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METHODS OF GROWING SMOOTH LICORICE (GLYCYRRHIZA GLABRA)

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Abstract. The article presents a brief overview of the requirements for planting and propagating Glycyrrhiza glabra (smooth licorice), the advantages of growing it from seeds, as well as other methods of planting and propagation. Additionally, some major scientific innovations introduced in this field by researchers of the Institute of Botany of the Academy of Sciences of the Republic of Uzbekistan are briefly described.

Keywords: Glycyrrhiza glabra (smooth licorice); propagation; seedling planting; methods; medicine; land reclamation; prospects.

Smooth Licorice (Glycyrrhiza glabra), known in Russian as “солодка голая”, is widely used in traditional medicine, scientific healthcare, the food industry, and about 20 other industrial sectors. The preparations derived from this plant are not only important in industrial sectors but also hold significant value in agriculture. For example, a biologically active substance extracted from licorice can stimulate plant growth. When 1 mg of this substance is mixed in 1 liter of water and applied as a treatment to seed potatoes before planting, it increases sprouting by 23%. It also accelerates the flowering and budding phases, ultimately boosting crop yields by 17%. Additionally, plants treated in this way show a sharp reduction in viral diseases [8].

In Uzbekistan, smooth licorice naturally grows along the banks and basins of the Amu Darya, Syr Darya, Zarafshan, Chirchik, and other rivers flowing into these water bodies. It once covered large areas. Unfortunately, during the Soviet era, the roots of licorice were ruthlessly harvested by the all-Union association "Soyuzlakritsa," leading to a significant decline in natural licorice habitats and the disappearance of the plant in many regions. As a result, in the lower reaches of the Amu Darya, specifically in the territory of the Republic of Karakalpakstan, natural licorice fields that once occupied 18,000 hectares and produced 59,354 tons of root reserves now remain only in small patches. In Surkhandarya, Bukhara, Khorezm, Samarkand, Syr Darya, Tashkent, and other regions, licorice persists only in small fragmented plots along canals, irrigation ditches, and floodplains. These areas are no longer accessible for mechanized farming. Therefore, protecting the plant, using its natural reserves wisely, and expanding its cultivation areas have become urgent tasks.

For this reason, to expand the cultivation areas of licorice, the President of Uzbekistan issued Resolution PC-2970 on May 16, 2017, titled “On Measures to Increase the Cultivation and Industrial Processing of Licorice Root in the Republic of Uzbekistan.” This was followed by Cabinet of Ministers resolutions on January 27, 2018 (No. 63) and February 15, 2019 (No. 138), addressing the cultivation of medicinal plants including licorice, and further measures to

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organize its industrial processing efficiently. These important decisions have led to a rapid increase in licorice cultivation areas and the accelerated development of the licorice raw material processing industry.

Over many years, Uzbek scientists, mainly from the Institute of Botany, have studied and developed various methods to cultivate this plant—from seeds, rootstocks, and seedling propagation. They developed crop rotation techniques involving licorice and cotton on saline soils unsuitable for traditional crops, and technology for growing licorice alongside fodder plants. The agro-technical practices for cultivation have been refined, confirming its value as a soil improver (ameliorant). Methods have also been developed for botanical reclamation of saline lands and for cultivating licorice in naturally moist areas near irrigation canals.

Soil preparation for planting. Licorice (Glycyrrhiza glabra) is a phreatophyte — a moisture-loving plant that grows well in areas with shallow groundwater, especially requiring a lot of water during the first year. Therefore, the planting area should be flat and well-drained so that water does not accumulate.

The selected field should be plowed to a depth of 28-30 cm and leveled, then harrowed. During chisel-harrowing, weeds and other plant roots and rhizomes are removed. The extracted weed and plant residues, as well as roots and rhizomes, should either be buried in the soil to decompose or burned to prevent contamination.

Methods of planting and propagation. Currently, technologies have been developed to cultivate licorice using three methods: from seeds, from rootstocks, and from seedlings.

1. Propagation method by sowing seeds.

According to the different sources, the germination rate and survival percentage of seeds sown under field conditions is very low, as reported by numerous researchers [6, 9, etc.].

