



## Ecological-anatomical characteristic and volatility of *Ranunculus arvensis* var. *spinosus*, genus *Ranunculus* L. (*Ranunculaceae* Juss.)

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### Abstract

*Ranunculus arvensis* var. *spinosus* is a cosmopolitan species distributed in Europe, the Mediterranean, Southwest Asia, North Africa. In Bulgaria, the species grows in the damp meadows and grassy areas along roads and ditches from 0 meters above sea level to 1000 m. altitude. *Ranunculus* species found along the Black Sea coast, Thracian Lowland, Vitosha, Rodopi. *Ranunculus arvensis* var. *spinosus* is pungent and poisonous. They contain alkaloids and belong to the noxious weed meadow. *Ranunculus arvensis* var. *spinosus* bloom from May to July. Cultivated plants in Plovdiv compared with that of Targovishte (where they come), are characterized by volatility, which characterizes them as a mesophyte. These have a larger basic epidermal cells and larger stomata. These plants are approach in anatomical features to plants in Ahtopol, where the climate is more humid than the Northeastern Bulgaria.

**Keywords:** *Ranunculus*, anatomy, volatility

### Introduction

Genus *Ranunculus* L. (Buttercups) is a widespread and economically important genus of the family *Ranunculaceae* Juss. In the flora of the world it is described more than 200 species, which are grouped in 50 genus. Genus *Ranunculus* L. is the only one, which is widespread in all continents.

Buttercups are bulbous plants which come from the region of the Mediterranean basin. The genus *Ranunculus* e morfologicheski well-defined, but not enough Histologically studied. The genus *Ranunculus* is well-defined morphological, but not enough studied. (Tamura 1995) investigated the plasticity in new fields, but also rapid speciation, adaptability to a wide range of climatic changes, short life cycle. This is an opportunity for a broad distribution over large areas (Sarukhán, 1973).

Some of the species of the genus *Ranunculus* have specific environmental requirements, resulting in only limited distribution. Much of buttercups found in a variety of soil and climatic conditions (Sarukhán, 1974).

According of the Flora of Bulgaria the morphological characteristics of *Ranunculus*

morphology-anatomical characteristics of fruits and seeds. Many species of the genus *Ranunculus* have economic importance. They are used for medicinal purposes, destroying the insecticidal and acaricidal (Malacha, 1993). Some species are used as ornamental plants (Ovczinnikov, 1937).

The study on the polymorphism of intraspecific variability in the genus *Ranunculus* is of the particular interest, as many species have significant morphological variability. In general, the genus *Ranunculus* may be at a higher power of

*Ranunculus arvensis* var. *spinosus* are: Stems are 20-60 cm tall. The stem and basal leaves are almost identical in shape, lobed. The flowers are pale yellow, small. The nuts are with longer or shorter spikes (Flora of Bulgaria. Флора на България – 151 стр 1970 г.

It is distributed across crops, grass and overgrown as weeds, up to 1000 m.

The aim of the study was to make the anatomical characteristics of different populations of *Ranunculus arvensis* var. *spinosus* and establish the variability of these populations.

## Material and methods

Four populations *Ranunculus arvensis* var. *spinosus* are investigated: three of them are natural populations – Targovishte, Ahtopol and Sofia and one of them is cultivated – Plovdiv, which are with various environmental performance, which in main extend showed the parameters of environmental variability. Anatomical and morphological indicators of stem and leaves are analyzed.

The geographical coordinates of the settlements are:

Targovishte – Northeastern Bulgaria, 170 m altitude 43° 15' 0" N, 26° 34' 58.8" E;

Ahtopol – South Black Sea Coast, 20 m altitude 42° 6' 0" N, 27° 57' 0" E;

Sofia – Western Bulgaria, 590 m altitude 42° 41' 51.2" N, 23° 19' 25.1";

Plovdiv - Upper Thracian lowland, cultivated with plants from Targovishte, 130 m altitude 42° 8' 36.11" N, 24° 45' 3.71" E.

