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Original article

Effects of Some Distillation Wastes Used in Growing Media on the Quality of Tomato and Cucumber Seedlings

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Abstract

The present research aimed to evaluate the utilization of some medicinal aromatic plants' distillation wastes (sage, thyme, mint, and basil) to provide an option for seedling growth media to ameliorate the seedling quality as well as to the restricted sources of peat. Tomato (Solanum lycopersicon) and cucumber (Cucumis sativus L.) were used as vegetative production materials. In the present study, including control media five different growing media consisting of distillation waste of thyme, sage, mint, and basil at 3:1 (peat: distillation wastes) rates were prepared. Consequently, it can be said some medicinal aromatic plant distillation wastes have the potential to be used as a support to seedling growing media.

Keywords: Distillation Wastes, Growing Media, Medicinal Aromatic Plant, Seedling.

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INTRODUCTION

Tomato (*Solanum lycopersicon*) and cucumber (*Cucumis sativus* L.) important members of the *Solanaceae* and the *Cucurbitaceae* families respectively, are among the top vegetables produced globally and, in our nation (FAO, 2023).

In the face of the rapidly increasing world population in recent years, there is a need for an increase in both soil and crop yields. It is vital to focus efforts on developing and improving agricultural systems in light of general issues such as limited arable land in the globe and in our nation, degradation in soil structure, and water shortages on a worldwide scale (Mishra et al., 2013).

The main factors of success in agricultural production include climatic conditions, systems preferred in cultivation, varieties, seedlings, and growing environments. The seedling substrate is essential to the growth of the seedlings (Ge et al., 2012). In particular, the biological and chemical properties of the media preferred in cultivation are expected to have some features such as suitable, homogeneous structure, good drainage, easy availability, and inexpensive (Sevgican, 1999). High-yield, high-quality and vigorous crops can be achieved with high-quality growing media composition. An appropriate growth medium must include a stable growth substrate, enough nutrients, water, and the ability for gas exchange and oxygen absorption by the roots (Tam and Wang, 2015).

Seedling growing media are generally prepared as a mixture by using various media components (peat, peat-perlite, peat-perlite-vermiculite) at different rates. Differences in the composition ratios of the components included in these growing media may cause a decrease in the number of seedlings grown, as well as a loss in material, time, and labor. Therefore, the ability of the seedling-growing media to be prepared to meet the demands of the vegetables planned to be grown will also contribute positively to obtaining the desired results (Uzun et al., 2001; Doğan, 2003). The primary substrate for the majority of commercial seedlings is a peat-based growing medium in many nations. Peat is a natural commodity and generally ideal for use in cultivation in terms of its properties, however, it is not renewable, and extreme utilization would harm the ecosystem (Zhang et al., 2012). The development of high-quality, reasonably priced seedling substrates that can replace peat is required in the future (Varış and Altay, 1991; Abad et al., 2001).

Ready seedlings are preferred as starting material in both open fields and greenhouse vegetable cultivation. Considering that in addition to obtaining a healthy, high-quality, and exemplary product in vegetable cultivation, the use of ready-made seedlings in production is inevitable. Production with ready-made seedlings comes to the fore in tomato and cucumber cultivation in our country.

Essential oils of medicinal and aromatic plants are known especially for their antioxidant, antibacterial, and antifungal properties, and play a role as an antimicrobial agent in folk medicine (Pinto et al., 2007). In recent years, it is noteworthy that medicinal and aromatic plants, which have important

effects in many ways, have been evaluated in different ways. In particular, studies have accelerated to obtain essential oils from valuable medicinal and aromatic plants and to evaluate the remaining waste after this acquisition. The fact that the essential oils obtained by the distillation method from medicinal aromatic plant species are rich in the main components they contain increases the commercial value of these plants, so it is important in many ways to evaluate the liquid and solid wastes remaining from these valuable plants after distillation (Yasak and Telci, 2020). In addition, the use of the remaining production wastes in different ways is in harmony with the prevention of environmental pollution, sustainability, and zero waste logic.

