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Influence of flower bud and fruit thinning and spraying with Salicylic acid on vegetative growth, yield and fruit quality of the Prickly pear (*Opuntia ficus – indica*)

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ABSTRACT

This study was conducted during two consecutive seasons of 2018 and 2019 at cactus pear orchard located on Abu Ghaleb area, "Cairo-Alexandria desert" road about 50km from Cairo, Egypt. The effect of handmade thinning (control, flower bud thinning to leave 6, 7, 8 and 9, fruits/cladode thinning to leave 6, 7, 8 and 9/ cladode) and the second one involved spraying with 3 concentrations of salicylic acid (S.A.) (control, 100 and 200 mg/L), and their interactions to improve a vegetative growth and cladodes, fruit quality and cladode minerals content of El-Shamia cactus pear plants were studied. The best results were recorded with handmade thinning and spraying with salicylic acid (S.A.) as well as their interaction showed that, leave 8, 9 fruits/cladode with spraying salicylic acid (S.A.) at 200 mg/L concentration improved number of new cladodes per plant, plant height, fruit set %, number of fruits/plants, yield (kg/plant), fruit length (cm), fruit diameter (cm), fruit shape index, firmness, fruit weight (g), pulp weight (g), peel weight (g), peel weight/ pulp %, pulp %, TSS %, TSS/ acid ratio, vitamin C, total sugar, reducing sugar and cladode content of N, K, Ca, Mg, Fe, Zn and Mn. On the other hand, reduced fruit drop %, seeds weight (g) and acidity %. Thus, this treatment was proved to be the most efficient in enhancing growth, quality and minerals content of cladodes of El-shamia cactus pear plants.

Keywords: Prickly pear (*Opuntia ficus – indica*), El-Shamia cactus pear, handmade thinning flower buds, handmade thinning fruits, salicylic acid, yield, fruit quality.

1. Introduction

The cactus is a drought-resistant succulent plant. Cacti are classified as members of the Desv family of cactaceae, according to the most recent classification revision. Cactus-pear fruits are luscious berries with a variety of shapes, sizes, and colors. They have a thick peel that encases a juicy, edible pulp with a subtle flavor and a lot of hard seeds. According to Gurrieri *et al.* (2000), Munoz De Chavez *et al.* (1995), Saenz and Sepulveda (2001), the visually appealing colors of the pericarp and pulp range from a soft green to greenish-white, canary-yellow, orange-yellow, lemon-yellow, red, cherry-red, and purple. The largest and most striking member of the Cactaceae family is Opuntia. About 300–400 species and numerous variations make up the Mexican-born genus Opuntia (Anaya-Perez, 2001; Benson, 1982; Odoux and Dominguez-Lopez, 1996; Stintzing and Carle, 2005). The most extensively grown edible cactus crop worldwide is the prickly pear, also known as the cactus pear (Opuntia spp.), which is found throughout South America and Mexico.

Numerous studies (Barbera *et al.*, 1991; Inglese *et al.*, 1995; Inglese, 1995; Gugliuzza *et al.*, 2002a) have looked at cactus pear horticultural practices, such as the removal of reproductive buds (RRB) for fruit thinning, in order to evaluate the impact on yield, yield components, and final fruit size and quality (Inglese *et al.*, 2002; Gugliuzza *et al.*, 2002a,b). Jorge *et al.* (2010) discovered that in the first experiment, thinning fruit buds involved either keeping four, eight, or twelve reproductive buds per mature cladode, or thinning every other bud or two out of every three buds) along the cladode at harvest. The results showed that thinning fruit buds reduced the amount of "Cristalina" fruit at harvest when four buds per cladode were kept, in contrast to the other treatments that improved the quality of the fruits. In order that satisfy customer demands, modern horticulture crop

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production chains must also improve the quality and postharvest life of their goods (Wills *et al.*, 1998). The first synthetic medication in history, acetylsalicylic acid, also referred to as aspirin, was created in 1897 by the Bayer Company to act as an anti-inflammatory by imitating the effects of an antiquated willow tree remedy (Weissman, 1991).

Salicylic acid, at one stage of time, was the world's bestselling drug synthesized in 1898 in Germany (Raskin, 1992b). The Latin word "Salix," which means willow tree, is the source of the English term salicylic acid (SA). It belongs to the class of plant hormones and is widely dispersed throughout the entire plant kingdom (Raskin *et al.*, 1990; Raskin, 1992a). Various regulatory roles in plant metabolism are given to SA (Popova *et al.*, 1997). A common signalling molecule, salicylic acid (SA) regulates many physiological processes, including stomata function, blooming, and seed germination (Raskin, 1992; Murphy *et al.*, 1999; Alvarez, 2000; Lucas and Lee, 2004). Salicylic acid has been identified as an internal plant growth regulator that affects a number of physiological and metabolic processes that are important for the growth and development of plants. Additionally, salicylic acid was mentioned as a crucial internal marker molecule for plant stress tolerance. In this regard, salicylic acid is important for the synthesis of proteins in plants subjected to both biotic and abiotic stressors. It also helps plants develop systemic resistance and shields them from various abiotic stress situations. According to Kök (2012). Ahmed *et al.* (2015), carrying out two sprays of salicylic acid at 100 ppm at growth start and shortly after fruit setting was responsible for boosting yield and fruit quality of Sukkary mango trees.

This study aimed investigate the effect influence of handmade thinning to flower buds and fruits, spraying with salicylic acid and their interaction to improve yield and fruit quality characters of prickly pear plants under reclaimed land stress conditions.

2. Materials and Methods

This study was conducted during two successive seasons of 2018 and 2019 at orchard located on Abu Ghaleb area, "Cairo-Alexandria desert" road around 50 km from Cairo, Egypt. Eight-year-old El Shamia Cactus Pear plants (*Opuntia ficus*-indica L.), planted in sandy soil, with a 3.5 x 4.0 m spacing between each plant (about 300 plants/feddan), are irrigated with a drip system using a well. Table (1) displays the results of the experimental soil's physical and chemical analyses. In the meantime, Table (2) contains the results of the chemical analysis of the irrigation water used. One hundred and eight healthy, nearly identical plants in terms of size, shape, and productivity were given the same horticultural treatments. This study used a factorial design with two factors: spraying with three concentrations of salicylic acid (S.A.) control, 100 and 200 mg/L, and nine rates of hand thinning (control, leave 6, 7, 8, and 9 flower buds/cladode, leave 6, 7, 8, and 9 fruits/cladode). The experiment was set up as a randomised complete block design with four replicates for each treatment, each represented by a single plant.

Table 1: - Analysis of experimental soil.

Soil Depth (cm)	Texture Class	pH Soil past	E.Ce (dSm-1)	Organic matter %	Soluble cations (meq/l)				Soluble anions (meq/l)			
					Ca^{++}	K^{+}	Na+	Mg^{++}	Cl^{-}	$SO_4^{=}$	HCO_3^{-}	$CO_3^{=}$
0-30	Sand	7.0	1.6	0.19	7	0.4	5	3.6	6	7	3	-
30-60	Sand	7.5	1.3	0.18	1.2	0.2	0.7	0.9	0.6	1.9	0.5	-

Table 2: - Chemical analysis of water used for irrigation.

pH	E.C. dSm-1	O.M %	Soluble cations (meq/l)				soluble anions (meq/l)			
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO_3^{=}$	HCO_3-	Cl^{-}	$SO_4^{=}$
7.1	0.93	0.7	1.60	1.21	6.25	0.28	0	0.20	8.21	0.93

During the second week of June, when half of the flowers had bloomed, primary flower buds were thinned. Fruit was thinned after a month. First, salicylic acid was dissolved in little amounts of ethyl alcohol, then water was added to achieve the necessary volume. applying salicylic acid at control concentrations of 100 and 200 ppm once, twice, or three times during the onset of fruit set and every two weeks thereafter.

Response of El Shamia Cactus Pear plants to the tested treatments was evaluated through the following determinations

2.1. Vegetative growth

The number of new cladodes per plant and plant height (measured in metres) were recorded during the final week of September.

2.2. Flowering measurements

2.2.1. Fruit set (%) and fruit drop (%)

At full bloom, the number of four cladode flowers on each replicate plant was counted, labelled, and the quantity of fruitlets that had set was recorded. In both the first and second seasons, fruit set percentages were determined at the start of May in the manner described below:

$$Fruit\ set\ \% = \frac{Number\ of\ developing\ fruitlets}{Total\ number\ of\ flowers\ at\ full\ bloom}\ X\ 100$$

Fruit drop (%)

Number of dropped fruits was counted at last week of June then fruit drop percentages were calculated as follows:

$$Fruit\ drop\ \% = \frac{Number\ of\ dropped\ fruits}{The\ initial\ number\ of\ fruitlets}\ X\ 100$$

2.3. Yield

At harvest time (the last week of July), the number of fruits per each treated plant was counted, and then the yield (kg per plant) was calculated number of fruits per plant x average weight of fruit.

2.4. Fruits physical and chemical properties

Ten fruits were taken at harvest time from each replicate for determination of the following physical and chemical properties: Fruit length (cm), fruit diameter (cm), fruit shape index, fruit firmness, fruit weight (g), pulp weight (g), peel weight (g), seeds weight (g), peel weight/ pulp %, pulp %, were determined by separating pulp from the peel and centrifuging the juice extracted from the pulp, total soluble solids (TSS%) in fruit juice, acidity (%) (expressed as citric acid per 100 ml juice), TSS/Acid ratio. Pulp content of F. Vitamin C (mg/100g f. w.) according to A.O.A.C. (1990) was determined. Total sugars (%), reducing sugars (%) were determined in fruit juice (100 ml juice) photo metrically at 490 mm to the phenol method and using ethyl alcohol for 1 hour at 70c as described by Dubois *et al*. (1956).

