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Effect of Different Organic Manures on Growth of Screw Vallisneria, *Vallisneria spiralis* Linne 1753

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Abstract: The aim of this study is to determine the role of different organic manures *viz*. raw cattle dung, poultry waste and vermicompost on the growth of *V. spiralis* in the container in open and shadow environmental condition. Experiment was conducted to study the role of different organic manures *viz.* cattle manure, poultry manure and vermicompost on the growth of *V. spiralis* in 100 g capacity pot for 28 days. All the manures were applied at the rate of two g pot^{-1}. Significant difference was not found among the treatments for water parameters, while significant difference was observed for nutrients of soil. Plastic pools manured with poultry and cattle manure did not show significant difference for final biomass, total length, number of leaf and runners of *V. spiralis*. It was concluded that the application of cattle manure with soil increase biomass, total length and produced good leaf quality of *V. spiralis.*

Key words: Organic manures · Water and soil chemistry · *V. spiralis*

INTRODUCTION

Aquatic plants refer to any organism living in water that photosynthesize and complete part or all of their life cycle in or near the water. Hundreds of fascinating and attractive plants are grown in aquaria for beauty and to maintain water quality. In addition, aquatic plants provide food, shed, shelter and breeding places to fishes [1, 2] and absorb many harmful nutrients and pollutants from water, as a buffer strip. They can significantly impact the assimilation of pollutants such as nitrogen and phosphorus from water by biological absorption or physicochemical adsorption [3, 4]. Submerged aquatic plants can increase the transparency of water through withholding suspended solids, thereby improving water quality of shallow lakes and ecosystem stability [4].

V. spiralis, a beautiful submerged aquatic plant with conspicuous transverse darker bands on leaves. Leaves are coiled and float horizontally beneath the water surface. Leaf colour ranges from light green in low light to various sheds of reddish to greenish brown in higher light intensities. The plant has runners to the base through which vegetative propagation takes place [5].

V. spiralis was used for maintaining the water quality and to support the ecosystem in the aquarium. Boyd [6] was among the earlier worker to demonstrate the potential of aquatic macrophytes in nutrient removal from the water. Bao [7] and Wang *et al*. [8] found that *V. spiralis* can remove the nutrients from static water and the growth of *Vallisneria* was affected by the level of nutrients and its environmental factors [9, 10].

The trade of ornamental plants in domestic and international market is increasing. The supply is mainly depend upon wild collection and may lead to ecological imbalance due to overexploitation. For the sustainable growth of the trade, it is necessary to intensify the culture techniques of native species.

Therefore, an attempt was made in the present study to grow *V. spiralis* by using locally available organic manures in open and shadow environmental conditions.

MATERIALS AND METHODS

Vallisneria *spiralis*: Aquatic freshwater plant *V. spiralis* was obtained from Local aquarium shop (Ratnagiri). The identification of plant was carried out by using the distinguishing characters given by Riemer [11] and Fassett [12].

Propagation: Plant was propagated by using the runners. The runners of *V. spiralis* were cut with scissor and planted in the pot containing the soil and sand mixture. The planted pot was kept in the plastic pool (650 L capacity) for future growth of the plants.

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Table 1: Chemical parameters of organic manures

Growth medium	Available nitrogen (%)	Available phosphorus (ppm)	Organic carbon (%)
Soil and sand mixture	2.30	2.45	0.37
Cattle manure	13.16	11.05	3.70
Poultry manure	38.96	197.50	0.60
Vermicompost	9.44	193.50	7.15

Soil texture-Sand: 40%, Silt: 26.67% and Clay: 33.33%

Runners: A horizontal branch arising from the base of a plant that consisting buds or nodes at its tip that produces new plants are called as runners or stolons, were obtained from wet laboratory, College of Fisheries, Shirgaon, Ratnagiri.

Growing Media: Cattle manure, poultry and vermi compost were used for preparing the growing media and their chemical analysis were carried out as per the method given in Table 1 [13].

Soil of laterite form available in college campus was used for the experiment.

Seven treatments such as control (T_0), cattle dung (T_1), poultry droppings (T_2), vermicompost (T_3), cattle dung + poultry droppings (1:1) (T_4), cattle dropping + vermicompost (1:1) (T_5) and poultry droppings + vermicompost (1:1) (T_6) were used as manures for growing *V. spiralis* for 28 days with four replicates.

