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Floral Structural Characteristics of Some Economic Cucurbits in Egypt

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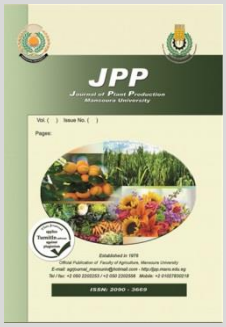

ABSTRACT

Studies on the floral morphology of seven species and two cultivars belonging to five genera of Cucurbitaceae were carried out to determine the relationship between these taxa. The study was carried out on the flowers' morphological, Micro-morphological, and anatomical feature. The results showed that the flowers were either solitary as in *Cucumis sativus* or in raceme inflorescence as in male flower of *Luffa aegyptiaca* only. Anther shapes winding as in *Cucumis melo* cv. *flexuosus*, oblong as in *C. moschata* or crescent shaped as in *L. aegyptiaca*. Pollen grains were spherical in most of the studied taxa except *C. melo* cv. *flexuosus* which has an oblate shape. Epidermal cell walls in sepals and petals are straight or sinuate. Hairs unicellular as in *C. sativus* or multicellular as in *C. pepo*; branched as in *C. moschata* or un-branched e.g. *L. siceraria*. The anatomical flower pedicel showed that the pedicel in the cross-section is angled as in the male flower of *L. siceraria*, and rounded as in *C. lanatus* cv. *colocynthis*, polygonal circular e.g. *C. lanatus*, polygonal oval as in *C. pepo*, or oblique circular as in female flower of *L. aegyptiaca*. The number of vascular bundles in petiole varies from seven as in male flower petiole of *L. siceraria* to 42 vascular bundles as in male flower petiole of *C. pepo*.

Keywords: Floral Morphology, Anatomy, Palynology, Cucurbitaceae.

INTRODUCTION

The Cucurbitaceae (cucurbits) or gourd family is a plant family consisting of about 965 species in around 95 genera (Christenhusz and Byng 2016). The plant in this family is grown around the tropics and in temperate areas. Cucurbants have economic importance; the fruits of many species are used as human foods (e.g. squash and cucumber). In addition, numerous species of Cucurbitaceae plants have some important chemical compounds with significant medicinal potential. (Luchian and Tedosiu 2019). Cucurbitaceae plants are annual or perennial herbs, most species are fast-growing prostrate or climbing vines with long-stalked palmate leaves, at the side of the leaf stalk in annual species there is a simple, branched, spirally coiled tendril. The flowers of these plants are unisexual, with male and female flowers on different plants (dioecious) or on the same plants (monoecious). The fruits are usually berry and known as pepo. (Simpson, 2019). The present work aims to determine the relationships or the similarity between some cucurbit taxa depending flower features.

MATERIALS AND METHODS

Materials

The cucurbits studied samples include nine taxa (seven species and two cultivars) representing five different genera (Table 1). These samples were obtained from the cultivation of their seeds in Kotoor city, Gharbia governorate, Egypt.

Table 1. List of nine taxa representing five different genera belonging to Cucurbitaceae together with their vernacular names and basic chromosome numbers.

NO	Species	Vernacular names	B.C.N
1	*Citrullus lanatus* (Thunb.) Matsum. & Nakai	Watermelon	11
2	*Citrullus lanatus* cv. *colocynthis*	Bitter cucumber	11
3	*Cucurbita moschata* Duchesne	Dovleac moscat	20
4	*Cucurbita pepo* L.	Summer squash	20
5	*Cucumis sativus* L.	Cucumber	7
6	*Cucumis melo* L.	Melon	12
7	*Cucumis melo* cv. *flexuosus* (L.) Naudin	Snake melon	12
8	*Lagenaria siceraria* (Molina) Standl	Bottle gourd	11
9	*Luffa aegyptiaca* Mill	Sponge gourd	13

B.C.N. = Basic chromosome number (n)

Methods

- Parts of flowers were separated over slides and cleared with warm lactic acid in order to determine trichomes and anticlinal cell walls and other aspects, then investigated microscopically.
- Pollen grains were examined by the scanning electron microscope (SEM), and samples were coated with gold for 4 min. in a sputter coater. These samples were analyzed using scanning electron microscope (Model JEOL-JEM-2100, JEOL Ltd. Tokyo, Japan) in the electron microscope unit, Faculty of Agriculture, Mansoura university.
- Flower pedicel sections were prepared according to the method of Sass (1958). are cut into parts, each of them equal to one centimeter in length. These parts are washed and dehydrated in a series of solutions of ascending concentrations of ethyl alcohol varying from 50 % to 100 % alcohol concentrations. The samples are embedded in paraffin wax (m.p 58-60), using xylol as solvent. Using rotary microtome, sections are cut at the thickness of 20 microns and then mounted on slides with the aid of egg –albumin as an adhesive. Wax is dissolved in Xylol and the slides are passed through a series of alcohol solutions varying from 100% to 50 % ethyl alcohol concentrations in descending order. The slides are stained in hematoxylin and eosin stain. Then the colored sections are kept as permanent preparations on the slides with Canada Balsam as the mounting medium.

RESULTS AND DISCUSSION

Flowering behavior:

All investigated plants had solitary male and female flowers on the same plant as in *Cucumis sativus* (Fig.1a), except *Luffa aegyptiaca* had the male flower in raceme inflorescence beside female flower solitary (Fig.1b). It had been recorded the presence of hermaphrodite flower in *Cucumis melo* (Fig.1c). Length of the petiole flower ranged from one cm in *Cucumis*

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sativus to 27.5 cm in *Lagenaria siceraria.* These results are in harmony with Jamwal and Sharma (2015) who reported that *Luffa cylindrical* male and female flowers on the same plant with the lower nodes bearing only staminate flowers, followed by nodes having both staminate and pistillate flowers. Male flowers appeared first on the vine under staminate nodes, it was borne on a pedunculate raceme.

The flower color was yellow in all examined plants as in *Cucurbita moschata* (Fig.1d) except *Lagenaria siceraria* (Fig.1e) which had white flowers. The bracts were absent in all examined plants e.g. *Lagenaria siceraria* (Fig.1f) except in *Citrullus lanatus* (Fig.1g), *Citrullus lanatus* cv. *colocynthis* (Fig.1h) and *Luffa aegyptiaca* were present (Fig.1i). This result is in harmony with Ajuru and Okoli (2013) who found that *Cucurbita moschata* flowers are yellow, with petals joined for half their length.

