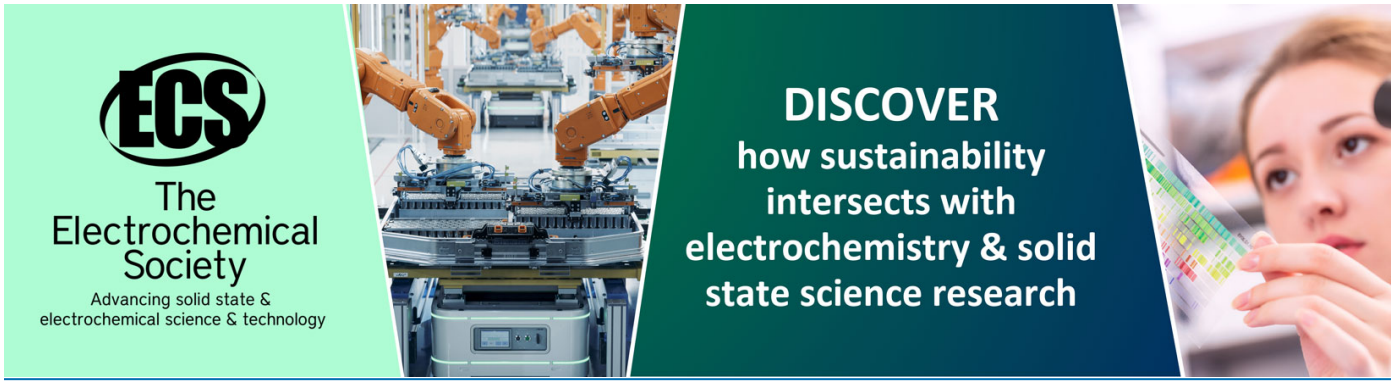
# Improving the method of cultivating narrow-leaved fireweed





# Improving the method of cultivating narrow-leaved fireweed

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**Abstract**. The research aim is to develop the most effective technology of Ivan-tea cultivation, as well as methods for fermenting plant leaves to produce black and red tea As a result of laboratory research and field experiments, a comparative analysis of the effectiveness of direct and seedling methods for the cultivation of fireweed was carried out; the identified responsiveness of fireweed seed to presowing seed treatment with growth regulators; established the optimal concentration of applied growth regulators and organic fertilizers for presowing treatment of seeds; a comprehensive system of crop protection Ivan-tea from pests and to obtain data on the possibility of using direct seeding of seeds of willow-herb in open ground for seed reproduction; methods of improvement of vegetative reproduction of cypress by rhizomes which in aggregate allow to draw a conclusion about success of the carried-out researches are developed. The proposed method for processing raw materials from cultivated and wild plants allows to obtain an innovative product with high commercialization potential, which enables to recommend it for introduction into food, agricultural, processing and pharmaceutical practices

## 1. Introduction

Due to the sharp rise in the price of food products, especially imported ones, due to the imposition of economic sanctions against Russia, import substitution becomes particularly relevant. This applies primarily to goods such as coffee and tea. If we continue to buy coffee abroad, many varieties of tea can be cultivated in the climatic conditions of the Russian Federation or replaced by unwarranted folk recipes for the production of soft drinks from wild and cultural plants with tonic, anti-inflammatory, antibacterial and other therapeutic actions [1-7].

In addition to taste qualities, fireweed has the widest range of healing qualities and, unlike usual, fireweed-based tea, does not contain caffeine, which allows to recommend it to people of different ages, including children. And this is not a complete list of the useful properties of this wonderful plant. Therefore, in order to preserve the areas of its distribution in nature while increasing its fees as raw materials for the pharmaceutical and food industry, use of its useful qualities in agriculture, it is necessary to solve the problem of cultivating fireweed, which was the purpose of the study.

