Study of the Epidermal Leaves Features of Some Species of Subfamily Papilionoideae Growing in the District of Central and Northern Iraq

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Abstract

This research included the epidermis anatomical study of thirty-two wild plant species belonging to six genera the genera *Astragalus, Lathyrus, Medicago, Pisum, Trifolium* and *Vicia* of the subfamily Papilionaceae distributing in central and northern Iraq districts. The samples were collected from 2022 to 2023. Approximately thirty-four field tours were carried out, including central and north Iraq regions, and a comprehensive survey of preserved herbarium specimen in the National Herbarium of Iraq and other university Herbariums for identification. The results showed that the ordinary epidermal cells showed significant and prominent variations on the upper and lower surfaces, as they could be divided into three shapes, including strongly undulated, little sinuate, and straight-curved ordinary epidermal cells. In the dimensions, it was found that the lower epidermal cells are larger compared to the size of the upper epidermal cells and that the number of stomata on the upper epidermal surface is greater than the lower epidermal surface. Moreover, the stomatal index on both surfaces showed significant differences, with the highest stomatal index recorded on the lower surface of the epidermis, compared with the upper surface gave the least. However, the shape of the guard cells on the two surfaces ranged between widely reniform and elongated reniform. Therefore, these dissimilar characteristics promote the separation and isolation of the studied species.

Keywords: Anatomical, Papilionoideae, Fabaoideae, *Astragalus*, *Medicago*

دراسة الخصائص التشريحية لبعض أنواع التحت عائلة Papilionoideae النامية في منطقة وسط وشمال العراق

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المستخلص

شمل هذا البحث دراسة تشريحية لبشرة اثنين وثلاثين نوعًا من النباتات البرية تنتمي إلى ستة أجناس، هي Astragalus, Lathyrus, Medicago, Pisum, Trifolium and Vicia، من التحت عائلة Papilionaceae المنتشرة في مناطق وسط وشمال العراق. جُمعت العينات بين عامي 2022 و2023. ونُفذت حوالي أربع وثلاثون جولة ميدانية، شملت مناطق وسط وشمال العراق، بالإضافة إلى مسح شامل لعينات المحفوظة في المعشب الوطني العراقي ومعاشب الجامعات الأخرى للتعريف والمقارنة مع النباتات الطرية التي تم جمعها. أظهرت النتائج اختلافات ملحوظة في خلايا البشرة على سطحيها العلوي والسفلي، حيث يمكن تقسيمها إلى ثلاثة أشكال: خلايا بشرة اعتيادية شديدة التموج، وخلايا بشرة اعتيادية صغيرة التموج، وخلايا بشرة اعتيادية مستقيمة المنحنية. في الأبعاد، وُجد أن خلايا البشرة السفلية أكبر حجماً مقارنةً بحجم خلايا البشرة العلوية، وأن عدد الثغور على سطح البشرة العلوي أكبر منه على سطح البشرة السفلي. علاوة على ذلك، أظهر مؤشر الثغور على كلا السطحين اختلافات كبيرة، حيث سُجِّل أعلى مؤشر ثغور على السطح السفلي للبشرة، مقارنةً بالسطح العلوي الذي أظهر أقل مؤشر ثغور. ومع ذلك، تراوح شكل الخلايا الحارسة على السطحين بين كلوي واسع ومستطيل. لذلك، تُعزِّز هذه الخصائص المختلفة فصل وعزل الأنواع المدروسة.

الكلمات المفتاحية: تشريحي، Papilionoideae, Fabaoideae, Astragalus, Medicago

Introduction

The anatomy or internal structure of the plant body is scientific evidence used in plant classification. These facts have greatly helped in solving some classification problems. Cho *et al.,* (2017) confirmed that anatomical characteristics have been a classification guide for over a hundred years, and anatomical studies began long ago. *Shakeel et al.,* (2022) showed that anatomical studies are of great importance and are equally useful as morphological studies in many cases because they are less affected by the surrounding conditions, so it is necessary to resort to studying anatomical characteristics. The analysis conducted by Yagueddu *et al.,* (2009) indicated the distinction of 6 species based on the characteristics of the lower epidermis of the leaves, and their use as a taxonomic guide to isolate species. There are many taxonomic studies in which anatomical evidence and characteristics contributed to solving many taxonomic issues within various taxonomic groups, including the study of Satil and Selve (2007) and Zarrei *et al.,* (2010). Some anatomical studies relied on cuticle characters, trichome types, venation systems and micro-morphological characteristics of the flower buds to clarify the

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evolutionary trends (Wagner, 2004). Furthermore, the tissue sections of the leaf, stem and petiole were relied upon in the classification of the species of the genus *Astragalus L.*: *A. annularis*, *A. boeticus* and *A. hamosus* by El-Sahhar *et al.,* (2014) who collected samples from Egypt and Syria. However, the study of Mehrabian *et al.,* (2007) depends on the transverse anatomical sections of the petiole of 24 species of *Astragalus* L.

Few anatomical studies have been recorded on specific aspects of the internal structure of different species of *Lathyrus* L. in diverse areas of the world. According to the currently available information. In this direction, Khalid *et al.,* (2009) studied some anatomical characteristics of 10 wild species belonging to several genera including the species *L. aphaca* in Pakistan and they showed that there is a possibility of separating the species based on the characteristics of the leaf epidermis including the stomatal complexes and trichomes. Kristic *et al.,* (2002) were interested in the anatomical characteristics of the species *L. latifolia* in Serbia, they showed that its leaves have stomata of the anisocytic type and it's composed of one columnar row, several spongy rows and are close in number on the upper and lower epidermis, while the stem has lateral extensions resembling wings. As for the study of Celep *et al.,* (2011) on the species *L. cilicicus*, they mentioned that some anatomical characteristics such as the number of layers of the cortex and pith rays in the root and the number of layers of parenchyma cells in the stems and the good exposure of the sclerenchyma in the leaves are important in identification.

In Türkiye, Cildir *et al.,* (2011) studied the anatomy of *Lathyrus* species based on anatomy and suggested that *L. haussknechtii* is a separate species and not a subspecies of *L. brachypterus*. Cildir *et al.,* (2012) also studied the genus *Lathyrus* using light microscopy and scanning electron microscopy on the epidermis of the sepals and petals, they recorded three types of trichomes: peltalic, capitate glandular and non-glandular. They demonstrated the importance of trichome type, size and density in separating *Lathyrus* species. Al-Samarrai (2014) studied Lathyrus, the histological anatomical sections of the stem, petiole, trichomes, venation system and crystals in Iraq. Moreover, Ismail (2015) discussed the anatomical sections of three species only of the legume family, *Medicago polymorpha,* and *Vicia* sativa, for the stem, petiole and leaf, trichomes, venation system and crystals.

