Scientific Papers. Series B, Horticulture. Vol. LXVII, No. 1, 2023
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

PRELIMINARY RESULTS REGARDING THE BEHAVIOR OF SOME *CAMASSIA* SPECIES IN IAŞI ECOLOGICAL CONDITIONS (NORTHEASTERN ROMANIA)

Alina-Ștefana OZARCHEVICI, Maria APOSTOL, Ciprian CHIRUȚĂ, Lucia DRAGHIA

University of Life Sciences "Ion Ionescu de la Brad" of Iași, 3 Mihail Sadoveanu Alley, Iasi, Romania

Corresponding author email: lucia@uaiasi.ro

Abstract

Camassia genus (Asparagaceae family) includes bulbous herbaceous plants native to North America where they have been cultivated for over 7000 years, especially for food purposes. In this paper, the behavior of two species of Camassia (C. quamash and C. leichtlinii), cultivated in the experimental field of University of Life Sciences of Iasi, Romania, was evaluated. The data obtained in the period 2021-2022 indicate the appropriate adaptation of the two Camassia taxa in the ecological conditions of Iași. A greater vigor of the C. leichtlinii plants was evident, respectively taller flower stems, with longer inflorescences, larger and numerous flowers. The correlations between the different morphological characters highlighted the existence of the positive correlation in most cases, stronger being between the height of the stems and the length of the inflorescences, and between the length of the inflorescences and the number of flowers/ stem. Negative correlations in both species were recorded between the number of flower stems/ plant and the number of flowers/ stem. From the phenological point of view, the initiation of vegetation and the appearance of flower stalks took place approximately simultaneously, instead, flowering was about 14 days earlier in C. quamash.

Key words: *camas, ornamental value, characters correlation.*

INTRODUCTION

Geophytes, defined as plants with underground organs specialized in the storage of reserve substances, are known for their importance, especially in food, being valued for their nutritional value, some considering that they could have played a particularly role in man evolution (Fulkerson & Tushingham, 2021; Carney et al., 2021). Also, many geophytes are plants with recognized ornamental value (Cantor, 2016; Toma & Petra, 2020; Draghia, 2011).

This category also includes *Camassia*, which are less cultivated in Romania, although they have special decorative properties. That is why they deserve more attention, as they can represent very good variants in completing the assortment of perennial flowering plants.

Camassia Lindl. is a genus of bulbous plants endemic to North America (Figure 1), identified in 31 US states and three Canadian provinces. The center of diversity for *Camassia*is considered to be southwestern Oregon, given that most species and subspecies of the genus have been identified in this area (Beckwith, 2004). It is an old genus, with shirt pollen being identified in sediments from regions located in the northwestern USA dating back to approx. 70000 years (Thoms, 1989, cited by Beckwith, 2004). Also, in a study of the Late Quaternary specific vegetation of the southwestern Columbia River basin, Barnosky (1985) supports the presence of camasia pollen in two time periods analyzed (33,000-23,500 BC and 8500 BC. - to date).

Camasias are known by various popular names, depending on the species and the area: camasia, Indian hyacinth, wild hyacinth, camash, quamash, etc.

The genus comprises six accepted species (Figure 1), four of which spread across the western North American continent (*C. cusickii* S.Watson, *C. howellii* S. Watson, *C. leichtlinii* (Baker) S. Watson, *C. quamash* (Pursh) Greene) and two in the eastern part (*C. scillioides* (Raf.) Cory, *C. angusta* (Engelm. & Grey) Blank) (Fishbein et al., 2010; Beckwith, 2004; Culley et al., 2013; http://bonap.net/NAPA/TaxonMaps/Genus/County/Camassia;http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=105373; https://wfoplantlist.org/plant-list/taxon/wfo-0000762871-2022-12?page=1)

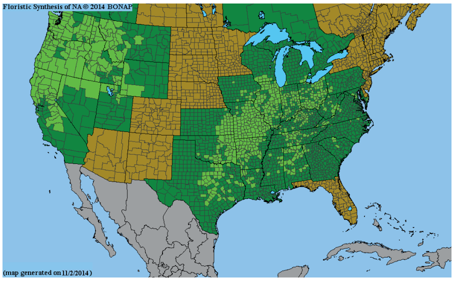


Figure 1. The natural habitats of *Camassia* species (http://bonap.net/NAPA/TaxonMaps/Genus/County/Camassia) distribution areas areas of origin

Some sources also indicate a seventh species, but unrecognized, *C. engelmanii* Spreng., whose name was first published in 1989, in Bollettino de Societta Toscona d'Orticultura (https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:532515-1).

The high morphological variability of the plants, associated with weak genetic differences both between taxa located in the same areas and between those geographically isolated, has justified the cataloging of the genus *Camassia* as a taxonomically difficult group, which has led to numerous studies to clarify species or subspecies delimitation and explain evolutionary mechanisms (Culley et al., 2013; Tomimatsu et al., 2009; Uyeda & Kephart, 2006).

Initially, the genus *Camassia* was placed in the Liliaceaefamily (Gould, 1942; Douglas et al., 2001), then temporarily placed in the family Hyacinthaceae (Dahlgren et al., 1985, cited by Fernandez & Daviña, 1991), but more recent DNA analysis place the genus in the Asparagaceaefamily, subfamily *Agavoideae* (Stevens, 2017; Halpin & Fishbein, 2013; Chase et al., 2009; Archibald et al., 2015; Davis, 2018).

