



Effect Of Licorice Root Extract And Nano Fertilizers On Vegetative Growth, Quality And Nutrient Of Pumpkin (*Cucurbita Pepo L.*).

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ABSTRACT

This experiment was carried out at two different locations, the first location (Duhok) and the second location Zakho (Batifa) during spring growing season (2023). To determine the effect of three concentrations of nano fertilizers (0, 5 and 9 g L⁻¹) and three concentrations of licorice root extract (0, 8 and 16 g L⁻¹) on two cultivars of pumpkin (Iranian cv. and Locally cv.). The results appeared that the B cv. was superior over the A cv. in weight of fruit (kg), phosphorus%, fruit number, nitrogen, potassium%, and calcium% under both locations, and nitrogen% in the first location. Foliar application of 5 g L⁻¹ nano fertilizer. significantly increased all the studied vegetative growth, yield and nutrient contents in both locations. Foliar application of 16g L⁻¹ licorice root extract gave the highest significant value of plant height (cm), Number of fruits. Plant⁻¹, nitrogen%, potassium% and calcium% under both locations, while 5 g L⁻¹ significantly increased fruit weight (kg). The combined influences of two factors, namely cultivars and nano fertilizer., cultivars and licorice root extract and nano fertilizers, and licorice root extract, significantly enhanced most of the studied parameters. The triple interaction among three factors caused significant positive differences in all vegetative growth, fruit weight kg. fruit⁻¹ and nutrient content in both locations.

Keywords: Pumpkin ·licorice root extract, Nano Fertilizers, Cultivars.

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INTRODUCTION

Cucurbita pepo L. is a climbing or creeping monoecious annual plant. In some cases it may persist for a while, making it a short lived perennial., Pumpkin, is a herb belonging to Cucurbitaceae order., the fruit of Cucurbitaceae is yellow-orangish and its seeds are olive-green. One of the most famous features of this herb is that it does not have skin [1]. The leaves have three to five rounded or obtuse apiculate lobules, the central one higher than the others. They are greenish in color, with or without white spots on the surface Its produced oil contains lots of nutrients such as unsaturated fatty acids, vitamin A, vitamin E, minerals, phytosterols, carotenoids and Protochlorophyll. The most important fatty acids which approximately constitute 90% of oil are linoleic acids, oleic acids, and palmitic acids. Linoleic acids have made up 50% of fatty acids [2]. These fatty acids play a role in treating intestinal worms, prostate hypotrophy, and urinary tract diseases [3]. In recent years, farmers pay more attention to soil quality and health, so that in the industrialized countries using natural, intra-farm, and non-chemical inputs is increasingly taken in consideration. On the other side, increase in the global energy carrier prices has encouraged farmers to apply alternative approaches in order to reduce in inputs consumption [4]. Using organic fertilizer is the best method to decrease pollution and the high cost of chemical fertilizer [5]. Sustainable agriculture causes a decrease in food contamination, thus enhancing the quality of food. On the contrary. chemical farming negatively impacts human health and the environment [6]. In a recent experiment, licorice extract was used as organic fertilizers. Plant growth is affected by many environmental factors as well as agricultural practices factors, including plant nutrition, following new technical agricultural processes, and cultivating cultivars suitable for environmental conditions in the region. The licorice root extract also contains mevalonic acid used in gibberellins synthesis [7]. The licorice plant was used around 2100 BC in ancient folk medicine and is called the “Grand father of herbs”, The licorice plant contains glycyrrhizin, a sweet-tasting substance. The percentage of glycyrrhizin in licorice roots ranges between 11-24, Its percentage in the roots increases with the age of the plant. as well as when the crop is harvested in the fall [8]. Consequently, crop various measures like nano-fertilizers consumption that contain required micronutrients for plant growth and organic fertilizers such as licorice root extract are able to overcome the competition between vegetative and reproductive organs and enhance performance potential. Unlike available fertilizers, a little investigation has been conducted on the impact of nano-fertilizers and organic fertilizers such as humic acid on the quantitative and qualitative performances of herbs such as pumpkin.

MATERIALS AND METHODS:

The experiment will be carried out on 23 May, (2023) in two locations., first at Vegetable Research Farm of Directorate of Agricultural Extension and Scientific Research of Dohuk, Kurdistan region/ Iraq, and the second location in Guvik village in Batifa,. Seeds were planted in the field and animal manure were be added before planting. Three factors in randomized Complete Block Design (RCBD) will be used with three replicates, the first factors were two cultivars (Iranian cv. (A) and locally cv. (B)the second factors was licorice root extract at three levels (0, 8 and 16 g.L⁻¹), and the third factor nano fertilizer with three concentration (0, 5 and 9 g.L⁻¹), so the experiment consist eighteen treatments (2*3*3=18) experimental units with three replication. Liquid licorice root extracts were sprayed three times at 10 days intervals. First spraying was after plant reach five leaves, second spraying after 10 days of first spraying and third spraying after 10 days of second spraying nano fertilizer will be added as licorice done. Data were analyzed by using [9].

THE EXPERIMENTAL TEARMENTS:

A. Vegetative growth characteristic, that include:

Six plant were randomly chosen from each experimental unit to measure the stem dimeter(cm) , fruit length (cm).

B. Quality characteristic of that include:

Fruit wight (kg. fruit⁻¹), number of seed. fruit⁻¹ , Fruit width (cm), fruit number. Plant⁻¹

B. Nutrient content (N%.P%.K%.Ca%).

RESULTS AND DISSUASION:

Table (1) shows that the (B) cv. was superior over the (A) cv. in both locations, which gave the highest value of stem dimeter which recorded (2.38cm in Duhok and 2.43 cm in Batifa). Spraying of Nano fertilizers not significantly affected on stem dimeter in both locations. Foliar application of licorice root extract at a concentration 16g. L⁻¹ produced the highest significant value of stem dimeter which gave (2.32 in Duhok location and 2.37 cm in Batifa location).

Regarding the combination between cultivars and Nano fert. had a significant effect, the best interaction (2.45 cm in Duhok) was observed between (B) cv. and 5 g.L⁻¹). Regarding the interaction between cultivars and Licorice root extract , the highest value (2.51cm Duhok location and 2.56cm) was observed between (B)cv. and 16g.L⁻¹ Licorice root extract in both location. The combination of Nano ferti and liquorice root extract in two locations produced no significant effect on the stim dimeter in two low locations.

