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Effects of Plant Growth Promoting Rhizobacteria (PGPR) on Yield and Fruit Quality of Quince

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Abstract. This study was carried out at Research and Application Orchard of Department of Horticulture of Agriculture Faculty in Selcuk University in 2011. At research; it was aimed to be determined the effects of *Bacillus mycoides* T8 and *Bacillus subtilis* OSU-142 bacteria strains on yield, fruit properties. The presence of T8, OSU-142 and T8+OSU-142 alone or in combination resulted in significant yield increase. Floral and foliar applications of T8, OSU-142 and T8+OSU-142 on quince significantly increased yield per tree, number of fruit, fruit weight, fruit width and fruit height respectively, compared with the control in 2011. The highest fruit weight was found from the OSU-142+T8 (362,43 g) application. Floral and foliar applications of T8 and T8+OSU-142 significantly increased yield per tree. Yield per tree were determined to be increased from 8549,16 kg/tree in the control to 12321,77 kg/tree by T8 application and to 11601,11 kg/tree by T8+OSU-142 application. It was determined that the bacteria applications did not changed importantly rate of soluble dry matter, titratable acidity and pH while increased width of fruits and height of fruits compared with the control in 2011. In the applications was increased firmness. The highest firmness was found from the OSU-142+T8 applications.
The results of the present study suggested that *Bacilus* T8 and *Bacillus* OSU-142 alone or in combination have a great potential to increase the yield and suggested in order to promote growth and development on quince cultivation.

Keywords: Quince, PGPR, fruit characteristics one

1. Introduction

Intensive farming practices, that warrant high yield and quality, require extensive use of chemical fertilizers, which are costly and create environmental problems. Therefore, more recently there has been a resurgence of interest in environmentally friendly, sustainable and organic agricultural practices [1]. Uses of bio-fertilizers containing beneficial microorganisms instead of synthetic chemicals are known to improve plant growth through supply of plant nutrients and may help to sustain environmental health and soil productivity [2].

Uses of bio-fertilizers containing beneficial microorganisms instead of synthetic chemicals are known to improve plant growth through supply of plant nutrients and may help to sustain environmental health and soil productivity [2]. So far considerable number of bacterial species mostly associated with the plant rhizosphere, have been tested and found to be beneficial for plant growth, yield and crop quality. They have been called 'plant growth promoting rhizobacteria (PGPR)' including the strains in the genera *Acinetobacter Alcaligenes, Arthrobacter, Azospirillium, Azotobacter, Bacillus, Beijerinckia, Burkholderia, Enterobacter, Erwinia, Flavobacterium, Rhizobium and Serratia* [3]-[5].In previous studies, it was found that PGPR can stimulate growth and increase yield in apple, citrus, high bush blueberry, mulberry and apricot [1], [5]-[7]. Many bacterial species have N_2-fixing properties, including *Bacillus* spp., *Azotobacter* spp., *Azospirillum* spp., *Beijerinckia* spp., *Pseudomonas* spp., etc. [8] and [9]. The use of those bacteria as bio-fertilizers or bio-

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control agents in agriculture has been a focus of research for a number of years. Organic fertilization is very important in organic fruit production due to use of inorganic fertilizers is not possible [10].

Bacillus OSU-142 was previously selected as a biological control agent for the management of some plant diseases and more recent studies showed that OSU-142 was able to fix N_2 asymbiotically and promote plant growth and yield in barley, sugar beet, tomato, pepper and apricot [11]-[15]. In addition, OSU-142 produce IAA and T8 was the new strain of bacteria produce gibberellic acid have been reported [16]. The objective of this study was, therefore, to investigate the growth promoting effects of floral and foliar applications of T8 and OSU-142 on quince on the basis of yield per tree, fruit weight, number of fruit.

2. Materials and Methods

The bacterial strains were grown on nutrient agar. A single colony was transferred to 500 ml flasks containing NB (Nutrient Broth) and grown aerobically in flasks on a rotating shaker (150 rpm) for 48 h at 27 ℃. The bacterial suspension was then diluted in sterile distilled water to a final concentration of 10^9 CFU ml^{-1} and the resulting suspensions were used to treat quince plants.

