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Identifying and Managing Variability for Site Specific Management
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A template for addressing productivity and environmental issues
In a sugarcane production system

Precision Agriculture projects

BPS001 project
2007-2011
Establishing geo-referenced management zones within sugarcane paddocks

'Moses' project
2011-2013
Providing a platform for practical variable rate nutrient programs in the Central Region
BPS001 project: Three key GIS mapping layers to manage paddock variability

Fine scale soil - EC or EM soil mapping surveys

Yield - processed satellite imagery or yield monitors on harvesters

Digital elevation - RTK (captured during soil mapping surveys)

Desktop analysis

30% of Mackay Sugar paddocks display considerable variation in yield and soil properties.

Mapping contrasting soil properties

The Veris 3100 Soil ECa Mapping System

Electromagnetic induction readings are collected from the soil from two depth intervals:

- 0-30 cm
- 0-90 cm
Soils mapping surface layer

Themed point data drawing (n=2800)

Kriged interpolated surface

R² = 0.86

Stability of soil mapping patterns

Fallow - March 2003

R² = 0.86

Fallow - May 2008

> 30,000ha mapped in Central region
Fine scale soil mapping
Validation of soil mapping patterns (80 ha)

Soil mapped as 1 unit – 1:100,000 soil survey

Increasing EC values

Site M1, Mackay (11.3 ha)
Yield variation: 79 - 151 TCH

Site B1, Burdekin
Yield variation: 19 - 148 TCH

Validation of satellite yield mapping patterns

Similar nutrient inputs (kg/ha): N- 170, P- 20, K- 100, S- 20
Within-paddock variability: Sub-surface drainage and position in the landscape (Central region)

Trial results indicate
Manipulation of N rates in defined areas with inherent waterlogging issues – pre wet season irrigation

Site specific management of identified constraints to crop growth (Sarina)

Geo-referenced sampling directed by soil/yield mapping patterns
Variable rate lime program: zonal soil analysis

Zone 1: 2.3 T/ha
Zone 2: 2 T/ha
Zone 3: 1 T/ha
Zone 4: nil

Acidic with elevated ESP levels

Cost effectiveness of site specific management

<table>
<thead>
<tr>
<th>Lime program</th>
<th>Rate/ha (tons)</th>
<th>Ha treated</th>
<th>Tonnes applied</th>
<th>$/ton spread</th>
<th>Total $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>2</td>
<td>37</td>
<td>74</td>
<td>187.60</td>
<td>13,882</td>
</tr>
<tr>
<td>Variable rate</td>
<td>Nil to 2.3</td>
<td>31.42</td>
<td>40</td>
<td>206.30</td>
<td>8,252</td>
</tr>
<tr>
<td>Benefit</td>
<td>-5.6</td>
<td>-34</td>
<td></td>
<td></td>
<td>5,630</td>
</tr>
</tbody>
</table>

Subsequent yield map observations and retesting of referenced sites to monitor responses to treatments
**Site specific agronomy:** Influencing zonal yield potential (Marian site)

- Yield: 100 TCH
- Yield: 50 TCH
- Yield: 25 TCH
- N rates not the issue
  - No response to 200 kg N/ha in defined low yielding zones

**Hierarchy of variables constraining yield in zones displayed in satellite yield map**

- 0-25 cm soil analysis: Reasonably similar chemical properties
- 40-60 cm soil analysis: Yield variability driven by sub-surface issues

Soil bulk density: 1.75 g/cm³
Defining constraints to yield

Soil bulk density: 1.75 g/cm³

A = 0-25 cm
B = 40-60 cm

Trial design

Treatments
1. Lime: 3,000 kg/ha
2. Ash: 250,000 kg/ha
3. Gypsum: 5,000 kg/ha
4. Dunder: 8,000 Lt/ha
5. Control

If unable to modify the yield potential through amelioration of elevated ESP zones then potential to reduce N inputs with VRA
A precision agriculture approach of site specific management provides a pathway for continuous improvement in the sugarcane industry - addressing productivity and environmental issues

**Ground-truthing of soil/yield mapping patterns facilitates:**

- Defining the interaction of topsoil and subsurface variables constraining crop growth (e.g., sodicity, subsurface drainage)
- Defining zonal management strategies to address constraints
- Improving zonal yield potential through mitigation of defined constraints
- The potential for variable rate application (e.g., nitrogen) where mitigation of constraints is uneconomical (dispersive sub-soils, sodic soils, poor sub-surface drainage)
- Selection of appropriate research trial sites
- Selection of adapted sugarcane varieties for defined areas

Makes farming a lot more interesting