

Full Length Research Paper

Family *Neuradaceae* J. G. Agardh in Saudi Arabia

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Morphological characters, seed coat sculpturing (SEM) of seed, leaf, pollen grains and also a key aspects were revisited to revise relationships between dissimilar taxa of the genus *Neurada* in Saudi Arabia. The present revision shows the occurrence of three distinctive varieties (var. *procumbens*, var. *al-eisawii* and var. *stellate*); the last two varieties considered a new registration in Flora of Saudi Arabia.

Key words: Morphological characters, *Neuradaceae*, Saudi Arabia.

INTRODUCTION

Neurada L. is a desert monotypic plant labeled from Aegypto-Arabia. It has a very wide circulation from North Africa, East Mediterranean region, Sahara, Sudan to Indian desert. *Neurada* L. among subfamily *Neuradaceae* of the family *Rosaceae* (Thorne, 1983). Later, Takhtajan (1980), Cronquist (1981) and Dahlgren (1983) divided *Neurada* into two genera (*Neuradopsis* and *Grielum*) which comprised subfamily *Neuradaceae*.

According to Zohary (1966) two varieties *Neurada procumbens* L. var. *procumbens* and var. *stellate* were recognized. *Neurada al-eisawii* was described by Barsotti et al. (2000) as a new species from the Southern desert of Jordan. He described the new species by some morphological characters in the fruit in insertion to the plant habit.

In Egypt *Neuradaceae* is recognized as a monotypic

family (Tackholm, 1956, 1974; Boulos, 1995, 1999; El Hadidi and Fayed, 1994-1995). According to a study carried out by Turki (2007), three distinctive varieties were found from Egyptian *Neuradaceae*.

In Saudi Arabia, *N. procumbens* is comprised in the family *Neuradaceae* as a monotypic genus (Migahed, 1974; Mandaville, 1990; Chaudhary, 1999).

Family *Neuradaceae*

Family *Neuradaceae* is a densely pubescent, prostrate and annual herb. Leaves alternate stipulate, sinuate to pinnately lobed. Flowers are usually solitary, bisexual, 5-merous, perigynous to epigynous, the receptacle discoid and woody in fruit. Sepals are valvate and petals free,

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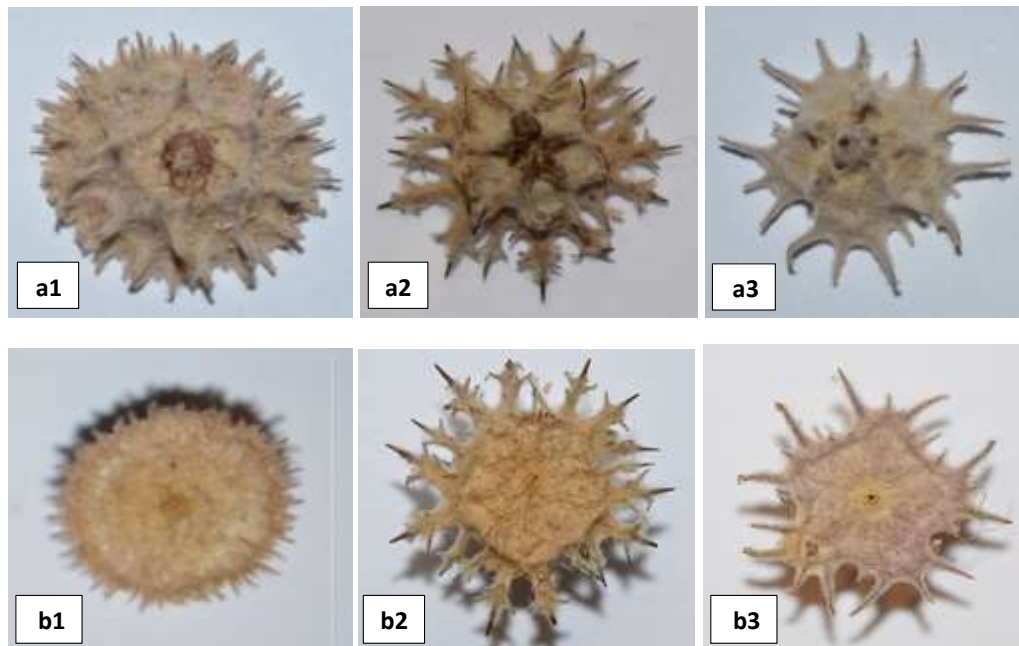


