Journal of Global Biosciences
ISSN 2320-1355
Volume 4, Number 9, 2015, pp. 3319-3324
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Research Paper

ALTERATION IN ORGANIC, INORGANIC AND MICROBIAL SOIL CONTENTS INDUCED BY CULTIVATION OF GROUNDNUT

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Abstract

Due to urbanization and rapid industrialization, the growth in world's population contributed to an increase in both quantity and variety of solid wastes generated due to domestic, industrial and other activities. Therefore, it has become difficult to identify an appropriate processing technique and suitable site for safe disposal of generated waste. The municipal solid waste (MSW) dumping ground located at Bhandewadi in Nagpur, India is overflowing with the deposited waste and hence it was necessary to critically examine the existing dumpsite to check the extent of pollution for suitability of growing plants. The groundnut plant was grown in area surrounding the industrial and MSW dumpsite area. To spot the growth of groundnut plant (leguminous plant), two different types of soils was taken both from industrial and MSW dumped areas with control samples from agricultural area. There was significant difference in chemical, physical and microbiological properties in all three soil samples taken initially and after the growth of groundnut. pH of solid waste and industrial soil became less after the growth of the plant whereas the value of nitrogen was more after growth of the plant. The remaining nutrients *viz.,* Ca, Mg. Na and K were more before the growth of plant but afterwards it decreased because of its use by plant. The groundnut plant grew well in solid waste and industrial soil as compared to agricultural soil. The plants grown in different soil was also analyzed for its heavy metal contamination level, which are presented in this paper.

Key words: *Arachea hypogea*, agricultural soil, industrial soil, solid waste soil, soil physicochemical properties, microbiological properties.

INTRODUCTION

Unorganized, random dumping of municipal wastes is very common in many Indian cities which cause adverse impacts to the environment. (Mahar et al, 2007). Nearly all human actions produce waste, which create risks to the environment and public health. (Zhu et al 2008). These dumpsites contain a variety of contaminants which can contaminate the soil of the area around the dumping site.The use of dumpsites as farm land is a common practice in urban and sub-urban centres. (Ogunyemi et al, 2003). Inspite of the foregoing, most discarded wastes dumpsites in many towns and villages in Nigeria attract people as fertile ground for cultivating variety of crops. (A.A. Amusan, et al 2005). Municipal solid waste compost utilisation may

promote nutrient availability, plant growth; stimulate respiration, photosynthesis and chlorophyll content. (A.Lakhdar et al 2011). Due to the discharge of effluents directly or after partially treating, the soil of the industrial area gets contaminated.. Thus to spot whether that area can be used for growing of crops, groundnut plant was grown in the area surrounding the industrial and solid waste site.

Peanuts also have an excellent ability to extract some nutrients from the soil, particularly phosphorus. Lack of phosphorus and molybdenum can cause nitrogen deficiency. It was also reported that municipal solid waste has the ability of improving soils that have been cropped for many years. It was also seen that municipal solid waste improve the physical characteristics and stimulation of microbial activity that can improve plant growth. (Simeon P.O et al 2013). Municipal solid wastes help in soil structure development, microbial activity stimulation and supply essential nutrients. Application of city garbage has resulted into valuable effect in improving the yield of many crops apart from improving soil properties. (Munendra pal et al 2014). It was seen that the vicinity bounded by municipal solid wastes increased the ease of N, P, and K content of soil. (Utpal go swami et al, 2008). Application of sewage sludge droppings improves soil physicochemical properties and enhances microorganism's activity.Soil organic matter increases from municipal solid waste compost. (A.Lakhdar et al 2011). It was seen that municipal solid waste can result in increased soil fertility and water retention in the soil, and thereby decreasing soil erosion and fertilizer requirements. The high cation exchange capacities of the dumpsites were likely as a result of decomposition of municipal wastes which yield more exchangeable bases raising the fertility status of municipal dumpsites (Anikwe et al 2002). The use of municipal solid waste had a major effect on the performance of the growth of the plant. So it is required to add municipal waste to soil to improve its fertility grade. (Simeon P.O et al 2013).The growth of the plant in the municipal solid waste soil did not raise the accessibility of toxic elements and their accumulation in crop tissue at such levels that could be dangerous to crop yield or public wellbeing.

