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Research Article
Evaluating Leaf Nutritional Status and Fruit Quality Attributes of "Sultani" Cultivar Fresh Fig Fruit Under Sinai Conditions

[1]Aml Reda Mahmoud Yousef, [2]Mustafa Nabil Sabet, [2]Mohamed Mohamed Amin Merwad, [2]Dorria Mohamed Mohamed Ahmed and [3]Abd El-Rheem Khalid Mohamed

[1]Department of Horticultural Crops Technology, National Research Centre, 33 El-Bohouth St., Dokki, Giza, Egypt
[2]Department of Pomology, National Research Centre, 33 El-Bohouth St., Dokki, Giza, Egypt
[3]Department of Soils and Water Use, National Research Center, 33 El-Bohouth St., Dokki, Giza, Egypt

Abstract
Background and Objective: Among many plant nutrients, potassium (K) stands out as the strongest influence on quality attributes that determine fruit marketability and consumer preference. Thus, the aim of this study was to improve leaves nutrients status and fruit quality attributes of Sultani fig cultivar grown in South Sinai of Egypt. **Methodology:** At two-seasons of study (2014 and 2015), different potassium forms at i.e., nitrophoska (slow resale fertilizer), potassium nitrate, mono potassium phosphate and potassium sulphate at different concentrations (0.5 and 1%) were used. Fig leaf area, nutrient status were measured. Fruit quality characteristics such as fruit weight, volume, moisture content, total soluble solids, total acidity and ascorbic acid content were assessed. Fruit skin and flesh colors (L*, C and H°), Total phenolic and total anthocyanin were also determined according to A.O.A.C. Data were analyzed with the two way ANOVA procedure of M-STATC program V.3.1., treatments means were compared by Duncan's multiple range tests at 5% level. **Results:** The obtained results revealed that all potassium forms with different concentrations reinforced nutrient status, fruit physical and chemical characteristics compared with control trees. **Conclusion:** Potassium nitrate at 1% and nitrophoska at (0.5 and 1%) were the best treatments to increase leaf area and its nutrients content. Moreover, they also improve fruit quality as well as physical and chemical properties.

Key words: Fig trees, Sultani cultivar, potassium forms, leaf nutrients content, fruit quality parameters

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Corresponding Author: Aml Reda Mahmoud Yousef, Department of Horticultural Crops Technology, Agricultural and Biological Research Division, National Research Center, 31 El Bohouth St., 12622 Dokki, Giza, Egypt Tel: +20201206067365

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

One of the oldest fruits known to humans is the fig fruit *(Ficus carica* L.,), which is part of the Moraceae family. Today, fig is an important crop worldwide for dry and fresh consumption[1,2]. These fruits are delicious and nutritious with higher levels than other common fruits. It is rich in protein and an excellent source of minerals, vitamins, fiber, organic acids and polyphenols, especially anthocyanin and other flavonoids that act as antioxidants and can protect against several common degenerative diseases[2-5]. Fig fruits are fat and cholesterol-free and contain a high number of amino acids. Fresh fig cultivars are needed to meet the consumer acceptance demand[3,6,7].

World fig production is concentrated and has spread throughout the Mediterranean region where it is well adapted to several types of soils and moderate climate due to its tolerance to salinity and drought[2,4,8]. Currently, it intends to make use of Egyptian competitive advantages in utilizing the desert lands with minimum quantities of water, slain soils and under the dry warm temperate climate[8,9].

Consequently, Sinai Peninsula in Egypt has the climate conditions, which are favorable for the expansion of fig crop, where the temperature and relative humidity provide the best conditions to produce good quality of fig cultivars. Now, the Egyptian Government is focused to extend the fig crop production and enhance its productivity with high quality fruit. So, adequate attention for of agricultural practice, nutritional status for fig tree under Sinai conditions, is required with good management for its cultivation and fertigation system.

Adequate supply of plant nutrients is a very important factor to produce the good quality fruits[10-12]. Generally, supplying the plant nutrients in a foliar manner is both highly efficient and sufficient to meet the plant's requirements. Of these nutrients, potassium is especially important for the productivity[13,14].

Also, potassium (K) is highly mobile in plants at all levels, from individual cell to xylem and phloem transport, fruits sink tissues, enzyme activation, turgor maintenance and stress tolerance. Potassium is involved in numerous biochemical and physiological processes vital to plant growth, yield, quality and stress[12,15]. Additionally, the crucial importance of potassium in quality formation in promoting synthesis of photosynthesis through regulates the opening and closing of stomata and therefore regulates CO_2 uptake[16].

In arid zones, water is scarce and rainfall is low, especially in the summer. This affects the absorption of nutrients in a negative way. Foliar application of potassium can help overcome such problems[12]. These effects might be dedicated to the potassium role in increasing tolerance to stresses and improving the formation and accumulation rates of sugars. It affects the fig fruit quality; shape, size, color, taste and other measurements attributed to healthy and excellence produce of many horticultural crops[15]. Foliar-applied potassium forms at fruit trees has been found by many recent studies as a potent tool to increase yields, specific fruit components and individual fruit size of various horticultural crops, in mangoes[15], in date palm[17], in olive[16] and in mandarin trees[17]. Therefore, the aim of this study was to evaluate the efficiency of foliar application with an important nutrient element (potassium) in different forms on leaf characters and increase fresh fruit quality of Sultani fig cultivar grown in south Sinai of Egypt.

MATERIALS AND METHODS

Plant materials: Fig fruits for this experiment were harvested from15 years old trees grown in Abo Kalam orchard located in El-Tour, South Sinai Governorate, Egypt, during two successive seasons of 2014 and 2015. To study the effect of foliar spray of potassium forms at different concentrations on leaf nutrients content and fruit quality characteristics, the foliar spray of fig trees with two different concentrations (0.5 and 1%) of potassium nitrate, mono potassium phosphate three times, at the beginning of growth at March, April and May were used, while, nitrophoska was added to soil, The selected fig trees were planted at 4×5 m apart under drip irrigation in saline soil and received common horticulture practices. The soil at Abo Kalam orchard has $CaCO_3$ (10.5%) with pH of 8.68, EC (8.8 dSm^{-1}) and contains 15.25, 12.7, 58.6 and 1.4 meq L^{-1} for Ca^{++}, Mg^{++}, Na^+ and K^+. Also, it has HCO^{-3}, (3.95 meq L^{-1}), Cl^- (54.6 meq L^{-1}) and SO_4 (29.6 meq L^{-1}), average of the two seasons for the upper layer of 0-30 cm soil depth.

Treatments: The selected fig trees were spraying with nine treatments as follows:

- Control
- Nitrophoska (NPK 19 19 19 Slow resale fertilizer-0.5%)
- Nitrophoska (NPK 19 19 19 Slow resale fertilizer-1%)
- Potassium nitrate (KNO_3-0.5%)
- Potassium nitrate (KNO_3-1%)
- Mono potassium phosphate (KH_2PO_4-0.5%)
- Mono potassium phosphate (KH_2PO_4-1%)
- Potassium sulphate (K_2SO_4-0.5%)
- Potassium sulphate (K_2SO_4-1%)

Untreated trees (control) were sprayed with only water. Each treatment consists of three replicates and each replicate was consisted of two trees.

