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EFFECT OF SOME PRE AND POSTHARVEST TREATMENTS ON GROWTH, YIELD, QUALITY AND STORABILITY OF PARSLEY

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ABSTRACT: This investigation were carried out during the winter season of 2017/2018 and 2018/2019 at the Agriculture Research Farm, El-Kassasien Hort. Res. Station, Ismalia Governorate, Egypt, and Handling Lab., Hort. Dept., Fac. Agric., Zagazig University, Egypt, to study the effect of foliar spray with calcium chloride ($CaCl_2$) at 0.5 and 1% and magnesium chloride ($MgCl_2$) at 0.2 and 0.4% as well as number of cuts on root system, vegetative growth, yield and oil yield of parsley plants (*Petroselinum crispum* Mill.) cv. local variety grown under sandy soil conditions. It aimed also to study the effect of the abovementioned treatments and two types of packaging bags (perforated and imperforated polypropylene bags) on storability of parsley plants during cold storage periods, (at harvesting, 7, 14 and 21 days). Significant increases in root system, vegetative growth characters yield and oil yield were recorded by foliar application with $CaCl_2$ at 1% or $MgCl_2$ at 0.4% without significant differences between them in most cases. The third cuts gave the highest values of root system, vegetative growth characters yield and oil yield as compared to the first and second cuts. Visual appearance, vitamin C and chlorophyll content of parsley plants were decreased as the storage period increased. Packing parsley herbs in perforated polypropylene bags recorded the best values of weight loss, visual appearance, vitamin C and total chlorophyll content as well as crude fiber % as compared to imperforated polypropylene bags. Parsley herbs obtained from plants treated with $CaCl_2$ at 1% or $MgCl_2$ at 0.4 % recorded the best values of weight loss, crude fiber %, higher general appearance and total chlorophyll content as well as vitamin C content during storage as compared with the control or other treatments.

Key words: Parsley, cuts, magnesium chloride, calcium chloride, yield, storage period, perforated bags.

INTRODUCTION

Parsley (*Petroselinum crispum* Mill.) is an important biennial plant, which is cultivated widely as an annual, very common and popular member of *Apiaceae* family which originated in the Mediterranean region and cultivated in many parts of the world. In Egypt, the flat-leaf parsley type is the most common type and is cultivated in a commercial scale for local consumption and export. It is a 'powerhouse' of nutrition, and is rich in B (b2, b3 and b6) vitamins, vitamin C (exceeds the amount of lemon by three times), β-carotene and zinc; it is an important dietary component for strengthening bone due to its high content of boron and fluorine. It is also contains iron (in a high percentage) and calcium in an absorbable form. Parsley has anti-inflammatory, antimicrobial, diuretic and hypoglycaemic properties due to its content of essential oil and phenolic compounds **(Taiz and Zeiger, 1998)**.

Magnesium (Mg) is an essential nutrient for plant growth and plays an important role in many plant physiological processes such as photosynthesis (Mg is the central element of the chlorophyll molecule), sugar synthesis, starch translocation, formation of plant oils and fats, control of nutrient uptake, increase iron utilization and aid nitrogen fixation in legume nodules. It also works as an enzyme activator, a constituent of many enzymes and a carrier of phosphorus in the plant **(Mengel and Kirkby 1987, Marschner 1995, Allison *et al.*, 2001).** Several studies have been dealing with the role of Mg on vegetable crops, Mg as foliar application at 1 or 2%

significantly enhanced growth and yield as well as essential oil yield of oregano **(Dordas, 2009)**. Foliar spray with $MgSO_4$ at 20g/ ℓ was most effective resulting in a significant increase in vegetative growth characters and essential oil content of thyme **(Khalid *et al.*, 2009)**. Fertilization parsley plants with magnesium sulphate at 75 kg/feddan resulted in the best values of stem/leaves per plant, plant fresh weights per square meter, plant fresh yield per feddan and essential oils **(Abd El-Aleem *et al.*, 2016).**

Calcium ions (Ca^{++}) play an important role in several biochemical processes **(Poovaiah, 1993)**. Many physiological disorders in storage vegetables and fruits are related to low calcium content in plant tissues **(Bangerth, 1979)**. Calcium has been described as an essential element for the maintenance of cell membranes and walls because it takes part in links with pectic substances which help cell to cell adhesion **(Heppler and Wayne, 1985)**.

Foliar application with Ca^{+2} at 0.5 or 1% significantly enhanced growth and yield as well as essential oil yield of oregano (Dordas, 2009). Foliar spray with calcium at 400 or 800 mg / ℓ Ca, improved growth and yield of lettuce plants **(Samarakoon *et al.*, 2020)**. Spraying snap bean with calcium chloride at 0.5% significantly increased plant growth, total dry weight and yield of snap bean plants, while it reduced weight loss (%), decay (%) and off-oder **(Mohammad *et al.*, 2009)**. After harvesting, parsley plants are a highly perishable crop due to its high moisture content, shriveling associated to rapid loss of weight, high respiration rate and short life. The major causes of quality loss of parsley plants are dehydration, leaf discoloration and decay. There was a considerable increase in weight loss percentage of stored parsley plants with prolonging the storage period, while total chlorophyll content, general appearance and vitamin C were decreased **(Hammam ,2016) and Abd El-Hameed *et al.*, 2018)**. Concerning the effect of packaging type on herb storability, the lowest significant fresh weight loss %, and the highest values of total chlorophyll, vitamin C content, essential oil % and its constitutes were recorded for polyethylene bags **(Hammam ,2016)**. Storage of parsley in perforated packages was minimum loss weight and maximum chlorophyll retained **(Masoud, 2011).**

Thus, this work aimed to study the effect of foliar application with magnesium and calcium chloride on growth, yield, and essential oil as well as improving storability of parsley leaves during storage.

MATERIALS AND METHODS

A. Field experiment

This experiment was carried out during the fall seasons of 2017-2018 and 2018-2019 at the Agricultural Research Farm, El-Kassasien Hort. Res. Station, Ismalia Governorate, Egypt, to study the effect of foliar spray with calcium chloride at 0.5 and 1%, and magnesium chloride at 0.2 and 0.4% as well as number of cuts on root system, growth, yield and its components as well as essential oil content of Parsley plants (*Petroselinum crispum* Mill.) cv. local variety (Egyptian flat leafed parsley) which obtained from Hort. Res. Inst., Agric. Res. Center, Egypt.

These treatments were distributed in a split plot design with three replications. The experiment included fifteen treatments which were the combination between five foliar application that randomly assigned in the main plots as follows: Calcium chloride ($CaCl_{2)}$ at 0.5, calcium chloride at 1%, magnesium chloride ($MgCl_2$) at 0.2%, magnesium chloride ($MgCl_2$) at 0.4%, and control (spraying with tap water), and three cuts which were distributed in the sub- plots.

The experimental soil was sandy in texture with 82.3 and 81.6% sand, 1.7 and 1.6 % silt, 16.0 and 16.8% clay, 8.4 and 8.2pH, 0.3 and 0. 8 % organic matter, 40 and 43 ppm N, 66 and 68 ppm P and 42 and 44 ppm K in the 1st and 2nd seasons, respectively.

