



**Light and Scanning Electron Microscopy of Some Species of Genus *Solanum* (Solanaceae)
With Special Reference to the Importance of Trichomes**

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Abstract: The trichomes are taxonomically very important because of their use in plant classification with other morphological characters. This study provides information about trichomes of six species add name of species here of genus *Solanum*. This study will also helpful to produce more information to develop modern nomenclature for trichomes. The plant material was taken from Sindh University Herbarium as well as new plant substance was gathered from the field for the study. During the trichomal analysis the plant components were observed under stereo zoom microscope. Provisional and long-term slides were produced. For the scanning electron microscopic observation, the plant material was treated with ethanol alcohol for 20 minutes, ca 1mm² piece of specimens were fitted on the stubs made of metal with double-sided cellophane tape and also covered with C-30-50 nm gold by Jeol JFC- 1500 Ion sputter machine. After coating samples were observed as well as pictures were captured on different magnifications by enhancing voltage between 5-15 KV by Scanning Electron Microscope (SEM) Jeol JSM-T200 & Jeol JSM-T6380 at Biological Research Centre and Central Research Laboratory Karachi, University of Karachi.

1. INTRODUCTION

The Family *Solanaceae* consist on 84 genera including 3000 species. Vastly dispersed in warm as well as temperate parts of the globe (Nasir, 1985). Mostly Angiospermic plants have hairs on their parts like animals and humans. They are scientifically called trichomes (Peter & Shanower 1998). A series of anticlinal and periclinal division of epidermal cells to form trichomes they are may be glandular and non-glandular (Esau 1953; Johanson 1975; Fahn 1979; Wagner 1991; Werker 2000; Kolb and Muller 2004). Functionally they protect the flora from herbivores, sunlight and excess loss of water (Croteau 1977, Werker 1993; Duke 1994; Kolb & Muller 2004). The trichomes are taxonomically very important because of their use in plant classification with other morphological characters. The systematic value of trichomes in phylogenetic partnership is renowned in *Lamiaceae*, (Metcalf & Chalk 1995). These trichomes provide the large amount of differentiating morphological attributes in the genus *Solanum* a few trichomes getting analyzed for a species or segment, eg, *Solanum. umbellatum* Mill., *S. storkii* Morton & Standl., *S. malacothrix* Knapp, section *Lepidotum* (Dunal) Seithe. The importance of trichomes in *Solanum* was discussed by many taxonomists (Cannon, 1909, Metcalfe & Chalk 1950, Memon 2009). The taxonomic value of trichomes is decreased by the point that hardly any standardized technical terms are available to them due to the numerous phrases applied in the past and not one of the earlier classifications accommodates the complete

distinctiveness of the trichome assortment (Roe 1971, Webster *et al* 1996; Navarro & Oualidi 2000). The botanical reading materials reveals in excess of 300 varieties (uniseriate, capitate, sessile etc) to characterize their great variation (Wagner 1991; Kolb & Muller 2004). Many workers are engaged to develop terminology for the trichome description. In this regard Payne (1978) produced glossary of trichomes which is very helpful in the study of trichomes.

This study provides information trichomes of six species of genus *Solanum*. This study will also helpful to produce more information to develop modern nomenclature for trichomes.

2. MATERIALS AND METHODS

The plant material was taken from Sindh University Herbarium as well as new plant substance was gathered from the field for the study.

Light Microscopy (LM)

During the trichomal analysis, the plant substance was observed under stereozoom microscope. Provisional and long-term slides were produced, 0.5-1cm piece of plant material was placed in 5 ml lactic acid for 20 minutes, trichomes were split up from their attachments (Ayyasamy & Baskaran, 2005; Parveen, 2006), then the trichomes were shifted on slide and explored using the light microscope. Long-lasting slides were also prepared by applying the Khasim (2002) techniques.

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Scanning Electron Microscopy.

