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PERFORMANCE OF LETTUCE CULTIVARS IN DEEP WATER CULTURE TECHNIQUE OF AQUAPONICS USING DIFFERENT MEDIA

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ABSTRACT
The experiment was carried out in winter season from August to October, 2021. Land craft aquaponics unit Hatkanagle to study the performance of lettuce cultivars in deep water culture technique of aquaponics using different media. Factorial completely randomized block design with two replication in protected condition .It used to record morphological and biochemical parameters of lettuce cultivars planted in different media combination at frequent intervals of time. The study concluded that, different media combination significantly affected to growth of lettuce cultivars. Choice of media in deep water culture technique of aquaponics is an important aspect for sustainable, suitable and effective production of lettuce. This will be good solution for various constraints observed in traditional farming.

KEYWORDS: Deep water culture, Lettuce, Media, Aquaponic, Hydroponic.

INTRODUCTION
Aquaponics is one of the modern soil free cultivation. It consists of two main parts; the hydroponics part for growing plants and the aquaculture part for raising aquatic animals. Aquaculture, also known as aqua farming, is the farming of aquatic organisms which is the fastest growing sector of the world's food economy, increasing by more than 10% per year (Shafahi and Woolston, 2014). Nutrient Film Technique (NFT), Vertical system, Media Based system, Deep Water Culture, Wicking Bed System are five primary methods in aquaponics (Datta, 2015). DWC is a hydroponic technique that allow plant roots to always be submerged in water containing nutrients. The purpose of the application of controlling the level of hydroponic nutrient solution in the type of Deep Water Culture (DWC) in the box is to ensure that the roots of the plant are always submerged in nutrient solution so that the nutrients are still fulfilled (Nursyahid et al, 2019).
Lettuce (Lactuca sativa L.) is a well known leafy vegetable with wide range of applications of family Asteraceae. It is a self-pollinated crop having chromosome number 2n=18. The region of Middle East (Egypt and Iran) is considered as centre of its origin (Kristova, 2008). The best temperature range for lettuce cultivation is 18°C to 25°C and night temperature is 10°C to 15°C (Ryder, 1998). It is mainly cool season crop. Cultivated lettuce is grouped into seven different types as Cos, Cutting, Stalk, Butterhead, Crisphead, Latin and Oilseed group (Still, 2007). Out of these types head and leaf lettuce are mostly popular and cultivated due to distinctive nutritional properties and consumer acceptance. The growth habit, leaf shape, texture and colour differ significantly among the group. Lettuce is well liked for its texture, crispiness, colour and slightly bitter taste. Lettuce is a rich source Vitamin A, C and B complex group of vitamins like thiamine, pyridoxine, and riboflavin. As a fresh, it is an excellent source of bulk and fibre. It also provides calcium, iron, copper and minerals in the leaf and being regarded as an important source of phytonutrients, including carotenoid in diet. Lettuce has several medicinal uses and health beneficial such as antioxidants, flavinoids and phenolic acids. These health beneficial components help to prevention and treatment of cancer, heart diseases, inflammation and diabetes (Lal et al, 2020).
Soilless culture systems are based on use of solid rooting media for growing plants. They are usually called "growing media" or "substrates"; however, sometimes terms like "aggregate systems", "supporting media" or "potting soil" are used. In choosing a growing medium, knowledge of its characteristics (physical, chemical and biological) is very important because they affect plant response and production cost. Absence of pests and pathogens is essential biostability and biological inertia are other parameters to be taken into consideration, particularly when long cycles are carried out or the growing medium is reused during successive growing cycles (Gruda, 2009).

New lettuce cultivation methods, especially under protected cultivation has provided a continuous increase in quality and productivity of this vegetable which offers some advantages such as nutritional control, ability to use higher planting densities, reduction of pests, disease and weeds. Organic and inorganic media may be used in this method. The characteristics of the various materials used as media directly and indirectly affect plant development and production. Aeration is an important factor affecting crop yield, since oxygen is a necessary element for cellular activity, involved in the breathing process, and when absent from the root system causes damage to the plant metabolic development. Therefore, media structure influences crop development, mainly for soilless crops. In brief, the choice of media in an aquaponic system must meet the appropriate water and air proportions that meet the plant needs. (Geisenhoff, 2016).

