

Araştırma Makalesi/Research Article (Original Paper)

The Effect of Different Application Times of GA₃ on Physical Characteristics of Black Myrtle Berries (*Myrtus communis* L.)

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Abstract: Myrtle (*Myrtus communis* L.) is a widespread Mediterranean shrub that is one of the most characteristic species in Turkey. Its berries and leaves are employed for food, pharmacology and cosmetic. Nowadays, there is a big demand for black myrtle fruits because of its high antioxidant capacity. But it contains high amount of seeds and this situation reduces marketing and production. Gibberellic acid (GA₃) is one of the most decreased seed number from 9.20 (control) to 2.17 seed/fruit. In addition, with three consecutive application of GA₃, seed rate decreased to 5.38% while 14.54% in control. Additionally important hormones used to improve fruit quality and provide seedlessness. The main objective of this study is to investigate the effects of GA₃ on seedlessness and quality in black myrtle fruits. Studies were carried out in the orchard of black myrtle cultivar located in Antalya. At different flowering stages, GA₃ dose of 100 ppm were applied to the whole of the plants. Some applications significantly reduced seed number in fruits. Three applications of GA₃ at ballon, full bloom and fruit set stages consecutively, these GA₃ applications caused the total seed weight reduced to 29.92 (mg/fruit) from 99.13 (mg/fruit) in control. Some GA₃ applications resulted in fully seedless fruits up to 12.00%. In addition, GA₃ applications did not change at fruit weight and fruit size of fruits.

Key words: *Myrtus communis*, Growth regulators, Fruit, Seedlessness

GA₃'in Farklı Uygulama Zamanlarının Siyah Mersin (*Myrtus communis* L.) Meyvelerinin Fiziksel Özellikleri Üzerine Etkisi

Özet: Mersin, Türkiye'de en karakteristik türlerden biri olan yaygın Akdeniz çalısıdır. Meyveleri ve yaprakları gıda, farmakoloji ve kozmetikte kullanılmaktadır. Günümüzde yüksek antioksidan kapasitesi nedeniyle siyah mersin meyvelerine büyük bir talep bulunmaktadır. Ancak meyveleri yüksek miktarda çekirdek içermekte ve bu durum meyvelerin pazarlamasını ve üretimi azaltmaktadır. Bu çalışmanın temel amacı, siyah mersin meyvelerinde Gibberellic acid (GA₃)'in çekirdek ve meyve kalitesi üzerindeki etkilerini araştırmaktır. Çalışmalar Antalya'da bulunan siyah mersin bahçesinde gerçekleştirilmiştir. Çiçeklenmenin farklı aşamalarında, tüm bitkilere 100 ppm GA₃ uygulanmıştır. Bazı uygulamalar meyvelerdeki çekirdek sayısını önemli ölçüde azaltmıştır. Balon, tam çiçeklenme ve meyve tutumunda GA₃'in ardı ardına üç kez uygulanması çekirdek sayısının 9.20'den (kontrol) ile 2.17'ye (adet/meyve) düşmesine neden olmuştur. Ayrıca, üç ardışık GA₃ uygulamasıyla, çekirdek oranı kontrolde %14.54 den %5.38'e azalmıştır. Ek olarak GA₃ uygulamaları, kontrolde 99.13 (mg / meyve) olan toplam çekirdek ağırlığının 29.92'ye (mg / meyve) düşmesine neden olmuştur. Çalışmada bazı GA₃ uygulamalarında %12.00 oranında tamamen çekirdeksiz meyvelerin oluştuğu belirlenmiştir. Ayrıca, GA₃ uygulamaları sonucunda meyve ağırlığı ve meyve büyüklüğünde değişim olmamıştır.

