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Analysis of Metals Present in Soils of Mango, Sapota, Lemon and Banana Fields at Guntur District

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ABSTRACT

Some of the heavy metals used in the agriculture fields are toxic in high concentrations. Generally heavy metals are added from mine tailings, domestic waste, application of fertilizers and Pesticides, coal combustion etc. In this study soil samples were collected from Sekuru of Tenali Mandalam in Guntur district. Soil samples were collected randomly dried, sieved and packed in the plastic bags and analyzed by using Atomic Absorption Spectrophotometer. Metals like Copper, Zinc, Lead, Manganese, Arsenic and Nickel were analyzed. The total of 72 samples were collected from Sekuru at a depth of four, six and eight inches. The average concentration of samples were as follows: Copper for 4 inches depth in Banana is 25.84 ppm, Lemon 20.89, Mango 9.88ppm andSapota 4.18ppm. For 6 inches 22.43ppm(Banana) 19.23 ppm(Lemon),11.16ppm(Mango). 4.06ppm(Sapota). and for 8 inches Banana 21.6ppm, Lemon 19.3ppm, Mango 9.96ppm and Sapota 3.78 ppm. The concentration of Zinc for 4 inches in Banana 44.77ppm, Lemon 55.37ppm Mango27.08ppm Sapota 16.04ppm. For 6 inches 49.42PPM(Banana), 45.89PPM(Lemon), 22.15PPM(Mango), 13.48ppm.(Sapota) For 8 inches 50.11 ppm(Bnana),42.46 ppm(Lemon), 22.69ppm(Mango), 12.60ppm(Sapota) .Concentration of Manganese for 4 inches 545.60ppm(Banana), 528.15ppm(Lemon) 387.67ppm(Mango), 179.49ppm(Sapota). For 6 inches 532.99 ppm(Banana), 448.67ppm(Lemon), 343.80 ppm(Mango), 189.49ppm(Sapota) and for 8 inches the concentration is 521.08ppm(Banana), 499.99ppm(Lemon), 344.55ppm(Mango), 180.81ppm(Sapota). Ihe average concentration of Nickel for 4 inches 0.19 for Banana, 0.19ppm for Lemon 0.65ppm for Mango and 0.14 ppm for Sapota. For 6 inches the concentration is 0.17ppm in Banana, 0.15ppm in Lemon, 0.67ppm for Mango and 0.17ppm for Sapota. And the concentration for 8 inches is as follows 0.15ppm for Banana,0.17ppm for lemon,0.51ppm for Mango and 0.16ppm for SapotaThe concentration of Arsenic in Mango and Sapota are absent and in lemon for 4 inches 5.22ppm and Banana 24.87ppm for 6 inches Lemon 4.13ppm and Banana 19.46ppm and for 8 inches Lemon 3.39ppm and banana 14.85ppm respectively.

Keywords: Heavy Metals, Copper, Lead, Zinc, Arsenic, Nickel, Manganese

I. INTRODUCTION

Heavy metals are also called trace metals and they have high densities, atomic weights or atomic numbers. Iron, copper, Tin are the earliest metals. Silver, Gold were the precious metals. Some heavy metals are harmful for example Cadmium, Mercury and Lead and some are harmless like Iron, Cobalt and Zinc and used as nutrients. (https://en. wikipedia.org/wiki/Heavy_metals).Heavymetals are added to the soil by the applications of pesticides, fertilizers, sewage sludge, combustion of coal and

mining etc. Application of sewage sludge, fertilizers and they preserve in the soil in the form of chemicals (Marina Efremova and Alexandra Izosimova 2012). The total concentration of heavy metals in soil and water however varies from local to regional and further to continental level. (Renutyagi 2014) In the Faculty of Science (Chemistry) Soil is contaminated with the heavy metals due to excess utilization of pesticides. It is one of the serous ecological problems all over the world (Side Hafizes Raman 2012). Heavymetals occurs in the soil by Pedogenesis process. or weathering which are called trace metals and these in excess concentration becomes toxic.(A.Kabata-Pendias and H.Pendias,2001) (G. M. Pierzynski,2000) Lead, Chromium, Arsenic, Zinc, Copper, Cadmium, Mercury and Nickel are common in contaminated soils. Soil is contaminated with heavy metals due to mine tailings, domestic waste, application of fertilizers and Pesticides, coal combustion etc. Heavy metals are added to the soils because of their deficiency. Co, Cu, Fe, Mn, Mo, Ni, Zn are added to compensate the deficiency.