Camasias are geophytes with flowering in late spring - early summer, the underground organ being a tunicate, ovoid or globular bulb, with brown or blackish-brown protective tunics (http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=105373). The linear leaves, which appear in early spring, form rosettes, from the middle of which start one or more flower stalks with flowers arranged in racemes. The flowers, actinomorphic or zygomorphic, composed of 6 lanceolate tepals (purple, blue, white), arranged in three, on two vertices, have filiform stamens, with yellow anthers. Fruits are dehiscent capsules with 6–36 black, glossy, ovoid or ellipsoid seeds, 2–4 mm (Douglas et al., 2001; Beckwith, 2004; Proctor, 2013; Davis, 2018; http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=105373).

Camasia bulbs are made up of two components: a mother bulb and a daughter bulb (Thoms, 1989; Beckwith, 2004; Stucki, 2018). The mother bulb acts as a food source for the growing daughter bulb and shrinks throughout the life cycle. The daughter bulb absorbs energy and nutrients from both the mother bulb and the leaves (Maclay, 1928; Thoms, 1989; Beckwith, 2004; Proctor, 2013; Davis, 2018).

After flowering, the above-ground organs disappear and the bulb goes dormant. For spring-flowering, summer-dormant plants, such as camas, the temperature pattern that bulbs require prior to leaf and flower emergence is a warm-cold-warm cycle (Cantor, 2016; Toma & Petra, 2020; Draghia, 2011; Davis & Davis, 2021).

As a rule, to initiate flowering, ornamental geophytes in temperate zones require a short period with temperatures around 20°C (Khodorova & Boitel-Conti, 2013). Prolonged high temperatures in the spring during the above-ground growth period result in earlier flowering, smaller flowers, but also a shorter vegetative growth period, resulting in smaller and less productive bulbs in next year. Low temperatures can prolong above-ground vegetative growth and subsequently bulb growth, but will also result in reduced flowering (Khodorova & Boitel-Conti, 2013; Thoms, 1989; Kuhnlein, 1991; Stevens & Darris, 2001; Russell, 2011). Camasia bulbs show good resistance to low temperatures (up to -30°C), so they wintering in the field. *C. quamash* and *C. leichtlinii* require a period of 80-81 days of cold (approx. 4°C) for leaf emergence (De Hertogh &Le Nard, 1993; Khodorova & Boitel-Conti, 2013).

Based on studies carried out in *C. leichtlinii*, which examined the effect of heat treatment duration on bulb growth and development, it was hypothesized that the daughter bulb and roots develop in the summer, to the detriment of the mother bulb, and that there would be a heat treatment duration after which daughter bulbs stop developing. It has also been estimated that there would be a cooling durationthat minimizes the duration of winter dormancy (Stucki, 2018; Davis & Davis, 2021).

In the spring, until the leaves enter senescence and the seeds have matured, camas have higher moisture requirements, after which, during the summer months, requirements are reduced (Thoms, 1989; Beckwith, 2004; Luna et al., 2008; Kuhnlein, 1991; Stevens & Darris, 2006).

According to archaeological evidence from the Willamette Valley (Oregon, USA), where ancient ovens and remains of charred bulbs have been discovered, it appears that the use of *Camassia* bulbs in food dates back more than 7,750 years, (Aikens, 1993, cited by Sultany & Kephart, 2007).

The importance of camas resides mainly in their food value. Two species of camasia (*C. quamash* and *C. leichtlinii*) were important food sources for the Straits Salish and other Coast Salish indigenous peoples of the Pacific Northwest coast, living in the Canadian province of British Columbia and in the US states of Washington and Oregon (Beckwith, 2004). Bulbs were also a major trade item for the indigenous peoples of this area, often being made intertribally exchanges with camas bulbs, and in western Washington no food except dried salmon varieties was widely traded (Gunther, 1973, cited by Davis, 2018).

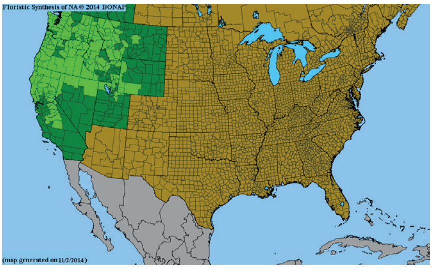
Nutritional analyzes show that camas bulbs have neglctable fat and protein content, but are good sources of fiber, carbohydrates, vitamins, calcium, magnesium, zinc and inulin (a polysaccharide from the fructan class, indigestible and with a less pleasant taste). Apart from its special nutritional and medicinal properties, inulin is believed to provide protection to plants against frost and drought (Turner & Kuhnlein, 1983; Proctor, 2013; Roberfroid, 2005).Camasia bulbs have been consumed for over 8000 years, the most intense period in the production and storage of the bulbs being assumed to be approx. 3000-4000 years ago in the Columbia Plateau area in the states of Washington, Oregon and Idaho (Carney et al., 2021). Archaeological research has established that bulbs were cooked in large ovens using heated rocks, water and vegetation (Proctor, 2013;Stucki et al.,2021; Thoms, 2008a, 2009). Across the southern plains and southeastern forests of North America, the oldest known earth ovens with rock heating elements date back more than 8,000 years. The bulbs of *C. quamash* were harvested in May-June and baked for one or two days in circular hollows on hot stones over which a layer of moistened vegetation was added. Prolonged steaming and the presence of volatile organic compounds from the stratified vegetation ensured the complete hydrolysis of inulin into digestible fructans and fructose (Thoms, 2008b; Proctor, 2013; Roberfroid, 2005; Konlande & Robson 1971; Turner & Kuhnlein, 1983).