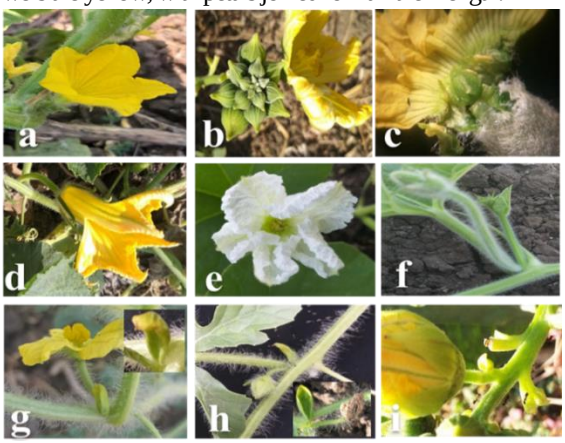


Fig. 1. flowering behavior

(a) *Cucumis sativus*, solitary flowers. (b) *Luffa aegyptiaca* male flower in raceme inflorescence. (c) *Cucumis melo*, hermaphrodite flower. (d) *Cucurbita moschata*, yellow flower. (e) *Lagenaria siceraria*, white flower. (f) *Lagenaria siceraria* bracteoles absent. (g) *Citrullus lanatus*, presence of bracteole. (h) *Citrullus lanatus* var *colocynthis*, presence of bracteole. (i) *Luffa aegyptiaca*, presence of bracteole.

Calyx:

It consists of five fleshy sepals in all the investigated plants (Fig. 2a), except *L. aegyptiaca* was leathery (Fig. 1i). Apex of sepal either acute as *C. lanatus* var. *colocynthis* (Fig.2b) or round as *C. melo* (Fig. 2c).

Corolla:

It composed of five petals in all studied taxa. It is equal in size as in *L. siceraria* (Fig. 1e) and united in seven taxa e.g. *C. moschata* (Fig. 2d), except two taxa it was free *L. siceraria* and *L. aegyptiaca* (Fig. 2e). These results are confirmed by Boulous (2002).

The apex of petals was mucronate in six taxa as in *C. melo* (Fig. 2f), aristate in two taxa as in *C. pepo* (Fig. 2g), or cuspidate in *L. aegyptiaca* only (Fig. 2h). Some investigated plants keep petals after the fruits ripen as in *C. melo* var.*flexuosus* , *C. sativus* (Fig.2i) and *C. pepo* (Fig.2j).

Androecium:

Anther had three shapes: winged as in *C. melo* var. *flexuosus* (Fig.2k), oblong as in *C. moschata* (Fig. 2a), and crescent shape as in *L. aegyptiaca* (Fig. 21).

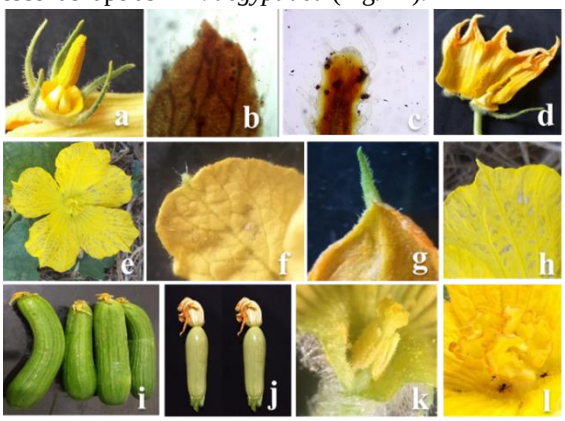


Fig. 2. Flower and fruit characteristics.

(a) *C. moschata*, sepals are fleshy. (b) *C. lanatus* cv. colocynthis, sepal apex is acute. (c) *C. melo*, sepal apex is rounded. (d) *L. aeavptiaca*, male flower in raceme an inflorescence. (e) *C. melo*, hermaphrodite flower. (f) *C. moschata*, petals united. (g) *L. aegyptiaca*, petals free. (h) *C. melo*, petal apex is mucronate shape. (i) *C. pepo* petal apex is aristate shape. (j) *L. aegyptiaca* petal apex is cuspidate shape. (k) *C. melo* cv.flexuosus, anther shape winding. (l) *L. aegyptiaca*, anther shaped- crescent.

Pollen grains:

Pollen grains are usually monads, mostly spheroidal (Fig. 3 a,-i) except in *C. melo* cv. *flexuosus* had oblate shaped (Fig. 3g).

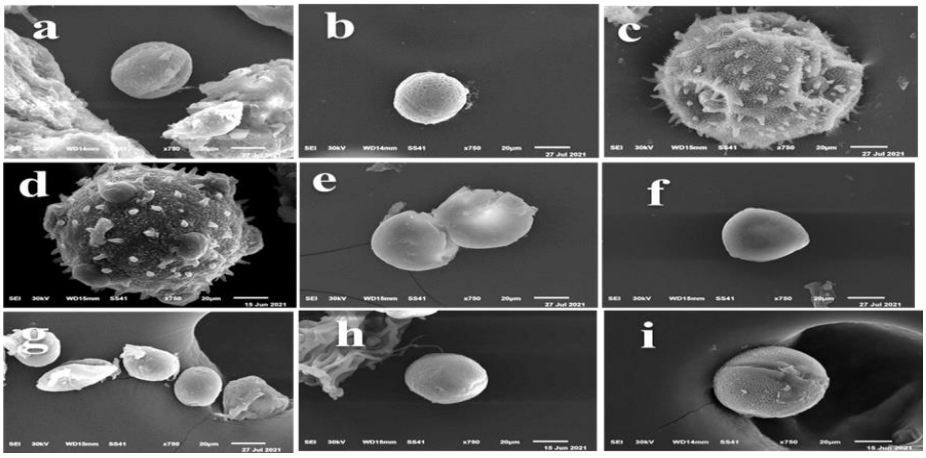


Fig. 3. Shape and size of pollen grains X 750.

