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# GROWING SALT-RESISTANT FLORA UNDER NATURAL CONDITIONS OF THE KYZYL-KUM DESERT AND ARID BED OF ARAL SEA, UZBEKISTAN

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## SUMMARY

The article explores the Kyzyl-Kum Desert and the Aral Sea plant and soil cover, the plant characteristics and regionalized cultural crops thriving in these regions, and the extraction of high-quality and environment-friendly products from that flora. This initiative aims to prevent the dispersal of 100 million tons of dust-salt mixture from the dried bed of the Aral Sea, carried by wind and storms and deposited onto agricultural fields. Therefore, in this area, the phytoremediation process through establishing saxaul plantations is crucial. Each saxaul tree bush can preserve more tons of sand with its roots, demonstrating robust growth in saline lands while utilizing mineralized groundwater. Additionally, saxaul trees contribute to maintaining the critical depth of groundwater within the normal range.

Consequently, this approach is the area's natural barrier against secondary soil salinization and erosion processes. Similarly, it is noteworthy that today, the country's population is growing fast, increasing its demand for food products. Based on this, obtaining high-quality and ecologically clean products from each cultivated agricultural crop is one of the most urgent issues today and the prime purpose of conducting research in these areas.

**Keywords:** Kyzyl-Kum Desert, arid bed of Aral Sea, phytoremediation, agricultural fields, saxaul plantations, groundwater, Amu Darya, soil cover, soil salinization, soil erosion

**Key findings:** Growing salt-resistant flora is viable under the natural conditions of the Kyzyl-Kum Desert and the arid bed of the Aral Sea, Uzbekistan, Karakalpakstan, Caspian Sea.

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## INTRODUCTION

Globalization, climate change, lack of freshwater resources, rapidly increasing population of the earth, and lack of food in every country are just some observed issues in Central Asia and worldwide with consequences. Based on this, creating high-yielding, fast-growing plant varieties, combating land degradation, and increasing soil fertility remain the most urgent problems.

In Central Asia, the Aral Sea is the largest closed salt lake. Administratively, more than half of the Aral Sea area traverses the southwestern part of Karakalpakstan, Uzbekistan, and the northeastern part of Kazakhstan (Ramazonov, 2018a, b). Until the 1960s, the area of the Aral Sea, including its islands, covers 68,000 km² on average. It also ranks as the fourth largest sea in the world, following the Caspian Sea, Lake Superior in the USA, and Lake Victoria in Africa.

Additionally, it is second to the second largest on the Eurasian continent, trailing after the Caspian Sea. The sea extends from north to southwest, with a length of 428 km, and its widest part at 235 km, located at 45° North latitude. The basin covers an area of 690,000 km², with a water volume of 1000 km³ and an average depth fluctuating around 16.5 m. It earned its designation as a sea due to its basin size (Ramazonov, 2020).

The Aral Sea originated in the Upper Pliocene in a depression where the Earth's crust experienced rifting. The button relief is generally flat, except for the western part. Numerous peninsulas and gulfs once characterized the Aral Sea. Administratively, the Aral Sea and the Aral Bay region encompass territories in Uzbekistan and Kazakhstan, including the lower sections of the Amu Darya and Syrdarya rivers, the areas around the sea, and the Aral Sea arid bed. The latter formed in the northeastern and southern parts due to a reduced sea level (Ramazonov, 2020).

Recently, its area, including the islands, was almost 68,000 square m with a water volume of 1000 cubic km. The average depth is 50.5 m, 38.6 cubic km from Amu Darya to the Aral Sea until the 60s of the 20th century, and 14.5 cubic km from Syrdarya, with a 5.5 cubic km of underground water added. The shipping season lasts seven months in the sea with large ports such as Aralsk and Moynok (Ramazonov, 2020).

The Aral Sea, which ranks fourth among the world's lakes for size, is overflowing with waters of the two largest rivers of Central Asia, i.e., Amu Darya and Syrdarya. This water basin also helps regulate the climate in Central Asia and mitigate sudden variations in the weather. Wind masses entering the region warmed up in winter and cooled down in summer under the influence of the Aral Sea (Ramazonov, 2020; Muminov *et al*., 2023).