From an ornamental point of view, camasia plants can be used in groups or alone, in flower borders or on the periphery of water features, alongside other bulbous or early flowering perennials. It can also be grown in containers to decorate balconies and large terraces, but it must be kept in a frost-free place over the winter. *Camasia* can also be used as a cut flower, lasting about a week.

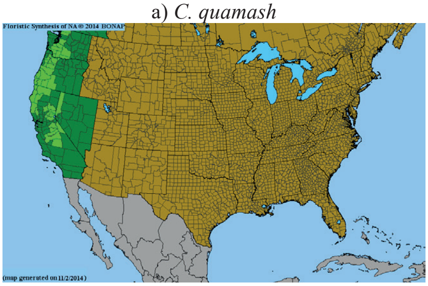
In this paper, the behavior of some *Camassia* taxa cultivated under unprotected conditions, in the north-eastern area of Romania, was evaluated.

MATERIALS AND METHODS

Two *Camassia* taxa were used for this study, respective *C. quamash* and *C. leichtlinii* 'Alba'. Both species are part of the group of camas originating from the western part of North America, with natural habitats in the USA and Canada (Figure 2 a, b).



a) *C. quamash*



b) *C. leichtlinii*

Figure 2. The natural habitats of *C. quamash* and *C. leichtlinii*

(http://bonap.net/NAPA/TaxonMaps/Genus/County/Camassia)

distribution areas areas of origin

C. quamash **(Pursh) Greene** (Figure 3) is the best-known species, with a wider distribution than the other species of the genus and is characterized by a large morphological variability (http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=242101517). It has globose bulbs, sometimes clustered, and grey-green, linear leaves, usually fewer than 10 per plant. Flower stems can be 20-80 cm tall, but in most cases do not exceed 50 cm.

Figure 3. *C. quamash* (original)

The flowers, usually zygomorphic, rarely actinomorphic, are up to 4 cm in diameter, arranged in racemes and open sequentially, from bottom to top. They have six blue-violet tepals and the anthers are usually yellow, sometimes blue-violet, purple or brown. After anthesis, the tepals wither separately or remain above the capsules. The capsules are light green to light brown in color and do not fall off after ripening (Douglas et al., 2001; Beckwith, 2004; Stevens & Daris, 2000, http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=242101517).

C. leichtlinii **(Baker) S.Watson**, known as the big camas, has ovoid bulbs, usually solitary, and lanceolate-canalic leaves, about 30 cm long, grouped in rosettes at the base of the flower stalks. The flowers are actinomorphic, with six tepals from bluish purple to bright blue or creamy white, arranged in racemes 30–40 cm long and marked by six filiform stamens, with yellow (sometimes purple) anthers. After anthesis, the tepals twist together and remain over the ovary. Inflorescences can reach 120 cm in height. The capsules are ovoid to ellipsoidal, dull green in color, and when mature, can often do detach from the pedicel (Douglas et al., 2001; Beckwith, 2004; Stevens & Daris, 1999; http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=242101516).

Cv.'Alba' (Figure 4) can reach heights of about 100 cm. The flowers have slightly recurved, cream-white colored tepals (Douglas et al., 2001; Beckwith, 2004).

Figure 4. *C. leichtlinii* 'Alba' (original)

The establishment of experimental crops was made on 28.10.2021, in the didactic field of the discipline of Floriculture, within the University of Life Sciences in Iași. Bulbs were planted in experimental plots, 40 cm between rows and 35 cm between plants per row.

The experiment was monofactorial, the experimental factor being represented by the species, with two graduations, thus resulting in two experimental variants: V_1 - *C. quamash* and V_2 - *C. leichtlinii* 'Alba'. The organization of the experiments was done in randomized blocks with three repetitions, with 10 plants/repetition. The observations and determinations were carried out from the moment of starting in the vegetation, respectively after 5 months from the establishment of the crops and until the complete drying of the aerial parts. The data focused on the following biometric indices: number of branches per plant, length of flower stalks, number of leaves, length and width of leaves, number of flowers, length and width of tepals. The results were compared with the average of the variants, and the interpretation was made using the analysis of variance, with the "LSD" test (Săulescu & Săulescu, 1967), the control being the average of the experimental variants.

In order to obtain a series of indications on the direction, strength and link between the analyzed morphological characters, an analysis of the correlations between them was also carried out. Grouping the measured data into pairs leads to a first estimate of the common distribution. Scatter plot of values and mathematical modeling by linear regression were used. The general equation for a linear regression model is

$$\bar{Y} = b_1 + b_2 X$$

where, b_1, b_2 are called regression parameters. The parameter b_2 represents the expected change in the response $\bar{Y}$ associated with one-unit increase in X. For a given model, the difference between the observed (measured) value of Y and the model-predicted value $\bar{Y}$ at the same given point is called the residual .

This analysis was carried out using the MS EXCEL application from the MS Office 2019 package.

