

## Cyto-Morphology of Three *Solanum* species in Aseer Region, South-West Saudi Arabia

Hussein M. Al Wadi  
Department of Biological Sciences, Faculty of Science,  
King Khalid University, Abha, Saudi Arabia

**Abstract:** Morphological and cytological characters of three species of spiny *Solanum* from Aseer region, southwest Saudi Arabia were investigated, namely, *Solanum forsskalii* Kotschy ex Dunal and *Solanum glabratum* Dunal var *sepicula* (Dunal) J.R.I. Wood. This work aims to explore cytological and morphological relationship between the taxa under consideration. *Solanum macracanthum* A. Rich, is characterized by different morphological features, especially its reproductive organs, which indicated low productivity of this taxon and pointed out to its hybrid situation. Cytological investigation of the three species proved that *S. forsskalii* Kotschy ex Dunal and *S. glabratum* Dunal var *sepicula* (Dunal) J.R. I Wood are stable cytologically while *S. macracanthum* A. Rich shows irregular meiosis. This conclusion supported the morphological study and both indicated the hybrid situation of *S. macracanthum*. Statistical treatment of the available morphological data suggests that *S. forsskalii* Kotschy ex Dunal is a probable parent of *S. macracanthum* A. Rich.

**Key words:** Morphology, cytology, *Solanum*, Aseer Region, Saudi Arabia

### Introduction

The genus *Solanum* belongs to family *Solanaceae*, one of the largest genera distributed all over the world (Gbile, 1979). The major center of development is Central and South America (Beg and Khan, 1988).

Many species of this genus were subjected to cytological and morphological studies in the world (Anis *et al.*, 1994; Moscone, 1992; Watanabe and Orrilo, 1993; Haroun and Al Wadi, 1999), however, other species were still in need for such investigation especially in South-West Saudi Arabia.

Haroun and Al Wadi (1999) have studied meiotic division and breeding of three wild species of *Solanum* in Saudi Arabia, namely, *Solanum incanum* L., *S. grossedentatum* A. Rich and *S. villosum* (L.) Mill.

The present study investigates macro- and micro- morphological characters as well as cytology of three spiny species of *Solanum* widely distributed in south western parts of Saudi Arabia (Fig. 1), namely: *Solanum forsskalii* Kotschy ex Dunal, *S. macracanthum* A. Rich and *S. glabratum* Dunal var *sepicula* (Dunal) J. R. I. Wood. This work aims to explore the cytological and morphological relationship between the taxa under consideration. It is the first phase in an integrated research programme to study phylogeny of the genus *Solanum* in Saudi Arabia.

### Materials and Methods

Specimens and seeds of the studied taxa were collected from the wild. Plants were dried, pressed after identification and kept as herbarium specimens at the Department of Biological Sciences, Faculty of Science, King Khalid University, Abha, Saudi Arabia. Identification of the species was according to Collenete (1985). Nomenclature has been checked in Collenete (1998).

Morphological characters were described and measured in five plants for each taxon from different site. Micro-characters were also studied under dissecting microscope (Wild M1B) and photographed using photomicroscope (Olympus CH 30).

Cytological investigations have been undertaken on pre-anthesis flower buds in the early morning. They were fixed in 1/3 v/v acetic alcohol for 24 hrs. Macerated young anthers were treated in drop of aceto-carmin to study meiotic parameters. Seeds were sown and planted in greenhouse to confirm morphological characters and use of the flowers for further cytological studies, if necessary. Statistical manipulations for the morphological data were done to achieve the taxonomic relationships between *Solanum* species in question. Matrix correlation coefficient was used to construct the

dendrogram. This statistical evaluation was carried out using SPSS statistical program version 7.5.

### Results

#### Morphology

***Solanum forsskalii* Kotschy ex Dunal:** Spiny shrubs, branches slender. Leaves alternate, petiolate, ovate, up to 3.00 x 2.50 cm<sup>2</sup> spineless. Flowers large 1.20 cm wide, bright violet. Fruits orange in colour and up to 0.5 – 0.8 cm in diameter. Shape and dimensions of other characters are mentioned in Fig. 2 a and Table 1. Trichomes were found on upper surface of the leaves. They are sessile, star shape, branched into arms. All arms are parallel to surface (Fig. 2 b). Height and leave measurements have been found different from place to another for the same species. This is mostly due to climate and ecological differences (i.e., ecotypes).

