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Research Article

DISTRIBUTION AND CULTIVATION TECHNOLOGY OF LICORICE PLANT IN UZBEKISTAN

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ABSTRACT

There are plants in nature that can grow even in saline, arid lands and increase soil fertility and improve soil quality.

One such plant in the Leguminosae family is licorice, whose scientific name is Glycyrrhiza glabra Linn.

Licorice (Glycyrrhiza glabra L.) possesses high environmentoptimizing function, enriching soil with organic matter and improving physical and chemical properties and biological activity of the soil, provides the basis for sustainable reproduction of fertility of degraded saline soils.

In Uzbekistan, 49% of irrigated land is affected by salinity and there are many degraded, abandoned areas. An alternative to the modern practice of land desalinization, which requires the use of irrigation water in high quantities and in turn aggravation of soil properties, can be a biological method of restoring fertility by growing licorice.

KEYWORDS

Glycyrrhiza glabra Linn, biological properties, salt tolerance, cultivation technologies, distribution.

INTRODUCTION

Biological properties of Glycyrrhiza glabra Linn

In the territory of the republic, licorice is a typical tugai plant, polycarp is a herbaceous plant with well-developed stems and a cylindrical structure. The stem is woody and 150-160 cm high, sometimes exceeding 200 cm or more in forest conditions. In saline soils, these values are about 50-70 cm. The leaves have a complex structure. It consists of 4-8 pairs of leaves, arranged in in series on the stems. The leaves are 11-18 cm long, ovate, elliptic, entire, hairy, 5 cm long and 2.5 cm wide. The flowers are white-purple, the pollen is large and heavy.

Due to its strong nectar secretion, it attracts bees and other insects. The above-ground part of licorice is used as nutritious animal feed. The stem contains 11-18% protein, 3.3-9.1% oil and other beneficial compounds. The bark of the underground part is brown, the length of the roots and rhizomes is 180-200 cm.

Underground Glycyrrhiza glabra The Linn plant has a broad root system, with a main root and many side roots. The main root, which is harvested for medicinal purposes, is soft, fibrous, and the inside is bright yellow [22].

The content of glycyrrhizic acid in roots and rhizomes is 3-24%, glucose-8%, sucrose-11%, starch-34%, fiber-24%. The amount of substances that can be extracted in water is 43% [13]. Glycyrrhiza glabra Linn has long been used in food and medicineIt is known as the sweet root. Licorice root is 50 times sweeter than sugar [6.].

Since GL, a sweet saponin, and GB, a species-specific flavonoid, are known to be important index compounds for underground parts of G. glabra[4,7], HPLC analysis was performed to determine their content in the roots and stolons collected in the habitat (Table 1). GL contents were found to vary from 4.76% to 6.13% of dry weight in the roots, and from 3.33% to 5.98% of dry weight in the stolons, depending on the sample[8]

Table 1. Contents of Glycyrrhizin (GL) and Glabridin (GB) in Underground Parts of G. glabra Collected in Uzbekistan[8]

		GL	GB
Root	12.3	6.13	0.12
Root	17.5	4.76	0.08
Root	20.5	5.87	0.15
Stolon	6.6	3.33	0.10
Stolon	10.4	3.35	0.20
Stolon	15.5	5.98	0.35

Table 2. Contents of Rutin (RT), Isoquercitrin (IQ), Pinocembrin (PN), Licoflavanone (LF) and Glabranin (GN) in Leaves of G. glabra Collected in Uzbekistan[8]

