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The effects of mixes of peat and olive pomace at various ratios on the vegetative growth of potted grapevine saplings

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Abstract

Numerous studies have been conducted in order to utilize the olive pomace, the solid waste left over from the oil processing of olives, which is widely cultivated, especially in Mediterranean countries, and to consider it a raw material that has added value instead of being considered waste. Some of these research are focused on establishing the re-utilization of olive pomace in agricultural production. Although some studies have reported that olive pomace can be utilized as fertilizer, soil improvement regulator, solid media culture, and even mulching material, this study was carried out due to the lack of sufficient scientific data on whether or not this material can be used as a growth medium in the cultivation of potted grapevine saplings. The study was carried out by growing ungrafted grapevine saplings of *Vitis vinifera* L. cv. Hatun Parmağı on media with peat and olive pomace at different ratios for six months, and then some vegetative growth parameters were examined. Due to the elevated olive pomace ratios in the growth medium, shoot and root growth of the grapevine saplings were restricted. The chlorophyll index and root fresh weight decreased dramatically when more than 25% (v/v) and 20% (v/v) crude pomace were available in the growth medium, respectively. Moreover, the availability of olive pomace in the medium significantly reduced shoot length, number of leaves, shoot weight, and leaf weight of grapevine saplings, regardless of the amount of olive pomace. However, it was found that 15% (v/v) or less of crude olive pomace could be utilized in growth medium mixtures when growing potted grapevine saplings; however, higher ratios would prevent the saplings from attaining marketable quality. While designing new studies, examining different grape varieties, fruit species, and lower olive pomace ratios would contribute to new and more comprehensive findings on the utilization of olive pomace in growing potted saplings.

Keywords: Olive Waste, Growing Media, *Vitis vinifera* L., Potted Sapling

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INTRODUCTION

Nowadays, research on the re-utilization of organic wastes left over from agricultural production and processing of agricultural products in agriculture and industry branches has been concentrated worldwide due to its economic contribution and the opportunity to save the cost of storage and the space allocated for storage (Taurisano et al., 2014; Obi et al., 2016; Harshwardhan and Upadhyay, 2017; Duque-Acevedo et al., 2020). Some of the studies on the re-utilization of agricultural wastes are carried out to establish whether they are eligible for re-utilization in agricultural production (Koul et al., 2022). The literature contains many studies reporting that plant wastes can be re-utilized as feed, fertiliser, soil conditioner, seedling and sapling growth medium (El-Mashad et al., 2003; Gruda, 2019; Sharma et al., 2019; Adegbeye et al., 2020; Raza et al., 2022; Lasoń-Rydel et al., 2022). Some of these studies have shown that the waste material utilized can be re-utilized in crop production due to its organic structure, richness in minerals, and rapid dissolution qualities. Indeed, the prerequisite for successful plant cultivation is the provision of the environmental conditions required by plants. As well as climatic conditions, the presence of sufficient, balanced, and absorbable minerals in the plant root is highly important for growing healthy plants (Marschner, 1995; Ağaoğlu et al., 2010; Koç et al., 2021). In recent years, studies on the possibility of using low-cost organic materials free from diseases and pests in this production model have increased with the effect of the widespread use of soilless agriculture (Carlile et al., 2015; Chrysargyris et al., 2021; Gruda, 2022). Furthermore, the global depletion of peat and perlite reserves, extensively utilized in soilless cultivation, and the emergence of waste issues in materials such as rock wool and glass wool make it necessary to identify alternatives that can be utilized in solid media culture (Dönmez et al., 2016). Here, agricultural wastes come out as highly potential products. Indeed, many agricultural wastes (cocopeat, paddy husk, etc.) are currently utilized in soilless agriculture, and new materials alternative to them have been searched (Carlile et al., 2019; Altun, 2024).

