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Research Article

CHARA ZEYLANICA IN RICE PRODUCTION TECHNOLOGY

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ABSTRACT
The selected aquatic weed based vermicompost appeared to have the potential of increasing the growth and yield by way of favorably increasing seed germination, production of leaves, earlier flowering and better yield. Compared to the control, the morphological, biochemical and reproductive characters showed improved results in all the C_1- C_5 treatments (1% - 5% vermicompost). However C_3 was preferably good. *Chara zeylanica* used vermicompost served as a good, less expensive, eco-friendly biofertilizer to the experimental paddy crop.

Key Words: *Aquatic Weed, Vermicompost, Chara zeylanica, Ecofriendly Biofertilizer, Paddy*

INTRODUCTION
Vermitechnology is a crop improvement tool. Organic farming is an agricultural production system which avoids or largely excludes the use of chemical fertilizers and pesticides. *Oryza sativa Linn.* is an important staple food and its demand is on the rise. In the present day agriculture, rice is a lackluster crop, because of increased cost of production.

Minimizing the fertilizer cost through organic farming/ aquatic weed utilization would pave way for dual benefit, one- aquatic weed management thereby saving the freshwater environments, the other- aquatic weed utilization in vermitechnology that would provide a need based ecofriendly biofertilizer containing the primary macronutrients(NPK), the secondary macronutrients (Ca and Mg), and the micronutrients Zn, Cu, Fe etc. *Chara zeylanica* Willdenow is a freshwater macroalgal weed which is characteristic of forming dense meadow in many freshwater ecosystems of Kanyakumari District. This is the basis for the present study.

MATERIALS AND METHODS
Germination Studies
Oryza sativa Linn. var. *sonal* (NP 3114) was selected for the present investigation and purchased from Agriculture College, Coimbatore. All the seeds were sterilized with 10% mercuric chloride and washed with distilled water. From this 240 seeds were taken and kept in 12 petridishes (20 seeds each) using filter paper. From the 1:1 ratio of *Chara*-cowdung used vermicompost, prepared 1% (C_1), 2% (C_2), 3% (C_3), 4% (C_4) and 5% (C_5) solutions and accordingly labeled all the petridishes. Similar preparation was done with 2:1 ratio of vermicompost also.

Two more petridishes were prepared and labeled as control. The seeds were spread over the filter paper separately in each petridish and moistured well with the respective vermicompost solutions. Control petridish was moistured only with water. All the setups were maintained in triplicates and kept in the laboratory under natural condition to observe the germination rate on the 5^{th} day and germination percentage was calculated.

Among the two ratios 1:1 and 2:1, better germinated seedlings were selected for further studies for pot experiments. 2:1 proportion *Chara*: cowdung vermicimpost was used for the pot experiment. Six pots of similar size were selected, clearly labeled (C_1, C_2, C_3, C_4,C_5 & Control) and filled separately with (2:1 ratio) vermicompost along with sterilized garden soil in fixed proportion and mixed well (3/4 of garden soil with ¼ of vermicompost). After ten days each of the pot was planted with single seven days old seedlings (with respect to the labels) which were grown in the petridish. They were kept in triplicates under direct sunlight.

Root and Shoot Length

On the 7th day from each setup in different treatment and in control, root and shoot length of three seedlings were measured and the mean ± S.D value were calculated and reported in tables and figures.

Fresh and Dry Weights

On the 7th day from each setup in different treatment and in control, the fresh and dry weights of three seedlings were measured and the mean ± S.D value were calculated and reported in tables and figures.

Bio-chemical Analysis

On the 7th day bio-chemical characters like Chlorophyll 'a', 'b' and total Chlorophyll (Arnon, 1949), protein (Lowry *et al.,* 1951), Carbohydrate (MacCreedy *et al.,* 1950) and lipid contents (Bligh and Dyer, 1959) were estimated and reported in table.

Reproductive Characters Study

Reproductive characters such as number of days required to produce the spike, number of spike-lets, length of the spike, number of grains per treatment, and mean grain weights were measured and represented in tables, figures and plates.

