

RESEARCH ARTICLE

(Open Access)**Evaluation of genetic diversity of cowslip populations (*Primula veris* L.) in Kosovo, based on some phenotypic traits and indicators.**MUZAFER LUMA¹ NDOC FASLIA²¹Agricultural Faculty, University of Prishtina, Kosovo.²Department of Plant Sciences and Technologies, Agricultural University of Tirana, Albania*Corresponding author: e-mail: muzafperluma69@gmail.com**Abstract**

Kosovo's territory is very rich in medicinal plants, and one of these plants is cowslip (*Primula veris* L.), which grows in almost all areas of the country. The study is focused in the western and eastern parts of Kosovo, in which are collected 20 cowslip samples, that represent 10 typical populations of this plant, distributed throughout the country. During three years (2016-2018), the populations included in this study, were analyzed for a number of bio-morphological indicators, as well as chemical analysis of the phenol content in flowers and roots are carried out.

For the analyzed populations, the plant phenological stages have been carefully observed, and a number of indicators and features have been measured. These phenotypic features and indicators have to do with: the number of flowering stalks, plant height, the number of leaves per plant, the size of the leaf, the number of flowers per plant, color of the flowers and leaves, the number of seeds, the type of the root system, etc. From the data obtained for each sample, the average parameters for each population are calculated, and then a statistical data processing is done. Based on the data processing, it is very evident that cowslip populations are characterized by a great diversity, between populations, as well as within the populations themselves. Diversity is present in the plant height, the height of the flowering stalks, the number of flowers per plants, the time of flowering and fructification etc. Some of these populations, such as those collected in Leqenat (P1M1) and Gollak (P8M1), have a great interest to be cultivated by the farmers, in the territory of Kosovo.

Keywords: plant diversity, plant population; phenotypic traits; chemical analysis

Introduction

Because of a very favorable geographic position of Kosovo, as well as the climatic and soil factors, the plant species diversity in this region is very large. There are about 1800 plant species in Kosovo, of which about 300 species are classified as medicinal and wild fruit tree species (Millaku 2010).

The aromatic and medicinal plants in Kosovo represent a great economic potential, for a sustainable rural development, as well as for the increase of income of farmer families, living in these rural areas.

Among the medicinal plants, that are grown in Kosovo, cowslip (*Primula veris* L.) is a very important plant, since it is collected, processed and marketed, for use in the pharmaceutical industry, due

to the high content of phenols in flowers and roots. In spite of the great interest, cowslip plant is not studied in details as a medicinal plant, both in terms of its diversity and for the ability to use some wild populations of this plant, for extensive production in Kosovo.

The objective of this study, is to identify and evaluate some cowslip populations in the eastern and western parts of Kosovo, as well as, to assess the genetic diversity of these populations, based on some phenotypic traits and indicators.

The purpose of the study is that, based on the diversity among the cowslip populations, to select some of these populations that have better traits, in terms of morphological and chemical indicators of

roots and flowers. These populations can be used, for cultivation on open field, by farmers in Kosovo.

Materials and methods

The studied and evaluated plant material, is collected in 10 sites, distributed in the eastern and western parts of Kosovo. A total of 20 samples have been collected, representing 10 typical cowslip populations. The territory where the samples are collected, has a large variation in height above sea level. The collection of the plants, has started at the altitude of about 770 m over the sea level in Radishevë, and has ended at a height of approximately 1730 m over sea level in Rashkodol.

Field sampling is based on the Marshall & Brown method, which guarantees the collection of the maximum diversity of populations, included in the study.

For each population, two samples have been taken, which are approximately 10 km away from each other. For each sample, are taken 20 plants, at a distance of 50-100 m, from each other. For the evaluation of the bio-morphological variation, a total of 15 indicators have been described, of which, 10 are for quantitative features, and 5 for qualitative features. Quantitative features taken in the study are: the height of the plant; the diameter of the stalk; number of leaves in rosettes; the size of the leaf, the number of flower stalks per plant; the length of the flower stalk; number of flowers per plant; the number of seeds per flower; number of seeds per plant.

