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Influence of Foliar Spray with Calcium Chloride on Growth, Yield and Quality of Lettuce (*Lactuca sativa* L.)

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Abstract

In the present investigation, effect of calcium chloride ($CaCl_2$) used as foliar application (0, 10, 20 mM) was studied on morphological, yield, and quality of lettuce (Romaine and Green Waves cultivars) during 2017/2018 and 2018/2019 seasons. Our results indicated that, foliar spray of calcium chloride either at 10 or 20 mM significantly increased vegetative growth and yield parameters i.e., leaf number per plant, fresh and dry leaf weight compared to control treatment. Also, foliar spray of calcium chloride resulted in a significant increase in yield and quality parameters i.e., TSS, chlorophyll content and Vitamin C. 'Romaine' cultivar was significantly superior to 'Green Waves' cvs in plant height, fresh and dry weight of the leaves, TSS and chlorophyll content. However, there was no significant difference in vitamin C content between the two tested cultivars. 'Green waves' cv. sprayed with 20 mM $CaCl_2$ gave the highest significant leaf number per plant. Fresh and dry leaf weight of 'Romaine'cv recorded the highest values when the plants were sprayed with 20 mM $CaCl_2$ in both seasons., In the first season, 'Romaine'cv sprayed with 20 mM of $CaCl_2$ produced the highest total yield, while the highest total yield in the second season was obtained from plants of both tested cvs sprayed with 20 mM $CaCl_2$. 'Romaine' cultivar treated with 20 mM of calcium chloride as foliar application had the highest TSS and chlorophyll content. Fascinatingly, high association existed between total yield and all studied traits, except leaf number per plant. Overall results suggest applying calcium chloride as foliar application at 20 mM for improving yield quantity and quality in both 'Romaine' and 'Green Waves' cultivars.

Keywords: *cultivars, calcium chloride treatments, yield components, yield quality*

Introduction

Lettuce (*Lactuca sativa*) crop belongs to Asteraceae family, is a vegetable that is cultivated for fresh leaves used particularly for salad. Additionally, lettuce is acceptable by consumers (Teng *et al*., 2021). It is one of the most important world-wide dietary products. It provides vitamins (Kim *et al*., 2016) and other nutrients including phenolic compounds, carotenoids and vitamin E (Nicolle *et al.*, 2004. Besides, it is a source of other bioactive compounds such as niacin, omega-3-fatty acids and flavonoids (Tahreem, *et al.,* 2020). These compounds can provide the human body with antioxidant and anti-inflammatory properties, which may be beneficial to human body health, as reducing risk like anemia, high blood pressure, certain cancers, and diabetes. Also, it is considered a good source of vitamin A (Niari *et al.,* 2012). Lettuce has a lot of dietary fibers (Liorach *et al.,* 2008). Further, it provides the human body with high quantities of minerals such as iron,

calcium, and potassium, which are important for the human body's metabolism.

Calcium has been considered an important nutrient in leafy vegetables. Calcium is the essential nutrient most commonly deficient in modern diets (Grusak, 2002) and increasing the calcium content in leafy vegetables could benefit the consumer. Further, it has been considered an important essential nutrient for plant growth as it plays an important role in the cell wall and cell membrane (Hepler and Winship, 2010). Also, calcium is an important constituent of plant tissues and has a vital role in maintaining and modulating various cell functions (Hepler, 2005). The calcium content of lettuce is affected by calcium uptake (Yuan W. *et al.,* 2018). Foliar application with calcium is needed as it considered an immobile element (Gaussoin *et al*., 2009). Source of calcium supply is considered the important factor for the efficiency of foliar application with calcium. Almeida *et al.,* (2016) revealed that usage of calcium chloride as foliar application was more efficient than either calcium oxide or chelate calcium. Calcium chloride can be used as a source for both of calcium and chloride (Rab and Haq, 2012). Also, Michałojć and Horodko (2006) found that among the calcium compounds that are used for plant spraying, calcium chloride is absorbed the best. Besides the vital role of calcium chloride in improvement of the quality of lettuce, it considered as one of the agro-chemicals that leads to enhance growth and yield productivity of several vegetable crops especially lettuce (Sabry M. *et al*., 2017).

