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Original article

FEATURES OF SEED GERMINATION OF RIBES AUREUM PURSH. DURING A PERIOD OF DEEP REST

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Abstract

The ability of golden currant to be reproduced with seeds under laboratory conditions in winter is investigated in the present contribution, and the influence of experiments on the removal of seeds from a dormant state is also studied in it. Analyzing the research results, it was found that the further germination of seeds of all the studied golden currant cultivars occurs only after passing a period of organic dormancy. It is noted that stratification, phytohormone treatment and scarification of seeds affect only the acceleration of germination and the initial stage of germination, but do not completely remove them from organic dormancy and further germination occurs only after passing deep dormancy.

Keywords: stratification; scarification; phytohormone; seed germination; golden currant

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Introduction

Golden currant (*Ribes aureum* Pursh.) is a promising berry crop. There are no established industrial plantations of this plant. It is found in forest belts, some amateur gardens and as an ornamental crop. It is valued for drought tolerance, heat resistance and stable yield, has good resistance to pests and diseases. Berries have a dessert sweet and sour taste, dietary and medicinal properties, an increased content of carotene and pectin, and they are suitable for fresh consumption and processing [11].

Golden currant berries are an invaluable product for nutrition. The content of ascorbic acid in black berries is 43.2 mg / %, in yellow or orange berries - 68.3 mg /%. Its leaves contain 200-470 mg/100 g of catechins and leucoanthocyanins, and 1.2 mg/100 g of carotene [15].

The combination of valuable vitamins, sugars, acids and pectin makes it possible to use berries in consumption both fresh and processed (jam, jelly, stewed fruit, wine). Berries can be stored frozen at -10 °C for up to 4 months or more [15].

Golden currant berries are of no small importance as a medicinal plant. They help to cleanse the body of poisons and toxins, contribute to the excretion of heavy metal salts and radionuclides. In addition, they help with hypertension, sclerosis and also have a diuretic and diaphoretic effect [15].

The presence of deep winter dormancy of this culture allows it to tolerate a sharply continental climate with cold winters and repeated thaws [1-3; 6; 8; 12; 13; 16].

The objective of our work was to overcome the organic deep dormancy of golden currant seeds in winter by conducting experiments with the use of phytohormones, effect of low temperature and mechanical damage to the seed peel. The research was carried out using bio-objects of the unique scientific installation "Biocollections of the VILAR State Medical University".

Mature seeds of most fruit plants usually do not germinate even under favorable environmental conditions. They start to grow only after the end of the dormancy period [5; 7; 9; 14].

Golden currant seeds are characterized by a state of deep organic dormancy. It is caused by dense seed covers, underdevelopment and physiological dormancy of the embryo. The pericarp contains inhibitors that decelerate germination. To neutralize this factor, careful soaking and washing of seeds, artificial removal of the pericarp or violation of its integrity (scarification) are used. When the coat of seeds is broken, they are able to swell and germinate [4].

The fruit of golden currant is a multi-seed berry. Its seeds are small, with a small (about 1/8 of length) straight embryo and a powerful endosperm. The seed peel is dense. The shelf life is not more than 1 year. They germinate without pre-sowing preparation, but slowly and not all. Stratification at temperatures from -2 to +2 °C for 2-4 months accelerates seed germination [10].

S.S. Baskin and D.M. Baskin indicate that in order to overcome the natural dormancy of seeds, it is enough to stratify seeds for 60 days at low temperatures [2].

N.D. Stidham *et al.* argue that golden currant seeds cooled in distilled water for 10 weeks have good germination; also, to stimulate seed germination, it is possible to use potassium nitrate [9; 10; 16-18].

In the international rules for determining the quality of seeds [7], germination in laboratory tests is now defined as the appearance and development from the seed embryo of those important structures that, in the tested seed type, indicate the embryo ability to develop in the soil under favorable conditions into a normal plant.

To bring the seeds out of the dormant state, they are subjected to positive stratification – the action of low positive temperatures. Stratification, in turn, can be replaced by treatment with physiologically active substances [11].

The use of growth regulators of hormonal nature makes it possible to remove seeds from a dormant state, expand the boundaries of the temperature optimum of germination, shorten the germination time [13], which is important for the introduction and acceleration of the plant breeding process. It is shown that the nature and conditions of the stimulating effect of hormones depend on the type of seed dormancy, specific characteristics of plants, class of the substance used and its concentration. In seeds with a dormant morphophysiological type, the embryo development is accelerated in this way, and the physiological mechanism of inhibition is disrupted [8].

In many cases, the dormant state of seeds is complicated by the presence of a dense seed peel [6].

