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Response of Manfalouty Pomegranate Trees to Foliar Spray with Different Sources of Calcium

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THIS study was done to investigate the effect of foliar application with different sources of calcium namely, calciven (liquid calcium product by central laboratory of organic agriculture), calcium carbonate and calcium chloride on yield and fruit quality of Manfalouty pomegranate cultivar during 2020 and 2021 seasons at the Experimental Orchard, Assiut Agriculture research station. Foliar sprays were applied three times: in April at full bloom, in June two months after fruit set and at one month later (July). Results indicated that, all treatments significantly increased total yield compared to the control, however all experimental treatments reduced the fruit cracking and sunburn percentages, this decrements were significantly, the lowest fruit cracking was recorded due to calciven followed by calcium chloride. In addition all treatments significantly increased weight, length, diameter of fruit, and juice percentage compared to the control. In addition, calcium chloride and calciven were superior to calcium carbonate for improved most of the fruit chemical and physical properties,

It could be recommended that spraying Manfalouty pomegranate trees with different sources of calcium was necessary to reduce the fruit cracking and sunburn percentages, increasing total yield, marketable yield and improve fruit quality.

Keywords: Calciven, Manfalouty pomegranate, Cracking, Calcium, Sunburn.

Introduction

Pomegranate (*Punica granatum* L.), is grown in tropical and subtropical areas (Khorsandi et al., 2009 and Sheikh & Manjula, 2012). Pomegranate fruit is in high demand worldwide because of its well-known good for health metabolites (Singh et al., 2019 and Mphahlele et al., 2014). Pomegranate fruit is currently promoted and known as a "super food." It adapts very well to Egypt's climate and soil, flourishing in semi-arid and arid environments. Because of this, it has been grown in these conditions since antiquity and has grown to be one of Egypt's most significant fruits. Pomegranates have recently emerged in Egypt as a promising export crop, It has therefore been enlarged on recently reclaimed sandy soils.

Fruit cracking is a dangerous physiological condition that affects a variety of fruit species, including the pomegranate, citrus, apple, banana, grape sweet cherry, persimmon, plum, litchi, avocado, and pistachio, It reduces the total yield and fruit quality (Blumenfeld et al., 2000 and Khadivi-Khub, 2015). Pressure from rapidly developing arils on stretched peel can cause pomegranate fruit to fracture (Singh et al., 2020).Some of the main causes of pomegranate fruit cracking as soil moisture, cultivar sensitivity, temperatures during day and night, irrigation, relative humidity, peel pliability, and calcium and boron shortage (Sheikh & Manjula, 2012 and Galindo et al., 2014).

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Fruit cracking caused farmers to lose a lot of money by drastically lowering their overall yield by up to 30–50% and seriously degrading the quality of their fruit, making it unfit for marketing (Singh and Kingsly 2006). Calcium xylem translocation is dependent on unidirectional transpiration stream because older tissues of the plant cannot transport calcium through the basic pH phloem pathway to other parts of the plant, calcium is important nutrient for plants , It is necessary for a number of structural functions in the cell wall and membranes. (White and Broadley, 2003).

Spraying calcium shown to have a poor efficiency in many instances, despite the possibility that it could be useful for increasing the Ca concentration in fruit. Limitations in Ca uptake, fruit penetration, epidermal properties, the existence and composition of the cuticle, and possibly poor Ca translocation rates in the phloem have all been suggested as causes for this (Conway et al., 2002 and Danner et al., 2015).

As significant microelements, calcium (Ca) performs a variety of functions in plants, including supporting the structure of cell walls, preserving cell membrane integrity, and preserving cell turgor pressure. Additionally, it functions as a cytoplasmic second messenger and a counter-ion for inorganic and organic anions in vessels (White, 2000).Calcium affects fruit quality primarily through the creation of Ca pectate, which is linked to improvements in cell wall and middle lamella strength (Faust, 1989).

Many studies have been carried out on the effects of calcium on the quantity and quality of pomegranate trees, but few of them compared an organic calcium supply (calciven) to other calcium sources, particularly in desert environments.(Khalil and Aly, 2013, Hegazi et al., 2014, Masoud et al., 2019 and El-Wahed et al., 2021) they reported that spraying $CaCl_2$ on pomegranate trees significantly decreased fruit cracking and fruit sunburn, while increased total yield, fruit weight, TSS%, juice % and Anthocianin. Using $CaCo_3$ as anti- sunburn for different fruit species growing under hot-dry climates lead to decreased the adverse effects of high temperature and reduced fruit sunburn which resulted in improved total yield and fruit quality (Glenn et al., 2003, Curry et al., 2004 and Morsy et al., 2008).

