STUDY THE INDUMENTUM FOR SOME SPECIES OF *EUPHORBIA* L. (EUPHORBIACEAE) IN IRAQ

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ABSTRACT

This research was aimed to investigate 16 species belonging to the genus *Euphorbia* in order to enrich the Iraqi flora with diagnostic characteristics of this genus depending of the surface covering of leaves, stems and floral parts. The studied species were collected from Baghdad, Najaf, Karbala, Wasit, Diyala, Irbil, Kirkuk and Basrah in the growing seasons 2019/2020. These species are*: *Euphorbia. shehbaziana, E. denticulate* Lam, *E. craspedia* Boiss., *E., kete, E. pulcherrima, E. cyathophora* Murray. *E. granulata* Forssk., *E. helioscopia* L., *E. hirta* L., *E. hypericifolia* L., *E. milli* Des Moul., *E. puplus* L., *E. heterophylla* L. , *E. prostrata* Aiton., *E. microsphaera* Boiss. and *E. macrocarpa* (Prokh.) Krylov. Results showed variations in types of trichomes which were glandular (stalked or sessile) or eglandular . The stalked glandular trichomes appeared only on the leaf and stem surfaces of *E.craspedia* and on the leaf surface of *E.hirta*. They were sessile glandular on the stem and floral surfaces of *E.craspedia* and leaf and floral part surfaces of *E.cyathophora* as well as floral parts of both *E.hypericifolia* and *E.milli*.The plant parts of the same plant vary from glabrous to hairy. Some of the species do not have any type of trichomes in all the studied parts. These species were *E. heterophylla , E. prostrata , E. microsphaera* and *E. macrocarpa*.

Key words: *Euphorbia* , trichomes, indumentum, glandular, Iraqi flora

دراسة الكساء السطحي لبعض أنواع الجنس *Euphorbia* L. (Euphorbiaceae) في العراق

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المستخلص

يهدف البحث الحالي دراسة 16 نوع تعود للجنس *Euphorbia* لإغناء الفلورا العراقية بصفات تشخيصية لهذا الجنس بالاعتماد على الكساء السطحي للاوراق والسيقان والاجزاء الزهرية. جمعت الأنواع قيد الدراسة من بغداد والنجف وكربلاء وواسط وديالى واربيل وكركوك والبصرة اثناء موسم النمو 2020/2019. وهذ الأنواع هي *Euphorbia. shehbaziana, E. denticulate* Lam, *E. craspedia* Boiss., *E., kete, E. pulcherrima, E. cyathophora* Murray. *E. granulata* Forssk., *E. helioscopia* L., *E. hirta* L., *E. hypericifolia* L., *E. milli* Des Moul., *E. puplus* L., *E. heterophylla* L. , *E. prostrata* Aiton., *E. microsphaera* Boiss. و *E. macrocarpa* (Prokh.) Krylov. أظهرت النتائج وجود تغاير في أنواع الشعيرات مابين غدية (معنقة أو جالسة) أو لاغدية. ظهرت الشعيرات الغدية المعنقة فقط على الورقة والساق للنوع *E.craspedia* و ورقة النوع *E.hirta*. وانتشرت الشعيرات الغدية الجالسة على سطح الساق والاجزاء الزهرية للنوع *E.craspedia* وعلى الورقة والاجزاء الزهرية للنوع *E.cyathophora* فضلا عن الأجزاء الزهرية للنوعين *E.hypericifolia* و. *E.milli* . تغايرت الأجزاء النباتية لنفس النبات من حيث كونها مشعرة أو ملساء وبعض هذه الأنواع لم تظهر فيها أي نوع من الشعيرات وفي جميع الأجزاء المدروسة والمتمثلة بالانواع *E. heterophylla , E. prostrata , E. microsphaera* and *E. macrocarpa*. .

الكلمات المفتاحية: *Euphorbia* , شعيرات، كساء سطحي، الفلورا العراقية، غدي.

