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Anti-algal potential of some edible greens in Hydroponics

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ABSTRACT

Some plant releases metabolites and some other substances that are not useful for plant growth, into the surrounding environment. Finding of this study reveals that the root exudates released by the plant species via root cells may check the growth of other living organisms specially, microorganisms living nearby plant roots. These microorganisms are able to utilize same nutrient composition, necessary for the growth of plant. In this study, various plant species with medicinal potential and algae is observed for symbiotic association. Plant species were grown in Hydroponics, a soilless culture system. Liquid nutrient medium is applied for plant growth. In due course, algal growth is observed inadvertently. Algal cell mass growth is analyzed by spectrophotometric method via. optical density at 640 nm. Plant species namely, A. viridis and A. hypochondriacus L. observed with insignificant response against algal cell growth. There was no relationship between the growth of these selected plant species and algae. Selected plant species and algae were growing individually by absorbing nutrients present in liquid media without affecting each other. But in case of species R. sativus L. and S.oleracea, altered growth of algal cell mass in non-circulating liquid medium was significantly observed. Also significant resistance against growth of algal mass was found in T. graceum L., C. olitorius L. and A. viridis, among these species A. viridis showed highest potential to resists algal growth. Environmental conditions and time period were same for all selected plant species.

Keywords: Hydroponics, algale, plant species, non-circulating, optical density symbiosis, time period

I. INTRODUCTION

Microbial world consist many unicellular organisms having high probability to grow in extreme conditions. Algae are one of the significantly known members of the microbial diversity. Algae is water loving organism, multiplies rapidly in favorable environment particularly in temperate water conditions. Sometimes rate of algal growth causes crisis for other living organism in neighborhood. Rapid and dominating growth pattern of algal biomass is termed as algal blooms, which is very common in water sources around industrial areas in developing countries. Substances released by industries in water bodies is one of the main reason for rise in algal mass. Although algae, especially photosynthetic algae is very important part of ecosystem. Surplus growth of any living population creates competition or overwhelm other species living in same area. It is well known fact that presence of algal bloom causes death of various living organism i.e. fishes, crabs, snails, earthworms

etc. Rise in algal bloom occurs due accumulation of various chemicals and substances that can support, growth of algal species. Mainly phosphorus, calcium, nitrogen, potassium rich water bodies are reported for presence of algal blooms. Sometimes algal blooms are also reported in fresh water bodies arises due to most favorable environmental conditions. Algal blooms are responsible to absorb high amount of nutrients and essential substances present in water bodies that are also essential for growth of other plant and animals. Hence, sometimes algal blooms are considered as source of pollution in water bodies.

This is very important to uphold balance in any kind of ecosystem weather it is terrestrial, forest, marine or fresh water (aquatic) ecosystem. This study is converging an aim of protecting Biodiversity of fresh water ecosystem via. averting growth of green algae. In this study, providentially some kind of anti-algal potential of red calico (*Alternanthera* spp.), commonly named as Lal bhaji is recorded. This was not the major aim of the study but the result was significant, revealing anti-algal strength of red calico plant, which will discussed in this paper. This is well known fact about medicinal properties of various known and unknown plant species. Some of the plant species comprises phytochemicals that can alter the growth of other living organisms. They may include species of other plant, animals or microorganism. This is very important to know the fact that plant comprises different living parts/organs, which means composition of phytochemicals usually varies between them. Phytochemicals are present in root, stem, leaves, fruit and flower could be different due to anatomical and physiological behavior of plant organ. Comprehensive study is required to evaluate unidentified potential of plant phytochemicals isolated from various plant species.Generally phytochemicals are extracted from plant parts are followed by analytical approaches.

