

Effect of Different Substrates on Growth Indices and Yield of Green Peppers at Hydroponic Cultivate

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Abstract: In order to introduce effectiveness substrate and select suitable cultivar with high yield in hydroponic cultivate system for growing green peppers with the scientific name *Capsicum annum* L. an experiment was done as a factorial experiment in completely randomized design with four replications on Figaro, LiricaRZ, Sereno's cultivars and three substrates include vermiculite + sand, peat + perlite and rock wool. The experiment was carried out in the Islamic Azad University, Jiroft branch, Iran, in 2011. Results showed that there was significant deference between interaction effect of green peppers and substrate in their leaf weight, root weight and dry stem and leaf weight in level of 5% and dry root weight in level of 1%. Correlation coefficient showed that there was direct relation between yield and number of leaf, fresh and dry weight of stem and leaf, dry and fresh weight of root in level of 1% and number of leaf in level of 5%. According to these results, substrate of peat + perlite had most effect on growing traits and yield of green pepper.

Keywords: Green pepper, growth indices, hydroponic, substrates, yield

INTRODUCTION

One of the main methods to achieve maximum product in minimum time and very good quality is growing plants by greenhouse method of soilless culture or hydroponic (Robbins and Evans, 2004). Materials which use as a substrate and protect of plant's root should be included the capacity keeping of water and high nutritious, enough aeration, suitable drainage and high capacity of exchanging cations and also should avoid of any bad effect on plants (Javanpour-Haravi *et al.*, 2004). Albaho *et al.* (2009) with investigated the effects of three substrate on grow and yield of two green pepper cultivars reported that different green pepper showed different reaction to substrates. These substrates had significant effect on their plant high, number of leaf, chlorophyll index and total yield plant. Maaswinkel *et al.* (2009) with compare perlite and rice husk and then investigated the effect of substrates on grow and yield of green pepper and understood that grow plants of rice husk is higher and included more yield in compare with grow plants of perlite. Choi *et al.* (2001) with compare culture medium of rock wool and perlite reported that peat and cocconut are cause of 19-20% increase in dry and weight of cucumber and also marketable of cucumber was better than perlite.

Aim of this research is introducing effectiveness substrate and select suitable cultivar with high yield in hydroponic cultivate system.

MATERIALS AND METHODS

Present project was perform in factorial experiment in completely randomized design with four replications in three substrates included vermiculite + sand (1:1), peat + perlite (1:1) and rock wool and three cultivars of green pepper (Sereno, LiricaRZ and Figaro). The experiment was carried out in the Islamic Azad University, Jiroft branch, Iran, in 2011. Pepper seeds for transplanting to the planting pans, were placed, then the seeding which were transfer to substrate had 4 or 5 leaf. In present research, Hoagland nutrient solution No. 1 was used as the base and each day was given it on plant in three stages of 20 min. PH of nutrient solution was regulating at 5.8 ± 0.2 . Average temperature of excrement was regulating at 18 ± 2 at night and 25 ± 2 at day. Relative humidity of green house moves between 60-70%. Then traits include stem length, stem diameter, leaf number, leaf weight, shoot and root dry weight and yield were measured. Finally, all data were analyzed by SAS software and Duncan test to compare the averages.

RESULTS AND DISCUSSION

According to results of variance analyzing, there was significant on interaction effect of cultivars and substrate on leaf's weight at level of 5% (Table 1). Maximum amount of leaf weight obtained from

Table 1: Means square of studied traits

Means square										
S.O.V	d.f	Leaf weigh	No. leaf	Stem length	Stem and leaf weigh	Dry stem and leaf weight	Root weight	Dry root weight	Root length	Yield
(S) Substrat	2	0.26 ^{n.s}	295.72 ^{n.s}	241.4 ^{n.s}	1450.99 ^{n.s}	75.46 ^{n.s}	515.61 ^{**}	6.03 ^{n.s}	35.7 ^{**}	105625.76 ^{**}
(C) Cultivar	2	0.34 ^{n.s}	1029.36 ^{**}	639.36 ^{**}	15305.77 ^{**}	701.75 ^{**}	565.4 ^{**}	6.16 ^{n.s}	296.3 ^{**}	294017.32 ^{**}
S × C	4	0.43 [*]	69.27 ^{n.s}	80.69 ^{n.s}	2882.3 ^{n.s}	135.14 [*]	96.06 [*]	36.9 ^{**}	30.97 ^{n.s}	17979.22 ^{n.s}
Error	27	0.23	349.51	159.74	6355.89	60.71	38.99	10.48	14.73	49791.29
C.V	%	10.85	13.56	9.02	14.26	9.72	13.63	14.31	10.63	8.50

