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Improving Pomegranate Fruit Quality by Using Some Practices

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THIS investigation was carried out during two successive seasons of 2013 and 2014 in a private farm located at the 64 Km on the Cairo-Alexandria Desert Road. Pomegranate trees (Wonderful cultivar) were selected to study the effect of two covering materials (white shaded net for trees and white agril bags for fruits) and potassium fertilization (K_2SO_4) on reducing pomegranate fruit disorders and improving fruit quality. The covering treatments started (after 21 days of fruit set till the 1st week of October) and K_2SO_4 as soil application at three rates (1.0, 0.75 and 0.50 kg /tree) divided monthly on batches (from March to September). The obtained results showed that, covering trees with white shaded net and supplemented with the application of 0.75 kg/tree K_2SO_4, increased fruit length (cm), fruit diameter (cm), fruit weight (g) and fruit volume $(cm)^3$. While, the rate of 1.0 kg/tree increased T.S.S %, T.S.S. acidity and vitamin C. The open field trees that fertilized with 1.0 kg of K_2SO_4 increased yield/tree (kg) and fruit edible part (%). There were convergence between the two rates of K_2SO_4 (1.0 & 0.75 kg/tree) in total sugars percentage and total anthocyanin content in fruit juice. The highest marketable fruits (%) and the lowest cracked fruits (%), sunburned fruits (%) per tree and fruit juice acidity (%) associated with covered trees with shaded net and fruits with agril bags and have been supplied with 1.0&0.75 kg/tree of K_2SO_4. Moreover, leaves N, P, and K contents increased by increasing the rates of K_2SO_4 fertilization, the maximum records were obtained with the open field treatments.

Generally, it can be recommended under the same conditions of this study that, covering pomegranate trees by white shaded net with the addition of K_2SO_4 at 0.75 kg/tree can be used in reducing fruit disorders and improving fruit quality, that led to increase the total income per fed, this in turn increased the net profit /fed. Increasing the benefit is nowadays used in the main areas of fruit production in Egypt.

Keywords: Pomegranate, Fruit Quality, Wonderful.

Growing of pomegranate (*Punica grantum* L.) is known in ancient period. It is estimated that pomegranate cultivation may have started somewhere during Neolithic age (Holland and Boryakov, 2008). Egypt was one of the early recipients of pomegranate in ancient world, the tree was formed in the tomb of king tut. The orient Egyptian considered the tree a symbol of life giving forces of fertility, even of immortality and uses the fruits in traditional medicine for

prevention of illness and healing, and it was mentioned in Holy Quran (Lonsky & Newman, 2007). Recently, it has been discovered the tremendous health benefits of fruits. It contains, potentiality active photo-chemicals incline sterols and steroids in seed (Ibrahim, 2010 and Walled *et al*., 2011). It is also rich in organic acids and anthocyanins in juice (Shanshan *et al*., 2009 and Hamidreza *et al*., 2008). So many industrials are based on its fruits and in drug manufacturing.

Pomegranate is mainly grown in tropical and sub-tropical regions of the world and favor for semi-arid climates (El-Falleh *et al*., 2009 and Ahmet *et al*., 2009). At recent days, there are an increasing in the cultivation of pomegranate, especially Wonderful variety that grown extensively in Egypt in the newly reclaimed areas. Although the environmental conditions of Egypt is suitable for pomegranate production, but export considered limited compared with other countries, due to low of quality that resulting from corruption physiological fruits such as cracked fruit, sun burns, lake of internal coloring and some fungal and pest infestation. Using potassium fertilization is considered one of the important practices during the growing season of pomegranate trees for improving fruit quality (Al-Obeed, 2001 and Abd-Allah & Magda, 2009). It plays an important role for formation of total soluble solids, total sugars, starch (Dutta *et al*., 2011), and also help to adjust water balance that reduce the fruit cracking that effects on the fresh market and are used for processing only as fruit juice (Abd El-Rhman, 2010). As a result of increasing the temperature in Egypt the fruit directly subjected to high sunlight that lead to burn fruit surface and change colour, this results in big economic losses (Schrader *et al*., 2002 and Sharma *et al*., 2006). Modification of the micro-climate by use of covering material as white shade net and bagging improving the quality of fruits, protect fruits from diseases, pets and reduce the infection of sunburn that led to decrease that fruit disorders at harvest (Wang *et al*., 2003, Wei *et al*., 2005, Wei *et al*., 2011 and Hudina *et al*., 2012).

The aim of this investigation was to study the effect of using potassium fertilization as (K_2SO_4) and two covering materials (white shaded net & agril white bags) on productivity and fruit quality of pomegranate (Wonderful cultivar).