RESULTS AND DISCUSSIONS

The observations and determinations made aimed to identifythe way in which the two camas species develop in the ecological conditions of northeastern Romania and, at the same time, the decorative impact of the plants during the growing season. Since these plants do not only decorate through flowers, but also through beautiful foliage, the study focused both on determining some characteristics of flowers and floral stems (height of flower stalks, length of inflorescences, size of tepals, number of flowers per inflorescence) and number and size of leaves.

Table 1 shows the data recorded on the main morpho-decorative characters of the camasia taxa grown in the experimental field. The results were statistically interpreted and compared with the average of the two variants.

Table 1. The dimensions of some morpho - ornamental characters

Variants	Height of floral stems		Length of inflorescence		Number of flowers/ stem		Diameter of flowers	
	Abs. val. (cm)	Relative val. %/ Signif.	Abs. val. (cm)	Relative val. %/ Signif.	Abs. val.	Relative val. %/ Signif.	Abs. val. (cm)	Relative val. %/ Signif.
V_1 (*C. quamash*)	25.7	70.99 ^{000}	8.9	60.14 ^{000}	13.7	88.39 ^{00}	3.5	70 ^{00}
V_2 (*C. leichtlinii*)	46.7	129.01 ^{XXX}	20.7	139.86 ^{XXX}	17.3	111.61^{XX}	6.4	128 ^{XX}
Average (control)	36.2	100	14.8	100	15.5	100	5.0	100
	$LSD_{5\%}$= 0.2; $LSD_{1\%}$= 0.6; $LSD_{0.1\%}$= 1.8.		$LSD_{5\%}$ = 0.7; $LSD_{11\%}$ = 1.7; $LSD_{0.1\%}$ = 5.3.		$LSD_{5\%}$ = 0.5; $LSD_{1\%}$ = 1.1; $LSD_{0.1\%}$ = 3.6.		$LSD_{5\%}$ = 0.2; $LSD_{1\%}$ = 0.6; $LSD_{0.1\%}$ = 1.8.	

a) b)

Figure 5. The appearance of flower stems (original):
a) *C. quamash;* b) *C. leichtlinii* 'Alba'

Regarding the total height of the flower stalks (Table 1, Figure 5), better results were recorded for *C. leichtlinii* 'Alba' (V_2) which exceeded the average by approx. 29%, the differences compared to the control, being very significantly positive.

The length of the inflorescences (Table 1, Figure 6) was another analyzed indicator, in which V_2 recorded very significantly positive differences, respectively 39.86% above the control values.

Regarding the number of flowers on the stem, the differences between the two variants were smaller, the control being surpassed by the V_2 variant by 11.6%. Apart from the number of flowers/ stem, another aspect must be specified regarding the total number of flowers/plant, was significantly higher in *C. leichtlinii* 'Alba' (47.3), compared to only 13.7 in *C. quamash*, a difference due to a number of 3-5 flowers stems/plant in *C. leichtlinii* 'Alba' and only one in *C. quamash*.

a) b)

Figure 6. Appearance of inflorescences (original):
a) *C. quamash;* b) *C. leichtlinii* 'Alba'

Important differences were also reported regarding the diameter of the flowers (Table 1, Figure 7), the results being in favor of the variant, V_2 with 6.4 cm, compared to 3.5 cm for V_1.

a) b)

Figure 7. Flower detail (original):
a) *C. quamash;* b) *C. leichtlinii* 'Alba'

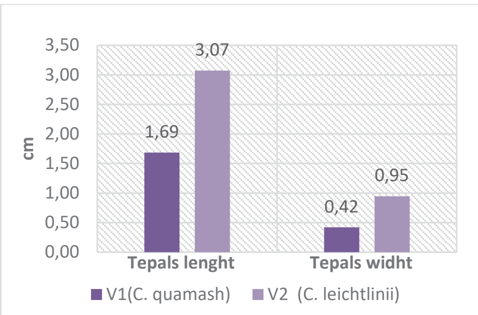


Figure 8. The size of the tepals

From the analysis of the size of the tepals (Figure 8), it can be seen that the average length varied between 1.69 cm at *C. quamash* and 3.07 cm at *C. leichtlinii* 'Alba', and the width between 0.42 cm respectively 0.95 cm.

Leaves complete the decorative appearance of camas plants, approximately 40-45 days before flowering and 30-35 days after flowering (Figure 9).

a) b)

Figure 9. The appearance of the leaves before the floral stems appear (original):
a) *C. quamash;* b) *C. leichtlinii* 'Alba'

The number of leaves/plant ranged from 19.2 at *C. quamash* to 22.3 at *C. leichtlinii*.

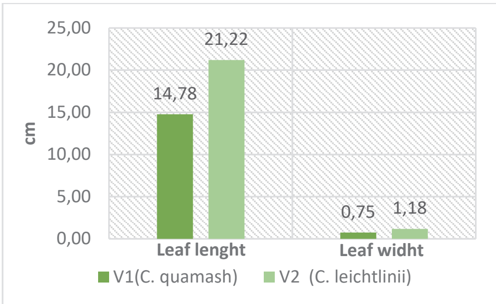


Figure 10. Leaf size

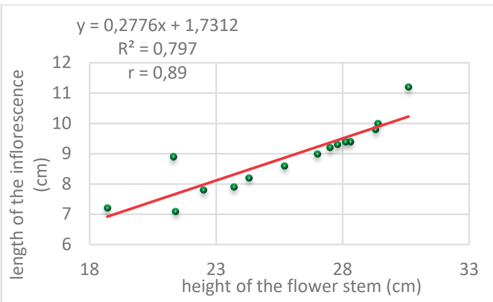
The dimensions of the leaves (Figure 10) varied within wider limits, especially in length, the average values exceeding 20 cm at *C. leichtlinii* 'Alba' (21.22 cm), while at *C. quamash* they were 14.78 cm. Average values of leaf width ranged between 0.75-1.18 cm.