In preserving the unique fauna of this region, earlier proposals have surfaced to establish protected transboundary natural areas in the Orol zone. An effective collaboration is also crucial to save endangered animals, including leopards, cobras, saigas, and other rare species. Therefore, an urgent need to enhance significantly regional cooperation is vital concerning water conservation, the management of transboundary water resources, and their rational use. However, it should be a requirement to study the vegetation and soil cover in these areas, monitoring the growth and development of farm crops and their productivity, which is of great scientific and practical importance.

## MATERIALS AND METHODS

The presented research engaged genetic-geographical, profile-geochemical, stationary-field, and chemical-analytical methods. Chemical, physicochemical, and agrochemical analyses of soils ensued, as outlined in the *Guide to Chemical Analysis of Soils* and *Methods of Agrochemical, Agrophysical, and Microbiological Research in Irrigated Cotton Areas*. Field and camera works proceeded according to the guidelines specified in the *Management of Land Monitoring in the Republic of Uzbekistan* and *For Maintaining the State Land Cadastre*, following the instructions on conducting soil surveys and drafting soil maps. The data statistical analysis used the method of dispersion (Dospekhov, 1985) and the Microsoft Excel program (Ramazonov, 2020, 2021; Baboev *et al*., 2021).

**Object of the research**

***Flora and fauna of the Kyzyl-Kum Desert and the Aral Sea arid bed***

Today, numerous ecological zones on the Kyzyl-Kum plateau prevail cautiously, protecting its flora and fauna. The presence of water as the lifeblood of the Kyzyl-Kum region ensures the development of a unique array of diverse flora and fauna types. Over 130 plant species, more than 300 insect pests, and bird species are prevalent in that desert. In Kyzyl-Kum, stunted shrubs and grasses flourish even in extreme weather conditions. These shrubs include saksovul (haloxylon), camel thorn, reed, selin, 'yuzgun,' 'chingil,' wild 'kavul,' 'kokbosh,' 'balykkoz,' and various types of tulips, acacia, and willow.

Overall, the fauna of the Kyzyl-Kum Desert is immensely diverse. This vast desert is also home to camels, jackals, mountain rams, gazelles, saigas, deer, wild donkeys, Przewalski's horses, mice, foxes, lizards, hedgehogs, rabbits, underground mammals, turtles, and rattlesnake. Eagles, falcons, mallards, wild ducks, blackbirds, fishermen, sparrows, golden vultures, doves, and other creatures also reside here.

Branched horsetail (*Equisetum ramosissimum*) belongs to the horsetail family Equisetaceae. It is a perennial spore herb with long, thin, creeping, and blackish rhizomes that express and contain spherical tuberous substances. The stems of the branched horsetail are spore-bearing and vegetative. In early spring, the plant produces unbranched, succulent, reddish shoots up to 25 cm high that bear spores. Spores ripen in April-May, leading to the succeeding die-off of these shoots. Subsequently, newer stems emerge from the rhizome at the beginning of summer, growing to heights of 10–50 cm. These stems are erect, branched, segmented, and green in color. Branches form in whorls of eight to 16 along the entire stem, directed obliquely upward.

The immature leaves unite on the stem, forming cylindrical tubular sheaths. Branched horsetail is usually rampant in meadows, tugai among bushes, and along riverbanks and can considerably be a weed in fields and gardens. Its distribution extends almost everywhere in the European part of Russia, Siberia, the Caucasus, Central Asia, and Kazakhstan. Additionally, it is prevalent in Karakalpakstan, the lower reaches of the Amu Darya River. The main resource values of branched horsetail include medicinal, poisonous, and tanning properties (Baboev *et al*., 2017; Fayziev *et al*., 2020; Ramazonov, 2020; Amanov *et al*., 2022).

The Aktavsky feather grass (*Stipa aktabensis*) belongs to the bluegrass family Poaceae. It is also a perennial dense, bushy, turfy herb, with a height of 25–30 cm. The leaves are narrow, with the upper ones widened and embracing the inflorescence. The inflorescence is 6–10 cm long and narrow, and bears spikelets. The axis of the caryopsis is about 13.5 cm long, geniculate-bent, and feathery along the entire length, with feather hairs measuring 4–5 mm. It blooms, bears fruit from April to June, and propagates through seeds. The main habitats include dry gravelly slopes and cracks in the rocks of the remnant low mountains.

