Biology of germination of medicinal plant seeds. Part XXIII: Seeds of *Oxyccocus palustris* Pers. from *Ericaceae* family

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**Summary**

At the beginning a short characteristic of *Ericaceae* family is elaborated then the biology of seeds germination of *Oxyccocus palustris* Pers. is described. In this experiments, the optimal condition of ability of germination of *Oxyccocus palustris* Pers. was established. It was found that the light and variable temperature (30°C over 8 hours, 20°C over 16 hours) were optimal for analysis of *Oxyccocus palustris* seed germination ability. The results also show that the pre-sowing treatments (stratification) were significant to obtain a higher percent of germinating seeds in comparison to non-stratified seeds. The capacity of germination of *Oxyccocus palustris* Pers. seeds stored in unheated room conditions gradually decreased in the first year after harvest. The viability of *Oxyccocus palustris* seeds is very short. Three years after harvest time, the seeds do not germinate.

**Key words:** *Ericaceae* family, *Oxyccocus palustris* Pers., germination, seeds

**INTRODUCTION**

**The characteristics of *Ericaceae* family**

In Poland 15 species from 10 genera belonging to *Ericaceae* family are noticed [1-5]. It is relatively few taxa in comparison to 82 genera and to over 2,500 species widespread all over the world.

The plants appear as a dwarf shrub, sub-shrub, shrub or a small tree, usually with alternating leathery and often evergreen leaves. The bisexual flowers are
solitary (axillary or terminal) or clustered in inflorescences. The corollas are usually radially symmetrical, although, many flowers of the family are somewhat bilaterally symmetrical. Moreover, the corollas are also composed of wholly fused, rarely partial petals. There are from 8 to 10 (alternatively with petals) stamens with anthers dehiscing by terminal pores. The carpel is superior or inferior and contains many ovules.

In *Ericaceae* family, the fruit can have a shape of a capsule, a berry or a drupe. As long as the fruit does not achieve full ripeness, the calyx remains on its surface. The embryo of seeds is straight, its length takes up 2/3 of whole seed. The basic number of chromosome 2n is: 8, 11, 12, 13 [1, 3, 6]. The species of *Ericaceae* family grow mainly in polar zone and in higher mountainous sites [1-4, 7-9]. In order to obtain normal phase of plant development, most of the species need acid soil.

Due to great difficulties caused by species diversity among the family, some of the scientists divide the family into two independent taxa: *Ericaceae* – containing flowers with superior carpel and a capsule as a fruit, and *Vacciniaceae* – in which all the plants have an inferior capsule in the flower and a fleshy fruit (berry) [5].

Almost always the fruit contains many small seeds ranging from 0.2 to 3.5 mm of length [5]. The seeds are well-supplied with nutritious material such as proteins and fat. The shape of the seeds varies from round-ovate to flat.

Many species of *Ericaceae* family are used in industry. The plants which are able to produce berries are very useful in food and pharmaceutical processing. Species containing essential oils are of practical application in cosmetics and medicine. Many species are also well-known as ornamental plants [2, 10, 11].

The herbal medicine in Poland is very interested in some species of this family. The most important species are as follows: *Ledum palustre* L., *Vaccinium myrtillus* L., *Vaccinium vitis idea* L., *Arctostaphylos uva-ursi* (L.) Sprengel, *Calluna vulgaris* Salisb., *Oxyccocus palustris* Pers. [2, 10, 11].

This part of the work elaborates on *Oxyccocus palustris* Pers. which is of great significance in healing and food processing.

The diagnostic features of *Oxyccocus palustris* Pers. – a plant description

The plant of this species is a shrub with a flexible, trailing along the ground stem with length coming up to 1 m. Dark, shiny evergreen leaves are alternating and almost sessile. The shape of the leaves is oblong-ovate, 5–12 mm long and 3–5 mm wide. Four-merous flowers are clustered in (axillary or terminal racemes) with inflorescence of 1–5. The flower occurs on (more or less) erect, red and slender, pubescence pedicels. The pinkish corolla is divided (towards the base) into lobes. There are 8 stamens and 1 style, nectar is produced on the base of the style [12, 13]. The fruit occurs on (more or less) erect, red and slender, pubescence pedicels. The pinkish corolla is divided (towards the base) into lobes. There are 8 stamens and 1 style, nectar is produced on the base of the style [12, 13]. The fruit of *Oxyccocus palustris* Pers is red, 8–10 mm in diameter, edible berry [1, 3, 5, 8, 9, 11]. The fruit can stay on the plant until spring.