Materials and Methods

This study was carried out during two successive seasons (2013 and 2014) at a private orchard located at Alexandria Desert Road (about 68 kilometers distance-Cairo). The aim of this experiment was to test the influence of potassium fertilization as (K_2SO_4), covering materials with white shaded net and agril white bags on productivity, fruit quality characteristics and leaf chemical c constituents of Wonderful pomegranate trees. The selected trees were grown in sandy soil under drip irrigation system at the same age 4 years old, planted at 3 x 4 meters-apart and subjected to the same agriculture practices.

Samples of the soil were analyzed at the beginning of the experiment as shown in Tables 1 and 2.

TABLE 1. Physical properties of the soil at the experiment site.

Parameters	Soil depth (0-30cm)
Sand (%)	84.5
Silt (%)	8.50
Clay (%)	7.00
Texture class	Sand loamy
Bulk density (gm^{-3})	0.49
Real density (gm^{-3})	2.51
Total porosity (%)	40.6
Field capacity (FC)	20.90
Wilting point (WP)	9.55
Available water (AW)	11.4
Water Holding capacity (WHC)	29.4

TABLE 2. Chemical properties of the soil at the experiment site.

Parameters	Soil depth (0-30cm)
OM (%)	0.98
pH (1:2.5)	7.63
EC (dSm^{-1})	3.10
Soluble cations, ($meq.L^{-1}$)	-
Ca^{++}	9.00
Mg^{++}	8.00
Na^{++}	12.9
K+	1.10
Soluble anions, ($meq.L^{-1}$)	-
Co_3^{--}	0.00
Hco_3^{--}	10.5
Cl^-	18.00
So_4^{--}	2.50
SAR	4.42
ESP (%)	4.99

The experimental trees were subjected to the following treatments:

- Control (adopted fertilization program in the farm).
- Potassium soil fertilization as (K_2SO_4) at the rate of 1.0 kg/tree.
- Potassium soil fertilization as (K_2SO_4) at the rate of 0.75 kg/tree.
- Potassium soil fertilization as (K_2SO_4) at the rate of 0.50 kg/tree.
- White shaded net.
- White shaded net with (K_2SO_4 at 1.0 kg/tree).
- White shaded net with (K_2SO_4 at 0.75 kg/tree).

- White shaded net with (K_2SO_4 at 0.50 kg/tree).
- Agril white bags.
- Agril white bags with (K_2SO_4 at 1.0 kg/tree).
- Agril white bags with (K_2SO_4 at 0.75 kg/tree).
- Agril white bags with (K_2SO_4 at 0.50 kg/tree).

The untreated (control) trees and treatments (5&9) received the recommended fertilization program as advised by the Ministry of Agriculture and Land Reclamation (2014). With respect to potassium sulphate (K_2SO_4) treatments, were divided on monthly batches, during the period from March to September in both seasons.

White shaded net was used at the area of 4200 m^2 (70 length x 60 width), the diameter was 0.28 mm. and the cell size was 3 x 7.4 m. Trees were covered after 21 days of fruit set till first week of October.

Agril white bags was sized at (25 x30 cm) used to cover 30 fruits/tree after 21 days of fruit set till the first week of October.

The experiment was designed in a completely randomized block design with 12 treatments, each treatment was represented by three replicates
(2 trees/ for each replicate) in both studied seasons.

The following parameters were measured to evaluate the tested treatments:

Fruiting and yield

At harvest time, total fruit number /tree and average fruit weight (g) were recorded and average total yield/tree were calculated as kg/tree. No. of cracked & sunburned fruits/tree and their percentages of No. of total fruits/tree were calculated. Marketable fruits/tree (%) was also calculated.

Fruit quality characteristics

Sample of fruits (n=15) of each treatment was randomly selected for determining the following physical and chemical properties:

Fruit physical properties

Fruit length & diameter (cm), and volume $(cm)^3$ were measured. Then, selected fruits were peeled by hand, then separately their rind and capillary membranes (non-edible part) and weighted, thus calculating the aril (edible part) weight/fruit by the difference between total fruit weight and non-edible part weight. Then, edible & non- edible parts weight /fruit (%) was calculated.

Fruit juice chemical composition

- Total soluble solids percentage (T.S.S. %) was determined by using hand refractometer.
- Total acidity (%) was determined according to A.O.A.C. (1995).

- Total sugars (%) were determined according to the methods described by (Dubois *et al*., 1956).
- Vitamin (C) as (mg) Ascorbic acid /100 ml. juice was determined according to A.O.A.C. (1995).
- Total anthocyanin (mg/100ml) content was determined according to Ranganna (1979).

