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Bio-ecology of *Taxus Baccata* L. in Kakheti

Tamar Nadiradze

Iakob Gogebashvili Telavi State University, Georgia
2200 Telavi, 1, Kartuli Universiteti str.
E-mail: nadiradze_t@yahoo.com

Abstract. The article discusses the bio-ecology of *Taxus baccata* L. in Kakheti (eastern Georgia), particularly in Tsinandali Park. Yew (*Taxus baccata* L.) preserved in Tsinandali Park (Telavi region, Georgia) was chosen as an object for long-lasting observation over plant vegetation. Vegetation of 47 new specimens were studied during the period 2001-2010. It was observed the buds opening, the vegetation finishing, the cambium active periods beginning and finishing, the sprout stiffen process, the rate and time of growth. The period between 2001 and 2004 is distinguished by the relatively intensive growth of yew samples. In 2004-2010 growth period was shortened. It is suggested, that shortening often growth period in yew specimen is related to the deficit of water in soil due to frequent drought and snowless winters in Telavi region in the last decade.

Observation conducted on the peculiarities of cambial growth confirms that yew has strong ability of frost-resistance. We consider that the bio-ecological studies of yew tree, as an endangered species, and its implementation in decorative gardening will contribute to its conservation.

Keywords: yew; spread; evergreen; coniferous; vegetation; cambium; life expanse; height growth period.

Introduction. Yew – *Taxus baccata* L. is a rare relict, included in the “Red Book”. As it’s an endangered species, the research of its bio-ecology contributes to its conservation.

It is naturally spread in Western Europe, northern Persia, and the Caucasus. In the mountains it elevates up to: 1100-1400 m height in the Alps; 1600 m - in the Carpathians, 1500 m – in the Caucasus, 2300-m - in Asia Minor from the sea level. In Caucasus it occurs in Georgia, Armenia and Azerbaijan. It’s spread almost in all regions of Georgia. It’s more widely represented in eastern Georgia. The unaffected yew grove is remained in the south slopes of the Caucasus, in Batsara Valley at the sources of the Alazani River, where the preserve was founded in 1935 to protect the yew forest. The preserve area is more than 3000 hectares. Here the beech and yew groves are spread at elevations of 1000-1500 (1666) meters from the sea level (1).

The yew grove occupies the area of 800 hectares in Batsara Valley; it’s the most extensive yew grove in the world [1]. Most of the yew trees existing here are more than 500-1000 years old. 220 000 yew trees grow on the preserved territory, 13 000 of them are 100 years older, and some of them with the height of 25-30 m and diameters of 150 m, reach 1200-1500 years.

Based on its biology, yew is characterized with the very slow updating, productivity and low growth rate that causes the high level of vulnerability from all kinds of negative factors. Mainly two kinds of stem damages can be seen almost at all young plants of the 11th block of the preserve and outside of it. In the first case the wood is eaten by mammals, e.g. roe, bear. In another case it’s scratched with fags or claws, in some cases the scratch diameter is 9 mm.

The dendroflora of yew in Batsara Valley includes 60 types of *Taxus baccata* L. Along with yew, Maple (*Acer campestre* L.), Ash (*Fraxinus excelsior* L.), Linden (*Tilia Caucasia* Rupr.), Chestnut (*Castanea sativa* Mill.), Cherry-laurel (*Laurocerasus officinalis* Rome.) and other species, included in the “Red Book of Georgia”, also exist there. All of these give Batsara Preserve the worldwide significance. Yew is an evergreen, conifer plant-tree, often 20-25 meters high, with the diameter of 1,5-2,5 m. The needle leaves are flat, arranged spirally, of 2-3, 5 centimeters length,

with short tips. The seeds are hard, 6-8mm length. The needle leaves contain poisonous substances, which are toxic for animals. Lives longer (1500-2000years).

Its bark is yellowish, doesn't contain pitch and is very hard, doesn't rotten for a long time. The bark is used in turnery, furniture manufacturing and for tool handles. Yew is a valuable decorative tree. It reproduces with seeds and sprout cuttings. The cuttings root easily in the river sand; give stump shoots and maintain this ability for about 300-400 years. The lower branches root easily at the place of touching the ground. In case of the seed reproduction, it springs up difficultly. It is characterized with the better vegetative reproduction.

Yew is characterized with the strong anti-bacterial features. The substances allocated from the plant leaves destroy the micro-organisms around.