Leaf area and nutrients content: Leaf area was determined at the end of each growing season during the first week of September according to Ahmed and Morsy[18]. Leaf samples were collected, washed and dried at 70°C until constant weight and then grounded for determining the following nutrient elements (Percentage as dry weight), N, P, K, Ca and Mg were determined using the methods outline by Wilde *et al.*[19].

Fruits: Mature fig fruits *(Ficus carica* L.) of Sultani cultivar were collected from treated and untreated trees. Undamaged fruits, uniform in shape, weight, color and firmness were selected, packed and transported carefully to the laboratory of Agricultural Development System (ADS) Project in Cairo University. The following parameters were determined in both seasons as follows.

Physical properties assessments: Fruit weight (g), volume (cm^3) and moisture percentage in the fruit were assessed. Fruit firmness was determined using Ametek pressure tester. Firmness of 5 fruits from each replicate was measured at two opposite points on the equator of each fruit. Results were calculated as (lb in^{-2}). Fruit samples were ground in electric blender for freshly prepared juice, soluble solid content was measured for each fruit with a digital refractometer (Atago, PR 32, Japan) and express in percentage[20].

Color measurements: Color was measured with a Minolta colorimeter (Minolta Co. Ltd., Osaka, Japan) on the basis of the CIELAB color system (L*, a*, b*, C* and h°). In this system, L*, a* and b* describe a three dimensional color space, where L* (Lightness) is the vertical axis and its value varies from 100, for perfect white to zero, for black. Values of a* and b* specify the green-red and blue-yellow axis, respectively. Chroma (C*) describes the length of the color vector, while Hue (h°) determines the position of such vector. C* and h° values are calculated based on a* and b* values according to the Eq. 1:

$$\text{Chroma } (C^*) = [(a^*)^2+(b^*)^2]\ 0.5 \quad \text{Hue } (h^o) = \tan^{-1}(b^*/a^*) \qquad (1)$$

Five fruits were measured objectively by averaging three measurements taken around the fruit equator, either in skin and flesh. Color was longitudinally determined on two points of each fruit[21].

Chemical properties assessments: Total acidity (%) of fruit juice was determined by titrating 5 mL juice with 0.1 N sodium hydroxide using phenolphthalein as an indicator. Ascorbic acid content (VC, mg/100 g fresh weight) was measured using 2, 6 dichlorophenolindophenol titration methods as described by AOAC[22].

Total anthocyanin content (mg/100 g fresh weight): Fruit skin and flesh anthocyanin content were measured calorimetrically at 535 nm according to Fuleki and Francis[23].

Total phenols content (mg/100 g fresh weight): A procedure of folinciocalteu[23] was adopted for determination of phenols in metabolic extract of fresh fruit. Total phenols were calculated as mg pyrogallol per 100 g fresh weight.

Statistical analysis: The design for this experiment was a Randomized Completely Block Design (RCBD) with three replications. Data were analyzed with the two way ANOVA procedure of M-STATC program V.3.1., treatments means were compared by Duncan's multiple range tests at 5% level of probability in the average of two seasons of study[24].

RESULTS AND DISCUSSION

Fruit physical properties: Concerning fruit, weight and volume of figs cv. Sultani were influenced by spraying different forms of potassium during the two successive seasons and explained in (Fig. 1, 2). All different potassium forms applications increased fruit weight and volume at both seasons compared to control fruits. Potassium nitrate at 1% treatment recorded the heaviest fruits (61.33 and 57.26 g) in both seasons, followed by nitrophoska 1% and mono potassium phosphate 1% (60.17 and 61.27 g) in the first season. Meanwhile, mono potassium phosphate 1% and potassium sulphate 1% recorded the heaviest (55.10 and 55.05 g) in the second season. On the other side, control fruits recorded the lowest fruit weight (52.08 and 46.07 g) in both seasons, respectively. Regarding to figs fruit volume (cm^3), the data appeared that all potassium forms and concentrations gave positive effect against control treatment. Spraying with potassium nitrate 1% recorded the highest fruit volume (58.67 and 53.67 cm^3). Meanwhile, control treatment gave the lowest fruit volume (50.33 and 43.67 cm^3) in both seasons, respectively.

Regarding to moisture content, foliar concentration of K increased moisture content of figs cv. Sultani at both seasons compared to control treatment are shown in (Fig. 3). Spraying

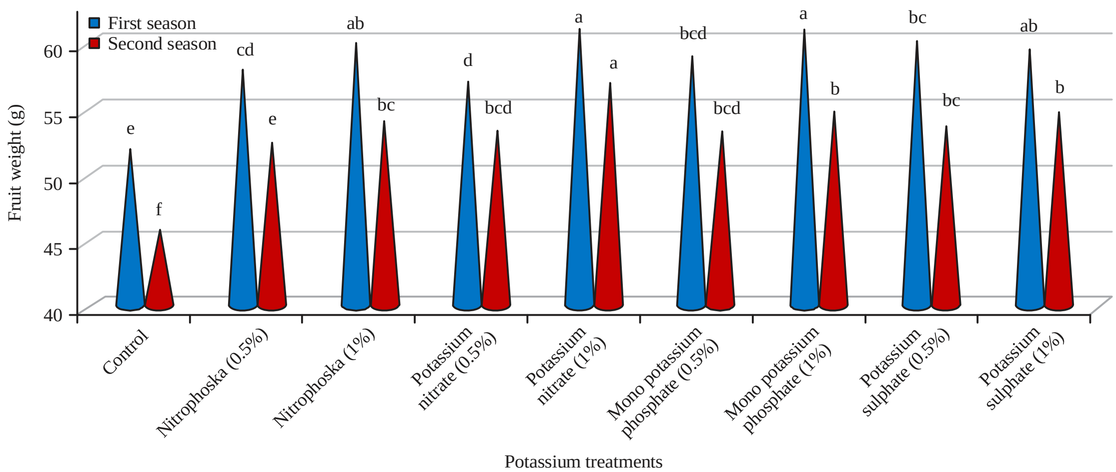

Fig. 1: Effect of different foliar application of potassium forms on weight of Sultani fig fruit during two seasons
Different letters are express for significant differences while the same are non-significant at L.S.D. p>0.05

