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Biosystematic studies on *Schouwia* DC. *(Brassicaceae)* in Egypt

Abstract

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Five different populations of *Schouwia* DC. from Egypt and Saudi Arabia were studied. Samples of these populations were studied morphologically, cytologically and biochemically. The morphological characters of flowers, fruits and seeds were investigated by light microscope while seed coat sculpture was investigated using Scanning Electron Microscope. The somatic chromosome number ($2n = 36$) with the mean length (1.76 µm) were also measured. Storage seed proteins were studied electrophoretically using SDS-PAGE technique. The present results revealed that *Schouwia* DC. is a monotypic genus with only one polymorphic species *Schouwia purpurea* (Forssk.) Schweinf.

Introduction

Schouwia DC. is a genus of desert plants, very distinctive among the Egyptian *Cruciferae* on account of its fleshy ovate and amplexicaul upper leaves; pink-rose flowers and winged, orbicular, dehiscent fruits with a long and conical beak. Seed coat sculpturing is very characteristic by having intercellular spaces between periclinal cell walls (Schulz 1936, Täckholm 1974, El Naggar 1987). *Schouwia* grows in large stands and is reported to be annual, but it may perennate if subjected to grazing pressures (Kowal & Cutler 1974). It is of entomological importance since it provides food and shelter for the desert locust *Schistocera gregaria* L. (Ghaout & al. 1991, Najagi & Torto 1996). The distribution of this genus extends from Sahara, through Arabia to India and to N. E. Trop. Africa (Hedge 1976). *Schouwia* has been studied from several points of view: morphologically, anatomically and economically (Bhaumik 1983, Kowal & Cutler 1974, Messeri 1938, Najagi & Torto 1996). However, nomenclature and species concept in the genus have been subjected to a considerable debate. On account of the diversity of beak and pedicel length, floral size and fruit shape, some taxonomists recognized two separate species: *Schouwia purpurea* (Forssk.) Schweinf. and *S. thebaica* Webb (Schulz 1936, Moggi 1967, Bhaumik 1983, El Hadidi & Fayed 1994-1995, Boulos 1995). Using the same characters some other taxonomists regarded *Schouwia* as a monotypic genus, the

single species called *S. purpurea* (Jafri 1977, El Naggar 1987, El Hadidi & al. 1988), or *S. thebaica* (Muschler 1912, Täckholm 1974). Since the chromosomal characters, electrophoretic banding patterns of storage seed proteins and seed coat sculpturing can often provide reliable taxonomic value in such cases (Davis & Heywood 1963, Moore 1968, Barthlott 1984, Gamal el Din & al. 1988), the present study attempts to discriminate the status of species within the genus using the above modern attributes.

Material and Methods

This study is based on herbarium specimens deposited in CAI, CAIM (abbreviation according to Holmgren & al. 1981) and AST (Assiut University Herbarium (proposed abbreviation) as well as field observations. Mature seed samples of *Schouwia* were collected from different localities: four from Egypt - Sinai, Kharga oases, Qena province and Wadi Al Assiuty - and one from Saudi Arabia, southern region, Al Darb (Fig. 1, Table 1). The seeds were examined by light and scanning electron microscope (SEM). Seven to ten seeds of each sample were selected to cover the range of variations. Voucher herbarium specimens of the studied taxa are kept in AST (Assiut University Herbarium). Material for SEM was prepared by mounting dry seeds directly onto clean stubs using double sided adhesive tape ringed with colloidal silver to improve electrical conductivity. These seeds were coated with gold in a Polaron E 5000 sputter coater to thickness of approximately 50-700 µm. They were then examined in a JOEL JSM SEM, which is operated at accelerated voltage of 15 Kv at the SEM UNIT, Assiut University. The terminology used here is that proposed by Cutler (1979) and Barthlott (1981, 1984) with some modifications.

Table 1. List of the studied samples of *Schouwia* and their localities.

Proposed taxa	locality
1 - Sample as *S. purpurea*	Sinai, El Aqaba gulf, Egypt.
2 - Sample as *S. thebaica*	Kharga Oasis, Egypt.
3 - Sample as *S. thebaica*	Qena province, Egypt.
4 - Sample as *S. purpurea*	Al Darb, Southern region, Saudi Arabia.
5 - Sample as *S. thebaica*	Wadi Al Assiuty, Egypt.

