Enriched Compost Production Technique from Water Hyacinth

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ABSTRACT

Water hyacinth is an aquatic weed and is known for causing a series of problems for aquatic life. If targeted properly, it can act as an extremely important alternative source of organic material for production of nutrient enriched organic manures by composting process. Water hyacinth has remarkable nutritive properties which not only result in healthy aquatic system but also add manure in the soil for sustainable productivity. Composting refers to the conversion of organic waste into organic manure. Composting is the biological decomposition and stabilization of organisms under condition that allows development of the thermophilic temperature as a result of biologically produced heat, with a final product sufficiently stable for storage and application to field without any adverse environmental effect .Keeping the above in mind the an experiment was conducted at the farm of Indian Institute of Soil Science, Bhopal (geographical location 23^0 18$''$ N latitude, 77^0 24$''$ E longitude, altitude 485 m amsl). Water hyacinth collected from Kaliasot river passing by Danish Kunj Bhopal and Cow dung as a raw material from Lamba Kheda village near IISS, Bhopal. Rock phosphate, lime and urea amendment, arranged from Soil Biology Division, IISS, and Bhopal for production of different types of enriched composts prepared from water hyacinth. Result of the study revealed that water hyacinth has remarkable nutritive properties that can be used for the production of nutrient enriched compost which not only result in healthy aquatic system but control act as soil amendments. Different enriched composts from water hyacinth viz; phospho compost, phospho compost with lime, phospho nitro compost, phospho sulpho nitro compost, vermicompost and microbial enriched composts. Among these composts, the highest percentage of N was evaluated in phospho nitro compost and phospho compost. The highest percentage of P and K were also recorded in phospho sulpho nitro compost (P 0.89and K 1.04) and the lowest percentage of P and K being recorded in control (P 0.56 and K 1.02).

Keywords: Water hyacinth, compost, phospho compost, phospho nitro compost, vermicompost and microbial enriched compost

I INTRODUCTION

The water hyacinth (*Eichorina crassipes*) is a floating obligate plant. It belongs to family *Pontederiaceae*. This well known species grows in all types of fresh water. Water hyacinth differs in size from a few inches to over three feet tall. It has showy lavender flowers and its leaves are rounded and leathery, attached to spongy and sometime inflated stalks. Water hyacinth is one of the most productive plants on earth and considered as one of the world's worst invasive aquatic plants (Gopal, 1984; Malik, 2006). Water hyacinth is one of the worst weed in the world aquatic or terrestrial environment (Holm *et al.*, 1977).

Fig. 1. Water hyacinth

The water hyacinth (*Eichhornia crassipes*) is a free floating aquatic weed originated in the 23.15% wetland area of north east region of India, where it was kept under control by natural predators (Abbasi *et al.*, 1996). Due to its fast growth and the robustness of its seeds, the water hyacinth has since then caused major problems in the whole area. At an average annual productivity of 50 dry (ash-free) tonnes per hectare per year, water hyacinth is one of the most productive plants in the world attributing the weed to cover water surfaces faster than most other plants (Abbasi *et al.*, 1986).

Compost is typically not a fertilizer, although when used at normal rates it can reduce the amount of required fertilizer. Compost can increase the water holding capacity of sandy textured soils, and can improve structure and water movement through heavier textured soils that are high in silt and clay content. By increasing the organic content of the soil, biological activity can be enhanced. Water and nutrient holding capacity can be improved in some soils. Some compost has the ability to suppress fungal diseases; research in this area is ongoing. Composts prepared from different organic wastes differ in their quality and stability. This mainly depends upon the composition of the raw material used for the composting process (Gour and Singh, 1995) (Ranalli *et al.*, 2001).

Composting is a biooxidative process in which the microorganism transform the more easily biodegradable organic matter into carbon dioxide, water, vapours, and other minerals (mineralisation process) or, with time, into more stable organic matter (humiliation process) called humic substances which are physically very similar to those present in soil(Kalamdhad *et al.*, 2011). Composting refers to the conversion of green waste into organic fertilizer with compost as end product. Composting is the biological decomposition and stabilization of organic substance under condition that allows development of the thermophilic temperature as a result of biologically produced heat, with a final product sufficiently stable for storage and application to land without any adverse environmental effect (Haug, 1980).

Much work has been carried out in different parts of the world to develop environmentally sound and appropriate methods for the management and control of water hyacinth. It recapitulated that the utilization of water hyacinth for composting has proved economically viable across the world (Gajalakshmi *et al.*, 2001). Researchers have recently substituted bean straw with water hyacinth as animal feed (raw material) (Tag El-Din *et al.,* 1992) for solid-phase fermentation for making pulp, paper and paper board and the vermicomposting of water hyacinth (Gupta *et al.,* 2007). However, a novel technology with ecologically sound and economically viable approach is needed to solve the problem of aquatic weed disposal and management. With an aim to solve the problems associated with water hyacinth the project has been proposed to prepare compost by using water hyacinth to improve nutritional contents by incorporation of different amendments. The project will be beneficial for those cities where the problems of aquatic weeds are much that can be over come through removal of such weeds. The compost preparation by exploitation of water hyacinth will help to treat this aquatic weed in a way which will further enhance the productivity of soil thereby keeping various ponds and lakes of the city in healthy state. This compost will provide an alternate method in contrary to conventional composts with an added advantage over chemical fertilizers. Therefore, water hyacinth biomass (harvested from water hyacinth in fasted natural water bodies), can be used as an effective source for bio-compost production through different types of composting.

II MATERIALS AND METHODS

This experiment was conducted at the form of Indian Institute of Soil Science Bhopal (geographical location 23^0 18" N latitude, 77^0 24" E longitude, altitude 485 m amsl). Water hyacinth as a source of waste material collected from Kaliasot river passing by Danish Kunj Bhopal and Cow dung as a raw material collected from Lamba Kheda village near ICAR, IISS Bhopal. Rock phosphate, lime, urea, microbial enriched compound and epigeic earth worm are the amendments arranged from Soil Biology Division ICAR,IISS Bhopal,Water hyacinth was used.

