Greywater Use for Agricultural Irrigation in Urban and Peri-urban Areas

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Introduction

Water crisis in South Africa

• Average rainfall 450mm/year
• 60% total water demand is for agricultural use
• Increased fresh water demand

Alternative sources need to be investigated

→ Wastewater reuse
   Toilet waste (black water)
   Non-toilet waste (greywater)
Grey water represents an environmental problem
  • Unpleasant odours
  • Health hazards
  • Soil erosion
  • Pollution of surface water by runoff
  • Mosquito breeding

Benefits of grey water reuse
  • Reduce water shortage
  • Reduce environmental degradation, eutrophication and health hazards
  • Reclaim wasted nutrients
  • Alleviate food shortages and poverty
Greywater re-use simultaneously addresses environmental and social needs.

Preliminary community trials by eThekwini Municipality were promising:

- community acceptance
- good yield of above-ground crops
Aims

Semi-field greywater irrigation trials were conducted to investigate:

- Effect of greywater on plant growth and yield
- Plant growth patterns over different seasons
- Microbiological contamination of the produce
Experimental design

Eight households selected from nearby community contributed greywater daily, pooled on site.

Three treatments
- Tap water
- Nutrient-amended water solution
- Greywater (experimental treatment)

Both leafy (above ground) and root (below ground) crops represented
- 25 replicates per treatment for
- Above ground:
  - spinach and green pepper
- Below ground:
  - carrots and beetroot

Results from crop cycles 2-4 of 6 crops cycles presented
- 1st crop cycle: pest problems
- crop cycles 5 and 6: results still being analysed
Plant growth and yield monitoring

Weekly growth measurements
- Plant height and stem diameter
- Number of leaves
- Leaf area
- Number of fruits

- *Results for plant heights presented here*

Yield measurements on crops
- Fresh weight
- Dry weight

- *Fresh weights presented here*
Plant heights, above-ground crops

Crop cycle 2

**A. SPINACH**

<table>
<thead>
<tr>
<th>Time (weeks)</th>
<th>Mean plant height (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10.00</td>
</tr>
<tr>
<td>2</td>
<td>15.00</td>
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<tr>
<td>3</td>
<td>18.00</td>
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<tr>
<td>4</td>
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<tr>
<td>9</td>
<td>30.00</td>
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<tr>
<td>10</td>
<td>32.00</td>
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</table>

**B. GREEN PEPPER**

<table>
<thead>
<tr>
<th>Time (weeks)</th>
<th>Mean plant height (cm)</th>
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<tbody>
<tr>
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<tr>
<td>2</td>
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<tr>
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<td>45.00</td>
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<tr>
<td>10</td>
<td>50.00</td>
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</tbody>
</table>

**Graphs**

- Greywater
- Nutrient solution
- Tap water

**Legend**

Spinach

Peppers
Plant heights, below-ground crops
Crop cycle 2

C. CARROT

D. BEETROOT
Plant heights, above-ground crops
Crop cycle 3

Spinach

A. SPINACH

Peppers

B. GREEN PEPPER
Plant heights, below-ground crops
Crop cycle 3

C. CARROT

D. BEETROOT
Stem heights, above-ground crops
Crop cycle 4

Spinach

Peppers

A. SPINACH

B. GREEN PEPPER
Plant heights, below-ground crops
Crop cycle 4

Carrot

C. CARROT

Beetroot

D. BEETROOT
### Spinach

#### Total Yield

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>150</td>
<td>200</td>
<td>250</td>
<td>300</td>
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</table>

### Peppers

#### Total Yield

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<th>T4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>100</td>
<td>150</td>
<td>200</td>
<td>250</td>
</tr>
</tbody>
</table>
**Total Yield**

### Carrot

**C. CARROT**

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<tr>
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<th>T3</th>
<th>T4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean fresh weight (g)</td>
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<td>700.00</td>
<td>600.00</td>
<td>500.00</td>
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</tbody>
</table>

Graph showing mean fresh weight of carrots across different treatments.

### Beetroot

**D. BEETROOT**

<table>
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<tr>
<th></th>
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<th>T3</th>
<th>T4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean fresh weight (g)</td>
<td></td>
<td>150.00</td>
<td>100.00</td>
<td>50.00</td>
</tr>
</tbody>
</table>

Graph showing mean fresh weight of beetroots across different treatments.
Conclusions

- Using greywater as a nutrient source produced increased plant heights and yields similar to that obtained when using chemical fertilizers.

- Grey water represents a potential resource for food production – but safety and site-specific factors must be investigated on a site by site basis.

- Greywater irrigated produce is likely to be safe for human consumption (based on microbiological analyses).
Acknowledgements

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