The number of seeds in berry ranges from 3 to 11. Seeds are from linear, ovate to almost circular, sharply pointed at one side. Seeds are 1.5–2.8 mm long,
1.0–1.8 mm wide and 1.0–1.8 mm thick [7, 14]. The colour of seeds is yellowish to red-brown without sheen. The seed coat is reticulate.

Oxycoccus palustris Pers. is distributed in Central and North Europe and spread from the Balkans, the Ural Mountains, Siberia to Manchuria [8, 9]. In Poland, the species is indigenous to peat bogs, usually in wetter parts. The plant usually makes a loose turf on the edge of transitional moor.

In natural sites the highest number of plants has been noted in North and Central Poland, whereas in the foothills and in the mountains it is sparse [15]. The Oxycoccus palustris Pers. is a species characteristic for ombrotropic peat bog (Sphagnetalia magellanici order) [16].

The chromosome number of Oxycoccus palustris is 2n=48,60,72. The ploidy level of cranberry have an influence on the size of the flower (6).

MATERIALS AND METHODS

Seeds of Oxycoccus palustris Pers. were picked from native sites in North Poland (near Wronki) at the stage of ripe fruit. The collection was carried out at the end of September and in the first part of October in 2006 and 2007. Every year after harvest, the fruit tissue was removed. Cleaned and dried diasporas were stored in paper bags in unheated room conditions.

In the experiments, in order to compare the results of germination, a part of the seeds was stratified (in moist sand, temperature 5°C), the remaining seeds were tested without pre-sowing treatments.

Analyses of germination were carried out according to ISTA seed estimation methodology. Blotting chromatography paper (Whatman 3) was used as a basis. The physical conditions used during the analyses of germination ability were as follows: light and changing temperature, darkness and changing temperature, light and constant temperature.

The seeds germinated on Petri dishes in constant temperature of 20°C in daylight. The climate chamber was applied to obtain darkness and changing temperature (30°C for 6 hours and 20°C for 18 hours), while the Jacobsen apparatus was used to make the temperature change (30°C for 8 hours and 20°C for 16 hours).

The results of germination analyses of stratified and non-stratified Oxycoccus palustris Pers. seeds were tested monthly from December 2006 to October 2007 and from December 2007 to October 2008.

Diagnostic features of seeds and seedlings

The seeds are contained in a fleshy, red berry with lathery pericarp. The shape of the seeds is linear, ovate to nearly circular with a reticulate surface. One side of the seed is sharply pointed. Its colour is from yellowish to dark brown or reddish to dark brown without sheen (phot. 1). Seed dimensions are as follows: length
1.0–3.0 mm, width 0.9–1.9 mm and thickness 1.0–1.8 mm. The seed number of berry ranges between 3 and 11. The mass of 1.000 seeds varies from 0.982 to 0.990 g.

The radicle appears in the narrow part of the seed (phot. 2), in 7th–9th day from the test beginning. The radicle is white and thin and gets longer in consecutive days. After 15 days, the lateral roots grew in the oldest part of radicle. Coming out of the cotyledons is the next phase of the plant development (phot. 3, 4). This process is observed between 20 and 25 days of analyses. Cotyledons are shiny green, smooth and their shape is lanceolate.

**Germination of seeds**

Numerous reports on *Oxyccocus palustris* were found in extensive research concerning natural site, the “rhythm” of development, fruit yielding and its usage in medicinal and food industry [2, 10, 11, 17-19]. Unfortunately, there is not much literature on the biology of germination of *Oxyccocus palustris* seeds [12]. It might be due to the fact that the plants are usually propagated by vegetative reproduction.