The details of experiment set up is given below:

(a) **Experimental setup**: There were seven pits for composting, dimension of each compost pits were length 6 to 7 feet. Width 3 feet and depth 2.5 feet. Fresh water hyacinth was chopped in small pieces and filled in each of those pits along with cow dung in the ratio of 2:1 as shown in fig 2

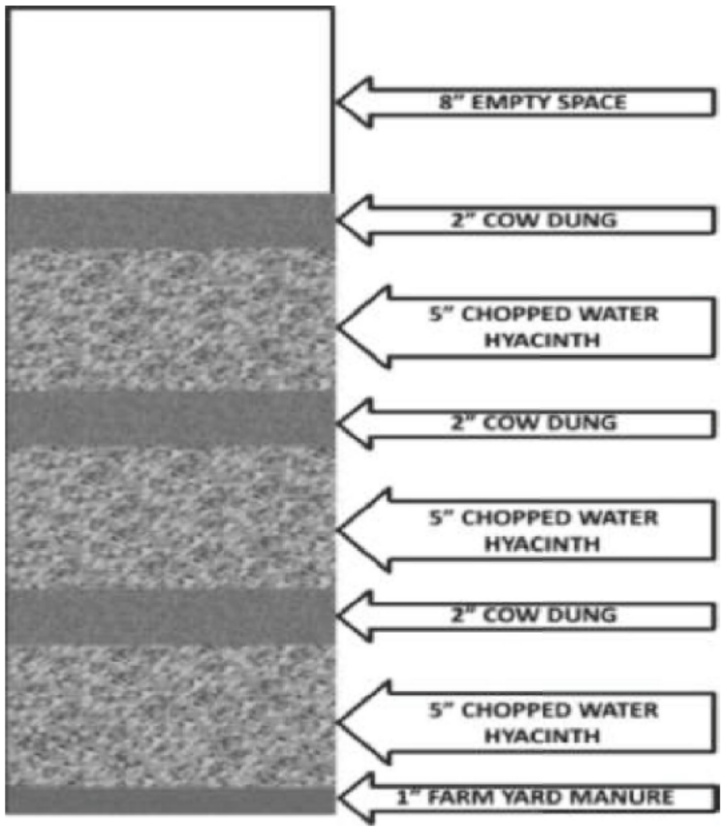

Fig. 2: Order of different layers of materials constituted for carrying out composting in pit

(i) The bottom most layer of mature compost was about 1 inch thick containing about 10 kilograms of farm yard manure.
(ii) The second layer above the manure compost's layer was of chopped fresh water hyacinth which was about 5 inch thick needed containing about 15.7 kgs of water hyacinth.
(iii) The third layer above second layer was of fresh cow dung which was about 2 inch thick containing approx 13.33 kilograms of cow dung.
(iv) The fourth layer above the cow dung layer was of chopped fresh water hyacinth (~15.7 kilograms) of 5 inch thickness.
(v) The fifth layer above fourth layer was of fresh cow dung (~13.33 kilograms) of 2 inch thickness.
(vi) The sixth layer above the fifth layer was of chopped fresh water hyacinth (~15.7 kilograms) of 5 inch thickness.
(vii) The seventh layer above sixth layer was of fresh cow dung (~13.33 kilograms) of 2 inch thick Each pit remained empty by about 8 inch for turning and watering operation.

Fig 3: A&B. Filling of pits for composting, C. Pits were covered to facilitate composting, D. Turning for aeration

In each pit, different materials were used for composting fresh water hyacinth with cow dung. It was observed that after 21 days material in each pit was partially decomposed, and then in each pit various treatments were imposed as mentioned in table 1 Earthworms and microbial culture were inoculated after 32 days. Following treatments were applied in each of those prepared pits:

Table 1
Composition of different materials used for composting from water hyacinth

S.No.	Material	Quantity in Kg	Material %
1	Water hyacinth + Cow dung	77+40	15.7+13.3
2	Rock phosphate	2.925	2.5
3	lime	2.34	2
4	Urea	0.06	0.5
5	Gypsum	11.7	10
6	Earth warm	2	-
7	Microbial culture	0.0585	-

As per the shown table above mentioned materials were applied in each pit. Prepration of microbial culture and their sub cultures of fungai (*A. awamori, A hetromorphous and R. pusillus*) were prepared by using potato dextrose agar media. Seven different types of composts were developed by incorporating the materials in varied ratio as shown in table 2 and3.

Table 2
Different types of compost

S. No.	Constituents/ Treatments	Compost type	Pit
1.	Water hyacinth and cow dung (T1)	III CONTROL	1
2.	Water hyacinth, cow dung and rock phosphate (T2)	IV PHOSPHO COMPOST	2
3.	Water hyacinth, cow dung and rock phosphate, lime (T3)	V PHOSPHOSULPHO COMPOST	3
4.	Water hyacinth, cow dung and rock phosphate, lime, urea (T4)	VI PHOSPHO NITRO COMPOST	4
5.	Water hyacinth, cow dung and rock phosphate, gypsum, urea (T5)	VII PHOSPHOSULPHO NITRO COMPOST	5
6.	Water hyacinth and cow dung, epigic earthworm (T6)	VIII VERMI COMPOST IX	6
7.	Water hyacinth and cow dung, microbial culture (T7)	X MICROBIAL ENRICHED COMPOST	7

Table 3
Ratio of components (Different formulations of composts) Different types of compost were prepared with defined ratio of contents as mentioned below:

S. No.	Compost Type	Quantities of materials							
		WH* (in Kg)	CD* (in Kg)	RP* (in Kg)	L* (in Kg)	U* (in gm)	Gyp* (in Kg)	MC* (in gm)	EW* (in No.)
1.	Control (T1)	77	40	-	-	-	-	-	-
2.	Phospho compost (T2)	77	40	2.925	-	-	-	-	-
3.	Phospho sulpho compost (T3)	77	40	2.925	2.34	-	-	-	-
4.	Phospho nitro compost (T4)	77	40	2.925	2.34	600	-	-	-
5.	Phospho sulpho nitro compost (T5)	77	40	2.925	2.34	600	11.7	-	-
6.	Vermi Compost (T6)	77	40	-	-	-	-	-	2500 Adult
7.	Microbial enriched compost (T7)	77	40	-	-	-	-	58.5	-

*** Water hyacinth (WH), Cow dung (CD), Rock phosphate (RP), Lime (L), Urea (U), Gypsum (Gyp), Microbial culture (MC), Earthworms (EW)**

