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Full Length Research Paper

Production of compost with useful microorganisms from sugar cane Bagasse enriched with rock Phosphate, Urea and Sulphur

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Nitrogen-fixing bacteria (*Azotobacter chroococcum*), phosphate solubilising bacteria (*Enterobacter cloacea*), sulphur oxidizing bacteria *(Thiobacillus thiooxidans),* phosphate solubilising fungi (*Trichoderma harzianum)* were used as a microbial activator in 15 different treatments for composting of bagasse enriched with rock phosphate, urea, and sulphur. The results showed that treatments were treated with Azotobacter bacteria increased nitrogen fixation, especially in the present of phosphate solubilising microorganisms. The soluble phosphorus increased in the treatments that were treated with rock phosphate and phosphate solubilising microorganisms, especially in the present of Azotobacter bacteria. These may have a synergistic effect between the two groups of organisms (phosphate solubilising microorganisms and Nitrogen-fixing bacteria). Production of CO_2 by microbial activities and respiration processes, decreased carbon concentrations and C/N ratio.

Key Words: Compost, rock phosphate, sugarcane bagasse, useful microorganisms.

INTRODUCTION

Composting transforms organic waste into a more uniform and biologically stable product that can act as slow release source of plant nutrients. Compost is an economic and safe way for treatment of organic waste and has high concentrations of organic matter and available nutrients (Verma, 2013). One of the largest agro-industrial byproducts in Iran is sugarcane bagasse, a fibrous residue of cane stalks left over after the crushing and extraction of the juice from the sugarcane.

This byproduct is commonly burnt or used by the sugar factories as a fuel for the boilers. Some reports have described the conversion of bagasse into value-added compost that has the potential to improve productivity of crops and reduce the problem of environmental pollution. However, some bagasse characteristics offer unique challenges to processors (Zayed and Abdel-Motaal, 2005).

One of the possible ways of increasing the nutrient content of the compost product is microbial enrichment technique with nitrogen fixers, P solubilises and sulphur oxidizer. Microbial inoculation and application of rock phosphate increased the nitrogen content. The present experiment was undertaken to improve the nutrient content and quality of the compost produced from agriculture waste through inoculation of microbial and enriched with rock phosphate, urea and sulphur(Kavitha and Subramanian , 2007).

MATERIALS AND METHODS

Bagasse used in this study was obtained from a sugar factory in Ahwaz City, Iran. Sugarcane bagasse was treated with bacteria and fungi (to enrich compost and decrease composting time), urea (to lower the C/N ratio), rock phosphate and sulphur (to enrich compost), in 15 different combinations in black plastic bags (table 1).

The experiments were set up in a complete randomized blocks design, with 5 replications and 15 treatments to compare the composting process. Moisture was