The objective of the study presented here was to asses the influence of foliar application of Calcium Chloride at different concentrations on growth, yield and quality characteristics of lettuce (*Lactuca sativa*) (Romaine and Green Waves cvs).

Materials and Methods

Experimental site soil characteristics and plant materials

This study was carried out at the Experimental Farm, Faculty of Agriculture, Assiut University, Assiut, Egypt, (Latitude 270°, 18 and Longitude 310° 18′, and the Altitude 70 m above sea level) during two winter seasons (2017-2018 and 2018-2019). The soil analysis of the experimental site is illustrated in Table (1). The analysis was carried out in the soil and water Department, Faculty of agriculture, Assiut university according to the recommended. According to soil analysis results, soil texture of the experimental site was clay with an average pH of 7.6. Seeds of two lettuce cultivars (Romaine and Green Waves) were obtained from the Gaara establishment for import and export (seed company). Green waves cultivar was imported from Sakata, Japanese.

Table 1. Analysis of chemical and physical characteristics of soil of experimental site for the two growing seasons.

Characteristic	Seasons	
	2017/ 2018	2018/ 2019
Chemical Properties		
PH(1:1)	7.6	7.5
EC ds/ m	1.1	1.3
Total Nitrogen (ppm)	13	15
Available Phosphorous (ppm)	10.2	9.5
Available Potassium(ppm)	312	300
Soluble Cations (meq/kg soil)		
Ca^{2+}	10.00	9.0
Mg^{2+}	4.00	3.0
Na^{+}	4.70	5.5
K^{+}	1.30	1.0
Soluble Anions, (meq/kg soil)		
Cl^{-}	5.70	4.0
HCO_3+ CO_3^{2-}	4.30	5.5
SO_4^{2-}	10.00	9.0
Physical Properties		
Clay %	47	46.5
Silt %	32.1	31.2
Sand %	20.9	22.3
Total $CaCO_3$	3.3	3.2

Treatments and Experimental design

The treatments were the foliar application with calcium chloride ($CaCl_2$) at either 10 mM or 20 mM while the control treatment was sprayed with distilled water. The plants were sprayed 5 times during the growing season starting 5 weeks after planting and subsequently at 12-day intervals. The experiment was conducted as strip-plots arrangement in randomized complete-block) design (RCBD with three replications. Each experimental plot consisted of two rows. Each row was 3.5 meters long and 70 cm wide. Planting was at 20 cm apart on one side of ridge. Lettuce seeds were sown on 10th and 8th October in the 2 growing seasons, respectively. Five weeks after planting, the drip point with a solution of $CaCl_2$ in various concentrations. Calcium chloride ($CaCl_2$) was dissolved in distilled water. A surfactant tween 20 (0.5%) was added with all treatment solutions. The pH of solution was set to 6.5-7. Foliar spraying was carried out early in the morning. All other cultural practices including irrigation, fertilization and pest control were carried out uniformly in all plots as recommended by the Egyptian Ministry of Agriculture for lettuce production.

Data recorded

1. Morphological Characters

Lettuce samples were randomly taken (10 plants per replicate for each treatment) for morphological assessment at the harvest time. Data comprised plant height (cm) measured from the ground level to the top living point of the plant, number of leaves per plant, fresh leaf weight (kg), and dry leaf weight (g) were recorded. Dry leaf was obtained by drying in an electric oven at 70°C until constant weight.

2. Yield quantity and quality

Total yield (ton/fed) was estimated as weight of harvested plants all over the growing season expressed in form of ton/fed. Total soluble solid (TSS) was determined using refractometer according to AOAC (2000). Chlorophyll content was assessed in the fifth fresh lettuce leaf using chlorophyll Meter (SPAD-502 Plus) (Minolta Camera Co., Osaka, Japan). Ascorbic acid content (mg/100 g leaf fresh weight) was determined by titration method using 2, 6 dichlorophenole - endo-phenole (AOAC, 2000).

