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# BIOLOGY OF CULTIVATION OF STEVIA REBAUDIANA BERTONI PLANT IN UZBEKISTAN

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## RELEVANCE OF THE TOPIC

Currently, at the stage of rapid development of our society, it is urgent to solve the issues of effective use of plant raw materials in the fields of food, pharmaceuticals, and medicine in order to increase the well-being of the population.

The decision of the President of the Republic of Uzbekistan dated May 20, 2022 "On measures to organize cultivation and processing of medicinal plants and their wide use in treatment" PQ-251 measures have been taken in order to support growth, as well as the wide use of medicinal plants in the prevention and treatment of diseases. In recent years, consistent reforms have been implemented in the republic regarding the protection of medicinal plants, the rational use of natural resources, the establishment of plantations where medicinal plants are grown and their processing.

Nowadays, there is an increasing demand for the use of natural sources that give a sweet taste and do not harm people's health [1,2,3].

One such source is the plant *S. rebaudiana*. In countries such as the USA, France, South Korea, Canada, Russia, Ukraine, China, 6-7% stevioside from the leaves of S. rebaudiana has been used for several decades in the preparation of confectionery products, various medicinal drinks, and preserves. Also, using it as a medicine gives positive results. Stevioside is the main sweet flavoring compound of S. rebaudiana leaves, which has been found to be free of mutagenic and carcinogenic substances, and therefore stevioside has been approved for widespread use by public health organizations.

The introduction of medicinal plants not only reduces the cost of imported raw materials, but also enriches the local biodiversity and partially satisfies the population's demand for medicinal plants [4,5,6].

It is clear that S. rebaudiana, which is among such introducers, will be important in the national economy of our country in the future, including in maintaining the health of the population. The possibility of cultivating S. rebaudiana, a tropical plant in the climatic conditions of Uzbekistan, determines the urgency of the problem.

## MATERIAL AND METHODS

Ontogeny of *S. rebaudiana* under conditions of introduction T.A. Rabotnov, biology of seed germination and seedling formation studied by I.G. Serebryakov. Morphobiological characteristics of the plant were studied on the basis of 10 copies of the plant in ontogeny. Morphological features of S. rebaudiana: root, stem, flower, inflorescence, seed, fruit structures were studied. In the phenological observations made on *S. rebaudiana* plant in Surkhandarya conditions G.E. Schultz's method was used, A phenospectrum was constructed according to I.N.

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Than 1500 years, adapted to the tropical region of South America, the leaf of this plant contains 6-7% stevioside. Although it is 200-300 times sweeter than sugar, it provides low calories and does not have a source of energy. Currently, *S. rebaudiana* is being propagated and widely used in confectionery, sweet drinks, diet foods, preserves and medicine.

*S. rebaudiana* transition to the generative period is observed in some introduced areas. In particular, in open field conditions of Ukraine, *S. rebaudiana* bloomed in september-october, sometimes several plants bloomed in july-august. The duration of flowering in one plant is extended to 1.5-2.0 months, total flowering was observed at air temperature of 7-9°. Under such low temperature conditions, *S. rebaudiana* shoot development was very slow, and as a result, the seed was not fully ripened. Low seed germination and rapid loss of seed germination are a challenge in plant introduction. Therefore, it is propagated vegetatively worldwide. It has preserved its genetic stability even when propagated from the introducer buds and in vitro method. Glycoside content in *S. rebaudiana* leaves showed little difference from seed or in vitro cultured plant, growth rate and glycoside content remained unchanged. In introduced areas, freezing of *S. rebaudiana* roots due to low temperature (in winter season) is observed. As a result, in order to prevent the death of the plant, the upper part of the earth is mowed in autumn, and then the root system is dug up and stored in special places.

According to the method of T.A. Rabotnov, we divided the growth and development of *S. rebaudiana* into the following periods: latent, virginal, generative. The virginal period, in turn, is divided into 4 stages: grass, juvenile, immature, adult virginal plant. Below we will dwell on these periods of this plant in detail.