2.5. Cladodes mineral content

Cladode mineral content was determined as follows: Cladode samples were collected for the determination of the contents of macro and micronutrients in the tissue in the last week of September. Ten discs (1 cm diameter) from apical cladodes were taken as samples from each replicate. Samples were sliced, dried, ground and digested according to Parkinson and Allen (1975). Nitrogen was estimated by the micro-Kjeldahl method by (Bremner, 1965). According to Matt (1968), phosphorus was calorimetrically measured using a Spekol spectrophotometer wavelength 882 UV. Potassium was determined by flame-photometer according to Jackson (1958). Calcium and magnesium were determined by titration against the versenate solution (Na-EDTA) method as described by Chapman and Pratt (1961). Iron, Zinc and Manganese were estimated by using Atomic Absorption Spectrophotometer “Jarill - Ash 850”.

2.6. Statistical Analysis

The obtained data in 2018 and 2019 seasons were subjected to an analysis of variance according to Clarke and Kempson (1997). Means were differentiated using the Range test at the 0.05 level Duncan, (1955).

3. Results and Discussion

3.1. Vegetative growth

The following data show the effect of flower bud thinning, fruit thinning and salicylic acid foliar application on vegetative growth, fruits quality and cladodes mineral content.

Data in table (3) showed the effect of flower buds and fruit thinning and spraying with salicylic acid, on number of new cladodes and plant height of the Prickly pear *(Opuntia ficus-indica L.*) plants during 2018 & 2019 seasons.

3.1.1. Number of new cladodes/ plant

Regarding to flower buds and fruit handmade thinning treatments, leave 8 fruits/cladode recorded the highest significant values in both seasons. On the other hand, control (without thinning) was the lowest significant value. Concerning to spraying with salicylic acid treatments, spraying with 200 mg/L show to be the highest significant value, which was observed in both seasons. The interaction between two studied factors, leave 8 fruits/cladode with spraying by salicylic acid at 200 mg/L gave highest significant values in both seasons.

3.1.2. Plant height (cm)

Regarding to flower buds and fruit handmade thinning treatments, leave 8 fruits/cladode recorded the highest significant plant height values in first season, while leave 9 fruits/cladode recorded the highest significant values in second season. On the other hand, control (without thinning) was the lowest significant plant height. Concerning to spraying with salicylic acid treatments, spraying with 200 mg/L showed the highest significant plant height value, which was observed in both seasons. The interaction between two studied factors, leave 9 fruits on cladode with spraying of salicylic acid at 200 mg/L gave highest significant values plant height in both seasons.

Table 3: Effect of flower bud and fruit thinning and spraying with salicylic acid, on number of new cladodes and plant height of the Prickly pear *(Opuntia ficus-indica L.*) plants during 2018 & 2019 seasons.

Parameters	No. of new cladodes/plant				Plant height (cm)			
Foliar spraying Flower bud and fruit thinning	**Control**	**S.A. 100 mg/L**	**S.A. 200 mg/L**	**Mean**	**Control**	**S.A. 100 mg/L**	**S.A. 200 mg/L**	**Mean**
				First season 2018				
Control	16.00r	24.00lm	28.00kl	22.67I	151.3q	154.6p	184.4d	163.8G
6 L.F.B. /cladode	18.00pq	25.00l	31.00hi	24.67H	141.5s	177.1fg	179.9e	166.2F
7 L.F.B. /cladode	19.00no	26.00kl	32.00gh	25.67G	160.3mn	157.2o	187.2b	168.2E
8 L.F.B. /cladode	25.00l	35.00de	38.00ab	32.67B	170.3i	165.2jk	189.1b	174.9B
9 L.F.B. /cladode	19.00no	32.00gh	35.00de	28.67E	162.7l	159.5n	189.2b	170.5D
6 L.F. fruits/cladode	21.00n	33.00fg	36.00cd	30.00D	144.2r	175.3i	180.3e	166.6F
7 L.F. fruits/cladode	20.00n	29.00j	34.00ef	27.67F	166.9j	163.6kl	188.3bc	172.9C
8 L.F. fruits/cladode	27.00k	36.00cd	39.00a	34.00A	174.4h	178.5ef	191.2a	181.4A
9 L.F. fruits/cladode	23.00m	34.00ef	37.00bc	31.33C	162.5l	161.8lm	186.6cd	170.3D
Mean	20.89C	30.44B	34.44A		159.3C	165.9B	186.4A	
				Second season 2019				
Control	17.00q	26.00k	30.00i	24.33I	142.0r	177.6f	180.4e	166.7F
6 L.F.B. /cladode	20.00no	29.00ij	33.00gh	27.33G	144.7q	175.8g	180.8e	167.1F
7 L.F.B. /cladode	21.00mn	30.00i	35.00ef	28.67EF	151.8p	155.1o	185.9d	164.3G
8 L.F.B. /cladode	26.00k	36.00de	39.00b	33.67B	160.8lm	157.7n	187.7cd	168.7E
9 L.F.B. /cladode	20.00no	33.00gh	35.00ef	29.33DE	163.2k	160.0m	189.7b	171.0D
6 L.F. fruits/cladode	19.00op	27.00k	32.00h	26.00H	163.0k	162.3kl	187.1cd	170.8D
7 L.F. fruits/cladode	24.00l	35.00ef	38.00bc	32.33C	167.4i	164.1jk	188.8bc	173.4C
8 L.F. fruits/cladode	28.00ij	37.00cd	40.00a	35.00A	170.8h	165.7ij	189.6b	175.4B
9 L.F. fruits/cladode	23.00m	34.00fg	36.00de	31.00D	174.9g	179.0ef	191.7a	181.9A
Mean	22.00C	31.89B	35.33A		159.8C	166.4B	186.9A	

Means having the same letter (s) in each row, column or interaction are insignificantly different at 5% level.
(LFB) = Leave flower buds - (LF) = Leave fruits - (SA) = Salicylic acid

3.2. Flowering characteristics

Data in table (4) showed the effect of flower bud and fruit thinning and spraying with salicylic acid, on fruit set (%) and fruit drop (%) of the Prickly pear *(Opuntia ficus-indica L.*) plants during 2018 & 2019 seasons.

3.2.1. Fruit set (%)

Regarding to flower buds and fruit handmade thinning treatments, leave 8 fruits/cladode recorded the highest significant fruit set percentage values in both seasons. On the other hand, control (without thinning) was the lowest significant fruit set percentage value. Concerning to spraying with salicylic acid treatments, spraying with 200 mg/L show to be the highest significant fruit set percentage value, which was observed in both seasons. The interaction between two studied factors, leave 8 fruits on cladode with spraying of salicylic acid at 200 mg/L gave highest significant fruit set percentage values in both seasons.

3.2.2. Fruit drop (%)

Regarding to flower buds and fruit handmade thinning treatments, leave 9 fruits/cladode recorded the lowest significant fruit drop percentage values in both seasons. On the other hand, control (without thinning) was the highest significant value. Concerning to spraying with salicylic acid treatments, spraying with 200 mg/L show to be the lowest significant fruit drop percentage value, which was observed in both seasons. The interaction between two studied factors, leave 9 fruits/cladode with spraying by salicylic acid at 200 mg/L gave lowest significant values in both seasons.

Table 4: Effect of flower bud and fruit thinning and spraying with salicylic acid, on fruit set (%) and fruit drop (%) of the Prickly pear *(Opuntia ficus-indica L.*) plants during 2018 & 2019 seasons.

Parameters	Fruit set (%)				Fruit drop (%)			
Foliar spraying / Flower bud and fruit thinning	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean
	First season 2018							
Control	65.23p	66.48op	67.73o	66.48H	41.03a	39.78b	38.53c	39.78A
6 L.F.B. /cladode	70.67n	71.42mn	72.17mn	71.42G	30.63gh	31.58fg	32.53ef	31.58C
7 L.F.B. /cladode	73.52k-m	72.57l-n	71.62mn	72.57F	28.68j	27.43k	26.18lm	27.43E
8 L.F.B. /cladode	81.19de	81.94cd	82.69b-d	81.94B	25.56l-n	26.51kl	27.46k	26.51F
9 L.F.B. /cladode	74.41j-l	75.66ij	76.91g-i	75.66E	25.83lm	25.08mn	24.33no	25.08G
6 L.F. fruits/cladode	77.05g-i	77.80f-h	78.55fg	77.80D	34.16d	32.91e	31.66fg	32.91B
7 L.F. fruits/cladode	76.24h-j	75.29i-k	74.34i-l	75.29E	30.67gh	29.92hi	29.17ij	29.92D
8 L.F. fruits/cladode	85.32a	84.37ab	83.42a-c	84.37A	25.34l-n	24.59no	23.84o	24.59G
9 L.F. fruits/cladode	79.38ef	80.63de	81.88cd	80.63C	18.15q	19.10pq	20.05p	19.10H
Mean	75.89B	76.24AB	76.49A		28.89A	28.54AB	28.19B	
	Second season 2019							
Control	66.48e	67.73qr	68.98q	67.73H	42.28a	41.03b	39.78c	41.03A
6 L.F.B. /cladode	71.42p	72.17op	72.92n-p	72.17G	32.07fg	33.02ef	33.97e	33.02C
7 L.F.B. /cladode	74.96l-n	74.01m-o	73.06n-p	74.01F	32.11fg	31.36gh	30.61h	31.36D
8 L.F.B. /cladode	82.42de	83.17c-e	83.92b-d	83.17B	29.43i	28.18jk	26.93lm	28.18E
9 L.F.B. /cladode	77.34h-k	76.39j-l	75.44k-m	76.39E	26.09m-o	25.34op	24.59p	25.34G
6 L.F. fruits/cladode	78.49g-i	79.24gh	79.99fg	79.24D	26.66l-n	27.61j-l	28.56ij	27.61E
7 L.F. fruits/cladode	75.36k-m	76.61i-l	77.86h-j	76.61E	35.11d	33.86e	32.61f	33.86B
8 L.F. fruits/cladode	86.67a	85.72ab	84.77a-c	85.72A	27.06k-m	26.31m-o	25.56n-p	26.31F
9 L.F. fruits/cladode	80.13fg	81.38ef	82.63de	81.38C	19.50r	20.45qr	21.40q	20.45H
Mean	77.03B	77.38AB	77.73A		30.03A	29.68AB	29.33B	

Means having the same letter (s) in each row, column or interaction are insignificantly different at 5% level.
(LFB) = Leave flower buds - (LF) = Leave fruits - (SA) = Salicylic acid

3.3. Yield and fruit quality

Data in table (5) showed the effect of flower bud and fruit thinning and spraying with salicylic acid, on number fruits/plant and yield kg/plant of the Prickly pear *(Opuntia ficus-indica L.*) plants during 2018 & 2019 seasons.