Statistical Analysis

Analysis of variance pertinent to strip plot arrangement in a randomized complete block design with three replications was conducted using Proc Mixed of SAS package version 9.2 (SAS, 2008). Means of the treatments were compared by Least Significant Difference (LSD) at 5% level of significance (Steel and Torrie,1980). Correlation coefficients values (r) were calculated for all pairs of studied characters.

Results

Effect of foliar application with calcium chloride ($CaCl_2$)

The current results revealed significant effects due to the foliar application with calcium chloride. The growth parameters of untreated plants (0 mM) were significantly lower than $CaCl_2$ treated ones except for plant height. Foliar application either with10 or 20 mM significantly increased vegetative growth expressed as leaf number per plant, fresh and dry weight of leaves in both growing seasons (Table2) compared to control treatment (0 mM). The maximum significant effect was observed when plants sprayed with 20 mM calcium chloride. Similar stimulatory effects of calcium chloride on leaf number per plant using either 10 mM or 20 mM in the first season (Table 2) was observed. There was no significant difference between 0 mM and 10 mM foliar application of calcium chloride on plant height parameter in both seasons (Table 2).

Table 2. Main effect of foliar application with calcium chloride ($CaCl_2$) on plant height, leaf number per plant-and fresh and dry leaf weight of 'Romaine' and 'Green waves' lettuce cultivars in the growing seasons of 2017/2018 and 2018/2019.

Foliar applications	Plant height(cm)	Leaf number per plant	Fresh weight of leaves (kg)	Dry weight of leaves (g)
	Season 1			
0 mM (control)	37.03	43.96	0.874	31.145
10 mM	37.83	47.18	1.010	39.624
20 mM	40.36	48.96	1.089	51.513
LSD $_{0.05}$	2.2224	2.4375	0.0636	2.6722
	Season 2			
0 mM(control)	36.85	43.12	0.824	28.072
10 mM	38.8	45.22	0.955	35.43
20 Mm	40.26	47.67	1.061	49.498
LSD $_{0.05}$	2.4416	1.5943	0.0583	4.6049

Results concerning total yield, of the two lettuce cultivars as affected by foliar application with calcium chloride treatments are presented in Table (3). Generally, all the foliar application with calcium chloride ($CaCl_2$) treatment significantly surpassed the control treatment regarding the total yield. The highest significant total yield was obtained by foliar application with calcium chloride at 20 mM in both seasons. However, foliar application with calcium chloride at 10 mM increased the total yield significantly at the first growing season but was not solid enough to cause significant increase in the second season as compared with the control treatment (0 mM) (Table 3).

Table 3. Effect of foliar application with calcium chloride ($CaCl_2$) on total yield, TSS, chlorophyll content and Vitamin C of leaves of 'Romaine' and 'Green waves' lettuce cultivars in the growing seasons of 2017/2018 and 2018/2019

Foliar applications	Total yield (ton/ fed.)	TSS	Total Chlorophyll content	Vitamin C
	Season 1			
0 mM(control)	13.279	4.91	23.9	61.55
10 mM	15.88	5.60	28.55	73.20
20 Mm	17.033	6.45	34.98	109.29
LSD 0.05	0.9807	0.1511	1.8048	6.4736
	Season 2			
0 mM(control)	13.75	4.94	23.69	61.68
10 Mm	14.366	5.57	27.78	72.73
20 Mm	17.016	6.51	33.41	96.61
LSD 0.05	1.3884	0.2258	1.6945	2.8427

Effect of cultivars

Plant height, fresh and dry weight of leaves varied with cultivars, as shown in Table (4). There were significant differences in plant height, fresh weight, and dry weight between 'Romaine' and 'Green waves' cultivars. 'Romaine' cultivar had greater plant height and heavier fresh and dry weight than 'Green

waves' cultivar (Table 4). The leaf fresh weight of 'Romaine' cultivar means were 1.207 g/plant and 1.127g/plant in the first and second seasons, respectively. The dry leaves weights of both cultivars differed in the same way as fresh weight. Nevertheless, 'Green waves' plants had higher leaf number per plant than the 'Romaine' plants, but this was significant in the first season only (Table 4).

