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Original Article

Fruit and Seed Variations in Citrullilus colocynthis plant grown in different elevations a.s.l. in Egypt

Wafaa Kamal Taia and Ahmed Mohamed Hassan

ABSTRACT

Fruits and seeds of *Citullilus colocynthis* grown in different elevations a.s.l., based on collected fresh individuals from two geographical regions in Egypt, Sinai and Matrouh. The soil from 11 chosen sites, has analyzed to investigate its chemical composition. Ripened fruits have been collected from each site and measured; meanwhile the associated species in each site have been recorded. The ripened fruits have shown great variations in colour, diameter and exocarp ornamentation. The seeds showed significant differences in their numbers /fruit, weights and wax depositions. The results were subjected to ANOVA test to qualify the degree of variations. While the fruits and seeds were measured and photographed using Stereomicroscope. This work indicates that the elevation a.s.l. does not affect both soil composition and the morphological characters of fruits and seeds.

Keywords:

Citullus colocynthis- Desert plant- Elevation a.s.l.- Fruit morphology- Seed morphology.

Wafaa Kamal Taia and Ahmed Mohamed Hassan

From
Alexandria University-Faculty of Science-Botany Department-Alexandria-Egypt.

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Introduction:

Citrullus colocynthis is one of the plants belonging to subfamily Cucurbitoideae, family Cucurbitaceae, order Cucurbitales, Rosids, Eudicot group (according to APG III taxonomical system, 2009). The genus comprise four diploid species (2n=22); Citrullus colocynthis, Citrullus ecirrhosus, Citrullus lanatus and Citrullus naudinianus. Morphological and cytogenetic studies have revealed that the four species of Citrullus are cross compatible with each other. The maintenance of identity of the different species was attributed to geographical isolation, differences in flowering habit, genetic differences, and structural changes in chromosomes

Citrullus colocynthis (L.) Schrad. is among the plants growing in the Egypto-Arabian deserts, pointing to its exceedingly rapid development, especially the fruit, which attains a diameter of 10 centimeters ; it is a medicinal plant known for their various healing properties (Amamou *et al.*,2011). However, seed germination is poor due to the extreme xeric conditions; therefore the vegetative propagation is more common and successful in nature. In the Egyptian arid zone the growth takes place between March and October but the most favorable period for the vegetative growth is during the rainy season, the growth declines as soon as the rains and the temperature decrease and almost stops during the cold and dry months of December and January. Colocynth prefers sandy soils and is a good example of good water management which may be useful also on research to better understand how desert plants react to water stress. **Al-Zahrani and Al-Amer (2006)** studied the distribution of *Citrullus colocynthis* (L.) Schrad. along the Coastal Plain and Al-Sarawat High Mountains in seven locations, The results show clear differences for the growth characters determined in each location especially between the lowest and highest ones.Al-Ghamdy et al. (2009) studied the plant species associated with *Citrullus colocynthis* in different altitudinal localities in the West of Saudi Arabia. The studied localities were represented by different ecological, geographical and edaphic sites.

Taxonomical studies in *Citrullus colocynthis* are rare and most of the studies concerning *Citrullus lanatus* (Singh and Matta ,2010). Accordingly, the present work aims to investigate how much the fruits and seeds of *Citrullus colocynthis* grown in different elevation levels in Egypt can be affected as step forward to know the best level for its growth and maintenance.

Materials and Methods

Study Area

Plant samples were collected between April to October 2010 from 11 Sites in two different geographical regions in Egypt; South Sinai representing Sinai proper region, and Matrouh area representing Mediterranean region. It is worth mentioning that individuals of *C. colocynthis* were found to be sparse in the wadies after Matrouh city.

The studied sites were as follows:

Four sites with individuals (1-5) were collected from Sinai on 24th and 25th of April, 2010.
Four sites with individuals (6-9) were collected from Sinai on the 1st of October, 2010.
Three sites with individuals (10-14) were collected from Matrouh on the 1st of August, 2010.

Site description, GPS data and associated species of every site were recorded and presented in table 1 and figures 1 and 2. Variation in temperatures and precipitation rates are summarized in table 2 as well as the climate chart of the two regions are illustrated in figure 3.

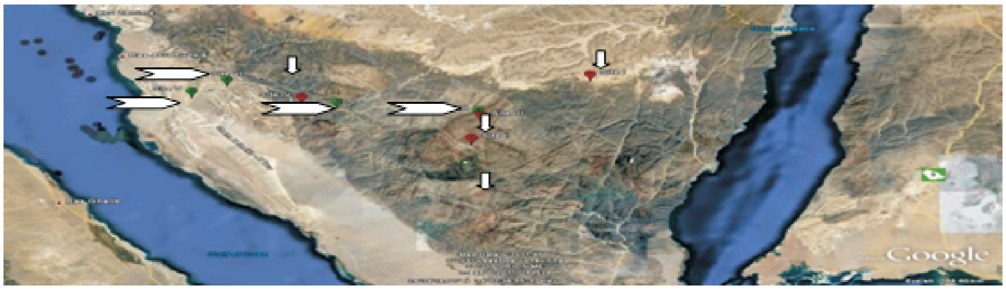


Fig.1 Map illustrate the location of the eight sites in Sinai Peninsula.