Olive pomace—one of the organic wastes that can be reutilized in agricultural production— contains high amounts of phytochemical compounds and minerals that are released during the extraction of oil from olives (Buono et al., 2011; Chrysargyris et al., 2023). Despite the long dissolution process, the composition of the minerals it contains has led researchers who study in the world's leading olive oil producer countries to research whether olive pomace can be utilized in plant production or how it can be utilized (Ameziane et al., 2020; Boutasknit et al., 2020; Regni et al., 2020; Tüzel et al., 2020; Alma and Söylemez, 2022). Indeed, it has been estimated that in Türkiye alone, approximately 2 million tons of olives were processed into olive oil in 2022, and it has been suggested that 35–40% of the olives processed into oil, i.e., 700–800 thousand tons of crude olive pomace, was generated as waste (Albayrak, 2023; Kıcı and Saltan, 2020). When a similar calculation is made over the amount of oil olives produced worldwide (approximately 20 million tons per year), it appears that approximately 7-8 million tons of olive pomace are released as waste (Anonymous, 2022). Reintroducing large quantities of organic waste material into production is crucial. It has been considered that the use of olive pomace in plant production would allow access to a low-cost raw material, and the special fields allocated for the storage of this material could be utilized for different purposes (Alkhalidi et al., 2023; Muezzinoglu, 2023; Enaime et al., 2024). Some studies have found that the high polyphenol content in olive pomace causes phytotoxicity in plants and therefore inhibits plant growth (Omer and Mohamed, 2012; Pinho et al., 2017; Ladhari et al., 2021). On the other hand, it has been found that the application of olive pomace compost improves both the physical properties of the soil and increases the organic matter content and has positive effects on the development of plants due to the partial loss of polyphenols contained in the olive pomace during the composting process (Baddi et al., 2009; Ouzounidou et al., 2010). However, the finding that different plant wastes (hazelnut husk, tomato compost, tea compost, mushroom compost, tobacco dust compost, apple compost, grape compost, etc.) can be used as a growth medium in seedling-sapling production (Kütük et al., 1995; Durukan, 2004; Aydın and Demirsoy, 2020; Akay et al., 2021; Çiçek and Yücedağ, 2021; Kartal and Geboloğlu, 2023) has led to the suggestion that olive pomace should also be investigated for use in different plant species for such purposes. Moreover, the number of the studies in the literature on whether olive pomace can be used in the production of potted fruit saplings is quite limited. This study, which was carried out to contribute to the literature in this field and to determine the possibility of using olive pomace in the cultivation of potted grapevine saplings, examined the vegetative growth of saplings of the Hatun Parmağı grape variety in different peat-olive pomace mixtures.

MATERIALS AND METHODS

Material

This study was carried out in 2021 using the experimental fields of the Agricultural Practice and Land Management and Research Center (ADYUTAYAM) at Adıyaman University, the laboratories of the Science and Technology Practice and Research Center (HUBTAM) at Harran University, and the Faculty of Agriculture at Adıyaman University. The study utilized 1-year-old ungrafted (own-rooted) open-rooted saplings of the Hatun Parmağı grape variety as plant material. The climatic data of the experimental field where the grapevine saplings were grown during the study were acquired from the climate station (Metos, Pessl Instruments, Austria) and presented in Table 1.

To determine the usability of pomace, a solid organic waste left over from olive oil production, in the production of potted grapevine saplings, some physical and chemical properties and plant nutrient contents of pomace supplied from the Ebrulim olive oil factory at Harran University were identified through analyses done in the Science and Technology Practice and Research Center at Harran University (HUBTAM). The analysis results showed that the olive pomace used in the study contained dry matter of 31.07%, fixed fat of 5.96%, and nitrogen of 1.09% (Table 2).

In addition to this, the olive pomace used in the study contained 704.9 ppm potassium, 212.0 ppm calcium, 6.302 ppm iron, and 60.15 ppm magnesium (Table 3).