Leaf mineral composition

Samples were taken from the middle leaves of terminal sprouted shoots and dried at 70 c till constant weight and grounded to determine the following nutrient elements:

- Nitrogen: was determined by the modified Micro-kjeldahl method as outlined by (Pregl, 1945).
- Phosphorus and potassium: was estimated by flame-photometer according
- to Murphy and Riely (1962).

Economical evaluation

An economic evaluation was calculated according to national market prices of all the production inputs and outputs as follows:

- Price of net (2) L.E/m x area of feddan = 8400 L.E.
- Price of materials used in the instillation of net = 8000 L.E.
  The total cost = 8400+ 8000=16400 L.E.
- Price of agril bags/fed according to the market price = 2500 L.E.
- Price of potassium sulphate calculated as number of trees/fed. (350) X price of 1 kg of K_2SO_4 (6 L.E).
- Operation costs (labor and fruits worm control) were calculated.
  Total cost = sum of all costs.
- Value of kg fruit (according to fruit quality).
  Total income L.E/ fed. (Ton /fed x price /Ton).
- Net profit (L.E) was calculated (total income- total cost).

* Economic evaluation was calculated according to Heady and Dillon (1961).

Statistical analysis

All the obtained data during the two seasons of study were subjected to analysis of variances (ANOVA) according to Snedecor and Cochran (1980). Meanwhile, differences between means were compared using Duncan's Multiple Range Test as described in SAS (1994).

Results and Discussion

Fruiting, yield and fruit physical characteristics

Data in Tables 3 & 4 demonstrated that, the maximum records of the most important Wonderful pomegranate fruit quality parameters were obtained by the fruits in which were covered with white shaded net and fertilized by potassium sulfate (K_2SO_4) at the rate of 0.75 kg/tree, which in turn increased fruit length,

diameter, weight and volume. While the highest records of fruits/tree yield and fruit edible part (%) associated with the trees in the open field that fertilized with 1.0 kg/tree of (K_2SO_4). Comparing with other treatments, the highest trees that fertilized with 1.0 kg of (K_2SO_4) and the highest fruit non-edible part (%) was in the white agril bags treatments that fertilized with 0.50 kg of K_2SO_4. Untreated fruits (control) were the lowest values in both studied seasons. Covering trees with net tend to lower the maximum temperature, this modification of microclimate by using white shaded net possibility increasing tree ability to uptake water and nutrients which ultimately accelerated the yield and fruit quality. (Saleh, 2005, Rajana *et al*., 2006 and Medany *et al*., 2009). Also the average relative humidity increased by 26 %. The increase in humidity associated with the decrease in the evaporation that led to promoted fruit development and increase fruit size (Lin & Hsu 2004 and Iglesias & Alegre, 2006). The positive effect of applying potassium is promoting the uptake of various nutrients through modifying soil pH towards acidity medium, it has pivotal contribution to fruit weight and size that reflected to the yield and fruit quality (Abd El-Wahab *et al*., 2008, Dhillon *et al*., 2009, Manning, 2010 and Safia *et al*., 2011).

TABLE 3. Effect of different cover materials and potassium fertilization on fruit length, diameter and volume of Wonderful pomegranate trees during 2013 & 2014 seasons.

Treatments	Fruit length (cm)		Fruit diameter (cm)		Fruit volume $(cm)^3$	
	2013	2014	2013	2014	2013	2014
Control (open field)	7.75 h	7.97 g	8.60 f	8.85 g	400.0 g	401.5 f
Open field +1.0kg K_2SO_4	8.42 b	8.70 bc	9.26 c	9.63 bc	440.5 b	456.0 a
Open field+0.75 kg K_2SO_4	8.13 e	8.66 c	9.23 e	9.52 d	435.8 c	445.7 b
Open field +0.50 kg K_2SO_4	8.23 d	8.60 b	9.27 e	9.33 e	423.5 e	434.9 c
White shaded net	7.73 g	8.27 e	8.70 e	9.11 f	417.4 f	423.2 d
Shaded net +1.0 kg K_2SO_4	8.35 c	8.76 b	9.41 ab	9.70 ab	435.4 c	446.3 b
Shaded net +0.75 kg k2so4	8.81 a	8.93 a	9.74 a	9.77 a	445.3 a	457.1 a
Shaded net +0.50 kg k2so4	8.15 e	8.73 b	9.33 bc	9.50 d	422.6 e	435.0 c
White Agril bags	7.83 f	8.13 f	8.66 ef	8.77 g	394.6 h	406.6 e
Agril bags+1.0 kg k2so4	8.10 e	8.23 e	9.30 e	9.55 cd	437.7 c	446.1 b
Agril bags +0.75 kg k2so4	7.83 f	8.27 e	9.27 e	9.53 d	429.3 d	435.5 c
Agril bags+0.50 kg k2so4	7.75 g	8.10 f	9.10 d	9.29 e	418.0 f	424.6 d

Values have the same letter are not significantly different at 5% level using Duncan's Multiple Range Test.