(b) Analytical Techniques: Different parameters were analyzed for the characterization of both substrates (water hyacinth and cow dung) and products (water hyacinth compost) by dry ashing and wet oxidation method (Issac and Johson, 1975). Moisture was measured by gravimetric method (AOAC,1990). pH in substrates and composts (Jackson,1973) were determined by hydroxyl ion activity of the soil water system. EC (Jackson, 1973) in substrates and composts. TOC (kjeldahl,1883) was determined by titration method. Ash%(Issac and Johson 1975) by using dry ashing method. Total Nitrogen (N) in substrates and composts were determined by (Kjeldahl, 1883). A suitable sample is digested with a strong acid so that it releases nitrogen which can be determined by a suitable titration technique. Substrates and composts samples for N determination were digested in sulphuric acid at a temperature between 360°C and 410°C. Total phosphorus(P) in substrates and composts(Jackson, 1967). Total Potassium (K) in substrates and composts (Jackson, 1967), the most common method for K determination is through flame photometer. The substrates and composts sample for K estimation can be digested in di-acid or in tri-acid. In addition digest obtained from dry ash is also taken for K determination. C: N ration (Sanchez, 2001) TOC and TN of compost ratio is C: N ratio. Cation exchange capicty in different substrates and composts (Knudsen et al,.1982) were determined by centrifugation method.

III RESULTS AND DISCUSSION

Composting of water hyacinth biomass was completed in 7 -8 weeks. The mature composts were black in colour, granular and fibrous with pleasant earthy

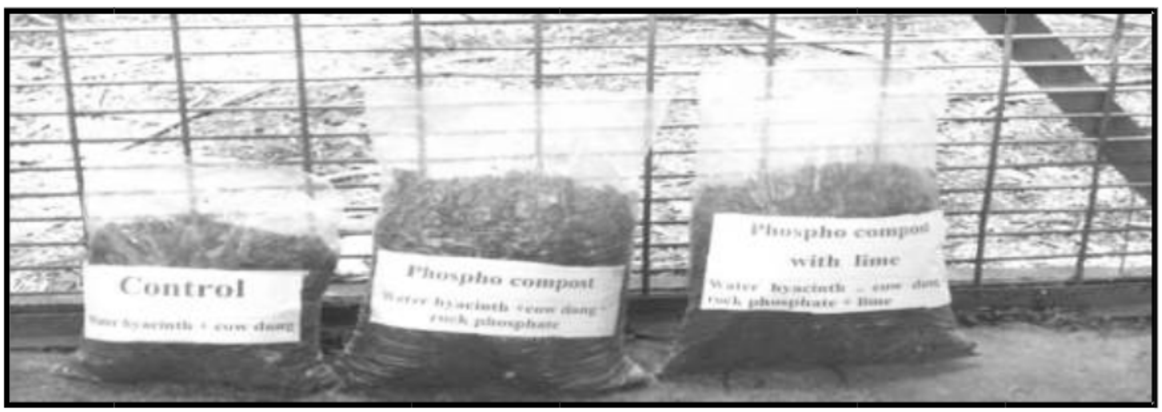

Fig.4a Matured composts : (Control, Phospho compost, Phospho compost with lime)

smell compared with control mixture which was light brown in colour, coarse in appearance with a foul smell. The appearance of black colour is indicative of its maturity.(Pandharipande *et al.* 2004) reported that the mature compost must be dark brown or black granular spongy in feel and smell normally

.Fig.4b: Matured composts (Phospho Nitro compost, Phospho Sulpho Nitro compost, Vermi Compost, Microbial enriched compost)

Water hyacinth and cow dung constituted the main ingredients in this study for the preparation of composts. Varied compositions of chemicals, earthworms and microbes have important role in the decomposition of substrates. The macronutrients substrates and composts (T1, T2, T3, T4, T5, T6 and T7) were determined. Initial studies performed with S1 and S2 showed significantly higher levels of nitrogen and Potassium in S1 in comparison to S2

Table 4
Evaluation of physiochemical parameters of water hyacinth and cow dung

S. No.	Parameter	Water Hyacinth (S1)	Cow dung (S2)
1	**Moisture (%)**	**78**	53
2	**Dry matter (%)**	12	47
3	**pH**	8.1	6.2
4	**EC**	0.48	0.40
5	**Ash (%)**	28	25
6	**TOC (%)**	**40**	25
7	**TN (%)**	**2.06**	1.08
8	**TP_2O_5 (%)**	0.48	0.41
9	**TK (%)**	**1.85**	0.41
10	**C: N**	19:1	23:1

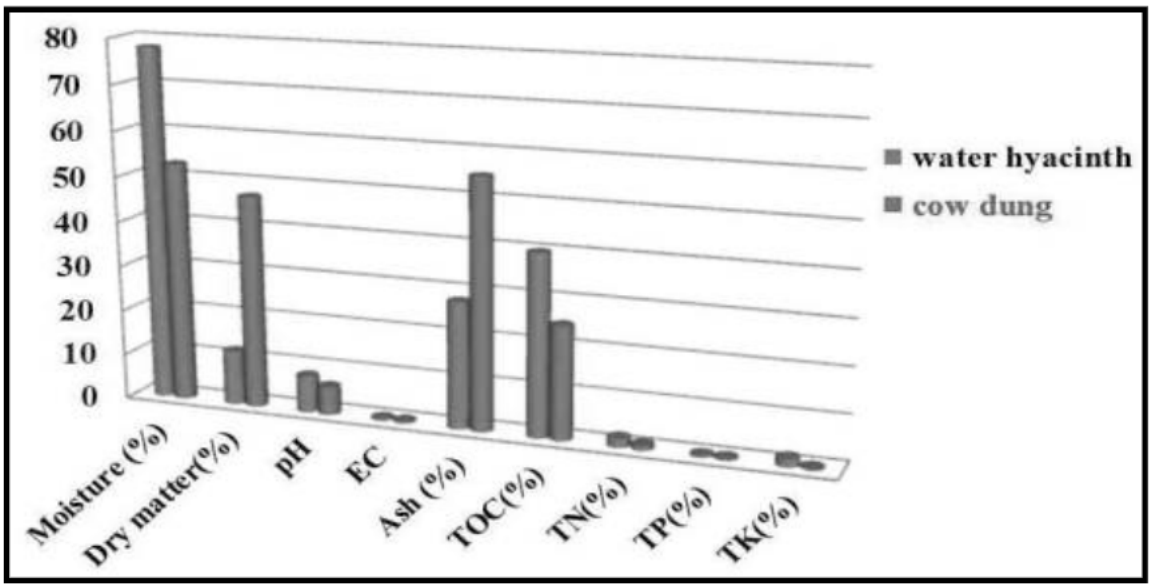

Fig.5: Graphical representation of physiochemical parameters of water hyacinth and cow dung

