

COMPARATIVE MORPHOLOGICAL STUDIES ON SOME SPECIES OF THE GENUS *FUMARIA*

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Abstract

Morphological studies using a stereomicroscope performed on flower and fruit parts of the 7 species belonging to *Fumaria* genus revealed some differences and similarities. In this genus the zygomorphic flowers include 4 petals and 2 sepals which were different in size. The colors of their flowers range from white (*Fumaria parviflora* Lam.) to purplish pink (*Fumaria rostellata* Knaff.) or deep pink (*Fumaria schleicherii* Soy.Will). The sepals length varies among the species ranging from 0.1-0.5 mm (*Fumaria vaillantii* Loisel.) to 4-4.5 mm (*Fumaria capreolata* L.). The fruits are different in shape, length and width but some species present erect fruit pedicels while for other species the fruit pedicels are arched. Also the length of pedicel bracts is a specific character for each of these species.

Rezumat

Studiul morfologic asupra florilor și fructelor pentru 7 specii ale genului *Fumaria* utilizând stereomicroscopul, a pus în evidență asemănările și diferențele între speciile studiate. Acest gen este reprezentat de flori zigomorfe formate din 4 petale și 2 sepale de diferite dimensiuni. Culoarea florilor variază de la alb (*Fumaria parviflora* Lam.) la roz purpuriu (*Fumaria rostellata* Knaff.) sau chiar la roz închis (*Fumaria schleicherii* Soy.Will). Lungimea separelor variază în funcție de specie de la 0,1-0,5 mm (*Fumaria vaillantii* Loisel.) până la 4-4,5 mm (*Fumaria capreolata* L.). Fructele se diferențiază după formă, lungime și lățime însă unele specii pot fi diferențiate și după natura pedicelului fructifer, care poate fi patul sau curbat. De asemenea lungimea pedicelului fructifer este un caracter morfologic specific pentru fiecare specie.

Keywords: *Fumaria*, fruits and flowers morphology, stereomicroscope

Introduction

In Europe, the *Fumaria* genus (Fam. *Fumariaceae*) includes 56 different species and subspecies [13] characterized as herbaceous and annual plants [10], presenting recumbent or ascending stems [7].

There are seven indigenous species in Romania [11,12]: *Fumaria rostellata* Knaff., *Fumaria parviflora* Lam., *Fumaria vaillantii* Loisel., *Fumaria schleicheri* Soy.Will., *Fumaria officinalis* L., *Fumaria kralikii* Jord., *Fumaria thuretii* Boiss. a variation of species [3]: *Fumaria officinalis* L. (*Fumaria densiflora*) and a hybrid *Fumaria jankae* Hausskn. (*Fumaria rostellata* X *Fumaria schleicherii*) spreading in the hills or lowland areas, through cultures, ditches and ruderal places [1].

The *Fumaria* species have branched stems, alternate and petiolate leaves [9]. They have small zygomorphic white, pink or red flowers including 2 persistent or caducous sepals [8]. The racemic blossoms include short flowers formed of 4 petals, [6] presenting a spurred superior petal while the inferior petal does not have a spur [2]. The fruits are small and indehiscent nucules with straight or curved pedicels [4].

Given the morphological similarities between species, the identification of different taxons is difficult [4] and based on several specific morphological characters: presence or absence of sepals, their length, the shape of the fruit, the length of the fruit pedicel [14] and the length of the fruit pedicel bracteole.

In order to avoid possible confusions between *Fumaria* genus, our study aims for a comparative morphological characterisation of flowers and fruits of the following species: *Fumaria rostellata* Knaff., *Fumaria parviflora* Lam., *Fumaria vaillantii* Loisel., *Fumaria schleicheri* Soy.Will., *Fumaria officinalis* L., *Fumaria jankae* Hausskn and *Fumaria capreolata* L.

Materials and Methods

The aerial parts of *Fumaria rostellata* Knaff., *Fumaria parviflora* Lam., *Fumaria vaillantii* Loisel., *Fumaria schleicheri* Soy.Will., *Fumaria officinalis* L., *Fumaria jankae* Hausskn and *Fumaria capreolata* L. were harvested from the spontaneous flora of Romania, Belgium and France as follows: may 2009 *Fumaria schleicherii* Soy.Will. from Cojocna, Cluj county, Romania; june 2009 *Fumaria vaillantii* Loisel from Bistrița, Bistrița-Năsăud county, Romania; may 2010 *Fumaria rostellata* Knaff. from Virșolț, Sălaj county, Romania); *Fumaria parviflora* Lam. from Săcuieni, Bihor county, Romania; *Fumaria jankae* from Săcuieni, Bihor county, Romania; april 2011 *Fumaria capreolata* L. from Brest, Finistere department, France; may 2011 *Fumaria officinalis* L. from Liege province, Belgium. The species were identified by the Department of Botany, Faculty of Pharmacy, University of Medicine and Pharmacy "Iuliu Hațieganu" Cluj-Napoca, Romania.

