UTILIZATION OF EICHHORNIA CRASSIPES IN SUSTAINABLE AGRICULTURE PRACTICES

Dissertation submitted in partial fulfilment of the requirements for the award of the degree of Bachelor of Science in

BOTANY

By

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ERNAKULAM

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CERTIFICATE

This is to certify that the dissertation entitled " Utilization of *Eichhornia crassipes* in sustainable agriculture practices" is an authentic work carried out by Roshni P V (AB20BOT033) under my supervision and guidance in the Department of Botany, Teresa's College (Autonomous), Ernakulum, in partial fulfilment of the requirements for the award of the Degree of Bachelor of Science in Botany. I further certify that no part of this work embodied in the project has been submitted for the award of any degree or diploma.

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DECLARATION

I ,Roshni P V hereby declare that the project entitled " UTILIZATION OF *EICHORINA CRASSIPES* IN SUSTAINABLE AGRICULTURE PRACTICES" submitted to Mahatma Gandhi University, Kottayam, in partial fulfilment of the requirement for the Degree of Master of Science in Botany is an original project done by us under the supervision and guidance of Dr.Arya P Mohan, Assistant Professor ,Department of Botany and Centre for Research, St. Teresa's college(Autonomous) Ernakulam and no part of it has previously formed the basis for the award of any degree , diploma or associateship in any institution.

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Place :ERNAKULAM

Date : 18/03/2024

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INTRODUCTION

Systematic position

Domain: Eukaryota
Kingdom: Plantae
Phylum: Spermatophyta
Subphylum: Angiospermae
Class: Monocotyledonae
Order: Pontederiales
Family: Pontederiaceae
Genus: Eichhornia
Species: *Eichhornia crassipes*

Eichhornia crassipes, commonly called water hyacinths, is a polyphyletic genus of the aquatic flowering plants family Pontederiaceae. It is a tropical floating aquatic plant with spikes of large blue flowers and is considered one of the most troublesome aquatic weeds in the world. This invasive plant can grow up to six feet deep in some areas, making it difficult for fishermen to navigate the lake. It can grow in all types of freshwater environments.

The most favourable conditions for its growth include: Stagnant water, shallow water depth (less than 6 meters), surface sediments rich in organic matter, and nutrients like nitrogen and phosphorous, water hyacinth's minimum growth temperature is 12°C, and its optimum growth temperature is 25–30°C. Its habitat ranges from tropical deserts to subtropical or warm, temperate deserts to rainforest zones. The temperature tolerance of the water hyacinth: Its minimum growth temperature is 12 °C. Its optimum growth temperature is 25–30 °C. Its maximum growth temperature is 33–35 °C. Its pH tolerance is estimated at 5.0–7.5. Leaves are killed by frost and plants do not tolerate water temperatures more than 34 °C (93 °F). Water hyacinths do not grow where the average salinity is greater than 15% of that is seawater (around 5 g salt per kg). In brackish water, its leaves show epinasty and chlorosis and eventually die. Rafts of harvested water hyacinth have been floated to the sea, which kills it.

Water hyacinth, the devastating weed that grows in water bodies either naturally or as a result of human interference, is considered a threat to the environment due to its negative effects on aquatic ecosystems. To alleviate its negative impact utilization of those become a better means in recent decades. As such, water hyacinth is known to have the potential to be utilized as a nutrient source via composting, almost all types of composting techniques are applicable in the preparation of compost from water hyacinth. Being an organic source, water hyacinth helps build up soil organic matter and, in turn, plays a vital role in the enrichment of the soil's physical, chemical, and biological properties. Aggregation of soil particles, porosity, density, water holding capacity, nutrient availability, cation exchange capacity, pH, soil, and microorganisms are the soil properties reported to improve with water hyacinth compost application. Moreover, water hyacinth compost seems to be far better than animal manure in the improvement of soil properties. As a result, water hyacinth compost shows a magnificent effect on plant agronomic growth parameters such as germination percentage, number of leaves, leaf area index, plant height, length of shoot and root, root: shoot ratio, biomass content, and yield parameters. However, utilization of water hyacinth has a few challenges like difficulties in harvesting, chance for heavy metal accumulation, hardness during decomposition, and less awareness. Properly managed water hyacinth compost would serve as an alternative for inorganic nutrient sources in the future thus indirectly the threat caused by this aquatic weed on the environment would become minimal.

Compost Production:

Composting remains among the most efficient methods of producing biofertilisers from water hyacinths. The presence of inorganic compounds such as nitrogen (N) and phosphorus (P) in the plant's roots makes it an appropriate raw material for inorganic fertilizers and compost manufacture. Composting can also help to largely reduce the application of chemical fertilizers on agricultural fields, thus providing an

eco-friendly agricultural approach. Compost made
shown to make better quality compost than compost
hyacinth and manure which suggests that compost
an alternative to peat in substrates for nurseries
therefore, could be a way of preventing secondary
hyacinth, cocopeat, and soil in the ratio 6 : 3 : 1 in In
(N, P, Na, K, and Ca) tested and improved comp
hyacinth is a good raw material for compost produc

OBJECTIVES

- Explore the feasibility of utilizing *Eichhornia crassipes* as a sustainable potting media.
- Investigate the growth performance and health of selected plants using *Eichhornia crassipes* as a potting mixture.
- To understand which ratio of the *Eichhornia crassipes* shows the best result.
- Develop and implement an effective bioremediation strategy to mitigate the impact of *Eichhornia crassipes* on aquatic ecosystems.
- Providing a practical and environmentally conscious solution for utilizing abandoned water bottles.

