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Anatomical Study of Some Species of the Brassicaceae Family

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ABSTRACT

Study complete in postgraduate laboratories at the College of Science, Department of Biology, University of Kufa.

The anatomical study revealed a variation in the formation of complex cells and epidermal cells, where they differed in their shapes and were irregular with wavy ridges and on the axial surfaces in R. sativusvar red L. and R. sativuslongipinntus L. Their walls were weak jagged in only R. raphenstrum. Also, the stomata were located on both sides of the leaf blade, and the upper epidermis contained fewer stomata compared to the lower epidermis.

Keywords- Anatomical, Brassicaceae, Radish, Rocket, Longipinntus

I. INTRODUCTION

In Iraq, Townsend (1980) in Flora if Iraq indicated that there are more than 500 genera and more than 2000 species spread around the world, especially in temperate regions, of which 80 or more are in Iraq, while Al-Musaw (1987) mentioned that this family includes About 380 genera and 3000 species in Iraq have 80 wild genera and 177 species. As for Al-Katib (2000), he mentioned 350 genera and 2,500 species spread over the most in temperate and cold regions in the northern hemisphere, of which 75 are wild and 18 species are cultivated for decorative and food purposes in Iraq. The crucifera family has plants that are distinguished by their great economic importance, as Al-Musawi (1987) mentioned that the plants of this family are widely used as vegetables (such as Raphanus L, Brassica L and Lepidum L) and ornamental plants such as Matthiola L. Also, some species have medicinal importance such as Brassica nigra L.

Radish, biologically known as *Raphanus sativus* linn belongs to Brassicaceae family. It is an annual herb and used as a vegetable commonly known as Mooli. Radish is called by various names in many states , such as Mullangi, Moolika, Mooli etc.(Singh and Singh. 2013, Sreelekshmi and Pratibha. 2015). Radish is an excellent species to study because; it has good economical and nutritional value. It also has a high source of two chief compounds, peroxidases and isothiocyanates Researches have been done on the antimicrobial prospective in *Raphanus sativus*. Raphanin is a constituent, which is present in seeds and leaves has already been reported for its antibacterial and antifungal activities. (Shukla *et al* .2011) . Even tender radish is recommended to be taken during pregnancy.

Wild radish (*Raphanus raphanistrum*) is a member of the Brassicaceae (syn. Cruciferae) or mustard family. It is an out crossing, diploid species with 2n = 18 chromosomes. Alternate names are jointed charlock (USA), ramnas (South Africa), runch (United Kingdom), white charlock and wild kale. Raphanus is the latinised form of the Greek word Raphanos, (a vegetable grown from antiquity) derived from ‘ra’, meaning quickly and ‘phainomai’ to appear. It was formally described by the Swedish botanist Carl Linnaeus in his seminal publication 'Species Plantarum' on page 669 in 1753. (Acevedo and Strong. 2012).

Diplotaxis harra, is a species of flowering plant in the family Brassicaceae. This plant is native to Europe, Asia, and Africa, but it is found throughout the temperate world, where it has naturalized. This is an erect mustard-like plant rarely reaching half a meter in height. It has lobed leaves and its stems are topped with dense inflorescences of yellow or occasionally light purple, flowers with small oval petals and large anthers. The fruit is a pod like silique two to four centimeters long. (List, 2010).

Eruca sativa originated in the Mediterranean region and is known by its common names: Rocket, True Rocket, Rocket Salad, Arugula, Roquette, or White Pepper. It is well recognized in traditional medicine for its therapeutic properties as an astringent, aphrodisiac, diuretic, digestive, emollient tonic, depurative, laxative, rubefacient, and stimulant, (Sharma *et al* , 2012). Tender leaves are reported to have stimulant, stomachic, diuretic.

The radish (*Raphanus* subsp. sativus) is an edible root vegetable of the family Brassicaceae that was domesticated in Asia prior to Roman times.

Radishes are grown and consumed throughout the world, being mostly eaten raw as a crunchy salad vegetable with a pungent flavor. There are numerous varieties, varying in size, flavor, color, and length of time they take to mature. Radishes owe their sharp flavor to the various chemical compounds produced by the plants, including glucosinolate, myrosinase, and isothiocyanate. They are sometimes grown as companion plants and suffer from few pests and diseases.