⇩ indicate the sites visited on 24th and 25th of April 2010; ⇨ indicate the sites visited on the 1st of October 2010.

Fig.2 Map illustrates the location of the three sites in Matrouh visited on the 1st of August 2010.

Table 1 Site and individual number, GPS data, Location description and the most important associated species.

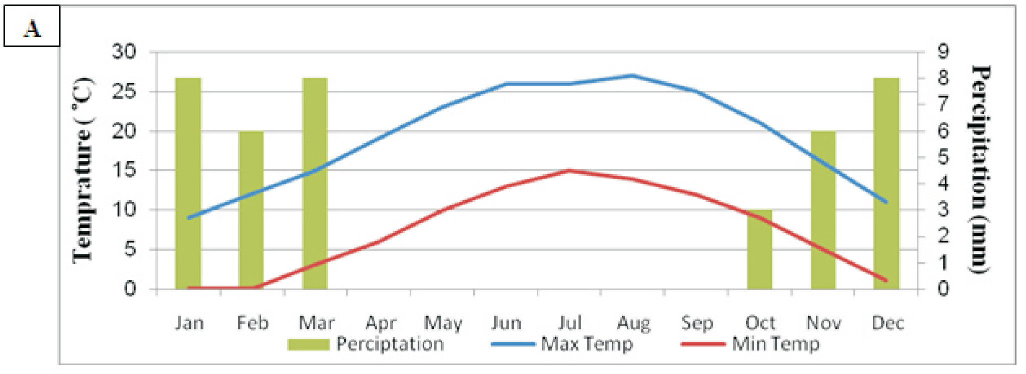
Region	Site	Individual	GPS Data	Site Description	Associated Species
Sinai 24-25 April 2010	I	1	N. 28 48' 31" E. 34 14' 00" Elevation. 869m	Dahab-Katherine Road side. Wadi El-Seaal Area	*Artemisia judica* *Zilla spinosa*
	II	2	N. 28 34' 26" E. 33 58' 11" Elevation. 1509m	300 m from Saint Katherine check point. El Kharizan area on road side	*Artemisia judica* *Zilla spinosa* *Fagonia mollis* *Echinops Sp.*
	III	3	N. 28 39' 27" E. 33 59' 42" Elevation. 1319m	Saint Katherine – Wadi Feran road side	*Artmisia judica* *Zilla spinosa* *Fagonia mollis* *Astragallus Sp.*
	IV	4 5	N. 28 43' 26" E. 33 35' 34" Elevation. 528m	Road side in Wadi Feran	*Zilla spinosa* *Haloxylon salicornicum*
Sinai 1 October 2010	V	6	N. 28 44' 45" E. 33 20' 51" Elevation. 175m	Road side of Wadi Feran- Saint Katherine road	*Zygophyllum album* *Haloxylons salicornicum*
	VI	7	N.28 47' 04" E.33 25' 24" Elevation 284m	Road side in Wadi Feran	*Zilla spinosa* *Haloxylon salicornium* *Anabasis articulata*
	VII	8	N.28 42' 16" E.33 40' 05" Elevation576m	Sandy Plain, 1km from road in Wadi Feran	*Artemesia judica*
	VIII	9	N.28 40' 38" E. 33 59' 02" Elevation1287 m	Road side in Al Terfa Village area	*Zilla spinosa* *Artemesia judica* *Achelia Sp.* *Alcanna Sp.*
Matrouh 1 August 2010	IX	10 11 12	N. 31 33' 44" E. 26 02' 73" Elevation. 36m	Road side in Sidi Barany Area. Abd El-Qader Haroun District Abo Settit Village	*Peganaum* *Thymelia hersiota* *Asphodilus Sp.*
	X	13	N. 31 31' 55" E. 26 02' 16" Elevation. 41m	Sandy plain in Sidi Barany Area, Aqarir Abo Harir village	*Thymelia hersiota-* *Asphodilus Sp.* *Sacarum Sp.* *Devira Sp.*
	XI	14	N. 31 26' 14" E. 26 51' 17" Elevation. 3m	Abo Lahwo Area, Wadi El-Kharashif	*Peganaum Sp.* *Thymelia hersiota* *Solanum nigrum*

Table 2 Summarize the groups according to the elevation a.s.l. and the associated species in each group

Region	Elevation	Group	Site	Ind. No.	Associated Species
Sinai	**1200-1509 m a.s.l.**	**1**	**2,3 &8**	**2,3 & 9**	*Astragallus Sp , Artemisia judica, Achelia Sp., Alcanna Sp., Fagonia mollis, Zilla spinosa*
	500-869 m a.s.l.	**2**	**1,4 &7**	**1,4,5 & 8**	*Artemisia judica, Haloxylon salicornicum, Zilla spinosa*
	175-284 m a.s.l.	**3**	**5 & 6**	**6 &7**	*Anabasis articulate, Haloxylon salicornium, Zilla spinosa, Zygophyllum album*
Matrouh	**3-41 m a.s.l.**	**4**	**9,10 &11**	**10,11,12,13 & 14**	*Peganaum Sp.,Thymelia hersuta Asphodilus Sp.,Sacarum Sp. Devira Sp.,Solanum nigrum*

Table 3 Average maximum and minimum temperatures (C) and precipitation (mm) of both Sinai (between 2007 and 2011) and Matrouh (between 1995 and 2012) regions.

