

Imperfection and variation in sexually dimorphic *Rhamnus*

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ABSTRACT: A study of floral and vegetative morphology of the genus *Rhamnus* is presented in order to help clarify the sexual dimorphism of the genus. Detailed descriptions of axillary inflorescence and morphology of staminate and pistillate flowers are presented. The presence of a very uncommon incomplete pistillate organs having ovary with ovule and style, but absent stigma within the funnel-calyx of perfect staminate flower is of special interest in *Rhamnus catharticus* L. and *Rhamnus saxatilis* JACQ. The incomplete staminate organs have filament with the anther reduced at the margin hypanthium of perfect pistillate flower. Distinctive characters between male and female plants are presented.

KEYWORDS: imperfection, *Rhamnus*, sexual dimorphism, dioecy

Introduction

The data about sexual dimorphism in *Rhamnus catharticus* L. and *Rhamnus saxatilis* JACQ. are rather confusing in the current literature. In many floras the flowers these species are characterized as dioecious (LINNAEUS 1753), dioecious and polygamous (HALÁCSY 1901; FIORI 1925-1929) or imperfectly dioecious and imperfectly bisexual (FURRER & BEGER 1925; BERTOŤOVÁ 1984), usually unisexual, but monoecious (DAVIS & YALTIRIK 1967; TUTIN 1968).

Material and methods

The study of living plants comprises the male and female individuals in their natural populations of the taxa *Rhamnus catharticus* L. (Tab. 1) and *R. saxatilis* JACQ. subsp. *saxatilis* (Tab. 2) from the Central Europe in the territory Slovakia. *R. catharticus* is currently distributed in

Tab. 1. *Rhamnus catharticus* L., number of studied localities, individuals male (M) female (F) and flowers staminate (S) pistillate (P)

No.	The orographic units	Localities	Individuals		Flowers	
			M	F	S	P
<u>West Slovakia:</u>						
1	Podunajská nížina lowlands	2	10	8	200	100
2	Záhorská nížina lowlands	1	4	6	200	120
3	Malé Karpaty Mts.	1	4	2	200	40
4	Tribeč Mts.	2	24	20	1000	500
<u>East Slovakia:</u>						
5	Šarišská vrchovina highlands	2	4	4	100	100
6	Slanské vrchy Mts.	2	8	16	200	400
Sum		10	54	56	1900	1260

Tab. 2. *Rhamnus saxatilis* JACQ., number of studied individuals male (M) female (F) and flowers staminate (S) pistillate (P)

No.	The orographic unit	Individuals		Flowers	
		M	F	S	P
<u>Southwest Slovakia:</u>					
1	Devínska Kobyla hill	30	30	1000	1000

the territory in low shrub-woodlands, in hilly areas, most often on limestone, at elevations of 200-1000 m (MERCCEL 1994). The occurrence of *R. saxatilis* in the type subspecies in the area studied is restricted to the Devínska Kobyla Hill, near Danube river, on limestone, at elevations of 300-400 m. Population on this locality consists of more than 100 of individuals. The studied locality is on the northern boundary of area of *R. saxatilis*.

The characters of individual plant organs were analyzed during three years (1993-1995) on 11 localities with different ecological conditions. The following characters were scored:

- (1) Number of flowers in inflorescence.
- (2) Number of sepals, petals, stamens and ovules.
- (3) Variation in shape and structure of staminate and pistillate flowers perfect and imperfect of the organs.

Staminate and pistillate flowers in the buds are based to the half March and flower from the beginning of May to the beginning of June, afterwards the staminate flowers with reduced pistillate organs are deciduous in both species.