Therefore, the research aims to reveal the differences in epidermal leaf characteristics among the studied species to differentiate among the genera of the species belonging to the subfamily Papilionaceae.

Materials and Methods

Preparation of Epidermis

The epidermis was prepared from fresh samples collected from the field during field survey, after being fixed in a solution of Formalin acetic acid alcohol (FAA), according to the Johanson method (1940). The fixation process continued for 18-24 hours then, the samples were washed with 70% ethyl alcohol once or twice and kept in 250 ml Vails plastic containers until use. Furthermore, the method mentioned by AL-Shammary (1991) was used with some modification of the leaf epidermis by taking a part of the mature leaf from a fixed place (the middle of the leaf) approximately including the midrib and part of the blade and the edge. The scraping or stripping off method was used to obtain the upper and lower epidermis with the help of a dissecting blade and forceps with two fine ends. Then the prepared epidermis was transferred to a clean petri dish filled with water to remove the remaining materials and tissue residues stuck to the epidermis. Then it was moved to a slide containing a drop of glycerine. The epidermis was spread and covered with the slide cover, thus becoming ready for examination and study.

The samples were examined and measurements of the stomata, shapes of the ordinary epidermal cells and their dimensions were taken using the micrometre of the eyepiece lens and the images of the epidermis and trichomes were taken under the camera fixed on the compound microscope type bscope. The density of the stomata and its relationship to ordinary epidermal cells were indicated by the stomatal index which was calculated based on Chin *et al.,* (1990); Pompelli *et al.,* (2010) and McAinsh & Taylor (2017).

Stomatal Index = Stomata Number / (Stomata Number + Ordinary Epidermal Cell Number) * 100

Results

Study of Ordinary Epidermal Cells and Stomata in The Leaf

Leaf epidermis

The anticlinal wall in the surface view of the ordinary epidermal cells in the species under study showed different shapes due to the difference in species and even between the Adaxial and Abaxial surfaces of the leaf and for the same plant species. Due to the many differences observed for the ordinary epidermal cells in the upper epidermis in the species under study, which facilitated their division and placement into three groups, which are:

1. **Strongly Undulate Ordinary Epidermal Cell:** *L. tuberosus, L. tuberosus A, P. sativum, P. sativum A, P. sativum N, T. boissieri, T. dichoranthum, V. assyriaca, V. michauxii, V. sativa var sativa.* In the lower epidermis, these traits have been distinguished in: *L. inconspicuous, L. tuberosus, L. tuberosus A, M. minima A, M. orbicularis, M. polymorpha A, M. rigiduloides, P. sativum, P. sativum A, P. sativum N, T. boissieri, T. nigrescens, T. resupinatum, V. michauxii, and V. sativa var sativa.*
2. **Little Sinuate- polygonal Ordinary Epidermal Cell:** *A. hamosus, A. hamosus A, A. hamosus N, M. minima, M. minima A, M. orbicularis, M. polymorpha, M. polymorpha A, M. rigiduloides, T. nigrescens, T. phitosianum, T. Resupinatum*.. In the lower epidermis, these traits have been distinguished in: *A. hamosus, A. hamosus A, A. hamosus N, M. minima, M. polymorpha, T. dichoranthum, and V. assyriaca.*
3. **Straight–Curved Ordinary Epidermal Cell:** The rest of the species under study in the upper and lower epidermis are included in Table (1) and Table (2).

The average dimensions of ordinary epidermal cells were varied, the cells were larger in some species on the upper Adaxial surface than on the lower surface. The highest average of ordinary epidermal cell length on the upper surface was 162.5 µm in *V. michauxii*. The lowest average of cell length was in *M. rigiduloides* at 30 µm. In comparison, the highest average cell width was 55 µm in *P. sativum* N and the lowest average cell width in *L. inconspicuus* at 12.5 µm. The dimensions of ordinary epidermal cells on the lower surface showed that the highest average length was found in *L. tuberosus A* at 192.5 µm. The lowest average length was 37.5 µm in *M. polymorpha A*, while the highest average of ordinary epidermal cell width in the lower epidermis stood at 42.5 µm in *T. dichoranthum* and the lowest was recorded in *M. minima A* and *V. sativa var sativa* was 17.5 µm, while the rest of the other species ranged between these two values.

Study of the stomatal patterns in the surface view of the upper and lower epidermis of the plant leaf

The results show that the stomata types in the leaves of the species under study are of the Anomocytic type (Ranunculaceous type). This type is common in all species. The guard cells are directly connected to the ordinary epidermal cells and missed the subsidiary cells. Additionally, the results illustrate that the stomata are present on the upper and lower surfaces, and the stomata numbers on the upper epidermis are more than on the lower epidermis.

The dimensions of guard cells varied among the study species, with the average length of guard cells on the upper surface ranging from 37.5 µm in *V. assyriaca* and *V. michauxii* as the maximum and 7.5 µm in *A. hamosus* as the minimum. The other species showed an overlap in this trait. While the highest average width of guard cells on the upper epidermal surface was 11 µm in *V. assyriaca*, the lowest average was recorded in *T. boissieri* at 4.5 µm. The average dimensions of guard cells on the lower epidermal surface reached an average length of 32.5 µm in *L.* tuberosus A as the maximum and 15 µm in *T. nigrescens* and *V. assyriaca* as the minimum. On the contrary, the other species ranged between these two averages.

In the upper epidermis, the highest rate of the stomatal index was 77.27 in *V. assyriaca*, and the lowest ratio was 37.7 in *A. hamosus.* While in the lower epidermis, the highest rate of the stomatal index was 88.57 in the *M. orbicularis*, and the lowest rate was 44.82 in *M. minima*. Nevertheless, the values of the rates in the remaining species ranged between these two limits.

The shape of the guard cells on the upper and lower epidermis was reniform in all species. It was between Widely Reniform and Elongated Reniform, as the guard cells on the upper epidermis were characterized by their wide reniform shape. The species included: *L. inconspicious*, *L. tubrosus*, *L. tuberosus A*, *M. orbcularis*, *M. polymorpha*, *M. polymorpha A*, *M. riguloides*, *P. sativum*, *P. sativum A*, *P. sativum N*, *T. boissieri*, *T. Dichoranthum*, *T. nigrescens*, *T. fitosianum*, and *T. resupinatum*. While, in the lower epidermis: *A. hamosus*, *A. hamosus A, A. hamosus N, L. inconspicuous, M. minima, M. polymorpha, M. polymorpha A, P. sativum, P. sativum A, P. sativum N, T. boissieri, T phitosianum, V. assyriaca, V. michauxii, and V. sativa var sativa*. In comparison, the guard cells were elongated reniform and included *M. minima A, V. assyriaca, V. michauxii and V. sativa var sativa*. While in the lower epidermis: *L. tuberosus, L. tuberosus A, M. rigiduloides, T. nigrescens, and T. resupinatum.* Widely reniform, the others of the species under study included the upper and lower surfaces of the epidermis. Table (1) and Table (2).