Site	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sinai	Max. Temp.	9	12	15	19	23	26	26	27	25	21	16	11
	Min. Temp.	0	0	3	6	10	13	15	14	12	9	5	1
	Precipitation	8	6	8	0	0	0	0	0	0	3	6	8
Matrouh	Max. Temp.	18	18	20	22	24	27	28	28	28	27	24	20
	Min. Temp.	8	9	11	13	16	19	22	22	21	18	14	11
	Precipitation	28	16	8	2	1	0	0	0	0	5	20	24



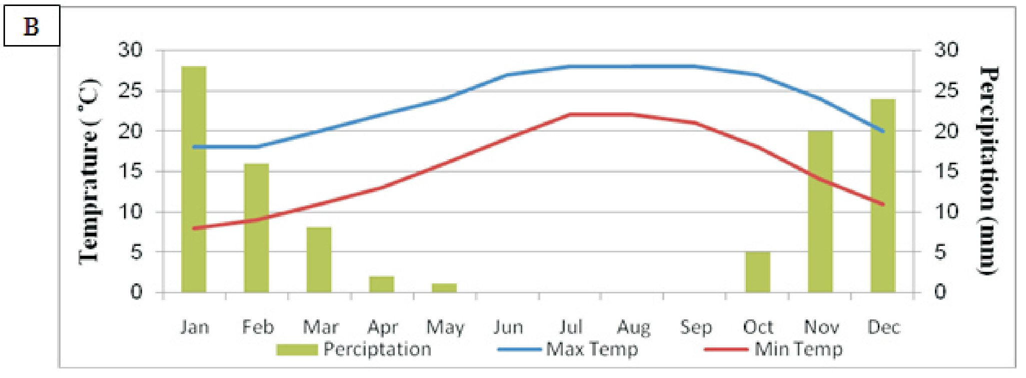


Fig 2: Climate chart of both (A) Sinai and (B) Matrouh Regions.

2-Soil chemical analysis

Saturated soil solution has been made for each sample according to **Jackson and Thomas (1960);** 1:5 soil: dist. water. The pH measured by pH meter. The electric conductivity measured using Conductivity Bridge. Bicarbonate have been estimated by titrating fixed volume with Sulphuric acid 0.005 N using few drops of Phenol phethalene and methyl orange as indicators (**Chapman and Pratt, 1961**). Chlorine ions Has been estimated by titrating fixed volumes from the saturated soil samples using 0.01 N silver nitrate after adding few drops of potassium chromate as indicator (**Jackson, 1967**). Sulphate ions by precipitation method and calibrate fixed volume with barium chloride (Jackson, 1967). The different cations; Na, K, Ca, Mg, Cu, Fe, Zn and Mn has been estimated in the saturated soil solution by using Atomic Absorption (**Allen et al., 1974**)

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3-Fruit morphology

Colors of the fruits and exocarp ornamentation were recorded directly in the field, and representatives of the fruits have been collected for measurements and counting the number of seeds/each fruit. Five fruits from each location were subjected to measurements by a ruler in cm.

4-Seed morphology

Mature fruits were collected from beneath the plant in each location and their colors were recorded. Meanwhile, seeds were counted in each collected fruit and air dried for further investigations. Ten mature seeds were measured, weighted, examined morphologically and photographed using light stereomicroscope for micropyle position, wax deposition and testa ornamentation.

Results

Description of the chosen sites and their GPS data and the associated species grown in each site were summarized in table 1 & 2. From the tables we find that Sinai sites are in three categories; group.1 includes sites 2,3 & 9 are more than 1200 m a.s.l.; group.2 has sites 1,4,5 & 8 are between 500- 869 m a.s.l. while group.3 has sites 6 & 7 are 175 & 284 m a.s.l.. Matrouh sites all in group 4; 10,11,12,13 & 14 are between 3 and 41 m a.s.l.. In the same time we find all the associated species were xerophytic plants; *Achelia Sp., Alcanna Sp. Anabasis articulate, Asphodilus Sp., Astragalus Sp., Artemisia judaica, Echinops Sp, Fagonia mollis, Haloxylon salicornicum, Peganum Sp., Thymelia hersuta, Solanum nigrum* and *Zilla spinosa.* These plants can tolerate dryness as shown in the climatic sharts A and B and table 3. The studied regions has low amount of rainfall and high degree of temperature throughout most of the year.

The physical characters of the soil in all the studied sites, in both Sinai and Matrouh, were uniform. The soil was sandy to loamy sandy in texture and its color varies from yellow to yellowish brown.