In this study we are discussing about real life situation, realizing effect of plant growth associated with other living organism living in surrounding of specific plant species. When occurrence of two organism together in specific area within same environmental condition is termed as Symbiotic relationship, this could be either temporarily or for a longer period depends upon various factors such as nutrient availability and its type, physiology of an organism, potential of adaptation, genetic composition etc.. Plant cell secrets various essential and non essential substances produced by their metabolic activities. Most of them are used for plant growth, via. development of leaf, shoot, root, flower, fruit and also for protection from other organisms like bacteria, fungi and viruses. Some substances, that are not useful of plant growth is released into the surrounding environment through roots commonly known as root exudates. Those compounds may include various sugars, proteins, amino acids, also various organic and inorganic substances. In case of soil based cultivation root exudates may be responsible to establish artificial rhizosphere (Dundek *et. al.*, 2011). These photochemical are stored in inner compound of plant cell surface but exported to the outer environment due to various reasons like –

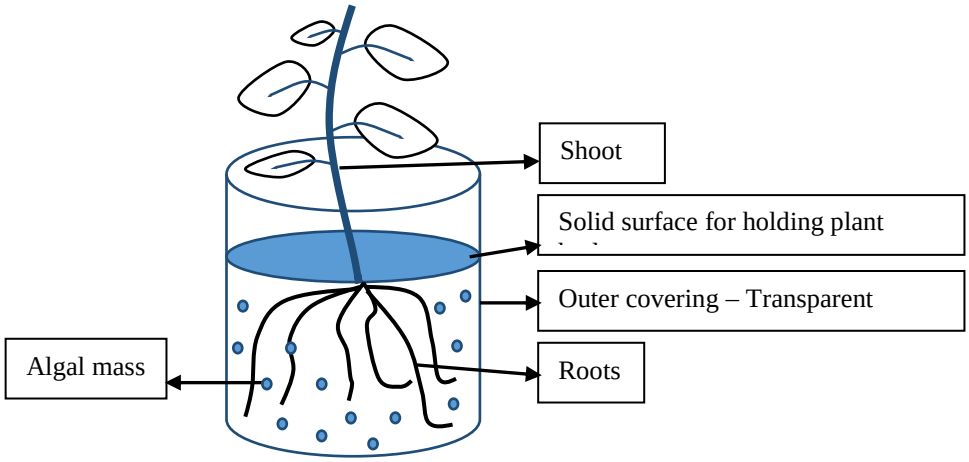
1. Excess secretion of substances resulting osmosis and diffusion.
2. In exchange with other substances
3. Death and replacement of older cells
4. Injuries occurred due to external factors like thermal, external forces etc.

This is associated study of various plant species with Hydroponic culture system. This method is based on soilless cultivation of plant species. Algae requires high amount of water or moist area to survive. Some of the local plant varieties has been selected to perform experiment. This could be meant for obtaining optimum

growth as well as supporting production of phytochemicals. Roots are the plant parts, which remains in continuous touch with water or liquid nutrient supply. In this condition, if any substance is released by the root to the surrounding liquid medium could show effect on the growth of fresh water green algae.

II. MATERIAL AND METHOD:

Fig 1: Showing Hydroponical Setup For The Cultivation Of Selected Plant Species.



a. Hydroponical setup

Hydroponical setup (Fig. 1) was considered to accomplish research study. A complete soilless plant cultivation method, liquid medium was used to grow selected plant species (Table 1). Outer surface of the hydroponical system was prepared through transparent material which could helpful to observe root growth and also morphological changes could be visible. Solid surface was used to inoculate seed and support for plant body after seed germination. Solid surface was prepared through sterilized foam piece holding by metal net.

b. Liquid Nutrient medium

Liquid nutrient medium comprised of various micro and macro elements in ionic form i.e. NO_3^-, NH_4^+, HPO_4^{2-}, $H_2PO_4^-$, K^+, Ca^{2+}, Mg^{2+}, SO_4^{2-}, BO_3^{3-}, Cl^-, Cu^{2+}, Fe^{2+}, Fe^{3+}, Mn^{2+}, MoO_4^-, Zn^{2+} etc. These are basic elements essential for plant growth and development of different parts of plant (Jones, 2005). These inorganic substances are naturally present in soil. Therefore, they are selected for artificially plant cultivating method. These elements may also support growth of some other living organisms such as bacteria, fungi and algae etc. This may arise due to loss of hygienic environment under solid surface surrounding root.

c. Meteorological factors

Many climatic factors like light, temperature, humidity etc. play an important role to support plant growth as well as other living organism to establish symbiotic relationship. In symbiotic relationship two different living organism exhibit same climatic factors to accomplish their life span. In this study DL (Dark and Light) period was maintained in ratio of 12:12. Artificial light was provided through fluorescent tubes of 1000 Lux or below. Temperature was maintained around 29 – 34 °C via. Programmable thermostat. Ideal humidity was maintained above 95 %. All these conditions were established under indoor environment.