The data obtained as a result of the determinations made were then compared with those from the specialized literature (Table 2) and it was observed that the own results fall within the ranges specified in the bibliography.

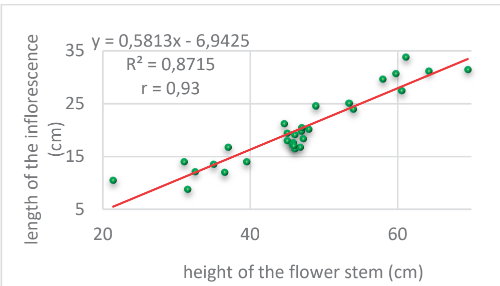
Table 2. The main morphological characters of the studied species (compared to the bibliographic data)

Specification	*C. quamash*		*C. leichtlinii* 'Alba'	
	Personal results (average values)	Bibliography	Personal results (average values)	Bibliography
Height of the floral stems (cm)	25.7	10–70(Beckwith, 2004) 20–70(Douglas et al.,2001) 20–80 (Brickell C., Cathey H.M., 2004)	46.7	20–100 (Douglas et al.,2001; Beckwith, 2004) 60–130 (Brickell C., Cathey H.M., 2004)
Number of flowers per stem	13.7	2–30(Beckwith, 2004)	17.3	4–80(Beckwith, 2004)
Length of tepals (cm)	1.7	1.5–4(Douglas et al.,2001)	3.1	2–4 (Douglas et al.,2001)
Width of tepals (cm)	0.4	0.2–0.8(Douglas et al.,2001)	0.9	0,5–1 (Douglas et al.,2001)
Flowers color	violet		white	
Number of leaves	19.2	Several to numerous (Douglas et al.,2001)	22.3	Several to numerous (Douglas et al.,2001)
Length of leaves (cm)	14.8	20–50 (Brickell C., Cathey H.M., 2004) 15–50(Douglas et al.,2001)	22.8	40–60 (Douglas et al.,2001; Beckwith, 2004) 20–60 (Brickell C., Cathey H.M.,2004)
Width of leaves (cm)	0.8	0.5–3 (Beckwith, 2004) 1–3 (Douglas et al.,2001)	1.3	1–2 (Douglas et al.,2001)

In the conducted study, the existing correlations between different morpho-decorative characters of the two *Camassia* taxa were analyzed and the co-responsible linear regressions were constructed. Pearson correlation coefficients were calculated and regression equations were written.



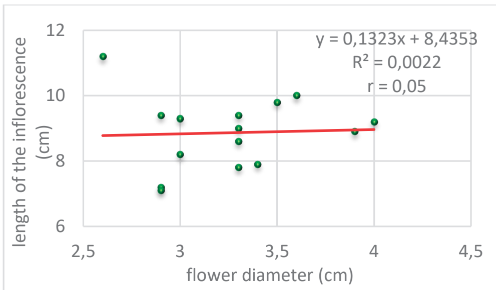
a)



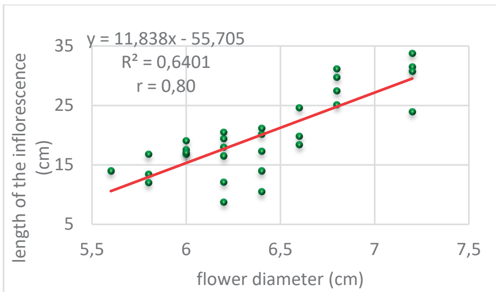
b)

Figure 11. Correlation between floral stem height and inflorescence length: a) *C. quamash;* b) *C. leichtlinii* 'Alba'

Between the height of the floral stems and the length of the inflorescences, very strong positive correlations were identified both at *C. quamash* (r = 0.89) and *C. leichtlinii* 'Alba' (r = 0.93) (Figure 11 a, b).



a)

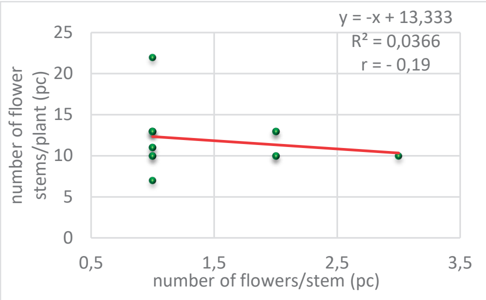


b)

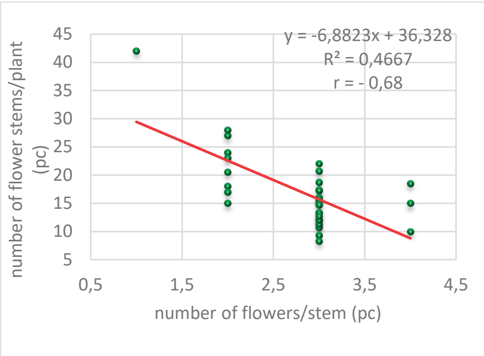
Figure 12. Correlation between flower diameter and inflorescence length:
a) *C. quamash;* b) *C. leichtlinii* 'Alba'

According to the obtained model, the increase of 1 cm in height of the floral stem, causes the increase of the length of the inflorescence by 0.797 cm in the case of *C. quamash*, respectively by 0.8715 cm in the case of *C. leichtlinii* 'Alba'.

