Botany

# Growth and Development Rhythm of Introduced Mexican and the Mediterranean Woody Plants in Subtropical Zone of Western Georgia

Vano Papunidze

Academy Member, Batumi Shota Rustaveli State University, Batumi, Georgia

**ABSTRACT:** The geography of flora is closely related to the plant spatial settlement, the origin and the expansion of their areal goes on slowly. Plant population is also spreading itself from the distant territories by spores, seeds, vegetative parts of the plant, or by the human intervention. In this case the plant is forced to adapt to the new biotic and abiotic conditions of the environment. In the subtropical climate zone of Adjara, the seasonal development of Mediterranean plants is in same period as in their homeland, but their timeframes are moved - reduced or prolonged according to local climate conditions. They are normally growing, blossoming and are fruitful. © 2018 Bull. Georg. Natl. Acad. Sci.

Key words: introduction, acclimatization, development rhythm

Plant introduction can be performed through acclimatization and naturalization. The process of adaptation to new, different environment, which is done in order to enhance its spread and areal, is the subject of acclimatization.

The process of introduction of the plant from the natural area to the changed environment (introducing process) has a history from the distant past. It was active during the early period and was associated with the invaders, seafarers and individual amateurs from foreign countries who would bring the wild, unusual and unknown plants to their homelands. Introduction of plants that had medical and other useful properties and could be eaten was of a special interest. Afterwards, plant introduction had imposed plant protection in nature and culture, preservation of rare and endangered species of plants, creation of plant collection and seed banks, selection of perspective species and searching for ways to spread them widely, etc.

Results of scientific research work on plant introduction were periodically covered in certain introduction centers and in whole regions [1-7]. The extensive development has been obtained by methodological researches of basic introduction materials.

These works cover the climate and ecogeographical conditions of natural plants, the issues of their adaptation in the new environment, the historical and floral analysis of the spread of presented plants. Comprehensive materials are presented for plant introduction, physicalecological characteristics of the introducents and their anatomical-morphological structure variability.

According to Mayr's theory of climatic analogies, the success of plant introduction, directly related to resemblance of climatic conditions is proved by the factual material. The transfer of plants from a dramatically different climate zone in the new zone often fails. Nevertheless, the absolutization of this process does not prevent the successful introduction of the plant from one climatic zone to another.

Comparative analysis of climatic data during plant introduction enabled us to make conclusion that climatic analogues do not exist in nature and during the introduction of plants from one geographical location to another, adaptation process of introducents to any climate conditions is going on in any case of deviation.

Today we consider plant introduction as plant transfers from their natural environment to the new natural-climatic areas, their cultivation and testing. The scientific grounds for plant introduction and acclimatization include a number of important issues of studying the origin of the forms of introduction plants, variability and heritage, physiology and biochemistry as ontogenetic and physiogenetic development. It is directly connected to the evolution theory and historical development of plants.

Scientific researches for the development of the theoretical and practical basis of plant introduction and acclimatization are carried out mainly in the botanical gardens, whose functions will further increase. Today's botanical gardens are one of the main bases of the world's plant gene fund protection, preservation of endangered species, scientific study of plants, closer ties of botanical science and the introduction objects, educating the population on the ecological principles, of educational and scientific programs and the distribution of printed products. At present, a wide range of scientific research work on plant introduction issues is being done in our country, as well as abroad.

The study of the rhythm of growth of introduced woody plant species of Mexican origin in the coastal zone of the Adjara region revealed that Mexico and Adjara coastline are different in the latitude climatic location and relief, as well as climatic conditions. Mexico is located in a tropical and subtropical zone and 50% of its area is located at 1000 m above the sea level. The average annual temperature of the Mexican lowland and the south is  $+23 - +25,7^{0}$ C and there are no freezes, while in the northern part it is  $+14 - +15^{\circ}$ C and the absolute minimum drops at -10-18,8°C. Large part of Mexico has lack of sediment, except for some southern regions. Most of the sediment come in the first half of summer and autumn. Most of the Mexican territories are deserted and covered by brown, black and tropical wetlands, where most of the xerophytes and some wetland plants dominate.

Nowadays, natural population area of growing Mexican woody plants in the Batumi Botanical Garden is high mountain zone of Mexico. Here are 12 species, most of which are brought in the first years of establishment of the Garden. A series of works [8, 9, 15] is done to study the plants seasonal development rhythm, growth dynamics, blossoming, fruitfulness and other issues.

Mexican plants are mostly evergreen and semievergreen trees and bushes, including few species of deciduous plants. The researched materials show that the majority of Mexican woody plants grow on the coast of Adjara in spring, mainly in April, and intensive growth is in May and throughout the summer months and continues until November.

