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Production of Enriched Compost from Water hyacinth (Eichorina crassipes)

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Abstract - Water hyacinth, an aquatic weed is known for causing a series of problems for aquatic life. It also has a few advantages to its recognition. If targeted properly, it can act as an extremely important alternative for meeting some of the most urgent needs of agriculture community. This study proposes and signifies 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 also add as a advantages on agriculture lands. The proximate analysis of different types of water hyacinth composts is observed. The results shown that various compost formed by using different amendments, an indicator for enriched water hyacinth composts.

Key words – water hyacinth, compost, amendments.

Introduction - 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). Compost is defined as the product resulting from the controlled biological decomposition of organic materials. Compost can be derived from a number of feed stocks including yard trimmings, bio solids (sewage sludge), wood by-products, animal manures, crop residues, biodegradable packing, and food scraps. Mature compost has little resemblance in physical form to the original biodegradable from which it is made. Compost is valued for its organic matter content, and it typically used as a soil amendment to enhance the chemical, physical and biological properties of soil. 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.

Compost has been considered as a valuable soil amendment for centuries. Most people are aware that using composts is an effective way to increase healthy plant production. It helps save money, reduces the use of chemical fertilizers, and conserves natural resources. Compost provides a stable organic matter that improves the physical, chemical, and biological properties of soils, thereby enhancing soil quality and crop production. When correctly applied, compost has the beneficial effects on soil properties, thus creating suitable conditions for root development and consequently promoting higher yield and higher quality of crops. (www.agritech.tnau.ac.in/org_farm/orgfarm_composting.html).

Composting process refers to the conversion of green waste into organic fertilizer with compost as an 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). 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. Composting is not a new idea. In the natural world, composting is what happens as leaves pile up on the forest floor and begin to decay. Eventually, nutrients from the rotting leaves are reclaimed by living roots. This completes nature's recycling process. As defined by Diaz *et al.* (1993).

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. Composting (S Ajay *et al*. 2011) as an alternative treatment has the advantage of producing a product that is easy to work into the soil compared with dried water hyacinth, because of the decomposed structure.

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 only means of utilization of water hyacinth which has proved economically viable across the world (Gajalakshmi *et al* 2001). In this background authors studied the utilization of water hyacinth as substituting bean straw with water hyacinth as animal feed (Tag El-Din *et al* 1992) feed for solid-phase fermentation raw material for making pulp, paper and paper board and the vermicomposting of water hyacinth (Gupta *et al* 2007) However, a novel technology with ecological sound and economically viable is urgently required to solve the problem of aquatic weed disposal and management. So this has been decided to prepare water hyacinth compost by using different amendment. In Bhopal there are many numbers of pond and small

lakes,river like Kaliasot. All are suffered by aquatic weeds like water hyacinth. Every year cities expenses big amount of money and use of machinery to remove water hyacinth from these ponds and lakes. There is no use of this removed weed, so this was the great ideacomes in mind that this can be utilized in best way by converting it into water hyacinth composting.
Hopefully this compost could be solving problems and utilized in our agriculture based country significantly.
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.

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 IISS Bhopal. Rock phosphate, lime, urea, microbial enriched compound and epigeic earth warm are the amendments arranged from Soil Biology Division ICAR, IISS Bhopal.
Water hyacinth was chopped manually at IISS Bhopal
The details of experiment set up are 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 1

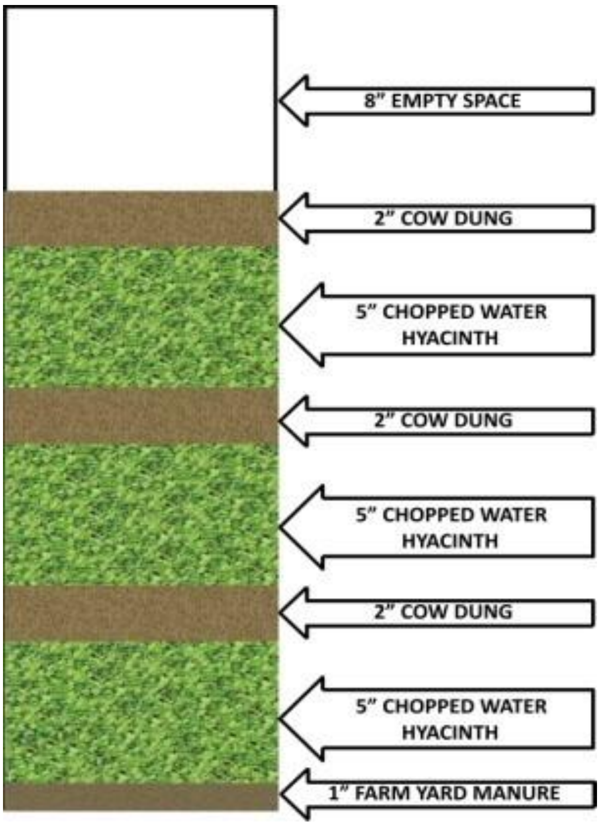

Fig. 1: Order of different layers of materials constituted for carrying out composting in pit