Preparation of Potted Plant Material: The reusable plastic cups of 5.8 cm diameter (85 ml capacity) were filled with 40 g soil and sand mixture (3:2) to about 2 cm and 2.0 g dried manure was added, remaining space of pot was filled with 60.0 g of soil and sand mixture. These pots were used for planting runners of *Vallisneria spiralis*. The planted pots were placed in circular plastic pools of 1.2 m diameter and 0.6 m depth were filled with tap water to about 650 L and were weekly topped up with freshwater to maintain the water level.

Sampling: The Water parameters analyzed were pH, dissolved oxygen, carbon dioxide, hardness, ammonia-nitrogen, nitrate-nitrogen and nitrite-nitrogen, while soil was analyzed for pH, specific conductivity, available nitrogen, phosphorous and organic carbon at a weekly interval.

Statistical Analysis: Standard statistical method such as Completely Randomized Design (CRD) was used for conducting the experiments. Data obtained from the experiments was analyzed by one-way ANOVA [14, 15].

RESULTS AND DISCUSSION

The growth parameters of *V. spiralis* are given in Table 2. Maximum biomass, total length, number of leaf and runners were 946.82 ± 72.8580, 28.96 ± 6.9515, 87.50 ± 4.8391 and 23.75 ± 0.8539, respectively was observed in plant grown with cattle manure and 1026.46 ± 101.7953, 137.55 ± 22.6709, 88.50 ± 2.7538, 20.50 ± 1.1902 for plant grown with poultry manure, there was no significant difference between cattle and poultry manure. As poultry manure is not easily available and expensive, cattle manure is suggested as good manure for production of *V. spiralis*. Lower production in other treatments may be due to less quantity of nutrient availability. The growth of *V. spiralis* was less in vermin compost which may be due to its higher organic carbon content than essential available nitrogen, which may limit nutrient uptake by plant [16].

It was observed that maximum biomass, total length, number of leaf and runners were observed in the manures which contain high available nitrogen.

Water Parameters of the Different Treatments: Banerjee *et al.* [17] observed alkaline pH of water after fertilization with cow dung and poultry manure. Singh and Sharma [18] reported slightly higher range of water pH using poultry manure as compared to cow dung. Similarly, in this study, pH of water increased to become alkaline gradually in all the treatments and it was high in poultry manure(Table 3). *Elodea nuttallii* and blue green algae increases the pH by releasing OH-ions [19-21].

Table 2: Growth parameters of *V. spiralis* grown in different organic manures for 28 days

		Treatments						
Sr. No.	Growth Parameters	T_0	T_1	T_2	T_3	T_4	T_5	T_6
1	Number of Runners	5.00 ± 0.4082	23.75 ± 0.8539	20.50 ± 1.1902	16.25 ± 0.7500	14.00 ± 1.0801	15.00 ± 1.6833	16.50 ± 0.6455
2	Biomass (%)	404.18 ± 25.9802	946.82 ± 72.8580	1026.46 ± 101.7953	426.34 ± 31.0982	271.48 ± 103.0461	600.40 ± 82.8494	651.75±42.8330
3	Total length (%)	8.67 ± 1.2736	28.96 ± 6.9515	137.55 ± 22.6709	27.31 ± 8.6084	33.31 ± 8.4708	103.51 ± 21.1279	76.65 ± 10.8047
4	Total leaf number	31.25 ±9.2770	87.50 ±4.8391	88.50 ±2.7538	81.50 ±8.9675	52.00 ±7.3824	52.50 ±3.5707	85.75 ±3.4731
5	Leaf width (cm)	0.45 ±0.0289	0.53 ±0.0479	0.53 ±0.0250	0.50 ±0.0408	0.53 ±0.0479	0.48 ±0.0250	0.50 ±0.0408

Table 3: Water parameters of *V. spiralis* grown in different organic manures for 28 days

