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RHYTHMOLOGICAL DIFFERENCES IN DEVELOPMENT OF *LAGOSERIS CALLICEPHALA* AND *LAGOSERIS PURPUREA (ASTERACEAE)*.

Aleksandr Rostislavovich Nikiforov[1], Aleksandra Aleksandrovna Nikiforova[2]

Nikita Botanical Gardens – National Scientific Centre
298648, the Republic of Crimea, the city of Yalta, urb.vil.Nikita
nikiforov.a.r.01@mail.ru

[2]Tavrichesky Federal University,
295007, the Republic of Crimea, the city of Cimferopol, 4, academician Vernadsky av.
nik.a.815@mail.ru

Introduction

Investigating Crimean representatives of *Lagoseris* Bieb genus (*L. purpurea* L., *L callicephala* (Willd.) Boiss. and *L. robusta* Czer. (last cultivar is commonly treated as a hybrid *L. callicephala* and *L. purpurea*)), perennial herbaceous plants, their morphological peculiarities and geographical isolation of their small population were revealed [8-10]. Nevertheless, recently systematical originality of well-known cultivars is disputed: they are united into one taxon - *L. purpurea* or *Crepis purpurea* (Willd.) M. Bieb. [3, 11]. Actually, according to present descriptions of overground organs and rhizomes, morphostructures of Crimean cultivars of *Lagoseris* genus are virtually identical. Plants characterize organs, similar by structure: stem and root system, underground rhizome, thickened and short caudex, overground rosellate shoots with downy blue-gray deeply separated into lacinias leaves, prolonged flower-bearing stems with bracteosus pink and purple inflorescences-baskets, cypsela-fruits. [8-10].

Since 2005 we observe seasonal development of *L. callicephala* plants under different conditions *in situ* (Upper layer of the Mountain Crimea).: north-east edge of Nikita yaila (1200 m above the sea level), scree at the Shagan-Kaya rock (Gurzuf yaila, 1430 m above the sea level) and scree at the Eklizi-Burun rock (ChatyrDag, 1527 m above the sea level). Besides, since 2011 plants of this cultivar were cultivated *ex situ* 300 m above the sea level in the climate of South Crimea seaside zone.

In 2012 we obtained seeds of *L. purpurea*, its populations are located within inside mountain range and Piedmont Crimea (collections by S.Svirin on the scree slopes of the Belbek river canyon). After its plants introduction in 2013, we had annual registration of their principal phases start and finish in seasonal development: vegetation, blooming, fruit-bearing and dissemination, as well as peculiarities of shoot and flower-bearing stems morphogenesis.

Study object is season development of *L. callicephala* and *L. purpurea,* characteristics of vegetative shoots and flower-bearing stems development.

Study tasks:

- To reveal influence of thermal conditions on shoot morphogenesis process;
- To determine main rhythmological parameters, typical for seasonal development of *callicephala* and *L. purpurea*;
- To find out phenological dates, cycles and conditions of vegetative and generative shoots development of study cases.

Study purpose is to compare cyclicity in development of vegetative and generative sphere of *L. callicephala* and *L. purpurea* plant shoots.

Phenological observations were conducted according to V.N.Golubyev method [1]. Annually growing conditions were recorded, that were typical for seasonal periods of growth, resting and dying of shoots and leaves, at the same time order of generative germs setting and conditions of flower-bearing stems development were specified.

Results and discussion

Until recently phases of seasonal development of *L. callicephala* and *L. purpurea* were recorded *in situ* only. In this way blooming terms of *L. callicephala* were determined since June till July, *L. purpurea* – since May till June [2, 8, 10], while for common taxon *L. purpurea* blooming period was fixed from June till July [11].