Furthermore, the interaction among three factors was a significant effect; the highest stimulator (2.61 cm in Duhok, and 2.62 cm in Batifa) was observed among (B cv., 16 g L-1 Nano fertiliser, and 5 ml L-1 Nano fertiliser). On the other hand the lowest stim dimeter (1.90 cm in Duhok) was observed among (A) cv., 0 g l⁻¹ Nano fertelizeri. And no spraying with licorice root extract) while in Batifa the lowest value observed in stim dimeter was (1.84 cm) among (First cv (A) *5g.L Nano fetri. And no spraying with licorice root extract.

Not: (A) means Iranian cultivars and (B) means locally cultivar. Fert. Means fertilizer.

Table (1): Effect of licorice root extract and Nano fertilizers on stem dimeter (cm) of pumpkin in two location.

Cultivars	Nano fertelizeri g L ⁻¹	Duhok stem dimeter(cm)			Cultivars* Nano fertelizeri.	Cultivars		
		licorice root extract (g.L ⁻¹)						
		0	8	16				
A	0	1.90cd	1.97bd	2.20ad	2.02b	1.99b		
	5	1.83d	2.03bd	2.13ad	2.00a			
	9	1.93bd	1.88cd	2.08ad	1.96b			
B	0	2.09ad	2.33ad	2.47ab	2.30ab	2.38a		
	5	2.31ad	2.43ac	2.61a	2.45a			
	9	2.43ac	2.33ad	2.47ab	2.41a			
licorice root extract (g.L ⁻¹)		2.08b	2.16ab	2.32a				
Cultivars*	A	1.89c	1.96c	2.14bc				
	B	2.28ab	2.36ab	2.51a				
licorice root extract (g.L ⁻¹)					Nano fertilizer.			
licorice root extract (g.L ⁻¹)								
licorice root extract (g.L ⁻¹)	0	2.00a	2.15a	2.33a	2.16a	2.16a		
	8	2.07a	2.23a	2.37a	2.22a			
	16	2.18a	2.10a	2.27a	2.19a			
Batifa								
A	0	2.00ce	2.07ae	2.30ae	2.12b	2.04b		
	5	1.84e	2.04be	2.14ae	2.01b			
	9	1.95ce	1.90de	2.10ae	1.98b			
B	0	2.19ae	2.43ad	2.57ab	2.40a	2.43a		
	5	2.32ae	2.44ad	2.62a	2.46a			
	9	2.45ad	2.35ae	2.49ac	2.43a			

licorice root extract (g.L ⁻¹)		2.13b	2.20ab	2.37a	
Cultivars*	A	1.93c	2.00c	2.18bc	Nano fertelizeri.
licorice root extract (g.L ⁻¹)	B	2.32ab	2.40ab	2.56a	
licorice root extract (g.L ⁻¹)	0	2.10a	2.25a	2.43a	2.26a
Nano fertelizeri.	5	2.08a	2.24a	2.38a	2.23a
	9	2.20a	2.12a	2.29a	2.21a

*Mean within a column, row and their interaction following with the same letters are not significantly different according to Duncan multiple range test at 0.05 level.

Table (2) shows that the (A) cv. was superior over the (B) cv. in both locations, which gave the highest value of fruit length (cm) where recorded (44.16cm in Duhok and 44.30 cm in Batifa). Spraying of Nano fertilisers significantly affected fruit length in both locations. Foliar application of licorice root extract at a concentration 16g. L⁻¹ produced the highest significant value of fruit length in both locations which gave 33.96cm in the Duhok location and 34.09 in Batifa location). Regarding the combination between cultivars and Nano fertelizeri. had a significant effect, the best interaction was between cultivar (A) and sparing plant with 5g.L⁻¹ Nano fertelizeri., in both location which recorded (46.68 cm in Duhok and 46.88 cm in Batifa location). Regarding the interaction between cultivars and Licorice root extract, the was significant effect between treatments, plant sprayed with (8&16 g.L Licorica root extract) and first cultivars (A) gave the maximum value of fruit length in both location.

The combination between Nano fertelizeri and licorice root extract in two locations produced significant effect on fruit length which recorded the highest length of fruit in both locations, which gave (37.26cm in Dohuk 37.46cm in Batifa location

Regarding the interaction among three factors (cultivars,Licorice root extract and Nano fertelizeri.) was significant effect, the highest fruit length was shows among interaction first cultivars (A)*spraying plant with 5 g.L⁻¹ Nano fertelizeri. and spraying with concentration 16g.L of licorice root extract, which recorded maximum length of fruit in both location (49.50cm in Dohuk and 49.70 cm in Batifa location) respectively.

Table (2): Effect of licorice root extract and Nano fertilizers on fruit length (cm) of pumpkin in two locations.

Cultivars	Nano fertilizers	Duhok fruit length			Cultivars*	Cultivars	
		licorice root extract (g.L ⁻¹)					
		g L ⁻¹	0	8	16		
A	0	40.00b	40.93b	44.87ab	41.93b	44.16a	
	5	41.33b	49.20a	49.50a	46.68a		
	9	40.93b	45.20ab	45.50ab	43.88ab		
	0	17.40cd	16.63d	19.83cd	17.96c		
	5	17.31cd	17.34cd	25.02c	19.89c		
B	9	18.44cd	18.71cd	19.01cd	18.72c	18.86b	
	licorice root extract (g.L ⁻¹)	29.24b	31.34ab	33.96a			
	Cultivars*	A	40.75b	45.11a	46.62a	Nnao fertelizeri.	
licorice root extract (g.L ⁻¹)	B	17.72c	17.56c	21.29c			
	0	28.70b	28.78b	32.35ab	29.94b		
	5	29.32b	33.27ab	37.26a	33.28a		
Nano fertelizer.	9	29.68b	31.96ab	32.26ab	31.30ab	44.30a	
	licorice root extract (g.L ⁻¹)	0	40.10b	41.03b	44.97ab		
	5	41.53b	49.40a	49.70a	46.88a		
	9	41.03b	45.30ab	45.60ab	43.98ab		
	0	17.50cd	16.73d	19.93cd	18.06c		
B	5	17.51cd	17.54	25.22c	20.09c	18.99b	
	9	18.54cd	18.81cd	19.11cd	18.82c		
	Licorice root extract	29.37b	31.47ab	34.09a			
Cultivars*	A	40.89b	45.24a	46.76a	Nano fertelizeri.	30.04b	
	licorice root extract	B	17.85c	17.69c	21.42c		
	Licorice root extract*	0	28.80b	28.88b	32.45ab		

Nano ferti.	5	29.52b	33.47ab	37.46a	33.48a
	9	29.78b	32.06b	32.36ab	31.40ab

*Mean within a column, row and their interaction following with the same letters are not significantly different according to Duncan multiple range test at 0.05 level.