REVIEW OF LITERATURE

The efficiency of Eichhornia crassipes in the removal of organic and inorganic pollutants from wastewater Saurabh Mishra, Abhijit Maiticonducted,Phytoremediation using water hyacinth is found to be an effective biological wastewater treatment method. Water hyacinth (Eichhornia crassipes), a notorious weed, being the most promising plant for removal of contaminants from wastewater is studied extensively in this regard. It has been successfully used toaccumulate heavy metals, dyes, radionuclides, and other organic and inorganic contaminants from water at laboratory, pilot, and large scale. The plant materials are also being used as sorbent to separate the contaminant from water.

Ecological and socio-economic utilization of water hyacinth (Eichhornia crassipes Mart Solms)Water hyacinth is used to treat waste water from dairies, tanneries, sugar factories, pulp and paper industries, palm oil mills, distilleries, etc. All the efforts of scientists and technocrats all over the world to eliminate these weeds by chemical and biological means have met with little success. The water hyacinth have been found to have potential for use as phytoremediation, paper, organic fertilizer, biogas production, human food, fiber, animal fodder

A small-scale study on removal of heavy metals from contaminated water using water hyacinth .This research focused on the use of water hyacinth to treat wastewater from heavy metals. Water hyacinths can grow in sewage, absorbing and digesting contaminants and transforming sewage effluents into comparatively clean water in the process. As a result, the plants have the potential to be used as natural water purification systems at a fraction of the cost of a standard sewage treatment facility. The experiment was performed using healthy, young, and acclimatized water hyacinths. Containment water with a cadmium concentration of 0.5 mg/L, arsenic concentration of 0.5 mg/L, lead concentration of 2 mg/L, zinc concentration of 5 mg/L, and copper concentration of 5 mg/L was added to five differentpolyethylene pots with 100 g of water hyacinth in each pot. After 30 days, the removal efficiency for heavy metals (Cd, As, Pb, Zn, and Cu) reached 59–92%, and the results were within the permitted limits according to the National Technical.Regulation on Industrial Wastewater in Vietnam. Based on this information, it is possible to deduce that water hyacinth can be utilized to remove cadmium, arsenic, lead, zinc, and copper from industrial wastewater effluents efficiently.

Extraction, Purification and Characterization of Nanocrystalline Cellulose from Eichhornia crassipes (Mart.) Solms: A Common Aquatic Weed Water Hyacinth nanocrystalline cellulose was extracted from Eichhorniacrassipes (Mart.) Solms through a series of processes viz., alkalization, bleaching, acid hydrolysis and sonication. After the chemical process, the obtained product at each stage was characterized to analyze the morphology, chemical characteristics and the thermal property. FTIR analysis reports the peaks at 1030 cm−1, 1055 cm−1 and 3000–2800 cm−1, which refer to C–O–C stretching vibration and C–H symmetric stretching validating the extracted cellulose and the efficacy of the process. The onset of degradation for raw water hyacinth and extracted cellulose occurs at 253.4°C and 226.9°C in thermogravimetric analysis. The particle size analysis analysis for sonicated sample shows that 93.02 nm proved that the sonicated sample is in nano size. In scanning electronmicroscopy, the morphology changes of each step processed water hyacinth and extracted cellulose have been studied.

Potential of Water Hyacinth (Eichhornia crassipes) as Compostand its Effect on Soil and Plant Properties:

Water hyacinth, the devastating weed grows in water bodies either naturally or as a result of human interference, is considered asthreat to environment due to its negative effects on aquatic ecosystems. To alleviate its negative impact utilization of those become asbetter mean in recent decades. As such, water hyacinth is known to has potential to be utilized as nutrient source via composting, allmost all types of composting techniques are applicable in preparation ofcompost from water hyacinth. Being an organic source, waterhyacinth helps build up soil organic matter, in turn play vital role in the enrichment of the soil physical, chemical and biologicalproperties.