The guard cells in all plant species are raised and located on upper and lower leaf surfaces. As for the arrangement of the guard cells the upper and lower ordinary epidermal cells, were surrounded by 3-6 ordinary epidermal cells in most of the species under study. The results of previous studies on the shapes and dimensions of ordinary epidermal cells and stomata, stomatal index, and guard cells in the upper and lower surfaces of the plant leaf showed that there are important fundamental changes between these shapes and values, which contributed to dividing the studied species into groups and separating the genera and species from each other.

Table (1) Quantitative and Qualitative Anatomical Traits of Stomatal Patterns in The Upper Epidermis of Leave (micrometre)

No.	Species	Ordinary epidermal cell dimensions		Ordinary epidermal cell shape	Stomatal index rate 1 mm^2	Guard cells		Guard cells shape
		Length	Width			Length	Width	
1	*A. hamosus*	39(45)57	28(30)35	little sinuate	(37.7)	6.75(7.5)8.5	4.85(5)5.25	reniform
2	*A. hamosus* A	40(42.5)45	15(17.5)21	little sinuate	(63.04)	14.5(15)16	4.85(5)5.25	reniform
3	*A. hamosus* N	60(65)67	20(25)28	little sinuate	(65.15)	17(17.5)18	9.75(10)10.5	widely elongated ren.
4	*L. inconspicuous*	71(75)80	9(12.5)17	straight–curved	(53.49)	22(22.5)23	7(7.5)8	widely reniform
5	*L. tuberosus*	141(147.5)151	11(15)20	strongly undulate	(54.54)	24(25)26	7(7.5)8	widely reniform
6	*L. tuberosus* A	76(82.5)95	19(22.5)29	strongly undulate	(71.11)	22(22.5)23	8.25(8.75)9	widely reniform
7	*M. minima*	45(50)57	29(30)36	little sinuate	(50.74)	14(15)16	4.85(5)5.5	reniform
8	*M. minima* A	46(52.5)57	34(40)49	little sinuate	(47.82)	19(20)21	7(7.5)7.85	elongated reniform
9	*M. orbicularis*	38(42.5)51	19(22.5)31	little sinuate	(64.70)	17(17.5)18	4.75(5)5.5	widely reniform
10	*M. polymorpha*	34(37.5)42	21(25)29	little sinuate	(39.50)	17(17.5)18	4.75(5)5.5	widely reniform
11	*M. polymorpha* A	35(37.5)41	18(20)26	little sinuate	(59.77)	17(17.5)18	7.5(8)8.5	widely reniform
12	*M. rigiduloides*	26(30)35	18(22.5)26	little sinuate	(49.15)	18(18.5)19	6(6.25)6.85	widely reniform
13	*P. sativum*	63(70)80	26(23.5)41	strongly undulate	(55.55)	19.75(20)21	9.75(10)10.5	widely reniform
14	*P. sativum* A	54(60)75	26(30)37	strongly undulate	(60.00)	19.75(20)21	4.5(5)5.5	widely reniform
15	*P. sativum* N	55(65)74	50(55)57	strongly undulate	(42.30)	29(30)31	4.5(5)5.5	widely reniform
16	*T. boissieri*	85(92.5)101	45(50)59	strongly undulate	(47.36)	21(21.25)22	4(4.5)5	widely reniform
17	*T. dichoranthum*	47(52.5)59	27(32.5)38	strongly undulate	(43.39)	18(19)20	7.25(7.5)8	widely reniform
18	*T. nigrescens*	47(50)56	19(25)32	little sinuate	(43.90)	17(17.5)18.25	4.5(5)5.5	widely reniform
19	*T. phitosianum*	51(57.5)63	49(52.5)55	little sinuate	(41.66)	21(21.25)22	6(6.25)6.5	widely reniform
20	*T. resupinatum*	29(35)42	18(25)31	little sinuate	(69.84)	17.25(17.5)18	4.5(5)5.5	widely reniform
21	*V. assyriaca*	49(52.5)57	36(40)45	strongly undulate	(77.27)	37(37.5)38	10.5(11)11.5	elongated reniform
22	*V. michauxii*	150(162.5)175	16(25)35	strongly undulate	(61.90)	37(37.5)38	9.5(10)10.5	elongated reniform
23	*V. sativa* var *sativa*	95(100)115	13(17.5)21	strongly undulate	(68.75)	23.5(24)25	7(7.5)8	elongated reniform

* Measurements were taken from 6-9 plant samples. * Values inside the brackets represent the average and values outside the brackets represent the lower and upper limits.

Table (2) Quantitative and Qualitative Anatomical Traits of Stomatal Patterns in The Lower Epidermis of Leave (micrometre)

