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Araştırma Makalesi / *Research Paper*

Effects of Different Growing Media on Seedling Quality in Organic Seedling Production

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ABSTRACT

This study was carried out with the aim of determining the utilizability of farm manure (FM), Enriched Media (EM), organic peat (P) and zeolite (Z) as organic seedling growing medias and then determining the effects of media on seedling quality. Organic eggplant and tomato seedling were produced with manure, enriched media, organic peat and zeolite in different ratios (FM+P (1:1), FM+Z (3:1), P+Z (3:1), EM+P (1:3), EM+Z (3:1), FM+P+Z (1:2:1), EM+P+Z (1:2:1)). Conventional seedlings were produced in commercial peat media. The effects of these various media on seedling quality were investigated in this study. When we look at the effects of the medias on the seedling quality parameters, it was determined that the FM+P media gave better results in the seedling root length, while it was determined that the stem length changed according to the species and years. In all other quality parameters, it was determined that generally, the EM+P media gave the best results. Among the environments used in the study, the EM+P media in seedling cultivation can be recommended both to increase the success of seedling production and to reduce the use of organic peat, which is difficult to find and has limited reserves and sustainability.

Keywords: Enriched media, farm manure, organic peat, seedling quality, zeolite

Organik Fide Üretiminde Farklı Ortamların Fide Kalitesine Etkisi

ÖZ

Bu çalışma, organik fide yetiştirme ortamları olarak çiftlik gübresi (ÇG), Zenginleştirilmiş Ortam (ZO), organik torf (T) ve zeolitin (Z) kullanılabilirliğini belirlemek ve ardından ortamların fide kalitesine etkilerini belirlemek amacıyla yapılmıştır. Farklı oranlarda (ÇG+T (1:1), ÇG+Z (3:1), T+Z (3:1), ZO+) gübre, zenginleştirilmiş ortam, organik torf ve zeolit ile organik patlıcan ve domates fidesi üretilmiştir. T (1:3), ZO+Z (3:1), ÇG+T+Z (1:2:1), ZO+T+Z (1:2:1)). Ticari torf ortamında geleneksel fideler üretilmiştir. Bu çalışmada çeşitli ortamların fide kalitesi üzerindeki etkileri araştırılmıştır. Ortamların fide kalite parametreleri üzerindeki etkilerine bakıldığında fide kök uzunluğunda ÇG+T ortamının daha iyi sonuç verdiği belirlenirken, sap uzunluğunun tür ve yıllara göre değiştiği belirlenmiştir. Diğer tüm kalite parametrelerinde genel olarak ZO+T ortamının en iyi sonuçları verdiği belirlenmiştir. Çalışmada kullanılan ortamlar arasında fide yetiştiriciliğinde ZO+T ortamı hem fide üretim başarısını artırmak hem de bulunması zor, rezervleri ve sürdürülebilirliği sınırlı olan organik torf kullanımını azaltmak için önerilebilir.

Anahtar kelimeler: Zenginleştirilmiş ortam, çiftlik gübresi, organik torf, fide kalitesi, zeolit

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INTRODUCTION

Today, the world population is increasing rapidly and it is estimated that the population will reach 9.3 billion people in 2050. Population growth, increased nutritional needs, and unconscious and excessive use of agricultural inputs have brought along important pollution problems in agricultural areas. With the emergence of environmental problems, alternative agricultural systems have been sought and agricultural production systems that do not disturb the natural balance and do not pollute the environment have gained importance. Organic production is one of them (Tan, 2014).

Organic farming results in much higher yields under water-scarce conditions than conventional farming (Gomiero et al., 2011). Because of its greater ability to store carbon in the soil, it is thought that organic farming, if adopted on a large scale, could represent a way to reduce CO_2 use. Next, the impact on biodiversity is highlighted: organic farming systems often accommodate more plant and animal biodiversity than conventional systems. Looking to the future of organic farming, there is clearly a need for more research and investment to explore the potential of organic farming to reduce the environmental impact of farming practices; however, the consequences of decreased productivity for the socio-economic system should also be taken into account and appropriate agricultural policies developed (Gomiero et al., 2011).