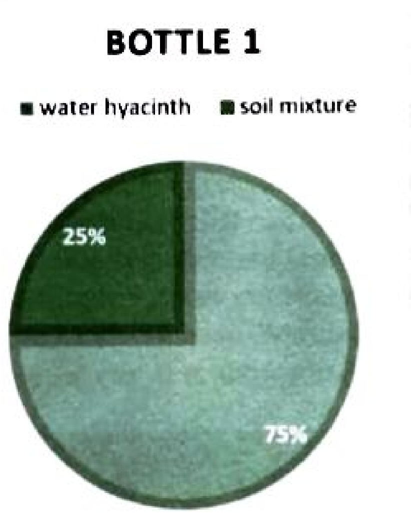
Aggregation of soil particles, porosity, density, water holding capacity, nutrient availability, cation exchange capacity, pH,soil microorganism are the soil properties reported to improve with water hyacinth compost application. Moreover, water hyacinthcompost seems to be far better than the animal manures in improvement of soil properties. As a result,water hyacinth compost showsmagnificent effect of plant agronomic growth parameters such as germination percentage, number of leaves, leaf area index, plantheight, length of shoot and root, root: shoot ratio, biomass content as well as yield parameters. However, utilization of water hyacinthhas few challenges like difficulties in harvesting.chance for heavy metal accumulation, hardness during decomposition, less awareness.Properly managed water hyacinth compost would serve as an alternative for inorganic nutrient sources in future thus indirectly the threat caused by this aquatic weed on environmental would become minimum. Compost, Growth attributes, Organic matter, Soil properties, Water hyacinth.Water hyacinth is a free-floating perennial aquatic weednative to tropical and sub- tropical South America. Even it is originated in the Amazon Basin andhas now spread to over 80 countries . It isabundantly present in almost all types of wetlands vary fromsmall fish ponds to big riverine lakes. Water hyacinth has been recognized as the most harmful aquatic weed in theworld due to its negative effects on people's livelihoods andwetland ecosystems. Water hyacinthdramatically impacts water flow, blocks sunlight fromreaching native aquatic plants and starves the water ofoxygen, often smother aquatic life by deoxygenating thewater and it reduces nutrients for young fish in shelteredbays.Water hyacinth also interfereswith water treatment, irrigation and water supply . The plants also create a prime habitat formosquitos and a species of snail, classically causesdiseases. It has blocked supply intakes for the hydroelectricplant, interrupting electrical power for entire cities. The weedalso interrupts local subsistence fishing,blocking access to the beaches. Therefore, the control of this devastating weedreceives attention and many efforts have been made tocontrol these weeds through chemical, physical andbiological methods. However, control of the weed has metwith little success , in turn a need foran alternative mean of its control arouse. So that, ratherthan destruction make them useful was sought as bettermean of control.Since water hyacinth is being an organic manure, itseffects in combating soil quality issues is well addressed.Water hyacinth helps to combat organic matter decline andsoil erosion . Hence, waterhyacinth is well known for its potential as nutrient replenishereither as green manure or compost. Water hyacinth isincreasingly being used as a nutrient supplier as compostedmaterial . From the literature, it is clear thatwater hyacinth has potential to prepare compost by meansof almost all the composting techniques and serve as a meanin soil fertility improvement. Composting of biodegradablewater hyacinth puts back the nutrients into the soil throughrecycling them and helps to optimize nutrient management.Bacteria, actinomycetes, streptomycetes and fungi areamong the mesophilic, thermo-tolerant microorganisms.

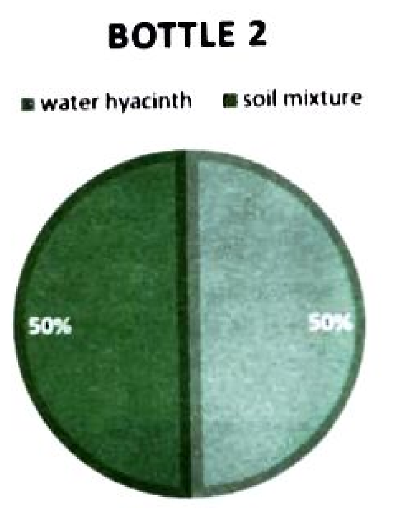
MATERIALS AND METHODS

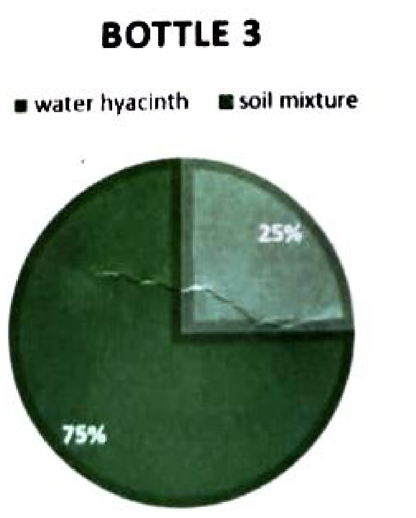
Potting mixture and pots

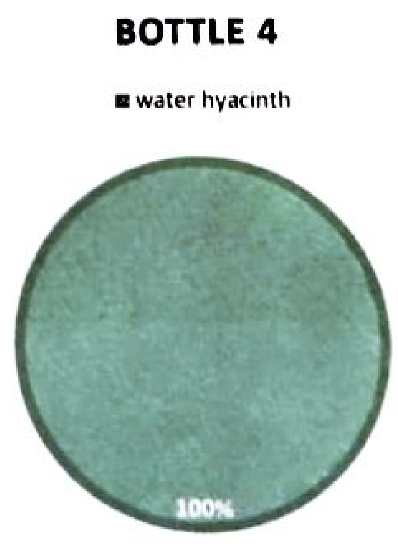
- Dried water hyacinth mixed with cocopeat and soil to make potting mixture.
- Four plastic bottles are prepared for each plant through this , the plastic bottles are not wasted and reusing it.

The proportion of water hyacinth and soil mixture in each bottles









Types of plants selected for study:

For this experiment we have selected two different types of plants, which were selected due to its easily availability.