3.3.1. Numbers fruits/plant and yield (kg/plant)

Regarding to flower buds and fruit handmade thinning treatments, leave 9 fruits/cladode recorded the highest significant number fruits/plant and yield (kg/plant) values in both seasons. On the other hand, control (without thinning) was the lowest significant number fruits/plant and yield (kg/plant) value. Concerning to spraying with salicylic acid treatments, spraying with 200 mg/L show to be the highest significant number fruits/plant and yield (kg/plant) value, which was observed in both seasons. The interaction between two studied factors, leave 9 fruits/cladode with spraying by salicylic acid at 200 mg/L gave highest significant number fruits/plant and yield (kg/plant) values in both seasons.

Table 5: Effect of flower bud and fruit thinning and spraying with salicylic acid, on number fruits/plant and yield kg/plant of the Prickly pear *(Opuntia ficus-indica L.*) plants during 2018 & 2019 seasons.

Parameters	Number fruits/plant				Yield (kg/plant)			
Foliar spraying / Flower bud and fruit thinning	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean
				First season 2018				
Control	108.0[	167.0r	221.0i	165.3I	14.05w	27.77o	39.29h	27.04H
6 L.F.B. /cladode	115.0z	172.0q	227.0h	171.3H	15.55vw	29.03no	41.29g	28.62G
7 L.F.B. /cladode	122.0y	176.0p	233.0g	177.0G	17.41uv	29.85mn	42.38fg	29.88F
8 L.F.B. /cladode	131.0x	184.0o	237.0f	184.0F	19.01tu	31.56lm	43.68ef	31.41E
9 L.F.B. /cladode	138.0w	190.0n	245.0e	191.0E	20.49st	32.81kl	45.40de	32.90D
6 L.F. fruits/cladode	144.0v	197.0m	253.0d	198.0D	21.72rs	34.32jk	46.73cd	34.25C
7 L.F. fruits/cladode	149.0u	205.0l	257.0c	203.7C	22.81qr	35.38ij	47.39c	38.20C
8 L.F. fruits/cladode	157.0t	210.0k	265.0b	210.7B	24.57pq	36.54i	49.95b	37.02B
9 L.F. fruits/cladode	161.0s	216.0j	273.0a	216.7A	28.87p	37.24i	52.93a	38.68A
Mean	136.1C	190.8B	245.7A		20.16C	32.72B	45.45A	
				Second season 2019				
Control	117.0[	176.0r	230.0i	174.3I	15.50w	29.29o	40.71h	28.50H
6 L.F.B. /cladode	224.0z	181.0q	236.0h	180.3H	17.65v	30.52no	42.62g	30.26G
7 L.F.B. /cladode	231.0y	185.0p	242.0g	186.0G	18.92uv	31.41mn	43.80fg	31.38F
8 L.F.B. /cladode	140.0x	193.0o	246.0f	193.0F	20.52tu	32.98lm	45.04ef	32.85E
9 L.F.B. /cladode	147.0w	199.0n	254.0e	200.0E	22.01st	34.27kl	46.81de	34.36D
6 L.F. fruits/cladode	153.0v	206.0m	262.0d	207.0D	23.24rs	35.70jk	48.16cd	35.70C
7 L.F. fruits/cladode	158.0u	214.0l	266.0c	212.7C	24.40qr	36.72ij	48.81c	36.64C
8 L.F. fruits/cladode	166.0t	219.0k	274.0b	219.7B	26.05pq	37.84i	51.32b	38.40B
9 L.F. fruits/cladode	170.0s	225.0j	282.0a	225.7A	27.34p	38.66i	54.23a	40.07A
Mean	145.1C	199.8B	254.7A		21.73C	34.15B	46.83A	

Means having the same letter (s) in each row, column or interaction are insignificantly different at 5% level.
(LFB) = Leave flower buds- (LF) = Leave fruits - (SA) = Salicylic acid

Data in table (6) showed the effect of flower bud and fruit thinning and spraying with salicylic acid, on fruit length and fruit diameter of the Prickly pear *(Opuntia ficus-indica* L.) plants during 2018 & 2019 seasons.

3.3.2. Fruit length (cm) and fruit diameter (cm)

Regarding to flower buds and fruit handmade thinning treatments, leave 9 fruits/cladode recorded the highest significant fruit length and fruit diameter values in both seasons. On the other hand, control (without thinning) was the lowest significant fruit length and fruit diameter value. Concerning to spraying with salicylic acid treatments, spraying with 200 mg/L show to be the highest significant fruit length and fruit diameter value, which was observed in both seasons. The interaction

between two studied factors, leave 9 fruits/cladode with spraying by salicylic acid at 200 mg/L gave highest significant fruit length and fruit diameter values in both seasons.

Table 6: Effect of flower bud and fruit thinning and spraying with salicylic acid, on fruit length and fruit diameter of the Prickly pear *(Opuntia ficus-indica* L.) plants during 2018 & 2019 seasons.

Parameters	Fruit length (cm)				Fruit diameter (cm)			
Foliar spraying / Flower bud and fruit thinning	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean
				First season 2018				
Control	6.47q	7.92j-l	9.22de	7.87EF	4.15n	5.70h	7.01b	5.62EF
6 L.F.B. /cladode	6.73p	7.86j-l	9.36cd	7.98F	4.45m	5.66h	7.03b	5.71E
7 L.F.B. /cladode	6.83p	7.79kl	8.78g	7.80F	4.43m	5.52hi	6.41d-f	5.45G
8 L.F.B. /cladode	7.13o	7.40n	8.68gh	7.74F	4.85l	5.15k	6.50de	5.50FG
9 L.F.B. /cladode	7.34no	8.09j	9.51bc	8.31D	5.04kl	5.70h	6.19fg	5.64E
6 L.F. fruits/cladode	7.51mn	8.43i	9.68b	8.54C	5.23jk	6.03g	6.29ef	5.85D
7 L.F. fruits/cladode	7.68lm	8.49hi	9.71b	8.63C	5.38ij	6.21fg	7.34a	6.31C
8 L.F. fruits/cladode	7.88j-l	8.92fg	9.73ab	8.84B	5.57hi	6.55cd	7.41a	6.51B
9 L.F. fruits/cladode	8.03jk	9.11ef	9.96a	9.03A	5.68h	6.75c	7.52a	6.65A
Mean	7.29C	8.22B	9.40A		4.98C	5.92B	6.86A	
				Second season 2019				
Control	6.55p	8.06ij	9.49cd	8.03EF	4.27l	5.83ef	7.23b	5.78FG
6 L.F.B. /cladode	6.81o	8.02i-k	9.48cd	8.10E	4.61k	5.81ef	7.26b	5.89EF
7 L.F.B. /cladode	7.01no	7.99jk	8.88fg	7.96F	4.51k	5.59fg	6.64c	5.58H
8 L.F.B. /cladode	7.24n	7.62lm	8.92fg	7.93F	5.03j	5.27hi	6.69c	5.66GH
9 L.F.B. /cladode	7.50m	8.27i	9.65bc	8.47D	5.11ij	5.93e	6.80c	5.95E
6 L.F. fruits/cladode	7.65lm	8.52h	9.74b	8.64C	5.35h	6.25d	6.68c	6.09D
7 L.F. fruits/cladode	7.78kl	8.71gh	9.82b	8.77C	5.46gh	6.41d	7.55a	6.47C
8 L.F. fruits/cladode	8.05ij	9.11ef	9.78b	8.98B	5.64fg	6.81c	7.59a	6.68B
9 L.F. fruits/cladode	8.12ij	9.30de	10.08a	9.17A	5.78ef	7.06b	7.78a	6.87A
Mean	7.41C	8.40B	9.54A		5.08C	6.11B	7.14A	

Means having the same letter (s) in each row, column or interaction are insignificantly different at 5% level.
(LFB) = Leave flower buds - (LF) = Leave fruits - (SA) = Salicylic acid

Data in table (7) showed the effect of flower bud and fruit thinning and spraying with salicylic acid, on fruit shape index and firmness of the Prickly pear *(Opuntia ficus-indica L.*) plants during 2018 & 2019 seasons.

3.3.3. Fruit shape index

Regarding to flower buds and fruit handmade thinning treatments, leave 9 flower buds/cladode recorded the highest significant fruit shape index values in both seasons. On the other hand, leave 8, 9 fruits/ cladode was the lowest significant fruit shape index value in first season but 7, 8, and 9 fruits they had lowest values in second season. Concerning to spraying with salicylic acid treatments, control show to be the highest significant fruit shape index value, which was observed in both seasons. The interaction between two studied factors, leave 9 flower buds/cladode with control gave highest significant fruit shape index values in both seasons.

3.4. Firmness (lb/inch^2)

Regarding to flower buds and fruit handmade thinning treatments, leave 7, 8, 9 fruits/cladode recorded the highest significant firmness values in first seasons, while leave 8, 9 fruits/cladode recorded the highest significant firmness values in second season. On the other hand, control (without thinning) was the lowest significant firmness value. Concerning to spraying with salicylic acid treatments, spraying with 100 and 200 mg/L showed the highest significant firmness value, which was observed in both seasons. The interaction between two studied factors, leave 9 fruits/cladode with spraying by salicylic acid at 200 mg/L gave highest firmness values in both seasons.