Table 4. Effect of cultivars on plant height, leaf number per plant, fresh and dry weight of leaves over foliar application treatments with calcium chloride ($CaCl_2$) for 'Romaine' and 'Green waves' lettuce cultivars in the growing seasons of 2017/2018 and 2018/2019.

Cultivars	Plant height (cm)	Leaf number Per plant	Fresh weight of leaves (kg)	Dry weight of leaves (g)
	Season 1			
Romaine	42.66	44.99	1.207	48.86
Green waves	34.15	48.42	0.775	32.65
F test	**	*	**	**
	Season 2			
Romaine	42.11	44.80	1.127	44.1
Green waves	34.68	46.67	0.767	31.25
F test	**	n.s	*	**

** Highly significant at 0.01; * significant at 0.05; ns insignificant

Significant differences were found between the two tested cultivars in the first season, as 'Romaine' cv recorded higher total yield than 'Green waves' cv. (Table 5). In the second season, the difference between the two cultivars was not significant. In both seasons, TSS and chlorophyll contents differed between the tested cultivars. 'Romaine' cv. showed higher TSS (6.95 and 6.96 in first and second seasons, respectively) than 'Green waves' cv. (4.39 and 4.34 in the first and second seasons, respectively). Also, plants of 'Romaine' cv, had higher chlorophyll content than 'Green waves' cv. in both seasons (Table 5). Regarding vitamin C content, there was no significant difference between the two tested cultivars in both seasons.

Table 5. Effect of cultivars on total yield, TSS, chlorophyll content and vitamin C of leaves of overall foliar application with calcium chloride ($CaCl_2$) treatments for 'Romaine' and 'Green waves' lettuce cultivars in the growing seasons of 2017/2018 and 2018/2019.

Cultivars	Total yield (ton/ fed.)	TSS	Total chlorophyll content	Vitamin C
	Season 1			
Romaine	16.47	6.95	30.84	81.37
Green waves	14.32	4.34	27.45	81.32
F test	*	**	*	n.s
	Season 2			
Romaine	15.488	6.96	29.37	77.79
Green waves	14.216	4.39	27.21	76.21
F test	n.s	**	*	n.s

** Highly significant at 0.01; * significant at 0.05; ns insignificant.

Interaction effect of cultivars and foliar application with calcium chloride ($CaCl_2$)

The interaction effect of foliar application with calcium chloride treatment and cultivar on plant height, leaf number per plant, fresh and dry leaf weight was significant (Table 6). During the 2017/2018 and 2018/2019 seasons, plant height of 'Romaine' plants was the tallest when sprayed with 20 mM calcium chloride ($CaCl_2$) as compared to the other foliar application treatments (Table 6). Green waves plants sprayed with water were the shortest one. Regarding leaf number plant, 'Green waves' cv. sprayed with 20 mM calcium chloride treatment ($CaCl_2$) gave the greatest significant leaf number per plant, while 'Romaine' plants sprayed with water (control) treatment gave the lowest value (Table 6). Fresh and dry weight of leaves of 'Romaine' cv. were the highest when plants sprayed with 20 mM calcium chloride, while 'Green waves' cv. plants of control treatment was the lowest in both seasons (Table 6).

Table 6. Interaction effect of foliar application with calcium chloride ($CaCl_2$) treatments and cultivars on plant height, leaf number per plant, fresh and dry weight of leaves of 'Romaine' and 'Green waves' lettuce cultivars in the growing seasons of 2017/2018 and 2018/2019.

