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A RESEARCH ON PRODUCTION OF BABY LEAF VEGETABLES IN FLOATING SYSTEM

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Abstract

In this research, the possibility of dill, parsley and leaf lettuce growth in a floating system was studied with the purpose of less nutrient (fertilizer) use. These baby leaf vegetables have short production cycles. The effect of full and half strength nutrient solutions on yield, quality and leaf nutrient status was studied. Research was carried during the spring production seasons of 2010. Standard nutrient solution ((mM) 12 N-NO_3, 3.8 N-NH_4, 2.8 P, 8.4 K, 3.5 Ca, 1.4 Mg, 9.5 Na, 8.0 Cl, 2.7 S, 0.04 Fe) was used as full strength (control treatment) and compared to half strength Hoagland nutrient solution. In both of the seasons total yield changed between 1030.78-1149.90 g m^{-2} in dill, 604.73-659.70 g m^{-2} parsley and leaf lettuce 162.60- 143 g $plant^{-1}$ respectively. In this study, the effect of treatments on some quality parameters (dry weight, vitamin C, nitrate, pH and EC) and nutrients uptake by plant were determined. When the results are evaluated as a whole, it was concluded that half strength nutrient solution decreased yield. Some savings could be achieved in terms of nutrient solution consumed by the plant with the negative impact on the environment.

Keywords

Floating system; Hoagland nutrient solution; yield; quality, baby leaf vegetable

1. Introduction

Baby leaf vegetables like dill, parsley and leaf lettuce are popular spice vegetables used in Turkey. Generally, leaves are used for garnish and flavoring dishes. Dill (Anethum graveolens) is a herb leaves and seeds are used for flavouring and seasoning [1]. It is the sole species of the genus Dill use fresh and dried leaves (sometimes called "dill weed" to distinguish it from dill seed) which are widely used as herbs in Europe and central Asia. Dill is best when used fresh as it loses its flavour rapidly if dried; however, freeze-dried dill leaves retain their flavour relatively well for a few months. Parsley is naturalized (grown) elsewhere and widely cultivated as a herb, a spice, and a vegetable. Parsley is one of the most important vegetables produced in the world. Its varieties differ according to the commercial organs. There are leafed parsley such as plain and curly leafed varieties and fleshy root parsley such as Hamburg varieties [2, 3]. Lettuce (Lactuca sativa L.) is a vegetable from Compositeae (Asteraceae) family which grows both in open field and greenhouse conditions during all year and consumed fresh and in salads and has appetizing character with vitamins and minerals in their leaves [4, 5, 6].

Dill, parsley and leaf lettuce which are the three types of leaf-edible vegetables used widely and increasingly in our country are also grown in Mediterranean and Southern European countries. These vegetables can be used fresh as salad and garnish and can be grown all year round [7]. They are rich in vitamins and minerals. It is known that Vitamin C is especially effective on many biological activities in human body [8].

Small-size leafy vegetables can profitably be cultivated in a floating system to get fresh market products or ready-to-use salads that are arousing more and more interest by consumers. Among hydroponic methods, the floating system is the easiest and cheapest way to produce baby leaf vegetables when soil cultivation is not feasible any more [9]. At the same time, fertilization is one of the most practical and effective ways of controlling and improving the yield and nutritional quality of crops for human consumption. The optimal fertilizer concentration for baby leaf vegetables depends on the environmental conditions.

The objective of this study was to investigate the possibility of the production of dill, parsley and leaf lettuce which have short production cycles and baby leaf vegetable to reduce the concentration of nutrient solution in floating system.

2. Materials and methods

The research was conducted in an 18 x 40 m sized PE greenhouse belonging to Ege University Bayindir Vocational Training School (27° 40' D, 38° 11' K) in the growing periods of spring and autumn 2010-2011.

Dill (Anethum graveolens L. cv. Gönen), parsley (Petroselinum crispum cv. Italian Giant) and leaf lettuce (Lactuca sativa cv. Nika) were the vegetable materials of the experiment. In the study, desks covered with polyethylene covering at a height of 1 meter from the ground, made of galvanized steel and sized 2.40 x 1.40 x 0.30 m. were used. Viols of 53.5 x 34 cm were placed inside the desks. Two big perlite sheets were spread to the growing area. The seeds were planted manually as 1.5 g seeds per m^2 [7].

