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***Neuradaceae* J. G. Agardh in Egypt**

Abstract

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Macromorphological characters and SEM of pollen grains aspects were used to re-assess the relationships between the different taxa of the genus *Neurada*. The study revealed the presence of three distinct varieties. The results contradict the consideration by Barsotti & al. (2000) of *Neurada al-eisawii* as a separate species and support the treatment of it as a variety of *Neurada procumbens*.

Key words: *Neurada*, Pollen morphology, Taxonomy.

Introduction

Neurada L. is a monotypic genus originally described from Aegypto-Arabia. It has a wide distribution extending from North Africa (Mediterranean region) west to India east through Arabia (i.e. Saharo-Arabian) with extension into the Sudanian region.

Neurada L. was included in a subfamily *Neuradoideae* of the family *Rosaceae* (Thorne 1983) or as a tribe of the same family (J. D. Hooker 1878). Latter, Takhtajan (1980), Cronquist (1981) and Dahlgren (1983) dealt with *Neurada* with two other genera (*Neuradopsis* and *Grielum*) included in subfamily *Neuradoideae*, as a distinct family *Neuradaceae* of the order *Rosales*.

Zohary (1966) recognized two varieties in *Neurada procumbens*: *N. procumbens* L. var. *procumbens* and *N. procumbens* var. *stellata* M. & D. Zohary. Barsotti & al. (2000) described *Neurada al-eisawii* as a new species from the Southern desert of Jordan. He distinguished the new species from the well known *N. procumbens* by some morphological features of the fruit in addition to the plant habit.

In Egypt *Neurada procumbens* L. was included in the family *Neuradaceae* as a monotypic genus by Täckholm (1956, 1974), Boulos (1995, 1999) and El Hadidi & Fayed (1994-95).

Family *Neuradaceae*

The family *Neuradaceae* is characterized by its connate carpels within the calyx tube (the main difference from *Rosaceae*), gynoeceium syncarpous with 10 styles, 10 locules while in *Rosaceae* gynoeceium apocarpous or syncarpous with 2-5 styles.

In *Neurada* L., the type genus of the family *Neuradaceae*, the seeds germinate within the hard discoid pericarp, both the radicles and plumules perforate the pericarp and grow downwards and upwards respectively and the old spiny hypanthium often persists as a collar round the base of the new plants. This phenomenon is not known in *Rosaceae*.

Neurada are widely distributed in Egypt, it is represented in all territories of the country.

On field trips made in spring of sequential years 2003 -2006, *Neurada* specimens were found that differ markedly from *N. procumbens* in habit and features of the fruit (Fig. 1).

No attention has been previously paid to the pollen and fruit characters as being delimitative. With this in mind, this work was undertaken for more accurate identification of the taxa of the genus *Neurada* in Egypt.

Material and methods

The present study is based on collections kept in Cairo University Herbarium (CAI) and fresh materials collected from the natural habitats in Egypt and kept in Menofiya University Herbarium (MNF).

Anatomically, fresh materials were fixed in F.A.A. The stems were sectioned at 20-30 μm in thickness and the leaves at 10-20 μm ; sections were stained in safranin and light green. The sections were examined by using Zeiss research microscope. All morphological and anatomical assessments were made on all plants at similar developmental stages and in comparable positions of each plant.

SEM micrographs was carried out on pollens grains from fresh materials by mounting them on brass stubs and coated with a thin layer of gold using JEOL JSM 530P SEM at electron microscopic unit, Faculty of Science, Alexandria University. Terminology of pollen according to El-Ghazaly (1991).

MNF: Acronym to the herbarium of faculty of Science, Menofiya University.

Results

Neurada procumbens L. var. *procumbens*

Densely pubescent prostrate non-succulent annual herb; main stems radiating from fruit coat, alternately branched; indumentum densely hairy with short and long hairs giving a wooly appearance. Leaves blue green, petiolate; lamina deeply dissected, 1.3-1.6 (1.8) cm long, 0.9-1.3 (1.5) cm wide, ovate – oblong, obtuse, petioles 0.5-1.0 cm long, with very minute stipules. Flowers solitary, axillary, upturned, regular, pentacyclic, subtended by 5 subulate bracteoles turning into prickles, pedicellate with 0.5 (0.7)-1 (1.3) cm long pedicel. Free hypanthium present. Perianth with distinct calyx and corolla; calyx 5 fids forming broad and flat calyx tube which is persistent; petals 5, whitish yellow, pale purple at margins, distinctly veined, 2.5- 3.0 mm long and 1.5-2.0 mm wide, inserted in the calyx tube; androecium with 10 free diplostamenous stamens borne on slightly prolonged hypanthium, 2-whorled, filaments subulate, glabrous, anthers ovoid – oblong, dehiscent with longitudinal slits, introrse; gynoecium 10 carpelled, syncarpous, partly inferior, 10 locular with one ovule in each, stylate with 10 free styles longer than stamens, stigmas 10 capitate; fruit hard,

