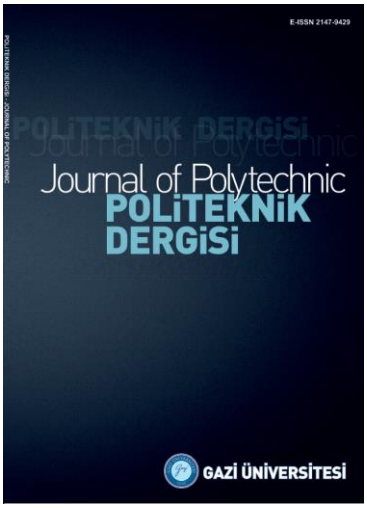

POLİTEKNİK DERGİSİ

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Effects of substrates on the growth of BETA VULGARIS SUBSP. VULGARIS in hydroponic systems

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Effects of Substrates on The Growth of BETA VULGARIS SUBSP. VULGARIS in Hydroponic Systems

Highlights

- Focuses on types of substrate materials (rice husk, coconut fiber, sand)
- The rate of media mix between coconut fiber, rice, and concentrations of Thiamine HCl (vitamin B1) on the growth of Rainbow Vinegar (Beta vulgaris subsp. Vulgaris).
- A different model system for the studies on nutrient growth interaction in Beta vulgaris subsp. Vulgaris
- A simple hydroponic culture system for Beta vulgaris subsp

Graphical Abstract

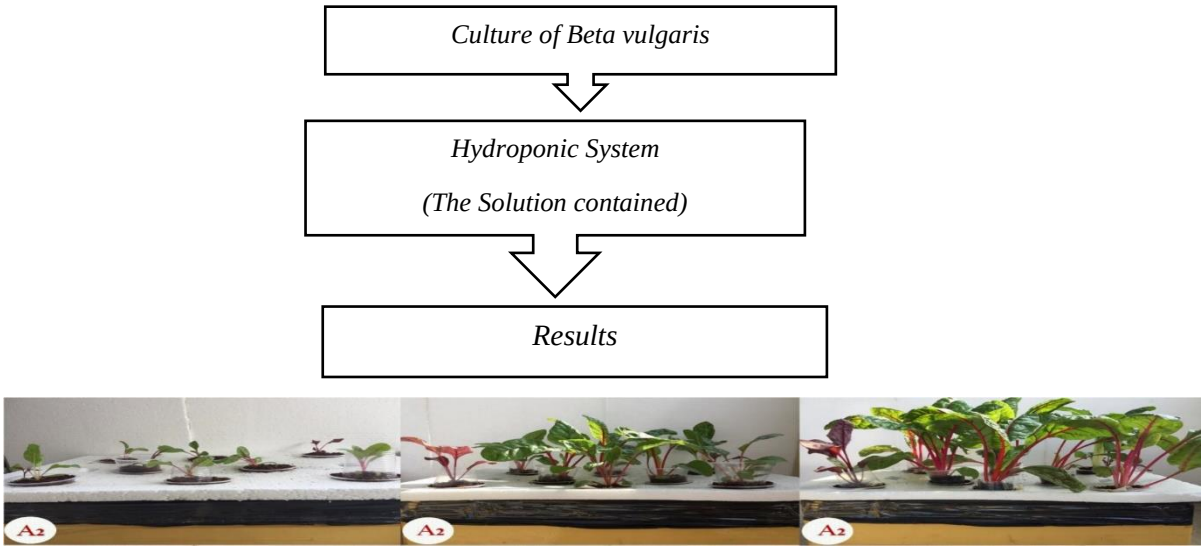

Figure: Culture of Beta vulgaris (A2) after 10; 20; 30 days, respectively

Aim

The method presented here provides Vulgaris to obtain a healthy plant having a well-developed root system with many lateral roots

Design & Methodology

Hydroponic system. For hydroponic growth, germinating sterilized seeds were planted (3 seeds .pot ') to a depth of 2 cm in plastic pots (I0cnl top diameter, 5 cm bottom diameter, and I0 cm height).