Table 1: Detail of different treatments

No	Treatments
1	Sugarcane bagasse (1kg)
2	Sugarcane bagasse (1kg) + urea (2%)
3	Sugarcane bagasse (1kg) + rock phosphate (1%)
4	Sugarcane bagasse (1kg) + urea (2%) + rock phosphate (1%)
5	Sugarcane bagasse (1kg) + urea (2%) + rock phosphate (1%) + sulphur (1%)
6	Sugarcane bagasse (1kg) + urea (2%)+ rock phosphate (1%) + sulphur (1%) + sulphur oxidizing bacteria (*Thiobacillus thiooxidans)* (0.1 ml inoculation in 50 ml distilled water)
7	Sugarcane bagasse (1kg) + urea (2%)+ rock phosphate (1%) + phosphate solubilising bacteria(*Enterobacter cloacea*) (0.1 ml inoculation in 50 ml distilled water)
8	Sugarcane bagasse (1kg) + urea (2%)+ rock phosphate (1%)+ sulphur (1%) + phosphate solubilising bacteria (*Enterobacter cloacea*) (0.1 ml inoculation in 50 ml distilled water)
9	Sugarcane bagasse (1kg) + urea (2%)+ rock phosphate (1%)+ sulphur (1%) + phosphate solubilising bacteria (*Enterobacter cloacea*) (0.1 ml inoculation in 50 ml distilled water) + Nitrogen-fixing bacteria (*Azotobacter chroococcum*) (0.1 ml inoculation in 50 ml distilled water)
10	Sugarcane bagasse (1kg) + urea (2%)+ rock phosphate (1%)+ sulphur (1%) + phosphate solubilising fungi(*Trichoderma harzianum)* (0.1 ml inoculation in 50 ml distilled water)
11	Sugarcane bagasse (1kg) + urea (2%)+ rock phosphate (1%)+ sulphur (1%) + phosphate solubilising fungi (*Trichoderma harzianum)* (0.1 ml inoculation in 50 ml distilled water) + Nitrogen-fixing bacteria (*Azotobacter chroococcum*) (0.1 ml inoculation in 50 ml distilled water)
12	Sugarcane bagasse (1kg) + urea (2%)+ rock phosphate (1%) + phosphate solubilising fungi (*Trichoderma harzianum)* (0.1 ml inoculation in 50 ml distilled water) + Nitrogen-fixing bacteria (*Azotobacter chroococcum*) (0.1 ml inoculation in 50 ml distilled water)
13	Sugarcane bagasse (1kg) + urea (2%)+ rock phosphate (1%) + Nitrogen-fixing bacteria (*Azotobacter chroococcum*) (0.1 ml inoculation in 50 ml distilled water)
14	Sugarcane bagasse (1kg) + urea (2%)+ rock phosphate (1%) + phosphate solubilising bacteria (*Enterobacter cloacea*) (0.1 ml inoculation in 50 ml distilled water) + Nitrogen-fixing bacteria (*Azotobacter chroococcum*) (0.1 ml inoculation in 50 ml distilled water)
15	Sugarcane bagasse (1kg) + urea (2%) + rock phosphate (1%) + sulphur (1%) + Nitrogen-fixing bacteria (*Azotobacter chroococcum*) (0.1 ml inoculation in 50 ml distilled water).

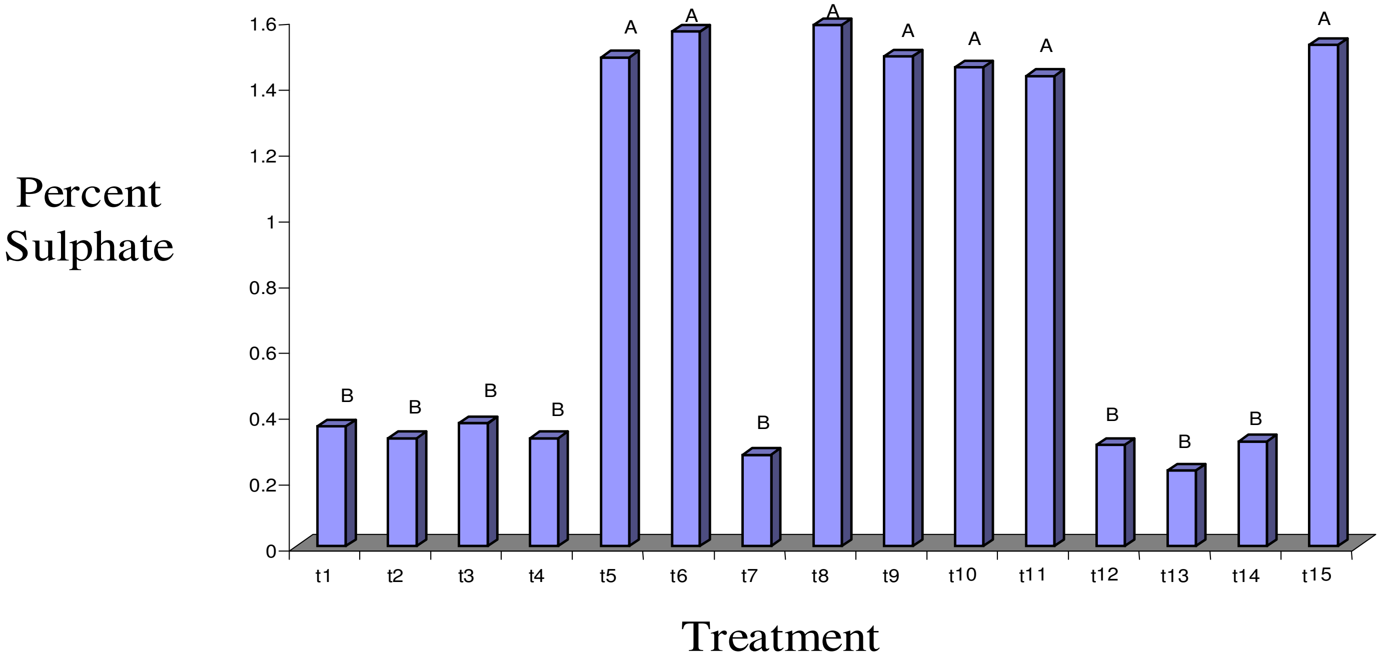


Figure 1: Percent sulphate at end of the experiment (after 2 months)