During long-term observations of *L. callicephala* seasonal development *in situ* it was found out that seed germination and phase of revegetation concerns the period of stable growth of daily average air temperature from +6°C till +8°C and higher (in April). Shoots that renew spring growth, have been developed since last spring till the beginning of frost period (end of November). At the same time in late summer plants have autumn generation of shoots with undeveloped leave plates. As soon as frost period begins all green leaves die. Apical and accessory bud at died leaves, buds of caudex and root winter having deep dormant season. Next season shoots of three generations start vegetation: two survived after winter – late-spring-autumn and late-summer-autumn, as well as not-wintered spring generation of shoots of buds, bursted during current spring. Shoots of wintered late-spring-autumn generation continue vegetative development up to the end of May. Increasing daily average air temperature till +11 - 12°C we have setting of generative germs. Then, if daily average air temperature increases (middle of June, +14°C), plants prolong flower-bearing stems. Blooming and fruit-bearing are connected with thermal optimum of yaila climate – the end of July, August (table 1). After short-term dessimination (using anemochory) in August, flower-bearing stems die.

Table 1

Phenological dates and duration of the principal phases in ***L. callicephala*** **development** ***in situ***

Observation year	Vegetation beginning and finish	Blooming beginning and finish	Fruit-bearing beginning and finish
2012	15.04 – 16.11	14.06 – 1.08	22.07 – 27.08
2013	16.04 – 15.11	15.06 – 30.07	24.07 – 25.08
2014	15.04 – 15.11	15.06 – 1.08	24.07 – 25.08
2015	18.04 – 14.11	15.06 – 1.08	25.07 – 25.08
Avearge phenodate	17.04 – 15. 11	15.06 – 1.08	24. 07 – 25. 08

Ex situ L. callicephala plants develop in another way. Seed germination starts since winter thaws (January-Feebruary), though germination maximum occurs in the end of March – beginning of April (+7-8 °C). During the first year of biocycle main shoot and first rossete laterals develop. Simultaneously two generations develop: main shoot form spring-summer-autumn growth, while laterals – summer-autumn growth. By autumn one more generation of shoots and leaves has been formed. During cool season three generations of shoots keep leaves green, though majority of spring-summer leaves dies gradually. New leaves develop if daily average air temperature increases up to +5 °C and higher (the end of February – beginning of March): this time survived buds burst, and form shoots of spring generation. In crown bud of two-years main shoot having daily average air temperature +11 °C generative germs happen: plant begins the phase of generative development. Flower-bearing stem becomes longer if daily average air temperature gets 14 °C: in this point flower buds develop, flower baskets open (the end of April, beginning of May). Blooming period continues till the middle of June. Fruit-bearing occurs in June-July (table2). After dissemination flowerbearing stem dies. Vegetative rossete laterals (spring-summer-autumn, autumn-spring-summer-autumn) enter generative phase of development having certain thermal conditions next year of biocycle.

Table 2

Phenological dates and duration of main phase in *L. callicephala ex situ*

Observation year	Beginning and finish of growth	Beginning and finish of blooming phase	Beginning and finish of fruit-bearing phase
2012	2.03 – 26.11	24.04 – 15.06	20.06 – 17.07
2013	1.03 – 25.11	25.04 – 17.06	22.06 – 15.07
2014	26.02 – 25.11	25.04 – 17.06	22.06 – 15.07
2015	1.03 – 24.11	25.04 – 15.06	22.06 – 15.07
Average phenodate	1.03 – 25. 11	25.04 – 16.06	21.06 – 16. 07

In this way *in situ L. callicephala* develops as a summer-green plant, while *ex situ* – summer-winter green. Difference in duration of development cycle of monaxonic monopodial shoot and beginning date of generative phase *in situ* and *ex situ* is grounded by considerable difference in vegetative sphere development term of expected generative shoot: *ex situ* vegetative sphere occupies almost all year round, but *in situ* – during frost-free season (from April to October) and revegetates next April. General regularity of *L. callicephala* shoot development under different conditions is transition into generative phase happens after wintering only and after shoot vegetative sphere is developed that takes two years or more. That's why juvenile plants of *L. callicephala* never enter generative phase of development during the first year of their biocycle.