Table (3) shows that the (A) cv. was superior over the (B) cv. in both locations, which gave the highest value of fruit weight (kg) which recorded (5.5kg in Duhok and 5.51 kg in Batifa location). Spraying of Nano fertilizers significantly affected on fruit weight in both location., where plant sprayed with 5g.L nano in both location. Foliar application of licorice root extract non non-significant effect of fruit weight in both location (Dohuk and Batifa) .

Regarding the combination between cultivars and Nano fertelizeri. had a significant effect, the best interaction was between cultivar (B) and sparing plant with 5g.L⁻¹ Nano fertelizeri., in both location which recorded (6.23 kg in Duhok and 6.24 kg in Batifa location). Regarding the interaction between cultivars and Licorice root extract, it was appeared significant effect between (cv. A) plant treated with contention 8g.Llicorice root extract.

The combination between Nano fertelizeri and licorice root extract in two locations produced significant effect on fruit weight which recorded highest weight of fruit in both locations which gave. The lowest value was between combination the plant sprayed with no nano fertilizer., and licorice root extract with 8 g.L which recorded the lowest value in both location (4.17kg in Dohuk and 4.77 kg) in Batifa location.

Furthermore the interaction among three factors (cultivars, Licorice root extract and Nano fertilizer.) was significant effect, the highest fruit weight was shows among interaction first cultivars (A)*spraying plant with 5 g.L⁻¹ Nano fertelizeri.and spraying with concentration 16g.L of licorice root extract which recorded maximum length of fruit in both location (49.50cm in Dohuk and 49.70 cm in Batifa location) respectively.

Table (3): Effect of licorice root extract and Nano fertilizer on fruit weight (kg) of pumpkin in two location.

Cultivars	Nano ferti.	Duhok fruit weight (kg)			Cultivars*	
		Licorice root extract (g.L ⁻¹)				
		0	8	16		
A	0	4.20cd	4.51ce	4.20ce	4.30bc	
	5	5.32a-c	6.23a	6.23a	5.92a	
	9	5.70ab	6.54a	6.54a	6.26a	
B	0	4.46ce	3.83de	2.90e	3.73c	
	5	6.23a	6.23a	6.23a	6.23a	
	9	6.02a	4.51bd	4.16cd	4.90b	
Licorice root extract (g.L ⁻¹)		5.32a	5.31a	5.04a		
Cultivars*	A	5.07ab	5.76a	5.66a	Nano ferti.	
	B	5.57a	4.85b	4.43b		
Licorice root extract (g.L ⁻¹)	0	4.33b	4.17b	3.55b	4.01c	
	5	5.77a	6.23a	6.23a	6.08a	
	9	5.86a	5.52a	5.35a	5.58b	
Batifa						
A	0	4.21cd	4.52bc	4.21cd	4.31bc	
	5	5.33ac	6.24a	6.24a	5.93a	
	9	5.72ab	6.56a	6.56a	6.28a	
B	0	4.47cd	3.84d	2.91e	3.74c	
	5	6.24a	6.2a4a	6.24a	6.24a	
	9	6.0a	4.53bd	4.18cd	4.92b	
Licorice root extract (g.L ⁻¹)		5.33a	5.32a	5.06a		
Cultivars*	A	5.08ab	5.77a	5.67a	Nano ferti.	
	B	5.59a	4.87b	4.44b		
Licorice root extract (g.L ⁻¹)	0	4.34b	4.18b	3.56b	4.02c	
	305	5.78a	6.24a	6.24a	6.09a	
	9	5.88a	5.54a	5.37a	5.60b	

*Mean within a column, row and their interaction following with the same letters are not significantly different according to Duncan multiple range test at 0.05 level.

Table (4) shows that the (B) cv. was superior over the (A) cv. in both locations, which gave the highest number of seed per fruit which recorded (735.45 in Duhok and 735.49 seed. Fruit⁻¹ in Batifa location). Spraying of Nano fertilizers significantly affected on number of seed per fruit in both location, as compared with untreated plant with gave the lowest number of seed .fruit-1

Foliar application of licorice root extract not significantly affected in first location Dohuk while at concentration 8 and 16g. L⁻¹ produced the highest significant value of seed number in second location which recorded (733.36seeds.fruit in Duhok location and 734.73seeds.fruit in Batifa location) which appeared with plant sprayed with concentration (8and 16 g.L⁻¹ Licorice root extract respectively).

Regarding the combination between cultivars and Nano fert. had a significant effect, the best interaction (776.30kg in Dohuk and776.31 kin Batifa location) was observed between (B) cv. And spraying plant contention 9 g.L⁻¹) in two location. Regarding the interaction between cultivars and Licorice root extract , the lowest value was observed in combination between cv. A * non-spraying with with licorice root extract in both loction with recorded (698.30seeds.in Dohuk and 698.38seeds .in Batifa location).Concerning the interaction between licorice root extract and nano ferti. It was shwes that their was no significant effect between them in both location.

Furthermore the interaction among three factors was significant effect, the highest fruit weight was observe in combination among cv. B *spraing plant with concentration 16g.L licorice rootb extract and concentration of nano ferti with (9g.L. ⁻¹) , which gave the maximum weight of fruit of pumpkin which gave (779.30 seeds. Fruit in Dohuk and 779.31 seed. Fruit in Batifa location) as compared with cv A and untreated plant with nano ferti. * spraying plant with 8g. L licorice root extract in both location as the same.