No.	Species	Ordinary epidermal cell dimensions		Ordinary epidermal cell shape	Stomatal index rate 1 mm^2	Guard cells		Guard cells shape
		Length	Width			Length	Width	
1	*A. hamosus*	49(52.5)59	21(25)28	little sinuate	(51.22)	14(17.5)20	4(5)6	widely reniform
2	*A. hamosus* A	67(72.5)78	25(27.5)31	little sinuate	(75.38)	17(20)23	6.5(7.5)8.5	widely reniform
3	*A. hamosus* N	37(40)46	18(22.5)29	little sinuate	(46.00)	29(30)33	7(7.5)8	widely reniform
4	*L. inconspicuous*	99(105)111	20(25)31	strongly undulate	(59.52)	23(25)27	6.5(7.5)8.5	widely reniform
5	*L. tuberosus*	122(127.5)132	21(25)29	strongly undulate	(55.88)	18(20)22.5	6.5(7.5)8.5	widely elongated ren.
6	*L. tuberosus* A	185(192.5)201	16(20)27	strongly undulate	(60.97)	29(32.5)34	8(8.5)9.25	widely elongated ren.
7	*M. minima*	41(47.5)52	33(40)47	little sinuate	(44.82)	16(17)21	3(4)5	widely reniform
8	*M. minima* A	75(80)90	13(17.5)25	strongly undulate	(67.57)	23(25)27	4.5(5)6	elongated reniform
9	*M. orbicularis*	39(45)51	20(25)30	strongly undulate	(88.57)	17(20)23	9(10)11	elongated reniform
10	*M. polymorpha*	50(57.5)64	30(35)40	little sinuate	(46.66)	25(27.5)30	4.5(5)6	widely reniform
11	*M. polymorpha* A	25(37.5)43	18(22.5)29	strongly undulate	(77.94)	20(22.5)25	7(7.5)8	widely reniform
12	*M. rigiduloides*	70(75)80	30(37.5)42	strongly undulate	(71.05)	17(20)23	6.5(7.5)8.5	widely elongated ren.
13	*P. sativum*	95(100)115	15(20)30	strongly undulate	(65.22)	25(27.5)29	9.5(10)10.5	widely reniform
14	*P. sativum* A	79(87.5)93	30(35)41	strongly undulate	(69.39)	24(25)26	9.5(10)10.5	widely reniform
15	*P. sativum* N	147(152.5)159	28(32.5)42	strongly undulate	(56.25)	25(27.5)30	6.5(7.5)8.5	widely reniform
16	*T. boissieri*	146(152)160	30(35)40	strongly undulate	(52.94)	16(17.5)19	4.5(5)6	widely reniform
17	*T. dichoranthum*	45(57.5)64	37(42.5)53	little sinuate	(47.73)	19(20)21	4.5(5)6	elongated reniform
18	*T. nigrescens*	55(67.5)73	20(27.5)34	strongly undulate	(71.87)	14(15)16	6.5(7.5)8.5	widely elongated ren.
19	*T. phitosianum*	49(55)61	21(27.5)35	strongly undulate	(72.73)	19.5(20)21.5	4.5(5)6	widely reniform
20	*T. resupinatum*	65(70)65	22(30)35	strongly undulate	(72.75)	15(16)16.5	7(7.5)8	widely elongated ren.
21	*V. assyriaca*	28(30)34	24(27.5)29	little sinuate	(66.66)	14(15)16	3.5(4)4.5	widely reniform
22	*V. michauxii*	86(90)99	30(37.5)41	strongly undulate	(58.62)	24(25)26	9.5(10)10.5	widely reniform
23	*V. sativa* var *sativa*	50(62.5)71	13(17.5)27	strongly undulate	(68.29)	21(22.5)24	7(7.5)8	widely reniform

* Measurements were taken from 6-9 plant samples. * Values inside the brackets represent the average and values outside the brackets represent the lower and upper limits.

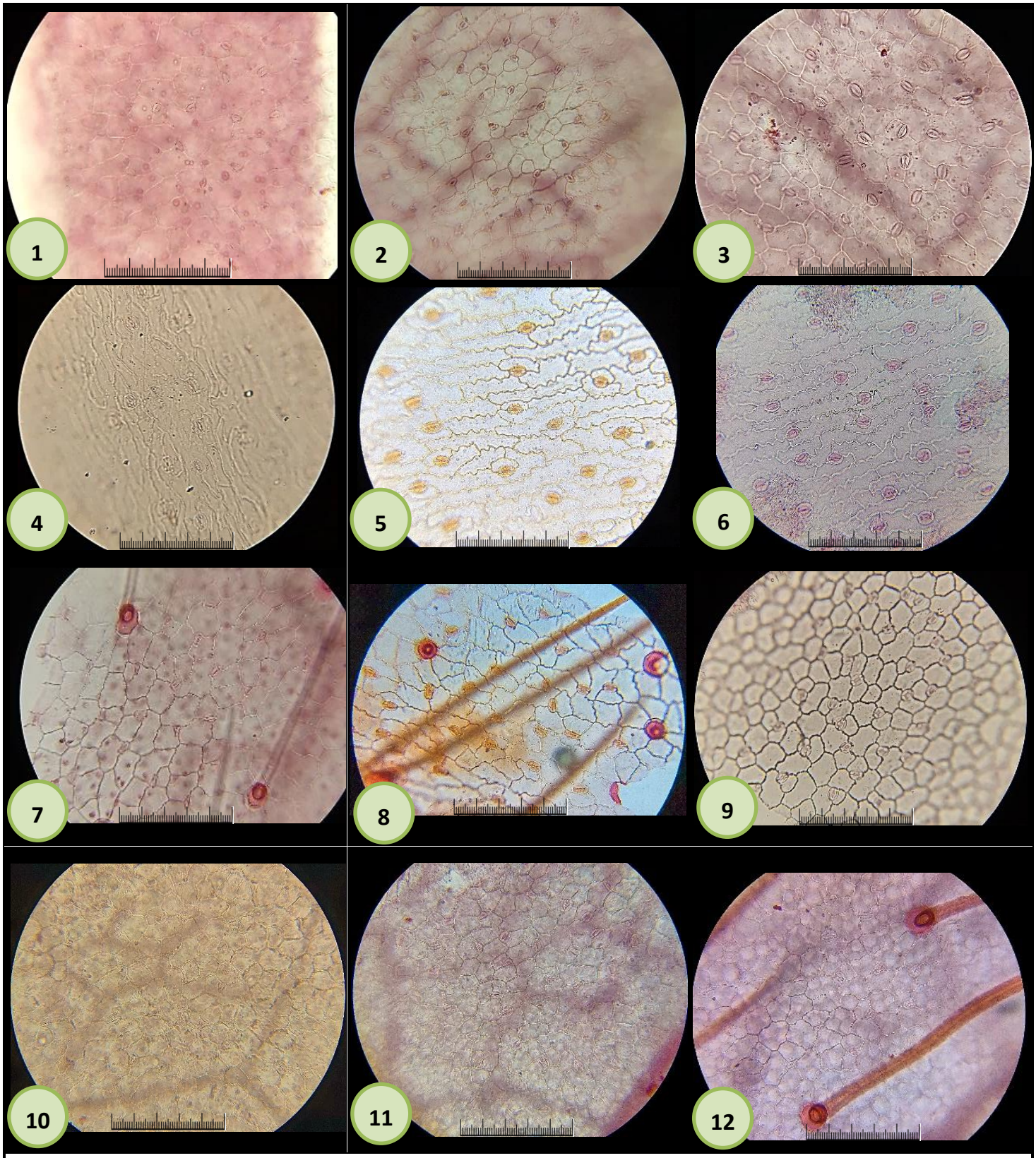


Figure: The Variations in the upper epidermis cells of the leaf in the studied species at 400X.