## 2. Material and methods

As objects of study, we selected seeds and plants of narrow-leaved fireweed. Laboratory research was carried out on the basis of scientific laboratories of the faculty of biotechnology and agronomy, and

field and production experiments were laid in the Urmarsky, Ibresinsky, Vurnarsky and Cheboksary districts of Chuvashia. The material for research was seeds, vegetative organs and planting of ivan-tea on the experimental field of the academy and natural plants (burning, heaths, deforestation) in different regions of the Chuvash Republic. Observations of plant growth, development were carried out during periods of growing seasons from June to October. In May, protected soil plants were transplanted into open soil conditions where they underwent acclimation for 10-14 days. During biometric observations and measurements, the methodology of G. N. Zaytsev (1974) was used, taking into account the classification of life forms of plants according to I. G. Seriskov (1964). Field and production experiments were the main method of study. Field germination and phenological observations of plant growth and development phases were carried out according to the State crop testing methodology (1985). Phenological observations of plant development were carried out according to the methodology of the Main Botanical Garden of the Russian Academy of Sciences (1979). The growth of biometric indicators of all studied plant organs in the dynamics of the growing season was recorded in absolute units (cm) and in relative units (growth factors). Statistical processing of research results was carried out according to the method of B. A. Dospekhov (1968).

The work also uses mathematical methods of information processing, review and analysis of available literature on the subject of research. Six variants were used in the experiments to study the efficacy of the drugs for germination energy and germination of fireweed seeds:

Control;
Soaking the seeds in an aqueous epine solution;
Soaking seeds in Baikal EM 1 aqueous solution;
Soaking seeds in an aqueous solution of zircon;
Soaking the seeds in an aqueous solution of the Bioflora preparation;
Soaking seeds in an aqueous solution of Biomiks preparation.

## 3. Results and discussion

Against the background of low germination energy and germination of acquired seeds, the use of biopreparations had a positive effect on the seed germination process, which depended on the chosen preparation (table 1).

**Table 1.** Comparative characteristic of the effect of the preparations on germination energy and germination of the fireweed seeds.

| Variant | Germination energy,% | Germination,% |
|---|---|---|
| Control | 8 | 12 |
| Epine | 11 | 14 |
| Baikal EM 1 | 10 | 13 |
| Zircon | 10 | 13 |
| Bioflora | 12 | 16 |
| Biomiks | 13 | 17 |

It follows from the table that Bioflora and Biomiks outperform other selected preparations as germination energy stimulators and seed germination.

In the next step, seeds were planted into pre-prepared soil to further cultivate the plants. After germination of seeds, the seedlings were pieced into separate cells of boxes in pre-prepared peat mixtures where they were kept to stable positive temperatures in the environment.

In May, plants from protected soil were transplanted into open soil conditions, where they underwent acclimation for 10-14 days. In addition, on separate plots, ivan-tea seeds were sown in the

open ground. This option was chosen for the comparative characterization of different methods of seed propagation of fireweed.

Direct sowing, compared to growing through seedlings, has a number of advantages: operations on preliminary sowing, diving, transportation and planting of seedlings into pre-prepared divisions are excluded. But, unfortunately, in our experiments this method of cultivation, despite repeated watering, did not give positive results in the spring method of sowing. Of the four options, not even single sprouts appeared on any division during the summer. Therefore, in October, we re-sowed Ivan-tea on the experimental field to study the effectiveness of autumn sowing seeds. Also in the second year of the study, we planned a vegetative method of propagating fireweed using root offspring.

A completely different picture was observed on the plots with plants planted through the seedlings. As our research has shown, in this case, the survival rate of fireweed seedlings was close to 100%. Practically all transplanted plants took root and went into growth amicably. At the same time, phenological observations and necessary measurements of plant height showed that a smooth activation of plant growth from June to August is characteristic of fireweed. Thus, the maximum intensity of growth processes occurred in August, and then a decrease in growth activity was observed, which can be explained by the transition of plants from the vegetative growth phase during the initial growth period to the generative development phases (budding, flowering, ripening), which are accompanied by natural inactivation of growth processes. The average monthly growth rates of the above-ground part of plants were 1.12 in May; In June, 1.37; In July, 1.29; In August, 1.11; September - 1.08.

The low crop of vegetative mass was caused not only by underdevelopment of the root system, but as it turned out, and with the appearance of natural pests Ivan-tea. Therefore, we have had to make significant adjustments to the initial research plan and develop pest control measures.

The determination of the yield of the vegetative mass of fireweed during the start of flowering showed a low yield in the first year of cultivation (275 c/ha) in the control version (without the use of growth stimulators and liquid organic fertilizers). In the test versions using liquid organic fertilizers, the increase from application of Biomiks 62.3 c/ha to control and from application of Biofora- 46.4 c/ha. The use of Epine and Baikal EM 1 had little effect on vegetative mass yield (crop gain was within the margin of error).