- The bottom of the pit filled with compost about 1 inch thick containing about 10 kgs of farm yard manure.
- The second layer above the manure compost's layer was of chopped fresh water hyacinth which was about 5 inch thick containing about 15.7 kgs of water hyacinth.
- The third layer above second layer was of fresh cow dung which was about 2 inch thick containing approx 13.33 kgs of cow dung.
- The fourth layer above the cow dung layer was of chopped fresh water hyacinth (~15.7 kgs) of 5 inch thickness.
- The fifth layer above fourth layer was of fresh cow dung (~13.33 kgs) of 2 inch thickness.
- The sixth layer above the fifth layer was of chopped fresh water hyacinth (~15.7 kgs) of 5 inch thickness.
- The seventh layer above sixth layer was of fresh cow dung (~13.33 kgs) of 2 inch thick Each pit remained empty by about 8 inch for turning and watering operation.

Fig 2: 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 1.0 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 types of composts were developed by incorporating the materials in varied ratio as.

Different formulations of composts

T1 (control) = Water hyacinth + cow dung

T2 (Phospho Compost) = T1 + Rock Phophate

T3 (Phospho Compost with lime) = T2 + Lime

T4 (Phosphor Nitro Compost) = T3 + Urea

T5 (Phospho Sulpho Nitro Compost) = T2 + Gypsom + Urea

T6 (Vermi Compost) = T1 + Epigeic earth warm

T7 (Microbial Enriched Compost) = T1 + Microbial Culture

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). 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.

Result 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 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 shown in figure 3(a) and 3(b).

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.

Fig.3a: Matured composts (Control,

Phosphocompost, Phospho compost with lime)

Fig.3b: Matured composts (Phospho Nitro compost, Phospho Sulpho Nitro compost, Vermi Compost, Microbial enriched compost)

Initial studies performed with S1 and S2 showed significant higher levels of nitrogen and Potassium in S1 in comparison to S2.

Table 2: Analysis of N, P, K parameters of water hyacinth and cow dung

S. No.	Parameter	Water Hyacinth (S1)	Cow dung (S2)
1	**TN (%)**	**2.06**	1.08
2	**TP_2O_5 (%)**	0.48	0.41
3	**TK (%)**	**1.85**	0.41

Table 3: Analysis of N, P, K parameters of Water hyacinth composts

S. No.	Parameters	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	TN (%)	1.14	1.2	1.27	1.32	1.16	1.16	1.23
2	TP (%)	0.56	0.86	0.87	0.88	0.89	0.59	0.58
3	TK (%)	1.02	1.03	1.03	1.036	1.04	1.03	1.03

Table 3: 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 manure. With the addition of P through rock phosphate the phosphorous concentration increased in the compost.The N contents and K contents have also exceeded 1.00%.

According to above mentioned table 2 and 3 there are various comparisons between different contents of parameters of substrates and prepared composts

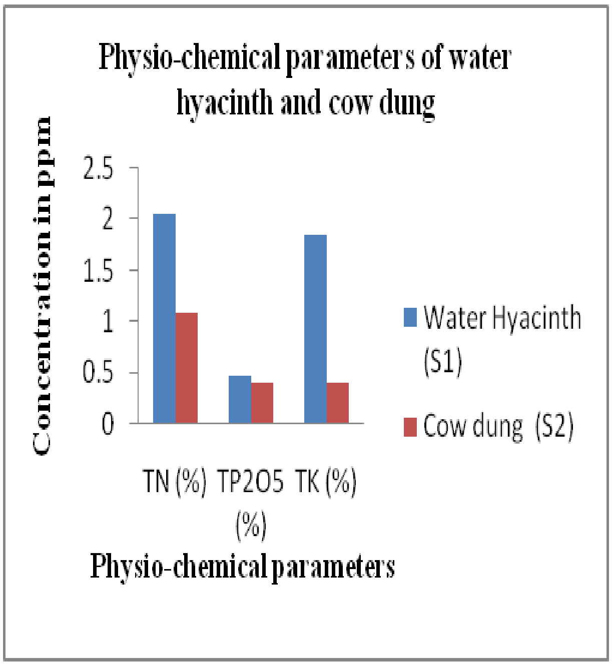

Fig.4: Physio-chemical parameters of water hyacinth and cow dung.

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 favourable for microbial mineralization of raw material. Decrease in pH, mineralization of proteinous 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 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.* (2007) have reported that the nitrogen content of vermicomposts increase due to mineralization of C-rich materials and, 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.