***Solanum macracanthum* A. Rich:** Erect branched shrub, branches slender, leaves alternate, petiolate, about 3.00 x 1.30 cm<sup>2</sup>, spiny on the mid-rib. Flowers arranged in extra – axillary cymes. Calyx spiny, corolla 1cm in diameter. Fruits orange in colour. Measurements and characters, description are listed in Table 1 and seen in Fig. 3 a. Trichomes of this species are found densely on the upper leaves. They are sessile, star shape, branched (Fig. 3 b).

***Solanum glabratum* Dunal var *sepicula* (Dunal) J.R.I. Wood:** Thorny shrublet, branches slender, leaves alternate, sub-sessile, mid-rib with hooked spines on the lower surface, narrow lanceolate, up to 6.00 x 3.00 cm<sup>2</sup>. Flowers 1.50 cm wide, purple in color arranged in extra-axillary cymes. Fruit berry, red, about 1 cm in diameter (Fig. 4a). Trichomes stalked, star shape. Other characters described and measured are mentioned in Table 1 and Fig. 4 b.

**Cytology:** Study of the meiotic chromosomes of the taxa under investigation recorded 24 as diploid number ( $x = 12$ ). This number is common for most *Solanum* species in the area (Haroun and Alwadi, 1999). Behavior of chromosomes during meiosis is normal at diakinesis and metaphase 1 stages.

Few univalents and multivalents were observed for *S. forsskalii* and *S. glabratum* Dunal var *sepicula* (Dunal) J. R. I. Wood, with high ratio of bivalents (Fig. 5a) and few abnormal cells as laggards (Fig. 5b). Observation of normal chromosome behavior for these species could interpret their high pollen fertility, recording 80 and 90% respectively (Table 2). This reflects diploid

Fig. 1: Geographic location of the sites at Aseer area , where the specimens have been collected for examination

Table 1: Morphological description and dimensions of morphological chracters of three *Solanum* species

Characters	Species		
	<i>S. forsskalii</i>	<i>S. macracanthum</i>	<i>S. glabratum</i> var <i>sepicula</i>
Habit	Thorny bushy shrublet	Spiny shrub	Very thorny shrublet
Hight	1m	1.5m	25-60cm <sup>2</sup>
Leaf	0.9-3x0.8-2.5cm without spine	1.5-3 x 0.8-1.3 with spine on mid-rib	1.9-6 x 0.3-3 with spine on the mid-rib
Petiol. L.	0.7	0.5	0.7
Corolla L.	8-12 x3.6 mm <sup>2</sup>	6-16 x 3.1 mm <sup>2</sup>	0.8-14 x 3.4
Anther. L.	1.3	0.4	0.7
Flowers	1.2 cm wide	1cm wide 1.5 cm wide	
Fruit colour	Orange	Orange	Red
Seed / fruit	30.1	5.4	33.4
Diameter of fruit (mm)	6.5	4.6	7.1

Table 2: Meiotic chromosome number, association, chiasma frequency, pollen fertility and diameter for three species of *solanum*

Species	Chr.No.	Chr. Assoc.				Chias. Freq.	Pollen diameter (μ)	%Pollen fertility
		I	II	III	IV			
<i>Solanum forsskalii</i>	24	1.4	10.1	-	0.6	1.78	18-21	80
<i>Solanum macracanthum</i>	24	3.1	5.1	1.2	1.3	1.37	11-20	35
<i>Solanum glabratum</i>	24	1.2	11.2	-	0.1	1.83	90	

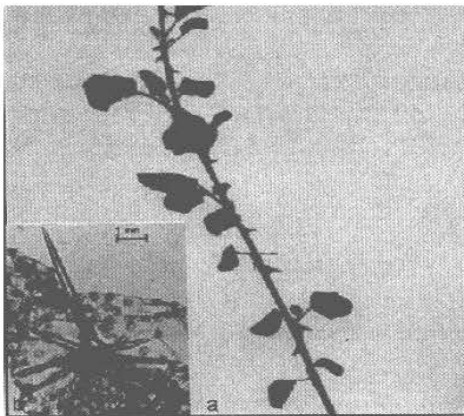


Fig. 2: a) Herbarium specimen of *Solanum forsskalii*  
b) Trichomes of *S. forsskalii*