In the year 2011 experiments were carried out on7-year-old quince trees, in the province of Konya, Turkey. These orchard 1164 m height above sea level, 38"01'55 N and 32"30'49 E coordinates, and there appears to be dominated by a typical terrestrial climate. The field experiment, 36 quince trees were selected and divided into four application groups including three trees with three replicates in a completely randomized design. Control trees were sprayed with sterile water, and trees in other application groups were sprayed at full bloom stage, 30 days after full bloom (DAFB) and 60 DAFB, with bacterial suspension 10^9 CFU ml^{-1} of *Bacillus* T8 or *Bacillus* OSU-142 or T8 + OSU-142 until run off.

Growth promoting effects of bacterial treatments were evaluated by determining average fruit weight, number of fruit, fruit width, fruit height, yield per tree, total soluble solids content (TSS), pH and acidity.

All data in the present study were subjected by analysis of variance (ANOVA) and means were separated by Duncan's multiple range tests.

3. Results and Discussion

Trials showed that bacterial treatments including *Bacillus* T8, *Bacillus* OSU-142 and *Bacillus* T8 + *Bacillus* OSU-142 applications affected yield per tree, number of fruit and fruit weight in this study. The results showed that yield per tree significantly increased by all bacterial treatments compared with control. Significant yield increase was obtained with T8+OSU-142 (11601.11 kg/tree) in T8 (12321.77 kg/tree) treatments in 2011 as compared with the control (Table 1). Similar findings were reported in the previous studies showing that application of OSU-142 may stimulate yield and quality parameters in sugar beet and barley [14] and apricot [1] and [15]. Floral and foliar bacterial applications in full bloom and shortly after flowering (cell division phase) stimulated fruit set and fruit development presumably through the effect of IAA and GA_3.Thus, producing IAA and GA_3 by OSU-142 and T8 may have positive effects on fruit set and development in quince.

There were significant differences between applications on fruit weight. Fruit weight was increased by bacterial application compared with the control and these effects were found statistically significant in 2011. The average fruit weight was found from OSU-142+T8 application 362.43 g, OSU-142 336.91 g and T8 290.03 g while was found from the control in 229.47 kg. Similarly Esitken et al., [17], BA-8, and OSU-142 applications, cherries and Pirlak et al., [18], BA-8, OSU-142 and BA-8+OSU-142 applications, reported in apple fruit weight increased. In addition, T8 application (48.49 pcs/tree) gave the highest number of fruit representing increases over control of 38.67 and 25.4%, respectively. Furthermore the highest fruit height and the highest firmness were founded by OSU-142+T8 application and the highest fruit width was founded by T8 application in 2011. It was determined that the bacteria applications increased importantly width of fruits and fruit weight compared with the control. The average fruit width was found from OSU-142 application 86.13 mm and OSU-142+T8 84.90 mm while was found from the control in 77.97 mm. The highest fruit height was obtained by OSU-142+T8 (105.02 mm) application, respectively. Similar finding was reported in previous study showing that application of OSU-142 and M3 may stimulate fruit diameter

and average shoot diameter in apple [12]. Likewise, De Silva et al. [15] reported that applying *Pseudomonas fluorescens* Pf 5 increased the leaf area and stem diameter of high bush blueberry. This is the first study to demonstrate that floral and foliar PGPR application can increase yield of quince.

The results of the present study suggested that *Bacillus* T8 and *Bacillus* OSU-142 alone or in combination have a great potential to increase the yield and fruit properties of quince plant. Therefore, they may be utilized as bio-fertilizer and bio-pesticide for fruit and vegetable production in sustainable and ecological agricultural systems.

Table 1. Effects of bacterial applications on yield and fruit quality in quince

Treatments	Yield per Tree	Number of Fruit	Fruit Weight	Fruit Width	Fruit Height	Number of Cores	Firmness	TSS	pH	Acidity
Control	8549,16 c	38,67 b	229,47 d	77,97 c	73,56 c	38,74 a	7,04 ab	15,73 a	2,75 d	1,89
OSU-142	11195,88 b	41,75 b	336,91 b	86,13 a	82,71 b	26,65 b	6,63 b	13,23 c	2,89 ab	1,63
T8	12321,77 a	48,49 a	290,03 c	83,78 b	81,65 b	27,00 b	6,57 b	14,67 b	2,83 b	1,72
OSU-142+T8	11601,11 a	42,97 b	362,43 a	84,90 ab	105,02 a	22,13 c	7,53 a	13,67 c	2,96 a	1,11

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