

Contribution to the Flower Morphology and Ecology of *Cirsium arvense*

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INTRODUCTION

Cirsium arvense (L.) Scop. is a significant weed occurring nevertheless not only in agricultural crops but nowadays probably more frequently and more abundantly mainly on large uncultivated areas which become reservoirs of diaspores for redistribution of the species into field cultures.

Besides generative reproduction the species is generally known for its ability of intensive vegetative reproduction and considerable attention was devoted to the problem in literature (e. g. Hron et Vodák 1959, Deyl 1964, Holm et al. 1977). Adventitious root buds on amply ramified side roots and on the upper part of the main root, appear already under frozen soil, so that leaf rosettes grow vigorously already early in spring, as at that time the roots contain large amounts of reserve substances. Thus, very soon a whole colony of plants (clone) appears, usually in the form of a circle.

Cirsium arvense reproduces generatively by achenes provided with pappus spread by the wind often to considerable distance from the mother plant. Yet the female plants produce also large amounts of barren achenes and besides that many ovaries do not mature to achenes, also because the ovules are massively consumed by certain species of small beetles.

Despite the problem of generative reproduction was repeatedly discussed in literature, e. g. achene production (Hayden 1934, Lhotská et Kropáč 1985), conditions of their germination (Bakker 1960, Holm et al. 1977, Deyl 1964, Fusjanov 1984, Roiková 1986), maintaining of achene germination capacity (Kohout et Zimová 1973, Deyl 1964, Holm et al. 1977), the question of sexuality of the flowers in this species has not yet been satisfactorily solved.

Some authors assume that *Cirsium arvense* is a dioecious plant. E. g. Detmers (1927) cultivated the species from seeds in connection with the study of flower sexuality finding that the plants were dioecious.

Another group of authors are of the opinion that the studied species belongs to the so-called gynodioecious plants, viz. that there are only female flowers on one individual the other bearing bisexual flowers (e. g. MacLeod 1885, Kugler 1970).

Yet another group of authors admit the existence of female and male plants (i. e. dioeciousness), but also the possibility of achene maturation in the flowers of male plants. E. g. Hodgson (1968) reports finding of male plants bearing both the pollen and seeds. Also Kay (1985) found in the southern part of Great Britain physiologically bisexual flowers in 15 per cent of the male clones (the plants produced 10 to 65 achenes in the head) and a tendency to bisexuality in 11 per cent of the male clones (the plants produced 2 to 10 achenes per head).

As for the representation of the generative organs in the flowers there appear both the stamina and the pistil in all of them. This implies that from the morphological aspect all flowers are bisexual, yet in the male flowers the pistil is suppressed the stamina in the female flowers being not functional. This fact is stressed also by Holm et al. (1977) who, on the basis of literary data and after several years' study of the flowers and flowering of various ecotypes of the species, conclude that in the majority world localities most flowers are functionally unisexual, though they admit that sometimes even functionally bisexual flowers may be produced.

The paper submitted is an attempt to contribute to the solution of the above problems on the basis of the study of flower morphology and biology of male and female clones of the above species in several selected localities on the territory of the Czech Socialist Republic. Apart from the study of flower sexuality (i. e. whether the female and male organs in the flowers are functional) the authoresses also focused on determining morphological characters in the flowers and inflorescences of female and male clones.

OBSERVATION, RESULTS AND THEIR EVALUATION

The study was performed 4 years in 10 selected localities in the Central Bohemian, South Bohemian, North Bohemian and North Moravian regions, prevailing off the cultivated area, where this plant species occurred for a long time and where always clones of male and female plants were found either in close vicinity or mutually not too distantly situated. In none of the above localities or other occasionally visited localities the authoresses were able to confirm, even in isolated cases, fertility of the female generative organs in male flower as reported e. g. by Kay (1985).

The following parameters were studied in the female and male flowers: 1. length of the flower, 2. length of the corollar tube, 3. length of the corollar rim, 4. length and structure of the stamina, 5. length and structure of the pistil.

In the female and male heads the following were studied: 1. diameter of the head observed from above, 2. height of the phyllary, 3. width of the basis of the phyllary, 4. height of the head and 5. number of flowers in female and male heads.

In the study of the individual characters the number of the cases investigated varied between 400 and 600. Only in the follow-up of the number of the flowers in head 320 female and equal number of male heads were studied. Each character was followed in at least 5 to 10 of the studied localities.

Study of the size of flower organs of female and male flowers allowed to draw the following conclusions:

1. The female flowers are on the average 15.4 mm long, while the male ones 16.8 mm, i. e. 1.4 mm longer than the female flowers (= 9.10 per cent).

2. The average length of the corollar tube amounts to 11.5 mm in the female flowers, the average length of the male flowers being 9.9 mm; this implies that the corollar tube of the female flowers is 1.6 mm longer than the corollar tube of the male flowers (16.16 per cent).

3. The average length of the corollar rim amounts in the female flowers to 2.4 mm, that of the male flowers being 4.8 mm (the corollar rim in the male flowers attains approximately double length as compared with the female flowers).