The characteristics of flower and fruit parts for the seven species were morphologically compared. A series of photos of the sepals, fruits and fruit pedicels were realized with the assistance of the Wild M3B (X6) stereomicroscope connected to a digital camera DP 200.

Results and Discussion

Morphological studies on flower and fruit parts of the seven *Fumaria* species revealed some similarities and differences (Figure 1-7). The primary parts of the flowers are similar. They are hermaphrodite and composed of four petals and two sepals when the upper petal is spurred and the lower petal is spatulate. The corolla colors for these species are different, ranging from white (*Fumaria parviflora* Lam.) to purplish pink (*Fumaria rostellata* Knaff.) or deep pink (*Fumaria schleicherii* Soy.Will). The calyx and corolla sizes are also different.



Figure 1

Flower (1A- Corolla, 1B-Sepals) and fruit (1C) of the species *Fumaria vaillantii* Loisel

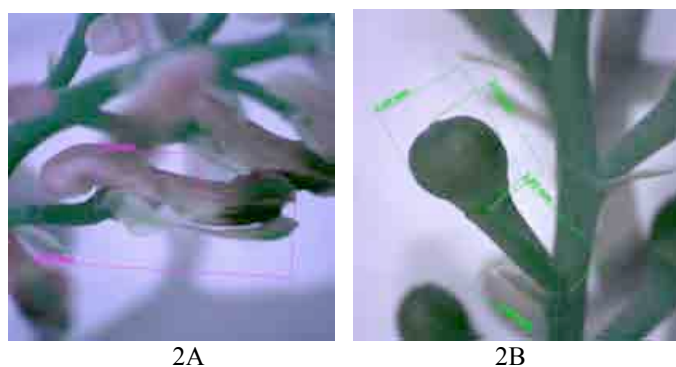
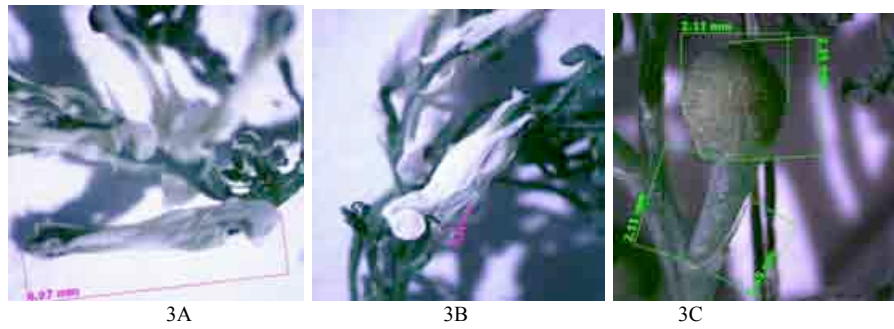


Figure 2

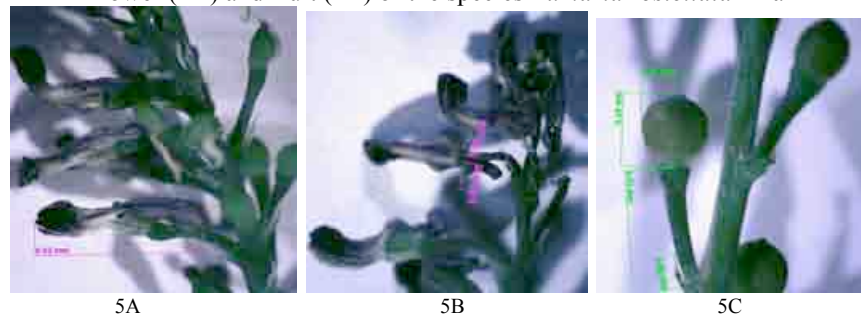
Flower (2A) and fruit (2B) of the species *Fumaria officinalis* L.

**Figure 3**

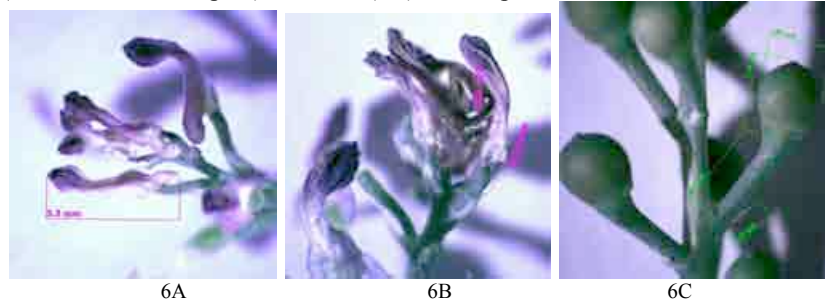
Flower (3A-Corolla, 3B-Sepals) and fruit (3C) of the species *Fumaria parviflora* Lam.