Table 5
Analysis of parameters of water hyacinth prior to composting

S. No.	Parameters (Water hyacinth)	Results obtained	References					
			1*	2*	3*	4*	5*	6*
1.	Moisture (%)	78	-	80.4	-	-	92. 8	-
2.	Dry matter (%)	12	-	10.2	-	-	-	-
3.	pH	8.1	-	-	-	7	8.1	5.35
4.	EC	0.48	-	-	-	-	0.46	-
5.	Ash (%)	28	19.2	27.2	-	-	41.7	-
6.	TOC (%)	40	34.9	-	33	33	33.8	21.5
7.	TN (%)	2.06	1.61	-	1.94	1.94	1.95	1.23
8.	TP (%)	0.48	0.31	0.79	-	-	0.54	0.39
9.	TK (%)	1.86	3.81	4.6	-	-	0.97	2.09
10.	Na (%)	0.52	0.56	0.37	-	-	-	-
11.	C: N	19.4:1	21:1	-	17:1	17:1	36:1	17:1

1*: Parra *et al.*, (1971); 2*: Aderibigbe and Brown (1993); 3*: Khan & Sarwar (2002); 4*: Malik (2007); 5*: Parveen and Padmaja, (2010); 6*: Basu *et al.*, (2011).

The evaluated values of water hyacinth mentioned in table 4 shows that the moisture content is 78% which is found to be similar with the work reported by (Aderibigbe and Brown, 1993) and(Parveen and Padmaja,2010). The contents of other properties and macronutrients shown in table 4 such as pH, EC, ash, TOC, TN, TP, TK and Na% were 8.1, 0.48, 28%, 40%, 2.06%, 0.48, 1.86% and 0.52%, respectively. The findings of the study were further compared and found to be similar with the studies conducted by (Parra *et al.*, 1971); (Aderibigbe and Brown 1993); (Khan & Sarwar 2002); (Malik 2007; Parveen and Padmaja, 2010; and Basu *et al.*, 2011). The Na contents present in the water hyacinth and manure may not pose any problem as most crops may not be affected. Most of the K and Na present in water hyacinth plant was water soluble. The water hyacinth is rich in N and K among macronutrients and iron and manganese among micronutrients. The results obtained for physico-chemical of substrates and amended water hyacinth composts are further discussed in detail.

Table 6
Analysis of physico-chemical parameters of seven different types of water hyacinth composts

S. No.	Parameters (Water Hyacinth)	Control	Phospho compost	Phospho compost (Lime)	Phospho Nitro compost	Phospho Sulpho Nitro compost	Vermi Compost	Microbial enriched compost
		T1	T2	T3	T4	T5	T6	T7
1	Moisture (%)	64	57	68	52	69	77	77.2
2	pH	7.53	7.47	7.91	7.77	7.07	7.76	7.72
3	EC	1.927	2.073	1.119	2.352	1.302	0.892	1.254
4	Ash (%)	58	63	43	36	57	51	56
5	TOC (%)	23.3	21	31.6	35.5	23.8	27.2	24.4
6	TN (%)	1.14	1.20	1.27	1.32	1.16	1.16	1.23
7	TP (%)	0.56	0.86	0.87	0.88	0.89	0.59	0.58
8	TK (%)	1.02	1.03	1.03	1.036	1.04	1.03	1.03
9	Na%	0.0274	0.0332	0.0360	0.02724	0.01876	0.029	0.026
10	C: N	20.44	17.5	24.88	26.89	20.52	23.45	19.84

Table 6 provides the data on analysis of water hyacinth compost made with incorporation of different organic, mineral and microbial cultures. The general properties of composts and the nutrient compositions of composts varied depending on the amendments applied to the organic mature. With the addition of P through rock phosphate the phosphorous concentration increased in the compost. The carbon nitrogen ratio in all the compost is near to 20:1 indicating good maturity of compost. The N contents and K contents have also exceeded 1.00%.

Moisture (%): Moisture loss during the composting process can be viewed as an index of decomposition rate, since the heat generated during decomposition leads to vaporization. An optimum moisture is required for organisms to survive. The preliminary moisture content with water hyacinth and cow dung were 78% and 53%, respectively. The moisture content in prepared composts (T1 –T7) was found in the range of 52% to 77% while the control showed moisture content of 64%, which is much lower than the individual substrate moisture content. (Umsakul *et al.*, 2010) have reported 70% moisture content at the final week of composting of water hyacinth.

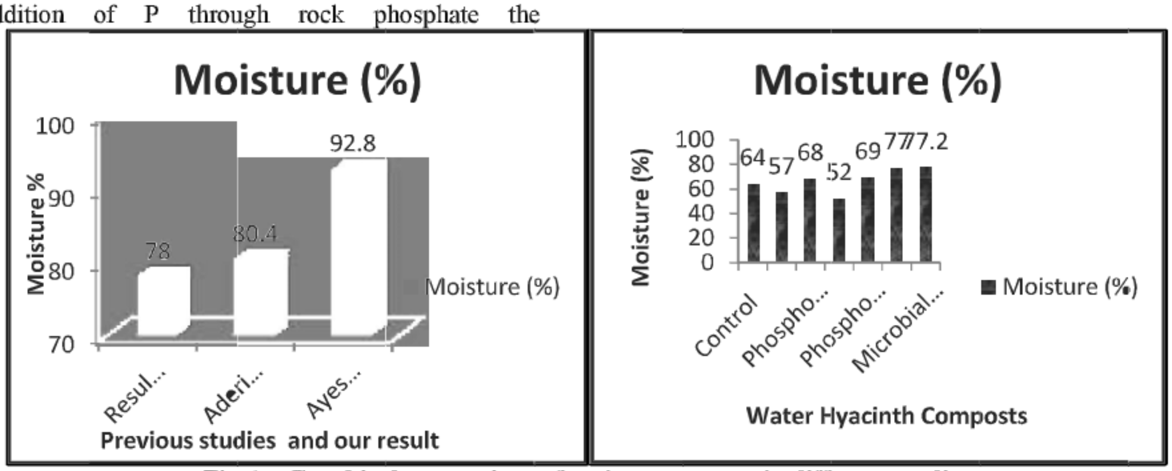

Fig.6 : Graphical comparison of moisture content in different studies

pH: pH of composts varied from slightly alkaline to neutral in range from 7.07 to 7.77. The difference in pH of different mixtures can be attributed to difference in physicochemical characteristics of contents used in the process. (Pramanik *et al.*, 2007) have postulated that decomposition of organic matter leads to the formation of ammonium (NH_4^-) and humic acids. The combined effect of these two oppositely charged groups actually regulates the pH of compost leading to a shift of pH towards neutrality or acidity.