Table 7: Effect of flower bud and fruit thinning and spraying with salicylic acid, on fruit shape index and firmness of the Prickly pear *(Opuntia ficus-indica* L.) plants during 2018 & 2019 seasons.

Parameters	Fruit shape index				Firmness (lb/inch^2)			
Foliar spraying **Flower bud and fruit thinning**	**Control**	**S.A. 100 mg/L**	**S.A. 200 mg/L**	**Mean**	**Control**	**S.A. 100 mg/L**	**S.A. 200 mg/L**	**Mean**
				First season 2018				
Control	1.559a	1.389hi	1.315mn	1.421D	8.58n	8.87m	8.85m	8.77F
6 L.F.B. /cladode	1.512b	1.389hi	1.331l-n	1.411D	9.43jk	9.31kl	9.17l	9.30E
7 L.F.B. /cladode	1.542a	1.411f-h	1.370ij	1.441C	9.73i	9.67ij	9.52i-k	9.64D
8 L.F.B. /cladode	1.470c	1.437de	1.335k-m	1.414D	10.36h	10.52gh	10.41h	10.43C
9 L.F.B. /cladode	1.456cd	1.419e-g	1.536a	1.471A	10.58f-h	10.80d-f	10.78d-g	10.72B
6 L.F. fruits/cladode	1.436de	1.398gh	1.539a	1.458B	10.72e-g	10.82d-f	10.95c-e	10.83B
7 L.F. fruits/cladode	1.428ef	1.367ij	1.323mn	1.373E	10.88c-e	10.94c-e	11.23ab	11.02A
8 L.F. fruits/cladode	1.415f-h	1.362jk	1.313n	1.363F	10.85c-f	11.00b-e	11.24ab	11.03A
9 L.F. fruits/cladode	1.414f-h	1.350j-l	1.324mn	1.363F	11.05b-d	11.11a-c	11.33a	11.16A
Mean	1.470A	1.391B	1.376C		10.24B	10.34A	10.39A	
				Second season 2019				
Control	1.534b	1.383j	1.313no	1.410D	8.65n	8.94m	8.92m	8.84G
6 L.F.B. /cladode	1.477c	1.380j	1.306no	1.388E	9.50jk	9.38kl	9.24l	9.37F
7 L.F.B. /cladode	1.554a	1.429gh	1.337l	1.440A	9.80i	9.74ij	9.59i-k	9.71E
8 L.F.B. /cladode	1.439fg	1.446ef	1.333lm	1.406D	10.43h	10.59gh	10.48h	10.50D
9 L.F.B. /cladode	1.468cd	1.395ij	1.419h	1.427B	10.65f-h	10.87d-f	10.85d-f	10.79C
6 L.F. fruits/cladode	1.430gh	1.363k	1.458de	1.417C	10.79e-g	10.89d-f	11.02c-e	10.90C
7 L.F. fruits/cladode	1.425h	1.359k	1.301op	1.361F	10.95c-e	11.01c-e	11.30ab	10.09B
8 L.F. fruits/cladode	1.427gh	1.338l	1.289p	1.351F	10.92c-e	11.07b-d	11.31ab	11.10AB
9 L.F. fruits/cladode	1.405i	1.317mn	1.296op	1.339G	11.12b-d	11.18a-c	11.40a	11.23A
Mean	1.462A	1.379B	1.339C		10.31B	10.41A	10.46A	

Means having the same letter (s) in each row, column or interaction are insignificantly different at 5% level.
(LFB) = Leave flower buds - (LF) = Leave fruits - (SA) = Salicylic acid

Data in table (8) showed the effect of flower bud and fruit thinning and spraying with salicylic acid, on fruit weight and pulp weight of the Prickly pear *(Opuntia ficus-indica* L.) plants during 2018 & 2019 seasons.

3.3.35. Fruit weight (g) and pulp weight (g)

Regarding to flower buds and fruit handmade thinning treatments, leave 9 fruits/cladode recorded the highest significant fruit weight and pulp weight values in both seasons. On the other hand, control (without thinning) was the lowest significant fruit weight and pulp weight value. Concerning to spraying with salicylic acid treatments, spraying with 200 mg/L showed the highest significant fruit weight and pulp weight, which was observed in both seasons. The interaction between two studied factors, leave 9 fruits/cladode with spraying by salicylic acid at 200 mg/L gave highest significant fruit weight and pulp weight values in both seasons.

Table 8: Effect of flower bud and fruit thinning and spraying with salicylic acid, on fruit weight and pulp weight of the Prickly pear *(Opuntia ficus-indica L.*) plants during 2018 & 2019 seasons.

Parameters	Fruit weight (g)				Pulp weight (g)			
Foliar spraying / Flower bud and fruit thinning	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean
	First season 2018							
Control	130.1r	166.3j	177.8e	158.1G	60.90t	86.90m	96.20g	81.33G
6 L.F.B. /cladode	135.2q	168.8i	181.9d	162.0F	68.79s	89.10l	99.30f	85.73F
7 L.F.B. /cladode	142.7p	169.6hi	181.9d	164.7E	69.80s	89.80kl	99.55f	86.38F
8 L.F.B. /cladode	145.1o	171.5gh	184.3c	167.0D	71.50r	91.20jk	101.0ef	87.90E
9 L.F.B. /cladode	148.5n	172.7fg	185.3c	168.8C	74.00q	91.90j	102.0de	89.30D
6 L.F. fruits/cladode	150.8m	174.2f	184.7c	169.9C	75.80p	92.90ij	102.9cd	90.53C
7 L.F. fruits/cladode	153.1m	172.6fg	184.4c	170.0C	77.30p	92.40ij	103.8c	91.17C
8 L.F. fruits/cladode	156.5l	174.0fg	188.5b	173.0B	79.85o	94.10hi	105.8b	93.25B
9 L.F. fruits/cladode	160.7k	172.4fg	193.9a	175.7A	83.00n	94.80gh	110.9a	96.23A
Mean	147.0C	171.3B	184.7A		73.44C	91.46B	102.4A	
	Second season 2019							
Control	132.5q	166.4j	177.0f	158.6F	65.40t	91.40m	100.7g	85.83G
6 L.F.B. /cladode	142.3p	168.6ij	180.6e	163.8E	73.29s	93.60l	103.8f	90.23F
7 L.F.B. /cladode	144.4op	169.8hi	181.0de	165.1E	74.30s	94.30kl	104.1f	90.90F
8 L.F.B. /cladode	146.6o	170.9g-i	183.1cd	166.9D	76.00r	95.70jk	105.5de	92.40E
9 L.F.B. /cladode	149.7n	172.2gh	184.3c	168.7C	78.50q	96.40j	106.5ef	93.80D
6 L.F. fruits/cladode	151.9n	173.3g	183.8c	169.7C	80.30p	97.40ij	107.4cd	95.03C
7 L.F. fruits/cladode	154.4m	171.6gh	183.5c	169.8C	81.80p	96.90ij	108.3c	95.67C
8 L.F. fruits/cladode	156.9l	172.8g	187.3b	172.3B	84.35o	98.60hi	110.3b	97.75B
9 L.F. fruits/cladode	160.8k	171.8gh	192.3a	175.0A	87.50n	99.30gh	115.4a	100.7A
Mean	148.8C	170.8B	183.7A		77.94C	95.96B	106.9A	

Means having the same letter (s) in each row, column or interaction are insignificantly different at 5% level.
(LFB) = Leave flower buds - (LF) = Leave fruits - (SA) = Salicylic acid

Data in table (9) showed the effect of flower bud and fruit thinning and spraying with salicylic acid, on peel weight and seeds weight of the Prickly pear *(Opuntia ficus-indica L.*) plants during 2018 & 2019 seasons.

3.3.6. Peel weight (g)

Regarding to flower buds and fruit handmade thinning treatments, control treatment recorded lowest significant peel weight values in both seasons. Most of other treatments gave higher peel weight than control. Concerning to spraying with salicylic acid treatments, control treatment showed the lowest significant peel weight value, which was observed in both seasons. The interaction between two studied factors, leave 6 flower buds with control of spraying salicylic acid gave lowest peel weight values in both seasons.

3.3.7. Seeds weight (g)

Regarding to flower buds and fruit handmade thinning treatments, leave 9 fruits/cladode recorded the lowest significant seeds weight values in both seasons. On the other hand, control (without thinning) was the highest significant seeds weight. Concerning to spraying with salicylic acid treatments, spraying with 200 mg/L show to be the lowest significant seeds weight value, which was observed in both seasons. The interaction between two studied factors, leave 9 fruits/cladode with spraying by salicylic acid at 200 mg/L gave lowest significant seeds weight values in both seasons.

Table 9: Effect of flower bud and fruit thinning and spraying with salicylic acid, on peel weight and seeds weight of the Prickly pear *(Opuntia ficus-indica* L.) plants during 2018 & 2019 seasons.

