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Study of Common Licorice (Glycyrrhiza glabra) Reserves in Atyrau and Western-Kazakhstan Regions

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The goal of the present work is to identify marketable thickets of common licorice (*Glycyrrhiza Glabra*) in the territory of Atyrau and West Kazakhstan regions (Western Kazakhstan) and estimation of the licorice raw reserves. Common licorice is a valuable drug plant used in medicine as an expectorant, anti-inflammatory and viral inactivating agent. Previously, the main places of harvesting licorice roots were located in the territory of Southern Kazakhstan. To expand information about raw reserves of liquorice roots, sand areas and river valleys of Western Kazakhstan were studied. Growth of licorice as part of the licorice-wormwood, sedge-forb meadow and grass-forb associations was noted on the territory of Atyrau and Western Kazakhstan regions. Common licorice raw reserves are identified in the area of 899.0 hectares, while exploitable volume is estimated at 5060.1 tons. The amount of possible annual collection of the air-dry licorice raw reaches 506.0 tons.

Keywords: common licorice (*Glycyrrhiza glabra*), yielding capacity, raw reserves, underground organs, Atyrau Region, West Kazakhstan Region, herbs.

The economy and industry of Kazakhstan should develop on country's own resource base. The flora of the Republic of Kazakhstan includes more than 5.500 vascular plants[1], many of which have medicinal properties[2] and can find practical application in medicine and pharmacy. The study of the distribution and productivity of medical herbs allows planning efficient use of the reserves. Common licorice (*Glycyrrhiza glabra* L., Fam. *Fabaceae*) is widely used among the pharmacopeial medical herbs. Its underground organs are used as the expectorate cough mitigating and emollient remedy in diseases of the upper respiratory tract[3-5]. Licorice root is prescribed in peptic ulcer disease of stomach and duodenal ulcers, at chronic inflammatory conditions of the gastrointestinal tract, especially at high acidity of gastric juice. Licorice root serves the basis when producing expectorant, anti-inflammatory and viral inactivating agents[6-10].

The Republic of Kazakhstan is one of the exporters of licorice root. Previously the main reserves of licorice root were extracted in the territory of South Kazakhstan (valley of the Chu River)[11-14], however, significant thickets of this herb exist in other regions as well.

Reconnaissance survey has shown that natural thickets of common licorice vegetate in the territory of Atyrau and West-Kazakhstan regions.

The goal of the present work is to identify marketable reserves of common licorice in the territory of Atyrau and West Kazakhstan regions (Western Kazakhstan) and estimate licorice raw reserves.

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Methodology

The studies were conducted in the vegetation period of 2014-2015 employing semistationary methods[15].

Resource determination of species was carried out according to established recommendations[16-20]: definition of total area (in hectares); setting up 10-15 model plots with an area of 1 m^2 each. The following was determined for each model plot: a) yield of underground organs (kg/m^2) in humid and air-dry conditions; b) floristic composition of plant association indicating the abundance by Drude scale; c) the phenological development stages of species growing in the territory under study; d) the calculation of exploitable volume of licorice raw and the amount of possible annual collection of raw reserves (tons), d) the total plant cover (hereinafter TPC). Calculation of the amount of possible annual collection of licorice raw reserves was made subject to a 10% of exploitable volume[21].

RESULTS AND DISCUSSION

In the territory of Atyrau Region common licorice is described for the following sites: the Oyl River valley, the village of Karabau in the floodplain of the Oyl River, sand of Taisoigan, floodplain of the Ural River, Zharipshykan, the flat areas between the villages of Mukur, Sagyz, and Miyaly, the floodplain of the Aktolkyn, Uter and Sergek rivers, clay plains and sand hills in the vicinity of the Kulsary village. Marketable thickets are noted also in sand of Taisoigan and floodplain of the Uter River.