Cultivation started by seeding and seven days later viols were placed in the pond. In the study, nutrient solution was applied as

(1) full strength and (2) half strength. Hoagland solution [10] was the full strength nutrient solution and accepted as the control treatment (Table 1). The pH of nutrient solution was kept between 5.5-6.0 and the electrical conductivity between 1.8-2.2 dS m^{-1}.

Vegetables reached harvest maturity in 50-65 days in the autumn period and 30-40 days in the spring period. The total weight of the crops harvested was calculated in grams (g). Measurements are given as g m^{-2}. Vitamin C (mg $100ml^{-1}$) and nitrate (mg kg^{-1}) [11] values were specified related to the characteristics of leaf quality on December 3, 2010 and April 20, 2011.

During the study period, the water budget technique was utilized for calculating the vegetable water consumption values related to the topics. Seasonal vegetable water consumption was determined by subtracting the nutrient solution volume filled in the pond at the beginning of the production period and the nutrient solution volume remaining in the ponds at the end of the production period and by dividing them into vegetable cultivation area. The results are presented as the consumed nutrient solution amount (mm) [12, 13].

All the statistical analysis was done on a completely randomized blocks design with three replications. The data obtained was subjected to analysis of variance (ANOVA) and the mean differences were compared by LSD tests at the significant level of 95%.

3. Results

Yield

Parsley (Petroselinum crispum)

Every season one harvest was made and effect of treatments was evaluated. In this regard, no significant effect was determined. Marketable yields during the spring of 2010 were obtained as 604.73 and 659.70, respectively (Table 1.).

Table 1. Effect of treatments on marketable yield of parsley (g m^{-2}). Spring, 2010

Treatments (Hoagland solution)	Marketable yield (g m^{-2})
Full -strength (1)	659.70
Half-strength (2)	604.73
$LSD_{(0.05)}$	*ns*

Dill (Anethum graveolens)

Dill was grown only during spring 2010 and significant difference was not observed between with a single harvest. Marketable yields of Dill varied about 1030.78 to 1149.90 g m-2 of fresh matter (Table 2.).

Table 2. The effect of treatments on marketable yieldof dill (g m^{-2}). (Spring, 2010)

Treatments (Hoagland solution)	Marketable Yield
Full -strength (1)	1149.90
Half-strength (2)	1030.78
$LSD_{(0.05)}$	*ns*

Leaf Lettuce

In the autumn period of 2011, effect of treatments on the marketable yield of lettuce was found statistically significant at the full strength treatment, and it was increased the plant weight 12.5%.

Although higher marketable yield of leaf salad was found in the full treatment, effect of the treatments on the number of leaves was found not significant (Table 3.).

Table 3. The treatments on Effect of Marketable yield of leaf lettuce (g m^2) (Autumn, 2010).

Treatments (Hoagland solution)	Marketable Yield (g $plant^{-1}$)	Number of Leaves (piece $plant^{-1}$)
Full -strength (1)	162.60 a	23.75
Half-strength (2)	143.00 b	17.75
$LSD_{(0.05)}$	*9.85*	*ns*

Some Quality parameters

Parsley

In the autumn period of 2010 dry matter of parsley changed significantly differed according to the treatments. The EC of the plant (leaf extracts) was significantly different in the spring period of 2011. However, other quality parameters as L, hue, Croma, vitamin C, nitrate, and pH was found non-significant according to treatments in all three periods. During the autumn of 2010, dry weight (%) of the leaves was found 24.7 % higher, and EC of leaf 15.3% higher during the spring season of 2011 in the half-strength Hoagland solution (Table 4).

Table 4. The effect of treatments on some quality parameters in Parsley.

Year& Period	Treatment (Hoagland solution)	Color			D.W (%)	Vit C (mgg^{-1})	Nitrate ($mgkg^{-1}$)	EC (dSm^{-1})	pH
		L	Hue	Croma					
2010 Spring	Full -strength (1)	41.867	127.84	29.50	5.96	0.12	61.00	2.81	6.16
	Half-strength (2)	41.257	128.60	31.23	6.53	0.14	37.02	2.59	5.90
	$LSD_{(0.05)}$	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*

Dill

No effect of treatments on the studied quality parameters was determined on samples taken from the dill grown in spring 2010 (Table 5.).

Leaf lettuce

In the trial 2011 autumn, vitamin C content of the leaves changed significantly. Full-strength treatments of vitamin C values were found 28.37% higher. The effect of treatments on leaf dry weight and nitrates were not statistically significant (Table 6.).

Table 5. The effect of treatments on some quality parameters in Dill.