Parameters	Peel weight (g)				Seeds weight (g)			
Foliar spraying / Flower bud and fruit thinning	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean
	First season 2018							
Control	43.80q	56.66j	60.02e-h	53.49E	25.40a	22.74h	21.58jk	23.24A
6 L.F.B. /cladode	51.60r	57.56ij	61.40c-f	53.52E	24.81b	22.14i	21.20kl	22.72B
7 L.F.B. /cladode	48.32p	58.22h-j	61.75c-e	56.10D	24.58bc	21.58jk	20.60m	22.25C
8 L.F.B. /cladode	49.18op	59.00g-i	62.54bc	56.91CD	24.42b-d	21.30j-l	20.76lm	22.16C
9 L.F.B. /cladode	50.33no	58.97g-i	63.05bc	57.45BC	24.17c-e	21.83ij	20.25m	22.08C
6 L.F. fruits/cladode	51.14mn	59.96e-h	62.78bc	57.96BC	23.86d-f	21.34j-l	19.02no	21.41D
7 L.F. fruits/cladode	52.19lm	59.63f-h	62.26cd	58.03B	23.61e-g	20.57m	18.34p	20.84E
8 L.F. fruits/cladode	53.23kl	60.56d-g	64.34ab	59.38A	23.42fg	19.34n	18.36p	20.37F
9 L.F. fruits/cladode	54.59k	59.03g-i	65.51a	59.71A	23.11gh	18.57op	17.49q	19.72G
Mean	49.38C	58.84B	62.63A		24.15A	21.05B	19.73C	
	Second season 2019							
Control	41.56m	52.20g	54.63d-f	49.46F	25.54a	22.80h	21.67jk	23.34A
6 L.F.B. /cladode	44.08l	52.77fg	55.47c-e	50.77E	24.93b	22.23i	21.33kl	22.83B
7 L.F.B. /cladode	45.40kl	53.78e-g	56.20cd	51.79D	24.70bc	21.72jk	20.70m	22.37C
8 L.F.B. /cladode	46.12jk	53.77e-g	56.72bc	52.20CD	24.48b-d	21.43kl	20.88lm	22.26C
9 L.F.B. /cladode	46.94jk	53.80e-g	57.43a-c	52.72CD	24.26c-e	22.00ij	20.40m	22.21C
6 L.F. fruits/cladode	47.59ij	54.43d-f	57.26bc	53.09C	24.01d-f	21.47j-l	19.14no	21.54D
7 L.F. fruits/cladode	48.86hi	54.02e-g	56.78bv	53.22BC	23.74e-g	20.68m	18.42p	20.95E
8 L.F. fruits/cladode	49.09hi	54.81d-f	58.58ab	54.16AB	23.46fg	19.39n	18.42p	20.42F
9 L.F. fruits/cladode	50.01h	53.82e-g	59.20a	54.35A	23.29gh	18.65op	17.70q	19.88G
Mean	46.63C	53.71B	56.92A		24.27A	21.15B	19.85C	

Means having the same letter (s) in each row, column or interaction are insignificantly different at 5% level.
(LFB) = Leave flower buds - (LF) = Leave fruits - (SA) = Salicylic acid

Data in table (10) showed the effect of flower bud and fruit thinning and spraying with salicylic acid, on peel weight and pulp of the Prickly pear *(Opuntia ficus-indica L.*) plants during 2018 & 2019 seasons.

3.3.8. Peel percentage

Regarding to flower buds and fruit handmade thinning treatments, control (without thinning) had the lowest significant peel percentage value in both seasons. Concerning to spraying with salicylic acid treatments, control treatment gave lowest significant values in first season, but in second season spraying with 200ppm salicylic acid had lowest significant values in second season. The interaction between two studied factors, inconstant trend could be noticed among treatments in both seasons.

3.3.9. Pulp percentage

Regarding to flower buds and fruit handmade thinning treatments, leave 9 fruits/cladode recorded the highest significant pulp percentage values in both seasons. On the other hand, control (without thinning) was the lowest significant pulp percentage value. Concerning to spraying with salicylic acid treatments, spraying with 200 mg/L show to be the highest significant pulp percentage value, which was observed in both seasons. The interaction between two studied factors, leave 9 fruits/cladode with spraying by salicylic acid at 200 mg/L gave highest significant pulp percentage values in both seasons.

Table 10: Effect of flower bud and fruit thinning and spraying with salicylic acid, on peel percentage and pulp percentage of the Prickly pear *(Opuntia ficus-indica* L.) plants during 2018 & 2019 seasons.

Parameters	Peel (%)				Pulp (%)			
Foliar spraying Flower bud and fruit thinning	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean
				First season 2018				
Control	33.67m	34.07fg	33.76l	33.83G	46.81m	52.25gh	54.11de	51.06 F
6 L.F.B. /cladode	30.77n	34.10f	33.75l	32.87H	50.88ij	52.78fg	54.59d	52.75DE
7 L.F.B. /cladode	33.86k	34.33d	33.95h-j	34.05DE	48.91l	52.95fg	54.73cd	52.20E
8 L.F.B. /cladode	33.89jk	34.40cd	33.93i-k	34.08CD	49.28l	53.18e-g	54.80cd	52.42E
9 L.F.B. /cladode	33.89jk	34.15f	34.03gh	34.02EF	49.83kl	53.21e-g	55.05cd	52.70DE
6 L.F. fruits/cladode	33.91jk	34.42c	33.99hi	34.11BC	50.27jk	53.33ef	55.71bc	53.10CD
7 L.F. fruits/cladode	34.09fg	34.55b	33.76l	34.13B	50.49jk	53.53ef	56.29ab	53.44BC
8 L.F. fruits/cladode	34.01gh	34.80a	34.13f	34.32A	51.02ij	54.08de	56.13b	53.74B
9 L.F. fruits/cladode	33.97h-j	34.24e	33.79l	34.00F	51.65hi	54.99cd	57.19a	54.61A
Mean	33.56C	34.34A	33.90B		49.90C	53.37B	55.40A	
				Second season 2019				
Control	31.37ef	31.37ef	30.86m	31.20F	49.36o	54.93hi	56.89d-f	53.73G
6 L.F.B. /cladode	30.98l	31.30g-i	30.71o	31.00H	51.50n	55.52gh	57.48cd	54.83F
7 L.F.B. /cladode	31.44cd	31.67ab	31.05k	31.39B	51.45n	55.54gh	57.51cd	54.83F
8 L.F.B. /cladode	31.46cd	31.46c	30.98l	31.30D	51.84mn	56.00fg	57.62cd	55.15EF
9 L.F.B. /cladode	31.36ef	31.24i	31.16j	31.25E	52.44lm	55.98fg	57.79cd	55.40DE
6 L.F. fruits/cladode	31.33f-h	31.41de	31.15j	31.30D	52.86kl	56.20e-g	58.43bc	55.83CD
7 L.F. fruits/cladode	31.65b	31.48c	30.94l	31.36C	52.98kl	56.47e-g	59.02b	56.16BC
8 L.F. fruits/cladode	31.29hi	31.72a	31.28i	31.43A	53.76jk	57.06de	58.89b	56.57B
9 L.F. fruits/cladode	31.10j	31.34fg	30.79n	31.08G	54.42ij	57.80cd	60.01a	57.41A
Mean	31.33B	31.44A	30.99C		52.29C	56.17B	58.18A	

Means having the same letter (s) in each row, column or interaction are insignificantly different at 5% level.
(LFB) = Leave flower buds - (LF) = Leave fruits - (SA) = Salicylic acid

Data in table (11) showed the effect of flower bud and fruit thinning and spraying with salicylic acid, on total soluble solids and acidity of the Prickly pear *(Opuntia ficus-indica L.*) plants during 2018 & 2019 seasons.

3.3.10. Total soluble solids percentage

Regarding to flower buds and fruit handmade thinning treatments, leave 9 fruits/cladode recorded the highest significant total soluble solids percentage values in both seasons. On the other hand, control (without thinning) was the lowest significant total soluble solids percentage value. Concerning to spraying with salicylic acid treatments, spraying with 100, 200 mg/L show to be the highest significant total soluble solids percentage value, which was observed in both seasons. The interaction between two studied factors, leave 9 fruits/cladode with spraying by salicylic acid at 100, 200 mg/L gave highest significant total soluble solids percentage values in both seasons.

3.3.11. Acidity percentage

Regarding to flower buds and fruit handmade thinning treatments, leave 9 fruits/cladode recorded the lowest significant acidity percentage values in both seasons. On the other hand, control (without thinning) was the highest significant acidity percentage value. Concerning to spraying with salicylic acid treatments, spraying with 200 mg/L show to be the lowest significant acidity percentage value, which was observed in both seasons. The interaction between two studied factors, leave 9 fruits/cladode with spraying by salicylic acid at 200 mg/L gave lowest significant acidity percentage values in first season and 10 mg/L in second season.

Table 11: Effect of flower bud and fruit thinning and spraying with salicylic acid, on fruit total soluble solids and acidity of the Prickly pear *(Opuntia ficus-indica L.)* plants during 2018 & 2019 seasons.

Parameters	TSS (%)				Acidity (%)			
Foliar spraying / Flower bud and fruit thinning	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean
	First season 2018							
Control	8.88l	9.91f-h	9.99e-g	9.59F	0.550a	0.520cd	0.490	0.520A
6 L.F.B. /cladode	9.23k	9.99e-g	10.07d-g	9.76E	0.530bc	0.530bc	0.480	0.513A
7 L.F.B. /cladode	9.32jk	10.13d-f	10.13d-f	9.86D	0.500ef	0.540	0.470	0.503B
8 L.F.B. /cladode	9.44jk	10.22b-e	10.19b-e	9.95CD	0.520cd	0.490	0.460	0.490DE
9 L.F.B. /cladode	9.51ij	10.26a-d	10.30a-d	10.02C	0.510de	0.480	0.490	0.493CD
6 L.F. fruits/cladode	9.70hi	10.28a-d	10.27a-d	10.08C	0.500ef	0.500	0.500	0.500BC
7 L.F. fruits/cladode	9.84gh	10.30a-d	10.39a-c	10.18B	0.500ef	0.470	0.480	0.483E
8 L.F. fruits/cladode	9.86gh	10.31a-d	10.47a	10.21B	0.490fg	0.460	0.500	0.483E
9 L.F. fruits/cladode	10.15c-e	10.42ab	10.43ab	10.33A	0.480gh	0.450	0.490	0.473F
Mean	9.55B	10.20A	10.25A		0.509A	0.493B	0.484C	
	Second season 2019							
Control	9.07n	10.10g-j	10.18f-i	9.78F	0.600a	0.570b-d	0.540e-g	0.570A
6 L.F.B. /cladode	9.42m	10.18f-i	10.26e-h	9.95E	0.580a-c	0.580a-c	0.530f-h	0.563AB
7 L.F.B. /cladode	9.51lm	10.32d-g	10.38c-f	10.07D	0.550d-f	0.590ab	0.520g-i	0.553BC
8 L.F.B. /cladode	9.63l	10.41b-e	10.32d-g	10.12D	0.570b-d	0.540e-g	0.510hi	0.540CD
9 L.F.B. /cladode	9.70kl	10.45a-e	10.49a-e	10.21C	0.560c-e	0.530f-h	0.540e-g	0.543CD
6 L.F. fruits/cladode	9.89jk	10.47a-e	10.46a-e	10.27BC	0.550d-f	0.550d-f	0.550d-f	0.550BC
7 L.F. fruits/cladode	10.03ij	10.49a-e	10.58a-c	10.37B	0.550d-f	0.520g-i	0.530f-h	0.533DE
8 L.F. fruits/cladode	10.05h-j	10.50a-d	10.66a	10.40B	0.540e-g	0.510hi	0.550d-f	0.533DE
9 L.F. fruits/cladode	10.34d-f	10.61a-c	10.62ab	10.52A	0.530f-h	0.500i	0.540e-g	0.523E
Mean	9.74B	10.39A	10.44A		0.559A	0.543B	0.534C	

