Saudi Journal of Biological Sciences xxx (2018) xxx–xxx

Contents lists available at ScienceDirect

Saudi Journal of Biological Sciences

journal homepage: www.sciencedirect.com

Original article

Effect of melatonin and gibberellic acid foliar application on the yield and quality of Jumbo blackberry species

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ARTICLE INFO

Article history:
Received 16 May 2018
Revised 25 June 2018
Accepted 26 June 2018
Available online xxxx

Keywords:
Blackberry
Melatonin
Quality
Gibberellic acid

ABSTRACT

Not many chemical hormone studies does exist in our country especially in berry fruits. Foliar application of melatonin and gibberellic acid hormones was performed in 2016 and 2017 in order to analyze the effects of different doses of hormone applications on fruit quality and yield. Pheonologic, pomological and some bioactive content analyses of these hormones were studied. According to the research results, while M + GA10 ppm (240.50; 3.9) and M + GA 5 ppm (226.50; 3.6) applications have the highest fruit number and weight (g), the highest fruit size was obtained from GA 5 ppm (21.21 mm fruit length, 16.56 mm fruit width) and M 10 ppm (21.10 mm fruit length, 16.20 mm fruit width) chemical applications in Jumbo blackberry species. The highest values in Ph, soluble solid content (SSC) and titratable acidity averages were obtained from GA 5 ppm (3.69; 10.80; 2.42) and GA 10 ppm (3.68; 10.70; 2.40) applications; the highest total antioxidant activity in bioactive characteristics averages was found in G 10 ppm 143.21 mg/g, the highest total phenolics was identified in G 5 ppm 72.68 ppm/GAE and the highest total flavonoids was determined in G 10 ppm 4925.75 ppm/QE.

1. Introduction

Berry fruits are the species which are demanded by consumers and utilized in various ways. Turkey is within the natural range of these species and we can see different types of one or more species in almost all regions. Economic analyses indicate that berry fruits are among the agricultural products with the highest yield from unit area. They are also more advantageous than many fruit species in terms of short-term fructification and quick delivery of maximum yield (El, 2008). Due to the diversification of fresh or frozen use of berry fruits in the food industry and especially the increase in its importance for dairy products industry, ice cream producers, confectionery and pastry producers; these fruits are processed regularly in the food sector as fresh, mashed, jam, molasses, syrup or fruit juice (Yetgin, 2009; Okatan, 2018). Blackberry from Rosaceae family of Rosales group, Rosaideae sub-family, Rubus genus and Eubautus sub-genus is a fruit type with rich vitamin and mineral content, again with rich antioxidant capacity, which has gained a special importance in recent years (Karakoç, 2011) (see Fig. 1).

Recent reseaches have shown that blackberries contain the chemicals with antioxidant and anticancer properties, which is of great importance in terms of human health, at a higher rate than the quantities mentioned in the literature. Although blackberries contain less amount of A, B, C vitamins, it has been found that they have protective traits against colon cancer and heart diseases due to their high fiber content. It has been observed that berry fruits consist high rates of ellagic acid and anti-cancer features which inhibit tumour development in animals under laboratory conditions (Pehluvan and Güleryüz, 2004). In adition, both fruits and leaves of blackberries, which have antiviral characteristics, prevent Gram-positive (*S. aureus*) and Gram-negative (*E. coli*) bacteria (Yiğit and Yiğit, 2014). Depending on the concentration, the blackberry extract destroys the virus population by up to 99%, resulting in its high use in the treatment of intra oral wounds since the 16th century (Danaher et al, 2011).

These fruit species have a large market share in the world as they are widely consumed, particularly in countries with high income levels. However, in Turkey, only wild types of them are consumed and their culture types are not well-known until recent years (Onur, 2006). While cultivation and breeding of this species began a long time ago in other countries, the importance of these species has just recently been realized.

Peer review under responsibility of King Saud University.

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https://doi.org/10.1016/j.sjbs.2018.06.008
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Please cite this article in press as: Çolak, A.M. Effect of melatonin and gibberellic acid foliar application on the yield and quality of Jumbo blackberry species. Saudi Journal of Biological Sciences (2018), https://doi.org/10.1016/j.sjbs.2018.06.008

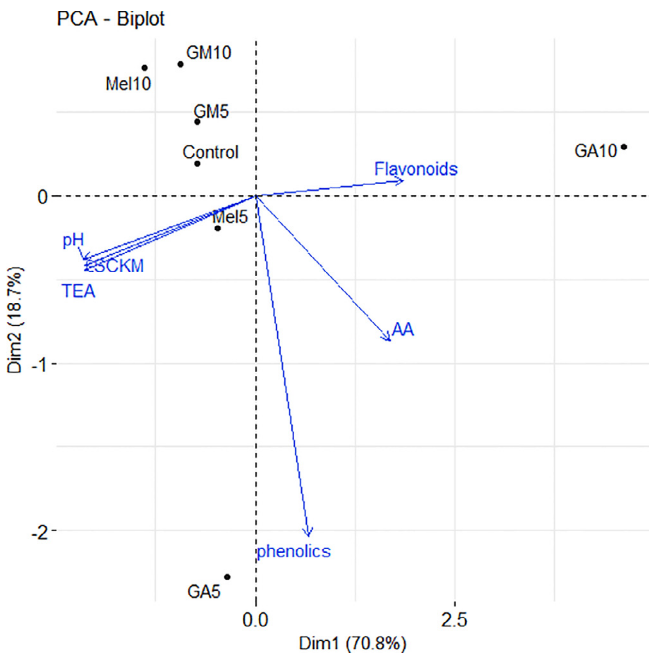

Fig. 1. Basic component analysis of chemical analysis.