The fact that medicinal and aromatic plants exhibit some important anti-activities is associated with their bioactive components. For example, menthol and menthone are the main bioactive components in mint, which is one of the important medicinal aromatic plants. Their functions vary, menthol is responsible for antifungal and antibacterial properties (Freire et al., 2012; Jha et al., 2014), while menthone is recognized as a growth inhibitor (Cavalieri and Caporali, 2010; Tomescu et al., 2015). It is known to affect respiratory activities (Mucciarelli et al., 2001; Skrzypek et al., 2015). Previous studies have shown that root respiration activities of cucumber (*Cucumis sativus* L.) plants can be affected by extracts from mint and its primary monoterpenoid components (Mucciarelli et al., 2001).

In the present study, it was aimed to determine the effects of solid distillation wastes of sage, thyme, mint, and basil medicinal aromatic plants added to the growing media, on the usability of tomato and cucumber seedlings in growing media and on the seedling quality.

MATERIALS and METHODS

The research was carried out in the laboratory of Isparta University of Applied Sciences, Faculty of Agriculture, Department of Horticulture and Anamas Seeds Company greenhouse, in 2018 year. Z-1000 F_1 tomato cultivar and Berke F_1 cucumber cultivar were used as production material in the study. The seedling growing mortar used to grow the seedlings of tomato and cucumber varieties used in the research was prepared in a way to provide a ratio of 3:1 peat: distillation waste, as it was found to be the best ratio in our preliminary studies. Distillation waste is obtained as a result of the distillation of sage, thyme, mint, and basil plants.

The plants used to get distillation wastes were collected during the growing periods of sage, thyme, mint, and basil. Wastes obtained after distillation were dried and lightly ground by hand to be used in seedling growing media. For sowing seeds of tomato and cucumber cultivars, viols with 150 eyes (each eye volume 4 x 4 cm) were used. The seeds of the cultivars used in the research were sowed on May 04. During the growing period following the seed sowing, the humidity conditions were constantly checked and irrigations were made as often as necessary.

In the study, various parameters were examined in order to determine the effects of distillation wastes of different plants on tomato and cucumber seedling quality. These parameters included hypocotyl length (cm), the number of leaves (pieces), seedling height (cm), stem diameter (mm), leaf width (cm), leaf length (cm), root length (cm), chlorophyll (SPAD), fresh and dry weight (g).

The research was planned according to the randomized plot design with 3 replications and 50 seedlings in each replication. The data obtained from the research were subjected to analysis of variance in the MINITAB (MINITAB 17 Inc.) package program and the difference between the significant means was determined according to the Tukey Multiple Comparison Test and shown with different letters.

RESULTS and DISCUSSION

Findings from the study are presented in Tables 1 and 2. Differences were also observed in the effects of different medicinal and aromatic plant distillation wastes on the growth of cucumber and tomato seedlings. When evaluated on the basis of the parameters examined, it is seen that the effect of control application on seedling characteristics (except root length) is higher in cucumber seedlings in general (Table 1). When the effects of media created from distillation wastes are evaluated comparatively, it is seen that thyme application (except root length) is more effective than other applications. The most striking application among the distillation wastes in terms of its effects on the root lengths of the cucumber seedlings was the mint application.

Table 1. Effect of seedling media containing different distillation wastes on cucumber seedling characteristics.

Examined Features	APPLICATIONS					
	Control	Mint	Sage	Basil	Thyme	F value
Seedling height (cm)	10,89a	4,01d	3,65d	4,70c	6,19b	266,9**
Hypocotyl length (cm)	5,39a	2,41c	1,86d	2,09d	2,79b	222,4**
Root length (cm)	10,03b	13,71a	10,68b	10,71b	9,92b	8,2**
Stem diameter (mm)	4,59a	3,18c	3,23c	3,43bc	3,69b	32,9**
Number of leaves (pcs)	3,50a	2,11cd	1,95d	2,25c	2,81b	67,1**
Leaf width (cm)	6,59a	3,41d	3,33d	3,90c	5,15b	138,7**
Leaf length (cm)	5,30a	2,89d	2,93d	3,33c	4,19b	119,3**
Chlorophyll (SPAD)	63,67a	37,47d	39,26d	42,60c	57,28b	148,3**
Wet weight (g)	4,75a	1,43d	1,03e	1,99c	2,43b	151,3**
Dry weight (g)	0,39a	0,15c	0,08d	0,17c	0,20b	137,7**

** = significant at $p< 0.01$. Means followed by the same letter(s) within each feature are not significantly different at $p \leq 0.05$.