Means having the same letter (s) in each row, column or interaction are insignificantly different at 5% level.
(LFB) = Leave flower buds - (LF) = Leave fruits - (SA) = Salicylic acid

Data in table (12) showed the effect of flower bud and fruit thinning and spraying with salicylic acid, on total soluble solids/ acid ratio and vitamin of the Prickly pear *(Opuntia ficus-indica L.)* plants during 2018 & 2019 seasons.

3.3.12. Total soluble solids /acid ratio and Vitamin C

Regarding to flower buds and fruit handmade thinning treatments, leave 9 fruits/cladode recorded the highest significant total soluble solids /acid ratio and vitamin C content in both seasons. On the other hand, control (without thinning) was the lowest significant total soluble solids /acid ratio and vitamin C value. Concerning to spraying with salicylic acid treatments, spraying with 200 mg/L show to be the highest significant total soluble solids /acid ratio and vitamin C value, which was observed in both seasons. The interaction between two studied factors, leave 9 fruits/cladode with spraying by salicylic acid at 100 mg/L gave highest significant total soluble solids /acid ratio in both season and with 200 ppm showed highest vitamin C content in both seasons.

Table 12: Effect of flower bud and fruit thinning and spraying with salicylic acid, on total soluble solids/ acid ratio and vitamin C of the Prickly pear (*Opuntia ficus-indica L.*) plants during 2018 & 2019 seasons.

Parameters	TSS/acid ratio				Vitamin C/mg/100g			
Foliar spraying / Flower bud and fruit thinning	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean
	First season 2018							
Control	16.15s	19.06mn	20.39hi	18.53F	13.56q	14.64j-l	15.20gh	14.47F
6 L.F.B. /cladode	17.42r	18.85mn	20.98d-f	19.08E	13.68pq	14.80i-k	15.29g	14.59E
7 L.F.B. /cladode	18.64op	18.76no	21.55d	19.65D	13.77pq	14.86i	15.52f	14.72D
8 L.F.B. /cladode	18.15q	20.86d-f	22.15b	20.39C	13.86p	13.72pq	15.67ef	14.42F
9 L.F.B. /cladode	18.65op	21.38d	21.02de	20.35C	14.06o	14.13o	15.74de	14.64DE
6 L.F. fruits/cladode	19.40kl	20.56fg	20.54fg	20.17C	14.23no	14.46lm	15.88cd	14.86C
7 L.F. fruits/cladode	19.68jk	21.91c	21.65d	21.08B	14.46lm	14.69i-k	16.02bc	15.06B
8 L.F. fruits/cladode	20.12hi	22.41b	20.94d-f	21.16B	14.40mn	14.82ij	16.19ab	15.14B
9 L.F. fruits/cladode	21.15de	23.16a	21.29d	21.86A	14.59k-m	15.08h	16.33a	15.33A
Mean	18.82C	20.77B	21.17A		14.07C	14.58B	15.76A	
	Second season 2019							
Control	15.12p	17.72m	18.85i	17.23F	13.69q	14.77j-l	15.33gh	14.60F
6 L.F.B. /cladode	16.24	17.55mn	19.36e-h	17.72E	13.81pq	14.93ij	15.42g	14.72E
7 L.F.B. /cladode	17.29n	17.49no	19.96cd	18.25D	13.90p	14.99i	15.65f	14.85D
8 L.F.B. /cladode	16.89o	19.28gh	20.24c	18.80C	13.99p	13.85pq	15.80ef	14.55F
9 L.F.B. /cladode	17.32n	19.72e	19.43e-g	18.82C	14.19o	14.26o	15.87de	14.77DE
6 L.F. fruits/cladode	17.98lm	19.04hi	19.02hi	18.68C	14.36no	14.59lm	16.01cd	14.99C
7 L.F. fruits/cladode	18.24kl	20.17c	19.96cd	19.46B	14.59lm	14.82i-k	16.15bc	15.19B
8 L.F. fruits/cladode	18.61jk	20.59b	19.38gh	19.53B	14.53mn	14.95ij	16.32ab	15.27B
9 L.F. fruits/cladode	19.51ef	21.22a	19.67jk	20.13A	14.72k-m	15.21h	16.46a	15.46A
Mean	17.47C	19.20B	19.54A		14.20C	14.71B	15.89A	

Means having the same letter (s) in each row, column or interaction are insignificantly different at 5% level.
(LFB) = Leave flower buds - (LF) = Leave fruits - (SA) = Salicylic acid

Data in table (13) showed the effect of flower bud and fruit thinning and spraying with salicylic acid, on total sugars and reducing sugars of the Prickly pear *(Opuntia ficus-indica L.*) plants during 2018 & 2019 seasons.

3.3.13. Total sugars percentage and reducing sugars percentage

Regarding to flower buds and fruit handmade thinning treatments, leave 9 fruits/cladode recorded the highest significant total sugars and reducing sugars values in both seasons. On the other hand, control (without thinning) was the lowest significant total sugars and reducing sugars value. Concerning to spraying with salicylic acid treatments, spraying with 200 mg/L show to be the highest significant total sugars and reducing sugars value, which was observed in both seasons. The interaction between two studied factors, leave 9 fruits/cladode with spraying by salicylic acid at 200 mg/L gave highest significant total sugars and reducing sugars values in both seasons.

Table 13: Effect of flower bud and fruit thinning and spraying with salicylic acid, on total sugars and reducing sugars of the Prickly pear *(Opuntia ficus-indica* L.) plants during 2018 & 2019 seasons.

Parameters	Total sugars (%)				Reducing sugars (%)			
Foliar spraying / Flower bud and fruit thinning	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean
	First season 2018							
Control	7.50p	8.62jk	8.69ij	8.27F	7.11m	8.21hi	8.27g-i	7.86F
6 L.F.B. /cladode	7.89o	8.99d-f	8.82f-i	8.47E	7.48l	8.29g-i	8.42e-g	8.06E
7 L.F.B. /cladode	7.97no	8.79g-i	8.87e-h	8.54E	7.53l	8.31f-h	8.49d-f	8.11E
8 L.F.B. /cladode	8.10mn	8.8e-h	8.94e-g	8.64D	7.78k	8.42e-g	8.57c-e	8.26D
9 L.F.B. /cladode	8.16m	9.02c-e	8.93e-g	8.70C	8.17h-j	8.48d-f	8.63b-d	8.43B
6 L.F. fruits/cladode	8.37l	8.75h-j	8.97d-f	8.70C	7.82k	8.51de	8.72bc	8.35C
7 L.F. fruits/cladode	8.51k	9.13bc	9.10b-d	8.91B	8.02j	8.61cd	8.81a-c	8.48B
8 L.F. fruits/cladode	8.53k	9.23b	9.13bc	8.96B	8.12ij	8.62cd	8.84a-c	8.53B
9 L.F. fruits/cladode	8.82f-i	9.97a	9.99a	9.59A	8.45d-g	8.73bc	8.96a	8.71A
Mean	8.21C	9.01A	9.05B		7.83C	8.46B	8.63A	
	Second season 2019							
Control	7.65n	8.83i	8.92hi	8.47F	7.23m	8.46i	8.57f-i	8.09G
6 L.F.B. /cladode	8.09m	8.92hi	8.93hi	8.65E	7.64l	8.52g-i	8.65e-h	8.27F
7 L.F.B. /cladode	8.24l	9.02gh	9.06e-g	8.77D	7.83k	8.53g-i	8.68e-g	8.35F
8 L.F.B. /cladode	9.25a-d	9.04f-h	9.12d-g	9.14AB	7.96k	8.64e-h	8.71ef	8.44E
9 L.F.B. /cladode	8.37k	9.08e-g	9.16b-f	8.87C	8.21j	8.68e-g	8.77c-e	8.55D
6 L.F. fruits/cladode	8.51j	9.13c-g	9.25a-d	8.96B	8.13j	8.65e-h	8.81b-e	8.53D
7 L.F. fruits/cladode	8.62j	9.16b-f	9.26a-c	9.01B	8.26j	8.73d-f	8.90a-d	8.63C
8 L.F. fruits/cladode	8.63j	9.18b-e	9.33a	9.05B	8.49hi	8.79b-e	8.93a-c	8.74B
9 L.F. fruits/cladode	8.92hi	9.29ab	9.33a	9.18A	8.77c-e	8.90a	8.99a	8.89A
Mean	8.48C	9.07B	9.15A		8.06C	8.66B	8.78A	

Means having the same letter (s) in each row, column or interaction are insignificantly different at 5% level.
(LFB) = Leave flower buds - (LF) = Leave fruits - (SA) = Salicylic acid

Data in table (14) showed the effect of flower bud and fruit thinning and spraying with salicylic acid, on nitrogen and phosphor of the Prickly pear *(Opuntia ficus-indica L.*) plants during 2018 & 2019 seasons.