Results

Floral and vegetative morphology

In both species the flowers are unisexual, dioecious, imperfectly bisexual and imperfectly polygamous, rarely perfect bisexual and perfect polygamous. Imperfection in floral structure of contrary sex have perfectly developed the staminate and the pistillate

flowers. Generally are long pedicellate, perigynous, calyx (3-)5-merous, mostly 4-merous, corolla petals 3 - 5, mostly 4. The flowers are arranged in axillary inflorescence. The inflorescence provides useful quantitative characters to distinguish between male and female plants. In *R. catharticus* the inflorescence in the male plants is (3-)8-flowered (Fig. 2S4), in the female plants (1-) 3-flowered (Fig. 3P4). In population the male shrubs with dull bark and small amount of inflorescences are almost equally represented. The shrubs of both sexes grow together, only rarely the distance is about 50 m. In *R. saxatilis* the inflorescence in the male plants is (1-) 3-flowered, in the female plants 1-flowered.

Staminate flowers

R. catharticus has inflorescence (3-)8-flowered, *R. saxatilis* (1-)3-flowered; petals are 2 - 5, mostly 4, hooded over the stamens, sometimes absent, inserted at mouth of the funnel-calyx, alternating with the sepals on apex of the teeth; stamens are 3 - 5, mostly 4, filaments conical to apex narrow, anthers terminal, equal quadrilocular, divergent on the base. *R. saxatilis* has filaments with rib.

Incomplete pistillate organs are within funnel-calyx on the base. The ovary with ovule 2-to-4 are perfectly developed, style reduced, stigma absent (Fig. 1S2). The rudiments in all studied flowers are developed equally. In *R. catharticus* rarely the style and stigma are perfect developed (Fig. 2S7).

Variation

In axillary inflorescences of *R. catharticus* the number of the flowers 3 - 8 appear on each individual, *R. saxatilis* has 1 - 3. Petals over the stamens are present mostly or absent. Sepals along with petals and stamens is three, four and five, mostly four. Ovules present in staminate are various in number 2 - 4, mostly 3. Reduced styles are bipartite, tripartite, quadripartite and bifid. In *R. saxatilis* are only bipartite and tripartite. In *R. catharticus* rarely are perfect developed with stigmas (Fig. 2).

Pistillate flowers

R. catharticus has the inflorescence (1-)3-flowered, *R. saxatilis* 1-flowered; petals are linear 4-to-5, mostly 4, placed on margin of the hypanthium along with imperfectly developed stamens, alternating with the sepals on base of the teeth. Ovary with ovules are based in middle of the hypanthium. The ovules are two, three or four, mostly three. Style is cylindrical, incised or parted, 3-4 mm long, 0.5 mm wide. Stigma is more or less spatulate (Fig. 1P2), *R. saxatilis* has oval.

Incomplete staminate organs on the margin of the hypanthium have well developed filaments, anthers are reduced or absent (Fig. 1P2a, 3P6). Filaments linear, on the base broader (Fig. 3P7). Only on one locality in Záhorská nížina lowlands (West Slovakia) the anthers with perfect pollen grains were found. The rudiments in all studied flowers are developed equally.