The two different plants are:

Solanum melongea

Solanum melongea also known as eggplant belongs to the family Solanaceae. It is a herb up to 1.5m tall. Simple leaves with hairs and are ovate to ovate oblong in shape. Leaf margin is sinuately lobed, winding in and out like a repeating s-shaped pattern. Brinjal plant was bought from Krishi Bhavan which were only 2 weeks old. Initially it was 7.5 cm long and it had four leaves. It is shown in image (A).

Solanum lycopersicum

Solanum lycopersicum commonly known as tomato plant. It belongs to the family Solanaceae. It is a herb that can either be erect or trailing, growing up to 2m in height. The plant is usually pubescent with glandular hairs which cause the plant to feel sticky upon touch. Leaves are alternate, pinnately compound. Tomato plant was bought from Krishi Bhavan which were only 2 weeks old. Initially it was 8 cm long and had four leaves. It is shown in image (B).

A

B

Image 1 – Two weeks old Brinjal (in image A) and Tomato (in image B) respectively.

COLLECTION OF RAW MATERIALS

Bottles for planting the seedlings

Water hyacinth

Collected water hyacinth

Dried water hyacinth

Dried water hyacinth

Preparation of potting

Making holes in the bottles

Filling the bottles with soil mixture

Planting the saplings

Cover with soil mixture

Planted Solanum melongena

Planted Solanum lycopersicum

OBSERVATION AND RESULTS

A comparative analysis of the growth patterns of *Solanum melongea* (Brinjal) and *Solanum lycopersicum* (Tomato) over a six-week period was conducted, with a total of eight plants planted for each species. These plants were distributed across four bottles, with two plants of each species in each bottle, featuring varying ratios of Eichornia crassipes.

Below are the observations:

Growth patterns of *Solanum melongea* (Brinjal) over six weeks:

WEEK 1

		BOTTLE 1	BOTTLE 2	BOTTLE 3	BOTTLE 4
SET 1	Height of the plant (in cm)	7.5	7	6.5	7
	No.of leaves	4	3	3	4
SET 2	Height of the plant (in cm)	7	7.5	7.5	6.5
	No.of leaves	4	3	3	4

WEEK 2

		BOTTLE 1	BOTTLE 2	BOTTLE 3	BOTTLE 4
SET 1	Height of the plant (in cm)	9	8.5	7.5	7.5
	No.of leaves	5	4	4	4
SET 2	Height of the plant (in cm)	8.5	9	8	7
	No.of leaves	5	5	4	4

WEEK 3

		BOTTLE 1	BOTTLE 2	BOTTLE 3	BOTTLE 4
SET 1	Height of the plant (in cm)	12.5	10.5	10	9.5
	No.of leaves	7	6	6	5
SET 2	Height of the plant (in cm)	11.5	11	10.5	9
	No.of leaves	6	7	6	5

WEEK 4

		BOTTLE 1	BOTTLE 2	BOTTLE 3	BOTTLE 4
SET 1	Height of the plant (in cm)	16.5	13.5	14	12
	No.of leaves	10	9	9	7
SET 2	Height of the plant (in cm)	16	13	13	12
	No.of leaves	9	9	8	7

WEEK 5

		BOTTLE 1	BOTTLE 2	BOTTLE 3	BOTTLE 4
SET 1	Height of the plant (in cm)	20	16.5	16.5	13.5
	No.of leaves	13	11	10	8
SET 2	Height of the plant (in cm)	19	16	15	12
	No.of leaves	13	11	9	7

		BOTTLE 1	BOTTLE 2	BOTTLE 3	BOTTLE 4
SET 1	Height of the plant (in cm)	25.5	19	17.5	13.5
	No.of leaves	16	13	11	8
SET 2	Height of the plant (in cm)	25	18	16	12
	No.of leaves	15	12	10	7

- Small buds are seen in bottle 1.
- New healthy leaves are appeared.

Week 5:

- Fruit bearing began in plants of bottle 2 and 3.
- Growth continued steadily except the plants in bottle 4.

Week 6:

- Continued appearance of new healthy leaves.
- Fruits are started to growing.
- The plants in bottle 4 shows stunted growth.

Solanum melongea demonstrated remarkable resilience throughout the experiment, overcoming initial setbacks to thrive and reach peak growth in the later weeks. This highlights its ability to adapt and succeed under varying conditions.

Growth patterns of *Solanum lycopersicum* (Tomato) over six weeks:

<u>WEEK 1</u>

		BOTTLE 1	BOTTLE 2	BOTTLE 3	BOTTLE 4
SET 1	Height of the plant (in cm)	10.5	12	15	17
	No.of leaves	10	11	20	11
SET 2	Height of the plant (in cm)	11	11	9	9
	No.of leaves	13	12	13	8

WEEK 4

		BOTTLE 1	BOTTLE 2	BOTTLE 3	BOTTLE 4
SET 1	Height of the plant (in cm)	17	18	19	-
	No.of leaves	21	20	24	-
SET 2	Height of the plant (in cm)	18	17	-	-
	No.of leaves	24	21	-	-

