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Investigation of Some Effective Factors on Yield Traits of Pepino (*Solanum muricatum*) as a New Vegetable in Iran

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Abstract: To find out the effects of media culture and foliar fertilization on some yield traits including the number of fruits per bush, mean weight of fruit, yield of per bush, long of fruits and diameter of fruits 9 months completely randomized factorial experiment (3×5) with four replications was conducted. Media culture treatments include 5 levels namely soil; mixture of soil and vermy compost; mixture of soil and sand; mixture of soil and peat moss and mixture of soil, sand and peat moss. Foliar fertilization treatments include 3 levels namely applying once a week, once a 3 week and no fertilization (control). The results showed that the media culture treatments on the whole of traits and foliar fertilization also on the whole of traits except yield of per bush had a significant difference ($p<0.01$). In the foliar fertilization except yield per bush the once a 3 week fertilization caused highest increase than other treatments and in the media culture treatments, the mixture of soil and peat moss showed highest increase than other treatments.

Key words: Foliar fertilization, media culture, Pepino (*Solanum muricatum*), yield traits

INTRODUCTION

Pepino (*Solanum muricatum*) belongs to the plant family Solanaceae and basically is a perennial crop which is cultivated as an annual like tomato. Pepino is small, herbaceous, or bushy, multi stem crop, with woody stem and up growing, to a usual height of 75 cm (Nemati *et al.*, 2007). Generally, it looks like the up growing bushes of tomato but in a smaller scale (Prohens *et al.*, 2003). Pepino is native to temperate parts of the And Mountains, Colombia, Peru and Chile, but it is unknown in these parts of the world and the origin is not found exactly (Popenoe, 1990). The English name of this fruit Pepino which is equal to cucumber comes from a Spanish word (Prohens *et al.*, 1996). Pepino is a berry with approximately 10 cm length and 6 cm width (Huxley, 1992). The weight of the mature fruit is 100-500 g. Ripe fruits appear greenish-yellow to creamy color with purple strips on the skin. It has a very pleasant sweet taste similar to honey melon. High quantities of vitamins and some medicinal actions such as antitumor effects are the main characteristics of the fruit (Prano-Widayat *et al.*, 2003). Ripe fruits contain 9.5% soluble solid, 4.6% carbohydrates, 0.06% acids and 34.25 mg (%) vitamin C (Bravo and Arias, 1983). Aromatic and volatile compounds such as esters, aldehydes, ketones, terpenes, alcohols and also mesifuran and beta-damascenone are found in the fruits (Rodriguez-Burruezo *et al.*, 2004). Pepino also contains high amounts

of vitamin A. The plant is found in mountains and many other places. It grows well in any type of soil and found more in higher latitudes. It is drought tolerant and regrows well after passing the stress (Popenoe, 1990). For an optimum fruit set, Pepino needs cool nights and days with temperatures between 12-15°C (Bravo and Arias, 1983). Temperatures below 10 and higher than 30 will reduce fruit set eventually (Prohens *et al.*, 2000). Irrigation for areas with an average rainfall of 1000 mm square yearly is not needed (Popenoe, 1990). 70% and 60-65% f.c. (field capacity) moisture is the best required for growth and pollination, respectively (Nemati *et al.*, 2007). Light and a well drained soil are the best conditions for an optimum yield (Chittendon, 1956; Popenoe, 1990). Propagation is easily done by seed and cutting. Cuttings root well without using mist or any plant growth regulator (rooting hormone). Micro propagation is one of the new techniques used for this crop (Popenoe, 1990).

Pepino is known as a new vegetable and is given attention by some countries today. Several researches are being done in countries like the Europeans, Japan and USA. It has also been exported from New Zealand and Chile in past few years (Popenoe, 1990). It is three years from the first time Pepino came to Iran; therefore, investigating some basic information and recognizing the effective factors on commercial yield such as media culture and foliar fertilization, with the little resources in hand seemed to be necessary and very useful. This study

aims to find out the suitable media culture and fertilization time range on the new vegetable Pepino in Iran and the world.

MATERIALS AND METHODS

A factorial experiment based on a completely randomized design with four replications was conducted to find out the effects of media culture and the foliar fertilization. This experiment started in November 2006 and finished in August 2007 in Mashhad (Iran). The media culture treatments used in this study include soil (S), mixture of soil+20% vermycompost (SV), (Sarkka *et al.*, 2002) mixture of soil and sand 1:3 (SS), mixture of soil+peat moss 1:2 (SP) and mixture of soil+ sand+peat moss 1:4:2 (SSP) and the foliar fertilization were used in three levels, control (N_0), applying once a week (N_1) and applying once a 3 week (N_3).