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Plant No.	Origin	Type of fruit	Type of HPLC profile	Content (% of dry weight)				
				RT	IQ	PN	LF	GN
01B01	Uzbekistan	*glabra*	RT-type	0.22	0.03	2.66	0.53	1.07
01B02	Uzbekistan	*glabra*	RT-type	0.25	0.05	1.53	0.21	0.25
01B03	Uzbekistan	*glandulifera*	IQ-type	0.05	0.57	0.45	0.00	0.09
01B04	Uzbekistan	*glabra*	IQ-type	0.04	0.39	1.79	0.16	0.42
01B05	Uzbekistan	*glabra*	RT-type	0.32	0.04	0.98	0.33	0.18
01B06	Uzbekistan	*glandulifera*	IQ-type	0.07	0.53	0.95	0.00	0.24
01B07	Uzbekistan	*glabra*	RT-type	0.29	0.03	1.74	0.12	0.39
01B08	Uzbekistan	*glabra*	RT-type	0.23	0.05	2.34	0.29	0.69
01B09	Uzbekistan	*glabra*	RT-type	0.24	0.05	1.53	0.22	0.22
01B10	Uzbekistan	—a)	RT-type	0.25	0.06	2.30	0.28	0.33
01A19[15)]	Kazakhstan	*glabra*	RT-type	0.26	0.03	1.39	0.21	0.52
01A20[15)]	Kazakhstan	*glandulifera*	RT-type	0.27	0.09	0.86	0.23	0.32
96A15[14)]	Italy	*glabra*	IQ-type	0.02	0.32	1.64	1.59	0.73
96B02[14)]	Spain	*glabra*	IQ-type	0.03	0.47	1.21	1.13	0.29
90A05[13)]	Turkey	—a)	IQ-type	0.06	0.84	1.09	0.47	0.16

Salt tolerance

Glycyrrhiza glabra Linn is a medicinal plant that the locals call qizilmiya. The most important feature of Glycyrrhiza glabra Linn is that it can be grown in saline soils, which leads to soil recycling [5]

Licorice is a salt and drought-tolerant native crop in arid regions that naturally spreads over approximately 2000 hectares across the Zarafshan, Sirdarya and Amudarya deltas and the Chirchiq and Angren areas of Uzbekistan. A total root dry mass in these areas accounted for almost 18.5 million tonnes [13].

The majority of plant species under water deficiency condition primarily retards growth and gradually deteriorates morphological and physiological properties. Nevertheless, licorice may thrive and even generate significant biomass in incredibly harsh conditions [9-10].

Since the native licorice population is declining sharply in recent years, studying production technology is prudent to exclude supply shortages. Given the fact that licorice is a drought-tolerant plant [12], comparatively few studies have been performed on the successful cultivation of licorice in deteriorated soils under water deficit condition by using of a proper irrigation regime. The cultivation of this climate-resilient crop is considered a preventive measure for combating wide-spread land degradation in the region. A hypothesis of this research is if licorice could grow well under water deficit conditions, then it might contribute to enhance crop productivity and soil quality, thereby may rejuvenate the dryland cropping system. Therefore, this study focused on evaluating the potential of licorice cultivation under different water deficit conditions (control 70–80%, moderate 50–60%, strong 30–40% and intense 10–20% relative

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water WC in the soil), thereby, contributing to the economic and environmental sustainability of degraded lands in arid zones.

Licorice increases the content of agro-technically valuable, drought-resistant soil aggregates by 70-80%, reduces soil density to optimal (1.3-1.4 g / cm3). Roots that penetrate to a depth of 3.5-4 m allow groundwater to pass through large areas of salinity, reducing their salinity. The amount of humus increases from 0.7% to 1.5-1.64% (depending on the age of the plant), enriches the soil with nutrients through the accumulation of nitrogen (in the leaves), phosphorus (in the stem) and potassium (in the seeds).

Nigmatov S.X. according to the data, when Glabra L seeds are planted in saline soils for several years, they develop the ability to grow even in saline soils. Seeds grown on non-saline soils were able to germinate at a salinity of 10–15 g/l, while seeds grown on saline soils were able to germinate at 15–20 g/l. When grown in the field, the salt tolerance of plants has increased in their ontogeny. Data on fruit, productivity and root collection were obtained. It has been found that licorice is more resistant to salts when planted through the roots (compared to those planted from seeds), and dies when the salt content is 15%. Most of the seedlings did not germinate when the salt content was 2.5%. The transition to high salinity led to a sharp slowdown in plant growth and development. In the chloride-sulphate area, water evaporation decreased and osmotic activity increased. As the roots grew rapidly, they absorbed more water from the lower layers of the earth, causing the groundwater to recede. The bulk of the roots accumulate in the top layer of soil, making them easier to dig.