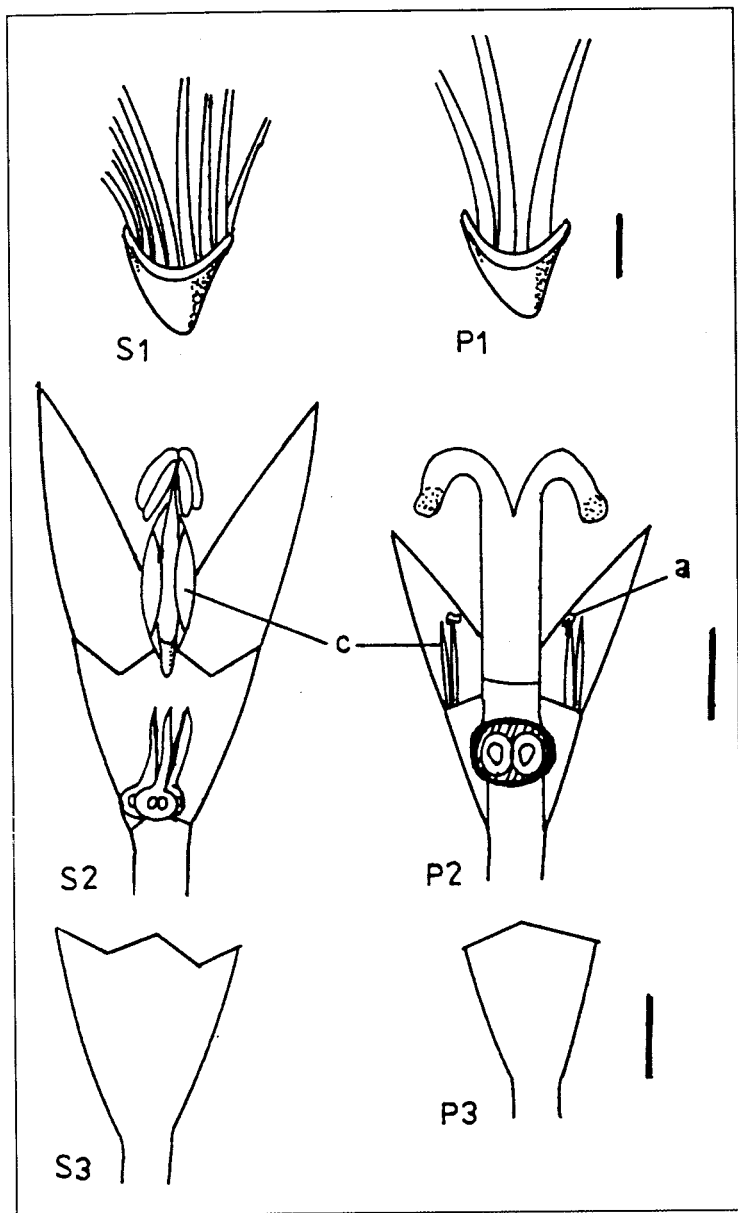


Fig. 1. *Rhamnus catharticus* L. - Main distinctive characters between staminate (S) and pistillate (P) flower. Inflorescence structure: S1-8-flowered, P1-3-flowered. Floral structure: S2 - longitudinal section of staminate flower with imperfectly developed pistillate organs within calyx, stigma absent, petal hooded over the stamen (c). P2 - Longitudinal section of pistillate flower with imperfectly developed staminate organs on margin of hypanthium, anthers reduced (a), petals linear (c). S3 - calyx toothed, P3 - calyx slightly toothed. - (Scale = 1 mm)