Twenty centimeter long herbaceous and semi hardwood cuttings with bark and leaves were taken. Cuttings should have 2-3 leaves at the top and 3-5 buds. The other end is cut with an angle. This side was put in a fungicide Mancozeb (2 in 1000 ratio) for five minutes in order to disinfect the cuttings. They were taken out, washed with water and planted out in pots with perlite and peat moss 1:1 mixture. The pots were placed in a greenhouse. The temperature of day and night is 20 and 15, respectively and the relative humidity holds at 50% till the roots appear. The rooted cuttings were transplanted into bigger pots with top diameter 25 cm after 20 days and planted out in their permanent bed after spring frost. The fertilizer containing macro and micro elements in concentration of 2 in 1000 ratio was grow more. Yield traits like the number of fruits per bush, mean weight of fruit, yield of per bush, long of fruits and diameters were collected and measured in the stage of ripening (fruits turning yellow followed by appearing of purple strips). The number of fruits per bush counted, the mean weight of fruits were measured by digital scale and the long and diameter of fruits were measured by Collis. Collected data from the completely randomized design in the form of factorial was analyzed by the MSTATC software. Mean comparison analysis was done by LSD test.

RESULTS AND DISCUSSION

Total results from variance analysis of Pepino characteristics are shown in the Table 1.

Results showed that foliar fertilization exerted a significant effect on the whole of traits except yield of per bush ($p < 0.01$) and media culture also exerted a significant effect on the whole of traits ($p < 0.01$) while the interactive of them did not. Once three a week fertilization (N_3) had a significant difference and also the highest quantity in whole of traits except yield. In the media culture, the mixture of soil and peat moss (SP) showed significant difference and also highest quantity than other media culture ($p < 0.01$).

Effects of foliar fertilization and media culture on number of fruit per bush: Foliar fertilization and media culture showed a significant effect on the number of fruits ($p < 0.01$) but the interactive did not (Table 1). The most number of fruits (5.66 fruit) was observed in once a three week (N_3) (N_3) treatment which had significant difference with control (N_0) with the least number (2.8) and also with once a week (N_1) treatment ($p < 0.01$). Fertilizing once a week (N_1) showed no significant difference with control (N_0) (Fig. 1). The most number of fruits (5.11) also was observed in the mixture of soil and peat moss (SP) which had significant difference with mixture of soil and sand (SS) with the least number of fruits (3.33) ($p < 0.01$) and the soil as well ($p < 0.01$). Other media cultures did not show any significant effect on the number of fruits per bush (Fig. 2).

Effects of foliar fertilization and media culture on mean weight of fruits: Foliar fertilization and media culture showed a significant effect on the mean weight of fruits ($p < 0.01$) but the interactive did not (Table 1). The highest mean weight of fruits (88 g) were observed in once a three week (N_3) fertilization which had significant difference with once a week (N_1) fertilization ($p < 0.01$) (Fig. 1). The highest mean weight of fruits (89.06 g) also were observed in the mixture of soil and peat moss (SP) which had significant difference with other media culture ($p < 0.01$) but other media culture do not had a significant difference with together (Fig. 2).

Table 1: Mean square from variance analysis of foliar fertilization, media culture and interactive effects of them on measured traits of Pepino

SOV	df	Diameter of fruits	Long of fruits	Yield of per bush	Mean weight of fruits	No. of fruits
Foliar fertilization	2	99.62**	9.73**	0.04	80.87**	23.75**
Media culture	4	1.52**	1.45**	0.06**	28.44**	4.61**
Foliar fertilization×Media culture	8	0.54 ^{ns}	0.17 ^{ns}	0.01 ^{ns}	0.32 ^{ns}	0.81 ^{ns}
Error	45	0.30	0.28	0.01	0.36	1.26