(a) *C. lanatus*, spheroidal shape. (b) *C. lanatus cv. colocynthis*, spheroidal shape. (c) *C. moschata*, spheroidal shape. (d) *C. pepo*, spheroidal shape. (e) *C. sativus*, spheroidal shape. (f) *C. melo*, spheroidal shape. (g) *C. melo* cv.*flexuosus*, oblate shape. (h) *L. siceraria*, spheroidal shape. (i) *L. aegyptiaca*, spheroidal shape.

Aperture types were porate in four studied taxa *C. pepo, C. melo* (Fig. 4a), *C. melo* cv.flexuosus *and C. moschata* (Fig. 3c) and two taxa had colpate apertures *C. lanatus and C. sativus* (Fig. 3e) while colporate apertures recorded in three taxa *C. lanatus* cv. colocynthis, *L. aegyptiaca and L. siceraria* (Fig. 4b,c). The number of apertures was often three except in both taxa *C. moschata* and *C. pepo* which had polypore apertures. Pollen grains texture were reticulate in three studied taxa *C. lanatus, C.*

lanatus cv. colocynthis and *Luffa aegyptiaca*(Fig. 4d), micro-reticulate in three studied taxa *C. melo* (Fig. 4e), *C. melo* cv.flexuosus *and L. siceraria*, spiny recorded in two studied taxa *C. moschata* and *C. pepo* (Fig. 4f) while granulose observed only in *C. sativus* (Fig. 4g). The pollen grains average diameter ranged between 27.2 X 36 µm in *C. melo* cv *flexuosus* and 110.4 X 112.8 µm in *C. moschata* (Table 2). These results are in agreement with those obtained by Teppner (2004), Perveen and Qaiser (2008), Abd – El Maksoud and Rania (2013), Mathew and Chandralekha (2016), Srivastava and Sharma (2016), Hasson *et al*. (2019) they reported that pollen grains are usually radially symmetrical, are polar, porate, or corporate, oblate spheroidal to prolate-spheroidal rarely sub-prolate or sub-oblate, sexine slightly thicker or thinner than nexine. The tectum was mostly coarsely reticulate rarely reticulated often verrucate. Pollen grains of *Lagenaria siceraria* free, spheroidal, tricolporate. *Cucurbita moschata* is found to be 10-12 prorate, exine is of projection type 'spinate and granulose.

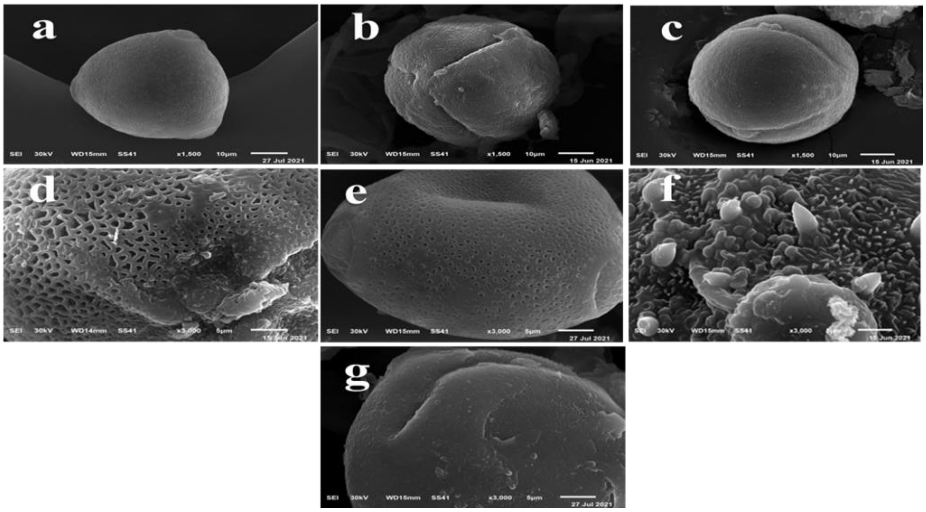


Fig. 4. apertures types of pollen grains X 1500

(a) *C. melo*, apertures porate.(b-c) *L. siceraria* , apertures tricolporate.(Figs. d-g) Exine sculpture of pollen grains X 3000.(d) *L. aegyptiaca*, exine sculpture reticulate.(e) *C. melo*, exine sculpture micro- reticulate.(f) *C. pepo*, exine sculpture spiny.(g) *C. sativus*, exine sculpture granulate.

Micromorphological characters:

Epidermal cell wall:

Micro-morphological investigations were carried out on the sepal and petal epidermal of all studied taxa to determine trichomes forms, the cell wall shapes, and the presence or absence of oxalate crystals.

The observations of sepal epidermal cell walls showed that the cell walls were mostly straight e.g. *C. moschata*, except two taxa the epidermal cell walls were straight and sinuate in *C. sativus* and *L. aegyptiaca*, while *C. lanatus* cv. *colocynthis*, only the epidermis cell walls were sinuate. Sandy crystals were recorded in three taxa *L. siceraria*, *L. aegyptiaca*, and *C. moschata* (Fig. 5a). The observation of petals epidermal cells showed that the cell walls sinuate in all examined taxa e.g. *L. aegyptiaca* (Fig.5b) except two taxa the epidermal cell walls was straight and sinuate in *C. lanatus* and *C. moschata* while *L. siceraria* had only straight epidermis cell walls.

Trichomes:

Numerous trichomes were observed on the sepal and petals of the studied taxa. Multicellular un-branched hairs were recorded in five taxa e.g. *C. moschata* (Fig. 5c). Apex of hairs either acute e.g. *C. moschata* (Fig.5c) or rounded as in *L. siceraria* (Fig.5d), multicellular hairs like sickle noted in *L. aegyptiaca* only (Fig. 5e), multicellular, multiseriate hairs presented in two taxa *C. melo* and *L. aegyptiaca* (Fig. 6a), multicellular with apex glandular recorded in all studied taxa as in *C. lanatus* cv. *colocynthis* (Fig. 6b). Petals multicellular unbranched hairs like an earthworm showed in e.g. *L. aegyptiaca* only (Fig. 6c) unicellular hairs observed in two taxa *Cucumis melo*, and *C. melo* cv. *flexuosus* (Fig. 6d), multicellular glandular hairs recorded on petals of three taxa *C. lanatus*, *C. lanatus* cv. *colocynthis* (Fig. 6e) and *C. moschata*. Multicellular hairs branched with acute apex and rounded apex recorded in three taxa *C. lanatus* (Fig.6f), *C. lanatus* cv. *colocynthis* and *L. aegyptiaca* (Fig.6e). These results agreed with those obtained by Ekeke *et al.* (2019) who reported that trichomes of *Benincasa hispida* are glandular and non-glandular with uniseriate stalk, clavate and multicellular gland heads. The non-glandular trichome types are found on the adaxial and abaxial surfaces of the male flower petals while glandular trichome types occurred on the adaxial epidermal surface of the male flower petals. The petals of the female flowers have glandular (multicellular gland head) trichomes and all the forms of non-glandular trichomes are identified on the lower epidermal surface of the male flower.