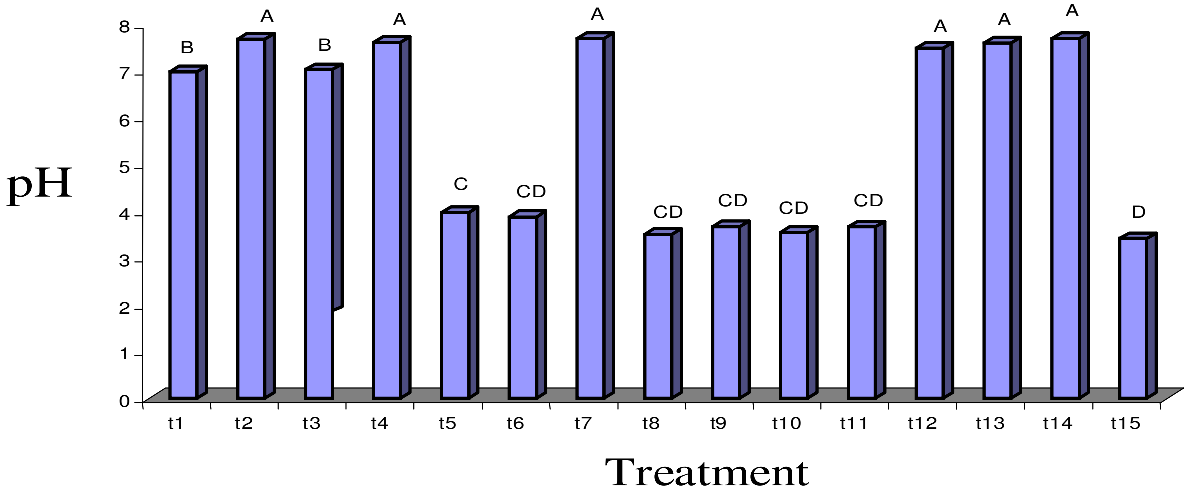


Figure 2: PH values at end of the experiment (after 2 months)

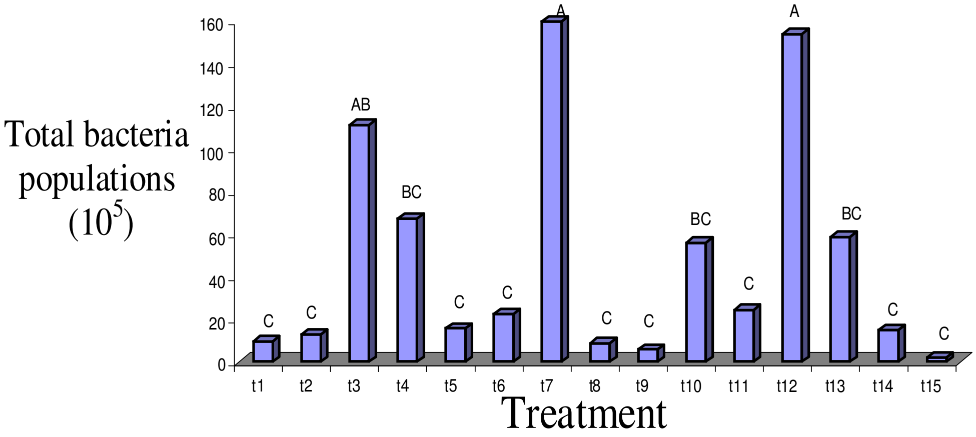


Figure 3. Total bacteria populations (10^5) at end of the experiment (after 2 months)