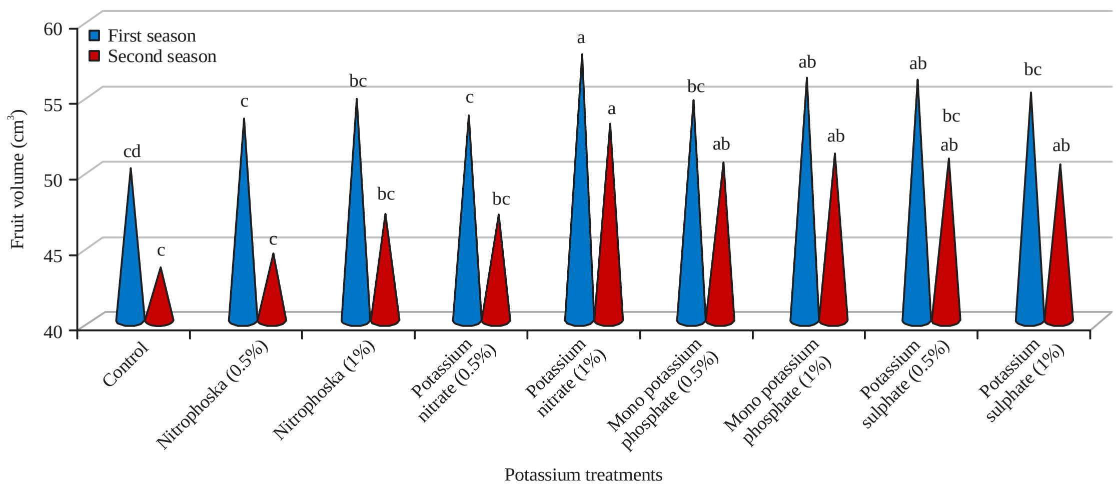

Fig. 2: Effect of different foliar application of potassium forms on volume of Sultani fig fruits during two seasons
Different letters are express for significant differences while the same are non-significant at L.S.D. p>0.05

with nitrophoska at 0.5% gave greater moisture content (75.43 and 74%) followed by potassium nitrate 1% (72.38 and 71.30%) in comparison with control treatment which showed less moisture content in both seasons, respectively (61.62 and 60.10%).

As for fruit firmness (lb in^{-2}) is a good indicator of shipping quality, texture and shelf life. The effect of different potassium forms and concentration on figs fruit firmness at both seasons under study could be noticed from Fig. 4. The obtained data revealed that there were slight differences between potassium forms compared to untreated (control) fruits. Nitrophoska at 1% and potassium nitrate at 1% treatments gave the firmer fruits (15.37, 15.10 lb in^{-2}) and (15.17, 14.90 lb in^{-2}) compared to all treatments. Meanwhile, control treatment recorded the lowest firmness (11.60 and 11.40) in the first and second season, respectively.

Results in Fig. 5 revealed that, leaf area (cm^2) of fig tree increased by all potassium treatments as compared to control with little differences between both seasons under study. Potassium nitrate 1% treatment recorded the highest leaf area (291.86 and 274.37 cm^2) for both ,seasons respectively. Whereas, untreated (control) trees recorded the lowest leaf area (183.46 and 168.62 cm^2) in the 1st and 2nd seasons, respectively.

The present results are in accordance with results obtained by Stino *et al.*[25], El-Razek *et al.*[26] and Mustafa *et al.*[27] on mango trees. They reported that potassium improved fruit quality. In addition, the crucial importance of potassium in

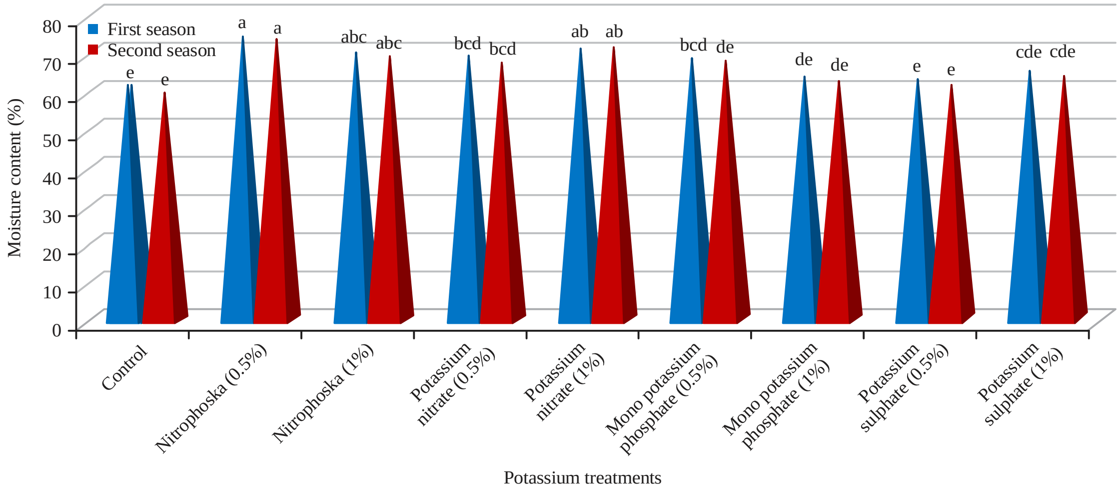

Fig. 3: Effect of different foliar application of potassium forms on moisture content of Sultani fig fruit during two seasons
Different letters are express for significant differences while the same are non-significant at L.S.D. p>0.05

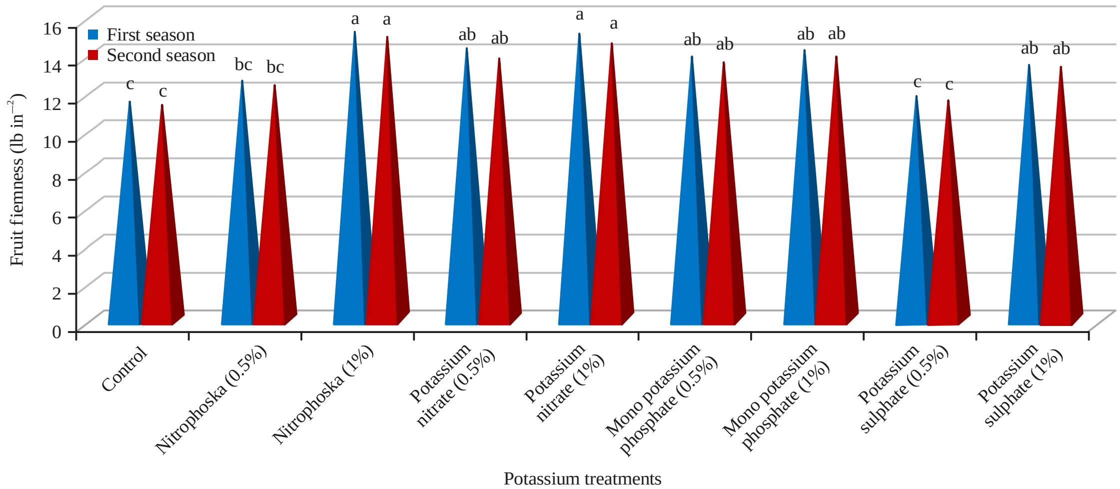

Fig. 4: Effect of different foliar application of potassium forms on firmness of Sultani fig fruit during two seasons
Different letters are express for significant differences while the same are non-significant at L.S.D. p>0.05

quality formation stems from its role in promoting synthesis of photosynthesis and their transport to fruit. In the same trend, spraying potassium using different forms had a positive effect on physical characteristics of Balady mandarin reported by Mostafa and Saleh[28]. This may be related to increased tissue pressure potential[29]. Potassium citrate at (1263 and 1895 g per tree) and mono potassium phosphate at (2000 g per tree) were the best treatments to increase leaf area of Zebda mango trees[11].