The seeds of parsley cultivar were planted directly in the field on 29th and 31st October in the first and second seasons, respectively. The experimental unit area was 7.5 m^2, it contained 5 rows with3m length each with 50 cm wide. One row was left between each two experimental units without spraying as a guard row to avoid the overlapping of spraying solution. The seeds were sown as broadcasting on the row surface. Thinning was done when plants had 4-5 leaves to leave two plants per hill, the average density was 60 plants/m^2.

Parsley plants were sprayed three times during the growth period at 20, 30 and 40 days from sowing. Each experimental unit received 2 ℓ spraying solution using spreading agent (Super Film) in all treatments. The untreated plants (check) were sprayed with 2 ℓ water with spreading agent.

The Horticultural practices suitable for parsley cultivation and production were followed according to the instructions of the Egyptian Ministry of Agriculture. The parsley plants were hand harvested

at the stage of marketable foliage size, by cutting at a height of 5 cm above soil surface. The plants were harvested three times per season (three cuts) with in the same plant, i.e. on 5th and 8th January, 4th and 7th February and 5th and 7th March in 2018 and 2019 seasons, respectively. Data were recorded as follow:

Root system traits

The root of parsley plants were carefully separated by washing the sand from them and roots were placed in a flat glass dish containing a little amount of water. Roots were straighter with forceps, so that they can not overlap and were held in position, according to **Helal and Sauerbesk (1986)** and the following data were recorded per root: Root length (cm), number of lateral roots, fresh and dry weight of root (g), and root volume (cm^3).

Vegetative growth

A random sample of five plants from each plot was randomly taken at harvest time to investigate growth parameters recorded: plant height (cm) and, number of leaf per plant and herm fresh and dry weight (g).

Herb yield

Fresh yield of herb per plant, plot and total herb yield /feddan were determined in all cuts.

Essential oil percentage and oil yield

Essential oil percentage was determined in fresh herbs according to the method described in the **British Pharmacopeia (1963)**. Oil yield per plant was calculated by multiplying oil percentage by herb yield/plant.

B. Postharvest experiment

Parsley plants of the second cut were taken at marketable foliage, and then transported to the Handling Lab., Hort. Dept., Fac. Agric., Zagazig Univ., Egypt. Plants uniform in size, color and healthy without any bruising or injures of leaves and stems were selected for postharvest experiment. About 100 grams of leaves were bunches as one replicate, bunches of plants which obtained from each treatments were divided into two groups; each group contained twelve bunches for each of the following treatments:

1- The bunch inserted into the imperforate polypropylene bags (20 × 25 cm) 30 µm in thickness.

2- The bunch inserted into the perforate polypropylene bags (20 × 25 cm) 30 µm in thickness.

The treatments were arranged in complete randomized design and stored at 0°C and 90-95% relative humidity for 21 days. The sample for each treatment was taken at random in three replicates and evaluated after harvest and then after 0, 7, 14, and 21 days of storage for the following properties.

Weight loss percentage: It was estimated according to the following equation:

$$\text{Weight loss \%} = \frac{\text{Initial weight of herb} - \text{weight of herb at sampling date}}{\text{Initial weight of herb}} \times 100$$

General Appearance (Score): General appearance was evaluated using a scale from 9 to 1, when 9=excellent, 7=good, 5=fair, 3=poor and 1=unsalable; planets rating (5) or below were considered as unmarketable, as described by **(Kader *et al.* 1973)**. It was recorded for both of the shriveling, wilting and color.

Chlorophyll content: Leaves were taken using a portable chlorophyll meter (SPAD-502, Minolta, Tokyo, Japan) and was expressed in arbitrary absorbance (or SPAD values).

Ascorbic acid content (Vitamin C): It was determined using the dye 2, 6-dichloro-phenol indophenols method **(A.O.A.C., 1990)**.

Crude fiber: It was determined (as dry weight basis) according to the method of **Maynard (1970).**

Statistical analysis

Data was subjected to statistical analysis for calculation of means, variance and stander error according to MSTAT software. Means separations were estimated by calculating LSD value at 5% level according to **(Snedecor and Cochran, 1980)**.

RESULTIS AND DISCUSSION

Field experiment

Root system

Effect of foliar application

Data presented in Table 1 show that, there were significant differences among the tested treatments in root system of parsley plants expressed as root length, lateral roots, fresh and dry weight of root per plant as well as root volume. Such data revealed that foliar application with calcium chloride ($CaCl_2$) at 1%

significantly increased all different root system parameters during both seasons of growth, while using foliar application with $CaCl_2$ at 0.5% ranked the second in all root system measurements and with significant differences between them and magnesium chloride in case of lateral roots number. On the contrary, the lowest values in all measured root system traits were recorded in case of control treatment. The stimulate effect of calcium chloride on root system of parsley plant may be probably due to the well supplied top layer, ensuring sufficient amounts of calcium and other nutrients for the roots. **(Emanuelsson, 1984)**. In this respect, similar findings were reported by **Emanuelsson (1984)** on barley.

Effect of number of cuts

Concerning the effect of different cuts on root system of parsley plants the same results show that, the growth of the third cut measured in terms of root length, lateral roots, fresh and dry weight of root per plant as well as root volume varied significantly under different cuts (Table1). The third cut increased significantly of this character than the other cuts, theses results were true in the two seasons. The increase in tested treatments of root system of parsley plants may be due to the longer growth period of the plants from the first up to third cut.

Effect of interaction between foliar application and number of cuts

Results in Table 2 showed significant variation on growth of root system, data revealed that, foliar application with most of using treatments showed significant variation on root system growth in the three cuts of both growing seasons. Foliar application with $CaCl_2$ at 1% in the second and third cut gave the tallest roots, highest values of lateral roots, fresh and dry root weight as well as root volume, however, the interaction between the second cut and foliar application with $CaCl_2$ at 1 % ranked the second in all root system measurements except root length. On the other side, the lowest values in all measured root system traits were recorded in case of control treatment in the first cut.

Table 1. Effect of foliar application with some nutritional elements and number of cuts on root system characters of parsley plants during 2017/2018 and 2018/2019 seasons

Characters / Treatments	Root system / plant									
	Root length (cm)		Root fresh weight (g)		Root dry weight (g)		No of lateral roots		Root volume (cm^3)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Foliar application										
Control	**23.90**	**25.57**	**8.06**	**9.71**	**1.75**	**2.08**	**6.8**	**8.7**	**5.64**	**5.79**
Calcium chloride at 0.5%	**33.10**	**33.47**	**14.88**	**16.77**	**3.22**	**3.60**	**7.5**	**10.6**	**10.41**	**10.11**
Calcium chloride at 1%	**35.17**	**35.53**	**18.76**	**19.40**	**4.30**	**4.13**	**8.4**	**11.1**	**13.76**	**11.61**
Magnesium chloride at 0.2%	**28.40**	**29.63**	**11.47**	**13.20**	**2.60**	**2.83**	**7.6**	**10.3**	**8.36**	**7.97**
Magnesium chloride at 0.4%	**30.47**	**31.20**	**13.46**	**14.54**	**2.92**	**3.05**	**8.1**	**10.8**	**9.51**	**8.61**
L.S.D at 5%	**2.00**	**2.46**	**2.26**	**1.84**	**0.17**	**0.18**	**0.6**	**0.7**	**1.11**	**1.22**
Number of cuts										
First cut	**25.26**	**26.12**	**11.95**	**13.13**	**2.68**	**2.81**	**6.9**	**9.4**	**8.60**	**7.89**
Second cut	**29.88**	**30.86**	**13.38**	**14.91**	**2.95**	**3.15**	**7.6**	**10.3**	**9.49**	**8.85**
Third cut	**35.18**	**36.26**	**14.64**	**16.12**	**3.25**	**3.45**	**8.5**	**11.2**	**10.53**	**9.72**
L.S.D at 5%	**1.69**	**2.52**	**1.13**	**0.93**	**0.15**	**0.15**	**0.4**	**0.4**	**0.90**	**1.03**