Table (4): Effect of licorice root extract and Nano fertilizers on number of seeds (Seed. Fruit-1) of pumpkin in two location.

Cultivars	Nano frti. Yeast g L ⁻¹	Duhok number of seeds			Cultivars* Nano fderti.	Cultivars		
		Licorice root extract (g.L ⁻¹)						
		0	8	16				
A	0	627.74c	660.66c	661.32c	649.91b	720.70b		
	5	739.07ab	765.60ab	766.20ab	756.96a			
	9	728.10b	767.30ab	770.30ab	755.23a			
B	0	661.98c	662.64c	663.30c	662.64b	735.45a		
	5	766.80ab	767.40	768.00ab	767.40a			
	9	773.30a	776.30a	779.30a	776.30a			
Licorice root extract (g.L ⁻¹)		716.16a	733.32a	734.74a				
Cultivars*		A	698.30b	731.19a	732.61a	Nnao fert.		
Licorice root extract (g.L ⁻¹)		B	734.03a	735.45a	736.87a			
Licorice root extract (g.L ⁻¹)		0	644.86b	661.65b	662.31b	656.27b		
Nano fert.		5	752.93a	766.50a	767.10a	762.18a		
		9	750.70a	771.80a	774.80a	765.77a		
Batifa								
A	0	627.75	660.67	661.33	649.92b	720.74b		
	5	739.17	765.70	766.30	757.06a			
	9	728.11	767.31	770.31	755.24a			
B	0	661.99	662.65	663.31	662.65b	735.49a		
	5	766.90	767.50	768.10	767.50a			
	9	773.31	776.31	779.31	776.31a			
Licorice root extract (g.L ⁻¹)		716.20b	733.36a	734.78a				
Cultivars*		A	698.34b	731.23a	732.65a	Nanoferti.		
Licorice root extract (g.L ⁻¹)		B	734.07a	735.49a	736.91a			
Licorice root extract (g.L ⁻¹)*		0	644.87b	661.66b	662.32b	656.28b		
		5	753.03a	766.60a	767.20a	762.28a		
Nano ferti.		9	750.71a	771.81a	774.81a	765.78a		

*Mean within a column, row and their interaction following with the same letters are not significantly different according to Duncan multiple range test at 0.05 level.

Table (5) shows that the (B) cv., was superior over the (A) cv. in both locations, which gave the highest value of fruit width (cm) which recorded (32.27cm in Duhok and 31.94 cm in Batifa). Spraying of Nano fertilizers significantly affected on fruit width in both locations. Foliar application of licorice root extract at concentration 16g. L⁻¹ produced the highest significant value of fruit width in two locations, respectively, (32.05cm in Duhok location and 32.15in Batifa location). Regarding the spraying plant with licorice root extract it were appeared that the highest value were shown in plant sprayed with maximum concentration of licorice with gave the lowest value of fruit width which gave (28.67cm in Dohuk and 28.33 cm in Batifa location).

The combination between cultivars and Nano fert. had a significant effect, the best interaction was between cultivar (B) and sparing plant with 9g.L⁻¹ Nano ferti., in both location which recorded (36.80 cm in Duhok and 36.70 cm in Batifa location).

Furthermore the interaction between cultivars and Licorice root extract , it was appeared that there were significant effect between treatments, compared with other treatments plant the highest value were recorded with plant not sprayed with licorice root extract and first cultivars (B) gave the maximum value of fruit width in both location..The combination between Nano ferti and licorice root extract in Dohuk locations produced significant effect on fruit wedith which recorded highest width of fruit in Dohuk location which gave significant effect compared with untreated plants.

Regarding the interaction among three factors (cultivars,Licorice root extract and Nano ferti.) was significant effect, the highest fruit wedith was shows among interaction second cultivars (B)*spraying plant with 5 g.L⁻¹ and 16 g.L⁻¹ Nano ferti. and spraying with concentration 5, 16g.L of licorice root extract which recorded maximum wedith of fruit in both.

Table (5): Effect of licorice root extract and Nano fertilizers on Fruit width (cm)of pumpkin in two location.

Cultivars	Nano ferti . Yeast g L ⁻¹	Duhok fruit width (cm)			Cultivars* Nano frti.	Cultivars		
		Licorice root extract (g.L ⁻¹)						
		0	8	16				
A	0	27.33d	26.02d	25.86d	26.41d	27.40b		
	5	28.10d	28.40d	28.70d	28.40c			
	9	27.10d	27.40d	27.70d	27.40cd			
	0	34.00ac	32.67c	26.33d	31.00b			
B	5	33.00bc	28.00d	26.33d	29.11c	32.27a		
	9	36.00ab	37.03a	37.06a	36.70a			
Licorice root extract (g.L ⁻¹)		30.92a	29.92a	28.67b				
Cultivars*		A	27.51d	27.27d	27.42d	Nano ferti.		
Licorice root extract (g.L ⁻¹)		B	34.33a	32.57b	29.91c			
Licorice root extract (g.L ⁻¹)		0	30.67ab	29.34cd	26.10d	28.70b		
Nano ferti.		5	30.55ab	28.20cd	27.52cd	28.76b		
		9	31.55ab	32.22a	32.38a	32.05a		
Batifa								
A	0	26.33de	25.02de	24.86e	25.41d	27.07b		
	5	28.00de	28.30cd	28.60d	28.30bc			
	9	27.20de	27.50cd	27.80cd	27.50c			
B	0	33.00bc	31.67c	25.33de	30.00b	31.94a		
	5	32.90bc	27.90de	26.23ded	29.01bc			
	9	36.10ab	37.13a	37.16a	36.80a			
Licorice root extract (g.L ⁻¹)		30.59a	29.59a	28.33b				
Cultivars*		A	27.18d	26.94d	27.09d	Nano ferti.		
Licorice root extract (g.L ⁻¹)		B	34.00a	32.23b	29.58c			
Licorice root extract (g.L ⁻¹)*		0	29.67cd	28.34cd	25.10e	27.70b		
Nano ferti.		5	30.45ac	28.10d	27.42d	28.66b		

*Mean within a column, row and their interaction following with the same letters are not significantly different according to Duncan multiple range test at 0.05 level.

