

MORPHOLOGICAL VARIATIONS OF *ARNEBIA* AND *ECHIUM* (BORAGINACEAE)

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ABSTRACT: The morphological study of 2 genera (7 species) of Boraginaceae showed that all the species were annual or perennial desert herbs, and the stem erect or prostrate. The results showed great variations between the two genera. The root in *Arnebia* coloured while it was not coloured in *Echium*. The stem height in *Arnebia* less than 40 cm. while in *Echium* it was 30 - 60 cm. Flowers were regular small in *Arnebia* and yellow coloured, and sepal straight, stamens inserted in corolla tube, anther oblong, while in *Echium* they were irregular, more long, varies in colour (violet, red, purple and blue), sepal recurved, stamens exerted, anther globular. Fruit dry nutlets, in *Arnebia* ovoid with or without calyx, while in *Echium* it was conical always with calyx. The results were arranged in indented Key to distinguish between the two genera.

INTRODUCTION

Boraginaceae in Egyptian flora was representing by 19 genera (Tackholm, 1974), *Arnebia* and *Echium* were two different genera from this family. These genera were distributed in Egypt in many floristic region such as Al-Arish region (south Sainai), Borg Al-Arab and Matroh region (West desert).

Members of boraginaceous plants were commonly cultivated for decoration such as *Echium* spp. and *Heliotropium* spp. Some species cultivated for their medicinal properties (Watson and Dallwitz, 1992).

According to Hickey and King, (1981) both *Arnebia* and *Echium* occur under the same subfamily Boraginoideae which characterized with gynobasic style and fruit achenes.

Most taxonomic treatments were based on micro morphological characters which are almost essential for critical identification (Hamed, 1978).

Many authors described various genera from this family e.g. Nowicke and Ridgway (1973), Tackholm (1974), Hickey and king (1981), Watson and Dallwitz (1992), Anjum - Perveen et.al. (1995) and Rettief et.al. (1998).

The present investigation was carried out to through ligh upon macro and micro morphological characters of the studied species in hope that the conclusions might lead to put artificial indented key for distinguishing the two studied genera.

MATERIALS AND METHODS

The investigated samples are 7 species representing the two genera *Arnebia* and *Echium* (see Tabl 1) All these samples are collected from Al-Arish region, south Sainai.

Table(1): for the name of the seven studied species arranged alphabetically together with their synonymous.

Species names	
1.	<i>Arnebia decumbens</i> (Vent.) Cross & Kralik = <i>Lithospermum decumbens</i> Vent.
2.	<i>A. hispidissima</i> (Lehm.) DC = <i>Dioclea hispidissima</i> Spreng.
3.	<i>Echium horridum</i> Batt
4.	<i>E. longifolium</i> Delile
5.	<i>E. rauwolfii</i> Delile
6.	<i>E. sericeum</i> (Vahl) klotz = <i>E. distanchum</i> Viv.
7.	<i>E. setosum</i> Vahl = <i>E. rubrum</i> Forssk.

Identification of the previous species depending on Täckholm, 1974. while the correction of names and their synonymous depending on Boulos, 1995 and Willis, 1967.

The methods adopted for the comparative study of different features of variation exhibited by plants were clearing the parts of mature foliage leaves and flowers in warm lactic acid. Floral parts have been dissected and spread over a slide for microscopic examinations. All figures were drawn using a Camera Lucida at bench level.

The studied samples were kept at the herbarium of Agricultural Botany Department, Faculty of Agriculture, Al-Azhar University.

RESULTS AND DISCUSSION

The macro - and micro morphological study of the 7 species of Boragina-ceae showed clear variations between the 2 genera *Arnebia* and *Echium*. These genera are characterized as follow:

1) *Arnebia* Forssk.

The two different species were annual herbs densely bristle hairs and with coloured root. In *A. decumbens* the plants spreading and prostrate, yellow - green coloured, hispid with yellowish hairs and the plant hight was 10-25cm. While in *A. hispidissima* the plants erect, richly branched, whitish hispid with white hairs (Fig.1) and the plant hight was 20-35cm. These results were in agreement with those of Täckholm (1974), Hamed (1978) and Watson and Dallwitz (1992).

Leaves simple exstipulate, in *A. decumbens* the lower once linear - oblong while the upper once linear - lanceolate with acute tip. In *A. hispidissima* leaf shape lanceolate to linear spridingly hairy of white bulbous based bristles (Fig. 11).

