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RESEARCH ARTICLE

Effects of Some Organic Preparations on the Development of Saplings of Viking Aronia (*Aronia melanocarpa* (Michx.) Elliot) Cultivar

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Abstract

Aronia (*Aronia melanocarpa (*Michx.) Elliot) is a perennial shrub in the form of perennial shrubs, belonging to the Rosacea family, growing in the southeast of North America and Canada. It's fruit contains very high amounts of anthocyanin and flavonoids. It is known as "super fruit" because of its contribution to human health.

The aim of this study was to investigate the effects of some organic preparations on the development of saplings of aronia cv "Viking". In the study, molasses (2%, 4%, 6%, 8% and 10%), vinasse (2%, 4%, 6%, 8% and 10%) and worm manure (2%, 4%, 6%, 8% and 10%) and the saplings which have not been subjected to any application and saplings treated with commercial compound fertilizers. Average shoot length (cm), average shoot diameter (mm), average stem diameter (mm), average leaf area (cm^2), average root length (cm), fresh stem weight, dry stem weight, fresh root weight, dry root weight and SPAD values measured at the end of sapling development.

The positive effects of vinasse and molasses applications in terms of the development of the shoots were determined. In terms of the number of shoot, the highest value was obtained with 7.56 pieces in the vinasse application of 2%. The maximum average shoot length was determined as 19.93 cm in vinasse 10% dose application. The maximum average shoot diameter was determined as 6.88 cm in 6% molasses application.

In terms of root development, the effects of vinasse and worm fertilizers were found to be statistically significant. The highest root dry weight vinasse 2% (30.51 g), the highest average root length was found in 6% application of worm manure (106 cm).

According to the results of the research, the use of vinasses (4-6%) and molasses (6-8%) can be recommended in the production of aronia saplings.

Bazı Organik Preparatların "Viking" Aronya *(Aronia melanocarpa* (Michx.) Elliot) Çeşidi Fidanlarının Gelişimi Üzerine Etkileri

Öz

Aronya (*Aronia melanocarpa* (Michx.) Elliot), *Rosacea* familyasına ait, Kuzey Amerika ve Kanada'nın güneydoğusunda yetişen, kışın yapraklarını döken çok yıllık çalı formunda, uzun ömürlü, üzümsü meyveler grubuna ait bir bitkidir. Meyvesi yüksek miktarda antosiyanin ve flavanoidler içermektedir. İnsan sağlığına katkısından dolayı 'süper meyve' olarak bilinmektedir.

Bu çalışmada Viking aronya çeşidi fidanlarının gelişimi üzerine bazı organik kökenli preparatların etkisini incelemek amaçlanmıştır. Çalışmada, fidanlara melas (%2, %4, %6, %8 ve %10), vinas (%2, %4, %6, %8 ve %10) ve solucan gübresi (%2, %4, %6, %8 ve %10) uygulanmıştır. Fidan gelişme dönemi sonunda bitkilerde ortalama sürgün uzunluğu (cm), ortalama sürgün çapı (mm), ortalama gövde çapı (mm), ortalama yaprak alanı (cm^2), ortalama kök uzunluğu (cm), yaş gövde ağırlığı (g), kuru gövde ağırlığı (g), yaş kök ağırlığı (g), kuru kök ağırlığı (g) ve yaprak alanı ölçülmüştür.

Sürgünlerin gelişimi açısından vinas ve melas uygulamalarının olumlu etkileri belirlenmiştir. Bitki başına sürgün sayısında en iyi sonuç %2'lik vinas uygulamasından (7.56 adet/bitki) elde edilmiştir. Ortalama sürgün uzunluğu yönünden en yüksek değer vinas'ın %10 doz uygulamasında (19.93 cm) belirlenmiştir. Ortalama sürgün çapı melas'ın %6'lık uygulamasında (6.88 cm) en iyi sonucu vermiştir.

Kök gelişimi açısından vinas ve solucan gübreleri uygulamalarının etkileri istatistiki olarak önemli bulunmuştur. Kök kuru ağırlığı yönünden vinas'ın %2'lik uygulaması (30,51 g) en iyi sonucu verirken, ortalama kök uzunluğu bakımından en iyi sonucu solucan gübresinin %6'lık uygulaması (106 cm) vermiştir.

Araştırma sonuçlarına göre aronya fidanı üretiminde vinas (% 4-6) ve melas (% 6-8) kullanımı tavsiye edilebilir.