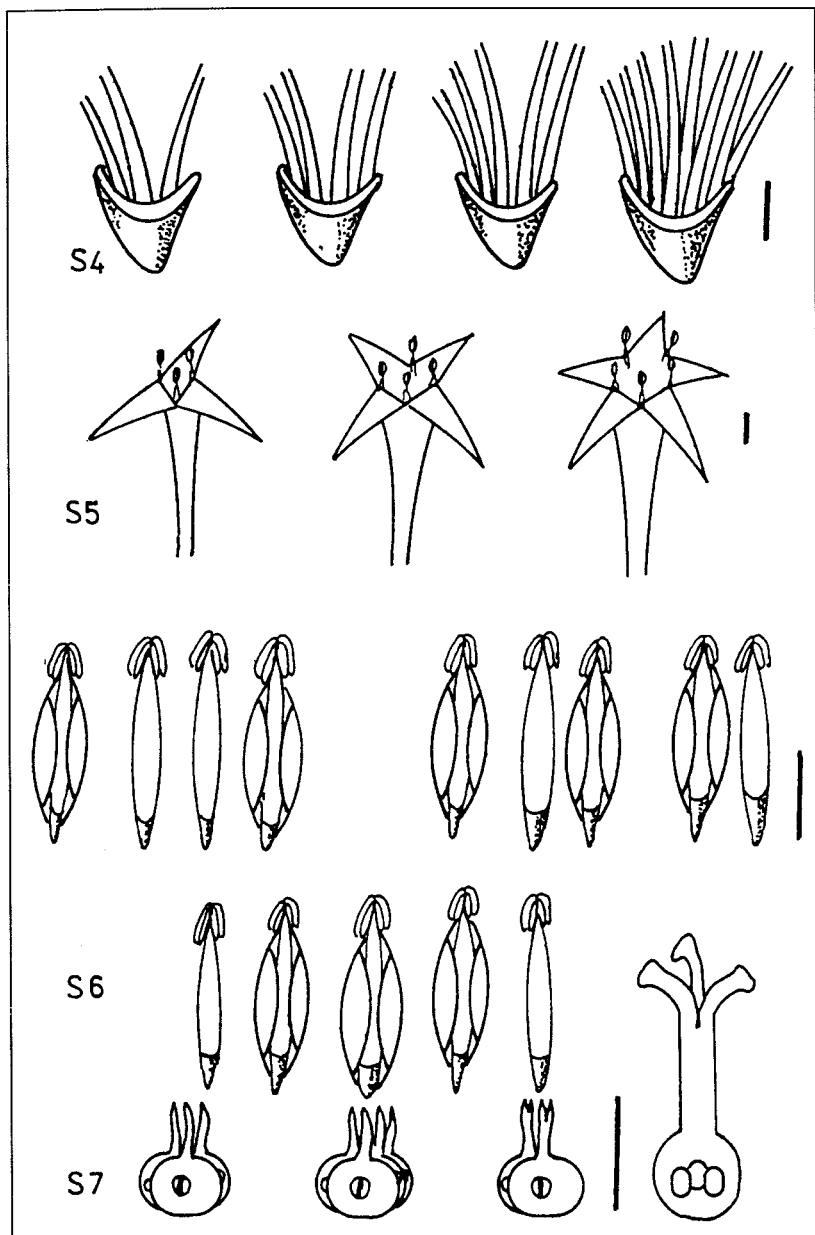


Fig. 2. *Rhamnus catharticus* L. - Variation in number, shape and structure of staminate flowers. S4 - Axillary inflorescence: 3-flowered, 4-flowered, 5-flowered, 8-flowered. S5 - Flower 3-merous, 4-merous, 5-merous. S6 - Petals over stamens are variously present or absent. S7 - Longitudinal section of ovary, ovules three, four and two; reduced styles tripartite, quadripartite, bipartite with bifid, rarely are perfect developed with stigmas. - (Scale = 1 mm)