TABLE 4. Effect of different cover materials and potassium fertilization on No. of fruits/tree, fruit weight and yield of Wonderful pomegranate trees during 2013 & 2014 seasons.

Treatments	No. of fruits| tree		Fruit weight (g)		Yield (kg)	
	2013	2014	2013	2014	2013	2014
Control (open field)	56.05 g	56.23 fg	369.3 j	375.6 k	20.70 k	21.12 i
Open field +1.0kg K_2SO_4	80.38 a	81.40 a	400.0 f	440.8 c	32.15 a	35.88 a
Open field+0.75 kg K_2SO_4	72.84 b	74.81 a-c	427.5 c	451.9 b	31.14 b	33.81 c
Open field +0.50 kg K_2SO_4	61.29 f	62.86 e-g	411.8 e	430.0 e	25.24 g	27.03 g
White shaded net	56.20 g	54.42 g	373.5 j	379.8 j	20.99 j	20.67 j
Shaded net +1.0 kg K_2SO_4	67.24 d	79.51 ab	431.0 b	437.0 d	28.89 d	34.76 b
Shaded net +0.75 kg k2so4	67.74 d	72.60 b-d	439.3 a	459.2 a	29.76 c	33.34 d
Shaded net +0.50 kg k2so4	55. 79 g	62.74 e-g	420.0 d	427.3 f	23.43 i	26.81 g
White Agril bags	56.92 g	54.89 g	371.0 k	372.0 l	21.12 j	20.42 k
Agril bags+1.0 kg k2so4	70.58 c	77.24 a-c	380.3 h	397.2 h	26.84 f	30.68 e
Agril bags +0.75 kg k2so4	70.50 c	69.28 c-e	388.1 g	415.3 g	27.36 e	28.77 f
Agril bags+0.50 kg k2so4	63.94 e	64.69 d-f	377.7 i	394.0 i	24.15 h	25.25 h

Values have the same letter are not significantly different at 5% level using Duncan's Multiple Range Test.

TABLE 4. Cont.

Treatments	Fruit (edible part) (%)		Fruit (non-edible part) (%)	
	2013	2014	2013	2014
Control (un-fertilized)	57.11 c	58.67 ab	41.50 h	41.50 f
Open field +1.0 kg K_2SO_4	61.23 a	60.38 a	39.75 i	39.75 g
Open field+0.75 K_2SO_4	59.25 b	59.00 ab	41.00 gh	41.53 f
Open field+0.50 K_2SO_4	51.00 f	55.41 cd	49.17 c	44.63 d
White shaded net	46.71 g	54.50 d	40.55 h	45.75 d
Shaded net+1.0 kg K_2SO_4	55.00 d	55.28 cd	44.83 ef	44.75 e
Shaded net+0.75 kg k2so4	54.67 de	57.19 bc	45.00 e	42.80 f
Shaded net+0.50kg K_2SO_4	53.65 e	56.33 c	46.30 d	43.75 e
White Agril bags	43.00 h	54.72 d	42.11 g	45.28 c
Agril bags+1.0kg K_2SO_4	53.51 e	48.11 e	46.50 d	51.93 b
Agril bags +0.75kg K_2SO_4	45.33 g	47.34 e	54.70 b	52.75 b
Agril bags +0.50kg K_2SO_4	44.31 gh	45.62 f	55.66 a	54.44 a

Values have the same letter are not significantly different at 5% level using Duncan's Multiple Range Test.

It can be noticed from Table 5 that, the differences among treatments were highly significantly as for the effect of treatments in both studied seasons .In this respect ,the lowest fruit cracking (especially 1st season) as well as sun-burn fruits (%) in both seasons was observed when the trees were covered with shaded net and supplemented with K_2SO_4 at both rates (1.0 & 0.75 kg) as they recorded (1.55 & 1.47 %) for the fruit cracking (in the-1st season) when compared with the control (5.11 & 4.75 %) in both seasons ,while the records were(1.18, 1.15 & 1.15, 1.02) for sun-burns fruits (%) in both seasons respectively , while the control trees recorded (21.30 & 23 %) in both seasons .Conversely ,the same previously of two materials treatments recorded the maximum no. of marketable fruits as they recorded (97.20, 98.40 & 96.40, 99.0%) when compared with the control ones (65.40 & 68.20%) respectively, in both seasons of study.

TABLE 5. Effect of different cover materials and potassium fertilization on fruit cracking, sun-burn and marketable fruits of Wonderful pomegranate trees during 2013 & 2014 seasons.