Originality

The hydroponic system is also crucial for the studies of growth nutrient interactions, and several hydroponic culture systems established for plant

Findings

The study results showed that in 3 types of media: rice husk, coir, sand, which use soil as a control, coconut fiber is the most suitable medium for Rainbow Vulgaris (Beta vulgaris subsp. Vulgaris) to grow

Conclusion

Three types of nutrient medium proposed by Knop, Hoagland, and Alan Cooper in the root system of Rainbow Root (Beta vulgaris subsp. Vulgaris), the nutrient medium presented by Hoagland, is suitable for growing vegetables

Declaration of Ethical Standards

The author(s) of this article declare that the materials and methods used in this study do not require ethical committee permission and/or legal-special permission.

Effects of Substrates on The Growth of BETA VULGARIS SUBSP. VULGARIS in Hydroponic Systems

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ABSTRACT

This research focuses on types of substrate materials (rice husk, coconut fiber, sand), the rate of media mix between coconut fiber, rice, and concentrations of Thiamine HCl (vitamin B1) on the growth of Rainbow Vinegar (Beta vulgaris subsp. Vulgaris). In the studies of nutritional absorption and metal toxicity in the roof, it is essential to growing plants without technical damage. The results showed that Hoagland solution combined coconut fiber, sand, and Thiamine HCl (vitamin B1) suitable for Beta vulgaris subsp. Vulgaris. The Rainbow grows remarkably from 20 days to 30 days for a faster, cleaner, and cultivating soil environment. The method presented here provides. Vulgaris to obtain a healthy plant having a well-developed root system with many lateral roots.

Keywords: Substrate, hoagland solution, beta vulgaris subsp. vulgaris, hydroponic system.

1.INTRODUCTION

Beetroot is a trendy vegetable in eastern and central Europe but is much less critical in Western Europe and the USA, known as garden beet. It is grown for its swollen root and is the horticultural form of Beta vulgaris subsp. Vulgaris (2n =18) includes the agricultural types sugar beet, mangold, and fodder beet. The species also includes chard (subsp. Cicla) and sea beet (subsp. Maritima), which is thought to be the ancestor of most cultivars [1, 2].

The earliest form of domesticated beet was leaf beet. The leaves eat, and the roots use for medical purposes only. Although much of this research applies to beetroot breeding, the horticultural crop's minor status has resulted in much less effort being expended on breeding research. Consequently, there is often an appreciable delay before new developments in sugar-beet breeding are applied to beetroot. This chapter concentrates upon research that has been carried out directly upon beetroot. The plant stores some of these compounds while some excreted through the roots through a process called rhizodeposition [3-6])

Transplanting was done early in the morning to avoid temperature shock to the plants [7, 8]. The plants used no fertilizers; the soil did not compress. For the molecular biological studies in higher plants, beta Vulgaris possesses many suitable properties, such as a short life cycle and high amenability to gene manipulation.

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The non-circulating hydroponics technology is undoubtedly one option for growing fresh vegetables for city dwellers' home consumption. Hydroponics technology has developed worldwide; however, it is not too late to start using this technology, which does not involve much of the initial investment. It could be considered a suspension pots method in a nutrient solution container for growing fresh vegetables. The entire crop could be grown in a nutrient solution container with a single filling. Everyone can practice this technology with little care to produce fresh vegetables in his courtyard, veranda, or rooftop without using soil as a growing medium[9, 10].

The hydroponic system is also crucial for the studies of growth nutrient interactions, and several hydroponic culture systems established for fully developed beta Vulgaris plants. Following some reports, we developed a hydroponic apparatus for young seedlings of beta Vulgaris [11, 12]. Hydroponic cultivation, a current practice all over the world, is a method that permits reasonable control of plant growth and development. However, maintaining optimal conditions for growth and development requires proper climate management and the use of well-balanced irrigation solutions that meet the mineral requirements of specific crops and cultivars[13, 14].