For propagation from seeds, the soil must be prepared very carefully, and especially in the first year of the vegetation period, very complex care work must be carried out. For multi-year cultivation, seeds can be sown either in autumn (October-November) or spring (April-May). The seeds are sown on specially prepared soil with ridges (furrows) spaced 60, 70, or 90 cm apart, and the ridge shoulder is not too deep. In spring, on light and sandy soils, seeds are sown at a depth of 1.0 – 1.5 cm, while in autumn, the sowing depth is 1 cm deeper than in spring.

According to the data from M.M. Badalov and others (1989), the seeding rate is 15-16 kg of seeds per hectare. Before sowing, the seed coats should be rubbed with sandpaper to break them, then soaked and treated with biostimulants. Treating the seeds in 0.0035% amber acid solution for 24 hours increases germination to 55-60%. Besides germination, amber acid also speeds up the process.

The treatment of seeds with amber acid should be done in a centralized manner. For this purpose, special open pools are dug and filled with concrete; their walls are covered with a waterproof (hydroinsulating) layer. The pools are 5 by 2 meters in size, 1.2 meters deep, and must hold 500 kg of seeds.

If there were no problems with sowing seeds, seed-based propagation would be quite easy even on large irrigated fields. However, planting other annual crops instead of licorice on fertile soils that require 4-5 years of resting time results in greater benefits compared to cultivating licorice.

In saline areas, seed germination is relatively very low, as licorice seeds and the emerging seedlings are sensitive to salinity (water-soluble salt residues in the soil exceeding 1.0–1.3%). Especially, the chloride salt at a concentration of 0.03% has a strong harmful effect on the

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emerging seedlings, causing their death. “Chloride sulfate spray slows down seed swelling, which in turn reduces the speed of germination, sprouting, and seedling development.” On average, in soil treated with chloride sulfate salt, licorice seed germination reaches only up to 15%, but the mortality of the emerged seedlings can be as high as 75-100%. In the Mirzachul region, the survival rate of licorice seedlings is very low, not exceeding 3.0-3.5%. The seedlings that are just sprouting—the juvenile stage—are very delicate and cannot tolerate even slight changes in conditions, resulting in their death [5, 14, 2, etc.].

For these reasons, establishing large licorice fields by seed sowing is a very complex and difficult task. As mentioned above, in saline soils this method is generally ineffective.

2. Propagation Method by Root Cuttings.

In the vegetative method of propagation using root cuttings of licorice, more than 2.5–3.0 tons of industrial-grade raw material is required from 4–5 year old licorice roots. The cuttings should be 13–16 cm long and 1.0–1.8 cm in diameter. The planting depth should be 12–15 cm in spring and 16–18 cm in autumn for good results [6, 15, 4, etc.].

Before preparing cuttings from licorice roots, to prevent them from drying out, they are stored by burying in separate pits (60–80 cm deep, 1.5 m wide, and as long as needed) under 20–25 cm of soil. The planting period should not exceed 10–15 days. Otherwise, due to daytime heat, the root buds may sprout prematurely and lose moisture from wind and heat by the time of planting, leading to damage from mechanical impact. Additionally, mold may develop, which reduces the sprouting ability of the cuttings. If cuttings lose more than 25–30% of their moisture, their sprouting quality decreases and the likelihood of failure increases.

The best planting times are in autumn (October–November) and spring (March–April). Planting at the recommended depths (12–15 cm in spring and 16–18 cm in autumn) yields good results. If planted too deep, sprouting becomes difficult; if too shallow, soil moisture evaporates in the heat causing cuttings to dry out. Rows should be spaced 70 cm apart, with 25 cm between plants within a row, requiring an average of 50,000 cuttings per hectare.

For planting root cuttings, more than 2.5–3.0 tons are needed per hectare. This amount of planting material can be obtained by cultivating a licorice field of about 2.4 hectares for 4–5 years, which yields about 14 tons per hectare. For 100 hectares, over 250–300 tons of industrial-grade root cuttings are required. This amount of raw material can be obtained from more than 43 hectares of licorice fields cultivated for over 4–5 years, each producing over 14 tons per hectare. Even then, more than 52% of the total yield must be root cuttings to supply 100 hectares.

Finding and acquiring such large quantities of planting material is difficult and expensive. Therefore, expanding licorice cultivation areas remains a challenging issue to this day.

3. Propagation Method by Planting Seedlings.

Because licorice products have a wide range of uses, demand for it has been increasing year by year. However, the existing licorice fields are limited and cannot fully meet this demand. Therefore, the need to expand licorice cultivation areas is steadily growing. To meet this demand, there is a necessity to multiply licorice planting areas.