**Figure 4**

Flower (4A) and fruit (4B) of the species *Fumaria rostellata* Knaff

**Figure 5**

Flower (5A-Corolla, 5B-Sepals) and fruit (5C) of the species *Fumaria schleicherii* Soy. Will.

**Figure 6**

Flower (6A-Corolla, 6B-Sepals) and fruit (6C) of the species *Fumaria jankae* Hausskn



Figure 7

Flower (7A) and fruit (7B) of the species *Fumaria capreolata* L.

The fruits of this genus are nucules and the pedicels of fruits are patent, erect or arched-recurved. The 7 species are differentiated by 11 characters as shown in Table I.

Table I
Floral and fruit morphological characters of seven *Fumaria* species

Characters/ Species	<i>F. vaillantii</i> Loisel.	<i>F. officinalis</i> L.	<i>F. parviflora</i> Lam.	<i>F. rostellata</i> Knaff.	<i>F. schleicherii</i> Soy.Will.	<i>F. jankae</i> Hauskn.	<i>F. capreolata</i> L.
Flowering	May- October	May- September	May- September	June- July	May- September	June-July	April- October
Petals color	Pale-pink	Purplish or deeper pink	White or tinged with pink	Purplish pink	Deep pink	Pink	White or creamy white
Wings of upper petal and apex of inner	Blackish- red-purple	Blackish- purple	Blackish-red or purple	Blackish- purple	Dark- purple with green stripe	Blackish- purple with green stripe	Blackish- red
Corolla length	4.5-5.5 mm	6-7 mm	4-5 mm	8.5-9.5 mm	4.5-5.5 mm	3-4 mm	11-12 mm
Sepals length	0.1-0.5 mm	2.5-3 mm	0.3-0.6 mm	3.5-4 mm	0.5-1 mm	0.5-1 mm	4-4.5 mm
Fruits shape	Globulous , smooth, with apex obtuse	Keel- shaped with apex emarginate	Subglobose to ovoid with apex short mucronulate	Ovoid with apex mucronulate	Spherical, smooth with apex apiculate	Ovoid with apex apiculate	Subglobose to ovoid, smooth with apex, obtuse
Fruits width	1.7-1.9 mm	2.4-2.6 mm	2.1-2.2 mm	2-2.2 mm	1.9-2.1 mm	1.9-2 mm	2.1-2.3 mm
Fruits length	2-2.1 mm	2.6-2.8 mm	2.3-2.5 mm	2.2-2.4 mm	2.1-2.3 mm	2.3-2.5 mm	2.4-2.6 mm
Fruits pedicels	Erect	Erect	Erect	Erect	Erect	Erect	Arched- recurved
Fruits pedicels length	0.7-0.9 mm	2.9-3.1	2.1-2.3 mm	2.4-2.6 mm	3.3-3.5mm	1.9-2.1mm	Arched- recurved
Fruits bracts length	0.7-0.8 mm	1.8-2 mm	1.6-1.7 mm	2.1-2.2 mm	0.9 -1.1 mm	1.3-1.5 mm	Arched- recurved

Every species included in this study bears an individual morphological feature as follows: *Fumaria vaillantii* Loisel. has small size sepals ranging from 0.1 mm to 0.5 mm the fruit of *F. officinalis* L. species is keel-shaped with apex emarginated, the corolla of *F. parviflora* Lam species is white, *F. rostellata* Knaff. presents well developed calyx and corolla with sepal length between 3.5-4 mm and petal length between 8.5-9.5 mm. The individual morphological features of *F. schleicherii* Soy. Will. concern the fruit pedicel and the fruit pedicel bracteola: the fruit pedicel length ranges between 3.3-3.5 mm and the fruit pedicel bracteole length ranges between 0.9-1.1 mm which is 1/3 of the fruit pedicel length. *F. capreolata* L. has a curved fruit pedicel, and *F. jankae* Hausskn. is a hybrid and shows intermediate characteristics belonging to *F. schleicherii* Soy. Will. and *F. rostellata* Knaff..

Conclusions

The results of our study designate the fact that each seven *Fumaria* species examined presents individual morphological features. Morphological similarities prove the existence of phylogenetic links between *Fumaria* species while morphological differences point out individual characteristics which allow avoiding possible confusions.

Only the species *Fumaria officinalis* L., officinal in the European Pharmacopoeia 7 Edition, [5] exhibits differential characters regarding the sepal length in the range 2.5-3 mm and globular or keel-shaped fruit with emarginated apex. These features allow the precise identification of this species and avoid substitution with other species belonging to the genus *Fumaria*.

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