Flowers in spike like cyme inflorescence, scorpioid and leafy. Flower small, regular and actinomorphic in *A. decumbens* and the bract as long as calyx, flower yellow coloured about 0.7 - 1.2 cm. long, and in *A. hispidissima* about 1-2 cm. long . calyx of 5 united sepals, imbricate and linear lobed with rounded straight apex (Fig. 5). Corolla of 5 united petals, funnel shaped, with narrow tube, the lobes orbicular and throat naked. Androecium of 5 epipetalous stamens inserted in corolla tube, filament long and unequal, anther oblong and connected basifixed with filament, pollen grains monads and 3 - colporate. Gynoecium of 2 carpel, superior, style long, filiform and 2 stigmas.

Fruit dry wrinkled nutlets covered with minute warts, about 1-2 mm. and the calyx persistence with the fruit only in *A. decumbens*. These results were in agreement with the results of Lawrence (1937), Täckholm (1974), Hamed (1978), Heemstra et al. (1990) and Anjum - Perveen et al. (1995).

Also the epidermal leaf study showed that the stomata are predominantly anomocytic (Fig. 15) and hairs were composed of two portions: terminal with wide lumina and warty rugose walls (Fig. 12) and basal with bulbous parts (Fig. 11). The previous results were in agreement with Solerder (1908) and Metcalfe and Chalk (1950).

2) *Echium* L.

The five studied species were annual erect herbs except *E. sericeum* which was perennial prostrate herbs, and the root of all species is uncoloured. The stem usually terete except in *E. longifolium* (Fig. 2) which was irregularly angled. Stem height 20 - 60 cm, the largest in *E. longifolium* and *E. rauwolfii* while the shortest in *E. sericeum*. Stem covered with stiff bristles from white tubercles (bulbous) hairs as in *E. horridum* and *E. longifolium* (Fig. 10), canescent with minute wooly bristle hairs (Fig. 12) as *E. sericeum*, or pubescent with hispid long hairs as in *E. rauwolfii*. Leaves simple exstipulate, different in shape and size from upper to lower.

The upper and floral leaves usually linear, entire with acute apex except in *E. sericeum* the floral leaves (bracts) triangular and lanceolate. The lower leaves broad linear tapering at base, these leaves rosseted and pale-green in *E. longifolium* while they were silvery-grey hispid in *E. sericeum*. The previous results were in agreement with those of Täckholm (1974), Watson and Dallwitz (1992) and Heemstra et al. (1995).

Flowers in spike like cyme loose as in *E. horridum* and *E. longifolium* or crowded and paniced as in *E. sericeum*. Flowers irregular somewhat zygomorphic and varies in size from 1.5 - 3.6 cm. the longest one in *E. longifolium* while the shortest one in *E. sericeum*. Calyx of 5 united parts with linear to lanceolate lobes with acute apex, sepals of *E. longifolium* covered with white bristles, calyx lobes recurved as in *E. longifolium* (Fig. 6). Corolla of 5 united petals mostly funnel shaped, bilabiate and throat open (Figs. 3 and 4). The petals varies in colour, violet in *E. horridum*, violet to reddish in *E. longifolium*, bright red in *E. rauwolfii*, purple in *E. sericeum* and blue in *E. setosum*. Androecium of 5 epipetalous exerted stamens, filaments long and unequal, the anther may be oblong as in *E. horridum* and *E. sericeum* (Fig. 7) or ovate to globular as in *E. longifolium*, *E. rauwolfii* and *E. setosum* (Fig. 8), pollen grains are 3-colporate. Gynoecium of two carpel, ovary superior, style single, long and filiform (Fig. 9) and stigma bifid.

Fruit dry, nutlets, tubercled-wrinkled, greyish-white, conical to pyramidal, 2 - 4 mm long, and the calyx persistent with the fruit. Most of these results were in agreement with Täckholm (1974), Hamed (1978), Heemstra et al. (1990).

The study of epidermal features of *Echium* spp. showed anomocytic stomata (Fig .15) and type of hairs as the same in *Arnebia* spp. (see figs. 13-14). The present results can be used to construct indentify key for the studied genera *Arnebia* (2 species) and *Echium* (5 species) as follows :

Plants annual or perennials desert herbs ;

Stem erect or prostrate

Root coloured ; stem less than 40 cm . high;

Flower regular (actinomorphic), small 1-2 cm . long, yellow coloured, sepal with straight rounded apex, stamens inserted in corolla tube, anther oblong ; fruit ovoid 1-2 mm. with or without

calyx *Arnebia*

Root not coloured ; stem 30 - 60 cm .