** : Significant at 1% level of probability; * : Significant at 5% level of probability; Ns: Non-significant

Table 2: Interactions between cultivar and culture substrate on the studied traits

Cultivar/substrate	Leaf weigh (g)	Dry stem and leaf weight (g)	Root weight (g)	Dry root weight (g)
Sereno/peat+perlite	4.19a	77.15b	64.06a	11.91cde
LiricaRZ/peat+perlite	3.83ab	88.24a	48.57b	18.05ab
Figaro/peat+perlite	3.45b	64.13cde	51.86b	18.92a
LiricaRZ/rock wool	3.33b	67.04cd	36.15cd	12.02cd
Figaro/rock wool	3.35b	59.74cde	37.44c	11.35cde
Sereno/vermiculite+sand	2.90c	67.03cde	29.68cd	12.81c
LiricaRZ/vermiculite+sand	3.58b	58.62de	29.38d	12.65c
Figaro/vermiculite+sand	2.93b	49.55f	20.62e	9.39de

Values with different letters are significantly different

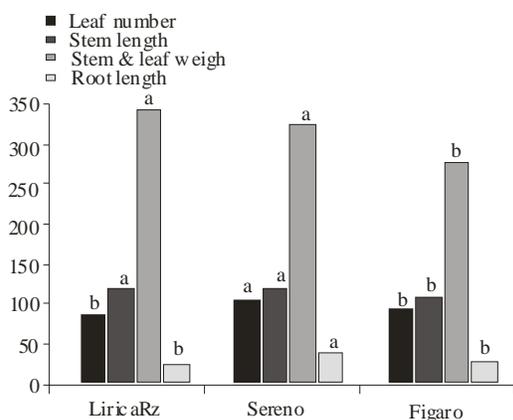


Fig. 1: Effect of cultivars on leaf number, stem length, stem & leaf weight and root length

Sereno/peat + perlite and LiricaRZ/peat + perlite with average of 4.19 and 3.38 g, respectively and minimum amount was relate to Sereno/ vermiculite + sand with average of 2.90 g (Table 2). Tabatabaei and Mohamad-Rezaei (2006) reported that there was significant difference between wet and dry weight of cucumber leaves. Variance analyzing results showed that there was significant difference between green peppers in number of leaf at level of 1% (Table 1). The most number of leaf was relate to Sereno by average of 105.91 and the lowest number of leaf was relate to LiricaRZ and Figaro by average of 89.91 and 89.83, respectively (Fig. 1). Results of analysis of variance in stem's length showed that there was significant deference between green peppers cultivars at level of 1% (Table 1). Maximum and minimum effects on stem's length were related to LiricaRZ and Sereno with average of 121.33

and 117.91 cm and Figaro with average of 107.33 cm, respectively (Fig. 1). Variance analyzing results showed that there was significant difference between cultivars of green pepper in wet weight of stem and leaf at level of 1% (Table 1). The most stem and leaf weight was related to LiricaRZ and Sereno with average of 344.55 and 324.51 g and the lowest stem and leaf weight was related to Figaro by average of 275.15 g, respectively (Fig. 1). According to variance analyzing results of interaction effect of cultivars and substrate, there was significant deference between dry weight of stem and leaf at level of 5% (Table 1). Maximum and minimum dry weight of stem and leaf was related to LiricaRZ/peat + perlite and Figaro/vermiculite + sand by average of 88.24 and 49.55 g, respectively (Table 2). Botez and Popescu (1995) reported the effect of peat on growing of tomato and improvement in plants growing and increase in dry weight and improvement of fruits quality with regard to soil's cultivation and they reported that cause of this was due to the rate of more nutritious and ability of keeping more foods and water.

Results of analysis of variance on root weight showed that there was significant difference between green pepper cultivars at level of 1% (Table 1). Maximum root weight was related to Sereno and LiricaRZ by average of 49.16 and 38.03 g and minimum root weight was related to Figaro by average of 36.84 g, respectively. Also, there was significant difference on root weight between substrates at level of 1% (Table 1). Peat + perlite substrate showed maximum root weight with average of 54.83 g and vermiculite + sand showed minimum root weight with average of 26.56 g. Interaction effect of cultivar and substrate on root weight became significant at level of