Some of the heavy metals are listed below

Copper

Copper is the metal or element with symbol Cu with reddish brown color. It is derived from the Latin word Cuprum and has an atomic number of 29. Copper is required for all the living organisms and in human beings copper is present in liver, muscle and the bone (Johnson, MD PhD, Larry E., ed. 2008 ., Inc. Retrieved 7 April 2013). Copper occurs in the nature directly and human beings started using copper long back ie from 8000 BC. It is used as fungicide in Bordeaux mixture.(Wiley-Vch (2 April 2007). Copper is also used as nutitional supplements and fungicides in agriculture. (Wiley-Vch (2 April 2007). .Copper sulphate helps to kill fungi, algae and virus etc. The diseases like Mildew, Leaf spots, Blight can be controlled by copper. Blitox is the fungicide that is prepared by Copper Oxychloride is very effective fungicide fight against fruit diseases, blights of potato and tomato, vegetables diseases of coffe and tea. Copper is used in preparation of electric wires roofing and plumbing.Copper is also painted to control the plant growth on boat hulls and shell fish (RyckLydecker. Retrieved 2016-06-03.)

Lead

Lead is the chemical element represented as Pb .It has atomic number of 82. It is heavy metals and more denser than most common materials. Lead is used for making water pipes as it is resistance to corrosion(Rich, V. (1994). It is also used in pharmaceutical, roofing currency and war fare.(Thornton, I.; Rautiu, R.; Brush, S. M. (2001).(Retrieved 5 February 2017) Lead is generally found combined with sulfur.(Langmuir, C. H.; Broecker, W. S. (2012). It occurs rarely in metallic form (Davidson, A.; Ryman, J.; Sutherland, C. A.; et al. (2014). Lead is released by mining, smelting, recycling, Manufacturing of batteries and disposal of waste. It becomes poison. When food and water are contaminated with lead or ingestion of contaminated soil dust. Poisoning typically results from ingestion of food or water contaminated with lead, and less commonly after accidental ingestion of contaminated soil, dust and lead based paint.("Toxicological Profile for Lead" (PDF). Archived from the original (PDF) on 2 July 2017.) Soil can be contaminated by the accumulation of lead through lead in pipes, lead from the paint etc. High levels of lead in the soil contaminates fruits and vegetables. Particulate emission from the lead accumulated in the pipes, led paint and emission from unleaded gasoline degrade the soil quality. (Agency for Toxic Substances and Disease Registry."Information for the Community: Lead Toxicity" Retrieved 11 February 2017). Total intake and uptake of lead from all sources in children is 29.5 and 12.5mg/d and 63.7 and 6,7m in adults. (World Health Organization (WHO). Report of the 30th Meeting of the Joint FAO/WHO. Expert Committee on Food Additives. Geneva and Rome, World Health Organization, 1987.)Lead when entered

in to the body uit reaches the blood, liver, lungs, spleen and kidney finally reaches the skeleton(Rabinowitz, M.B.et al , 1976). Lead accumulates in the human body and remains in the bones for 17-27 years (Rabinowitz, M.B et al , 1976).

Zinc

Zinc is the chemical element denoted by ZN its atomic number is 30. Zinc is an essential element deficiency of Zn causes diarrhea, growth retardation, Delayed sexual maturation (Hambidge, K. M. & Krebs, N. F. (2007).It is also found along with copper and lead in ores(Lehto, R. S. (1968). Zinc can be released by weathering of rocks naturally. It is also released in the soil by mining waste, Phosphate fertilizers, Fossil fuel combustion Manure,sewage sludge and pesticides etc . Addition of more zinc becomes toxic and effects plants (Broadley, M. R.et al (2007). It is also used as anti corrosion agent (Greenwood, N. N.; Earnshaw, A. (1997). Zinc is present in cooked dried beans, Nuts Peas and seeds (Journal of the American Dietetic Association. on January 14, 2017.)