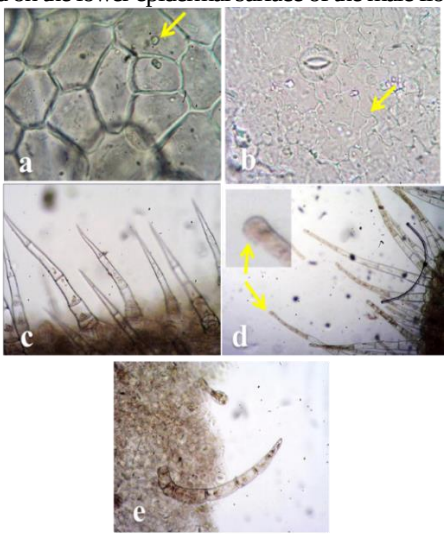


Fig. 5. Types of epidermal cell walls and hairs on sepals and petals of Cucurbitaceae.

(a) *C. moschata*, sand crystals and sepal epidermal cell walls straight.(b) *L. aegyptiaca*, petal epidermal cell sinuate.(c) *C. moschata*, multicellular hairs with acute apex.(d) *L. siceraria*, multicellular hairs with rounded apex.(e) *L. aegyptiaca*, multicellular hairs (like sickle).

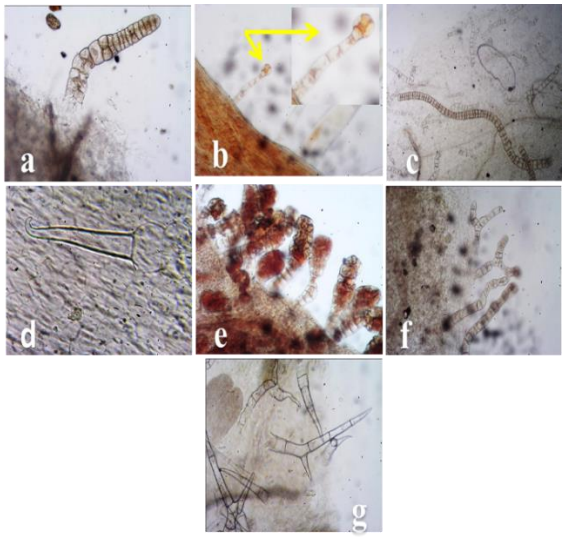


Fig. 6. Types of hairs on sepal and petals of Cucurbitaceae.
(a) *L. aegyptiaca*, multicellular multiseriate hairs. (b) *C. lanatus* cv. colocynthis, multicellular glandular hairs on sepals.(c) *L. aegyptiaca*, multicellular hairs like an earthworm on petals.(d) C. melo cv. flexuosus, unicellular hooked hairs on petal.(e)*C. lanatus*, multicellular glandular hairs on petal.(f) *C. lanatus*, multicellular branched hairs with rounded apex.(g) *L. aegyptiaca*, multicellular branched hairs with acute apex.

Anatomical characters of flower pedicel:

Outline shape

The anatomical studies were done on the pedicel of male and female flowers. The pedicel of the male flower in outline shape was angled in two taxa *L. aegyptiaca* (Fig.7a) and *L. siceraria* (Fig.7b) and the number of angled either five or seven in pedicel of studied taxa as in (Figs 7a, b); the pedicel rounded in *C. lanatus* cv. *colocynthis* only (Fig.7c), polygonal circular in two taxa *C. lanatus* and *C. sativus* (Fig. 7d), polygonal oval in four taxa *C. moschata*, *C. pepo*, *C. melo*, and *C. melo* cv. *flexuosus* (Fig. 7e). Number of angled was five, eight, or nine.

The pedicel of the female flower was angled in the external shape in four taxa *C. moschata*, *C. pepo*, *C. sativus*, and *L. siceraria* (Fig. 7f). Number of angled was five, six, and nine in the pedicel studied taxa. The pedicel was rounded in the external shape in three taxa *C. lanatus*, *C. lanatus* cv. *colocynthis* and *C. melo* cv. *flexuosus* or oblique circular in two taxa *C. melo* (Fig.7g) and *L. aegyptiaca* (Fig.7h). The results are in harmony with the finding of Ekeke *et al.* (2015) who found that among the different representatives of the genera studied, the shape of the fruit stalk varied from one genus to another the fruit stalk is fairly triangular, 4-angled, 6-angled, 5-angled, irregular and oval or spherical.

Epidermis:

The epidermis layer of the pedicel was simple (one layer) in all the examined taxa e.g. *L. siceraria* (Fig. 8a). The epidermal cells of male and female flowers pedicel were covered by cuticle layer. The cuticle was smooth in all studied taxa. In male flowers, the cuticle layer varies in thickness from 2.17`µm in *C. sativus* to 8.16µm in *C. pepo*. While in female flowers cuticle layer thickness varies from 4.3 µm in *C. melo* cv. *flexuosus* to 6.7 µm in *C. moschata*. Big cells were recorded in most of the examined samples as in *C. sativus* (Fig.8b). The average thickness of the epidermal layer in the male flower pedicel ranged between 13.55 µm in *C. lanatus* and 35.34µm in *C. melo* cv. *flexuosus*. While in female flowers pedicel the average thickness of the epidermis layer ranged between 25 µm in *C. lanatus* cv. *colocynthis* to 47.82 µm in *C. pepo* (Table.4).

The results are in harmony with the finding of Ekeke *et al.* (2015) who found that the nature of epidermis in the fruit stalk had only 1-layer and was predominantly oval in shape.