Table 2. Effect of interaction between foliar application with some nutritional elements and number of cuts on root system characters of parsley plants during 2017/2018 and 2018/2019 seasons

Treatments		Root system / plant									
		Root length (cm)		Root fresh weight (g)		Root dry weight (g)		No of lateral roots		Root volume (cm^3)	
Foliar application	Number of cuts	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	First cut	19.7	22.5	7.35	8.87	1.59	1.86	6.2	7.9	5.11	5.15
	Second cut	23.6	25.0	7.96	9.83	1.74	2.11	6.8	8.6	5.60	5.90
	Third cut	28.4	29.2	8.86	10.42	1.93	2.26	7.5	9.5	6.21	6.33
Calcium chloride at 0.5%	First cut	28.5	27.6	13.47	15.24	2.92	3.26	6.8	9.7	9.40	9.10
	Second cut	32.2	33.1	14.89	16.68	3.21	3.59	7.5	10.7	10.35	10.10
	Third cut	38.6	39.7	16.28	18.39	3.54	3.96	8.3	11.3	11.50	11.15
Calcium chloride at 1%	First cut	29.8	29.3	16.60	17.29	3.89	3.68	7.6	10.1	12.50	10.35
	Second cut	35.8	35.6	19.21	19.28	4.29	4.14	8.4	11.1	13.80	11.64
	Third cut	39.9	41.7	20.47	21.64	4.71	4.57	9.2	12.0	15.00	12.85
Magnesium chloride at 0.2%	First cut	23.4	25.2	10.17	11.43	2.35	2.55	6.8	9.4	7.55	7.18
	Second cut	28.1	29.4	11.39	13.87	2.59	2.81	7.6	10.3	8.35	7.90
	Third cut	33.7	34.3	12.86	14.29	2.85	3.12	8.4	11.3	9.20	8.85
Magnesium chloride at 0.4%	First cut	26.4	26.0	12.15	12.82	2.64	2.73	7.3	9.8	8.45	7.70
	Second cut	29.7	31.2	13.47	14.91	2.91	3.09	8.0	10.7	9.35	8.70
	Third cut	35.3	36.4	14.76	15.88	3.22	3.34	8.9	11.8	10.75	9.45
L.S.D at 5%		3.55	5.64	2.54	2.08	0.35	0.33	0.9	1.0	2.01	2.31

Vegetative growth

Effect of foliar application

It is obvious from the data presented in Table 3 that, there were significant differences among the tested treatments in vegetative growth characters of parsley plants expressed as plant height, number of leaves per plant, fresh and dry weight of plant. Such results revealed that foliar application with magnesium chloride ($MgCl_2$) at 0.4% significantly increased all different vegetative growth characters during both seasons of growth, while using foliar application with $CaCl_2$ at 1% ranked the second in most vegetative growth characters and without significant differences between them in herb dry weight. On the contrary, the lowest values in all measured vegetative growth characters were recorded in case of control treatment. The positive effect of Mg^{+2} applications on vegetative growth of parsley plant may be due to the important physiological role of Mg^{+2} on molecule structure, enzyme activity and protein synthesis **(Jones *et al.* 1991)**. While, the favorable effect of Ca^{+2} on increased vegetative growth of parsley may by due to that calcium is required for cell division and elongation, and it increases plant height by enhancing the mitotic activity in plant shoot meristems **(Rab and Haq, 2012)**. These results are in accordance with those of **Khalid *et al.* (2009)** on thyme and **Abd El-Aleem *et al.* (2016)** on parsley.

Effect of number of cuts

Regarding the effect of different cuts on vegetative growth characters of parsley plants, the same results show that the growth of third cut measured in terms of plant height, number of leaves per plant, fresh and dry weight of herb varied significantly under different cuts (Table 3). The third cut increased significantly of this character than the other cuts, theses results were true in the two seasons. The increase in tested treatments of vegetative growth characters of parsley plants may be due to the longer growth period of the plants from the first up to third cut. Present results are confirmed by the findings of **Abd El-Hameed *et al.* (2016)** on parsley who found that the second cut increased significantly vegetative growth than the other cuts.

Table 3. Effect of foliar application with some nutritional elements and number of cuts on vegetative growth characters of parsley plants during 2017/2018 and 2018/2019 seasons

Characters / Treatments	Vegetative growth							
	Plant height (cm)		No. of leaves /plant		Herb fresh weight (g)		Herb dry weight (g)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Foliar application								
Control	34.1	38.2	15.4	18.6	20.08	28.68	2.38	3.42
Calcium chloride at .5%	40.9	42.9	18.6	22.3	25.21	32.09	3.27	3.85
Calcium chloride at 1%	43.4	46.1	19.4	23.9	27.32	34.42	3.34	4.18
Magnesium chloride at 0.2%	42.3	47.2	20.3	22.9	26.74	35.85	3.22	4.29
Magnesium chloride at 0.4%	44.7	49.3	21.2	25.2	30.24	41.71	3.79	4.99
L.S.D at 5%	2.4	2.6	2.84	1.8	2.01	3.00	0.99	0.84
Number of cuts								
First cut	37.6	42.6	15.6	17.7	18.88	27.70	2.24	3.05
Second cut	41.4	45.3	18.7	22.8	26.26	34.31	3.31	4.16
Third cut	44.2	46.3	22.6	27.3	32.61	41.64	4.05	5.23
L.S.D at 5%	1.6	2.5	1.00	1.9	2.25	1.76	0.56	0.67

The vegetative sample was taken one day before every cut.

Effect of interaction between foliar application and number of cuts

Presented data in Table 4 showed significant variation on vegetative growth characters, data revealed that foliar application with most of using treatments showed significant variation on vegetative growth in the three cuts of both growing seasons. Foliar application with $MgCl_2$ at 0.4% in the third cut gave the highest values of plant height, number of leaves per plant, fresh and dry weight of herb followed by the interaction between the third cut and foliar application with $CaCl_2$ at 1% or with $MgCl_2$ at 0.2% without significant difference between them in most cases in both seasons. The lowest values in all measured vegetative growth traits were recorded in case of control treatment in the first cut.