** $p < 1\%$, ns: Non significant

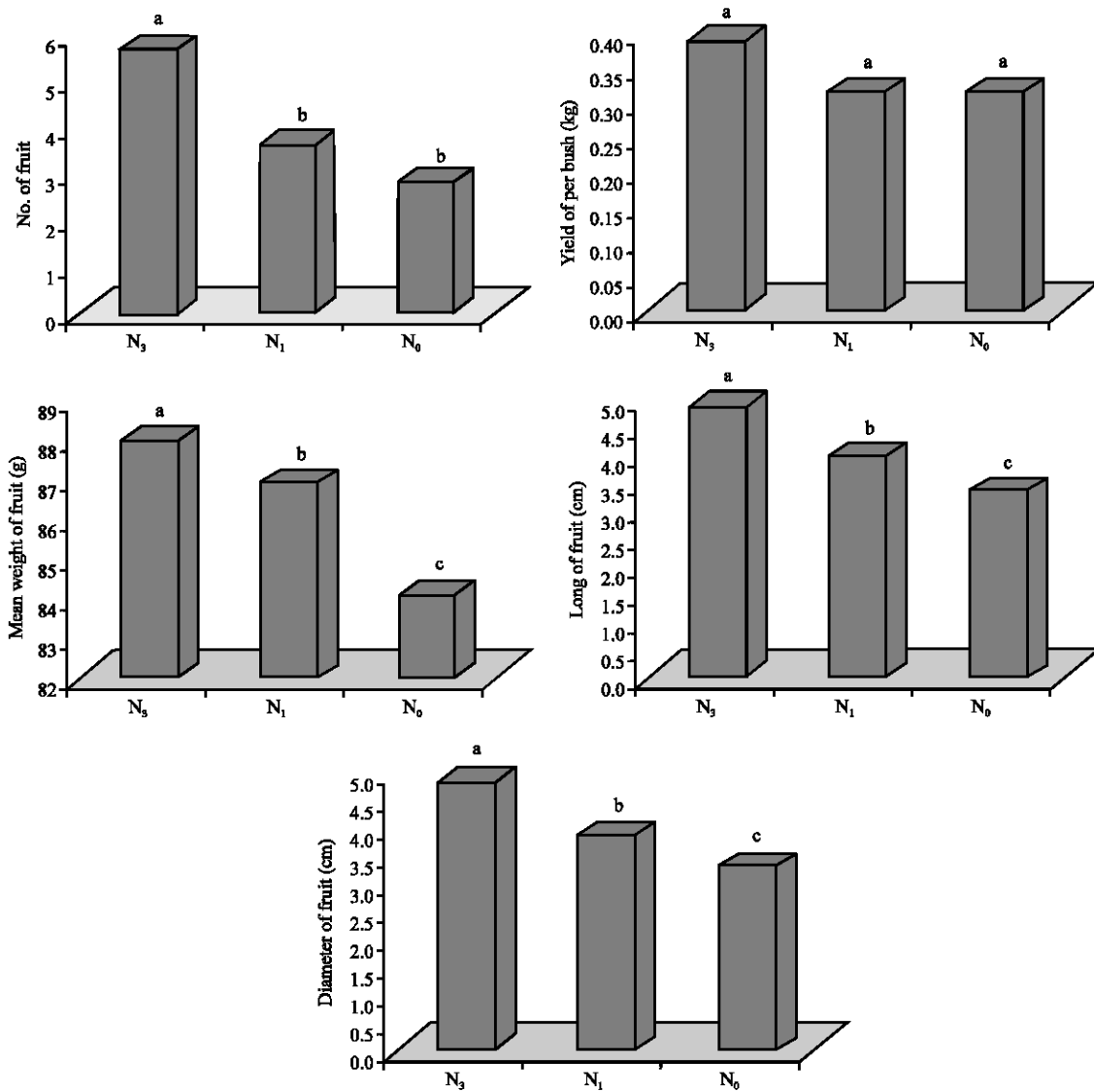


Fig. 1: The effects of foliar fertilization on yield traits in Pepino, N₀: No fertilization (control), N₁: Once a week, N₃: Once a three week. Values labeled with the same letter(s) are not different at the 1% significance level

Effects of foliar fertilization and media culture on the yield of per bush: Media culture showed a significant effect on the yield of per bush ($p < 0.01$) but foliar fertilization and the interactive effect did not show any significant effects (Table 1). The highest yield (0.46 g) was seen in the mixture of soil and peat moss (SP) which had significant difference with other media culture ($p < 0.01$) but other media culture do not had a significant difference with together (Fig. 2).

Effects of foliar fertilization and media culture on the long and diameter of fruits: On the two traits (long and diameter of fruits) foliar fertilization and media culture had

a significant effect but the interactive effect did not show any significant effect (Table 1).