For the scanning electron microscopic observation, the plant material was treated with ethanol alcohol for 20 minutes, ca 1mm² piece of specimens were fitted on the stubs made of metal with double-sided cellophane tape and also covered with C-30-50 nm gold by Jeol JFC- 1500 Ion sputter apparatus. After coating samples were observed as well as pictures were captured on different magnifications by enhancing voltage between 5-15 KV by Scanning Electron Microscope (SEM) Jeol JSM-T200 & Jeol JSM-T6380 at Biological Research Centre and Central Research Laboratory Karachi, University of Karachi (Ascensao *et al*, 1995; corsi & Botega, 1999; Navarro & Oualidi, 2000).

Measurement of the trichomes

For every type of trichome the proportions (at broadest position) were calculated as well as the quantity of cellular material per trichome was measured on SEM and LM micrographs (Ascensao *et al*, 1995). Around 3-5 calculations were obtained with ocular micrometre from every section of the plant.

$$\text{Caliberati on Constant (c)} = \frac{\text{No.of Divisions on stage } \mu\text{m (x)} \times .01 \times 1000}{\text{No.of divisions on ocular } \mu\text{m (y)}}$$

3. RESULTS AND DISCUSSION

Scanning electron micrograph image for distribution and type of trichome of *Solanum cordatum* Forsk. is described in (Fig. 1).

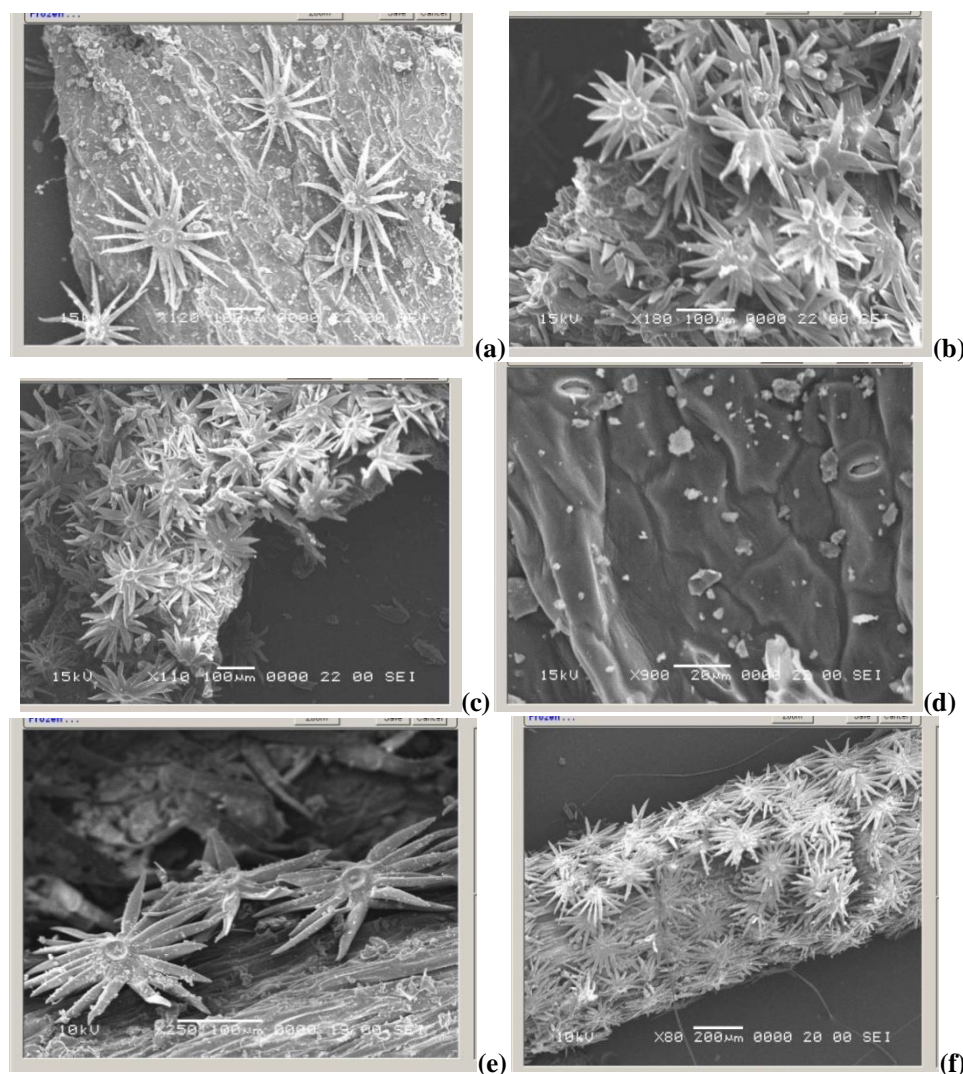


Fig. 1 Scanning Electron Micrograph of *Solanum cordatum* Forsk. Showing the distribution and kinds of trichomes,

a→ Stellate trichomes scattered in moderation on top part of the surface of the leaf.