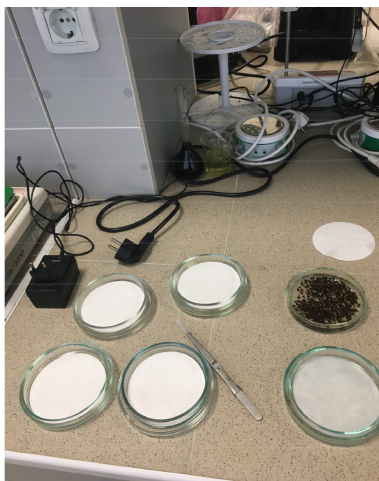
Materials and methods

All experiments were carried out in the laboratory for the research of technological properties of agricultural materials (Federal Scientific Agroengineering Center VIM, Moscow, Russia) according to the method of V.A. Kolesnikov [9]. Before the experiment, the berries were stored frozen in the freezer for about 4 months at a temperature of -20°C . After defrosting the fruit to extract the seeds, the juice was squeezed out. Then the remaining pulp was repeatedly and thoroughly washed with tap water, separating the seeds using a fine-mesh sieve. The finished seeds were placed in a glass jar with a pre-prepared pink solution of potassium permanganate (KMnO_4) and soaked for 14-25 days at room temperature; after this time experiments began. The laboratory germination of seeds was carried out in Petri dishes on wet filter paper in a 3-4-fold repetition of 50-100 pcs. in the thermostat at a temperature of $+20$ to $+23^{\circ}\text{C}$ according to State Standard 12038-84 (Fig. 1).

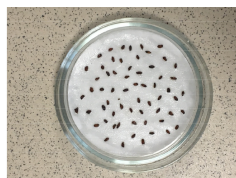
In the 1st experiment, working solutions of phytohormones (epin, heteroauxin, gibbersib), in which samples were kept for 12 hours before germination, were used (Table 1).

In the 2nd experiment, seeds were pre-stratified in a wet state in a refrigerator at a temperature of $+2$ to $+5^{\circ}\text{C}$ before germination (Table 1).

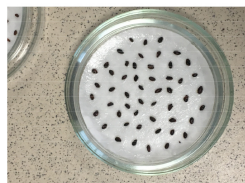
In the 3rd experiment, scarification was used: the removal of the seed peel, after which the seeds were spread on moistened filter paper in Petri dishes and germinated in a thermostat; the temperature was maintained from $+20$ to $+23^{\circ}\text{C}$ (Table 2). As necessary, the filter paper was moistened every 1-2 days with distilled water. The seed was considered germinated in the presence of a root, the size of which is equal to the seed.



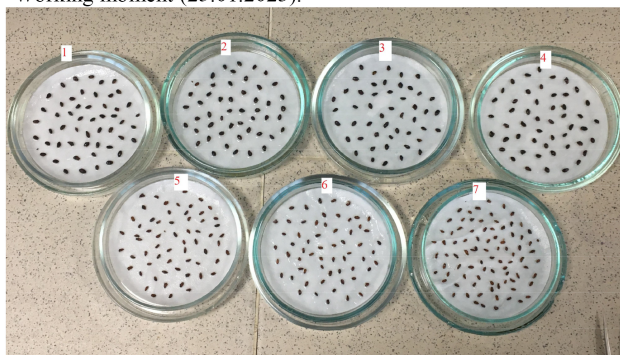
Working moment (25.01.2023).



Experiment 3, variant 1 –
scarification (January).



Experiment, variant 1 –
treatment with phytohormone
Epin-Extra (January).



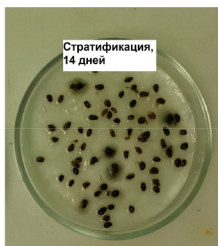
Golden currant seeds: 1-4 – numbers of experiment variants (standard); 5-7 – numbers of variants for the scarification experiment (25.01.2023).



Experiment, variant 2 – scarification.
(13.02.2023).



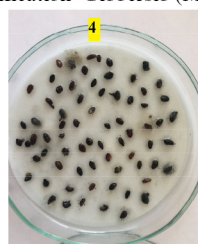
Experiment 3, variant 3 – scarification
(13.02.2023).



Experiment 2, variant 1 – stratification (March).



Experiment 2, variant 2 – stratification+Gibbersib (March).

Experiment 3, variant 3 – scarification
(25.04.2023)Experiment 1, variant 1 – treatment with
Epin-Extra (25.04.2023).**Fig. 1.** Carrying out experiments

The experiments were carried out in the 3-fold repetition in different periods from January to April. Germination was estimated by the ratio of the number of germinated seeds to the number set for germination, thus, expressed as a percentage. The completion of seed germination was judged by their pecking [10]. The seed germination was carried out at an average optimal temperature ($t = +20\text{ }^{\circ}\text{C}$) [6] without access to light.

Results

All the studied plants belong to the species producing a significant amount of seeds. The shape of the seeds is ovoid-oval. The color is brown or light-brown. They are 0.34 ± 0.04 mm long and 0.15 ± 0.07 mm wide, and the weight of 1000 seeds is 0.54 g.

