Site-specific nutrient management

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What is site-specific nutrient management (SSNM)

\begin{itemize}
\item Supplying plants with nutrients to optimally match their spatial and temporal need for supplemental nutrients
\end{itemize}
Lowland rice production in Asia

- Small landholdings and fields
- Large variation among fields and among seasons
- Needs for nutrient inputs can vary greatly across short distances

Principles and objectives of SSNM are similar for

- Small fields with little or no mechanization in Asia
  - Concern: Variability between fields, seasons, and years
  - Need: Simple technologies

- Large fields with mechanization
  - Concern: Within field variability
  - Need: Sophisticated technologies (‘precision agriculture’)
Why is SSNM important for FBMPs?

• It can increase profit
  – Higher yields
  – Higher nutrient use efficiency (output/input)
  – Reduced disease and pests
• It can benefit environment

SSNM provides an approach for

• Before the season determination of fertilizer needs
  – Prescriptive
  – Can be plant or soil based

• Within-season adjustment in fertilizer N rates
  – Responsive to current conditions
  – Corrective
  – Plant-based --- ‘Matching supply to crop needs’
Principles for N management

- Determine total fertilizer N requirement from
  - Anticipated crop response to applied N
  - A target N use efficiency

- Select first fertilizer N application based on
  - Anticipated crop response to applied N
  - Traits of crop variety

- Vary within-season fertilizer N based on
  - Plant N status
  - Anticipated crop response to applied N

Optimal rate of fertilizer N depends upon crop response to N

![Graph showing yield response with nitrogen application](image)

- Step 1: Establish a yield target
- Step 2: Effectively use existing nutrient
- Step 3: Apply N to meet crop needs
  Target: Achieve 18 to 25 kg grain increase per 1 kg N applied
Estimated total fertilizer N requirement

40 to 55 kg fertilizer N for each 1 ton increase in grain yield from use of fertilizer N

<table>
<thead>
<tr>
<th>N use efficiency (kg grain increase/kg N applied)</th>
<th>15</th>
<th>18</th>
<th>20</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop response to N (t/ha) ↓</td>
<td>Fertilizer N rate (kg/ha)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>65</td>
<td>55</td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>2</td>
<td>130</td>
<td>110</td>
<td>100</td>
<td>80</td>
</tr>
<tr>
<td>3</td>
<td>195</td>
<td>165</td>
<td>150</td>
<td>120</td>
</tr>
<tr>
<td>4</td>
<td>220</td>
<td>200</td>
<td>160</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>250</td>
<td>200</td>
<td></td>
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</tbody>
</table>

Select rate for first fertilizer N application based on crop response to N

<table>
<thead>
<tr>
<th>Crop response to N (t/ha)</th>
<th>Fertilizer N rate (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inbred and hybrid rice</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>45</td>
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</tbody>
</table>
Vary within-season fertilizer N

Diverse technology options for a similar objective
– Plant tissue or sap analysis
– Plant sensors
  • On-the-go sensors (precision agriculture)
  • Hand held meters
  • Low tech leaf color measurement

Apply fertilizer N to match crop needs for N at critical growth stages
Adjust N dose upward or downward based on crop monitoring

Apply high N dose

Apply intermediate N dose

Apply little or no N

Vary within-season fertilizer N based on plant N status and crop response to N

(Amount of N to apply at active tillering and panicle initiation to rice in Indonesia)

<table>
<thead>
<tr>
<th>LCC reading (immediately before N application)</th>
<th>Application of urea (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crop response 1 t/ha</td>
</tr>
<tr>
<td>LCC ≤3</td>
<td>75</td>
</tr>
<tr>
<td>LCC = 3.5</td>
<td>50</td>
</tr>
<tr>
<td>LCC ≥4</td>
<td>0</td>
</tr>
</tbody>
</table>

Common principles for site-specific N management across degrees of technological sophistication

- Determine total fertilizer N requirement from
  - Anticipated crop response to applied N
  - A target N use efficiency

- Select first fertilizer N application based on
  - Anticipated crop response to applied N
  - Traits of crop variety

- Vary within-season fertilizer N based on
  - Plant N status
  - Anticipated crop response to applied N
1. Establish a yield target – the crop’s total needs

2. Effectively use existing nutrients

3. Fill the gap between total needs and indigenous supply

SSNM: Optimally supply the crop with nutrients

Feeding crop needs!