Table 1. Some climatic data from the experimental field where grapevine saplings were grown

Months	Ave. Temperature (°C)	Ave. Max. Temp. (°C)	Ave. Min. Temp. (°C)	Total Precipitation (mm/da)
April	17.0	31.7	3.6	1.8
May	24.6	37.6	12.1	14.4
June	27.2	39.4	15.9	0.2
July	32.5	41.7	21.3	-
August	32.0	41.7	22.0	4.0
September	26.0	37.0	13.8	-
October	20.2	32.4	11.6	20.6

Table 2. Some physical and chemical properties of the pomace used in the study

Ash (%)	Oil (%)	Dry Matter (%)	N (%)	C (%)	H (%)	S (%)
5.09	5.96	31.07	1.09	46.03	6.58	4.86

Table 3. Some nutrient content of pomace used in the study

P (ppm)	K (ppm)	Fe (ppm)	Ca (ppm)	Cu (ppm)	Mg (ppm)	Zn (ppm)	Mn (ppm)
0.239	704.9	6.302	212.0	0.731	60.15	0.692	0.554

Since the amount of plant nutrients contained in pomace is relatively low compared to other widely utilized growing materials and their dissolution rates and intake from the root medium by the active and passive transport of plants are predicted to be slow, this study did therefore not use pomace alone as a rooting medium but examined different ratios of peat-olive pomace mixtures. The peat used in this study was TS-1-type peat produced by Klasmann-Deilmann (Klasmann-Deilmann, Potground H, Germany). Table 4 shows the compositions of different mediums of peat-olive pomace mixture prepared for grapevine sapling cultivation in this study. A growth medium containing 100% peat was used as a control group, and the other growth media were prepared by gradually increasing the olive pomace content.

Table 4. Peat-olive pomace mediums, the effects of which were examined in the study

Growing Media	Mixing Ratio (v/v)
Control	100% Peat
6P-1OP	85% Peat + 15% Olive Pomace
4P-1OP	80% Peat + 20% Olive Pomace
3P-1OP	75% Peat + 25% Olive Pomace
2P-1OP	67% Peat + 33% Olive Pomace
1P-1OP	50% Peat + 50% Olive Pomace
1P-2OP	33% Peat + 67% Olive Pomace

Method

Before moving the saplings to the prepared rooting medium, the roots were pruned to cut off 70% of them. Also, the strongest shoot on the saplings was pruned over 2 buds, and the other shoots were cut off from the bottom and removed. Saplings were planted on 12/04/2021 in 5-litre black rubber tubes containing different growth medium mixtures (Figure *1a*). The tubes were punched with an equal number of holes at the same locations to provide ventilation and drainage of excess water. In order to examine the effects of growth medium, the study was carried out according to a randomized block design with 4 replicates. A total of 84 potted grapevine saplings were investigated in the study. After planting, saplings were irrigated until the tubes were saturated with water (Figure 1*b*).

Figure 1. Planting the saplings in tubes (*a*), irrigating the saplings (*b*), setting up the experimental plots (*c*), and a view of the saplings with single-shoot (*d*)

During the growth period, the saplings in all growth media were irrigated simultaneously, and periodically sprayed, weeded, and carried out other care practices. In May, saplings were forced to develop a single shoot by leaving the one with the best growth strength on the sapling and taking out the others from the bottom (Figure 1*d*). In order to prevent the formation of shoots other than the single (main) shoot left on the saplings during the experiment, the saplings were periodically checked, and fresh shoots were cut off when they were just beginning to shoot.

The chlorophyll index in the sapling leaves was determined by SPAD-502 (Konica Minolta Sensing, Inc., Japan) just before the saplings were uprooted in October (Erdogan et al., 2018). Chlorophyll measurements were made on three mature leaves of all saplings in each growing mixture. Subsequently, saplings were uprooted, and the number of leaves was identified (Kara and Fakhar, 2020). Then shoot lengths of the saplings were measured with a tape measure (Kamiloğlu and Güler, 2014). Total fresh weight of leaves , totalfresh weight of shoots, and total fresh weight of roots were measured with precision balance. Then, leaf, shoot and root samples were packaged separately and dried in a drying oven at +65 °C for 72 hours, and their dry weights were determined on a precision scale after drying (Müftüoğlu et al., 2006; Tunçel and Dardeniz, 2013; Güneş, 2015; Cangi and Etker, 2019). The analysis of variance was run to the results using the Minitab version 18.0 program and the differences between the means were determined through Tukey multiple comparison test.