The current work was hence performed to observe the development of groundnut plant in the soils collected from industrial and solid waste dumping site soil as well as to observe the changes in organic inorganic and microbial soil constraints. The contamination level of heavy metals was also checked in the plant to observe whether it can be consumed or not.

MATERIALS AND METHODS

Study area selected for collection of soil samples:

Soils samples were collected from Bhandewadi municipal solid waste dumping site and from industrial area (vicinity of steel industry) located in Nagpur. Agriculture soil collected from farm was used as a control during experimentation.

Physicochemical parameters performed at the onset of experiment:

Preliminarily physico-chemical and microbiological parameters of three different soils (agricultural, industrial, solid waste) were performed.

Growth of groundnut plants in various soils:

Groundnut plant was grown individually in three soils collected from agricultural, industrial and solid waste sites. The soil collected from agriculture field was considered as control. After attaining a particular height and when it seems that the plant has develop up to maturity it was removed from the soil and was used to evaluate for further parameters.

Evaluation of physicochemical parameters of soil after growth of groundnut plant:

The plant which was removed from the soil, while the soil in which the plant was grown was taken to process for physicochemical parameters.

The present study thus performed was to see whether municipal and industrial dumping site area is favorable for growth of the plant, so that this waste dumping lands can be used for growing of crops to meet the needs of people. The contamination status of plant was also checked to see whether it is consumable or not.

RESULTS AND DISCUSSIONS

Physical characteristics of soil

The physical characteristics of soil before and after the growth of groundnut plant were evaluated and the results obtained are presented in Figure1.

Table 1: Results of physicochemical parameters from different sources

Different kinds of soil	Bulk density (gm/cm^3)	Porosity (%)	Water holding capacity %	pH	EC
Agriculture(control)	1.40	32.6	38.2	7.5	0.42
Solid waste	1.38	20.4	22.4	7.7	0.47
Industrial	1.40	22.4	24.2	7.9	0.35
Agricultural soil after plant growth	1.40	24.6	27.4	6.8	0.36
Solid waste soil after plant growth	1.42	26.8	30.8	6.4	0.47
Industrial soil after plant growth	1.40	28.4	32.6	6.6	0.31

Chemical Characteristics of soil

The chemical characteristics of soil before and after the growth of groundnut plant were evaluated and the results obtained are as shown in Figure 2.