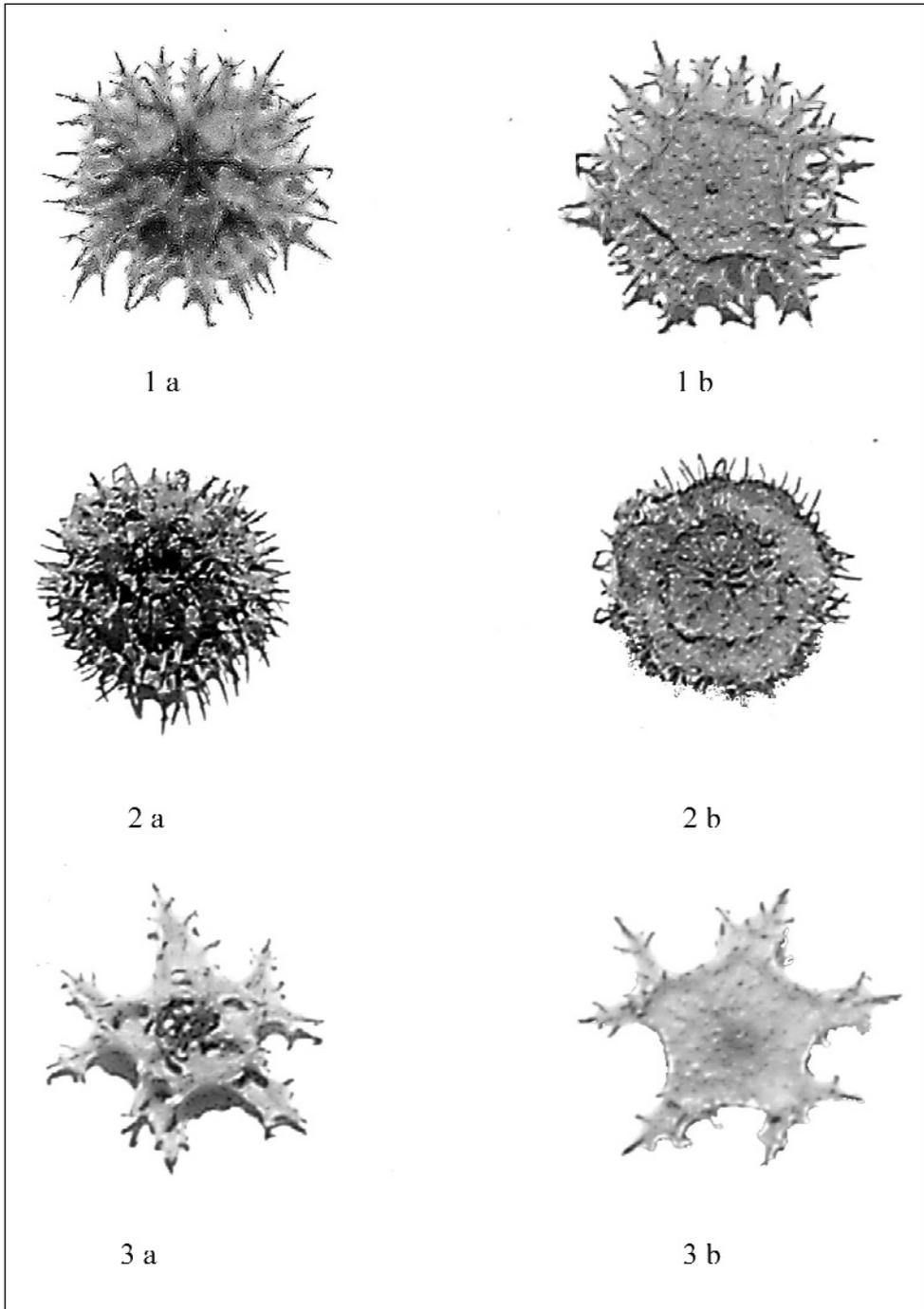


Fig. 1. Fruit photographs of the studied taxa (**a**: abaxial surface, **b**: adaxial surface): **1**) *Neurada procumbens* var. *al-eisawii*; **2**) *N. procumbens* var. *procumbens*; **3**) *N. procumbens* var. *stellata*.