Introduction

Aronia (*Aronia melanocarpa* (Michx.) Elliot) is a perennial shrub in the form of deciduous berries, a plant belonging to the Rosaceae family, growing in the southeast of North America and Canada. Its fruit contains high amounts of anthocyanins and flavonoids. It is also called 'super fruit' due to its contribution to human health (Snebergrova et al., 2014).

Aronia fruits began to be consumed starting from the middle of the 20th century. It is also grown as an ornamental plant, especially in European and Asian countries, due to its red leaves in autumn (Hirvi and Honkanen, 1985). The 3 most well-known species of aronia are *Aronia arbutifolia* L. Persian (with red fruit), *Aronia prunifolia* Marsh. Rehd. (Purple fruit) and *Aronia melanocarpa* (Michx.) Elliot (Black fruit) (Fidancı, 2015).

Aronia is very important for food scientists as it has intense phenolic compounds. Anthocyanins are water-soluble polyphenols responsible for purple, blue and some red colors in many plant tissues. Regular consumption of anthocyanin-rich foods has been associated with a decrease in hypertension and a reduced risk of cardiovascular disease in humans (Hakkinen et al., 1999).

Aronia is one of the fruits with the most antioxidants in the world. Aronia fruit contains an antioxidant polyphenolic natural mixture that fights against free radicals that damage cells caused by environmental pollution, stress and daily life activities (Seidemann, 1993).

Aronia is also rich in phenols, antioxidants, vitamins and minerals. It has been stated that these chemicals contain prevent cancer and heart diseases. Bioflavonoids, which are found in record amounts in aronia, have been reported to be a more effective neutralizer than classical antioxidants such as vitamin C and beta carotene. Today, it is stated that the main cause of most diseases is the damage caused by free radicals (Dilas et al., 2012).

Studies on its benefits to human health, its importance in human nutrition and cell culture have increased the importance of aronia. Many studies have been conducted to evaluate the composition and pharmacological properties of aronia fruit. This has enabled thousands of decares of aronia to be planted in Europe and America in recent years (Fidancı, 2015).

The use of aronia in both food and health sectors has made it a promising fruit. Some researchers have stated that aronia fruit is rich in protein, fiber, minerals, vitamins and organic acids apart from high phenolic compounds and carotenoids (Wawer et al., 2006; Koponen et al., 2007; Chrubasik et al., 2010; Snebergrova et al. et al., 2014). Aronia berries are also consumed fresh, but they are not preferred much because of their taste. Aronia is generally consumed by mixing it with pear and apple juice. In addition, due to the high anthocyanin it contains, aronia concentrate is also used in the pharmaceutical and food industry to give food products their natural red color. In industry, it is mostly used in the production of fruit juice, tea, sauce, syrup, wine, alcoholic beverages (Benvenuti et al., 2004). It is also used for coloring food and as a nutritional supplement (Tolic et al., 2015).

The first studies on the aronia species in Turkey started in 2012, commercial culture studies started in 2017 and the first large aronia orchards were established in Manisa with 50 da and 60 da in Kırklareli. Apart from these, small gardens have started to be established in Yalova, Samsun, Çanakkale, Istanbul, Bursa and Antalya. In 2018 and 2019, aronia orchards continued to be established in Kırklareli, Bolu, Bursa, Ankara, İzmir, Çanakkale, Trabzon, Kırşehir, Giresun, Tekirdağ and Konya.

Recently, the use of organic fertilizers has become widespread due to the increase in the costs of the use of synthetic fertilizers and the damage they cause to nature. The use of vermicompost in Turkey and in the world is getting more and more common.

Earthworms feed on plant and animal waste. Accordingly, in farms; organic materials such as animal excrement, plant production residues and domestic waste are given to earthworms as food and organic fertilizer called “vermicompost” is obtained. Vermicompost regulates plant growth with humic acid and growth hormones it contains, improves soil structure and increases plant production by adding nutrients to the soil (Ay, 2016).

Vermicompost can be easily applied to all plants with its effect on improving soil properties and providing nutrients to the plants it is applied to. Vermicompost plays an important role in plant nutrition and it is thought that it can make serious contributions in the future of organic agriculture.

Molasses is a preparation that contains abundant organic matter, macro and micro trace elements, which is released as a by-product from the processes carried out in the sugar factory to turn sugar beet into sugar. Molasses applications are known to have positive effects on vegetative growth in plants (Ulusu and Yavuzaslanoğlu, 2017). Molasses meets the nutrients needed by plants. It contributes greatly to the rapid growth of plants and the development of fruits.

