Investigating Nitrogen Fixation By Azotobacter in Soil

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Overview of presentation

- **Background**
- **Objectives**
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- **Methodology**
- **Results and Discussion**
- **Conclusion**

Background

- **Project has been initiated by Solid Waste Recycling Ltd in collaboration with the research team from the University of Mauritius**
- **Composting of unsorted MSW which was collected around the Island and application of the MSW compost for crop production as composts improve the physical and chemical properties of soil**
- **Enrichment of MSW compost, characterised by low nitrogen content, to convert them into value-added products which in turn will increase fertilizer use efficiency and their market value**
- **Enrichment is carried out by the use of chemical or biological additives; biofertilizers are preferred as they are eco-friendly, less expensive and have the ability to fix nitrogen in the air thereby stimulating plant growth**

Objectives

- **Evaluate the effect of compost enrichment on germination**
- **Investigate the evolution of the nitrogen content of soil during plant growth**
- **Compare the rates of growth and yields of crops in different mixtures of compost, soil, chemical fertilizers and biological additives**

Literature Review

- **Several studies have shown that the combination of compost and chemical fertilizer is an appealing alternative but it's not always the case**
- **Kavitha and Subramanian (2007) - maximum grain and straw yields at a mixture of 25% of enriched compost and 75% of inorganic fertilizer at the recommended dose**
- **Tahir et al. (2006) - Pot trials revealed that enriched compost supplemented with 50% of N fertilizer supported better growth and yield of tomato compared to 100% of N fertilizer**
- **Thakur and Sharma (1998) – The inoculation of compost with *Azotobacter* and rock phosphate has shown an increase in total N content at 30 and 60 days of composting**
- **Hepperly et al. (2009) – the crop yield from compost addition was comparable to that at recommended fertilizer rate**

Methodology

- **Composting process**
  - **MSW and poultry litter were composted in windrows for 48 days**
  - **Biological inoculum was added to speed up the process**
  - **Enrichment of compost during curing phase**

- **Germination**
  - **Garden bean, cucumber, radish and tomato seeds were sown in plastic pots containing different mixtures of soil and enriched compost**
  - **The number of emerged seedlings, height and dry weight of the seedlings were recorded**

Methodology

- **Growth response experiment**
  - Crops: Lettuce, groundnut and tomato
  - Treatments:

T1	soil + enriched compost (1% phosnitroculum + 5% NPK)
T2	soil + enriched compost (1% phosnitroculum only)
T3	soil + enriched compost (5% azotobacter only)
T4	soil + non-enriched compost
T5	soil + non-enriched compost + 1% phosnitroculum upon planting
T6	soil + non-enriched compost + 3% azotobacter upon planting
T7	soil + recommended fertilizer
T8	soil + non-enriched compost + 50% recommended fertilizer +1% phosnitroculum upon planting

Results & Discussion

- **The temperature of the compost > 55°C for several days; volatile solids content and organic carbon content decreased by 30.27% and 16.82% in 15 days**
- **The nitrogen content of the MSW compost was 2.26%**
- **Seedling emergence in the presence of enriched compost:**
  - **Cucumber and radish have shown improved ability to thrive in treatment with higher percentage of azotobacter-enriched compost followed by tomato and bean.**

Radish

Cucumber

Results & Discussion

- **Nitrogen content of soil**
  - **There was considerable loss of N in treatments T7 (100% recommended fertilizer) and T8 (50% recommended fertilizer); it could be attributed to loss of N through leaching**
  - **The loss of N in the microbial-enriched composts was gradual and not so important; it was due to the presence of *azotobacter* which fixes atmospheric nitrogen in the rhizosphere**
  - **The soil was thus not depleted of its nutrients rapidly**

Results & Discussion

- **Growth response experiment - Lettuce**

Treatments	Length of root (cm)	Height of plant (cm)	Fresh weight (g)
T1	9.8	31.7	114.8
T2	19.7	42.5	239.3
T3	14.3	35.8	432.5
T4	8.8	31.7	130.8
T5	7.8	31.3	127.4
T6	10.6	38.0	611.7
T7	7.3	29.5	109.5
T8	8.3	30.7	118.0

Significant difference in the growth rate and yield of lettuce has been observed in treatments T2, T3 and T6 which consist of biofertilizers compared to the other treatments

Results & Discussion

- **Growth response experiment - Groundnut**

Treatments	Length of root (cm)	Fresh weight (g)	Dry weight (g)
T1	21.7	133.3	66.7
T2	26.3	325.0	71.0
T3	NA	NA	NA
T4	18.6	158.3	101.0
T5	**29.7**	**191.7**	**122.7**
T6	20.9	175.2	NA
T7	**26.9**	**205.0**	**128.9**
T8	24.6	178.3	111.1

In this experiment, the rate of growth and yield of groundnut were comparable to that of recommended fertilizer rate

Results & Discussion

- **Growth response experiment – Tomato (Crop Rotation)**
- **Tomato seeds were sown in the treatments that were used for lettuce cultivation without further organic amendments**

Treatments	Length of root (cm)	Fresh weight (g)	Dry weight (g)
T1	38.3	1748.2	99.6
T2	**38.0**	**2435.0**	**138.8**
T3	NA	NA	NA
T4	28.0	1550.6	110.1
T5	32.0	1400.2	100.8
T6	NA	NA	NA
T7	32.0	1695.8	135.6
T8	36.0	740.5	52.5

The microbial-enriched compost could sustain the highest yield of tomato

Results & Discussion

- **Growth response experiment – Tomato (New Treatment)**
- **Growth of tomato was investigated in freshly prepared treatment mixtures**

Treatments	Length of root (cm)	Fresh weight (g)	Dry weight (g)
T1	46.0	1875.6	112.5
T2	27.0	1460.2	86.1
T3	NA	NA	NA
T4	44.0	1450.9	105.9
T5	43.0	1060.3	75.3
T6	**29.0**	**2973.0**	**219.9**
T7	38.0	1850.4	135.1
T8	36.0	925.1	68.5

Yield was significant upon the addition of ***azotobacter*** during plantation (T6)

Conclusion

- Pot trials have shown good germination of crops on addition of *azotobacter*-enriched compost
- The loss of N was not significant in the presence of the *azotobacter*-enriched compost
- Yield from the treatments varied with respect to the types of crop
- Microbial-enriched compost could sustain satisfactory yield from crop rotation
- Enrichment of MSW compost with biofertilizers or the addition of the biofertilizer as a supplement after cultivation has shown better growth and yields of crops compared to treatments which consist of 100% recommended fertilizer rate or a mixture of fertilizer and compost
- The use of *azotobacter* is thus an effective biological management option for stimulating plant growth

Thank you
for your attention!