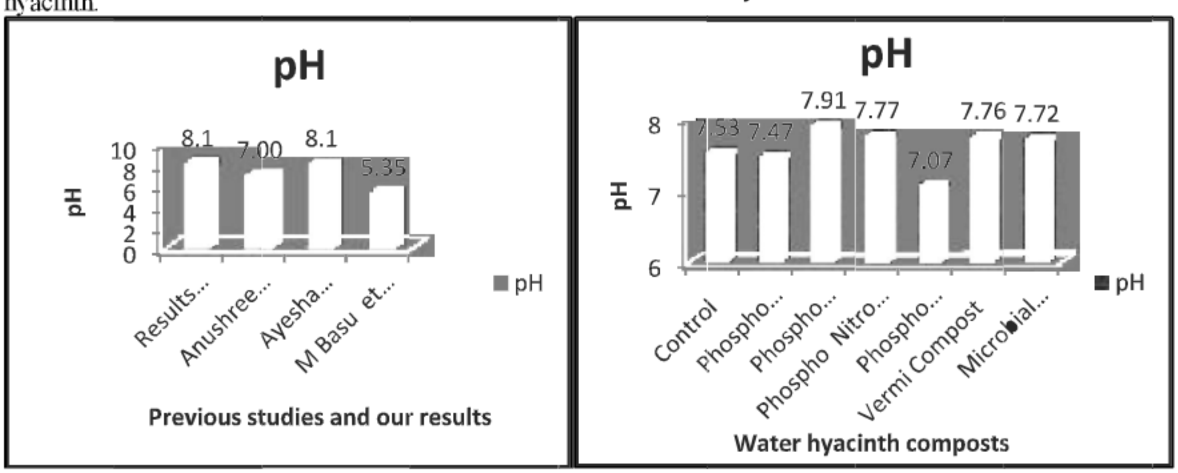

Fig.7 : Graphical comparison of pH in different studies

The variation in pH values may be due to N and P mineralization and decomposition of organic matter into intermediates of organic acids like ammonium and humic acids (Ndegwa and Thompson, 2000). These two groups actually regulate the pH of compost leading to a shift of pH towards neutrality. pH of composts produced from different treatments was neutral to slight alkaline, which is within the optimal range for plant growth(Goh and Haynes, 1977). The pH for all the composting units was not different significantly.

IV ELECTRICAL CONDUCTIVITY

Electrical conductivity (EC) of vermicomposts was higher than initial wastes. The EC reflects the salinity of any material and it is a good indicator of the applicability and utility of a compost or vermicompost for agricultural purposes. The EC was in the range of 0.892–2.352 dSm^{-1} for different composts (Table6). This increase in EC might have been due to release of different mineral ions, such as phosphate, ammonium, potassium etc. (Kaviraj and Sharma, 2003).

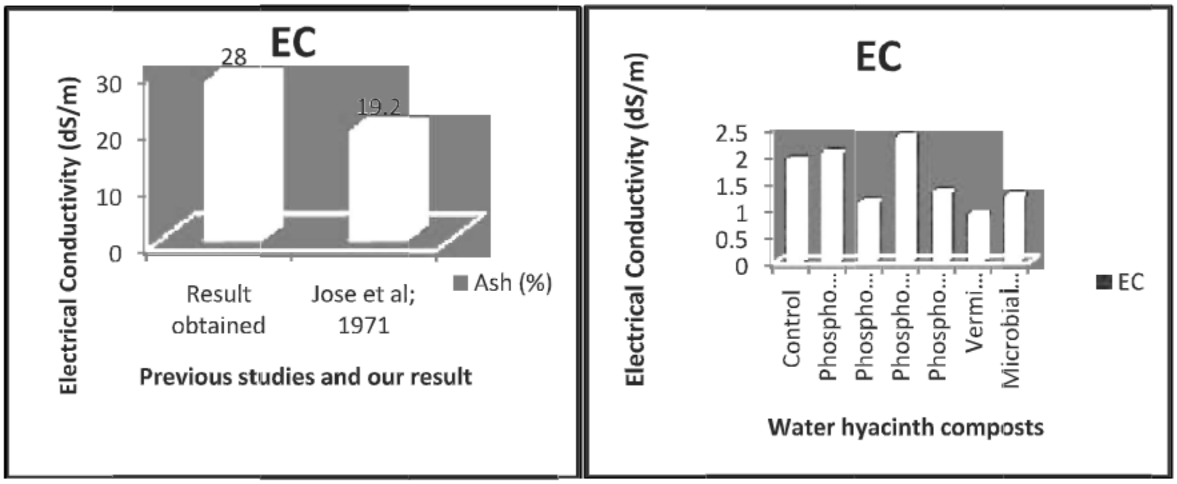

Fig.8 : Graphical comparison of electrical conductivity in different studies

Ash%: High Ash content indicates possible: (i) excess mineralization (old compost) (ii) contamination with dirt base material during turning (iii) poor quality feedstock or (iv) soil or mineral products added. Finding the source and reducing ash is often the fastest means of increasing nutrient quality of compost. Ash values may be disturbed by lixiviation, inopportune blending of soil during turnover operations and even deliberate incorporation of insoluble minerals (Godden *et al;*2004).