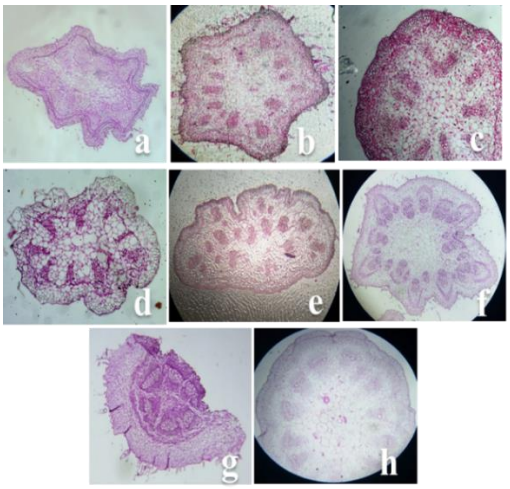
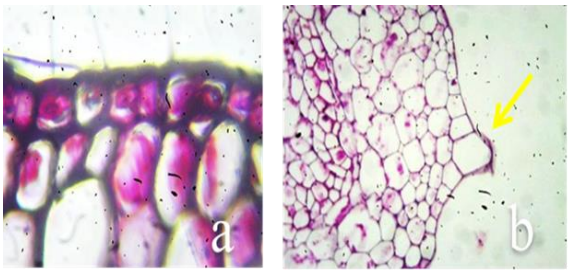


Fig. 7. Cross sections in the pedicel male and female flowers of Cucurbitaceae.
(a) T.S of *L. aegyptiaca*, pedicel of male flower angled shape with seven angled.(b) T.S of *L. siceraria*, pedicel of male flower angled shape with five angled.(c) T.S of *C. lanatus c.v. colocynthis* , pedicel of male flower rounded shape.(d) T.S of *C. sativus*, pedicel of male flower polygon circular shape.(e) T.S of *C. pepo*, pedicel of male flower polygon oval.(f) T.S of *L. siceraria*, pedicel of female flower angled shape with six angled. (g) T.S of *C. melo*, pedicel of female flower oblique circular.(h) T.S of *L. aegyptiaca*, pedicel of female flower rounded shape.



Figs. 8. Epidermal cells size in the pedicel male and female flowers of Cucurbitaceae.
(a) T.S. of *L. siceraria*, epidermal cells size is symmetrical in male flower. (X=164). (b) T.S. of *C. sativus*, female flower asymmetrical cells epidermal. (X=170)

Cortex:

All male and female flower pedicels are parenchymatous cells in plant taxa. In male flower pedicel, the average thickness of the cortex layer ranged between 153.12 µm in *C. moschata* and 348.53µm in *C. pepo*. In female flower pedicel, the average thickness of the cortex layer ranged between 316.72µm in *L. aegyptiaca* and 622.2µm in *L. siceraria* (Table. 2). The cortex of the female taxa contained idioblast. Secretory cells were recorded in all examined samples except *C. moschata*. The cortex of male flower pedicel contained idioblast except in *C. sativus*. Secretory cells were recorded in all examined taxa e.g. *C. lanatus* (Fig.9a) except *C. melo* (Fig.9b). The number of cortex layers in male flower pedicel ranged between 4 layers in *C. sativus* and 10 layers in *Citrullus lanatus*. Also, in female flower pedicel the number of cortex layers ranged between 5-6 layers in two taxa *C. sativus* and *C. melo* cv.*flexuosus* and 11-12 layers in *C. melo* (Table. 4). The results are in harmony with the finding of Ekeke *et al.* (2019) who reported that *Benincasa hispida* male flower cortex 53 - 64 µm thick, and sclerenchyma 2 - 3 µm thick. The female

flower stalks cortex 112 - 116 µm thick, sclerenchyma 2 - 3 µm thick. Ekeke and Agogbua (2018). Found that the male flower stalk of *Trichosanthes cucumerina* cortex with 4 parenchymatous layers.

Table 2. Data matrix of observed characters for the examined plants. List of 63 different characters recorded comparatively depending on the morphological and anatomical characteristics of taxa studies.

Taxa characters	***Citrullus lanatus***	***Citrullus lanatus* cv. *Colocynthis***	***Cucurbita moschata***	***Cucurbita pepo***	***Cucumis sativus***	***Cucumis melo***	***Cucumis melo* cv. *flexuosus***	***Lagenaria siceraria***	***Luffa aegyptiaca.***
1.Flowers: solitary 1/ in an inflorescence 0	1	1	1	1	1	1	1	1	1-0
2. " hermaphrodite1/ unisexual 0	0	0	0	0	0	1	0	0	0
3. " bracteates 1/ ebracteate 0	1	1	0	0	0	0	0	0	0
4. " calyx sepals fleshy 1/ leathery 0	1	1	1	1	1	1	1	1	0
5. " " " apex acute 1/ rounded 0	1	1	0	1	1	0	0	1	1
6. " " " permanent with fruit 1/ deciduous 0	0	0	0	1	1	0	1	0	0
7. " " " epidermal cell walls straight 1/ siuate 0	1	0	1	1	1-0	1	1	1	1-0
8. " " " sandy crystals present 1/ absent 0	0	0	1	0	0	0	0	1	1
9. " " " hairs multicellular branched 1/ unbranched 0	1	1	0	0	0	0	1-0	0	1-0
10. " " " " " multiseriate present 1/ 0	0	0	0	0	0	1	0	0	1
11. " corolla petals color, yellow 1 / white 0	1	1	1	1	1	1	1	0	1
12. " " " epidermal cell walls straight 1/ sinuate 0	1-0	0	1-0	1	0	0	0	1	0
13. " " " hairs, unicellular 1/ multicellular 0	0	0	0	0	0	1-0	1-0	0	0
14. " " " " multicellular glandular 1/ eglandular 0	1-0	1-0	1-0	0	0	0	0	0	0
15. " " " " " branched 1/ unbranched 0	1-0	1-0	1	0	0	0	0	0	1-0
16. Pollen grains: shape spheroidal 1 / oblate 0	1	1	1	1	1	1	0	1	1
17. Number of aperature per pollen three 1/ poly 0	1	1	0	0	1	1	1	1	1
18. Male epidermal cells, symmetrical in size 1 / asymmetrical 0	0	0	0	1	0	0	0	1	0
19. " cortex, secretory cells present1 / absent 0	1	1	1	1	1	0	1	1	1
20. " " idioblast present 1 / absent 0	1	1	1	1	0	1	1	1	1
21. " phloem idioblast present 1 / absent 0	1	1	0	1	1	1	1	1	1
22. " pith secretory cells present 1 / absent 0	0	1	1	0	0	0	0	1	1
23. " " idioblast present 1 / absent 0	1	1	0	0	0	1	0	1	1
24.Female epidermal cells, symmetrical in size 1/ asymmetrical 0	1	1	0	0	0	0	1	0	1
25. " cortex secretory cells present 1 / absent 0	1	1	0	1	1	1	1	1	1
26. " xylem vessels in series1/ in clusters 0	0	0	1-0	1-0	1-0	0	0	0	1-0
27. " tylosis present 1/ absent 0	1	0	0	0	1	0	0	0	1
28.Corolla apex	mucronate	mucronate	aristate	aristate	mucronate	mucronate	mucronate	mucronate	cuspidate
29. Anther shapes	winding	winding	oblong	oblong	winding	winding	winding	winding	crescent
30. Pollen grains apertures	colpate	colporate	porate	porate	colpate	porate	porate	colporate	colporate
31. Pollen grains texture	reticulate	reticulate	spiny	spiny	granulat	micro-reticulate	micro-reticulate	micro-reticulate	reticulate
32.Male pedicel section outline	polygonal circular	rounded	polygonal oval	polygonal oval	polygonal circular	polygonal oval	polygonal oval	angled	angled
33. Female pedicel section outline	rounded	rounded	angled	angled	angled	oblique circular	rounded	angled	oblique circular
34. pericycle layer of female pedicel	parenchyma with sclerenchyma	parenchyma with sclerenchyma	only parenchyma cell	only parenchyma cell	parenchyma with sclerenchyma	only parenchyma cell	only sclerenchyma	parenchyma with sclerenchyma	only sclerenchyma
35. Number of vascular bundles in male petiole	12	10	14	26	8	10	7	15	12