Water is, of course, always the main component of growing plants. But the central portion, usually about 90 percent, of most plants' dry matter comprises three chemical elements: carbon, oxygen, and hydrogen. Carbon comes from the air, oxygen from the air and water, and hydrogen from water. In addition to these

three, plants contain other elements, such as nitrogen, phosphorous, potassium, and calcium, obtained from the soil. The soil then supplies many chemical elements, but they constitute only a tiny portion of the plant. Yet the various factors that occur in plants in comparatively small amounts are just as essential to growth as those which compose the bulk of plant tissues[15-17].

By integrating these techniques, it is possible to reduce wastes and associated environmental impacts, and at the same time, generate an additional crop [18-20]. This report describes a new simple hydroponic culture method that enables beta Vulgaris to develop many lateral roots with high viability.

2. MATERIALS AND METHODS

Culture of Beta vulgaris subsp.Vulgaris. Beta vulgaris subsp. Vulgaris seeds were labeled and washed with sterile water, then germinated for 24 h on coir.

Hydroponic system. For hydroponic growth, germinating sterilized seeds were planted (3 seeds .pot ') to a depth of 2 cm in plastic pots (I0cnl top diameter, 5 cm bottom diameter, and I0 cm height). During the one-week, distilled water irrigated the seedlings daily. The seedlings placed each pot in a nutrition container (15 cm height, 12cm diameter pot) with 200 mL of a modified Hoagland solution.

In one set of experiments, in hydroponics (two experiments, each treatment in 20 replicates), the plant shoots were grown under normal winter environmental conditions in Rehovot during November, February, for 110 days (10-11h light, 10 *25*°C). The nutrient containers were placed in a water bath to keep the roots under a constant temperature of 22°C. In the second set of experiments (two experiments each treatment in 20 replicates), the plants were grown for 45 days in a phytotron, at a constant temperature of 22°C (day and night) with a photoperiod of 9 h light: 15 h dark

3. RESULTS

In this experiment, the primary roots grew for a more extended period than those cultured by the methods developed for monitoring the growth of the primary root. The viability of the root is essential for the study of root function in nutrient uptake and to examine the damage symptoms of the root under stress conditions [21, 22]

Thus, this experiment showed that using the nutritive medium proposed by Hoagland will help Rainbow Rainbow (Beta vulgaris subsp. Vulgaris) grow better than when using water and lips. The nutritional school offered by Knop or Alan Cooper. It can be explained by Hoagland's proposed healthy environment, which contains all the macronutrients and micronutrients needed for the Rainbow mustard (Beta vulgaris subsp. Vulgaris) to grow and develop. When Knop offered a healthy environment in addition to macronutrients, the

Table1. Effects of the nutrient medium on the growth and development of Rainbow (Beta vulgaris subsp. Vulgaris) during 30 days

NT	Number of Leaf/plant			Plant height (cm)			Leaf length (cm)			Leaf width (cm)			Root length (cm)		
	10 days	20 days	30 days	10 days	20 days	30 days	10 days	20 days	30 days	10 days	20 days	30 days	10 days	20 days	30 days
A_0	3,80^{ab}	4,50^{c}	6,00^{c}	9,58^{b}	14,08^{c}	20,30^{d}	4,62^{c}	9,01^{d}	11,17^{d}	3,12^{c}	3,97^{d}	6,03^{d}	-	-	20,25^{c}
A_1	**4,03^{a}**	**6,00^{a}**	7,10^{b}	**11,52^{a}**	19,72^{a}	29,03^{b}	**7,85^{a}**	12,80^{b}	17,82^{b}	**4,35^{a}**	6,10^{b}	10,12^{b}	-	-	25,13^{b}
A_2	3,67^{b}	**6,00^{a}**	**7,83^{a}**	9,50^{b}	**19,90^{a}**	**35,23^{a}**	6,87^{b}	**13,80^{a}**	**21,87^{a}**	3,36^{b}	**7,37^{a}**	**13,75^{a}**	-	-	**27,1^{a}**
A_3	3,67^{b}	5,50^{b}	7,00^{b}	8,60^{c}	17,88^{b}	25,67^{c}	5,80^{d}	10,47^{c}	15,30^{c}	2,85^{d}	5,27^{c}	7,92^{c}	-	-	24,78^{b}