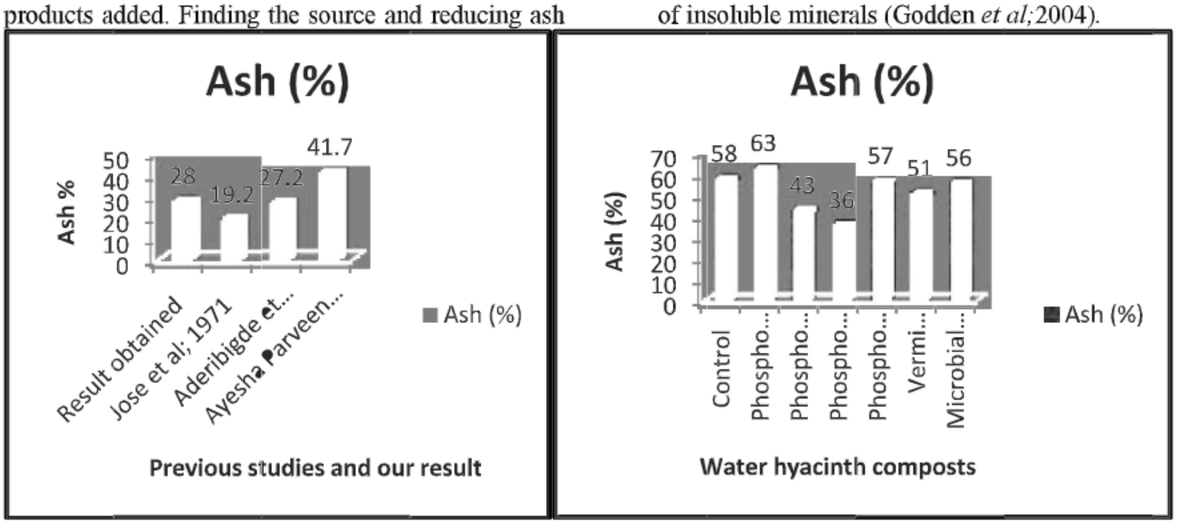

Fig.9 : Graphical comparison of ash content in different studies

An increase in ash% was seen after compost preparation in comparison to the substrates. Lime is generally recommended to correct soil acidity as evidence with pH value 7.91 and 7.77 for T3 and T4, respectively (table 6). Increased ash % in composts may be due to addition of mineral products to the substrates (T2).

V TOTAL ORGANIC CARBON

Reduction in organic matter and total C-content has direct correlation with rate of decomposition (Ros *et al*., 2006) so, total organic content of composts were measured. Total organic C-content was observed 40% for water hyacinth which was decreased with composting. Highest percent reduction was observed 21% with T2 followed by T1 and T7 (23.3% and 24.4%) composts (Table 6).

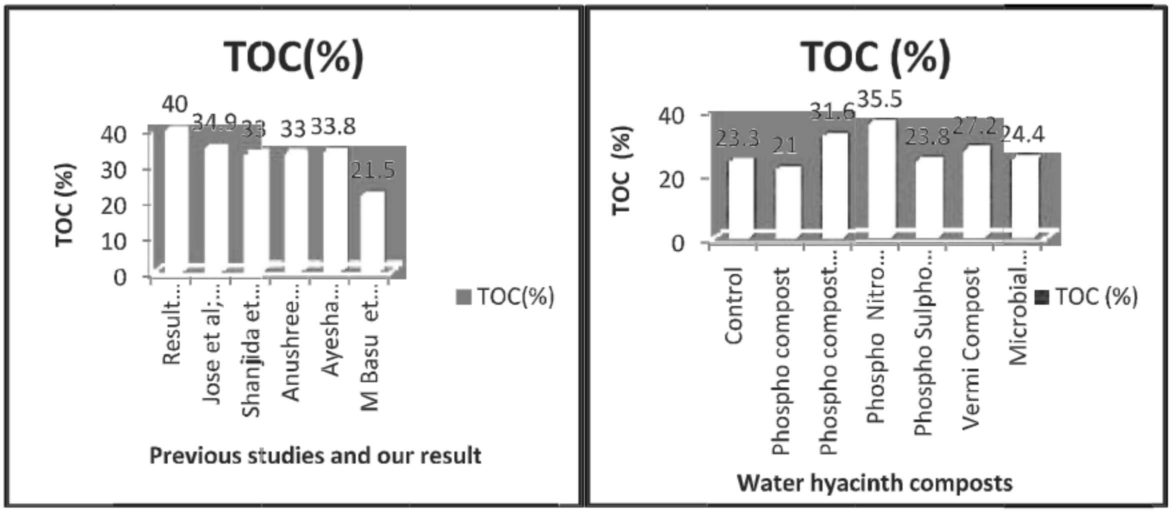

Fig.10 : Graphical comparison of total organic carbon content in different studies

Reduction in total organic C-content may be due to greater availability of easily biodegradable substances which were mineralized by microbes during respiration and thereby releasing CO_2(Benito *et al*., 2003) These results are in agreement with the previous studies on vermicomposting of agricultural and industrial wastes(Gupta *et al*., 2007); (Suthar 2010; Raj and Antil, 2011);(Yadav and Garg, 2011).

Total N: Total N content of compost depends on the initial N content present in the feed material and the degree of decomposition(Crawford, 1983). Presence of N rich weeds having lesser toxicity proved to be favorable for microbial mineralization of raw material. Decrease in pH, mineralization of protein us organic material and conversion of ammonium nitrogen into nitrate may be responsible for addition of N in compost (Yadav and Garg, 2011). Total nitrogen (TN) content in the prepared composts was approximately equal to