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II. MATERIALS AND METHODS

Study complete postgraduate laboratories at the College of Science, Department of Biology, University of Kufa.

Preparation of Formalin Acetic Alcohol (FAA) Solution

This solution was prepared according to Johansen (1940) by mixing:

90 ml of Ethyl Alcohol 70%-
- Formaldehyde 5ml
Acetic acid 5ml-

Preparation of Safranin stain 0.5%

This stain was prepared by dissolving 0.5 g of safranin in 100 ml of 50% Ethyl Alcohol solution (Johansen, 1940).

Preparation of Fast green stain 0.1%

This stain was prepared by dissolving 0.1 g of fast green in 100 ml of Absolute Ethyl Alcohol solution (Johansen, 1940).

Preparing of epidermis samples

Epidermis of both stem and leaf were peeled from fresh specimen. The fresh stems and leaves were immersed in water to prevent desiccation to procure epidermal cells. Peels from stem and both adaxial and abaxial surfaces of leaf were obtained with the help of the razor blade. Epidermal peels were stained with safranin 0.5% : glycerin mixture (1:10). After preparing, slides were observed under light microscope. The parameters studied were: the shape, length and width of epidermal cells, presence and absence of stomata on each epidermis, type of stomata, stomatal index and length and width of the guard cells.

The percentage proportion of the ultimate division of the epidermis of leaf and stem which have been converted into stomata is termed as Stomatal Index (SI) and is represented by the formula of Salisbury (1927):

$$SI=S/S+E \times 100$$

Where:

S = number of stomata per unit area

E = number of ordinary epidermal cells in the same unit area

For measurements, 15 readings were taken to obtain the mean.

Clearing of leaves

Leaves were immersed in 5% KOH solution for 7-14 days, with several changes of solvent to remove chlorophyll pigments. Leaf samples were then washed with water several times. Then, they were stained with 0.5% safranin: glycerine mixture (1:10). After preparing, slides were observed under compound light microscope. The terminology of Hickey (1973) was followed for the description of leaf architecture.

III. RESULT AND DISCUSSION

Surface view of foliar epidermis:

Table (1) summarized the observed stomatal complexes and measurements of foliar epidermal cells as well as stomatal complexes in each studied plants. Results revealed presence of variation in stomatal complex and epidermal cells configuration at different taxonomic levels (Plates from 1 to 5).

Ordinary epidermal cells*:*

In the studied species, foliar epidermal cells varied in their shapes. They were irregular with undulating walls on both adaxial and abaxial surfaces. In *R. sativus* longipinntus and *R. sativus*var., The shape of epidermal cells on both surfaces seen to be polygonal with feebly sinuous walls. The adaxial and abaxial surfaces of the leaves of *R. raphanistrum* have nearly rectangular or sub circular epidermal cells in outline with straight to feebly undulated walls. In *E. Sativa*, the epidermal cells of both surfaces were polygonal with undulated walls. In *D. harra*, the epidermal cells of both surfaces were polygonal with undulated walls.

In the above studied species, the larger average length of the epidermal cells on the adaxial surface observed on the leaves of *R. sativus longipinntus* was about 155.49 µm. On the abaxial surfaces, the larger average length was 138.65 µm in *R. raphanistrum*.

The less average length of epidermal cells on both adaxial and abaxial surfaces was observed on the leaves of *D. harra* and *R. sativus var.*, respectively. It was about 81.43µm in *D. harra* and 154.32µm in *R. sativus var.* while, larger mean width of the abaxial surfaces was noticed on the leaves of *D.harra*, it was 65.23µm. R. sativus has the larger mean width of the adaxial surface 43.76 µm. The less average width of the epidermal cells of the adaxial surfaces was on the leaves of *R. raphanistrum*, it was about 34.61µm and *E. sativa* with 37.62 µm has less average width of abaxial surfaces. However, the upper epidermis is somewhat different from the lower epidermis. The cells of the upper epidermis are larger and slightly sinuous than the lower. Upper lateral leafy pubescent, scattered simple unicellular hairs (table 1).