4. The average filament length of the female flowers equals to 12.9 mm, that of the male flowers to 14.4 mm. Thus, in the male flowers, the average filament length of the stamens is 1.5 mm longer than in the female flowers (11.6 per cent). The average length of the anthers of the female flowers is 1.3 mm, that of the male flowers being 4.4 mm. Thus, the male flowers anthers are 3.1 mm longer than those of the female flowers (238.4 per cent).

5. The average pistil length in the female flowers amounts to 18.4 mm, that of the male flowers being 20.4 mm. Thus, pistils of the male flowers are on average 2.1 mm longer than those of the female flowers (= 11.4 per cent).

The above results of measuring the flower organs of female and male flowers of the species studied allow to conclude that the male flowers are generally longer than the female ones. They also have a markedly longer corollar tube than the female flowers, as well as the staminal filament and especially the anther. It is noteworthy that the male flowers has normally developed ovary, style average than the female flowers; the pistil in the male flowers has normally developed ovary, style and stigma. Yet, in all the male flowers which the authoresses studied there was a rudimentary ovula which did not develop any further inside the ovary. Only the corollar tube in the female flowers is longer than in the male ones.

Measuring of the head size of the female and male plants revealed the following data:

1. The average width of the female heads (observing from above) is 17.1 mm, that of the male heads being 26.1 mm, i. e. 9.0 mm more than the average width of the female heads (52.6 per cent).

2. The average height of the phyllary of the female plants amounts to 14.9 mm, that of the male plants equals 13.1 mm. Thus, the female plants have the average phyllary height 1.8 mm greater than the male ones (13.7 per cent).

3. The average width of the phyllary base in the female plants (measured at the broadest spot) equals to 9.3 mm, the average width of the phyllary base in the male ones being 9.7 mm, i. e. only 0.4 mm more than in the female plants (4.3 per cent).

4. The average height of fully flowering head in the female plants is 21.2 mm, that in the male plants being 20.8 mm. The average head height of the female plants is 0.4 mm greater than in the male plants (1.9 per cent).

5. The average number of flowers in the female heads amounts to 99.13, that in the male ones to 112.32, i. e. 13.19 more than the average flower number in the female heads (13.3 per cent).

Results of measuring the above characters in female and male inflorescences demonstrated that it was the width in which they differentiated most. The male plant heads are distinctly broader in observation from above than the heads of the female plants. On the other hand, female plants have distinctly higher phyllary than the male plants. As far as the phyllary base width is concerned, there are only negligible differences between the female and male plants. Male plants have somewhat broader bases of the phyllary than the female ones, on



Photo 1: Female plant of *Cirsium arvense* (L.) Scop.



Photo 2— Male plant of *Cirsium arvense* (L.) Scop.

the other hand, female heads are slightly higher than the male ones (photos 1, 2).

The pronouncedly greater width of fully flowering male heads is connected with the fact that 1. the male flowers have longer corollar rim than the female flowers so that they are more patent than the female flowers whereby the head increases its width, 2. the male flowers have longer stamina, the long fertile anthers reach the upper edge of the corollar rim and pull the corollar cusps still more, whereas the short sterile anthers of the female flowers hardly protrude from the corollar tube, 3. the male heads have lower phyllaries than the female ones, so that the flowers can lean out from the head, 4. the number of flowers in male heads is somewhat higher than in the female ones.

The above data on the size of female and male heads do not justify to conclude that the male heads are considerably smaller than the female ones as reported e. g. by Hron et Vodák (1959) and Deyl (1964). The data on the width of the head — 15 mm — reported by Lhotská (1957), are somewhat lower than the data on the width of the heads of female plants found by the authoresses. Yet the values of the head width of the male plants found by the authoresses approach more or less to the values reported by Reed (1970), viz 2 to 2.5 cm, nevertheless also regardless of the flower sexuality.

Study of the morphological characters in female and male flowers and inflorescences of *Cirsium arvense* demonstrated that the female and male flowers and inflorescences distinctly differed. The mutual differences are visible to the naked eye, directly in natural conditios.

SUMMARY

Study of the morphology and ecology of the flowers and inflorescences of female and male clones of *Cirsium arvense* in 10 selected localities in the Czech Socialist Republic revealed the following:

1. All studied flowers of female and male clones had stamina and a pistil. In the female flowers there were nevertheless stamina with short filament and a short, not functional and rudimentary anther, whereas in the male flowers the pistil was normally developed and even longer than in the female flowers; notwithstanding, all male flowers which the authoresses studied contained rudimentary ovula in the ovary.

Thus, from the functional point of view all the flowers observed were unisexual and the studied species had the characters of a dioecious plant. Yet with respect to the existence of normally developed pistil in the male flowers it cannot be excluded that there could not develop a normal ovula capable of fertilization in the ovary of some male flowers. On the other hand, the function of stamina in female flowers cannot be assumed, due to reduction of the anthers.

2. Female and male flowers mutually differ in the first place by the length of the corollar rim which in the male flowers attains approximately double length as compared with the female flowers. The male flowers are also somewhat longer (9.1 per cent) than the female ones.

3. Female and male heads mutually differ in the first place by their width (when observed from

above). The diameter of the male heads is larger approximately by one half (52.6 per cent) than in the female heads. The female heads have, on the contrary, a somewhat higher phyllary (13.7 per cent) than the male ones.

The differences between the female and male flowers and inflorescences are easily visible to naked eye.

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