The yew is less demanding from the soil. It perfectly grows on the sour, and weak alkaline carbonate soils. It grows better on the weak alkaline limestone; grows slowly, annual height growth rarely exceeds 20cm; endures shade and dryness.

Yew begins fruit-bearing at the age of 20-25 (in open space) or 60-100 (in the forest) [3]. It easily stands the fungal disease, damages caused by insects, branch cut. In the culture, it is used in decorative gardening; has lots of garden forms; is frequently found in the parks and gardens of Georgia.

In Kakheti region, Besides Batsara Preserve, yew is also found in Tsinandali Park. One of the 47 yew trees existing here, stands at the entrance of the park, reaches 7 meters and has a strong trunk. The lower branches lay on the ground. Some of them have roots. One plant occupies approximately 10 m² space. Here also are trees of 12 m in height and 38 cm in diameter.

Sources and methods

The aim of our research was the study of the bio-ecology of yew specimens preserved in Tsinandali Park that is considered as an issue of a great importance, as, in fact, the yew collection of Tsinandali Park hasn't been studied from this viewpoint. We have studied the bio-ecology of 47 yew trees existing in Tsinandali Park.

The observation has been conducted on each specimen since 2001. The penology and penometry has been conducted on the selected plants systematically/ once or twice in the decade/ for ten years. We have observed the periods of bud opening, vegetation ending, starting and finishing of cambium action, sprout woodening process, the time and rate of the height growth.

Besides the apical growth, the cambial growth of the lateral branches has also been studied. For this purpose we took the patterns from the twigs once in every ten days from the early spring to the late autumn, then placed them in 60-70% alcohol [5], [6], [7], and observed the dividing of the cells of secondary meristem and development of annual cycle through a microscope. Transverse veneer was taken with safranin and the process of new wood cells development was determined; the research was conducted according to the methodical instructions by Iatsenko-Khmelevski, 1954, Lobzhanidze e., 1961, and Tsitsvidze 1973.

Conclusions:

The observations revealed:

1. In Tsinandali Park *Taxus baccata* L. starts vegetation in the end of May and finishes in the beginning of April.

2. The apical growth of sprouts ends in August-September;

3. The bud opening and the beginning of sprout growth in almost don't depend on the changes of air temperature. As usually, the yew pollens at first, and then the sprout growth start.

4. The cambium activity in the sprouts begins in 4-8 days after the opening of the bud. For example, in 2005 the buds opened on April 26th, the needle leaves completely appeared on May 5th, cambium activity started on April 30th.

5. In addition, the observations revealed, that these processes don't start simultaneously on every side of the plant. The Cambium activity first starts on the light side.

The results of the following years' observation are given in the table N1.

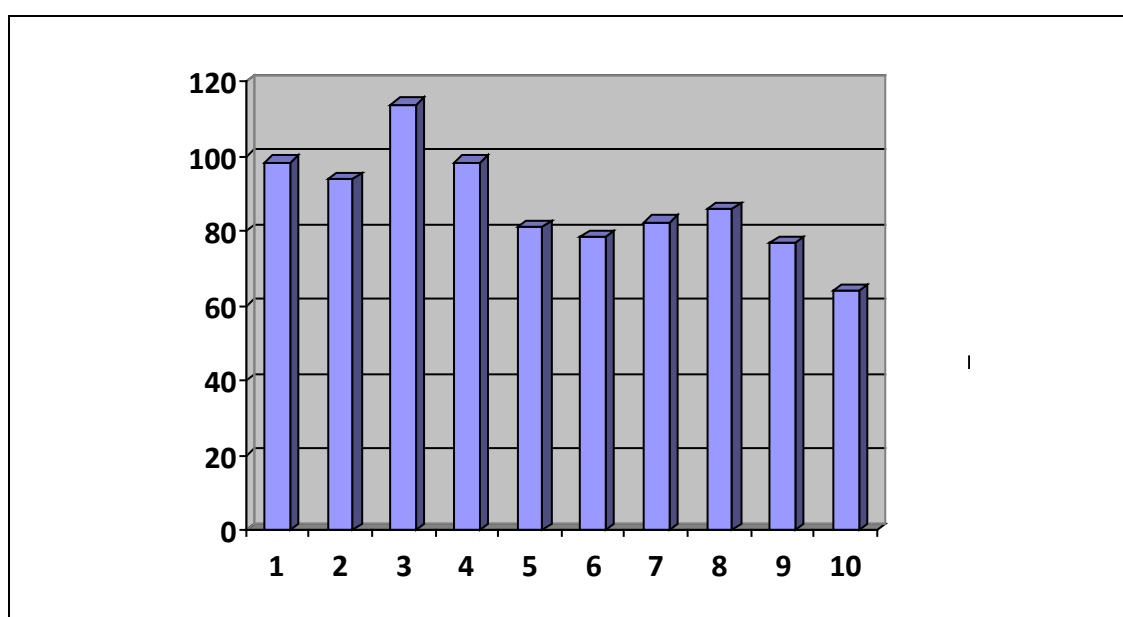
Chronology of the yew vegetation in Tsinandali Park, Table N1