Stomatal complexes :

Generally, the leaves are amphistomatic, stomata are located on both sides of the leaf blade, located transversely to the longitudinal axis of the leaf. The upper epidermis has significantly fewer stomata compared to the lower epidermis. All this leads to a reduction in water loss from the surface of the sheet. The closing stomata cells on both sides of the leaf are almost the same length. Anomocytic, anisocytic, and diacytic types of stomata were noted. Occasionally, a hemiparacitic type of stomata is found. The stomata are oval, elongated-oval and surrounded by 3-6 cells. The predominant type of stomatal apparatus is anomocytic. Stomata are submerged (plate1).

Stomatal index:

Stomatal index is one of the useful tools in order to distinguish species. It was found that stomatal index has low value on the adaxial surface as compared to the abaxial surface. It was about 51.46,54.56,23.5, 43.72 and 29.89% abaxially and 37.61,41.33,15.32, 29.5 and 16.4% adaxially, respectively.

Bar chart for the stomatal index is shown in plate, from which it can be seen that *R. sativus var.* has the highest stomatal index on adaxial and abaxial surfaces, about 41.33% and 84.56%, respectively. While *D. harra*showed the lowest stomatal index on adaxial side, about 29.98% for adaxial side, *R. raphanistrum* has the lowest stomatal index for abaxial side, 15.32%. (Table 1 and 2).

These results consistent with the description given by (Al-Arkwazi, 2017, Al-Saadi*et al*, 2019 , Al-Abide, 2019).

Table 1: Differences in the characteristics of upper epidermal cells (adaxial surfaces) of the studied species dimensions (µm; st.mm^{-2})

	OCL	OCW	SL	SPL	SW	SPW	SI
Raphanus sativus L.	155.49 ± 0.31	41.76 ± 0.69	28.46 ± 1.53	14.21 ± 1.43	20.73 ± 0.81	5.76 ± 0.52	37.6 %
Raphanus sativus var.	154.32 ± 1.92	43.76 ± 0.45	25.83 ± 0.41	18.58 ± 0.29	18.86 ± 0.64	6.33 ± 0.49	41.3 %
Raphanus raphanistrum	98.51 ± 6.81	34.61 ± 0.93	28.71 ± 0.52	20.45 ± 0.53	19.43 ± 0.25	6.87 ± 0.31	15.3 %
Eruca Sativa	97.29 ± 2.57	36.7 ± 1.54	26.23 ± 0.64	13.87 ± 0.86	17.92 ± 0.65	5.27 ± 0.57	29.5 %
Diplotaxis harra	81.43 ± 0.83	39.61 ± 1.62	24.26 ± 0.35	15.42 ± 0.39	17.45 ± 0.64	5.72 ± 0.28	16.4 %

OCL= Ordinary Cells Length, **OCW**=Ordinary Cells Width, **SL=** Stomata Length**, SPL**= Stomata Aperture Length, **SW**= Stomata Width, **SPW**= Stomata Aperture Width, **SI**= Stomatal Index

Table 2: Differences in the characteristics of lower epidermal cells (abaxial surfaces) of the studied species dimensions (µm; st.mm^{-2}).

	OCL	OCW	SL	SPL	SW	SPW	SI
Raphanus sativus L.	80.31 ± 0.54	22.63 ± 1.31	24.43 ± 0.27	16.30 ± 0.38	16.62 ± 0.74	6.35 ± 0.43	51.4%
Raphanus sativus var.	79.37 ± 0.76	29.42 ± 1.76	27.56 ± 0.55	19.19 ± 0.92	19.43 ± 0.42	4.84 ± 0.50	54.5%
Raphanus raphanistrum	138.65 ± 0.49	45.76 ± 1.54	25.64 ± 0.22	14.53 ± 0.71	18.81 ± 0.72	4.87 ± 0.22	23.5%
Eruca Sativa	129.98 ± 12.3	37.62 ± 0.72	25.68 ± 0.79	17.29 ± 0.44	17.06 ± 0.83	6.13 ± 0.25	43.7%
Diplotaxis harra	112.81 ± 10.76	65.23 ± 0.18	23.81 ± 0.93	18.65± 1.38	16.34 ± 0.52	6.13 ± 0.25	29.9%

