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Growth and Quality analysis of strawberry (*Fragaria ananassa*) *cv*. Chandler in two production system

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ABSTRACT

The Department of Horticulture at Sam Higginbottom University of Agriculture, Technology and Sciences in Prayagraj conducted an experiment over 140 days in the years 2019–2020 and 2020–2021 to investigate the effects of different grow, micro and bloom nutrient dose and substrate combinations under Hydroponics and pot cultivation in Prayagraj climatic zones for higher yield and quality of strawberry. The experiment was set up using a Factorial Randomized Block Design (FRBD), with three replications, each with two hydroponic systems and 12 T_0 (control). The two different types of Planting systems (pot experiments and hydroponic experiments), as well as their interaction, has a big impact on the Plants's yield and quality parameters. The results show that Plants grown in a hydroponic system along T_7 (with Grow, Micro, and Bloom) at 24-hour intervals of 42 days optimize production and perform best in terms of growth, yield and quality contributing traits. In comparison to soil and soilless medium, the hydroponic system produced yields that were 20-92% and 16-91% greater, respectively. The nutrient absorption was likewise the highest under this method, indicating that nutrients are available to Plants in hydroponic systems more readily than in soilless medium or soil, and that this method provided the largest net returns and benefits and rate of cost.

Key words: *Strawberry, Hydroponics, Grows, Micro and bloom nutrient dose, Vermicompost, Perlite, Cocopeat, Yield, Quality.*

Introduction

Strawberry (*Fragaria × ananassa Duch*) is one of the most popular soft fruits cultivated in plains as well as in the hills up to an elevation of 3000 m in humid or dry regions. In India it is being widely cultivated in Himachal Pradesh, Uttar Pradesh, Maharashtra, West Bengal, Delhi, Haryana, Punjab and Rajasthan. Sub-tropical areas in Jammu have also the potential to grow the crop under irrigated condition. There are limitations when cultivating strawberries in the soil related to the prohibition of chemical fumigants for the control of phyto pathogens and to the ergonomic difficulties of cultivating the Plants on the ground (Godoi *et al.*, 2009).

As a Plants with short roots, strawberries require efficient nutrition management. The soil supports the root system physically and serves as a reservoir for nutrients and water. Strawberries may be grown without soil to satisfy the year-round growth in demand. Soilless culture is a synthetic way of giving Plants a base and a source of nutrients and water. Substrates should be able to store water and nutrients, provide appropriate root system aeration, be lightweight, and be devoid of pathogenic organisms and Plants-toxic chemicals (Johnson *et al.*, 2010). Utilizing various organic and inorganic substrates enables the Plants to better absorb nutrients, grow and

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develop to their full potential, and keep water and oxygen at optimal levels (Albaho *et al.,* 2009). Strawberries are cultivated in greenhouses using soilless agriculture in temperate places including northern and central Europe, Korea, Japan, and some parts of China. Strawberries are produced in glasshouses in Holland, where the temperature, irrigation, and CO_2 supply are all controlled. Other nations employ a range of growth containers and soilless medium to grow strawberries in polyethylene-covered greenhouses, including micro or macro tunnels. Strawberry farming in greenhouses offers the benefit of higher yield per unit area, early harvesting when market prices are high, comparatively simpler pest control with less chemical use, and better fruit quality (Dinar, 2003).

