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THE EFFECTS OF ORGANIC FERTILIZATION ON THE QUALITY OF EGGPLANT SEEDLINGS

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Abstract: This study investigated the effects of chemical fertilizer (20-20-20) and two different organic fertilizers (compost and wood ash) applications on eggplant seedling quality. Peat was used as the growing medium. Some seedling quality parameters such as stem diameter, seedling height, number of leaves, leaf chlorophyll content, leaf area, root length and total seedling dry weight were investigated. In general, although applying chemical fertilizer is the best value in the seedling quality parameters, it was determined that statistically ($P<0.05$), similar values were obtained in applying compost. As a result, it was determined that compost fertilizer applications could compete with compound fertilizers. Compost application, which stands out regarding seedling dry weight, leaf chlorophyll content and leaf area values, has been determined to provide height control in seedlings compared to chemical fertilizer application.

Keywords: Eggplant, Seedling quality, Compost, Wood ash

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1. Introduction

Türkiye ranks 4th in world vegetable production with 31.7 million tons of vegetable production. Eggplant production, which constitutes approximately 3% of this vegetable production, is 832,938 tons in an area of 167 thousand/da (TSI, 2021). Plants used in eggplant production can be planted directly on the field by sowing seeds or planting seedlings. However, seedling cultivation has many advantages (earliness, high yield, high resistance to root diseases, homogeneous growth, energy, seed, land and time savings) compared to direct seed sowing (Özer and Kandemir, 2016; Yılmaz et al., 2018; Demir et al., 2020; Tüzel et al., 2021). The advantageous use of ready-made seedlings has increased the use of seedlings in greenhouse cultivation to 100% (Demir et al., 2020). In recent years, in parallel with the increase in vegetable production, the production of vegetable seedlings has also increased rapidly. In the ready-made seedling sector in Türkiye, only 588 million seedlings of 9 vegetable types are produced in companies registered with the Seedling Producers Sub-Association in Antalya. Eggplant seedling production constitutes 4% (23 million) of the total seedling production (Anonymous, 2023).

Although the media used to grow the seedlings differed, peat was the most preferred medium. It is used by mixing in specific proportions with materials such as peat, perlite or vermiculite. It is preferred due to its many advantages (free from diseases and high water holding capacity) (Tüzel et al., 2021). However, although peat gives very successful results in germination and emergence, fertilization is needed, especially when the seedlings reach the 2-leaf stage. For this reason, those who want to grow organic seedlings, especially those who want to grow seedlings, carry out alternative growing environments or organic fertilizers (Yılmaz et al., 2018; Tüzel et al., 2021). Since seedling production, the growing period is short and plant roots develop in a very small medium volume, it is necessary to pay attention to fertilizer applications to prevent nutrient deprivation of the plant. Nitrogen is the most important factor affecting seedling development, and giving nitrogen in the form that plants can take significantly increases tomato seedlings' fresh and dry weights (Tüzel et al., 2021).

Additional fertilizer has become an essential input item for seedling growers. For this, preparing preparations to be used as different organic fertilizers may potentially reduce the input cost and increase the seedling quality. Therefore, this study aimed to investigate the effects of different organic fertilizers that can be used as an alternative to commercial fertilizers on the quality of tomato seedlings.

2. Material and Methods

The research was carried out in the glass greenhouse of Ondokuz Mayıs University, Faculty of Agriculture, Department of Horticulture, between April 15 and May 30, 2023. The study used seeds of eggplant (*Solanum melongena* L. cv. Aydın siyahı) cultivar as plant material. The seeds were sown in 216 mesh EPS viols with outer dimensions of 695 x 470 x 75 mm and inner dimensions of 31 x 31 x 65 mm (mesh volume). Viols were filled with peat (100%). The seeds were kept in the germination cabinet at 27 °C until germination and emergence. Then, the viols were placed on the seedling benches in the greenhouse, the temperature of which was adjusted to 23-24 °C during the day and 19-21 °C at night. Fertilization was applied twice when the seedlings reached their first true leaf stage and the third leaves started forming until all leaves and growing media were wet.

The research used chemical fertilizer (20-20-20) and two different organic fertilizers (compost water and wood ash) to improve seedling quality. In the preparation of compost water, the stem and leaf wastes of tomato plants were composted using the heap method (Inckel et al, 2005). Holes with a diameter of 2 cm (10 cm spacing) were drilled in the plastic (770L) container used to implement this method. Tomato pruning residues (5 cm in diameter) were divided into pieces, forming a 25 cm heap. On top of this pile, 10 cm high burnt animal manure was applied. Garden soil with a height of 2 cm was added over the animal manure. This process was continued until the container was full. Finally, the heap was moistened and put on hold. The composting process continued for 60 days. During this period, the batch was mixed weekly.