Conversely, the correlation between flower diameter and inflorescence length (Figures 12 a, b), although positive in both cases, is non-existent at *C. quamash* (r = 0.05), but strong at *C. leichtlinii* 'Alba' (r = 0.80). Increasing flower diameter by 1 cm leads to 0.6401 longer inflorescence length.



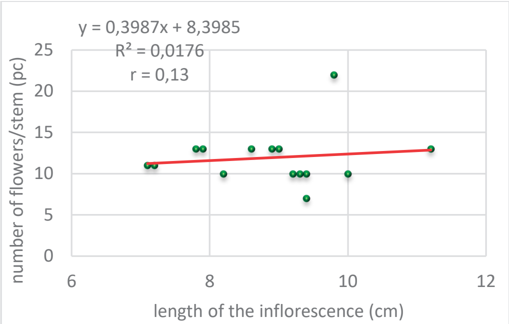
a)



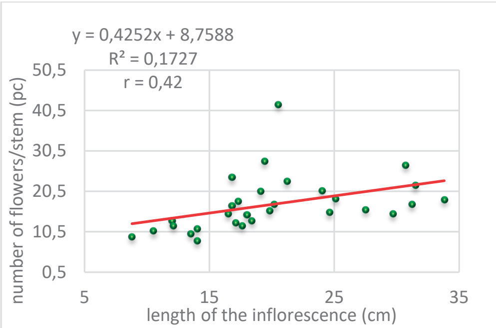
b)

Figure 13. Correlation between the number of flower stems/plant and the number of flowers/stem: a) *C. quamash;* b) *C. leichtlinii* 'Alba'

For the pair of characters number of floral stems/plant-number of flowers/stem (Figure 13 a, b), the correlations were negative, very weak at *C. quamash* (r = -0.19) and strong at *C. leichtlinii* 'Alba' (r = -0.68). It is observed that when the number of flower stems per plant increases, the number of flowers per stem decreases. Also, according to the obtained model, it follows that in case of the appearance of a new stem, the number of flowers on the stem decreases by 0.4667.



a)



b)

Figure 14. Correlation between inflorescence length and number of flowers/stem: a) *C. quamash;* b) *C. leichtlinii* 'Alba'

Figure 14 (a, b) shows the presence of a positive correlation between the length of the inflorescences and the number of flowers/stem, moderate at *C. leichtlinii* 'Alba' (r = 0.42) and very weak at *C. quamash* (r = 0.13).

The study of the correlations between the different morphological characters highlighted the existence of the positive correlation in most cases, the exception being in the case of the number of floral stems and the number of flowers per stem where, in both cases, a negative correlation was obtained.

For a better highlighting of the development of the main phenophases of the shirts in the first year of culture (2021-2022), the phenological diagram was drawn up (Figure 15). It can be seen that both species start growing in the last week of March. The appearance of flower stalks and flowering register a gap of approx. a week, earlier being *C. quamash*. The flowering period is approximately three weeks, with the two species covering a period of flower decoration between the second week of May and the first week of June.

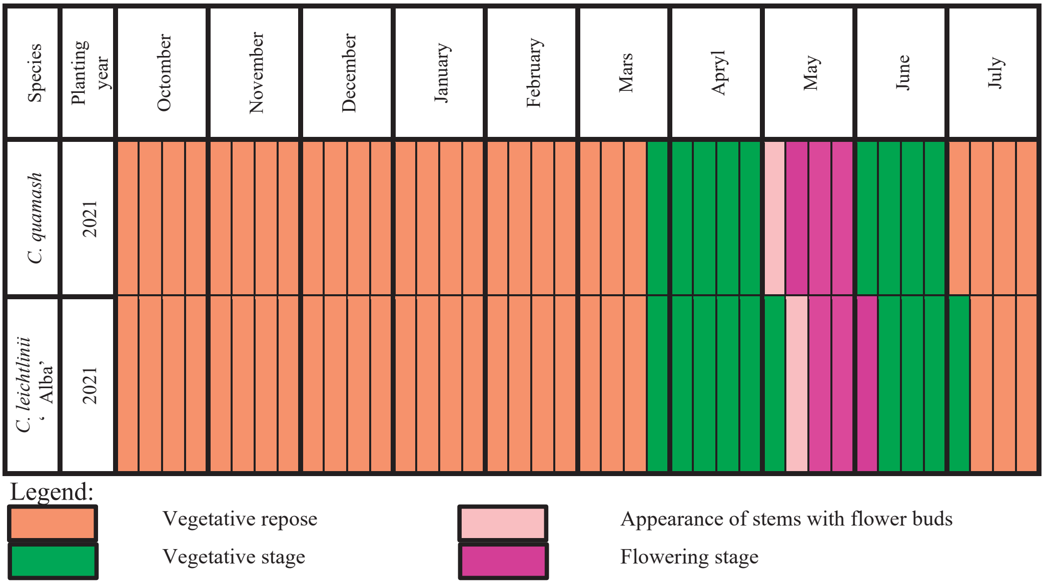


Figure 15. The phenological diagram of camas

CONCLUSIONS

The preliminary data obtained in the period 2021-2022 indicate the appropriate adaptation of the two *Camassia* taxa studied in the ecological conditions of Iași, the results falling within the limits of the specialized literature.