WEEK 5

		BOTTLE 1	BOTTLE 2	BOTTLE 3	BOTTLE 4
SET 1	Height of the plant (in cm)	20	20	20.5	-
	No.of leaves	25	23	26	-
SET 2	Height of the plant (in cm)	21	-	-	-
	No.of leaves	26	-	-	-

WEEK 2

		BOTTLE 1	BOTTLE 2	BOTTLE 3	BOTTLE 4
SET 1	Height of the plant (in cm)	12	15	16.5	-
	No.of leaves	13	15	22	-
SET 2	Height of the plant (in cm)	13.5	14	10	-
	No.of leaves	17	15	15	-

WEEK 3

		BOTTLE 1	BOTTLE 2	BOTTLE 3	BOTTLE 4
SET 1	Height of the plant (in cm)	14.5	17	17	-
	No.of leaves	18	17	24	-
SET 2	Height of the plant (in cm)	15	15.5	11.5	-
	No.of leaves	20	18	16	-

WEEK 6

		BOTTLE 1	BOTTLE 2	BOTTLE 3	BOTTLE 4
SET 1	Height of the plant (in cm)	23	22	21	-
	No.of leaves	29	25	28	-
	Height of the plant (in cm)	22.5	-	-	-
SET 2	No.of leaves	31	-	-	-

Week 1:

- 4 bottles are taken and each bottle is filled with different amount of eichornia.
- All plants have normal growth.

Week 2:

- Plant senescence is observed in both plants in 4th bottle.
- New leaves arise and normal growth observed in other 3 bottles.

Week 3:

- Plants present in bottle 1 shows rapid growth than other two bottles

Week 4:

- Plant senescence is observed in plant 2 of 3rd bottle.

Week 5:

- Plant senescence is observed in plant 2 of 2nd bottle.
- Small buds are seen in bottle 1 of 2nd plant.

Week 6:

- Bottle 1 Showed healthy growth and more than one flower.
- 1st plant of both bottle 1 and 2 shown slow growth of plant.
- More than 2 buds sceen in plant 1 and 2 of bottle 1.

Observations on the varying ratios of Eichornia crassipes in each bottle:

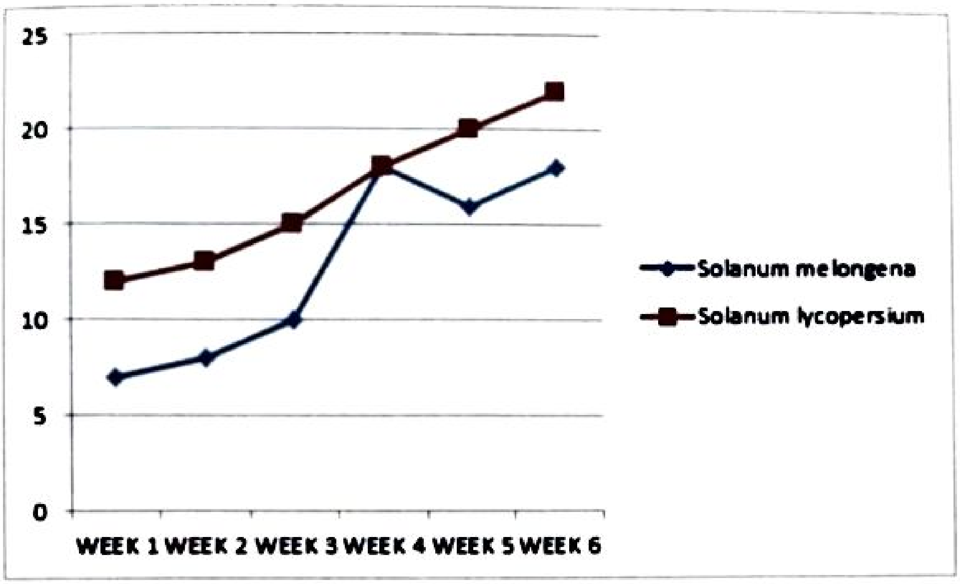
Bottle 1: The lowest concentration of Eichornia crassipes led to the best growth of both *Solanum melongea* and *Solanum lycopersicum*.

Bottle 2: Both vegetable brinjal and tomato shown slow growth of plant.

Bottle 3: Higher ratio of Eichornia crassipes led to slower growth of Solanum melongea and very poor growth of Solanum lycopersicum