Table 2. continue

36. Average number of xylem vessels in male petiole	4	4	6	6	4	6	6	7	14
37. Number of vascular bundles in female petiole	14	9	40	42	9	9	12	23	14
38. Average number of xylem vessels in female petiole	22	8	23	7	20	18	8	6	17
39.Anther filament in mm	2	3	11	10	2	1	2	2	10
40.Pollen grains polar	44	42.4	110.4	110.5	46.3	47.3	27.2	45.3	71.6
41. " " equatorial	49.6	40	112.8	106.9	43.5	47.2	36.6	46.3	67.4
42. " " P/E in µm	0.895	1.06	0.968	1.03	1.06	0.996	0.75	9.66	1.054
43. " " porate in µm	-	5.6	15.2	20	-	9.9	7.2	8	10.52
44. " " colpate in µm	40	30.4	-	-	29.47	-	-	40	60
45. " " spiny in µm	-	-	9.6	8	-	-	-	-	-
46.Male petiole cuticle layer thickness in µm	4.43	2.65	3.3	8.16	2.17	2.64	6.4	5.65	4.52
47. " epidermal layer thickness in µm	13.55	19.99	29.42	34.54	25.25	20.1	35.34	33.74	24
48. " cortical layers thickness in µm	319.42	315.66	153.12	348.53	188.55	215.06	164.36	265.49	211.85
49. " cortical cell number	10-8	9-7	7-6	9-8	4	6-5	4-3	5-4	7-6
50. " pericyclic layers thickness in µm	56.14	6.59	74.81	25.6	20.05	38.47	36.27	20.7	50.14
51. " pericyclic cell number	2	2	3-2	2	2	3-2	3-2	3-2	3-2
52. " meta xylem vessels diameter in µm	38.43	38.96	63.26	84.7	27.38	41.87	54.49	101.6	64.01
53. " proto xylem vessels diameter in µm	6.4	7.15	15.7	30.76	11.2	11.2	12.8	18.24	26.92
54. " pith dimension in µm	400.9*368.7	597.3*780.8	1422.7*832.3	3429*368.5	916.5*307.3	458.9*376.2	774*127.3	1814*1419	2792*620.7
55.Female petiole cuticle layer thickness in µm	4.8	6.12	6.7	4.8	6.15	5.44	4.3	6.1	4.8
56. " epidermal layer thickness in µm	26.99	25	35.46	47.82	45.66	25.38	36.82	42.7	19.23
57. " cortical layers thickness in µm	532.77	573.05	495.55	383.65	456.61	546.05	354.12	622.2	316.72
58. " cortical cell number	9-8	8-6	11-10	13-9	6-5	12-11	6-5	9-7	11
59. " pericyclic layers thickness in µm	890.45	106.09	109.63	183.71	114.44	134.26	275.87	231.08	455.17
60. " pericyclic cell number	4	4-3	3-2	3-2	4-3	4-3	3	4	4
61. "meta xylem vessels diameter in µm	85.04	84.7	108.85	123.07	79.68	65.83	173.07	88.54	181.15
62. " proto xylem vessels diameter in µm	23.15	22.13	19.61	26.92	30.82	14.45	13.67	24.03	25.01
63. " pith dimension in µm	2341.3*3062	1539.6*1354.7	4687.3*3604	726.2*7284.3	2410 *873.4	336.59*297.5	1446.2*1259.5	2739*2242.7	5108.6*3485.4

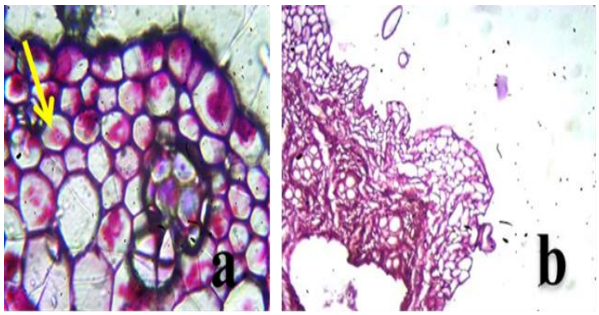


Fig. 9. Cross sections in the pedicel male and female flowers of Cucurbitaceae.

T.S of *C. lanatus*, male flower epidermal layer is simple and secretory cells in cortex. (X=164). (b) T.S of *C. melo*, cortex without secretory cells (x=170).