b→ Stellate trichomes thickly dispersed on the bottom part of surface of the leaf.

c→ Stellate trichomes tightly scattered on sepal.

d→ Bottom surface of the leaf displaying stomata.

e & f→ Stellate trichomes densely distributed on stem.

Scanning electron micrograph image for distribution and type of trichome of *Solanum incanum* L. is described in detail in (Fig.2).

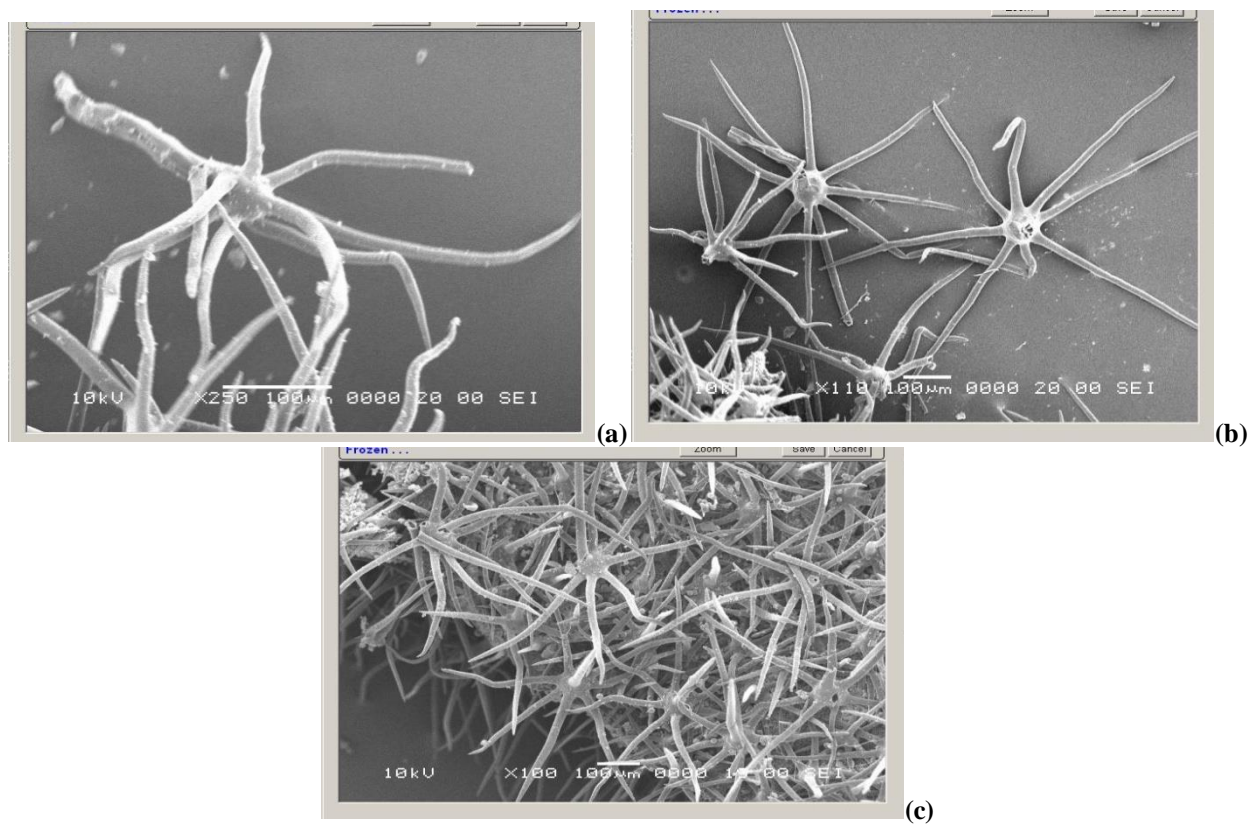
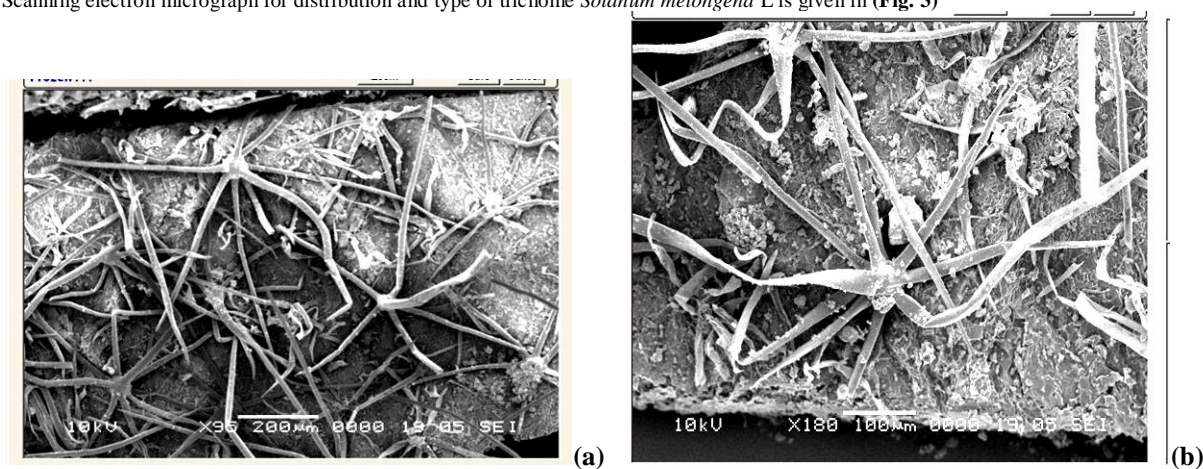