Vinas comes out as a by-product of sugar beet processing in sugar factories to turn it into sugar. Then, the vinas obtained as a by-product is also processed in yeast factories and made usable by minimizing the amount of potassium available. Vinas is a substance that contains a large amount of organic matter, micro and macro trace elements. Gel organic fertilizers and liquid organic fertilizers are produced in the Vinastan fertilizer industry (Türker et al., 2015).

The rapid increase in fruit growing in the world also increases the demand for saplings. Due

to its contributions to human health and nutrition, the demand for aronia fruit is increasing rapidly in Turkey. As a result of this, the interest in aronia production increases, so the need for aronia saplings arises. It is known that the production of aronia saplings in Turkey is still far from meeting the demand. In this study, the effects of vermicompost, molasses and vinas organic preparations on the growth of aronia saplings were investigated.

Material and Methods

This study was carried out in Selcuk University Faculty of Agriculture, Horticulture Department Research and Application greenhouses in 2020.

In the research, saplings of the "Viking" aronia cultivar, which were propagated by tissue culture methods, were used as material. Viking aronia cultivar has a gray-brown branch and shoot color, oval-shaped, pointed and thin margins, alternating leaf arrangement. The upper surface of the leaves is dark green, the lower surface is light green and has a hairy structure (Fidancı, 2015).

In the research, vermicompost, molasses and vinas applications were made to aronia saplings. Vermicompost 'BSK Tarım Ürünleri Hayvancılık Gıda San. ve Tic. Ltd. Sti.', vinas 'Integro Gıda San. ve Tic. A.Ş.' molasses was obtained from 'Konya Şeker A.Ş.'.

Vermicompost contents;
Total amount of organic matter: 67.94%
Total humic-fulvic acid amount: 4.47%
Nitrate nitrogen amount: 0.56%
Water-soluble potassium oxide amount: 5.26%
EC : 22.2 µmos
pH : 7.36

Molasses contents;
Total nitrogen amount: 7%
Total amount of phosphorus: 7%
Total potassium amount: 7%
Dry matter amount: 80%
Amount of water: 10%
Amount of sugar: 50%
Density: 1.35 gr / cm3

Vinas contents;
Total nitrogen content: 18%
Total amount of amino acids: 8.8%
Total potassium amount: 55%
Total magnesium amount: 18.6%
Total amount of phosphorus: 14.8%
Crude protein: 41.8%
Raw ash: 6.3%

The saplings included in the experiment were planted in 9 liter pots containing a mixture of soil, burnt farm manure and sand prepared at a ratio of 2:1:1. Root and shoot pruning was done before planting in saplings. The applications, which started with the bud burst in the saplings, were carried out with irrigation water once a month between April and August.

In the study, 2%, 4%, 6%, 8% and 10% concentrations of molasses, vinas and vermicompost were applied. No application was made to the control group saplings. Irrigation and fertilization were done in the seedlings used in the experiment as in normal nursery conditions.

The experiment was established according to the randomized plot design with 3 replications and 3 saplings in each replication, and a total of 144 saplings were used.

The following measurements and observations were made by removing the saplings during the period when they were shedding leaves and resting.

Shoot length (cm): At the end of the experiment, annual shoot lengths were measured with a ruler.

Shoot diameter (mm): At the end of the experiment, the diameters of the annual shoots were measured with a caliper.

Plant fresh and dry weight (g): At the end of the experiment, the parts of the saplings removed except for the root part were weighed and the fresh weights of the above-ground parts were determined. Then, after keeping the above-ground components in an oven at 72°C for 48 hours, their dry weights were determined.

Root fresh and dry weight (g): At the end of the experiment, the roots of the uprooted plants were weighed and the root fresh weight was determined. Then, after these roots were kept in an oven at 72°C for 48 hours, their dry weights were determined.

Sapling length (cm): At the end of the trial, the length of the saplings was measured with a ruler.

Leaf area (cm^2): The area of mature leaves taken from seedlings at the end of the growing season was measured using Adobe Photoshop program.

Root length (cm): After removal, the root lengths of the plants were measured with a ruler.

Number of shoots (number/plant): At the end of the experiment, the shoots on the plants were counted.

Each treatment was carried out three trees in completely randomized plots with three replicates. All data in the present study were subjected by analysis of variance (ANOVA) and means were separated by Duncan's multiple range tests.

Results and Discussion

The effects of the applications on sapling growth in Viking aronia cultivar are given in Table 1. The effects of the applications were found to be statistically significant.