Foliar application	Cultivar	Plant height (cm)	Leaf number Per plant	Leaf Fresh weight (kg)	Leaf Dry weight (g)
		Season 1			
0 mM (control)	Romaine	41	42.4	1.047	41.449
	Green waves	33.06	45.53	0.702	20.84
10 mM	Romaine	42	46.16	1.214	51.117
	Green waves	33.66	48.2	0.805	28.132
20 mM	Romaine	45	46.4	1.359	54.021
	Green waves	35.73	51.53	0.819	49.006
LSD $_{0.05}$		2.2169	2.365	0.0856	3.7256
Season 2					
0 Mm (control)	Romaine	40.33	41.23	1.001	37.225
	Green waves	33.36	45	0.646	18.92
10 mM	Romaine	41.16	44.4	1.13	44.61
	Green waves	34.98	46.03	0.781	26.257
20 mM	Romaine	44.81	46.6	1.25	50.433
	Green waves	35.7	48.73	0.873	48.562
LSD $_{0.05}$		2.169	3.1419	0.1179	4.9115

The Interaction effect of calcium chloride treatment and cultivar was significant. In both tested cultivars, foliar application with calcium chloride surpassed the control treatment in both seasons. In the first season, 'Romaine' cv. plants sprayed with 20 mM of calcium chloride produced the highest total yield, while the highest total yield in the second season was obtained from both two tested cultivars plants sprayed with

20 mM of calcium chloride (Table 7). Total soluble solids were significantly affected by the cultivar and foliar application of calcium chloride treatment interactions. In both seasons, 'Romaine' cultivar treated with 20 mM of calcium chloride as foliar application treatment had the highest TSS content (Table 7). On the other hand, in 'Green waves' cultivar, plants sprayed with water had the lowest TSS content in both seasons (Table 7).

The interaction effect of foliar application calcium chloride treatment and cultivar was significant for chlorophyll content. 'Romaine' plants sprayed with 20 mM of calcium chloride had the highest value in both seasons. On the other hand, the lowest value for chlorophyll content was obtained from plants of 'Green waves' cv, of control spray treatment. However, in the second season, there was no significant difference in chlorophyll content for both cultivars in control spray treatment (Table 7) In both seasons, 'Green waves' cv. had significantly the lowest vitamin C content in plants grown in control spray treatment. On the other hand, in the first season, the highest significant value for vitamin C content was obtained from plants of 'Green waves' cv. sprayed with 20 mM calcium chloride, while in the second season, both 'Romaine' and 'Green waves' cultivars treated with 20 mM calcium chloride as foliar application recorded the highest value for vitamin C content (Table 7).

Table 7. Interaction effect of cultivars and foliar application with calcium chloride treatments ($CaCl_2$) on total yield, TSS, chlorophyll content and vitamin C of 'Romaine' and 'Green waves' lettuce cultivars in the growing seasons of 2017/2018 and 2018/2019.

Foliar application	Cultivar	Total yield (ton/ fed.)	TSS	Total chlorophyll content	Vitamin C
		Season 1			
0 mM (control)	Romaine	13.983	6.16	25.12	64.26
	Green waves	12.575	3.66	22.68	58.84
10 mM	Romaine	17.033	7.0	28.30	74.96
	Green waves	14.733	4.2	28.81	71.43
20mM	Romaine	18.408	7.73	39.12	104.87
	Green waves	15.658	5.16	30.86	113.71
LSD $_{0.05}$		1.4526	0.2144	2.7635	5.2787
Season 2					
0mM (control)	Romaine	14.000	6.25	24.49	64.39
	Green waves	12.350	3.63	22.88	58.97
10 Mm	Romaine	15.566	6.93	26.86	73.12
	Green waves	13.166	4.21	28.68	72.33
20 mM	Romaine	16.900	7.69	36.75	95.88
	Green waves	17.133	5.33	30.05	97.33
LSD $_{0.05}$		2.0223	0.3453	1.5928	3.2552

Correlation coefficients among characters

Correlation coefficient among pairs of studied characters were estimated and presented in Table (8). Nineteen significant r coefficients were detected in the first season. In the second season, twenty-one coefficients achieved significance. Total yield associated with all studied traits, except leaf number per plant.