MATERIALS AND METHOD

Experimental site

The experiment was conducted in polyhouse erected at site of Land Craft Aquaponics Unit, Hatkanangale. Dist.: Kolhapur situated in tropical region at 16º 74′ North latitude and 74º 41′ East longitudes. Agro-ecologically this area comes under sub-mountain zone of Maharashtra state with annual rainfall range of 700 to 2500 mm with an average rainfall of 1057 mm. The research was conducted in winter season from August to October, 2021.The analytical work for plant, water and media samples was carried out at Post Graduate Laboratory, Horticulture Section and PG Laboratory, Soil Science and Agricultural Chemistry Section of Rajarshee Chhatrapati Shahu Maharaj College of Agriculture, Kolhapur.

Experimental Design and treatment

The experiment was conducted under Factorial Completely Randomized Block Design with Factor A cultivars and Factor B media in two replications. Each cultivars viz. Iceberg (C1), Romaine(C2), Butterhead (C3), Ice queen (C4), Red romaine (C5), and Batavia (C6) planted in media combination of Coco Peat (control)(M1), Peat moss (M2),Coco Peat + Peat moss (2:1)(M3),Coco Peat + Peat moss + Vermicompost (2:1:1)(M4),Cocopeat + Vermicompost (2:1)(M5),Cocopeat + FYM (2:1)(M6) respectively. Seedlings were transplanted at 4 to 5 leaf stage in plugs of foaming tray at 20×20 cm2 which were floating in hydroponics RCC beds of dimensions 29.0 m length x 3.0 m width x 0.45 m height with a polyethylene linings.

Growing environment

Auaponics consists of two basic terms Aquaculture + hydroponics in which aquaculture practices are integrated with plant based agricultural production system. Cycle of Nutrient rich water in deep water culture technique was maintained throughout production. Rohu, Catla, Tilapia fishes which were grown in small fish tanks for about 2 months to be transferred in the main tanks @2,000 fishes per tank. Fishes are fed daily with 4 mm size pellets of premium quality Indo-Aqua floating fish feed manufactured by ShivSamarth Associates, Pro Indo Aqua Fish Feed, Kolhapur, Maharashtra which are having 23% proteins, 4% fats contents. Feed was supplied twice a day @ 1.0 kg each tank in morning and evening sessions. The whole unit is covered with a shed. Each main fish culture tank is provided with 25 inlet pipes for supply of oxygen to fishes. Fishes produce waste through their faecal matter, urine and through gills which is rich in ammonia. Both this faecal matter and ammonia are harmful to the fishes. This tank water is then transferred to the 4 sludge collector side tanks each of 2,000 lit capacities with 1.5 hp motors. In sludge collector, all solid waste settles down and water is cleared of all the solid waste. This water then moved into the bio filter which is called as Moving Bed Biofilm Reactor (MBBR) where nitrosomonas bacterial colonies initially converted the ammonia (NH_4^+) to nitrite (NO_2^-) form which is further converted to nitrate form (NO_3^-) by Nitrobacter colonies which is primary source for nutrition to the plants to be grown in hydroponics method. This treated water from single aquaculture tank and rich in nitrates and other nutrients released by the fishes is then moved in 4 hydroponic beds with the help of 3.0 hp motor. Water from these beds is again recollected in an underground tank of 8,000 lit capacity from where this water is again recirculated in the main fish culture tanks with 3.0 hp motors per tank. In this way, the water is reused with circulation system. Fishes in tanks are harvested after 10 months which are grown up to around 0.6 to 1.0 kg weight. Polyhouse was provided with rollable aluminets at suitable height for temperature and light control. The cladding material was 200 micron, UV stabilized, anti dust, anti drip, CO extruded high density polyethylene film which was 5 layered for sidewalls and 7 layered for roofing. Throughout the investigation, temperature in the range of 26℃ to 28℃ and a relative humidity of 60-70% were maintained inside the polyhouse with aluminets and fan-pad cooling system.