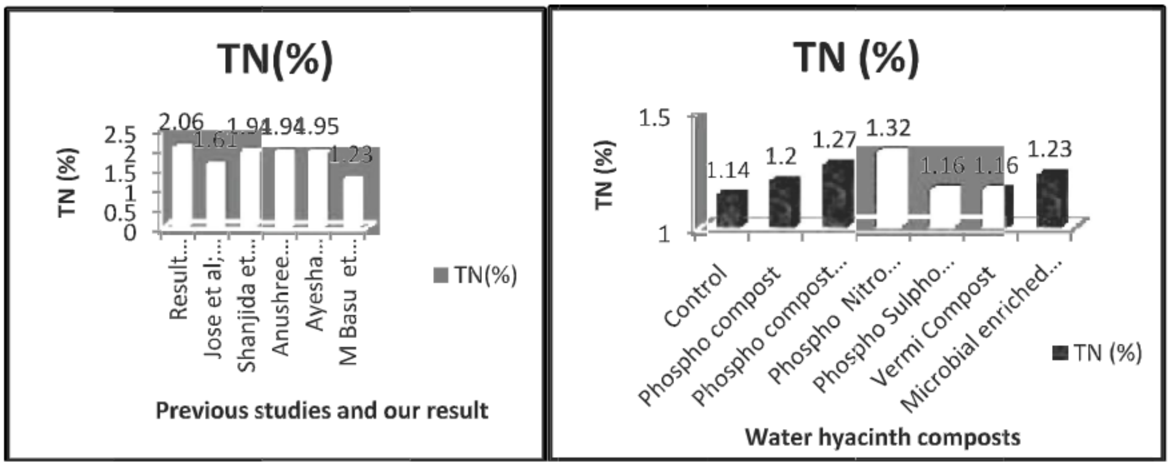

Fig.11 : Graphical comparison of total nitrogen content in different studies

initial substrate (S2). The initial TN content of the substrates was 2.06 and 1.08 g kg-1 for S1 and S2, respectively. Whereas, TN content of treated composts was in the range of 1.16 to 1.23 g kg-1 after composting. (Plaza *et al.* 20070 have reported that the nitrogen content of vermicomposts increase due to mineralization of C-rich materials and, possibly, due to the action of N-fixing bacteria. Decreases in pH may be another important factor in nitrogen retention by compost which otherwise may be lost as ammonia at higher pH values. The difference in TN content of composts was different from each other.

Total Phosphorous: Phosphorous is also an essential element for plant growth which also increased on composting. This may be due to transformation of unavailable forms of phosphorus to easily available forms by microbial enzymes like alkaline and acid phosphatases etc. On composting, phosphorous content were enhanced in all composts. Maximal increase was found in compost (T5) approx 58.90% followed by T4 (57.1%) and T3 (55.4%) composts. Acid phosphatases and alkaline phosphatases may be responsible for this

Transformation(Ghosh *et al.*, 1999).

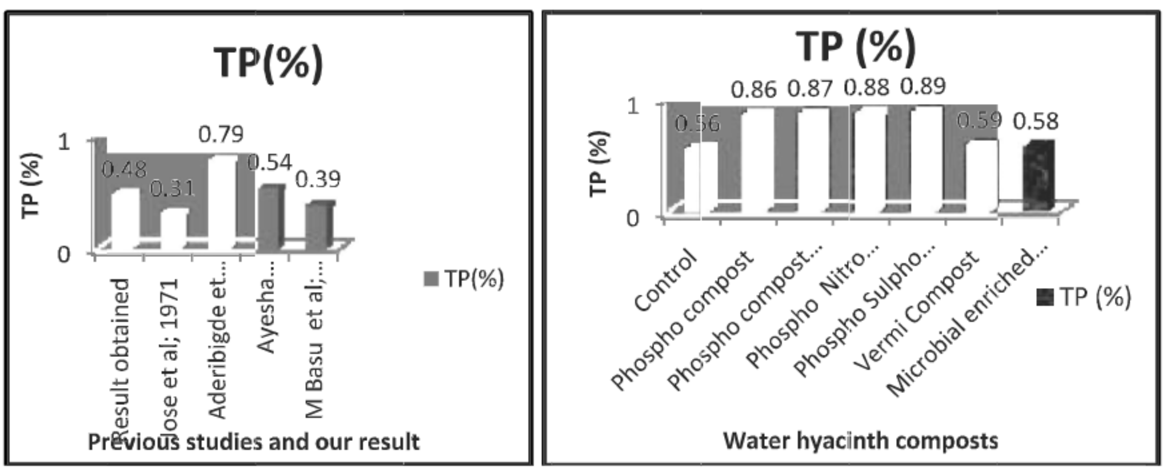

Fig.12 : Graphical comparison of total phosporous content in different studies

After vermicomposting phosphorus content was highest in T4 and T5, and minimum in T1, CD + WH mixture (Table7). (Le Bayon and Binet 2006)have reported that some amount of phosphorus is converted to more available forms partly by earthworm gut enzymes, i.e., acid phosphatases and alkaline phosphatases. Actions of phosphorus-solubilizing microorganisms present in earthworm's casts may also be responsible for the release of phosphorus in vermicomposting (Prakash and Karmegam, 2010).

Total Potassium: The potassium (K) content was greater in all the composts than initial waste (S2) (Table 5). The increase in potassium content was 1–2% in the composts as compared with K content in control. The differences in the results can be attributed to the differences in the chemical nature of the initial raw materials.(Suthar 2008) has reported 104 - 160% increase in potassium content during vermicomposting. (Sangwan *et al.* 2010) have also reported an increase in K in vermi composts after bioconversion of sugar industry waste.

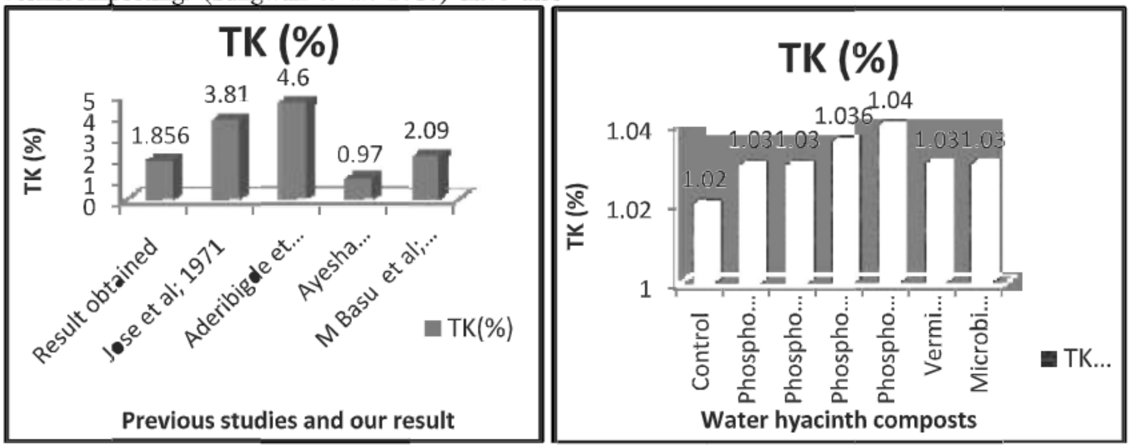

Fig.13: Graphical comparison of total potassium content in different studies

(Kaviraj and Sharma 2003) have reported that enhanced number of micro-flora present in the gut of earthworms might have played an important role in the process and increased potassium content during vermicomposting process.

Sodium%: There was slight difference in sodium content (Na) in all the composts as compared to initial substrates combination (Table 5). Final Na content was in range of 0.018–0.036.The increase in Na content was 0.72–1.40 fold in the final composts as compared to Na content in control substrates combination.