Note: In the same column, the average values with the characters (a, b, c, d.) followed the same with no statistical difference (P <0.05) (-): No figures available

The solution contained the following: KNO_3: 3.9 g.L-1; KH_2PO_4: 26.9 g.L-1; K_2SO_4: 4,3 g.L-1; $MgSO_4$: 30.8 g.L-1; $ZnSO_4$: 0.015 g/L-1; H_3BO_3: 0.02 g.L-1; $MnSO_4$: 0.115 g.L-1; $CuSO_4$: 0.01 g/L-1; $NH_4Mo.7H_2O$: 0.003 g.L-1; $FeSO_4$: 0.64 g.L-1; Na-EDTA. : 0.86 g.L-1. The solution in the container was changed every 2nd day to keep the roots under a constant mineral concentration.

micronutrients required for plants also contain too many types of vitamins that can hinder the growth and development of Rainbow Chard (Beta vulgaris subsp Vulgaris). When studying the effects of several healthy environments on the growth and development of broccoli grown by hydroponics technique, in the treatment using mixed nutrition solution according to the formula, Hoagland gives the best results[23, 24].

Figure 1. Effect of Hoagland hydroponic nutrition on the growth and development of Rainbow mustard (Beta vulgaris subsp. Vulgaris after 10; 20; 30 days (left to right respectively).

Effect of media on the growth and development of Rainbow mustard (Beta vulgaris subsp. Vulgaris) after 30 days

The analysis results in Table 2 and Figure 2 show that different media types affect the growth of Rainbow Chard.

of decomposing. These are favorable factors for profitable plant growth and development

Effect of the incidence of mixing medium between coconut fiber and rice husk on the growth and development of Rainbow chard (Beta vulgaris subsp. Vulgaris) after 30 days

Table 2: Effect of media on the growth of Rainbow Chard (Beta vulgaris subsp. Vulgaris) after 30 days

NT	Number of Leaf/plant			Plant height (cm)			Leaf length (cm)			Leaf width (cm)			Root length (cm)		
	10 days	20 days	30 days	10 days	20 days	30 days	10 days	20 days	30 days	10 days	20 days	30 days	10 days	20 days	30 days
B_0	3,80^{a}	4,50^{b}	6,00^{c}	9,85^{a}	14,08^{b}	20,34^{d}	6,42^{b}	9,02^{d}	11,17^{d}	3,12^{b}	3,97^{b}	6,03^{c}	-	-	20,25^{b}
B_1	**3,50^{b}**	**3,83^{c}**	7,10^{b}	**6,27^{c}**	11,55^{c}	21,85^{c}	**3,78^{d}**	5,78^{a}	11,9^{c}	**1,97^{d}**	2,63^{d}	5,15^{d}	-	-	17,94^{d}
B_2	3,67^{a}^{b}	**6,00^{a}**	**7,83^{a}**	9,50^{b}	**19,90^{a}**	**35,23^{a}**	6,87^{a}	**13,8^{a}**	**21,87^{a}**	3,36^{a}	**7,37^{a}**	**13,25^{a}**	-	-	**27,1^{a}**
B_3	3,67^{a}^{b}	4,00^{c}	7,00^{b}	8,60^{c}	13,5^{b}	23,88^{b}	4,69^{c}	7,4^{c}	14,52^{c}	2,48^{c}	3,57^{c}	6,45^{b}	-	-	19,55^{c}

Note: In the same column, the average values with the characters (a, b, c, d) followed the same with no statistical difference (P <0.05) (-): No figures available.