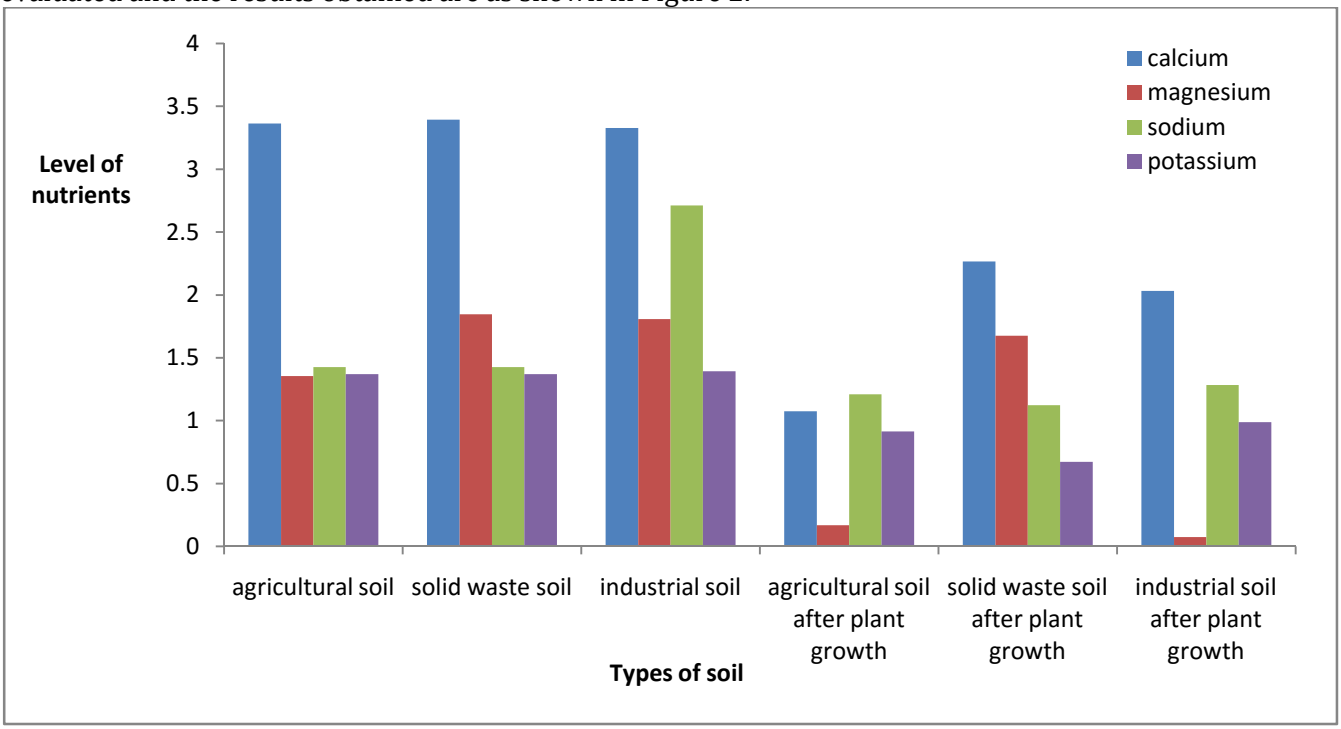

FIGURE 2: Amount of nutrients present in soil before and after the growth of the plant.

Table 2: Fertility status of different soil before and after the growth of groundnut plant

Different kinds of soil	Organic carbon(%)	N	P_2O_5	K_2O
Agriculture	1.254	388.864	57	253
Solid waste	1.292	426.496	85	220
industrial	1.292	323.635	64	271
Agricultural soil after plant growth	1.912	499.80	51	312
Solid waste soil after plant growth	3.98	487.496	71	341
Industrial soil after plant growth	3.95	437.496	48	471

Table 3: Heavy metal analysis before and after the analysis of different soils

Different kinds of soil	Cd	Cr	Co	Cu	Fe	Mn	Ni	Pb	Zn
Agriculture	0	18.2	32.2	25.4	2918	386	23.3	11.3	60
Solid waste	0	26.7	14.6	36.4	2874	250	24.9	14	52.9
industrial	1.1	26.4	45.4	17.6	3433	1265	45.2	36.8	40.7
Agricultural soil after plant growth	0	14.3	26.3	17.1	1486	287	10.3	3.3	43.5
Solid waste soil after plant growth	0.9	15.2	11.3	23.2	1038	127	15.9	4.7	45.2
Industrial soil after plant growth	0	19.2	21.2	10.7	2375	974	36.7	23.1	23.2

TABLE 4**: Analysis of heavy metals in different parts of plant:**

Plant portion grown in agricultural soil.	Cd ND	Cr 3.9	Co 5.9	Cu 8.3	Fe 932	Mn 99	Ni 10	Pb 3	Zn 16.5
Plant portion grown in solid waste soil.	ND	11.5	3.3	13.2	422	123	9	4.3	7.7
Plant portion grown in industrial soil.	0	7.2	14.2	6.9	1058	91	8.5	13.7	17.5

Permissible limit of heavy metals:
Cd – 10, Cr – 64, Cu – 63, Ni – 50, Pb – 140 , Zn – 200.

As from the values in Table 1 it can be predicted that the pH of the soil initially was basic in nature, but after three months of growth when the plant has attained till maturity it is seen that the pH changes to slightly acidic condition. Electrical conductivity of the soil decreased. The water holding capacity of three soils was fairly good. Good water holding capacity shows the good physical condition of soil.

From the above data in Table 2, it was observed that the nitrogen level increased in the soil after the growth of the groundnut plant. Since the nitrogen level increased this might have also help the plant to grow well in industrial as well as solid waste soils. The nitrogen level increased because of groundnut being a leguminous plant. Humus is also able to increase the water holding capacity of the soil. Soils with low organic matter have poor structure, hold little water, and erode or leach nutrients easily. Soils with high organic matter levels have good structure, good water holding capacity. Nutrient status of soil increases as soil organic matter increases. (Campell et al 1996). The amount of potassium increased a little after the growth of the plant because the plant might have used it in little quantity and since municipal wastes contribute in the increase of potassium. Therefore there is increase in the value of potassium in the soil.