Anahtar Kelimeler: *Myrtus communis*, Büyüme düzenleyici madde, Meyve, Çekirdeksizlik

Introduction

Myrtle (*Myrtus communis* L.) is a widespread Mediterranean shrub that is one of the most characteristic species in Turkey. It grows naturally especially in 500-600 m above sea level in the coastal areas of Aegean, Marmara and Mediterranean regions that have the Mediterranean climate (Oğur 1994; Baytop 1999). Furthermore, there is no registered myrtle cultivar in Turkey (Uzun and Bayır 2012).

M. communis L. is belonging to the Myrtaceae family. This family contains stilbene compounds that have some significant biological activities (Keskin and Kunter 2017).

Myrtle is traditionally used in the treatment of stomach, hypoglycemic and oral diseases. It is also used for constipation, building an appetite, reducing hemorrhage and externally for wound healing (Duke 1988; Twaij *et al.* 1989; Ogur 1994; Ozek *et al.* 2000). *M. communis* has been used for medicinal and nutritional purposes since ancient times. The leaves and fruits of myrtle traditionally used as antiseptic, disinfectant, and hypoglycemic agents (Barboni *et al.* 2010).

Myrtle is known as “Mersin” or “Murt” or “Hambeles” in Mediterranean Region of Turkey (Aydın and Özcan 2007). Myrtle fruits have white and black colour. White myrtles which are called Hambeles are mostly cultivated and consumed mainly as fresh fruit in Turkey. Mersin fruits are collected from the naturally grown areas by local people and sold in the regional markets. The black myrtle fruits are mainly consumed as fresh fruit (edible), dried fruit and fruit tea, also it is used in the marmalade and jam production. Due to the fact that the fruit shelf life of black myrtle is quite long (about 3-4 months), it remains in the market for a long time for fresh consumption. Black myrtle has a lot of small seeds inside while Hambeles with greater fruit size contains rudimentary seeds but shelf-life is very short. In Italy, particularly in Sardinia, black berry is used to produce the characteristic myrtle liqueur (Mulas *et al.* 2000).

Nowadays myrtle berries and leaves are mostly employed for the formulation of liquors and the good antioxidant activity of myrtle liquors has also been reported (Tuberoso *et al.* 2010). Black berries, that are astringent but sweetish and edible, contain flavonoids and anthocyanins (mainly myricetin glycosides), having strong antioxidant properties (Barboni *et al.* 2010). There is great interest for black myrtle fruits because of their high antioxidant capacities and phenolic properties. However, the main complained subject of black myrtle which is emphasized by fresh-fruit consumer is the large number of hard seeds inside fruit.

Gibberellic acid (GA₃) is one of the most important hormones used to improve fruit quality and provide seedlessness. With GA₃ applications, successful results have been obtained in seedless fruit production in some fruit types such as grapes, loquat, pears, and cherries at various stages of production. 100 ppm GA₃ applications provided seedlessness before the flowering in Çavuş, Balbal ve Hamburg Misketi grape varieties (Fidan 1969). Also 250 ppm GA₃ seedless fruit production has been provided in loquat (Goubran and El-Zeftawi 1986; Lin *et al.* 1999). These ratios varied according to type, dose and time. Its known to increase the parthenocarpic fruit production like auxins and even they are sometimes more efficient (Seçer 1989; Westwood 1993; Erio 1998; Bora and Sarma 2006). Therefore, this study was conducted to determine the effects of gibberellic acid applications in different times around flowering on seedlessness and some physical fruit characteristics in the black myrtle fruits.

Material and Methods

The research was carried out in the orchard of 7 years old of “Yakup” black myrtle cultivar located in Antalya. Trees were planted 3x3 m apart and grown on terra-rosa soil with drip irrigation. GA₃ (G7645-sigma) applications were made at the dates specified in 2017 (Table 1). Before the applications, GA₃ was dissolved in ethyl alcohol at a dose of 100 ppm and 0.1% spreader adhesive (Wax-Wet) was added. At different flowering stages, GA₃ dose of 100 ppm was applied to the whole of the plants. In the control application, only water + emissive adhesive mixture was applied to the trees. The applications were done in 3 replicates as each tree is one replicate. Fruits were harvested when soluble solids reached 21% on 16 November 2017. In the harvested fruits; fruit weight (mg), fruit volume (ml), fruit diameter and length (mm), developed seed number per fruit (number/fruit), undeveloped (rudimentary; seeds have 2 mg or less weight) seeds (seed/fruit), total seed weight (mg/fruit), seed ratio (%) and seedless fruit ratio (%) were determined. The study was set up according to the “Randomized Blocks Experimental Design”. In the variance analysis for the applications, the differences between the averages were determined with Tukey multiple comparison test at 5% level.