Waste oak tree wood ash (*Quercus* sp.) used in lye production was taken from the bakery (Yazıcıoğlu brothers' bread oven) that produces bread in the Samsun region. Compost and ash analyses (pH, E.C., nitrogen, phosphorus and potassium) were determined according to Kaçar and İnal (2008) (Table 1).

Table 1. Some chemical properties of compost and wood ash fertilizer

Values	Compost	Wood ash
pH	7.73	12.0
EC (dS m^{-1})	3.58	14.04
Nitrogen (%)	0.40	0.13
Phosphorus (%)	0.84	0.79
Potassium (%)	0.44	6.76

EC= conductivity

The compound fertilizer used in the study was prepared at 1000 ppm. The conductivity (EC) values of the solution obtained from the compound fertilizer were measured as 1.3 ds/m. Strainers were prepared by adjusting the EC values of ash and compost water according to the value of the compound fertilizer (1.3 ds/m). The strains obtained were used in fertilization two times as the first true leaf period and the 2-3 leaf period. While fertilizing, infiltrates were applied until all the leaves of the seedlings and the seedling growing medium were wet.

In order to determine the quality of the seedlings, when the seedlings come to the planting stage (four-five true leaf periods), the following measurements will be made in 3 replications and ten seedlings in each replication, in total 30 eggplant seedlings;

Leaf chlorophyll content: Chlorophyll content (CCI) in the leaves will be determined in the leaves of the seedlings between 09:00 and 11:00 in the morning using a chlorophyll meter (CCM-200, Opti-Sciences, U.S.A.).

Leaf area: All sheets were fixed on A3 paper and photocopied. Leaf areas were measured using a planimeter (Placom Digital Planimeter, SOKKISHA Planimeter Inc., Model KP-90) on the photocopier.

Seedling height: In measurement plants, the parts of the seedlings from the root collar to the growth point will be measured with a ruler.

Stem diameter: It will be measured with the help of a caliper 1 cm above the root collar in measurement plants.

Number of leaves: It will be determined by counting the total number of leaves in the measurement plants.

Root length: In measurement plants, the parts of the seedlings from the root collar to the tip of the longest root will be measured with a ruler.

Root, stem and leaf fresh and dry weights: For measurement, the roots will be washed and separated so that there is no root loss during the removal process of the seedlings. Then, the roots, stems and leaves will be divided into parts and their wet weights will be weighed. Leaves, roots and stems separated from the plant will be placed separately in small paper bags in an oven at 80 ^{o}C. The drying process will be carried out for at least 48 hours. Whether the drying process has been completed by applying the weight change method on the samples that have not completed their drying within this period will be decided. When it is understood that the samples are completely dry, the dry weights of the leaves, roots and stems will be weighed with a scale sensitive to 0.01 g.

2.1. Statistical Analysis

The research will be set up using the 3-replication Random Plots trial design. IBM SPSS version 20.0 statistical analysis program will be used to analyze the variance of the result obtained from the research and determine the differences between the means (Tukey test).

3. Results and Discussion

Different organic fertilizer applications' significant ($P<0.05$) effects on plant height, stem diameter, leaf number, leaf chlorophyll content, leaf area and total seedling dry weight were determined in eggplant seedling cultivation. When the seedling quality parameters were examined, it was determined that the highest plant height, stem diameter, number of leaves,

leaf chlorophyll content, leaf area and relative growth rate values were obtained from chemical fertilizer application. It was determined that the highest total seedling dry values were obtained from wood ash application. In addition, in compost application, similar values were obtained for the number of leaves, leaf chlorophyll content and leaf area values with chemical fertilizers (Table 2). Seedling height (3-19 cm) and stem diameter (3-4 mm) were determined in eggplant seedling cultivation. In the study examining the effect of different paclobutrazol applications for seedling height counter, 7-12 cm spacing of eggplant seedlings was evaluated as ideal (Geboloğlu et al., 2015).