While the qualitative features taken in the study are: hair of the stalk; distribution of the leaves on the stalk; leaves shape; color of the flower ; the color of the calyx etc.

After collecting of the samples, measurements were made for each plant, and an average was calculated for each sample, as well as the average indicators for each population. For the main biomorphologic indicators, the correlation analysis of the features (Plascak 1993) was performed, based on the level of correlation: 0-0.1 no correlation; 0.1-0.25

very weak correlation; 0.25-0.4 weak correlation; 0.4-0.5 moderate correlation; 0.5-0.75 strong correlation; 0.75-0.9 very strong correlation; 0.9-1 fully correlation.

Results and discussion

For each plant, included in the sample, measurements were made for some phenotypic indicators, and then the average for each sample was calculated. After this, the average was calculated for each of 10 populations, included in the study. The data for each population are presented in the table below:

For all indicators related to biomorphological features, correlation coefficients were calculated in order to analyze the level of correlation between the studied features.

Based on the data obtained from the processing, it results that there are very strong correlations between the height of the plant and the length of the flowering stalk ($r = 0.92$); there is a moderate strong correlation between the height of the plant and the number of seeds per flower ($r = 0.59$); as well as between the height of the plant and the number of seeds for plants ($r = 0.58$).

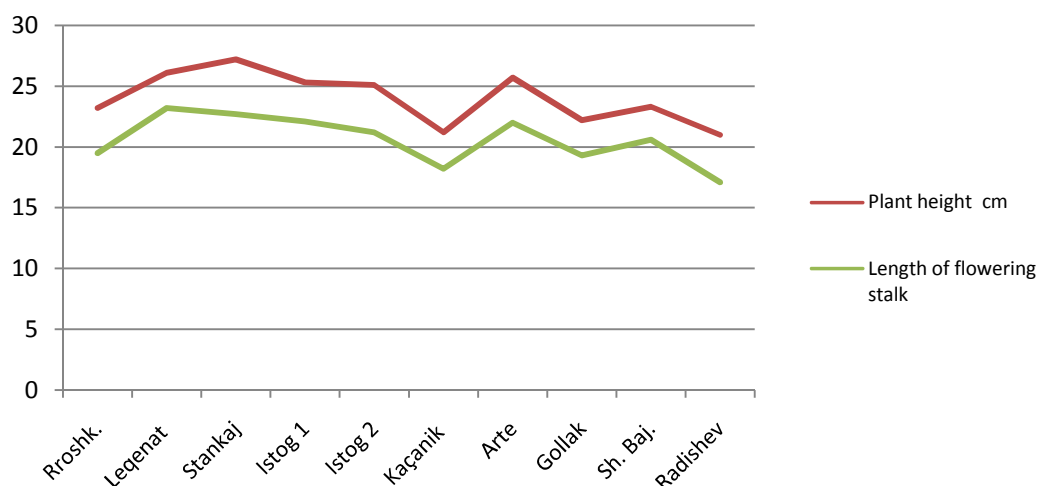
Between the height of the plant and the number of leaves per plant, there is a negative correlation ($r = -0.08$).

The correlation between the flowering stalk length and the number of stalks per plant, results to be poor ($r = 0.26$); also between the length of the flowering stalk and the number of seeds for flowers ($r = 0.32$). A moderate correlation exists between the flowering stalk length and the number of flowers per plant ($r = 0.47$); while strong correlation exists between the length of the flowering stalk and the number of seeds for plants. ($r = 0.57$).

Referring to the data on the table, for the phenotypic indicators, there is noted a high diversity among the populations, regarding the height of the plant, the diameter of the stalk, the number of leaves in rosettes, the number of seeds per plant, etc.