OCL= Ordinary Cells Length, **OCW**=Ordinary Cells Width, **SL=** Stomata Length**, SPL**= Stomata Aperture Length, **SW**= Stomata Width, **SPW**= Stomata Aperture Width, **SI**= Stomatal Index

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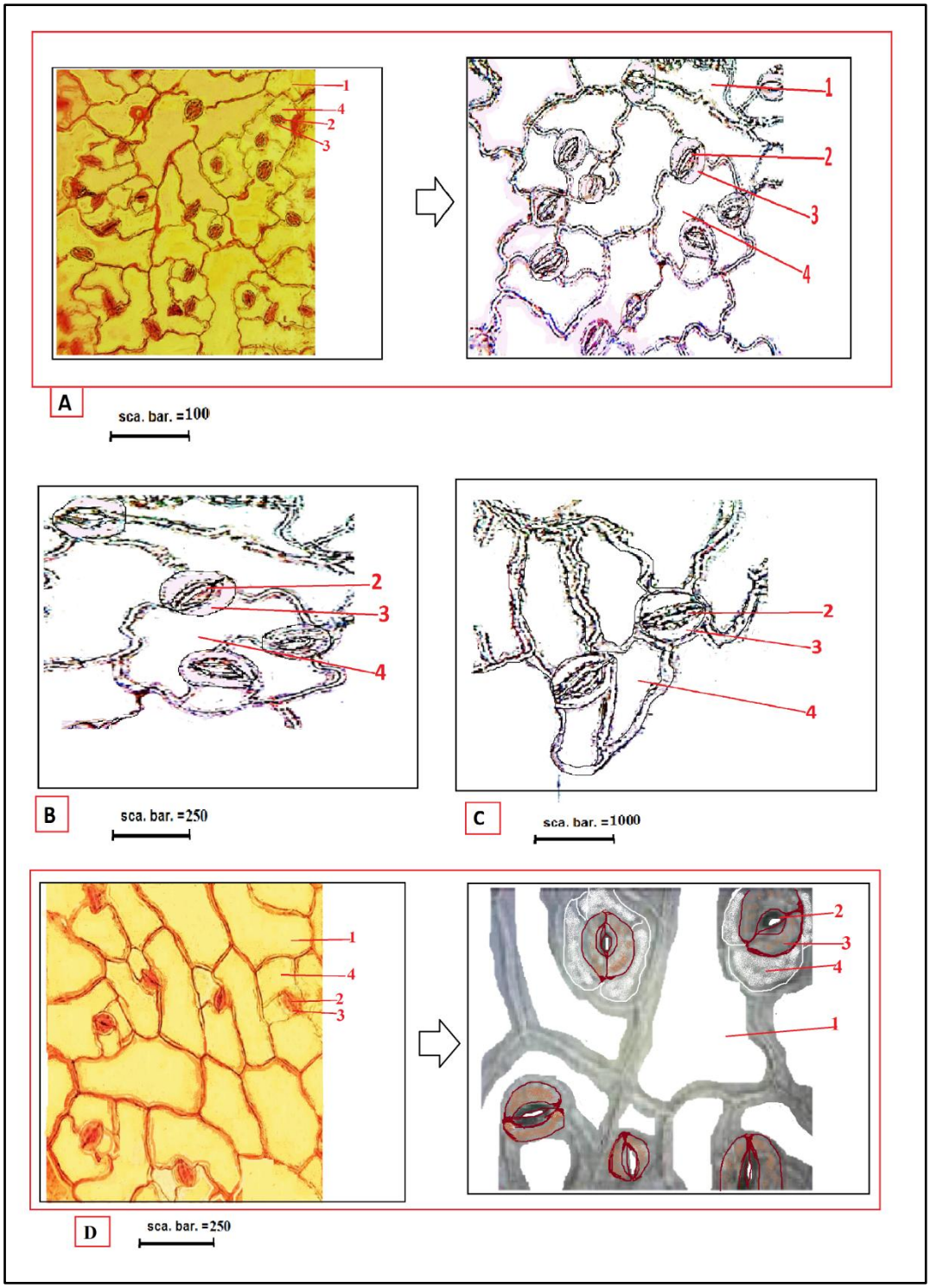

Plate 1: Epidermis of the *Raphanus sativus* leaf. The image A is shown in X 40 magnification with scale bars =100 µm------1, the images B and D are shown in X 100 magnification with scale bars =250 µm------1 and the images C and E is shown in X 400 magnification with scale bars =1000 µm------1.