Table 1. Effects of applications on sapling shoot and stem properties

Application	Shoot number (unit)	Shoot length (cm)	Stem diameter (mm)	Sapling length (cm)	Leaf area (cm^2)
Control	6.00 b*	11.89 d	5.54 bc	47.67 c	1.62 g
%2 Vinas	7.56 a	14.67 c	5.75 bc	45.33 d	2.78 e
%4 Vinas	6.56 ab	18.44 ab	6.59 a	46.89 cd	3.82 de
%6 Vinas	6.22 b	19.08 a	6.43 ab	48.44 b	4.55 c
%8 Vinas	5.33 c	18.00 ab	6.26 ab	51.33 a	2.22 f
%10 Vinas	7.22 a	19.93 a	6.06 b	45.89 d	2.65 e
%2 Molasses	6.22 b	10.56 d	5.86 b	46.67 cd	4.46 c
%4 Molasses	6.56 ab	13.70 c	5.76 bc	46.22 cd	4.32 c
%6 Molasses	6.44 ab	13.59 c	6.88 a	47.56 c	5.39 b
%8 Molasses	6.22 b	15.24 c	6.28 ab	46.22 cd	6.01 a
%10Molasses	6.89 a	13.99 c	5.65 bc	43.67 d	6.16 a
%2 Vermikompost	5.33 c	14.73 c	5.45 bc	44.11 de	4.19 c
%4 Vermikompost	5.89 b	13.70 c	5.80 b	45.89 d	3.00 e
%6 Vermikompost	6.11 b	14.32 c	6.02 b	43.56 e	3.83 de
%8 Vermikompost	6.89 a	17.17 b	5.60 bc	41.78 f	3.15 e

*: There is no difference between the averages shown with the same letter in the same column

While some applications increased the average number of shoots compared to the control, in some applications, decreases were determined compared to the control. While the number of shoots increased in 2% vinas and 10% vinas applications, a decrease was detected in 8% vinas application. In molasses applications, an increase was determined only at 10% dose compared to the control, and the effects of other applications were found to be statistically insignificant. In vermicompost applications, an increase was observed only at the 8% dose compared to the control, while a decrease was determined at the 2% dose compared to the control. When the applications were evaluated collectively, the highest increases were observed in 2% vinas, 10% vinas, 10% molasses and 8% vermicompost, respectively.

In general, it was determined that there was a statistically increase in the average shoot length in all applications compared to the control, but vinas applications were more effective than molasses and vermicompost. The applications that increased the shoot length the most compared to the control were 10% vinas, 6% vinas, 4% vinas, 8% vinas and 8% vermicompost. Of these, 10% vinas increased the shoot length by 67.6%, 6% vinas 60.5% and 4% vinas 55.1% compared to the control, these rates are very important for plant development. It is thought that the positive effect of vinas applications on the shoot length is due to the very rich plant nutrient content. Vermicompost applications were also found to be statistically significant compared to the control group. 8% dose vermicompost application showed an increase of 44% compared to the control. Similarly, in a study examining the effects of vermicompost on vine seedlings, it was determined that 10% dose vermicompost application increased the shoot length 2.5 times compared to the control group (Açıkbaş, 2016). Again, in the study conducted by Bellitürk et al., (2017) on olive saplings, 10% dose vermicompost application increased the sapling height. Although molasses applications increased compared to control, it was not statistically significant.

The effects of the applications on the stem diameter were not found to be significant in general. It was determined that an increase was achieved in all vinas applications compared to the control, but only 4% vinas and 6% molasses applications showed a significant increase in shoot diameters compared to the control. In other applications, it remained at the same level as the control. Similarly, Belliturk et al. (2017), the effects of vermicompost applications on olive saplings on trunk diameter were not found significant.

In general, the treatments did not cause a significant increase in the length of the saplings compared to the control. Only in vinas 8% and vinas 6% applications, the sapling lengths increased

compared to the control, and in other applications, it was statistically in the same group as the control. In a study examining the effects of vermicompost on the development of olive saplings, applications significantly increased the height of the saplings (Bellitürk et al., 2017). This situation can be explained by the bush form of the aronia plant.

The effects of the applications on the leaf area were found to be statistically significant. In all of the applied organic preparations, positive results were obtained compared to the control. Molasses applications increased the leaf area the most compared to control, followed by vermicompost and vinas. The applications that increased the leaf area the most compared to the control were found to be 10%, 8%, 6% and 6% of vinas, respectively. The effect of organic preparations on increasing leaf areas is a result of the high content of nutrients such as nitrogen and phosphorus.

Results related to the effects of vermicompost, molasses and vinas applications on stem fresh weight in aronia saplings Table 2. has also been given.