1- ***A. hamosus*** **2-*A. hamosus* A** **3-*A. hamosus* N** **4-*L. inconspicuus***
5-*L. tuberosus* **6-*L. tuberosus* A** **7-*M. minima*** **8-*M. minima* A**
12-*M. rigiduloides* **11-*M. polymorpha* A** **10-*M. polymorpha*** **9-*M. orbicularis***

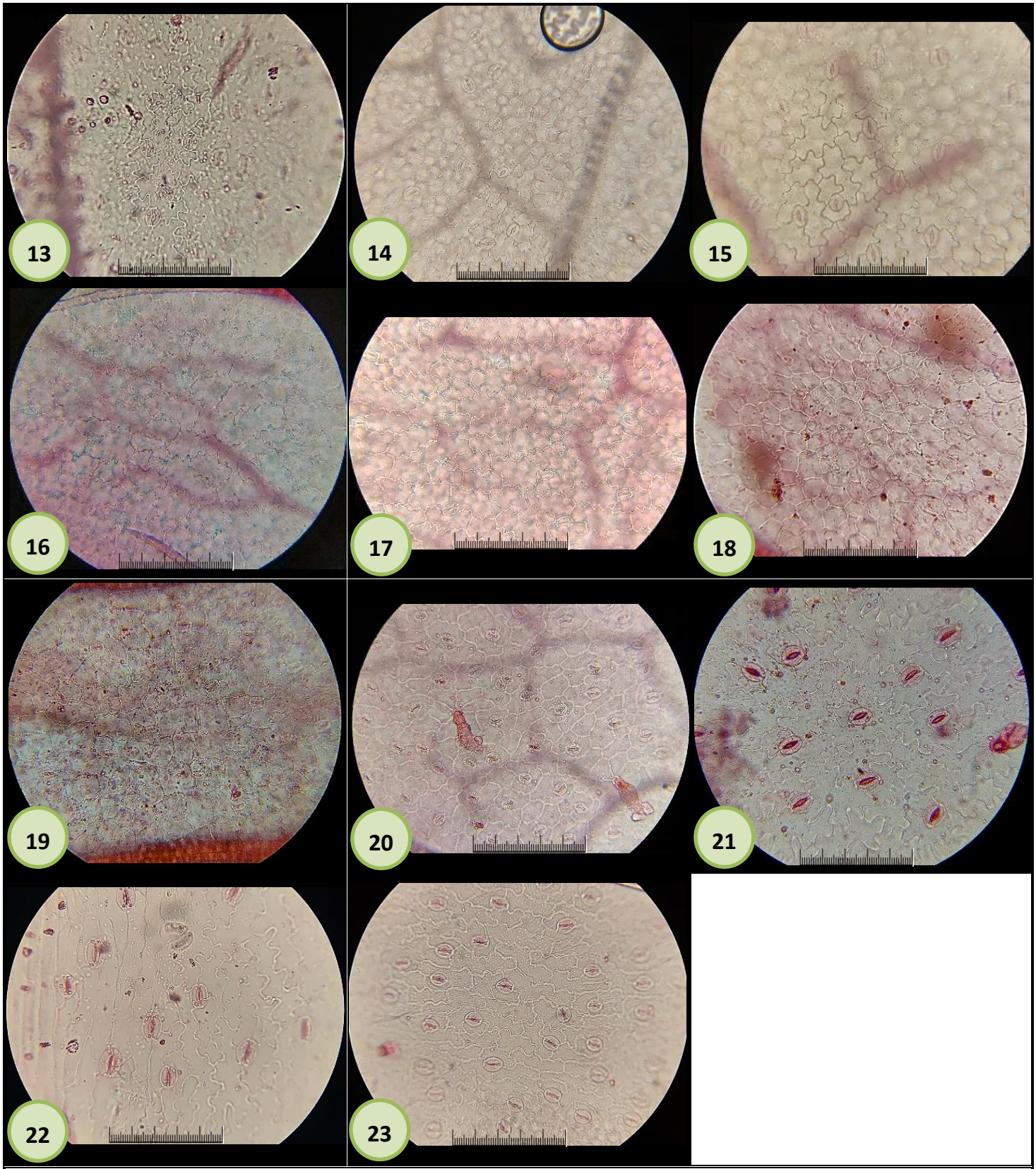


Figure: The Variations in the upper epidermis cells of the leaf in the studied species at 400X.

13- ***P. sativum*** **14-*P. sativum* A** **15 -*P. sativum* N** **16-** ***T. boissieri***
17 -*T. dichoranthum* **18 -*T. nigrescens*** **19 -*T. phitosianum*** **20 -*T. resupinatum***
21-*V. assyriaca* **22- *V. michauxii*** **23 -*V. sativa* var *sativa***