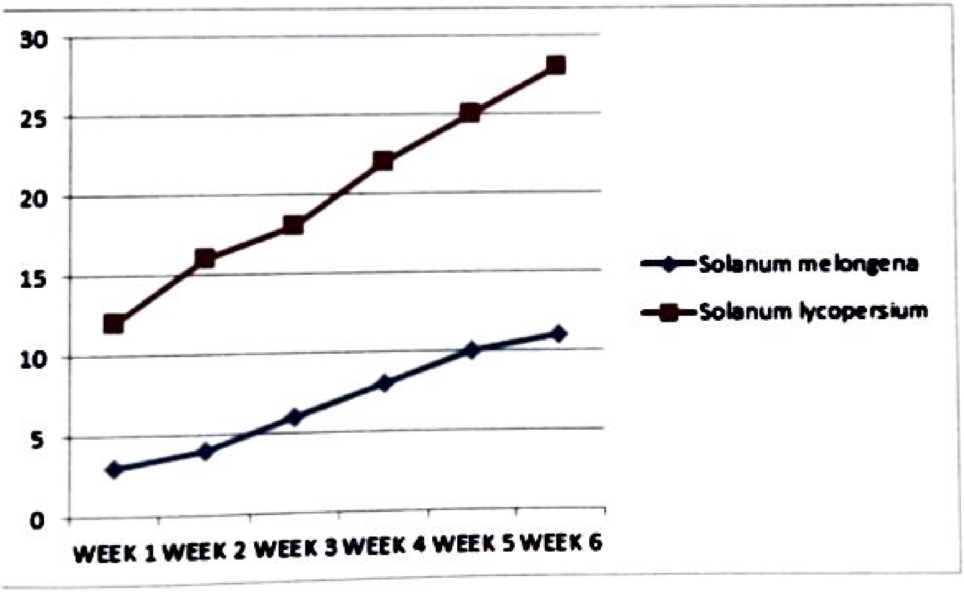
Bottle 4: Eichornia crassipes alone made no growth and both the plants died.

PLANT HEIGHT GROWTH RATE



A

PLANT LEAVES GROWTH RATE



B

Image A: The graphical representation of the height of the two plants species over six weeks.

Image B: The graphical representation of the no. of leaves of the two plants species over six weeks.

PLANT GROWTH IN BOTTLES

Solanum melongea

Solanum lycopersicum

DISCUSSION

Eichhornia crassipes, commonly known as water hyacinth, have been recognized as a troublesome and valuable resource in ecological management. In this project, we explore its potential as a nutrient-rich compost for enhancing soil fertility when mixed with coco peat and soil in various ratios, and planted in plastic bottles, thereby contributing to sustainable gardening practices.

To alleviate its negative impact utilization of those become a better means in recent decades. Despite all the problems created by Eichhornia crassipes (Mart.) Solms., some positive aspects have been reported. 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. As a fertilizer, 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 accelerates the process and produces 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. The organic manure gives far more better result than chemical fertilizer and it costs nothing, but only labor. Eichhornia crassipes (Mart.) Solms. produces pathogen free rich compost which increases soil fertility, thereby improves the fertility of soil. (Sahana et al.,2022).As such, water hyacinth is known to have the potential to be utilised as a nutrient source via composting, almost all types of composting techniques are applicable in the preparation of compost from water hyacinth. Being an organic source, water hyacinth helps build up soil organic matter and, in turn, plays a vital role in the enrichment of the soil's physical, chemical and biological properties. Aggregation of soil particles, porosity, density, water holding capacity, nutrient availability, cation exchange capacity, pH, and soil microorganisms are the soil properties reported to improve with water hyacinth compost application. Moreover, water hyacinth compost seems to be far better than animal manure in the improvement of soil properties. As a result, water hyacinth compost shows a magnificent effect on plant agronomic growth parameters such as germination percentage, number of leaves, leaf area index, plant height, length of shoot and root, root: shoot ratio, biomass content as well as yield parameters(Afreen et al., 2022).

The invasive water hyacinth (Eichhornia crassipes) poses a significant challenge to Sri Lanka's water bodies, leading to severe blockages in irrigation and fishing activities. Hence, this study explored composting as a solution to overcome this constraint. By blending water hyacinths with locally available resources such as cow dung, goat manure, Gliricidia sepium leaves, poultry manure, banana peel, and dry leaves, high-quality compost with a balanced C:N ratio was produced. A Completely Randomized Design (CRD) with three replicates was implemented across six treatments to form the compost piles. The treatments included T1: Dry leaves 8% + Goat manure 15% + Gliricidia 5% + Cow dung 20% + Water hyacinth 50% + Banana residue 2%, T2: Dry leaves 8% + Goat manure 15% + Gliricidia 5% + Water hyacinth 50% + Poultry manure 20% + Banana residue 2%, T3: Dry leaves 8% + Goat manure 15% + Gliricidia 5% + Cow dung 10% + Water hyacinth 50% + Poultry manure 10% + Banana residue 2%, T4: Dry leaves 8% + Goat manure 15% + Gliricidia 5% + Cow dung 15% + Water hyacinth 50% + Poultry manure 5% + Banana residue 2%, T5: Dry leaves 8% + Goat manure 15% + Gliricidia 5% + Cow dung 5% + Water hyacinth 50% + Poultry manure 15% + Banana residue 2%, T6: Dry leaves 8% + Goat manure 15% + Gliricidia 5% + Water hyacinth 50% + Banana residue 2%. Over a two-month composting period, analysis of physicochemical properties revealed variations in sand content (1.96% to 5.72%), moisture (60.67% to 64.67%), and electrical conductivity (0.23 mScm-1 to 0.51 mScm-1). Encouragingly, all compost types shared a consistent blackish-brown appearance and were odourless. Chemical properties pH (6.5-8.5), C (< 20%), total N (> 1%), C: N ratio (10-25), total P (> 0.5%), and total K (> 1%) spanned ranges, however, obtained the quality standards (SLS 1246:2003), showcasing the packaging solutions. Recycling plastic bottles as plant containers not only reduces plastic waste but also provides a low-cost and accessible option for urban gardening, especially in areas with limited space.