Where:
1=Ordinary epidermal cells, 2=Stomata apparatus pore, 3=guard cells, 4=Accessory cells, 28= Ordinary adaxial epidermal cells, 29= Trichome base, 30= trichome cell. 31= trichome tip
Plates showed that A, B and C = The upper (adaxial) epidermis, D=The lower (abaxial) epidermis, E= Trichome of the leaf upper epidermis.

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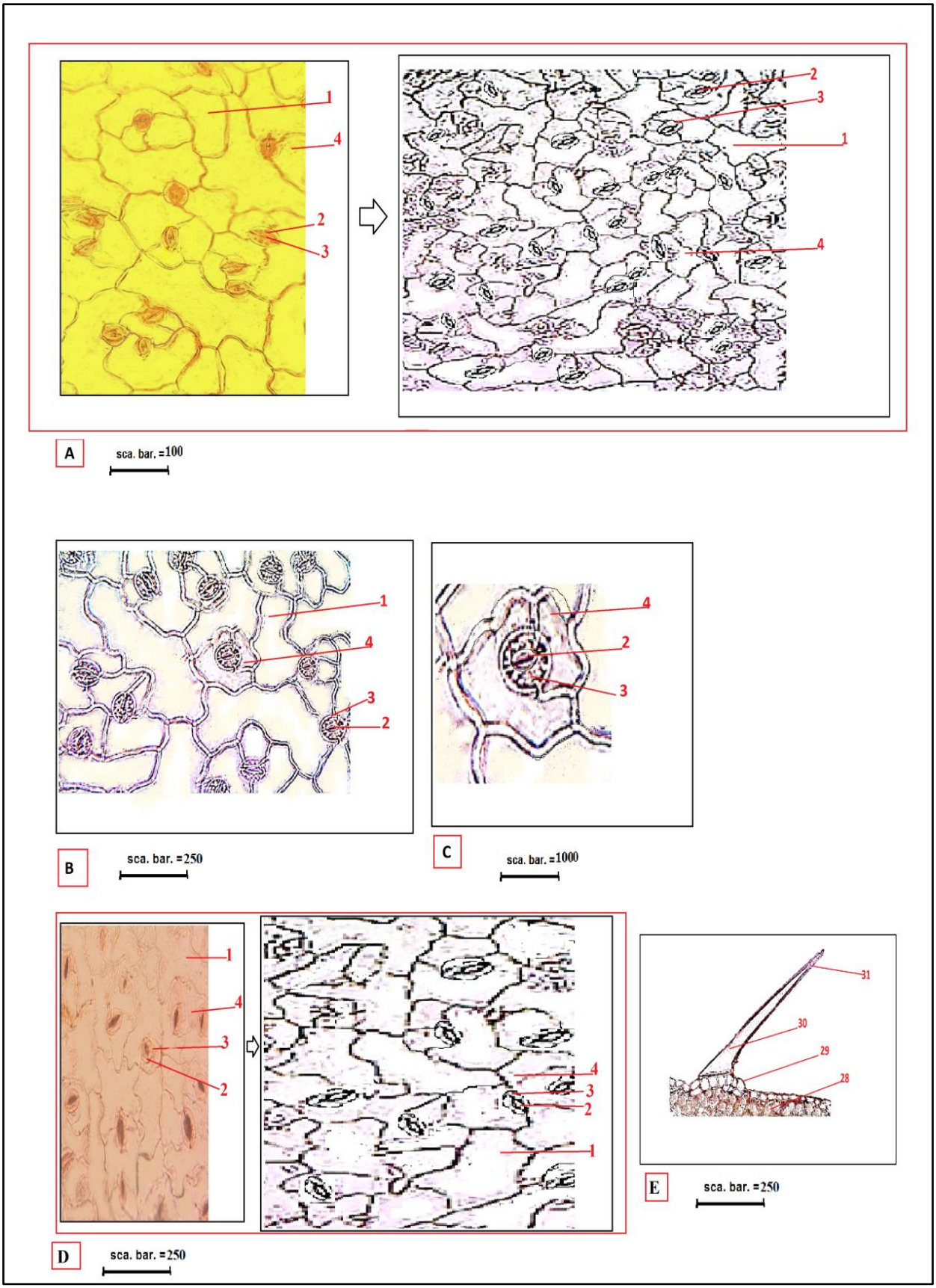

Plate 2: Epidermis of the *Raphanus satvus*var.