Table 1. Main phenotypic indicators

No	Populations	Phenotypic indicators										
		Altitude (m)	Plant height (cm)	Diameter of the stalk (mm)	No. of leaves per plant	Leaf length (cm)	Width of the leaf (cm)	No. of flowering stalks per plant	Length of the flowering stalk (cm)	No. of flowers per plant	No. of seeds per flower	No. of seeds per plant
1	Rroshk.	1672	23.2	1.7	5.3	6.2	3.7	1.35	19.5	10.1	34.25	352
2	Leqenat	1513	26.1	2.25	11.5	6.7	3.75	2.6	23.2	22.5	31.5	550
3	Stankaj	1525	27.2	2.20	5.8	7.5	4.2	1.35	22.7	11.5	28.6	335
4	Istog 1	1500	25.3	1.85	7.2	4.78	2.6	1.75	22.1	9.2	37.5	550
5	Istog 2	1594	25.1	2.3	7.6	4.7	2.5	1.6	21.2	11.5	37.8	450
6	Kaçanik	950	21.2	2	7.5	4.45	2.2	1.55	18.2	14	28	410
7	Arte	900	25.7	2	7.7	4.6	2.56	1.6	22	14.1	33.6	480
8	Gollak	940	22.2	1.63	5.6	3.5	1.7	1.45	19.3	11.5	29.2	320
9	Sh. Baj.	992	23.3	1.8	6.5	4.2	2.5	1.5	20.6	12.3	32	390
10	Radishev	770	21	1.6	6.7	4.6	2.7	1.5	17.1	9	30.6	285

**Figure 1.** Variation for plant height and length of flowering stalks

The data show that the highest plants are those of the population taken in Stankaj (27.2 cm), while the plants with the lowest height are those of the population taken in Radisheve (21 cm).

Related to the flowering stalk, plants with the greatest length are those of the population collected in the Leqenat (23.2 cm) and with the smallest length, are those of the population collected in Radisheve (17.1 cm).

Referring to the data obtained from the measurements, it is shown that there is a great

diversity for indicators: the diameter of the stalk, the number of leaves per plant and the size of the leaves. The largest number of leaves per plant, has the population taken in Leqenat (11.5) and the smallest number, has the population taken in Rroshkodol (3.5).

Also for the number of flowers per plant there is a great variation. The largest number of flowers for plants has the population taken in Leqenat (22.5) and the smallest number, the population collected in Radishevë (9).