The primary cause for variation in the number and range of Aktavsky feather grass is inappropriate grazing. Livestock grazing proceeds in a rotational way in various countries worldwide. This plant is also on the list of the Red Book of Uzbekistan. The Aktavsky feather grass holds the rarest narrow endemic status of the Central Kyzyl-Kum Desert. Its distribution is visible in the remnant low mountains of the Central Kyzyl-Kum, Republic of Karakalpakstan, and Bukhara regions. It occurs in the Sultanuizdag vicinity in the Karakalpakstan region.

The Poplar Aryan (*Populus ariana*) belongs to the Willow family Salicaceae. It is a tall tree, with a height up to 10.0 m, with a trunk diameter of 30–40 cm. Turanga is a dioecious plant, with male and female flowers born on different trees. The leaves on branches form crowns ranging from rhomboid to ovoid, exhibiting varying numbers of teeth. The presence of different leaves refers to age variability. Turanga leaves are leathery, rough, and dense, either green or green-gray.

In its natural habitat, the tree blooms before the leaves emerge, typically in late March to April and, occasionally, in early May. The flowers form cylindrical earrings, with anthers and stigmas displaying a claret-red hue with a purple tint, although green-flowered forms are also evident. The fruit is a capsule, and the tiny, pinkish-white seeds mature in late June to early July. *Populus ariana* commonly exists along the banks of the Amu Darya River, its channels, and in tugai along ancient rivers. It is widespread across Central Asia, Kazakhstan, China, and Iran, with particular prevalence under Karakalpakstan conditions, specifically the lower reaches of the Amu Darya. The Aryan poplar holds a resource value as fodder (Ramazonov, 2020).

Leafless Juzgun (*Calligonum aphyllum*) belongs to the Buckwheat family Polygonaceae. The Latin name of the genus, derived from the Greek words 'callos' (meaning beautiful) and 'gonos' (meaning knee), reflects the plant's distinctive gracefully connected appearance of branches. The shrub height ranges between 0.5 to 4 m and is highly branched, with curved stems and old branches. Young shoots are longer, sinuous-curved, and segmented, resembling a leafless structure.

The leaves are inconspicuous, linear, and acicular, measuring a length of 3–7 mm. Flowers are axillary, solitary, bisexual, and regular, with 5-membered perianth. The latter leaves are white, pink, pinkish-purple, and greenish. The fruit is a nut with long feathery development, several times longer than the nut, giving the fruit a generally spherical shape. It grows in the desert in various habitats on sandy and clay soils. Distribution was mainly dominant in the Eastern Ciscaucasia and Transcaucasia, the South of the Lower Volga region, Kazakhstan, and Central Asia under the Karakalpakstan conditions. It is common in the Kyzyl-Kum, the Ustyurt plateau, and the remnant low mountains. The chief resource values are fodder, tanning, and good phytomeliorant.

The *Salsola chiwensis* plant belongs to the family Marevye-Chenopodiaceae. Its first description in 1914 came from the Botanist M.G. Popov in his plant collection from Sultanuizdag. It is a semi-shrub, 30–60 cm tall, glabrous, leaves are alternate, fleshy, semi-lumpy, and spike-shaped inflorescence, with fruits translucent, kidney-shaped, and broadly obviate wings develop on the leaves. Its flower blossoms in July bears fruit in September, and propagates by seeds. It occurs singly and in thickets, growing on gray-brown gypsum and marly soils. The primary variations in the number and range are the anthropogenic factor, improper grazing, cattle driving, and transport loads. Its listing as Solyanka Khiva in the Red Book of Uzbekistan has the status as a relic and endemic species of Northern Uzbekistan. It spreads in the republics of Uzbekistan and Turkmenistan, and in Karakalpakstan, it is available on the chink of Ustyurt, Sultanuizdag, and Kyzyl-Kum.

The Cherkez Richter (*Salsola richteri*) belongs to the family Marevye-Chenopodiaceae. A tall shrub, typical psammophyte, up to 2.5 m high, with a trunk up to 15.0 cm thick, has light bark, thin annual branches, flexible, almost white, glossy varnished, and leaves are alternate and linear. The flower arrangement is singular, forming a spike-shaped inflorescence in the aggregate. The flowers are 1–2 cm apart and do not develop simultaneously. In autumn, at the base of the inflorescence, fully mature fruits emerged in the middle flowers and at the top buds. Under the weight of the fruit, the inflorescences hang down, giving the plant a weeping shape with five-member, tiny flowers. Fruits are dry, single-seeded, and bloom from late May to September; fruits ripen from July to late autumn. Richter's solyanka is endemic to the sandy deserts of Central Asia. The range of this plant covers mainly the sandy deserts of the Karakum and Kyzyl-Kum. It is widespread in Turkmenistan, Uzbekistan, and the Karakalpak region, particularly in the Kyzyl-Kum desert. The main resource value is medicinal, fodder, and good phytomeliorant.

