Unravelling Synergistic Effects of Palm Bunch Ash and Glutathione on Plant Growth

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Introduction: Palm bunch ash (PBA)

Fresh Fruit Bunch (FFB)
- Palm oil cultivated from mesocarps of the oil palm fruits

Empty Fruit Bunch (EFB)
- 22% of FFB, major waste
- Mostly incinerated to be disposed

Palm Bunch Ash (PBA)
- > pH 7 & rich in potassium
- Reduces soil acidity and acts as a potash fertiliser [1]
Introduction: Glutathione (GSH)

GSH is a tripeptide, found abundantly in most plant tissue

Roles: Antioxidant, regulates enzymatic & photosynthetic activities

Induced by abiotic stresses; Inhibited by extreme stresses.

Mitigate oxidative stress and damage to plants

Exogenous applied GSH

Seed soaking

Foliar spray

Improved growth and yield of various plants [2]
Problem Statement

• Plants are susceptible to environmental stresses.
• Individual application of PBA and GSH improve growth of plants.
• However, there is yet to be a research on the effects of the combined application of PBA and GSH on plant growth.

Objective

• To assess the effects of PBA, GSH and their combined application on okra plant growth through:
  • Examination of growth parameters like plant height, stem girth, number of leaves per plant and leaf area.
Experimental Design

4 groups, 4 replicate pots & 6 seeds each:

A. **Control group**
   - Water-soaked & planted in black soil (3 kg) only

B. **PBA group**
   - Water-soaked & planted in PBA-soil (200 g: 3 kg) mix

C. **GSH group**
   - GSH-soaked (100 mg/L) & planted in black soil (3 kg) only

D. **PBA-GSH (Combination) group**
   - GSH-soaked (100 mg/L) & planted in PBA-soil (200 g: 3 kg) mix
Experimental Procedures

1) Seed Soaking
- 60 seeds in GSH
- 60 seeds in water

2) PBA: Soil Mixing
- 200g PBA: 3 kg black soil for 8 pots

3) Planting
- 6 seeds in each pot accordingly
- Watered daily

4) pH & NPK Soil Test
- Soil samples added with reagents
- Compared against colour charts
Results & Discussion

Soil Test, Plant Height, Stem Girth, Number of Leaves per Plant, Leaf Area
Soil Test

For NPK level: 0 = depleted, 1 = deficient, 2 = adequate, 3 = sufficient, and 4 = surplus.

<table>
<thead>
<tr>
<th>Soil Sample</th>
<th>Day 0</th>
<th>Day 42</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Black soil</td>
<td>PBA</td>
</tr>
<tr>
<td>pH</td>
<td>6.5</td>
<td>&gt; 7.5</td>
</tr>
<tr>
<td>Nitrogen, N</td>
<td>N2</td>
<td>N0</td>
</tr>
<tr>
<td>Phosphorus, P</td>
<td>P3</td>
<td>P3</td>
</tr>
<tr>
<td>Potassium, K</td>
<td>K2</td>
<td>K4</td>
</tr>
</tbody>
</table>

- No change in properties; pH: 6.5 - black soil, 7 - PBA-soil mix.
- Nitrogen level **adequate**; Phosphorus level **sufficient** in all soils
- Potassium level **surplus** for PBA-soil mix
Plant Height

- GSH > Control > PBA-GSH (combination) > PBA

Stem Girth

- Surplus in K: ↓ N-metabolising enzymes [3].
- Combination recorded the thickest stem girth

Synergistic effect observed, GSH: ↑ photosynthetic activities
PBA: Accumulation of K is lower in stems [3].
**No. of leaves**

Overall trend: Slight decrease

**Leaf surface area**

**Synergistic effects** observed,

GSH: ↑ photosynthetic pigments [4].

PBA: Fulfilled ↑ demand of K,

↑ rate of photosynthesis [5].
Visual Assessment

Control: White Spots, Chlorosis, Wilting

PBA: Curling & shrunken leaves, White flies and eggs

GSH: Bigger leaves with a few yellow leaves

PBA-GSH: Bigger leaves with darker green

Powdery mildew: Fungus that favours high humidity [6].

Vectors of okra enation leaf curl disease (OECD) [7];

Increased photosynthetic pigments and improved resistance to diseases; Indicates presence of more chlorophyll [5];
Conclusion

PBA-GSH (Combination) group

• Synergistic effects of combination PBA-GSH group were evident in later stages:
  • PBA fulfilled the increasing nutrient demand
  • GSH enhanced enzymatic and photosynthetic activities

• Future Works:
  • Lab analysis of 1) Black soil and PBA composition; 2) Enzymatic and photosynthetic activities of plants
  • Encapsulation work to produce controlled release for PBA and GSH
Thank You
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References


[4] Vittoria Locato, Sara Cimini, & Gara, L. D. (2017). Glutathione as a Key Player in Plant Abiotic Stress Responses and Tolerance. In Glutathione in Plant Growth, Development (pp. 127-145). Unit of Food Science and Human Nutrition, Department of Medicine, Campus Bio-Medico, University of Rome, via Álvaro del Portillo 21, 00128 Rome, Italy: Springer International Publishing AG.