symmetrically echinate or spinose with 2-3 mm spines directed upward, fruit receptacle circular, 1.5-1.8 (2) cm in diameter, with slightly raised crust in adaxial surface.

Representative specimens:

M: Mersa Matruh, 5km SE El Omaid protectorate road, 15/5/2003, Z. Turki (MNF); Garawla between El-Alamain and Mersa Matruh, 22/3/1974, Täckholm et al (CAI); Ras El-Hekma, 25/5/1954, Megahid et Shafey (CAI); Abu Mandour, Rossetta, 11/3/1978, H. Hosni (CAI). - **Di:** Wadi El-Mizeirie, G. El-Maghara, N. Sinai, 24/4/1959, L. Boulos (CAI); 40 km west Ismailiya, 28/3/2003, Z. Turki (MNF).

Neurada procumbens var. *stellata* M. & D. Zohary in Zohary & Angelis, de, Palest. J. Bot. Jerusalem, ser 5.; 249 (1952)

Leaves whitish green, larger than the type, 1.8-2.3 cm long, 1.0-1.3 cm wide, petiole 0.8-1.3 cm; pedicels 0.7-1.2 cm long; flowers with white petals; fruits receptacle pentagonal, 1.8-2.7 cm diameter, without crust in the adaxial surface, fruit margins deeply 5-lobed, each lobe with 3 prickly teeth.

Representative specimens:

Di: El-Natroun–El-Alamain Desert road, 15/4/2003, Z. Turki (MNF); Malalat el Khadra, wadi El-Natroun, 7/2/1968, Zahran et al (CAI); Tahrir province, 8/6/1973, Ibrahim et al (CAI) – **Dg:** Cairo-Suez road, wadi um Derma, 30/12/1960, Täckholm et al (CAI); Wadi Angabia, Suez road, 16/3/1956, M. Imam (CAI).

Neurada procumbens var. *al-eisawii* (Barsotti, Borzatti & Garbari) Turki, comb. nova

Syn.: *Neurada al-eisawii* Barsotti, Borzatti & Garbari, Bot. Chron. **13:** 113 (2000)

Holotypus: Giabal El Guzman, Barsotti 368.4.98.1 (PI).

Leaves whitish green, 1.5-2.0 cm long, 0.8-1.7 cm wide, petiole 0.8-1.0 cm; pedicels 1.0-1.2 cm long; flowers with white petals; fruits receptacle pentagonal, 1.0-1.2 cm diameter, without crust in the adaxial surface, fruit with external patent spines that are prickled at the base, 5-7 mm long and internal, not prickled spines, 4-5 mm long.

Representative specimens:

Di: Egyptian-Chinese friendship forest, 5km east El Sadat city, 12/5/2004, Z. Turki (MNF); *ibid.* 20/3/2005, Z. Turki & F. Shehata (MNF)

Note: No previous collections were found deposited in Egyptian herbaria

ANATOMICAL FEATURES

In all studied taxa, stem is terete in outline. The epidermis is uni-layered with cubic to barrel-shaped cells. Collenchyma forms a continuous band intermingled with a tannin containing cells. The cortical parenchyma contains oxalate crystals. Secondary thickening was developed from a conventional cambial ring. Cortical and medullary bundles are absent. Leaves are less succulent, dorsiventral with anomocytic stomata.

POLLEN GRAINS

Pollens of the three studied taxa are isopolar, with radial symmetry, triangular in polar view, tricolpate. Exine microreticulate, with irregular carinate profile; lumina subcircular-polygonal, homobrochate (Fig. 2).