Media and plant analysis methods

Table 1

Sr. No.	Parameters	Methods used	References
1.	pH(1: 10)	Potentiometer	Jackson(1973)
2.	EC(1: 10)	Conductometry	Jackson(1973)
3.	Organic carbon (%)	Loss in weight (Ignition method)	Chopra and Kantar (1976)
4.	Total nitrogen (%)	Micro-kjeldahl method(Digestion Distillation)	Bremner and Mulvaney(1982)
5.	Total phosphorous (%)	Vanadomolybdate yellow Colour in nitric acid system	Jackson(1973)
6.	Total potassium (%)	Flame photometry (H_2SO_4+$HClO_4$)	Jackson(1973)

Biochemical analysis

Table 2

Sr .no.	Parameters	
1.	Chlorophyll	Ranganna, 2005
2.	Total carotene(mg/ 100g)	Davis, 1976
3.	Crude fibre (%)	Thimmaiah, 1999
4.	Ash (%)	Choprav and Kanwar (1976)

Harvesting

The crop was harvested after 28 days of transplanting. Plant are cut by scissors and packed in polythene sheets.

Data recorded

Number of leaves, plant height, leaf length, leaf width, plant spread, leaf area, root length, root weight, fresh weight of consumable produce, dry weight of consumable produce, chlorophyll content ,crude fibre content , carotene content at harvest.

Statistical analysis

The data generated through the present investigation was analyzed as per the method given by Panse and Sukhatme (1985).

Observations and Results

Morphological observations (Table 5)

1. Number of leaves

Maximum number of leaves at harvest (26.20) was produced in treatment combination of cultivar Butterhead placed in a Cocopeat + Vermicompost (2:1) (C3M5) which was statically at par with treatment combination of Butterhead and Cocopeat + Peat moss+ Vermicompost (2:1:1) (C3M4) (26.10) and Red Romaine in Cocopeat + Peat moss (2:1) media (C5M5) (24.80). Minimum number of leaves (13.40) was recorded in treatment combination of Red Romaine in Peat moss media (C5M2).The significant increase in number of leaves was observed due to favorable conditions for plant growth in DWC of aquaponics. These results are in agreement with number of leaves which were reported by Jahedur et al. (2019).

2. Leaf length (cm)

Significantly longer leaves at harvest (31.50 cm) were recorded in treatment combination of Romaine cultivar in Cocopeat + Vermicompost (2:1) (C2M5) and minimum leaf length (17.40 cm) was recorded in treatment combination of Butterhead in Peat moss media (C3M2).

The significant variation in interaction of lettuce cultivars and media is the result of genotypic characters or heredity of variety and the growing environment especially nourishment of plant supplied through the different types of media certainly impact on growth of plants. These results are in close in conformity with Jahedur et al. (2019) in lettuce and Yanti et al. (2020) in kale.

3. Plant height (cm)

At the time of harvest, results were found to be significant. Highest plant height (33.20 cm) was produced in treatment combination Red Romaine cultivar placed in Cocopeat + Vermicompost (2:1) (C5M5) and minimum height (20.40 cm) was recorded in treatment combination of Butterhead in Peat moss media (C3M2).Differences observed in plant height might be due to plant genetic makeup of different varieties which is further modified by the source of nutrients made available through the different media substrates in which the plants were grown. Supportive findings were recorded by Zineb et al. (2021) in lettuce.

4. Leaf width (cm)

Non-significant results were observed for interaction effect at 14 days and the time of harvesting. The combination of different media has better results on growth of plant as they influenced all growth parameters. Lal et al. (2020) observed similar results for leaf width.

5. Plant spread

Significant variations observed at the time of harvesting. Maximum (33.63 cm) plant spread recorded in interaction effect of (C4M5) i.e. Ice Queen cultivar of lettuce planted in media Cocopeat + Vermicompost (2:1) which was statistically at par with plant spread of treatment combination Batavia cultivar of lettuce in media of Cocopeat + Vermicompost (2:1) (C6M5) (32.45 cm). Plant spread was measured in treatment combination of Butterhead in Peat moss media (C3M2) was minimum (20.40 cm). Similar results were reported by Lal et al. (2020) and concluded that increase in plant spread significantly increased yield of lettuce.