The data regarding the morpho-decorative characteristics analyzed in the camas species indicate a greater vigor of the *C. leichtlinii* plants, expressed by higher values of the number and height of the floral stems (approx. 29% above average), the number and size of the leaves, the number and size of flowers (approx. 11.6%, respectively 28% above average) from the inflorescences.

The study of the correlations between the different morphological characters highlighted the existence of the positive correlation in most cases, stronger being between the height of the stems and the length of the inflorescences and between the length of the inflorescences and the number of flowers on the stem.

87% of the variation in the length of the inflorescence is determined by the variation in the height of the floral stem at *C. leichtlinii*, respectively 79% at *C. quamash*.

Negative correlations in both species were recorded between the number of flower stems per plant and the number of flowers per stem.

46% of the variation in the number of flower stems/plant was determined by the variation in the number of flowers per stem at *C. leichtlinii*.

Flowering takes place from early May to early June (approx. three weeks at each species), the earliest being *C. quamash*.

Depending on the morphological characters, the analyzed species can be recommended, in particular, for ensuring spring - early summer decor in landscaping. At *C. leichtlinii*, the use as cut flowers is not excluded, taking into account the greater length of the flower stems (40-60 cm).

REFERENCES

Archibald, J.K., Kephart, S.R., Theiss, K.E., Petrosky, A.L., & Culley, T.M. (2015). Multilocus phylogenetic inference in subfamily Chlorogaloideae and related genera of Agavaceae–informing questions in taxonomy at multiple ranks. *Molecular Phylogenetics and Evolution*, 84, 266–283.

Barnosky, C.W. (1985). Late Quaternary vegetation on the southwestern Columbia Basin, Washington. *Quaternary Research* 23:109- 122.

Beckwith, B.R. (2004). *The Queen Root of This Clime: ethnoecological investigations of Blue Camas (Camassia leichtlinii (Baker) Wats, C. quamash (Pursh) Greene; Liliaceae) and its landscapes on Southern Vancouver Island, British Columbia* (PhD dissertation). University of Victoria, Victoria, BC.

Brickell, C.,& Cathey, H.M.,editors. (2004). *A – Z Encyclopedia of garden plants.* The American Horticultural Society, DK Publishing.

Cantor, M. (2016). *General floriculture*. Cluj Napoca RO: AcademicPres Publishing House.

Carney, M., Tushingham, S., McLaughlin, T.,& d'Alpoim Guedes, J. (2021). Harvesting strategies as evidence for 4000 years of camas (Camassia quamash) management in the North American Columbia Plateau. *Royal Society Open Science* 8: 202213.

Chase, M.W., Reveal, J. L., & Fay, M.F. (2009). A subfamilial classification for the expanded asparagalean families Amaryllidaceae, Asparagaceae and Xanthorrhoeaceae. *Botanical Journal of the Linnean Society*, 161(2), 132–136.

Culley, T.M., Ju-Fang Leng, J.F., Kephart, S.R., Cartieri, F.J., & Theiss, K.E. (2013). Development of 16 Microsatellite Markers within the Camassia (Agavaceae) Species Complex and Amplification in Related Taxa. *Applications in Plant Sciences*, 1(8): 1300001.

Davis, M. (2018). Determining the Influence of Nutrition and Temperature on the Growth and Development of *Camassia* spp., Oregon State University.

Davis, M., &Davis, A.S. (2021). Effects of heat treatment and chilling duration on camas growth and development. *Scientia Horticulturae,* 282: 110048.

De Hertogh, A.A., &Le Nard, M. (1993). Botanical aspects of flower bulbs.*The physiology of flower bulbs*. Amsterdam, The Netherlands:Elsevier Science Publishing Co.

Douglas, G.W., Meidinger, D., & Pojar, J., editors. (2001). *Illustrated Flora of British Columbia*. BC Ministry of Environment, Lands and Parks and BC Ministry of Forests, Victoria, Vol 6: 282-287.

Draghia, L.(2011). *Floriculture*.Iasi, RO:„Ion Ionescu de la Brad" from IasiPublishing House.

Fernandez, A., & Daviña J.R. (1991). Heterochromatin and Genome Size in Fortunatia and Camassia (Hyacinthaceae). *Kew Bulletin*, 46(2):307.

Fulkerson, T.J., & Tushingham, S. (2021). Geophyte field processing, storage, and women's decision-making in hunter-gatherer societies: An archaeological case study from western North America. *Journal of Anthropological Archaeology*, 62:101299.

Gould, F.(1942). A systematic treatment of the genus CamassiaLindl. *American Midland Naturalist,* 28: 712-742. (https://doi.org/10.2307/2420901).

Halpin, K.M., &Fishbein, M. (2013). A Chloroplast Phylogeny of Agavaceae Subfamily Chlorogaloideae: Implications for the Tempo of Evolution on Serpentine Soils. *Systematic Botany* 38(4):996-1011.