In recent years, the number of organic farming areas and producers has been increasing around the world. With the increase in demand for organic products, the need for organic seedlings comes to the fore. Along with that; organic seedling demand is not enough to fill the existing areas of seedling companies with organic seedlings. In addition, since organic and conventional seedling production cannot be done in the same area, seedling companies do not engage in organic seedling production and it is very difficult for producers to reach organic seedlings. It is known that if it is ordered in advance for organic seedling production, it is produced by very few companies, and in general, the producer himself has to produce seedlings. One of the most important issues in organic seedling production is the growing environment, it affects seedling emergence, seedling growth, and quality of seedlings. These media are all solid sources other than soil, which, individually or in combination, do better than agricultural soil. Growing media, by taking over the function of the soil, provides aeration of the seedling root system, creates a water and nutrient media for the plant, and therefore it is of great importance to choose the best media for seedling productivity (Ahmed, 2017; Balliu et al., 2017). The election of the substrate in organic agriculture is critical to the correct development of the plant, especially when traditional plant varieties are used (Olaria et al., 2016).

The use of a single medium may not meet the actual needs of the plant and it is more appropriate to use the mediums as a mixture. The use of organic materials in the mixing of media increases its permeability, contributes to mineral particle aggregation and acidity correction (Luquı et al., 2019). Various studies have shown that seed germination, seedling emergence, development, and quality of plants depend on the quality of the growing media (Mathowa et al., 2017; Pascual et al., 2018). The quality of the seedling directly affects the yield and product quality. Farmers need high-quality seedlings to get products in a shorter time. In addition, high-quality seedlings are tolerant to abiotic and biotic stresses, while guaranteeing the yield and harvest quality of the crop (Ronga et al., 2021). The best productions are achieved with seedlings of quality. Thus, seedling production requires technologies, such as new substrates and containers that provide healthy and vigorous plants for the formation of seedbeds (Costa et al., 2012; Tüzel et al.,2020). The best growing media should be a mixture that will meet the needs of the seedling. Various mixtures prepared from different materials are used by seedling companies after being determined by preliminary trials. Although prepared seedling growing media may be beneficial for one plant, it may not be beneficial for others. For this reason, by preparing various mixtures, it is necessary to determine the most suitable growing media mixtures that will meet the demands of most vegetables or the most suitable growing media mixtures separately for each species (Demirsoy, 2004). In a study done; the best seedling performance was obtained with 3:3:2:2 ratio growing media of composted manure, peat, perlite, and vermiculite (Li et al., 2022). High-quality seedlings are a valuable product that can improve the early formation of crops, while increasing the quality, homogeneity and yield of the final product, and shortening the production time (Park et al., 2022). Tomato (*Solanum lycopersicum* L.) and eggplant (*Solanum melongena* L.) are two important members of the Solanaceae family, which are known and widely used around the world. They are widely consumed because of their nutritional and medicinal value (Çolpan et al., 2013; Kim et al., 2014; Haska et al., 2022). The aim of this study was to determine the use of organic peat, zeolite, farm manure, solid media as an alternative seedling growing media in organic and conventional seedling production of eggplant and tomato species, which are common in our country, and to determine the performance of seedlings grown in organic

peat and different media mixtures in terms of seedling quality.

MATERIAL AND METHODS

This study was carried out between 2020-2021 years. Research site, plant variety, media preparation, seedling cultivation, cultural processes, measurement and analysis are given below.

Research site

The study was conducted at Bursa Uludağ University (Universities place category with the GPS coordinates of 40° 13' 8.0364" N and 28° 52' 12.0036" E.). Faculty of Agriculture, Research and Experiment Field, in Turkey.

Plant variety

In the study, "pala-49" variety in eggplant (*Solanum melongena* L.) and "H-2274" variety in tomato (Lycopersicon esculentum M.) species were used.