**Latent period.** Seed dormancy is one of the main adaptive features. Fruits and seeds perform functions such as protection of the fruit and storage until the time of germination. Seed fertility is the reproduction and recovery of a plant from the seed, and it is considered one of the main indicators that decide the fate of the species and determine the quality of the seed. This period includes the time elapsed from the ripening of the seed to the appearance of the root. The seeds of *S. rebaudiana* ripened from mid-october to early december under Surkhandarya conditions, 5 (sometimes 6) seeds of *S. rebaudiana* are produced in a basket. We know that the seeds of many flowering plants undergo a period of primary dormancy. If the primary resting period of some plants is considered to be several tens of days, in some plants this state is maintained for several decades and germinates only when favorable conditions are born. The dormancy period of S. rebaudiana seeds in the soil was extended to 1.5-2.5 months in the field conditions of Surkhandarya region. The seeds of S. rebaudiana grown under these conditions are 3.8±0.19 mm long, 1±0.1 mm wide, light, dispersed by wind. In laboratory conditions, 41±2.8% of seeds germinated at a temperature of 28º, favorable for seed germination, and 15-18% of seeds germinated in field conditions (air temperature 10-13°. *S. rebaudiana* seeds lose a lot of germination when stored for a long time. The weight of 1000 seeds is 0.26-0.29 g, and seed viability is preserved for up to 37 months. The germination process begins with the coagulation of the seeds, which means that after the seeds have been soaked, the pods have matured and become larger and begin to burst the seed coat.

**Virginal period**. Grass stage. Traditional nutritious plants growing in our republic are often planted in autumn (october, november). Since *S. rebaudiana* is a tropical plant, its seeds were sown in different periods (2002) in January, February and March. S. rebaudiana seed leaves are inverted ovate, light green, 0.7±0.05 cm long, 0.4±0.05 cm wide. The seed coat comes to the surface of the soil with the cotyledon leaf, sometimes it can remain under the soil. The leaves of seed pods, which are initially light green in color, gradually turn green and are covered with hairs to an extent that is invisible to the eye. In january, the seed germination in the soil under the film was higher compared to the seeds planted in other periods. Seeds sown in January germinated in 7-8 days. After 10-15 days, grass sprouting was observed. The root grows up to 1.2±0.08 cm before the emergence of the seed leaf. The bud located at the base of the seed pod begins to develop after 10-11 days. At this time, the length of the arrow root is 3±0.14 cm, from which II-order roots with a length of 0.8±0.1 cm begin to form. The grass stage lasted 10-11 days on average (2020-2021).

**Juvenile stage.** In the middle of February, the first true leaves began to appear on the branch growing between the seed-bearing leaves (Fig. 3.2. g). The shape of the leaves is heart-shaped, pointed, with green leaves, the length of the leaf is 0.4±0.05 cm, and the width is 0.2±0.05 cm. From the neck of the root two and third-order lateral roots were formed. At this time, the root length of the arrow reached 4.5 ±0.6 cm. The tap root of *S. rebaudiana* disappears, in some cases it is preserved.

The two true leaves formed are located opposite each other on the branch, similar to the leaf of a mature plant, after 20 days 4 pairs of leaves have appeared. The leaves are lanceolate with a pointed tip, and the edges are serrated. By the beginning of April, the leaves have been shed with seeds. Juvenile stage included 40-45 days of plant life.

Table 1 below provides information on the growth characteristics of murtak organs in the conditions of Shorchi district. In the first days of the experiment, the growth of the plants organs is slow.

Table 1 Plants organs during seed germination growth and development

| The day after sowing | Length, cm | | |
|---|---|---|---|
| | plant part | seed leaf | hypocotyl and rhizome |
| 8 | 0,8 ± 0,05 | 0,4 ± 0,04 | 0,5 ± 0,04 |
| 11 | 1,2 ± 0,07 | 0,5 ± 0,04 | 0,7 ± 0,06 |
| 14 | 1,6 ± 0,07 | 0,7 ± 0,04 | 0,9 ± 0,06 |
| 17 | 2,7 ± 0,08 | 0,8 ± 0,05 | 1,9 ± 0,1 |
| 20 | 3,8 ± 0,09 | 0,9 ± 0,07 | 2,7 ± 0,09 |
| 23 | 4,2 ± 0,06 | 0,9 ± 0,05 | 3,3 ± 0,1 |