RESULTS AND DISCUSSION

The physical structure, chemical content, and mineral content of olive pomace used in the preparation of growth medium for grapevine saplings in this study are similar to the findings of researchers investigating this material previously (Dermeche et al., 2013; Ilay et al., 2013; Kara et al., 2022).

Table 5 presents the findings on the effects of growth media of different peat-olive pomace mixtures on shoot length, leaf number, and chlorophyll index of Hatun Parmağı grape variety seedlings in this study, in which the effects of olive pomace on the development of potted grapevine saplings were examined. According to the findings, the longest shoots were formed in the control (100% peat) group. The shoot lengths of the saplings decreased ($p<0.01$) due to the increase in olive pomace rate in the growth medium mixtures examined. Similarly, the saplings in the control group, the only growth medium without olive pomace, yielded better results for the leaf number. However, regardless of the amount of olive pomace added to the growth medium, the presence of olive pomace in the medium had a statistically similar effect on the leaf number of grapevine saplings and there were dramatic decreases in the leaf number of saplings ($p<0.01$). The highest values in terms of chlorophyll index in the leaves of grapevine saplings were recorded from the control group, but the saplings in this group and the saplings grown in 6P-1OP, 4P-1OP, and 2P-1OP media were statistically ($p<0.01$) in the same group. The saplings grown in the 1P-2OP medium had the lowest chlorophyll index.

Table 6 shows the effects of the growth medium of different peat-olive pomace mixtures on the fresh weight of shoots, fresh weight of leaves, and fresh weight of roots of grapevine saplings. Accordingly, the highest values in terms of the fresh weight of shoots were recorded in the control group, while the lowest values were recorded in the 1P-2OP medium. Although the medium containing pomace was in the same statistical group in terms of the fresh weight of shoots, the shoot development of the saplings was significantly limited due to the increase in the amount of olive pomace. It was found that a mixture ratio of 85% peat and 15% olive pomace was the best for using olive pomace in the growth of potted grapevine saplings to promote shoot development. Hence, the analysis of the fresh weight of leaves revealed that the control group had the highest value, followed by the 6P-1OP group. It is quite remarkable that Control, 6P-1OP, and 4P-1OP were in the same statistical group for the fresh weight of the root. These growing mediums caused heavier roots to form in grapevine saplings compared to the other growth media examined in the study *($p<0.01$)*. 1P-1OP and 1P-2OP media resulted in saplings with lower values than the other mediums in terms of all three parameters.

Table 5. Effects of peat-olive pomace medium on shoot length, leaf number, and chlorophyll index of grapevine saplings

Growing Media	Shoot Length** (cm)	Leaf Number** (count/sapling)	Chlorophyll Index**
Control	73.50 ± 6.76^{a}	162.5 ± 56.1^{a}	41.29 ± 1.43^{a}
6P-1OP	47.00 ± 7.44^{b}	80.3 ± 28.1^{b}	37.61 ± 2.25^{a}
4P-1OP	41.75 ± 9.07^{bc}	49.0 ± 10.4^{b}	37.38 ± 2.90^{a}
3P-1OP	41.38 ± 11.18^{bc}	53.5 ± 31.0^{b}	36.53 ± 0.87^{ab}
2P-1OP	43.25 ± 4.50^{b}	49.0 ± 22.2^{b}	37.68 ± 1.83^{a}
1P-1OP	26.75 ± 5.01^{cd}	47.0 ± 15.7^{b}	31.38 ± 0.90^{bc}
1P-2OP	14.35 ± 2.47^{d}	53.7 ± 8.8^{b}	29.63 ± 3.92^{c}