According to vegetative rhythm *L. purpurea* is characterized as a summer-winter green plant [2]. It was found out that seed germination *ex situ* connects with daily average air temperature +7-11 °C (March, April). Plants develop synchronously as daily average air temperature degree increases, passing virginal phases of onthogenesis. In the beginning of June having temperature +17+18 °C main shoot begins generative development – generative germs are set. In case of daily average air temperature +19+20°C and higher (June) the plant launches blooming. Synchronically with flower-bearing stem, system of rossete laterals, sourced from accessory bud, begins to develop. Under thermal conditions mentioned above, laterals produce flower-bearing stems. Blooming continues up to mid-autumn due to constantly developing laterals with set generative germs. But if daily average air temperature decreases +15 °C below (middle of October) generative organs don`t set anymore: next laterals have only vegetative sphere that develops. As a result the most powerful plants form up to 30 or more flower-bearing stems during season.

Air temperature decrease in November till +10 °C or below slows down generative development of ready flower-bearing stems. Before wintering shoots with developed vegetative sphere function, flower-bearing stems keeps flower buds and inflorescences, though fruits aren`t able to ripen. Vegetative rosette shoots winter with green leaves of late summer-autumn generation and keep on their development next spring (the end of February, the beginning of March). Setting of generative germs depends upon thermal conditions of the beginning of April, while blooming starts in May (air temperature +12-14 °C).

Therefore, in comparison with *L. callicephala*, plants of *L. purpurea* have different way of flower-bearing stems development and occupies larger range of thermal conditions. As a result blooming phase of *L. purpurea* is much more continuous. It is casued by difference in rate of main and laterals vegetative sphere development, necessary for their transition into generative state. Vegetative development of *L. callicephala* shoot makes no less than two seasons, but blooming always depends upon daily average air temperature increase after wintering. Cycle of *L. purpurea* shoot vegetative development also depends upon temperature regime, but having themal maximum durig late-spring-summer-mid-autumn period it is rather shortened. That's why if *L. callicephala* laterals, developed at axial flower-bearing stem, bear function of assimilation in spite of environmental conditions, *L. purpurea* laterals cycle completely during season mentioned above. At the same time a number of flower-bearing stems of *L. callicephala*, during season, depends upon conditions of vegetative shoots development, formed last season, for *L. purpurea* only thermal factor is important, that is mid-autumn decrease of air temperature.

It`s a well-know fact that plant rhythms are endogenous and possible to be controlled by microclimate, and association to its conditions is worked out during cultivar adaptation to environmental conditions [4-7]. So, rhythmological peculiarities of seasonal development become apparent as far as certain climatic conditions supply (and other external factors), which affect on realization of plant morphostructural potential. Shoot capacity of *L. purpurea* of complete cycling during frost-free season is a key character of this cultivar. Shoot morphogenesis of *L. callicephala* implements being effected by different rhythmological parameters.

Conclusions

1. Development of shoot generative sphere of *L. callicephala* and *L. purpurea* coinsides with period of daily average air temperature increase after wintering, but blooming – with seasonal thermal maximum.
2. In spite of thermal regime vegetative sphere development of *L. callicephala* occupies several seasons.
3. Shoot development of *L. purpurea* during summer transient: they cycle completely without break.
4. Rhythmological characteristics of *L. callicephala* and *L. purpurea* are specified genetically, that is determined by various bioecological endogenous characters of study cultivars.

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For the first time *Lagoseris callicephala* and *Lagoseris purpurea* were investigated from the point of view of seasonal differences. It concerns either blooming and fruiting terms or development peculiarities of vegetative sphere of shoots, development of flower-bearing stems and correlation of generative phase with different thermal conditions.

Key words: *Mountain Crimea, Lagoseris callicephala; Lagoseris purpurea, seasonal development.*