Fresh herb yield and oil yield

Effect of foliar application

The obtained results in Table 5 show that, there were significant differences among the tested treatments in fresh herb yield and oil yield of parsley plants expressed as fresh herb yield per plant and per plot, total fresh herb yield per feddan and essential oil percentage as well as oil yield per plant. Such data revealed that foliar application with magnesium chloride ($MgCl_2$) at 0.4% was the superior treatment which significantly increased all different fresh herb yield and oil yield parameters during both seasons of growth, while using foliar application with $MgCl_2$ at 0.2% and $CaCl_2$ at 1% ranked the second in all fresh herb yield and oil yield without significant difference between them in most cases. On the contrary, the lowest values in all measured fresh herb yield and oil yield traits were recorded in case of control treatment. The enhancing effect of magnesium element on herb yield and oil percentage may be attributed to its aids in the formation of many compounds, such as sugars, proteins, it regulates the uptake of other plant nutrients, especially phosphorus and it is involved in the translocation and metabolism of carbohydrates **(Kiss, 1989)**. The obtained results are in harmony with those of **Dordas (2009)** on oregano**, Khalid *et al.* (2009)** on thyme and **Abd El-Aleem *et al.* (2016)** on parsley.

Table 4. Effect of interaction between foliar application with some nutritional elements and number of cuts on vegetative growth characters of parsley plants during 2017/2018 and 2018/2019 seasons

Treatments		Vegetative growth							
		Plant height (cm)		No. of leaves /plant		Herb fresh weight (g)		Herb dry weight (g)	
Foliar application	Number of cuts	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	First cut	31.2	34.8	12.7	15.1	14.73	22.35	1.78	2.41
	Second cut	34.3	38.7	15.2	18.6	20.55	29.16	2.41	3.49
	Third cut	36.7	41.2	18.4	22.1	24.95	34.54	2.94	4.37
Calcium chloride at 0.5%	First cut	37.5	39.4	15.3	17.3	18.54	25.64	2.39	2.80
	Second cut	41.3	43.7	18.4	22.5	25.46	31.04	3.31	3.78
	Third cut	44.0	45.5	22.1	27.0	31.62	39.59	4.11	4.98
Calcium chloride at 1%	First cut	39.7	44.6	16.1	18.6	19.83	27.58	2.28	3.08
	Second cut	43.7	46.7	18.9	24.2	27.68	33.92	3.49	4.17
	Third cut	46.9	47.1	23.2	29.0	34.46	41.75	4.25	5.29
Magnesium chloride at 0.2%	First cut	38.6	45.8	16.7	17.8	19.73	28.90	2.17	3.19
	Second cut	42.5	47.6	20.0	23.1	26.88	35.57	3.33	4.28
	Third cut	45.7	48.2	24.1	27.8	33.62	43.08	4.17	5.39
Magnesium chloride at 0.4%	First cut	41.2	48.6	17.4	19.7	21.56	34.04	2.59	3.76
	Second cut	45.3	49.8	21.0	25.5	30.72	41.86	4.03	5.09
	Third cut	47.5	49.5	25.2	30.5	38.43	49.24	4.76	6.12
L.S.D at 5%		3.7	5.7	2.1	4.3	5.04	3.94	1.25	1.50

The vegetative sample was taken one day before every cut.

Table 5. Effect of foliar application with some nutritional elements and number of cuts on fresh herb and oil yield of parsley plants during 2017/2018 and 2018/2019 seasons

Characters / Treatments	Fresh herb and oil yield									
	Fresh herb yield /plant (g)		Fresh herb yield/plot (kg)		Total fresh herb yield/ feddan(kg)		Essential oil percent (%)		Oil yield /plant (ml)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Foliar application										
Control	22.85	31.02	10.284	13.957	5484.9	7443.9	0.013	0.014	0.297	0.424
Calcium chloride at 0.5%	27.54	34.42	12.393	15.490	6609.5	8261.5	0.016	0.019	0.438	0.662
Calcium chloride at 1%	30.66	37.75	13.796	16.987	7357.7	9059.9	0.018	0.022	0.554	0.845
Magnesium chloride at 0.2%	29.08	38.18	13.084	17.182	6978.3	9163.9	0.016	0.021	0.470	0.793
Magnesium chloride at 0.4%	33.57	45.05	15.106	20.272	8056.7	10811.1	0.020	0.024	0.687	1.069
L.S.D at 5%	2.49	2.30	1.105	1.036	597.1	552.6	0.002	0.002	0.071	0.043
Number of cuts										
First cut	21.54	30.10	9.695	13.546	5170.6	7224.3	0.016	0.019	0.345	0.584
Second cut	29.66	37.71	13.346	16.969	7117.9	9050.3	0.018	0.021	0.546	0.820
Third cut	35.02	44.04	15.757	19.818	8403.7	10569.5	0.016	0.019	0.577	0.872
L.S.D at 5%	1.74	1.88	0.783	0.845	418.0	450.7	0.001	0.001	0.051	0.034

The cut was done at the next day of taken the vegetative sample.

Effect of number of cuts

As for effect of different cuts on fresh herb yield and oil yield of parsley plants the same results show that, the fresh herb yield of third cut measured in terms of fresh herb yield per plant and per plot, total fresh herb yield per feddan varied significantly under different cuts (Table 5). The third cut increased significantly of this character than the other cuts, theses results were true in the two seasons. Regarding essential oil percentage and oil yield it is clear from the data in Table (5) that, there were significant differences among different cuts on oil yield, however the second cut gave the highest values of theses characters followed by the third cut with significant difference between them in most cases in the two seasons. The Present results are confirmed by the findings of **Abd El-Hameed *et al.* (2016)** on parsley.

Effect of interaction between foliar application and number of cuts

Presented data in Table 6 showed significant variation on fresh herb yield and oil yield. Data revealed that foliar application with most of using treatments showed significant variation on fresh herb yield and oil yield in the three cuts of both growing seasons. Foliar application with $MgCl_2$ at 0.4% in the third cut gave the highest values of fresh herb yield per plant and per plot, total fresh herb yield per feddan as well as oil yield per plant followed by the interaction between third cut and foliar application with $CaCl_2$ at 1% or $MgCl_2$ at 0.2% with significant difference between them in most cases in both seasons. The lowest values in all measured fresh herb yield traits were recorded in case of control treatment in the first cut. Meanwhile the interaction between foliar application with $MgCl_2$ at 0.4% in the second cut gave the highest values of essential oil percentage (0.022 and 0.025%) in the 1st and 2nd seasons, respectively.