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INTRODUCTION

Euphorbiaceae family as typically delimited was one of the largest families of the flowering plants, composed for over 300 genera and 8000 species., The family very showing a great deal of variety in range, composed of all types of plants cover from large woody trees through climbing lianas to natural weeds that grow prostrate to the soil, (18,1)**.** In Iraq, the family contained about seven genus and about 51 species. *Euphorbia* L. was the largest genus in spurge family, with about 2100 universal species (21). High morphological flexibility and diversity of this genus makes taxonomical studies, on *Euphorbia* likeable for botanists. The species *Euphorbia* have their own economic value and hence subscribe the floristic wealth of tropical and subtropical countries of world. This genus was also well reputable for the production of useful secondary metabolites like alkaloids, flavonoids and the terpenes in nature (16,20). Many individuals have different kinds of hairs (trichomes), in some or in all their parts, may be glandular, or eglandular, branched ,or non-branched. Some particular groups of species seem to be recognized by specific form of epidermal features, one of them is trichomes (11,12). These tricomes considered a significant taxonomic part in many families of plants (14). Trichomes treated pertinent destination in corporative systematic investigation. They change the boundary layer over the species surfaces, function in light piping and modifying heat loss. They could also, working herbivory, pathogens, and act in storage and excretion of secondary metabolites, (2,14). (6) stated that glandular trichomes are the positions of plant natural product synthesis, and collection for protection against the insect predation. Many studies attempted to use plant trichomes as a base for taxonomy (Artificial system for classification). Keeping in opinion the difficulty of *Euphorbia* taxonomy, the current research covered with the study of 16 species be included in to *Euphorbia* in order to enrich the flora with diagnostic characteristics of this genus depending of the indumetum of leaves, stems and floral parts. These species are:*E. shehbaziana*, *E. denticulate* Lam, *E. craspedia* Boiss., *E. kete*, *E. pulcherrima*, *E. cyathophora* Murray. *E. granulata* Forssk., *E. helioscopia* L., *E. hirta* L., *E. hypericifolia* L., *E. milli* Des Moul., *E. puplus* L., *E. heterophylla* L. , *E. prostrata* Aiton., *E. microsphaera* Boiss. and *E. macrocarpa* (Prokh.) Krylov. This study was aimed to investigate 16 species belong to the genus Euphorbia from the family Euphorbiaceae to inrich the Iraqi flora with importance information of this genus.

MATERIALS AND METHODES

During various field trips to the Iraqi governorates: Baghdad, Najaf, Karbala, Wasit, Diyala, Irbil, Kirkuk and Basrah in the growing seasons 2019/2020. ,Samples were collected by taking parts of the leaf, stem and reproductive parts such as flowers. samples were washed with tap water, followed by distilled water. Epidermis of the studied parts were peeled from fresh specimen and transferred to a mixture of safranin at a concentration 0.5% : glycerin at a concentration of 10:1 for 2-5 minutes (13). The work was done in the laboratories of the University of Baghdad, College of Science, Department of Biology, with an light microscope - Olympus type, and the results were photographed with a Sony camera with a magnification of 16 megapixels.

RESULTS AND DISCUSSION

Trichomes considered relevant in corporative systematic investigation (3, 17). They could be used as important taxonomic tools and can frequently delimit species, genera or family in taxonomic study (4,7,15,19). Some particular groups of plants seem to be characterized by specific type of epidermal features; one of them was trichomes (11,12). It was clear from the current study that there is a variation in the hairs of the examined species. All the details of the examined trichomes were summarized in Table 1and 2 and shows in Plate 1and 2. In the studied species, the plant parts vary from glabrous to hairy. They were glabrous only in *E. heterophylla* , *E. prostrata* , *E. microsphaera* and *E. macrocarpa*. . Others have different types of trichomes .Different types of eglandular and glandular trichomes were observed. The study revealed variations in trichome shapes, number of their cells, apexes, length, base width(thin or thick wall) and in glandular type, differences appear in

presence or absence of stalk, number of cells, base width and in head shapes, number of cells, head length and width. All these variations were important in species separation.

Eglandular trichomes could be classified according to the cells number to:

1- Unicellular hairs :

a- Simple hairs: This type of long or short trichomes consisted of a single cell with acute or rounded apex (tip), vertical or oblique on the plant part surfaces.

b- Branched hairs: The trichome is unicellular but branched , it was observed only on the floral part surfaces of *E. cyathophora*.

2- Bicellular hairs: This type consisted of two cells unequal in length. This type observed on the floral part surface , stem and leaf surfaces of *E. pulcherrima* and on the leaf surface of *E. hirta.* The lower cell of the trichome was longer than the upper cell only in *E. hirta*.

3- Multicellular hairs: trichomes in this type consisted of 3 or 4 or 5 cells, they were observed only on the leaf and floral part surfaces of *E.hirta*.

4- Stalked or sessile stellate type hairs with 4, 5 and 6 arms surrounded by thick walls only observed on the leaf and stem surfaces of *E.cyathophora* .