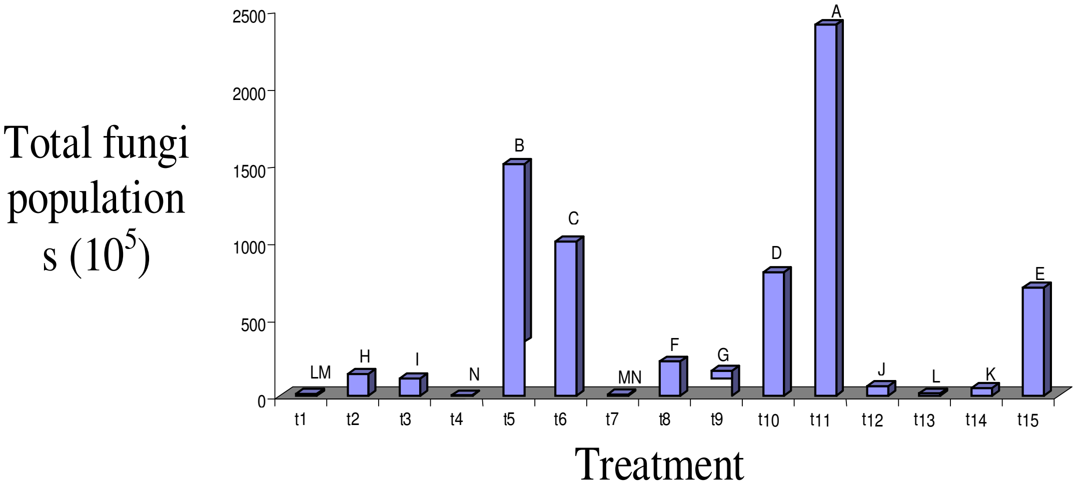


Figure 4. Total fungi populations (10^5) at end of the experiment (after 2 months)

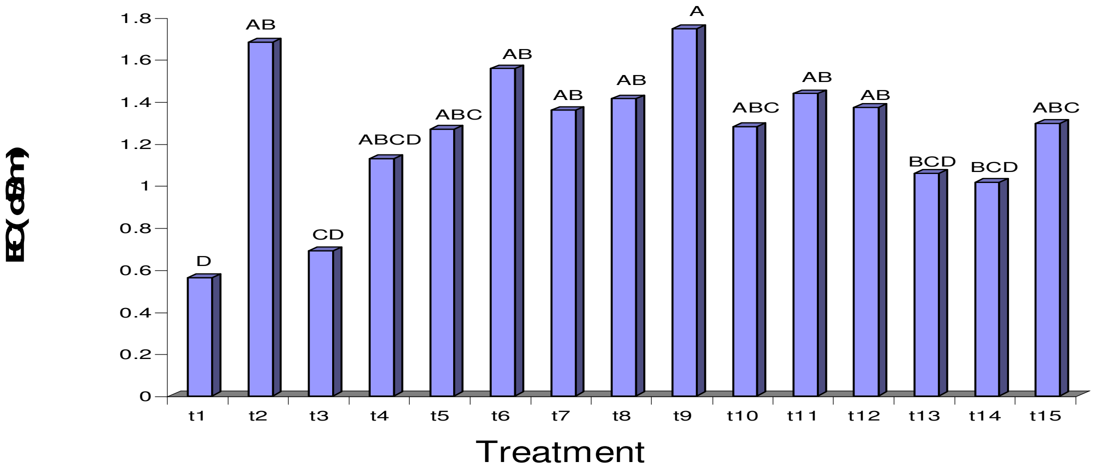


Figure 5. EC (dS/m) values at end of the experiment (after 2 months)

maintained at 60%. Check moisture every week and add water if needed. The total number of bacteria and fungi were determined using the MPN method at the beginning and the end of the experiment. Soluble phosphorus, sulphate, organic carbon, nitrate, ammonium nitrogen and C/N ratios were determined at 20-days intervals. pH and EC values were determined every day. The composting was allowed to continue for 120 days.

RESULTS AND DISCUSSION

In the reference experiment, the results showed that sulphate concentrations increase in the all treatments that were treated with sulphur. Furthermore, Treatments were treated with sulphur and microbial inoculants increased sulphate concentrations more than other treatments (Figure 1).

The results showed that the tested bagasse was alkaline raw material with an initial pH around 8. During the composting process there was a correlation between the amounts of sulphate produced and the reduction in pH values. The pH of all treatments decreased till the end of the experiment (Figure 2).