Arsenic

Arsenic is chemical element having atomic number 33.Arsenic occurs in many minerals in combination with sulphur and metals. It is used in production of pesticides , insecticides and herbicides (Grund, Sabina C et al (2005),It is used as wood preservative and toxic to insects bacteria and fungi (Marlatt, C. L. (1897). Important Insecticides: Directions for Their Preparation and Use. p. 5.) Lead hydrogen arsenate is an insecticide used for fruit trees.(Lichtfouse, Eric (2004). Arsenic is used in poultry and swine production to increase weight and to prevent infections. (Trace Elements in Soils and Plants, Third Edition". CRC Press Retrieved 2016-08-02.) Arsenic is found in food water soil and air. More concentration of Arsenic is accumulated in leafy vegetables, rice, apple, grape juice etc (Bentley, Ronald; Chasteen, T. G. (2002).

Nickel

Nickle is an element with atomic number 28.It is silvery white lustress metal and it is found in earth crust only in small amounts. It is silver white metal with a slight golden tinge. It is present in Ulframafic rocks and interiors of larger nickel iron meteorites and not exposed to oxygen.(Nickel – Handbook of Mineralogy" (PDF). Handbookofmineralogy.org. Retrieved 2016-03-02)Nickle element is used long back 3500 BCE. By Axel Fredrik Cronstedt it was first isolated as chemical element in 1751. Nickel found in combination with sulphur and iron in Pentlandite with sulphur in millerite with arsenic in mineral nickeline and with arsenic and sulfur in nickel galena (National Pollutant Inventory – Nickel and compounds Fact Sheet. Npi.gov.au. Retrieved on January 9, 2012.) Addition of phosphate fertilizers is an important source of nickel and industrial emission of nickel hundred times than from natural resources (Kabata-Pendias A, MukherjeeAB (2007)). Nickel is used in the production of Stainless steel, coinage, electric guitar stringed and rechargeable batteries etc(Engineer, Engineering Record, Building Record, and Sanitary (1896-01-01). Nickel is present in plants and consumed by man.(Haber, Lynne T Bates, Hudson K et al (2017)) It is found in water and food and increases by mining smelting dumping of nickel in waste water. Nickel which is absorbed by the human body can be removed through urine and gastrointestinal tract every day. Nickel may be considered as occupational hazard in large doses.(Butticè, Claudio (2015))..Nickel enters the plants and get accumulated in the leaves and seeds reaches the food chain and the uptake of nickel by the plant is related to its toxicity (WelchRM, CaryEE (1975).

Manganese

It is silver gray metal looks like iron. It ahs atomic number of 25.It is found along with iron and difficult to fuse and oxidize (Holleman, Arnold F.; Wiberg, Egon; Wiberg, Nils (1985). Manganese is in the production of stainless steel. Manganese play an

important role in photosynthesis and also used as electron storage and delivery to chlorophyll reaction centers(Diedrick, K., (2010). The effect of manganese toxicity depend upon the different plant species and its high concentration decreases growth (SayedRohollaMousaviMahmoodShahsavari and Maryam Rezaei). Manganese ions and its common ions are Paramagnetic (Lide, David R. (2004). Magnetic ore is mixed with iron and carbon ore to produce ferromanganese and then reduced in a electric furnace. (Corathers, L. A.; Machamer, J. F. (2006).Manganese is the 12th most abundant element of the earth and comprises about 1000ppm (0.1%) of the earth crust.(Emsley, John (2001). 9000ppm of manganese is present in the soil with an average of 440ppm (Emsley, John (2001))

II. METHODOLOGY

Study area

Sekuru

Sekuru village is located in Chebrolu Tehsil of Guntur district in Andhra Pradesh, India. It is situated 10km away from sub-district headquarter Chebrolu and 18km away from district headquarter Guntur. As per 2009 stats, V N Palem is the gram panchayat of Sekuru village. The total geographical area of village is 2257 hectares. Sekuru has a total population of 10,380 peoples. There are about 2,951 houses in Sekuru village. Tenali is nearest town to Sekuru which is approximately 15km away. Variety of crops like Paddy, Maize etc are grown here. Many mango and Sapota crops are rich in this area. Pesticides like Blitox-Copper oxychloride, Ridomil - Metalaxyl+Mancozeb (zinc and Manganese) SAAF-Fungicide consists of carbendazim and Manganese, Coppersulfate, Proxam- Insecticide contains Sodium were used in Sekuru,

Collection of the samples

First the areas are identified and soil samples are collected from different depths. I made a V shaped cut in the soil taken soil samples by digging. Samples are collected randomly in the selected areas. Materials like Polythene bags, Rubbers, Stickers, Meter scale, Tools like shovel spade khurpi, augers. Samples are collected from proper depth and place them in the polythene cover, dried them and sieved. Samples from Sekuru are collected randomly. Samples are collected from Sekuru village with depth 4 inches,6 inches and 8 inches. By using the spade small cut is made in the soil from top to bottom of the designed sample depth. These samples are taken in a clean polythene cover dries for two days and grinded using rollers sieved and packed in zip covers label it.