Based on the results of the first year of research, experiments were planned for the second year to develop the most effective methods of seed and vegetative reproduction types. For this purpose, various sowing options for planting fireweed were tested, as well as methods for collecting willow-seed seeds.

As a result of the experiments carried out, the best results were obtained in the variant with simultaneous procurement of seed and planting material, which formed the basis of the idea in the design of the patent. This method assumes the following algorithm for their execution.

During the summer, during the growing season of the fireweed, a site with healthy plants is pre-selected. Further in September, we mowed with the help of a sickle, a scythe (hand-held mower) fireweed stems at a height of 15-20 cm from the ground. After that, the stems of the plants with above-ground organs were placed in the linen bag with flowers down and suspended in a well-ventilated room for complete seed refilling. In this method of seed harvesting, all seeds with cannons present on flower-bearing shoots are heated due to nutrients contained in stem and leaves, as well as their preservation is ensured. Seeds were then collected, having previously been separated from the "pluff" by being swept between the palms.

In the second year of studies, seeds collected in autumn before sowing were wetted with water to prevent their spread and mixed with dry sand and wood ash in a ratio of 1:1 to prevent thickening of crops. In another embodiment, paper strips were used for seeding, on which seeds were glued to the toilet paper for uniform distribution by means of a starch adhesive. The required distance between plants was achieved by gluing seeds onto a strip of paper using tweezers.

In general, with the seed reproduction of the fireweed, there is a difficulty due to their high volatility, so before the sowing seeds equipped with paratroopers (fluff) we collected in paper bags,

and then the bags were cut with strips and moistened with water from the spray bottle. The seeds were sown in grooves previously prepared by a hoe to a depth of 1-1.5 cm according to the 70x30 cm pattern (70 is the distance between grooves, and 30 is the distance between plants in a row), sprinkled with loose soil on top. After sowing, the beds were watered out of a hand leach with small holes.

For the second year, we used our seeds and their earlier sowing, immediately after snow fell and the possibility of minimal soil treatment with manual labor tools. Thus, if in 2015 sowing was carried out only on May 7, in 2016 we made spring sowing in the second half of April. In addition, a certain soil moisture was constantly maintained until the emergence of seedlings by watering from a watering can. This allowed us to get quite friendly seedlings, which at the age of one and a half months already reached a height of 10-15 cm. Timely watering and feeding with organic fertilizers allowed us to achieve active growth of plants and accumulation of green mass.

Thus, the complete absence of natural precipitation in May and June months was compensated by frequent watering, which allowed us to obtain by the time of flowering sufficiently healthy and strong plants capable of withstanding sharp temperature fluctuations of the growing period, which were quite a lot during 2016.

In general, good care has allowed us to achieve the flowering of fireweed in the first year of vegetation, although the literature indicates the data for the second year of flowering of plants in the seed method of cultivation of Ivan-tea. In our experiments, flowering continued for a month and a half, from July to the end of August, after which boxes of 6-10cm long with small seeds were formed on the flowers.

As the results of field experiments of the second year of research showed, the use of the methods chosen by us significantly increased the germination of Ivan-tea seeds (table 2). As can be seen from the presented results of the study, the seed method of boiling water cultivation is very labour-intensive and requires clear and timely execution of agricultural operations and availability of pre-tested seeds for germination. It can be recommended for obtaining healthy mother seeds for the subsequent cultivation of plants with rhizomes. Therefore, we studied the vegetative reproduction of Ivan-tea by means of underground organs, which proved to be the easiest and most convenient method of cultivation.

**Table 2.** Germination seeds of fireweed depending on the methods of sowing, %.

| Experience options | Replications | | | | Average value |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | |
| Control (direct crops) | 10,4 | 10,8 | 13,7 | 12,1 | 12,0 |
| Wetting with water before sowing | 16,2 | 17,7 | 15,8 | 8,5 | 17,5 |
| Mixing seeds with sand and ash | 24,1 | 23,6 | 26,4 | 27,7 | 25,45 |
| Sowing with paper strips | 18,3 | 19,2 | 17,0 | 20,6 | 18,8 |

For vegetative reproduction rhizomes from the plants which remained after bevelling of an underground part which were dug out in October of the earth by means of a shovel were used, were transferred transported) on in advance prepared site and landed on depth in the 8-12th way of laying to grooves kidneys up. In this case, we recorded almost their 100% survival.