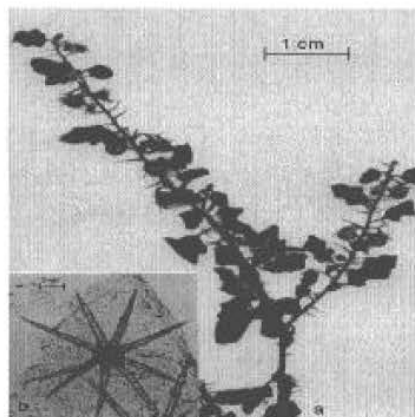


Fig. 3: a) Herbarium specimen of *S. macracanthum*  
b) Trichomes of *S. macracanthum*

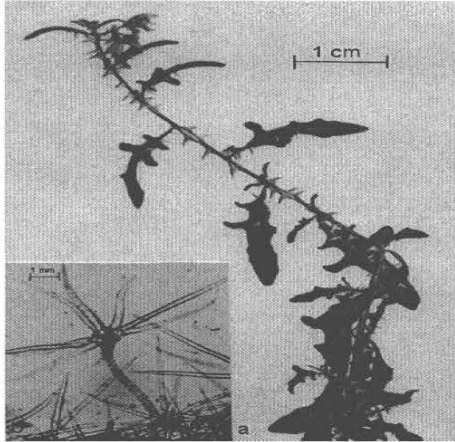


Fig. 4: a) (Dunal) Herbarium specimen of *S. glabratum* (Dunal) var. *sepicula* J. R. I Wood b) Trichomes of *S. glabratum* (Dunal) var. *sepicula* J. R. I Wood

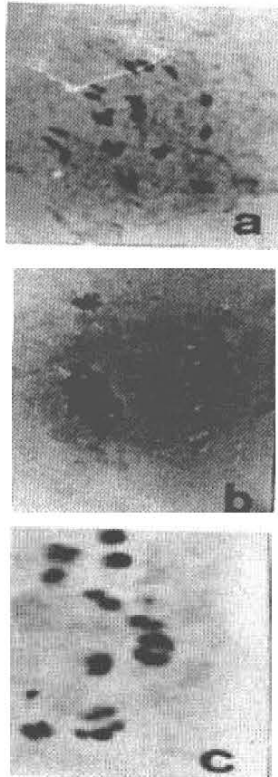


Fig. 5: a. Univalent and bivalent chromosomes recorded for *S. forsskalii* b) Abnormal cells and laggards of *S. forsskalii* c) Abnormal cells and irregular pairing of chromosomes of *S. macracanthum*

nature of both species and their cytogenetic stability.

Behavior of *S. macracanthum* A. Rich chromosomes shows some meiotic disorders in forms of abnormal cells and irregular pairing. Univalent and multivalent chromosomes (Fig. 5c) were also observed and found high compared to that recorded for the other two taxa (Table 2).

### Discussion

Morphological investigation shows that *S. macracanthum* A. Rich differs from *S. glabratum* Dunal var *sepicula* (Dunal) J.R.I. Wood and *S. forsskalii* Kotschy ex Dunal in shape and dimensions of the reproductive organs (i.e. flower dimensions, anther length, fruit size). On the other hand, cytological investigation reveals a strong relationship between *S. forsskalii* Kotschy ex Dunal and *S. glabratum* Dunal var *sepicula* (Dunal) J. R. I. Wood rather than with *S. macracanthum* A. Rich.

Chiasma frequency of *S. macracanthum* is 1.37 which is relatively lower than *S. forsskalii* (1.78) and *S. glabratum* (1.83) Dunal var *sepicula* (Dunal) J. R. I. Wood. This difference could be attributed to the irregular meiosis pattern recorded for *S. micracanthum*. Davis and Heywood (1967) reported the same concept for structural hybrid *Solanum gross dentum*. and for some other species of *Solanum*. Statistical treatment of the morphological data reveals a high correlation coefficient between *S. forsskalii* Kotschy ex Dunal and *S. macracanthum* A. Rich (0.50) while a lower correlation coefficient (0.20) has been recorded for *S. glabratum* Dunal var *sepicula* (Dunal) J. R. I. Wood. This would suggest that *S. forsskalii* Kotschy ex Dunal is probably a parent of *S. macracanthum* A. Rich. This conclusion discusses low productivity of this taxon as well as its hybrid situation.

Open pollination is common for majority of species of this genus in the study area (Haroun and Al Wadi, 1999), which could predict that there is a high potential of cross-pollination with some related species in the area especially for *S. macracanthum* A. Rich.

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