Especially on lands with low fertility, saline soils, or areas unsuitable for planting regular agricultural crops, planting licorice can create a nutritious fodder source for livestock and produce root yields. This method can also rehabilitate lands unsuitable for conventional crops,

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resulting in significant economic benefits. It was necessary to identify such a method and develop a technology for cultivating licorice by planting it in these areas.

To fulfill these needs, new effective methods for propagating licorice by planting were developed. From 1992 to 2000, special scientific research was conducted, leading to a new propagation method—growing seedlings from licorice seeds and then planting the seedlings to produce planting material. As a result, the problem of obtaining large quantities of planting raw material for large-scale planting was solved.

Seedlings can be grown under clean soil conditions (open field or greenhouse) at any time of year, allowing planting in any desired area as needed. This method proved to be more effective in all respects compared to previous methods.

A.D. Kuziyev defended his PhD dissertation on "Bioecological foundations of growing and cultivating seedlings from licorice (Glycyrrhiza glabra L.) seeds." The first and third patents for licorice propagation by planting (in 1996 and 2006) were obtained by scientists of the Botanical Institute of Uzbekistan (A.D. Kuziyev and scientific supervisor O.A. Ashurmetov). The second patent (1998) was obtained by Russian researchers.

In this new method, seedlings are first grown from seeds in fertile, clean soil under open field or greenhouse conditions. The grown seedlings can then be planted in any soil conditions.

Propagation of licorice by root cuttings and seedlings gives good results in saline soils and areas near groundwater. This method allows planting even on strongly saline lands (with 2.0–2.5% and even up to 3.0% water-soluble salt residues).

Cuttings have a survival rate of 65–70%, while seedlings show 85–95%, even up to 100% viability.

When applying this new method, the plants show strong sprouting ability and can be successfully planted even in strongly saline areas with close groundwater without irrigation, relying on natural moisture, as confirmed by scientific experiments.

Thus, the third method of propagation by planting licorice seedlings has been identified and cultivation technologies have been developed.

3.1. Method of Planting Seedlings

This method can be used to plant seedlings on irrigated fields left for reclamation due to soil salinization (where the content of water-soluble salts in the soil dry residue is up to 2.5% — sulfate 1.5%, chloride 0.5%). Fields with soil salinity exceeding 2.5% (depending on chloride levels) reduce the survival rate of planted plants (cuttings and seedlings) by 50%. For such fields, it is recommended to carry out salt leaching in autumn before planting to get better results.

Seedlings and rootstocks allocated for planting must not be left outdoors or under direct sunlight. This is because seedlings quickly lose moisture in such conditions, leading to a loss of sprouting and growth ability in the buds. Therefore, it is necessary to plant the dug-up seedlings and rootstocks promptly. If immediate planting is not possible, the non-sprouting roots should be cut off, and the seedlings and rootstocks set aside for planting should be buried in the ground to preserve them.

Before planting, the root length of seedlings (measured from the root collar) should be 14-16 cm, the stem length 5-8 cm, and the surrounding rootstocks should also be trimmed to a length of 5-8 cm.

There is no difference between the soil preparation and cultivation agrotechnics for planting

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cuttings and seedlings, except for slight differences in planting methods. The difference lies in whether the prepared seedlings are planted vertically or laid along the furrow, while cuttings are only planted laid along the furrow.

It is recommended to plant licorice seedlings with a spacing scheme of 90 cm × 25 cm × 1 (rows × spacing × number of plants). Planting depth depends on soil conditions: in spring, 12-15 cm, and in autumn, 16-18 cm.

Providing water sequentially along the furrows during planting of both cuttings and seedlings gives good results. When planting in autumn or spring, on average 50,000 cuttings or 44,000 seedlings are used per hectare.

The best times for planting cuttings and seedlings are considered to be October-November in autumn and March-April in spring. If cuttings or seedlings are planted late in autumn, they may suffer from frost damage during or after planting. Late planting in spring makes it harder for the plants to sprout and survive due to rapid loss of soil moisture. When planted at the right time, 90-97% of seedlings survive.

When planting seedlings in furrows 90 cm wide (28–36 cm deep), if planting vertically or laid, the depth of the furrow for placing seedlings should be 15–20 cm.

1 - picture. Appearance of seedlings placed upright along the furrow. As seen in the picture, the soil taken from one side of the ridge is enough to cover the seedlings.