This research looked at how foliar sprays with three different calcium formulations (calcium chloride, calcium carbonate, and calciven as an organic source) affected the yield and fruit quality of pomegranates.

Materials and Method

The investigation was done at the experimental farm of Assiut Agriculture Research Station, Agriculture Research Center (A.R.C.), Assiut Governorate, Egypt during 2020 and 2021 seasons, and the soil is sandy calcareous located in semi-arid region. Trees were seven years old, planted at 3 ×3 m and used a drip irrigation system in irrigation.

Three sources of calcium were used in this experiment namely calciven (Chelated calcium 15% in liquid form product by central laboratory of organic agriculture), calcium carbonate 40% ($CaCo_3$) and calcium chloride 36% ($CaCl_2$) each of them sprayed at concentration of 2 and 3%, the control was sprayed with distilled water and the spray was done till runoff (4 L/ tree). All foliar application were done during three stages; in April at full bloom, in June two months after fruit set and at one month later (July). Twenty one trees were subjected to the common horticultural practices and received the same practices usually applied in orchard, including the irrigation and pest control.

Experiment was including seven treatments as follow:

T1- Control
T2- Calciven at 2%
T3- Calciven at 3%
T4- Calcium chloride at2%
T5-Calcium chloride at 3%
T6- Calcium carbonate at 2%
T7-Calcium carbonate at 3%

This study was designed as a randomized complete block design (RCBD) with three replicates/treatment and one tree per each.

Measurements.

At the end of August, the fruits had been harvested when they were mature. (180 days after flowering). The total fruit yield was recorded per tree (kg/tree), Sample of fifteen fruits of each treatment was selected randomly at the harvest date to determine the following measurements.

Sunburn %, fruit cracking % and the marketable fruits% per tree were calculated according to following equations:

Sunburn % =Number of sunburn fruit/ total fruit number x 100

Cracking % = Number of cracking fruit / total fruit number x 100

Marketable fruits %= Marketable fruits number/ total fruit number x 100.

Fruit length and diameter (cm) were measured by using a digital Vernier. Fruit weight (g) was measured using an electronic balance, fruits were peeled and the weight of peel and total grains were measured also Juice volume (ml/100g grains) were determined.

Total soluble solids percentage (T.S.S. %). total acidity (%), total sugar (%), vitamin C as (mg) ascorbic acid /100 ml juice were determined according to A.O.A.C. (1995).Tannin content mg/g tannic acid was determined according to Cam and Hisil (2010).

Total Anthocianin content (mg/100ml) was determined according to Rabino and Mancinelli (1986).

Statistical analysis

Using the Statistix version 8.1 software (Analytical Software, 2005), data were statistically analyses. The least significant difference test at $P \leq 0.05$ was used to assess differences between means.

Results and Discussion

Fruit cracking %

Results in Table 1 reveled that spraying trees with different sources of calcium significantly reduced fruit cracking compared with control, (7.96 and 7.02 %), the least fruit cracking (3.74 and 4.31%) was obtained with calciven at 3% (T2), followed by calcium chloride at 3% (T5) (4.66 and 4.1 %) in the two seasons respectively. Additionally, the differences between calcium treatment and control were significantly, while the differences between calcium treatments were statistically not significant in most cases. These results are in same line with (Sohrab et al 2018) who show that cracking fruit was decreased after foliar sprays of calcium fertilizers.. Foliar sprays of 'Manfalouty' pomegranate trees with $CaCl_2$ at 2% decreased fruit cracking in comparison with the control trees by approximately 10% (Bakeer, 2016). The beneficial effects of calcium on reducing pomegranate fruit cracking may be attributable to its crucial functions in stabilizing membrane systems, enhancing the bonds between epidermal and other fruit cells, and strengthening cell walls by forming calcium pectates in the middle lamella. Along with controlling the mechanics of photosynthesis and proteins, Calcium also inhibits the development of abscission zones between fruits and branches. (Poovaiah, 1986 and Tony & John, 1994).