The data obtained from the experiment was subjected to mean, standard deviation and ANOVA (Zar, 1996). The influence of vermicompost on *Oryza sativa* was observed and studied (Table 2).

RESULTS AND DISCUSSION

Vermicomposting of aquatic weeds is a positive biotechnological approach to produce an eco -friendly nutrient rich medium and play substantial role in the local socio- economy as green manure/compost. In the present study the harvested aquatic weed (*Chara zeylanica*) biomass was utilized in vermicomposting in combination with garden soil and cow dung as additives to reduce moisture levels and maintain C: N ratio. Vermicomposting process was successfully completed. This observation is in agreement with the reports of Wile *et al.,* (1975 and 1978*).*

100% germination occurred in C_3 treatment with 2:1 ratio *Chara zeylanica* used vermicompost. In the anaerobic pot culture (Figure 1) of rice, shoot growth was accelerated and the length was maximum (4.12cm) against the minimum (2.98cm) shoot length in the control setup. Fresh and dry weight of the seedlings also increased. The biochemical contents including the enzymes concentrations were proportionately higher (Figure 2). Consequently early flowering occurred in the treated plants producing more number of sturdy spikelet.

Rice is the common, staple food stuff throughout India and is rich in carbohydrate, protein and minerals (Khush, 2005). It is cultivated in 42mha consuming more than 60lakh tones of nitrogen in India (Nayak *et al.,* 2001). Hence large amount of chemical fertilizers must be added to the soil where rice is grown (A1-Neaim and Siddig, 2004). Excessive application of nitrogen fertilizer leads to contamination of potable water because nitrate remaining in the soil profile leach to ground water (Singh *et al.,* 1995). To make agriculture more sustainable, soil has to be ameliorated with other fertilizers which improve crop yield. In the present study vermicompost was prepared from *Chara zeylanica* and applied to *Oryza sativa*. Pot experiment was done to evaluate the growth response of rice to Fertilizer Nitrogen by Murtaza *et al.,* (2000). Studies on tillering of a number of paddy varieties under different environmental condition were already carried out (Chatterjee *et al.,* 1970; Chatterjee and Maiti 1981).

Maximum germination percentage (100%) was resulted in C_3 treated with 3% vermi extract (Figure 1-i). The effect of presoaking seed treatment in the extract of *Phormidium foveolarum* on the germination and development of the seedlings of wheat (*Triticum vulgare*) was studied by Kushwaha and Gupta (1969). Shoot length increased constantly in C_1-C_3 treatments. Singh *et al.,* (2007) studied growth in paddy var. pusa 44 and pusa basumathi treated with farmyard manure and blue green algae, which produced higher measure of shoot length than the control. Similar findings were also reported in rice plants treated with organic manures (Thakur *et al.,* 2011). The weight of the rice plant (7days old) increased in all the treatments. The highest fresh weight 0.66g in C_3 and the next highest value 0.58g was got in C_4. Highest

dry weight (0.09gm) was obtained in C_3 (Figure 1-ii). Liang *et al.,* (2003) reported that application of organic manure increased the weight of rice and barley plant.

The concentrations of bio molecules such as carbohydrate, protein and lipid contents were higher than that in control (Table 1). The carbohydrate content ranged from a minimum mean value of 59.67 in control to the maximum of 80.21mg/g in C3 treatment seedlings. It was also true with the experiment by Arancon *et al.,* (2002). The protein content in leaves occurred in the descending order as C_3> C_2> C_1> C_4> C_5 and control.