high ; flower irregular (zygomorphic) 1.5 - 3.6 cm . long , colour varies from violet red, purple and blue). Sepal apex rounded and recurved, stamens exerted from corolla tube, anther oblong or globular; fruit conical 2-4 mm. usually calyx *Echium*



Fig. (1): *Arnebia hispidissima*



Fig. (2): *Echium rauwolfii*

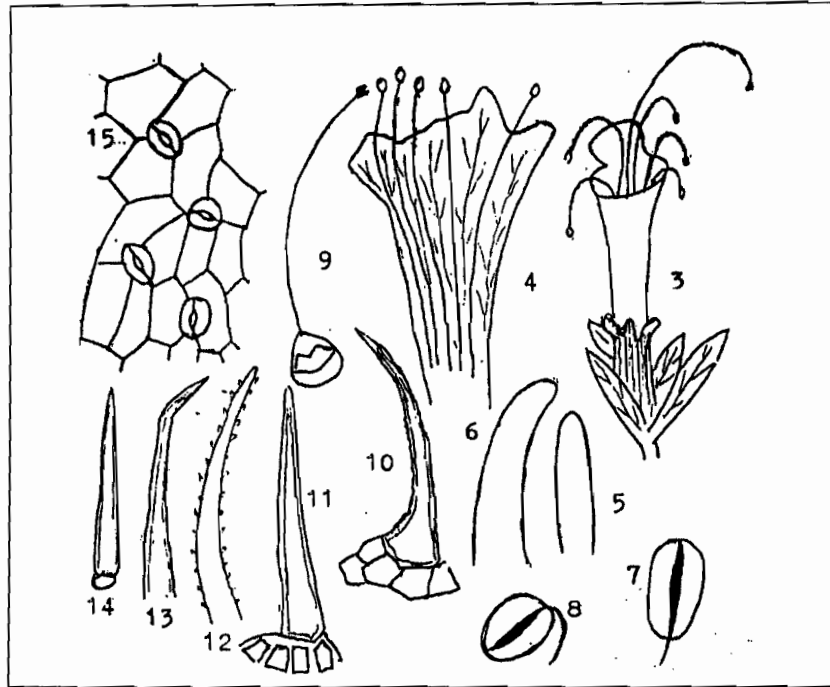


Fig. (3-15): The shape of flower, sepal, anther, pistil, hairs and stomata, 3 and 4: enlarged and open flower of *Echium longifolium* respectively X2, 5 and 6: sepals of *Arnebia hispidissima* and *Echium longifolium* resp. x 3.5, 7 and 8: anther of *E-sericeum* and *E-setosum* resp. x 15, 9: pistil of *E. longifolium* x 10, 10-14: types of hairs, 16 e. *longifolium* leaf, 11. *Arnebia hispidissima* leaf, 12. *E. sericeum* leaf, 13 and 14 petal and sepal hairs of *E. horridum* resp. all x 200 15: stomatal type in *E. longifolium*, leaf x 100.

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الاختلافات المورفولوجية لجنس *Echium, Arnebia* (الفصيلة البوراجينية)

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الدراسة الظاهرية لجنسين (٧ أنواع) من الفصيلة البوراجينية أظهرت أن جميع الأنواع أعشاب صحراوية حولية أو معمرة - وأن ساق النبات إما قائم أو زاحف . كما أظهرت نتائج الدراسة اختلافات كبيرة بين الجنس محل الدراسة . في جنس *Arnebia* كان الجذر ملونا بينما كان الجذر غير ملون في جنس *Echium*. ارتفاع الساق في جنس *Arnebia* أقل من ٤٠سم بينما في جنس *Echium* كانت الساق ٣٠ - ٦٠ سم .

الازهار منتظمة وصغيرة وصفراء في جنس *Arnebia* كما أن السبلات مستقيمة والتمك مستطيل والاسديه داخل انبوبة التويج . أما الازهار في جنس *Echium* فكانت غير منتظمة وأكبر حجما وتختلف الوانها من البنفسجى والاحمر والأرجوانى والأزرق والسبلات ملتفه للخارج والتمك إما مستطيل أو كروى والاسديه تبرز خارج انبوبة التويج .

أما الثمار فهي جافة بنيدهه إما بيضة الشكل و الكأس مستديم مع الثمرة أو متساقل كما في جنس *Arnebia* أو تكون الثمرة مخروطية والكأس دائما مستديم مع الثمرة كما في جنس *Echium*. جميع هذه النتائج نظمت على شكل مفتاح مسنن للتمييز بين الجنس محل الدراسة .