4R Nutrient Management: Key to Increasing Rubber Yield in Myanmar

Tin Maung Aye
Agronomist and soil scientist
Growing environments in Myanmar

Rubber (*Hevea brasiliensis*) can grow well in many parts of Myanmar.

- well-drained, weathered soils, nonlateritic red, or alluvial soils.
- rainfall of around 250 cm evenly distributed with at least 100 rainy days per year
- Temperature range of about 20 to 34 °C, with a monthly mean of 25 to 28 °C
- High atmospheric humidity of around 80%

The economic life period of rubber is around 32 years — up to 7 years of immature phase and about 25 years of productive phase.
Myanmar

Geography
- N 9° 58’ to 28° 29’
- E 92° 10’ to 101° 10’
- Mountainous country with plateaus, valleys and plains

Land frontier
- with Bangladesh 272 km
- with China 2227 km
- with India 1453 km
- with Laos 235 km
- with Thailand 2099 km

Total Land area
- 67.7 million hectares
Weather and Climate Myanmar

Tropical monsoon with three distinct seasons
- Hot dry season (March – April)
- Raining season (May – Oct)
- Cool dry season (Nov- Feb)

- Temperature variation
- Rainfall <1000mm to 5000mm

Four Agro-climatic Regions
- The Delta Region
- The Coastal Region
- The Central Dry Zone Region
- The Mountainous Region
### Land Resource and Its Utilization in Myanmar

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Area (million ha)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net sown area</td>
<td>11.92</td>
<td>17.6</td>
</tr>
<tr>
<td>Fallow land</td>
<td>0.32</td>
<td>0.5</td>
</tr>
<tr>
<td>Cultivable waste land</td>
<td>5.37</td>
<td>7.9</td>
</tr>
<tr>
<td>Reserved forests</td>
<td>18.24</td>
<td>27.0</td>
</tr>
<tr>
<td>Other forests</td>
<td>15.35</td>
<td>22.7</td>
</tr>
<tr>
<td>Others</td>
<td>16.46</td>
<td>24.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>67.66</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Source: MOAI 2014

- Potential expansion of new agriculture land remains more than 5 million ha
A Brief History of Rubber in Myanmar

- Introduced into Myanmar around 1876 and commercially planting was started in 1905
- Rubber project was implemented in 1956 under Agriculture and Rural Development Corporation (ARDC) and its sown area was sharply increased in 1960
- Rubber area declined between 1970 and 1980 due to nationalization by the Socialist Government in 1962
- Political change in 1988 also brought about the changes in the country’s economic policy. Rubber plantation area has increased
Uses of Rubber in Myanmar

- Consumer products (clothing & footwear)
- Tire products & inner tubes
- Industrial goods (hoses, belts, plates, etc.)
Traditional Production Systems

- Planted on a wide range of soils with traditional methods
- Produced mainly by smallholder farmers with locally available clones
- Generally do not apply optimum inputs
- Resulting in low latex yields and soil nutrient depletion
Current Production Systems

- Grown in many parts of the country, mainly in Ayeyarwaddy, Bago, Tanintharyi and Yangon regions, Mon, Kachin, Kayin and Shan states

- Rubber is a one of the National Priority Crops, grown mainly for rubber export market

- Recently changing in agricultural policy favours, rubber becomes as an “Export Crop” for rubber grower
Rubber Production in Myanmar

<table>
<thead>
<tr>
<th>Year</th>
<th>Sown area (000’ ha)</th>
<th>Yield (t/ha)</th>
<th>Production (000’t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998-99</td>
<td>149</td>
<td>0.48</td>
<td>23</td>
</tr>
<tr>
<td>2001-02</td>
<td>186</td>
<td>0.59</td>
<td>37</td>
</tr>
<tr>
<td>2002-03</td>
<td>185</td>
<td>0.59</td>
<td>40</td>
</tr>
<tr>
<td>2003-04</td>
<td>189</td>
<td>0.55</td>
<td>40</td>
</tr>
<tr>
<td>2004-05</td>
<td>203</td>
<td>0.57</td>
<td>52</td>
</tr>
<tr>
<td>2005-06</td>
<td>226</td>
<td>0.59</td>
<td>64</td>
</tr>
<tr>
<td>2006-07</td>
<td>295</td>
<td>0.60</td>
<td>73</td>
</tr>
<tr>
<td>2007-08</td>
<td>380</td>
<td>0.64</td>
<td>89</td>
</tr>
<tr>
<td>2008-09</td>
<td>428</td>
<td>0.65</td>
<td>93</td>
</tr>
<tr>
<td>2009-10</td>
<td>463</td>
<td>0.67</td>
<td>112</td>
</tr>
<tr>
<td>2010-11</td>
<td>504</td>
<td>0.69</td>
<td>128</td>
</tr>
</tbody>
</table>