It is analyzed anatomical and morphological parameters of stem and leaves, fixed in 75% alcohol. From each population are examined 10 plants. The results are mathematically processed and presented as the average of obtained from 20-30 measurements, including the standard deviation.

## Results

### 1. Leaf

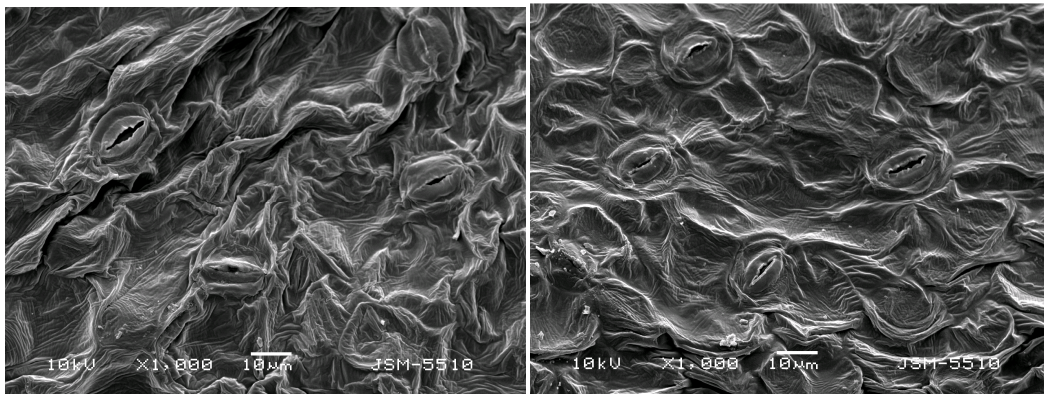
It is investigated the following parameters of the leaves: the length of the basic cells, the width of the basal cell and the height of basic cells of the top and and the bottom leaf epidermis of plants from all four populations.

The length of the top epidermal cells ranged from 357,5±2,16 µm to 432,1±2,37 µm, and the bottom leaf epidermis varies from 361,9±2,01 µm to 425,3±2,03 µm. The smallest length of the basic epidermal cells is of the plants located in Targovishte while the biggest one is of the plants from Ahtopol. There are no major variations in the width of the top epidermal cells - from 21,3±1,71 µm in Sofia to 25,9±1.35 µm in Ahtopol. Larger variations are observed in the width of the bottom epidermal cells - from 19,6±1,63 µm in Sofia to 27,7±2,25 µm in Ahtopol. The height of the top leaf epidermis varies from 22.9±1,48 µm (Sofia) to 31,1±2,15 µm (Ahtopol). There were no big differences in the height of the main epidermal cells of the bottom epidermal cells. The data are between 31,0±1,63 µm for plants from Ahtopol and 37,2±1,49 µm for cultivated plants in Plovdiv. The data are presented in Table 1.

**Table 1** Anatomical characteristic of the basic cells of the leaf epidermis

Taxon	Habitat	Top (ad) leaf epidermis, µm			Bottom (ab) leaf epidermis, µm		
		Length	Wdth	Height	Length	Wdth	Height
R. arvensis var. spinosus	Targovishte	357,5±2,16	23,2±1,12	23,7±2,14	361,9±2,01	20,9±1,65	35,3±1,15
	Ahtopol	432,1±2,37	21,6±0,95	31,1±2,15	413,4±2,05	27,7±2,25	31,0±1,63
	Sofia	385,1±2,07	21,3±1,71	22.9±1,48	373,4±2,01	19,6±1,63	32,7±1,35
	Plovdiv	429,4±2,14	25,9±1.35	24,3±1,53	425,3±2,03	25,3±1,09	37,2±1,49

### 2. Stomata



**Fig. 1** Scanning of the stomata in the bottom leaf epidermis in plants from Targovishte

**Fig. 2** Scanning of the stomata in the bottom leaf epidermis in cultivated plants in Plovdiv

The structure of the stomata in the bottom leaf epidermis in plants from Targovishte (Fig. 1) and in plants from Targovishte, but cultivated in Plovdiv (Fig. 2) of *R. arvensis* var. *spinosus*, is represented. By its location the stomata are less sunk than those of epidermal steam.