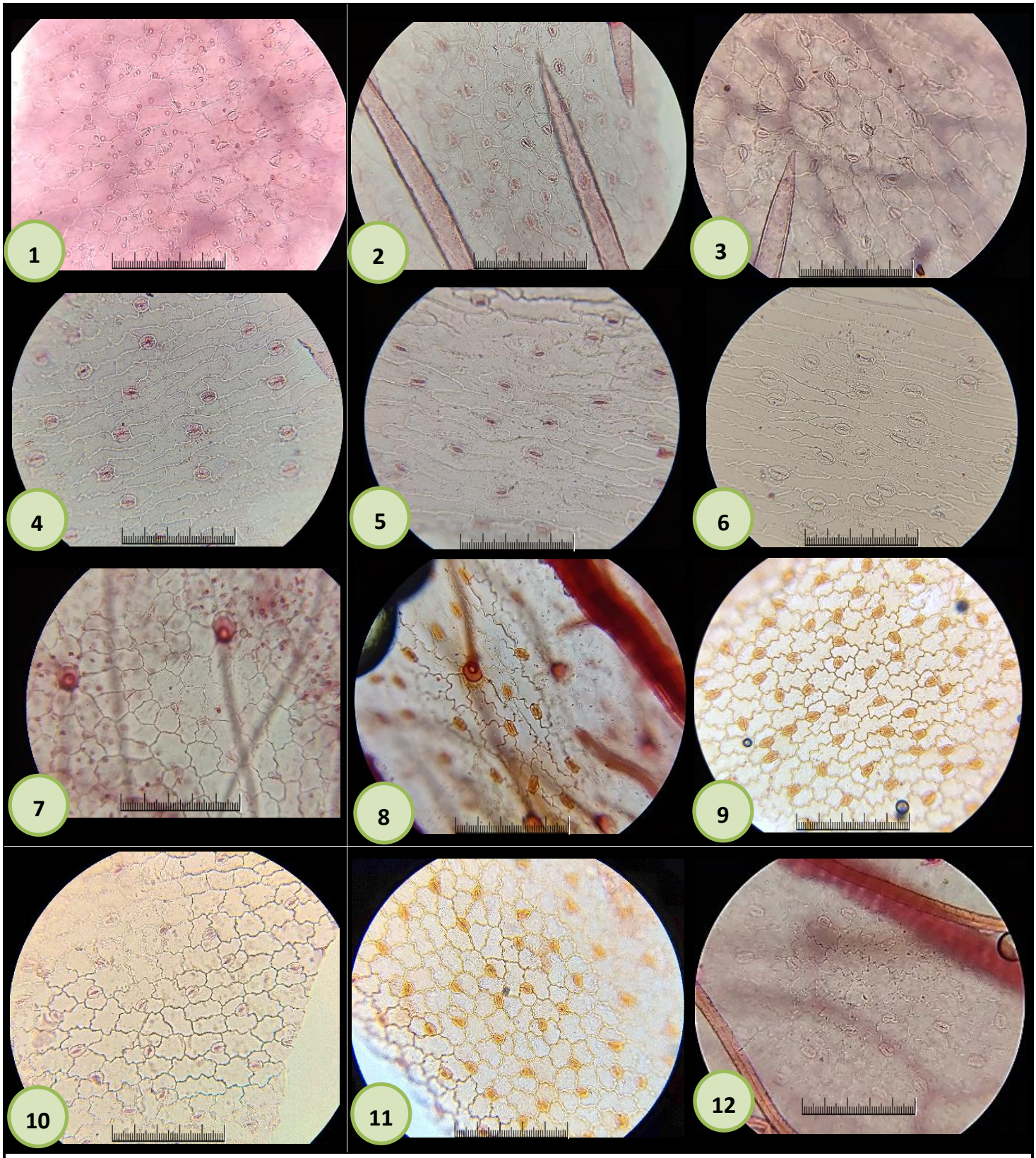
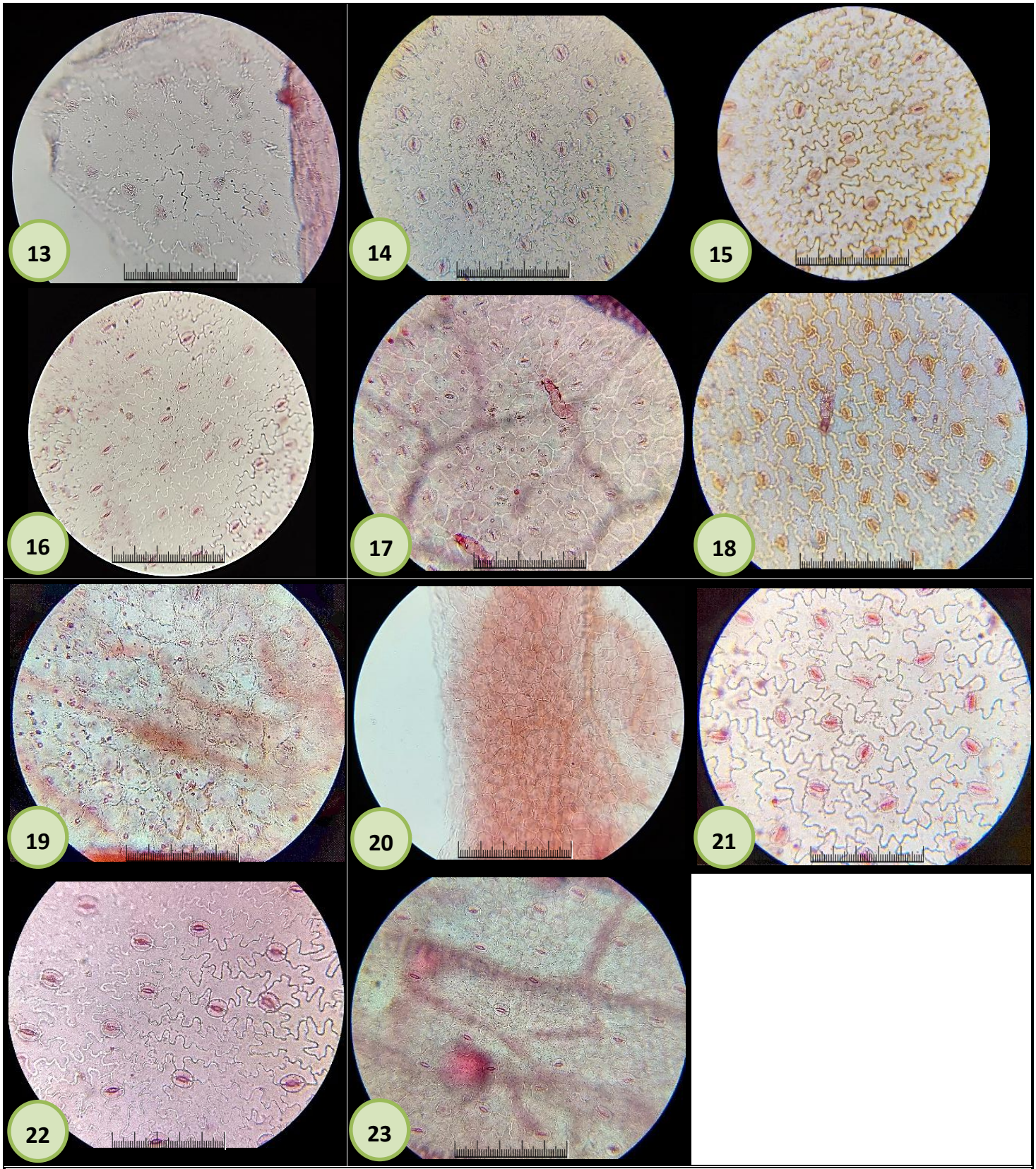


Figure: The Variations in the lower epidermis cells of the leaf in the studied species at 400X.

1- *A. hamosus* 2-*A. hamosus* A 3-*A. hamosus* N 4-*L. inconspicuus*
5-*L. tuberosus* 6-*L. tuberosus* A 7-*M. minima* 8-*M. minima* A
12-*M. rigiduloides* 11-*M. polymorpha* A 10-*M. polymorpha* 9-*M. orbicularis*



Figure; The Variations in the lower epidermis cells of the leaf in the studied species at 400X.