Raised platforms make cultivation easier and more labor-efficient, remove the need for fumigant soil materials, and reduce the incidence of leaf diseases, which reduces the need for pesticide applications. Additionally, fruit quality has improved in terms of sensory quality as well as chemical and microbiological pollutants. Hydroponic systems can be either closed, in which case the nutrient solution supplied to the roots returns to the reservoir, or open, in which case it does not. Currently, growing in pots or polybags utilizing a variety of substrates is more common than closed systems with drainage-loss of the nutritional solution. However, the tendency is toward production utilizing a substrate in a closed system with recirculation of the nutrient solution because of economic and environmental concerns (Lieten *et al.,* 2004). Because of its physical and chemical properties, such as excellent porosity, lack of reaction to fertilizer nutrients, long durability without alterations in its physical characteristics, the possibility of sterilization, and being an abundant and renewable raw material at low cost, coir is widely used as a substrate in the soilless cultivation of vegetables and flowers (Carrijo *et al.,* 2002). Alternative soilless cultivation production systems are a current intensive cultivation technique that can offer more effective use of fertilizers and water under protected settings. With farmers owning tiny land holdings and costly land regions, this strategy allows for maximum yields, which makes it economically viable. One of the most common substrates for the development of hydroponic strawberries in underdeveloped nations is the mix of several growth medium. Scientific interest in soilless cultivation in greenhouse environments has grown in regions of the world where it hasn't previously been practiced. Soilless media provides greater advantages than weed-seed-free medium, reduced incidence rates for root diseases, and easier crop nutrition control. In addition, soilless Plants production systems have been used for millennia and allow crops to be produced in areas with unsuitable soil or soil that has been polluted in some way.

Materials and Methods

Hydroponic and soil Plants were grown and maintained at the Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. The Agricultural Experimental Station Greenhouse Complex is a state of the art facility, equipped with automatic heating and cooling systems. Supplemental light was used for either system due to the 140 days of experiences per year. The greenhouse temperature was maintained at 70°F during the day (5:30 AM to 6:30 PM) and 60°F (6:31 PM to 5:29 AM) at night with relative humidity averaging at 30%. Sixty bare-root, ever-bearing strawberry Plants ('Chandler,' *Fragaria x ananassa*) were purchased from the nursery. Thirty strawberries were Planted in hydroponic conditions and thirty strawberries were Planted in soil conditions. The soil Plants and the hydroponics Plants were randomized and placed in eleven rows on two tables. Both the hydroponic and the soil-grown Plants were numbered for recording and monitoring Plants health. In both growing conditions, first-buds and runners were manually removed to increase fruit production.

Soil system: The Chandler strawberries were Planted according to manufacturing instructions, in 3-gallon black plastic nursery pots with drainage holes in the bottom of the pots. Two strawberries were Planted in each pot, approximately 10" apart. The soil was a mixture of M_0 – Soil, M_1 – Vermicompost + Perlite + Cocopeat (15:40:45) and M_2 – Vermicompost + Perlite + Cocopeat (25:35:40). The pH of the soil was monitored using a portable pH meter before Planting and during the season.

Hydroponic system: The Nutrient film technique system is employed consisting of vanilla round shaped pots that each having 2.8 litter capacity were placed on above of each other with help of a metal pole to form a cylinder shaped column. The 20 cm PVC cut-pipe sleeves placed between every tow pots to keep pots vertically apart of each other and

the first pot from the bottom placed at 45 cm elevation from surface of the ground which gave a column with height of 162 cm. The distance between row and columns was 100 cm and 70 cm, respectively. Each column consist four pots and each pot accommodated four Plants with sixteen Plants per column. Each pot supplied with nutrient solution through micro tubes with 8 liters per hour discharging capacity from above lateral lines. Treatments include different concentrations of GROW, MICRO and BLOOM at different hour viz. (12 hour, 18 hour and 24 hour), also Plants growth stages stated as seedling stage, vegetative growth, Transition, bloom and bloom ripening. There were 11 treatments each replicated thrice followed by a change of nutrients and water after every 20 days. The experiment was laid out in Factorial Randomized Block Design.

Results and Discussion

Yield attributes

Yield attributes, which determine yield, is the resultant of the vegetative development of the Plants. All the attributes of yield viz. No. of flower/Plants, Days taken to first flowering, Days taken to first fruit, No. fruits per Plants, Average fruit weight (g) and Yield per setup (kg) of strawberry (*Fragaria ananassa)* cv. Chandler were significantly influenced by different treatments and two different system. Among the concentration (Grow, micro and bloom) in treatments T_7 of 24 hr giving the highest growth (44.46, 55.90, 82.09, 23.00, 18.20 and 47.86), respectively as compared to other treatment and hour in hydroponic system followed by T_8(44.03, 57.87, 86.76, 22.39, 17.69 and 47.08) and minimum (0.00, 0.00, 0.00, 0.00 and 0.00 cm) was T_0(Plain water) at harvest. However, similar trend was also obtained in pot experiment of different growth media in (Table 1-2).