Results of the chemical analyses of the soil in the eleven sites were summarized in table 4, The PH of the soil solution in both locations (Sinai and Matrouh) all the eleven sites were alkaline, with PH over 7. It range from 7.05 in site 3 to 7.79 in site 4 in Sinai, while it was 7.66 and 7.71 in Matrouh (Fig 1 B). The total soluble salts were higher in Sinai sites (1-9), except in sites 1 and 9, than those in Matrouh district (10 & 11). (Fig.1 A). It ranges from 0.28 dS m-1 in site 9 to 4.56 dS m-1 in site 3 with moderate contents of 1.31 dS m-1 in site 5 and 1.13 dS m-1 in site 2. The rest of sites in Sinai have soluble salt content less than one dS m-1 (table 7). Soil in Matrouh district has low total soluble salts less than one dS m^{-1} which range from 0.21 dS m^{-1} in site 10 to 0.7 dS m-1 in site 11.

SAR expresses the relative activity of Sodium ions in the exchange reactions with the soil. It measures, as well, the relative concentration of Sodium to Calcium and Magnesium. For that we measured the SAR in the soil samples collected from the studied sites. From table (4) and Fig. (2 A) we find the least SAR in Sinai in site 1 (0.519) while the highest SAR in site 3 (3.384). In Matrouh, site 10 has the lowest value (0.396) while site 11 has the highest value (6.765).

The Bicarbonate ions have been investigated in the soil of the different sites. From the results which summarized in table (4) and fig(2 B), we find that the amount of bicarbonate in the soil of the studied sites ranges in Sinai from 1.6 meq L^{-1} in site 5 to 3.8 meq L-1 in site 7, while it was 2.0 meq L^{-1} in site 10 and 2.8 meq L^{-1} in site 11 in Matrouh. The Chlorine and Sulphate ion concentrations are considerably low in all the studied sites. In site 3 in Sinai which has the highest amount of Chlorine (30.5 meq L^{-1}), whereas site 8 the lowest Chlorine concentration (1 meq L^{-1}). In Matrouh Chlorine concentration was low as it was 1.5 meq L^{-1} in site 10 and 3.0 meq L^{-1} in site 11. The Sulphate ion concentration in Sinai, ranges from 0,385 meq L^{-1} in site 1 and reaches up to 14.48 meq L^{-1} in site 3, while in Matrouh it was 0.972 meq L^{-1} in site 10 and 5.619 meq L^{-1} in site 11.

The different cations and heavy elements present in the soil of the studied sites were evaluated and summarized in table (4) and illustrated in Figs. (3 A & B). From the table we can notice that the soil in the two regions, at all elevations, is considerably poor, as the amount of the cations was low.

In Sinai, the Sodium ions ranged from 4.9 meq L^{-1} in site 1 to 26.2 meq L^{-1} in site 2. While in Matrouh, the Sodium ions varied greatly between the two sites, it was 5.6 meq L^{-1} in site 10 and 42.2 meq L^{-1} in site 11. Potassium ion concentration varied greatly within the sites in spite of the locations. In the soil gathered from Sinai sites it ranged from 0.16998 meq L^{-1} in site 1 to 0.75567 meq L^{-1} in site 3. In Matrouh soil the Potassium ion content was 0.131654 meq L^{-1} in site 10 and 0.61454 meq L^{-1} in site 11 (Fig.3 A).

Soil contents of Ca^{++}, Mg^{++} are closely related as when the Ca^{++} increased the Mg^{++} increased respectively. Our soil analysis revealed that the highest Ca^{++} and Mg^{++} was generally in Sinai, where they reach 24.6 meq L^{-1} in Ca^{++} and 7.8 meq L^{-1} in Mg^{++} in site 3. Soil from Matrouh has the same Ca^{++} content of 1.6 meq L^{-1} and varied in Mg^{++} content where it was 0.4 meq L^{-1} in site 10 and 1.2 meq L^{-1} in site 11 (Fig.3 A).

The amount of heavy elements as Fe, Mn, Cu and Zn present in the soil have a great effect on plant growth and metabolism. The great amount of these elements is considered as ecological stress and may cause metabolic disorders in plants. Thus in our study we have analyzed the soil in order to evaluate the amount of these elements in the studied soil. From table (4) and fig (3 B), we can notice that the Fe amount is considerably low, in Sinai it ranged from 0.195 meq L^{-1} in site 5 and reach 1.585 meq L^{-1} in site 7, while in Matrouh it was 0.134 meq L^{-1} in site 10 and 0.248 meq L^{-1} in site 11. Mn element concentration is an considered from the most important elements in metabolic disorders, as its increase can cause stresses on plants. In Sinai its concentration ranged from 0,344 meq L-1 in site 6 to 2.69 meq L^{-1} in site 3 while in Matrouh it was 0.479 meq L^{-1} in site 10 and 1.403 meq L^{-1} in site 11. Copper and Zinc are from the elements which cause pressure and ecological stresses on plants. In both locations, their concentration were very low, as the copper concentration in Sinai ranges from 0.036 meq L^{-1} in site 9 to 0.91 meq L^{-1} in site 2 and it was 0.07 meq L^{-1} in site 10 and 0.127 meq L^{-1} in site 11 in Matrouh. The lowest Zinc concentration in Sinai was 0.061 meq L^{-1} in site 6 and the highest concentration was 0.429 meq L^{-1} in site 4 . In Matrouh, the Zinc concentration was 0.077 meq L^{-1} in site 10 and 0.06 meq L^{-1} in site 11.(Fig 3 B) .