Sunburn %

Data illustrated in Table 1 clear that all treatments significantly reduced the percentage of fruit sunburn compared with control, the lowest values of sunburned fruit percentage (28.16 and 28.01%) (27.83 and 28.56 %) were recorded under calcium carbonate at 2% and 3%, followed by Calciven at 2% and 3% (33.06 and 32.83 %) (32.12 and 31.82%), while the control gave the greatest values of fruit sunburn (51.50 and 52.50) during the two study seasons respectively. Additionally, the differences between treatments not significant in most cases.

These results are in same line with those obtained by (Glenn et al., 2001, Melgarejo et al., 2004 and Morsy et al., 2008) they reported that spraying calcium carbonate for different type of trees living under high temperature decreased the negative effects of UV radiation and high temperature resulted in improving total yield and fruit quality. Moreover,(Davarpanah et al 2018) concluded that using calcium nitrate and kaolin is considered as an effective way to reduce sunburned fruit percentages of pomegranate.

Marketable yield %

Table 1 indicated that used different sources of calcium significantly increased marketable yield compared to control, this increment which lead to the decreasing of fruit cracking and fruit sunburn .Additionally there is a negative relationship between fruit cracking percentage and fruit sunburn percentage on hand and marketable yield on the other hand. So increasing the marketable yield was parallel with decreasing cracking fruit and sunburned fruit. In addition there is no significant difference between calcium carbonate and calciven at the two concentrations. These results agreement with Abd El-wahed et al (2021) observed that spraying calcium chloride at 2 and 4% gave the highest percentage of marketable fruit of pomegranate.

Yield and fruit physical properties:

Total yield

Data in Table 2 cleared that all foliar treatments significantly increased yield compared to control, the highest yield (16.15 and 16.60 kg /tree) was obtained with T3Calcivin at 3% during both seasons, followed by T2 calciven at 2% (15.95and 16.12 kg/tree) while the control gave the lowest yield (13.23 and 13.67 kg/tree) in both seasons respectively, this increment in yield maybe due to increasing fruit weight, these findings were in same line with those of (Sheikh and Manjula 2012) who found that pre-harvest foliar treatment of calcium chloride at 1% improved yield kg/ tree in comparison to control in the pomegranate cultivar "Ganesh." . However, (Sohrab et al 2018) recorded that Calcium fertilization applied as foliar had no effects on total yield of pomegranate.

Fruit length and diameter

Concerning to fruit length and its diameter data in Table 2 showed that spraying different sources of calcium increased fruit length and diameter compared with control. Moreover, calciven at 3% increased fruit length and its diameter compared with the other treatments and this increment only significant during the second season. In addition T3 Calciven at 3% gave the highest values of fruit length and diameter

TABLE 1. Effect of different sources of calcium on fruit cracking%, sunburn% and marketable yield% of Manfalouty pomegranate during 2020and 2021seasons.

Treatments	Cracking %		Sunburn%		Marketable yield%	
	2020	2021	2020	2021	2020	2021
T1 Control	7.96a	7.02a	51.50a	52.50a	40.53c	40.47c
T2 Calciven at 2%	3.98c	3.88bc	32.12bc	31.82bc	63.90ab	64.30ab
T3 Calciven at 3%	3.74c	3.31c	33.06bc	32.83bc	63.19ab	64.02ab
T4 Calcium chloride at 2%	4.72bc	4.55bc	33.74c	34.13c	61.54b	61.32b
T5 Calcium chloride at 3%	4.66bc	4.10c	35.83bc	34.86c	59.51b	61.04b
T6 Calcium carbonate at 2%	5.88b	5.84b	28.16b	28.01b	65.96a	66.15a
T7 Calcium carbonate at 3%	5.66b	5.83b	27.83b	28.56b	66.51a	65.61a

According to the least significant difference test values in a column that are followed by the same letters are not significantly different ($P < 0.05$)

TABLE 2. Effect of different sources of calcium on fruit length, diameter and yield of Manfalouty pomegranate during 2020and 2021seasons

Treatments	Yield(kg)		Fruit length(cm)		Fruit diameter(cm)	
	2020	2021	2020	2021	2020	2021
T1 Control	13.23c	13.67c	7.84b	8.14c	7.60b	7.72c
T2 Calciven at 2%	16.95a	17.12a	8.77a	8.98b	8.55a	8.82b
T3 Calciven at 3%	17.15a	17.60a	8.86a	9.72a	8.63a	9.50a
T4 Calcium chloride at 2%	15.12b	15.75b	8.32ab	9.12b	8.43ab	8.91b
T5 Calcium chloride at 3%	15.20b	15.73b	8.54ab	9.22b	8.32ab	8.83b
T6 Calcium carbonate at 2%	14.98b	15.20b	8.16ab	8.92b	8.12ab	8.75b
T7 Calcium carbonate at 3%	14.86b	15.43b	8.26ab	9.14b	7.94ab	8.90b