Fruit color: Sultani fig fruit color is associated to the accumulation of anthocyanin. This group of pigment is mainly responsible for the surface color of the fruit[21]. During color progress, the fig color is expressed as color parameters; Lightness (L), Hue angle (h°) and Chroma (C*) either in skin or/and flesh fruits. There were differences in these fruit color parameters during the average of the two successive seasons of 2014 and 2015 (Fig. 6a, b for skin color) and (Fig. 7a, b for flesh color), in all applied treatments.

Lightness (L*): Sultani cultivar fig fruits showed increase of lightness either in skin or flesh fruits. The results were revealed that, the highest values (73.67 and 73.25, for skin color) of lightness of skin fig fruit were recorded with nitro potassium treatment at 1%, followed by the same application at 0.5%. Meanwhile, the same trend was noticed in fig flesh fruits, but with mono potassium treatment at 1% (17.97 and 17.88) in both seasons respectively. While the least significant lightness values (47.31 and 40.18) were observed with untreated fruits in skin and flesh color, respectively.

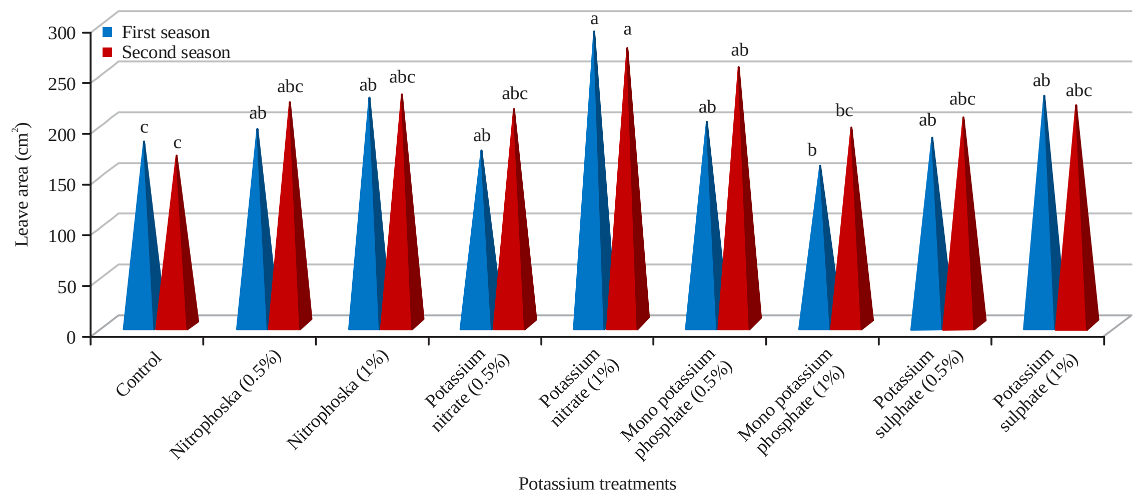

Fig. 5: Effect of different foliar application of potassium forms on leaf area of Sultani fig fruit during two seasons

Different letters are express for significant differences while the same are non-significant at L.S.D. p>0.05

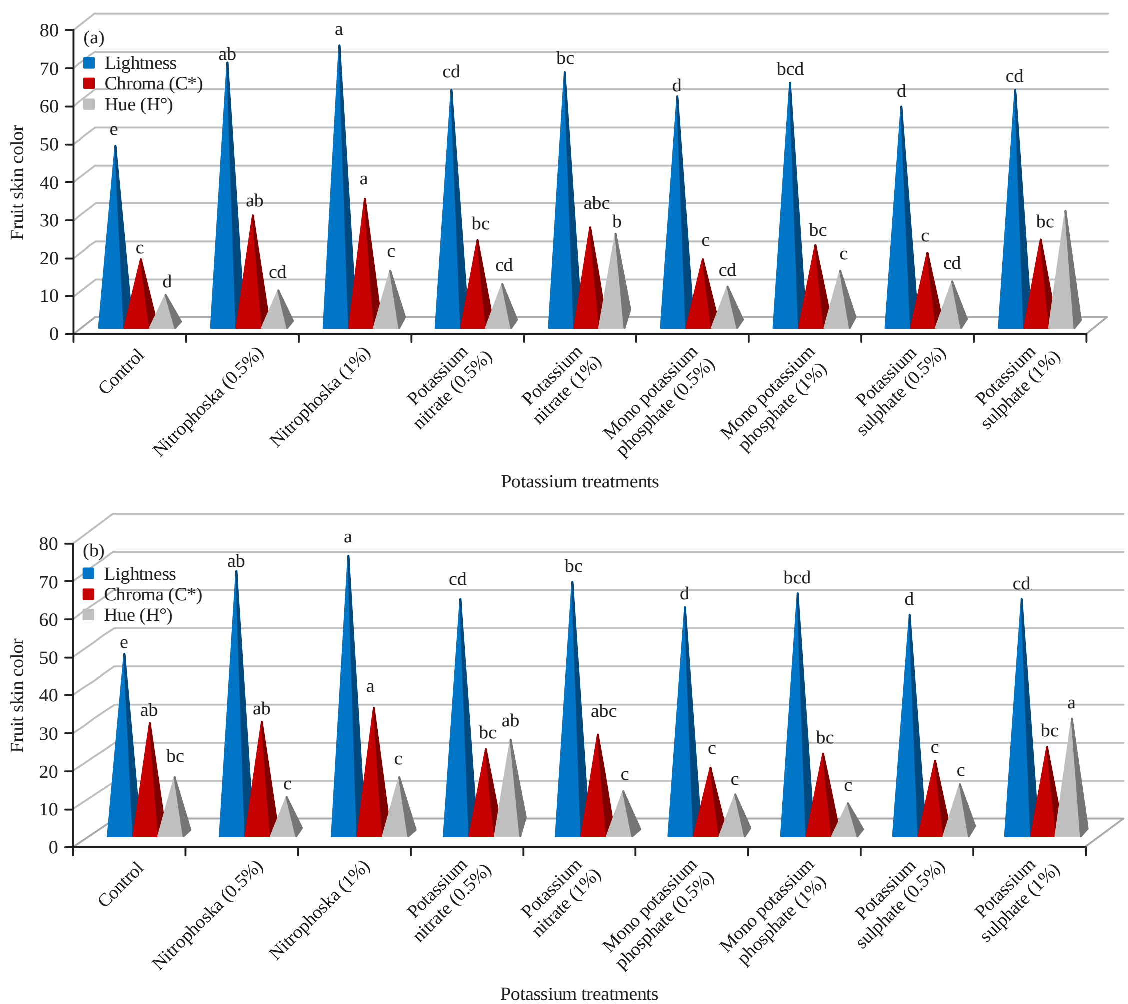

Fig. 6(a-b): Effect of different foliar application of potassium forms on skin color (Lightness, chroma and hue angle) of Sultani fig fruit at (a) 1st season and (b) 2nd season

