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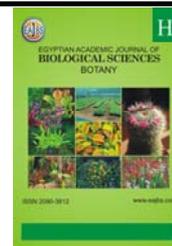
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**A Series of Taxonomic Studies of Wild Plants in Saudi Arabia**  
**3 – B- The Structure of the Surface of the Style for Certain Types of the Genus**  
**Solanum Developing in Saudi Arabia**

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**ABSTRACT**

The results of a study determining the exact composition of the surfaces of the style and trichomes by scanning electron microscopy of 12 samples of plants of the genus *Solanum* are: *Solanum macrocantham* ssp.1, *Solanum macrocantham* ssp. 2, *Solanum nigrum* ssp.1, *Solanum nigrum* ssp. 2, *Solanum nigrum* ssp. 3, *Solanum nigrum* ssp. 4, *Solanum nigrum* ssp. 5, *Solanum schimperianum*, *Solanum sarratense*, *Solanum incanum*, *Solanum villosum* and *Solanum coagulans*.

Differences in the composition of the surfaces of the style and the trichomes of the samples under study could be classified into three types of style and seven types of trichomes, which can be reliably used in the classification of genus, and these differences have been made into a key to classification based on the results obtained.

**INTRODUCTION**

This second study covers several types of the genus *Solanum* growing in Saudi Arabia in a series of within-taxonomic studies on plants in Saudi Arabia. The genus *Solanum* L. belongs to the family Solanaceae in the order Solanales, and it is a plant genus of great importance for food security in most countries of the developing world. The family Solanaceae represent one of the most economically and medicinally important families of angiosperms. The genus *Solanum* is a hyper-diverse taxon of this family. The species of *Solanum* in the world that are mainly distributed in the tropical and sub-tropical areas, with a small number in the temperate areas (Jennifer *et al.*, 1997). About 21 species and one variety in this genus are used as herbal medicines (Hu *et al.*, 1999). *Solanum torvum* L. is a small solanaceous shrub, distributed widely in Pakistan, India, Malaya, China, Philippines, and tropical America (Nasir, 1985). For many decades, different ethnic groups have used the dried stem and root of this plant for treatment of various ailments.

Its Chinese medicinal name is Jinniukou (Anonymous, 2000), while the active components such as solinidine and other steroids active extracted from the roots and leaves of some species are useful as pharmaceuticals (Obute, Ndukwu and Okoli, 2006). The works of Seithe (1962), Danert (1970), and Gili (1970) provided elements for D'Arcy's (1972, 1991) scheme, which is widely used today. According to D'Arcy(1972, 1991), Solanum is divided into seven subgenera [Archaeosolanum Marzell, Bassovia (Aubl.) Bitter, Leptostemonum (Dunal) Bitter, Lyciosolanum Bitter, Minon Raf. (Brevantherum (Seithe) D'Arcey), Potato (G. Don) D'Arcy, and Solanum Seithe] and 60 to 70 sections. Well-defined and most likely monophyletic subgenera and sections exist along with a plethora of poorly described groups, and a significant number of Solanum species have no conclusive subgeneric or sectional affiliation. Even for well-characterized infrageneric groups, phylogenetic relationships with other groups are unknown (Bohs and Olmstead, 1997).

The family Solanaceae, which is a type of plant covered with large seeds, includes approximately 98 genera and approximately 2,300 species grouped into 3 subfamilies (Al- wadi and Lashin, 2007). In Saudi Arabia, there are 7 genera and approximately 32 species (Collenette, 1999).

## MATERIALS AND METHODS

Fresh specimens from 12 Solanum species were collected from the following locations: Makkah, Bisha, An Nimas, Tanumah, and Jabal Sawdah in Saudi Arabia. See Table (1) and Figs. (1 and 2).

Table 1: The names and locations of samples collected.

