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EFFECT OF DIFFERENT DOSES OF POTASSIUM ON THE YIELD AND FRUIT QUALITY OF 'ALBION' STRAWBERRY CULTIVAR

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Abstract

This study was carried out to determine effect of the potassium fertilizer rate on yield and fruit quality of day-neutral strawberry cultivar 'Albion' during 2013-2015 years. Frigo seedlings of Albion cultivar were planted in June 2013. In the experiment, 0-5-10-15 kg/da K_2O fertilizer was applied and identified as K-0, K-5, K-10 and K-15. Fruit weight, fruit length, fruit width, yield per plant, total soluble solid (TSS), titratable acidity (TA), pH, total phenolic and anthocyanin were determined. Applications exhibited a range of 10.95-27.94g for fruit weight, 24.95-37.91mm for fruit width, 34.44-52.18mm fruit length, 3.87-4.26 for pH, 7.00-8.10% for total soluble solids and 0.97-1.20% for titratable acid. Total phenolic content was observed in 650.28-900.02mg (Gallic acid equivalents (GAE)/100g) and anthocyanin content was observed 155.06-204.18mg/100g. We can recommend the K-10 and K-15 applications according to obtained data in our research for producers.

Key words: *Strawberry, albion, K_2O, phenolic, anthocyanin*

INTRODUCTION

Although commercial strawberry (*Fragaria x ananassa* Duch.) cultivation started towards the end of 1970 in Turkey, it is currently one of the biggest strawberry producers in the world with 372.498 tons production annually (FAO, 2015). Strawberry cultivation is generally carried out in open field or walk-in plastic tunnels to provide earliness in Turkey. There is a big demand for greenhouse strawberry production, during the recent years to extend the harvest period. The cultivation of strawberries in greenhouses in Turkey was also increasingly expanded in the Mediterranean Region during the last few decades. (Ercişli et al., 2005). The quality characteristics of strawberry fruit is concerned with: sugar rate, acidity, durability, brittleness, verjuice, aroma, allure and nutritive value (Kader, 1991; Salame-Donoso et. al., 2010).

Albion is a day neutral strawberry cultivar. Day neutral strawberry varieties show better performance in areas with highland climate. Because the day-neutral strawberry varieties are not affected by the length of day and consistently produces fruit. Therefore, they are recommended for areas with highland climate.

A study published in 2001 showed that strawberries actually contain in three basic flowering structures: short-day, long-day, and day-neutral. These refer to the day-length sensitivity of the plant and the type of photoperiod that cause flower formation. Day-neutral cultivars produce flowers regardless of the photoperiod (Hokanson and Maas., 2001).

The objective of this study was to determine the effect of different doses of potassium on the yield and fruit quality in 'Albion' strawberry variety.

MATERIALS AND METHODS

This study was carried out in the Corum region during 2013-2015. Albion strawberry seedlings were planted on black mulch for the commercial plantation, in June 2013. The soil properties of experimental area are presented in Table 1. Potassium applications were made as 0-5-10-15 kg on decares (K-0, K-5, K-10 and K-15). Pomological and chemical characteristics that is fruit weight, fruit length, fruit width, yield per plant, total soluble solid content (TSS), titrable acidity (TA) and pH, total phenolic (mg/100g) and anthocyanin (mg/100g) were investigated.

Table 1. Physical and chemical characteristics of the soil before cropping of strawberry.

Soil Properties	Analysis Results
Sand (%)	67
Silt (%)	19
Clay (%)	14
Salinity (mmhos/cm)	140.80
pH (1:2,5)	7.95
Calx (%)	34.23
Organic Matter (%)	2.28
Azote (ppm)	1141.96
Phosphor (ppm)	8.97
Potassium (ppm)	128.40
Calcium (ppm)	4078.60
Magnesium (ppm)	60.94
Iron (ppm)	2.74
Cupper (ppm)	0.45
Manganese (ppm)	4.75
Zinc (ppm)	0.47

The fruit characteristics of the strawberries were determined and cluster samples were randomly selected in 40 units of fruits. The weight and yield of per plant were determined using a 0.01g-sensitive weighing. The measurements of both the length and width (diameter) of fruits were made using a 0.01 mm-sensitive digital compass.

Total soluble solids contents (TSS): Samples of the examined cultivars were pooled to obtain a composite sample and analyzed for SSC using a digital refractometer. (Atago Model PR-1, Tokyo).

pH measurements were performed using a Hanna HI 98103 pH meter at 20 °C.