Fruit and seed characters are summarized in table 5. The fruits of *C. colocynthis* are spherical pepo, smooth variegated with darker irregular green lines, about the size of orange with hard rind and light in weight. The mesocarp is filled with a soft, dry and spongy bitter white pulp, in which ovate compressed seeds are embedded. Measurements are for 5 to 10 fruits in the same individual in each location. The ripened fruit diameter in Sinai varied from 5 cm in site 8 individual 9 to 9 cm in site 5 individual 6 with means from 5 in the former to 8.333 in the later.In Matrouh, the ripened fruit size varied from 5 cm in sites 9 individual 12 and site 11 individual 14 to 9 cm in site 9 individual 10 with means from 5.75 in site 14 to 8.5 in site 9. Colors of ripened fruits of the *C. colocynthsis* in the studied sites varied from pale green to dark green with the intermediate shades of green. Pale green color was recorded in sites 4 and 5 in Sinai and site 11 in Matrouh. While green color was recorded in sites 2, 4, 6 and 8 in Sinai and sites 9 and 10 in Matrouh. Dark green was recorded in sites 1 and 3 in Sinai and sites 9 and 10 in Matrouh. The ornamentation of the exocarp shows different shapes as shown in plate 1, In most of the studied sites the exocarp is longitudinally stripped with pale green, narrow irrigated lines. In sites 4, 9, & 11 the exocarp has irregularly patches of pale green areas intermingled with the dark green color. In sites 9 individuals 10, 11 & site 10 the pale green lines are wider and sinuate, in site 7 the exocarp was smooth and yellow and without any lines or ornamentation.

Seeds of C. citrullilus are numerous, ovate or broadly ovate and compressed, borne on parietal placenta. The following seed characters have been studied using stereomicroscope in selected seeds from 5 fruits in each site. The number of the seeds per fruits varies greatly between the fruits of the same individual. In Sinai the fruits enclosed from 36 seed in site 4 to 442 seed in site 5 with means from 61 seeds/fruit in site 4 to 384 seeds/Fruit in site 1. In Matrouh the fruits enclosed from 100 seed in site 11 to 325 in site 9 individual 10 with means varied from 115.5 in individual 11 to 293 in individual 10. Mature seeds of C. colothynsis collected from both Sinai and Matrouh were found to vary in the shades of brown, from dark brown to yellowish brown or even grayish brown. In Sinai the seeds were grayish brown in sites 2, 3 and 7, dark brown color was recorded only in site 8. Brown color was almost the most prominent color as it was recorded in sites 1, 4 and 7, another shade of brown which was brighter than the previous one was recorded in site 6. Light brown color was recorded in nearly all sites of Matrouh (sites 9 and 10), except for site

11 in which the seeds bore a yellowish brown color. The testa covered by wax depositions with different densities and ornamented by two depression lines at the two sides of the micropyle which may be straight or curved as shown in table (5). The micropyle position was either terminal or in flat surface. The seed weights differ within the different individuals and range from 0.255g in individual 5 to 0.53g in individual 1 (table 5).

The measurable characters were subjected to ANOVA test to qualify the differences between the studied individuals. From table (6) the highly significant differences were in the Fruit diameter, number of seeds per fruits and seed weight; while seed length and width were significantly different.

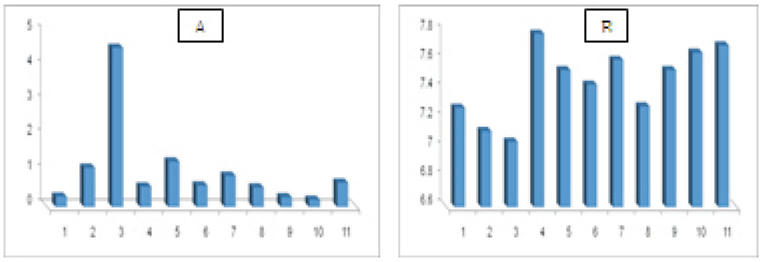

Fig (1): A, Electric conductivity; B, pH of the soil samples from the 11 studied sites

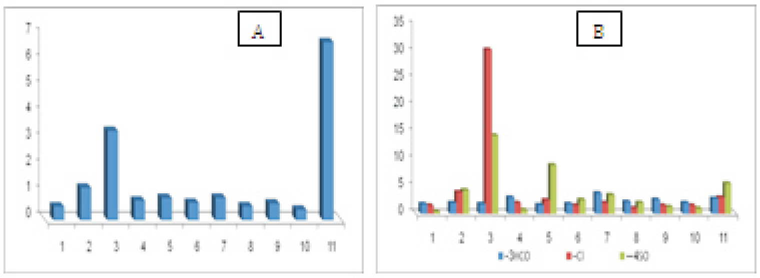

Fig (2): A,Sodium absorption ratio (SAR); B, Anions concentration in of the soil samples collected from the 11 studied sites (blue HCO3, Red Cl, Green So4)