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Some of the local vegetable plant varieties have been selected for obtaining optimum growth. List of selected plant (Table 1). Effect of phytochemicals released by roots on algal growth is studied. This could be difficult to study in soil cultivated plant because roots are completely embedded inside soil surface. Hence transparent mechanical setup is required to observe root growth and it's phytochemical on algal growth.

Table 1: List of Selected Plant Species for the Experiment

Common name (Hindi/English)	**Scientific name**	**Family**
Palak/Spinach	*Spinacia oleracea*	Amaranthaceae
Chauleyi, rajgira/ Spiny pigweed	*Amaranthus viridis*.	Amaranthaceae
Lal bhaji/ Red calico plant	*Amaranthus tricolor*	Amaranthaceae
Methi / Fenugreek	*Trigonellafoenum graceum* L.	Fabacecae
ChechBhaji / Jute	*Chorchorus olitorius* L.	Tiliaceae
Kheda bhaji	*Amaranthus hypochondriacus* L.	Amaranthaceae
Muli /Radish	*Raphanus sativus* L.	Brassicaceae

Identification of algae was done by using microscopic analysis based on morphological and habitat characteristics such as color, filament, smell and occurrence etc. It was recognized as fresh water green algae. Measurement of algal growth rate was done by spectrophotometric analysis (Table 2).

Dry weight method

Dry weight method was used to detect growth rate of algal biomass in 100 ml after 10 days. Algal biomass was extracted through whatman filter paper followed by drying in oven at 70 °C for 1 hr. Final dry weight was measured in digital weighing balance to compare total algal mass in each experimental setup of different plant species. Plant species with high anti-algal potential would be measured with low dry weight on the contrary those plant species having no relationship with algal growth would be measured with higher dry weight (Table 3).

Table 2: Showing Development Of Algal Growth Based On Optical Density

No. of days	**Optical density based on algal cell mass (640 nm)**						
	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**
	Kheda 6	**Methi 1**	**Chech 3**	**Laal (0)**	**Muli 5**	**Palak 4**	**Chaulai 7**
Day 1 - 15	**Agal biomass was not reported in first 1-15 days**						
Day 16	0.018 ± 0.01	0.00 ± 0.01	0.010 ± 0.01	0.00 ± 0.01	0.016 ± 0.01	0.012 ± 0.01	0.91 ± 0.01
Day 17	0.029 ± 0.01	0.010 ± 0.01	0.012 ± 0.01	0.00 ± 0.01	0.022 ± 0.01	0.014 ± 0.01	0.192 ± 0.01
Day 18	0.047 ± 0.01	0.014 ± 0.01	0.012 + 0.01	0.00 ± 0.01	0.036 ± 0.01	0.014 ± 0.01	0.401 ± 0.01
Day 19	0.081 ± 0.01	0.018 ± 0.01	0.014 ± 0.01	0.011 ± 0.01	0.068 ± 0.01	0.025 ± 0.01	0.799 ± 0.01
Day 20	0.161 ± 0.01	0.027 ± 0.01	0.019 ± 0.01	0.016 ± 0.01	0.124 ± 0.01	0.029 ± 0.01	1.402 ± 0.01