Table 6. Effect of interaction between foliar application with some nutritional elements and number of cuts on fresh herb and oil yield of parsley plants during 2017/2018 and 2018/2019 seasons

Treatments		Fresh herb and oil yield									
		Fresh herb yield /plant (g)		Fresh herb yield/plot (kg)		Total fresh herb yield/ feddan(kg)		Essential oil percent (%)		Oil yield /plant (ml)	
Foliar application	Number of cuts	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	First cut	18.06	24.35	8.128	10.957	4335.2	5843.9	0.012	0.013	0.216	0.316
	Second cut	23.55	32.16	10.597	14.472	5651.9	7718.3	0.014	0.015	0.329	0.482
	Third cut	26.95	36.54	12.127	16.443	6467.9	8769.5	0.013	0.013	0.350	0.475
Calcium chloride at 0.5%	First cut	20.54	27.64	9.243	12.438	4929.5	6633.6	0.016	0.019	0.328	0.525
	Second cut	28.46	34.04	12.807	15.318	6830.3	8169.5	0.017	0.021	0.483	0.714
	Third cut	33.62	41.59	15.129	18.715	8068.7	9981.5	0.015	0.018	0.504	0.748
Calcium chloride at 1%	First cut	22.83	30.58	10.273	13.761	5479.1	7339.1	0.017	0.021	0.388	0.642
	Second cut	31.68	37.92	14.257	17.064	7603.9	9100.7	0.019	0.024	0.601	0.910
	Third cut	37.46	44.75	16.857	20.137	8990.3	10739.9	0.018	0.022	0.674	0.984
Magnesium chloride at 0.2%	First cut	21.73	30.90	9.778	13.905	5215.1	7415.9	0.014	0.019	0.304	0.587
	Second cut	29.88	38.57	13.446	17.356	7171.1	9256.7	0.018	0.022	0.537	0.848
	Third cut	35.62	45.08	16.029	20.286	8548.7	10819.1	0.016	0.021	0.570	0.946
Magnesium chloride at 0.4%	First cut	24.56	37.04	11.052	16.668	5894.3	8889.5	0.020	0.023	0.491	0.851
	Second cut	34.72	45.86	15.624	20.637	8332.7	11006.3	0.022	0.025	0.783	1.146
	Third cut	41.43	52.24	18.643	23.508	9943.1	12537.5	0.019	0.023	0.787	1.210
L.S.D at 5%		3.89	4.20	1.751	1.890	934.6	1007.8	0.008	0.009	0.114	0.076

The cut was done at the next day of taken the vegetative sample.

The storage experiment

Weight loss Percentage

Results presented in Table 7 emphasized that weight loss percentage of parsley plants was increased considerable and consistently with the prolongation of storage period, whilst the maximum loss was occurred at the end of storage period (21days). The loss in weight may be attributed to transpiration, respiration and other senescence related metabolic process during storage **(Bakowski and Michalik, 1986)**. These results are in accordance with **Hammam (2016) and Abd El-Hameed *et al.* (2018)** on parsley. Regarding the effect of packaging type, data revealed that there were significant differences between the two treatments during storage (7, 14 and 21 days). Parsley fresh herb packed in perforated polypropylene bags had the lowest value of weight loss percentage as compared to imperforated polypropylene bags. The favorable effect of packaging type, that parsley plant packed in perforated polypropylene bags resulted in the of minimum loss weight, which might be due to the reduction in respiration rate and carbohydrate resource was consumed slightly. These results agreed with **Masoud (2011)** and **Hammam (2016)** on parsley.

Table 7. Effect of foliar application with some nutritional elements and bags type on weight loss percentage of parsley plants during cold storage in 2017/2018 and 2018/2019 seasons

Foliar application treatments	packaging type	2017/2018 season					2018/2019 season				
		Storage period (days)									
		Initial	7	14	21	Mean	Initial	7	14	21	Mean
		Weight loss %									
Control	Perforated bags	-	0.99	1.81	4.62	**2.47**	-	0.85	1.63	4.51	**2.33**
Calcium chloride at 0.5%		-	0.57	1.33	4.09	**1.99**	-	0.48	1.18	3.93	**1.86**
Calcium chloride at 1%		-	0.50	1.24	3.98	**1.90**	-	0.43	1.11	3.86	**1.80**
Magnesium chloride at 0.2%		-	0.65	1.42	4.18	**2.08**	-	0.53	1.26	4.10	**1.96**
Magnesium chloride at 0.4%		-	0.59	1.36	4.12	**2.02**	-	0.49	1.21	3.97	**1.89**
Mean		**-**	**0.66**	**1.43**	**4.19**	**2.09**	**-**	**0.55**	**1.27**	**4.07**	**1.96**
Control	Imperforated bags	-	1.06	1.86	4.69	**2.53**	-	0.89	1.70	4.60	**2.39**
Calcium chloride at 0.5%		-	0.77	1.55	4.33	**2.21**	-	0.62	1.37	4.25	**2.08**
Calcium chloride at 1%		-	0.69	1.48	4.25	**2.14**	-	0.57	1.31	4.18	**2.02**
Magnesium chloride at 0.2%		-	0.86	1.66	4.47	**2.33**	-	0.71	1.46	4.37	**2.18**
Magnesium chloride at 0.4%		-	0.80	1.59	4.39	**2.26**	-	0.64	1.40	4.29	**2.11**
Mean		**-**	**0.83**	**1.62**	**4.42**	**2.29**	**-**	**0.68**	**1.44**	**4.33**	**2.15**
Mean (S)		**-**	**0.62**	**1.36**	**4.20**	**-**	**-**	**0.74**	**1.53**	**4.31**	**-**
Control		-	1.02	1.83	4.65	**2.50**	-	0.87	1.66	4.55	**2.36**
Calcium chloride at 0.5%		-	0.67	1.44	4.21	**2.10**	-	0.55	1.27	4.09	**1.97**
Calcium chloride at 1%		-	0.59	1.36	4.11	**2.02**	-	0.50	1.21	4.02	**1.91**
Magnesium chloride at 0.2%		-	0.75	1.54	4.32	**2.20**	-	0.62	1.36	4.23	**2.07**
Magnesium chloride at 0.4%		-	0.69	1.47	4.25	**2.14**	-	0.56	1.30	4.13	**2.00**

LSD at 5%	Treatments (T)	Bags type (B)	Storage period (S)	T × B	S × B	T × S	T ×B× S
1st season	0.21	0.13	0.16	0.30	0.23	0.36	0.51
2nd season	0.20	0.18	0.16	0.29	0.22	0.36	0.51

All foliar application treatments significantly reduced the weight loss percentage as compared with untreated plants. However, parsley plants sprayed with $CaCl_2$ at 1% retained their weight during storage as compared with untreated plants. Moreover, parsley plants sprayed with $CaCl_2$ at 0.5% followed by $MgCl_2$ at 0.4% resulted prominent reduction in weight loss percentage during storage without significant difference between them. On the other hand, the highest values of weight loss percentage were recorded with untreated plants (control). These results were true in the two seasons and in agreement with **Mohammad *et al.* (2009)** and **Arish *et al.* (2015)** on snap bean who emphasized that weight loss percentage was decreasing significantly by foliar application with calcium chloride at 0.5% and 1%. The stimulate effect of calcium chloride on weight loss may be probably due to the importance of Ca supplies for improving parsley growth under these conditions, which may be attributed to calcium role in plant such as; promotes proper plant cell elongation; strengthen cell wall structure; it forms calcium bectate compounds which give stability to cell walls and bind cells together; participates in enzymatic and hormonal processes **(Marschner, 1995** and **Mengel and Kirkby, 2001).** Regarding the effect of interaction among foliar application, packaging type and storage period, data in the same Table (7) revealed that, after 21 days of storage, there were significant differences, however, parsley plants which sprayed with $CaCl_2$ at 1% and packed in perforated polypropylene bags had the lowest weight loss percentage followed by parsley plants which sprayed with $CaCl_2$ at 0.5% and packed in perforated polypropylene bags and plants which sprayed with $MgCl_2$ at 0.4% and packed in perforated polypropylene bags with no significant differences among them.

