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# REDUCING WATER STRESS ON APRICOT SAPLINGS CV. ZANJELLY

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## Abstract

This experiment was carried out at the college of agricultural engineering science/University of Baghdad for the 2017-2018 growing season in order to reduce water deficit in apricot saplings using different treatments. The factorial experiment included two factors, the first factor was irrigation after loss of 25% of available soil water as well as 50%. The second factor included foliar application at given concentrations of the following, Silicon (potassium silicate) 6 ml/L S1, anti transpiration (stress relief) 3 ml/L S2, salicylic acid 100 mg/L S3, ascorbic acid 100 mg/L S4 and the comparison treatment with no foliar applications S0. Trials were conducted as a Nested Design with three replicates. Results were as follows, water deficit W2 increased proline, POD, decreased leaf water potential and RWC, As for S1, S2, S4 treatments decreased proline and POD levels and increased leaf water potential and RWC for both seasons.

***Key words:*** stone fruit, drought stress, proline, peroxidase.

## Introduction

Apricot *Prunus armeniaca* L. are stone fruit belonging to the genus Prunus and Rosacea family, an economically and nutritionally important fruit in Iraq as fruit is not only consumed fresh but dried and is used to make jams. In the last few years apricot production has decreased as statistics indicate Iraq's apricot production for the year 2000 reached 27000 tons and for 2010 18926 tons, recording a 29% reduction and for the year 2016 production recorded 13871 with a % 48.6 decrease (FAO, 2016). One of these reasons is the scarcity of irrigation water.

Drought is one of the most important factors effecting the agricultural sector, limiting yields and effecting crop distribution around the world (Yongxing, 2014). Limited rainfall in the Iraqi region for the past two decades accompanied by high temperatures and increased evaporation rates as well as increased dam constructions on river sources decreased water levels for Euphrates and Tigris rivers ending up in the loss of many orchards and agricultural lands pushing farmers to leave the agricultural field and head to the city. In order to limit drought modern irrigation technologies should be used as well as available facilities in order to increase plant ability to adapt to low irrigation levels without damaging the plant. Many researches have pointed out the damage a decrease in irrigation water could have on a plant, as Chalmers, (2007) noticed a decrease in water stress when grape vines were exposed to water stress, as well as Dichio *et al*., (2007) whom mentioned a decrease in water stress in leaves as well as a decrease in vegetative growth when % 11 of field capacity was depleted. Joody, (2009) indicated an increase in proline as well as a decrease in water stress and RWC when apricot trees were irrigated with saline water, Abass and Alak, (2016) also pointed out that the most efficient use of water was at 60% and 40% of the comparison treatment (50% of available water).

Many researches point out that silicon decreases water stress in plants, being a beneficial element in resistance to different biotic and non-biotic stresses (Eneji *et al*., 2008) by arranging cell osmosis and improving water conditions by decreasing transpiration rates as well as improving mineral uptake and decreasing toxic element uptake by plants as well as improving the removal of Reactive oxygen species ROS (Sacala, 2009), also Frantz, (2012) noticed a change in anti-oxidative enzyme activity, a regulation of element uptake as well as an increase in stress resistance Silicon applications. Cai and Qian, (1995) pointed out that apple trees fertilized with silicon had an increase in growth as well as total yield. The findings of Wang and Galletta, (1998) also supported that silicon applied to strawberry increased vegetative growth,

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**Table 1:** Effect of Water Deficit and Different Applied Treatments on Leaf Proline Content (Mmole. $g^{-1}$ wet weight).

| | 2017 | | | 2018 | | |
|---|---|---|---|---|---|---|
| S | W | | Mean | W | | Mean |
| | $W_1$ 25% | $W_2$ 50% | | $W_1$ 25% | $W_2$ 50% | |
| S0(control) | 5.67 | 8.67 | 7.17 | 6.33 | 9.33 | 7.83 |
| S1(silicon) | 4.00 | 6.33 | 5.17 | 4.83 | 6.93 | 5.88 |
| S2(stress relief) | 4.00 | 5.33 | 4.17 | 4.50 | 6.00 | 5.25 |
| S3(salicylic acid) | 5.00 | 8.00 | 6.50 | 5.17 | 8.27 | 6.72 |
| S4(ascorbic acid) | 5.33 | 6.33 | 5.83 | 5.67 | 6.60 | 6.13 |
| Mean | 4.80 | 6.93 | | 5.30 | 7.43 | |
| LSD | W= 0.50 | S= 0.80 | W×S= 1.13 | W= 0.55 | S= 0.87 | W×S= 1.23 |

chlorophyll leaf content, Saleem and Joody, (2019) noticed an increase in nitrogen, phosphorus, potassium, calcium, boron and silicon levels when silicon was foliar applied to apple trees.

Anti-transpiration treatments are used on plants in order to increase plant tolerance to drought stress, Song *et al.*, (2011) noticed its effect on partially closing stomata by forming a wax layer on the leaf surface decreasing water loss by transpiration, Saleem and Joody, (2016) noted foliar applied anti-transpiration stress relief (0, 1.5 and 3 ml.$L^{-1}$) on apple saplings increased height, number of branches, leaf area and number.