2 - picture. Appearance of seedlings laid down along the furrow. When covering the seedlings laid in the furrow, a cultivator can be used by running it along the ridge.

Young seedlings can be transplanted starting from 55 days after germination from the seed. However, the survival and establishment of seedlings at this young age is somewhat challenging and requires more careful agrotechnical care. In experiments, even when seedlings were transplanted at 41 days after sowing, 46% of the seedlings successfully sprouted and survived (see pictures 3-4).

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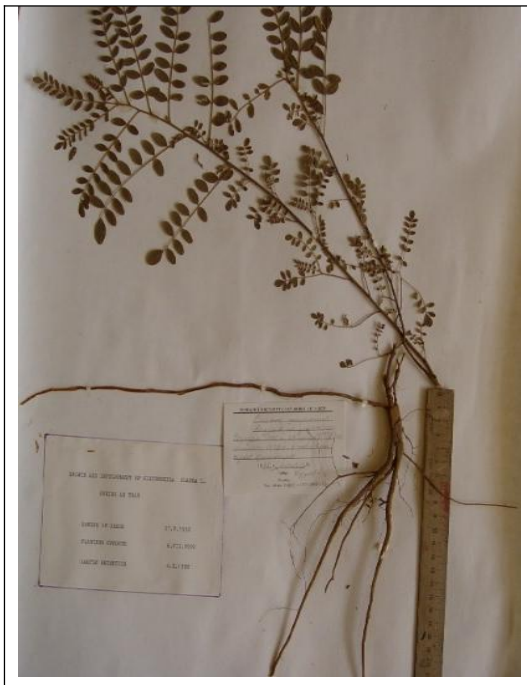

3-4-pictures. The appearance of seedlings 41 days after sowing the seeds, following their transplantation, in November.

This illustration shows the average condition of licorice seedlings grown from seeds planted in the field on May 27 and transplanted to another location on July 6, developing until autumn.
Licorice is water-demanding. Therefore, it grows well along irrigation canals, riverbanks, and in areas where groundwater is close. For licorice, in places where groundwater is at a depth of 1.5–2.5 meters, irrigation is sufficient 3–4 times in the first year and twice annually in subsequent years (with 800–1000 m³ of water per hectare each time). If groundwater is deeper than 3 meters, irrigation frequency increases to twice, [4].
According to Zakirov and Pausner (1973), "licorice is a mesophilic plant requiring sufficient water for good development." Other sources also confirm that planting licorice from rootstocks in areas with nearby groundwater and irrigated conditions yields good results. If the soil surface layer is dry, rootstock cuttings do not root well and may dry out, [6].
Whether planting from cuttings or seedlings, it is beneficial to irrigate sequentially along the furrows during planting.
One-year-old seedlings planted in autumn are watered 1–3 times depending on weather and soil conditions. In the following year, they are watered 5–7 times and weeded 1–2 times. In subsequent years, weeding is not necessary; 4–6 waterings are sufficient. If planted in spring, 6–8 waterings are done in the first year, and 4–6 times in the second and subsequent years. Irrigation is mainly done by furrow infiltration but should avoid waterlogging. Necessary irrigation channels should be dug, and runoff water must be drained away. After irrigation, the soil is loosened to a depth of 10–15 cm with softening tools, which helps retain moisture, reduces salinity, and prevents crusting. In the first year, loosening is done after irrigation and

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plant emergence; in the second year, loosening occurs early spring before sprouting. Early spring tillage removes some weeds and retains soil moisture. In later years, tillage between rows is not recommended as cultivator blades may damage rootstocks growing along the furrows.
Irrigation timing depends on climate and groundwater depth.
Seedlings planted in spring are weeded 1–2 times in the first year and once in the second year. In subsequent years, weeding is unnecessary.
Root harvest: Digging out the underground parts (roots and rootstocks) at the end of the fifth year yields good results with abundant and quality harvest.
Licorice roots can be dug out as early as the end of the third year. At this time, the glycyrrhizin content in the roots meets state standard requirements, but yields are low (4–5 tons). From the third year onward, root yield rapidly increases. Licorice growth and yield depend on soil, water, and agrotechnical conditions, and by the end of the fifth year, more than 12–16 tons of roots and rootstocks can be harvested. The harvested raw material quality is also high. In addition, the aboveground parts yield 70–80 tons of dry matter (hay).
Below, Figures 5–10 illustrate the roots of licorice plants grown from seedlings, cultivated for two, four, and five years, the process of digging and harvesting roots, drying them in open air, and images of five-year-old roots suitable for industrial use.