At the end experiment, the results showed that the numbers of total fungi increase and the numbers of total bacteria decrease in all treatments. The enrichment with sulphur greatly increased the total number of fungi compared to the non-treated. These results are in harmony with pH, sulphate concentration and the total number of fungi results, which means that the beneficial effects are related to the added microorganisms and enriched materials. Sulphur enrichment prepares suitable environment for the growth and activities of fungi that Produce CO_2, decrease carbon concentrations and C/N ratio in the treatments (Figure 3, 4).

Results showed that EC values increased in all treatments. The treatments that were treated with sulphur indicated greater increase in EC values than other treatments because present of sulphur in these treatments increase the numbers of total fungi and their activities that had a positive effect on the release of elements so increase EC values (Figure 5).

The soluble phosphorus increased in the treatments were treated with rock phosphate and phosphate solubilising microorganisms, especially in the present of Azotobacter bacteria. These may have a synergistic effect between the two groups of organisms (phosphate solubilising microorganisms and nitrogen- fixing bacteria)(Figure 6).

The results showed that treatments were treated with Azotobacter bacteria increased nitrogen fixation, especially in the present of phosphate solubilising microorganisms. This may have a synergistic effect between the two groups of organisms (phosphate solubilising microorganisms and nitrogen-fixing bacteria).

The treatments were treated with sulphur had the lowest content of nitrate because sulphur oxidation decreased pH in these treatments so nitrogen-fixation bacteria could not well grow and act (Figure 7). Graph 1 show how nitrogen contents change in all treatments.

In composting process, microorganisms break down organic matter and produce carbon dioxide (CO_2), inoculation of microorganisms improved this process so in the treatments that were treated with microorganisms greater increase of CO_2 and decrease of C/N ratio than

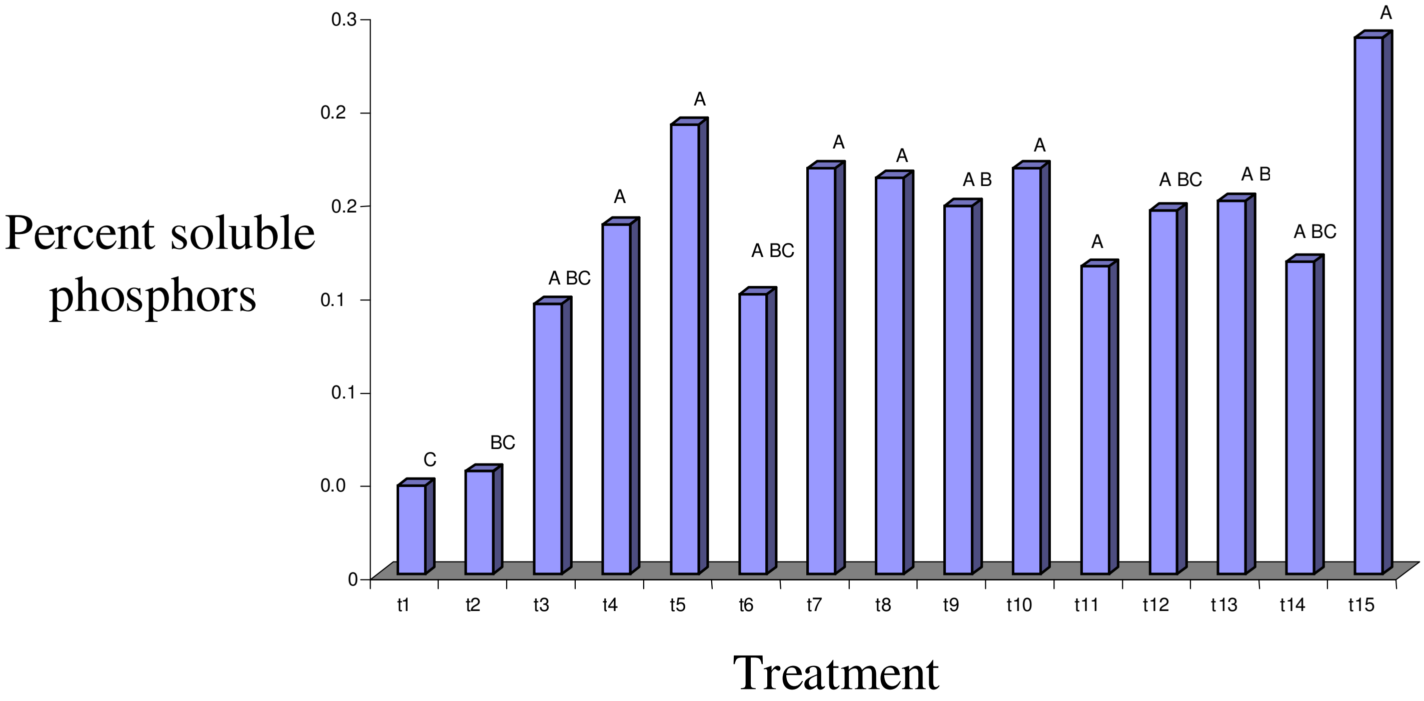


Figure 6: Percent soluble phosphors at end of the experiment (after 2 months)