Different letters are express for significant differences while the same are non-significant at L.S.D. p>0.05

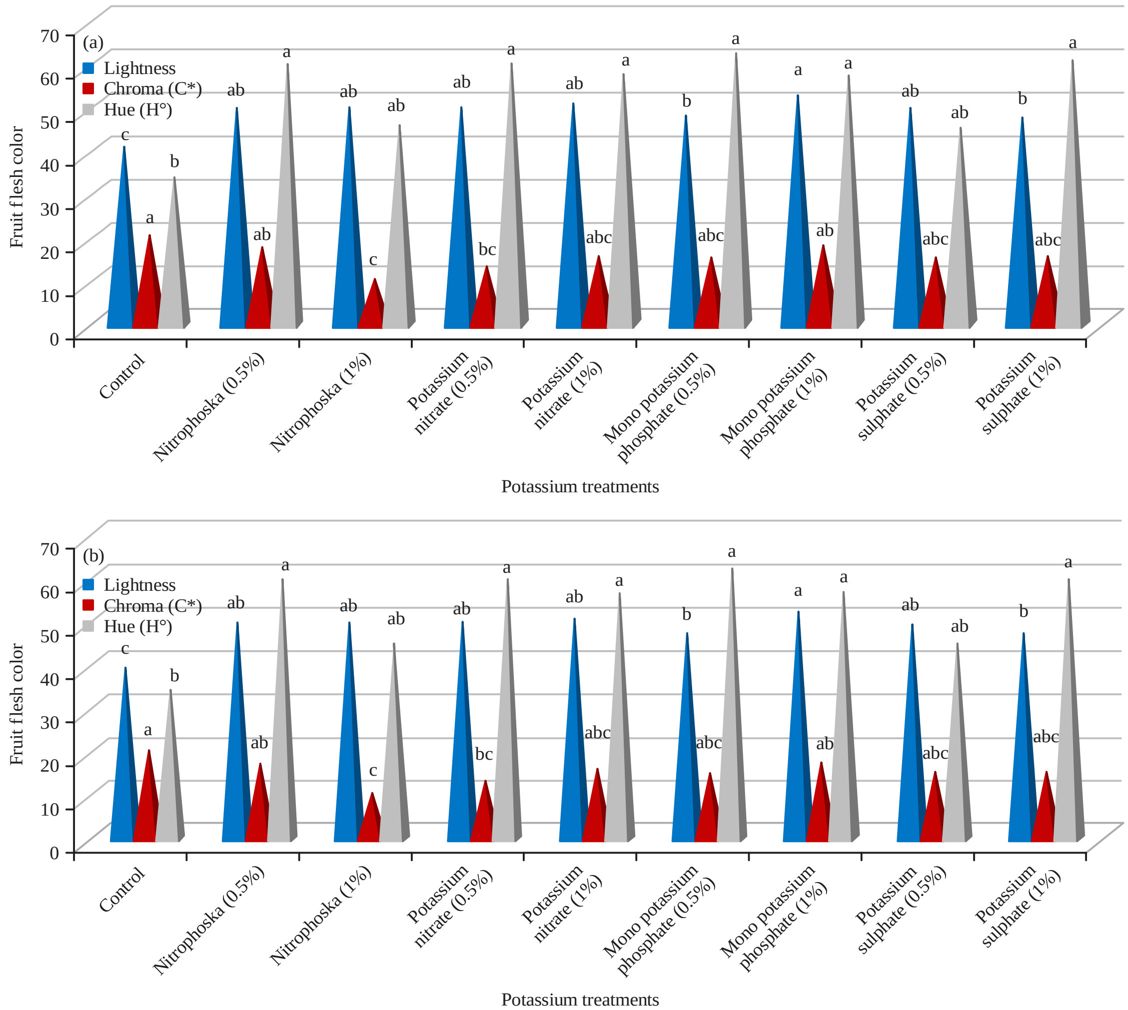

Fig. 7(a-b): Effect of different foliar application of potassium forms on flesh color (Lightness, chroma and hue angle) of Sultani fig fruits at (a) 1st season and (b) 2nd season

Different letters are express for significant differences while the same are non-significant at L.S.D. p>0.05

Hue angle (H°): There was a noticeable reduction trend of hue angle color (H°) values was observed of Sultani fig peel fruits treated with all potassium treatments and concentrations except fruits treated with potassium nitrate and potassium sulphate at 1% which appear the largest hue values (24.77, 24.60 and 30.92, 30.73) of peel fruits compared with untreated ones (15..22 and 15.04) during both seasons of study. On the opposite side, results in Fig. 7a, b cleared a great increase trend in flesh fig fruits due to all potassium applications with less hue (H°) values accompanied with less potassium concentrations compared with control fruits which revealed the least significant hue values (34, 34.39) at both seasons, respectively.

Chroma (C*): Chroma (C*) was exhibited significantly higher increment of skin fig fruits of in all applied potassium treatments as compared with control fruits. The least chroma values (17.72 and 17.50) of mono potassium at 0.5% of chroma at the two seasons of study. Moreover, the highest C* average was recorded with nitro potassium at 1% (33.53 and 33.14), respectively. The opposite reduction of chroma flesh was noticed in fig fruits, compared with untreated ones (control) which revealed the least significant values of (C*) (34.42 and 34.39) at the seasons of 2014 and 2015, respectively.

The results are coincide with those reported with[2], who concluded that skin color of fig fruits showed the greatest content of almost 3% of the anthocyanin identified in the variety. In addition, the reason of color differences in fig types and cultivars can be connected according to the type and cultivar properties[30,31].

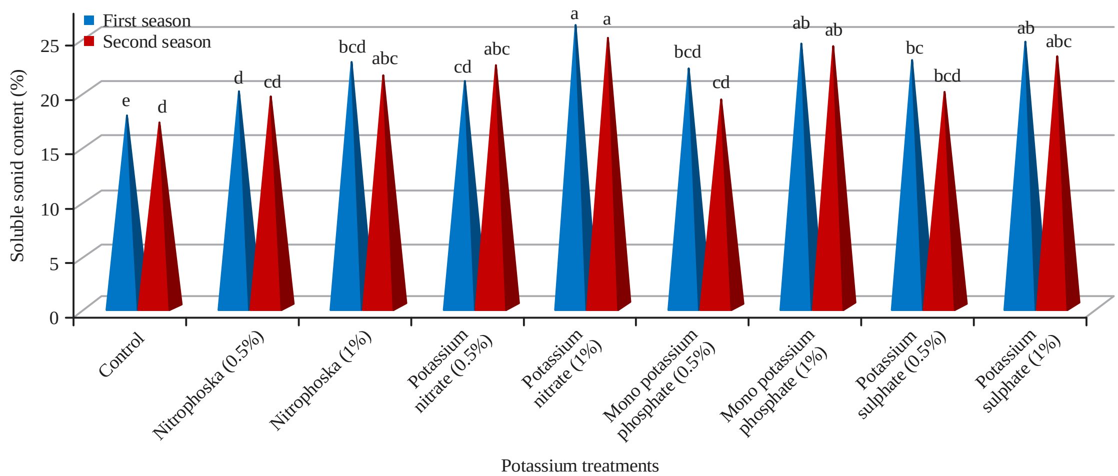

Fig. 8: Effect of different foliar application of potassium forms on soluble solid content (%) of Sultani fig fruit during two seasons
Different letters are express for significant differences while the same are non-significant at L.S.D. p>0.05