Questionnaire was conducted in Sekuru about the pesticides and fertilizers usage.Ch Srinivasarao farmer in Sekuru explained that the species like Banganipalli, Chitoor mango and Neelam were planted long back. Palasapota species were sold.

Selected location: Sekuru is chosen as it was rich with these crops.

Selected samples: Soil samples of Mango, Sapota, Lemon and Banana were collected from Sekuru

Selected heavy metals: Copper, Zinc, Manganese. Lead, Nickel, Arsenic

Sampling Procedure

Soil samples are collected in Sekuru ofTenali In Sekuru samples of Mango, Banana, Lemon and Sapota are collected randomly. Four samples of soil with four inches were collected from Mnago 1,2and 3 totally twelve samples. Samples are collected in the same manner for the remaining three soil samples of Sapota, Lemon and Banana. Mean is taken for these samples and the average is considered for graphs. These samples are analyzed to identify the concentration of heavy metals and Copper, Manganese, Zinc, Lead, Nickel, and Arsenic are analyzed. Twelve samples are analyzed and mean is calculated then standard deviation is taken Variation can be shown between the same samples based on depth as follows

Table 1. Average concentration of Copper in Mango, Sapota Lemon and Banana in Sekuru

SNO	PLACE	METAL NAME	SAMPLE	DEPTH	Average	STANDARD DEVIATION
1	Sekuru	Copper	Mango	4inches	9.88	3.24
				6inches	11.16	3.45
				8inches	9.96	2.44
2	Sekuru	Copper	Sapota	4inches	4.18	0.78
				6inches	4.069	0.98
				8inches	3.78	0.97
3	Sekuru	Copper	Lemon	4inches	20.89	3.34
				6inches	19.23	2.69
				8inches	19.03	2.11
4	Sekuru	Copper	Banana	4inches	25.84	3.58
				6inches	22.43	2.98
				8inches	21.6	2.90

Table 2. Average concentration of Zinc in Mango, Sapota Lemon and Banana in Sekuru

SNO	PLACE	METAL NAME	SAMPLE	DEPTH	Average	STANDARD DEVIATION
1	Sekuru	Zinc	Mango	4inches	27.08	3.99
				6inches	22.15	2.17
				8inches	22.69	2.21
2	Sekuru	Zinc	Sapota	4inches	16.04	2.36
				6inches	13.48	1.86
				8inches	12.60	1.41
3	Sekuru	Zinc	Lemon	4inches	55.37	4.47
				6inches	45.89	4.72
				8inches	42,46	2.88
4	Sekuru	Zinc	Banana	4inches	44.77	14.33
				6inches	49.42	15.56
				8inches	50.11	11.83

Table 3. Average concentration of Manganese in Mango, Sapota, Lemon and Banana soil samples

SNO	PLACE	METAL NAME	SAMPLE	DEPTH	Average	STANDARD DEVIATION
1	Sekuru	Manganese	Mango	4inches	387.67	34.84
				6inches	343.80	17.12
				8inches	344.55	22.01
2	Sekuru	Manganese	Sapota	4inches	179.70	28.92
				6inches	189.49	27.89
				8inches	180.81	30.15
3	Sekuru	Manganese	Lemon	4inches	528.15	61.56
				6inches	448.67	21.65
				8inches	449.99	21.08
4	Sekuru	Manganese	Banana	4inches	545.60	24.94
				6inches	532.99	18.99
				8inches	521.08	10.064

Table 4. Average concentration of Lead in Mango, Sapota Lemon and Banana in Sekuru