According to the least significant difference test values in a column that are followed by the same letters are not significantly different ($P < 0.05$)

(8.86and 9.72 cm) (8.63 and 9.50 cm) during both seasons respectively, followed by T5 calcium chloride at 3% (8.54 and 9.22cm) (8.32 and 9.03 cm) respectively, while the control gave the lowest values (7.84 and 8.14 cm) (7.60 and 7.72) in the two seasons respectively. These results are similar with El akkad et al. (2016) they stated that spraying Manfalouty pomegranate trees with calcium chloride at increased fruit length and fruit diameter as compared with control. Sohrab et al (2018) reported that spraying 'Ardestani' pomegranate cultivar with calcium chloride at 1 and 2% increased fruit length. The effects of calcium spraying on fruit length may be related to the functions of calcium in cell membrane permeability, cell division, and elongation (Carpita and McCann, 2000).

Fruit weight, peel and grains weight
Fruit weight

Results in Table 3 revealed that, comparing to the control, all treatments increased fruit weight. this increment was significantly between calciven treatments and control .while the increment between calcium chloride and carbonate compared with control were not significant, in addition the highest fruit weight (448.30 and 458.33 g) was recorded under Calciven at 3%(T3) in both seasons respectively .followed by Calciven at 2% (T2) (442.12and 450.22 g) while the control gave the lowest values (271.53 and 278.33 g) during both seasons respectively. These results nearly in the same line with Badawy et al. (2019) indicated that spraying "Manfalouty" pomegranate trees with calcium chloride at 2% two times increased fruit weight comparing to the control ,similarly Masoud et al (2019) who mentioned that, spraying 'Manfalouty' pomegranate trees with 2% calcium chloride significantly increased fruit yield also, Badran (2015) stated that spraying 'Samany' and 'Zaghloul' date palms with 5% calcium carbonate three times increased bunch weight, resulting in consequence increased overall yield and fruit weight. These effects could be due to how calcium affects plant cell growth and division, cell membrane permeability, nitrogen metabolism, and glucose transport (White 2000)

Peel and grains weight:

Data presented in Table (3) clear that all treatments increased peel and grains weights compared with control, for peel weight the differences between calciven and calcium carbonate compared with control were significant, while for grains weight the differences between calciven and calcium chloride compared with calcium carbonate and control not significant. Additionally the highest values of grains weight (214.87 and 220.00g per fruit) was obtained with calcium chloride at 3% (T5) compared to the controls and other treatments, which produced the lowest values (144.14 and 147.33g per fruit). Also the highest peel weight values recorded under calciven at 3% (T3) (237.47 and 240.00g per fruit).These results are not agreement with those obtained by Sohrab et al (2018) they observed that peel and grains weight of pomegranate are unaffected by calcium application in both seasons studied.

TABLE 3. Effect of different sources of calcium on fruit weight, peel and grains weight (g) of Manfalouty pomegranate during 2020and 2021seasons.

Treatments	Fruit weight(g)		Peel weight(g)		grains weight(g)		Juice ml/100g grains	
	2020	2021	2020	2021	2020	2021	2020	2021
T1 Control	271.53b	278.33b	127.39b	131.00b	144.14b	147.33b	37.07c	37.90c
T2 Calciven at 2%	442.12a	450.22a	235.55a	239.21a	206.57a	211.01a	39.55ab	40.50a
T3 Calciven at 3%	448.30a	453.33a	237.47a	240.00a	210.83a	213.33a	40.50a	40.83a
T4 Calcium chloride at 2%	379.50ab	388.50ab	166.32ab	169.25ab	213.18a	219.25a	38.95ab	39.44b
T5 Calcium chloride at 3%	384.30ab	390.00ab	169.43ab	170.00ab	214.87a	220.00a	40.85ab	41.76ab
T6 Calcium carbonate at 2%	380.00ab	382.45ab	230.51a	229.42a	149.49b	153.03b	38.13bc	38.42b
T7 Calcium carbonate at 3%	382.63ab	386.67ab	232.53a	231.00a	150.30b	155.67b	38.53bc	39.96ab

According to the least significant difference test values in a column that are followed by the same letters are not significantly different ($P < 0.05$)

Juice content %:

Data illustrated in Table 3 indicated that all treatments were significantly increased Juice% content comparing to the control. Moreover, treatments calcium chloride at 3% (T5) and Calciven at 3% (T3) recorded the highest numerical values of Juice content%. Same result was obtained by Ahmed et al., (2014) they cleared that foliar applications of $CaCl_2$ three times in March, May, and June enhanced juice volume on Manfalouty Pomegranate fruit in comparison to control.