Gibberellic acid is responsible for plant growth and leaf enlargement in plants (Matthew et al., 2009). Until recently, the melatonin hormone was thought to exist only in animals. It has later been found that this hormone also occurs in the plants and that it protects antioxidant properties. With the discovery of melatonin in plants, the studies on melatonin has rapidly started to increase (Poeggeler and Hardeland, 1994; Antolínet al., 1997).

As well as making berry fruit cultivation common, developing suitable species, performing adaptation works in different species, the works for raising awareness about cultivation techniques that will guide in berry fruit cultivation and provide the most accurate production also gain importance. The goal of this paper is to analyze the effects of different doses of melatonin and gibberellic acid chemicals on the yield and quality of blackberry plant grown in the ecology of Uşak province in Turkey and to present the first basic study source for blackberry and other berry fruits especially in melotonin application.

2. Materials and methods

2.1. Plant material

Jumbo blackberries were used as plant material in our study carried out in 2016 and 2017. The plant material was conducted in species of Jumbo blackberry found in the 5-year-old Blackberry garden with 5 decare of field in Usak province. Our experiment was established as 3 replications, each of which would have 10 plants. Plants are at the distance of 1.5 m between rows and 0.6 m above rows. Melatonin (M), gibberellic acid (GA) and melatonin + gibber ellic acid (M + GA) are applied through foils as foliar applications. For each application at 2 different doses (5 ppm and 10 ppm) 2.5 ppm M and 2.5 ppm GA for M + GA 5 mixtures and 5 ppm M and 5 ppm GA mixtures for m + GA 10 ppm were applied twice in flowering period and fructification period.

2.2. Chemical material

The melatonin chemical was provided by Sigma company (M5250 SIGMA Melatonin powder, ≥98% (TLC), Germany). Gibberellic acid chemical and all other used materials was from Merck company (Cas-No: 77-06-5, Merck KGaA, Germany.

2.3. Determination of Bioctive contents

2.3.1. Determination of pomological and chemical fruit characteristics

The weight (g), length (mm) and width (mm) of the fruit were measured by applying 3 replications on randomly-selected total 30 blackberries after they were harvested. Soluble solid content (SSC), pH (%) and titratable acidity contents of the fruits were also determined (AOAC, 1995).

2.3.2. Identification of Total Phenolic Content (TPC)

By employing the Folin-Ciocalteu method, The TPC of blackberry juice extract was indicated. 4500 μL deionized water and 500 μL unsubtilised Folin-Ciocalteureagent were laced with 1000 μL extract. Following 60 s, 4000 μL of 7.5% (w/v) aquatic Na_2CO_3 was mixed. And then, the solution was taken to 30 min of maturing period at 30 °C, which was then followed by measuring the absorbance at 765 nm through employing an UV–Vis spectrophotometer. And the result was aligned with a gallic acid calibration curve. The all phenols were identified as gallic acid equivalents (mg gallicacid/g extract), the valves of which have been suggested as medium of triple assessment (Kähkönen et al., 1999).

2.3.3. Identification of Total Flavonoid Content (TFC)

The TFC of the plant extraction was identified by employing aluminum chloride colorimetric assay (Chang et al., 2002). To begin with, 0.5 ml aliquots of the extract and 0.01–1.0 mg/ml of quercetin were mixed with 2 ml of distilled water and then with 0.15 ml of sodium nitrite (5% $NaNO_2$ w/v). Upon waiting for 6 min, 0.15 ml of it (10% $AlCl_3$, w/v) was accompanied. The solutions were made to rest for 6 min more. The last volume was adjusted to 5 ml level by adding instantly the water under distillation, then it was mixed utterly and left to rest up to quarter of an hour. The absorbtion of each composition was identified at the level of 510 nm together with an empty tube as a controller. TFC was determined as mg quercetin equivalent to per gram of sample with the help of calibration curve of quercetin. Every test that indicate the level of extract was conducted for three times (n = 3).

2.3.4. Idenetification of Antioxidant Activity (DPPH)

The DPPH (2,2-diphenyl-1-picrylhydrazyl) was conducted by employing Thaipong et al. technique (Thaipong et al., 2006). The existing solution was made up through solving 24 mg of DPPH into 100 ml of methanol which was then stocked at −20 °C till necessity accurs (Brand-Williams et al., 1995). The working solution was derived by way of stirring 10 ml of existing solution with 45 ml of methanol so as to make the absorbtion of 1.1 ± 0.02 units at 515 nm emplaying the spectrophotometer Shimadzu UV Mini 1240. 150 μL plant extract were put under reaction with 2,850 μL of the DPPH sol for an hour under the darkness. Afterwards, the absorbtion level was applied at 515 nm. The antioxidant level showed a demise in absorbtion value under the equation. The outcomes of the absorbtion were transformed into the table content via a standardized calibration curve. These outcomes was then noted in ascorbic acid equivalents (AAE). The extract which supplies 50% of radical scavenging activity (IC_{50}, the concentration of the sample to scavenge 50% of the DPPH radicals) was counted up by the the graphic of scavenging percentage against extract concentration. In order to achieve this goal, subtilization series (five different concentrations) were made up for every plant sample extract. The resulting valves were counted up and given in μg/ml.

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