Growing media preparation

Organic and conventionally grown eggplant seedlings, farm manure (FM), enriched medium (20% vegetable compost, 70% biologically activated fermented farm manure, 5% vermicompost mixture, natural enzymes from earthworms, 5% Leonardite, liquid humic-fulvic acids and rooting bacteria) (EM), organic peat (P) and zeolite (Z) in different ratios of P + Z (3:1), EM + P (1:3), FM+ P + Z (1:2:1), FM+P (1:1), EM+P+Z(1:2:1), FM+Z (3:1)) and EM + Z (3:1) grown in media obtained from mixtures.

Seedling cultivation and cultural processes

In the seedling greenhouse; seeds were sown in viols filled with various growing media. Cultural care of the seedlings is done regularly, after germination and observation of true leaf emergence, commercial fertilizer (15:15:15) was applied in conventional viol. Farm manure sherbet was given to the organic viols by irrigation twice, with an interval of fifteen days. Fertilizer syrup was obtained by diluting fully burned farm manure with 1/6 water (rested for two days, chlorine evaporated, sediment settled to the bottom).

Measurement and analysis

The study was planned in a randomized plot design with three replications. When the seedlings reached the planting height (cm), fresh and dry weight (g), number of true leaves (number/plant), root-stem lengths (cm) were measured in seedlings. The variance analyzes of the results obtained from the study were determined using the SPSS 23 program, and the statistical differences between the results were determined by the DUNCAN test ($P \leq 0.05$).

RESULTS AND DISCUSSION

Measurements were made when eggplant and tomato seedlings were ready for planting. As a result of the measurements, it was observed that the medias were statistically significant at the $p \leq 0.05$ level in terms of root length in organic and conventional seedlings, eggplant and tomato seedlings in the 1st and 2nd years. In the first year of the experiment, eggplant seeds did not germinate in EM +Z media. When all media were compared, in the eggplant seedling, the highest root length was observed at 16.06 cm in the 1st year and 15.65 cm in the 2nd year in the FM+P media. While the highest root length, in tomato seedlings was observed at 13.90 cm in its conventional media, in the 2nd year was observed at 17.92 cm in FM+P+Z media (Figure 1).