For the third year of research, we conducted experiments in the laboratory of landscape design of the "Chuvash State Agricultural Academy" to study the possibility of reproduction of fireweed using cuttings. The experiments were carried out during the growing season of the fireweed. For the experiments, cuttings from plants were cut, which were placed for 30 minutes in a fungicide solution to a depth of 1.5-2 cm. After this, the cuttings were washed in distilled water and dropped into a solution with root stimulants - root and root, where they were kept for several days.

After this, plastic containers with pre-prepared soil were prepared. To do this, they took the soil from the territory of the educational and scientific and industrial complex "Campus" of the Chuvash State Agricultural Academy, added peat, sawdust, coarse sand and chalk to neutralize the resulting mixture. The resulting mixture was poured into glasses.

Holes in the soil with depth of 2.5-3 cm were made with a thin stick to transplant the cuttings and ready cuttings were placed there at a distance of 5-8 cm from each other. The soil was then flaked around the base of the prunes, watered with the remaining root stimulant solutions, covered with a film, thus creating a mini-particle for prunes, and placed in the greenhouse in the lower tiers of the racks to provide shade and increased humidity. Subsequently, the cuttings were periodically watered with warm water with weak Epine solution. After the roots appeared on the cuttings, the plant containers were moved to the upper tier of the racks closer to the windows to increase illumination. As additional escapes grew, a tempering procedure was carried out, for which purpose the containers were transferred to a greenhouse located between the buildings of the engineering faculty and the sports buildings.

Thus, by early September, we were able to obtain entrenched shoots ready for transplantation. Of the thirty cuttings planted in two plastic boxes, 18 cuttings became viable. Half of them we transferred to the open ground, and half were left until spring next year for subsequent transfer to a permanent place.

In order to evaluate the efficiency of the use of agrochemical administration in the cultivation of crop plants, it is common to determine the energy efficiency or energy efficiency coefficient. For this purpose, a cultivation and culture cleaning routing is used, which includes all agricultural technical activities. Calculations were carried out on vegetative reproduction of plants with the help of cuttings. As it turned out, this method of vegetative reproduction gives the best results while observing agricultural techniques and planting dates. The survival rate of cuttings in the autumn method of cultivation approaches 100 percent, and the yield of the green mass of plants showed maximum results compared to other methods of reproduction. The only problem for boiling cake cultivation with cuttings is the excessive number of manual labor, which dramatically increases the costs of the processes of harvesting and planting cuttings of root offspring. Calculations have shown that this takes more than half (about 54%) of all production costs allocated for cultivation. However, the energy cost of producing a green mass of boiling cake was at a very decent level, especially on experimental versions. The energy efficiency factor on all options was also higher than one, indicating that it is possible to recover the allocated funds and profit from this type of agricultural activity.

Of all the specimen used, the best results were obtained in the versions using the Bioflor preparation, although similar data showed the preparations Epine and Biomiks (table 3).

**Table 3.** Energy Evaluation of the Use of Growth Regulators in fireweed Cultivation.

| Indicators | Check | Epin's application | Use of the Bioflora | The use of the Biomiks |
|---|---|---|---|---|
| Productivity: | | | | |
| -green mass, t / ha | 35,5 | 41,03 | 44,8 | 43,6 |
| -dry matter, t / ha | 6,2 | 7,1 | 7,5 | 7,4 |
| - feed units, units / ha | 6023 | 6685 | 7490 | 7397 |
| Raw protein collection, t/ha | 1,07 | 1,16 | 1,35 | 1,31 |
| Energy spent, GJ/ha | 23,7 | 27,3 | 29,7 | 29,1 |
| Produced energy with crop, GJ/ha | 64,2 | 72,9 | 81,2 | 78,8 |
| Net energy income, GJ/ha | 40,5 | 51,8 | 51,1 | 49,7 |
| Energy coefficient effectiveness | 1,58 | 1,82 | 1,98 | 1,94 |

| | | | | |
|---|---|---|---|---|
| Energy cost, GJ/ha: | | | | |
| - Green mass | 0,8 | 0,94 | 1,1 | 0,98 |
| - Crude protein | 23,1 | 26,7 | 29,0 | 28,3 |

## 4. Conclusion

In general, using the proposed methods of seed and vegetative methods of reproduction, we have managed to obtain from each plant the maximum number of seeds and rhizomes for subsequent reproduction or sale to the population, thus being able to supply the population of the Russian Federation with quality food, pharmacological and fodder raw materials.

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