In the Taisoigan Sands, common licorice inhabits as part of the licorice-wormwood (*Glycyrrhiza glabra – Artemisia arenaria*) association. Common licorice with an abundance of cop1 and vitality of 2-3 points is dominating plant, while sandy wormwood with an abundance of sp-cop and vitality of 2-3 points is codominant (Table 1, Fig. 1). The vitality of the species, which are components in the association, is 1-3 points. Species composition of the associations is not rich – about 12-14 species with TPC of 60-75%.

Species are ranged in 2 tiers of high and low herbs. The upper tier (30-40 cm high) is composed of species such as *Artemisia arenaria* – sp-cop, *Achnatherum splendens* – sol, *Syrenia siliculosa* – sol, *Dianthus ramosissimus* – sol, and *Agropyron desertorum* – un. The lower tier (up to 25 cm high) is composed of *Glycyrrhiza glabra* – cop1, *Cynodon dactylon* – sol, *Achillea micrantha* – sol, *Poa bulbosa* – sol, *Jurinea tenuiloba* – sol, and others.

Thickets of the common licorice are situated not in compact, but in the individual sites in topographic lows between the bumpy sand. Area covered by the licorice associations is 78.2 ha. The yield of underground organs in terms of air-dry weight amounted to 18118 kg/ha. Exploitable

Table 1. The species composition of licorice-wormwood association in the Taisoigan Sands

List of species	Phytocoenotic role	Plant height, cm	Abundance (according to the Drude scale)	Pheno-phase	Vitality
Glycyrrhiza glabra L.	Dominant	20-22	Cop1	Flower-bud	2-3
Artemisia arenaria DC.	Codominant	30	Sp-cop	Vegetation	2-3
Cynodon dactylon (L.) Pers.	Component	5-6	Sol	Fruit	2
Carex physoides Bieb.	Component	10-12	Sol	Dieback	3
Achillea micrantha Willd.	Component	12-15	Sol	Flower-bud	2-3
Achnatherum splendens (Trin.) Nevski	Component	35-40	Sol	Bud	2-3
Poa bulbosa L.	Component	16-20	Sol	Fruit	3
Syrenia siliculosa (Bieb.) Andrz.	Component	30-40	Sol	Fruit	1-2
Euphorbia seguieriana Neck.	Component	40	Sol	Flower-bud	2-3
Dianthus ramosissimus Pall.ex Poir.	Component	30-35	Sol	Dieback	3
Jurinea tenuiloba Bunge	Component	20-28	Sol	Dieback	2
Agropyron desertorum (Fisch.ex Link.) Schult.	Component	30-35	Un	Fruit	2

volume of underground organs is estimated at 1416.8 tons, the amount of possible annual collection of licorice raw reserves – 141.7 tons (Table 2).

In the valley and the floodplain of the Uter River, common licorice grows within the composition of sedge-forb meadow (*Carex diluta + Carex vulpine – Herba varia*) association. Total plant cover amounts to 90-95%. The territory is characterized by light brown loamy soils and is rich in herbs. The floodplain areas are aligned with a small difference in height and development of the micro-relief. The expansion zone is used as pastures and hayfields. The transformation amounted to 30-35%. The moistening of the association is due to the high precipitation, close-lying groundwater and river floods.

Licorice is a component with an abundance of sp dominated by *Carex diluta*, codominant – *Carex vulpine*. Other species are

Table 2. Raw reserves of common licorice underground organs in the territory of Atyrau and West Kazakhstan regions (air-dry weight)

Location of commercial thickets	The area of thickets, ha	yielding capacity, kg/ha	Exploitable volume, tons	Amount of possible annual collection of the licorice raw, tons
Taisoigan Sands (Atyrau Region)	78.2	18118	1416.8	141.7
Sergek River valley (Atyrau Region)	52.8	25365	1339.3	133.9
Naryn Sands, 10 km from Zhambyl village, (West Kazakhstan Region)	768	3000	2304.0	230.4
Total:	899.0		5060.1	506.0