Figure 1. Photographs of fruits of the deliberate taxa (a: abaxial surface, b: adaxial surface): 1) *Neurada procumbens* var. *al-eisawii*; 2) *N. procumbens* var. *procumbens*; 3) *N. procumbens* var. *stellata*. Key: 1. Fruit circular in adaxial surface; var. *procumbens*; 1. Fruit pentagonal in adaxial surface; 2, Fruit having branched spine; var *al-eisawii*; 2, Fruit having unbranched spine; var. *stellata*.

and pentamerous. It has ten free stamens, and gynaecium of 3-10 carpels immersed in the receptacle. Fruits are discoid, woody, spiny with winged bound formed from the enlargement of sepals in fruit, the seeds develop inside the stiff discoid pericarp, the radicles and the plumules perforate the pericarp and grow down and up correspondingly and the old spiny hypanthium often continue as a collar curved the base of the new plants. Furthermore, *Neurada* seeds are likely heteromorphic, with both spinose and spineless sides, which involve the vertical scattering of seeds and diaspores, and the exact site in which they lie in the soil (Hegazy et al., 2014).

This family is symbolized by its connate carpels inside the calyx tube.

Neurada are wide-ranging in distribution in Saudi Arabia, it is found in all sandy soil of the Kingdom.

For all the field excursions during the spring of consecutive years 2014 -2015, *Neurada* samples were found which clearly differ from *N. procumbens* in pattern and structures of fruit (Figure 1).

MATERIALS AND METHODS

This work was done on fresh plant material collected from the natural habitations in Saudi Arabia (Al-Oassim, Al Kharj, (NJw); Nafud, (NF) and Nuairiya, Dammam and Dahran (E), and kept in

College of Science of Herbarium, Imam Abdulrahman Bin Faisal University.

Morphologically, fruits and leaf characters were examined on fresh material. Photographs was taken for SEM on leaf, and seed and pollens grains were examined from fresh resources by escalating them on stubs and covered with a tinny coating of gold using Fei, Inspect S50, Czech Republic SEM at the electron microscopic unit, Institute For Research And Medical Consultation (IRMC). Terms of pollen conferring to El-Ghazaly (1991).

RESULTS

N. procumbens L. var. *procumbens*

Annual herb 15-40 cm, densely grey-tomentose; stem prostrate; leaves 0.5-3.1 x 0.3-1.5 cm, oblong-ovate, sinuate-pinnatifid; sepals 2-2.5 x 1-1.5 mm, ovate-triangular, acute; petals 1 x 1 mm, white, cream or pinkish; fruit 1-2.3 mm diam. With 2-8 mm spines. Figure 1. (1 a, b).