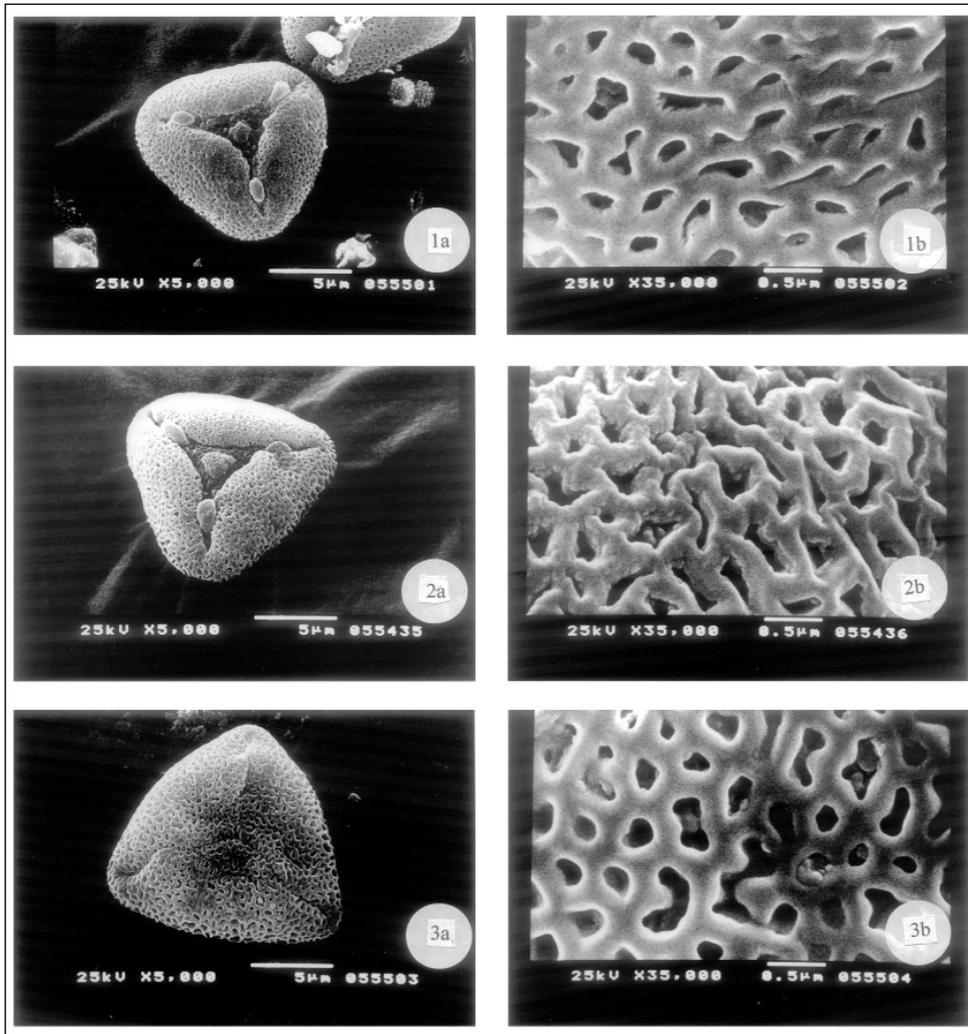


Fig. 2. SEM micrographs of pollen grains of the studied taxa (**a**: polar view, **b**: exine morphology): **1**) *Neurada procumbens* var. *al-eisawii*; **2**) *N. procumbens* var. *procumbens*; **3**) *N. procumbens* var. *stellata*.

Discussion and Conclusion

The different morphological characteristics of the studied taxa of *Neurada procumbens* revealed that they varied from each other and can be distinguished in field depending, where often occur together, on the habit of the stem (prostrate or procumbent), plant height, length of leaves and fruit characters. These differences may depend on the water supply, salinity, and probably also on temperature. Borzatti De Loewenstern and Garbari (2002) reported that no significant differences in the karyotype morphology of *N. procum-*

bens var. *stellata* and *N. al-eisawii*. They contributed the morphological differentiation between them to the local schizogenic process of population fragmentation of the annual prostrate plant *Neurada procumbens*. The specimens collected from Egypt differ slightly in the measurements of the leaves and pedicels length from that described by Borzatti & al. from Jordan. This may be due to the environmental condition. Anatomical and pollen characters seem to be insignificant in characterizing the studied taxa.

Accordingly, it is judged appropriate to recognize *Neurada al-eisawii* as a variety under *Neurada procumbens* rather than a separate species. Consequently the three studied Egyptian taxa may be considered as three different varieties of *Neurada procumbens*.

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