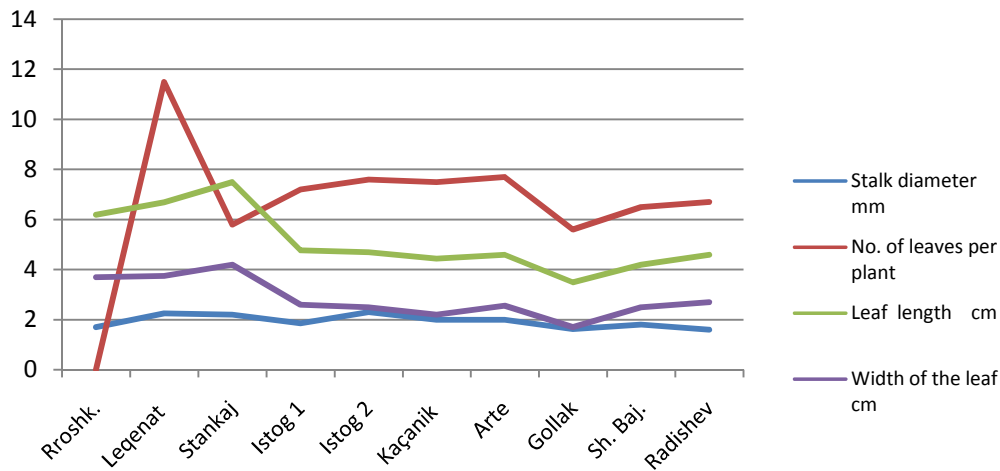


Figure 2. Variation for the stalk diameter, number of leaves and leaf dimensions

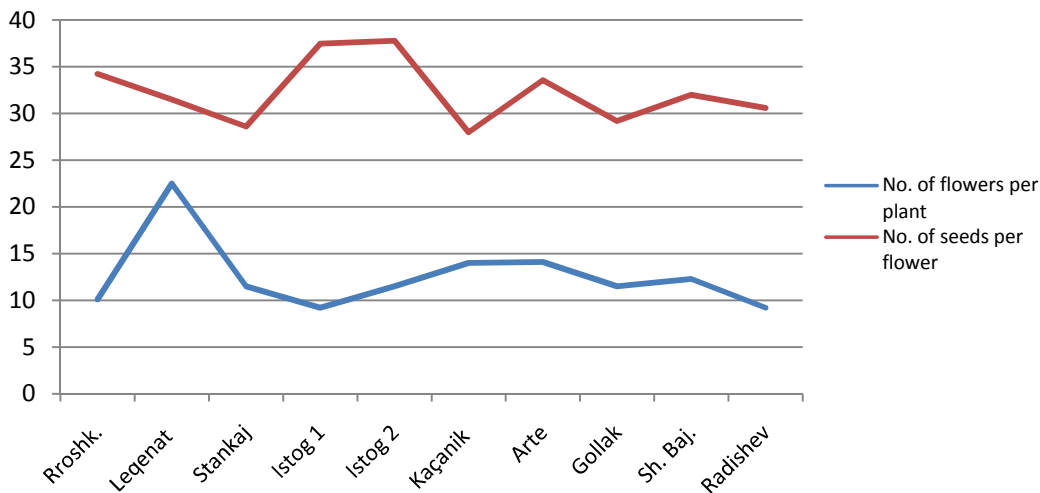


Figure 3. Variation for number of flowers per plant and number of seeds per flower

Conclusions

Cowslip plant is very common and widespread in the territory of Kosovo, and has a very large biomorphological diversity, both between the populations and within the populations themselves.

There is a significant variation in terms of the height of the plant, the number of flowering stalks per plant, the number of flowers for plant, the number of seeds for plant and so on.

Diversity for biomorphologic indicators is heavily influenced by climatic conditions, especially by the altitude over the sea level.

Some cowslip populations, such as those collected in Leqenat, Gollak and Kaçanik regions, are of a high interest to be selected and cultivated for extensive production by farmers in Kosovo.

References

1. Aliu, S; Millaku, F; Gaqshi, B; Morphological differences of cowslip populations in different habitats in Republic of Kosovo. (2011)
2. Harborne, J.B. Comparative biochemistry of the flavonoids—VII, Correlations between flavonoid pigmentation and systematics in the family Primulaceae. *Phytochemistry* 7, 1215–1230. (1998)

3. Millaku F; Flora sub alpine dhe alpine e Alpeve Shqiptare (Kosove) . (1999)
4. Millaku F; Inventari Bimët mjekesore Aromatike dhe Pemët Frutore të Egra në Kosovë. (2010)
5. Milligan G.W. An Examination of the Effect of Six Types of Error Perturbation on Fifteen Clustering Algorithms,” *Psychometrika*, 45, 325–342. (1980)
6. Morozovska M; Krzakova M; Genetic variation in natyral and cultivated populations of *Primula veris* L. *ACTA BIOLOGICA*, series Botanica 45/2 177-182 (2003)
7. Papadhopulli, G; Bimët Mjekesore te Shqipërise. (1976)
8. Paris R; On the flavonoids of native species of *Primula*. Presence of a heteroside of kaempferol in the flowers of *Primula officinalis* Jacq. *Ann. Pharm. Franc*, 17, 331–335. (1979)
9. Rexhepi F; Flora e maleve te larta te Kosoves (1986)
10. Richards J. *Primula* Second Ed. Portland, OR, USA: Timber Press.(2003)
11. Tukey J. A problem of multiple comparisons,” Dittoed manuscript of 396 pages, Princeton University.(1993)