Fig. 2 4 Scanning Electron Micrograph of *Solanum incanum* L. Showing the distribution and kinds of trichomes,
a & b→ Stellate individual trichome.
c→ Stellate trichomes densely distributed on leaf.
Scanning electron micrograph for distribution and type of trichome *Solanum melongena* L is given in (Fig. 3)



Scanning electron micrograph for distribution and type of trichome *Solanum nigrum* L is given in (Fig. 4)
Fig.: 3 4 Scanning Electron Micrograph of *Solanum melongena* L. Showing the distribution and kinds of trichomes,
a & b→ Stellate trichomes moderately distributed on leaf.

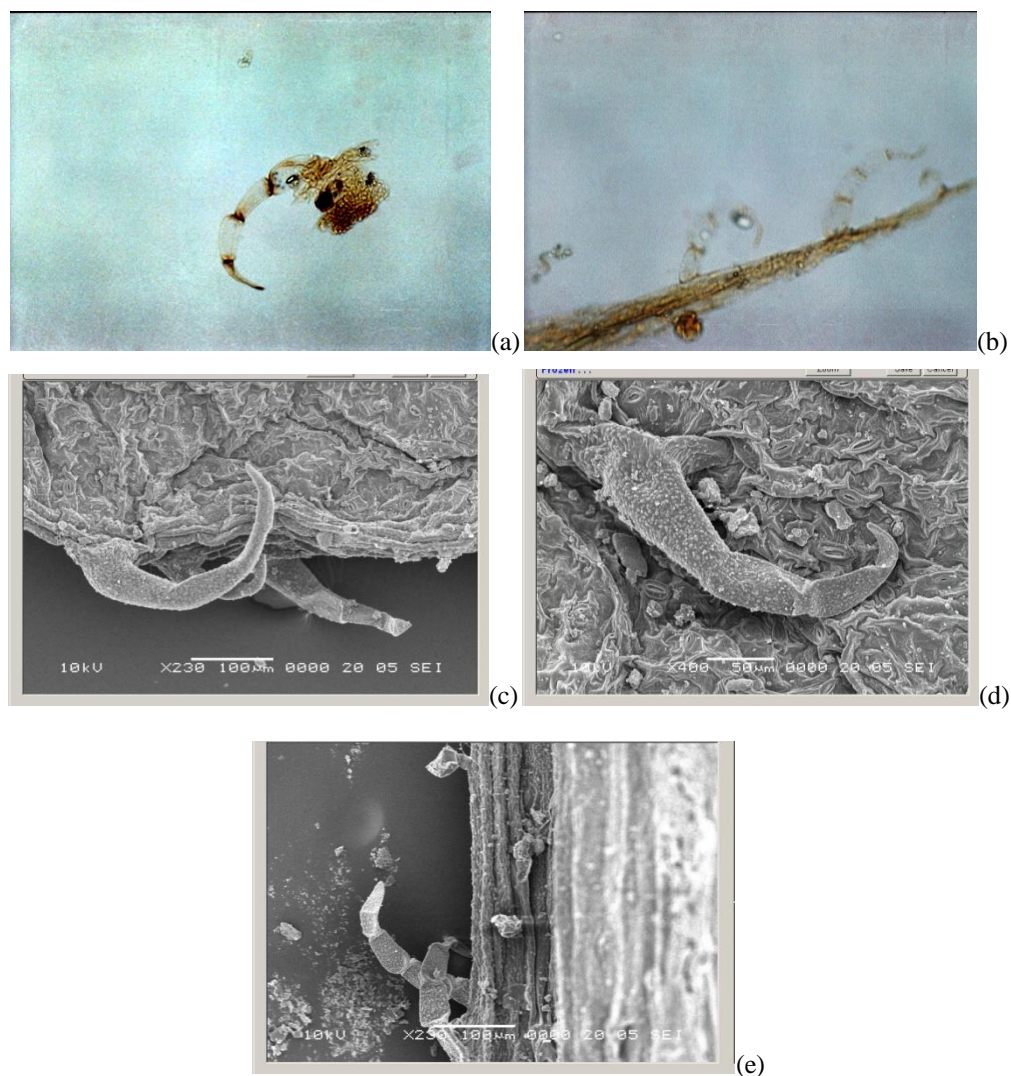


Fig.: 4 *Solanum nigrum* L. Showing the distribution and kinds of trichomes,