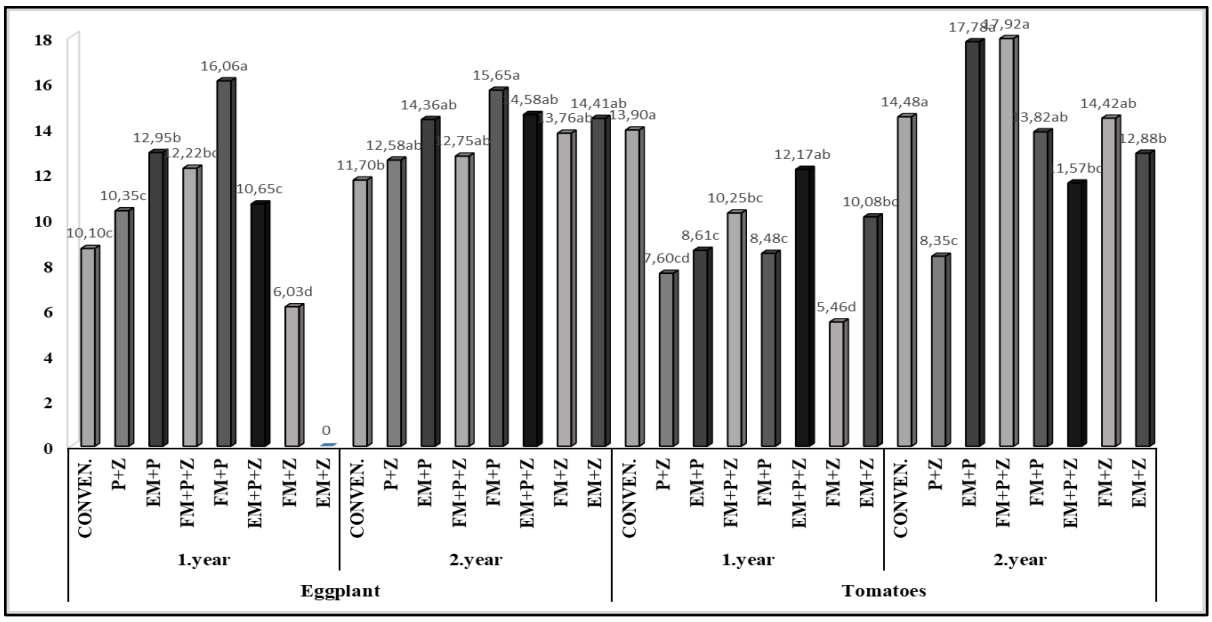

Figure 1. Effect of different growing medias on seedling root length (cm) of eggplant and tomato seedlings

According to these results; In general, it can be said that FM+P medium has a positive effect on seedling root length in eggplant. It can be said that EM+P+Z medium has a positive effect on seedling root length at 1. year, however FM+P+Z at 2. year in tomatoes. The results of this study are similar to the results of other studies. Baran et al. (1996) reported that with the increase in the peat ratio in the seedling mixtures, aeration and drainage conditions, which are the basic conditions of good development for plants, are provided in the best way due to the increase in the total void volume. Likewise, Polat et al. (2017) stated that the mixture of peat and peat:perlite (1:1) gave ideal results in terms of seedling growth. Ünal (2013) said that the highest tomato seedling root length was 13.87 cm in media containing peat-barnyard manure-perlite (2:1:1) and peat-sand-NPK (2:2:15 kg/da). Yılmaz et al. (2018) stated that they obtained the highest seedling root length of 15.00 cm from the control media, peat. Jeevitha et al. (2019) determined the highest seedling root length value as 5.68 cm in 75% vermicompost + 25% farm manure media. Atif et al. (2016) reported that optimum growth was observed in tomato seedlings with the use of peat, compost and conventional application media in equal proportions. Manh et al. (2014) reported that using a substrate in which vermicompost, rice husk ash and coconut husk mixture were mixed at a ratio of 1:1:1, respectively, they obtained the highest germination rate and plant height value in muskmelon.

Stem length

As a result of the evaluations made in terms of eggplant seedling stem length, it was found that the media was statistically significant at the $p \leq 0.05$ level in the 1st year, while it was insignificant in the 2nd year. In terms of tomato seedling stem length, the media were found to be statistically significant at the $p \leq 0.05$ level in 1 and 2 years. Accordingly, the highest stem length of eggplant seedlings was determined in the first year with 8.69 cm in the conventional seedling medium. While the highest stem length in tomato was determined in the 1st year with 13.33 cm in FM+P media, it was determined in the 2nd year with 14.93 cm in EM +P+Z media (Figure 2).