Fruit chemical properties

Titratable acidity%

Data presented in Table 4 cleared that all treatments reduced the percentage of acidity compared with control which gave the highest values (1.28 and 1.26%), also calcium chloride treatment at 3% (T5) gave the lowest values (1.11 and 1.08 %) in both seasons of study respectively. Moreover the differences between treatments were not significant. These results are similar with the results of El akkad et al., (2016) they cleared that foliar application of Manfalouty pomegranate trees with $CaCl_2$ decreased total acidity compared with control.

TSS%:

Concerning to the results illustrated in Table 4 it's cleared that spraying calciven and calcium chloride significantly increased TSS% compared with the control and calcium carbonate. In addition calcium chloride at 3% (T5) gave the highest values (17.45 and 18.16%), followed by calciven at 3% (T3) recorded (17.33 and 17.83%) during both seasons respectively. Furthermore, the differences between T2, T3, T4 and T5 were not significant. These results are similar to those attained by Badawy et al., (2019) indicated that foliar application of "Manfalouty" pomegranate trees with $CaCl_2$ increased T.S.S (%) comparing to the control. Also Sohrab et al., (2018) indicated that spraying with $CaCl_2$ at 1% increased TSS only in the second season. Ramezanian et al., (2009) stated that foliar sprays of $CaCl_2$ increased soluble solid contents. On the other hand Korkmaz and Aşkın, (2015) observed that TSS not influenced by foliar Ca $(NO_3)_2$ treatments.

Total sugar%

Regarding to the results in Table 5 it can concluded that calcium carbonate at 2 and 3% treatments gave the highest values of total sugar content and significantly increased it compared with control and calciven treatments, while the differences between it and calcium chloride were statistical not significant during the two experimental seasons, the least total sugar values were obtained under control. These results are similar with obtained by Badran (2015) who reported that spraying 'Zaghloul' and'Samany' date palm three times with 5% calcium carbonate

TABLE 4. Effect of different sources of calcium on titratable acidity, TSS, and total sugar % of Manfalouty pomegranate during 2020and 2021seasons.

Treatments	Acidity%		TSS%		Total sugar %	
	2020	2021	2020	2021	2020	2021
T1 Control	1.28a	1.26a	16.00b	16.83bc	12.61c	12.78c
T2 Calciven at 2%	1.19ab	1.18ab	17.00ab	17.52ab	13.21b	13.44b
T3Calciven at 3%	1.17ab	1.17ab	17.33a	17.83ab	13.32b	13.50b
T4 Calcium chloride at 2%	1.13ab	1.10ab	17.12ab	17.69ab	13.75ab	13.98ab
T5 Calcium chloride at 3%	1.11ab	1.08ab	17.45a	18.16a	13.71ab	13.83ab
T6 Calcium carbonate at 2%	1.23ab	1.24ab	16.00b	16.75bc	13.82a	14.00a
T7 Calcium carbonate at 3%	1.20ab	1.24ab	15.50b	16.33bc	14.18a	14.22a

According to the least significant difference test values in a column that are followed by the same letters are not significantly different ($P < 0.05$)

increased total sugar. Moreover this results not agreement with (Sohrab et a.,l 2018) who observed that total sugar content not affected by foliar sprays with calcium on pomegranate trees.

Anthocianin, Tannins, Vitamin C

Anthocianin mg/100m

Data presented in Table 5 clear that all treatments significantly increased Anthocianin compared with the control, the differences between calciven and calcium chloride not significant during the second season; in addition Calciven at 3% (T3) recorded the highest Anthocianin values, followed by calcium chloride at 3% (T5) while the control gave the least values. These results are in harmony with those indicated by El akkad et al. (2016) they reported that spraying the trees of Manfalouty pomegranate with calcium chloride increased Anthocianin. Also, Badawy et al. (2019) observed that spraying "Manfalouty" pomegranate with $CaCl_2$ at 2% improved Anthocianin in comparison to the control.