**: There is a statistically significant ($p<0.01$) difference between the mean values in the same column.

Table 6. Effects of peat-olive pomace media on the fresh weight of shoots, leaves and roots of grapevine saplings

Growing Media	Shoot Fresh Weight** (g)	Leaf Fresh Weight** (g)	Root Fresh Weight** (g)
Control	29.12 ± 8.34^{a}	71.64 ± 11.28^{a}	71.84 ± 14.83^{a}
6P-1OP	11.31 ± 3.42^{b}	41.44 ± 8.38^{b}	72.30 ± 6.05^{a}
4P-1OP	6.85 ± 1.54^{b}	28.68 ± 3.71^{bc}	77.76 ± 8.20^{a}
3P-1OP	7.13 ± 3.90^{b}	28.30 ± 11.52^{bc}	53.35 ± 3.77^{ab}
2P-1OP	7.26 ± 1.25^{b}	25.95 ± 2.78^{bc}	53.05 ± 18.74^{ab}
1P-1OP	3.87 ± 0.64^{b}	18.80 ± 3.21^{c}	35.41 ± 9.75^{b}
1P-2OP	3.95 ± 0.37^{b}	15.40 ± 3.40^{c}	28.71 ± 6.20^{b}

**: There is a statistically significant ($p<0.01$) difference between the mean values in the same column.

Table 7 presents the results for the changes in the dry weights of shoots, leaves, and roots of ungrafted grapevine saplings according to the growth medium. The results showed that the saplings with the highest values for the dry weight of shoots were grown in the control medium, and the ones with the lowest values were grown in the 1P-1OP medium. However, the saplings grown in 1P-1OP and 1P-2OP media were in the same statistical group for the dry weight of shoots, and they differed from the saplings grown in the other studied medium with respect to this characteristic ($p<0.01$). Similar to the dry weight of shoots, the highest values for the dry weight of leaves were recorded in the saplings grown in the control medium, and the lowest values were recorded in the saplings grown in the 1P-2OP medium ($p<0.01$). Moreover, the saplings grown in 3P-1OP, 2P-1OP, 1P-1OP, and 1P-2OP media were statistically similar in terms of the dry weight of the leaves. Depending on the olive pomace ratio in the growth medium, the dry weight of the roots of grapevine saplings varied. Unlike the fresh weight of the root, the dry weight of the root values showed that the saplings grown in the 6P-1OP medium yielded higher values compared to those grown in the other growth media, and they differed according to this characteristic. Additionally, grapevine saplings grown in 1P-1OP and 1P-2OP media were statistically in the same group for the dry weight values of roots and had lower values than the mixture of other mediums analyzed.

Table 7. Effects of peat-olive pomace media on the dry weight of shoots, leaves, and roots of grapevine saplings

Growing Media	Shoot Dry Weight** (g)	Leaf Dry Weight** (g)	Root Dry Weight** (g)
Control	9.43 ± 2.32^{a}	22.11 ± 2.46^{a}	16.89 ± 3.44^{ab}
6P-1OP	4.49 ± 1.12^{b}	14.12 ± 2.13^{b}	19.44 ± 2.61^{a}
4P-1OP	2.65 ± 0.42^{bc}	9.74 ± 1.11^{bc}	17.06 ± 0.98^{ab}
3P-1OP	2.59 ± 1.29^{bc}	9.32 ± 3.61^{c}	11.31 ± 2.32^{bc}
2P-1OP	2.64 ± 0.63^{bc}	8.56 ± 1.52^{c}	11.51 ± 4.90^{bc}
1P-1OP	1.34 ± 0.25^{c}	6.30 ± 1.25^{c}	9.30 ± 2.80^{c}
1P-2OP	1.49 ± 0.14^{c}	5.21 ± 1.07^{c}	7.05 ± 1.62^{c}