By the growth rhythm, plants can be divided into three groups. The first group includes plants that grow in summer or early September, such as: *Pinus montezumae* Lamb., P. *Patula Schiecht*. et., *Cupressus guadalupensis* Wats., C. *Lusitanica Mill., Choisya ternata* H.B.; In the second group of plants, which continue to grow until mid-autumn: *Taxodium mucronatum* Ten., *Persea gratissima* Gaertn.f. And the third group consists of plants that are characterized by long vegetation and stop



Fig. 1. Callistemon macropunctatus



Fig. 3. Acer palmatum f. Palmatifidum

growing with the decline of temperature in November-December, such as Cestrum elegans Lindl., Eupatorium micranthum Less. etc. Two plants grow from Choisya ternata H.B., Persea gratissima Gaertn.f. Sometimes sprout growth in different species varies from 1.5-2 months to almost 7-8 months, such as: Pinus montezumae Lamb., P. Patula Schiecht. et., Cupressus guadalupensis Wats., C. Lusitanica Mill. Choisya ternata H.B., has the smallest growth - 10 cm in average and others - Cestrum elegans Lindl., Eupatorium micranthum Less., Taxodium mucronatum Ten., Pinus patula Schiecht. et. grow longest - 30 to 80 cm and sometimes more.

Blossom of Mexican plants on the coast of Adjara begins at different times of the year. The earliest (in January) begins *Senecio petasites* D.C., and the latest (in July) - *Eupatorium micranthum* Less. Most of the plants blossom in April-May. *Taxodium mucronatum* Ten., *Persea gratissima* Gaertn.f., *Pinus montezumae* Lamb., P. *patula* 





Fig. 2. Asimina triloba



Fig. 4. Acca sellowiana

Schiecht. et. - are characterized by a relatively short duration of blossoming (about a month). Cupressus guadalupensis Wats., C. Lusitanica Mill - blossom during almost a month and a half. Plants with the longest blossoming (up to 7 months and more) are: Cestrum elegans Lindl, Eupatorium micranthum Less. The latter species are sometimes blossoming in winter too. We see the flowers on the bushes as well as the seeds ripening at different stages. Choisya ternata H.B. - sometimes is characterized by a very weak second blossoming.

Comparison of blossoming periods of plants of natural vegetation and introduced Mexican plants on the coast of Adjara showed that blossoming periods in the plants are moved more or less by the influence of new climatic conditions. For example, blossoming of *Eupatorium micranthum* Less, compared to blossoming in its homeland is very much delayed, and instead of September-October, it blossoms from July to the next February or on the contrary, blossoming of *Cestrum elegans* Lindl is longer than usual, but the blossoming periods are moved in other plants too, for example: movement of blossoming periods of *Taxodium mucronatum* Ten., *Senecio petasites* DC, *Choisya ternata* HB refers to Mexican plants' heredity fluctuations and their seasonal development change by the influence of the new environment, as well as the ability to adapt.

Most of Mexican plants on the Adjara coast almost annually produce seeds, but the seeds do not have very high ability to grow. Some species are characterized by self-regeneration. Such is -*Cupressus lusitanica* Mill, whose seedlings are quite grown trees with seeds. *Taxodium mucronatum* Ten., *Pinus montezumae* Lamb. And P. *Patula Schiecht*. et. - are not fruitful seedlings. All of the presented species, except coniferous, are characterized by good vegetative self-regeneration, especially - *Choisya ternata* H.B.

In the early years many plants were introduced into the coast of Adjara from the tropical zone of Mexico, many of which have sometimes been killed due to the sharp drop of temperatures. At present, most of the Mexican plants', which grow on the coast of Adjara, natural population area is Mexico's high mountain zone and therefore their cold-resistance ability is relatively high. But our environmental conditions are not favorable for all types. Under the low temperature in winter, some of the evergreen species' leaves are falling, onetwo-year sprouts freeze, and sometimes the upper part dies. In 1949-50's winter, under -8,6°C the plant was frozen to the root, and some died, such as: Pinus montezumae Lamb., Senecio petasites DC, Cestrum elegans Lindl., Persea gratissima Gaertn.f., Jucca elephantipes and more. It should be noted that most of the frozen plants still provide reliable shoots.

It is noteworthy that despite the difference of coastal Adjara and climatic conditions of Mexico, Mexican woody plants introduced in our environment, have changed their seasonal development rhythm more or less and have adapted to the new conditions. Although, sometimes they are damaged because of our minimum critical temperatures, they still blossom, produce seeds, some species produce self-seedlings and have the vegetative ability of self-regeneration, which testifies that the introduction of woody plants from high mountainous regions of Mexico on the coast of Adjara, should be considered successful. It is proved by the fact that some Mexican woody plants and succulents have already found their use in planting of greenery of Adjara, such as *Cupressus lusitanica Mill, Taxodium mucronatum* Ten., *Jucca, Agava, Opuntia* and others.