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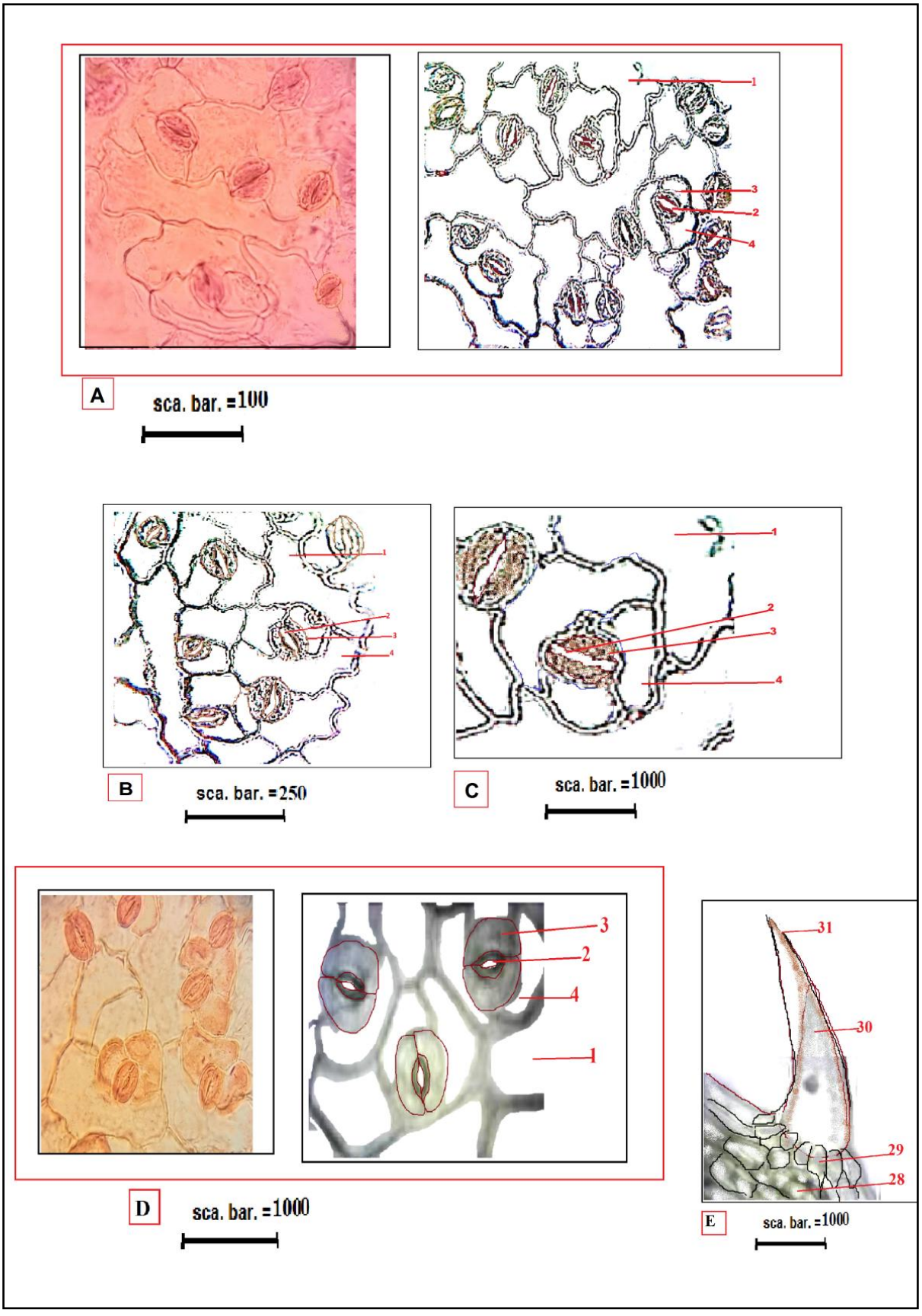

Plate 3: Epidermis of the *Raphanus raphanistrum* leaf.

