Nitrogen cycling enhanced by conservation agriculture in a rice-based cropping system of the Eastern Indo-Gangetic Plain

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Conventional rice-based cropping systems in Eastern Indo-Gangetic Plain

- 2-3 crops per year
- Puddling and ponded soil for rice crop
- Residue burnt/removed
- Intensive tillage for dryland crop
Conservation agriculture

- Minimum soil disturbance
- Increased crop residue retention
- Change in N mineralisation in CA system
- Change in N balance
- Change in N forms
Research question

➢ How does N cycle change in short-medium term with minimum soil disturbance and increased crop residue retention in a rice-based cropping system
How it was tested?

<table>
<thead>
<tr>
<th>Crop rotation</th>
<th>Lentil-mungbean-rice</th>
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</thead>
<tbody>
<tr>
<td>Variety</td>
<td>BARI Masur 6-BARI Mungbean 6-BINA Dhan 7</td>
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<tr>
<td>Duration</td>
<td>2.6 years (7 crops grown sequentially)</td>
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</tbody>
</table>

November-March → March-May → June-October
How it was done?

Soil disturbance

- Strip-planting (SP)
- Bed planting (BP)
- Conventional tillage (CT)

Residue levels

- High residue (HR)
- Low residue (LR)
Strip Planting
Strips 5-7 cm wide and 7 cm deep
Total N input and uptake (7 crops)
Partial N Balance after 7 crops
(inputs – outputs)

Residue levels

Partial N balance (kg N/ha)

HR

LR

SP
CT
Soil N-stocks at 0-15 cm

Initial N-stocks-1787 kg N ha\(^{-1}\)

![Graph showing Soil N-stocks for different tillage and residue treatments. SP and CT for tillage, HR and LR for residue treatments. Initial N-stocks are 1787 kg N ha\(^{-1}\).]
Gain or loss of soil N
(Final, 2013 minus initial, 2010 N-stocks)

- N losses in CT
- N gain in SP

Loss or gain of soil N (kg N/ha)

Residue levels
Estimated N Balance
(Final N stock and total inputs – Initial N-stocks and total outputs)
Soil N status overtime (at 0-15 cm)

Total Soil N (%)

Cropping cycles

Initial After Crop 1 After Crop 4 After Crop 7

SP CT
Soil disturbance effects

Total soil N (%)
Residue effects

Total soil N (%)

- **0-7.5 cm (Surface)**
  - HR: 0.09
  - LR: 0.12

- **7.5-15 cm (Sub-surface)**
  - HR: 0.06
  - LR: 0.09

- **0-15 cm (Whole plough layer)**
  - HR: 0.09
  - LR: 0.12
Total soluble N
(after Crop 7)

0-15 cm (Whole plough layer)

Tillage
Residue

TSN (mg N/kg)

SP
CT

Residue levels

HR
LR
Potentially Mineralizable N
(at 60 DAS during Crop 7)

- 0-7.5 cm (Surface soil)
- 7.5-15 cm (Sub-surface soil)
- 0-15 cm (Whole plough layer)

PMN (mg N/kg)
Yield and leaf N of Crop 7

- Seed yield of lentil (t/ha)
- Leaf N of lentil (g/kg)

**Residue levels**

**Tillage**

- HR
- LR

**Residue**

- SP
- CT
Key Findings

- Strip planting and HR increased the total soil N, N-stocks, N-accumulation rate, plant N, and crop yield
- High residue retention produced a positive N balance
- Labile N – PMN and TSN increased in SP and HR
Implications

- Increase in soil N pool may decrease N requirements over time in SP and HR

- Continue to study effect of soil disturbance and residue on N dynamics in this legume-dominant and in cereal dominant rice-based systems of Bangladesh
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Questions
Mineral N
(at 60 DAS during Crop 7)

NH$_4$-N

NO$_3$-N

Mineral N (NH$_4$-N + NO$_3$-N)
Bed planting
Annual N accumulation rate at 0-15 cm