a & b → Light Microscopic Photographs showing the simple uniseriate multicellular non-glandular trichomes on petiole.

Scanning Electron Micrographs showing,

c & d → Simple uniseriate multicellular non-glandular trichomes sparsely distributed on leaf.

e → Simple uniseriate multicellular glandular and non-glandular trichomes sparsely distributed on stem.

Scanning electron micrograph image for distribution and type of trichome of *Solanum surattense* Burm is described in (Fig 5).

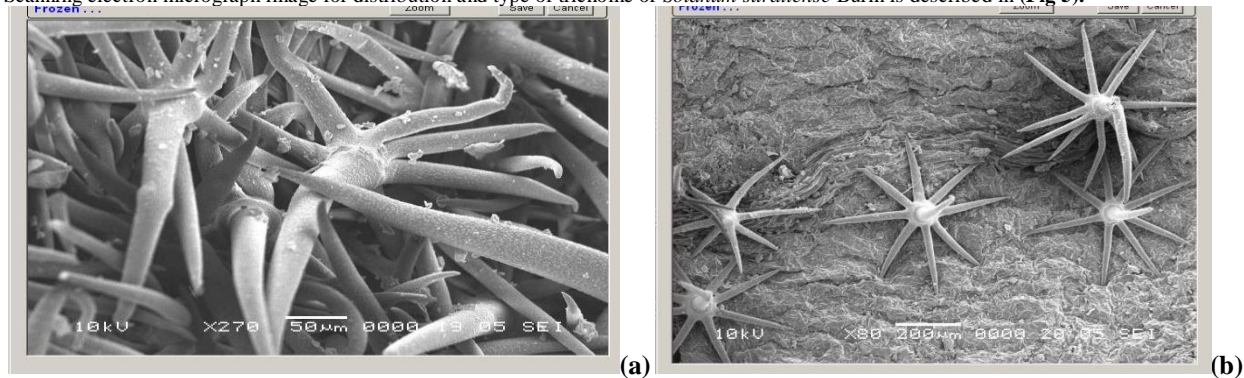


Fig. 5. 4 Scanning Electron Micrographs of *Solanum surattense* Burm. Showing the distribution and kinds of trichomes,

a → Stellate trichomes densely distributed on sepal.

b → Stellate trichomes moderately distributed on leaf.