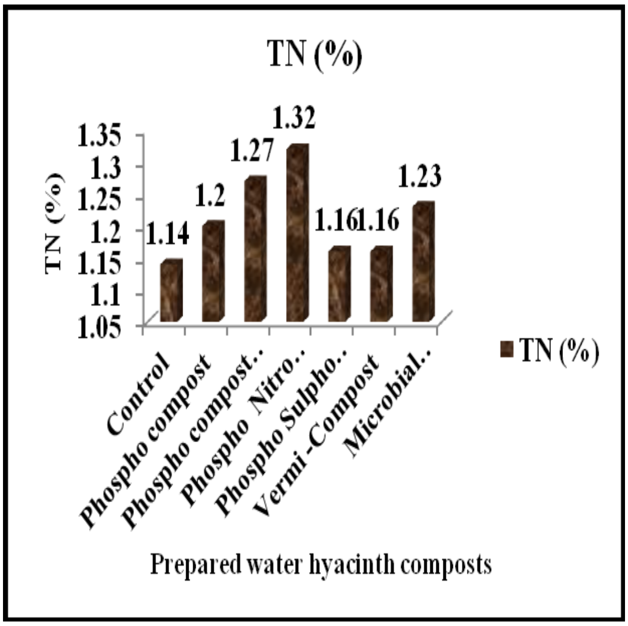

Fig. 5: Graphical comparison of Total Nitrogen content in different studies

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).

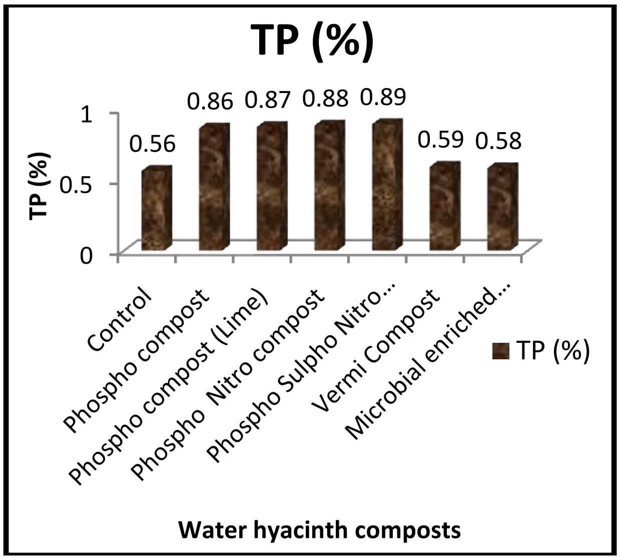

Fig6: Graphical comparison of total phosphorous content in different studies

After vermicomposting phosphorus content was highest in T4 and T5, and minimum in T1, CD + WH mixture 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) (Table3). 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.

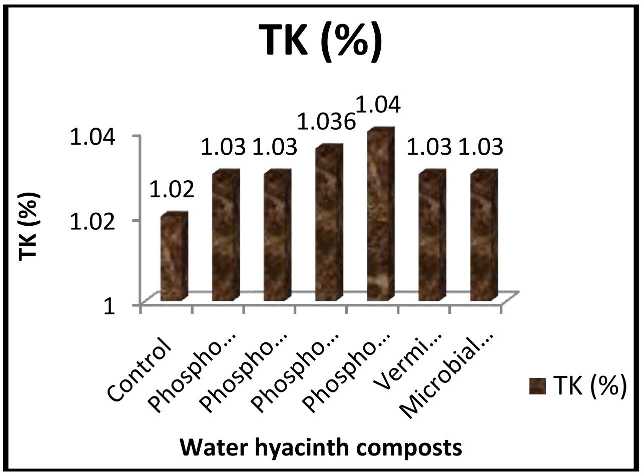

Fig.7: Graphical comparison of total potassium content in different studies

Conclusion - This study signifies 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 also add as an advantage on agricultural lands as soil amendments.

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 inoculation and prepared different composts.. These are control, phospho compost, phospho compost with lime, phospho nitro compost, phospho sulpho nitro compost, vermicompost and microbial enriched compost. Among composts, the highest percentage of N was evaluated in phospho nitro compost and in 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 in control compost (P 0.56 and K 1.02).

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References

[1] **Abdurrahman Hanay Fatih Biiyiiksonmez, Fatih M. Kiziloglu and Mustafa Y. Canbolat.** (2004). Reclamation of Saline-Sodic Soils with Gypsum and MSW Compost, *Compost Science & Utilization*, Vol. 12, pp. 175-179.