6. Leaf area

The interaction effects of lettuce cultivars and media also had significant results on leaf area produced by different cultivars. The maximum leaf area of (371.50 cm2) per plant was recorded in treatment of Batavia cultivar and Cocopeat + Vermicompost (2:1)(C6M5) which was statistically at par with Iceberg placed in Cocopeat + Vermicompost (2:1)(C1M5) (366.00 cm2). The minimum leaf area of 53.00 cm2 was produced by interaction effect of Butterhead and Peat moss (C3M2).

In aquaponics system characteristics of the material used as substrate directly affect plant development resulting in variation in growth parameters. Results for leaf area produced in the current investigation are in confirmation with earlier results reported by Zineb et al. (2021).

7. Root length

The data in respect of root length as an interaction of cultivars and media recorded at harvest produced the maximum length of roots (69.55 cm) in Ice Queen and Cocopeat + Vermicompost (2:1) (C4M5) treatment combination while minimum root length (30.15cm) was observed in treatment of Red Romaine and Peat moss media (C5M2).

Effect of plant and media led to significant variation in growth roots. Organic medium enhanced the growth of roots which significantly increased yield of plant. Lal et al. (2020) observed that root length of lettuce cultivars was maximum in organic medium.

8. Fresh weight

The interaction effects of lettuce cultivars and media had significant results on fresh yield of lettuce. The maximum fresh weight (185.40 g) was recorded interaction effect of (C1M5) i.e. Iceberg (C1) cultivar of lettuce planted in media Cocopeat + Vermicompost (2:1) (M5) which was statistically at par with (164.50 g) treatment of Iceberg cultivar of lettuce in media of Cocopeat + Vermicompost (2:1) (C1M5). Lowest average fresh weight per plant (62.80 g) was recorded in treatment combination of Red Romaine in Peat moss media (C5M2).

The average leaf weight is important character for selection in lettuce for commercial production to grower. These results were in close conformity with results reported by Abbey M. et al., (2019) and Delaide et al. (2016).

Biochemical parameters (Table 6)

9. Nitrogen (%)

The interaction effect of cultivars and media on nitrogen was found significant. The maximum 4.09 % nitrogen percentage was observed in cultivar Ice Queen (C4) and Cocopeat + Peat moss + Vermicompost (2:1:1) (M5) which is at par with Ice Queen (C4) and Cocopeat + FYM (2:1) (M6) and lowest 1.08 % nitrogen Butterhead (C3) and Peat moss media (M2).Nitrogen is one of the most important mineral nutrients determining plant growth removing N supply considerably decrease plant growth. These results are agreed with Farang et al. (2013).

10. Phosphorous (%)

Significant results were recorded in interaction effect of cultivars and media. The maximum 0.18% phosphorous percentage was observed in cultivar Ice Queen and Cocopeat + Vermicompost (2:1) (C4M6) which is followed by C1M6 (0.16%) and minimum was recorded in C2M2 and C5M2. Nutrient solution used in DWC of aquaponics was significantly affecting the nutrient composition plants grown in this system. These results are similar with Farang et al. (2013) and Delaide et al. (2016).

11. Potassium (%)

The maximum (3.15 %) potassium was analyzed in cultivar Ice Queen (C4) and Cocopeat + Peat moss + Vermicompost (2:1:1) (M5) and minimum (0.65%)potassium Red Romaine (C5) and Peat moss media (M2).Potassium content of plant is significantly affected by cultivar characters and media composition. Low Potassium level was depicted in organically grown lettuce in deep flow techniques system were high chlorophyll content in lettuce was noticed by Zineb et al. (2021).

12. Chlorophyll content (mg/100 g)

In interaction effect, maximum (0.0218 mg) chlorophyll was recorded in cultivar Batavia (C6) and Cocopeat + Peat moss + Vermicompost (2:1:1) (M5) and minimum (0.0103 mg) chlorophyll Butterhead (C5) and Peat moss media (M2).Chlorophyll plays important role in photosynthesis which directly affects to growth of plant. Similar results for chlorophyll content obtained by Zineb et al. (2021).

13. Ash (%)

In interaction of cultivars and media, maximum 12.75% ash was recorded in cultivar Ice Queen and Cocopeat + Peat moss + Vermicompost (2:1:1) (C4M4) and minimum (6.00%) ash in Butterhead and Peat moss media (C3M2).Ash percentage is an estimate of a sample's weight when all water has been removed; it means the weight of the sample, excluding the weight of the water in the sample. Higher dried weight indicates maximum nutrient or mineral composition of plant. This result is in accordance with Delaide et al. (2016).