General appearance (GA)

Data in Table (8) show that general appearance (score) of parley plants significantly decreased with the prolongation of storage periods in both seasons, where the minimum values were occurred at the end of storage period. The decrease in GA of parsley plants during storage period might be due to shriveling, wilting, color changes and decay **Ouzounidou *et al.* (2013)**, these results are true in both seasons of study. Similar results were reported by **Ouzounidou *et al.* (2013) and Abd El-Hameed *et al.* (2018)** on parsley plants. Concerning the effect of packaging type, the same results indicate that parsley fresh herb packed in perforated polypropylene bags was significantly lower than those of packed in imperforated polypropylene bags. The favorable effect of packaging type that parsley plant packed in perforated polypropylene bags resulted in the maximum GA, which might be due to the reduction respiration rate and carbohydrate resource was consumed slightly. These results agreed with **Ouzounidou *et al.* (2013)** and **Hammam (2016)** on parsley.

With respect to the effect of foliar application on GA of parsley plant, data in Table (8) show that, all foliar application treatments significantly affected GA of parsley herb as compared with untreated plants. However, parsley plants which sprayed with $CaCl_2$ at 1% gave the best GA during storage as compared with untreated plants followed by, plants sprayed with $CaCl_2$ at 0.5% and $MgCl_2$ at 0.4% without significant difference between them. On the contrary, the lowest values of general appearance were recorded in case of untreated plants (control). As for the effect of interaction among foliar application, packaging type and storage period, results in Table (8) revealed that, after 21 days of storage, there were significant differences for GA, however, parsley plants which sprayed with $CaCl_2$ at 1% and packed in perforated polypropylene bags had the best general appearance followed by parsley plants which sprayed with $CaCl_2$ at 0.5% and packed in perforated polypropylene bags and plants which sprayed with $MgCl_2$ at 0.4% and packed in perforated polypropylene bags without significant differences among them in both seasons of study.

Table 8. Effect of foliar application with some nutritional elements and bags type on general appearance of parsley plants during cold storage in 2017/2018 and 2018/2019 seasons

Foliar application treatments	packaging	2017/2018 season					2018/2019 season				
		Storage period (days)									
		Initial	7	14	21	Mean	Initial	7	14	21	Mean
		General appearance score*									
Control	Perforated bags	9.00	5.67	5.00	1.00	**5.16**	9.00	7.00	5.33	1.00	**5.58**
Calcium chloride at 0.5%		9.00	8.33	7.67	5.00	**7.50**	9.00	8.67	8.00	5.33	**7.75**
Calcium chloride at 1%		9.00	8.67	8.00	5.33	**7.75**	9.00	9.00	8.33	5.67	**8.00**
Magnesium chloride at 0.2%		9.00	8.00	7.33	3.67	**7.00**	9.00	8.33	7.67	5.00	**7.50**
Magnesium chloride at 0.4%		9.00	8.33	7.67	5.00	**7.50**	9.00	8.67	8.00	5.00	**7.67**
Mean		**9.00**	**7.80**	**7.13**	**4.00**	**6.98**	**9.00**	**8.33**	**7.46**	**4.40**	**7.30**
Control	Imperforated bags	9.00	5.33	5.00	1.00	**5.08**	9.00	7.00	5.00	1.00	**5.50**
Calcium chloride at 0.5%		9.00	7.67	7.00	3.33	**6.75**	9.00	8.00	7.00	3.67	**6.91**
Calcium chloride at 1%		9.00	7.67	7.00	3.67	**6.83**	9.00	8.00	7.33	3.67	**7.00**
Magnesium chloride at 0.2%		9.00	5.67	5.33	3.00	**5.75**	9.00	7.67	5.67	3.00	**6.33**
Magnesium chloride at 0.4%		9.00	7.33	5.67	3.33	**6.33**	9.00	8.00	7.00	3.67	**6.91**
Mean		**9.00**	**6.73**	**6.00**	**2.86**	**6.15**	**9.00**	**7.73**	**6.40**	**3.80**	**6.53**
Mean (S)		**9.00**	**7.26**	**6.56**	**3.43**	**-**	**9.00**	**8.03**	**6.93**	**3.70**	**-**
Control		9.00	5.50	5.00	1.00	**5.12**	9.00	7.00	5.16	1.00	**5.54**
Calcium chloride at 0.5%		9.00	8.00	7.33	4.16	**7.12**	9.00	8.33	7.50	4.50	**7.33**
Calcium chloride at 1%		9.00	8.16	7.50	4.50	**7.29**	9.00	8.50	7.83	4.67	**7.50**
Magnesium chloride at 0.2%		9.00	6.83	6.33	3.33	**6.37**	9.00	8.00	6.67	4.00	**6.91**
Magnesium chloride at 0.4%		9.00	7.83	6.66	4.16	**6.91**	9.00	8.33	7.50	4.33	**7.29**

LSD at 5%	Treatments (T)	Bags type (B)	Storage period (S)	T × B	S × B	T × S	T ×B× S
1st season	0.23	0.14	0.20	0.32	0.29	0.45	0.64
2nd season	0.19	0.12	0.17	0.27	0.24	0.39	0.55

* Score: 9= Excellent, 7= Good, 5= Fair, 3= Poor, 1= unsalable

Total chlorophyll content

Results in Table (9) show that there was significant reduction in total chlorophyll content (SPAD) of parsley plants during storage, where the maximum total chlorophyll content was occurred at harvesting time and the minimum values were occurred at the end of storage period (21 days). Generally, parsley plants became yellowish green with the extension of the storage period. This decrement in total chlorophyll content could be attributed to gradual increase in of destruction by chlorophyll degrading peroxidase activity and also transformation chloroplasts to chromoplasts by chlorophyllase activity **(Charles *et al.*, 1991).** These results were in agreement with those obtained by **Masoud (2011)**, **Hammam (2016)** and **Abd El-Hameed *et al.* (2018)** on parsley plants.

A major problem for parsley marketing is the extension of its shelf life without significant change in chlorophyll content and color parameters during storage, such as changes resulting in leaf yellowing. Concerning the effect of packaging type, data revealed that there were significant differences between two packaging type during storage; however, parsley fresh herb packed in perforated polypropylene bags seems to be the most effective in reducing the total chlorophyll loss as compared with imperforated polypropylene bags with significant differences between them. These results were true in the two seasons and agree with **Ouzounidou *et al.* (2013)** and **Abd El-Hameed *et al.* (2018)** who concluded content of parsley leaves during storage.