Pericycle

In male and female flowers pedicel the pericycle layer takes three cases, the first case consists of parenchymatous cells only e.g. *C. moschata* (Fig.10a). Some plant taxa pericycle layer consists of sclerenchymatous cells only e.g. *L. aegyptiaca* (Fig.10b). Some plant taxa pericycle layer consists of parenchymatous cells accompanied with sclerenchymatous cells e.g. *C. sativus* (Fig.10c). Idioblast are recorded in all examined taxa e.g. *L. siceraria* (Fig.11a). In male flower, the average thickness of pericycle layer ranged between 6.59µm in *C. lanatus* cv. *colocynthis* and 74.81µm in *C. moschata*. In female flowers, the average thickness of the pericycle layer ranged between 106.09µm in *C. lanatus* cv. *colocynthis* and 455.17µm in *L. aegyptiaca*. Also, the number of cells of the pericycle layer in male flowers ranged between 2 in four taxa *C. lanatus, C. lanatus cv. colocynthis, C. pepo and C. sativus* and 3 in remainder taxa. Also, in the female flowers, the number of cells of the pericycle layer ranged between 2-3 in three taxa *C. moschata*, *C. pepo*, and *C. melo* cv.*flexuosus*, and 3-4 in the remainder taxa (Table.2).

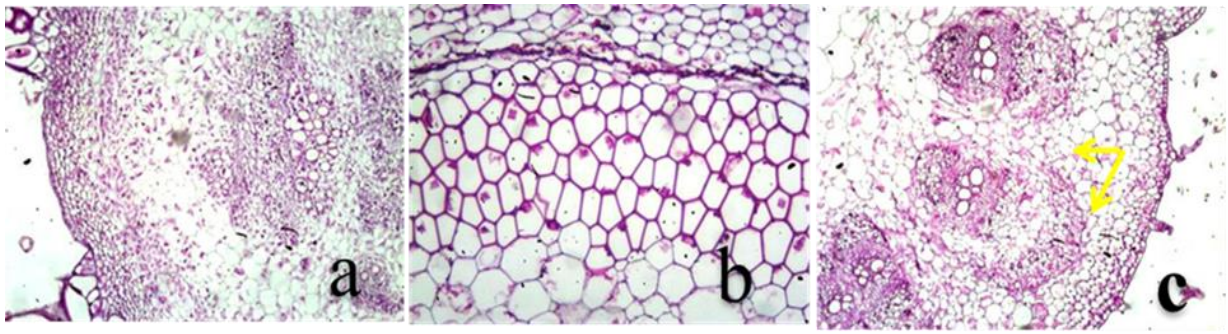


Fig. 10. Cross sections in the pedicel male and female flowers of Cucurbitaceae.

(a) T.S of *C. moschata* , female pericycle layer is only parenchymatous cells (x=164). (b) T.S of *L. aegyptiaca*, female pericycle layer is sclernchymatus cells only (x=170). (c) T.S of *C. sativus*, female pericycle layer is parenchymatous cells accompanied with sclernchymatus cells (x=164).

Vascular bundles

They were bicollateral, the number of them in male pedicel ranged between seven in *C. melo* cv. *flexuosus* and 26 *C. pepo*. In female flowers number of vascular bundles ranged between nine in three taxa *C. lanatus* cv. *colocynthis*, *C. sativus*, and *C. melo*, and 42 in *C. pepo*. In the transverse

section of the pedicels of the male and female flower, the vascular bundles are arranged in a circle e.g. *C melo* . The results are in harmony with the finding of Ekeke *et al.* (2019) reported that *Benincasa hispida* male flower stalk has 16-vascular bundles and female flower 14 vascular bundles. Ekeke *et al.* (2017) reported that in male flower stalks, the number and nature of vascular bundles were found to be diagnostic. The number of vascular bundles in *C. lanatus* is 9, *C. colocynthis* 10. The sclerenchymatous cells are continuous in the species but slightly differed in thickness. In *C. lanatus* (3-4 layers), *C. colocynthis* (2-7 layers). In the same vein the thickness/layers of parenchymatous include *C. lanatus* (1- 3 layers), *C. colocynthis* (5-7 layers).

Phloem

Idioblast cells are recorded in all of the examined taxa e.g. *C. sativus* (Fig. 10c).

Xylem

In male flower pedicel all examined taxa, xylem vessels occur in clusters while in female flower most examined taxa, xylem vessels occur in clusters such as *L. siceraria* (Fig. 11b), while in few taxa the vessels are in clusters and series or arms as in *C. sativus* (Fig. 11c).

In male flower pedicel, the average dimension of meta-xylem vessels ranged between 27.38 µm in *C. sativus* and 101.6 µm in *L. siceraria*. The average dimension of protoxylem vessels ranged between 6.4 µm in *C. lanatus* and 30.76 µm in *C. pepo*. While in female flower pedicel the average dimension of metaxylem vessels ranged between 106.09 µm in *C. lanatus* cv. *colocynthis* and 455.17 µm in *L. aegyptiaca*. The average dimension of protoxylem vessels ranged between 13.67 µm in *C. melo* cv. *flexuosus* and 30.82 µm in *C. sativus*.

Pith

In male flowers pedicel, most of the examined taxa had solid pedicel e.g. *C. lanatus* cv. *colocynthis* (fig.7c) while three species have hollow pedicel as in *C. melo* (Fig.11f). All taxa pith consists of parenchyma cells. Many taxa had idioblast and secretory cells were observed in their pith. While in female flowers all examined taxa had solid pedicel all taxa had idioblast and secretory cells were observed in the pith of all studied taxa e.g. *C. lanatus* (Fig.11g). The average dimension of pith was recorded (Table .2). The results are in harmony with the finding of Ekeke *et al.* (2019) who reported that *Benincasa hispida* male flower stalk has hollow pith, while the female flower stalk pith is not hollow.