Treatments	Fruit cracking (%)		Sun-burn fruits (%)		Marketable fruits (%)	
	2013	2014	2013	2014	2013	2014
Control (un-fertilized)	5.11 a	4.75 a	21.30 a	23.1 a	65.40 h	68.20 e
Open field +1kg K_2SO_4	2.53 cd	2.43 e	6.89 d	5.93 e	79.10 f	77.00 d
Open field+0.75 K_2SO_4	2.76 bc	2.51 c	11.86 e	9.63 b	77.20 g	78.40 d
Open field+0.50 K_2SO_4	3.11 b	2.89 b	14.03 b	9.83 b	79.00 f	78.50 d
White shaded net	2.98 b	2.50 e	3.03 e	2.64 d	90.70 e	95.10 c
Shaded net+1.0 kg K_2SO_4	1.55 e	1.35 f	1.18 h	1.15 fg	97.20 a	98.40 a
Shaded net+0.75 kg k2so4	1.47 e	1.40 f	1.15 h	1.02 g	96.40 ab	99.00 a
Shaded net+0.50kg K_2SO_4	2.25 d	1.93 e	2.16 e-g	1.75 ef	95.30 b c	95.10 c
White agril bags	3.00 b	2.84 b	2.84 ef	2.11 de	93.20 d	96.10 bc
Agril bags+1kg K_2SO_4	1.83 e	1.75 e	1.81 gh	2.00 de	96.00 ab	97.40 a
Agril bags +0.75kg K_2SO_4	2.39 d	2.25 d	1.91 gh	1.83 d-f	97.40 a	97.20 ab
Agril bags +0.50kg K_2SO_4	2.45 cd	2.34 d	2.06 f-h	1.73 ef	94.00 cd	95.30 bc

*Values have the same letter are not significantly different at 5% level using Duncan's Multiple Range Test.

These findings are in agreement with Glenn & Puterka (2007) and Simin *et al*., (2014). They showed that reducing cracking due to the effects of shaded net on radiation, humidity evapotranspiration, temperature and moisture stress of the soil which effects on pulp grows ultimately the pell cracks and rind pliability.

Meanwhile, decreasing fruit cracking by covering fruits with agril bags due to the effect of bagging on heat stress of fruits and water content of rind which decrease the transpiration from the fruit surface. Sun- burn may attributed to the weather, particularly prevalence of high temperature, light and radiation that leads to burn fruit surface and changes colour, thus results economic losses (Morteza *et al*., 2014).

Covering trees with shaded net and fruits with agril bags protect the fruit from exposure to the direct sunlight, these results are in full agreement with Glenn *et al*. (2002), Yuan *et al*. (2010) and Abo El-Wafa (2014). Moreover, Singh *et al*., (2006), Radha *et al*., (2007), Kaiser (2009), and Safia *et al*. (2011) showed that, using different sources of potassium fertilization reduced fruit cracking, sun burn and increased marketable fruits. Pomegranate damage due to the sunburn is discoloration or burring of fruit surface exposed to the direct sun and drying occurs in fruit led to less in marketing and economic losses. So, marketable percentage increase as a result of decreasing fruit disorders (Xiang *et al*., 2011, Samara & Shalan, 2013 and Hegazi *et al*., 2014).

Fruit juice chemical composition

Data in Tables 6 & 7 observed that, fruit juice chemical composition was positively significantly affected by treatments. The results of statically analysis of T.S.S (Table, 7) showed that, in the first season of study ,the highest T.S.S% content in fruit juice was recorded in the pomegranate trees (Wonderful cv.) in the open field trees and that covered with white shaded net which received 1.0 kg of K_2SO_4/tree, as they recorded(15.97 & 17.77 %) respectively, while in the second one, covered trees by white shaded net with the addition 1.0 kg of K_2SO_4/tree gave the highest values (17.20%) comparing with other treatments .

There were a convergence among the treatments that fertilized with two doses of K_2SO_4 (1.0 & 0.75 kg/tree) in the fruit juice total sugars (%) as compared with other treatments. In this respect, the trees that shaded with net and received1.0 kg/trees of K_2SO_4 produced the richest of fruit juice content in total sugar, while the control ones were the poorest.

The reason of enhanced sugar content could be the participation of potassium in biosynthesis and transfer of sugar and the increasing of T.S.S tend to increase of sugar content (Bentley & Viveros, 1992, Mustafa *et al*., 2008, Hegazi *et al*., 2014 and Morteza *et al*., 2014).