Table 3. Floristic composition of sedge-forb meadow association

List of species	Phytocoenotic role	Plant height, cm	Abundance (according to the Drude scale)	Pheno-phase	Vitality
Carex diluta Bieb.	Dominant	30-35	Cop2-soc	Fruit	4
Carex vulpine L.	Codominant	25-30	Cop1	Vegetation	3-4
Cynodon dactylon (L.) Pers.	Component	5-6	Sol	Fruit	3-4
Beckmannia eruciformis (L.) Host	Component	5-10	Sol	Fruit	2-3
Butomus umbellatus L.	Component	45-50	Sol	Flower	4-5
Alopecurus aequalis Sobol.	Component	40	Sol	Flower	4-5
Inula caspica Blume	Component	25	Sol	Bud	3
Althaea officinalis L.	Component	40-60	Sp	Bud	4-5
Alisma plantago-aquatica L.	Component	30-50	Sol	Vegetation	3-4
Agropyron fragile (Roth) Candargy	Component	25	Sol	Fruit	2-3
Xanthium strumarium L.	Component	10-15	Sol	Vegetation	3-4
Glycyrrhiza glabra L.	Component	25-28	Sol-sp	Flower	4-5
Tamarix elongata Ledeb.	Component	120-200	Sol-un	Flower	4-5
Cynanchum sibiricum Willd.	Component	Creeping shoot	Sol	Flower	2
Gypsophila patrinii Ser.	Component	40-50	Sol	Flower	2
Gypsophila paniculata L.	Component	35	Sol	Flower	2
Onopordon acanthium L.	Component	60-65	Sol-un	Flower	4

Species are ranged in 3 tiers (Fig. 2)

components with an abundance of sp-sol-un. Species composition is quite significant - about 45-50 species (Table 3).

Top wood tier (450-500 cm high) is formed by *Elaeagnus angustifolia, Salix alba*. Medium, bushy tier (120-150 cm high) is composed of *Tamarix elongata*. The third grassy tier consists of 3 sub-tiers: juncaceous (120-150 cm high); medium-grown herbs, 40-65 cm high (*Calamagrostis epigeios, Onopordon acanthium, Leonurus glaucescens, Gypsophila patrinii*) and low-growing herbs, 30-35 cm high (*Plantago major,Rumex crispus, Bidens cernua, Inula caspica, Xanthium strumarium* and others). Association has horizontal structure occasioned to the decrease to the watercourse of the river.

The thickets area amounted to 52.8 ha (Table 2). The yield capacity of underground organs is estimated at 25365 kg/ha, exploitable volume – 1339.3 tons, and the amount of possible annual collection of licorice raw – 133.9 tons.

Common licorice thickets in the territory of the West Kazakhstan Region are identified in the vicinity of the Zhambyl village, natural landmark of Balyktinsk spills, in 10 km from the Ural River floodplain, in the vicinity of Ushtobe village, in the Syrymbet tract, on the plain of Zhanakalinsk district, in floodplain forests of the