Table 1: Effect of *Chara zeylanica* used vermicompost on biochemical analysis of *Oryza sativa*

Parameters	Treatments					
	Control	**C_1**	**C_2**	**C_3**	**C_4**	**C_5**
Carbohydrate	59.67± 5.69	73.33± 9.45	76.19± 15.10	80.21± 4.00	71.42± 9.45	66.18 ±8.50
Protein	3.42 ± 0.72	4.27± 0.46	4.64± 0.40	6.33± 0.50	3.53± 0.60	3.62± 0.72
Lipid	0.18± 0.01	0.21 ± 0.01	0.26± 0.01	0.31± 0.01	0.19± 0.01	0.17± 0.01

Table 2: ANOVA: Between Groups Design

Source	**SS**	**df**	**MS**	**F**	**P**
Root length	14.78	5	2.96	12.5	0.0002
Error	2.85	12	0.24		

Source	**SS**	**df**	**MS**	**F**	**P**
Shoot length	1.28	5	0.26	1.3	0.3135
Error	2.29	12	0.19		

Source	**SS**	**df**	**MS**	**F**	**P**
Flowering day	199.10	5	39.82	55.1	0.0001
Error	8.67	12	0.72		

Source	**SS**	**df**	**MS**	**F**	**P**
Spike length	53.98	5	10.80	5.4	0.0079
Error	24.01	12	2.00		

Source	**SS**	**df**	**MS**	**F**	**P**
Number of seeds	9749.00	5	1950.00	8.2	0.0014
Error	2857.00	12	238.10		