Higher yield of hydroponics results from the easy availability of nutrients and water to the Plants which allow for continuous production year round. The present results get support from the findings of Treftz *et al.* (2015) who reported 17per cent increase in the yield of hydroponics grown strawberries as compared to soil-grown strawberries. Greenhouse production of strawberry has the advantage of increased yield per unit area, early production when market prices are high, relatively easier pest management with reduced use of chemicals, as well as better fruit quality (Dinar, 2003).

Table 1. Effects of different treatments under two different system on No. of flower/Plants, Days taken to first flowering and Days taken to first fruit of strawberry *(Fragaria ananassa)* cv. Chandler.

Treatments	No. of flower/Plants						Days taken to first flowering						Days taken to first fruit					
	Hydroponics system			Pot system			Hydroponics system			Pot system			Hydroponics system			Pot system		
	12_{hrs}	18_{hrs}	24_{hrs}	M_0	M_1	M_2	12_{hrs}	18_{hrs}	24_{hrs}	M_0	M_1	M_2	12_{hrs}	18_{hrs}	24_{hrs}	M_0	M_1	M_2
T_0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T_1	31.27	37.52	38.19	30.11	36.36	37.03	76.32	74.95	73.98	76.89	75.52	74.55	100.16	99.83	99.36	100.57	100.24	99.77
T_2	26.72	31.51	32.18	25.83	30.37	31.04	74.61	73.24	72.27	75.18	73.81	72.84	94.50	94.17	93.90	94.91	94.58	94.31
T_3	33.56	38.94	39.61	32.39	37.77	38.44	59.77	58.40	57.43	60.34	58.97	58.00	117.03	116.70	116.33	117.44	117.11	116.74
T_4	27.45	32.19	32.86	26.47	31.07	31.74	68.91	67.54	66.57	69.48	68.11	67.14	89.94	89.61	89.24	90.35	90.02	89.65
T_5	29.08	34.03	34.70	27.97	32.91	33.58	64.08	62.71	61.74	64.65	63.28	62.31	115.12	114.79	114.42	115.53	115.20	114.83
T_6	32.66	38.17	38.84	31.53	37.04	37.71	71.59	70.22	69.25	72.16	70.79	69.82	111.21	110.88	110.56	111.62	111.29	110.97
T_7	38.09	43.79	44.46	36.89	42.59	43.26	58.24	56.87	55.90	58.81	57.44	56.47	82.79	82.46	82.09	83.20	82.87	82.50
T_8	37.50	43.36	44.03	34.35	39.73	40.40	60.21	58.84	57.87	62.33	60.96	59.99	87.46	87.13	86.76	119.43	119.10	118.73
T_9	35.52	40.90	41.57	36.34	42.20	42.87	61.76	60.39	59.42	60.78	59.41	58.44	119.02	118.69	118.32	87.87	87.54	87.17
T_{10}	32.69	37.71	38.38	31.60	36.62	37.29	67.34	65.97	65.00	67.91	66.54	65.57	100.98	100.65	100.30	101.39	101.06	100.71
T_{11}	29.50	34.15	34.82	28.40	33.05	33.72	67.05	65.68	64.71	67.62	66.25	65.28	104.00	103.67	103.36	104.41	104.08	103.77
	SE(m)	C.D. at 5%		SE(m)	C.D. at 5%		SE(m)	C.D. at 5%		SE(m)	C.D. at 5%		SE(m)	C.D. at 5%		SE(m)	C.D. at 5%	
Hour and soil	0.438	0.904	*	0.439	0.905	*	0.705	1.456	*	0.717	1.479	*	1.023	2.112	*	1.026	2.117	*
Treatments	0.839	1.732	*	0.84	1.734	*	1.351	2.788	*	1.373	2.833	*	1.959	4.044	*	1.964	4.054	*