The glandular type was either stalked or sessile, they were stalked only on the leaf and stem surfaces of *E.craspedia* and on the leaf surface of *E.hirta*. They were sessile glandular on the stem and floral surfaces of *E.craspedia* and leaf and floral part surfaces of *E.cyathophora* as well as floral parts of both *E.hypericifolia* and *E.milli*. Glandular trichomes have been shown to secrete viscous exudates that provide a defense mechanism against arthropods (8,9,10). The study revealed that, the abaxial side of the leaf has more hairs than the adaxial surface. The reason may be due to that, the abaxial surface has more stomata than the adaxial surface, so, presence of trichomes in high amount in this side reduced water loss by transpiration. This result was supported by Aliwy (5).

Table 1. Quantitative data of the eglandular trichomes of the studied species

Species	Plant part	Description of trichome	Trichome length(µm)	Tricome base width(µm)
E. shehbaziana	**Stem**	**Eglandular Long unicellular , oblique on the surface with acute apexes (plate1 fig1)**	**(1100-1140)1119.24**	**(1100-1140)1119.24**
		Eglandular Short unicellular , oblique on the surface with acute apexes (plate1 fig2)	**(54.4-59.84)57.57**	**(54.4-59.84)57.57**
	Floral parts	**Eglandular Short unicellular , oblique on the surface with acute apexes (plate1 fig 3)**	**(68-84.52)73.24**	**(68-84.52)73.24**
E. denticulate	**Stem**	**Eglandular Long unicellular , oblique on the surface with acute apexes (plate1 fig4)**	**(250-255.5)252.83**	**(20-30)25**
		Eglandular Short unicellular , vertical on the surface with convex apexes (plate1 fig5)	**(81.6-89.78)85.56**	**(21.76-27.2)22.96**
	Floral parts	**Eglandular Short unicellular , oblique on the surface with acute apexes (plate1 fig 6)**	**(60-150)133.33**	**(20-30)25**
E. craspedia	**Stem**	**Eglandular unicellular with acute apex (plate1 fig 7)**	**(149.6-370)213.54**	**(20-24.48)22.68**
	Leaf	**Eglandular unicellular with acute apex (plate1 fig11)**	**(176.8-231.2)208.53**	**(29.92-40.8)36.26**
	Floral parts	**Eglandular unicellular with acute apex**	**(54.4-89.76)70.17**	**(19.04-24.48)21.76**
E. kete	**Stem**	**Eglandular Long unicellular and filiform shape with thick walls , has acute apexes and swollen base (plate1 fig14)**	**(440-450)445.33**	**(70-80)75**
		Eglandular Long unicellular , vertical on the surface with convex apexes and thick walls (plate1 fig15)	**(300-500)480**	**(30-40)35**
	Leaf	**Eglandular Long unicellular with thick walls , oblique on the surface with acute apexes and swollen base (plate1 fig16)**	**(149.6-182.24)163.2**	**(21.76-27.2)24.48**
		Eglandular Long unicellular with calcified walls (plate1 fig17)	**(100-200)126.66**	**(30-40)34.5**