Experiments with phytohormones and stratification carried out in the period from January to February did not yield results, the seeds did not peck out. Repeated experiments in March showed that, in the variant stratification, the laboratory germination was 3.0%, the beginning of germination was noted on day 15, in the stratification variant with the treatment with phytohormone gibbersib – 7.6%, in the stratification variant with the treatment with heteroaux-

in – 6.7%. Experiments conducted in April showed the following results: in the epin-extra variant, the seeds germinated on the 10th day and the germination was 21.8 %; in the variant stratification with epin extra, the laboratory germination was 20%, the onset of germination was noted on day 37; in the variant stratification with gibbersib, it was 24.0%, and the onset of germination was noted on day 10 (Table 1).

Table 1.

Effect of golden currant seeds treatment with phytohormones under conditions of preliminary stratification (+3...+5 °C) for the laboratory germination

№	Variants of experiment, amount of seeds in experiments – 50	Period	Duration of stratification at +3...+5 °C, days	GO ¹ (days)	DG ² (days)	LG ³ (%)
1	Stratification	January, February	14	–	–	0.00
2	Stratification	March	20	15	–	3.00
3	Stratification+epin-extra	March	20	–	–	0.00
4	Stratification+gibbersib	March	20	10	15	7.60
5	Stratification+heteroauxin	March	20	10	15	6.70
6	Stratification+epin-extra	April-May	12	37	40	20.0
7	Stratification+gibbersib	April-May	20	10	18	24.0
8	Epin-extra	April	20	10	18	21.8
9	Control, without stratification, without treatment	January, February, March, April	–	–	–	0.00

Note: GO¹ – germination onset; DG² – duration of germination (from the germination onset); LG³ – laboratory germination.

To accelerate the seeds awakening, we used scarification, i.e. the removal of seed peel. After such an operation, in the experiments conducted from January to April, the months showed high ‘pecking’ activity, compared to other experiments. The germination onset was noted on 8-10 days, and the duration of germination was from 28 to 41 days. The laboratory germination was from 18.7 to 38.5%, and that of the control variant - from 0 to 8.0% (Table 2).

It was noted that, during laboratory germination experiments, the seed peel rotted on some seeds or mold fungi formed.

The seeds of golden currant, for the most part, have a very dense seed coat, which does not allow water and air to penetrate into the seed to the embryo and start its growth. This allows the seeds to remain viable for a long time.

Table 2.

Effect of scarification on the laboratory germination of golden currant seeds

№	Variants of experiment	GO ¹ (days)	DG ² (days)	LG ³ (%)
1	Scarification (January-March)	10	41	18.7
2	Scarification (April)	8	22	38.5
3	Control without scarification (April)	15	28	8.0
4	Control without scarification (January-March)	–	–	0.0

As can be seen from the experiment (Table 2, Fig. 2), the seeds have good germination after the mechanical treatment of their peels (scarification).

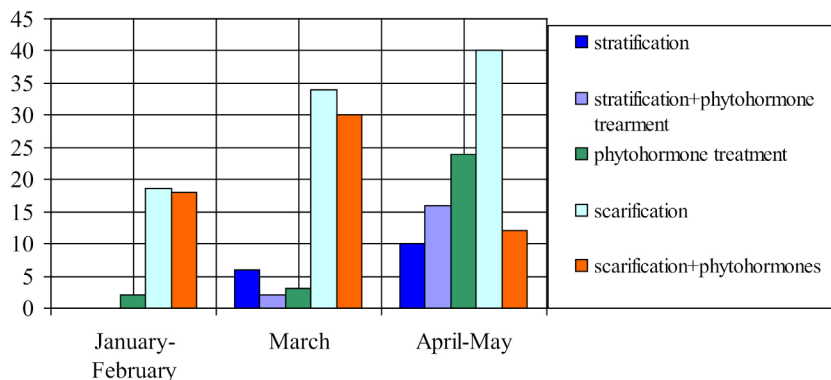


Fig. 2. Effect of different ways of golden currant seeds treatment on the seed germination, %.

Conclusions

1. Golden currant seeds can be brought out of a state of deep organic dormancy by various ways of influencing them.
2. The seed coat is very dense. Thus, it protects the embryo from premature germination and the seeds can fall into a dormant state.
3. There are inhibitors (substances that slow down the embryo growth) in the seed coat, which can delay the embryo germination. When they are dissolved and removed from the embryo, it begins to grow.
4. Scarification (mechanical damage to the seed coat) is the most efficient way to remove golden currant seeds from the state of organic dormancy.

Sponsorship information. This work was carried out in accordance with the research topic of the Federal State Budgetary Scientific Institution VILAR

“Formation, preservation and study of biocollections of the gene pool of various directions in order to preserve biodiversity and use them in health-preserving technologies” (FGUU-2025-0001). The research was carried out as part of work with bioobjects of the unique scientific installation “Biocollections of the Federal State Budgetary Scientific Institution VILAR”.

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