Evaluation of composts for improving fertility and productivity of soils in United Arab Emirates

Abdullah Alshankiti & Shagufta Gill
The application of organic matter has received increasing attention recently, not only because of the beneficial effects of organic matter application, but also due to the increasing availability of cheap sources of organic matter, such as sewage sludge and compost.”

Source: REINHARD F. HUTTL AND MARIO FUSSY
Organic matter management, 2001
Soil Protection and Re-cultivation, Brandenburg University of Technology, Cottbus, Germany
Main Issues

• Beneficial effects

• Increasing availability

• Policy Implication
Beneficial effects
Beneficial effects


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Beneficial effects

Figure 2. Soil and compost moisture characteristic curves
Increasing availability

Solid Waste Management in GCC: Challenges & Opportunities
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Contribution of Materials to Municipal Solid Waste – GCC Countries

Background: Municipal solid waste (MSW)

- MSW is a source of valuable materials or pollutants?

![Bar chart showing MSW generated in GCC countries](image)

Source: 2008 AFED (MSW data of 2004 or 2007)
Ref: MSW Average in Arab World = 0.7 kg/capita/day

Disposal to open pit
Biodegradable portion > 50%

Municipal sewage sludge

International Center for Biosaline Agriculture
120 million tons of waste produced in GCC in 2010
Compost Sample Collection

Bee’ah Materials Recovery Facility (MRF) – Sharjah

Total annual production 30,000 ton of which 95% used by Municipality

Waste Water Treatment Plant, Dubai Municipality

Total annual sludge production (4000-5000 ton)
Compost Sample Collection

Municipal Solid Waste (MSW) & Compost Plant Al-Ain

Total production 10,000 ton.

Four Types of Compost

- Fully domestic base
- Half domestic and half green
- Fully based on green matter
- Half animal manure and half green
# Characteristics of Compost Samples

<table>
<thead>
<tr>
<th>Sample</th>
<th>pH</th>
<th>EC, dS m⁻¹</th>
<th>N, %</th>
<th>P, %</th>
<th>K, %</th>
<th>OM, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abu Dhabi (Compost used at ICBA)</td>
<td>6.98</td>
<td>12.58</td>
<td>0.57</td>
<td>0.87</td>
<td>0.60</td>
<td>30.28</td>
</tr>
<tr>
<td>Bee’ah Sharjah</td>
<td>6.81</td>
<td>9.19</td>
<td>2.5</td>
<td>1.92</td>
<td>0.50</td>
<td>42.49</td>
</tr>
<tr>
<td>Al-Ain</td>
<td>7.38</td>
<td>7.35</td>
<td>0.87</td>
<td>0.92</td>
<td>0.40</td>
<td>34.48</td>
</tr>
<tr>
<td>DM Dubai (Sludge)</td>
<td>6.23</td>
<td>4.6</td>
<td>5.85</td>
<td>4.04</td>
<td>0.45</td>
<td>71.80</td>
</tr>
</tbody>
</table>

Abu Dhabi (Compost): Green matter; Bee’ah Sharjah (compost): Green matter + Sewage sludge(70:30)
Municipal Solid Waste(MSW) & Compost Plant Al-Ain (compost) : Green matter; DM, Dubai: Sewage Sludge
Characteristics of Compost Samples

- Significant variation of OM, N, P, K contents in the four samples observed indicating the effect of different sources of MSW was used for composting
- Organic matter content of composts varied from 30.28% (Abu Dhabi Compost) to the highest 71.80% (Dubai sewage sludge)
- P ranged between 0.87-4.04%
- K ranged between 0.40-0.6%
- Nitrogen also varied, highest being for sewage sludge (5.85%) and the lowest for Abu Dhabi compost (0.57%)
- EC (1:1) ranged between 4.6 dS/m (sludge) and 12.58 dS/m (Abu Dhabi compost)
Objectives

To Study:

• The dynamics and nutrients availability (Immobilization / mineralization of N, P) from compost material

• The efficiency in short & long term (Release of available N and P over time) of compost material
Treatments

Control (no compost)

• 10 tons ha⁻¹ (0.44 %) compost
• 20 tons ha⁻¹ (0.88 %) compost
• 40 tons ha⁻¹ (1.76 %) compost

• Sampling intervals: 0, 5, 10, 20, 30, 45, 60 days
• Replicates: 3 per treatment per sampling interval

Incubation Study

Soil per container: 100 g

Incubation Temperature: 30 °C
Accumulation of mineral N (NH$_4$) during incubation

- Increased mineralization is observed with the increase of compost application rates
- Overall maximum NH$_4$ accumulation is observed within first week of application where 20 tons compost was applied

Changes in the concentrations of available NH$_4$-N in the soils with the application of different rates of composts over 60 a period of days
Accumulation of mineral NO$_3$-N during incubation

- Increased mineralization is observed with the increase of application rates of compost.
- Overall maximum NO$_3$ mineralization is found after 6th week of application where 20 tons compost was applied. Exception being after 20 days with 10 tons application.

Changes in the concentrations of available NO$_3$-N in the soils with the application of different rates of composts over 60 a period of days.
Accumulation of mineral N (NH$_4$ and NO$_3$) during incubation

- Net increase of mineralization is observed with the increase of application rates of compost.
- Maximum net mineralization is observed after first week of application where 20 tons compost was applied.

Changes in the concentrations of net available NH$_4$-N, NO$_3$-N in the soils with the application of different rates of composts over 60 a period of days.
Effect of incubation on soil P concentration

Incubation Study

• Increased P mineralization is observed with the increase of compost application rates

• Maximum P mineralization is found within first interval and remains consistent

Changes in the concentrations of available P in the soils with the application of different rates of composts over 60 a period of days
Effect of incubation on soil K concentration

- Increased K mineralization is observed with the increase of compost application rate.
- Minimum mineralization is observed within first interval and remains consistent within 3 interval and then increased from 4th interval.

Changes in the concentrations of available K in the soils with the application of different rates of composts over 60 a period of days.
The effect of compost concentrations on organic matter content

• Similar trend of weight loss is observed over time

• Relative rate of decomposition increased with the increase of application rate

• Gradual increase of OM decomposition is evident over time

Changes in the concentrations of organic matter in the soils with the application of different rates of composts over a period of 60 days
The effect of compost concentrations on pH

Insignificant increase of pH observed with the increasing application rates of compost on soil pH as compare to control over a period of time.

Changes in soils pH with the application of different rates of composts over a period of 60 days.
Future Plan

• To establish soil types based recommendations for optimum use of composts
• Introduce new technology (biochar and bio-fertilizer) in UAE
• Use of Biochar as a means to stabilize composts and sequester carbon
• Improve the efficiency of composting process and stabilize composts through the use of appropriate microorganisms