For the study Solanum melongea , typically used as a vegetable in cooking, it is a berry by botanical definition. As a member of the genus Solanum, it is related to the tomato, chili pepper, and potato, although those are of the New World while the eggplant is of the Old World. Like the tomato, its skin and seeds can be eaten, but, like the potato, it is usually eaten cooked. Eggplant is nutritionally low in macronutrient and micronutrient content, but the capability of the fruit to absorb oils and flavors into its flesh through cooking expands its use in the culinary arts .Solanum lycoperiscum is botanically a berry, a subset of fruit, the tomato is considered a vegetable for culinary purposes. It has a strong savoury umami flavour, rather than significant sweetness they are commonly used culinarily as a vegetable ingredient or side dish.The result obtained favoured a 50% ratio in which eichornia was mixed with soil and coco peat. Thus the attempt to grow Solanum melongea using organic compost i.e. eichomia along with soil and coco peat technique was significant. It yielded safe and nutrient-rich leafy vegetableseven during the off-season.

The use of solid organic fertilizer in closed agricultural production system must be combined with foliar application to improve fertilizing effectiveness. Nutrient contents in tissues of green biomass determine the quality of liquid organic fertilizer. Six potential green biomasses, *Tithonia diversifolia* (Hemsl.) A. Gray. Gliricidia sepium (Jacq.) Kunth ex Walp., *Leucaena leucocephala* (Lamk.) de Wit, Ageratum conyzoides L.. *Eichhornia crassipes* (Mart.) Solms, and banana corms were identified its nutrient contents. Samples were dried at 60 oC for 48 hours, grinded, analyzed for N, P, K, Ca-ex, Mg-ex, C, cellulose and lignin contents. Results indicated that T. diversifolia and A. conyzoides had the highest N content compared to other biomasses. A. conyzoides had the highest P content, followed by T. diversifolia. A. conyzoides had the highest K content, followed by G. sepium. The highest Ca-ex content was in L. leucocephala, followed by A. conyzoides. The highest Mg-ex content was found in A. conyzoides, followed by L. leucocephala. The highest C content was found in E.crassipes, followed

Water hyacinth is a naturalized aquatic weed native to tropical America and is one of the world's top ten harmful weeds, and it actively reproduces in eutrophic lakes and marshes.It has a high content of inorganic components such as nitrogen, phosphorus, and potassium. Due to its low carbon content, it can be used effectively as a green manure.The authors (2001) clarified the dynamics of nitrogen mineralized from water hyacinth applied as a green manure using the 15N method in a rice cultivation experiment. In rice cultivation in tropical and subtropical regions, we have shown that this weed can be used as a green manure without composting.In this study, we will clarify the effect of water hyacinth as a green manure, which has been observed in rice cultivation, in vegetable cultivation as well. Experiment: We used lettuce, spinach, komatsuna, radish, okra, edamame, and corn, and compared the yield in a pot test with water hyacinth application rates set at several levels.As a result, we found that the appropriate application rate for each type was Although the dosage was different, water hyacinth produced a remarkable yield increase effect for all vegetables.This means that water hyacinth can be used for vegetable cultivation in tropical and subtropical regions, although there are problems with harvesting and transportation. However, since lettuce and spinach, which have low nitrogen absorption capacity, require excessive nitrogen input in terms of nitrogen balance, there are concerns about the accumulation of soil nitrogen due to continuous use of water hyacinth, as well as okra and corn. It is necessary to consider the appropriate application amount in the future.(Didik et al.,2003)

Through achieving these objectives, this project aims to demonstrate the potential of repurposing abandoned water bottles as a sustainable and cost-effective alternative method. Furthermore, this approach can be implemented in various settings, including urban areas, where access to natural water bodies may be limited. By repurposing

plastic bottles for plant cultivation, communities can engage in sustainable practices while addressing local environmental challenges and reducing plastic pollution. It also analyses the economic viability of adopting recycled water bottles for transporting *Eichhornia crassipes*, considering factors such as material costs, labour requirements, transportation efficiency, and potential savings or benefits compared to conventional

The adoption of *Eichhornia crassipes* for farming is swiftly emerging as the preferred technique for cultivating diverse agricultural crops.Using *Eichhornia crassipes*, also known as water hyacinth, as a sustainable potting medium can have several positive impacts. Firstly, it's an abundant and fast-growing plant, making it readily available and cost-effective. Secondly, it absorbs excess nutrients like nitrogen and phosphorus from water .Lastly its biomass can be harvested and used for various purposes such as biofuel production or as a natural fertilizer or as sustainable potting medium contributing to sustainable resource management.

Using *Eichhornia crassipes* as a sustainable potting medium in urban areas, such as flats and apartments, offers numerous benefits. Its ability to thrive in various conditions makes it ideal for indoor gardening, providing greenery and improving air quality. Additionally, its rapid growth rate allows for continuous replenishment, reducing the need for frequent replacement of potting soil. *Eichhornia crassipes* also absorbs excess nutrients from water, aiding in wastewater treatment when used in hydroponic systems. Moreover, its dense root system helps prevent soil erosion and promotes soil health in confined urban spaces. Overall, incorporating *Eichhornia crassipes* as a potting medium in urban settings contributes to sustainable living practices and enhances the greenery and livability of indoor environments.