Quality parameters

The result of the present study indicated that quality parameters of such as Total soluble sugars (0brix), Ascorbic Acid (mg/100g) and Titrable acidity, Moisture content (%) and Dry weight (g) of strawberry *(Fragaria ananassa)* cv. Chandler were significantly influenced by different treatments and two different system. Among the concentration (Grow, micro and bloom) in treatments T_7 of 24 hr giving the highest growth (14.61, 70.50, 0.96, 95.61 and 5.24), respectively as compared to other treatment and hour in hydroponic system followed by T_8(14.12, 69.42, 0.75, 94.77 and 6.01) and minimum (7.65, 40.49, 0.59 and 93.06) was T_2(12hr) at harvest. However, similar trend was also obtained in pot experiment of different growth media (Table 3-4).

Although there are numerous benefits to the hydroponic system, it does not automatically guarantee a high quality product.As this technology is advancing, it is important to consider the sensory attributes of the hydroponic product since taste is one of the main drivers of consumption Ho (2004).

Caruso *et al.* (2011) reported improved fruit quality through nutrient solution with EC 1.3 dS/cm in spring season and through 2.2 mS/cm in winters under NFT in strawberry cv. Alpine. Souza *et al.* (2011) observed fastest transplanting stage and grafting stage at 30 and 61 days after transplanting under hydroponics system for commercial grafts production in peach. Motosugi *et al.* (1995) reported increase in anthocyanin level with ammonium nitrogen nutrient solution at pH 3–3.5 under NFT in grapevines.

The total soluble solids represent the acids, sugars, soluble salts, proteins and other dissolved substances of the cell sap Wills *et al.*, (2008). In our study we found that total soluble solids (TSS) of strawberry were maximum when grown on the T_7 (14.61 %) as compared to the other media including control. These results showed that nutrients can improve the TSS of strawberry fruits. Ali *et al.* (2003) has reported that farm yard manure based growing medium caused an increase in TSS percentage.

Table 2. Effects of different treatments under two different system on No. fruits per Plants, Average fruit weight (g) and Yield per setup (kg) of strawberry *(Fragaria ananassa)* cv. Chandler.

Treatments	No. fruits per Plants						Average fruit weight (g)						Yield per setup (kg)					
	Hydroponics system			Pot system			Hydroponics system			Pot system			Hydroponics system			Pot system		
	12_{hrs}	18_{hrs}	24_{hrs}	M_0	M_1	M_2	12_{hrs}	18_{hrs}	24_{hrs}	M_0	M_1	M_2	12_{hrs}	18_{hrs}	24_{hrs}	M_0	M_1	M_2
T_0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T_1	11.93	14.88	15.55	10.87	13.72	14.39	7.40	9.58	10.25	6.24	8.42	9.09	14.99	18.46	19.13	13.83	17.30	17.97
T_2	17.28	20.33	21.00	16.09	19.14	19.81	9.67	11.79	12.46	8.70	10.66	11.33	29.51	34.70	35.37	28.37	33.56	34.23
T_3	16.34	19.52	20.19	15.18	18.36	19.03	12.58	15.17	15.84	11.41	14.00	14.67	36.50	42.14	42.81	35.34	40.97	41.64
T_4	17.58	20.92	21.59	16.47	19.81	20.48	9.81	12.10	12.77	8.76	10.98	11.65	29.55	34.66	35.33	28.43	33.54	34.21
T_5	16.99	20.31	20.98	15.86	19.18	19.85	11.33	13.80	14.47	10.22	12.68	13.35	32.75	38.21	38.88	31.64	37.10	37.77
T_6	17.05	20.08	20.75	15.88	18.91	19.58	12.60	15.30	15.97	11.47	14.17	14.84	36.82	42.91	43.58	35.69	41.78	42.45
T_7	18.82	22.33	23.00	17.88	21.19	21.86	14.79	17.53	18.20	13.60	16.33	17.00	41.10	47.19	47.86	39.91	45.99	46.66
T_8	18.23	21.72	22.39	17.11	20.60	21.27	14.25	17.02	17.69	13.09	15.86	16.53	40.18	46.41	47.08	39.02	45.25	45.92
T_9	17.33	20.51	21.18	16.17	19.35	20.02	13.57	16.16	16.83	12.40	14.99	15.66	37.49	43.13	43.80	36.33	41.96	42.63
T_{10}	16.68	19.67	20.34	15.59	18.58	19.25	12.58	15.05	15.72	11.49	13.96	14.63	34.13	39.34	40.01	33.04	38.25	38.92
T_{11}	17.16	20.24	20.91	16.06	19.14	19.81	11.50	13.86	14.53	10.40	12.76	13.43	32.68	37.73	38.40	31.58	36.63	37.30
	SE(m)	C.D. at 5%		SE(m)	C.D. at 5%		SE(m)	C.D. at 5%		SE(m)	C.D. at 5%		SE(m)	C.D. at 5%		SE(m)	C.D. at 5%	
Hour and soil	0.27	0.557	*	0.267	0.552	*	0.219	0.453	*	0.22	0.454	*	0.463	0.956	*	0.463	0.956	*
Treatments	0.517	1.067	*	0.512	1.057	*	0.42	0.867	*	0.421	0.869	*	0.887	1.83	*	0.887	1.83	*