		Eglandular Short unicellular with calcified walls , vertical on the surface with convex apexes (plate1 fig18)	(40-80)60.5	(15-30)21.2
	Floral parts	Eglandular Long unicellular with thick walls and acute apexes , has zig – zag shape (plate1 fig19)	(136-244.8)178.93	(40.8-54.4)46.24
		Eglandular Long unicellular , vertical on the surface with thick walls and convex apexes , has swollen base (plate1 fig20)	(200-450)400	(20-60)38.33
E. pulcherrima	Stem	Eglandular Unicellular trichome (plate1 fig21)	(136-149.6)144.16	(10.88-13.6)12.24
		Eglandular Short Bicellular, the basal cell shorter than the apex cell (plate1 fig22)	(108.8-133.28)122.4	(24.48-35.36)29.61
		Eglandular Long Bicellular, the basal cell shorter than the apex cell and has a bone shape (plate1 fig23)	(250.42-400)388.99	(37.24-45.25)42.25
	Leaf	Eglandular Unicellular trichome (plate1 fig24)	(136.149.6)144.16	(10.88-13.6)12.24
		Eglandular Bicellular trichome , the basal cell shorter than the apex cell	(236.64-258.4)246.81	(13.6-21.76)18.18
	Floral parts	Bicellular the basal cell shorter than the apex cell (plate2 fig25)	(367-391.68)378.08	(32.64-38.68)35.35
E. cyathophora	Stem	Stalked stellate (plate2 fig26)	(120-700)418.33	(80-430)197.66
		Short unicellular with convex apex	(27.2-29.92)28.59	(24.48-25.02)24.75
		Long unicellular with acute apex (plate2 fig27)	(326.4-334.56)329.5	(21.76-24.48)23.3
	Leaf	Eglandular unicellular with acute apex (plate2 fig29)	(110-130)120	(30-50)40
		Sessile stellate (plate2 fig30)	(200-290)248.33	(40-54)45.38
		Stalked stellate	(150-300)205.22	(50-62)59
	Floral parts	Unicellular branched (bified) (plate2 fig32)	(100-158)127.5	(60-64.82)62.5
		Unicellular with acute apex (plate2 fig33)	(300-339)321.33	(20-23.5)22.1
E. granulata	Stem	Eglandular Long unicellular with convex apex and thick wall (plate2 fig35)	(320-340)330	(59.84-62.56)61.2
		Eglandular short unicellular with convex apex and thick wall (plate2 fig35)	(68-72.7)69.36	(48.96-54.4)51.68
	Floral parts	Eglandular unicellular with convex apex and thick wall (plate2 fig36)	(231.2-242.04)237.5	(54.4-62.56)58.48
E. helioscopia	Stem	Long hairs (plate2 fig37)	(350.22-380.08)365.76	(32.64-40.8)35.78
	Leaf	Short type	(160-180)170	(40-60)50
		Long type	(500-600)540	(42.2-55.6)49.22
E. hirta	Leaf	Eglandular unicellular	(87.04-97.7)91.56	(19.04-21.76)20.4
		Eglandular Bicellular (plate2 fig39)	(40.8-81.6)64.37	(27.2-32.64)29.92
		Eglandular multicellular (3 cells) (plate2 fig40)	(198.56-209.44)203.09	(51.68-68)61.65
		Eglandular multicellular (4 cells) (plate2 fig41)	(272-285.6)278.38	(38.08-46.24)41.7
		Eglandular multicellular (5 cells) (plate2 fig42)	(272-285.6)278.38	(54.4-65.28)59.24
	Floral parts	Eglandular multicellular (3 cells)	(272-285.6)278.38	(40.8-46.24)43.52
E. hypericifolia	Stem	Eglandular unicellular calcified walls and acute apexes (plate2 fig43)	(163.2-315.22)262.02	(43.52-78.88)64.37
	Leaf	Eglandular unicellular , branched with calcified wall	(261.12-353.6)319.14	(27.2-43.52)43.45
	Floral parts	Eglandular unicellular with thin walls	(54.4-95.2)76.82	(13.6-21.6)18.16
E.milli	Floral parts	Short unicellular , vertical on the surface with convex apexes (plate2 fig46)	(27.2-32.5)30.46	(13.6-19.04)16.32
E. puplus	Stem	Unicellular with thin wall (plate2 fig47)	(300-430)360	(30-46.24)42.22
	Leaf	Unicellular with thin wall (plate2 fig48)	(272-598.4)466.93	(19.04-26.24)23.52
		Unicellular with thick wall (plate2 fig49)	(108.8-136)123.3	(10.88-13.6)12.24

Table 2. Quantitative data of the glandular trichomes of the studied species

Species	Plant part	Description of trichome	Stalk Length(µm)	Base width(µm)	Head Length(µm)	width(µm)
E. craspedia	Stem	Sessiled glandular with bicellular ellipsoid head (plate1 fig8)	Sessile	Sessile	(16.32-27.2)20.85	(19.04-29.92)24.48
		Sessiled glandular with unicellular hemispherical head (plate1 fig9)	Sessile	Sessile	(19.04-24.48)21.76	(21.76-24.48)23.12
		Glandular with bicellular head and unicellular stalk (plate1 fig10)	(16.32-19.04)17.22	(8.16-10.88)9.06	(27.2-29.92)29.01	(19.04-24.48)21.76
	Leaf	Glandular with unicellular ovoid head and unicellular stalk (plate1 fig12)	(10.88-13.6)12.24	(13.6-19.04)16.32	(30.8-40.8)39.44	(21.76-24.48)23.12
	Floral parts	Sessiled glandular with unicellular hemispherical head (plate1 fig13)	Sessile	Sessile	(27.2-29.92)28.56	(29.92-35.36)32.64
E. cyathophora	Stem	Glandular hair with obsolete stalk and unicellular head (plate2 fig28)			(35.36-39.44)37.01	(24.48-25.84)25.12
	Leaf	Sessiled glandular (plate2 fig31)			(27.2-35.24)29.23	(21.76-24.48)20.5
	Floral parts	Sessiled glandular (plate2 fig34)			(19.64-50.32)36.64	(16.32.21.76)20.5
E. hirta	Leaf	Glandular with unicellular stalk and unicellular head (plate2 fig38)	(27.2-32.64)29.92	(8.16-21.76)13.6	(24.48-27.2)25.84	(13.6-21.76)17.68
E. hypericifolia	Stem	Sessiled glandular (plate2 fig44)	Sessile	sessile	(55.4-76.2)60.74	(37.18-58.4)43.52
	Floral parts	Sessiled glandular (plate2 fig45)	Sessile	sessile	(19.04-24.48)21.76	(21.76-24.48)23.12

