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Effects of Late Fall Foliar Boron Sprays on the Fruit Set of Sweet Cherry Trees cv. 0900 Ziraat

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Abstract: ***In this study the effect of boron (B) sprays in late fall to the consistently low yielding 0900 Ziraat sweet cherry trees on the percentage of fruit set was investigated. Four boron doses were applied (0-75-100-150 g / tree, from 20.8 % B source) four weeks before leaf fall. There was an increase in the amount of boron content of spur flower buds in sprayed trees which in turn improved the fruit set of this cultivar (over 30.0 %) compared to untreated control trees (15.7 %).*** **Fall foliar B sprays can be considered a valuable tool for obtaining a better yield in sweet cherry trees when needed.**

Keywords: *Prunus avium*, nutrition, spur bud, fruit yield

1. Introduction

Turkey is the leading sweet cherry producer with around 500.000 tons / year in the world (1). The exported sweet cherry fruits from Turkey are mainly 0900 Ziraat cultivar which is also known as "Turkish Cherry" in the European markets with its excellent eating quality (2). Unfortunately, the fruit set of this cultivar is lower compared to other commercial sweet cherry cultivars. Turkish sweet cherry growers have been insisting on that this cultivar gives low yield even in the best pollination and fertilization conditions.

Boron (B) is important in pollen germination and pollen tube growth, which is likely to increase fruit set (3,4). Previous studies indicated that improving boron status of fruit buds in some fruit species decreases the percentage of flower and small fruit drops and thus enhances fruit set (5,6,7). Premature flower and fruit drop of tree crops has been attributed to B deficiency, suggesting that B movement to reproductive structures is restricted or that growth and development of floral structures have a higher demand for B than do vegetative structures (8). Therefore, boron fertilization are recommended to increase yield, particularly when plants are grown on soils with a low content of available boron. However, in some fruit trees such as sour cherry, almond, olive and apple with no visible boron deficeny it was reported that increased boron content to a certain degree by soil and/or leaf boron applications resulted in better fruit set and yield (4,9,10,11). In literature, there is few works on sweet cherry boron nutrition. Also, the success of supplemantal boron nutrition in sweet cherry trees was reported to be cultivar dependent (12).

The objective of this study was to determine the effects of different doses of soluble boron sprays (Etidot67, produced by Eti Mine Works, Turkey) in late fall to the foliage of consistently low yielding 0900 Ziraat sweet cherry trees on the boron level of dormant fruit buds and the percentage of fruit set.

2. Material and Method

The sweet cherry trees (cv 0900 Ziraat) on Mazzard seedling rootstock were grown in the experimental orchard of Horticulture Department of KSU, Kahramanmaraş, Turkey. The trees were eight years old and trained with Spanish Bush (multiple leader) system. Trees were drip irrigated and received regular cultural practices. The orchard soil was loamy clay with low B content as in all the region (13).

In this study four boron treatments were applied to trees (0-75-100-150 g / tree). The boron source was a newly developed fertilizer 'Etidot 67' (contains 20.8 % Boron; disodium octaborate tetrahydrate) produced by Eti Mine Works in Turkey which is specialized in commercial boron products. Each dose of 'Etidot67' was mixed with 10 liter tap water per tree without surfactant. Control trees received only water. The mixtures were sprayed to trees at noon time. The treatments were repeated on three trees. Trees were sprayed 4 weeks before natural leaf fall in 2015 and 2016. Unfortunately the flowers in the spring of 2015 were fully damaged by a frost and the related data were then disregarded. Therefore we presented only the results of the experiment conducted in 2016.

The boron content of the leaves of experimental trees before the sprays was determined. A hundred fruit buds from fruiting spurs on two-year old branches from each tree were collected monthly during the winter (from December to March) for determining their boron content. Tissue boron content was determined by ICP-OES spectrometer (14) at the laboratory of East Mediterranean Transition Zone Agricultural Research Institution, Kahramanmaraş. In order to determine fruit set, four branches, 1.5 to 2 m above ground from four directions were labeled on two- and three- year-old wood (total length was approximately 1 meter for each branch). The dormant spur buds, flowers at full bloom and fruits were counted on above mentioned branches on three trees for each treatment. The mean number of spurs on the labeled branches was 76 on 1 meter branch length. Analyses of variance were performed on all data. Differences between means were evaluated using Duncan's Multiple Range Test at $P \leq 0.05$.

3. Results and Discussion

The leaf boron content of 0900 Ziraat sweet cherry trees did not statistically differ four weeks prior to boron sprays in fall (Table 1) The leaf boron content of the experimental trees was between 59.37 and 68.35 ppm. This boron range in sweet cherry leaves was found to be sufficient according to previous studies (15,16,17). However, it was reported that although plant tissue samples with B levels in sufficient ranges were not likely to exhibit visual symptoms, tissue levels in this range may not be adequate for maximum yield and quality (18).

Table 1. Leaf B content of sweet cherry cv. 0900 Ziraat trees four weeks before boron spray in fall.