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

Syn.: *Neurada al-eisawii* Barsotti, Borzatti & Garbari,

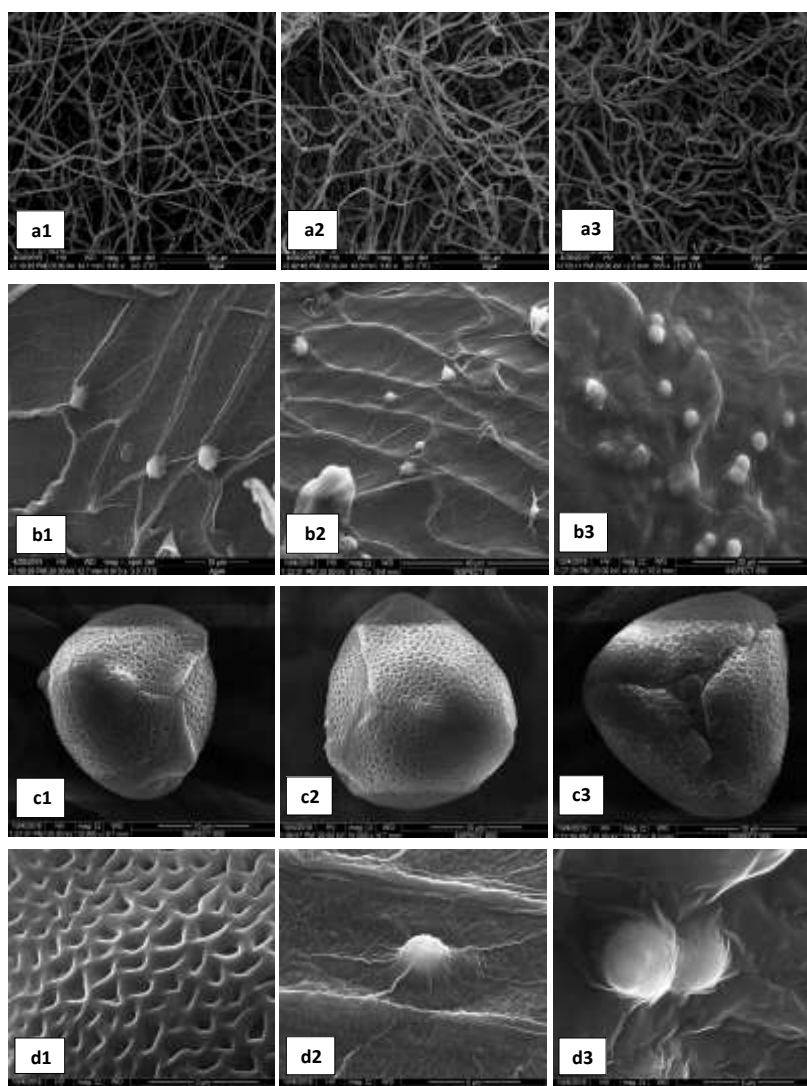


Figure 2. SEM micrographs of leaf hair (a), sculpture of seed (b), pollen grains (c) and type of granules (d) of the studied taxa (1, *Neurada procumbens* var. *procumbens*; 2: *N. procumbens* var. *al-eisawii*; 3: *N. procumbens* var. *stellata*).

Bot. Chron. 13: 113 (2000) Holotypus: Giabal El Guzman, Barsotti 368.4.98.1 (PI).

Leaves: greenish white; 1.7-2.2 cm long; 1.0-1.9 cm wide; petiole 0.9-1.2 cm; flowers with white petals; fruit with external obvious branched spines (Figure 1, 2a, b).

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

Leaves: greenish white; 1.9-2.4 cm long, 1.0-1.3 cm wide; petiole 1.0 -1.4 cm; flowers with white petals; fruit boundaries intensely 5- lobed; each lobe with 3 spines, (unbranched spine) (Figure 1, a3, b3).

Morphological feature

The following key is suggested for delimiting the taxa studied on the basis of morphological characters of fruits.

Leaf hair: leaf of all studied taxa was covered with densely unicellular branched hair (Figure 2a1, a2 and a3).

Seed coat sculpturing

The seed coat sculpturing (SEM) of the studied taxa was investigated. The spermoderm patterns were reticulate with granules (Figure 2b1, b2, b3, d2 and d3).

Pollen grains

In polar view, the pollen grain of the revised taxa are tricolpate, triangular, isopolar, exine microreticulate, with asymmetrical carinate profile; lumina subcircular polygonal and Homobrochate (Figure 2 (c1, c2, c3 and d1)).