Table 2. The effects of different organic fertilizer (compost and wood ash) and chemical fertilizer (20-20-20) applications on stem diameter, plant height, leaf number, leaf chlorophyll content, leaf area, root length and total seedling dry weight

	Stem diameter (mm)	Plant height (cm)	Leaf number (piece)	Chlorophyll content (CCI)	Leaf area ($cm^{2)}$	Root length (cm)	Total dry weight (g)
Control	1.6 c	4.68 d	2.0 b	8.4 b	8.8 b	10.6	0.073 b
Compost	2.3 b	7.96 b	3.0 a	13.8 a	28.8 a	11.9	0.227 a
Wood ash	1.8 c	6.30 c	2.0 b	9.2 b	10.7 b	11.0	0.320a*
Chemical	2.8 a*	9.25 a*	3.3 a*	16.5 a*	35.1 a*	10.9	0.277 a

*P<0.05

In our study, seedling height values varied between 4.68-9.25 cm considering the average size of the eggplant seedlings, the similar values of chemical fertilizer and compost applications offered an opportunity to give an idea on many issues. The seedling height values were determined to be within the desired ranges in chemical fertilizer and compound fertilizer applications. However, compost application came to the fore regarding seedling height control. Mainly when the 4-5 leaf periods of eggplant seedlings are considered, it has been observed that chemical fertilizer applications may exceed the desired values. It has been a scientific fact that the nitrogen content of chemical fertilizers is decisive here (Table 1-2). In studies conducted similar to our study, it is reported that the highest seedling length in eggplant is reached in chemical fertilizer applications (Fadıllıoğlu, 2022). In a different study, it was reported that the seedling height values in eggplant varied between 13 and 21 cm and the highest values were obtained in the control application. In contrast, 400 ppm tebuconazole application provided significant seedling height control (Öztürk and Dursun, 2020). In our study, a significant amount of height control was achieved with the application of wood ash without any chemical application.

In the study, where one of the important indicators of seedling quality was the number of leaves, it was reported that the number of leaves in eggplant seedlings varied between 3.4 and 4.8. The study determined that the number of leaves was a determinant in height control and paclobutrazol application provided height control by reducing the number of leaves (Geboloğlu et al., 2015). In our study, we can characterize the number of leaves as less than the control application as a nutritional problem. However, it is thought that the antagonistic effect due to the high potassium level can be mentioned in the wood ash (Table 1). Considering that compost application is similar to chemical fertilizer in terms of other quality criteria, it has been determined that it increases seedling quality and provides height control (Table 2). Stem diameter, plant height and dry matter content of seedlings play a decisive role in seedling quality and height control (Uçan and Uğur, 2021). When the seedling root lengths in eggplant are examined, it has been reported that it varies between 9-11 cm (Öztürk and Dursun, 2020). Although similar values were obtained in our study, no statistical difference was found.

The fact that the production period is short in seedling cultivation and the growing environments are limited in nutrients has made fertilization necessary. Nitrogen is one of the most important factors affecting seedling growth. For nitrogen to be quickly taken up by plants, it must be decomposed by microorganisms. Therefore, it is reported that the decrease in mineral N content due to mineralization in organic fertilization limits growth (Tüzel et al., 2021). In our study, it is thought that results stemming from a similar problem emerged. However, it has been determined that especially the compost application is competitive. When the leaf chlorophyll content, total seedling dry weight and relative growth rate values were examined, the chemical bore application came to the fore. In contrast, the compost application showed similarity with the chemical fertilizer application. However, it was determined that wood ash application came to the fore in total seedling dry weight values and this value also affected the relative growth rate (Table 2).

4. Conclusion

As a result of the study, it was determined that compost application could compete with compound fertilizer in eggplant seedling cultivation. It has been determined that using compost as fertilizer comes to the forefront regarding seedling quality values and especially seedling

height control compared to chemical fertilizer application.

Fertilizer use is an essential input in seedling cultivation. Compost application is one of the materials that can be prepared quickly and cheaply as a homemade solution. In addition to all these advantages, the use of compost increases the dry weight of the plant, the root development is balanced, and in addition to all these, it provides limited height control. It has revealed the potential to reduce seedling production costs significantly.

Author Contributions

The percentage of the author(s) contributions is presented below. All authors reviewed and approved the final version of the manuscript.

	K.M	A.Ç.T	A.A	H.Ö
C	15	15	30	40
D	20	20		60
S				100
DCP	30	30	20	20
DAI	10	30	10	50
L	20	30	20	30
W	20	30	20	30
CR	20	30	20	30
SR	20	30	20	30
PM	20	30	20	30
FA	20	30	20	30

C=Concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management, FA= funding acquisition.

Conflict of Interest

The authors declared that there is no conflict of interest.

Ethical Consideration

Ethics committee approval was not required for this study because of there was no study on animals or humans.

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