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## Effect of Substrate and Variety on Some Important Quality and Quantity Characteristics of Strawberry Production in Vertical Hydroponics System

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Sasan Jafarnia, Sara Khosrowshahi, Abdollah Hatamzadeh, Ali Tehranifar: Effect of Substrate and Variety on Some Important Quality and Quantity Characteristics of Strawberry Production in Vertical Hydroponics System

### ABSTRACT

Most growing media for strawberries in soilless culture are peat moss, rockwool, coir, perlite or some other mixtures. Nowadays, using mixture of peat moss and perlite is one of the mostly used substrate for production of hydroponic strawberries in developing countries. The effects of three different media based on 100%: 0, 80%: 20% and 60%: 40% v/v perlite and peat moss were evaluated on quantity and quality of three varieties of strawberry (*Fragaria ananassa*) in soilless culture. Perlite/ peat moss substrate 100%:0% ratio (v/v) produced the highest number of runners, crowns number was the highest in 60% perlite+ 40% peat moss substrate and both substrates of 80%+ 20% and 60%:40% perlite/peat produced the highest percentage of Total soluble solid. Fresno variety had the highest number of crowns production between three studied varieties. In addition, although Fresno variety produced the highest number of runners, the highest value of percentage of Total soluble solid was related to Selva variety. All in all, the results showed that based on the goals of planting strawberries, both Fresno and Selva varieties and also 80%:20% and 60%:40% perlite/peat moss are the best ones in production of strawberries in Iran.

**Key words:** Peat moss, Perlite, Soilless Culture, Strawberry, Variety, Runner, Crown, Total soluble solid.

### Introduction

Hydroponic plant production has been practiced for several millennia and it permits crops to be grown where no suitable soil exists or where the soil is contaminated in some manner. In one of the seven wonders of the ancient world, the Hanging Gardens of Babylon, plants were grown in a steady stream of water[12,22]. In addition, more complete control of the environmental factors that affect plant growth and yield (root environment, fertigation, light temperature, humidity, etc.) is possible[11].

Strawberry is commonly produced as early spring crop or out-of-season in open field, glasshouse or polyethylene tunnel. Pests and diseases in soil

culture have always been problems especially in protected areas[7]. Suitable mixture of substrate in soilless culture within greenhouse systems, extend harvesting duration, out of season strawberry production and increase in yield[24]. Material properties of substrate exhibit direct and indirect effects on plant physiology and production[4]. In order to grow strawberry, different substrates such as peat moss, coconut coir, perlite, rockwool and pine bark have been used. However, peat has been the best substrate for hydroponic culture[14]. There are different reports related to use of zeolite and perlite as substrates in hydroponic culture[19]. Kanazirska *et al.*[13] reported decreasing potassium exchange in substrates of perlite and mixtures of perlite/zeolite

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cucumber hydroponic culture. Due to high price and not easy availability of peat moss, producers usually try to replace it by other substrates like perlite or zeolite, but in Iran there are rich natural sources of peat moss in the north of Iran and, as a result, it can be used in hydroponic systems as a cheap substrate individually or combined with perlite.

Other factors like varieties, temperature, and the rate of humidity and size of container can also affect the plant growth and fruit yield of strawberry[5]. The variety of strawberry is completely related to environmental factors and although some varieties are the best ones in one part of the world, they may produce lower amount of fruits in other parts or vice versa[10]. The objective of this investigation was to determine the effects of perlite and peat moss as substrates and using three different varieties on the number of crowns, Runners number and the percentage of Total soluble solid in vertical system soilless culture.

### Materials and Methods

The used strawberry varieties (Kordestan, Fresno and Selva) were obtained from the agricultural center of Sanandaj and Hashtgerd. Selection of these varieties was based on their yields, accessibility and abundance. The experiment design was split plot based on a randomized complete block. Therefore, type of substrates was the primary factor and the type of varieties was secondary factor. Moreover, the number of replication was three. Three different media mixtures were 1:0, 0.8:0.2 and 0.6:0.4 v/v ratios of perlite and peat moss.

The hydroponic system was vertical and the nutrition system was open. The vertical system was made of four Styrofoam pots at 25 cm diameter in 1.1 meter height. The greenhouse operated at 10-15°C during night and 20-25°C daily temperature. The columns were fixed at 1.3 columns m<sup>-2</sup> and 21 plants m<sup>-2</sup> density (16 plants column<sup>-1</sup>). Lieten[15] nutrient solution containing NO<sub>3</sub>, NH<sub>4</sub>, H<sub>2</sub>PO<sub>4</sub>, SO<sub>4</sub>, K, Ca and Mg with 11.5, 0.5, 1.5, 1.5, 3.5, 4.5 and 1.5 mmol L<sup>-1</sup> and micronutrients Fe, Mn, Zn, B and Cu with 20, 20, 10, 12 and 0.75 μmol L<sup>-1</sup> were used based on 100-250 mL plant<sup>-1</sup> day<sup>-1</sup> depending on growth stage. The pH and EC of nutrient solution were adjusted to 5.8 and 0.9-1.4 dS m<sup>-1</sup>, respectively. Several factors as the most important indicators of generative and productive traits were calculated. The number of leaves, flowers number and the number of fruits were measured three times a week and the total number of them in each replicate during the growth season used in variance analysis.

Data was analyzed by software SPSS. The analysis of variance and Duncan multiple range test were used to find significant differences in the means.