		
5 - picture, 2 years old plant	**6 - picture, 4 years old plant**	**7 - picture, 5 years old plant**
		
8-picture, Digging up and harvesting licorice roots	**9-picture, Drying the harvested roots in the open air**	**10-picture, Five-year-old roots suitable for industrial raw material**

If no other crop is planned to be planted after harvesting the root yield, the licorice field can be restored without replanting by performing the necessary agrotechnical measures. In this way, the

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above-ground parts can be harvested every year, and the underground root yield can be harvested again after 5 years. Moreover, the subsequent harvest can yield even more than the previous one. This approach saves the cost of purchasing planting material and planting expenses.
The harvesting of licorice root for industrial raw material purposes, depending on soil conditions, is best done in March and October if there are special places for drying the roots. In cases where there are no special root-drying facilities, harvesting during the summer months gives better results. The dug-up roots and rhizomes must be kept in cool, humid places and protected from rainfall. They should be dried quickly either in open air or in specially heated locations.

Summary of some experimental results on cultivation of licorice (Glycyrrhiza glabra) by scientists of the Uzbekistan Botanical Institute

Experiments conducted on the lands left for reclamation in Mirzachul have demonstrated that licorice can be grown in rotation with alfalfa and that it possesses soil amelioration properties [10, 12]. It was found that using intermediate crops during the crop rotation period of licorice on strongly saline soils (with 2.5 - 3.0% dry residue) gave good results [11]. Another new direction in establishing licorice fields was developed for areas where groundwater is close to the surface, and where soil is degraded and saline due to waterlogging, and grazing grasses have disappeared — the method for growing licorice under natural moisture conditions was identified and worked out [7].
Additionally, to expand agrocenoses, the morphological, ecological characteristics, phenology, physiology, promising varieties, yields, chemical composition of above-ground and underground parts of the plant, soil chemistry, pest control measures, and other aspects were studied.
Most of our scientific experiments related to licorice cultivation were conducted on saline soils with salt content (dry residue) from 1.5 to 3.0%. Licorice showed good growth on soils with salt content (dry residue) up to 2.0–2.5% (including 1.5% sulfate and up to 0.3% chloride salts). However, when the salt content exceeded 2.5%, the survival rate of planted cuttings and seedlings decreased. In the first years after planting licorice, soil salinity initially increased, but starting from the third year, the strongest period of ameliorative activity began, and by the end of the fifth year, about 80-85% of the salinity was reclaimed [11, 13].
Licorice roots have typical phreatophyte features and penetrate soil layers 5-7 meters deep, allowing the plant to access groundwater. It was proven that during the first year of vegetation, licorice roots can use soil moisture formed from groundwater at a depth of 2.5-3.0 meters, which confirms the possibility of growing licorice under natural moisture conditions where groundwater is close [7].
The experiments showed great benefits of crop rotation. Crop rotation increased yield and improved crop quality. In fields left for reclamation due to increased soil salinity (cotton yield dropped below 7-12 centners per hectare), when licorice + alfalfa rotation was applied, cotton yields reached 25-30 centners in the first rotation and 30-32 centners in the second. In these fields where licorice was grown, water-soluble salts in the soil decreased from 2.0-2.5% to 1.0-1.2% during the first five years, and the root and rhizome yield of licorice reached 27 tons per hectare [12].
Intercropping licorice with other salt-tolerant crops yields good results, enabling efficient land use and additional fodder production. Under Mirzachul conditions, the wet biomass yields of