For chromosomal characters, roots 1-2 cm long were exercised from germinated seeds pretreated with 0.05% colchicine for 4-5 hours at 4°C and fixed in Carnoy's solution (1:3 glacial acetic acid, ethanol v/v) overnight. The procedure of Darlington and La-Cour (1976) for Feulgen squash technique was followed.

Total seed proteins extracts were prepared by extracting appropriate proteins of girding ungerminated seeds samples with 0.125 M Tris-borate, pH 8.9 for 24 hours at 4°C and centrifuged at 1000 rpm for 20 min.

The supernatant was used for electrophoresis. The method for discontinuous PAGE technique was adopted here based on that of Laemmli (1970). Total protein content was determined by Rad Assay. Molecular weights of the storage seed proteins for each sample were identified according to Matta & al. (1981) and gel-pro analyzer v.3.0 computer program.

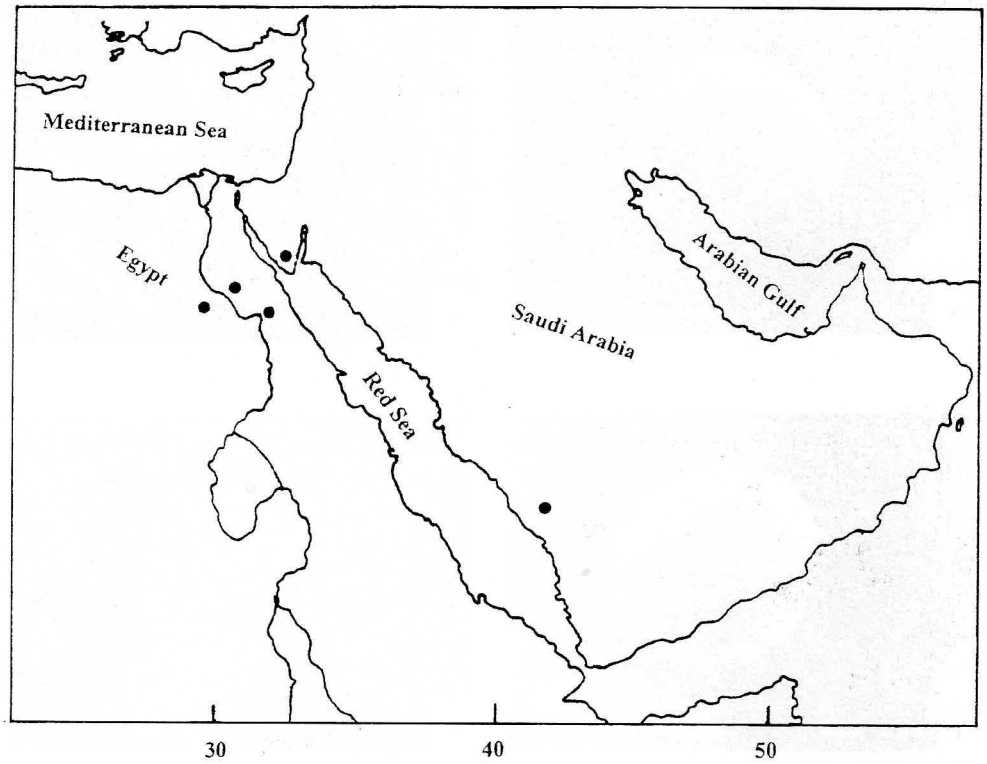


Fig. 1. Location map showing the distribution of the studied samples of *Schouwia* DC.

Results and Discussion

Generally, in *Brassicaceae* as in other natural families such as *Asteraceae* and *Poaceae*, the generic limits (for example between *Erucaria* and *Reboudia*, *Brassica*, *Sinapis* and *Erucastrum)* are often more difficult to establish than the specific limits within these genera (Hedge 1976, Clayton 1982, Al Shabaz 1984, Cronquist 1985). In contrast, *Schouwia* is a very distinctive genus but the specific limits within it are very difficult to recognize. There is some variation in pedicel and beak lengths, floral size and shape of fruit. The specimens characterized by short pedicels (3 mm long), long beaks (8 mm long) and large flowers have been distinguished as a separate species *S. thebaica* by Webb in 1848. This taxon of *Schouwia* has a geographical distribution restricted to the west part of Saharo-Sindian region (west Africa to the east part of Sinai). The second taxon is characterized by long pedicels (8 mm long), short beaks (3 mm long), small flowers and a distribution limited to the east part of the Saharo-Sindiana region (from India westwards to the east and central part of Sinai). This description applies to the type form which has been regarded as *Schouwia purpurea* (Forssk.) Schweinf. Muschler in 1933 considered the above two species as two subspecies viz. *S. purpurea* subsp. *schimperi* and the type subspecies while the same author in 1912 regarded them as only two varieties.