### Results and Discussion

Variance analysis of generative traits and production was significant in most cases (P<0.05). Comparisons of media showed that the highest runner numbers (0.73) was related to 100% perlite, the highest crown numbers (1.86) was obtained in 60% perlite + 40% peat moss and the highest percentage of Total soluble solid was due to 60% perlite + 40% peat moss and 80% perlite + 20% peat moss, respectively, and Although the percentage of Total soluble solid in 80% perlite + 20% peat moss and 60% perlite + 40% peat moss had a little difference, this difference was not significant (P<0.05) (table 1). The lowest value of crown (1.42) and runner (0.57) numbers were obtained in 80% perlite + 20% peat moss; however, the lowest value of percentage of Total soluble solid was related to 100% perlite (table1).

Data of the effects of varieties on these parameters showed that the highest number of crown (1.72) was obtained in Fresno and Kordestan, the highest number of runners (1.00) was related to Fresno and the highest percentage of Total soluble solid were related to Selva and Fresno, respectively, and the difference between these values were not significant at P<0.05 (table 2). Although The lowest values in crown (1.33) and runner (0.54) numbers were obtained in Selva, the lowest percentage of Total soluble solid was related to Kordestan (table2).

Interaction between variety and substrate on crown number showed that the highest numbers of crowns were obtained in Fresno variety cultured in 60% perlite+ 40% peat moss, Selva variety in 100% prlite and Kordestan variety cultured in 60% perlite+ 40% peat moss substrates, respectively, and the lowest value was related to Selva variety at the same substrate. There were two groups of values related to the highest and lowest values and there were no significant differences in values among each group (table 3). Considering the data on interactions between variety and substrate on runners number, the highest numbers were obtained when two varieties of Selva and Kordestan planted in 60% perlite+ 40% peat moss and Selva cultured in 100% perlite and the lowest value was related to Kordestan variety in 60% perlite + 40% peat moss (table 4).

Data related to Interaction between variety and substrate on Total soluble solid showed that highest values were obtained from Selva in 60% perlite+ 40% peat moss and 80% perlite+20% peat moss. These values were significantly different from other values, but the difference between these two values was insignificant (P<0.05). The lowest values was related to Kordestan variety planted in 100% perlite substrate (table 5).

**Table 1:** Effect of substrate on quantitative properties

Substrate	crowns number	Runners number	Percentage of Total soluble solid
100% perlite	1.53b	0.73a	6.50b
80% perlite + 20% peat moss	1.42b	0.57b	7.15a
60% perlite + 40% peat moss	1.86a	0.59b	7.23a

**Table 2:** Effect of variety on quantitative properties

Variety	crowns number	Runners number	Percentage of Total soluble solid
Fresno	1.72a	1.00a	7.60a
Selva	1.33b	0.54b	7.90a
Kordestan	1.72a	0.60b	6.30b

**Table 3:** Interaction between variety and substrate on crowns number

Interaction between variety and substrate on crowns number	100% perlite	80% perlite + 20% peat moss	60% perlite + 40% peat moss
Fresno	1.56b	1.61b	2.12a
Selva	2.06a	1.60b	1.53b
Kordestan	1.63b	1.63b	1.98a

**Table 4:** Interaction between variety and substrate on Runners number

Interaction between variety and substrate on Runners number	100% perlite	80% perlite + 20% peat moss	60% perlite + 40% peat moss
Fresno	1.24a	0.98b	0.82b
Selva	0.58b	0.72b	0.87a
Kordestan	0.82a	0.43b	0.38b

**Table 5:** Interaction between variety and substrate on Percentage of Total soluble solid

Interaction between variety and substrate on Total Soluble Solid	100% perlite	80% perlite + 20% peat moss	60% perlite + 40% peat moss
Fresno	7.23a	7.12a	7.15a
Selva	7.12b	8.32a	8.34a
Kordestan	6.87b	6.56b	7.22a

**Discussion:**

crowns and runners are responsible for producing nutrients and regulating metabolic activities in plants and they also protect flowers and fruits during periods in which the weather is not suitable for plants[9]. The number of crowns is so important when the goal is quality and the number of runners is one of the most important factors when the production of new strawberry plants is the most important factor for farmers and producers[3]. Paying attention to this topic is so important when one season varieties like Fresno is used[9]. The numbers of crowns were the highest in Fresno variety cultured in 60% perlite+ 40% peat moss, Selva variety in 100% perlite and Kordestan variety cultured in 60% perlite+ 40% peat moss substrates. There are several studies in which it has presented that perlite is the best media for strawberries in comparison with other substrates having peat moss[1,2,3].

The number of runners, fruits and Total soluble solid are related to each other and according to Garate *et al.*[6] and increase in the number of runners and fruits causes decrease of Total soluble solid. Han *et al.*[8] presented that these productive factors are completely related to the diameter of crowns, which can be used to predict plant yield potential[9]. According to effects of varieties, it was obvious that the effects of substrates and varieties can be changeable based on different factors and according to many researchers choosing the best

varieties and substrates is related to the important factors. In other words, if producers want to have better plants for having more new strawberry plants, the number of runners can be one of the most important factors, but the goal is having highest number of fruit, the number of crowns and its diameters are two first important factors[16,17]. Lieten & Roeber[16] mentioned that substrate of mixed perlite and peat moss is useful for varieties which need high amount of Copper to produce high quality strawberries, but in some varieties growing in peat substrate the quantity of produced strawberries increases. According to them, type of media has to be defined based on necessities of producers and market places. In this study 100% perlite and 60% perlite + 40% peat moss were the best substrates for two different varieties and in other studies, also, it was presented that these two substrates had better results than other types of perlite and peat moss composition on crowns number, the number of runners and Total soluble solid[20,21].

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