13- *P. sativum* 14-*P. sativum* A 15 -*P. sativum* N 16- *T. boissieri*
17 -*T. dichoranthum* 18 -*T. nigrescens* 19 -*T. phitosianum* 20 -*T. resupinatum*
21-*V. assyriaca* 22- *V. michauxii* 23 -*V. sativa* var *sativa*

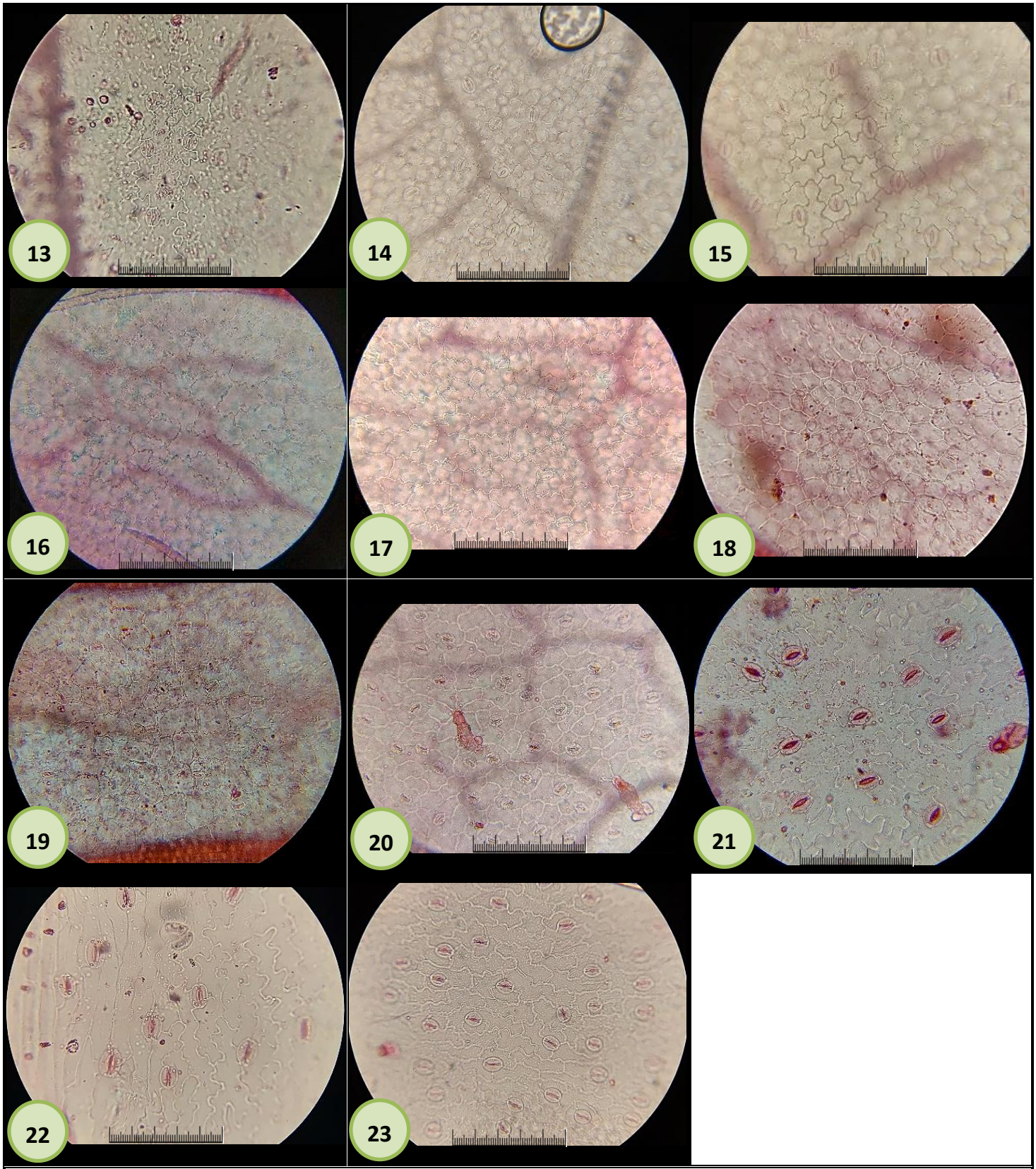


Figure: The Variations in the upper epidermis cells of the leaf in the studied species at 400X.

13- *P. sativum* 14-*P. sativum* A 15 -*P. sativum* N 16- *T. boissieri*
17 -*T. dichoranthum* 18 -*T. nigrescens* 19 -*T. phitosianum* 20 -*T. resupinatum*
21-*V. assyriaca* 22- *V. michauxii* 23 -*V. sativa* var *sativa*

