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WATER HYACINTH AS A GREEN MANURE FOR ORGANIC FARMING

SHARDA VIDYA & LAKSHMI GIRISH

Department of Botany, Smt. C.H.M. College, Ulhasnagar, Maharashtra, India

ABSTRACT

Eichhornia crassipes (Mart.) Solms is a noxious aquatic weed that pollutes all fresh water bodies. To check its vigorous growth, control measures are required. One such method is its use as composting material. The wheat crop (*Triticum vulgare)* was treated by using compost derived from *Eichhornia crassipes*. The wheat plant was allowed to grow for fifteen days and the effect was studied by comparing with control. The physical parameters of crop were percentage germination, length of shoot, length of root, root: shoot ratio and biomass content. The chemical parameters studied were chlorophyll content, protein content and reducing sugar content. The soil analysis was also done to study the changes in the physical and chemical parameters of soil. The physical and chemical parameters of soil were pH, moisture content and organic matter content. The results revealed that all parameters had higher values as compared to control in case of wheat plants as well as soil. The results signify the use of *Eichhornia crassipes* (Mart.) Solms as the organic manure.

KEYWORDS: *Triticum vulgare, Eichhornia crassipes,* Manure, Water Hyacinth

INTRODUCTION

Eichhornia crassipes (Mart.) Solms. known as water hyacinth is a free-floating perennial hydrophyte belonging to the family Pontederiaceae. The leaves are broad, thick, glossy, and ovate and float above the water surface. They have long, spongy and bulbous stalks. The feathery, freely hanging roots are purple-black. It is one of the most productive plants on the earth and is considered the world's worst aquatic weed (Grodowitz, 1998). It tolerates annual temperatures ranging from 21.1°C to 27.2°C and its pH tolerance is estimated at 5.0 to 7.5. The 'beautiful blue devil' water hyacinth, grows rapidly as a dense green mat over stagnant water bodies such as lakes, streams, ponds, waterways, ditches and backwaters and is recognized by its lavender flowers and shinning bright leaves.

The plant is euryhaline, tolerating both fresh and marine water; hence it spreads at an alarming rate (Lata & Veenapani, 2011). The weed is known as *Jal khumbe* in Hindi, *Pisachitha tamara* in Telugu, *Akasa* or *Vengaya tamarai* in Tamil and as *Kola vazha* in Malayalam. The so called "menace and nuisance" has tremendous potentiality of high rates of vegetative growth (Penfound and Earle, 1948). According to Maine *et al,* (1999) and U. S. EPA (1988), this macrophyte is one of the most invasive aquatic weeds in the world causing a serious hindrance to nation's development activities. The plant is now considered as a serious threat to biodiversity. The environmental hazards associated with these plants are degraded water quality and drastic changes in the plant and animal community, light and oxygen diffusion are severely curtailed reduction in water movement etc. (Gopal, 1987).

Other environmental hazards includes clogging of irrigation, hydropower and water supply ways, hindrance of water transport, blockage of canals and rivers causing flooding. Despite all the problems created by *Eichhornia crassipes* (Mart.) Solms., some positive aspects have been reported. Gopal (1987) reported that it contains 64% methane and can be

used for biogas generation and for water purification. It is also valuable in traditional medicine, biogas production, mushroom bedding material, carbon black production, making of ropes, production of fibre boards, as animal fodders and fish feed, green manure, compost, and as an ornamental plant.

Fertilizer is any organic or inorganic material of natural or synthetic origin (other than liming materials) that is added to a soil to supply one or more plant nutrients essential to the growth of plants. One largely overlooked resource available for soil fertility remediation is the use of non-traditional organic materials such as weeds. The use of decayed tissues of unwanted plants to provide nutrients for crops is a crude but effective way of exploiting weeds and is a simpler technique than any of the other alternatives. According to Beckman (1973), the use of manure application enhances soil productivity, increases the soil organic carbon content, soil micro-organisms, improves soil crumb structure, the nutrient status of the soil and enhances crop yield. Organic manure is also very cheap and effective as a good source of nitrogen for sustainable crop production, but its availability remains an important issue due to its bulky nature, while inorganic fertilizer is no longer within the reach of poor-resource farmers due to its high cost.