The present morphological investigations revealed that there is some overlapping in all the above mentioned characters between the studied samples.

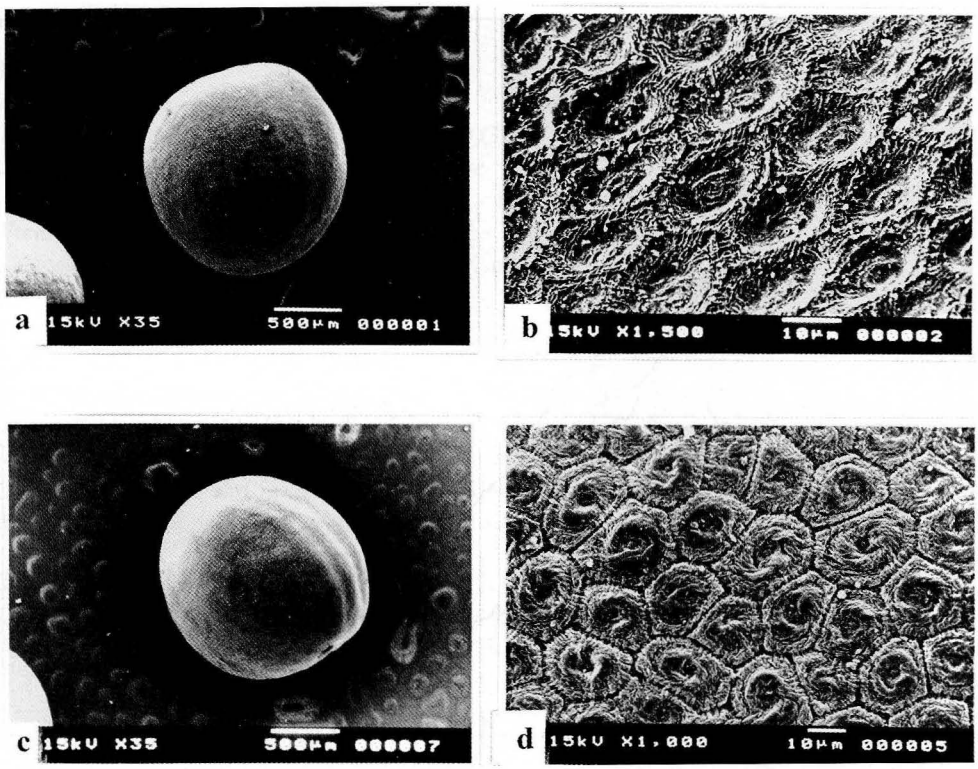


Fig. 2. SEM micrographs of seeds and seed coat sculpture of the studied samples of *Schouwia* DC.: **a,** seed of Sinai sample; **b,** seed coat sculpture of Sinai sample; **c,** seed of Al Darb sample; **d,** seed coat sculpture of Al Darb sample.

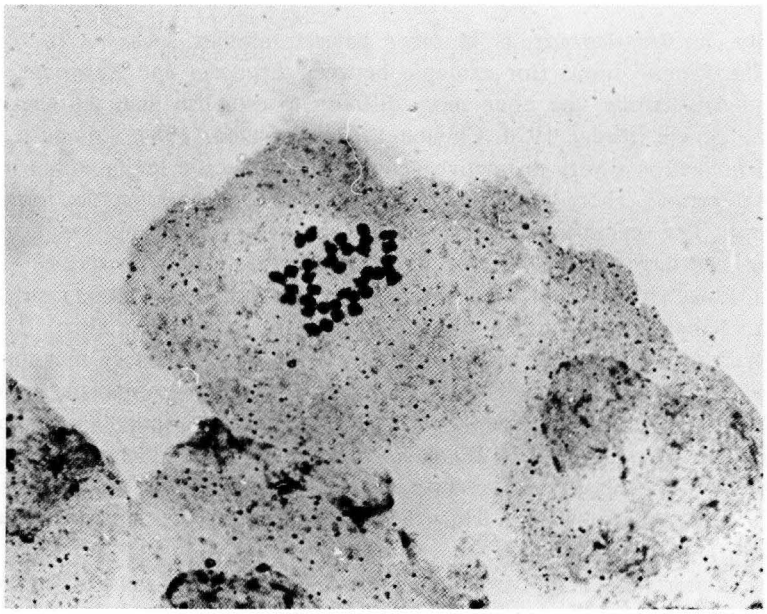


Fig. 3. Morphochromosomal characters of *Schouwia* as shown by Feulgen-stain for Qena-sample ($x = 1025$).