Scanning electron micrograph for distribution and type of trichome *Solanum melongena* L is given in (Fig. 6)

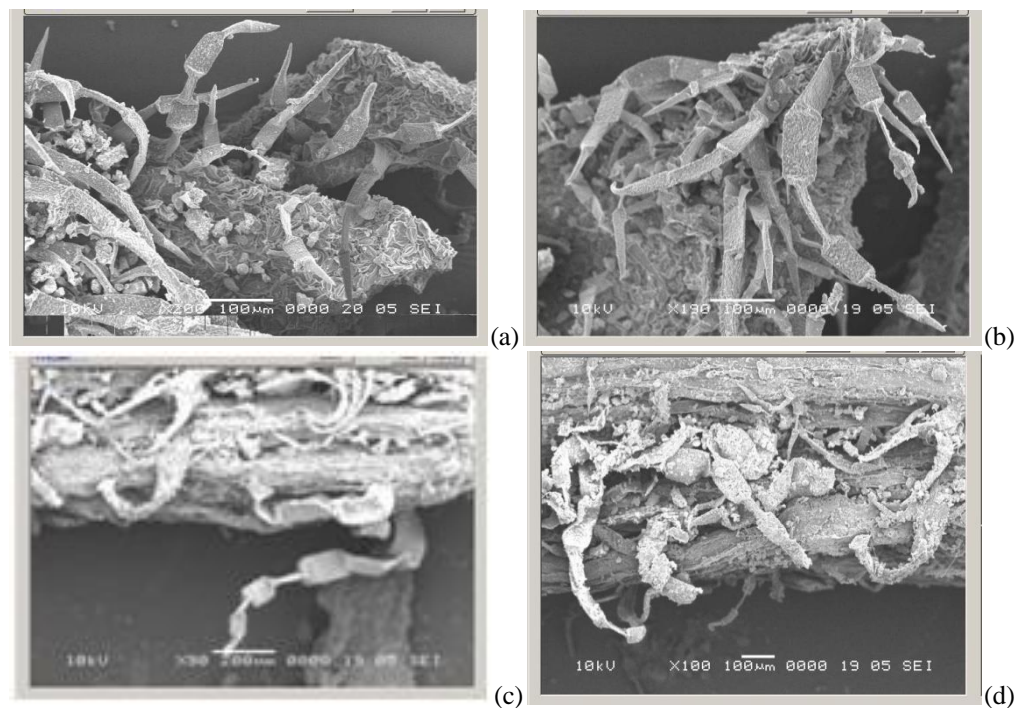


Fig.: 6.4 Scanning Electron Micrographs of *Solanum tuberosum* L. Showing the distribution and kinds of trichomes,
a → Simple uniseriate multicellular glandular and non-glandular trichomes moderately distributed on upper leaf surface.
b → Simple uniseriate multicellular glandular and non-glandular trichomes densely distributed on lower leaf surface.
c & d → Simple uniseriate multicellular glandular and non-glandular trichomes densely distributed stem

Table 1 Detail of trichomes in the species of Solanaceae.

Name of species	Size of trichome in μm				Size of Basal cell in μm				Width of Basal cell in μm			
	L	H	Av	St. Dev.	L	H	Av	St. Dev.	L	H	Av	St. Dev.
<i>Solanum nigrum</i> L.	55	300	214	± 97.52	90	150	114.8	± 16.53	45	70	55.7	± 1.08
<i>S. tuberosum</i> L.	112	620	307	± 168.38	40	90	64	± 15.69	22	40	31	± 5.44

L=Minimum value; H=Maximum value; Av=Average; St. Dev= Standard Deviation.