Salicylic acid plays an important role in plant responses towards Abiotic stress conditions such as water stress, salt stress and heavy metals (Anwar *et al.*, 2013).

An increased use of ascorbic acid has risen because of its anti-oxidative properties, stimulating and promoting vegetative and fruit growth for different fruit trees. Its effect on growth resembles the effect of plant growth promoters (Khan *et al.*, 2011). Ascorbic acid is considered important to the plant by increasing resistance towards different stresses, it is considered a non-enzymatic anti-oxidant (Tavili *et al.*, 2009). Ahmed and Morsey (Ahmed and Morsy, 2001) pointed out that apple trees C.V. Anna grafted upon MM106 using ascorbic acid at a concentration of 250 mg/L resulting in an increase in leaf area and length of new shoots grown during the experiment. Al-Dory, (2012) also found that apricots C.v Labib treated with ascorbic acid at a concentration of 125, 250, 375 mg.$L^{-1}$ led to an increase in vegetative growth characteristics.

## Materials and Methods

This experiment was carried out at the apricot orchard of college of agricultural engineering science / university of Baghdad in objective to decrease water dificit on two year old apricot saplings using different applied treatments. A factorial experimental design was carried out including two factors for the growing season 2017-2018 as a nested design. The first factor included irrigation after loss of 25% of available soil water W1 as well as 50% W2. The second factor included foilar application at the following concentrations, Silicon (potassium silicate) 6 ml/L S1, transpiration depressant (stress relief) 3 ml/L S2, salicylic acid 100 mg/L S3, ascorbic acid 100 mg/L S4 and the comparison treatment were only water was foliar applied S0. Ten treatments were applied as three replicates. Data was collected at the end of the experiment and analyzed, least significant differences were calculated under a 5% probability (AL-Rawi and Abdualaziz, 2000).

**Parameters measured**

1. Leaf Proline content (RWC): were measured as mentioned by (Bates *et al.*, 1973).
2. Relative Water Content (RWC): was measured as mentioned by (Ahmed, 1984).
3. Peroxidase enzyme activity evaluation (POD): was measured using the method mentioned by (Kim *et al.*, 1988).
4. Water Potential in Leaf: was measured as mentioned by (Yaseen, 2001).

**Table 2:** Effect of Water Deficit and Different Applied Treatments on Leaf Water Potential (bar).

| | 2017 | | | 2018 | | |
|---|---|---|---|---|---|---|
| S | W | | Mean | W | | Mean |
| | $W_1$ 25% | $W_2$ 50% | | $W_1$ 25% | $W_2$ 50% | |
| S0(control) | 13.67- | 17.33- | 15.50- | 12.67- | 19.00- | 15.83- |
| S1(silicon) | 11.67- | 14.33- | 13.00- | 11.00- | 14.67- | 12.83- |
| S2(stress relief) | 11.00- | 13.00- | 12.00- | 9.67- | 12.67- | 11.17- |
| S3(salicylic acid) | 11.67- | 13.67- | 12.67- | -11.00 | 12.33- | 11.67- |
| S4(ascorbic acid) | 12.00- | 14.00- | 13.00- | -11.00 | 13.33- | 12.17- |
| Mean | 12.00- | 14.47- | | -11.07 | 14.40- | |
| LSD | W= 0.59 | S= 0.93 | W×S= 1.32 | W= 0.76 | S= 1.21 | W×S= 1.71 |

## Results and Discussion

**Effect of water deficit and different applied treatments on leaf proline content (Mmole. $g^{-1}$ wet weight)**

From table 1, it can be noticed that water deficiency increased Proline levels, Treatment W2 gave the highest rate recording 6.93 and 7.34 (Mmole.$g^{-1}$) wet weight for both seasons respectfully,

**Table 3:** Effect of Water Deficit and Different Applied Treatments on Leaf Relative Water Content (%).

| S | 2017 | | | 2018 | | |
|---|---|---|---|---|---|---|
| | W | | Mean | W | | Mean |
| | $W_1$ 25% | $W_2$ 50% | | $W_1$ 25% | $W_2$ 50% | |
| S0(control) | 46.00 | 37.33 | 41.67 | 49.00 | 39.33 | 44.17 |
| S1(silicon) | 52.00 | 46.00 | 49.00 | 54.33 | 46.67 | 50.50 |
| S2(stress relief) | 54.67 | 49.00 | 51.83 | 58.00 | 51.00 | 54.50 |
| S3(salicylic acid) | 53.33 | 46.33 | 49.83 | 55.00 | 48.33 | 51.67 |
| S4(ascorbic acid) | 50.67 | 42.67 | 46.67 | 52.00 | 44.33 | 48.17 |
| Mean | 51.33 | 44.27 | | 53.67 | 45.93 | |
| LSD | W= 1.52 | S= 2.40 | W×S= 3.40 | W= 1.67 | S= 2.64 | W×S= 3.73 |

treatments affected Proline levels significantly. Treatment S2 (stress relief) gave the lowest rate reaching 4.17 and 5.25 (Mmole.$g^{-1}$ wet weight) for both seasons respectively followed by S1 (silicon) reaching 5.17 and 5.88 (Mmole.$g^{-1}$) wet weight for both seasons respectively as for S0 which recorded the highest average reaching 7.17 and 7.83 (Mmole.$g^{-1}$) wet weight for both seasons respectively. The interaction between both factors gave a significant effect on Proline content, W2 S0 gave the highest Proline average reaching 8.67 and 9.33 (Mmole.$g^{-1}$) wet weight for both seasons respectively in comparison to W1 S2 which gave the lowest rate reaching 4.00 and 4.50 (Mmole.$g^{-1}$) wet weight for both seasons respectively.