Results of the study of the growth and development rhythm of Mediterranean plants in the Batumi Botanical Garden confirmed that the climatic conditions Mediterranean are characterized by strong drought in summer, cold winters, spring and quite humid autumn, and because of this reason our climatic conditions turned out to be favorable for the normal growth and development of the given plants. They are characterized by the ability to respite twice - during a severe drought in summer and a low temperature in winter, in spring and partly in autumn they grow intensively.

In the subtropical zone of Adjara, most of the Mediterranean plants develop in accordance with local climate, some with deviations. These plants have the following cycles of rhythm:

1. Plants of one period of growth are: *Pinus pinaster* Ait., P. Pinea L., *Cedrus atlantica Manett.*, *Abies pinsapo* Boiss., A. *cephalonica Loud.* etc. These plants characterized by one growth period - spring-summer. Blossoming and seedling are normally going. Sprouts are woody for winter, and there is no negative impact of low temperatures.

2. Plants of two periods are: *Chamaerops humilis* L., *Quercus ilex* L., Q. *occidentalis* J. Gay. etc. The first period of growth is going on from March to June, the second - after a short break - from July to mid-September. In winter, sometimes even cold frosty periods do not damage the sprouts,

it is only late 10-20 days of vegetation and blossoming, which leads to more intensity of vegetation and ending in a short period of time.

3. Plants of three growth period are: *Arbutus* unedo L., Ulex europaea Huda., Viburnum tinus L., Cytisus scoparius (L.) Link Fabaceae, Olea europaea L., Myrtus communis L., Nerium oleander L. and others. The first period of growth starts in early spring (March) and is going on till the start of the summer season, the second period - from July to September, and the third period of growth - in autumn. Some species of this group are blossoming in autumn, they grow normally, but their shoots are damaged in winter frosts, but in the first vegetative period, these plants self - regenerate

the damaged parts and their growth and development is normal.

In the subtropical climate zone of Adjara, the seasonal development of Mediterranean plants is in same period as in their homeland, but their timeframes are moved - reduced or prolonged according to local climate conditions. They are normally growing, blossoming and are fruitful. This circumstance shows that exotic plants adapt to the new conditions, which is of great importance for their introduction in our conditions. Many of them are used in planting of greenery - Nerium oleander L., Myrtus communis L., Pinus pinaster Ait., P. Pinea L., Cedrus atlantica Manett., Chamaerops humilis L., Ouercus occidentalis J.Gay and others.

#### *ბოტანიკა*

## დასავლეთ საქართველოს სუბტროპიკულ ზონაში მექსიკის და ხმელთაშუა ზღვის ინტროდუცირებულ მერქნიან მცენარეთა ზრდისა და განვითარების რიტმი

### ვ. პაპუნიძე

აკადემიის წევრი, ბათუმის შოთა რუსთაველის სახელმწიფო უნივერსიტეტი, ბათუმი, საქართველო