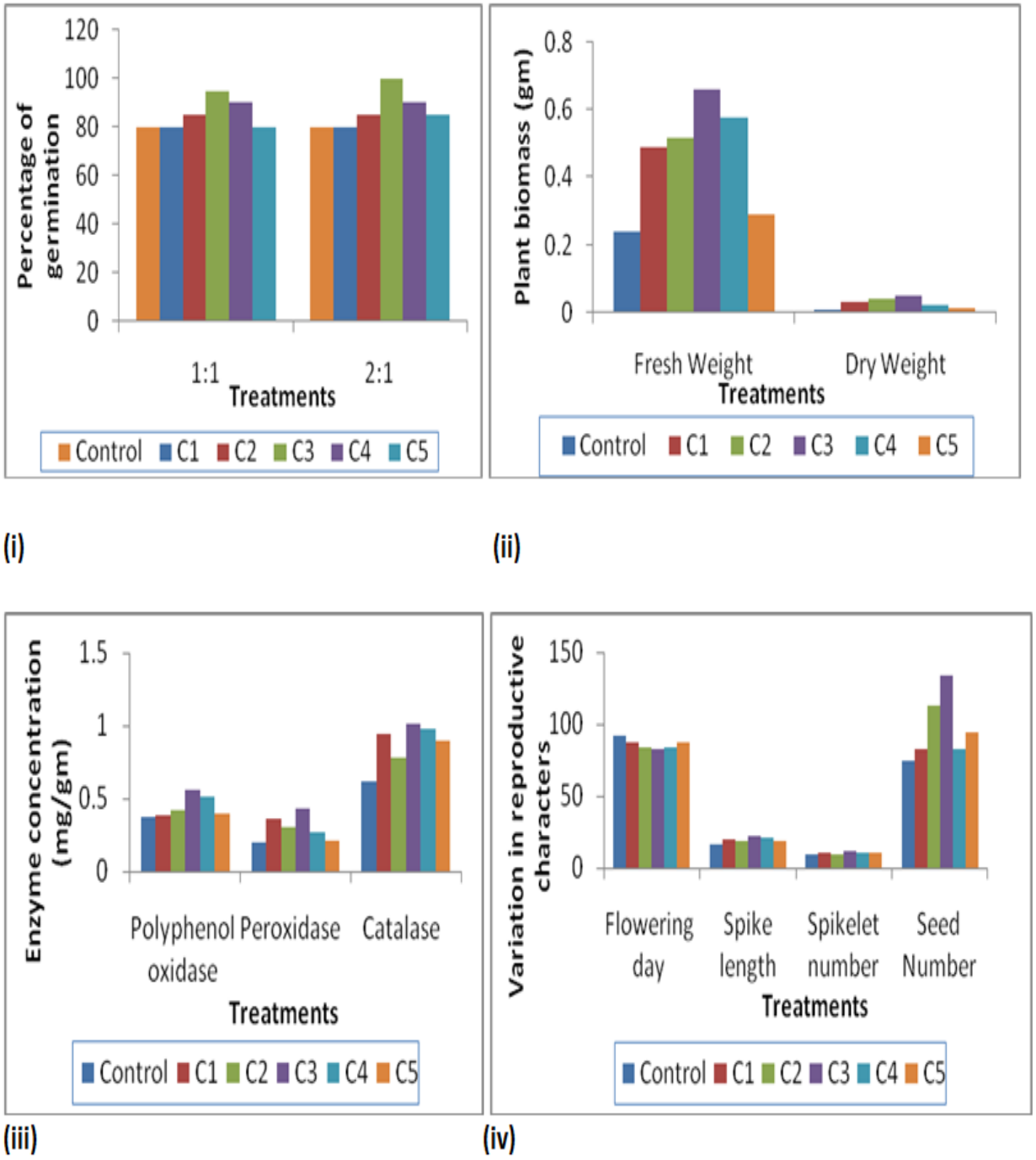

Figure 1: Effect of *Chara zeylanica* used vermicompost in *Oryza sativa*

(i) Germination percentage
(ii) Fresh and dry weight
(iii) Enzyme concentration
(iv) Reproductive characters