Regarding treatments, it is clear from the same results in Table (9) that all foliar application

treatments significantly reduced the loss of total chlorophyll content as compared with untreated plants, while, parsley plants which sprayed with $MgCl_2$ at 0.2 or 0.4% significantly increased chlorophyll content of parsley plants followed by plants sprayed with $CaCl_2$ at 1% without significant difference among the three treatments. On the contrary, the lowest values of total chlorophyll content were recorded in case of untreated plants (control). With respect to the effect of the interaction among foliar application, packaging type and storage period, results in Table (9) revealed that, after 21 days from storage there were significant differences for total chlorophyll content, however parsley plants which sprayed with $MgCl_2$ at 0.2 or 0.4% and packed in perforated polypropylene bags recorded the highest values of total chlorophyll content followed by parsley plants sprayed with $CaCl_2$ at 1% and packed in perforated polypropylene bags without significant differences among them in both seasons of study.

Table 9. Effect of foliar application with some nutritional elements and bags type on total chlorophyll (SPAD) of parsley plants during cold storage in 2017/2018 and 2018/2019 seasons

Foliar application treatments	packaging type	2017/2018 season					2018/2019 season				
		Storage period (days)									
		Initial	7	14	21	Mean	Initial	7	14	21	Mean
		Chlorophyll content (SPAD unit)									
Control	Perforated bags	32.72	32.37	31.31	28.03	**31.10**	34.69	34.28	32.24	28.66	**32.46**
Calcium chloride at 0.5%		35.71	35.23	33.42	30.45	**33.70**	37.60	37.00	34.82	31.66	**35.27**
Calcium chloride at 1%		36.00	35.55	33.83	30.84	**34.05**	38.19	37.45	35.29	32.00	**35.73**
Magnesium chloride at 0.2%		36.22	35.72	34.04	31.32	**34.32**	38.44	37.82	35.44	32.15	**35.96**
Magnesium chloride at 0.4%		36.64	36.07	34.56	31.91	**34.79**	38.82	38.29	36.08	32.73	**36.48**
Mean		**35.45**	**34.98**	**33.43**	**30.51**	**33.59**	**37.54**	**36.96**	**34.77**	**31.44**	**35.18**
Control	Imperforated bags	32.72	32.15	31.07	27.31	**30.81**	34.69	34.11	32.03	28.34	**32.29**
Calcium chloride at 0.5%		35.71	33.73	32.02	28.54	**32.50**	37.60	35.72	33.68	30.09	**34.27**
Calcium chloride at 1%		36.00	34.31	32.43	29.19	**32.98**	38.19	36.15	34.09	30.62	**34.76**
Magnesium chloride at 0.2%		36.22	34.52	32.65	29.63	**33.25**	38.44	36.32	34.22	30.86	**34.96**
Magnesium chloride at 0.4%		36.64	35.04	33.11	30.06	**33.71**	38.82	36.61	34.51	31.27	**35.30**
Mean		**35.45**	**33.95**	**32.25**	**28.94**	**32.65**	**37.54**	**35.78**	**33.70**	**30.23**	**34.31**
Mean (S)		**35.45**	**34.47**	**32.84**	**29.72**	**-**	**37.54**	**36.37**	**34.24**	**30.83**	**-**
Control		32.72	32.26	31.19	27.67	**30.96**	34.69	34.19	32.13	28.50	**32.38**
Calcium chloride at 0.5%		35.71	34.48	32.72	29.49	**33.10**	37.60	36.36	34.25	30.87	**34.77**
Calcium chloride at 1%		36.00	34.93	33.13	30.01	**33.52**	38.19	36.80	34.69	31.31	**35.24**
Magnesium chloride at 0.2%		36.22	35.12	33.34	30.47	**33.79**	38.44	37.07	34.83	31.50	**35.46**
Magnesium chloride at 0.4%		36.64	35.55	33.83	30.98	**34.25**	38.82	37.45	35.29	32.00	**35.89**

LSD at 5%	Treatments (T)	Bags type (B)	Storage period (S)	T × B	S × B	T × S	T ×B× S
1st season	0.36	0.23	0.32	0.51	0.46	0.72	1.02
2nd season	0.47	0.30	0.42	0.66	0.59	0.94	1.33

Vitamin C content

Data in Table (10) showed that vitamin C content of parsley fresh herb significantly decreased with the prolongation of the storage periods in the two seasons of study. The reduction of vit. C during storage might be attributed to the higher rate of sugar loss through respiration than water loss through transpiration. Similar results were obtained by **Masoud (2011)** and **Hammam (2016)** on parsley plants. For the effect of packaging type, the data in the two seasons stated that there was a significant difference between packaging types. Parsley plants packed in perforated polypropylene bags retarded vitamin C loss as compared with imperforated polypropylene bags. These results agreed with **Masoud, (2011)** and **Hammam (2016)** on parsley fresh herb.

As for treatments, it is clear from the same results in Table (10) that all foliar application treatments significantly increased vitamin C content as compared with untreated plants while, parsley plants which sprayed with $CaCl_2$ at 1% significantly increased vitamin C content of parsley herb followed by plants sprayed with $CaCl_2$ at 0.5% with significant difference between. In contrast to this, the lowest values of vitamin C content were recorded in case of untreated plants (control). With regard to the effect of interaction among foliar application, packaging type and storage period, results in Table (10) revealed that, after 21 days from storage there were significant differences for vitamin C content, however parsley plants which sprayed with $CaCl_2$ at 1% and packed in perforated polypropylene bags recorded the highest values of vitamin C content (40.25 and 42.37 mg/100gm) in the first and second seasons, respectively, followed by parsley plants sprayed with $MgCl_2$ at 0.4% and packed in perforated polypropylene bags with significant differences between them in both seasons of study.

Crude fiber percentage

Data in Table (11) show the effect of cold storage periods on crude fiber (%) of parsley herbs during storage in the two seasons. Data revealed that crude fiber content of parsley herbs increased with the prolongation of storage period, where the minimum values were occurred at the harvesting time (3.31 and 3.23 %) in the 1st and 2nd seasons, respectively, meanwhile the maximum values were noticed at the end of storage period (21days) 5.83 and 5.74 % in the 1st and 2nd seasons, respectively. In general, this means that, there were positive correlation between weight loss percentage (Table7) and crude fiber percentage. With respect to the effect of packaging type, the data in the two seasons stated that there was no significant difference between packaging types for crude fiber percentage, these results are true in both seasons of study.

All foliar application treatments significantly reduced crude fiber percentage as compared with untreated plants. However, parsley plants sprayed with $CaCl_2$ at 1% recorded the minimum values of crude fiber during storage as compared with untreated plants. Moreover, parsley plants sprayed with $CaCl_2$ at 0.5% ranked in the second followed by $MgCl_2$ at 0.4% without significant differences among the three treatments. On the other hand, the highest values of weight loss percentage were recorded by untreated plants (control). These results were true in the two seasons. In contrast to this, the highest values of crude fiber (%) were recorded in case of untreated plants (control). Respecting the effect of interaction among foliar application, packaging type and storage period, results in Table (11) indicate that, after 21 days from storage there were significant differences for crude fiber (%), however parsley plants which sprayed with $CaCl_2$ at 1% and packed in perforated polypropylene bags recorded the minimum values of crude fiber percentage (5.17 and 5.08 %) in the first and second seasons, respectively, followed by parsley herbs sprayed with $CaCl_2$ at 0.5% and $MgCl_2$ at 0.4% and packed in perforated polypropylene bags without significant differences between them in both seasons of study.