**: There is a statistically significant ($p<0.01$) difference between the mean values in the same column.

Ilay et al., (2013) reported that the presence of olive pomace in sunflower and bean growth media, regardless of the amount, greatly inhibited plant growth (plant height, leaf number, fresh and dry weight). Rahil et al., (2021) determined that 100% olive pomace medium was not suitable for use in cucumber and eggplant cultivation due to its high salt concentration and low acidity, but if olive pomace was mixed with peat moss at a ratio of 1:1, it did not adversely affect plant growth and productivity. Varol et al., (2020) found that if olive pomace compost was used in olive sapling production, it would improve the macro- and micro-element content of the saplings. Kamel (2023) found that olive pomace treatment of lettuces grown in loamy soil conditions improved the fresh weight (yield), head width, and leaf number of the lettuces. In olive orchards, Camposeo and Vivaldi (2011) found that the mulching of defatted olive pomace affected the canopy development of trees positively, while Nasini et al. (2013) found that the treatment of olive pomace as a soil conditioner positively affected the canopy development of trees. In contrast to short-term laboratory incubations, Innangi et al., (2017) found that soil organic matter coverage and biological activity improved when long-term studies were carried out on olive pomace-treated soils. On the other hand, Proietti et al., (2015) reported that olive pomace has a strong phytotoxic effect on plants, and this effect diminished after the composting process. Indeed, Alma and Söylemez (2022) reported that the presence of 5% (v/v) crude olive pomace in the growth medium restricted the growth of pepper seedlings (plant height, leaf, dry weight of leaves and roots, chlorophyll index) and decreased the vegetative growth parameters of plants with higher pomace content. Papafotiou et al., (2004) found that the height, dry weight of roots, number of bracts and the number of nodes where the first bract was formed reduced as the proportion of olive pomace compost gradually rose in peat-olive pomace compost medium in which rooted shoots of *Euphorbia pulcherrima* were grown. On the other hand, Ceglie et al., (2011) reported that composted olive pomace can be an alternative growth medium to peat for tomato seedlings. The findings of the present study are compatible with the findings of the researchers, who found that the vegetative growth of plants would be negatively affected if raw olive pomace was utilized in a seedling-sapling growth medium.

Table 8 presents the coefficients determined by running Pearson's correlation test on the results related to vegetative growth parameters of grapevine saplings grown for 5 months in growth media created by using peat and olive pomace at different ratios and the findings on their statistical significance under the study. The findings showed that all vegetative growth parameters were positively correlated with each other and statistically significant at the significance level of 1%. Additionally, the highest correlation coefficient ($r = 0.994$) was found between the leaf fresh weight (LFW) and the leaf dry weight (LDW). The lowest correlation coefficient ($r = 0.382$) was found between leaf number (LN) and the root fresh weight (RFW). In general, the detection of statistically significant and positive correlations between the vegetative growth parameters of grapevine saplings indicates that the reliability of the study findings from growth media of peat-olive pomace mixture at different ratios examined hereunder is also high. Indeed, different studies have found strong positive correlations between the leaf number of grapevine saplings and their root length, between leaf surface and leaf weight, and between the length of the mother shoot and the internode number (İşçi et al., 2019; Demirova, 2023; Atak and Çorak, 2024).

Table 8. Correlations between some growth parameters of grapevine saplings grown on medium with different ratios of peat-olive pomace mixtures

	LN	CI	SFW	LFW	RFW	SDW	LDW	RDW
SL	0.673**	0.786**	0.796**	0.832**	0.681**	0.833**	0.836**	0.589**
LN		0.513**	0.846**	0.846**	0.382**	0.860**	0.823**	0.387**
CI			0.582**	0.639**	0.712**	0.601**	0.655**	0.623**
SFW				0.967**	0.483**	0.987**	0.943**	0.463*
LFW					0.580*	0.983**	0.994**	0.576**
RFW						0.536**	0.610**	0.926**
SDW							0.968**	0.529**
LDW								0.618**

Abbreviations: SL: shoot length; LN: leaf number; CI: chlorophyll index; SFW: shoot fresh weight; LFW: leaf fresh weight; RFW: root fresh weight; SDW: shoot dry weight; LDW: leaf dry weight; RDW: root dry weight
**: Pearson's correlation coefficient was statistically significant ($p<0.01$).