Titrable acidity (TA) was determined with potentiometrically using 0.1M NaOH to the end point of pH 8.1 and expressed as grams of citric acid per litre. (AOAC, 1984).

Determination of total phenolic content: Total phenolics content of strawberry were determined by using the Folin-Ciocalteu phenol reagent method. (Singleton and Rossi, 1965). Absorbance was measured on a spectrophotometer (MRX Dynex Technologies, USA) at 765 nm. The total phenolic contents were expressed as mg of Gallic acid equivalents (GAE)/l of extract.

Anthocyanins: Total anthocyanin content was measured with the pH differential absorbance method, as described by Cheng and Breen (1991). Briefly, absorbance of the extract was measured at 510 and 700 nm in buffers at pH 1.0 (hydrochloric acid–potassium chloride, 0.2 M) and 4.5 (acetate acid–sodium acetate, 1 M). Anthocyanin contents were calculated using a molar extinction coefficient of 29,600 (cyanidin-3-glucoside).

$A = (A\ \lambda 510 - A\ \lambda 700)\ pH\ 1.0 - (A\ \lambda 510 - A\ \lambda 700)\ pH\ 4.5$

Results were expressed as mg cyanidin-3-glucoside equivalents $100g^{-1}$ fw.

RESULTS AND DISCUSSION

In this research, fruit weight, fruit length, fruit width, yield per plant, total soluble solid content (TSS), titratable acidity (TA) and pH were determined in 2014 to 2015 growing seasons. Some pomological and chemical properties of Albion cultivar are presented in Table 2. The Fruit weight was found to vary from 10.95 to 27.94g according to the applications. K-10 application was the highest at 27.94g. K-15 application was followed by 26.71 g. Both of these applications were included in the same group. There was not significantly different between K-10 and K-15 applications. But there were observed significant differences between this group and other applications (K-5 and K-0) ($P<0.05$). The highest fruit length was obtained from K-15 application (52.18 mm). Other applications were followed by 40.48 mm, 38.11 mm and 34.44 mm (K-0, K-10 and K-5 respectively). Both of these three applications were included in the same group and there were significant differences ($P<0.05$) between this group and K-15 application (Table 2). Applications K-10 and K-15 were obtained (37.91 and 34.05 mm respectively) higher value of fruit width from others. There were not significant differences between these applications. The lowest value of fruit width was obtained from K-5 application (21.83 mm), but difference was not statistically significant between K-5 and K-0 application (Table 2).

The weight of albion fruits were reported by Hughes et. al. (2010) as 15.7 to 16.4 g. Our results were much higher than those values. These are considered to be caused by potassium treatments. The same researchers (Huges et. al., 2010) and Ballington et al., (2008) were declare the yield value as 2.1 to 2.4 kg/m and 309-775 g/plant respectively. Our findings were lower than those reported in the literature.

In our research, the highest value in terms of yield per plant was obtained from K-15 appli-

cation (285.20g) taken from the lowest yield K-0 applications (146.09g). However, differences between treatments were not statistically significant (Table 2). The highest SSC value was obtained from K-5 application (8.10%). The others applications followed by 7.90, 7.60 and 7.0 (K-0, K-10 and K-15 application respectively). Differences between K-15 (lowest SSC value) and other treatments were statistically significant (Table 2) ($P<0.05$).

SSC values were reported by Ruan et al., (2013) and Ornelas-Paz et al., (2013) as 8.35% and 6.6 to 9.0% respectively. Along with partially coincide, the values obtained in this research were lower than reported values in the literature generally. The reason for this the fruits used in this study were very large and they contain large amounts of water.

The highest value in terms of titratable acid was obtained from K-5 application (1.20%). This treatment was followed by the K-15 and K-0 applications. The differences between these three treatments were not statistically significant. The differences between K-10 (having the lowest value) applications and other treatments were statistically significant ($P<0.05$). Titratable acidity values were reported by Akhato and Recameles, (2013) and Ornelas-Paz et al., (2013) as 0.50 to 0.84% and 0.70 to 1.2% respectively in strawberries. Our findings were upper than these values.

When our findings were observed with respect to pH, the highest value was determined in K-15 treatment. This was followed by application of K-5 and K-10 respectively.