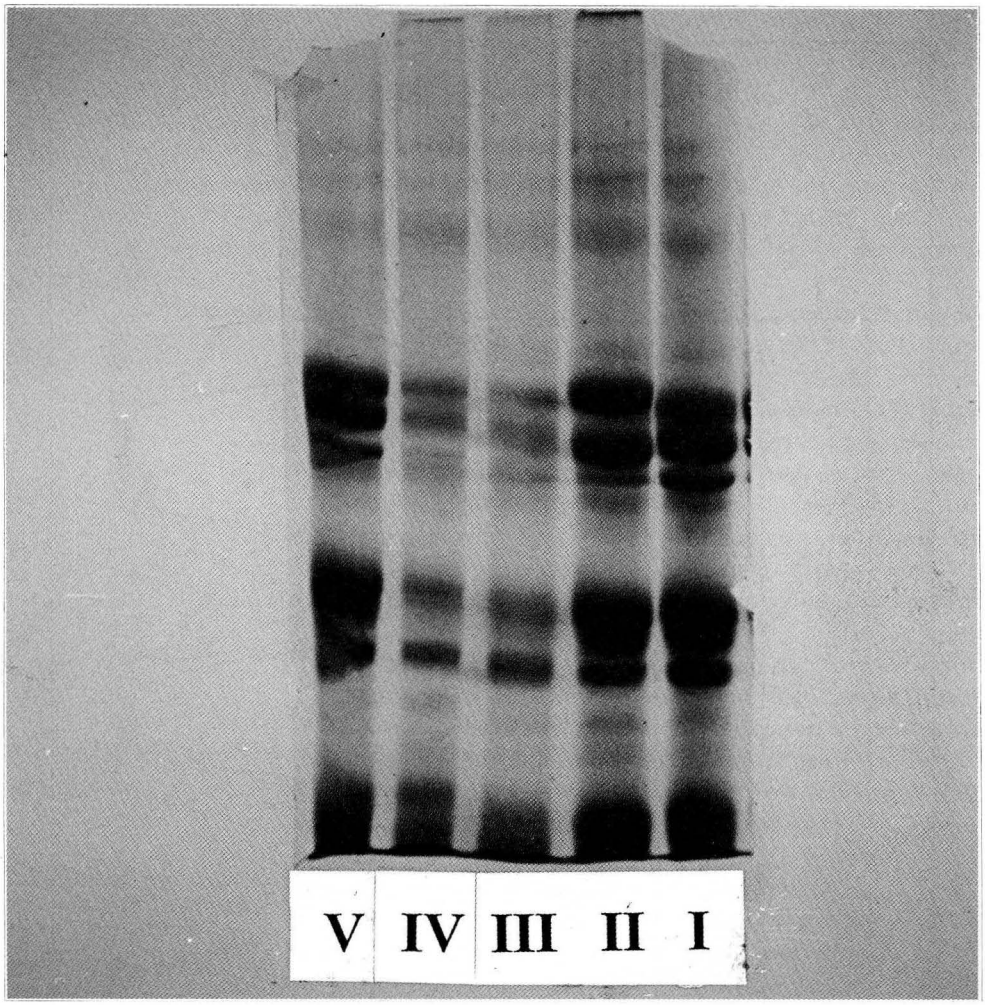