Table 10. Effect of foliar application with some nutritional elements and bags type on vitamin C of parsley plants during cold storage in 2017/2018 and 2018/2019 seasons

Foliar application treatments	packaging type	2017/2018 season					2018/2019 season				
		Storage period (days)									
		Initial	7	14	21	Mean	Initial	7	14	21	Mean
		Vitamin C (mg/100gm)									
Control	Perforated bags	86.42	66.31	35.37	21.84	**52.48**	88.83	69.17	39.34	25.77	**55.77**
Calcium chloride at 0.5%		91.86	82.46	60.00	38.79	**68.27**	94.63	83.81	62.72	40.35	**70.37**
Calcium chloride at 1%		92.35	86.35	62.83	40.25	**70.44**	95.40	88.42	65.41	42.87	**73.02**
Magnesium chloride at 0.2%		91.09	77.62	53.11	32.49	**63.57**	93.82	80.62	58.23	36.53	**67.30**
Magnesium chloride at 0.4%		91.55	82.10	58.93	37.56	**67.53**	94.30	82.95	62.06	39.62	**69.73**
Mean		**90.65**	**78.96**	**54.04**	**34.18**	**64.46**	**93.39**	**80.99**	**57.55**	**37.02**	**67.24**
Control	Imperforated bags	86.42	64.75	35.06	20.73	**51.74**	88.83	68.55	39.17	23.65	**55.05**
Calcium chloride at 0.5%		91.86	74.88	50.28	31.00	**62.00**	94.63	75.60	53.72	33.95	**64.47**
Calcium chloride at 1%		92.35	75.31	51.55	31.38	**62.64**	95.40	77.45	54.11	34.18	**65.28**
Magnesium chloride at 0.2%		91.09	73.46	48.64	28.66	**60.46**	93.82	74.09	52.16	31.68	**62.93**
Magnesium chloride at 0.4%		91.55	74.19	50.09	29.17	**61.25**	94.30	74.87	53.00	32.85	**63.75**
Mean		**90.65**	**72.51**	**47.12**	**28.18**	**59.62**	**93.39**	**74.11**	**50.43**	**31.26**	**62.30**
Mean (S)		**90.65**	**75.74**	**50.58**	**31.18**	**-**	**93.39**	**77.55**	**53.99**	**34.14**	**-**
Control		86.42	65.53	35.21	21.28	**52.11**	88.83	68.86	39.25	24.71	**55.41**
Calcium chloride at 0.5%		91.86	78.67	55.14	34.89	**65.14**	94.63	79.70	58.22	37.15	**67.42**
Calcium chloride at 1%		92.35	80.83	57.19	35.81	**66.54**	95.40	82.93	59.76	38.52	**69.15**
Magnesium chloride at 0.2%		91.09	75.54	50.87	30.57	**62.02**	93.82	77.35	55.19	34.10	**65.11**
Magnesium chloride at 0.4%		91.55	78.14	54.51	33.36	**64.39**	94.30	78.91	57.53	36.23	**66.74**

LSD at 5%	Treatments (T)	Bags type (B)	Storage period (S)	T × B	S × B	T × S	T ×B× S
1st season	0.49	0.31	0.43	0.69	0.62	0.98	1.38
2nd season	0.49	0.31	0.44	0.70	0.63	0.99	1.40

Table 11. Effect of foliar application with some nutritional elements and bags type on crude fiber of parsley plants during cold storage in 2017/2018 and 2018/2019 seasons

Foliar application treatments	packaging type	2017/2018 season					2018/2019 season				
		Storage period (days)									
		Initial	7	14	21	Mean	Initial	7	14	21	Mean
		Crude fiber (%)									
Control	Perforated bags	3.85	4.56	5.59	6.54	**5.13**	3.70	4.23	5.33	6.37	**4.90**
Calcium chloride at 0.5%		3.17	3.66	4.47	5.31	**4.15**	3.11	3.52	4.38	5.19	**4.05**
Calcium chloride at 1%		3.10	3.54	4.34	5.17	**4.03**	3.04	3.46	4.25	5.08	**3.95**
Magnesium chloride at 0.2%		3.27	3.79	4.62	5.43	**4.27**	3.18	3.66	4.58	5.42	**4.21**
Magnesium chloride at 0.4%		3.20	3.71	4.53	5.39	**4.20**	3.14	3.59	4.46	5.31	**4.12**
Mean		**3.31**	**3.85**	**4.71**	**5.56**	**4.35**	**3.23**	**3.69**	**4.60**	**5.47**	**4.24**
Control	Imperforated bags	3.85	4.74	5.82	6.80	**5.30**	3.70	4.38	5.68	6.70	**5.11**
Calcium chloride at 0.5%		3.17	3.95	4.89	5.75	**4.44**	3.11	3.88	4.80	5.71	**4.37**
Calcium chloride at 1%		3.10	3.88	4.77	5.60	**4.33**	3.04	3.72	4.67	5.55	**4.24**
Magnesium chloride at 0.2%		3.27	4.30	5.32	6.25	**4.78**	3.18	4.16	5.18	6.15	**4.66**
Magnesium chloride at 0.4%		3.20	4.13	5.16	6.08	**4.64**	3.14	3.92	5.00	5.96	**4.50**
Mean		**3.31**	**4.20**	**5.19**	**6.09**	**4.70**	**3.23**	**4.01**	**5.06**	**6.01**	**4.57**
Mean (S)		**3.31**	**4.02**	**4.95**	**5.83**	**-**	**3.23**	**3.85**	**4.83**	**5.74**	**-**
Control		3.85	4.65	5.70	6.67	**5.21**	3.70	4.30	5.50	6.53	**5.01**
Calcium chloride at 0.5%		3.17	3.80	4.68	5.53	**4.29**	3.11	3.70	4.59	5.45	**4.21**
Calcium chloride at 1%		3.10	3.71	4.55	5.38	**4.18**	3.04	3.59	4.46	5.31	**4.10**
Magnesium chloride at 0.2%		3.27	4.04	4.97	5.84	**4.53**	3.18	3.91	4.88	5.78	**4.43**
Magnesium chloride at 0.4%		3.20	3.92	4.84	5.73	**4.42**	3.14	3.75	4.73	5.63	**4.31**

LSD at 5%	Treatments (T)	Bags type (B)	Storage period (S)	T × B	S × B	T × S	T ×B× S
1st season	0.57	N.S	0.51	0.81	0.72	1.14	1.62
2nd season	0.56	N.S	0.50	0.80	0.71	1.13	1.60

CONCLUSION

From the previous results of this investigation, it could be concluded that spraying parsley plants with any of $CaCl_2$ at 1% or Mg Cl_2 at 0.4 % significantly enhanced root system, vegetative growth characters, herb yield and oil yield with no significant differences between them in most cases, while the third cut was the superior one for increasing root system, vegetative growth characters, herb yield and oil yield. Furthermore, parsley fresh herbs obtained from plants treated with the previous treatments and packing in perforated polypropylene bags also reduced weight loss percentage and crude fiber (%), maintained chlorophyll and vitamin C as well as gave parsley herb with good appearance after 21 days at 0°C and 90-95% RH.

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