Table (6) shows that was significant effect with cultivars in both locations, which gave the highest number of seed per fruit which recorded (5.57 in Duhok and 5.91 seed. Fruit⁻¹ in Batifa location). Spraying of Nano fertilizers significantly affected on number of fruit per fruit in both location, as compared with A cv., that gave lowest number of fruit per plant. Applying nano fertilizers appeared significant effect as compared with untreated plant with nano I both location. Foliar application of licorice root extract not significantly affected in two locations,

Regarding the combination between cultivars and Nano fert. It had a significant effect, with both cultivars as compared with untreated plant which gave lowest number of fruit per plant, in both locations.

Regarding the interaction between cultivars and Licorice root extract, the highest value was observed in combination between cv B nad spraying plant with 16 g. L licorice root extract with the maximum value as compared with untreated plant.

Furthermore, to the interaction between licorice root extract and nano ferti. It was shows that there was significant effect between them in both locations.

Furthermore, the interaction among three factors it was appeared significant effect, the highest fruit number was observed in combination among cv.A *spraying plant with concentration 16g.L licorice root extract and concentration of nano ferti with (5g.L⁻¹), which gave the maximum weight of fruit of pumpkin which gave (6.22 fruits. plant in Dohuk and 7.22 seed. Fruit in Batifa location)as compared with cv A and untreated plant with nano ferti. * spraying plant with 8g. L licorice root extract in both location which gave (4.01 in Dohuk ad 4.02 in Batifa location).

Table (6): Effect of licorice root extract and Nano fertilizers on number of Fruit number (fruit .plant⁻¹) of pumking in two location.

Cultivars	Nano ferti. Yeast g L ⁻¹	Duhok fruit number			Cultivars* Nano fert.	Cultivars
		0	8	16		
A	0	4.01b	4.06b	4.12b	4.06cb	5.27a
	5	4.67b	6.07a	6.22a	5.65a	
	9	6.00a	6.27a	6.00a	6.09a	
B	0	4.18b	4.24b	4.30b	4.24b	5.57a
	5	6.25a	6.28a	6.31a	6.28a	
	9	6.27a a	6.00	6.27a	6.18a	
Licorice root extract (g.L ⁻¹)		5.23a	5.49a	5.54a		
Cultivars*	A	4.89b	5.46a b	5.45a b	Nano fert.	
Licorice root extract (g.L ⁻¹)		5.57a b	5.51a b	5.63a		
Licorice root extract (g.L ⁻¹)d*	0	4.09b	4.15b	4.21b	4.15b	
Nnao fert.	5	5.46a	6.17a	6.27a	5.97a	
	9	6.13a	6.13a	6.13a	6.13a	
Batifa						
A	0	4.02d	4.07d	4.13d	4.07c	5.61a
	5	5.67c b	7.07a b	7.22a b	6.65b	
	9	6.02b c	6.29a c	6.02b c	6.11b	
B	0	4.19d	4.25d	4.31d	4.25c	5.91a
	5	7.25a	7.28a	7.31a	7.28a	
	9	6.29a c	6.02b c	6.29a c	6.20b	
Licorice root extract (g.L ⁻¹)		5.57a	5.83a	5.88a		
Cultivars*	A	5.23b	5.81a b	5.79a b	Nano ferti.	
Licorice root extract (g.L ⁻¹)		5.91a	5.85	5.97a		
Licorice root extract	0	4.10c	4.16c	4.22c	4.16b	

(g.L ⁻¹)*	5	6.46b	7.17a	7.27a	6.97a
Nano fert.		c	b		
9		6.15c	6.15c	6.15c	6.15a

*Mean within a column, row and their interaction following with the same letters are not significantly different according to Duncan multiple range test at 0.05 level.

Table (7) revealed that the B cv. had a highest nitrogen percentage (5.60%) in Duhok location compared with B cv. (2.18%), the same in Batifa location there were significant effects between two cultivars. Foliar application of 9 g L⁻¹ nano ferti. produced highest significant value (9.22% in Duhok) whereas in Batifa location foliar application of 5g.L nanop ferti. Recorded highest value of heist value of nitrogen percentage (1.65 %).

Foliar application of 16 ml L⁻¹ Licorice root extract (g.L⁻¹) in both locations had a highest significant nitrogen percentage (4.98% and 1.13%) respectively.

The interaction between B cultivar and 9 g L⁻¹ Licorice root extract (g.L⁻¹) in Duhok location gave the highest value (13.72%), the interaction between B cv. and 5 g L⁻¹ Licorice root extract (g.L⁻¹) in Batifa gave the highest value (2.19%). The highest value (4.98% in Duhok) was observed between B cv. and 16g. L⁻¹ Licorice root extract (g.L⁻¹). The combination between B cv. and Licorice root extract (8 and 16 g.L⁻¹), appeared significant differences in both location the highest nitrogen percentage (6.7% in first location and 1.36% in second location) was observed between 16 g L⁻¹ Licorice root extract (g.L⁻¹) B cv. Furthermore the interaction between Licorice root extract (g.L⁻¹) and nano ferti. Was significant compared with non-treated plants.

The combination among three factors was significant differences, in Duhok location the interaction among B cv., 16 g L⁻¹ Licorice root extract (g.L⁻¹) and 9g. L⁻¹ nano ferti., produced the maximum value (16.72% in first location), whereas in Batifa Location the interaction among B cv., *16 g L⁻¹ Licorice root extract (g.L⁻¹) and 5g.L nano fertilizers recorded highest value (2.55%).

Table (7): Effect of licorice root extract and Nano fertilizers on nitrogen percentage (%) of pumpkin in two location.