It is investigated the following parameters of the stomata – the length, width and number of stomata  $\text{mm}^2$  of the top and the bottom leaf epidermis. The results were compared between the

all four populations - Table 2. The shape of the stomata, expressed by a ratio of length: width is almost the same in the both of the leaf epidermis (1.1 to 1.3). Larger numbers of stomata are located in the bottom epidermal leaf from  $32,1 \pm 1,75 \text{ pc/mm}^2$  in Targovishte to  $41,3 \pm 1,54 \text{ pc/mm}^2$  in the cultivated plants in Plovdiv. The stomata of the top leaf epidermis ranged from  $29,4 \pm 1,59 \text{ pc/mm}^2$  to  $33,5 \pm 2,59 \text{ pc/mm}^2$  in the plants from Plovdiv.

**Table 2** Anatomical characteristic of the stomata

Taxon	Habitat	Stomata of the top (ad) leaf epidermis			Stomata of the bottom (ab) leaf epidermis		
		Length $\mu\text{m}$	Width $\mu\text{m}$	Amount $\text{mm}^2$	Length $\mu\text{m}$	Width $\mu\text{m}$	Amount $\text{mm}^2$
<i>R. arvensis</i> var. <i>spinosus</i>	Targovishte	$36,3 \pm 1,21$	$31,7 \pm 2,45$	$29,4 \pm 1,59$	$39,7 \pm 2,52$	$32,4 \pm 1,79$	$32,1 \pm 1,75$
	Ahtopol	$39,7 \pm 1,36$	$30,6 \pm 2,14$	$36,3 \pm 1,98$	$45,3 \pm 2,12$	$34,1 \pm 1,65$	$36,2 \pm 1,32$
	Sofia	$36,7 \pm 2,06$	$33,1 \pm 1,52$	$38,2 \pm 1,74$	$35,1 \pm 1,96$	$39,3 \pm 2,14$	$38,4 \pm 1,32$
	Plovdiv	$39,2 \pm 1,63$	$33,5 \pm 2,59$	$40,1 \pm 1,90$	$40,3 \pm 2,31$	$36,2 \pm 2,65$	$41,3 \pm 1,54$

### 3. Steam

There is studied the basic parameters of the flower steam – the length of the main cell, the width of the cells and stomata amount. The length of flowering steam cells varies from  $352,1 \pm 1,75 \mu\text{m}$  in plants from Targovishte to  $419,1 \pm 1,98 \mu\text{m}$  in plants from Kiten. The length of the flowering streams in cultivated plants in Plovdiv ( $401,9 \pm 2,13 \mu\text{m}$ ) approach to this in plants from Ahtopol

( $419,1 \pm 1,98 \mu\text{m}$ ). The smallest width of the main flowering stem cells are in plants from Sofia -  $29,1 \pm 2,15 \mu\text{m}$ , and the largest cells are in Plovdiv -  $37,3 \pm 1,26 \mu\text{m}$ . The width of the cultivated plants was similar to this from Ahtopol. The largest number of stomata from flowering stem has in plants from Plovdiv and Targovishte -  $46 \text{ mm}^2$ . The results are presented in Table 3.