Strawberries are very rich source of ascorbic acid contents, (Food and Nutrition Board, 1989) and contain more vitamin C as compared to oranges (Ayub *et al.*, 2010). It is known that organic cultivation improve the ascorbic acid contents of the fruits. We observed with our growing media a significant influence on ascorbic acid contents in our strawberry Plants. However, the nutrients, T_7 showed more significant effects on ascorbic acid and Moisture content (%) of fruits.

Conclusion

The present investigation entitled "Growth, Yield and Economic analysis of strawberry *(Fragaria ananassa)* in two different production systems cv. Chandler" was carried out during 2018-2019 in Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. Hydroponic seems to be a promising technique to grow crops using soil-less growing media to avoid soil-borne pests and diseases as well as scarcity of space. The different components of the hydroponic system were designed for the ebb and flow technique. In ebb and flow technique the basic principal is the maintenance of the flow of nutrient around the roots of the Plants. The nutrient solution is circulated 24 x 7 schedules although intermittently. The timing of operation of nutrient flow is based on the volume of water required for a given length of pipe in one go. The experiment was laid out three replications and keeping 11 treatments including control of hydroponic structure and pot cultivation condition.Results and discussion which were presented in the preceding chapters are summarized below.

Vegetative parameters

Plants height

The maximum Plants height was recorded in treatment T_7(with Grow, micro and bloom) in 24 hr with (10.03, 15.95, 18.29 and 18.72 cm), respectively as compared to other treatment and hour in hydroponic and minimum (5.94, 0.00, 0.00 and 0.00 cm) was T0(Plain water) at different days interval 30, 60 90 120 days. However, similar trend was also obtained in pot experiment of different growth media.

Plants spread

The highest Plants Spread was recorded in treat-

Table 3. Effects of different treatments under two different system on Total soluble sugars (0brix), Ascorbic Acid (mg/100g) and Titrableacidityof strawberry *(Fragaria ananassa)* cv. Chandler.