Cultivars	Duhok nitrogen			Cultivars*	Cultivars	
	Nnao ferti.	Licorice root extract (g.L ⁻¹)				
		g L ⁻¹	0	8	16	
A	0	0.67i	0.83hi	0.62i	0.71d	2.18b
	5	0.74hi	1.10gi	1.46fi	1.10d	
	9	1.72fi	4.72e	7.72d	4.72b	
B	0	0.87hi	0.96	0.84hi	0.89d	5.60a
	5	1.82hi	2.18fg	2.54f	2.18c	
	9	10.72c	13.72b	16.72a	13.72a	
Licorice root extract (g.L ⁻¹)		2.76c	3.92b	4.98a		
Cultivars*	A	1.04f	2.22e	3.27d	Nano ferti.	
	B	4.47c	5.62b	6.70a		
Licorice root extract (g.L ⁻¹)	0	0.77e	0.90e	0.73e	0.80c	
	5	1.28de	1.64d	2.00d	1.64b	
	9	6.22c	9.22b	12.22a	9.22a	
Batifa						
A	0	0.68bc	0.84b	0.63bc	0.72d	0.81b
	5	0.75b	1.11b	1.47ab	1.11b	
	9	0.63c	0.55d	0.58d	0.59e	
B	0	0.88b	0.97b	0.85	0.90c	1.24a
	5	1.83ab	2.19ab	2.55a	2.19a	
	9	0.61c	0.64b	0.67bb	0.64de	
Licorice root extract (g.L ⁻¹)		0.90b	1.05a	1.13a		
Cultivars*	A	0.69d	0.83c	0.89c	Nano fert.	
	B	1.11b	1.27a	1.36a		
Licorice root extract (g.L ⁻¹)	0	0.78de	0.91d	0.74ef	0.81b	
	5	1.29c	1.65b	2.01a	1.65a	
	9	0.62ef	0.60f	0.63ef	0.61c	

*Mean within a column, row and their interaction following with the same letters are not significantly different according to Duncan multiple range test at 0.05 level.

The results in Table (8) showed that the B cv. was superior over the A cv. which had a highest phosphorus percentage (0.37% in Duhok and Batifa). Foliar application of 9 g L⁻¹ nano fert. produced highest value in both locations (0.58%) respectively. In neither of the locations had significant on the application of licorice root extract have a substantial impact. The interaction between B cv. and 9 g L⁻¹ nano fert. had a highest value (0.68% in Duhok and Batifa). The interaction between cultivars B and licorice root extract had a significant effect in Duhok and Batifa location.

The interaction between Licorice root extract (g.L⁻¹) and nano fert., with 9 g.L showes significant which gave highest value of phosphorus as compared with othe treatment .

The triple interaction among B cv., 9 g L⁻¹ nano fert. and 16.g. L⁻¹ Licorice root extract (g.L⁻¹) produced highest phosphorus percentage (1.01% in Duhok and Batifa), whereas the interaction among B cv., 5 g L⁻¹ nano fert. and 4 g L⁻¹ Licorice root extract (g.L⁻¹)produced the lowest phosphorus percentage (0.13% in Dohuk location.

Table (8): Effect of licorice root extract and Nano fertilizers on phosphorus percentage (%) of pumpkin in two location.

		Duhok p				
Cultivars	Nano fert.	Licorice root extract (g.L ⁻¹)			Cultivars*	Cultivars
		Yeast	0	4		
A	g L ⁻¹					
	0	0.14c	0.13c	0.14c	0.14d	
	5	0.15c	0.18c	0.21c	0.18cd	0.26b
B	9	0.25c	0.58b	0.61b	0.48b	
	0	0.15	0.19c	0.17c	0.17cd	
	5	0.24c	0.27c	0.30c	0.27c	0.37a
Licorice root extract (g.L ⁻¹)	9	0.35cc	0.68b	1.01a	0.68a	
	Cultivars*	A	0.18d	0.30bc	0.32bc	Nano fert.
	Licorice root extract (g.L ⁻¹)	B	0.25cd	0.38b	0.49a	
Licorice root extract (g.L ⁻¹)*	0	0.15c	0.16c	0.15c	0.15b	
	8	0.19c	0.22c	0.25c	0.22b	
	16	0.30c	0.63b	0.81a	0.58a	
Batifa						
A	0	0.14c	0.15c	0.14c	0.14d	
	5	0.15c	0.18c	0.21c	0.18cd	0.27b
	9	0.24c	0.57b	0.61b	0.47b	
B	0	0.15c	0.19c	0.17c	0.17cd	
	5	0.24c	0.27c	0.30	0.27c	0.37a
	9	0.35c	0.68b	1.01a	0.68a	
Licorice root extract (g.L ⁻¹)	0	0.21b	0.34a	0.41a		
	Cultivars*	A	0.18d	0.30bc	0.32bc	Nano frt.
	Licorice root extract (g.L ⁻¹)	B	0.25cd	0.38b	0.49a	
Licorice root extract (g.L ⁻¹)*	0	0.15c	0.17c	0.15c	0.16b	
	5	0.20c	0.23c	0.26cc	0.23b	
	9	0.30c	0.63b	0.81a	0.58a	

Table (9) shows that the B cv. had a highest potassium percentage (0.73% in Duhok and 0.38 in Batifa) compared with A cv. (0.39% and 0.33%) respectively. The highest value (1.08% in Duhok was noticed at concentration 5 g L⁻¹ nano fert. , and (0.43% in Batifa location at concentration 9 g. L nano fert. Foliar application of 16 g L⁻¹ licorice root extract had a highest significant value (0.63% in Dohuk location).the lowest value of potassium in second Batifa was noticed in plant spraying with non licorice root extract which gave lowest percentage (0.34%).

The highest potassium percentage (4.16% in Duhok),was observed in combination between cv B and spraying plant with, 5 g.L nano fert.which gave (1.53%)compared with untreated plant which gave lowest value (0.19%) in first location.

The interaction between B cv. and 16 g L⁻¹ licorice root extract generated the maximum value at both sites. (0.84 in Dohuk and 0.39% in Batifa location) respectively. The combination between licorice root extract and nano frt. Showes significant. The interaction among B cv., 16 g L⁻¹ licorice root extract and 5g. L⁻¹ nano fert. produced highest potassium percentage (1.83%) in Duhok location.

Table (9): Effect of licorice root extract and Nano fertilizers on potassium percentage (%) of pumpkin in two location.