These stress adaptability functions of licorice plants allow them to survive under extreme conditions. i.e., drought, salinity, and heat stresses, and thereby develop proper tolerance mechanisms. In agreement with these phenomena, the results of this experiment also showed a slight reduction in the weight of the dry root compared with that of the shoot mass. More specifically, in the 50–60% WC application, the plant growth parameters were higher than in the 70–80% WC procedure, suggesting a low water deficit promotes growth and biomass development of the licorice plant. This impact is consistent with a depth rooting method and an effective licorice transpiration process that retains growth dynamics over a long vegetative period, also under a deficit irrigated environment. It is well-known that licorice accumulates less secondary metabolites in the roots under stress environment, defining sufficient WC is essential for normal biosynthesis processes [17]. Glycyrrhizic acid level varies between 5–10% of the weight of the root of the licorice plant depending on various growing conditions. In our experiments, this value ranged between 6.04 to 7.40%, which are in agreement with previous reports [24]. However, this experiment confirms that a low water deficit may induce secondary metabolite biosynthesis in the licorice roots, improving the quality of the raw products. This outcome is consistent with the findings of several researchers who confirmed that low drought-stress plants generally produce higher levels of secondary metabolites [3]. It is highly likely that mutualistic association of beneficial microbes in the rhizosphere of licorice contributed to utilising water and nutrients more efficiently and improved soil quality. Many researchers have noted that crop residues decrease soil bulk density and temperature while maintaining a good plant growth condition [1,2,7]

Consistent with these findings, licorice residues in this study also had many beneficial effects on the improvement of soil physical structures, chemical

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compositions and possibly biological functions. It turned out that the enhanced abundance of macronutrients in the soil contributes to the beneficial actions of microbes in the root rhizosphere to secrete organic acids and lower the pH in their area, which could have induced the breakdown of bound phosphates in the soil [15]. It is well documented that the significant effects of soil microorganisms depend on soil moisture [14,23,25]

According to Shantz et al. (2016), a number of processes have developed in licorice to thrive under exceptionally harsh conditions, including mutualism with beneficial soil microbes that promote nutrient and water absorption and improve drought stress tolerance of plants [21]

Cultivation technologies

Licorice is grown vegetatively in degraded or low-yielding areas where other crops are unprofitable. In one place, licorice can grow for more than ten years. When the crop rotation is over, the rhizomes are removed and the field is prepared for growing other crops.

There are additional benefits of growing licorice for reclamation purposes: root and surface biomass, which have medicinal properties and valuable nutritional properties for animal feed. With proper care, the roots can be harvested as early as the third year, with a yield of 10 t. The profit can be about 11 million from 1 hectare of land ...

The licorice plant is propagated in three main ways: by seeds, rhizomes, and seedlings. The first method is by sowing seedsThis requires the selection of well-established, well-plowed, weed-free, mulched, machined, leveled in autumn areas. The seeds are sown at a depth of 1-3 cm. Sowing can be done by mechanization in autumn and early spring. 4-5 kg of seeds are sown per hectare. After sowing, the field is irrigated and the topsoil is required to remain moist until the grass is formed. As the soil temperature rises above 10 C, sprouting of grasses is observed. Grasses are mainly cultivated between rows when they reach 20-25 cm. During the growing season, the plant site is watered 8-10 times. After every 2-3 irrigations, loosening and processing of row-spacings with ketmon and care for them are carried out. However, given the relatively low germination of seeds on saline soils (1.5-2.0%), the cultivation of industrial crops by growing licorice seeds is impossible..[33]

The second way is propagation by rhizomes. In this method, the plant material, i.e. rhizome, dug out from the fields. With the help of tools with a sharp blade, rhizomes 10-15 cm long are cut. It is recommended to spend 2000-3000 kg of rhizomes per hectare. Pre-prepared and well-established fields are plowed with an interval of 90 cm, and the rhizomes are planted to a depth of 5-8 cm mechanized. This process is carried out both in autumn and early spring. Taking into account soil moisture, frequent watering of the rhizome and maintaining soil moisture is effective. Depending on the condition of the plants, agrotechnical measures are carried out on the sown areas, they are watered and cared for 6-8 times a year (during the growing season). From the 2nd year of vegetation, the irrigation rate is reduced depending on soil conditions. This method is mainly effective in the construction of large industrial areas. However, when multiplied by this method by 12000-3000 kg of valuable raw materials are consumed(1 ha)[33].