Eichhornia crassipes can be synthesized into nanoparticles can have several positive impacts. Firstly, it's an eco-friendly and sustainable approach, reducing the reliance on conventional chemical methods that may have harmful environmental effects. Secondly, the plant contains various bioactive compounds that can be used as reducing and stabilizing agents in nanoparticle synthesis, potentially enhancing the properties and applications of the nanoparticles. Additionally, this approach can provide economic opportunities for communities where water hyacinth is abundant, such as in developing countries, by turning a problematic invasive species into a valuable resource. Overall, using *Eichhornia crassipes* for nanoparticle synthesis aligns with the principles of green chemistry and sustainable development.

The experiment involves blending *Eichhornia crassipes* biomass with varying ratios of soil and coco peat to create potting mixtures tailored for different plant species. The experiment utilized four different ratios: 25%, 50%, 75%, and 100% of *Eichhornia crassipes* mixed with soil and coco peat. The plant used for the study was *Solanum melongena* and *Solanum lycoperiscum*. The choice of plastic bottles as pots provided a controlled environment for observation. Observations revealed notable differences in plant performance among the different ratios. The 25% and 50% mixtures demonstrated favourable growth, suggesting compatibility with the plant's requirements. However, the 75% and 100% mixtures exhibited limited growth and struggled to thrive, indicating potential challenges or imbalances in nutrient availability or soil structure. Throughout the experiment, meticulous records were maintained, documenting parameters such as the number of leaves and plant height. These data not only provided quantitative insights into the growth patterns but also facilitated the evaluation of the plant's overall health and vigour under each condition. The findings of this study contribute valuable insights into the cultivation practices of Eichornia crassipes, shedding light on the optimal soil compositions and ratios for promoting healthy growth. Furthermore, the use of recycled plastic bottles as pots highlights the potential for sustainable gardening practices and resource utilization.

REFERENCE

potential to produce top-notch compost locally. Data analysis utilised Minitab 17, applying ANOVA to evaluate treatment variances at $p = 0.05$. Post-ANOVA, Tukey's test discerned significant mean differences. The study identifies T3 as the superior composting treatment, achieving high-quality compost with significantly higher nutrient levels ($p<0.05$). It showcases composting as a viable strategy to convert the challenge of water hyacinth invasion into an agricultural benefit, simultaneously mitigating its environmental impact and producing valuable compost. This approach not only addresses the issue of invasive species but also advances sustainable agricultural practices by facilitating the creation of nutrient-rich compost, enhancing agricultural productivity. Suggestions for future studies include detailed analyses of heavy metal components and the long-term impacts of using such compost in agricultural settings, ensuring safe and productive use of water hyacinth compost.(Elilini et al.,2024)

Water hyacinth is rich in nutrients like nitrogen, phosphorus, and potassium, essential for plant growth. As it decomposes, it releases these nutrients into the soil, enhancing soil fertility and structure. This can lead to improved soil health and long-term productivity without the need for external inputs. Incorporating it into compost enhances soil fertility and improves plant health. The compost serves as a natural fertilizer, It has the potential to suppress weed growth when used as a mulch or incorporated into the soil. This natural weed-suppressing effect can reduce the need for herbicides and manual weed management, saving time and labour. Reducing the dependency on synthetic chemicals, thus promoting organic farming practices. Mixing water hyacinth compost with soil and coco peat creates a balanced growing medium. Soil provides stability and essential minerals, while coco peat improves soil structure, water retention, and aeration. This combination ensures optimal conditions for plant growth and root development. By testing various ratios of water hyacinth compost, soil, and coco peat, the project explores optimal combinations for plant growth. This experimental approach allows for observations on how different proportions affect plant health, yield, and overall sustainability.

by G. Sepium. T. diversifolia had the highest cellulose content, followed by E.crassipes. Lignin content of all biomasses was similar. Lastly, E.crassipes had the highest C/N compared to other biomass, and both T. diversifolia and A. conyzoides had the lowest C/N. It is concluded that A. conyzoides is the most promising green biomass for production of liquid organic fertilizer, followed by T. diversifolia and G. sepium.(Fahrurrozi et al .,2017). The benefits of this method include more efficient water and nutrient utilization, no use of pesticides and fertilizers, and improved yields and quality of produce. With the increasing demand for food and the growing concern over the safety and quality of our food supply, this cultivation method represents a sustainable and innovative solution to meet the needs of a growing population. For future studies, we intend to explore using *Eichhornia crassipes* as nanoparticle foliar spray for agricultural purposes, which presents a promising avenue for sustainable farming. By harnessing the natural properties of this plant, such as its ability to absorb nutrients and its antimicrobial effects, it could offer an eco-friendly alternative to chemical fertilizers and pesticides. Additionally, its potential to mitigate nutrient runoff could help address environmental concerns associated with conventional farming practices. Further research into its efficacy, safety, and scalability would be beneficial to fully understand its potential impact on agricultural sustainability.

CONCLUSION

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