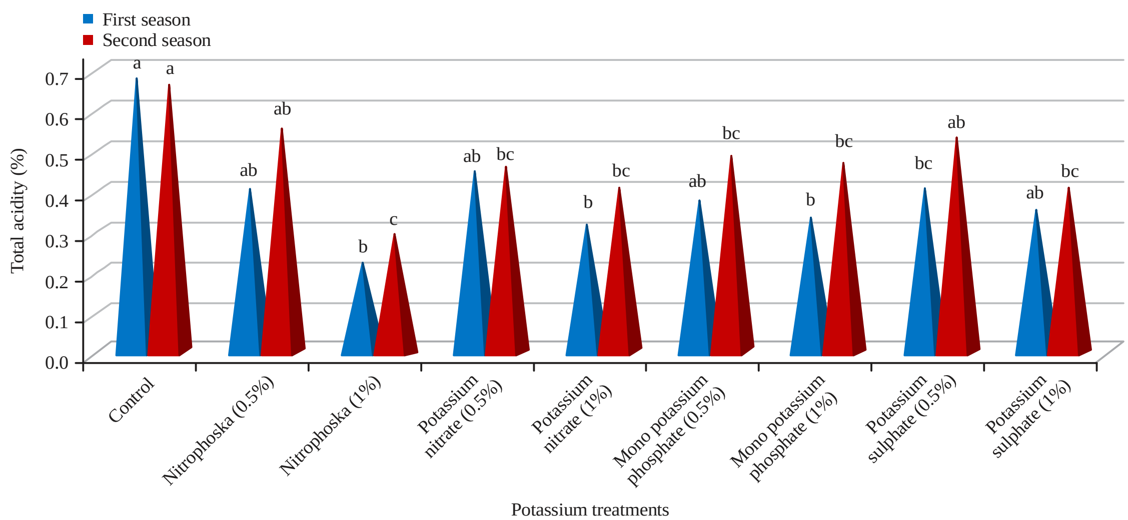

Fig. 9: Effect of different foliar application of potassium forms on total acidity of Sultani fig fruit during two seasons
Different letters are express for significant differences while the same are non-significant at L.S.D. p>0.05

In general, chroma is one of the most important appearances used to define the quality of fruit color and has a critical impact on the consumer acceptance[5,32]. Furthermore, the results are further in line with those found that genotypes with black and purple skin color fruits had higher values expressed as chroma (C*) values, (indicates color saturation)[3,33]. Also, fig fruits seemed to be brighter than ripe ones, as reflected by a decrease in lightness (L*) with maturity and higher color intensity (higher C* value) than ripe ones. The differences in fruit color may result from differential expression of genes controlling the anthocyanin pathway, with the highest expression associated with the dark purple varieties[2,10,34,35]. Finally, foliar potassium application has been correlated with fruit color improvement.

Fruit chemical properties: Concerning the soluble solid content (%), data in Fig. 8 show that all different spraying treatments produced significantly higher soluble solid content as compared to the control. Potassium nitrate 1% treatment had the highest soluble solid content (26.17 and 25.13%) followed by mono potassium phosphate 1% (24.43 and 24.39) during the two successive seasons, respectively. On the contrary, control treatment recorded the lowest content (17.73 and 17.17%).

Regarding, total acidity was affected by spraying with different forms and concentration of potassium recorded in Fig. 9. Foliar spraying with nitrophoska 1% gave the lowest TA percent (0.23 and 0.30%) in the both, followed by potassium nitrate 1% (0.32 and 0.41%)

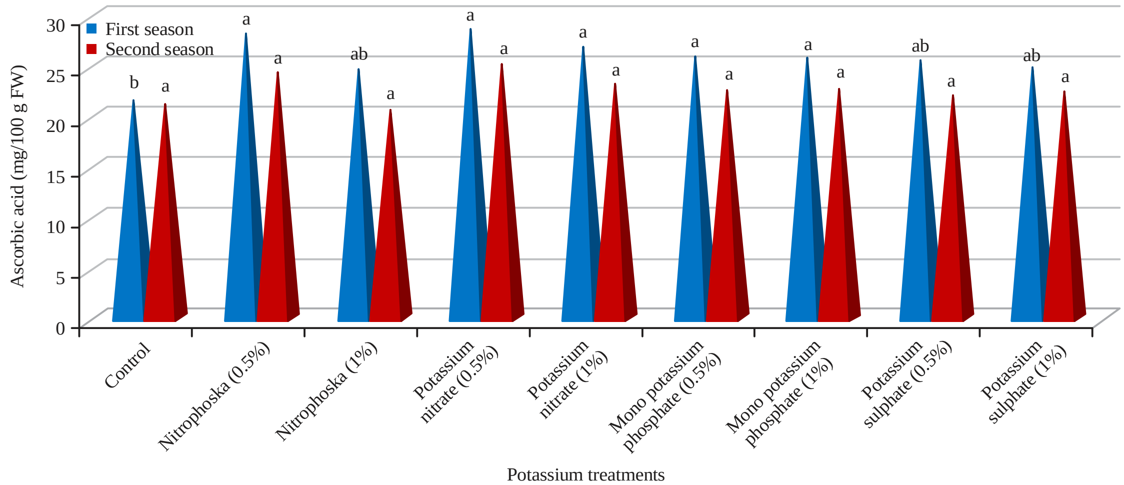

Fig. 10: Effect of different foliar application of potassium forms on ascorbic acid content of Sultani fig fruit during two seasons
Different letters are express for significant differences while the same are non-significant at L.S.D. p>0.05