not noticeable. The growth of Murtak's organs begins on the 8th day of the experiment. It can be seen that when the total length of the shoot reaches 0.8 0.05 cm, the hypocotyl and rhizome are 0.5±0.04 cm long, and the seed coat breaks through. When the total length of the shoot reaches 4.2±0.06 cm, initial leaf bumps begin to appear on the third shoot. The rapid growth of Murtak's organs corresponds to the 14th day of the experiment (1.6±0.07 cm), and on the 20 th day, it begins to slow down (3.8±0.09 cm). On the 23rd day, the growth of seed coat leaves

stopped (0.9± 0.07), root and hypocotyl growth accelerated (3.3±0.1 cm). The leaves fall off with seeds.

**Immature stage.** At the end of April, I-order branches reached a height of 23.5±1.2 cm, and one pair of leaves came out from the joint, then the emergence of II-order branches was observed. In may, when the number of leaves reached 14 0.7 pairs, 4-6 II-order branches began to grow from the joints of I-order branches. The height of I-order branches of *S. rebaudiana* reached 29±2.1 cm, the leaf size reached 5.5±0.1-2.5±0.1 cm. During this period, the above-ground parts of the plant and II-order branches grew rapidly. The length of the root system (arrow root) is 13±2 cm, its diameter is 18±2 cm. At the end of June and the beginning of July, the height of the plants reached 82±3.4 cm, they had up to 8-12 branches of the I-II order 30±2-25±1.3 cm long and 10-13 cm long III-order branches. At this time, the distance between the longest joint in the plant was 4.5-5.5 cm, and the shortest joint was 0.5-1.0 cm. In September, the growth of I-order branches of *S. rebaudiana* was very slow. From this time on to the flowering period, the size of the stem and leaf, and the distance between the joints in the stem are almost unchanged. This stage lasted 60-75 days.

**Generative period**. Complete information about the reproductive period of S. rebaudiana in Surkhandarya conditions is not provided in the literature. In our studies, it was found that all of the *S. rebaudiana* growing in the field entered the generative period. In the first year of all seedlings, mesotonic and acrotonic branching was observed in most bushes, and in some bushes, bazeton branching type was observed, from which generative branches were formed. At the end of August, with the shortening of the length of the day, buds appeared in the baskets on the generative branches, and they developed for 20-25 days, and the first flowers began to open. Budding, opening of the first flower, seed formation in the first year in the saline conditions takes place in september and october. The length of the I-order generative branch is 8-12 cm, one generative branch has 5 to 30, and one plant has 200-250 baskets (inflorescences). The diameter of the basket is 0.4±0.05 cm, and 5 flowers are placed in it. Fruits and seeds are formed from the flowers of the plant in the first growing year.

Popuk root grows to a depth of 25-30 cm and spreads to the side. The generative period stops at the beginning of December, when cold temperatures affect the plant.

**Cenile period**. The senile period of *S. rebaudiana* began in 6-7 years.

During this period, the height of the I-order branch reached 98±2.8 cm, strong particleization appeared in the root system (caudex). Hence, *S. rebaudiana* the phenomenon of particleization in the caudex of a plant is one of the signs of its aging. In summary, it can be said that the latent period includes the time from seed maturation to germination Cenile period. The senile period of *S. rebaudiana* began in 6-7 years.

During this period, the height of the I-order branch reached 98±2.8 cm, strong particleization appeared in the root system (caudex). Hence, *S. rebaudiana* the phenomenon of particleization in the caudex of a plant is one of the signs of its aging. In summary, it can be said that the latent period includes the time from seed maturation to germination. In the conditions of Surkhandarya region, all S. rebaudiana bushes have entered the generative period. During the

generative period, it was observed that the tap root of *S. rebaudiana* deepened to 25-30 cm and grew to the side by 30-35 cm. The flowering period of plants depends on its origin, biological characteristics, early or late arrival of the spring season, and the duration of flowering depends on the weather conditions of the area where the plant grows and agrotechnical measures. As can be seen from table 2, the beginning of flowering in *S. rebaudiana* in most cases corresponds to September. Full flowering is observed in the plant 30-35 days after the flowers open. Flowering period lasted 84-92 days, full flowering (70% flowering) occurred mainly in october (2019, 2020) and early november (2021).