14. Crude Fibre

Significantly superior (2.31%) crude fibre was analyzed in treatment of Batavia and Cocopeat+ Vermicompost (2:1) (C6M5) and minimum 0.51% crude fibre recorded in Red Romaine and Peat moss media (C5M2).Crude fibre content differs with cultivars and media. Insoluble fibre content is higher in romaine cultivars than in crisphead lettuce cultivars. These results are in accordance with Kim et al. (2016 a).

15. Carotenoid (mg/100g)

In interaction effect, (0.109 mg) maximum Carotenoid was recorded in cultivar Batavia (C6) and Cocopeat + Peat moss + Vermicompost (2:1:1) (M5) and minimum(0.052 mg) in Butterhead and Peat moss media (C3M2) and Red Romaine and Peat moss (C5M2).

Similar results are given by Kim et al. (2016a) indifferent cultivars of lettuce.

16. Media analysis

Report of media analysis is presented in Table 3 It was revealed from the data that Cocopeat + Peat moss+ Vermicompost (2:1:1) (M5) media superior in nutrient content, which had suitable range of pH and EC and maximum organic matter (%), organic carbon (%) and ash (%).

Table 3: Media analysis report

Media	N (%)	P (%)	K (%)	pH	EC (d S/m)	Organic matter (%)	Organic (C %)	ASH (%)
M1	0.32	0.24	1.44	6.58	0.624	83.27	48.2966	13.33
M2	0.22	0.77	0.84	4.80	1.000	84.14	48.8012	7.67
M3	0.98	0.33	0.92	5.22	1.800	82.00	47.56	9

M4	2.80	0.47	1.86	6.07	1.700	80.00	46.4	7
M5	3.36	1.12	1.94	6.59	1.380	88.00	51.04	15
M6	0.42	0.24	0.64	6.55	0.668	85.00	49.3	9

17. Water analysis

Average readings of water parameters were recorded manually throughout the growing season are presented in table Standard ranged of all essential parameters was maintained by supplying sufficient nutrient solution to DWC of aquaponics.

Water is key element used in aquaponics system because it is shared between the two major components of the system i.e. (fish and plant components), it is major carrier of nutrient resources within the system and it sets the overall chemical environment. These results are in confirmation with Goddek et al. (2018).

Table 4 water analysis

Parameters	Values
p H	5.6
EC (d S/m)	1.01
DO (ppm)	5.2
TDS(mg/L)	600
Ferrous (ppm)	6
Nitrate(ppm)	60

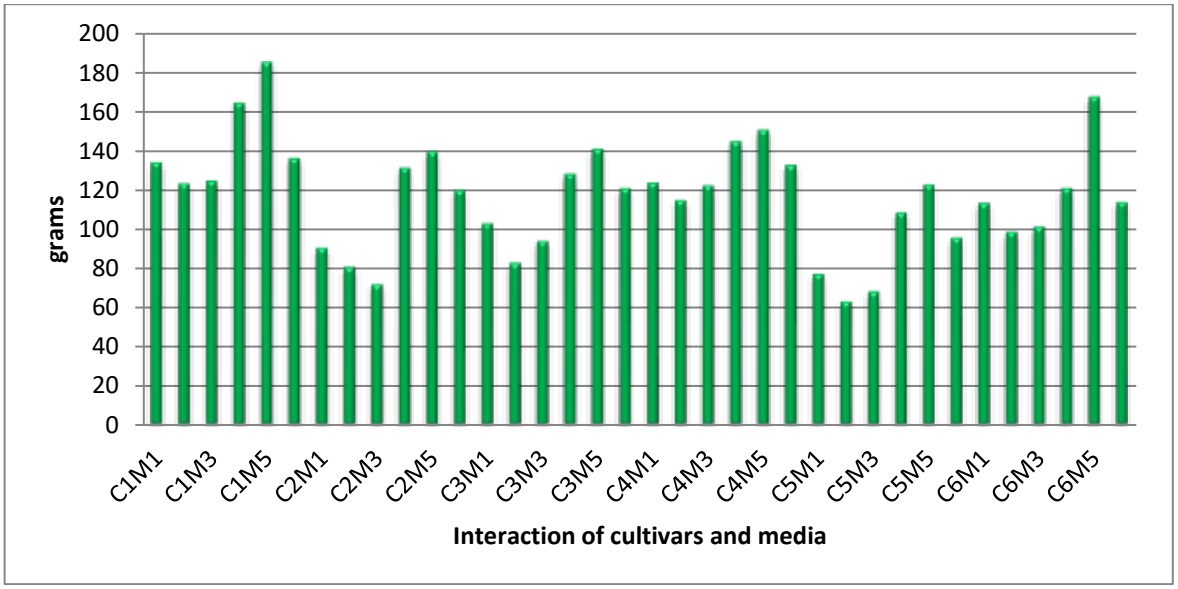
Table 5 Morphological observations of cultivar and media interactions at harvest