Figure 2. Effect of coconut fiber media on the growth and development of Rainbow mustard (Beta vulgaris subsp. Vulgaris) after 10; 20; 30 days (from left to right respectively).

The study results showed that in 3 types of media: rice husk, coir, sand, which use soil as a control, coconut fiber is the most suitable medium for Rainbow Vulgaris (Beta vulgaris subsp. Vulgaris) to grow and grow root in hydroponic systems. The coir substrate can retain adequate moisture, have high ventilation, and is capable

The analytical results in Table 3 show that the mixing ratio of medium type between coir and rice husk influence not much different on the growth of Rainbow char

Table 3. The effect of the mash mix of coconut fiber and rice husk on the growth and development of Rainbow Rainbow (Beta vulgaris subsp. Vulgaris) after 30 days

NT	Number of Leaf/plant			Plant height (cm)			Leaf length (cm)			Leaf width (cm)			Root length (cm)		
	10 days	20 days	30 days	10 days	20 days	30 days	10 days	20 days	30 days	10 days	20 days	30 days	10 days	20 days	30 days
C_0	3,67 a	**6,00 a**	7,83 b	**9,5[a]**	**19,9[a]**	**35,23 a**	**6,87 a**	**13,8 a**	**21,87[a]**	**3,63 a**	**7,37 a**	**13,25[a]**	-	-	**27,10[a]**
C_1	**3,83 b**	4,17 b	**8,5[a]**	8,10 b	17,62[b]	30,65 b	5,85 b	8,94 b	20,95[b]	2,87 c	4,75 b	10,32[b]	-	-	20,17[b]
C_2	3,17 b	3,17 d	5,5[d]	5,88 c	13,23[d]	21,93 d	4,70 c	7,75 c	12,88[c]	2,33 d	4,22 c	6,82[c]	-	-	17,58[c]
C_3	3,67 a	3,83 c	6,00 c	8,00 b	15,3[c]	23,17[c]	4,95 c	8,67 b	13,22[c]	3,00 b	4,68 b	6,23[d]	-	-	17,33[c]

Note: in the same column, the average values with the characters (a, b, c, ...) followed the same with no statistical difference (P <0.05), (-): No figures available

Thus, this experiment has not seen the effectiveness of the mixing ratio of 70:30, 50:50, 30:70 media between coconut fiber and rice husk compared to using coconut fiber medium. This explanation can describe by the high husk content of potassium husk and SiO2, which is not suitable for the development of Rainbow chard (Beta vulgaris subsp. Vulgaris). The husk also absorbs heat due to its high carbon content, which causes the growing medium and nutrient environment to affect root growth and absorption. Besides, the coir medium's structure can hold moisture well, is capable of decomposing, and still tighter than rice husks, thereby helping the tree stand and absorb nutrients easily. These may be the factors that give more advantages to the coir body than when mixing between coir and rice husk.

The effect of the media mix ratio between coir and sand on the growth and development of Rainbow chard (Beta vulgaris subsp. Vulgaris) after 30 days

The analysis results in Table 4 and Figure 3 show that coconut fiber and sand's mixing ratio has different effects on the Rainbow chard's growth

Table 4. The effect of the medium mixing ratio between coir and sand on the growth and development of Rainbow mustard (Beta vulgaris subsp. Vulgaris) after 30 days

NT	Number of Leaf/plant			Plant height (cm)			Leaf length (cm)			Leaf width (cm)			Root length (cm)		
	10 days	20 days	30 days	10 days	20 days	30 days	10 days	20 days	30 days	10 days	20 days	30 days	10 days	20 days	30 days
D_0	3,67 c	**6,00 a**	**7,83 a**	**9,50 a**	**19,90 a**	35,23 b	6,87 a	**13,8 a**	21,87 a	**3,63 a**	**7,37 a**	**13,25[a]**	-	-	27,1 a
D_1	**4,33 a**	**6,00 a**	6,83 b	8,45 b	17,37 c	22,13 c	6,00 c	10,68[b]	13,88 b	2,80 c	5,73 c	7,03[c]	-	-	21,18[b]
D_2	3,83 bc	5,17 b	5,83 c	8,47 b	14,88 d	19,88 d	6,55 b	9,25 d	13,67 b	3,10 b	4,08 d	7,20[c]	-	-	18,27[c]
D_3	4,00 b	5,33 b	**8,00 a**	**9,67 a**	18,47 b	**37,68 a**	**7,10 a**	10,13[c]	**22,27 a**	3,58 a	6,25 b	12,73[b]	-	-	**27,58[a]**