For centuries the use of organic fertilizers has been synonymous with successful and stable agriculture. In recent years an increasing number of health-conscious consumers prefer for foodstuffs grown on soils to which only natural organic materials have been added. Farmers and gardeners who practice what is now known as organic gardening are meeting the demand for these foods (Steffen, 1979). The response of soil to organic fertilizer application depends on many factors, including type and composition, application level and method, soil properties and climatic conditions (Abdel-Sabar and Ebo El-Seoud, 1996). Research results have shown that the use of organic materials can significantly improve the physical, chemical and microbial characteristics of cultivated soil and increase crop production (Steffen, 1979; Darmody *et al*., 1983; Pera *et al*., 1983). *Eichhornia crassipes* (Mart.) Solms. produces pathogen free rich compost which increases soil fertility, thereby improves the fertility of soil. The benefit of using either crop residues such as water hyacinth residues has been reported by Widjajanto *et al.* (2001, 2002).

Green manuring is an effective contributor to soil organic matter build-up. Availability of green manure N largely depends on quantity and quality of green manure, the time it is turned under and soil properties. During the first year of turning, about 40-45% of organic N in green manures may be expected to become available for plant nutrition (Greenland, 1994). The potential productivity of water hyacinth in nutrient enriched waters has led to its selection as a biomass source for organic fertilizers (Moorhead and Nordstedt, 1993). This obnoxious water weed's high suitability for use as organic fertilizer may be attributed to its low and narrow margin carbon: nitrogen ratio (C:N) of 1:24.3 with a lignin content of only 9% compared with C: N ratio of 1:80 and lignin content of 17% in wheat straw (Mallik *et al*., 1990). Branch roots in water hyacinth can absorb plant nutrients and keep them into its trunks and leaves.

Compost consists of high organic matter, so it can improve physical properties of soil. It also improves soil structure, ventilates the soil and makes it easy for water percolating through soil. Chemical properties of water hyacinth in compost are to add nutrients to soil. It gradually emits nutrients useful to plants in long period. It also resists acid and alkaline in soil and adds food source for microbe. As a result, there is a large amount of microbe and microbial activity. In conclusion, Water Hyacinth can be brought to make compost, mulching and to clean the sewage. It is a good way to change waste products into useful things.

CHEMISTRY OF WATER HYACINTH: (JAFARI, 2010)

- Fresh plant contains 95.5% moisture, 0.04% N, 1.0% ash, 0.06% P2O5, 0.20% K2O, 3.5% organic matter.
- On a zero-moisture basis, it is 75.8% organic matter, 1.5% N, and 24.2% ash.
- The ash contains 28.7% K_2O, 1.8% Na_2O, 12.8% CaO, 21.0% Cl, and 7.0% P_2O_5.
- The CP contains, per 100 g, 0.72 g methionine, 4.72 g phenylalanine, 4.32 g threonine, 5.34 g lysine, 4.32 g isoleucine, 0.27 g valine, and 7.2 g leucine
- Water hyacinth roots naturally absorb pollutants, including such toxic chemicals as lead, mercury, and strontium 90 (as well as some organic compounds believed to be carcinogenic) in concentrations 10,000 times that in the surrounding water.

WATER HYACINTH AS GREEN MANURE

- Water hyacinth can be used on the land either as a green manure or as compost.
- As a green manure it can be either ploughed into the ground or used as mulch.
- The plant is ideal for composting.
- After removing the plant from the water it can be left to dry for a few days before being mixed with ash, soil and some animal manure.
- Microbial decomposition breaks down the fats, lipids, proteins, sugars and starches.
- The mixture can be left in piles to compost, the warmer climate of tropical countries accelerating the process and producing rich pathogen free compost which can be applied directly to the soil.
- The compost increases soil fertility and crop yield and generally improves the quality of the soil.
- In developing countries where mineral fertilizer is expensive, it is an elegant solution to the problem of water hyacinth proliferation and also poor soil quality.
- It contains many trace elements, seldom found in synthetic fertilizers, so it helps plants to be more disease resistant.
- The nutrients are in the compost are not leached out by rain-water and all available to the plants.

The objective of this study was to determine the overall growth parameters and yield responses of wheat to water hyacinth manure. In the present study, water hyacinth manure was added as an additional substrate material for organic fertilizer to determine the effect of water hyacinth on the growth of plants and to determine further if it will be cheaper and soil friendly.

MATERIAL AND METHODS

Classification

Division: Spermatophyta

Sub – Division: Angiospermae

Class: Monocotyledonae

Series: Coronariae

Family: Pontederiaceae

Genus: Eichhornia

Species: *E. crassipes* (Mart.) Solms.

Collection and Preparation of Water Hyacinth Manure

Eichhornia crasssipes (Mart) Solms. was collected from the water garden of Smt. C. H. M. College campus in the month of July-August, 2012. About 3 kg of the plant material was cut into small pieces and composted in soil for forty five days under shade. Water was sprinkled after every layer in order to maintain moisture content. The manure was mixed with soil and used for treatment studies.