It's also clear from Table 6 that, with regard to fruit juice acidity %, the data took other way around whereas, the lowest values was found in the treatments that covered with white shaded net & white agril bags and supplemented with two doses of K_2SO_4 (1.0&0.75) kg/tree comparing with other fertilized treatments, while the highest values was in the un- fertilized treatments in both studied seasons.

TABLE 6. Effect of different cover materials and potassium fertilization on Manfalouty fruit juice total soluble solids (%), total sugars (%) and acidity (%) during 2013 & 2014 seasons.

Treatments	T.S.S (%)		Total sugars (%)		Acidity (%)	
	2013	2014	2013	2014	2013	2014
Control (un-fertilized)	12.77 a-c	11.53 g	11.53 e	11.80 e	1.33 a	1.31 a
Open field +1kg K_2SO_4	15.97 a	16.13 b	13.79 ab	13.20 ab	1.10 f	1.13 f
Open field+0.75 K_2SO_4	15.10 b	13.30 de	12.87 b-d	12.80 a-c	1.17 e	1.19 d
Open field+0.50 K_2SO_4	14.17 b	12.93 ef	12.94 b-d	12.77 a-c	1.20 d	1.32 c
White shaded net	13.43 d	12.53 fg	12.07 de	11.80 e	1.29 b	1.32 a
Shaded net+1.0 kg K_2SO_4	15.77 a	17.20 a	13.8 6 a	13.51 a	1.09 g	1.11 g
Shaded net+0.75 kg k2so4	15.30 b	16.23 b	13.54 a-c	13.11 ab	1.10 f	1.14 f
Shaded net+0.50kg K_2SO_4	14.67 bc	13.70 d	12.41 de	12.67 b-d	1.17 e	1.17 e
White agril bags	12.95 e	12.40 fg	11.98 de	12.04 c-e	1.25 c	1.27 b
Agril bags+1kg K_2SO_4	14.85 b	15.33 c	13.42 a-c	13.15 ab	1.11 f	1.10 g
Agril bags +0.75kg K_2SO_4	14.83 b	14.87 cd	12.88 b-d	12.60 b-d	1.07 g	1.11 g
Agril bags +0.50kg K_2SO_4	14.67 bc	13.10 de	12.75 cd	11.95 de	1.15 e	1.19 d

Values have the same letter are not significantly different at 5% level using Duncan's Multiple Range Test.

TSS/acid ratio is known as a primary driver of flavor quality. The highest ratio of TSS/acidity were observed by white shaded net treatment with the addition 1.0 kg of K_2SO_4/tree (14.47 & 15.49), respectively in both seasons and open field treatment (14.51) in the first season, while the lowest ratio was detected in control treatments (9.60 & 8.80) in both seasons, respectively ,and these are in agreement with Dussi *et al*. (2005), Mustafa *et al*. (2008) and Safia *et al*. (2011).

With regard to ascorbic acid (vitamin C) data in the Table 7 also reveal that potassium fertilization at 1.0 kg/tree of K_2SO_4 increased vitamin C concentration in the treatments that covered with shaded net, agril bags and in open field comparing with other treatments. The reason of increased ascorbic acid might be that potassium plays a key role in the proper carbohydrate metabolism and close relationship between carbohydrate metabolism and formation of ascorbic acid has been reported by Su *et al*. (2008) and Lie *et al*. (2011).

Concerning total juice and anthocyanin content, it can be noticed that the highest percentage of anthocyanin was in the treatments that covered with white

shaded net and fertilized with two rates of K_2SO_4 (1.0 & 0.75 kg/tree) as well as open field treatment that fertilized with 1.0 kg of K_2SO_4/tree, followed by agril bags treatments which fertilized with K_2SO_4 at (1.0 & 0.75 kg/tree) comparing with other treatments in both studied seasons. This incensement of anthocyanin may be due to the treatments on the open field and shaded net provide sufficient light for the fruits that important for enhance Anthocyanin content (Liu, 2010), continuing in the interpretation of results Marschner, (1995) reported that, sugar forms part of anthocyanin molecule and any factors affected sugar content could also affect on anthocyanin synthesis ,so potassium appears to enhance anthocyanin accumulation through translocation of complex sugars to fruits.

TABLE 7. Effect of different cover materials and potassium fertilization on total sugars, vitamin C, anthocyanine and tannins of Wonderful pomegranate fruit juice during 2013 & 2014 seasons.