The most long and diameter of fruit (in respect 4.88 and 4.82 cm) were seen with once a three week (N₃) fertilization which had a significant effect with control (N₀) with the least long and diameter of fruit (in respect 3.28 and 3.23 cm) and also with once a week (N₁) treatment ($p < 0.01$). Fertilization once a week (N₁) also showed a significant difference with control ($p < 0.01$) (Fig. 1).

In the media culture treatments the most long and diameter of fruits (in respect 4.74 cm and 4.68 cm) were observed in the mixture of soil and peat moss (SP) which had significant difference with other media culture

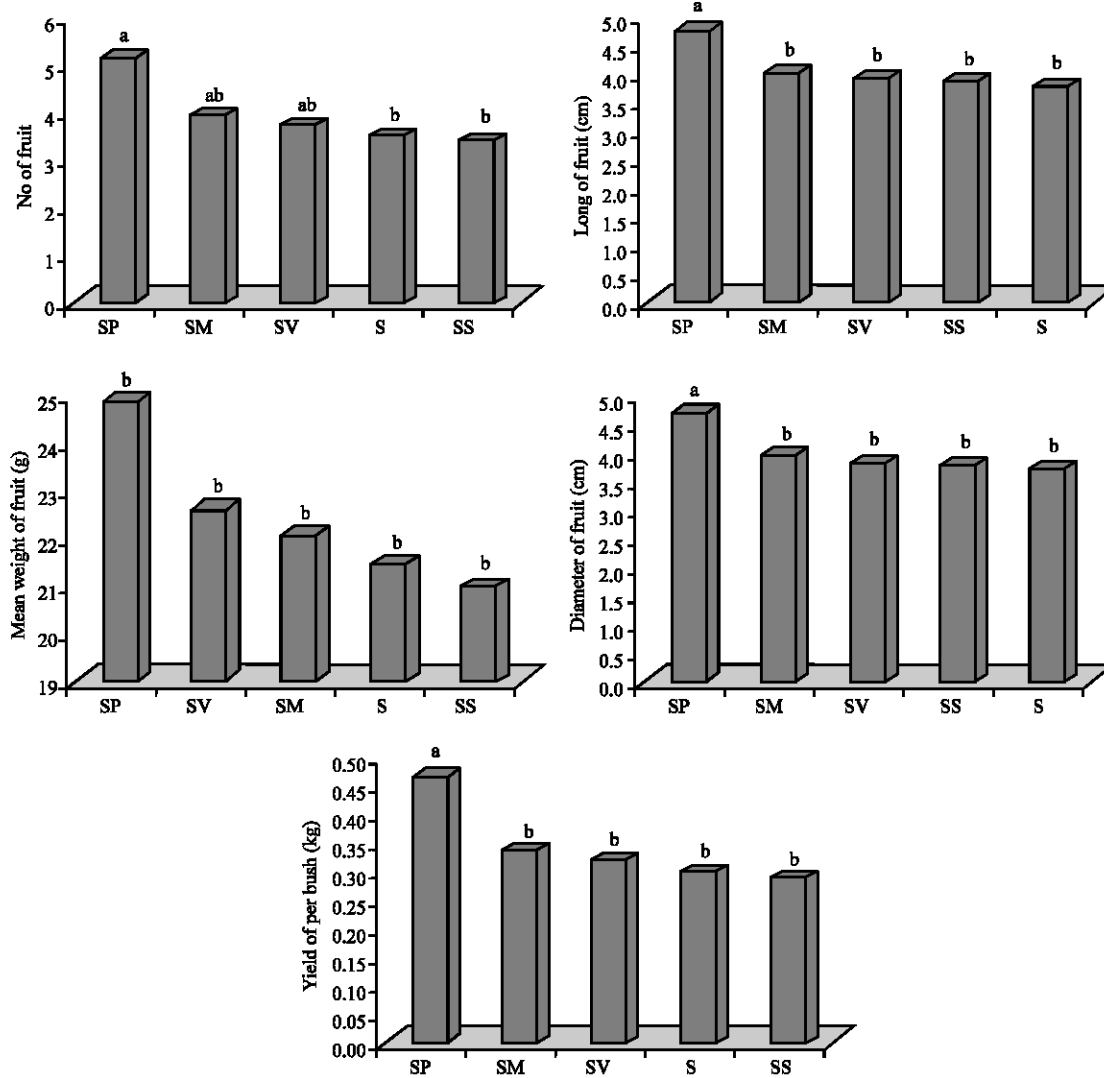


Fig. 2: The effects of media culture on yield traits in Pepino, S: Soil, SV: Mixture of soil and vermy compost, SS: Mixture of soil and sand, SP: Mixture of soil and peat moss, SSP: Mixture of soil, sand and peat moss. Values labeled with the same letter(s) are not different at the 1% significance level

($p < 0.01$) but other media culture do not had a significant difference with together (Fig. 2).