Multi-branched Tamarix (*Tamarix ramosissima*) belongs to the Tamarix family Tamaricaceae. This large shrub grows up to 2.0–2.5 m. In Karakalpakstan, it is widespread but is intolerant to saline soils and unable to grow in sands. It develops best in the floodplain of the Amu Darya, in tugai along the banks of channels and canals, on fallow lands. It often forms clean, dense thickets. Its leaves are small, sessile green, and gray scale-like, which secrete salt on their surface. The flowers are tiny, with a calyx and a pink corolla of four to five petals. Flowers come together in long clusters (Ramazonov, 2020). The fruit is a drop-down capsule, and the seeds are little, with hairs. It blooms in May and August, breeding in parks and gardens as ornamental plants. In the lower reaches of the Amu Darya, it is permanently rampant in tugai arboreal and shrub communities; it is widespread in Southwestern Siberia, the Caucasus, and Central Asia—in the conditions of the lower reaches of the Amu Darya, Karakalpakstan. The chief resource values are decorative, dyeing, and tanning. The lands of the lower Amu Darya and the Aral Sea are extensive with modern and ancient deltas, the Kyzyl-Kum, and the Ustyurt plateau. The delta's ancient and present surface part had no previous exposures to periodic floods and through certain stages of its development—construction, and desertification—before it contributed to irrigation (Ramazonov *et al*., 2020).

## RESULTS AND DISCUSSION

Making the land in the agricultural areas of the lower reaches of the Amu Darya and the Aral Sea beneficial rationally and efficiently, scientists must create salt-resistant, fertile, quick-growing crop varieties, maintain moisture in the soil, fight against soil erosion, and prevent the process of desertification, as one of the most needed problems to address.

Groups of plants are distinguishable in the delta part of the Amu Darya, tugai, halophytic, and the desert. Wetlands, especially in areas with high humidity, can cut into four chief lithological and geomorphological regions, considering the structure, cattail, Phragmites australis - reed, and Ceattophyllum - the formation of hornworts in plants. The diversity of vegetation species and the scale of the ranges decline due to a rapid reduction in wetland areas. The most common vegetation on the lakes and periodically flooded island areas is reed formation (Ramazonov, 2020). In the 1960–1970s, the total area of reeds on the lakes and swamps of the Amu Darya delta and the Aral Sea was 500,000 ha. According to the analysis of modern satellite imagery data, the area of reeds is 70,000/ha. In the next 20–30 years, the area of reed in the irrigated area has sharply decreased, which led to the opening of the upper soil layer and intensification of the desertification process.

*Turangil-Ropulus arainal* and *Lox-Elcacagnus tureosnica* are permanent and prime woody plants of tugai forests. The species Jungar-*Solis songaria* and *Solis Wilhelmsiana-Vilgelma a*re very rare nowadays. Today, the *Turangil* Formation plants, Badai-Tukai and Nurimtubek, are in good condition. The *Turangil* Formation is widespread on the Amu Darya and Moshyankol banks, around the Kazakh River moving stream, and the Moinak Canal. This formation in other delta parts has declined sharply (Ramazonov, 2020; Khujanazarov *et al*., 2021).

From 1960 to 1968, the tugai forest area in the delta region, which developed a unique microclimate and performed functions of combating erosion, deflation, disruption of the relief, and other processes, amounted to 300,000 ha. However, their section has sharply decreased due to massive area development in the delta. In addition to cultivated plants on the irrigated lands of the Republic of Karakalpakstan, the flora consists of the following ecological groups discussed below.

- The youngest group of aquatic freshwater formations - consists of a cluster of reeds and sedges that grow in areas where the water table is close to the surface.
- In the groups of saline soils, mainly in low-mineralized groundwater, a collection of arboreal shrubs and saline comb plants, turangil, dzhiyida, Karelenia, reed grass, pig, and sometimes hemp tugai, also provide valuable fibers. Under such vegetation cover, relatively high subdivisions of meadow-tugai soils arise.