The aim of the study was to ascertain the biology of germination of *Oxyccocus palustris* seeds. During the first year of analysis, the methodology of seed germination was checked. After three months from the experiment beginning the methodology was extended by a variant of stratified seeds.

It was found that, in laboratory conditions, the light and variable temperature (30°C over 8 hours, 20°C over 16 hours) were optimal for analysis of *Oxyccocus palustris* seed germination ability. The results show that the pre-sowing treatments (stratification) were significant to obtain a higher percent of germinating seeds in comparison to seeds which were non-stratified (fig. 1, 3). Figure 2 and 4 shows the ability of stratified seeds to germinate.

![Graph showing germination capacity of Oxyccocus palustris Pers. seeds in the first year after harvest.](image)

Figure 1. Germination capacity of *Oxyccocus palustris* Pers. seeds in the first year after harvest – 2006. Non-stratified seeds
Phot. 1. *Oxyccocus palustris* Pers. seeds

Phot. 2. Germination of *Oxyccocus palustris* Pers. seeds

Phot. 3. Seedlings of *Oxyccocus palustris* Pers.

Phot. 4. *Oxyccocus palustris* Pers. seedlings in a subsequent development stage
Figure 2. Germination capacity of Oxyccocus palustris Pers. seeds in the first year after harvest – 2006. Stratified seeds

Figure 3. Germination capacity of Oxyccocus palustris Pers. seeds in the first year after harvest – 2007. Non-stratified seeds

Figure 4. Germination capacity of Oxyccocus palustris Pers. seeds in the first year after harvest – 2007. Stratified seeds
In laboratory conditions, the seeds collected in 2006 germinated poorly – up to 40%. Moreover, non-stratified seeds obtained from the same harvest germinated even worst – up to 20%. In addition, the seeds lost their viability after 3 months from the harvest.

Much better results were obtained in the second year of the seed testing. The figure 4. shows the curve of the fluctuation of germination capacity in particular months, which varies from 40-80% during the whole year in different laboratory conditions.

Non-stratified seeds sprouted a little worse but with bigger monthly fluctuation. Figure 3. shows the results. Diaspores stopped germinating in the last month of seed testing.

Viability of stored seeds

The capacity of germination of *Oxyccocus palustris* Pers. seeds stored in room conditions decreased both in the first and second year of experiment.

The seeds collected in 2006 stopped germinating after 11 months. The germination of seeds gathered in 2007 decreased up to few per cent (non-stratified seeds) and up to 25% (stratified seeds) at the end of seeds testing. Viability of the seeds of *Oxyccocus palustris* is very short. Diaspores stored in the conditions of unheated room keep their viability to 2 years but their germination capacity is only few percent. Three years from harvest time, the seeds do not germinate.

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BIOLOGIA KIEŁKOWANIA NASION ROŚLIN ZIELARSKICH.
CZĘŚĆ XXIII: NASIONA OXYCCOCUS PALUSTRIS PERS. Z RODZINY ERICACEAE

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S t r e s z c z e n i e

W artykule przedstawiono ogólną charakterystykę rodziny Ericaceae, a następnie omówiono biologię kiełkowania oraz opisano cechy morfologiczne nasion i siewek Oxycoccus palustris Pers. W badaniach ustalono optymalne warunki laboratoryjne do oceny zdolności kiełkowania nasion. Stwierdzono, że zabieg przedsiewny – trzydziestodniowa stratyfikacja w wilgotnym piasku i temperaturze 5°C, a także temperatura zmienna (20°C/30°C) zwiększają zdolność kiełkowania nasion. Nasiona żurawiny w ciągu pierwszych miesięcy po zbiorze kiełkują dość dobrze (40–80%). Po tym okresie zdolność kiełkowania waha się. Żywotność materiału nasiennego przechowywanego w warunkach nie ogrzewanego magazynu utrzymuje się do dwóch lat po zbiorze.

Słowa kluczowe: rodzina Ericaceae, Oxycoccus palustris Pers., kiełkowanie, nasiona