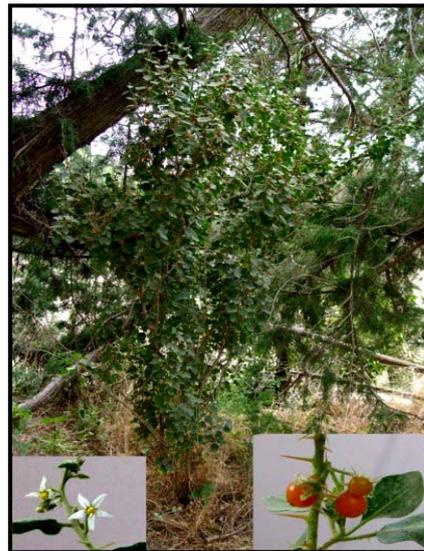
No.	Sample name	Collection site	Sample coordinates
1	<i>Solanum macrocantham</i> ssp.1	Tanumah -Alehifah	18°53'13.29"N 42°10'4.41"E
2	<i>Solanum macrocantham</i> ssp.2	Tanumah - AqbaAlarbuah	18°55'56.99"N 42° 9'9.78"E
3	<i>Solanum nigrum</i> ssp.1	Tanumah - AqbaAlarbuah	18°55'58.93"N 42° 9'9.51"E
4	<i>Solanum nigrum</i> ssp.2	Tanumah - Alehifah	18°53'12.70"N 42°10'4.73"E
5	<i>Solanum nigrum</i> ssp.3	An Nimas - Atma Dam	19° 5'43.33"N 42° 8'8.38"E
6	<i>Solanum nigrum</i> ssp.4	An Nimas - Bani Mashhour	19° 7'32.84"N 42° 9'7.25"E
7	<i>Solanum nigrum</i> ssp.5	Bisha	20° 1'31.75"N 42°36'52.29"E
8	<i>Solanum schimperianum</i>	Tanumah - Alehifah	18°53'13.45"N 42° 9'48.73"E
9	<i>Solanum sarratense</i>	An Nimas - Atma Dam	19° 5'56.01"N 42° 8'13.64"E
10	<i>Solanum incanum</i>	An Nimas - Bani Mashhour	19° 5'42.46"N 42° 8'4.95"E
11	<i>Solanum villosum</i>	Jabal Sawdah	18°17'32.87"N 42°22'8.73"E
12	<i>Solanum coagulans</i>	Makkah	21°24'21.38"N 39°51'55.30"E



Fig. 1: Map of Saudi Arabia, showing samples collected.



*Solanum macrocantham* ssp.1



*Solanum macrocantham* ssp.2



*Solanum nigrum* ssp.1



*Solanum nigrum* ssp.2



*Solanum nigrum* ssp. 3



*Solanum nigrum* ssp. 4

Fig. 2: Plants in their natural habitats.



*Solanum nigrum* ssp. 5



*Solanum schimperianu*



*Solanum sarratense*



*Solanum incanum*



*Solanum villosum*



*Solanum coagulans*

Fig. 2: continued: Plants in their natural habitats.

Healthy specimens of flowers were collected and fixed in F.A.A. (1:1:18) glacial acetic acid : 40% formaldehyde : 70% ethanol (v/v). Specimens were dried, pressed after identification, and kept by the researcher. The isolated pistils of the specimens were kept in 70% ethanol and washed several times in double-distilled water. Then, they were dehydrated in a graded series of ethanol (30%, 50%, 60%, 70%, 80%, 90%, 100%, and 100%) and dried in vacuum apparatus, put on stubs and covered with carbon and then gold before being observed on a Jeol/JSM 5300 microscope at King Abdulaziz University, Saudi Arabia.

## RESULTS AND DISCUSSION

According to (Javadi 2014) studied glandular and non-glandular trichomes potentially related to tomato resistance of nine tomato genotypes (*Lycopersicon hirsutum* Humb & Bonpl), extensively cultivated in western Iran.

According to Eric T. McDowell and others (2011) Glandular trichomes play important roles in protecting plants from biotic attack by producing defensive compounds. Has been investigated the metabolic profiles and transcriptomes to characterize the differences between different glandular trichome types in several domesticated and wild *Solanum* species: *Solanum lycopersicum* (glandular trichome types 1, 6, and 7), *Solanum habrochaites* (types 1, 4, and 6), *Solanum pennellii* (types 4 and 6), *Solanum arcanum* (type 6), and *Solanum pimpinellifolium* (type 6). In this study determining the exact composition of the surfaces of the style and trichomes, by scanning electron microscopy of 12 samples of plants of the genus *Solanum* could be classified into three types of style and seven types of trichomes:

First: the surface of the style is only with plicata:

- 1- The style surface is with plicata and is glabrate, and the trichome is stellate granular. This is found in *Solanum nigrum* ssp.4.
- 2- The style surface is with plicata, with longitudinal above lineate. Two types of trichomes can be found along with this characteristic:
  - A- Stellate glabrate, which occurs in *Solanum macrocantham* ssp.1, or
  - B- Lanceolate granular, which occurs in *Solanum sarratense*.
- 3- The style surface has serial plicata above lineate, which co-occurs with three types of trichomes:
  - A- Stellate granular, found in *Solanum nigrum* ssp.1,
  - B- Spherical and stellate glabrate, found in *Solanum incanum*, or
  - C- Lanceolate granular, found in *Solanum coagulans*.
- 4- The style surface has serial plicata, and the trichome is clavate, as in *Solanum nigrum* ssp.3.