Cultivars	Nano fert. Yeast g L ⁻¹	Duhok k			Cultivars* Nano fert.	Cultivars
		0	8	16		
B	0	0.22ij	0.20ij	0.15j	0.19e	0.39b
	8	0.33gi	0.63e	0.93d	0.63b	
	16	0.32gi	0.35fh	0.38fh	0.35d	
	0	0.17j	0.26hj	0.22ij	0.21e	
B	5	1.23c	1.53b	1.83a	1.53a	0.73a
	9	0.41fg	0.44fg	0.47f	0.44c	
	Licorice root extract (g.L ⁻¹)	0.45c	0.57b	0.66a		
Cultivars*	A	0.29f	0.39e	0.49d	Nano fert.	
	Licorice root extract (g.L ⁻¹)	B	0.60	0.74b	0.84a	
	Licorice root extract (g.L ⁻¹)*	0	0.20e	0.23e	0.18e	
Nano fert.	5	0.78c	1.08b	1.38a	1.08a	
	9	0.37e	0.40d	0.43d	0.40b	
	Batifa					
A	0	0.32cf	0.30	0.25ef	0.29c	0.33b
	8	0.25ef	0.28df	0.31cf	0.28c	
	16	0.40a	0.43a	0.44a	0.42a	
B	0	0.27df	0.36ac	0.32	0.31c	0.38a
	8	0.34bd	0.37bc	0.40a	0.37b	
	16	0.44a	0.44a	0.45a	0.44a	
Cultivars*	Licorice root extract (g.L ⁻¹)	0.34b	0.36a	0.36a		Nano fert.
	A	0.32b	0.34b	0.33b		
	Licorice root extract (g.L ⁻¹)	B	0.35b	0.39c	0.39a	
Licorice root extract (g.L ⁻¹)*	0	0.30c	0.33b	0.28c	0.30b	
	5	0.30c	0.33b	0.36b	0.33b	
	Nano fert.	9	0.42a	0.44a	0.44a	

*Mean within a column, row and their interaction following with the same letters are not significantly different according to Duncan multiple range test at 0.05 level.

Table (10) demonstrated that the A cv. and B cv. shwes ni significant impact on calcium percentage. Foliar application of 5g L⁻¹ nano fert. significantly enhanced calcium% in the both locations (0.46% and 0.47%) respectively. Foliar application of Licorice root extract produced highest value in Duhok location and the Batifa location).

The interaction between B cv. and 5 g L⁻¹nano fert. in the both location increased calcium% (0.48% and 0.49%). The highest percentage (0.43% in Duhok location and 0.42% in Batifa location) was showed between A cv. and 16 g L⁻¹ Licorice root extract (g.L⁻¹). The interplay between 5 g L⁻¹ nano and 16 g L⁻¹ Licorice root extract (g.L⁻¹). enhanced the calcium% in the both locations (0.50% and 0.51%) respectively

Table (10): Effect of licorice root extract and Nano fertilizers on Calcium percentage (%) of pumpkin in two location.

Cultivars	Nano fert. Yeast g L ⁻¹	Duhok Ca			Cultivars* Nano fert.	Cultivars
		0	8	16		
A	0	0.30f	0.31f	0.32ef	0.31c	0.40a
	5	0.41bd	0.45ac	0.48ab	0.45ab	
	9	0.42bc	0.44	0.48ab	0.44ab	
	0	0.29f	0.33	0.30	0.31c	
B	5	0.42bc	0.49ab	0.52a	0.48a	0.40a
	9	0.37cf	0.40be	0.43bc	0.40b	
	Licorice root extract (g.L ⁻¹)	0.37b	0.40a	0.42a		
Cultivars*	A	0.38c	0.40ac	0.43a	Nano fert.	
	Licorice root extract (g.L ⁻¹)	B	0.36bc	0.41ab	0.42ab	
	Licorice root extract (g.L ⁻¹)	0	0.30d	0.32d	0.31d	

		(g.L ⁻¹)*				
Nano frt.		5	0.42bc	0.47ab	0.50a	0.46a
		9	0.39c	0.42bc	0.45ac	0.42b
			Batifa			
A		0	0.29h	0.30h	0.31gh	0.30d
		5	0.42be	0.46ad	0.49ac	0.46ab
		9	0.41cf	0.43be	0.47ad	0.43bc
B		0	0.28h	0.32fg	0.29h	0.30d
		5	0.43be	0.50ab	0.53a	0.49a
		9	0.36h	0.39gh	0.42be	0.39c
Licorice root extract (g.L ⁻¹)			0.37b	0.40a	0.42a	
Cultivars*	A		0.37bc	0.40ac	0.42a	Nano fert.
Licorice root extract (g.L ⁻¹)	B		0.36c	0.40ac	0.41ab	
Licorice root extract (g.L ⁻¹)*		0	0.29c	0.31c	0.30c	0.30c
Nano fert.		5	0.43bc	0.48ab	0.51a	0.47a
		9	0.38c	0.41c	0.44bc	0.41b

*Mean within a column, row and their interaction following with the same letters are not significantly different according to Duncan multiple range test at 0.05 level.

The combination among cultivars, nano fert. and Licorice root extract (g.L⁻¹). was significant effect, the highest value (0.52%) in Duhok location and 0.53% in Batifa location was observed among B cv., 5 g L⁻¹ nano fertilizers and 16g L⁻¹ licorice root extract respectively.

It's found that from table (1-10), the effects of spraying licorice root extracts and nano fertilizers on the vegetative characteristics qualitative and nutrient content of the Pumpkin, the results showed that there is a significant effect on the majority of vegetative properties (fruit width, fruit length, fruit number). These increases may be attributed to the effect of licorice root extract, which contains a variety of significant compounds, including glycyrrhizin, polysaccharide, vitamins, and mevalonic acid, which have the same effect in the synthesis of gibberellin. Those outcomes are comparable to those attained by [10] when licorice root extract was used to influence onion growth and yield.

Furthermore the foliar application of licorice root extract significant effect of leaf number of plant it also obtained from the results by [11] on Brassicaceae family., when used the rate of 3g.l⁻¹ of licorice root extract.

Most vegetative growth features were improved as a result of the mixing methods (licorice root extract*nano fertilizers) and (hybrid*licorice root extracts). The cause of this increase may be attributed to licorice root extracts found in plant growth hormones like gibberellins, cytokines, and indole acetic acid.