Almost all of the studies in the literature found that the presence of crude pomace in the growth media negatively affected the vegetative growth of plants, although the examined plant species were different. However, the findings by Pinho et al., (2017), who reported that the physical and phytochemical content of olive pomace generated as waste from olive mills varied according to the extraction method of olive oil (2 phase-3 phase), suggest that it is necessary to take into consideration that the phytotoxic effects of olive pomace, which is planned to be used in the growth medium, may vary depending on the extraction method. Furthermore, the findings of the researchers who have reported that olive pomace composts contain relatively low amounts of polyphenols after the composting process, and therefore their phytotoxic properties are largely lost, indicate that olive pomace compost can be added to plant growth media (Altieri and Esposito, 2010; Karaca et al., 2015). Findings of the present study are compatible with the findings of other studies, which have reported dramatic reductions in the leaf number, shoot-stem length, biomass, root weight, chlorophyll content of leaves, and similar growth parameters of plants with a higher crude olive pomace content in growth media. However, since both crude olive pomace and pomace compost can have varying effects on plant growth, even at a limited level, it is necessary to conduct trials before production to determine the effects of these materials on the plant species and variety planned to be cultivated, as well as the most appropriate dose and rate of use.

CONCLUSION

This study, which was conducted to determine the potential for the reutilization of olive pomace, showed that the growth of grapevine saplings transferred to the growth medium to which olive pomace was added was limited, and their vegetative growth was significantly inhibited upon the increase in the amount of olive pomace added to the medium. Almost all the analyzed vegetative growth parameters showed that the control (100% peat) medium yielded better results than the other media. Additionally, it was determined that 6P-1OP (85% peat and 15% olive pomace) medium can be practically used for the marketability of potted grapevine saplings, a traded agricultural product. On the other hand, it was concluded that the addition of more than 15% olive pomace by volume to the growth medium of saplings was not eligible as it would cause negative effects on the vegetative growth of grapevine saplings and there would be problems in the marketing of those saplings. Furthermore, finding of the present study that the presence of proportionally low amounts of pomace in the growth medium of saplings may have a positive effect on the root dry weight may be due either to the storage of some of the phytochemicals contained in olive pomace by the grapevine saplings in their own roots to alleviate the stress factor in the root medium or to the transport to the roots of some compounds synthesized in order to regulate such a condition in the plant due to the inhibition of the uptake of one or more of the plant nutrients in the root medium by these compounds. However, it is necessary to establish similar experiments once again and to do more comprehensive chemical and biotechnological analyses in order to confirm the validity of these two hypotheses. Indeed, the findings that vegetative growth of grapevine saplings were limited or even diminished with the increase in the amount of olive pomace in the root medium may be due to the low tolerance of the grape variety (Hatun Parmağı) used as plant material in the study to some phytochemical compounds contained in pomace, or it may be due to the sensitivity of grape varieties belonging to the species *Vitis vinifera* L. to the presence of these phytochemical compounds in the root area. Further research on the use of other cultivated grapevine species and cultivars as plant material would contribute to a more comprehensive evaluation of the findings of this study on the use of olive pomace in the cultivation of potted grapevine saplings.

Consequently, the findings of the study indicate that olive pomace can be utilized in the preparation of root medium in the cultivation of grapevine saplings at volumetric ratios of 15% and below. Such use would not only allow the waste material generated in olive oil processing facilities to be reutilized but also reduce pollution occurring in nearby olive oil processing facilities.

Compliance with Ethical Standards

Peer-review

Externally peer-reviewed.

Conflict of interest

The authors declared that for this research article, they have no actual, potential or perceived conflict of interest.

Author contribution

The contribution of the authors to the present study is equal. All the authors read and approved the final manuscript. All the authors verify that the Text, Figures, and Tables are original and that they have not been published before.

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