Table 2 Flowering phenology of *S. rebaudiana* in Shorchi district (observed in 10 plants)

| Observed year | Beginning of budding to be | flowering period | | | |
|---|---|---|---|---|---|
| | | beginning | gross | ending | duration (days) |
| 2019 | 23.08 | 10-30.09 | 30.10-16.11 | 20.11-9.12 | 91 |
| 2020 | 20.08 | 13-27.09 | 29.10-18.11 | 21.11-5.12 | 92 |
| 2021 | 27.08 | 2.09-21.10 | 4.11-25.11 | 26.11-1.12 | 84 |

Due to the rain and snow in December, the air temperature drops (to 5, -5°), as a result, cases of frost damage of flowers are observed. Studies have shown that a single flower of *S. rebaudiana* blooms for 3-4 days, all flowers in a basket for 12-15 days, and a generative stem and plant for 84-92 days. The duration of flowering in *S. rebaudiana* depends on the weather conditions, also the air temperature in December 2000 is somewhat warm, 8-12° during the day, in 2001 the daytime temperature in december is lower, 7-9°, in 2002 it is also the air temperature was low, 5-8°. On december 4-5, 2002, an unexpected drop in air temperature to -20° was observed. In the field, the above-ground organs of the plant were affected by frost, but the seeds of the plant remained fertile, and the root system was also preserved, and next year vegetative shoots grew from it.

Dependence of seed quality on ripening periods. The dormant period of the seed, its duration depends on a number of reasons. The most important of these is the type of plant it belongs to, the ecology and geography of its growing conditions. In the conditions of Shorchi district, the air temperature and relative air humidity change significantly in autumn. *Stevia rebaudiana* goes into the generative period in a short day. It is during this period that the effect of environmental factors on the ripening of plant seeds becomes important. Slightly higher air temperature in different periods (autumn) and compatibility of air relative humidity (closer to the indicator in the homeland) also had an effect on the indicator of seed germination. This was confirmed in our research (Table 3).

Table 3 Seed germination of *stevia rebaudiana*

| Determined period (day, month, year) | Seed germination, % |
|---|---|
| 12.10. 2021 | 97±0,3 |
| 10.11.2021 | 85±0,5 |
| 02.12.2021 | 82±0,6 |

Fertilization of seeds ripened at different times in Shorchi district was 97±0.3% in october (12.10.2021), 85±0.5% in november (10.11.2021) and 82±0.6% in december (02.12.2021) organized.

Entering the generative period of a plant is one of the main criteria that determine their acclimatization. The studied plant *S. rebaudiana* started its generative period in the first vegetation year in Surkhandarya region. Usually they bloom quite late, that is, at the beginning of September. As a result, it produces high-quality seeds and reproduces well from seed. The propagation and maintenance methods we recommend can be used by farms growing *S. rebaudiana*. It is preferable that quality raw materials are mainly made from leaves. Drying is carried out under natural conditions on a gauze mat in the shade. Raw materials are stored in a dry, well-ventilated place with a temperature of 18-35 °. It is required that the moisture content of leaf raw material is not higher than 14%. It was found that the amount of stevioside in the leaves of *S. rebaudiana* cultivated in Surkhandarya region was 11.6% in june, 12.8% in september, and 12.5% in december.

## CONCLUSIONS

The short-day tropical plant S. rebaudiana, introduced into the Surkhandarya region, goes through all stages of ontogeny. The sum of effective temperatures affects only the timing of the beginning of the growing season. The beginning of budding and flowering is due to the shortening of the day length.

2. The highest content of stevioside in the leaves was noted in the generative period (12.8%), which confirms the opinion about the participation of glycosides in the formation of reproductive organs.

3. The success of the introduction of *S. rebaudiana* was estimated at 75 points, which allows us to consider this species quite promising in the conditions of Surkhandarya.

4. Based on the study of ontogenesis and biology of seeds, techniques for seed propagation of plants have been developed: the timing and rates of sowing, the depth of seeding, and recommendations for caring for plants.

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