Khodorova, N.V. &Boitel-Conti, M. (2013). The Role of Temperature in the Growth and Flowering of Geophytes. *Plants* 2:699-711.

Kuhnlein, H.V., &Turner, N.J. (1991). *Traditional plant foods of Canadian indigenous peoples.Nutrition, botany, and use*. Philadelphia, PA:Gordon and Breach Science Publishers. Vol 8.

Luna, T., Evans, J., & Wicks, D. (2008). Propagation protocol for *Camassia quamash* (Pursh) Greene plants, *Native Plant Network*. Moscow, ID: University of Idaho, College of Natural Resources, Forest Research Nursery.

Maclay, A.M. (1928). *Studies of the Life History of Camassia quamash (Pursh) Greene*(MSc Thesis). State College of Washington, Pullman, WA.

Proctor, K.Y. (2013). *Renewing Central Coast Salish Camas (Camassia leichtlinii (Baker) Wats., C. Quamash(Pursh) Greene; Liliaceae) Traditions Through Access to Protected Areas: An Ethnoecological Inquiry.*(MSc Thesis) University of Victoria, Canada.

Roberfroid, M. (2005). *Inulin-type Fructans: Functional Food Ingredients*. Boca Raton, FL: CRC Press.

Russell, M. (2011). Dormancy and germination pre-treatments in Willamette Valley native plants. *Northwest Science*, 85(2), 389–402.

Săulescu, N.A. & Săulescu, N.N., (1967). *Field of experience*.Bucharest, RO: Agro-Forestry Publishing House.

Smith, H., (1978). *Camas: The Plant That Caused Wars*. Smith, Smith, & Smith Publishing.

Stevens, M., &Darris, D.C. (1999). Plant guide for great camas (*Camassia leichtlinii*ssp. *suksdorfii)*. USDA-Natural Resources Conservation Service, National Plant Data Center, Greensboro, NC, and Corvallis Plant Materials Center, Corvallis, OR.

Stevens, M., Darris, D.C., &Lambert, S.M. (2000). *Plant guide for common camas (Camassia quamash ssp. breviflora)*. USDA-Natural Resources Conservation Service, National Plant Data Center, Greensboro, NC, and Corvallis Plant Materials Center, Corvallis, OR.

Stevens, M., Darris, D.C., & Lambert, S.M. (2001). Ethnobotany, Culture, Management,and Use of Common Camas. *Native Plants Journal,* vol. 2, 1:47-53.

Stevens, P.F. (2017). Angiosperm Phylogeny Website, Version 14, July 2017 http://www.mobot.org/MOBOT/research/APweb/.

Stucki, D., (2018). *Evaluating the Effects of Traditional Harvest and Climate on Common Camas (Camassia quamash) in Weippe Prairie, Idaho*. (MSc Thesis), Oregon State University.

Stucki, D., Rodhouse,S., Thomas, J., &Reuter, R.J. (2021). Effects of traditional harvest and burning on common camas (*Camassia quamash*) abundance in Northern Idaho: The potential for traditional resource management in a protected area wetland. *Ecology and Evolution,*2021;11:16473–16486.

Sultany, M.L.,&Kephart, S.R. (2007). Blue Flower of Tribal Legend:"Skye blue petals resemble lakes of fine clear water". *Kalmiopsis* 14: 28-35.

Thoms, A.V. (1989). *The northern roots of hunter-gatherer intensification: camas and the Pacific Northwest*. (PhD dissertation), Washington State University, Pullman, WA.

Thoms, A.V.(2008a).Ancient savannah roots of the carbohydrate revolution in south-central North America. *Plains Anthropologist*, 53(205):121-136.

Thoms, A.V.(2008b). The fire stones carry: Ethnographic records and archaeological expectations for hot-rock cookery in western North America. *Journal of Anthropological Archaeology*, 27(4):443–460.

Thoms, A.V. (2009). Rocks of ages: propagation of hot-rock cookery in western North America. *Journal of Archaeology Science*: 36(3):573–591.

Toma, F., &Petra, S.(2020.). *Floriculture and floral compositions*. Bucharest, RO:Total Publishing.

Tomimatsu, H., Kephart, S.R, & Vellend, M.(2009). Phylogeography of Camassia quamash in western North America: postglacial colonization and transport by indigenous peoples. *Molecular Ecology* 18:3918–3928.

Turner, N.J., &Kuhnlein, H.V. (1983).Camas (*Camassia* spp.) and riceroot (*Fritillaria* spp.): Two liliaceous "root" foods of the Northwest Coast Indians. *Ecology of Food and Nutrition*, 13(4):199-219.

Uyeda, J.C., &Kephart, S.R. (2006). Detecting Species Boundaries and Hybridization in *Camassia quamash* and *C. leichtlinii* (Agavaceae) Using Allozymes. *Systematic Botany*, 31(4):642-655.

http://bonap.net/NAPA/TaxonMaps/Genus/County/Camassia - The Biota of North America Program 2013 county distribution maps (North America Plant Atlas).

https://wfoplantlist.org/plant-list/taxon/wfo-0000762871-2022-12?page=1- Plant List | World Flora Online.

http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=105373 - Flora of North America (FNA), vol. 26:303 (*Camassia*).

http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=242101516- Flora of North America (FNA), vol. 26:306 (*Camassia leichtlinii*).

https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:532515-1 – Plant of the World Online. Kew Royal Botanical Garden.