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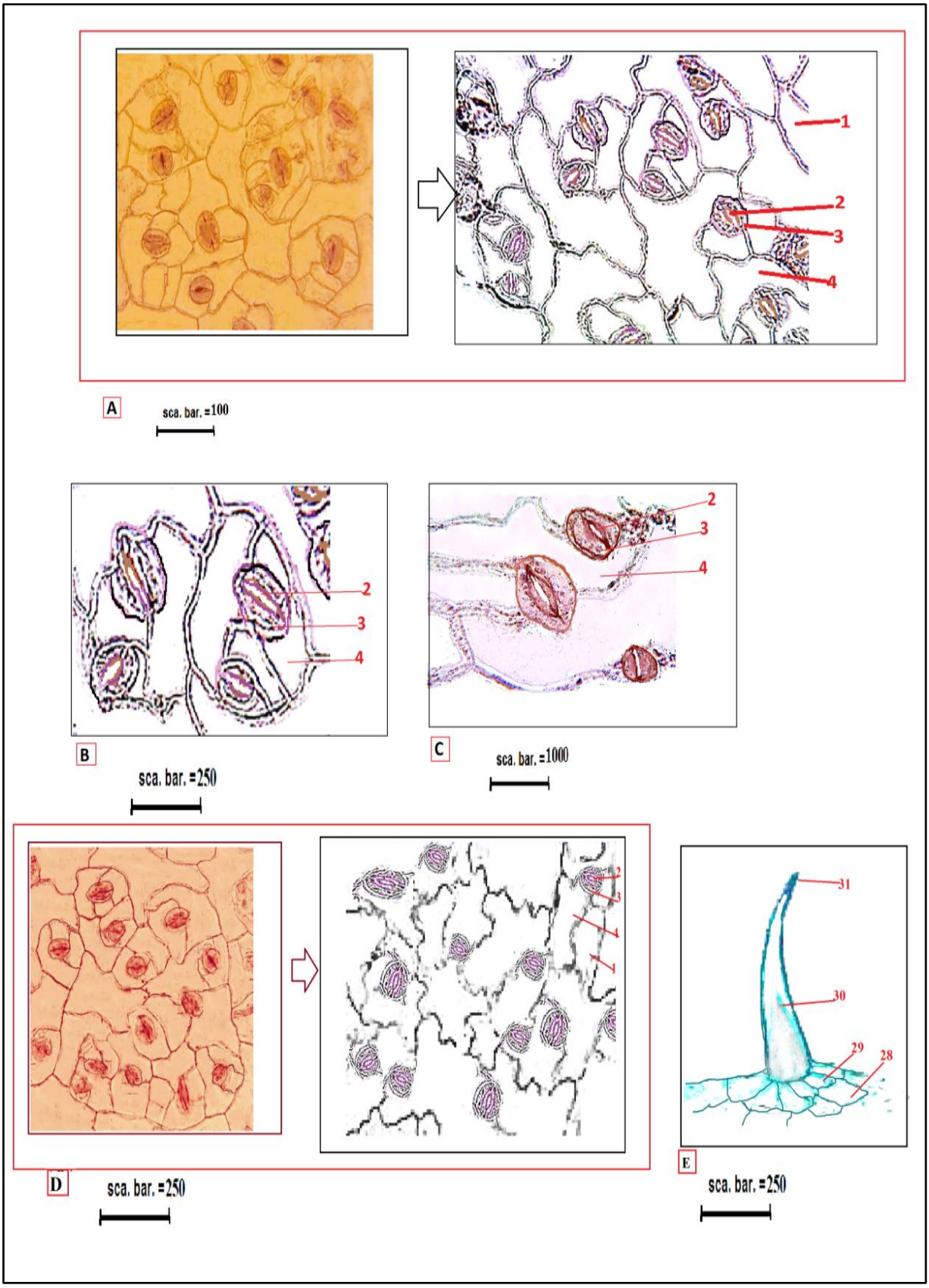

Plate 4: Epidermis of the *Eruca Sativa* leaf.