The benefits of using mineral elements to improve plant growth are known for over 2000 years. Nowadays, liquid fertilizers have become more common (Kholde and Zadeh, 2005). In general, the importance of using fertilizers on vegetables is more than other parts of agriculture (Peyvast, 2002). According to our results, foliar fertilization treatments except trait of yield of per bush show significant effect on other measured traits. Once a three week (N_3) treatments showed significant difference in whole of traits except trait of yield of per bush. Results of other researches shows that using foliar

fertilizer FFNV33 on Husk tomato from Solanaceae (Trejo-Tellez *et al.*, 2004) plant family or other foliar fertilizers on tomato and pepper will give out the same results (Sarkka *et al.*, 2002; Popescu *et al.*, 1976). Foliar fertilizing once a week (N_1) compared to once a 3 week (N_3) has a less effect on most traits. Increasing amount of microelements followed by their toxic role in the plant is much more than the other treatment (once a week). Therefore, probably there is enough time in once a three week (N_3) treatment to absorb and take these elements. Therefore, accumulation of microelements and the resultant negative effects and toxicity decrease. Applying fertilizer once a 3 week (N_3) is also suitable and commercial

(economical) for Pepino, because the number of applying decreases in this way. The applying of fertilizers is suggested to be done in one month or 45 day intervals in such experiments. Considering the effects of media culture on measured traits of Pepino in this study, show which in the whole of measured traits had significant effect and among media culture treatments, mixture of soil and peat moss (SP) show significant increase. Others observed the same results on pepper and egg plant (Eltez *et al.*, 1994). Mixture of soil and peat moss (SP) have some specific characteristics such as fibric and porous structure, keeping water well, well drained and high CEC which may be the main reason for the observed results. Soil (S), mixture of soil and vermy compost (SV), mixture of soil and sand (SS) and mixture of soil, sand and peat moss (SSP) do not appear to have a significant effect on Pepino measured traits. Soil and peat moss (SP) media culture showed significant difference compared to soil (S) culture, probably because soil (S) does not have enough pores and the air do not circulate well. The difference observed between mixture of soil and sand media (SS) culture and mixture of soil and peat moss (SP) culture in affecting Pepino traits may be related to less water holding ability and CEC of soil and sand (SS). Ineffectiveness of mixture of soil and vermy compost (SV) media culture on yield traits in Pepino might be mainly due to increasing EC in the mixture (Gajdos, 1997). Present results do not agree with others who observed beneficial effects of vermy compost on increasing yield of greenhouse tomato and marigold (Atiyeh *et al.*, 2000, 2002) and also on germination and growth of cucumber (Hilgado, 2002). Soil, sand and peat moss (SSP) media culture did not show a significantly different effect compared with soil and peat moss (SP) media culture on Pepino's traits. This probably refers to the different peat moss ratio in the media mixture. As the ratio of peat moss content in the media mixture drops (falls down) its useful effects decrease. In general, the stronger effect of foliar fertilization treatments compared with the effects of media culture may be most related to its potting culture. Pepino grows in a form of a bush and has fibrous roots. That is why potting culture limits the growth and media cultures (only SP) could not show their real effect. The other possible reason can be related with its environmental requirements and the difficulty of its adaptation to Mashhad (Iran)'s climate. As we mentioned before according to the resources Pepino requires cool nights and temperate days (12-25°C) for an optimum fruit set. Temperatures out of 10-30°C range will adversely affect the fruit set. High temperatures in spring or summer will also inhibit flowering (Prohens *et al.*, 2000). High temperatures are followed by late flowering and the falling of flowers (Peyvast, 2002). The range of night and

day temperatures is higher than 12-25°C and the humidity is low in Mashhad. So, the main reason of no significant effects of whole of media culture except mixture of soil and peat moss (SP) on most of traits is probably related to environmental factors which even cover the media culture effects while cultured in Mashhad.

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