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different crops interplanted with licorice were: Sudan grass 78-490 centners/ha, maize 279-840 centners/ha, corn 234-800 centners/ha, vigna 87-270 centners/ha, dolichos 95-280 centners/ha.
When maize was planted for one year on a field where licorice had been grown for four years, and then clover was planted without soil tillage (to promote rapid sprouting), clover sprouting reached 52.5%, compared to only 6-15% in fields without prior licorice cultivation. Alfalfa grown in place of licorice showed good growth and development and higher yield, and the quality of cotton fiber (strength, length) improved [11].
The above-ground parts of licorice are used for silage, hay, and flour for livestock. Its nutritional value is highly rated; it contains biologically active substances regulating metabolism, acting as phytoestrogens. These substances especially benefit animals with weakened hormonal activity by promoting growth and are valuable because they increase cattle productivity and fattening, increasing milk fat content by 1-1.2% [1].
In the second year, licorice fields yield 70-100 centners per hectare of nutritious hay, and from the third year onwards, yields exceed 220-300 centners per hectare. In fields harvested and grazed by livestock, new shoots and leaves regrow quickly if moisture is sufficient. Harvesting can be done manually or mechanically.
For haymaking and silage, cutting the stems twice a year—in late June and August—gives good results. At this time, the stems are mostly lignified but leaves are fully preserved. If harvesting coincides with the beginning of seed maturation, the roots are not damaged and leaves remain intact.
Licorice flowers produce delicious medicinal honey. At least 45 kg of nectar per hectare can be harvested at one time. Nectar extraction can be repeated several times. Licorice flowers are mainly pollinated by insects, especially bees, which are important for increased seed yields.

References:

1. Andoskina L.T., Muinova S.S. Age and seasonal dynamics of the content and quality of acids in the above-ground mass of licorice (Glycyrrhiza glabra) // Ecological and biological features of important raw material plants in cultivation. Tashkent: Fan, 1978. pp. 98-106.
2. Badalov M.M., Pauzner J.I.E. Effect of succinic acid on the germination of licorice seeds under conditions of the hungry steppe // Prospective raw material plants of Uzbekistan and their cultivation. Tashkent: Fan, 1979. pp. 114-121.
3. Badalov M.M., Zakirov K.Z., Muinova S.S., Nigmatov S.Kh., Pauzner J.T.E. Recommendations on propagation of licorice from seeds. Tashkent, 1989. 8 pages.
4. Badalov M., Ashurmetov O.A., Aprasidi G.S., Khojimatov K.Kh. Cultivation and agricultural technology of licorice. Tashkent, 1996. 16 pages.
5. Zakirov K.Z., Pauzner L.E. Recommendations on the introduction of licorice cultivation on saline lands of the hungry steppe. Information bulletin No. 86. Tashkent: Fan, 1973. 21 pages.
6. Kerbobaev B.B., Gladyshev A.I. Turkmen licorice root. Ashgabat: Ylym, 1971. 96 pages.
7. Kuziyeva A.D. Establishment of licorice plantations under natural moisture conditions // Biodiversity of plants in Uzbekistan: problems and achievements. Materials of the Republican scientific conference. Tashkent, 2018. pp. 101-104.

JOURNAL OF APPLIED SCIENCE AND SOCIAL SCIENCE
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8. Nikonov G.K. Chemical study and prospects for the use of licorice in the national economy // Study and use of licorice in the USSR national economy. Alma-Ata: Gylym, 1991. pp. 17-20.
9. Pauzner J.I.E., Muinova S.S. Features of development of Glycyrrhiza glabra and Glycyrrhiza uralensis at different sowing times on irrigated serozems near Tashkent // Materials on biology of Glycyrrhiza species. Tashkent: Fan, 1970. pp. 45-63.
10. Pauzner L.E., Nigmatov S.Kh., Muinova S.S., Khaidarov N.A., Zhuravleva N.F. Role of licorice in amelioration of saline soils // Ecological and biological features of important raw material plants in cultivation. Tashkent: Fan, 1978. pp. 24-26.
11. Tukhtaev B.E. Bioecological basis of using licorice for reclamation of saline lands. Abstract of Candidate of Biological Sciences dissertation. Tashkent, 1991. 22 pages.
12. Khaidarov N. Bioecological aspects of Glycyrrhiza glabra and agrocenotic environment. Abstract of Candidate of Biological Sciences dissertation. Tashkent, 1989. 23 pages.
13. Khojimatov K.Kh., Kuziyev A.D., Streltsova L.F. Some aspects of licorice in improving land use of saline soils // Collection of scientific works on medicinal plant cultivation. Moscow, 2006. pp. 396-400.
14. Shamsuvalieva L.A. Influence of salinity on morphogenesis of Glycyrrhiza species // Journal of Desert Problems. 1998 (a), No. 1, pp. 61-67.
15. Shitov Yu.V. Licorice root (Glycyrrhiza glabra). Alma-Ata: Kaynar, 1980. 104 pages.