Biofertilizer: *Azolla pinnata* in-combination with Inorganic Fertilizer on Growth and Yield of Rice

Mohamad Izdzuan bin Mohamad Khair, Elisa Azura Azman, Roslan Ismail, Muhammad Naim Fadzli Abdul Rani
MALAYSIA
Rice Industry in Malaysia

Malaysia consumed 2.7 million tonnes of rice in 2016. Of the amount consumed, 67% was produced locally, while the rest was imported primarily from Thailand, Vietnam, and Pakistan.

Malaysia performed fairly well in terms of paddy yield. In terms of paddy yield in 2016, it produced 3.2 million tonnes per hectare compared to Thailand's 2.9 million tonnes per hectare.

Malaysia's rice consumption grew faster than its production. Compared to neighboring countries, its rice consumption and production remain relatively small.

Paddy subsidies and incentives vs percentage of Ministry of Agriculture’s expenditure

Note: Statistics based on year 2016

Source: NIA

Despite the declining trend, the paddy and rice industry continues to receive more budgetary assistance than any other crop.

Off the 14 million employed persons in Malaysia, 1.6 million workers, or 11.4%, belonged to the agriculture, forestry, and fishing industry. Within this category, around 200,000 were paddy farmers, mostly aged 50 years and above. The monthly household income for paddy farmers stood at RM2,527, putting them in the Bottom-40 income category.

Rice Importers

- Philippines: 649,241 (2.5%)
- Thailand: 398,678 (1.6%)
- Vietnam: 603,583 (2.4%)
- Indonesia: 1.7 million (7.4%)

5%: self-sufficiency rate

South-East Asia plays a central role in the global rice economy, accounting for 16 million tonnes, or 40%, of world's rice exports, with Thailand and Vietnam being the region's top exporters. Malaysia, Indonesia, and the Philippines are net importers.
Problem statement

Paddy cultivation in Malaysia is too dependent on the use of chemical fertilizers.

Excessive use of chemical fertilizers will have a detrimental effect on the environment.

Therefore, this research seeks to find an alternative the use of chemical fertilizers.

Thus, a study of the use of Azolla in rice cultivation whether it can have the same effect as chemical fertilizers on rice production or not.
Azolla pinnata in rice field
Benefit of Azolla

- Improves water quality (Costa et al., 2010)
- Contributes 40-60 kg N/ha/rice crop (Kannaiyan, 1993)
- Increase the growth and yield of rice (Singh & Singh, 1995)
- Animal feed
Treatments Azolla with inorganic fertilizer

Table 1: Treatments of Azolla in-combination with and/or without inorganic fertilizers

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>PK + Azolla</td>
</tr>
<tr>
<td>T2</td>
<td>NP + Azolla</td>
</tr>
<tr>
<td>T3</td>
<td>NK + Azolla</td>
</tr>
<tr>
<td>T4</td>
<td>Control (Standard fertilizer rate)</td>
</tr>
<tr>
<td>T5</td>
<td>Azolla only</td>
</tr>
</tbody>
</table>

N - source of N is Urea  
P - source of P is Triple Super Phosphate  
K - source of K is Muriate Of Potash
Effect on the rice yield

![Bar chart showing the effect of different treatments on rice yield. The treatments are labeled as PK+Azolla, NP+Azolla, NK+Azolla, NKP, and Azolla. The yields are measured in grams per pot (g). The chart indicates different yield levels for each treatment, with some treatments marked with letters (c, bc, ab, a) to denote significant differences.](image-url)
Effect on the soil at harvest

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Treatments</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>PK+ Azolla</td>
</tr>
<tr>
<td>Soil pH</td>
<td>5.2\textsuperscript{a}</td>
</tr>
<tr>
<td>CEC (cmol(+)/kg)</td>
<td>16.6\textsuperscript{a}</td>
</tr>
<tr>
<td>Total Nitrogen (%)</td>
<td>0.16\textsuperscript{a}</td>
</tr>
<tr>
<td>Organic carbon (%)</td>
<td>1.52\textsuperscript{a}</td>
</tr>
<tr>
<td>Avail. P (mg/kg)</td>
<td>67.8\textsuperscript{a}</td>
</tr>
<tr>
<td>Exc. K (cmol(+)/kg)</td>
<td>0.24\textsuperscript{a}</td>
</tr>
</tbody>
</table>
N P K content in rice plant at harvest

- **N content in leaf (%)**
  - PK+Azolla: a
  - NP+Azolla: a
  - NK+Azolla: a
  - NPK: a
  - Azolla: a

- **P content in leaf (%)**
  - PK+Azolla: a
  - NP+Azolla: a
  - NK+Azolla: a
  - NPK: a
  - Azolla: a

- **K content in leaf (%)**
  - PK+Azolla: a
  - NP+Azolla: b
  - NK+Azolla: bc
  - NPK: b
  - Azolla: b
Conclusion

Azolla can be used as a biofertilizer for rice planting as treatment NK+Azolla shows a comparable total yield result with inorganic fertilizer without Azolla. It can reduce the inorganic fertilizer, thus able to reduce the cost of the inorganic fertilizer.
Terima Kasih