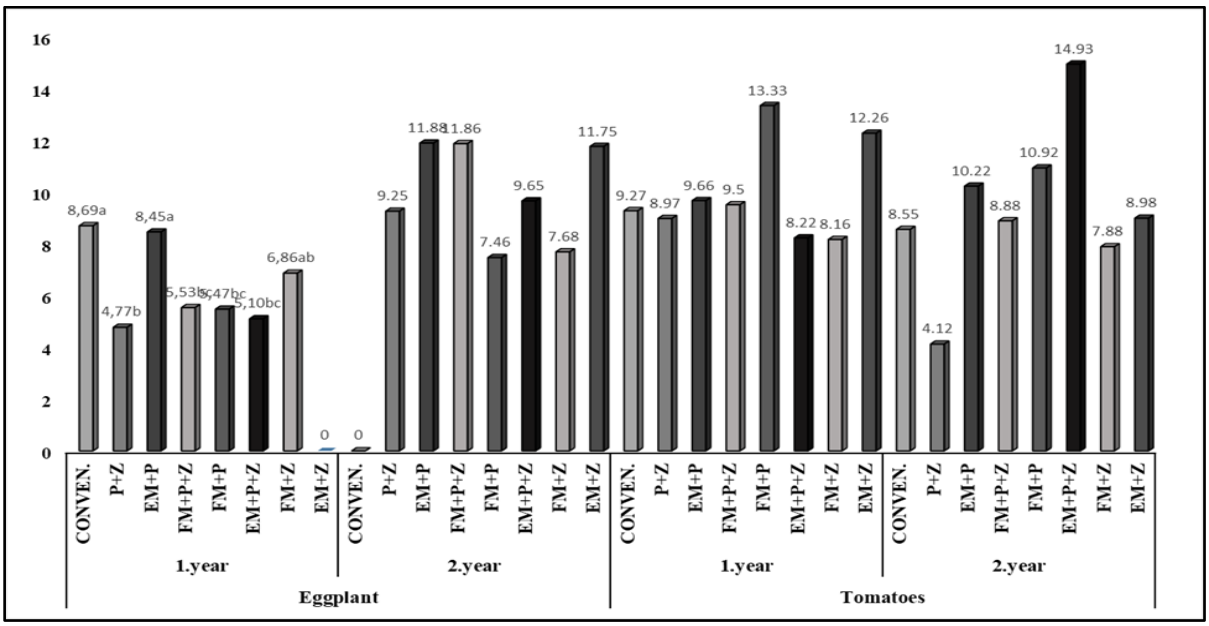

Figure 2. Effect of different growing medias on seedling stem length (cm) of eggplant and tomato seedlings

The results of this study are similar to the results of other studies. Varış et al. (2004) stated that they obtained the highest result in tomato seedling length from peat-perlite (3:1), seedling media. Kurtar (2013) stated that some summer vegetables such as watermelon, melon, cucumber, summer squash, pumpkin and chestnut squash in organic seedling cultivation, determined the highest stem length of 21.5 cm in the chestnut squash seedling in the conventional system. Tüzel et al. (2015) said that; among the organic sources, farmyard manure is the most important as it contains all the nutrients needed for growth including trace elements, albeit in small quantities.

Number of true leaves

In terms of the number of true leaves, the differences between environments in eggplant were found to be statistically significant at the level of $p \leq 0.05$ in the 1st year, but insignificant in the 2nd year. In terms of the number of tomato true leaves, it was observed that the environments were statistically significant at the $p \leq 0.05$ level in the 1st and 2nd years. The highest number of leaves in the eggplant seedling was determined as 3.85 (number/plant) in EM+P media. While the highest number of leaves in tomato was detected in the 1st year with 4.38 (number/plant) in FM+P media, in the second year it was determined with 6.67 (number/plant) in EM+P+Z media (Figure 3).