[2] **Aderibigbe, A.O., Johnson, C.O.L.E., Makkar, H.P.S., Becker, K., Foidl, N. (1997). Chemical composition and effect of heat on organic matter- and nitrogen-degradability and some antinutritional components of Jatropha meal Animal. Feed Science and. Technology. 67, 223-243.**

[3] Afzal, Aslam, Saadia Irfan. (2004). Enhancement of germination of seed by different priming technique. Journal of Santa Cruz Vol.16 pp. 19-34.

[4] Ajay S. Kalamdhad, W. Roshan Singh, Ganesh Chandra Dhal, (2011). Agitated Pile Composting of Water Hyacinth, 2nd International Conference on Environmental Science and Development Vol.4 pp. 79-84.

[5]Alexander, M. (1977). Introduction to soil microbiology, 2nd ed., John Willy and San Newyork.

[6] Anderson, J.P.E. (1982). Soil respiration. In: Page, A.L., Miller, R.H., Keeney, D.R. (Eds.), Methods of Soil Analysis, Part 2. Chemical and Biological Properties. American Society of Agronomy and Soil Science Society of America, Madison, WI, pp. 841–845.

[7] AOAC. (1990). Official Methods of Analysis: Association of Analytical Chemists. 14th Ed., Washington, USA, 22209.

[8] AOAC Method. (1992). Total, soluble, and insoluble dietary fibre in foods. Enzymatic-gravimetric method, MES-TRIS buffer. Official Methods of Analysis of the Association of Official Analytical Chemists, 15th ed., 3rd suppl.Association: Arlington, VA, 991.43.

[9] Ayesha Praveen, A.C.K. Padmoj (2010). Bioconversion of Municipal Solid Waste (MSW) and Water Hyacinth into organic manure by Fungal Consortium; Journal of sustainable Development Vol.3, pp. 91-97.

[10] Boltz, D.F., ed. (1978). Colorimetric Determination of Nonmetals. Interscience Publishers, New York, N.Y. Bouyoucos, H.J. and Mick, A.H. (1940): An electrical resistance method for the continuous measurement of soil moisture under field condition. Tech.bull.172, pp.1-38.

[11] Bray R.H. and Kurtz, L.T. (1945). Determination of total, organic and available forms of phosphorus in soil science 59:39-45.

[12] Canet, R., Pomares, F. (1985). Changes in physical, chemical and physicochemical parameters during the composting of municipal solid wastes in two plants in Valencia. Biores. Technol., Vol, 51: pp. 259-261.

[13]Das Ayan and Kalamdhad Ajay S, (2011): Evaluation of Water Hyacinth Compost Stability Using Respirometric Techniques, Vol. (1), pp 109-113.

[14] Ekelemu J.K. (1998). Malacostraca species inhabiting water hyacinth in River, Southern Nigeria, Nigerian Field. 63: pp. 149.

[15] G. J. Jann, D. H. Howard, and A. J. Salle. (1959). Method for the Determination of Completion of Composting, Vol 7: pp. 271-275.

[16] Gillman G.P., Sin chair D.F., Beech T.A. (1986). Recovery of organic carbon by the Wellesley and Black procedure in highly weathered soils. Communes soil Sci. PlantAnaly. Vol 17(8): pp. 885-89.

[17] Hasan, M.R.; Chakrabarti, R. (2009). Use of algae and aquatic macrophytes as feed in small-scale aquaculture: a review. FAO Fisheries and Aquaculture Technical Paper. No. 531. Rome, FAO.pp .123.

[18] http://www.aoac.org/vmeth/newsmtd.htm (Accession date:10 may2012).

[19] http://www.norweco.com/html/lab/test_methods/4500norgbfp.htm(Accession date: 10 may2012).

[20] http://www.fao.org/docrep/ARTICLE/AGRIPPA/551_E (Accession date: 3may 2012).

[21] www.agritech.tnau.ac.in/org_farm/orgfarm_composting.html. (Accession date: March 11, 2012).

[22] Issac, R.A. and Johnson, W.C. (1975). Collaborative study of wet and dry techniques for the elemental analysis of plant tissue by atomic absorption spectrophotometer. J. AOAC 58, 436.

[23] J.A. Galbiatti, A.G. Cavalcante. (2007). Nitrate and Sodium contents on lettuce and drained water as function of fertilizing and irrigation water quality in Brazil. International Journal of Plant Production Vol 2; pp. 205-214.

[24] Kjeldahl, J. (1883). A new method for the determination of nitrogen in organic matter. Z. Anal. Chem. 22:366.

[25] M. Basu. B. S. Bhadoria and S. C. Mahapatra, (2011). Influence of Soil Ameliorants, Manures and Fertilizers on Bacterial Populations, Enzyme Activities, N Fixation and P Solubilization in Peanut Rhizosphere under Lateritic Soil. British Microbiology Research Vol 1(1); pp. 11-25.

[26] Malik A.(2007). Environmental challenge vis a vis opportunity: The case of water hyacinth. Environment International;33(1): 122-38.