Second: The style surface is grooved:

- 1- Longitudinal glabrate grooves and a lanceolate granular trichome are found in *Solanum nigrum* ssp.5.
- 2- Lineate grooves and a lanceolate granular trichome are found in *Solanum macrocantham* ssp.2.
- 3- Longitudinal above lineate grooves and a lanceolate granular trichome are found in *Solanum nigrum* ssp.2.

Third: The surface of the style has crisped:

- 1- The surface of the style is crisped, and the trichome is stellate lineate, which occurs in *Solanum schimperianum*.
- 2- The surface of style is crisped in some cases, above lanceolate glabrate morphology, and the trichome is lanceolate granular, which occurs in *Solanum villosum*.

This study has produced a key based on the characteristics obtained from the study samples. Table (2) presents a summary of the characteristics of the style and trichome from the samples studied by scanning electron microscopy (Figs. 3 and 4).

Table 2: Summary of the characteristics of styles and trichomes of the study samples, by scanning electron microscopy.

No	Component Sample	Style surface	Trichome
1	<i>S. macrocantham</i> ssp. 1	With plicata a longitudinal above lineate	Stellate glabrate
2	<i>S. macrocantham</i> ssp. 2	With grooves lineate	Lanceolate granular
3	<i>S. nigrum</i> ssp.1	With plicata serial above lineate	Stellate granular
4	<i>S. nigrum</i> ssp.2	With grooves a longitudinal above lineate	Lanceolate granular
5	<i>S. nigrum</i> ssp.3	With plicata serial	Clavate
6	<i>S. nigrum</i> ssp.4	With plicata glabrate	Stellate granular
7	<i>S. nigrum</i> ssp.5	With grooves a longitudinal glabrate	Lanceolate granular
8	<i>S. schimperianum</i>	Crisped	Stellate lineate
9	<i>S. sarratense</i>	With plicata a longitudinal above lineate	Lanceolate granular
10	<i>S. incanum</i>	With plicata serial above lineate	Spherical and stellate glabrate
11	<i>S. villosum</i>	Crisped on some above lanceolate glabrate	Lanceolate granular
12	<i>S.coagulans</i>	With plicata serial above lineate	Lanceolate granular

### Key to the characteristics of the style surface and trichomes among the study samples:

#### A - The surface of the style with plicata

- 1 - Glabrate and with stellate granular trichomes *Solanumnigrum* ssp. 4  
 2 - Longitudinal above lineate +  
 +Stellate glabrate *Solanum macrocantham* ssp.1  
 ++Lanceolate granular *Solanum sarratense*  
 3 - the surface of style is with plicata serial @  
 @ The trichomes are stellate granular *Solanumnigrum* ssp. 1  
 @@ The trichomes are spherical and stellate glabrate *Solanum incanum*  
 @@@ The trichomes are lanceolate granular *Solanum coagulans*  
 4 - Serial with clavate trichomes *Solanumnigrum* ssp. 3

#### B - Style with grooved surface

- 1 - Longitudinal glabrate style with lanceolate granular trichome *Solanumnigrum* ssp. 5  
 2 - Lineate style and lanceolate granular trichome *Solanum macrocantham* ssp. 2  
 3 - A longitudinal above lineate style and lanceolate granular trichome *Solanumnigrum* ssp. 2

#### C - The surface of the style has crisped

- 1 - Crisped style and stellate lineate trichome *Solanum Schimperianum*  
 2 - Crisped style on some specimens above lanceolate glabrate and lanceolate granular trichomes *Solanum villosum*.