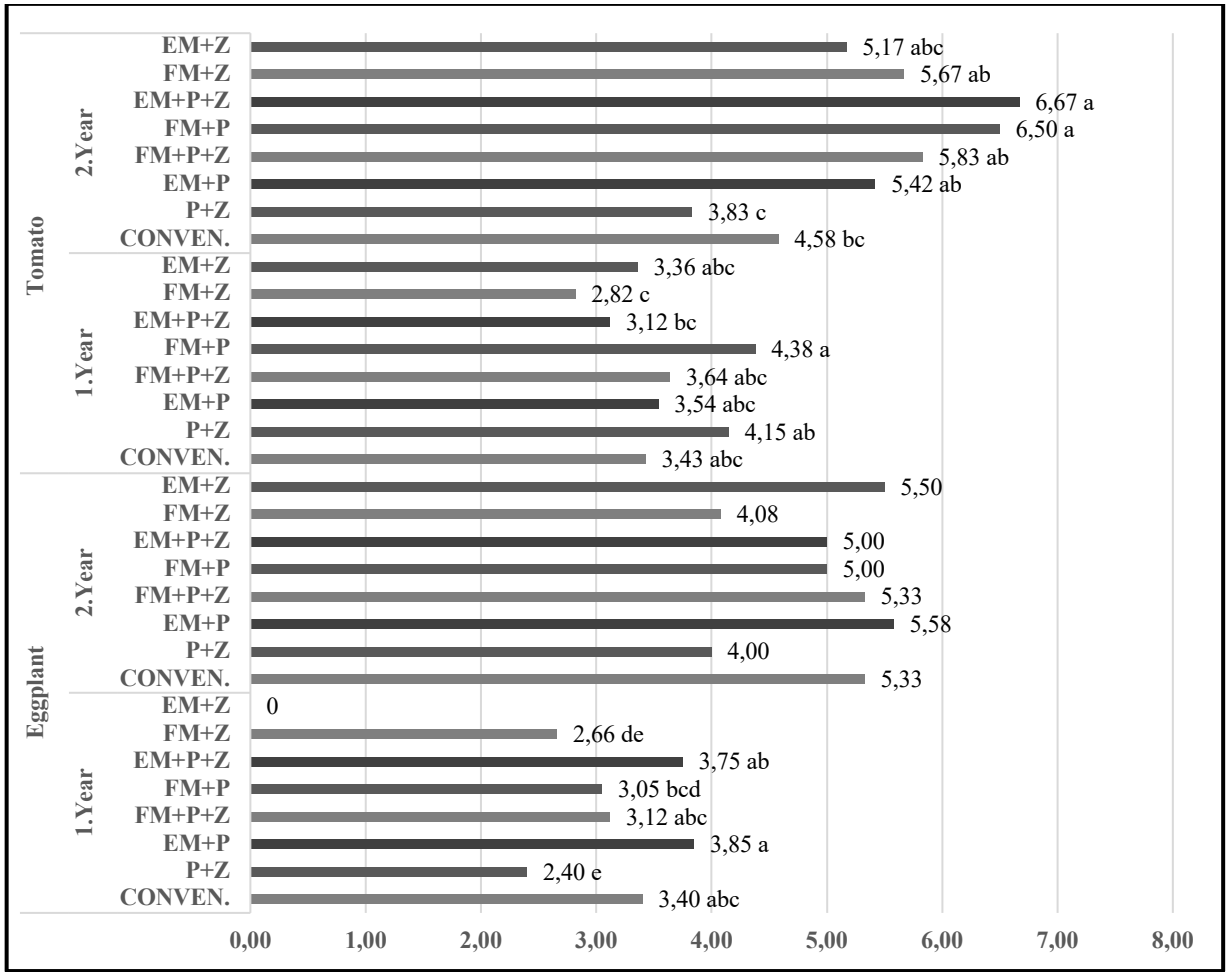

Figure 3. Effect of different growing medias on number of true leaves (number/plant) of eggplant and tomato seedlings

It is seen that different species give different results according to different media and years in number of true leaves. The results of this study are similar to the results of other studies. Varış et al. (2004) stated that while the highest number of seedling true leaves in tomatoes was obtained from the normal cinder-slag (1:1) media, they obtained the lowest true leaf number from the soil mortar (1:1:2) media. Demir et al. (2010) have expressed, as a result of the study of pepper seedlings grown in zeolite, peat, perlite, and their mixtures in different ratios determined that the highest true leaf number was 6.53 in 6P + 4Z (60% peat + 40% zeolite) medium. Demir et al. (2014) used zeolite, peat, perlite and various mixtures of these materials as growing media in their studies aiming to determine the effect of zeolite on seedling quality and plant nutrient content of cabbage. They stated that they determined the highest number of true leaves with 5.59 from 7P + 3Z (70% peat + 30% zeolite) media. Çinkılıç (2008) stated that in the production of cucumber seedlings, the highest number of true leaves was determined with 5.00 pieces in ground grape marc+ 25% perlite media.

