NEAR-INFRARED SPECTROSCOPY ON FRESH PLANT MATERIAL FOR REAL TIME IN-FIELD NUTRIENT ANALYSIS

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JOURNEY TO A SOLUTION

Started with customer feedback
• Wanted to know what is happening in their crops in real time
• Didn’t want to be overwhelmed with information
• Needed to make decisions quickly

Objectives:
• Actionable insights in real-time
• Help growers achieve their crops’ economic potential

Investigated range of technologies and landed on near-infrared (NIR) spectroscopy
PRESENTATION OUTLINE

• Why Spectroscopy

• Solution and its components

• Results

• Next steps

• Summary
WHY SPECTROSCOPY?

Desirable characteristics

• Immediate result while in the field correlated to N
• Doesn’t require sample processing
• Compute time is minimal
• Minimise the need for consumables and maintenance
• Potential for multiple analyses from a single scan - priority is N in cereals
• Reliable and robust for in-field use

Implications

• Plant specific – need for “representative” sampling
• Requires going into the paddock
**SOLUTION COMPONENTS**

User captures scan with spectrometer, submits data and receives report via smartphone application.

- **Device**
- **Smartphone app**
- **Cloud Models**
  - Chemometric model provides nutrient estimate
  - Nutrient status model

Example reporting commentary:

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Estimate</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>2.0 - 2.5%</td>
<td>Deficient</td>
</tr>
</tbody>
</table>
SPECTROSCOPY
NIR HARDWARE

Expensive:
- Range: 350 – 2500nm
- High resolution: 1nm

Cheap:
- Range: 900 – 1100nm
- Resolution: 30nm

Selected device
- Range: 900-1700
- Resolution: 3.5nm
CHEMOMETRIC MODELLING

1. Scan leaves of a plant
2. Send plant to lab
3. Match scans to Total N
4. Chemometric modelling process
5. Deploy chemometric model
CHEMOMETRIC MODELLING

Final dataset

- > 10 000 plant samples collected
- Scanned multiple leaves of each plant
- Wheat and barley
- Across 2017, 2018, 2019
- WA, SA, VIC, NSW
- Tillering through to flowering
- Paddock and field trials sites

Tested the model across:

- Growth stages
- Geographies
- Climatic conditions
- Soil types
- Fertility levels
MODEL PERFORMANCE RESULTS

Actual Testing Scenario

R^2 = 0.934
MAPE = 12.31

<table>
<thead>
<tr>
<th>Nitrogen</th>
<th>Average R^2</th>
<th>Average MAPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>90.30%</td>
<td>12.70%</td>
</tr>
</tbody>
</table>
WHAT DOES THIS MEAN FOR A GROWER

• Extensive field testing across WA and East Coast already being conducted

• N-Status outputs derived from CSBP’s history of trial data and expertise in soil and plant nutrition - means we don’t need grower data to build this solution

• Reduces uncertainty of nitrogen applications

• Have more confidence in their decision to apply N, or not
NEXT STEPS

Pilot launch of the solution in 2020

- Assess modelling performance in upcoming season
- Continue to seek out feedback and integrate into the solution
- Investigation of other crops types and other nutrients
- Continuous evaluation of model performance
SUMMARY

• Understood the problem
• Assessed the options
• Assembled the components of the solution
• Sought grower feedback and will continue refine the solution
• Pilot launch this coming season