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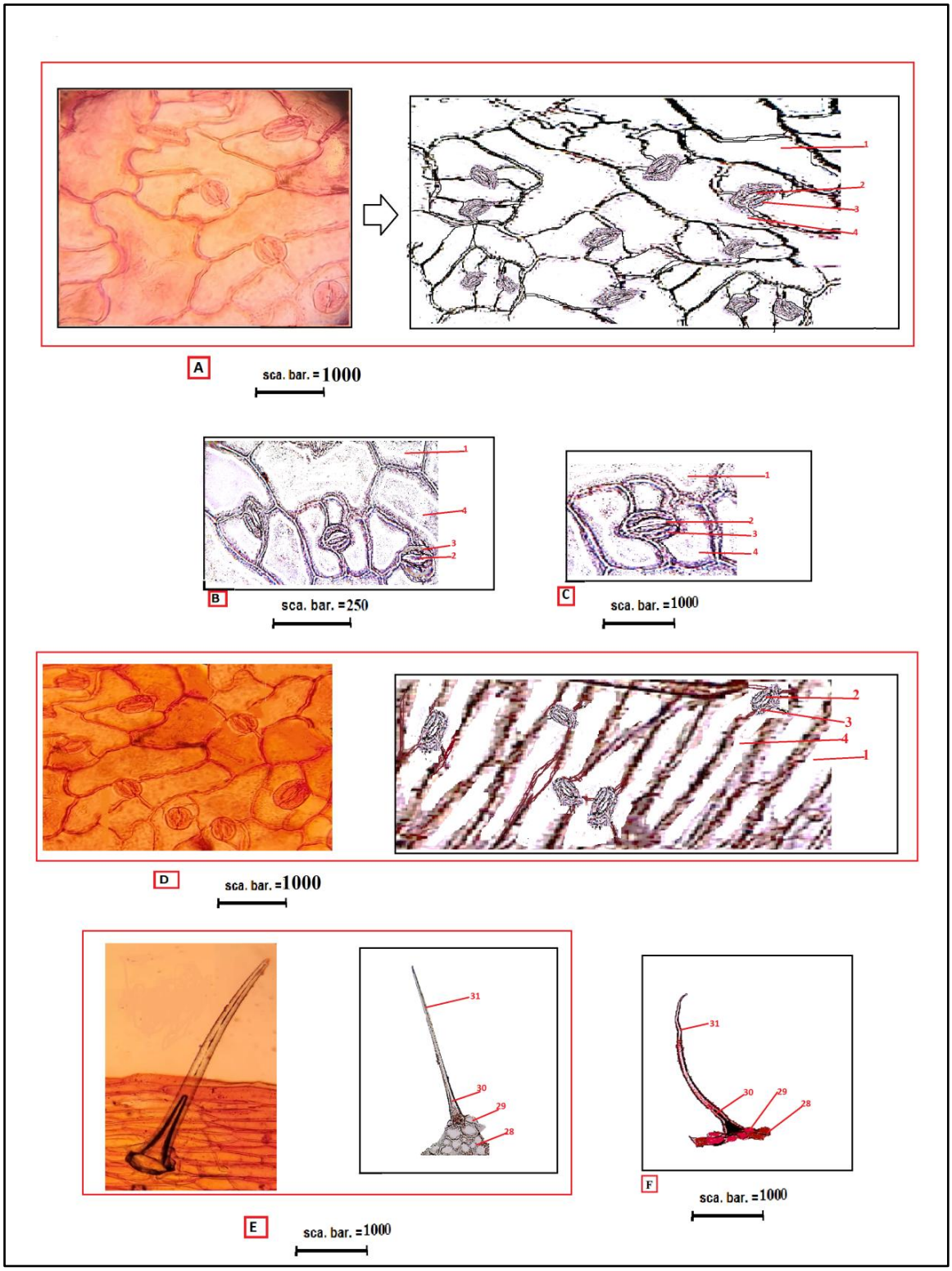

Plate 5: Epidermis of the *Diplotaxis harra* leaf.

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