Seedling root fresh and dry weights

In organic and conventional seedling production, in the 1st and 2nd years, it was determined that the media were statistically significant at $p \leq 0.05$ in terms of seedling root fresh of eggplant and tomato seedlings. While the highest root fresh weight was determined as 4.02 g in the 1st year in the eggplant seedling, the highest root fresh weight was determined in the 2nd year with 1.93 g in the EM+P media. The highest root dry weight was detected in the EM+P media with 0.54 g in the 1st year and 0.27 g in the 2nd year. While the highest root fresh weight in tomato seedlings was seen in the conventional media with 4.01 g, it was determined in the EM+P media with 1.29 g in the 2nd year. Again,

the highest root dry weight in tomato seedlings was determined as 0.57 g in FM+P+Z media in the 1st year, while it was determined in EM+P+Z media with 0.12 g in the 2nd year (Table 1).

Table 1: Eggplant, tomato seedlings root fresh weights (g), root dry weights (g), I. and II. year measurements

Media	Eggplant				Tomato			
	Root fresh weights g)		Root dry weights (g)		Root fresh weights (g)		Root dry weights (g)	
	I. Year	II. Year	I. Year	II. Year	I. Year	II.Year	I. Year	II.Year
Conv.	4,02 a*	0,99 e	0,52 a	0,13 d	4,01 a*	0,42 d	0,42 ab	0,006 d
P+Z	0,41 c	1,15 c	0,10 c	0,09 e	0,78 bc	0,04 g	0,25 abc	0,013 d
EM+P	3,63 ab	1,93 *	0,54 a*	0,27 a*	1,50 abc	1,29 a*	0,33 abc	0,09 b
FM+P+Z	1,73 abc	1,09 d	0,35 ab	0,22 b	3,59 ab	0,27 f	0,57 a*	0,06 c
FM+P	0,98 bc	0,89 g	0,25 bc	0,16 c	0,22 c	0,42 d	0,03 c	0,08 b
EM+P+Z	0,51 c	0,91 f	0,14 bc	0,14 d	1,74 abc	0,64 b	0,27 abc	0,12 a*
FM+Z	0,22 c	0,73 h	0,06 c	0,16 c	2,46 abc	0,39 e	0,38 abc	0,06 c
EM+Z	-	1,34 b	-	0,21 b	0,86 bc	0,59 c	0,12 bc	0,06 c

* The letters indicate different groups at the $p \leq 0.05$ level.

According to these results; While it can be said that EM+P media has a positive effect on the root fresh and dry weight of eggplant seedlings, we can talk about the positive effect on tomato seedling root fresh and dry weight due to the presence of P+Z media in the mixtures with the highest values in both years. Çayci et al. (1998) stated that they obtained the highest root dry weight in the tomato H-2274 variety from the control group (100% peat). This result is in agreement with our findings. Ahmed (2017) stated that the highest root fresh weight of 1.60 g was obtained only from peat medium, and the highest root dry weight was obtained from only peat medium with 0.12 g. Namal (2019) declared that the highest seedling root dry weight in tomato is obtained from mixture (70% peat + 10% zeolite + 10% diatomite + 10% vermicompost (1.32 g), and 70% peat + 15% zeolite + 15% vermicompost (1.13 g).) Olaria et al. (2016), while the highest root fresh weight was determined in pepper with 0.71 g, in S3 (60% peat + 30% vermicompost + 10% perlite) media, they stated that they determined the highest root dry weight with 74.11 mg in S3 (60% peat + 30% vermicompost + 10% perlite) media.