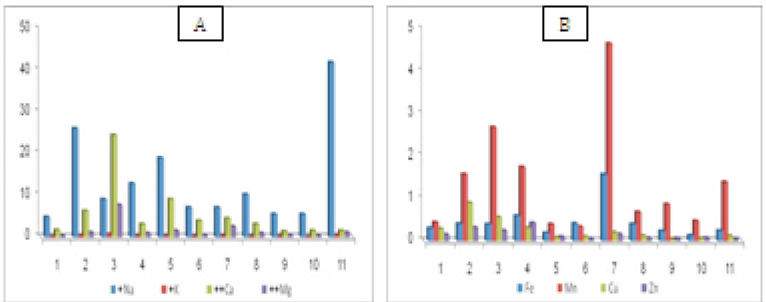

Fig (3):Cations concentrations in the soil collected from the 11 studied sites, A, Na (Blue), K (Red), Ca (Green) Mg (Violet); B, Fe (Blue), Mn (Red),Cu (Green),Zn (Violet)

Plate 1 photographs of the fruits collected from the different studied sites (1-14)

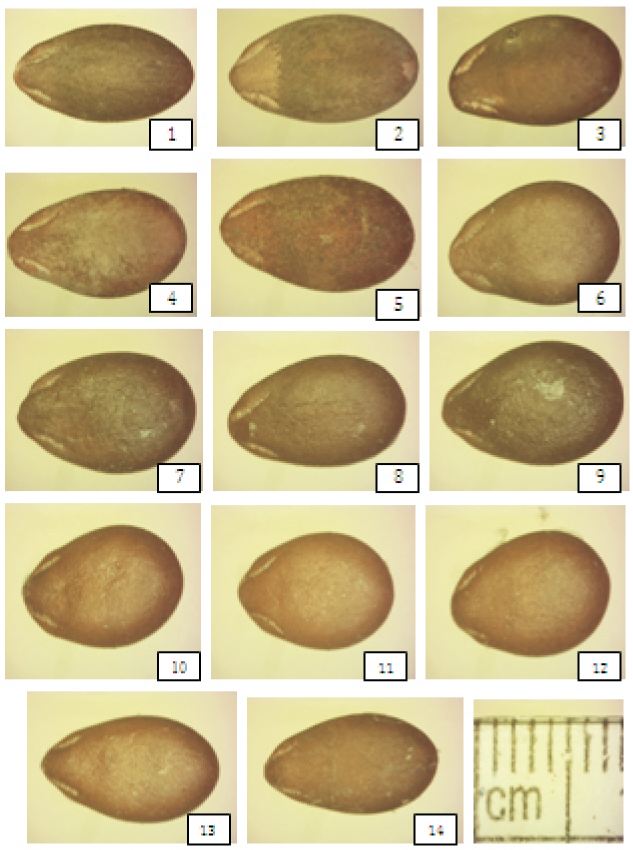

Plate 2 photographs of the seeds collected from the different studied sites (1-14)

Table (4): Data of the soil analysis collected from the 11 sites in Sinai and Matrouh Regions

No	EC (dS m^{-1})	PH	SAR
1	0.3	7.28	0.519
2	1.13	7.12	1.238
3	4.56	7.05	3.384
4	0.59	7.79	0.744
5	1.31	7.54	0.842
6	0.62	7.44	0.664
7	0.9	7.61	0.853
8	0.56	7.29	0.529
9	0.28	7.54	0.638
10	0.21	7.66	0.396
11	0.7	7.71	6.765

Sodium Adsorption Ratio (SAR) expresses the relative activity of sodium ions in the exchange reactions with the soil. This ratio measures the relative concentration of sodium to calcium and Magnesium.

Table 4 cont.

No.	Cations (meq L^{-1})								Anions (meq L^{-1})		
	Na^{+}	K^{+}	Ca^{++}	Mg^{++}	Fe	Mn	Cu	Zn	HCO_3^{-}	Cl^{-}	SO_4^{--}
1	4.9	0.16998	1.8	0.4	0.312	0.446	0.295	0.158	1.8	1.5	0.385
2	26.2	0.35109	6.4	1.2	0.413	1.59	0.91	0.325	2	4	4.364
3	9.2	0.75567	24.6	7.8	0.401	2.69	0.57	0.252	1.8	30.5	14.48
4	13	0.4146	3.2	1	0.602	1.759	0.314	0.429	3	2	0.693
5	19.2	0.37208	9.2	1.6	0.195	0.402	0.089	0.103	1.6	2.5	9.03
6	7.2	0.24873	4	0.6	0.419	0.344	0.109	0.061	1.8	1.5	2.556
7	7.2	0.43612	4.6	2.6	1.585	4.68	0.21	0.166	3.8	2	3.454
8	10.4	0.26885	3.2	1	0.405	0.692	0.129	0.075	2.2	1	2.036
9	5.6	0.20901	1.4	0.6	0.237	0.877	0.036	0.066	2.6	1.5	1.253
10	5.6	0.13165	1.6	0.4	0.134	0.479	0.07	0.077	2	1.5	0.972
11	42.2	0.61454	1.6	1.2	0.248	1.403	0.127	0.06	2.8	3	5.619