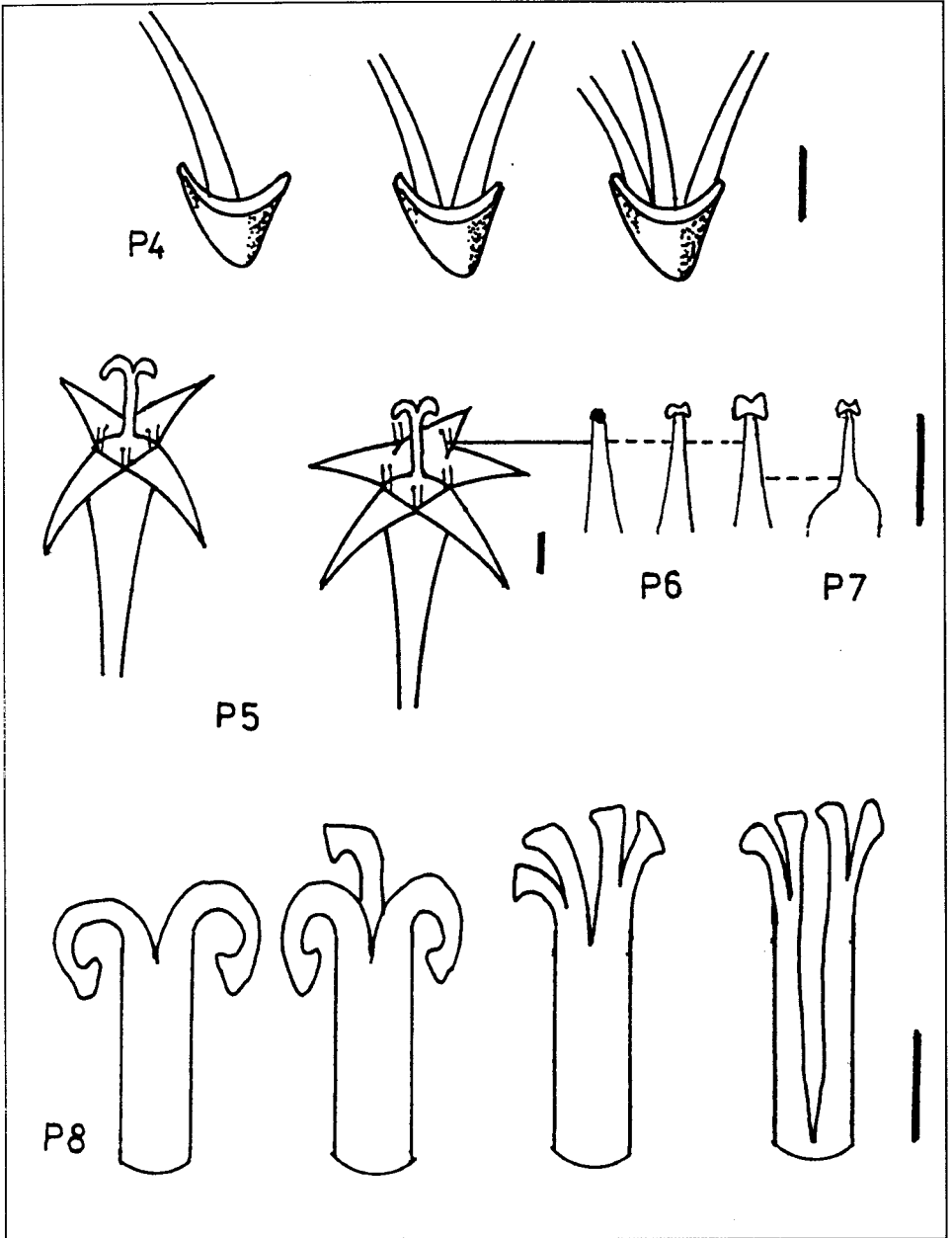


Fig. 3. Variation in number, shape and structure of pistillate flowers. P4 - Axillary inflorescence in *Rhamnus catharticus*: 1-flowered, 2-flowered, 3-flowered, *R. saxatilis* has 1-flowered. P5 - Flower 4-merous, 5-merous. Longitudinal section of stamens, imperfectly developed anthers in *R. catharticus* (P6) and *R. saxatilis* (P7). P8 - Longitudinal section of styles: Bifid, trifold, quadrifid and bipartite in both of species. - (Scale = 1 mm)

Variation

In *R. catharticus* the number of the flowers in axillary inflorescences ranges from 1 - 3, mostly 2, *R. saxatilis* has one flower. Calyx is 4 and 5-merous, mostly 4. Imperfect anthers are dotted and concave. Styles bifid, trifid, quadrifid and bipartite, mostly trifid and quadrifid. There are the populations in Podunajská nížina lowlands comprising the shrubs only with styles trifid and only with styles quadrifid and other with all type (Fig. 3P8).

Conclusion

Rhamnus catharticus and *R. saxatilis* are dioecious, rarely monoecious species. The pistillate organs within staminate flowers are imperfectly developed, but rarely are perfect developed. The staminate organs on margin of the hypanthium of the pistillate flowers are also imperfectly developed, but rarely are perfectly developed. Variation in organs perfectly and imperfectly developed is expressive. The distinctive characters between male and female shrubs were ascertained.

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