Differences between other applications and K-0 treatment (the last rank) were statistically significant ($P<0.05$). The determined pH values were reported by Akhatou and Recamales, (2013) and Ornelas-Paz, et al., (2013) as 3.51 to 3.82 and 3.39-3.80 respectively. The data determined in our study were higher than those reported in the literature.

Table 2. Effect of application on fruit weight, fruit length, fruit width, yield per plant, soluble solid content (TSS), titratable acidity (TA) and pH.

	Fruit Weight (g)	Fruit Length (mm)	Fruit Width (mm)	Yield Per Plant (g)	TSS (%)	Titratable Acidity (%)	pH
K-0	10,95±0,64* c	40,48±2,25* b	24,95±0,91* b	146,09±7,32	7,90±0,10* a	1,08±0,02** ab	3,87±0,13** b
K-5	17,26±1,79 b	34,44±0,57 b	21,83±0,34 b	181,20±11,90	8,10±0,15 a	1,20±0,07 a	4,06±0,04 ab
K-10	27,94±1,58 a	38,11±2,29 b	37,91±2,51 a	215,70±54,10	7,60±0,12 a	0,97±0,04 b	4,02±0,04 ab
K-15	26,71±1,05 a	52,18±0,65 a	34,05±0,21 a	285,20±46,00	7,00±0,06 b	1,16±0,01 ab	4,26±0,03 a

In this research, total amount of phenolic were determined as 650.28-900.02 mg/100g in Albion fruits (Table 3 and Figure 1).

The differences between applications were statistically insignificant in terms of total phenolic and anthocyanin amount (Table 3, Figure 1 and Figure 2) ($P<0.05$).

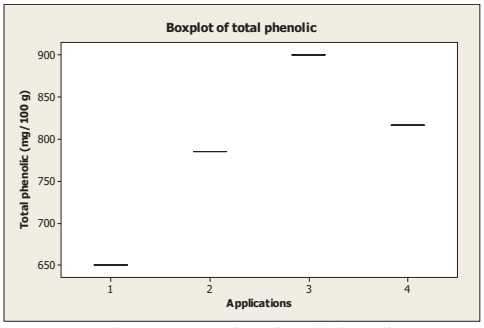

Figure 1. Boxplot of total phenolic

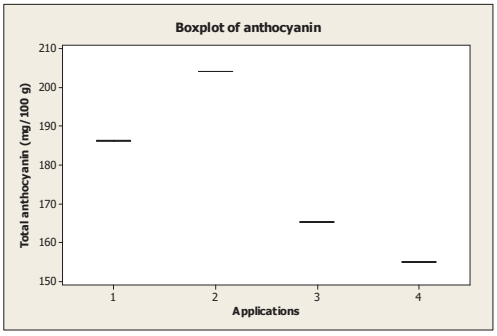

Figure 2. Boxplot of total anthocyanin

The highest phenolic contents were obtained from K-5 application. Application K-15 took place at the last in ranking.

The total amount of phenolic and anthocyanin were reported by Diamante. et al. (2012) as

1576-2466 mg gallic acid /kg FW and 385-470 mg Pel-3-GL/kg FW respectively.
The total amount of phenolic was reported by Capocasa et al., (2008) as 1.8-3.2mg GAE/g in strawberry. Medina, 2011 is reported the total phenolic content as 282 mg GAE/100g in organically grown strawberries.

Table 3. Total phenolic and anthocyanin contents

Application	Total Phenolic (mg/100 g)		Anthocyanin (mg/100 g)	
	Mean	Ave Rank	Mean	Ave Rank
K-0	650.28±0.01 d	2.0	186.27±0.01 b	8.0
K-5	785.37±0.01 c	5.0	204.18±0.00 a	11.0
K-10	900.02±0.01 a	11.0	165.34±0.01 c	5.0
K-15	816.87±0.01 b	8.0	155.06±0.00 d	2.0

The total amount of phenolic and anthocyanin were reported by Ornelas-Sun 2013 as 195.6-325.0 mg GAE/100g and 0.9-56.4 mg/100 g respectively.
Our findings were higher than the value reported in the literature in terms of both the total amount of phenolic and anthocyanins.

CONCLUSIONS

We can recommend the K-10 and K-15 applications according to the obtained data in our research for producers. Because, these applications showed higher values than control applications and K-5 application in terms of both yield and some quality characteristics and the total phenolic.

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