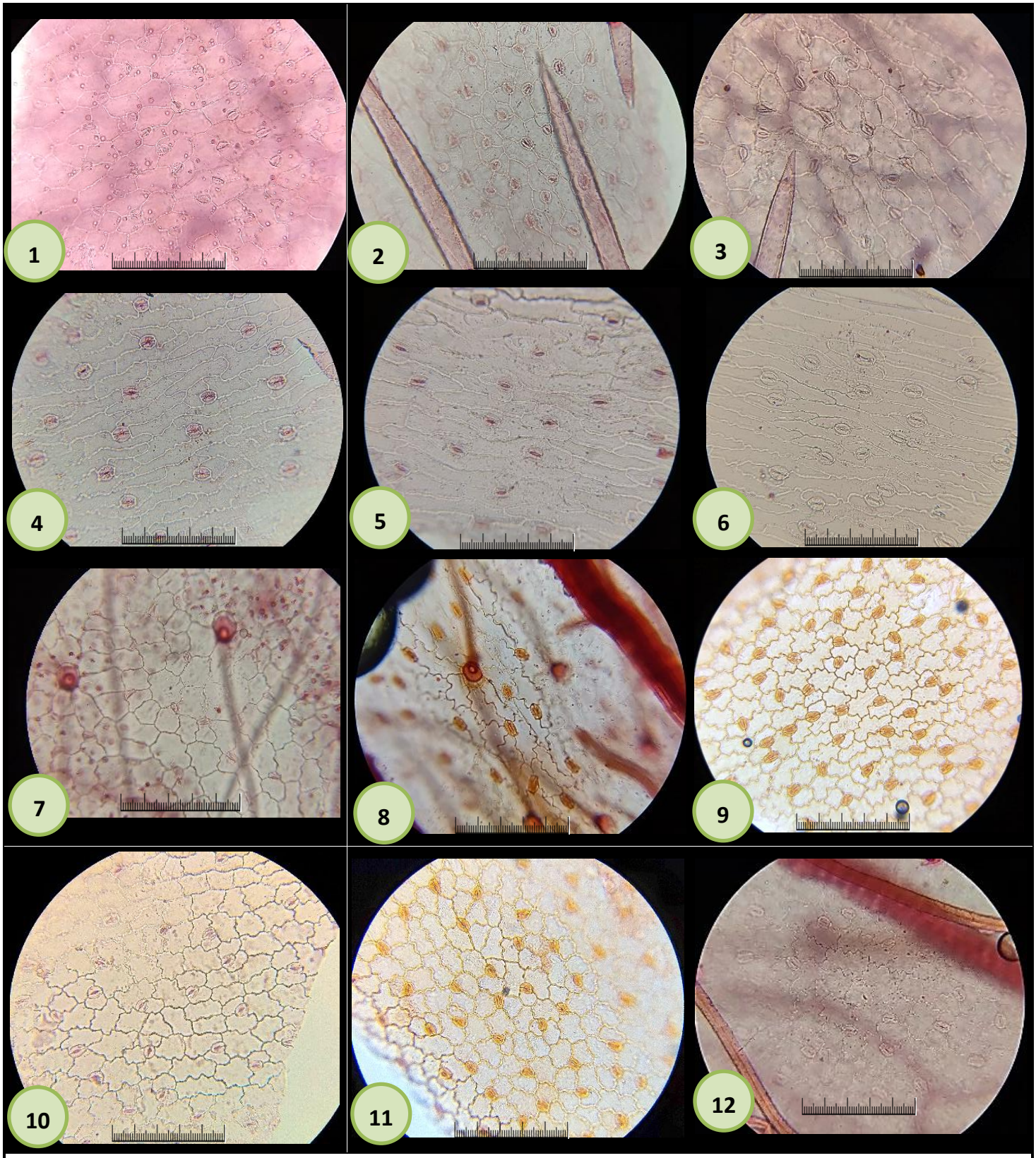


Figure: The Variations in the lower epidermis cells of the leaf in the studied species at 400X.

1- *A. hamosus* 2-*A. hamosus* A 3-*A. hamosus* N 4-*L. inconspicuus*
5-*L. tuberosus* 6-*L. tuberosus* A 7-*M. minima* 8-*M. minima* A
12-*M. rigiduloides* 11-*M. polymorpha* A 10-*M. polymorpha* 9-*M. orbicularis*

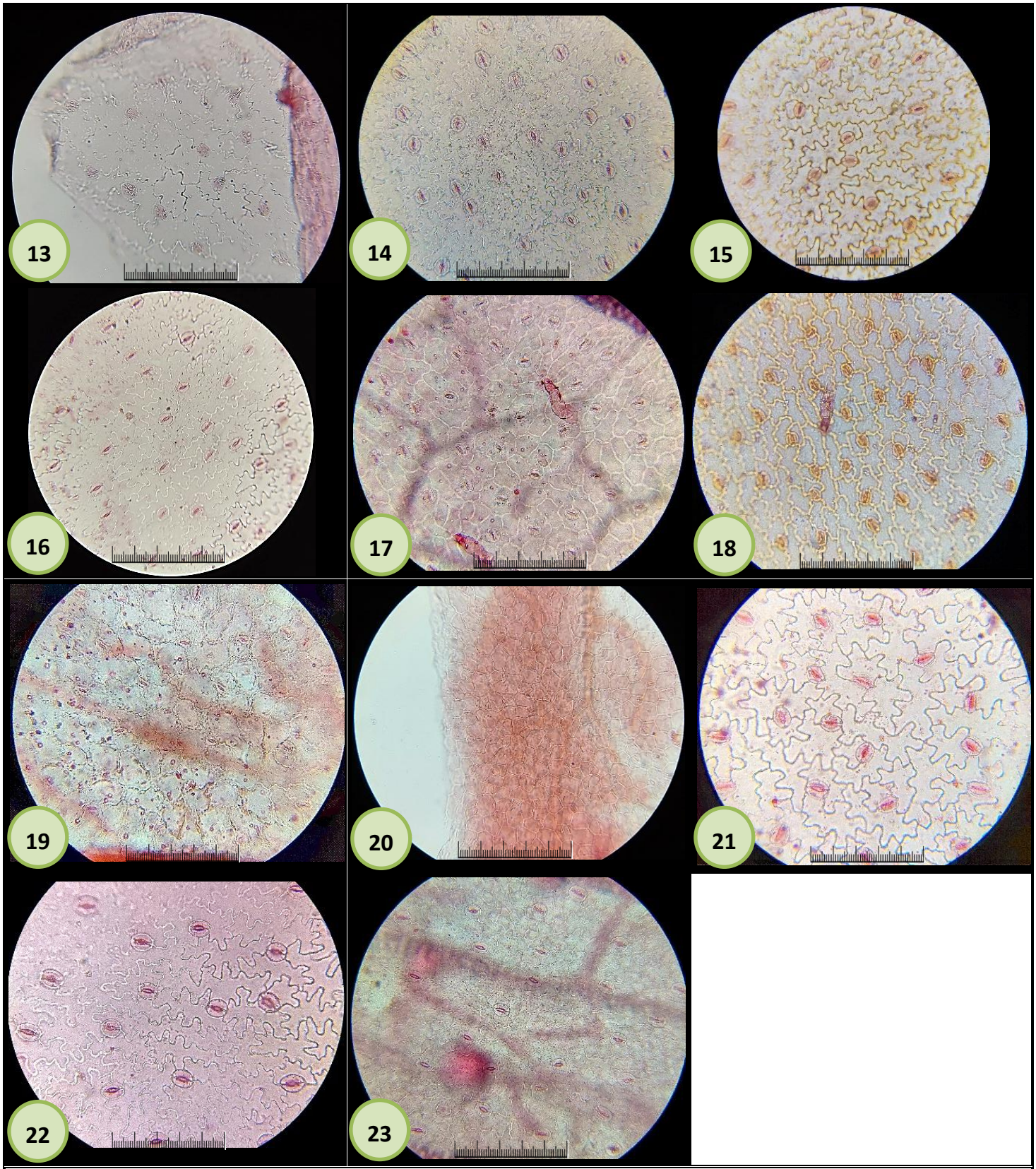


Figure: The Variations in the lower epidermis cells of the leaf in the studied species at 400X.

13- *P. sativum* 14-*P. sativum* A 15 -*P. sativum* N 16- *T. boissieri*
17 -*T. dichoranthum* 18 -*T. nigrescens* 19 -*T. phitosianum* 20 -*T. resupinatum*
21-*V. assyriaca* 22- *V. michauxii* 23 -*V. sativa* var *sativa*

Conclusion

The study of the anatomical characteristics of the genera and species of subfamily Papilionaceae contributed significantly to the isolation and separation of the studied species, as the species were divided into three groups based on the shape of the ordinary epidermal cells, which was considered a distinctive distinguishing characteristic among them. Also, the characteristic of the heterogeneity of the shape of the guard cells was relied upon. Furthermore, significant differences were observed between the upper and lower epidermal surfaces, depending on the ordinary epidermal cell size, the number of stomata, and the dimensions of the stomatal index, which enhances the separation and isolation of the studied species according to these characteristics.

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