№	Years of observation	Bud opening	End of vegetation	Beginning of cambium activity	The end of cambium activity	Duration of height growth (days)
1	2001	26. IV	27. IX	30. IV	27. IX	100
2	2002	21. IV	12. X	28. IV	12. X	95
3	2003	11. IV	10. X	18. IV	25. IX	115
4	2004	15. IV	28. X	20. IV	22. IX	100
5	2005	20. IV	10. X	29. IV	15. X	83
6	2006	23. IV	20. IX	29. V	23. IX	80
7	2007	25. IV	25. IX	30. IV	30. IX	86
8	2008	27. III	15. IX	8. IV	20. IX	91
9	2009	30. III	25. IX	6. IV	27. IX	78
10	2010	12. IV	30. IX	19. IV	5. X	67

6. Formation of the wood cells lasts 120-150 days in the lateral twigs, and 140-170 days – in the stem. The studies of sprout woodening conducted over the years revealed that the sprout woodening starts instantly after the xylem cells formation, or a bit later, and lasts for a quite long period.

7. The growth of yew sprout is rapid in the beginning of vegetation, and then stunts. The height growth lasts on average 80-90 days. The dynamics are as following:

Diagram N1.

The height growth of yew in 2001-2010 years

In the vertical axis - the growth duration in days, horizontal axis – in years (2001-2010)

The diagram suggests, that in Tsinandali Park yew specimens grew longer in 2001-2004 years, and from 2004 to 2010 the duration of height growth reduced. In our opinion this isn't connected with its age, as, considering the life expectancy, the yew specimens in Tsinandali Park are not so old (not more than 400 years). Probably, the growth duration is effected by the droughts and snowless winters frequented in last decades in Kakheti region, which cause the lack of water in the soil and have a negative effect on the plant growing.

Observation conducted on the peculiarities of sprout woodening and cambium activity confirms the strong ability of frost-resistance of yew.

According to the research data, we suppose that intensive irrigation from the beginning of April is desired for their future development.

So, yew is under the risk of complete extinction and is preserved as small graves and units of trees. It's included in all regional "Red Books", including the "Red Book" of Georgia (1982) and the Red List of Georgia (2006), also in the red list of IUSN.

Naturally renewal process is weak almost everywhere, but in gardens, parks and generally, in open spaces it is characterized with the good growth and development. Therefore, we consider that the bio-ecological studies of the yew tree, as an endangered species, and its implementation in decorative gardening will contribute to its conservation.

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Биоэкология *Taxus Vaccata L.* в Кахетии

Тамар Надирадзе

Телавский государственный университет, Грузия
2200, г. Телави, Картули университетска, 1
E-mail: nadiradze_t@yahoo.com

Аннотация. В статье рассматривается био-экология ягодного *Taxus L.* в Кахетии (Восточная Грузия), в частности на территории Цинандали парка. Тис (*Taxus* ягодный *L.*) сохранился в Цинандальском парке (регионе Телави, Грузия) был выбран в качестве объекта для длительного наблюдения за вегетации растений. Растительность 47 новых образцов была изучена в период 2001-2010 годов. Были отмечены почки открытия, растительность, активные периоды начала и окончания, скорость и время роста. Период между 2001 и 2004 отличается сравнительно интенсивным ростом образцов тиса. В 2004-2010 годах рост был сокращен. Предполагается, что сокращение часто в период роста тиса связано с дефицитом воды в почве из-за частых засух и бесснежных зим в регионе Телави в последнее десятилетие.

Наблюдения проводились на особенностях камбиальными рост подтверждает, что тис имеет сильную способность морозостойкость. Мы считаем, что био-экологических исследований с участием тиса, как вымирающий вид, и ее реализации в декоративном садоводстве будет способствовать его сохранению.

Ключевые слова: тис; распространение; вечнозеленые; хвойные; растительности; камбий; жизни твердью период роста высоты.