Note: in the same column, the average values with the characters (a, b, c, ...) followed the same with no statistical difference (P <0.05), (-): No figures available

This experiment showed that the efficiency of the 30:70 media mix between coconut fiber and sand media was better than using coconut fiber media or mixing coconut fiber media and sand media. At 70:30 and 50:50 ratios. This result shows that the substrate is firmer, can support the tree, has good ventilation, and moderate humidity when combining coconut fiber and sand at a ratio of 30:70.

This experiment added thiamine HCl (vitamin B1) at a concentration of 0.6 g / l to the Hoagland nutrient medium, the Rainbow mustard (Beta vulgaris subsp. Vulgaris) in the soaked hydroponic system. Roots will grow and develop better than without thiamine HCl (vitamin B1).

Figure 3. The effect of the 30:70 media mix ratio on coir and sand on the growth and development of the Rainbow mustard (Beta vulgaris subsp. Vulgaris) after 10; 20; 30 days (from left to right respectively).

Effect of thiamine HCl (vitamin B1) concentration on Rainbow mustard's growth and development mustard (Beta vulgaris subsp. Vulgaris) after 30 days.

Table 5. Effect of thiamine HCl concentration (vitamin B1) on the growth and development of Rainbow mustard (Beta vulgaris subsp. Vulgaris) after 30 days

NT	Number of Leaf/plant			Plant height (cm)			Leaf length (cm)			Leaf width (cm)			Root length (cm)		
	10 days	20 days	30 days	10 days	20 days	30 days	10 days	20 days	30 days	10 days	20 days	30 days	10 days	20 days	30 days
E_0	3,67 b	**6,00^{a}**	7,83 b	9,50^{b}	**19,90 a**	35,23c	**6,87 a**	**13,8^{a}**	21,87 b	**3,63 a**	**7,37 a**	13,25^{b}	-	-	27,10^{c}
E_1	3,17 c	3,96^{c}	7,92 b	11,22^{a}	16,50 c	35,45^{bc}	5,42 c	10,33 c	21,95 b	2,52 c	4,27 c	13,35^{b}	-	-	28,67^{b}
E_2	3,50 b	4,08 b^{c}	8,17 b	9,53^{b}	15,68 d	36,27^{b}	5,30 c	10,83 b	22,02 b	2,20 d	4,58 b	13,45^{b}	-	-	21,50^{d}
E_3	**4,00 a**	4,42^{b}	**8,83 a**	**11,43^{a}**	17,58 b	**39,87^{a}**	6,25 b	10,03 c	**24,52 a**	2,93 b	5,42 c	**14,07^{a}**	-	-	**30,3^{a}**
E_4	3,17 c	4,17^{b} c	6,33 c	9,85^{b}	16,25 c	30,63^{d}	5,47 c	7,42^{d}	18,72 c	2,22 d	4,33 c	8,23^{c}	-	-	22,67^{b}

Note: in the same column, the average values with the characters (a, b, c, ...) followed the same with no statistical difference (P <0.05), (-): No figures available

The analytical results in Table 4 and Figure 3 show that the concentrations of thiamine HCl (vitamin B1) have different effects on the growth of Rainbow Chard.

Figure 4. Effect of concentration of 0.6 g / l thiamine HCl (vitamin B1) on the growth and development of Rainbow mustard (Beta vulgaris subsp. Vulgaris) after 10; 20; 30 days (from left to right respectively)

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