Table 8. Correlation coefficient values (r) among eight characters of growth, yield and quality in lettuce in 2017/2018 (left side diagonal) and 2018/2019 (right side diagonal.

	Character	1	2	3	4	5	6	7	8
1.	Leaf number	---	-0.344	-0.266	-0.215	0.317	0.152	0.658**	0.240
2.	Plant height (cm)	-0.116	----	0.954**	0.965**	0.543*	0.791**	0.304	0.720**
3.	Fresh weight of leaves (kg)	-0.116	0.957**	-----	0.950**	0.628**	0.791**	0.3057	0.809**
4.	TSS	-0.116	0.957**	0.944**	-------	0.629**	0.873**	0.4143	0.786**
5.	Total chloro-phyll content	-0.116	0.957**	0.944**	0.582**	--------	0.675**	0.773**	0.809**
6.	Dry weight of leaves (g)	-0.116	0.957**	0.944**	0.582**	0.672**	-------	0.694**	0.844**
7.	Vitamin C	-0.116	0.957**	0.944**	0.582**	0.672**	0.781**	-------	0.657**
8.	Total yield	-0.116	0.957**	0.944**	0.582**	0.672**	0.781**	0.769**	-----

Discussion

Our results revealed a significantly increased vegetative growth (i.e., plant height leaf number per plant, fresh and dry weight of leaves) in both growing seasons compared to control treatment (0 mM) due to foliar application with calcium chloride ($CaCl_2$) either 10 or 20 mM.. A similar finding was reported in other crops such as strawberry (Kazemi, 2015) and lettuce crop (Almeida *et al.,* 2016). This effect can be attributed to the role of calcium ions participation in regulating processes in cell division. Calcium is responsible for regulation of plant growth and development (Cao *et al.,* 2017). It is very important for cell walls and membranes and is necessary to membrane permeability (Hepler, 1994; Marschner, 1995). Growth parameters also varied with cultivars. In this study, there were significant differences in plant height, fresh weight, and dry weight between 'Romaine' and 'Green Waves' cultivars. 'Romaine' cultivar had taller and heavier plants than 'Green Waves' cultivar. Differences in fresh weights between the 2 cultivars were noted by many researchers. For example, Mou, (2009) found that 'Perilla Green' and 'Breen' lettuce cultivars had higher fresh weights compared with other studied cultivars.

Main effects of foliar application of calcium chloride ($CaCl_2$) on yield and yield quality showed that all the foliar application with calcium chloride treatments significantly surpassed the control treatment regarding the total yield. The highest significant total yield was obtained by applying the foliar application with calcium chloride at 20 mM in both seasons. Results reported by Del Amor and Marcelis (2003) suggested

that calcium enhancing effect on growth and yield can be ascribed to increased nutrients uptake. Significant differences were also found among the tested foliar application treatments of calcium chloride regarding quality parameters. A pronounced increase in TSS, chlorophyll content and vitamin C was recorded for calcium chloride treatments. The greatest concentration of calcium chloride, used here, was the most effective. Other researchers found that calcium chloride increased chlorophyll content in leaves of cucumber (Kazemi, 2013), and cowpea (Mohamed and Basalah, 2015). The increase in chlorophyll content could be due to the increment in nitrogen and magnesium uptake as a result of foliar application of calcium chloride (Sabry M. *et al*., 2017). Also, Heaton and Matangoni (1996) found that activation of the chlorophyll metabolism in lettuce leaves as a result of the presence of Ca ion inside the plant cell when plants received calcium in form of calcium chloride (Ritchey *et al*., 1995).