SNO	PLACE	METAL NAME	SAMPLE	DEPTH	Average	STANDARD DEVIATION
1	Sekuru	Lead	Mango	4inches	Nil	Nil
				6inches	Nil	Nil
				8inches	Nil	Nil
2	Sekuru	Lead	Sapota	4inches	Nil	Nil
				6inches	Nil	Nil
				8inches	Nil	Nil
3	Sekuru	Lead	Lemon	4inches	Nil	Nil
				6inches	Nil	Nil
				8inches	Nil	Nil
4	Sekuru	Lead	Banana	4inches	Nil	Nil
				6inches	Nil	Nil
				8inches	Nil	Nil

Table 5. Average concentration of Arsenic in Mango, Sapota, Lemon and Banana in Sekuru

SNO	PLACE	METAL NAME	SAMPLE	DEPTH	Average	STANDARD DEVIATION
1	Sekuru	Arsenic	Mango	4inches	Nil	Nil
				6inches	Nil	Nil
				8inches	Nil	Nil
2	Sekuru	Arsenic	Sapota	4inches	Nil	Nil
				6inches	Nil	Nil
				8inches	Nil	Nil
3	Sekuru	Arsenic	Lemon	4inches	5.22	0.333
				6inches	4.13	0.577
				8inches	3.39	0.605
4	Sekuru	Arsenic	Banana	4inches	24.87	3.475
				6inches	19.46	0.801
				8inches	14.85	2.121

Table 6. Average concentration of Nickel in Mango, Sapota, Lemon and Banana in Sekuru

SNO	PLACE	METAL NAME	SAMPLE	DEPTH	Average	STANDARD DEVIATION
1	Sekuru	Nickel	Mango	4inches	0.65	0.293
				6inches	0.67	0.045
				8inches	0.51	0.113
2	Sekuru	Nickel	Sapota	4inches	0.14	0.021
				6inches	0.17	0.01
				8inches	0.16	0.030
3	Sekuru	Nickel	Lemon	4inches	0.19	0.003
				6inches	0.15	0.015
				8inches	0.17	0.007
4	Sekuru	Nickel	Banana	4inches	0.19	0.003
				6inches	0.17	0.015
				8inches	0.15	0.0075

Mango crops in Sekuru

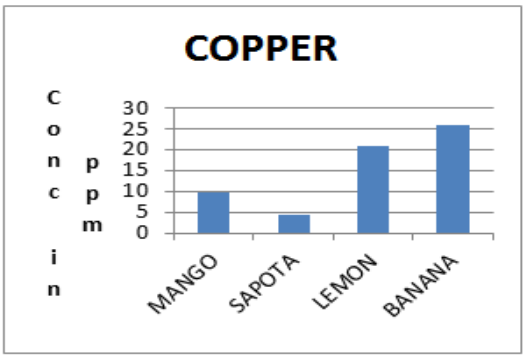
Lemon crops in Sekuru

Collected Soil samples

Samples in Polythene cover

Graphs showing the concentrations of Copper, Zinc, Manganese, Lead, Arsenic and Nickel Average concentration of Copper in ppmfor Mango, Sapota, Lemon and Banana

4in



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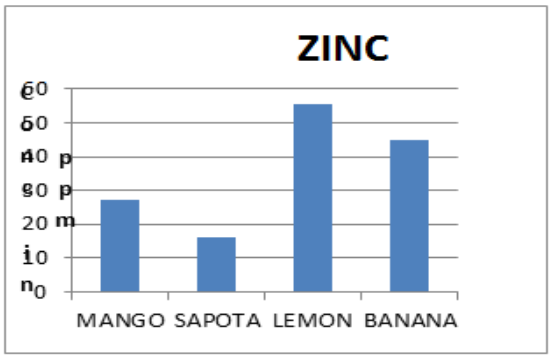

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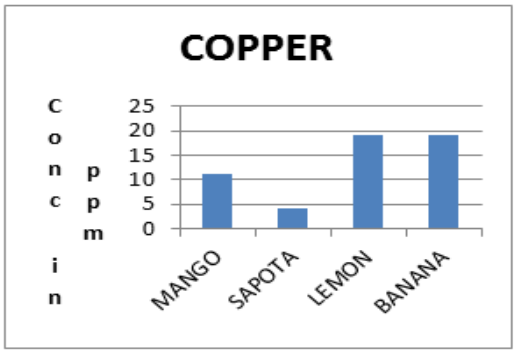