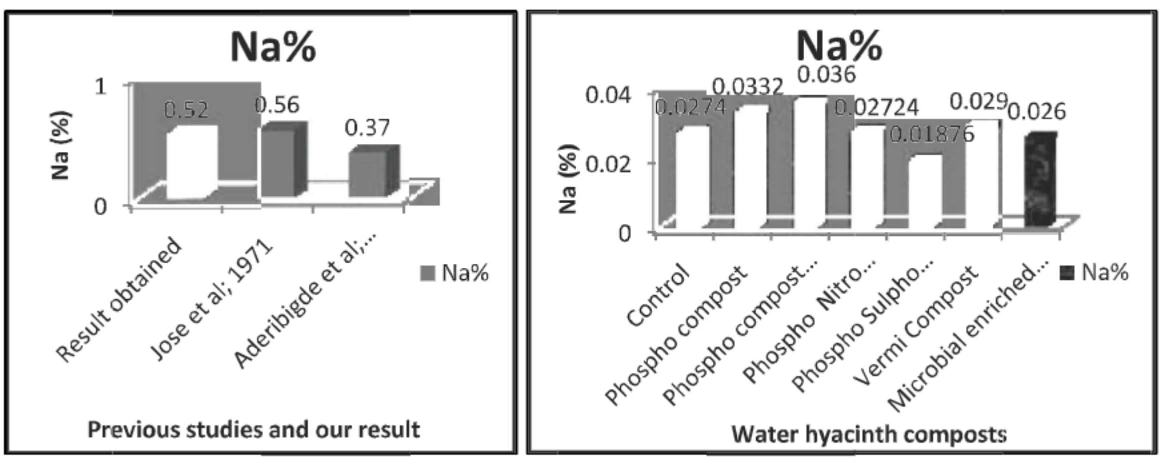

Fig.15 : Graphical comparison of total sodium in different studies

Variation in the Na content may be due to the difference in initial feed substrate characteristics in different composts (Yadav and Garg, 2011). The Na content was different in all the composts. The Na content was different in all the composts except in T4. An increase in Na % was observed with T2 (21.2%), T3 (31.4%) and T6 (5.8%) while with T5 (-31.5%) and (T7 -5.1%) Na % was reduced.

C: N ratio: Initial C: N ratio was in range of 19.42–23.15 (at 0 day), but after 45 days there was a significant change in the C: N ratio in all the composting units. The C: N ration decreased in compost T2 and T7 while an increase in C: N ratio was observed in compost T3, T4, T5 and T6. The increase in C: N ratio may be due to the N loss mainly through ammonia volatilization whereas the enhance C: N ratio resulted due to losses of carbon mainly as carbon dioxide, the carbon content of the compostable material decreased with time and N content per unit material increased.

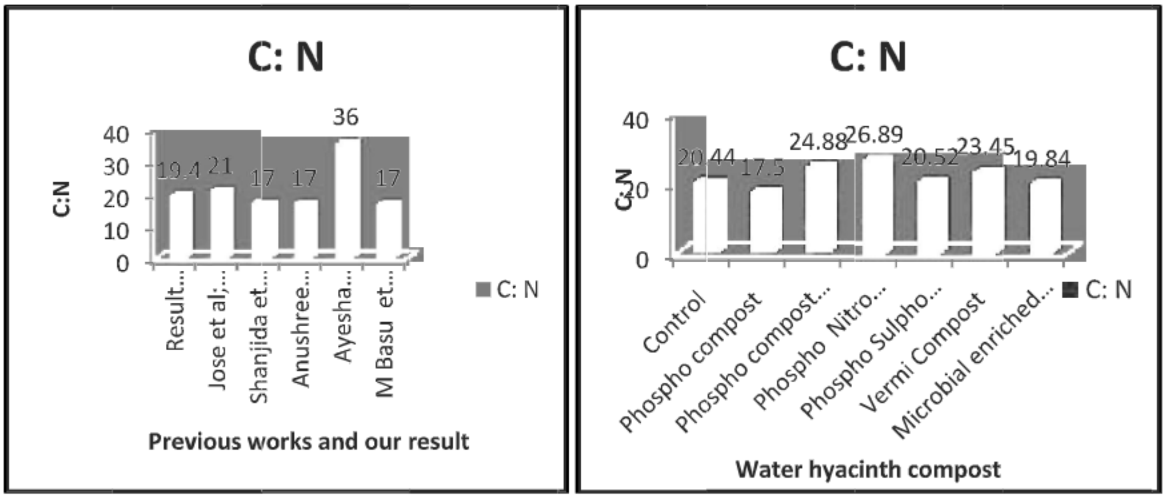

Fig.16 : Graphical comparison of C: N ratio in different studies

Final C: N ratio was in the range of 17.5–26.89. The lowest C: N ratio was in T2 unit containing water hyacinth, cow dung and rock phosphate (17.5) while highest in compost T4 unit containing water hyacinth, cow dung, rock phosphate, lime and urea had highest C: N ratio (26.89). The C/N ratio decreased and was <20 at the end of the process, suggesting the compost had reached an acceptable degree of maturation as suggested by (Golueke, 1981). [Electron transfer capacity as a rapid and simple maturity index for compost. (Yuan *et al.*, 2012)] However**,** (Hirari *et al.* 1983) have stated that the C:N ratio cannot be used as an absolute indicator of compost maturity, since the values for well-composted materials present a great maturity variability, due to characteristics of the waste used.

V CONCLUSION

The water hyacinth has remarkable nutritive properties that can be used for the production of nutrient enriched compost which not only result in healthy aquatic system but also add as an advantage on agricultural land. The result of the studies have shown that the water hyacinth composts prepared by combining different amendments such as rock phosphate, lime, urea, gypsum microbial cultures and earthworm, the highest percentage of N was evaluated in phospho nitro compost and in phospho compost with lime; their values are (1.32 and 1.27) respectively. Where the control compost gave the lowest value of N that is 1.14. The highest percentage of P and K were found in phospho sulpho nitro compost that are P 0.89, K 1.04 and the lowest percentage of P and K in control compost (P 0.56 and K 1.02). The phospho compost with lime gave highest value of sodium percent that is 0.36 where the phospho sulpho nitro compost gave the lowest percent of sodium. The C: N ratio in all the composts is near to 20:1, indicating good maturity of the compost.

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