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Effects of Pre-harvest Plant Growth Regulator Sprays on Fruit Quality of 'Deveci' Pear (*Pyrus communis* L.)

Fatih Ali CANLI[*1] Mustafa PEKTAŞ[2] Mustafa KELEN[1]

[1] Department of Horticulture, Faculty of Agriculture, Suleyman Demirel University, 32260, Isparta, Turkey
[2] Egirdir Horticultural Research Institute, Egirdir, Isparta, Turkey

[*]Corresponding Author
e-mail: canlifat@ziraat.sdu.edu.tr

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Abstract

This study was conducted to evaluate effects of the pre-harvest benzyladenine (BA) (50 ppm, 100 ppm and 150 ppm) and BA + Gibberallic acid (GA_{4+7}) (12,5 ppm, 25 ppm and 50 ppm of each) applications on fruit quality in 'Deveci' pear (*Pyrus communis* L.). The pear trees were sprayed with BA or BA + GA_{4+7} 14 days after full bloom. Fruits were harvested at their maturity and evaluated right after harvest in terms of size, firmness, pedicel length, and soluble solids content (SSC). The effects of BA and BA + GA_{4+7} on pedicel length, SSC and acidity were significant. Fruit treated with 25 ppm BA + GA_{4+7}, 100 ppm BA or 150 ppm BA had significantly higher SSC than the control. 12.5 ppm BA and 50 ppm BA treatments increased the titretable acid content of the fruit as compared to the control. There were no significant differences in fruit size, pH and firmness among the treatments.

Key words: Benzyladenine (BA), gibberellic acid (GA), fruit quality, firmness, SSC

INTRODUCTION

Pear (*Pyrus communis* L.) is an important fruit crop in the world [1]. As in many other crops, improvement of size, appearance and internal quality of pear fruits are important objectives pursued by researchers. Plant growth regulators are used to improve fruit size and quality, extend the storage life and to increase the profitability in some fruits [2-4].

Gibberellins are synthesized just after flowering and their synthesis shows a correlation with fruit growth [5]. Gibberellins plays and important role in fruit set and development [6]. Due to their role in fruit development, gibberellins are widely used to improve fruit size [7]. Among the wide range of gibberellins, the most widely used ones are GA_3 and GA_4 [8].

Cell division at the early stages of fruit crops is affected especially by endogenous cytokinins [9]. Among cytokinins, BA is the first one being discovered with promoting effect on cell division [10,11]. Cytokinins alone or in combination with gibberellins are reported to increase fruit size in many fruit crops without changing the leaf/fruit ratio [12].

GA_3 is widely used in grape to increase the size and quality [13]. The preharvest spray of GA_3 has become and standard procedure in sweet cherry production in North America [13] and Canada [14] since its application at right time and right concentrations increases fruit size and firmness in late maturing cultivars [15,16).

Pre-harvest applications of cytokinins alone or in combination with gibberellins at cell division stage of the fruit can improve the fruit size and quality in some pome fruits such as apples and small fruited summer pears [17-19]. Hayashi ve Tanabe [20] reported that in 'Kousui' pear, GA_4 applications can increase the fruit size even if it is applied after cell division stage of the fruit is ended. The promoting effects of synthetic cytokinins on cell division and cell number play an important role in increasing fruit size in pear fruit [21]. Most early maturing pear cultivars have small fruits, thus even small increases in the fruit size can increase yield and profit in summer pears [19].

Although the effects of pre-harvest PGR applications on fruit quality in grape and cherries have been extensively studied [13, 14, 16] and found wide acceptance among growers [13, 14], the use of PGR in pears to increase the fruit size and quality is relatively new.

Increasing fruit size, yield and the percentage of large fruits can provide a premium prize for fruit growers. There are several promising reports that PGRs increase the fruit size, quality and percentages of large fruits in summer pears. However effects of these chemicals on winter pears have not been studied. The objective of this study was to evaluate the effects of pre-harvest PGR applications on fruit quality and size in a winter pear named 'Deveci'.

MATERIALS AND METHODS

Plant material

Uniform and healthy 6-year-old trees of 'Deveci' pear grafted on 'Quince A' rootstock grown in Egirdir Horticultural Research Station were selected and used in this study.

Pre-harvest PGR applications and evaluations

Selected trees were sprayed with different concentrations of BA or BA + GA_{4+7} 14 days after full bloom

(Table 1). The application was carried out in the afternoon in a non windy day and trees were wetted to run off.

Fruits of all treatments were harvested when the control trees were considered mature according to harvest criteria's such as color and days after full bloom.

Fruit length, diameter and pedicel length were determined using a digital caliper. Fruit firmness measurements were carried out using a firmness tester (Model FT 327, GULLIMEX Fruit Pressure Tester, Alfonsine, Italy; with a 11.1 mm diameter probe) at two opposite positions located at the fruit's maximum width. Average of these two measurements was recorded as the firmness of each fruit.

RESULTS AND DISCUSSIONS

No significant differences observed between control and treated fruit with respect to fruit weight, fruit length, fruit diameter and length/diameter ratio, however, the effects of BA and BA + GA_{4+7} on pedicel length, SSC and fruit acid were significant (Table 1 and Table 2).