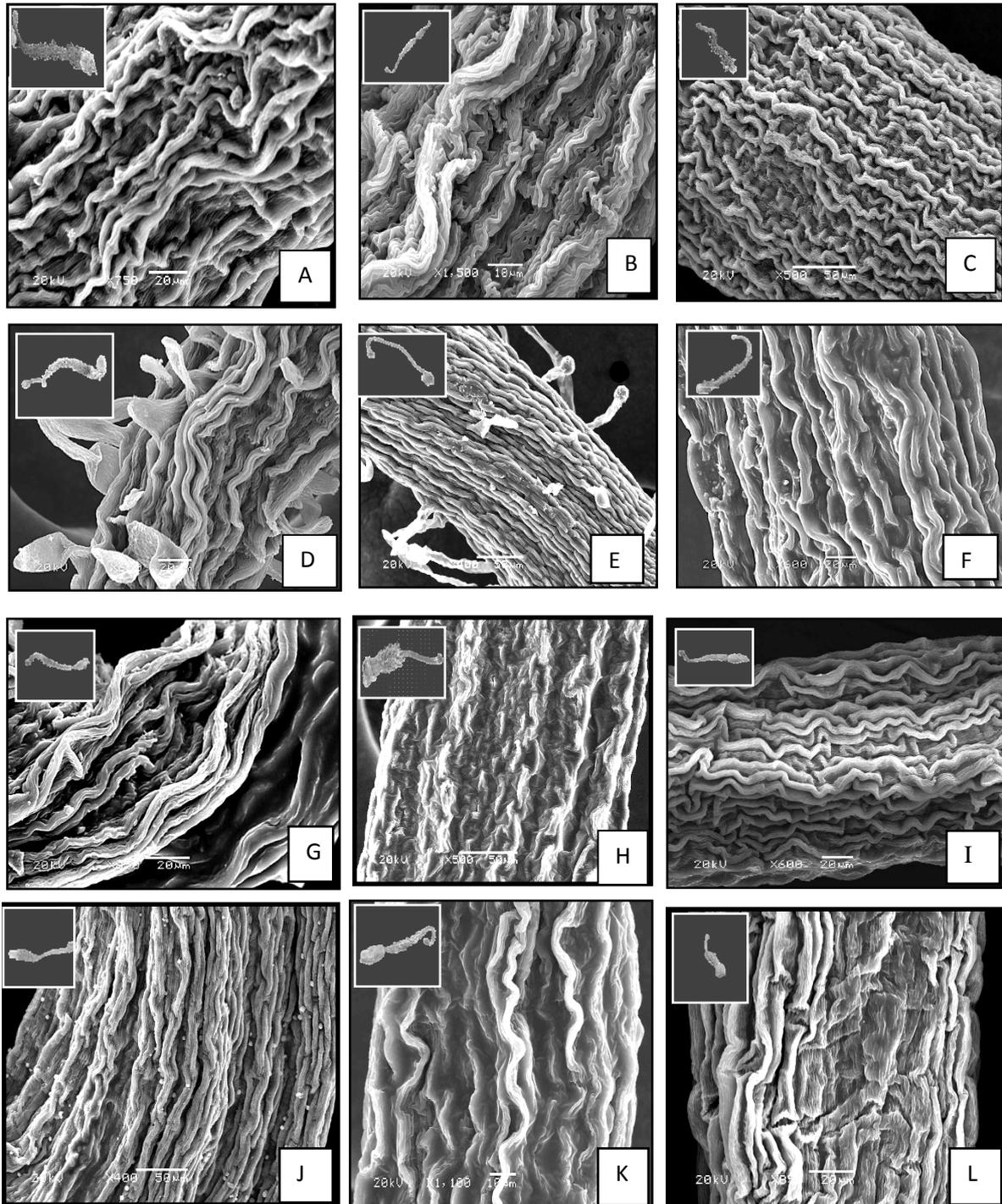


Fig. 3: Ultrastructure (scanning electron microscopy) of the style surface types: (A) *S. macrocantham* ssp.1, 750X. (B) *S. macrocantham* ssp. 2, 1500X. (C) *S. nigrum* ssp.1, 500X.(D) *S. nigrum* ssp. 2, 650X. (E) *S. nigrum* ssp. 3, 400X. (F) *S. nigrum* ssp.4, 600X. (G) *S. nigrum* ssp. 5, 850X. (H) *S. schimperianum*, 500X. (I) *S. sarratense*, 600X. (J) *S. incanum*, 400X. (K) *S. villosum*, 1100X. (L) *S. coagulans*, 850X.