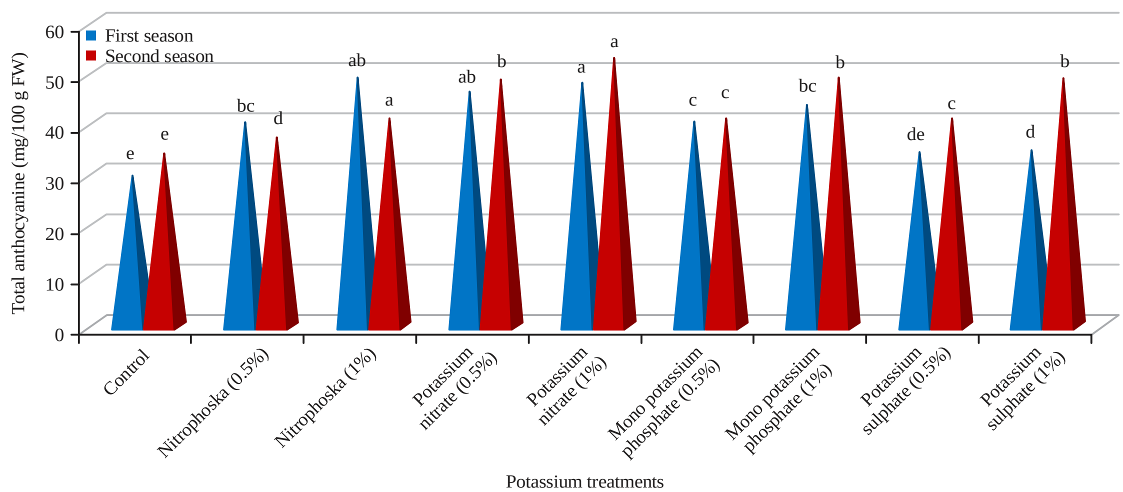

Fig. 11: Effect of different foliar application of potassium forms on total anthocyanin content of Sultani fig fruit during two seasons
Different letters are express for significant differences while the same are non-significant at L.S.D. p>0.05

On the other contrary, control treatment recorded the highest percent in both seasons (0.69 and 0.67%), respectively.

As for ascorbic acid content (mg/100 g FW), there was no significant differences were found between different potassium treatments during the both seasons under study (Fig. 10). Since, nitrophoska 0.5% and potassium nitrate 0.5% gave the highest value of ascorbic acid in the first season (28.33 and 28.67 mg) whereas, potassium nitrate 0.5% treatment gave the highest value (25.33 mg) in the second season. The lowest value was calculated at control trees which recorded (21.67 and 21.33 mg) in both seasons, respectively.

With regard to the effect of different potassium applications on fruit chemical properties, the obtained results were in agreement with those of Stino *et al.*[25] and Abd El-Razek[26] on mango trees. They found that potassium improved fruit chemical properties as TSS and acidity. In addition, Kumar *et al.*[36] found that potassium have profound influence on fruit chemical properties through its influence on soluble solids and acidity percent. While, ascorbic acid content was not or slightly affected due to potassium treatments.

Total anthocyanin content: Anthocyanin belong to the widespread class of polyphenol compounds. The total anthocyanin content accumulated in skin of Sultani fig fruits treated with different potassium forms and concentrations showed an increase of total anthocyanin content compared with untreated fruits (control) at both seasons of 2014 and 2015, illustrated in Fig. 11. Meanwhile, the results of the

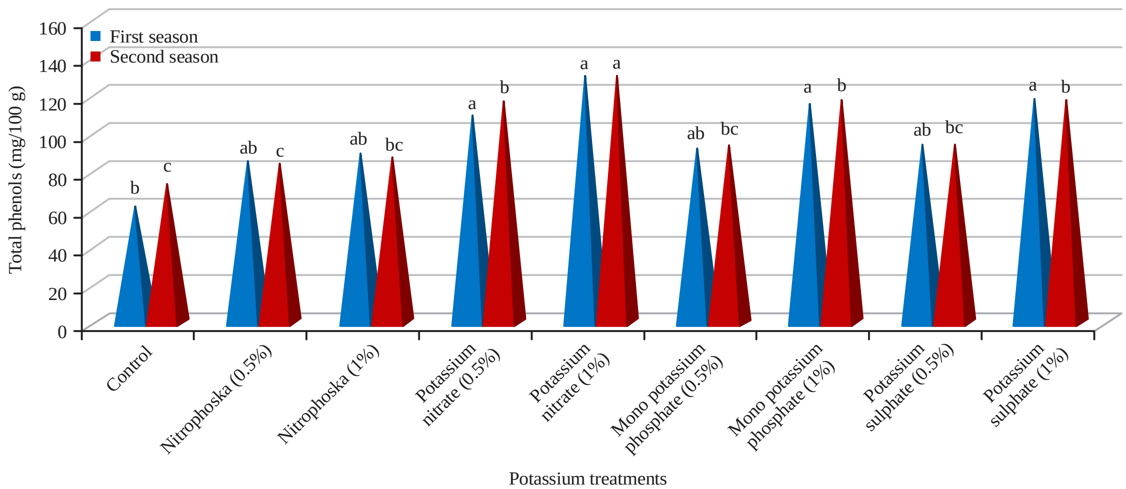

Fig. 12: Effect of different foliar application of potassium forms on total phenols content of Sultani fig fruit during two seasons
Different letters are express for significant differences while the same are non-significant at L.S.D. $p>0.05$

second appeared similar tend with little higher anthocyanin intensity than the first season. Among all treatments, the higher potassium concentrations (1.0%) cleared higher anthocyanin content than the smallest potassium applications (0.5%).

In addition, fig fruits treated with potassium nitrate at 1% had the highest anthocyanin levels (43.60 and 48.98 mg/100 g FW) at both seasons respectively. On the other side, nitrophoska application at 0.5% contain the lowest anthocyanin content (40.41 and 37.83 mg/100 g FW)) at both seasons, respectively compared of all treated and control fig fruit.

Anthocyanin pigments are responsible for the red purple to blue colors of many fruits, vegetables and grains, it was water-soluble used as natural food colorants and black fig fruits might be a good sources of anthocyanin[2,3,5]. Previous studies[30,31,37], proved that total anthocyanin contents were strongly influenced by fruit skin color of fig genotypes and ranged between (32 and 97 mg/100 g^{-1} FW) fig fruits, the results were within this range. Moreover, Solomon *et al.*[2] and Crisosto *et al.*[3] added that fig varieties with dark skin contain higher levels of anthocyanin and flavonoids accompanied by higher antioxidant activity compared with fig varieties with lighter skin, which accordance with the findings of Sultani fig fruit.

Total phenol content: As shown in Fig. 12, Fig fruits that treated with potassium formulas at different concentrations (0.5-1.0%) showed a progressive significant increase in total phenol content. Applied fruits of potassium nitrate at (1%) was the highest phenols content ranged between (119.48-130.14 mg/100 g FW) compared with control fruits (119.48-130.14 mg/100 g FW) for the two seasons of study, respectively. In general, Sultani fig fruits had a significantly high total phenol content as reflection to increasing potassium concentration (1.0%).

Furthermore, all fig fruits treated with the lowest concentration of potassium forms (0.5%) had a significant increment of phenols content compared with untreated ones. In addition, the higher effect of potassium formula was cleared first for potassium nitrate, followed by potassium sulphate and potassium phosphate and finally nitrophoska application, which had the lowest level of total phenol content in fig fruit.