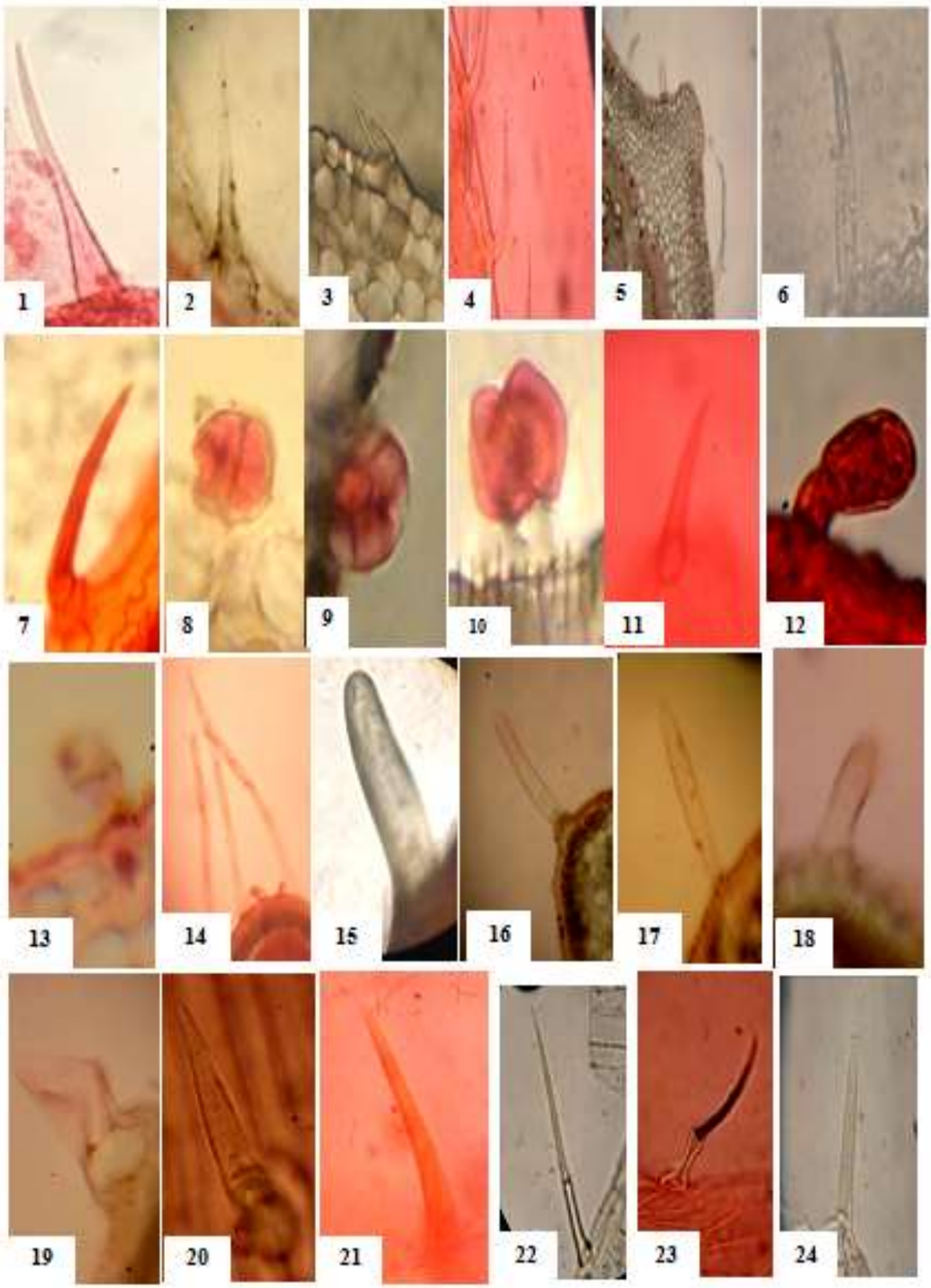

Plate 1. Different types of trichomes in the examined species (500X)