When the observations made after the application of the distillation wastes to the tomato seedlings are evaluated, it is seen that the effect of the control application on the seedling characteristics (except for root length and chlorophyll) is higher in general. The root length parameter, which was taken into consideration, did not give statistically significant results. When the seedlings were examined in terms of hypocotyl length, sage application gave the worst result among other applications. However, the sage application showed similar results with the control and basil application, and it was seen that tomato seedlings had a positive effect on stem thickness. The data obtained as a result of sage application showed that the inhibitory effect of sage on seedling length, leaf number, hypocotyl length, leaf width, fresh and dry weight parameters is quite high. Similarly, the inhibitory effect was also determined in the seedlings treated with mint, in the parameters of seedling height, leaf width and length, and fresh weight. When basil application was evaluated, its effect was seen less than other applications in evaluations except for hypocotyl length, stem thickness, and chlorophyll parameters. However, the basil application showed much more effect than other applications in terms of chlorophyll among the investigated parameters. When all the data on seedling quality are examined, it is seen that basil application generally comes after thyme application in terms of its effects on tomato seedlings. This shows that basil application can be a medium-strong inhibitor.

Table 2. Effect of seedling media containing different distillation wastes on tomato seedling characteristics.

Examined Features	APPLICATIONS					
	Control	**Mint**	**Sage**	**Basil**	**Thyme**	**F value**
Seedling height (cm)	22,2a	11,50c	11,03c	12,49c	14,43b	90,5**
Hypocotyl length (cm)	3,28a	3,22a	2,23b	3,20a	3,26a	34,0**
Root length (cm)	10,92	10,73	13,27	9,76	9,58	3,2ns
Stem diameter (mm)	3,61a	1,97b	2,34ab	2,08ab	2,45b	26,8**
Number of leaves (pcs)	5,40a	3,56b	3,56b	3,69b	3,95b	30,2**
Leaf width (cm)	10,18a	4,33c	5,12c	5,19c	6,07b	82,9**
Leaf length (cm)	10,0a	4,56c	4,59c	5,01bc	5,62b	76,7**
Chlorophyll (SPAD)	54,09b	53,41b	55,69b	60,15a	53,91b	4,6*
Wet weight (g)	5,97a	1,21c	1,23c	1,40bc	1,73b	214,0**
Dry weight (g)	0,54a	0,13b	0,13b	0,17b	0,18b	93,7**

** and *= significant at $p< 0.01$ and $p< 0.05$ respectively, ns = non-significant. Means followed by the same letter(s) within each feature are not significantly different at $p \leq 0.05$.

Meng et al. (2018) demonstrated that the usage of compost material composed of a spent mushroom substrate and pig manure as a growth medium for seedlings of tomato and pepper did not affect both vegetables' germination rates. On the other hand, tomato and pepper seedlings' best growth

parameters were seen grown in two growth media compositions; compost: perlite (5:1, v:v); compost: peat: perlite (4:1:1, v:v:v). Ünal (2015) demonstrated that the quality characteristics of tomato seedlings such as the length of hypocotyl, seedling, and seedling root, as well as fresh weights of shoot and root, improved as a result of the addition of wasted mushroom compost to the growing medium. Wiafe-Kwagyan and Odamtten (2018) showed that the use of the spent mushroom compost at lower concentrations supported tomato and pepper vegetative growth. In another study, Bilderback et al. (2005) demonstrated the effects of various growth media such as tea waste compost, tree bark compost, and soil on lettuce growth. According to the stated study, the highest head weight of plants was obtained from grown in tea waste compost, tree bark compost, and soil, respectively. Kütük et al. (1999) pointed out that waste of tea and mushroom compost can be used as an alternative organic fertilizer to barnyard manure in terms of product amount and physical and chemical quality characteristics of the spinach plant. Yu et al. (2019) indicated that with the utilization of various substrate composts, beneficial microbes have the competence to boost plant growth and yield as well as prevent plant disease through sustaining soil productivity via complicated bacteria–soil-plant interaction.

Conclusion

As a result, it is seen that different distillation waste types can give different responses to seedling characteristics. This It has been determined that these reactions vary according to the species of waste and the application rate of waste, and even the characteristics of the grown species. In this study, although the highest values on the cucumber and tomato seedling properties of distillation wastes were obtained from the control application when the difference between the applications is examined, it is seen that the thyme application, which has the weakest inhibitory effect, can be emphasized. Thus, it is thought that the use of an organic material known as waste by improving its properties may be important in terms of both economic and environmental gains.

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