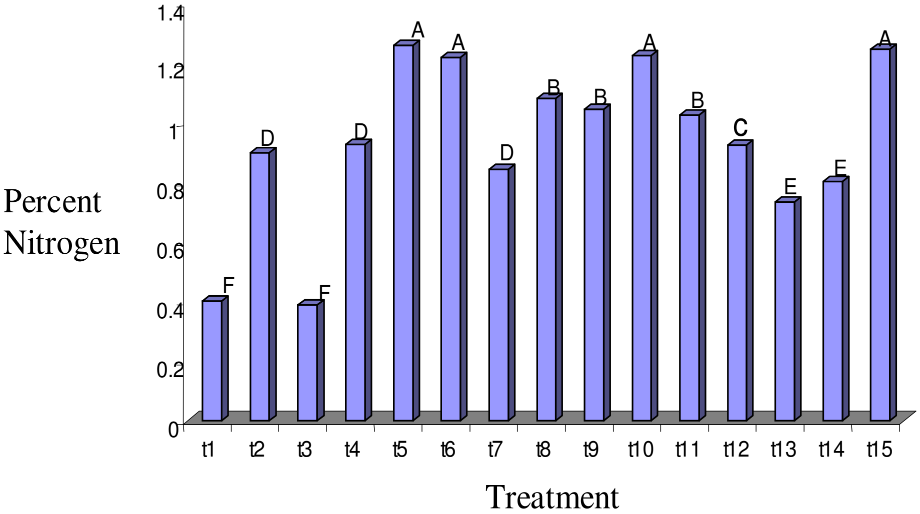
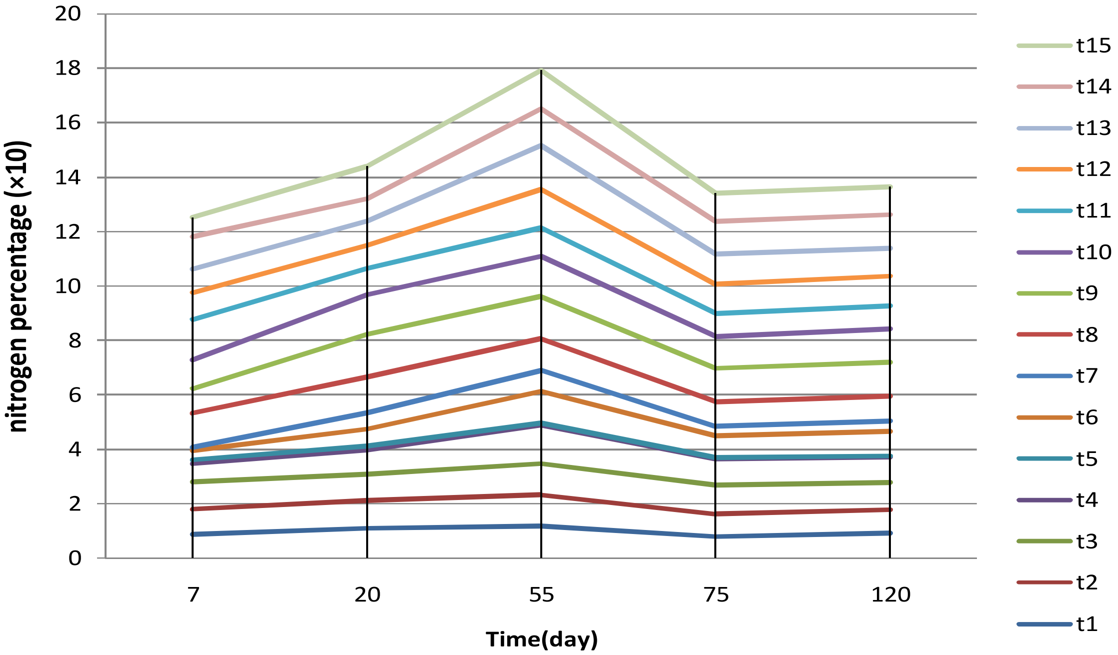


Figure 7: Percent Nitrogen at end of the experiment (after 2 months)

other treatments. Furthermore, Treatments were treated with sulphur and microbial inoculants decreased C/N ratio compared to the non-treated.

