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The Efficacy of Harpin (Messenger Gold) on Fruit Set and Fruit Quality on '0900 Ziraat' Sweet Cherry

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Abstract

The study has been carried out to determine effects of Harpin treatment on fruit set and fruit quality characteristics on 0900 Ziraat Sweet cherry cultivar, which has low fruit set problem. The study was carried out in Suşehri, a district of Sivas in 2015, Turkey. As plant material in the study, it was used five old trees of 0900 Ziraat' sweet cherry variety grafted on MaxMa 14 rootstock. 125, and 250 mg L-1 doses of Harpin was applied both once and twice. While the first application was made at 10 % full bloom (17 April), the second application was made one month before commercial harvest (22 May). Compared to the control, it was determined that Harpin had a significant effect on fruit set on 0900 Ziraat Sweet cherry cultivar. While the fruit set ratio in control treatment was 11.8 %, this ratio reached to 22.0 % with twice 250 mgL-1 Harpin treatment. One of the most significant results of the study is that both increasing number of treatments and increasing amount of dosage led to an increase in fruit set as well. The fruit quality characteristics such as fruit size, fruit color, pH, SCC and titratable acidity was not affected by Harpin treatment. However, differences on fruit firmness and stem retention force between treatments were statistically significant.

Keywords: Harpin, 0900 Ziraat, Fruit set, Prunus avium

INTRODUCTION

Due to its health benefits and economic gainings for producers cherry, which is one of the most valuable fruits in Turkey, draws more and more attention. Intense employment of 0900 Ziraat variety in cherry cultivation stands out in Turkey which is the leader in cherry production in the world. Due to its fruit quality this variety is valued and known as Turkish cherry all around the world. Even though pollinators are employed because of its self-incompatibility, still low fruit yield is the disadvantage of this variety. It is asserted that the cause of low fruit yield is the inconvenient weather conditions during the pollination period. Considering the hypothesis that bioregulators which can affect many important processes in fruits might compensate this disadvantage, in this study the effects of Messenger Gold (Harpin) on fruit quality, specifically fruit yield, are investigated.

Harpin is a protein isolated from Erwinia amylovora bacteria which cause fire blight on fruit trees. It is thought that this protein has several cellular impacts on various processes or factors such as plant's resistance [1], activation of reactive oxygen types [2], transportation of effector proteins in plant cytoplasm [3] and depolarization of cell membrane [4]. The product commercially called Messenger Gold which consists of 1% Harpin and stimulates growth is generally used on vegetables in order to increase the resistance against diseases. Studies indicate that harpin increases resistance against diseases on vegetables and fruits such as tobacco [5,6], pepper [7], cantaloupe, watermelon [8], apple [9], helianthus, tomato, cabbage, cucumber and lettuce. Intrigued by the fact that this product, which has effects on cell mechanism, has never been used on cherry before and hoping that it might have impacts on fruit yield, in this study it is aimed to investigate the effects of Messenger Gold (Harpin) on fruit yield and fruit quality.

MATERIALS and METHODS

The study was carried out in a commercial orchard of 0900 Ziraat located in Suşehri town in Kelkit Valley in 2015. Trees were grafted on MaxMa 14 rootstocks and trained to Steep Leader System, with a planting spacing of 4 m x 3.5 m. Twenty 5 years-old trees were selected and grouped into four blocks of 5 trees. Selected trees were uniformly sprayed with an aqueous solution containing active ingredient Harpin once (125 or 250 mgL-1) and twice (125 or 250 mgL-1). For each treatment, a tree was used in each block and one tree in each block received no treatment and served as control. Sprays were applied to whole trees until run-off with a low pressure hand sprayer at 10 % full bloom (17 April) and one month before commercial harvest (22 May). Then two limps were tagged per tree and flowers per limp were counted at full bloom. Tagged limps were harvested at commercial harvest date and the number of fruits per limp was recorded. Then, fruit set ratios (the number of fruits x 100/ the number of flowers) were calculated.

Fifty fruits from per tree were randomly collected at commercial harvest and used fruit quality measurements. Fruit diameters were measured at the widest point of the fruit using a digital caliper and expressed as fruit size. Skin color and flesh color was assessed using the color chart developed by the Centre Technique Interprofessionnel des Fruits et Légumes (CTIFL) (Planton and Edin, 1995). This prototype chart provides a range of red color chips numbered from 1 to 8, with 1 being a light pink-red and 8 being a very dark red. A 20-ml juice sample was titrated with 0.1 N NaOH to pH of 8.1 and titratable acidity (TA) was expressed as grams of malic acid per 100 ml-1 of juice. Soluble solids concentration (SSC) was measured by using a digital refractometer (PAL-1, McCormick Fruit Tech., Yakima, Wash). Fruit firmness was determined in terms of the maximum force (N) that is needed to penetrate the fruit vertically. Measurements were carried out by the universal test device Zwick Z0.5 (Zwick/Roell Z0.5, Germany), a device that can apply force up to 500 N and has a 1.8 mm thick stainless-steel tip, at a speed rate of 0.5 mm/s and maximum 10 mm deep into the fruit. Stem retention force (SRF) was measured using a Tronic SH-50 digital force gauge.