The third method is to sow the seeds in the gray soil, grow seedlings from them, and then transplant them to saline soils.Including, when seedlings that have gone through one vegetation period are transplanted to saline soils, their growth and maintenance is 70-80%. From 4-5 years of vegetation, the raw material ripens. The raw material of industrial importance consists of roots and rhizomes, the bark is brown, the inside is orange, with a characteristic odor and a very sweet taste. From one hectare it is possible to grow 8-10 tons of fodder and 20-25 tons of nutritious fodder. The underground part of the plant is mainly dug to a depth of 0-50 cm, cleaned of soil and dried.

Thus, it is advisable to use rhizomes and seedlings in the cultivation of licorice, which is a valuable raw material.

Distribution and cultivation in Uzbekistan

Glycoriza glabra L. grows in Southeast Europe, Southwest Asia, the Middle East and Central Asia. Grows well in sunny valleys near streams. Currently, licorice is widespread in India, Iran, Afghanistan, China, Pakistan, Iraq, Azerbaijan and Uzbekistan. Glycyrrhiza glabra Linn is found in the wild, but can also be grown on farms.
The licorice family includes 13 species, 12 of which grow in our country. Licorice is widely distributed in the north-west of Uzbekistan. Growing licorice has proven beneficial for Uzbekistan for three reasons: environmental, economic and social. In Uzbekistan, in the face of environmental challenges such as declining Aral Sea levels, soil salinization, climate change, sandstorms and water scarcity, licorice cultivation is mitigating the severe side effects of environmental change. This is the most effective way to rehabilitate the land.

Most species of the glycyrrhiza family are plants of the Mediterranean flora. Despite the fact that the species is widespread in the Mediterranean floristic region, the main raw material base of G. glabra is the regions of Central Asia and Kazakhstan, as a result of uncontrolled mining of licorice root, raw material reserves have tripled in recent years [20]

In Uzbekistan, its goloy series is widespread in the Kyzylkum and Karakum deserts, on the banks of the Pamir-Alay, Tien-Shan, Amudarya and Syrdarya rivers. The Korzhinsky type is widespread in the Aral Sea, the lower reaches of the Caspian Sea. Glycyrrhiza glabra Linn prefers fertile, sandy and loamy soils near rivers or streams, where the plant thrives in the wild. Glycyrrhiza glabra Linn grows in nutrient-rich soils in subtropical climates.

The licorice plant is found mainly along rivers, streams and ditches. Due to its well-developed root system, it grows in deserts, mountain slopes with deep groundwater, as well as in low mountains and saline soils. In terms of distribution, licorice occupies the largest area compared to other species in this category, and is most common in the Amudarya and Syrdarya basins.

According to Borisov D.A., licorice habitats range from hot and humid subtropics to sharply continental: dry and hot summers and cold winters. The plant grows in temperatures down to -17.8 ° C. Humidity is 206-2465 mm in the areas where these crops grow, and the humidity coefficient is 0.22-3.60.

Muinova S.S. (1985) studied up to 3 generations in the vicinity of Tashkent in order to study the morphobiological and valuable economic indicators of hairless licorice species. He conducted experiments on the populations of the Amu Darya, Zarafshan, Kura, Araks, Terek and Astrakhan. According to Muinova S.S., the germination rate for native populations was 20.1-24.5%, and for introducers - 18.2-20.2%. Seeds from the Amudarya and Zarafshan regions sprouted at the end of March, and seeds from the Kura, Andokhan and Terekzon regions - in mid-April. In the second year, all populations grew rapidly, reaching a plant height of 85-92 cm. Many branches grew, and by May 20, plant height was 133.5-135.4 cm, Kura - 114.0 cm, and the lowest - Terek. The mass of roots in 4 years was 18-26 t/ha.The largest number of root crops was taken from the Kura 26.4 t/ha, Amu Darya 21.4 t/ha and Astrakhan up to 16.1 t/ha.

CONCLUSION

Thus, Glycyrrhiza glabra Linn has been proven to be one of the most important reclamation plants. The fact that the licorice plant can grow even in saline soils and loosen dense soil layers, and that it is widespread even in adverse climatic conditions, allows us to study it in more depth. Stress adaptability features of licorice, i.e., drought and salt tolerance, allow for this plant's cultivation under extremely harsh environments and might be used as a valuable practice to combat desertification through developing a highly value-added sustainable crop production system in arid regions. In our next study, we aim to study the extent to which these properties of licorice are related to its microbiological world.

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