Stem fresh and dry weights

Organic and conventional seedling production were found to be statistically significant at $p \leq 0.05$ level in terms of the stem fresh and dry weight of eggplant and tomato in the 1st and 2nd years. According to the measurements made in the 1st and 2nd years of the eggplant seedling in terms of stem fresh and dry weight; while the highest stem fresh weight was determined in the conventional media with 8.36 g in the 1st year, it was observed in the EM+P media with 9.12 g in the 2nd year. The highest stem dry weight was determined in EM+P media with 1.38 g and 1.23 g in the 1st and 2nd years, respectively. This situation is similar to root fresh and dry weight. According to the measurements; while the highest fresh stem weight in tomato seedlings was determined at 11.00 g in FM+P+Z media in the 1st year, it was determined in EM+P+Z media with 3.63 g in the 2nd year. While the highest stem dry weight was determined as 1.61 g in FM+P+Z media in the 1st year, it was detected in the EM+P+Z media with 0.47 g in the 2nd year (Table 2).

Table 2: Eggplant, tomato seedlings stem fresh weights (g), stem dry weights (g), I. and II. year measurements

Media	Eggplant				Tomato			
	Stem fresh weights (g)		Stem dry weights (g)		Stem fresh weights (g)		Stem dry weights (g)	
	I. Year	II. Year	I. Year	II. Year	I. Year	II. Year	I. Year	II. Year
Conv.	8,36 a*	2,29 f	1,34 a	0,37 f	7,35 ab	1,37 e	1,43 a	0,32 b
P+Z	1,14 c	2,14 g	0,21 b	0,31 g	5,65 ab	0,23 h	0,77 ab	0,04 d
EM+P	8,20 a	9,12 a*	1,38 a*	1,23 a*	6,88 ab	1,77 c	0,89 ab	0,23 cd
FM+P+Z	3,54 b	5,54 b	0,70 b	0,76 b	11,00 a*	1,25 f	1,61 a*	0,17 d
FM+P	2,71 b	2,76 e	0,43 b	0,45 e	2,63 bc	1,93 b	0,30 b	0,27 bc
EM+P+Z	2,72 b	2,84 d	0,42 b	0,47 d	4,93 b	3,63 a*	0,71 ab	0,47 a*
FM+Z	1,60 b	1,52 h	0,24 b	0,26 h	6,93 ab	1,19 g	1,02 ab	0,17 d
EM+Z	-	5,40 c	-	0,62 c	9,90 a	1,51 d	1,01 ab	0,20 d

* The letters indicate different groups at the $p \leq 0.05$ level.

Based on these results; While it can be said that EM+P media has a positive effect on the eggplant stem fresh and dry weight in general. On the tomato seedling root fresh and dry weight has been seen the positive effect of the FM+P+Z media in the 1st year and the positive effect of the EM+P+Z media in the 2nd year. In addition, we can talk about the positive effect due to the presence of P+Z environment in the mixtures with the highest values in tomato seedling root fresh and dry weight. Demirsoy (2004), in the seedling media study; stated that the best results for the eggplant root dry weight were obtained from the forest soil media. Mininni et al. (2012) stated that they observed that the fresh and dry weights of the seedlings increased depending on the increasing compost ratios of the medias. Ünal (2013) said that peat-stable anureperlite, peat-sand-NPK, peat-stable manure and peat gave positive results for tomato and pepper seedlings growth. Tüzel et al. (2015) said that; liquid composted farmyard manure could be more suitable for commercial use considering its effects on plant fresh weight, availability, and cost. Sönmez et al. (2016) the effects of spent mushroom compost used in growing media on the seedling quality and nutrient contents of eggplant (Solanum melongena) were determined under greenhouse conditions. Costa et al. (2011) evaluated the effect of vermiculite and crushed cassava stems, both pure and as a mixture, on eggplant-seedling growth. At the end of this study; the media mixtures of vermiculite and cassava stems, between 40 and 60%, are the best substrate for eggplant seedlings.

CONCLUSIONS

When we look at the eggplant and tomato seedling quality parameters, it was determined that FM+P media gave better results in the seedling root length, ın all other quality parameters, it was determined that EM+P media gave the best results. Among the environments used in the study, EM+P environment in seedling cultivation can be recommended both to increase the success of seedling production and to reduce the use of organic peat, which is difficult to find and has limited reserves.

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