Year& Period	Treatments (Hoagland solution)	Color			D.W (%)	Vit C mgg^{-1}	Nitrate ($mgkg^{-1}$)	EC (dSm^{-1})	pH
		L	Hue	Croma					
2010 Spring	Full - strength (1)	46.67	126.67	34.36	7.00	0.16	58.19	2.67	6.0
	Half-strength (2)	47.67	126.33	36.43	6.00	0.23	53.13	3.00	6.0
	LSD $_{(0.05)}$	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*

Table 6. The effect of treatments on some quality parameters of leaf lettuce.

Year & Period	Treatments (Hoagland solution)	DW (%)	Vit. C (mgg^{-1})	Nitrate ($mgkg^{-1}$)
2011 Autumn	Full -strength (1)	9.99	76.33 a	90.82
	Half-strength (2)	15.56	54.67 b	68.85
	LSD (0.05)	*ns*	*13.68*	*ns*

Plant water consumption

Amount of nutrient solution consumed by the plant in floating system according to the growing period were given in Figure 1, 2, 3 and 4. Both years of 2010 and 2011 in spring and autumn periods, amount of nutrient solution consumed by plants in Full–strength treatment was found 35.71, 23.81, 34.23 and 22:32 mm and 32.74, 25.80, were 35.71 and 23.81 mm in half-strength.

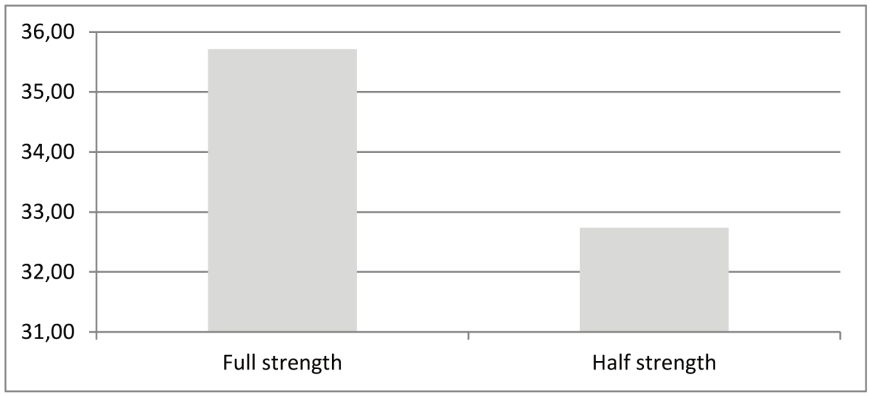

Figure 1. The amount of nutrient solution consumed by the plant (mm) (Spring 2010).

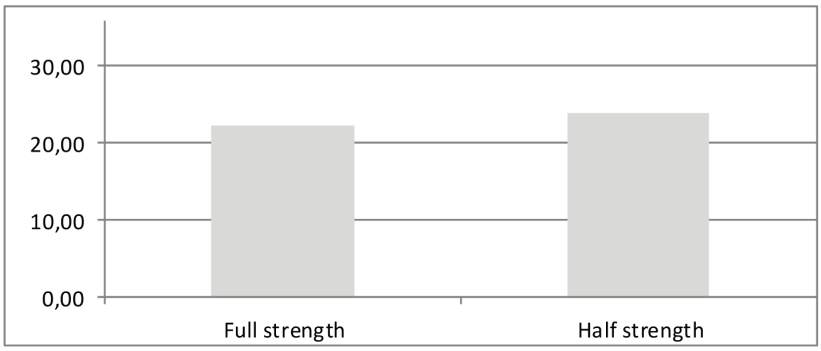

Figure 2. The amount of nutrient solution consumed by the plant (mm) (2010 Autumn).

4. Discussion

Vegetable production varies depending on many factors as cultivation period, method of production and climatic conditions, such as the number of plants per unit area. In our study, the effect of different nutrient solutions on yield with respect to growing period and plant species was found statistically non-significant.

In our study, the average leaf lettuce yields was 162.60g plant-1 in full strength and 143.00 g plant-1 in half strength nutrient solution, below the limits specified in the literature [14]. There was no difference in quality parameters between treatments.

In our experiment, the nitrate content of the leaves of Parsley, dill and leaf lettuce was determined below the limits constitute a hazard to human health [8, 15]

5. Conclusion

It is concluded that baby leaf vegetables grown in a floating system can successfully be grown under unheated greenhouse conditions. It is also concluded that half strength Hoagland nutrient solution can be suggested in order to preserve water and environment by providing nutrient use efficiency.

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