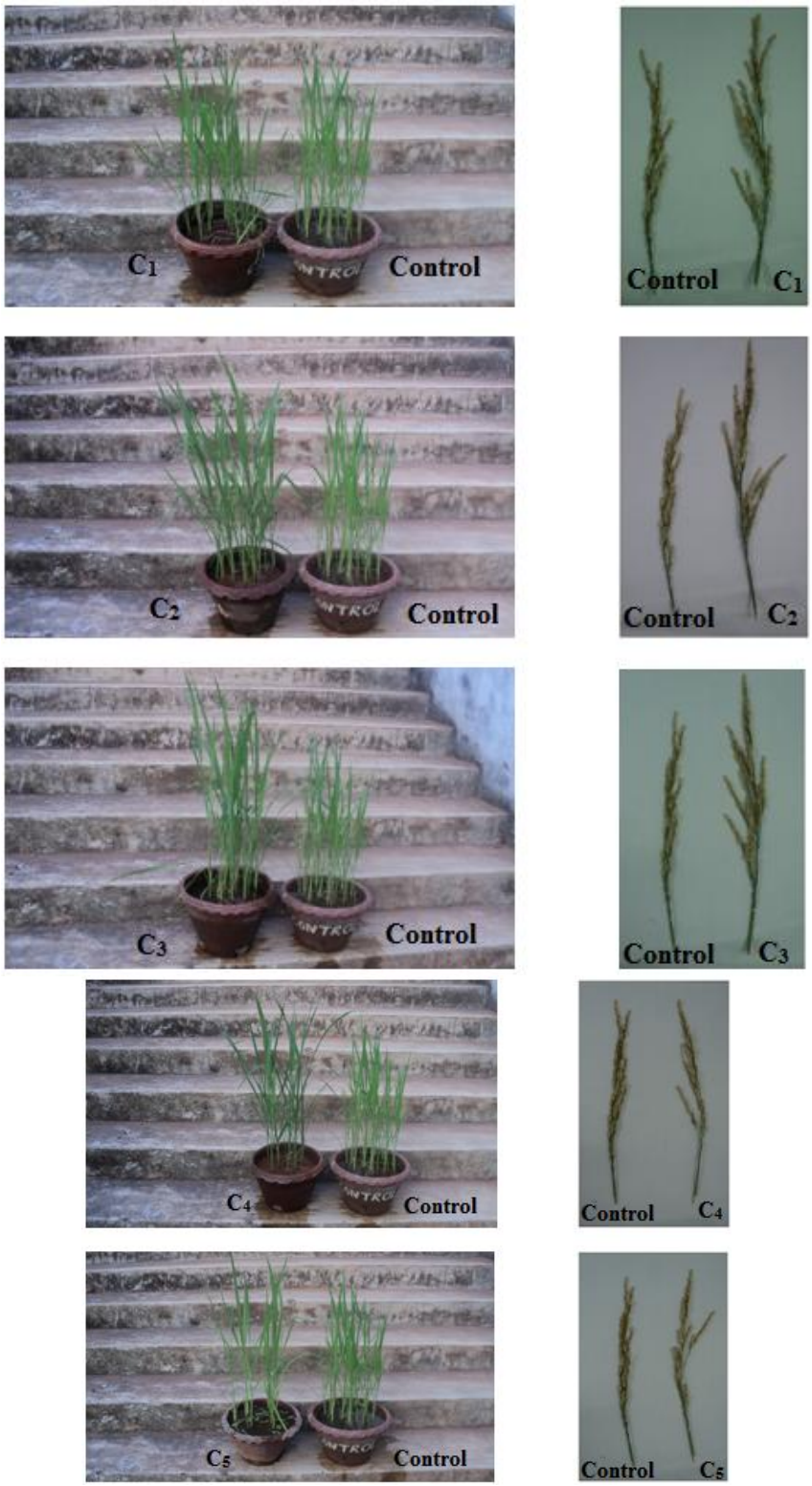

Figure 2: Rice variety - sonal (NP 3114)

C– *Chara zeylanica* vermicompost influence in paddy growth

The favourable impact of vermicompost on leaf protein was also reported by Hirumani Yadav and Vijayakumar (2004). A maximum of 6.26mg/g in C3 and minimum of 3.42mg/g of protein in control was reported. The concentration of enzymes Peroxidase, Polyphenol oxidase and Catalase remained higher as 0.43, 0.56 and 0.01 in C_3 treatment seedlings than control (Figure 1-iii). The values showed significant influence of vermicompost treatments.

Length and number of spikelet increased constantly in all the treatments. In the mature plant the highest length of spikelet value 22.06cm was got in C_3. Jeon *et al.,* (2011) observed that the application of green manure in rice plant increased the number and length of spikelet. The number of grains increased constantly in all the treatments. In the mature plant the highest number of grains 134.00 was got in C_3 and next highest value 112.67 was got in C_2 (Figure 1-iv). Khan *et al.,* (2008) observed that the application of farmyard manure and poultry manure increased the number of grains in maize (Zea mays). Satyanarayana *et al.,* (2002) observed that the application of farmyard manure and green manure increased the number of grains in rice plant. Fresh seed weight was increased in the vermicompost treated cereals over control. Such observation was reported earlier by Bra *et al.,* (2006).

Vermicompost is known to suppress plant diseases and symptoms caused by different fungi and insect pests (Edwards and Burrows, 1988; Scott, 1988; Nakamura, 1996; Szczech, 1999; Rodriguez *et al.*, 2000; Chaoui *et al.,* 2002; Rao *et al.,* 2001; Arancon *et al.,* 2005a and b; Babidha *et al.,* 2012).

Conclusion

The present finding highlights that the selected aquatic weed (*Chara zeylanica*) based vermicompost appears to have the potential of increasing the growth and yield by way of favourably increasing seed germination, production of leaves and earlier flowering and better yield. The aquatic weed based biofertilizer also protected the crop from disease symptoms. Vermicomposing of this macroalgal biomass is a novel work and vermicompost is found to be a good, less expensive, eco-friendly manure to the paddy crop.

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REFERENCES

A1-Noaim Ahmed A and Siddig H Hamad (2004). Effect of biofertilization along with different level of nitrogen fertilizer application on growth and grain yield of Hassawirice (*Oriza sativa* L.) *Basic and Applied Science* **5**(2) 215- 224.

Ansari AA (2009). Indigenous approach organic solid waste management Guyana (South America) University of Guyana. *Global Journal of Environmental Research* **3**(1) 26-28.

Arancon NQ, Edwards CA and Lee S (2002). Management of plant parasite nematode populations by use of vermicomposts. *Proceedings of Brighton crop protection conference pests and diseases* **8B-2** 705-716.