Manure Treatment

Twenty plastic pots of equal sizes were taken and were divided equally for control as well as experimental sets. The water hyacinth manure was mixed with garden soil (1:1 ratio) and filled in the pots. Fifty wheat seeds were sown in these pots and were allowed to germinate for fifteen days. A control set without manure was also maintained along with for the equal duration. The experiment was conducted in triplicate and average values were recorded.

Analysis of the Plant and Soil

The preliminary parameters studied were percentage germination, root length, shoot length, root-shoot ratio, fresh weight, dry weight of the seedlings. The physiological parameters analyzed were chlorophyll content, reducing sugar and protein content of leaves according to standard protocol of Arnon (1949), Folin and Wu (1927) and Lowry *et al*, (1950). Soil analysis was done for the parameters of pH, moisture content and organic matter content (Walkley & Black, 1934).

RESULTS AND DISCUSSIONS

Experimental Design and Treatments

Figure 1: Water Hyacinth Compost

The present study revealed that the application of water hyacinth manure had significant influence on the growth attributes and yield of the wheat plant when compared to control. There was a significant increase in the percentage of germination, fresh weight, dry weight, biomass, root and shoot length when compared to control. (Table 1). All parameters had higher values as compared to control in case of wheat plants as well as soil. (Table 1, 2 & 3).

Table 1: Physical Parameters of Wheat Plant

Sr. No	Sample Pot	% Germination	Fresh Wt. (gm)	Dry. Wt. (gm)	Biomass	Shoot Length (cm)	Root Length (cm)	Root/Shoot Ratio (cm)
1	Expt.	44/50	13.85	1.24	12.59	15.99	14.75	0.922
2	Control	18/50	4.65	0.533	4.12	13.58	10.83	0.797

The chemical parameters like chlorophyll a, protein content and reducing sugar also recorded higher values compared to control (Table 2).

Table 2: Physiological Parameters of Wheat Plant

	Chl. A Content Mg/G	Protein Content Mg/G	Reducing Sugar Mg/G (420nm)
Experiment	11.149	0.313	0.72
Control	10.103	0.274	0.38

Table 3: Physicochemical Parameters of Soil

	pH	Moisture Content (%)	Organic Matter (%)
Experiment	6.5	57.31	23.2
Control	4.5	52.04	21.4

The study of water hyacinth as biofertilizer revealed that the incorporation of water hyacinth into soil crop system increased the performance of the wheat plant. Majid (1983) have reported enhancement in yield/plant in rice, corn, sesame, brinjal, onion and gourd, using water hyacinth compost. Majid *et al.* (1980) & Majid (1992), reported the increased yield in above plants with both compost as well as manure of water hyacinth used in combination with other aquatic weeds. Our results are in agreement with previous findings. Gunnarsson & Petersen (2006) also highlighted that using composted water hyacinth material could serve as quality manure for improving soil fertility conditions and thus crop yields on the whole. Enhanced affects of water hyacinth have been reported by Kayum *et al.* (2008) on productivity of tomato and Amitava *et al,* (2008) on rice. Chukwuka & Omotayo (2008 & 2009), indicated the soil fertility potential of water hyacinth

compost and revealed its enhanced affect on productivity of *Zea mays* crop. With this result it can be suggested that, by the addition of water hyacinth manure into cultivation which affected the performance of test plant may be probably due to the increase of nitrogen availability released from water hyacinth during the process of mineralization. This is in agreement with Contantinides & Fownes (1994) who mentioned that quality and quantity of added organic materials into soil may influence the decomposition rate and mineralization process. The same phenomenon was also reported by Widjajanto *et al.* (2001). The differences in the growth attributes of wheat seedlings after the addition of water hyacinth manure may be due to the physical and biochemical properties of the soil as has been reported by Lata & Veenapani (2011).

CONCLUSIONS

The aquatic weed water hyacinth (Eichhornia crassipes (Mart.) Solms.), besides being a nuisance in nutrient-enriched public water bodies, is a low-cost alternative source of organic fertilizer in plentiful supply (Murugesan *et al*., 1994). The weed is a good absorber of nitrogen, phosphorus and potassium from water and can be used as a good source of compost material. The possible ways of combating its proliferation and the various methods of eradicating this “weed” not proved much. Hence the present investigation aims towards the exploration of “best out of waste”. Thus its utilization may become a way of its management. The results also signify the use of *Eichhornia crassipes* as the organic manure.

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