Nutrients	Total soluble sugars (0brix)						Ascorbic Acid (mg/100g)						Titrable acidity (Citric acid % on reshweiht basis)					
Doses	Hydroponics system			Pot system			Hhydroponics system			Pot system			Hydroponics system			Pot system		
ml	12_{hrs}	18_{hrs}	24_{hrs}	M_0	M_1	M_2	12_{hrs}	18_{hrs}	24_{hrs}	M_0	M_1	M_2	12_{hrs}	18_{hrs}	24_{hrs}	M_0	M_1	M_2
T_0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T_1	11.70	14.61	15.28	10.54	13.45	14.22	44.06	51.41	52.58	42.98	50.38	51.42	0.62	0.71	0.76	0.51	0.49	0.54
T_2	7.65	9.60	10.27	6.54	8.49	9.16	40.49	47.28	47.95	39.35	46.14	46.81	0.59	0.68	0.69	0.36	0.46	0.46
T_3	8.06	10.10	10.77	7.08	8.97	9.64	50.64	58.72	59.39	49.52	57.60	58.27	0.77	0.87	0.87	0.54	0.65	0.64
T_4	9.87	12.19	12.86	8.88	11.05	11.72	50.06	57.93	58.60	48.94	56.82	57.49	0.65	0.63	0.79	0.42	0.41	0.56
T_5	9.47	11.73	12.40	8.34	10.60	11.27	41.09	47.77	48.44	39.96	46.64	47.31	0.71	0.88	0.89	0.48	0.66	0.66
T_6	10.88	13.20	13.87	9.72	12.04	12.71	53.49	61.43	62.10	52.33	60.27	60.94	0.83	0.85	0.96	0.60	0.63	0.73
T_7	11.61	13.94	14.61	10.42	12.75	13.42	61.19	69.83	70.50	60.00	68.64	69.31	0.82	0.86	0.96	0.59	0.63	0.73
T_8	11.16	13.45	14.12	10.00	12.28	12.95	60.22	68.75	69.42	59.06	67.58	68.25	0.75	0.94	0.90	0.52	0.72	0.67
T_9	10.59	12.81	13.48	9.50	11.72	12.39	54.70	62.53	63.20	53.61	61.44	62.11	0.70	0.88	0.95	0.47	0.66	0.72
T_{10}	11.49	13.84	14.51	10.39	12.74	13.41	47.41	54.33	55.00	46.31	53.23	53.90	0.68	0.86	0.93	0.45	0.64	0.70
T_{11}	10.24	12.56	13.23	9.25	11.42	12.09	40.86	47.65	48.32	39.72	46.51	47.18	0.79	0.86	0.86	0.53	0.64	0.63
	SE(m)	C.D. at 5%		SE(m)	C.D. at 5%		SE(m)	C.D. at 5%		SE(m)	C.D. at 5%		SE(m)	C.D. at 5%		SE(m)	C.D. at 5%	
Hour and soil	0.209	0.431	*	0.21	0.433	*	0.62	1.279	*	0.619	1.278	*	0.021	0.043	*	0.023	0.047	*
Treatments	0.4	0.826	*	0.402	0.83	*	1.187	2.449	*	1.186	2.447	*	0.039	0.081	*	0.043	0.089	*

ment T_7(with Grow, micro and bloom) in 24 hr with (58.29, 95.37, 129.53 and 157.71 cm), respectively as compared to other treatment and hour in hydroponic system and minimum (30.13, 0.00, 0.00 and 0.00 cm) was T0(Plain water) at different days interval 30, 60 90 120 days. However, similar trend was also obtained in pot experiment of different growth media.

No. of leaves

The highest No. of leaves was recorded in treatment in T_7 (with Grow, micro and bloom) 24 hr highest (11.24, 18.56, 24.20 and 25.71 cm), respectively as compared to other treatment and hour in hydroponic system and minimum (5.78, 0.00, 0.00 and 0.00 cm) was T0(Plain water) at different days interval 30, 60 90 120 days. However, similar trend was also obtained in pot experiment of different growth media.

Root length

The maximum Root length was recorded in treatment T_7(with Grow, micro and bloom) in 24 hr with (22.32, 36.68, 50.85 and 57.23 cm), respectively as compared to other treatment and hour in hydroponic system and minimum (9.40, 0.29, 0.00 and 0.00 cm) was T0 (Plain water) at different days interval 30, 60 90 120 days. However, similar trend was also obtained in pot experiment of different growth media.

