Response of Phosphorus in *Pterocarpus indicus*- A Nitrogen-Fixing Tree Species and Its Sensitivity

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**Introduction**

*Pterocarpus indicus* or angsana- promising nitrogen-fixing tree species

- Belongs to family Leguminosae, sub-family Papilionoideae and a close relative to *Dalbergia*
- Native to SE Asia, common in urban planting and reforestation programs.
- Wood: moderately heavy, hard, strong and durable - fine furniture, cabinet works, paneling and other specialized joinery
- Listed and classified in Appendix II and vulnerable endangered species in CITES and IUCN

- Grow on variety of soil types: fertile to infertile agricultural (Allen and Allen, 1981; Ng, 1992).
  - In contrast to *P. macrocarpus*, no study conducted in relation to habitat, associated species, occurrence, symbiotic relationship, phosphorus and soil nutrient required (Liengsiri *et al.*, 1998).
  - Phosphorus:- an essential nutrients for plant growth.
    - Function: for storage and transfer of energy, photosynthesis, transport of electron process and synthesis of sugars and starch.
- Main symptom associated: distinct purple color appearing in older and young leaves (Dell *et al.*, 2001).
Objectives:

1. To define the response and symptoms of P stress and
2. To determine the P concentration ranges and its sensitivity
Materials and Methods

Experimental design:

1. Two potted trials x Two soil types x 10 treatments each (refer to notes)

2. Soil Type: a) Yalanbee soil-clay loam (YB) and b) Yellow sand (YS)

3. CRBD with 4 replications pots/ Stats ANOVA Analysis-SPSS

4. Harvesting: Ten weeks, YFEL and other parameters

5. Extraction: Digestion of plant materials using oven CEM Mars 5 (Huang et al., 2004).

Phosphorus potted trials of *P. indicus* using two soil types
Results & Discussions

- Shoot growth response significantly (P ≤ 0.05) to P fertilizer

- Steep increase at low P, narrow optimum range and depressed at high P for both soils x contrast to gradual increase/decrease in shoot growth to increasing P treatment (Ulrich & Hills, 1967; Shedley, 1995) (Figure 1)

- Similar soil Colwell P concentrations at 118 mg P/kg with max. yield although YB had greater buffering capacity with higher P and less severe toxicity symptoms (Figure A1-2).
• The max. seedling growth at P rates-
  YS at P128: 0.56±0.04g
  YB at P320: 3.60±0.13g

• Compared to other woody plants, surprisingly there was a narrow response range between P deficiency and toxicity.

• P toxicity usually occur in high fertilizer rate in yellow sand due to low buffering capacity but not Yalanbee clay loam where P adsorption is much higher.

• Therefore, *P. indicus* may be sensitive to P supply which may affect growth.

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B) Foliar nutrient concentration and plant symptoms

• P concentration in YFEL increased linearly with increase P fertilizer i.e from 0-1.92mg/g in the YS and 0-5.5 mg/g in YB plants (Figure 2.0)

• Growth was greater in YB than YS plants as the leaves in YS were smaller

• Early symptoms associated with P deficiency were more dominant in YS plants at lower P fertilizer (P0-P32) than for YB treatment (P0-P80).
Figure 2.0 Total P concentration in the YFELs for *Pterocarpus indicus*

![Graph showing total P concentration in the YFELs for *Pterocarpus indicus*.](graph.png)

<table>
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<tr>
<th>Element</th>
<th>Description</th>
<th>Symptoms</th>
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<tbody>
<tr>
<td>P</td>
<td>Deficient</td>
<td>Malformed, stunted with soft small leaves, stunted stem, short internodes and malformed apical buds.</td>
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<tr>
<td></td>
<td>Adequate</td>
<td>Dark green leaves and taller healthy leaves.</td>
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<tr>
<td></td>
<td>Toxic</td>
<td>Shorter, stunted stems, coppicing branches with rosette-like small leaves, pale yellow and necrotic spots on old leaves.</td>
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Common symptoms in *Pterocarpus indicus* for P deficiency, adequate and toxicity

[Images of plants showing deficiency, adequacy, and toxicity]
Conclusion

- This study shows that *P. indicus* is sensitive to fertilizer P supply
- Readily exhibit symptoms
- Care necessary for the use of phosphatic fertilizers in forest nurseries involving the species and other N-fixing trees and
- Further studies recommended to investigate root adaptive response and sensitivity to luxury P fertilizer level.

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