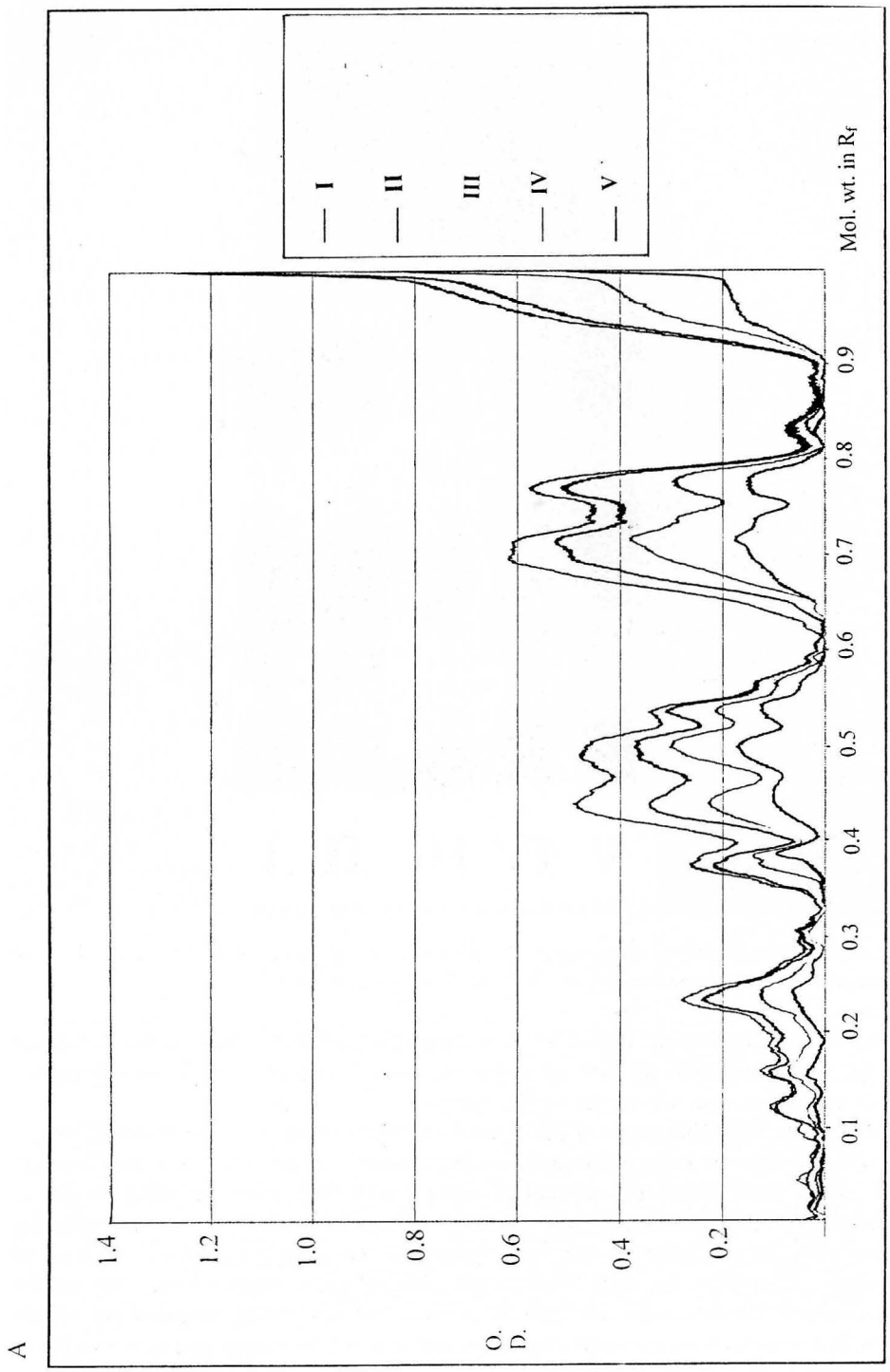