Sr. No.	Water parameters	Treatments						
		T_0	T_1	T_2	T_3	T_4	T_5	T_6
1	Temperature (ºC)	27.36 ± 0.0244	27.46 ± 0.0400	27.44 ± 0.0244	27.42 ± 0.0374	27.40 ± 0	27.40 ± 0.0316	27.42 ± 0.0374
2	pH	7.41 ± 0.3682	7.56 ± 0.4226	7.87 ± 0.5253	7.70 ± 0.4637	7.56 ± 0.4320	7.16 ± 0.2926	7.69 ± 0.4388
3	Specific conductivity (ms)	1.08 ± 0.0323	0.97 ± 0.0768	1.10 ± 0.0633	1.12 ± 0.0337	0.96 ± 0.0579	0.92 ± 0.0564	1.01 ± 0.0400
4	Dissolved oxygen(mgL^{-1})	6.00 ± 0.9985	5.95 ± 0.8962	6.28 ± 0.9578	5.90 ± 0.8165	6.26 ± 0.9239	6.34 ± 0.9293	6.40 ± 0.8854
5	Free Carbon dioxide (mgL^{-1})	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	Total alkalinity (mgL^{-1})	41.80 ± 0.8602	43.00 ± 0.7071	47.40 ± 2.0640	43.40 ± 1.2884	44.80 ± 1.4967	43.20 ± 0.8000	46.20 ± 1.5297
7	Total hardness (mgL^{-1})	77.00 ± 1.9235	80.00 ± 1.3038	78.00 ± 1.1402	74.20 ± 2.4980	72.80 ± 2.5179	72.80 ± 3.2156	73.20 ± 2.6721
8	Ammonia-nitrogen (mgL^{-1})	0.03 ± 0.0088	0.06 ± 0.0259	0.11 ± 0.0514	0.06 ± 0.0267	0.06 ± 0.0259	0.03 ± 0.0125	0.08 ± 0.0285
9	Nitrate-nitrogen (mgL^{-1})	0.01 ± 0.0012	0.03 ± 0.0031	0.06 ± 0.0167	0.04 ± 0.0106	0.04 ± 0.0092	0.03 ± 0.0055	0.05 ± 0.0131
10	Nitrite-nitrogen (mgL^{-1})	0.01 ± 0.0017	0.02 ± 0.0014	0.03 ± 0.0022	0.02 ± 0.0014	0.02 ± 0.0014	0.02 ± 0.0019	0.02 ± 0.0014

Khandagale [22] found highest value of pH in pond treated with poultry manure and pH recorded by him was on alkaline side. Crossley [23] reported that in *Aponogeton elongatus* aquaria steady increase in water pH up to the end of experiment. High pH was also found by Ng *et al.* [24] in the tanks containing *Elodea densa*. Jamsandekar [25] observed pH increase in planted aquarium tanks.

In planted tank, Crossley [23] observed that electrical conductivity of water increased slowly and observed between 238-249 µscm^{-1}. Govind *et al.* [26] observed differences in specific conductivity of ponds treated with different organic manures. Ng *et al.* [24] reported that specific conductivity of water decreased due to ornamental aquatic plant, *Elodea densa*. In this study, specific conductivity increased initially but gradual decreased after second week onwards in all types of manures whereas, control did not show variation in specific conductivity of water.

In present study, dissolved oxygen increased in all the treatments including control due to photosynthesis and there was no significant difference among the treatments. Mccord and Loyacano [27] recorded high dissolved oxygen level in ponds containing aquatic plant, *Eleocharis dulcis*. Culley and Epps [28] reported that Duck weed produced oxygen in pond water. Jamsandekar [25] observed high dissolved oxygen in *Vallisneria spiralis* and *Hydrilla verticillata* planted tanks. Similarly, results are obtained in the present study. Singh and Sharma [18] reported that oxygen was higher in ponds treated with poultry excreta than other organic manures.

During present study, free carbon dioxide was absent in all the treatments up to the end of the experiment.

During the present study, total alkalinity gradually increased up to 28 days. The range of total alkalinity was 38-56 mgL^{-1} and highest value was observed in poultry manure. Ng *et al.* [24] reported increased in total alkalinity in *Elodea densa* tanks. Jamsandekar [25] observed increased total alkalinity in planted tanks and maximum total alkalinity was observed in *Vallisneria spiralis*.

Ng *et al.* [24] reported low total hardness due to *Elodea densa*. Watten and Busch [29] reported low hardness in hydroponics system. Jamsandekar [25] observed decrease in total hardness values in planted tanks. In the present study, the total hardness decreased gradually in all the treatments and did not show significant difference among the treatments.

An aquatic plant reduces ammonia by direct absorption [30, 31]. Abissy and Mandi [32] reported that ammonia may be reduced by *Typha* and *Juncus* in the culture system. Jamsandekar [25] observed maximum ammonia uptake in *Vallisneria spiralis*. Toetz [33] suggested that ammonia nitrogen of water was reduced by the aquatic plants. Similar results were obtained during the present study, the range of ammonia-nitrogen was 0.003 to 0.276 mgL^{-1} and highest value (0.276 mgL^{-1}) was observed in poultry manure, which may be due to high pH.