3.3.14. Nitrogen percentage

Regarding to flower buds and fruit handmade thinning treatments, leave 9 fruits/cladode recorded the highest significant nitrogen percentage values in both seasons. On the other hand, control (without thinning) was the lowest significant nitrogen percentage value. Concerning to spraying with salicylic acid treatments, spraying with 200 mg/L show to be the highest significant nitrogen percentage value, which was observed in first season, while spraying with 200 mg/L in second season recorded the highest significant value. The interaction between two studied factors, leave 9 fruits/cladode with spraying by salicylic acid at 200 mg/L gave highest significant nitrogen percentage values in both seasons.

3.3.15. Phosphor percentage

Regarding to flower buds and fruit handmade thinning treatments, insignificant differences among treatments could be noticed in both seasons. Concerning to spraying with salicylic acid treatments, spraying with 200 mg/L show to be the highest significant phosphor percentage value, which was observed in both seasons. The interaction of the two studied factors, there are insignificant differences among most of the treatments of cladode phosphor percentage in both seasons.

Table 14: Effect of flower bud and fruit thinning and spraying with salicylic acid, on cladode nitrogen and phosphor percentage of the Prickly pear *(Opuntia ficus-indica* L.) plants during 2018 & 2019 seasons.

Parameters	N (%)				P (%)			
Foliar spraying / Flower bud and fruit thinning	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean
	First season 2018							
Control	0.440p	0.570l-n	0.630j-l	0.547G	0.146d	0.191a-d	0.200a-d	0.179A
6 L.F.B. /cladode	0.380q	0.610k-m	0.650i-k	0.547G	0.152cd	0.192a-d	0.211a-d	0.185A
7 L.F.B. /cladode	0.490op	0.690h-j	0.700hi	0.627F	0.157b-d	0.196a-d	0.219a-d	0.191A
8 L.F.B. /cladode	0.520no	0.680ij	0.680ij	0.627F	0.162b-d	0.202a-d	0.226a-d	0.197A
9 L.F.B. /cladode	0.560mn	0.710g-i	0.810c-e	0.693E	0.164b-d	0.206a-d	0.228a-d	0.199A
6 L.F. fruits/cladode	0.580lm	0.740f-h	0.830b-d	0.717D	0.170a-d	0.210a-d	0.232a-c	0.204A
7 L.F. fruits/cladode	0.610k-m	0.760e-g	0.850bc	0.740C	0.178a-d	0.212a-d	0.235a-c	0.208A
8 L.F. fruits/cladode	0.630j-l	0.780d-f	0.880ab	0.763B	0.181a-d	0.215a-d	0.239ab	0.212A
9 L.F. fruits/cladode	0.670ij	0.800c-e	0.910a	0.793A	0.184a-d	0.222a-d	0.250a	0.219A
Mean	0.542C	0.704B	0.771A		0.166C	0.205B	0.227A	
	Second season 2019							
Control	0.475q	0.605n	0.665k-m	0.582G	0.199c	0.244a-c	0.253a-c	0.232A
6 L.F.B. /cladode	0.415r	0.645l-n	0.685j-l	0.582G	0.205bc	0.245a-c	0.264a-c	0.238A
7 L.F.B. /cladode	0.525p	0.725ij	0.735h-j	0.662F	0.210bc	0.249a-c	0.272a-c	0.244A
8 L.F.B. /cladode	0.555op	0.715i-k	0.715i-k	0.662F	0.215bc	0.255a-c	0.279a-c	0.250A
9 L.F.B. /cladode	0.595no	0.745hi	0.845c-e	0.728E	0.217a-c	0.259a-c	0.281a-c	0.252A
6 L.F. fruits/cladode	0.615mn	0.775gh	0.865cd	0.752D	0.223a-c	0.263a-c	0.285a-c	0.257A
7 L.F. fruits/cladode	0.645l-n	0.795fg	0.885bc	0.775C	0.231a-c	0.265a-c	0.288ab	0.261A
8 L.F. fruits/cladode	0.665k-m	0.815e-g	0.915ab	0.798B	0.234a-c	0.268a-c	0.292ab	0.265A
9 L.F. fruits/cladode	0.705i-k	0.835d-f	0.945a	0.828A	0.237a-c	0.275a-c	0.33a	0.272A
Mean	0.577C	0.739B	0.806A		0.219C	0.258B	0.280A	

Means having the same letter (s) in each row, column or interaction are insignificantly different at 5% level.
(LFB) = Leave flower buds - (LF) = Leave fruits - (SA) = Salicylic acid
The optimum level of Nitrogen in cactus pear cladode = 0.79 %, Phosphorus = 0.26 % and (Salama, *et al*., 2021).

Data in table (15) showed the effect of flower bud and fruit thinning and spraying with salicylic acid, on cladode potassium and calcium percentage of the Prickly pear *(Opuntia ficus-indica* L.) plants during 2018 & 2019 seasons.

3.3.16. Potassium percentage and Calcium percentage

Regarding to flower buds and fruit handmade thinning treatments, leave 8, 9 fruits/cladode recorded the highest significant potassium and calcium percentage values in first season, leave 9 fruits/cladode recorded the highest significant potassium and calcium percentage values in second season. On the other hand, control (without thinning) was the lowest significant potassium and calcium percentage value. Concerning to spraying with salicylic acid treatments, spraying with 200 mg/L show to be the highest significant potassium and calcium percentage value, which was observed in both season. The interaction between two studied factors, leave 9 fruits/cladode with spraying by salicylic acid at 200 mg/L gave highest significant cladode potassium and calcium percentage values in both seasons.

Table 15: Effect of flower bud and fruit thinning and spraying with salicylic acid, on cladode potassium and calcium percentage of the Prickly pear *(Opuntia ficus-indica L.*) plants during 2018 & 2019 seasons.

Parameters	K (%)				Ca (%)			
Foliar spraying / Flower bud and fruit thinning	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean
				First season 2018				
Control	2.06r	2.61op	2.74no	2.47G	4.84t	5.68no	6.35g-i	5.62E
6 L.F.B. /cladode	2.19qr	2.91l-n	3.04k-m	2.71F	4.91t	5.83l-n	6.44f-h	5.73DE
7 L.F.B. /cladode	2.27qr	3.12h-l	3.17jk	2.85E	5.04st	5.94k-m	6.55e-g	5.84CD
8 L.F.B. /cladode	2.28q	3.24i-k	3.76c-e	3.09D	5.23rs	5.68no	6.64d-f	5.85CD
9 L.F.B. /cladode	2.40pq	3.32h-j	3.87b-d	3.20C	5.38p-r	5.72m-o	6.70c-e	5.93C
6 L.F. fruits/cladode	2.57op	3.40g-i	3.94a-c	3.30BC	5.53o-q	6.02j-l	6.81b-d	6.12B
7 L.F. fruits/cladode	2.52op	3.53f-h	3.98ab	3.34B	5.51o-q	6.05j-l	6.90bc	6.15AB
8 L.F. fruits/cladode	2.70no	3.59e-g	4.02ab	3.44AB	5.60n-p	6.15i-k	6.98b	6.24A
9 L.F. fruits/cladode	2.84mn	3.68d-f	4.12a	3.55A	5.35qr	6.23h-j	7.25a	6.28A
Mean	2.43C	3.27B	3.63A		5.27C	5.92B	6.74A	
				Second season 2019				
Control	2.10s	2.68no	2.81l-n	2.53G	4.97r	5.81l-n	6.48de	5.75F
6 L.F.B. /cladode	2.25rs	2.98kl	3.11jk	2.78F	5.04qr	5.96kl	6.57ef	5.86E
7 L.F.B. /cladode	2.32qr	3.19ij	3.24ij	2.92E	5.17q	6.07jk	6.68de	5.97CD
8 L.F.B. /cladode	2.35qr	3.31h-j	3.83c-e	3.16D	5.36p	6.15i-k	6.77cd	6.09C
9 L.F.B. /cladode	2.47pq	3.39hi	3.94b-d	3.27C	5.51op	5.64no	6.83cd	5.99CD
6 L.F. fruits/cladode	2.64n-p	3.47gh	4.01a-c	3.37BC	5.66m-o	5.85lm	6.94bc	6.15C
7 L.F. fruits/cladode	2.59op	3.60fg	4.05ab	3.41B	5.73mn	6.18h-j	7.03b	6.31B
8 L.F. fruits/cladode	2.77m-o	3.66e-g	4.09ab	3.51B	5.48op	6.28hi	7.11b	6.29B
9 L.F. fruits/cladode	2.91lm	3.75d-f	4.19a	3.62A	5.81l-n	6.36gh	7.38a	6.52A
Mean	2.49C	3.34B	3.70A		5.41C	6.03B	6.87A	

Means having the same letter (s) in each row, column or interaction are insignificantly different at 5% level.
(LFB) = Leave flower buds - (LF) = Leave fruits - (SA) = Salicylic acid
The optimum level of Potassium = 3.75 % and Calcium in cactus pear cladode = 6.08 % (Salama *et al*., 2021).

Data in table (16) showed the effect of flower bud and fruit thinning and spraying with salicylic acid, on magnesium and iron of the Prickly pear *(Opuntia ficus-indica L.*) plants during 2018 & 2019 seasons.

3.3.17. Magnesium percentage

Regarding to flower buds and fruit handmade thinning treatments, leave 9 fruits/cladode recorded the highest significant magnesium percentage values in both seasons. On the other hand, control (without thinning) was the lowest significant magnesium percentage value. Concerning to spraying with salicylic acid treatments, spraying with 200 mg/L show to be the highest significant magnesium percentage value, which was observed in both seasons. The interaction between two studied factors, leave 9 fruits/cladode with spraying by salicylic acid at 100, 200 mg/L gave highest significant magnesium percentage values in both seasons.