Table 1. Effects of BA and BA + GA_{4+7} applications at cell division stage on fruit size (average fruit weight, fruit length, fruit diameter and length/diameter ratio) of 'Deveci ' pear (*Pyrus communis* L.).

Treatment	Concentration (ppm)	Pedicel length (mm) *	Fruit weight (gr)	Fruit diameter (mm)	Fruit length (mm)	Fruit length/Fruit diameter
Control	0	4.17 ab	300.46	82.04	88.66	1.08
BA + GA_{4+7}	12.5	4.53 ab	290.08	80.80	84.66	1.06
BA + GA_{4+7}	25	4.88 a	331.88	83.73	88.25	1.02
BA + GA_{4+7}	50	3.98 b	342.39	86.92	91.50	1.06
BA	50	4.61 ab	315.52	82.46	89.05	1.08
BA	100	4.54 ab	243.90	76.72	83.41	1.09
BA	150	4.91 a	302.78	84.61	85.07	1.06

The juice was obtained by mashing fruits in a plastic container and the SSC of each replication was determined in room temperature using a reflactometer (Model N.O.W. 507-1, Nippon optical works. Co. ltd. Tokyo, Japan), with a brix scale of 0-32.

The pH of the fruit was measured by dipping a digital pH meter in the fruit juice. The titratetable acid content was determined by taking 10 ml of the previously extracted fruit juice and titrating up to pH 8.1 using 0,1 N NaOH. Then the consumed NaOH was used to calculate the acidity in terms of % malic acid.

Experimental design and statistical analysis

The experiments design was a completely randomized design. Each treatment had three replicates (trees) and for each replication, 30 (3 x 10) fruits were sampled randomly to determine the average fruit weight, fruit firmness, soluble solid concentration (SSC) and pedicel length.

Data were subjected to analyses of the variance, then means were separated by Duncan's multiple range tests using statistical analysis system (SAS) program (SAS Institute, Carry, N.C).

Increasing fruit size, firmness and delaying maturity are fairly consistent effects of gibberellins and gibberellin plus benzyladenine combinations in fruit crops [15-19], in contrast with those results; there were no differences between the mean fruit size parameters of fruits (weight, length and diameter) from controls and PGR treatments in 'Deveci' (Table 1). These results are most probably due to time of application: we applied BA + GA_{4+7} and BA 14 days after the full bloom. This time of application was most probably not suitable for this variety due to the fact that cell division stages of winter pears are potentially longer than that of the summer pears.

Although the effects of PGRs on pedicel length were significant, the effects of PGRs on pedicel length were complex (Table 1). Medium and low levels of BA + GA_{4+7} and all levels of BA had longer pedicels than the control; however they were not statistically higher than the control. This is most probably caused the unexpected values obtained from 50 ppm BA + GA_{4+7}. There are variable reports on the effects of GA3 on pedicel length and only Horvitz et al. [22] reported that GA_3 treatment increased the percentage of cherries with long pedicels.

When compared with untreated control fruit, some of the BA + GA_{4+7} and BA treatments increased SSC in 'Deveci' pear (Table 2). The results on increased SSC obtained with BA and BA + GA_{4+7} applications in this study are consistent with the results of the other researchers [23,24].

Table 2. Effects pre-harvest BA and BA + GA_{4+7} applications on fruit quality (average pedicel length, fruit firmness, soluble solids, pH and acidity) of 'Deveci ' pear (*Pyrus communis* L.).

Treatment	Concentration (ppm)	Firmness (lb)	SSC (%)*	pH	Titratetable acid*
Control	0	21,87	14,05 c	4,39	0,13 bc
BA + GA_{4+7}	12.5	21,88	14,16 c	4,28	0,16 a
BA + GA_{4+7}	25	26,12	17,50 a	4,41	0,12 c
BA + GA_{4+7}	50	22,85	15,52 abc	4,46	0,16 a
BA	50	19,86	14,80 bc	4,62	0,12 bc
BA	100	20,77	16,44 ab	4,45	0,14 abc
BA	150	25,15	16,65 ab	4,36	0,15 ab

25 ppm BA + GA_{4+7} and 100 and 150 ppm BA applications resulted in fruits with higher SSC in cv. Deveci, but the lowest BA + GA_{4+7} and BA levels had no effect on SSC (Table 1). The effects of GA_3 on SSC of fruits were variable and SSC of the fruits is not always increased by GA3 application [14, 25].

The effects of PGRs on titratetable acid content were also complex. Although there were no significant linear relationship between PGR levels and acidity, some levels of BA + GA_{4+7} (12.5 and 50 ppm) and BA (150 ppm) had significantly higher levels of acidity than the control.

The pre-harvest application of BA + GA_{4+7} and BA increased the fruit SSC and titratetable acid content. However BA + GA_{4+7} or BA applications were in effective in increasing fruit size. These is most probably caused by the fact that winter pears need longer time for maturation, and most probably have longer cell division stage than summer pears. Application time is very important for a given PGR to be effective [15, 16]. Having longer cell division stage winter pears may require multiple applications of PGRs at cell division stage to increase the cell number and fruit size.

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