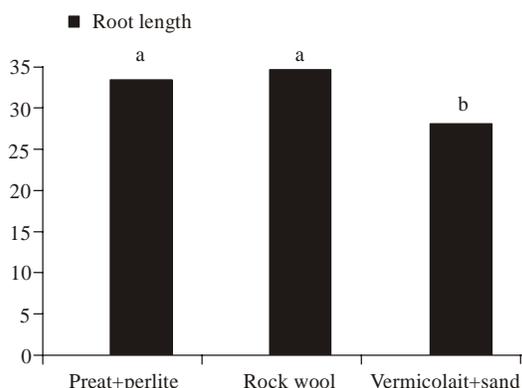


Fig. 2: Effect of substrates on root length

5% (Table 1). Maximum and minimum root weight obtained from Sereno/peat + perlite and Figaro/vermiculite + sand by average of 64.06 and 20.62 g, respectively (Table 2). Walters *et al.* (1990) reported increase plant's grow and weight of root and stem and increasing the level of peat by investigated different rate of sphagnum of peat (25-50 and 75%) on plant's grow of asparagus at culture medium of sand. There was significant relation on interaction effect of cultivar and substrate of dry root weight at level of 1% (Table 1). Maximum amount of dry root weight was related to Figaro/peat + perlite and LiricaRZ/peat + perlite by average of 18.92 and 18.05 g (Table 2). Jalili-Marandi (1997) reported that there was significant relation in interaction effect of grape at culture medium from the point of view of became rooted, root length, root weight and dry weight percent with regard to wet weight of root.

Results of analysis variance on root length showed that there was significant relation between cultivars at level of 1% (Table 1). The most root length was related to Sereno with average of 37.10 cm and the lowest root length was related to Figaro and LiricaRZ with average of 29.18 and 27.94 cm, respectively (Fig. 1). Also, there was significant difference between different levels of substrates on root length at level of 5% (Table 1).

Maximum root length was related to substrate of rock wool and peat + perlite by average of 33.96 and 33.05 cm and minimum length of root was related to vermiculite + sand by average of 27.21 cm, respectively (Fig. 2). Srame and Dubsky (2008) reported the replacement of peat with compressed rock wool which contains 25 and 35% of water and was cause of increasing the capacity of keeping water in organic substrates and improvement the ability of wetting substrate after irrigation. According to results of analysis variance, green pepper cultivars on yield became significant. Also, the effect of substrate on yield became significant at level of 1%. But, there was no significant relation between interaction effect of substrate and cultivar (Table 1).

Yield showed positive correlation with all the studied traits except root length (Table 3). We can declare that an increase in yield was as a result of increasing of these traits. It seems that complete nutrition and suitable substrate were cause of increasing vegetative grow and as a result of increasing the number of leaf and leaf weight at green pepper bush. One of suitable grow sign in plants was increasing length and diameter of stem and leaf, which was obtained because of suitable available of nutrition at substrate and then total yield was increase by increasing of stem's length and wet and dry weight of stem and leaf (Table 3). Cause of increase yield and other traits of growth plant were suitable of root at substrate from the point of view of aeration and keeping water and yield was increase by increasing wet and dry weight of root by attention to correlation coefficient table (Table 3). By attention to the mention topics, measuring growth plant's factors was indicative of positive effect of peat on growth plant. The effect of peat on increase yield was through increase absorbable rate of nitrogen, iron and zinc at different culture medium. Also, it effects on increase absorption of lead and nickel through plant and this increase was not in culture medium of arable soil. Therefore, it suggests using of peat to provide nutrition needs of plant (economical and much used elements) at culture medium of potted without no worry about pollution effects (Abdollahi

Table 3: Correlation coefficient between studied traits

Traits	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Leaf weigh (1)	1							
Leaf number (2)	0.354*	1						
Stem length (3)	0.436**	0.546**	1					
Stem & leaf weigh (4)	0.613**	0.586**	0.596**	1				
Dry stem & leaf weight (5)	0.509**	0.635**	0.693**	0.818**	1			
Fresh root weight (6)	0.564**	0.627**	0.534**	0.584**	0.615**	1		
Dry root weight (7)	0.359**	0.379**	0.390**	0.717**	0.568**	0.499**	1	
Root length (8)	0.122	0.384*	0.264	0.185	0.380*	0.637**	0.169	S
Total plant yield	0.619**	0.422*	0.563**	0.693**	0.675**	0.710**	0.571**	0.262

** : Significant at 1% level of probability; * : Significant at 5% level of probability

et al., 2007). Perlite is propose as a substrate with very good traits at culture soilless because of high absorb of water, increase efficiency of irrigation, reuse of substrate at next culture and finally decrease in production cost (Djedidi *et al.*, 1999).

CONCLUSION

Using organic and inorganic substrate give an opportunity to plants to absorbing nutrition and suitable grow, optimizing water and keeping oxygen. Therefore, it is necessary to choose best substrate for producing plants between several materials. Using mix of peat + perlite with ratio of 1 to 1 is cause of increase in vegetative grow and yield of green pepper by studying growing traits of green peppers at different substrates. Also, substrate of rock wool provide suitable medium for growth of root and could applicable at hydroponic system as a suitable substrate by attention to lacking of any pollution.

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