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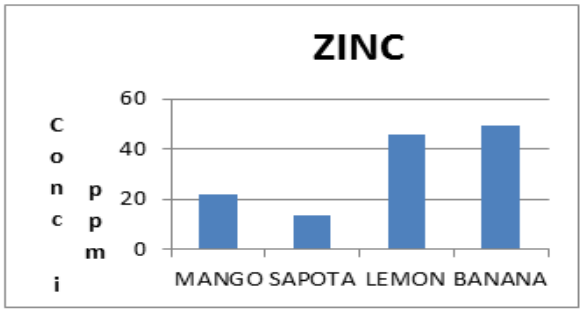

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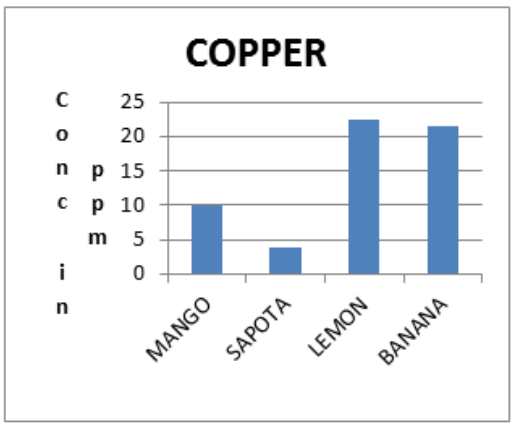

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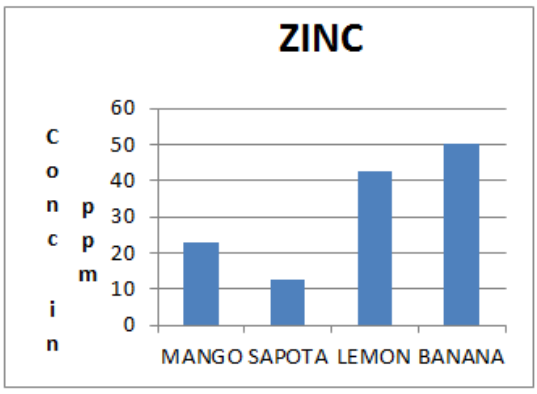
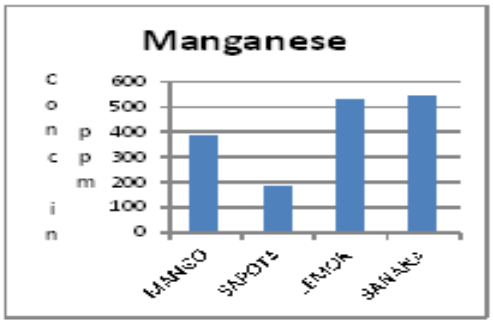


Concentration of Zinc in ppm for Mango, Sapota, Lemon and Banana

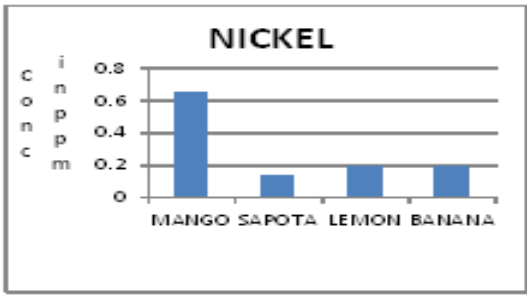
Concentration of Manganese in ppm for Mango, Sapota, Lemon and Banana

4 inches



Concentration of Nickel in ppm for Mango, Sapota, Lemon and Banana

4 inches



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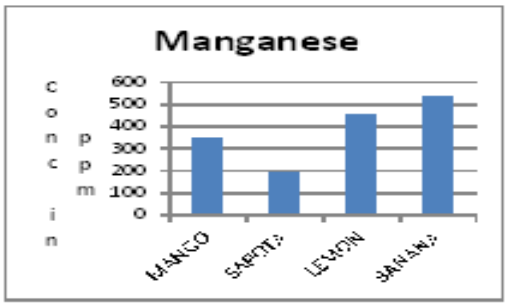