Govind *et al*. [26] reported variation in values of nitrate-nitrogen among the organic manures. In *Elodea densa* cultured tanks, minimum level of nitrate-nitrogen was observed by Ng *et al*. [24]. Aquatic plants such as *Vallisneria* spp. and *Cryptocoryne* reduced nitrate level in culture tanks [34]. During the present investigation, range of nitrate-nitrogen varied between 0.01 to 0.13 mgL^{-1}.

During the present study, the highest nitrite-nitrogen (0.031 mgL^{-1}) was observed in poultry manure. Ng *et al*. [24] observed the maximum uptake of nitrite in *Elodea densa* culture tanks. Subosa [35] recorded values of nitrite-nitrogen in the range of 0.18 to 0.23 µg L^{-1} and did not found significant difference. Jamsandekar [25] observed low values of nitrite-nitrogen content in tanks planted with *V. spiralis* while, no change or slight increase was recorded with *Nomaphila stricta* plants. It is evident that the absorption capacity differs as per aquatic plant.

Table 4: Soil Parameters of *V. spiralis* grown in different organic manures for 28 days

		Treatments						
Sr. No.	Soil parameters	T_0	T_1	T_2	T_3	T_4	T_5	T_6
1	pH	6.72 ± 0.1393	7.56 ± 0.3265	7.98 ± 0.4598	7.80 ± 0.4147	7.72 ± 0.3992	7.74 ± 0.3829	7.76 ± 0.3868
2	Available nitrogen (%)	0.11 ± 0.0387	0.38 ± 0.0389	0.47 ± 0.0789	0.35 ± 0.0344	0.34 ± 0.0315	0.37 ± 0.0401	0.34 ± 0.0336
3	Available phosphorus (ppm)	4.86 ± 0.7679	5.46 ± 0.8495	7.20 ± 1.1683	7.20 ± 1.3472	8.56 ± 1.6639	7.30 ± 1.2309	7.80 ± 1.5540
4	Organic carbon (%)	0.49 ± 0.0375	1.64 ± 0.2561	0.79 ± 0.2289	3.80 ± 0.2511	0.72 ± 0.1346	0.77 ± 0.1802	3.34 ± 0.2501

Soil Parameters of the Different Treatments: In the present study, values of soil pH ranged between 6.3 to 8.8 and the highest value was observed in treatment with poultry manure (Table 4). Subosa [35] observed pH values increased gradually to slightly alkaline levels in composted agricultural and industrial wastes. Khandagale [22] recorded pH in the range of 5.58 to 6.62 and highest pH was observed in chicken manure pond.

Nitrogen is important nutrient as it indicates productivity of the soil. After decomposition of organic matter nitrogen subsequently converted into soluble nitrate form, which is used by submerged rooted plants. Banerjea [36] concluded that available nitrogen content of soil in the range of 50-75 mg/ 100g was more favourable. Khandagale [22] recorded that, chicken manure treatment showed highest values of available nitrogen of soil. In the present study, available nitrogen of soil was in the range of 0.056 to 0.70% and highest was observed in poultry manure due to high nitrogen content present in poultry manure as compared to other manures. However, plant's nitrogen absorption and accumulation was often affected by the environmental conditions and nutrient concentrations [37].

Banerjea [36] reported that available phosphorus content in soil was important for aquatic productivity. Khandagale [22] recorded that the values of soil available phosphorus was ranged between 0.22 to 0.969 mg kg^{-1} soil and highest was observed in chicken manure. In present study, soil available phosphorus was in the range of 3-12.5 ppm and highest was observed in combination of vermicompost and poultry manure.

Banerjea [36] suggested organic carbon content of soils below 0.5% indicated as poor productive. Mishra *et al*. [38] recorded values of organic carbon ranged between 0.25 to 0.8%. Khandagale [22] recorded the values of organic carbon were ranged between 0.39 to 2.26% and the highest was observed in the poultry manure. In present study, organic carbon of soil was in the range of 0.25-4.49 % and highest value was observed in vermicompost, as it already has high organic carbon as compared to other organic manures.

It was concluded that the application of cattle manure at the rate of two g per 100g capacity pot for 28 days with soil increase biomass, total length and produced good leaf quality of *V. spiralis.*

Experiment I was conducted to study the role of different organic manures *viz.* cattle manure, poultry manure and vermicompost on the growth of *V. spiralis* in 100g capacity pot for 28 days. All the manures were applied at the rate of 2g pot^{-1}. Significant difference was not found among the treatments for water parameters, while significant difference was observed for nutrients of soil. Plastic pools manured with poultry and cattle manure did not showed significant difference for final biomass, total length, number of leaf and runners of *V. spiralis*.

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