Treatments	TSS /acid ratio		Vitamin C mg ascorbic acid/100mljuice		Total juice Anthocyanin (%)	
	2013	2014	2013	2014	2013	2014
Control (un-fertilized)	9.60 f	8.80 g	23.20 e	24.43 c-e	0.33 d	0.32 e
Open field +1kg K_2SO_4	14.51 a	14.27 b	27.53 a	28.11 a	0.39 a	0.37 a
Open field+0.75 K_2SO_4	12.90 c	11.18 d	25.86 b	25.23 c	0.36 bc	0.35 bc
Open field+0.50 K_2SO_4	11.81 d	10.51 e	24.15 cd	24.30 de	0.35 cd	0.34 cd
White shaded net	10.41 e	9.49 ef	24.50 c	24.93 cd	0.30 e	0.13 ef
Shaded net+1.0 kg K_2SO_4	14.48 a	15.49 a	27.61 a	27.9 a	0.40 a	0.37 a
Shaded net+0.75 kg K_2SO_4	13.91 b	14.23 b	24.28 cd	24.20 d	0.39 a	0.37 a
Shaded net+0.50kg K_2SO_4	12.53 c	11.71 d	24.18 cd	23.9 e	0.38 ab	0.35 bc
White Agril bags	10.36 e	11.27 d	23.50 de	24.16 de	0.30 e	0.30 f
Agril bags+1kg K_2SO_4	13.37 b	13.94 c	26.85 a	27.1 b	0.38 ab	0.36 ab
Agril bags +0.75kg K_2SO_4	13.86 b	13.40 c	24.35 cd	24.52 ce	0.38 ab	0.36 ab
Agril bags +0.50kg K_2SO_4	12.76 c	11.01 d	23.60 c-e	23.8 e	0.36 bc	0.33 de

Values have the same letter are not significantly different at 5% level using Duncan's Multiple Range Test.

Leaf mineral composition

The obtained results from Table 8 indicated that, there were an increment in N, P and K content in pomegranate leaves by increasing the rate of potassium fertilization (K_2SO_4) during both seasons, the highest percentage in N, P and K were observed in the open field treatment compared with the treatments that covered with shaded net and agril bags . The control trees showed the lowest record .These results may be due to the role of potassium in transport of water and nutrients by stimulating specific enzyme and plant growth hormones to the parts of plant (Habib *et al*., 2011 and Hamouda *et al*., 2015).

TABLE 8. Effect of different cover materials and potassium fertilization on Nitrogen, Phosphor and potassium of Wonderful pomegranate leaves during 2013 & 2014 seasons.

Treatments	N (%)		P (%)		K (%)	
	2013	2014	2013	2014	2013	2014
Control (un-fertilized)	0.86 g	0.90 g	0.786 h	0.730 g	0.749 ef	0.780 de
Open field +1kg K_2SO_4	1.50 a	1.60 a	1.140 a	1.070 a	1.148 a	1.159 a
Open field +0.75 kg K_2SO_4	1.37 b	1.36 c	0.943 d	0.940 c	0.824 b-d	0.870 c
Open field+0.50 kg kg K_2SO_4	1.13 d	1.11 e	0.857 f	0.901 e	0.800 de	0.825 c-e
White shaded net	0.88 f	0.93 g	0.790 h	0.855 f	0.728 f	0.770 e
Shaded net +1kg K_2SO_4	1.54 a	1.50 b	1.120 b	0.990 b	0.875 b	0.930 b
Shaded net+0.75 kg K_2SO_4	1.34 b	1.40 c	0.932 d	0. 931 e	0.815 cd	0.840 cd
Shaded net +0.50 kg K_2SO_4	1.20 e	1.00 f	0.904 e	0.904 e	0.770 d-f	0.820 c-e
White Agril bags	0.85 g	0.88 g	0.820 g	0.844 f	0.720 f	0.770 e
Agril bags+1kg K_2SO_4	1.48 ab	1.55 a	0.990 c	0.900 e	0.864 bc	0.834 cd
Agril bags +0.75kg K_2SO_4	1.30 c	1.33 d	0.895 e	0.893 e	0.792 de	0.820 c-e
Agril bags +0.50kg K_2SO_4	0.95 f	1.10 e	0.853 f	0.866 f	0.750 ef	0.800 de

Values have the same letter are not significantly different at 5% level using Duncan's Multiple Range Test.

Economic consideration

The economical comparative study between different treatments that shown in Table 9 were calculated at the average of two studied years, expect the treatments that shaded with net that calculated as the average of 5 years (life period of the net)with considered to deducting the cost of used materials .The cost of instillation of net resulted in annual recurring cost. White shaded net with two rates of fertilization (0.75 &1 kg |tree) were superior in total income |fed which in turn increased the net profit |fed (21405 &20525 L.E), respectively comparing with other treatments. While the control treatments was the least one

(6950 L.E). Finally, using white shaded net with addition 0.75 kg/tree of K_2SO_4 increased the benefit compared to the control which is nowadays used in the main areas of fruit production in Egypt.