**Effect of Water Deficit and Different Applied Treatments on Leaf Water Potential (bar)**

From table 2, it may be concluded that water deficiency had a significant effect on leaf water potential. Treatment W1 gave the highest water potential reaching -12.00 and -11.07 bar in comparison with W2 which gave -14.47 and -14.40 bar for both seasons respectfully. Treatments had a significant effect on this parameter, treatment S2 recorded the highest water potential levels reaching -12.00 and -11.17 bar followed by S3 reaching -12.67 and -11.67 bar for both seasons respectfully as for S0 which gave the lowest average for this parameter reaching -15.50 and 15.83 for both seasons respectfully. Interaction treatments had a significant effect on this parameter; W1 S2 gave the highest water potential reaching -11.00 and -9.67 bar in comparison to the treatment W2 S0 which gave the lowest average reaching -17.33 and -19.00 bar respectfully.

**Effect of Water Deficit and Different Applied Treatments on Leaf Relative Water Content (%)**

From table 3, it can be concluded that water deficiency had a significant effect on Relative leaf Water Content. W1 gave the highest rate reaching 51.33% and 53.67% in comparison to W2 which recorded 44.27% and 45.93% for both seasons respectfully. As for the treatments which recorded significant differences on this parameter. S2 gave the highest average reaching 51.83% and 54.50 followed by S3 reaching 49.83% and 51.67% for both seasons respectively, as for S0 which gave the lowest rate reaching 41.67% and 44.17% for both seasons respectfully as for the interaction treatments which had a significant effect on the given parameter, W1 S2 gave the highest average recording 54.67% and 58.00% for both seasons respectfully compared to W2 S0 which gave the lowest rate reaching 37.00% and 39.33% for both seasons respectfully.

**Effect of Water Deficit and Different Applied Treatments on Leaf Peroxidase Content (enzyme unit.$g^{-1}$)**

From table 4, it may be concluded that water deficiency increased peroxidase enzyme activity. Treatment W2 gave the highest rate reaching 12.00 and 11.13 enzyme unit.$g^{-1}$ for both seasons respectfully as for W1 which gave the lowest average recording 6.67 and 6.41 enzyme unit.$g^{-1}$ for both seasons respectfully. Treatments had a significant role in decreasing this parameter. S2 gave the lowest average reaching 8.00 and 7.73 enzyme unit.$g^{-1}$ followed by S1 which reached 8.67 and 8.3 enzyme unit.$g^{-1}$ respectfully, as for S0 which recorded the highest average 10.50 and 9.98 enzyme unit.$g^{-1}$ for both seasons respectfully, as for the interaction treatments which recorded

**Table 4:** Effect of Water Deficit and Different Applied Treatments on Leaf Peroxidase Content (enzyme unit.$g^{-1}$).

| S | 2017 | | | 2018 | | |
|---|---|---|---|---|---|---|
| | W | | Mean | W | | Mean |
| | $W_1$ 25% | $W_2$ 50% | | $W_1$ 25% | $W_2$ 50% | |
| S0(control) | 7.33 | 13.67 | 10.50 | 6.97 | 13.00 | 9.98 |
| S1(silicon) | 6.33 | 11.00 | 8.67 | 6.27 | 10.33 | 8.30 |
| S2(stress relief) | 6.33 | 9.67 | 8.00 | 6.13 | 9.33 | 7.73 |
| S3(salicylic acid) | 7.00 | 13.00 | 10.00 | 6.63 | 11.67 | 9.15 |
| S4(ascorbic acid) | 6.33 | 12.67 | 9.50 | 6.03 | 11.33 | 8.68 |
| Mean | 6.67 | 12.00 | | 6.41 | 11.13 | |
| LSD | W= 0.78 | S= 1.23 | W×S= 1.74 | W= 0.71 | S= 1.13 | W×S= 1.60 |

significant differences on this parameter, W1 S2 gave the lowest average reaching 6.33 and 7.73 enzyme unit.$g^{-1}$ for both seasons respectfully in comparison to treatment W2 S0 which gave the highest average reaching 13.67 and 13.00 enzyme unit.$g^{-1}$ for both seasons respectfully.

## Conclusion

From given results it may be concluded that all treatments decreased the effect of water deficiency on saplings especially Stress relief and silicon, it may be recommended to foliar apply Stress relief, silicon, ascorbic acid and salicylic acid on trees exposed to drought stress.

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