Table (5): Fruit and seed characters investigated for the collected 14 individuals showing mean, standard deviation, minimum and maximum values

Key to abbreviations: D.G.=Dark green, .G.=Light green, G.=Green; B.=Brown, G.B.=Grayish brown, D.B.=Dark brown, L.B.=Light brown, Y.B.=Yellowish brown; Ret.=Reticulate, Ret.Rug.= Reticulate rugate; O.=Ovate, B.O.=Broadly ovate; Ter.=terminal,

	I	II	III	IV		V	VI	VII	VIII	IX			X	XI
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Fruit Diam.	(6-8) 7 ±1.414	(6.5-7) 6.75 ±0.354	(6-7.5) 6.75 ±1.061	(7-7) 7 ±0	(6-6) 6 ±0	(7.5-9) 8.333 ±0.764	(6.5-6.7) 6.6 ±0.141	(7-7) 7 ±0	(5-5) 5 ±0	(8-9) 8.5 ±0.5	(6.5-7.5) 7 ±0.5	(5.5-6) 5.833 ±0.289	(7-8) 7.667 ±0.577	(5-6.5) 5.75 ±0.645
Fruit Color	D.G	G	D.G	L.G	G	L.G	G	G	D.G	D.G	D.G	G	G	L.G
No.of Seeds/ Fruit	(384-384) 384 ±0	(61-101) 84.667 ±20.98	(72-88) 80 ±11.313	(36-86) 61 ±35.355	(96-110) 102.33 ±7.094	(281-442) 374.333 ±83.512	(129-129) 129 ±0	(287-315) 301 ±19.799	(89-120) 104.5 ±21.92	(198-325) 249.667 ±66.725	(100-131) 115.5 ±21.92	(182-194) 188 ±8.485	(286-300) 293 ±9.899	(135-210) 172.5 ±53.033
Seed Color	B	G.B	G.B	B	B	D.B	G.B	B	D.B	L.B	L.B	L.B	L.B	Y.B
Seed Orna.	Ret.	Ret.	Ret.	Ret.	Ret.	Ret.	Ret.	Ret.	Ret. Rug.	Ret.	Ret.	Ret.	Ret.	Ret.
Seed Length	(0.7-1) 0.84 ±0.114	(0.7-0.9) 0.76 ±0.089	(0.7-0.8) 0.733 ±0.058	(0.7-0.7) 0.7 ±0	(0.6-0.7) 0.667 ±0.058	(0.7-0.8) 0.76 ±0.055	(0.6-0.7) 0.675 ±0.05	(0.6-0.8) 0.7 ±0.071	(0.7-0.8) 0.75 ±0.05	(0.6-0.7) 0.65 ±0.058	(0.6-0.7) 0.65 ±0.058	(0.6-0.7) 0.675 ±0.50	(0.6-0.7) 0.65 ±0.058	(0.6-0.8) 0.7 ±0.082
Seed Width	(0.4-0.5) 0.48 ±0.045	(0.4-0.5) 0.48 ±0.045	(0.4-0.5) 0.433 ±0.058	(0.4-0.5) 0.467 ±0.058	(0.4-0.5) 0.433 ±0.058	(0.4-0.5) 0.48 ±0.045	(0.4-0.4) 0.4 ±0	(0.4-0.5) 0.42 ±0.045	(0.4-0.5) 0.42 ±0.045	(0.3-0.4) 0.375 ±0.05	(0.4-0.4) 0.4 ±0	(0.4-0.5) 0.45 ±0.058	(0.4-0.5) 0.425 ±0.05	(0.4-0.4) 0.4 ±0
Seed Ratio	(1.4-2) 0.76 ±0.261	(1.4-1.8) 0.59 ±0.188	(1.6-1.75) 1.7 ±0.087	(1.4-1.75) 1.517 ±0.202	(1.4-1.75) 1.55 ±0.180	(1.4-2) 1.6 ±0.245	(1.5-1.75) 1.688 ±0.125	(1.4-2) 1.68 ±0.236	(1.4-2) 1.805 ±0.249	(1.5-2) 1.75 ±0.204	(1.5-1.75) 1.625 ±0.144	(1.4-1.75) 1.513 ±0.165	(1.4-1.75) 1.538 ±0.149	(1.5-2) 1.75 ±0.204
Seed Shape	O	O	O	B.O	B.O	B.O	O	O	O	B.O	O	O	O	O
Seed Weight	(0.513-0.546) 0.53 ±0.017	(0.271-0.352) 0.314 ±0.041	(0.369-0.380) 0.375 ±0.008	(0.249-0.272) 0.257 ±0.013	(0.243-0.265) 0.255 ±0.011	(0.417-0.444) 0.433 ±0.14	(0.393-0.407) 0.398 ±0.008	(0.373-0.417) 0.390 ±0.024	(0.402-0.41) 0.406 ±0.004	(0.315-0.363) 0.34 ±0.026	(0.303-0.329) 0.317 ±0.013	(0.343-0.348) 0.345 ±0.003	(0.33-0.36) 0.349 ±0.017	(0.313-0.349) 0.332 ±0.018
Micropyle Position	Ter	Ter	Ro	Ro	Ter	Ro	Ter	Ter	Ter	Ro	Ter	Ro	Ro	Ter
Wax Depositions	+	+	++	++	+	+	+++	+	+	++	+	++	++	+
Depression Lines Degree	++	+++	+++	++	++	+++	+++	+++	+	+++	+	++	++	+
Depression Lines Length	++	+++	+++	++	++	++	+	+	+	+	+	++	++	+
Depression Lines Curvature	+	++	++	+	+	++	-	+	-	-	-	-	+	-