From the experiment and the values as represented in Table 3&4, it is evident that the heavy metals of all the three soils (agricultural, industrial and solid waste soil) was determined initially before the growth of plant and after the plant developed. Nine different heavy metals were determined (Cd,Cr,Co,Cu,Fe,Mn,Ni,Pb,Zn) in the three soil before and after the growth of the plant. The heavy metal analysis of the plant portion was determined to see whether there is any contamination in the plant so that it can be consumed by the humans. From the Table 3&4 it is observed that all the values of the heavy metals in the soil initially and after the growth were within the permissible limit. The amounts of heavy metals in the plant portion were also within the permissible range which doesn't pose any harm to the individual.

CONCLUSIONS

Groundnut plant was preferred because as we know it's a leguminous plant which if grown makes the soil fertile. In this way an unused land can be transformed to a productive land. So by this procedure a land also becomes fertile and since the plant is a edible plant it can also be consumed as no contamination is seen in that plant. It was observed that the soil physicochemical and microbial properties were changed which might have facilitate the growth of the groundnut plant in that waste land which was beneficial both for the plant as well as the soil. This established a good soil plant correlation. It is therefore suggested that the dumpsite and the control area with their adequate soil nutrients and low levels of metals should eventually be converted to an agricultural farmland. Hence we arrive at a conclusion that solid waste and industrial wastes dumping site area can be used.

ACKNOWLEDGEMENT

I am very thankful to my institute and my guide who provide me the immense support , funds and all the lab facilities which help me in completeing the research work.

REFERENCES

1) Mahar et al (2007), Landfilling of pretreated municipal solid waste by natural convection of all and its effects, Journal of Environmental science and health,351-359.
2) Zhu et al , (2008),Improving solid waste management in India ,A source book for policy makers and practitioners, The world bank, Washington ,D.C.
3) S. Ogunyemi et al , (2003) Journal of Agricultural Science, 15:2, 87 – 94.
4) A.A Amusan et al , (2005), Characterstics of soils and crop uptake of metals in municipal wastes dumpsites in Nigeria. J.hum E col 17(3):167-171(2005).
5) A.Lakhdar, et al (2011), Municipal solid waste compost application improves productivity, polyphenol content and antioxidant capacity of mesembryanthemum edule , Journal of hazardous material 191(2011)373-379.

6) Simeon P.O, Amba .B (2013), Effect of municipal solid waste on the growth of maize. Academic journal of interdisciplinary studies MCSER publishing E- ISSN 2281- 4612, ISSN 2281-3993 OCTOBER 2013 VOL 2 NO 10).
7) Munendra pal et al. (2014).Utilisation of unused bio- wastes for agricultural production –a review. ISSN -0972-5210.Plant archives Vol 14 no1,pp 597-604.
8) Utpal Goswami and H.P Sharma, (2008). Study on the impact of municipal solid waste dumping on soil quality in Guwahati city. Department of environmental science, Guwahati University poll Res 27(2): 327-330(2008).
9) A.Lakhdar et al , (2011) Municipal solid waste compost application improves productivity, polyphenol content and antioxidant capacity of mesembryanthemum edule , Journal of hazardous material 191(2011) 373-379.
10) M.A.N Anikwe et al Department of Agronomy, Faculty of Agriculture (2002), Emugu state University of science and Technology, Long term effect of municipal waste disposal on soil properties and productivity of sites used for urban agriculture in Abakaliki,Nigeria , Bioresource Technology 83(2002)241-250.
11) Simeon P.O, Amba .B (2013), Effect of municipal solid waste on the growth of maize. Academic Journal of Interdisciplinary Studies MCSER Publishing E-ISSN 2281-4612, ISSN2281-3993 OCTOBER 21013 VOL 2 NO 10.
12) Campbell B M et al J.A (1996), The influence of trees on soil fertility on contrasting semiacid soil types at Matopos,Zimbabwe, Agroforest systems 1996;28:159-172.