Table 1. GA₃ application periods and doses

Application	GA ₃ Application Periods	GA ₃ Doses
Control	Ballon (B)	0 ppm
1 st App.	Ballon (B)	100 ppm
2 nd App.	Ballon (B) + Full Bloom (FB)	100 ppm + 100 ppm
3 rd App.	Ballon (B) + Full Bloom (FB) + Fruit Set (FS)	100 ppm + 100 ppm+100 ppm
4 th App.	Full Bloom (FB)	100 ppm
5 th App.	Full Bloom (FB) + Fruit Set (FS)	100 ppm + 100 ppm
6 th App.	Fruit Set (FS)	100 ppm

Results and Discussion

The results of the GA₃ application on the fruit characteristics of black myrtle are given in Table 2. In the study, the statistical difference between applications in terms of fruit weight was not significant. With applications, the highest value of fruit weight was obtained in the control group (680.70 mg) while the lowest value was determined with one application of GA₃ at fruit set stage (544.36 mg) (Table 2). Similarly, Alim and Uzun (2017) indicated that 100 ppm GA₃ application to black myrtle fruits at different times was not effected on fruit weight. In addition, Uzun *et al.* (2016) determined that the fruit weight of black myrtle (Yakup) is compatible with the results obtained with values between 0.76-0.90 g. The effect of GA₃ on the fruit weight and volume vary depending on the dose, time, and fruit variety. Fruit weight and fruit size values (volume, diameter and length) are not significantly affected by GA₃ treatments. Fruit weight ranged from 544.36 mg/fruit in fruit set treatment to 680.70 mg/fruit in control. According to a study made in strawberry fruit weight showed a decrease with application of GA₃, when compared to the control group (13.7 g); 50 and 100 ppm GA₃ treatments statistically decreased fruit weight of strawberry (13.01 g and 12.33 g, respectively) (Eshghi *et al.* 2012).

When assessed for effect on fruit volume of GA₃ applications, it was similar to fruit weight values. The highest fruit volume value (0.83 ml) was found in the control, while the lowest was found in two applications of GA₃ at and Full Bloom stages consecutively and one application of GA₃ at fruit set stage (0.67 ml). According to a study made in strawberry, fruit volume showed a statistical decrease with the application of GA₃ (Gündogdu *et al.* 2017).

The effect of the applications GA₃ on the fruit diameter and length were not statistically significant. The highest value of fruit diameter and length was obtained in the control group (10.57 mm and 12.20 mm, respectively) while the lowest value of fruit diameter was determined with three applications of GA₃ at ballon, full bloom and fruit set stages consecutively (9.28 mm), fruit length was determined with two applications of GA₃ at Ballon and Full Bloom stages consecutively (10.64 mm). In another study, Alim and Uzun (2017) reported that the diameter of the fruit decreased in parallel with the number of seeds.

In the study, the statistical difference between applications in terms of fruit flesh ratio is significant. The highest fruit flesh ratio (94.62%) was found in three applications of GA₃ at ballon, full bloom and fruit set stages consecutively, while the lowest was found in the control (85.46%). Although the developed number of seeds decreased, GA₃ applications increased the rate of fruit flesh ratio. Moreover, these applications did not affect the fruit weight. This is a very important result in terms of fruit quality.