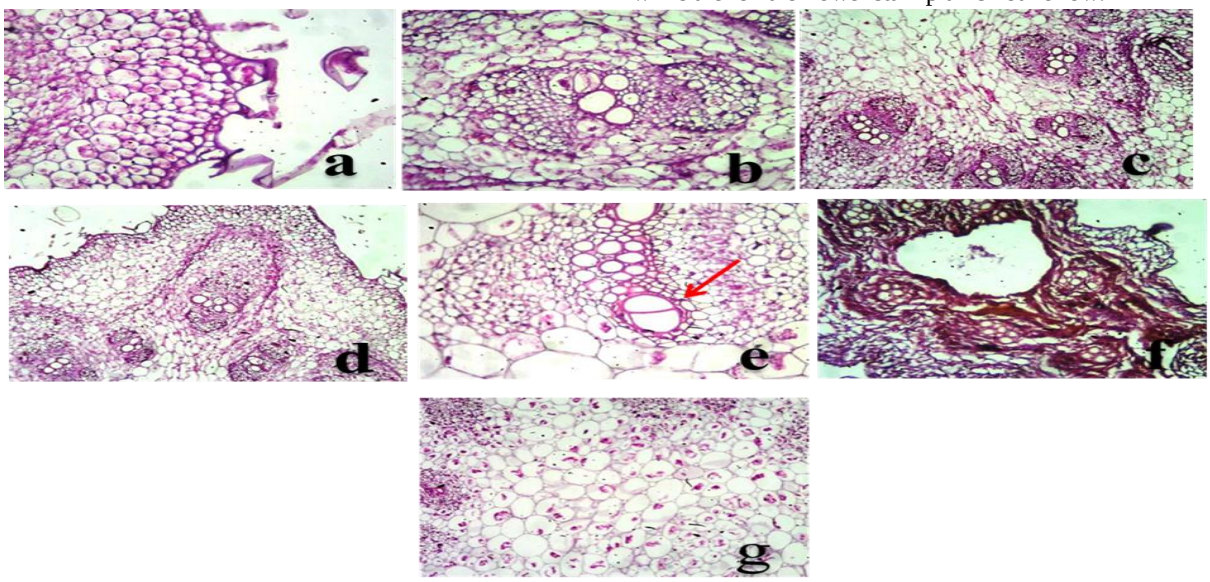


Fig. 11. Cross sections in the pedicel male and female flowers of Cucurbitaceae.

(a) T.S of *L. siceraria* , female pericycle layer is contain idioblast (x=170). (b) T.S of *L. siceraria* , female xylem vessels occur in clusters (x=170). (c) T.S of *C. sativus* , female xylem vessels in clusters and series or arms (x=164). (d) T.S of *L. siceraria*, female vascular bundles are arranged in the circle and some in the angeld (x=164). (e) T.S of *L. aegyptiaca*, tylosis in female xylem vessels (x=170). (f) T.S of *C. melo* , hollow pedicel in male flower (x=170). (g) T.S of *C. lanatus* , solid pedicel, idioblast and secretory cells in female flower. (x=164).

The dendrogram (Fig.12) showed that the higher value of similarity coefficient 0.839 between *C. lanatus* and *C. lanatus* cv. colocynthis. While the lower value of similarity coefficient 0.727 between *C. melo* and *C. melo* cv. Flexuosus. This dendrogram showed also that the remaining taxa clustered in two groups. The first group includes two taxa *C. moschata* and *C. pepo* which are united at similarity level 0.784, the second group includes 7 taxa, divided into two groups the first group includes two taxa *C. melo* and *C. melo* cv. flexuosus united at the similarity level of 0.727.The second group *C. lanatus* which united with *C. lanatus* cv. colocynthis at similarity level 0.839, in the second step *L.siceraria* united with them at similarity level 0.617. and the last step *C. sativus* which united at similarity level 0.569.

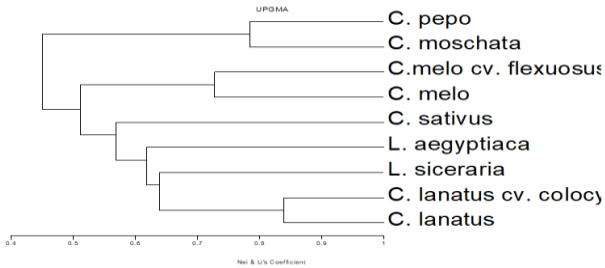


Fig. 12. The Multi-Variate Statistical Package program (MVSP) was used to analyze the obtained data which consists of 36 characters.

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الصفات التركيبية لأزهار بعض القرعيات الاقتصادية في مصر

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الملخص

أجريت هذه الدراسة على سبعه انواع وصنفين تقع تحت خمسه اجناس تابعه للفصيلة القرعية، لتحديد العلاقة بين هذه الأصناف. أجريت الدراسة على الصفات الزهرية (والتي تتضمن الصفات المورفولوجية والميكرومورفولوجية وكذلك الصفات التشريحية لعنق الزهرة). واظهرت النتائج أن الأزهار اما مفردة كما في *Cucumis sativus* أو في نورات غير محدودة النمو عنقودية كما في النوع *Luffa aegyptiaca* فقط والذى يمتاز ايضا باحتوائه على الأزهار المؤنثة المفردة. المتوك: تأخذ اشكال مختلفة اما على شكل جناح كما في النوع *Cucumis melo* var. *flexuosus*، مستطيل الشكل كما في النوع *Cucurbita moschata* أو هلالي الشكل كما في النوع *Luffa aegyptiaca* . حبوب اللقاح: مفردة كروية الشكل في كل النباتات المدروسة، فيما عدا النوع *Cucumis melo* cv. *flexuosus* فهي مفلطحة الشكل. جدر خلايا البشرة لسبلات وبتلات ازهار النباتات المدروسة اما مستقيمة أو مموجة . الشعيرات: اما وحيدة الخلية كما في النوع *Cucumis sativus* أو عديدة الخلايا كما في النوع *Cucurbita pepo* ، متفرعة كما في النوع *Cucurbita moschata* أو غير متفرعة كما في النوع *Lagenaria siceraria* . الصفات التشريحية لعنق الزهرة المذكرة والمؤنثة ان عنق الزهرة في المقطع العرضي يكون مضلع كما في *Lagenaria siceraria* ، مستدير كما في *Citrullus lanatus* cv. *colocynthis*، مستدير عديد الأضلع كما في النوع *Citrullus lanatus* بيضي عديد الأضلع كما في النوع *Cucurbita pepo* أو غير منتظم الاستدارة كما في عنق الزهرة المؤنثة للنوع*Luffa aegyptiaca*. أظهرت النتائج التشريحية ان عدد الحزم الوعائية في عنق الزهرة يتراوح ما بين 7 حزم كما في عنق الزهرة المذكرة للنوع *Lagenaria siceraria* الى 42 حزمة كما في عنق الزهرة المؤنثة للنوع *Cucurbita pepo*.