Table 2. Effects of applications on some stem and root properties of sapling

Application	Stem fresh weight (g)	Stem dry weight (g)	Root fresh weight (g)	Root dry weight (g)	Root length (cm)
Control	13.03 b*	12.16 d	33.10 f	18.95 b	67.6 d
%2 Vinas	10.47 b	9.73 f	62.37 a	30.51 a	77.0 c
%4 Vinas	15.40 ab	14.31 b	61.50 a	27.03 ab	85.0 b
%6 Vinas	19.50 a	16.06 a	58.03 b	25.35 ab	80.6 c
%8 Vinas	15.60 ab	12.95 c	45.53 d	24.28 ab	59.6 e
%10 Vinas	15.03 ab	13.98 c	51.70 c	22.63 ab	61.3 e
%2 Molasses	11.53 b	10.35 e	38.00 e	18.74 b	85.6 b
%4 Molasses	14.47 ab	11.64 de	50.83 c	22.87 ab	77.6 c
%6 Molasses	14.43 ab	12.30 d	46.50 d	21.69 ab	68.3 d
%8 Molasses	15.03 ab	11.42 d	56.60 b	22.87 ab	54.6 f
%10Molasses	13.03 b	11.02 de	37.83 e	18.06 b	88.0 b
%2 Vermikompost	14.47 ab	10.14 e	51.57 c	23.31 ab	77.6 c
%4 Vermikompost	12.53 b	10.80 e	55.90 b	25.93 ab	73.0 d
%6 Vermikompost	14.93 ab	12.17 d	63.90 a	24.68 ab	106.0 a
%8 Vermikompost	11.43 b	10.33 e	47.53 d	25.10 ab	80.0 c
%10 Vermikompost	10.90 b	8.82 g	45.70 d	21.91 ab	96.3 a

*: There is no difference between the averages shown with the same letter in the same column

The effects of the applications on stem fresh weight were not found to be significant in general. Compared to the control, only 6% increase in vinas application was detected. In this application, stem fresh wet weight increased by 66% compared to the control. Similarly, Belliturk et al. (2017), the application of vermicompost in olive saplings did not have a significant effect on the dry weight of the plant.

Differences were determined between the effects of applications on stemk dry weight. While vinas applications increased the stem dry weight compared to the control except 2% dose, the stem dry weights were generally decreased in molasses and vermicompost applications compared to the control. The highest stem dry weights occurred in 6%, 4%, 10% and 8% vinas applications, respectively. This effect of vinas applications can be explained by its rich nutrient content. All doses of molasses, vinas and vermicompost increased the root fresh weight statistically compared to the control. The applications that increased the root fresh weight the most compared to the control were determined as 6% vermicompost, 2%, 4% and 6% vinas, respectively. Increases in 6% vermicompost, 2% and 4% vinas applications compared to control were calculated as 93.1%, 88.4% and 85.8%, respectively. Similarly, Açıkbaş (2016) found that vermicompost application in vine saplings increased the root fresh weight by 58% compared to the control. Again, Belliturk et al. (2017) also determined that the application of 10% dose vermicompost on olive saplings increased the root fresh weight by 25% compared to the control.

Although the average root dry weight results increased in most of the applications compared to the control, these increases were not found to be statistically significant, only 2% of vinas

application increased the root dry weight statistically significantly compared to the control. Root dry weight of 18.95 g in the control vinas 2% dose was determined as 30.51 g in this application. In the study conducted by Sax and Scharebroch, (2017), the effect of vermicompost application on aronia saplings on root dry weight was not found significant. On the other hand, in Açıkbaş (2016) grape saplings, Bellitürk et al. (2017) also determined that the application of vermicompost in olive saplings increased the root dry weight.

Differences were determined between the effects of the applications on the root length of the saplings. In some applications, while the root length increased significantly compared to the control, in some applications a decrease was determined. The applications with the highest increase compared to the control were determined as 6% vermicompost, 10% vermicompost, 10% molasses, 2% molasses and 4% vinas, respectively. Of these, the increase in 6% vermicompost compared to the control was calculated as 56.8%. On the other hand, root lengths decreased in 8% molasses, 8% vinase and 10% vinasse applications compared to the control.

Conclusions

The effects of vinas, molasses and vermicompost applications on the development of aronia saplings were generally positive. The highest values were obtained in the application of 2% vinas in the number of shoots, 10% vinas in the shoot length, 6 and 8% in the plant length, 10% molasses in the leaf area, and 6% molasses in the stem diameter. In general, it has been determined that the positive effects of vinas and molasses applications on plant development are more than vermicompost. Vinas and vermicompost applications had a significant effect on root development compared to other applications. In general, molasses (6-8 %) and vinas (4-6 %) applications can be recommended in growing aronia saplings.

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