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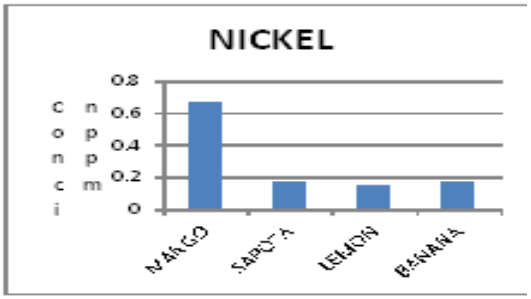

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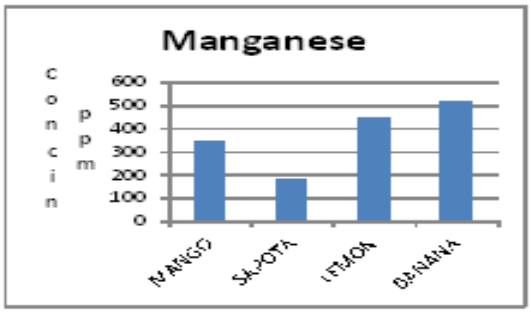

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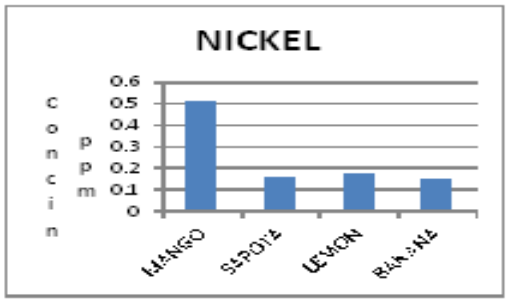

III. RESULTS AND DISCUSSIONS

Average concentrations of Copper, Zinc, Manganese, Lead, Nickel and Arsenic were shown in the table 1,2,3,4,5 and 6.

Concentration of metals for 4 inches, 6inches and 8 inches varies as follows

1 Copper 4inches depth - 25.84ppm 20.89ppm > 9.18ppm >4.18 ppm
Banana > Lemon> Mango >Sapota
Copper 6 inches depth -22.43 ppm >19.23ppm >11.16ppm > 4.0ppm
Banana > Lemon> Mango >Sapota
Copper 8inches depth-21.6 ppm > 19.03 ppm> 9.96ppm> 3.78ppm
Banana > Lemon> Mango >Sapota

2 Zinc 4inches depth - 55.37 ppm > 44.77ppm > 27.08 >16.4 ppm
Lemon > Banana > Mango >Sapota
Zinc 6 inches depth - 49.42PPM > 45.89PPM >22.15ppm>13.48ppm
Banana>Lemon>Mango>Sapota

Zinc 8inches depth-50.11ppm > 42.46ppm > 22.69ppm > 12.60ppm
Banana > Lemon> Mango >Sapota

3 Manganese 4inches depth - 545.60ppm > 528.15ppm > 387.67ppm > 189.49ppm
Banana > Lemon> Mango >Sapota
Manganese 6 inches depth - 532.99ppm, > 448.67ppm, > 343.80ppm> 189.49ppm
Banana > Lemon> Mango >Sapota
Manganese 8inches depth- 521.08ppm > 449.99ppm> 344.55ppm> 180.81ppm
Banana > Lemon> Mango >Sapota
4 Nickel 4inches depth - 0.65ppm > 0.14ppm Mango > Sapota
Lemon and Banana are equal ie 0.19ppm
Nickel 6 inches depth - 0.67ppm > 0.15ppm Mango > Lemon
Sapota and Banana are equal ie 0.17ppm
Nickel 8inches depth-
0.51 > 0.17 >0.16 > 0.15
Mango > Lemon > Sapota> Banana
Lead is absent in all the samples .Arsenic is absent in Mango and Sapota but present in Lemon and Banana.

IV. CONCLUSION

In analysis the heavy metals concentration of 4 inches is more than 6 inches and 8 inches. The concentration of metals like copper, zinc, lead Arsenic and Manganese in soil sample of Banana is more except for Zinc 4inches and Nickel 8 inches. Next to banana soil sample the concentration is more in lemon soil sample. The concentration of Arsenic in Mango and Sapota are absent and in Lemon for 4 inches 5.22ppm and Banana 24.87ppm for 6 inches Lemon 4.13ppm and Banana 19.46ppm and for 8 inches lemon 3.39ppm and Banana 14.85ppm respectively.

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