Myanmar Agriculture in Brief 2013
What are the main constraints to closing yield gaps?

Estimated yield gap (1.3 t/ha)

Current yield (± 0.70 t/ha)

Attainable yield (± 2.00 t/ha)

Myanmar ± 0.80

Malaysia ± 1.70

Thailand ± 1.70
Improved Genetics + Agronomy + ....

- Fertility management
- Weed management
- Pests & Diseases control

+ Mechanization
+ Processing
+ Marketing

For example: Average latex yield in Myanmar (around 0.7.0 t/ha) is far below than achievable yields while latex yield is 1.7 t/ha in Thailand and 8.1 t/ha in Malaysia
### Impact: Genetics + Agronomy

#### Example: Green Revolution Rice in LAC

**Peter Jennings**: Found semi-dwarf gene at IRRI (IR8)
Later moved to rice program at CIAT

One-off increase in rice yields in LAC with introduction of semi-dwarf rice in favourable environments (~2t/ha)

No major increase in yield with the release of a further 400 semi-dwarf varieties over next 30 years

Improve rice agronomy:

- **fertilizer use**
- time of seeding
- seedling density
- seed treatment to control insects
- weed control
- irrigation management

=> additional 2t/ha
## Suitable Rubber Clones in Myanmar

<table>
<thead>
<tr>
<th>Location</th>
<th>Clones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bago, Yangon and Ayeyarwaddy</td>
<td>PB-260, PB-235, RRIM-717, RRIM-623, GT-1</td>
</tr>
<tr>
<td>Taninthary, Mon and Kayin</td>
<td>BPM-24, RRIC-100, RRIM-717, PB-260, PB-235</td>
</tr>
<tr>
<td>Kachin and Shan</td>
<td>RRIM-600, GT-1, PR-255, PR-107, RRIM-623</td>
</tr>
</tbody>
</table>
Rubber Production Constraints

- Many growers plant local clones with limited inputs
- Little knowledge about how to use fertilizer better
- Usually get low latex yields and decline in soil fertility
- Emerging pests and diseases
Balanced Nutrition to Close Yield Gap

Increased Yield (1 t/ha)

Targeted yield (± 1.7 t/ha)

Current yield (± 0.7 t/ha)
4R Nutrient Stewardship Concept

1. Application of the **right source** of plant nutrients at the **right rate**, the **right time**, and in the **right place** are essential in the management of plant nutrition to increase sustainability of rubber production.

2. Right rate is often overemphasized due to its simplicity and direct relation to cost. Right source, time, and place are more frequently overlooked and these may offer greater opportunities for improved performance.

3. They **must be synchronized** with the rubber tree, soil, climate, and management environments.
Appropriate site-specific nutrient management to achieve maximum profits and environmental sustainability

Right sources: Inorganic fertilizers and organic fertilizers can be used.

Conceptual illustration of application of the right source of plant nutrients to improve better crop yield and profits
Appropriate site-specific nutrient management to achieve maximum profits and environmental sustainability

Right rate: Nutrients must be applied to achieve a realistic yield goal.

Conceptual illustration of application of the right quantity of plant nutrients to increase better crop yield and profits
Appropriate site-specific nutrient management to achieve maximum profits and environmental sustainability

Conceptual illustration of application of plant nutrients at the right time to increase better nutrient uptake by the plant
Appropriate site-specific nutrient management to achieve maximum profits and environmental sustainability.