Trees subject to B spray	Leaf B content (ppm, dry weight)*
Treatment #1 trees (control)	66.27 a
Treatment #2 trees	59.37 a
Treatment #3 trees	62.40 a
Treatment #4 trees	68.35 a

*: Means with the same letter within columns are not significantly different according to Duncan's Multiple Range Test at $P \leq 0.05$.

The boron contents of dormant spur flower buds from December to March were statistically different between boron sprayed trees and untreated control trees (Table 2). The average boron level of four months was only 82.6 ppm in untreated control trees; however, it was 117.4 and 114.0 ppm with 50 g and 75 g /tree B doses, respectively, being in the same statistical group, and 142.1 ppm with the highest B dose (100 g/tree). There was an apparent increase in the amount of boron in the flower buds of B sprayed trees. It was demonstrated that in four fruit species, including sweet cherry, the export of foliage-applied B occurred rapidly (15). This exported B in the autumn readily moves from the leaves into the adjacent buds, enhancing B levels, which later express in flowers at bloom (16, 19, 20). In a previous late season boron spray study, different B concentrations were measured in 'Summit' and 'Hedelfinger' sweet cherry dormant flower buds (12). Our study confirmed the effectiveness of fall foliar sprays of boron on increasing the boron level of dormant flower buds of 0900 Ziraat sweet cherry trees.

Table 2.The effect of boron sprays in fall on the boron content of dormant spur flower buds of 0900 Ziraat sweet cherry trees.

Treatments (20.8 % B)	B content of dormant flower buds (ppm, dry weight)*				
	Dec.	Jan.	Feb.	Mar.	Average
0 g / tree	72.7 a	77.6 a	94.4 a	85.8 a	82.6 a
50 g / tree	117.4 b	108.2 b	122.1 b	122.1 b	117.4 b
75 g / tree	106.8 b	116.4 b	126.5 b	106.1 b	114.0 b
100g / tree	127.7 b	154.1 b	138.4 b	148.2 c	142.1 c

*: Means with the same letter within columns are not significantly different according to Duncan's Multiple Range Test at $P \leq 0.05$.

In all experimental trees, the mean number of flowers on 1 meter fruiting branch length was in the same statistical group (between 111 and 134 flowers), However, in boron -sprayed trees the mean fruit numbers in the same branch length were found higher (an average of 40 fruits) compared to untreated control trees (21 fruits). With all boron doses the fruit set of 0900 Ziraat sweet cherry trees ranged from 30.4 % to 36.3 %, while it was as low as 15.7 % in untreated control trees.

Table 3. The effect of fall boron sprays on the number of flowers, fruits and percentage of fruit set on per unit branch lenght (1 meter).

Treatments (20.8 % B)	Mean number of flowers*	Mean number of fruits*	Percentage of fruit set*
0 g / tree	133 a	21.0 a	15.7 a
50 g / tree	127 a	42.8 b	33.7 b
75 g / tree	111 a	40.3 b	36.3 b
100 g / tree	134 a	40.8 b	30.4 b

*: Means with the same letter within columns are not significantly different according to Duncan's Multiple Range Test at $P \leq 0.05$.

According to Bekefi (21) high yields of sweet cherries are achieved when fruits are set by 20-30% of the flowers. In our study, enhancing boron levels of spur flower buds increased fruit set drastically in trees which did not have boron deficiency. In leaf boron-optimum trees this might be explained by the competition for boron among the developing numerous flowers in a short period in early spring which may lead a transient B-deficiency in the whole tree (22). In pecan trees it was concluded that as long as leaf B is within the recommended sufficiency range, timing of foliar B application during the critical pre pollination period appears to be more valuable for pecan production than are increasing leaf B levels (23). Since in our study there was no significant difference in fruit set by three boron treatments, low (50 g/tree) or medium (75 g/ tree) doses of boron from 20.8 % B source (Etidot67) seemed to be sufficient for obtaining a high percentage of fruit set in 0900 Ziraat sweet cherry trees.

It was reported that soil-applied B remained mostly in the roots while very little was translocated in the above-ground portions of the tree at full bloom (20). Therefore in fruit species, especially which open their flowers prior to leafing in spring such as sweet cherry and other stone fruits, the boron status of the fruit buds could be better enhanced by fall foliar boron sprays. However, cultivar responses to boron application should be taken into consideration. Also climatic factors of the prevailing season might affect the fruit set percentages. For these reasons, long-termed studies in sweet cherry cultivars should be done to clarify the optimum boron levels of spur flower buds for improving fruit set while avoiding B toxicity.

4. Conclusion

In this study it was proved that B contents of dormant spur flower buds of 0900 Ziraat sweet cherry trees with no leaf B deficiency were increased to a level by fall boron sprays with 'Etidot67' which in turn positively affected the fruit set in the next season. Therefore fall foliar B sprays can be considered a valuable tool for obtaining a better yield in sweet cherry trees when needed.

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