The foliar application of licorice root extract and on the cauliflower had significant difference on the curd weight, yield m² and total yield.these results are similar to the obtained by [12] when spraying fenugreek plants with licorice root extract at a concentration of 30 g.l⁻¹ which caused appreciable increases the weight of seeds in pods, the quantity of seeds per plant, and the overall weight of seeds per plant. It also matches of the results [13].

The reason for this diversification can be attributed to the adaptability of genes and morphological characteristics, and physiological factors during the growth period of the crop, according to [14]. [15]. Yield is well known as a complicated phenomenon controlled by many genes, and the expression of such genes is continuous in nature. The Fajr cv. is significantly superior to the Rawaa cv. in yield characteristics and results in increased yield, as shown in tables (12,13, 14, and 15). This might be due to the good foliage or to increase in the vegetative growth in Tables (6 and 7) which number of leaves and leaf area of the Fajr cv. which reflected or lead to an increase in the yield characters, these positive effects can be attributed to stimulation of the N assimilation pathway and nitrogen use efficiency, as mentioned [16].

From the tables, it can be seen that the significance of vegetative development, quantity, and qualitative yield characters treated with NPK fertilizers, particularly fruit width (cm)fruit number and number of seeds per fruit and may be due to the role of fertilizers in increasing the vegetative growth characters and yield characters, or might be due to higher levels of N, P & K, which found suitable for lettuce, resulted in enhanced photosynthetic and other metabolic activities which lead to increase in various plant metabolites responsible for cell division and cell elongation. This finding correlates with the findings of [16]. in lettuce. NPK fertilizer is a complex fertilizer comprised primarily of the three primary nutrients required for healthy plant growth, which are referred to as the primary macronutrients. So, NPK fertilizer can provide sufficient and balanced nutrients for plant growth, thus it also shows the function of nitrogen, phosphorus, and potassium nutrients as important nutrients in plant metabolism. Nitrogen, phosphorus, and potassium are nutrients needed in large quantities and can move from one part to another part of plants, The enhancement in plant growth may be attributed to the beneficial effects of nitrogen on stimulating meristematic activity for producing more tissues and organs, since nitrogen played major roles in the synthesis of structural proteins to its vital contribution towards several biochemical processes in the plant related growth, phosphorus is considered an important macronutrient plant, making up about 0.2 % of a plant's dry weight. It is one component of key molecules such as nucleic acids, phospholipids, and ATPs. It is involved in several plant functions, including controlling enzyme

reactions, regulation of metabolic pathways, energy transfer, photosynthesis, and transformation of carbohydrates as well as the formation of protein leading to increases in vegetative growth parameters [17].

Potassium is directly involved in enzyme activation, maintenance of water status, energy relations, and translocation of assimilates. It has an important role in protein synthesis. The enzyme responsible for the synthesis of starch (starch synthetase) is activated by potassium element. Thus, with inadequate K, the level of starch declines while soluble carbohydrates and N compounds accumulate [18]. Non NPK recorded a high value with the third level in most parameters which is superior on other levels and control levels with no fertilizer. The present study also finds out as shown in the tables that spraying with traditional fertilizer in proportions of (20:20:20) had a positive effect on the studied qualities in several parameters. The reason for this positive effect is due to the increased availability of nutrients, which leads to an increase in the efficiency of the photosynthesis and carbohydrate process and its use for growth and improving the vegetative and root growth of seedlings. These results are consistent with what was mentioned by[19]. who found that a high yield of lettuce is obtained by using NPK fertilizers.

Conclusions:

It may be concluded from the findings of the present study that: The cultivar (B) recorded superior performance of growth, yield, and quality attribute compared to the (A) cv., and a foliar spray using Nano fertilizer proved extremely efficient and more effective in increasing the growth parameter and quantitative yield characteristics of than a foliar spray with normal NPK fertilizer., and spraying plants with the high concentration of licorice root extracts gave the best result of the vegetative growth and the yield quantitative and qualitative characters of summer squash plants and we recommended using other plant extract such as (garlic extract, fenugreek extract and yeast extract)and the various concentration of nano fertilizers with other vegetable crop in different locations.

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تأثير مستخلص جذور عرق السوس والأسمدة النانوية على النمو الخضري وبعض العناصر للقوع العسلي.

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الخلاصة

أجريت هذه التجربة في موقعين مختلفين الموقع الأول (دهوك) والموقع الثاني (زاخو) (باتيفا) خلال موسم النمو الربيعي (2023). لتحديد تأثير ثلاثة تراكيز من الأسمدة النانوية (0، 5 و 9 غم/لتر) وثلاثة تراكيز من مستخلص جذور عرق السوس (0، 8 و 16 غم/لتر) على صنفين من القرع العسلي (صنف الایرانی (أ) والصنف المحلي (ب)). أظهرت النتائج أن الصنف ب تفوق على الصنف أ في وزن الثمار (كجم) ونسبة الفسفور وعدد الثمار والنیتروجين والبوتاسيوم والکالسیوم في كلا الموقعين، بينما أدى التسميد الورقی ب 5 غم/لتر من الأسمدة النانوية إلى زيادة معنوية في جميع صفات النمو الخضري المدروسة والانتاج ومحتوى العناصر الغذائية في كلا الموقعين. أعطى الرش الورقی لمستخلص جذر عرق السوس 16 غم. لتر-1 أعلى قيمة معنوية لارتفاع النبات (سم) وعدد الثمار (نبات) ونسبة النیتروجين والبوتاسيوم والکالسیوم في كلا الموقعين، بينما أدى الرش الورقی 5 غم لتر-1 إلى زيادة معنوية في وزن الثمار (كغم). كما أدى التأثير المشترك لعاملين، وهما الأصناف والأسمدة النانوية، والأصناف ومستخلص جذر عرق السوس والنانو فدرت، ومستخلص جذر عرق السوس، إلى تحسين معنوي لمعظم المعايير المدروسة. تسبب التفاعل الثلاثي بين العوامل الثلاثة في اختلافات معنوية موجبة في جميع صفات النمو الخضري ووزن الثمار (كغم) ومحتوى المغذيات في كلا الموقعين.

الكلمات المفتاحية: القرع العسلي ، مستخلص جذور عرق السوس ، الأسمدة النانوية، الأصناف.