Treatment Combination	Number of leaves	Leaf length (cm)	Plant height (cm)	Leaf width (cm)	Plant spread (cm)	Leaf Area (cm2)	Root length (cm)	Fresh weight (g)
C1M1	18.90	22.70	24.80	14.40	27.52	271.00	35.65	134.00
C1M2	15.00	20.50	23.80	13.40	23.63	263.75	33.30	123.30
C1M3	17.50	20.60	23.80	13.65	24.25	326.50	35.35	124.70
C1M4	19.80	25.50	26.70	14.85	29.30	325.00	37.70	164.50
C1M5	20.60	30.40	30.40	15.50	28.90	366.00	38.80	185.40
C1M6	19.00	24.60	25.50	14.70	28.00	320.50	36.80	136.20
C2M1	19.90	28.30	31.90	12.70	25.82	204.50	36.30	90.40
C2M2	18.10	23.40	25.55	11.35	24.05	179.50	32.30	80.50
C2M3	20.30	30.20	30.30	12.30	24.25	198.55	35.50	71.70
C2M4	19.70	31.30	32.30	12.95	28.98	262.00	39.00	131.20
C2M5	21.70	31.50	33.90	14.10	32.27	291.50	39.15	139.60
C2M6	21.60	29.80	33.10	13.60	24.28	246.00	38.50	119.80
C3M1	21.20	21.60	23.60	11.30	24.93	79.50	59.50	102.70
C3M2	20.60	17.40	20.40	10.30	20.40	53.00	42.30	82.70
C3M3	20.80	18.90	20.90	10.55	20.55	68.00	44.45	93.70
C3M4	26.10	24.70	26.70	11.80	26.52	121.50	57.50	128.10
C3M5	26.20	28.30	30.60	12.10	26.87	157.00	58.05	140.90
C3M6	24.45	22.50	24.50	11.55	22.62	115.00	57.15	120.70
C4M1	18.30	23.00	25.00	11.80	28.58	195.00	55.15	123.70
C4M2	14.50	21.70	23.70	11.20	26.87	132.50	51.50	114.70
C4M3	16.50	22.80	24.80	11.60	27.08	169.00	53.50	122.30
C4M4	19.80	26.50	28.50	12.10	32.20	192.50	67.00	144.80
C4M5	20.50	29.90	31.90	12.75	33.63	205.50	69.55	150.80
C4M6	18.20	25.60	27.60	11.70	30.88	185.00	66.50	132.80
C5M1	22.20	27.90	30.50	11.00	27.02	188.50	32.80	76.90
C5M2	18.60	24.45	24.05	10.00	23.93	141.50	30.15	62.80
C5M3	19.70	27.35	29.95	10.60	30.50	148.50	29.80	68.10
C5M4	21.60	29.40	31.40	11.05	31.72	258.00	35.15	108.30
C5M5	24.80	31.20	33.20	11.70	33.32	263.50	35.80	122.50
C5M6	22.90	29.30	31.10	11.15	30.97	202.25	34.80	95.50
C6M1	19.40	26.30	31.20	14.00	31.00	306.50	40.65	113.20
C6M2	17.20	24.00	28.60	13.15	28.27	256.00	38.50	98.50
C6M3	17.50	26.10	30.90	13.90	30.48	270.50	40.50	101.10