Results showed that a sharp increased in Temperature amounts for all treatments, particularly at the beginning period of experiment. Also, the lower temperature amounts were found in treatment were treated with T*richoderma harzianum* fungi, particularly at the beginning of the composting process. Temperature amounts in treatments treated with sulphur were always higher than other treatments because sulphur oxidation decreased pH in these treatments then fungi could well grow and act so temperature increased.

Therefore, we can infer rock phosphate, urea and sulphur enriched composts were prepared by mixing microbial inoculants (phosphate solubilising



Graph 1: Percent Nitrogen during the experiment

microorganisms and nitrogen-fixing bacteria) with sugarcane bagasse (in case rock phosphate and sulphur together) in the shortest time.

REFERENCES

Chen YP, Rekha PD, Arunshen AB, Lai WA, Young CC (2006). Phosphate solubilizing bacteria from subtropical soil and their tricalcium phosphate solubilizing abilities. *Journal of Application Soil Ecology* 34,33-41.

Illmer P, Schinner F (1995). Solubilization of Inorganic calcium phosphates-solubilization mechanisms. *Journal of Soil Biology and Biochemistry* 27, 257-263.

Kavitha R, Subramanian P (2007). Bioactive Compost - A Value Added Compost with Microbial Inoculants and Organic Additives. Journal of Applied Sciences, 7: 2514-2518.

Khan AA, Jilani G, Akhtar MS, Naqvi SMS, Rasheed M (2009.) Phosphorus Solubilizing Bacteria: Occurrence, Mechanisms and their Role in Crop Production. *Journal of Agricultural biological Science* 1, 48-58.

Khan KS, Joergensen RG (2009). Changes in microbial biomass and P fractions in biogenic household waste compost amended with inorganic P fertilizers. *Journal of Bioresource Technolology*100,303-309.

Khan MS, Zaidi A, Wani PA (2007). Role of phosphate-solubilizing microorganisms in sustainable agriculture. A review Agrononomy Sustainable Development 27,29-43.

Kim K, Jordan D, Mcdonald CA (1998) Enterobacter agglomerans, phosphate solubilizing bacteria, and microbial activity in soil: effect of carbon sources. *Journal of Soil Biology and Biochemistry* 30, 995-1003.

Kumar V, Singh KP (2001). Enriching vermicompost by nitrogen fixing and phosphate solubilizing bacteria. . *Journal of Bioresource Technolology*, 76, 173-175.

Pradhan N, Sukla LB (2005). Solubilization of inorganic phosphate by fungi isolated from agriculture soil. *Journal of African Biotechnology* 5,850-854.

Reddy M, Kuma S, Babita K, Reddy MS (2002). Biosolubilization of poorly soluble rock phosphate by Aspergillus tubingensis and Aspergillus niger. Bioresource Technology Journal, 841: 187-189.

Rodriguez H, Fraga R (2000). Phosphate solubilizing bacteria and their role in plant growth promotion. *Journal of Biotechnology Advances* 17, 319-339.

Sahu SN, Jana BB (2000). Enhancement of the fertilizer value of rock phsophate engineered through phosphate-solubilizing bacteria. Ecological Engineering Journal, 15: 27-39.

Sharma, A (2002). Biofertilizer for sustainable agriculture. Agrohouse Publication, India.

Sundara B, Natarajan, V, Hari, K, (2002). Influence of phosphorus solubilizing bacteria on the changes in soil available phosphorus and sugarcane and sugar yields. *Journal of Field Crop Research* 77, 43-49.

Verma S (2013).Effect of Compost on Soil Phosphorus Availability.PHD thesis agriculture university of Adelaid.

Zayed G, Abdel-Motaal H (2005). Bio-production of compost with low pH and high soluble phosphorus from sugar cane bagasse enriched with rock phosphate. World Journal of Microbiology & Biotechnology 21:747–752