**Table 3** Anatomical characteristic of flowering stem

Taxon	Habitat	Length $\mu\text{m}$	Width $\mu\text{m}$	Amount $\text{mm}^2$
	Targovishte	$352,1 \pm 1,75$	$39,1 \pm 1,42$	$41,2 \pm 2,32$
	Ahtopol	$419,1 \pm 1,98$	$34,3 \pm 1,46$	$45,4 \pm 1,96$
	Sofia	$374,2 \pm 1,69$	$29,1 \pm 2,15$	$42,7 \pm 1,52$
	Plovdiv	$401,9 \pm 2,13$	$37,3 \pm 1,26$	$45,9 \pm 1,72$

### Discussion

A large part of buttercups found in a variety of soil and climatic conditions. (Tamura, M, Wang,). In general, the type *Ranunculus arvensis* has a high capability of plasticity in new areas. They are characterized by adaptability to a wide range of climate change, which are an opportunity to spread over large areas. Many species have significant morphological variability (Salisbury J.). Exactly, these are the arguments in which we focused our studies to demonstrated the variability of the species *Ranunculus arvensis* depending on their habitat.

The main variable parameter in plants of the all four populations is the length of the top and the bottom leaf epidermal. The plants taken from Targovishte and grown in Plovdiv vary significantly

with the values of length of leaf epidermal (top and bottom) than those grown in Targoshte. The cultivated plants are close to length of upper and lower leaf epidermis to those of Ahtopol, where the climate is more humid, compared to Targovishte. The same pattern was observed for the length of stomata on top and bottom leaf epidermal. Cultivated plants from Targovishte in Plovdiv were with the same anatomical stomata parametersq which closer them to those of Ahtopol rather than those of their habitat. Width and height of the main epidermal cells did not differ significantly.

The plants taken from Targovishte and grown in Plovdiv vary significantly with the values of length of leaf epidermal (top and bottom) than those grown in Targovishte.

The length of the flowering stems in population grown in Plovdiv is close to that in Ahtopol. The number of stomata in the flowering cell stem is larger in cultivated plants compared to those of their natural habitat.

#### Conclusion

The analysis of the investigated anatomical parameters of the stems and leaves suggests that the most variable is the length of the top and the

bottom epidermal cells and the less variable is the size and number of stomata.

The cultivated plants in Plovdiv in comparison with those of Targovishte (origin) are characterized by variability which characterizes them as a mesophytic. They have a larger primary epidermal cells and larger stomata. These plants are close in anatomical features to plants in Kiten, where the climate is more humid compared to northeastern Bulgaria.

#### References

- Iordanov, D., 1970. Flora of Bulgaria, 4, p.151.
- Malach, E., 1993. Географическое видов родов лютик (*Ranunculus*) L. флоры Росического Дальнего Востока /Комаровское чтения- Владивосток, p. 82-106.
- Ovczinnikov, P., 1937. *Ranunculus*. Flora URSS, vol. VII. Ranales and Rhoeadales. Botanicheskii Institut Akademii Nauk USSR, Moscow, USSR, p. 351–509.
- Salisbury J. 1934. On the morphology, ecology and distribution of *Ranunculus lenormandii* and *R. hederaceus*. J. Bot. Land., 72, p. 185-196.
- Sarukhán, J., Harper, J., 1973. Studies on plant demography: *Ranunculus repens* L., *R. bulbosus* L., and *R. acris* L. I. Population flux and survivorship. Journal of Ecology, 61, p. 675-716.
- Sarukhán, J., 1974. Studies on plant demography: *Ranunculus repens* L., *R. bulbosus* L., and *R. acris* L. II. Reproductive strategies and seed population dynamics. Journal of Ecology, 62, p.151-177.
- Tamura, M., 1995. Angiospermae. Ordnung Ranunculales. Fam. Ranunculaceae. II. Systematic Part. p. 223–519.
- Tamura, M. 1963. Morphology ecology and phylogeny of the Ranunculaceae II. Sci. Rep. Osaka Univ. 12, p. 140-156.
- Wang, W., 1995. Revision of *Ranunculus* (Ranunculaceae). Bull. Bot. Res. North-East. Forest. Univ. 15, p. 1-179.