C6M4	20.80	27.55	32.15	14.60	32.15	318.50	47.50	120.80
C6M5	22.20	28.60	33.20	15.00	32.45	371.50	53.30	167.70
C6M6	19.10	26.60	30.70	14.10	32.00	305.50	41.65	113.70

Table 6 Biochemical observation of cultivar and media interactions at harvest

Treatment Combination	Nitrogen (%)	Phosphorous (%)	Potassium (%)	chlorophyll (mg/100 g)	Ash (%)	Crude fibre (%)	Carotenoid (%)
C1M1	2.91	0.11	1.12	0.0136	6.75	1.43	0.068
C1M2	2.21	0.07	0.95	0.0124	5.15	0.93	0.062
C1M3	2.43	0.09	1.02	0.0134	8.75	0.86	0.067
C1M4	3.39	0.12	1.36	0.0152	6.35	0.90	0.076
C1M5	3.00	0.13	1.96	0.0160	10.90	1.45	0.080
C1M6	2.67	0.16	1.40	0.0148	5.55	0.91	0.074
C2M1	1.80	0.05	1.44	0.0114	12.50	2.00	0.067
C2M2	1.41	0.03	1.04	0.0105	11.00	1.66	0.058
C2M3	1.69	0.04	1.38	0.0120	11.20	1.95	0.059
C2M4	2.26	0.08	1.96	0.0124	9.95	2.05	0.062
C2M5	2.39	0.10	2.04	0.0176	9.50	2.10	0.081
C2M6	1.93	0.06	1.34	0.0147	5.45	1.94	0.061
C3M1	1.30	0.12	1.68	0.0134	5.50	1.46	0.057
C3M2	1.08	0.05	0.92	0.0116	6.00	0.94	0.052
C3M3	1.23	0.09	1.40	0.0119	5.80	1.50	0.060
C3M4	1.93	0.14	2.04	0.0123	4.80	2.15	0.062
C3M5	2.16	0.13	2.00	0.0163	6.00	2.20	0.088
C3M6	2.00	0.12	1.93	0.0123	8.95	1.60	0.073
C4M1	3.63	0.10	2.72	0.0138	11.95	0.64	0.069
C4M2	3.24	0.08	2.04	0.0117	13.45	0.51	0.058
C4M3	3.38	0.10	2.20	0.0136	8.95	0.78	0.068
C4M4	3.91	0.16	3.10	0.0162	12.75	0.94	0.081
C4M5	4.09	0.18	3.15	0.0192	11.85	0.80	0.096
C4M6	3.99	0.13	2.16	0.0178	10.15	0.91	0.089
C5M1	1.53	0.07	1.50	0.0148	5.55	1.01	0.074
C5M2	1.32	0.03	0.65	0.0103	6.35	0.51	0.052
C5M3	1.56	0.04	0.98	0.0108	12.25	0.61	0.054
C5M4	2.13	0.08	1.74	0.0156	5.45	0.78	0.078
C5M5	2.25	0.09	1.73	0.0177	6.55	1.11	0.089
C5M6	1.93	0.07	1.45	0.0150	9.45	0.98	0.075
C6M1	2.27	0.09	2.06	0.0175	6.15	1.76	0.087
C6M2	2.06	0.07	1.88	0.0127	6.85	1.51	0.063
C6M3	2.20	0.11	1.94	0.0176	5.95	1.65	0.088
C6M4	3.31	0.12	2.37	0.0209	5.85	2.11	0.104
C6M5	3.80	0.13	3.12	0.0218	11.15	2.31	0.109
C6M6	2.95	0.12	2.39	0.0190	10.65	1.99	0.095



Fresh weight graph 1

CONCLUSION

It has been observed that cultivars and media showed positive relation in DWC of aquaponics system. It could be concluded that heads formed in DWC are less compact, yet cultivars like Iceberg followed by Batavia performed well in different media combination. The lettuce grown in Cocopeat media in combination with organic supplements like vermicompost and FYM had better results for plant growth. Acidic and course sized media like peat moss retard yield of lettuce in DWC. Biochemical parameters of cultivars also varies with nutritional support from media and cultured water.

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