Day 21	0.210 ± 0.01	0.042 ± 0.01	0.029 ± 0.01	0.021 ± 0.01	0.148 ± 0.01	0.048 ± 0.01	1.900 ± 0.01
Day 23	0.321 ± 0.01	0.063 ± 0.01	0.051 ± 0.01	0.040± 0.01	0.239 ± 0.01	0.099 ± 0.01	2.249 ± 0.01
Day 24	0.510 ± 0.01	0.097 ± 0.01	0.116 ± 0.01	0.048 ± 0.01	0.380 ± 0.01	0.170 ± 0.01	----
Day 25	0.820 ± 0.01	0.140 ± 0.01	0.230 ± 0.01	0.045 ± 0.01	0.520 ± 0.01	0.280 ± 0.01	----
Day 26	0.771 ± 0.01	0.160 ± 0.01	0.300 ± 0.01	0.040 ± 0.01	0.771 ± 0.01	0.420 ± 0.01	----

Table 3: Showing Final Dry Weight Of Each Specimen In Gm/100 Ml

S. No.	**Botanical name of selected plant**	**Initial weight of filter paper in gm (A)**	**Final weight of filter paper with algal biomass in gm (100 ml of liquid nutrient media sample) (B)**	**Dry weight of algal biomass in gm/100 A - B = C**
1	*Amaranthus viridis*.	**3 gm**	**3.91**	**0.91**
2	*Amaranthus hypochondriacus* L.		**3.85**	**0.85**
3	*Raphanus sativus* L.		**3.67**	**0.67**
4	*Spinacia oleracea*		**3.35**	**0.35**
5	*Chorchorus olitorius* L.		**3.28**	**0.28**
6	*Trigonellafoenum graceum* L.		**3.18**	**0.18**
7	*Amaranthus tricolor*		**3.11**	**0.11**

III. RESULT

Major aim of this study was to check feasibility of green leafy vegetable cultivation in Hydroponical setup (Prabhas *et. al*., 2017). Fortunately some other significant result has been observed during this study. Usually sterile liquid nutrient media is used to support growth of plant species in Hydroponics. Especially in non circulatory hydroponic system, there is a necessary requirement of replacement of liquid media time to time because minerals and other growth factors are absorbed by the plant through roots. Concentration of soluble nutrients gradually decreases with rise in growth of plant body. Soluble nutrient are also responsible to attract various kind of microorganism like algae, fungi, bacteria etc. Hence, significant growth of green algae has been observed in non-circulating liquid nutrient medium, in case of failing replacement for long time. Growth of algae was analyzed by means of various measures i.e. microscopic identification, cell count, dry weight, Optical density etc.

Spectrophotometric analysis of algal cell mass growth in liquid nutrient medium (Fig. 2) is analyzed by spectrophotometric method via. optical density at 640 nm (Visible region). Two plant species, *A. viridis* and *A. hypochondriacus* L. showed insignificant response against algal cell growth. There was no relationship between the growth of these selected plant species and algae. Plant and algae were growing individually by absorbing nutrients present in liquid media without affecting each other. But in case of species *R. sativus* L. and *S.oleracea* altered growth of algal cell mass in non-circulating liquid medium was significantly observed. Environmental conditions and time period were same as applied for *A. viridis* and *A. hypochondriacus* L. species. Significant

resistance against growth of algal mass was found in *T. graceum* L., *C. olitorius L.* and *A. viridis*, among these species *A. viridis* showed highest potential to resists algal growth. Dry weight of algal biomass was recorded in each test specimen (Table 3.

Fig 2: Showing Potential Of Selected Plant Species Against Algal Mass Growth In Non-Circulating Hydroponic System.

IV. CONCLUSION AND DISCUSSION

The major aim of this study was to determine feasibility of selected plant species in Hydroponics. This was additional finding in this study, achieved auspiciously without any earlier anticipation (Prabhas *et. al*., 2017) and 2016). Result obtained in this study was based on optical density of algal cell mass into the liquid medium applied for plant growth. There are some possible factors may also affect the obtained values of optical density, such as

- Growth of other microscopic organisms like bacteria.
- Substances released by plant through root into the liquid medium.
- Dead cell mass of plant root

But this could be an important finding because this study reveals that the symbiotic relationships between plant and algae. This is also confirmed that the inimitable method of hydroponic system is more useful in various research studies that are not possible in the soil plant cultivation techniques.

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