the environment (e.g. Soil loss, Inefficient Use of Nutrients & Water),
- Some of the effects of management upon the environment are quantifiable,
- The ECO-MAP method of displaying the overall state of the field environment in a holistic way, helps identify crop management challenges,
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