Arancon NQ, Edwards CA, Bierman P, Metzger JD and Lunch C (2005a). Effect of vermicompost produced from cattle manure, food waste and paper waste on the growth and yield of peppers in the field. *Pedobiologia* **49** 297-306.

Arancon NQ, Galvis P and Edwards CA (2005b). Suppression of insect pestpopulations and plant damage by vermicomposts. *Bioresource Technology* **96** 1137-1142.

Arnon DT (1949). Copper enzymes in isolated chloroplast polyphenol oxidase in Beta vulgaris. *Journal of Plant Physiology* **24** 1-5.

Babidha N and Ramaswamy M (2012). Ameliorative effects of vermicompost on root- knot nematode, *Meloidogyne incognita* (Kofoid and White) with reference to organic constituents in the leaves of vegetable Lady's finger plant, *Hibiscus esculentus L. (var. cobh HI). International Journal of Biological Technology.*

Bligh FG and Dyer WF (1959). A rapid method of total lipid extraction and purification. *Canadian Journal of Biochemistry and Physiology* **37** 911-917.

Bra BS, Dhillon Benipal NS, Jogdeep S and Mavi MS (2006). Balanced use of inorganic fertilizers and farm yard manure for higher crop yields and better soil health in maize, wheat cropping system. *Journal of Research, Punjab Agricultural University* **43**(2) 104-107.

Bremner JM and Mulvancy CS (1982). Nitrogen ± total. In: *Methods of Soil Analysis Part 2, Chemical and Microbiological properties,* edited by Page AL, Miller RH and Keeney DR, *American Society of Agronomy,* Madison, Wisconsin 595-641.

Bury M, Kiepas-Kokot A and Songin H (2009). Dung-value of vermicomposts manufactured with local technology method from sewage sludge (in Polish) Zesz. Nauk. AR im. H. Kollataja w Krakowie 372, Sesja Naukowa **75** 151-156.

Chatterjii AK (2005). Introduction to environmental biotechnology. Pentice Hall, India Pvt. Ltd., New Delhi 5-8.

Estherrani DV, Perumalsamy K and Isaiarasu L (2007). Vermicompost production from leaf litter using the epigeic, exotic earthworm, *Journal of Ecotoxicology and Environmental Monitoring* **17**(1) 37-41.

Hirumani Yadav and Vijayakumar (2004). Impact of vermicompost on biochemical characters of chilli. *Journal of Ecotoxicology and Environmental Monitoring* **14**(1) 51-56.

Jayabal A and Kuppuswamy GK (1997). Recycling of agricultural and agro industrial wastes for the production of vermicompost and its effect on soil fertility management. Paper presented on the scientific conference and General Assembly on Food security in harmony with nature, Banglore.

Jeon WT, Choi B, El-Azeem SAMA and Ok YS (2011). Effect of different seedling methods on green manure biomass, soil properties and rice yield in rice based cropping systems, *African Journal of Biotechnology* **10**(11) 2024-2031.

Kannan J, Suganya K, Balaji T and Mohamed Haroon AR (2011). Vermicomposting-Sustainable method of agricultural residue management. *Indian Journal of Environment and Ecoplanning* **18**(1) 99-103.

Kasthuri H, Shanthi K, Sivakumar S, Rajakumar S, Son HK and Song YC (2011). Influence of Municipal solid waste compost (MSWC) on the growth and yield of green gram (*Vigna radiata* (L) Wilczek), fenugreek (*Trigonella foenum-graecum* L.) and on soil quality. *Indian Journal of Environmental Health and Science, Engineering* **8**(2) 101-110.

Khush GS (2005). What it will take to feed 50 billion rice consumers in 2030. *Plant Molecular Biology* **59** 1-6.

Kittumath MS, Giraddi RS and Basavaraj S (2007). Nutrient changes during earthworm, *Endrilus eugeniae* (Kinberg) mediated vermicomposting of agro industrial wastes.