The overall anthocyanin content is considered a differentiating mark for figs; it belongs to the widespread class of phenolic compounds[35], the fresh and dried figs extant relatively high amounts of polyphenols[37]. The results were further in the same line with[2,5,33,35], they showed higher total phenolic content of fig varieties, which mainly concentrated in the peel with dark cultivars, having the highest phenolic content. The phenolic content and composition of fruits and vegetables depend on the genetic and environmental factors and enhanced by the presence of metals[37,18] which supports the previous findings[2,5,31].

Finally, it found close correlations between total anthocyanin and total phenolic content; they made an important contribution to the total antioxidant capacity (ascorbic acid) in fig fruits, cultivars and genotypes[2,33,34].

Leaf nutrient status: Effect of different applications forms of potassium on some macro nutrients content of fig leaf (*Ficus carica* L. cv. Sultani) during the two successive seasons are given in Table 1 and 2.

Table 1: Effect of different foliar applications of potassium forms on leaf nutrient contents/as a dry weight basis of Sultani fig at the first seasons (2014)

	Leaf nutrient contents				
Treatments	N (%)	P (%)	K (%)	Ca (%)	Mg (%)
Control	1.09[c]	0.214[ab]	0.915[d]	1.81[c]	0.295[f]
Nitrophoska (0.5%)	1.61[abc]	0.167[b]	2.93[ab]	3.56[a]	0.973[a]
Nitrophoska (1%)	1.34[bc]	0.151[b]	2.77[ab]	2.73[b]	0.79[c]
Potassium nitrate (0.5%)	1.68[ab]	0.204[ab]	3.03[a]	2.89[b]	0.706[d]
Potassium nitrate (1%)	1.94[a]	0.240[a]	3.09[a]	2.93[b]	0.423[e]
Mono potassium phosphate (0.5%)	1.49[abc]	0.198[ab]	2.15[bc]	2.81[b]	0.753[cd]
Mono potassium phosphate (1%)	1.49[abc]	0.204[ab]	1.68[cd]	2.91[b]	0.923[ab]
Potassium sulphate (0.5%)	1.54[abc]	0.173[ab]	2.25[abc]	2.77[b]	0.896[b]
Potassium sulphate (1%)	1.70[ab]	0.181[ab]	2.59[ab]	2.87[b]	0.906[b]

*Significant differences at L.S.D. p>0.05, means followed by the same letter(s) are not significantly different

Table 2: Effect of different foliar application of potassium forms on leaf nutrients/as a dry weight basis content of Sultani fig at the second season (2015)

	Leaf nutrient contents				
Treatments	N (%)	P (%)	K (%)	Ca (%)	Mg (%)
Control	1.12[bc]	0.181[ab]	1.00[c]	1.83[c]	0.296[c]
Nitrophoska (0.5%)	1.63[ab]	0.167[ab]	2.52[b]	2.96[a]	0.950[a]
Nitrophoska (1%)	1.32[bc]	0.151[b]	2.50[b]	2.73[bc]	0.790[b]
Potassium nitrate (0.5%)	1.96[a]	0.172[ab]	2.51[b]	2.89[abc]	0.850[ab]
Potassium nitrate (1%)	1.71[ab]	0.159[b]	3.33[a]	2.96[a]	0.820[b]
Mono potassium phosphate (0.5%)	1.51[ab]	0.240[a]	2.51[b]	2.84[abc]	0.890[ab]
Mono potassium phosphate (1%)	1.68[ab]	0.136[b]	3.50[a]	2.90[ab]	0.810[b]
Potassium sulphate (0.5%)	1.59[ab]	0.121[b]	2.33[b]	2.73[c]	0906[ab]
Potassium sulphate (1%)	1.68[ab]	0.184[ab]	3.20[a]	2.83[abc]	0.893[ab]

*Significant differences at L.S.D. p>0.05, means followed by the same letter(s) are not significantly different

The obtained data revealed that leaf N content resulting from the supplemental foliar application and affected significantly during the two seasons compared with control since; the control gave the lowest value (1.09 and 1.12%), while potassium nitrate 0.5% recorded the highest value (1.94 and 1.96%) in this respect. As for phosphorus, there was no significant difference was detected between different treatments concerning leaf phosphorus content in the first season.

Potassium nitrate 1% treatment gave the highest phosphorus content (0.240%) compared to all other treatments and control. On the other hand, all treatments showed a noticeable differences in the second season. Regarding to leaf potassium content data cleared that, all potassium forms and concentrations were caused significantly differences compared with control. Potassium nitrate treatments (0.5 and 1% concentrations) gave the highest significant content of potassium in the first season, whereas, mono potassium phosphate (0.5, 1%) gave the same trend in the second season.

From the mentioned results, it is clear that, nitrophoska 0.5% treatment was the most effective one compared with the other treatments. Since this treatment gave, the best results of calcium content (3.56%) in the first seasons. Meanwhile, in the second season potassium nitrate treatments (0.5 and 1% concentrations) gave the highest calcium content. On the other side, control treatment gave the lowest value (1.81 and 1.83%) in the first and second seasons, respectively.

Magnesium content increased significantly in all different treatments of potassium. Potassium sulphate 1% treatment gave the highest value (0.973%) in the first season while, potassium sulphate 0.5% treatment recorded the highest content of magnesium (0.950%) in the second season. On the other side, control treatment gave the lowest value (0.295 and 0.296%) in the first and second seasons, respectively.

The aforementioned results were agreed with those obtained by Jahangiri *et al.*[30] and Duenas *et al.*[31] on Balady mandarin, since spraying potassium from several forms i.e., KH_2PO_4 or KNO_3 raised N, P and K levels in the leaves. In the same trend several authors stated that, potassium has an important role to regulate losses water in plants through stomata and water uptake by roots including nutrients from soil[38-40] with a strong impact leaf nutrient content. Potassium related with carbohydrates production and involved with several enzymes activation. This may be an interpretation for the positive effect of potassium treatments on level of nutrients in fig leaves. These results may be supported by findings of Arquero *et al.*[38], Sarrwy *et al.*[39] and Hussein[40], who reported that calcium concentration in the fig leaf varied 0.68-2.98% from April to November. The Mg, K, P and N elements increase along with the translocation of photosynthesis.

CONCLUSION

From the results, it could be concluded that, all potassium forms had a positive effect on fruit physical and properties as well as leaves nutrients content as compared with control of fig cv. Sultani. It could be concluded that, potassium nitrate at 1% and nitrophoska at 0.5 and 1% were the best treatments to increase leaf area and its nutrients content. Moreover, they also improve fruit quality as well as physical and chemical properties.

SIGNIFICANCE STATEMENTS

This study discovers the response of using some different potassium forms and concentrations that can be beneficial for Fig leaf and fruit quality characteristics. This study will help the researcher to uncover the critical area of apply these treatments for similar locations and fruits that many researchers were not able to explore. Thus, a new application on these macronutrients and possibly as potassium forms, Thus, the application of these macronutrients, particularly the different potassium forms, can be of benefit to both researchers and fruit producers.

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