TSS and chlorophyll contents differed between the tested cultivars in both seasons. 'Romaine' cv. showed higher TSS than 'Green waves' cv. Also, plants of 'Romaine' had higher chlorophyll content than 'Green waves' cv. in both seasons. Kim *et al.,* (2016), revealed a difference in nutritional value of lettuce among varieties. Vitamin C content differed between the two tested cultivars in both seasons. Gordana Aćamović *et al.* (2011) and Still (2007) showed that vitamin C content in lettuce crop is dependent upon its type, being higher in green-colored leaf lettuce types, and lower in leaf types of red-leaf lettuce. Also, Mou (2005) found a higher vitamin C content in leaf lettuce than in head-forming type. The impact of $CaCl_2$ is under control of many factors among them the genotype, environmental conditions and form of calcium used and its concentration (Yuan W. et al., 2018). In comparison with other workers, we obtained promising results while used lower concentrations of $CaCl_2$. We speculate that this may be in part due to the frequency of foliar application as we utilized spraying five times. Another reason is most likely as a result of Ca in the soil where its concentration was close to the critical level. Interestingly, high association existed between total yield and all studied traits, except leaf number per plant. In conclusion, this study indicates positive effects of foliar application of calcium chloride ($CaCl_2$) on lettuce productivity parameters. Application of calcium chloride ($CaCl_2$) at 20 mM here was the most apt treatment.

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تأثير الرش باستخدام كلوريد الكالسيوم على النمو والمحصول والجودة فى الخس

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الملخص

اجريت التجربة الحقلية خلال موسمين متتاليين ٢٠١٨/٢٠١٧ و ٢٠١٩/٢٠١٨ وذلك بهدف دراسة تأثير الرش باستخدام كلوريد الكالسيوم بتركيزات ١٠ مليمول ،٢٠ مليمول بالاضافة الى معاملة الكنترول (الرش بالماء) علي النمو والمحصول والجودة فى صنفي الخس "الرومين" و" جرين ويفز"، وتم الرش ٥ مرات خلال موسم النمو.

واوضحت النتائج الاتى:

ادى استخدام كلوريد الكالسيوم رشا على الاوراق سواء بتركيز ١٠ او ٢٠ مليمول الى زيادة معنوية فى صفات النمو الخضرى مثل صفة عدد الاوراق للنبات، الوزن الطازج للاوراق والوزن الجاف لها. وكذلك ادى الى زيادة معنوية فى المحصول الكلى وجودتة متمثله فى صفات المواد الصلبة الكلية القابلة للذوبان ومحتوى الكلورفيل وفيتامين سى مقارنه بمعاملة الكنترول. اما بالنسبة لتأثير الأصناف، فقد تفوق صنف الخس "الرومين" على صنف "جرين ويفز" فى المحتوى من المواد الصلبة الكلية القابلة للذوبان ومحتوى الكلورفيل ،ولكن لم يوجد فرق معنوى بين الصنفين بالنسبة لمحتوى الاوراق من فيتامين سى اما عن التأثير التداخلى المتبادل بين استخدام الرش الورقى بكلوريد الكالسيوم والاصناف المستخدمة قيد الدراسة، فقد ادى الرش بتركيز ٢٠ مليمول على الصنف "جرين ويفز" الى زيادة معنوية فى عدد الاوراق للنبات، بينما اعطى صنف "الرومين" اعلى وزن طازج وايضا جاف للاوراق عندما تم رشة بنفس التركيز وذلك خلال موسمى الدراسة. ايضا اعطى الرش الورقى بتركيز ٢٠ مليمول اعلى قيمة معنوية للمحصول الكلى خلال الموسم الاول، ولكن فى الموسم الثانى تساوى الصنفين فى المحصول الكلى. بالنسبة لصفات الجودة،فأعطت نباتات صنف "الرومين" التى تم رشها بتركيز ٢٠ مليمول من كلوريد الكالسيوم اعلى محتوى من المواد الصلبة الكلية القابلة للذوبان والكلورفيل فى الاوراق خلال موسمى الدراسة. من الجدير بالذكر ان الزياده فى المحصول يرافقها زياده فى كل الصفات التى درست باستثناء عدد الاوراق على النبات.

ونستنتج من هذة الدراسة ،ان الرش الورقى بكلوريد الكالسيوم بتركيز ٢٠ مليمول كان اكثر فاعلية فى تحسين المحصول وجودتة فى صنفى الخس قيد الدراسة.