Kostecka J, Kaniczak J and Nowak M (1999). Some characteristics of vermicompost produced from domestic wastes. Fol. University of Agriculture Stetin 200, *Agriculture* **77** 173-178 (in Polish with English summary).

Kostecka J and Blazej J (2001). Growing plants on vermicompost as a way to produce high quality foods. *Bulletin of the Polish Academy of Sciences Biological Sciences* **48** 1-10.

Kushwaha AS and Gupta AB (1969). Effect of algal growth promoting substances of Phormidium foveolarum on seedlings of some varieties of wheat. *Hydrobiologia* **35**(2) 324-332.

Liang Y, Yang Y, Yang C, Shen Q, Zhou J and Yang L (2003). Soil enzymatic activity and growth of rice and barley as influenced by organic manure in an anthropogenic soil. *Geoderma* **115** 149-160.

Lohani S (2005). Potentiality of biogas generation non-dung based plant resource in Nepal. A case study submitted to Central Department of Environmental Science, Tribhuvan University, Kirtipur, Kathmandu, Nepal.

Mac Creedy MJ, Guggoly Sibires V and Ovens HS (1950). *Journal of Analytical Chemistry* **22**(9) 1156-1158.

Nayak P, Prasana R, Pabby A, Domnic TK and Singh PK (2004). Effect of urea, blue green algae and Azolla on nitrogen fixation and chlorophyll accumulation in soil under rice. *Biology and Fertility of Soils* **40** 67-72.

Padmavathiamma PK, Loretta Y and Usha Kumari RR (2008). An experimental study of vermibiowaste composting for agricultural soil improvement. *Bioresource Technology* **99** 1672-1681.

Paola C and Silva Ceppi (2008). Chemical, physical and biological compost and vermicompost characterization: A chemometric study. *Chemometrics and Intelligent Laboratory Systems* **90**(1) 64-71.

Rakshit A, Sarkar NC and Sen D (2008). Influence of organic manures on productivity of two varietes of rice. *Journal of Central European Agriculture.*

Satyanarayana V, Prasad PVV, Murthy VRK and Boote KJ (2002). Influence of integrated use of farmyard manure and inorganic fertilizers on yield and yield components of irrigated lowland rice. *Journal of Plant Nutrition* **25**(10) 2081-2090.

Singh B, Singh Y and Sekhon GS (1995). Fertilizer use efficiency and nitrate population of ground water in developing countries. *Journal of Contaminant Hydrology* **20** 167- 184.

Singh YV, Singh BV, Pabbi S and Singh PK (2007). Impact of Organic Farmingon yield and quality of basmathi rice and soil properties.9.Wissensschaftstagung Okologischer Landbau. Beitrag archiviert unter Available: http://orgprints.org/view/projects/w1ssenschafystagung-2007.html.

Suthar S (2007). Nutrients changes and biodynamic of epigeic earthworms *Perionys excavates* during recycling of some agricultural wastes. *Bioresources Technology* in press.

Uma B and Malathi M (2009). Vermicompost as a soil supplement to improve growth and yield of *Amaranthus* species. *Research Journal of Agriculture and Biological Sciences* **5**(6) 1054-1060.

Vasanthi D and Kumarasamy (1999). Efficacy of vermicompost to improve soil fertility and rice yield. *Journal Indian Society of Soil Sciences* **42**(2) 268-272.

Wile I and Neil J (1975). Harvesting and potential uses of aquatic plants. 50th Anniversary Meeting A.S.A.E. Cornell University, Ithaca, N.Y.

Wile I and Neil J, Lumis G and Pos J (1978). Production and utilization of aquatic plant compost. *Journal of Aquatic Plant Management* **16** 24-24.

Wong JMC, Fang GX and Wong MH (1997). Feasibility of using ash residues composting materials for sewage sludge. *Environmental Technology* **18** 563-568.

Zar JH (1996). *Biostatistical Analysis,* 3rd edition. Prentice Hall International, U.S.A.