A Potential Strategy to Improve Productivity of Cocoa Plantation through Pollination

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Introduction

- Pollination is one of main factors that involved in cocoa production
- The number of cocoa flowering is up to 6000 – 10,000 flowers per year, but only 5% or less that success to be a tiny pod (fruit set) (Urquhart, 1961; Posnette, 1944; Soetardi, 1950).
- Pollination was happened by natural and artificial pollination

![Diagram showing natural and artificial pollination](image)
The Dynamics of Flowering of Cocoa in East Java

Flowering Score:
0 = no flower
1 = 1-5 flowers/tree
2 = 6-15 flowers/tree
3 = 16-50 flowers/tree
4 = 50-150 flowers/tree
5 = >150 flowers/tree

Artificial Hand Pollination
Natural Agent (Insect) – Entomophily
Artificial Pollination
Study Case in Kaliwining Experimental Station, East Java, Indonesia

• Increase the Cocoa Pod 24.29 - 47.20% (up to 20%) (Hartatri et al., 2018)

• The ratio manpower for pollination 8.47% of Total (Personal Communication)
  • 1 manpower = 140 – 150 flowers/day or in average 15 - 20 plants/day
  • Pollination manpower needs around 55-70 manpower.ha⁻¹.year⁻¹
Natural Pollination

- Mostly, the insect come to cocoa flower are from Diptera, esp. *Forcipomyia* spp. is an insect that helping cocoa pollination, with pollen load until 200 pollen/midge (Nugroho, 2013)

- *Forcipomyia* and other insects that help are sensitive to the environment and farm management (pest-insecticide).

- Suitable microclimate for *Forcipomyia* spp. to grow and develop and carry out pollination is at the temperature range of 25–35 °C and the relative humidity of 60–80%; (Ibrahim & Husein, 1978; Nugroho, 2013; Zakariyya et al., 2016), wind speed is 0-0.5 m/s.
Strategy for Optimizing the Natural Pollination

• Improve the Plant Performance
  • Superior of Plant Material (Clones or Hybrid)
  • Implementing GAP (pruning, fertilizer) to induce the flowering

• Enhancing Population of Midges/Beneficial Insects
  • Spreading The Organic Material (providing breeding substrates in suitable containers may help in the population of *Forcipomyia* spp. to built-up) Saripah & Alias (2018)
    • Cocoa Pods-Healthy, Banana Stumps, Rotting Leaf-Litter

• Maintaining the Environment/Microclimate
  • Management of Shade Trees – canopy cover
  • Pruning
  • The implementation of IPM
Table 3. Fluctuation of *Forcipomyia* spp. population under different shade trees on September 2015–February 2016 (Data ± Deviation Standart)

<table>
<thead>
<tr>
<th>Shade trees</th>
<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
<th>January</th>
<th>February</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Leucaena</em> spp.</td>
<td>32.1 ± 10.03 a</td>
<td>9.4 ± 3.78 a</td>
<td>14.6 ± 5.73 a</td>
<td>21.63 ± 6.45 a</td>
<td>47.3 ± 10.98 a</td>
<td>36.4 ± 10.86 a</td>
</tr>
<tr>
<td><em>Cassia surattensis</em></td>
<td>21.8 ± 6.63 b</td>
<td>10.5 ± 4.70 a</td>
<td>10.8 ± 3.89 ab</td>
<td>14.4 ± 5.56 b</td>
<td>35.0 ± 9.67 b</td>
<td>31.3 ± 10.89 a</td>
</tr>
<tr>
<td><em>Areca catechu</em></td>
<td>17.0 ± 8.12 b</td>
<td>10.0 ± 3.46 a</td>
<td>7.2 ± 3.21 b</td>
<td>19.97 ± 7.34 ab</td>
<td>28.8 ± 8.76 b</td>
<td>23.0 ± 13.45 ab</td>
</tr>
</tbody>
</table>

Figures in the same column with the same letter are not significantly different according to Tukey test (p>95%).
Shading Trees

- The usage of another tree for intercropping/as a shade trees for cocoa plantation in farms scale in Indonesia (7 Provinces) has been reported by Daymond et al (2017): *Cocos nucifera* (42.5 %), *Gliricidia sepium* (33.4 %), Banana (16.7 %), Durian (6.7 %), without shade trees (5.0 %), *Parkia speciosa* (4.1 %), etc.
The implementation of ‘waste to wealth’ concepts with the use of debris from the cocoa fields filled in the transferable breeding containers may help in increasing the population of cocoa pollinators (Saripah & Alias, 2018).

Number of Forcipomyia appear in 200 grams substrate (Rahayu, et al. 2017) – Preliminary Research
Conclusion

• Pollination can be conducted through natural and artificial pollination

• The strategy to improve the successful pollination through natural pollination:
  • Improve the Plant Performance
  • Enhancing Population of Midges/Beneficial Insects
  • Maintaining the Environment/Microclimate through shade management, pruning, and implementation of IPM.
THANK YOU