TABLE 9. An economic comparative study among studied treatments on Wonderful pomegranate trees.

Treatments	Cost of used materials |fed (LE)	Operation cost	Total cost(LE)	Yield ton/fed	Value of kg/ fed fruit (LE)	Total income / fed. (LE)	Net profit (LE)
Control (un-fertilized)	-	300	*300	7.25	1	7250	6950
Open field +1.0 kg K_2SO_4	2100	550	*2650	11.25	1.5	16875	14225
Open field+0.75 K_2SO_4	1575	550	*2125	10.90	1.5	16350	14225
Open field+0.50 K_2SO_4	1050	550	*1600	8.83	1.5	13245	11645
White shaded net	16400	1050	**4330	7.35	2.5	18375	14045
Shaded net+1.0 kg K_2SO_4	18500	1050	**4750	10.11	2.5	25275	20525
Shaded net+0.75 kg k2so4	17975	1050	**4645	10.42	2.5	26050	21405
Shaded net+0.50kg K_2SO_4	17450	1050	**4540	8.20	2.5	20500	15960
White Agril bags	2500	1050	*3350	7.39	2.5	18475	15125
Agril bags+1.0kg K_2SO_4	4600	1050	*5650	9.39	2.5	23475	17807
Agril bags +0.75kg K_2SO_4	4075	1050	*5125	9.58	2.5	23950	18825
Agril bags +0.50kg K_2SO_4	3550	1050	*4600	8.45	2.5	21125	16525

*Average of total cost after 2 years.
** Average of total cost after 5 years.

Generally, on the basis of presented data, we can conclude that, a convergent has been observed between uses two rates (1.0 & 0.75 k/tree) of potassium sulphate with covering trees by white shaded net for reducing fruit disorders (cracking & sun-burn) and improving physical and chemical properties of fruits. So we can be recommend using white shaded net with 0.75 kg /tree of K_2SO_4 for getting a higher quality of fruits and thus increase the price of marketable that leading to get high profit of Wonderful pomegranate fruits.

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استخدام بعض المعاملات لتحسين جودة ثمار الرمان

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اجريت هذة الدراسة خلال موسمى ٢٠١٣ و٢٠١٤ بمزرعة خاصة كيلو ٦٤ بطريق مصر اسكندرية الصحراوى تم اختيار اشجار الرمان صنف وندرفول واجريت عليها معاملات تغطية الاشجار بالشبك الابيض و تكييس الثمار باكياس الجريل الابيض وذلك بعد ٢١ يوم من بداية العقد حتى الاسبوع الاول من شهر اكتوبر وكذلك استخدام التسميد البوتاسى فى صورة سلفات البوتاسيوم بثلاث معدلات ١ , ٧٥، , ٥٠، كجم | للشجرة تضاف ارضيا على دفعات خلال الفترة من مارس الى سبتمبر وذلك لدراسة تاثير هذة المعاملات على تقليل عيوب ثمار الرمان وتحسين الجودة .

اوضحت النتائج ان: تغطية الاشجار بالشبك الابيض مع استخدام التسميد بسلفات البوتاسيوم بمعدل ٧٥، كجم /للشجرة ادى الى زيادة طول وقطر الثمار وحجم ووزن الثمار اما معدل ١كجم/ للشجرة فقد ادى الى زيادة نسبة المواد الصلبة الكلية وفيتامين فى العصير. زيادة المحصول ونسبة الحب كانت فى اشجار الحقل التى تم تسميدها بمعدل ١كجم /للشجرة ، بينما كان هناك تقارب بين معدلى التسميد ١، ٧٥، كجم /للشجرة فى زيادة محتوى العصير من الانثوثيانين و السكريات الكلية وانخفاض نسبة الحموضة وكذلك الحصول على اقل نسبة للثمار المصابة بالتشقق ولفحة الشمس وبالتالى اعلى نسبة للثمار القابلة للتسويق كانت مع تغطية الاشجار بالشبك والتكيس للثمار مع كلا معدلى التسميد ١، ٧٥، كجم/للشجرة مقارنة بباقى المعاملات. تزايد محتوى الاوراق من العناصر النيتروجين والفوسفور والبوتاسيوم مع زيادة معدل التسميد وخاصة مع الاشجار التى فى الحقل. عموما يمكن من هذة الدراسة التوصية بتغطية اشجار الرمان بالشبك الابيض مع استخدام معدل التسميد ٧٥، كجم /للشجرة وذلك لتقليل عيوب الثمار وتحسين جودة الثمارمما يودى الى زيادة العائد وبالتاى تحقيق اعلى ربح ٠حيث انها فى الوقت الحاضر العامل المؤثر فى مناطق انتاج الفاكهة فى مصر ٠