Table 2 Detail of trichomes in the species of Solanaceae

Name of species	Size of trichome in μm				Size of arm in μm				Width of arm in μm			
	L	H	Av	St. Dev.	L	H	Av	St. Dev.	L	H	Av	St. Dev.
<i>Solanum cordatum</i> Forssk.	180	430	317	± 86.10	60	200	131	± 47.31	18	32	23.2	± 5.92
<i>S. incanum</i> L.	650	900	788	± 85.32	390	475	422.5	± 33.35	18	32	24.8	± 4.32
<i>S. melongena</i> L.	750	850	814.5	± 35.31	270	400	333.5	± 56.28	18	30	23.4	± 3.75
<i>S. surrattense</i> Burm.	480	550	514	± 22.21	140	250	202	± 42.11	25	60	44	± 12.94

L=Minimum value; H=Maximum value; Av=Average; St. Dev= Standard Deviation.

Taxonomic key to the species based on the trichome characters Genus: *Solanum* L.

1. Glandular trichomes are smaller than non-glandular 55-300 μm long....., *S. nigrum* L.
- *1. Not like above (2)
2. Basal cell is 40-90 μm long and 22-40 μm wide..... *S. tuberosum* L.
- *2. Basal cell is 90-150 μm long and 45-70 μm wide..... (3)
3. Stellate trichomes with 12-17 arms *S. cordatum* L.
- *3. Stellate trichomes with 7-9 arms (4)
4. Trichomes densely present..... *S. incanum* L.
- *4. Trichomes sparsely present..... (5)
5. Trichome 480-550 μm long, the arm 140-250 μm long.... *S. surrattense* Burm.
- *5. Trichome 750-850 μm long, the arm 270-400 μm long.... *S. melongena* L.

4. CONCLUSION

Three types of trichomes, plain uniseriate multicellular non-glandular, plain uniseriate multicellular glandular and stellate trichomes observed in 6 species of genus *Solanum*. The four species of genus, *S. cordatum* Forssk, *S. incanum* L. *S. melongena* L. and *S. surratense* Burm. possess stellate trichomes. In *S. cordatum* Forssk, stellate trichomes were observed with 9-17 arms scattered in moderation on both leaf surfaces (Fig.) and thickly dispersed on stem, petiole and pedicel (Fig.). their average length was $317 \pm 86.1 \mu\text{m}$ the length of arm was $131 \pm 47.31 \mu\text{m}$ and width of arm was $23.2 \pm 5.92 \mu\text{m}$. In *S. incanum* L. *S. melongena* L. and *S. surratense* Burm. stellate trichomes were observed with 7-9 arms. The trichomes were normally scattered on either top as well as lower surfaces (Fig.) but densely distributed on sepal (Fig.) the average length of trichome was $514 \pm 22.2 \mu\text{m}$, the length of arm was $202 \pm 42.11 \mu\text{m}$ and width of arm was $44 \pm 12.94 \mu\text{m}$. In *S. incanum* L. and *S. melongena* L. trichomes were more or less similar in size but differ in distribution, normally distributed in *S. melongena* L. (Fig.) and densely distributed in *S. incanum* L. (Fig.). Plain uniseriate multicellular glandular and non-glandular trichomes were observed in *S. nigrum* L. and *S. tuberosum* L. In *S. nigrum* L. 2-4 celled trichomes thinly distributed on the plant body (Fig.). the glandular trichomes were very much smaller in size than non-glandular trichomes (Fig.). the average length of trichome $214 \pm 97.5 \mu\text{m}$, the length of basal cell was $114.8 \pm 16.5 \mu\text{m}$ and width of basal cell was $55.7 \pm 1.08 \mu\text{m}$. while in *S. tuberosum* L. 4-9 celled trichomes were observed normally distributed on stem (Fig.) and densely distributed on both leaf surfaces especially on the venation. The glandular and non-glandular trichomes were more or less same in size not variable as in *S. nigrum* L. the average length of trichome was $307 \pm 168.38 \mu\text{m}$, the size of basal cell was $64 \pm 15.7 \mu\text{m}$ and width of basal cell was $31 \pm 5.4 \mu\text{m}$.

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