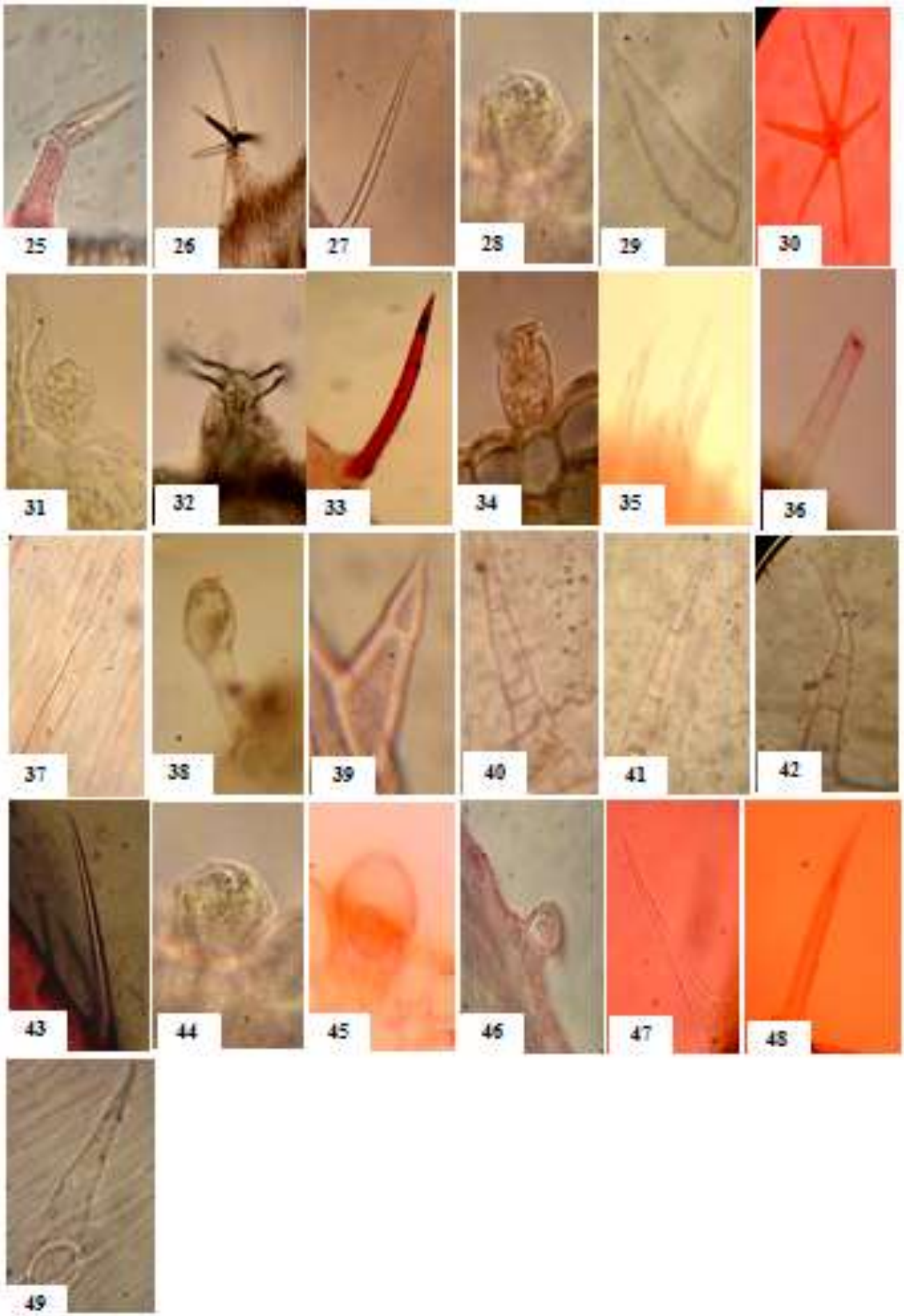

Plate 2. Different types of trichomes in the examined species (500X)

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