Leaf area

The highest Leaf Area was recorded in treatment T_7 (with Grow, micro and bloom) in 24 hr with (5.97, 9.32, 12.56 and 27.02 cm), respectively as compared to other treatment and hour in hydroponic system and minimum (3.40, 0.00, 0.00 and 0.00 cm) was T0 (Plain water) at different days interval 30, 60 90 120 days. However, similar trend was also obtained in pot experiment of different growth media.

Flowering parameters

Total no. of flowers per Plants

The highest No. of flower/Plantswas recorded in treatment T_7 (with Grow, micro and bloom) in 24 hr with (44.46), respectively as compared to other treatment and hour in hydroponic system and minimum (0.00) was T0 (Plain water). However, similar trend was also obtained in pot experiment of different growth media.

Days taken to first flowering

The Days taken to first flowering was recorded in minimum treatment T_7(with Grow, micro and bloom) in 24 hr with (55.90), as compared to other treatment and hour in hydroponic system and highest (73.98) was T2 (with 3 ml Grow, 3 ml micro and 3 ml bloom). However, similar trend was also obtained in pot experiment of different growth media.

Table 4. Effects of different treatments under two different system on Moisture content (%),andDry weight (g)of strawberry *(Fragaria ananassa)* cv. Chandler.

Nutrients	Moisture content (%)						Dry weight (g)					
Doses ml	hydroponics system			Pot system			hydroponics system			Pot system		
	12_{hrs}	18_{hrs}	24_{hrs}	M_0	M_1	M_2	12_{hrs}	18_{hrs}	24_{hrs}	M_0	M_1	M_2
T_0	0	0	0	0	0	0	50	50	50	100	100	100
T_1	93.11	93.97	94.64	91.97	92.83	93.50	6.95	6.54	5.87	7.86	7.70	7.03
T_2	93.06	93.47	94.14	92.15	92.31	92.98	6.89	6.03	5.36	8.03	7.17	6.50
T_3	93.26	94.12	94.79	92.14	93.00	93.67	6.74	5.88	5.21	7.86	7.00	6.33
T_4	93.66	94.56	95.23	92.55	93.45	94.12	6.34	5.44	4.77	7.45	6.55	5.88
T_5	93.20	94.13	94.80	92.07	93.00	93.67	6.80	5.87	5.20	7.93	7.00	6.33
T_6	93.44	94.37	95.04	92.28	93.21	93.88	6.56	5.63	4.96	7.72	6.79	6.12
T_7	93.99	94.94	95.61	92.79	93.75	94.42	6.86	5.91	5.24	8.02	7.07	6.40
T_8	93.14	94.10	94.77	91.98	92.93	93.60	6.01	5.06	4.39	7.21	6.26	5.59
T_9	93.02	93.97	94.64	91.93	92.88	93.55	6.98	6.04	5.36	8.07	7.13	6.46
T_{10}	93.43	93.84	94.51	92.52	92.68	93.35	6.58	6.17	5.50	7.49	7.33	6.66
T_{11}	92.83	93.77	94.44	91.73	92.67	93.34	7.17	6.23	5.56	8.27	7.33	6.66
	SE(m)	C.D. at 5%		SE(m)	C.D. at 5%		SE(m)	C.D. at 5%		SE(m)	C.D. at 5%	
Hour and soil	0.106	0.22	*	0.113	0.233	*	0.106	0.22	*	0.113	0.233	*
Treatments	0.204	0.421	*	0.216	0.446	*	0.204	0.421	*	0.216	0.446	*

Days taken to first fruit

The highest Days taken to first fruit was recorded in treatment T_7 (with Grow, micro and bloom) in 24 hr with (82.09), as compared to other treatment and hour in hydroponic system and highest (99.36) was T2 (with 3 ml Grow, 3 ml micro and 3 ml bloom). However, similar trend was also obtained in pot experiment of different growth media.