Table (6) Characters subjected to ANOVA test

No	Data Char.	F	P-Value	F Critical
1	**Fruit Diameter**	7.356792	4.66E-05	2.249514
2	**Number of Seeds/ Fruit**	21.99528	5.06E-09	2.249514
3	**Seed Length**	2.956184	0.003598	1.949864
4	**Seed Width**	2.629427	0.008419	1.949864
5	**Seed Weight**	44.07678	3.83E-15	2.088929

DISCUSSION

The study of the effect of elevations a.s.l. and its relation with both the soil constituent and vegetative types has drawn the attention of many scientists since the last decade. Al-Zahrani and Amer (2006) found that the elevation rates affect the mineral contents of *Citrullilus colocynthis* grown in different altitudinal levels of Sarawat mountain in Saudi Arabia. They conclude that *C. colocynthis* tolerates a wide range of environmental conditions. Sen and Bhandari (1974) found that the growth of *Citrullus colocynthis* depends on the amount of rainfall, and stop completely during the arid months. Thus, we can expect that the elevation a.s.l. can affect the development of the fruits and seeds in the studied sites. The climate Charts clarify that these geographical regions are mostly dry throughout the year and the precipitation contents decreased with decreasing elevation. Abd El-Ghani (2000) and Xu *et al*. (2006) indicated to the association between soil characters and the vegetation pattern in arid zones. In our investigation the differences in the soil characters is uncorrelated with the elevations, as sites 2, 3 in group 1 has the highest salt contents, while site 8 in the same group has poor soil. We can notice that all the associated species are xerophitic and mostly the same in all the elevation groups. Thus we cannot relay on the soil characters in the differences between the colocynthe plants. In spite of that the morphology of the fruits and the number of seeds/fruit differed in the different sites as shown in the results. We can say that these differences are in response to other ecological stresses and the ability of adaptation in each individual.a.s.l. The fruits are widely used medicinally as an anti-inflammatory, purgative in constipation, anti-rheumatic and anti-diabetic in Mediterranean countries (Abd El-Baky *et al*. 2009 and Sebbagh *et al*., 2009). The seeds of *C.colocynthis* have been subjected to a range of pharmacological, phytochemical and nutritional investigations in recent years. Each plant produces 15–30 round fruits, about 7–10 cm in diameter, green with undulate yellow stripes, becoming yellow all over when dry. Seeds are small (6 mm in length), smooth and brownish when ripe (Schafferman *et al.,* 1998). Seeds containing represent 75% of the weight of fruit (Abu-Nasr and Potts, 1953). Our results coincid with the obove mentioned data as the fruit diameter ranged from 5 to 9 cm in all the studied individuals and the seed length varried from 0.6 to 0.8 cm in length. Praven et al., 2013 found that 30 globular fruits having a diameter of almost 7 to 10 centimeters. The outer portion of the fruit is covered with a green skin having yellow stripes. The fruits may also be yellow in color. The ripe fruits are characterized by a thin but hard rind. The fruits have a soft, white pulp which is filled with numerous ovate compressed seeds. The results obtained from the study of the fruits and seeds from the eleven sites with different elevations indicates that the elevations a.s.l. has an effect on the morphological characters. This effect can be extend internally to the chemical composition of the plant. Kuti and Rovilo (1992) found that Fruit set and seed yield of *C.colocynthis* pollinated by hand and bees have no significant differences for number of flowers/plant and number of seeds/fruit, highly significant ($P<0.01$) differences were found between pollination techniques for number of fruits/plant, seed weight and seed viability. Mean fruit weight and fruit size were significantly ($P<0.05$) affected by pollination technique. They concluded that honey bees appear to be far more efficient pollinators of *C.colocynthis* than controlled or hand-pollination method. The percentage of flowers that set fruit under controlled pollination was generally between 20%, while under natural or bee-pollination more than 85% of flowers set fruits. They conclussion support our data, as the number of seeds per fruit and seed weight may be due to the way of pollination between the studied individuals in the different sites

The high structure diversity in seeds provides most valuable criteria for classification between species and family level. Seed characters are only slightly influenced by environmental conditions (Barthlott, 1984). In spite of that the seed characters are significantly different between the studied individual. Seed length and width as well as the amount of wax deposition and depression lines length and curvature varried between the studied individuals .

Our conclussion that *Citrullilus colocynthis* plant grow in the different elevation levels and its growth and flourishing according to water availability. While fruit size, fruit oenamentation, the number of seeds per fruitrs and seed weight are affected by the both water availability and soil characters. The differences in the number of seeds per fruits and seed weight between the studied individuals may be due to the different ways of pollination in the different sites.

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