Tannins %

Data in Table 5 clear that all treatments significantly decreased tannins content comparing to the control, in addition, Calcivin at 3% (T3) gave the lowest values compared with the other treatments. These results supported by Masoud et al (2019) they reported that calcium chloride reducing tannins percentage in pomegranate fruits.

Vitamin C content

Results in Table 5 cleared that all treatments significantly increased V.C compared with the control which gave the least values of Vitamin C. Additionally, calciven at 3% recorded the highest values of vitamin C compared with the other treatments followed by calcium chloride at 3%. These results are in harmony with El akkad et al. (2016) observed that Vitamin C content were higher than the control when Manfalouty pomegranate trees were sprayed with $CaCl_2$ two months after fruit set.

Conclusion

Under this investigation, it is clear that spraying calcium in different sources and concentrations increased total and marketable yield and improved fruit quality of pomegranate, spraying calciven and calcium chloride at 3% treatments gave the superior values of such characters compared with the other investigated treatments.

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Conflicts of interest

No conflicts

TABLE 5. Effect of different sources of calcium on Anthocianin, Tannins, V.C and Juice% of Manfalouty Pomegranate during 2020and 2021seasons.

Treatments	Anthocianin mg/100m		Tannins%		V.C mg/100ml	
	2020	2021	2020	2021	2020	2021
T2 Calciven at 2%	59.73b	61.06ab	0.38b	0.37bc	25.50ab	25.66a
T3 Calciven at 3%	61.41a	62.96a	0.35c	0.36bc	26.07a	26.40a
T4 Calcium chloride at 2%	58.88bc	60.50ab	0.37bc	0.37bc	25.00b	25.50a
T5 Calcium chloride at 3%	60.53a	61.28ab	0.37bc	0.38b	25.72ab	25.93a
T6 Calcium carbonate at 2%	58.12c	59.98b	0.37bc	0.38b	24.90b	25.33ab
T7 Calcium carbonate at 3%	58.30c	60.73b	0.38b	0.38b	24.73b	25.60a

According to the least significant difference test values in a column that are followed by the same letters are not significantly different ($P < 0.05$)

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استجابة اشجار الرمان المنفلوطى للرش بمصادر مختلفة من الكالسيوم

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تهدف هذه الدراسة الى توضيح تاثير الرش بمصادر مختلفة من الكالسيوم وهى الكالسيفين (كالسيوم مخلبى فى صورة سائله من انتاج المعمل المركزى للزراعة العضوية) وكربونات الكالسيوم وكلوريد الكالسيوم على اشجار الرمان المنفلوطى خلال عامى ٢٠٢٠ و٢٠٢١ بمحطة البحوث الزراعية باسيوط . تم الرش بمعدل ثلاث رشات وباستخدام تركيزات ٢٪ و٣٪ , وكانت الرشة الاولى خلال مرحلة التزهير الكامل(ابريل) ,والرشة الثانية بعد شهرين من العقد(يونيه), والرشة الثالثة بعد شهر من الرشه الثانية (يوليو) . واوضحت النتائج ان جميع معاملات الرش اثرت معنويا على زيادة المحصول الكلى مقارنة بالكنترول,من جهة أخرى جميع المعاملات ادت الى تقليل نسبة تشقق الثمار ولسعة الشمس وكانت هذة الزيادة معنوية.كما اوضحت النتائج ان معاملات الرش بالكالسيوم ادت الى زيادة وزن وابعاد الثمار وايضا زيادة المواد الصلبة الكلية والسكريات الكلية ونسبة العصير وفيتامين سى ومحتوى الثمار من الانثوثيانين مقارنة بالكنترول, علاوة على ذلك يتضح من خلال هذه الدراسة ان رش كلوريد الكالسيوم والكالسيفين كان افضل من كربونات الكالسيوم خاصة عندالرش بتركيز٣٪ فى تحسين معظم الصفات الطبيعية والكيميائية.

من خلال ما سبق يمكن التوصية برش اشجار الرمان المنفلوطى بمصادر مختلفة من الكالسيوم لتقليل تشقق الثمارولسعة الشمس وزيادة المحصول الكلى والتسويقى وايضا تحسين جودة الثمار.

الكلمات المفتاحية : كالسيفين- الرمان المنفلوطى - التشقق- الكالسيوم - لسعة الشمس.