საფუძვლიანადაა განხილული დედამიწის სხვადასხვა ფლორისტულ რეგიონში ბუნებრივი წარმოშობის მცენარეთა კლიმატური, ეკოლოგიურ-გეოგრაფიული პირობების, ახალ გარემოში მათი გამოცდის, ანუ მცენარეთა ინტროდუქციის განვითარების თეორიის აქტუალური საკითხები. მრავალი წლის კვლევების საფუძველზე, შესწავლილია ბათუმის ბოტანიკურ ბაღში ინტროდუცირებულ მექსიკის და ხმელთაშუა ზღვის მცენარეთა გავრცელების ისტორიული და ფლორისტული ანალიზი, მათი ფიზიკურ-ეკოლოგიური თავისებურებები, აჭარის ზღვის სანაპირო ზონაში ზრდა-განვითარების რიტმის და პერსპექტიულ სახეობათა შერჩევის სავითხები. ბათუმის ბოტანიკურ ბაღში ინტროდუცირებული მექსიკური მერქნიანი მცენარეების უმეტესი ნაწილის ბუნებრივი გავრცელების არეალი მექსიკის მაღალმთიანი ზონაა. მათი დიდი ნაწილი ბაღის დაარსების პირველ წლებში იქნა შემოტანილი. ინტროდუცირებული მექსიკური მერქნიანი მცენარებული ზრდის რიტმის მიხედვით სამ ჯგუფად იყოფა: პირველ ჯგუფში შედის მცენარეები, რომელთა ზრდა ზაფხულში ან სექტემბრის დასაწყისში მთავრდება, ასეთებია: Pinus montezumae, P.patula, Cupressus guadalupensis, C. Lusitanica და სხვა. მეორე ჯგუფში - მცენარეები, რომლებიც თითქმის შუა შემოდგომამდე აგრძელებენ ზრდას - Taxodium mucronatum, Persea gratissima და სხვა. ხოლო, მესამე ჯგუფს მიეკუთვნება მცენარეები, რომლებსაც ხანგრძლივი ვეგეტაცია ახასიათებთ და ნოემბერ-დეკემბერში ზრდას წყვეტენ. ასეთ მცენარეებს მიეკუთვნება: Cestrum elegans, Eupatorium micranthum და სხვა. მექსიკური მცენარეების უმრავლესობა თითქმის ყოველწლიურად თესლმსხმოირობს, მაგრამ მათი აღმოცენების უნარი დაბალია, ზოგიერთი მათგანი თვითგანახლების უნარს ამჟღავნებს. ხმელთაშუა ზღვის რეგიონებიდან ინტროდუცირებული მცენარეების უმეტესი ნაწილი ჩვენი კლიმატური პირობების შესაბამისად ვითარდება, ზოგიერთი მცირე გადახრით გამოირჩევა და გააჩნიათ ზრდის რიტმის შემდეგი პერიოდები: ზრდის ერთი პერიოდი - Pinus pinaster, P.pinea, Cedrus atlantica, Abies pinsapo, A. cephalonica და სხვა; ზრდის ორი პერიოდი - Chamaerops humilis, Quercus ilex, Q. occidentalis os boss; orocol bso 3960000 - Arbutus unedo, Ulex eupopaea, Viburnum inus, Cytisus scoparius, Olea europaea, Myrtus communis, Nerium oleandez cos bbas.

#### REFERENCES

- Manjavidze D. (1961) Some peculiarities of climatic conditions and their impact on plants in the area of Batumi. 1. Batumi Botanical Garden. Moambe, 9-10: 174-180.
- Tsitsvidze A. (1958) For the issue of acclimatization of some exotic varieties introduced into the Black Sea coast 2. of Adjara.
- Ginkul S. (1936) Introduktsiia i naturalizatsiia rastenii vo vlazhnykh subtropikakh SSSR. Batumi (in Russian). 3
- 4. Gulisashvili V.Z. (1948) Itogi introduktsii rastenii v Tbilisskom botanicheskom sadu i puti dal'neishei introduktsii. Vestnik Tbilisskogo botanicheskogo sada. issue 57. Tbilisi (in Russian).
- Gulisashvili V.Z. (1967) Proiskhozhdenie drevesnoi rastitel'nosti subtropicheskogo i umerennogo klimatov 5. i razvitie ee nasledstvennykh osobennostei. Tbilisi (in Russian).
- Gulisashvili V.Z. (1969) Stadiinost' v razvitie rastenii v sviazi s ikh proiskhozhdeniem (in Russian). 6.
- 7. Krasnov A.N. (1913) Batumskii botanicheskii sad za pervyi god ego organizatsii. Zh. Russkie subtropiki (in Russian).
- Matinian A.B. (1958) Rezul'tati akklimatizatsii drevesno-kustarnikovykh rastenii v Batumi. Biul. GBS, 8. 32: 7-10. (in Russian).
- 9. Matinian A. B. (1962) Severo-amerikanskie drevesnye ekzoty, dichaiushchie na Batumskom poberezh'e (in Russian).
- 10. Papunidze V.R. (1989) Derev'ia i kustarniki Batumskogo botanicheskogo sada (Golosemennye) (in Russian).
- 11. PapunidzeV.R. (2007) Derev'ia i kustarniki Batumskogo botanicheskogo sada (Pokrytosemennye) (in Russian).
- 12. Sharashidze N. (1977) Osobennosti uglevodnogo obmena nekotorykh subtropicheskikh rastenijakh
- v usloviiakh vlazhnykh subtropikov v sviazi s ikh morozostoikost'iu. Tbilisi (in Russian).
- 13. Mayr H. (1909) Die naturgesetzlicher Grundlage des Waldbaues.
- 14. Walter H. (1960) Klimadiagrammveltatlas. Veb. Gustav Fisher Verlag.
- 15. Papunidze V. (2016) Eco-physiological peculiarities of adaptation and change regulation of the plants Introduced in Georgian Littoral. Georgian National Academy of Sciences, Ajara Autonomous Republic Regional Scientific Centre.

Received June, 2018