Yield parameters

No. of fruits/Plants

The No. fruits per Plants was recorded in treatment T_7 (with Grow, micro and bloom) in 24 hr with (23.00), as compared to other treatment and hour in hydroponic system and minimum (0.00) was T0 (Plain water). However, similar trend was also obtained in pot experiment of different growth media.

Average fruit weight (g)

The highest Average fruit weight (g) was recorded in treatment T_7 (with Grow, micro and bloom) in 24 hr with (18.20), as compared to other treatment and hour in hydroponic system and minimum (0.00) was T0 (Plain water). However, similar trend was also obtained in pot experiment of different growth media.

Yield per setup (kg)

The highest Yield per setup (kg) was recorded in treatment T_7 (with Grow, micro and bloom) in 24 hr with (47.86), as compared to other treatment and hour in hydroponic system and minimum (0.00) was T0(Plain water). However, similar trend was also obtained in pot experiment of different growth media.

Quality parameters

Total soluble sugars (0 brix)

The highest Total soluble sugars (0 brix) was recorded in treatment T_7 (with Grow, micro and bloom) in 24 hr with (15.28), as compared to other treatment and hour in hydroponic system and minimum (0.00) was T0 (Plain water). However, similar trend was also obtained in pot experiment of different growth media.

Ascorbic Acid (mg/100g)

The highest Ascorbic Acid (mg/100g) was recorded in treatment T_7 (with Grow, micro and bloom) in 24 hr with (70.50), as compared to other treatment and hour in hydroponic system and minimum (0.00) was T0 (Plain water). However, similar trend was also obtained in pot experiment of different growth media.

Titrable acidity

The highest Titrable acidity (Citric acid % on reshweiht basis) was recorded in treatment T_7 (with Grow, micro and bloom) in 24 hr with (0.96), as compared to other treatment and hour in hydroponic system and minimum (0.00) was T0 (Plain water). However, similar trend was also obtained in pot experiment of different growth media.

Moisture content (%)

The highest Moisture content (%) was recorded in treatment T_7 (with Grow, micro and bloom) in 24 hr with (95.61), as compared to other treatment and hour in hydroponic system and minimum (0.00) was T0 (Plain water). However, similar trend was also obtained in pot experiment of different growth media.

Dry weight(g)

The highest Dry Weight(g) was recorded in treatment T_1 (with Grow, micro and bloom) in 24 hr with (5.87), as compared to other treatment and hour in hydroponic system and minimum (0.00) was T0 (Plain water). However, similar trend was also obtained in pot experiment of different growth media.

Economics

Even though the cost incurred was comparatively higher is soil - less method, the net return was Rs5,831 higher for hydroponics in 24 hr and Rs5,438 higher for pot experiment in [Vermicompost + Perlite + Cocopeat (25:35:40)]. The return per rupee (B:C ratio) was found higher hydroponics in 24 hr (1:3.09), however with (1:2.84) pot experiment in [Vermicompost + Perlite + Cocopeat (25:35:40), respectively of two years and pooled data

Conclusion

In soil-grown Plants, fertilizers are incorporated into the ground or applied topically, while in hydroponics, a solution of ionic chemicals aids in the delivery of nutrients to the Plants' internal organs. Because fertilizers are delivered directly to the roots of Plants via hydroponics, it is better at supplying them with

the nutrients they require. Hydroponics has been shown to be superior and sustainable for producing a variety of crops due to its improved control over the environmental conditions. It has shown to be a very efficient approach for growing fruits of outstanding quality with great yielding potential, especially in the case of berry crops like strawberry. Strawberries cultivated hydroponically have been discovered to provide fruits with increased levels of vitamin C, Total soluble sugars (^{0}brix), and Ascorbic Acid (mg/100g). The fertilizer requirements of the Plants can be addressed more effectively by using various hydroponic systems and substrates. According to the crop's needs, the best possible supply of nutrients and water must be made available to guarantee that the Plants may continue to develop without any shortage or excess of either. With the previously mentioned benefits, hydroponics is a better option than traditional techniques for producing fruits with less water and fertilizer consumption.

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