Conceptual illustration of application of plant nutrients at the right place to improve better crop yield and profits.
Nutrient demand estimation for mature rubber trees under tapping has to account for the following:

1. Nutrients removed with the harvested latex
2. Nutrients immobilized in the rubber tree
3. Nutrients recycled to the soil from dying off plant materials
Key to increasing yields for maximum profits and environmental sustainability

| Annual nutrient removal, immobilization and recycling in mature rubber under tapping (Planting density 475 tree/ha; 15-year old rubber plantation) | 1.5 t ha\(^{-1}\) Dry latex yield |
|---|---|---|---|---|
| | N | P | K | Mg |
| Removal with harvested latex | Kg/tree | 0.06 | 0.02 | 0.08 | 0.02 |
| Immobilized in rubber tree | Kg/tree | 0.07 | 0.01 | 0.03 | 0.007 |
| Nutrient recycle | Kg/tree | 0.05 | 0.003 | 0.004 | 0.02 |

Sources: Values from literatures (The figures are approximate values only)
Right source and time to increasing yields for maximum profits and environmental sustainability

Annually plant nutrients to be applied to rubber tree according to the various fertilizer sources at right time in Myanmar
Right rate to increasing yields for maximum profits and environmental sustainability

Fertilizer recommendation for rubber plantation in Myanmar (kg ha⁻¹)

<table>
<thead>
<tr>
<th>Age of rubber tree</th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immature rubber up to 4th year of planting</td>
<td>40</td>
<td>40</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>Immature rubber from 5th year to tapping</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>5</td>
</tr>
<tr>
<td>Mature rubber under tapping</td>
<td>35</td>
<td>15</td>
<td>50</td>
<td>5</td>
</tr>
</tbody>
</table>
Right place to apply NPK fertilizers to rubber tree

Right place to increasing yields for maximum profits and environmental sustainability
Right place to increasing yields for maximum profits and environmental sustainability

Right place to apply Mg and organic fertilizers to rubber tree
Production Situation in Myanmar

**Biological Potential Yield under Optimum Growing Condition**
Dried latex yields of 2 t per ha per year appear to be close to the potential yield limit.

<table>
<thead>
<tr>
<th>Latex yield (t/ha/year)</th>
<th>Actual yield</th>
<th>Targeted yield</th>
<th>Potential yield</th>
<th>Attainable yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.8</td>
<td>Actual Yield</td>
<td>Abiotic and biotic, management constraints</td>
<td>Socio-economic limitation</td>
<td>Balanced fertilizer application</td>
</tr>
</tbody>
</table>

**Targeted yield**
Targeted yield can be achieved by good agricultural practice such as balanced fertilizer application.

**Production Situation in Myanmar**

- Latex yield (t/ha/year)
What can you do about implementation of concept?

If all knowledge is there, just implement... but Knowledge gap may exist. What can be done?

- If yield gap factor are known: use Best Management Practices (BMP) approach
- If yield gap factor are unknown: use Plantation Intelligence (IP) approach,
- Or go immediately to large scale experimentation
Improved Nutrient Management
(Fertilizer Trials)

✓ Balance fertilizer application (35N-15P-50K-5Mg kg per ha) can double the latex yield

✓ Return on investment of fertilizers (more than 4 X?)
Conclusions

- In Myanmar, improved research techniques and agronomy procedures will use in future to boost rubber yields and improve farmers’ livelihoods through better income.

- Due to its present and future importance of agriculture commodities, a production strategic plan would be required to enhance the productivity of crops in terms of expending growing cropping areas as well as yield per unit area.

- International and regional collaborations and their assistances are needed particularly among researchers, educators, private sectors and farmers to address these important issues.
Great opportunity to transform the rubber crop into a major commercial crop in the Myanmar agriculture. Investment in rubber sector can be supported the income generation for rural communities in Myanmar.

Due attention is not only focus on technical issue but also focus on the best way to manage other issues, such as socio-economic, environmental, ethnic and political situations, which have to be considered to ensure both appropriateness and adoption of rubber planation management.

Private and Public Partnership is essential to develop the rubber sector in Myanmar.
Public/Private Sector Partnership is also important to develop the agriculture sector

- There may have some challenges for Public/Private Sector Coordination

- Agro-industries, traders, government and development partners can facilitate agriculture production to satisfy domestic consumers and exporters’ requirements through extension

- Such as dissemination of quality seeds and fertilizers, access to other inputs, contracts, market information, etc.
Many thanks!