Although the effect of GA₃ applications on seedless fruit rate was not statistically significant in the study, the highest seedless fruit ratio was found in three applications of GA₃ at ballon, full bloom and fruit set stages consecutively (12.00%), while the lowest was found in the control, one applications of GA₃ at ballon stage, two applications of GA₃ at ballon and full bloom stages consecutively and application of GA₃ at full bloom stages (0.00%). Similarly, Alim and Uzun (2017) indicated that (B+FB+FS) 100 ppm GA₃ applications at ballon, full bloom and fruit set stages consecutively (10.67%) increased seedless fruit ratio compared control fruits (0.00%).

Table 2. Effects of GA₃ applications on black myrtle fruit characteristics

Application	Fruit Weight (mg)	Fruit Volume (ml)	Fruit Diameter (mm)	Fruit Length (mm)	Fruit Flesh Ratio (%)	Seedless Fruit Ratio (%)
Control	680.70	0.83	10.57	12.20	85.46c*	0.00
1 st App.	656.26	0.80	10.30	11.56	90.06b	0.00
2 nd App.	549.26	0.67	9.75	10.64	90.41b	0.00
3 rd App.	578.69	0.71	9.28	10.90	94.62a	12.00
4 th App.	657.62	0.80	10.40	11.51	91.51ab	0.00
5 th App.	644.44	0.79	9.94	11.96	93.64ab	2.67
6 th App.	544.36	0.67	9.48	10.90	91.64ab	6.67

*There are significant differences ($p<0.05$) between means indicated same later in the same column

GA₃ applications were statistically significant on the number of developed seeds of black myrtle fruits depending on the application time. The applications caused a significant reduction in the number of seed of fruits compared to the control. The lowest developed seed number was found in three applications of GA₃ at ballon, full bloom and fruit set stages consecutively (2.17 seed/fruit), while the highest was found in the control (9.20 seed/fruit). GA₃ treatments have reduced the number of seeds, while fruit weight and fruit size did not change (Table 3).

The seed number results of the present study are similar to the studies done by Alım and Uzun (2017) and Uzun *et al.* (2016) in black myrtle; Fellman *et al.* (1991) in grapes and Aslmoshtaghi and Shahshavar 2013) in loquat.

Table 3. Effects of GA₃ applications on black myrtle seeds characteristics

Application	Developed Seed (seed/fruit)	Rudimentary Seed (seed/fruit)	Total Seed Weight (mg/fruit)	Seed Ratio (%)
Control	9.20a*	1.71	99.13a	14.54a
1 st App.	5.69b	1.83	65.36b	9.94b
2 nd App.	4.43bc	1.80	52.64bc	9.59b
3 rd App.	2.17c	1.05	29.92c	5.38c
4 th App.	4.72bc	1.97	55.99bc	8.49bc
5 th App.	3.13bc	1.62	40.29bc	6.35bc
6 th App.	3.64bc	1.21	46.14bc	8.36bc

*There are significant differences ($p<0.05$) between means indicated same later in the same column

In the study, difference between the applications in terms of total seed weight and seed ratio was determined. Total seed weight was reduced in parallel with the number of developed seed when compared to control.

In the present study, it was found that total developed seed weight was the lowest in three applications of GA₃ at ballon, full bloom and fruit set stages consecutively. At the same time, this application was found to contain the least number of developed seed (29.92 mg/fruit), while the highest was found in the control (99.13 mg/fruit). Similarly, Alım and Uzun (2017) indicated that two applications of GA₃ at ballon and full bloom stages (10.67%) decreased total seed weight compared control fruits (94.27 mg/fruit). Furthermore, Lu *et al.* (1997) reported that lowered the total seed weight of GA₃ applications in grape.

As a result of the study, it was determined that GA₃ applications influenced the fruit quality of black myrtle. Some applications significantly reduced seed number in fruits. Three applications of GA₃ at ballon, full bloom and fruit set stages consecutively decreased seed number. In general, three applications of GA₃ at ballon, full bloom and fruit set stages consecutively increased the fruit quality more.

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