Table 4. Floristic composition of the grass-forb association in the Naryn Sands

List of species	Phytocoenotic role	Plant height, cm	Abundance (according to the Drude scale)	Pheno-phase	Vitality
Melica transsilvanica Schur	Dominant	30	Cop1	Bud	4
Elytrigia repens (L.) Neski	Codominant	20	Sp-cop	Ear	4-5
Ferula nuda Spreng.	Component	15-20	Sol	Fruit	4
Artemisia austriaca Jacq.	Component	20-22	Sol	Vegetation	4
Artemisia tschernieviana Besser	Component	40	Sol	Vegetation	4-5
Festuca becheri (Hack.) Trautv.	Component	22	Sol	Flower	4
Euphorbia sp.	Component	5-10	Sol	Fruit	4-5
Astragalus alopecurus Pall.	Component	25-30	Un	Vegetation	4
Achillea micrantha Willd.	Component	12-15	Sp-sol	Bud	4
Linaria genistifolia (L.) Mill	Component	28	Sol	Bud-Flower	4
Helichrysum arenarium (L.) Moench.	Component	8-12	Sol	Vegetation	4-5
Glycyrrhiza glabra L.	Component	25	Sol	Vegetation	4-5
Poa annua L.	Component	8-12	Sol	Fruit	4-5
Poa bulbosa L.	Component	8-12	Sol	Fruit	4-5
Carex physoides Bieb.	Component	5-10	Sol	Fruit	4-5
Phlomis pungens Willd.	Component	20-25	Sol	Beginning of vegetation	3
Onosma setosa Ledeb.	Component	20-25	Sol	Bud-Flower	4
Calamagrostis epigeios (L.) Roth.	Component	40-50	Sp-sol	Vegetation	5
Artemisia lercheana Web.	Component	20-28	Sol	Vegetation	2-3
Tragopogon ruber L.	Component	16	Un	Flower	4-5
Lepidium ruderale L.	Component	16	Sol	Fruit	4-5
Lappula spinocarpos (Forssk.) Aschers.	Component	4-8	Sol	Fruit	4
Anisantha tectorum (L.) Nevski	Component	20	Sol	Vegetation	1-2
Silene viscosa (L.) Pers.	Component	25	Un	Bud-Flower	4
Lactuca tatarica (L.) C.A. Mey.	Component	40-45	Sol	Vegetation	4
Ceratocarpus arenarius L.	Component	3-4	Sol	Sprout	3-4
Polygonum aviculare L.	Component	4-8	Sol	Vegetation	4
Gallium aparine L.	Component	4-8	Sol	Vegetation	4
Gypsophila patrinii Ser.	Component	40-50	Sol	Flower	4
Syrenia siliculosa (Bieb.) Andrz.	Component	15-30	Sol	Flower	4
Taraxacum leucanthum (Ledeb.) Ledeb.	Component	14-15	Sol	Flower	4-5

Ural river, and in the territory of Ordinsk forestry.

Marketable thickets are observed in the Naryn Sands in the vicinity of the Zhambyl village within the composition of grass-herb association (*Herba varia – Elytrigia repens + Melica transsilvanica*) (Fig. 3, Table 4). The area is represented by the gently rolling hills with loamy sand soils. The hydrological regime is formed by precipitation, groundwater, and natural runoff. In spring, moistening is added due to the floods of the lake. The aspect is gray-green, TPC amounts to 30-80%, TPC on the elevated areas is lower, while in depressions - higher.

Fig. 1. Appearance of common licorice in the Taisoigan Sands

Fig. 2. Harvestable plants of common licorice in the valley of the Uter River

Fig. 3. Thickets of common licorice in the Naryn Sands

The territory is slightly used for grazing livestock. Degradation is not more than 5%. On the sands common licorice grows in separate spots sized from 20x30 up to 150x200 m, forming almost monotypic thickets. The occurrence of plants equals to 13.0±0.6 generative shoots per m^2. The main bulk of roots and rhizomes underlay at a depth of 50 cm.

The association is dominated by *Melica transsilvanica* with an abundance of cop1 and vitality of 4 points, codominant is *Elytrigia repens* with an abundance of sp-cop and vitality of 4 points. Other species are components with an abundance of un-sp-sol and vitality of 1-5 points.

Plants are ranged in 3 tiers: upper tier is reed grass (40-50 cm high) represented by *Calamagrostis epigeios*; average tier is herbaceous (20-30 cm high) formed by *Ferula nuda, Melica transsilvanica, Glycyrrhiza glabra, Artemisia austriaca, Artemisia tschernieviana, Astragalus alopecurus, Phlomis pungens*, and other herbs; the lower tier is herbaceous (up to 15 cm high) formed by *Achillea micrantha, Helichrysum arenarium, Poa annua, Poa bulbosa, Carex physoides* and others.

The total area of common licorice thickets in the Naryn Sands is estimated at 768 ha at yield capacity of 3000 kg/ha (Table 2). Exploitable volume is estimated at a level of 2304 tons, the amount of possible annual collection of licorice raw reserves is 230.4 tons.

CONCLUSION

Thus, the total area of the common licorice thickets in the territory of the Atyrau and Western-Kazakhstan regions made up 899.0 ha, exploitable volume – 5060.1 tons, and the amount of possible annual gathering of the air-dry licorice raw – 506.0 tons.

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