DISCUSSION

The morphological features of the taxa *N. procumbens* indicate diversity. In the field, they can be differentiated by stem pattern, plant stature, extent of leaves and fruit type. Borzatti De Loewenstern and Garbari (2002) stated no noteworthy changes in the karyotype morphology of *N. procumbens* var. *stellata* and *N. al-eisawii*. Turki (2007) revealed the presence of three distinct varieties on Egyptian specimens depending on fruit characters and stated that anatomical and pollen types seem to be irrelevant. The specimens collected from Saudi Arabia almost close by in the dimensions of the leaves and pedicels extent from that designated by Turki from Egypt. Seed cote of *N. procumbens* var. *procumbens* and var. *al-eisawii* have the same sculpture and also the same kind and density of granules (solitary granules) while var. *stellata* carries out a densely two types of granules, (single and double granules). Pollen types appear to be irrelevant in typifying the deliberate taxa.

Consequently, fitting to identify *Neurada al-eisawii* as a variety under *N. procumbens* instead of a distinct species is suggested. Therefore, the three deliberate Saudi Arabian taxa may be deliberated as three dissimilar varieties of *N. procumbens*.

This result agrees with the investigation by Turki (2007) and contradicts that by Barsotti et al. (2000) of *Neurada al-eisawii* as a new species.

N. procumbens var. *al-eisawii* and var. *stellata* are considered new registration in Flora of Saudi Arabia.

ACKNOWLEDGMENTS

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CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

REFERENCES

- Barsotti G, Borzatti de Loewenstern A, Garbari F (2000). *Neurada al-eisawii* (Neuradaceae), a new species from the southern desert of Jordan. *Botanika Chronika* 13:111-115.
- Borzatti de Loewenstern A, Garbari F (2002). Karyological aspects of the genus *Neurada* (Neuradaceae J. G. Agardh). – *Caryologia* 55(4):361-365.
- Boulos L (1995). *Flora of Egypt Checklist*. Al Hadara Publishing, Cairo; First edition.
- Boulos L (1999). *Flora of Egypt, Vol 1. (Azollaceae-Oxalidaceae)*. – Cairo. Available at: <https://doi.org/10.1111/j.1756-1051.1999.tb01119.x>
- Cronquist A (1981). *An Evolution and classification of flowering plants*. Second edition. The New York Botanical garden, New York, USA. Available at: http://www.nybgpress.org/Content/Site185/FilesSamples/180865GeneralBo_00000103182.pdf
- Chaudhary SA (1999). *Flora of the Kingdom of Saudi Arabia*. (vol. 1) Ministry of Agriculture and Water. National Agriculture and Water Research Center Kingdom of Saudi Arabia, Riyadh.
- Dahlgren RM (1983). General aspects of angiosperm evolution and macrosystematics. *Nordic Journal of Botany* 3:119-149.
- El-Ghazaly GA (1991). *Pollen flora of Qatar*. Scientific and applied research center, Doha: Qatar University.
- El Hadidi MN, Fayed AA (1994-95). *Materials for Excursion Flora of Egypt*. *Taekholmia* 15:57.
- Hegazy AK, Alatar AA, Khan MA, Lovett-Doust J (2014). Interaction Between “Safe Sites” and “Safe Sides” for Germination of *Neurada procumbens* (Neuradaceae) in the Middle East. *Folia Geobotanica*. 49. 10.1007/s12224-013-9187-8.
- Mandaville JP (1990). *Flora of eastern Saudi Arabia*. London: Kegan Paul International jointly with the National Commission for Wildlife Conservation and Development, Riyadh. 130-155.
- Tackholm V (1956). *Students, Flora of Egypt*. Cairo University. p. 649.
- Tackholm V (1974). *Students, Flora of Egypt, ed. 2*. Cairo University, p. 888.
- Takhtajan AL (1980). Outline of the classification of flowering plants (*Magnoliophyta*). *Botanical Review* 46(3):225-359.
- Thorne RF (1983). Proposed new realignments in the angiosperms. *Nordic Journal of Botany* 3:85-117.
- Turki ZA (2007). *Neuradaceae* J.G. Agardh in Egypt. *Flora Mediterranea* 17:137-142.
- Zohary M (1966). *Flora of Palestine*. Israel Academy of Sciences and Humanities, Jerusalem 346 p.