Fig. 4. SDS-PAGE of the total seed proteins of *Schouwia* samples from different localities: **I,** Sinai; **II,** Kharga Oasis; **III,** Qena province; **IV,** Al Darb; **V,** Wadi Al Assiuty.

In addition, at least in the region where samples were collected, there is not a clear-cut limit for the distribution of each proposed taxon. Accordingly we can not recognize distinct taxa at any rank among the studied samples.

SEM results show that seeds of the studied samples of *Schouwia* are globose, brown, up to 3 × 3 mm in size; epidermal cell patterns are isodiametric and 5-polygonal; anticlinal cell boundaries are channelled straight and with some radiating striations; periclinal cell walls are domate with concave or sunken central portion and radiating striation (Fig. 2). In spite of the wide range of the phytogeographical regions of collections as well as the high diversity of morphological characteristics among the studied samples of *Schouwia*, the analysis of seed coat sculpturing revealed that all the investigated samples have the same characters and can not be recognized as belonging to distinct separate taxa within the genus.


A
O.D.
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.1
0.2
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0.7
0.8
0.9
Mol. wt. in R_f
I
II
III
IV
V

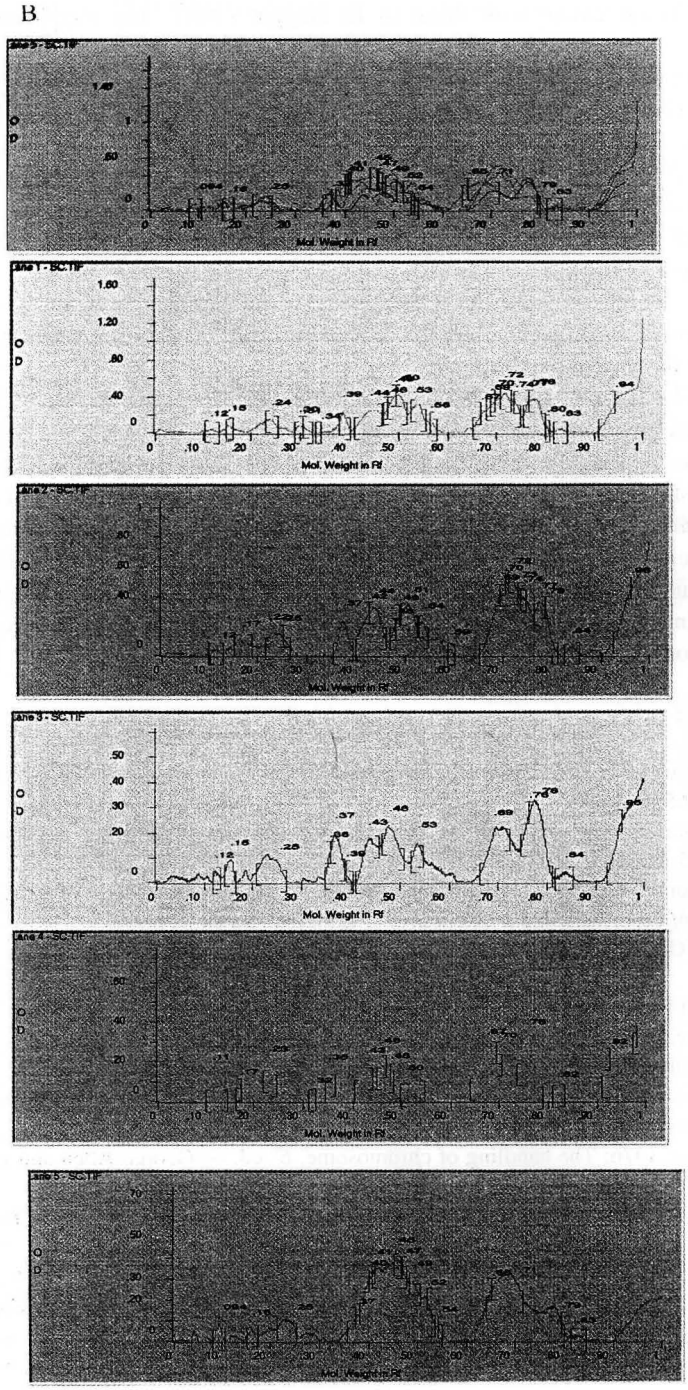

Fig. 5. Scans of lanes of Fig. 4 as appeared by using Gel-Pro Analyzer V. 3.0 computer programme. Samples coming from: **I,** Sinai; **II,** Kharga Oases; **III,** Qena province; **IV,** Al Darb; **V,** Wadi Al Assiuty.

These results are in agreement with those of El Naggar (1987) and Fayed and El Naggar (1988).

Present results revealed that all the studied collections of *Schouwia* have the same chromosome number ($2n = 36$), with mean chromosome length (1.76 µm) (Fig. 3). This is in confirmation of the number so far reported by a previous study of *S. thebaica* Webb (Sikha & Sharma 1979). On the other hand, the same somatic chromosome number in *Schouwia* ($2n = 36$) coincides with those found in other taxa of *Cruciferae;* such as *Succowia balearica* of subtribe *Vellinae* (Manton 1930) and *Brassica juncea* of subtribe *Brassicinae* (Mukherje 1973).

However this coincidence might mean a phylogenetic relationship only in the first case. The extremely small chromosome lengths gave no chance to carry out comparative karyotype analysis on the investigated samples.

Fig. 4 shows a similar pattern of protein bands and their corresponding R_f values and it demonstrates that there are no characteristic bands distinguishing between the studied samples. This indicates that all the investigated taxa have the same genome and similar immediate products (storage seed protein). On the other hand present results reveal that, in spite of using the same volume of extracted proteins for each sample, the densitometric profiles of these proteins show some variation (Figs. 4 & 5a, b). Samples representing Sinai, Kharga oases and Wadi Al Assiuty seem to be characterized by higher intensity than those representing Qena and Al Darb. These variations might be attributed to variations in the environmental conditions.

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