The experiment was laid out in a randomized complete block design with four blocks (replicate), each consisting of five trees. Each experimental plot contained a single tree. Data were analyzed by analysis of variance and means separation was carried out using Duncan's Multiple Test. All analyses were conducted using the SAS statistical package (SAS Institute, Cary N.C.).

RESULTS

This study was carried out to contribute to the solution of low fruit yield problem of 0900 Ziraat, an important cherry variety in cherry cultivation due to its superior quality, by investigating the effects of Harpin on fruit yield and fruit quality. When compared to the control group, it was observed that applying Harpin has significantly increased fruit yield. While in control group only 11.2 % of blossoms have turned into fruits, 22 % of blossoms of the trees treated with 250 mg dosage of Harpin twice have turned into fruits, which accounts for almost 100% increase in fruit yield. Studying the outcomes, it can be seen that as treatment dosage and frequency increase fruit yield increases as well (Table 1). To illustrate, while 14.8% of blossoms have turned into fruits with 125 mgL-1 Harpin treatment for once, applying the same dosage twice resulted in 17.9% of blossoms having turned into fruits.. Similarly, while 125 mgL-1 Harpin treatment has caused 14.8% of blossoms to turn into fruits, 250 mgL-1 Harpin treatment on the other hand has increased this ratio up to 17.7%.

Compared to control treatments, Harpin treatments did not have any significant effects on fruit quality characteristics such as fruit size, fruit colour, SSC, TA and pH. However, Harpin treatments significantly decreased stem retention forces. (Table 2 and 3). While 250 +250 mgL-1 Harpin treatment decreased fruit firmness, other treatments did not cause in significant changes in fruit firmness compared to control treatment (Table 2).

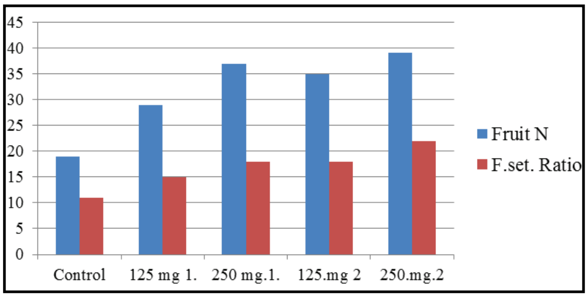

Figure. 1. The effects of Harpin treatments on fruit set of 0900 Ziraat sweet cherry (%)

Table. 1. The effects of Harpin treatments on fruit set of 0900 Ziraat sweet cherry

Treatments (mgL-1)	Flower numbers	Fruit numbers	Fruit set ratio
Control (0 mg/L)	170.0b	19.0c	11.2c
MS (125 mg/L)	191.8a	28.7ab	14.8ab
MS (250 mg/L)	206.8a	36.8a	17.7a
MS (125+125mg/L)	196.0ab	35.0a	17.9a
MS (250+250 mg/L)	177.0b	39.0a	22.0a

Table 2. The effects of Harpin treatments on fruit quality (fruit size, firmness, fruit colour, SRF) of 0900 Ziraat sweet cherry

Treatments (mgL-1)	Fruit size (mm)	Firmness (N)	Skin color	Flesh color	SRF (N)
Control (0 mg/L)	28.1a	0.41a	4.3a	1.33a	2.31a
MS (125 mg/L)	28.0a	0.38a	3.4a	1.13a	1.60b
MS (250 mg/L)	28.2a	0.35ab	4.2a	1.13a	1.86b
MS (125+125mg/L)	28.8a	0.39a	3.9a	1.10a	1.68b
MS (250+250 mg/L)	28.0a	0.29b	4.0a	1.10a	0.95c

The difference between mean values shown with the same letter is not significant ($p<0.05$)

Table 3. The effects of Harpin treatments on fruit quality (TA, SSC and pH) of 0900 Ziraat sweet cherry

Treatments (mgL-1)	SSC (%)	pH	TA (%)
Control (0 mg/L)	15.9a	3.7a	0.59a
MS (125 mg/L)	15.8a	3.7a	0.66a
MS (250 mg/L)	15.1a	3.7a	0.61a
MS (125+125mg/L)	16.8a	3.7a	0.58a
MS (250+250 mg/L)	14.6a	3.8a	0.56a

The difference between mean values shown with the same letter is not significant ($p<0.05$)

Harpin which is a protein isolated from Erwinia amylovora bacteria that cause fire blight on fruit trees is generally used to increase the resistivity of fruits and vegetables against diseases. Considering the fact that the effects of Harpin on fruit yield and fruit quality of cherry or any other fruit variety have never been studied before makes the results of this study valuable, especially with the result that it caused 100% increase in the fruit yield.

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