3.3.18. Iron (ppm)

Regarding to flower buds and fruit handmade thinning treatments, leave 9 fruits/cladode recorded the highest significant iron (ppm) values in both seasons. On the other hand, control (without thinning) was the lowest significant iron (ppm) value. Concerning to spraying with salicylic acid treatments, spraying with 200 mg/L show to be the highest significant iron (ppm) value, which was observed in both seasons. The interaction between two studied factors, leave 9 fruits/cladode with spraying by salicylic acid at 200 mg/L gave highest significant iron (ppm) values in both seasons.

Table 16: Effect of flower bud and fruit thinning and spraying with salicylic acid, on magnesium and iron of the Prickly pear *(Opuntia ficus-indica* L.) plants during 2018 & 2019 seasons.

Parameters	Mg (%)				Fe (ppm)			
Foliar spraying / Flower bud and fruit thinning	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean
				First season 2018				
Control	0.707u	0.927i-k	0.967fg	0.867EF	44.85t	46.37mn	47.46g	46.23H
6 L.F.B. /cladode	0.737t	0.867o-q	0.977ef	0.860F	45.00st	46.53lm	47.70f	46.41G
7 L.F.B. /cladode	0.777s	0.857pq	0.996de	0.877E	45.20rs	46.66kl	47.88f	46.58F
8 L.F.B. /cladode	0.797s	0.897l-n	1.040bc	0.911D	45.41r	46.82jk	48.20e	46.81E
9 L.F.B. /cladode	0.827r	0.887m-o	1.012d	0.909D	45.68q	46.94ij	48.47d	47.03D
6 L.F. fruits/cladode	0.847qr	0.877n-p	1.020cd	0.915D	45.92p	47.12hi	48.72c	47.25C
7 L.F. fruits/cladode	0.877n-p	0.917j-l	1.050b	0.945C	46.03op	47.04ij	49.04b	47.37C
8 L.F. fruits/cladode	0.907k-m	0.947g-i	1.063ab	0.972B	46.06op	47.18hi	49.31a	47.52B
9 L.F. fruits/cladode	0.937h-j	0.957f-h	1.076a	0.990A	46.22no	47.32gh	49.47a	47.67A
Mean	0.824C	0.904B	1.022A		45.60C	46.89B	48.47A	
				Second season 2019				
Control	0.716w	0.936k-m	0.976hi	0.876EF	45.24t	46.76mn	47.85g	46.62H
6 L.F.B. /cladode	0.746v	0.876q-r	0.986gh	0.869F	45.39st	46.92lm	48.09f	46.80G
7 L.F.B. /cladode	0.786u	0.866rs	1.005fg	0.886E	45.59rs	47.05kl	48.27f	46.97F
8 L.F.B. /cladode	0.806u	0.906n-p	1.049cd	0.920D	45.80r	47.21jk	48.59e	47.20E
9 L.F.B. /cladode	0.836t	0.896o-q	1.021ef	0.918D	46.07q	47.33ij	48.86d	47.42D
6 L.F. fruits/cladode	0.856st	0.886p-r	1.029de	0.924D	46.31p	47.51hi	49.11c	47.64C
7 L.F. fruits/cladode	0.886p-r	0.926l-n	1.059bc	0.957C	46.42op	47.43ij	49.43b	47.76C
8 L.F. fruits/cladode	0.916m-o	0.956i-k	1.072ab	0.981B	46.45op	47.57hi	49.70a	47.91B
9 L.F. fruits/cladode	0.946j-l	0.966h-j	1.085a	0.999A	46.61no	47.71gh	49.86a	48.06A
Mean	0.833C	0.913B	1.031A		45.99C	47.28B	48.86A	

Means having the same letter (s) in each row, column or interaction are insignificantly different at 5% level.
(LFB) = Leave flower buds - (LF) = Leave fruits - (SA) = Salicylic acid
The optimum level of Magnesium = 0.93% and Iron = 47.90ppm in cactus pear cladode (Salama *et al.,* 2021)

Data in table (17) showed the effect of flower bud and fruit thinning and spraying with salicylic acid, on zinc and manganese of the Prickly pear *(Opuntia ficus-indica L.*) plants during 2018 & 2019 seasons.

3.3.19. Zinc (ppm)

Regarding to flower buds and fruit handmade thinning treatments, leave 8, 9 fruits/cladode recorded the highest significant zinc (ppm) values in both seasons. On the other hand, control (without thinning) was the lowest significant zinc (ppm) value. Concerning to spraying with salicylic acid treatments, spraying with 200 mg/L show to be the highest significant zinc (ppm) value, which was observed in both seasons. The interaction between two studied factors, leave 8, 9 fruits/cladode with spraying by salicylic acid at 200 mg/L gave highest significant zinc (ppm) values in both seasons.

3.3.20. Manganese (ppm)

Regarding to flower buds and fruit handmade thinning treatments, leave 9 fruits/cladode recorded the highest significant manganese (ppm) values in both seasons. On the other hand, control (without thinning) was the lowest significant manganese (ppm) value. Concerning to spraying with salicylic acid treatments, spraying with 200 mg/L show to be the highest significant manganese (ppm) value, which was observed in both seasons. The interaction between two studied factors, leave 9 fruits/cladode with spraying by salicylic acid at 200 mg/L gave highest significant manganese (ppm) values in both seasons.

These results were in a harmony with those found by Barbera *et al*., 1991; Inglese *et al.,* 1995; Inglese, 1995; Gugliuzza *et al*., 2002a), who removal of reproductive buds (RRB) for fruit thinning and regarding their positive effect on yield, yield components, and final fruit size and quality. Also, Inglese *et al*., 2002; Gugliuzza *et al.,* 2002a,b). Jorge *et al.* (2010) in order to examine the effects of applying thinning fruit buds which improved the quality of the fruits per clouded. Furthermore, (Kök

2012). Ahmed *et al.* (2015) found that sprays of salicylic acid at growth start and just after fruit setting was responsible for improving yield and fruit quality.

Table 17: Effect of flower bud and fruit thinning and spraying with salicylic acid, on zinc and manganese of the Prickly pear *(Opuntia ficus-indica* L.) plants during 2018 & 2019 seasons.

Parameters	Zn (ppm)				Mn (ppm)			
Foliar spraying / Flower bud and fruit thinning	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean	Control	S.A. 100 mg/L	S.A. 200 mg/L	Mean
	First season 2018							
Control	16.09u	17.40l-n	18.38gh	17.29G	503.0y	582.0p	648.0i	577.7I
6 L.F.B. /cladode	16.36tu	17.46l-n	18.61fg	17.48F	510.0x	589.0no	679.0h	592.7H
7 L.F.B. /cladode	16.50st	17.55k-m	18.81ef	17.62EF	517.0w	594.0n	697.0g	602.7G
8 L.F.B. /cladode	16.62r-t	17.63j-l	18.96e	17.74DE	525.0v	586.0op	716.0f	609.0F
9 L.F.B. /cladode	16.76q-s	17.70j-l	19.11de	17.86D	534.0u	591.0no	734.0e	619.7E
6 L.F. fruits/cladode	16.89p-r	17.86i-k	19.37cd	18.04C	546.0t	602.0m	747.0d	631.7D
7 L.F. fruits/cladode	17.03o-q	17.94ij	19.62bc	18.20BC	553.0s	609.0l	762.0c	641.3C
8 L.F. fruits/cladode	17.15n-p	18.02i	19.80ab	18.32AB	562.0r	624.0k	785.5b	657.2B
9 L.F. fruits/cladode	17.27m-o	18.16hi	19.95a	18.46A	574.0q	639.0g	803.0a	672.0A
Mean	16.74C	17.75B	19.18A		536.0C	601.8B	730.2A	
	Second season 2019							
Control	16.28v	17.59m-o	18.57hi	17.48G	510.0y	589.0p	655.0i	584.7I
6 L.F.B. /cladode	16.55uv	17.65mn	18.80gh	17.67F	517.0x	596.0no	686.0h	599.7H
7 L.F.B. /cladode	16.69tu	17.74mn	19.00fg	17.81EF	524.0w	601.0n	704.0g	609.7G
8 L.F.B. /cladode	16.81s-u	17.82lm	19.15ef	17.93DE	532.0v	593.0op	723.0f	616.0F
9 L.F.B. /cladode	16.95r-t	17.89k-m	19.30de	18.05D	541.0u	598.0no	741.0e	626.7E
6 L.F. fruits/cladode	17.08q-s	18.05j-l	19.56cd	18.23C	553.0t	609.0m	754.0d	638.7D
7 L.F. fruits/cladode	17.22p-r	18.13jk	19.81bc	18.39BC	560.0s	616.0l	769.0c	648.3C
8 L.F. fruits/cladode	17.34o-q	18.21j	19.99ab	18.51AB	569.0r	631.0k	792.5b	664.2B
9 L.F. fruits/cladode	17.46n-p	18.35ij	20.14a	18.65A	581.0q	646.0j	810.0a	679.0A
Mean	16.93C	17.94B	19.37A		543.0C	608.8B	737.2A	

Means having the same letter (s) in each row, column or interaction are insignificantly different at 5% level.
(LFB) = Leave flower buds - (LF) = Leave fruits - (SA) = Salicylic acid
The optimum level of Zinc = 20.35 ppm and Manganese = 810.45 ppm in cactus pear cladode (Salama *et al*., 2021)

4. Conclusion

In conclusion, results obtained in the current study reveal that handmade thinning leave 8, 9 fruits/cladode and spraying salicylic acid at a rate of 200 mg/L alone or in combination had a positive influence on tree growth as well as enhanced fruit yield and quality of the prickly pear plants under desert stress conditions.

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