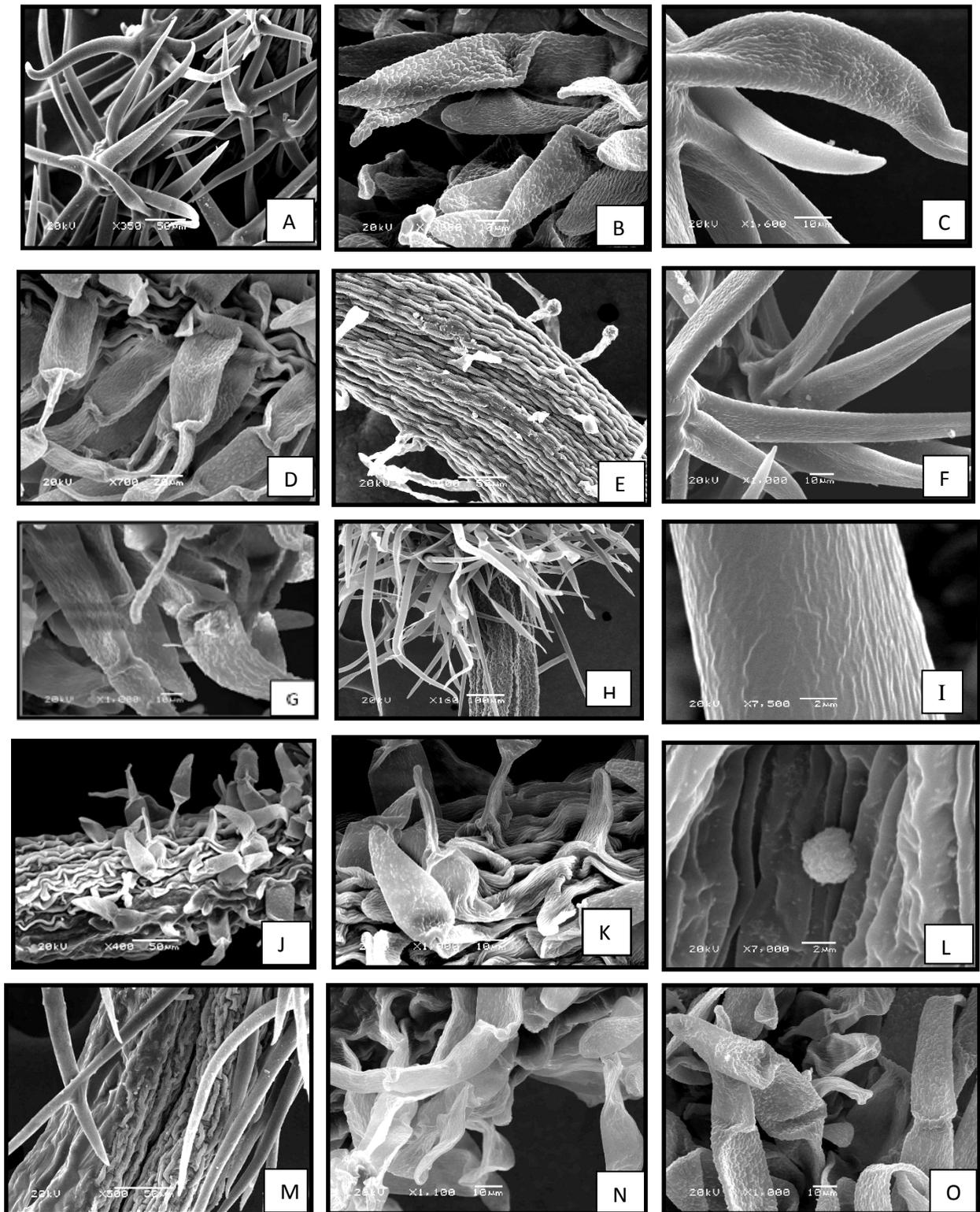


Fig. (4): The trichomes on the surface of the stylus (scanning electron microscopy): (A) *S. macrocantham* ssp. 1, 350X. (B) *S. macrocantham* ssp. 2, 1300X. (C) *S. nigrum* ssp. 1, 1600X. (D) *S. nigrum* ssp. 2, 700X. (E) *S. nigrum* ssp.3, 400X. (F) *S. nigrum* ssp.4, 1000X. (G) *S. nigrum* ssp.5, 1000X. (H-I) *S. schimperianum*.(H) 160X, (I) 7500X.(J-K) *S. sarratense*, (J) 400X, (K) 1000X. (L-M) *S.incanum*, (L) 7000X, (M)500X. (N) *S. villosum*, 1100X. (O) *S. coagulans*, 1000X.

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