- A group of succulent halophytes – salty, fatty grass plants that grow well on highly saline soils, mainly in highly mineralized groundwater, and can accumulate immense water-soluble salts in their assimilation organs. The plant group's 'ash content' can reach up to 46% of the dry weight, and the chlorine ions content is much higher. This group includes fatty, bushy, and grate hodgepodge of the Caspian plants.
- Group of meadow or rootstock grasses - includes plant formations common in silty meadow soils and form a continuous grass cover, with the main representative being saline grasses. Groundwater is very close, and the leading plants in the wetlands are salineros, sarsan, potash, sveda, and other plants.
- Group of non-succulent halophytes - consists of plants that retain less salt in their mass than oily grass, assortment, and develops in a slightly humid environment in less mineralized groundwater conditions.
- A group of weeds - slightly moist, slightly saline, and moderately saline, and well developed in wormwood, wastelands, abandoned soils, developed sedges, and sedges.
- A group of sparse and low vegetation - blue-green algae, diatoms, and green grasses are typical on dry bare and bare soils. Therefore, with support from past studies, restoring the formation of plants lost due to desertification is necessary to enhance and further develop biodiversity (Ramazonov, 2020; Khujanazarov *et al*., 2021).

To ensure food security in the republics, the population demand for soybean plants requires a gradual increase. On history and distribution, the plant also grows in the tropical and subtropical zones of Africa, Southern Asia, and Australia, with cultivation on the islands of the Pacific and Indian Ocean. The most popular type of cultivated soybean is *Glycine max* L. The species is a source of great nutritional and technological importance for humanity.

In China, images of soybeans were evident on the surface of various objects found during excavations, asserting that the soybean plant has been familiar to humans since the third millennium BC. The description of its cultivation was notable in the early Chinese literature. China is also addicted to soybeans like its neighboring countries, Korea and Japan. In the 19th century, European interest in the East bore fruit, with many gaining influences from the Chinese culture and its national products, including soybeans. The United States began researching the properties of soybeans in the mid-19th century. Americans quickly felt how profitable soybeans were for industrial purposes. Within 50 years of their acquaintance with the plant, enterprising Americans occupied about a million hectares of soybeans.

The drought in the lower reaches of the Amu Darya caused the depletion of water resources and the voluminous amount used to irrigate farm crops, drying up the Aral Sea. Soya came to Russia much earlier, after 17th-century expeditions to explore the Middle East. At the world exhibition in Vienna, Russian breeders amazed the Europeans with bred soybeans. Soybean plant cultivation has been successful in Russia up to now, in the Krasnodar, Stavropol Territories, and Rostov Region. Raw soy is not edible, but various product preparations are through fermentation. Soybeans hold the record for protein content. This fact makes it possible to produce several products from soy, including vegetable substitutes for food of animal origin, meat, and milk. All the main methods of cooking dishes and soy products originated in East Asian cuisine. The primary goal of soybean cultivation is to satisfy the population's need for oil, and soybean pulp use is vital in producing high-quality poultry meat (Ramazonov, 2020; Khujanazarov *et al*., 2021).

Miso soup preparation requires a paste of the same name, which comes from soybean seeds. Soybean seeds are also ingredients in making soy flour. Soybean oil, pressed from soybean seeds, can be beneficial for frying, just like any vegetable oil. Soya milk is white and is part of the tofu cheese dish. Skimmed soymilk is a component of soy meat that resembles meat in appearance. The skimmed soymilk film, called yuba, comes in frozen or dry form, dipped in soy sauce, as an excellent 'soy asparagus' snack. The Tempeh-pressed soy curd bars serve as an addition to soups and an independent dish.

For processing and preparing various products from soy, Eastern technologies are similar to the production of dairy products. Soybeans are also a waste-free product. Today, soybean plant cultivation is prevalent worldwide, mainly for oil extraction in the food industry. Similarly, soybean oil has become a valuable vegetable oil because of its easy digestion by the body (Ramazonov, 2020; Amanov *et al*., 2022).

Soya is a legume cultivated successfully since ancient times, with China being the soybean homeland. The soya seeds contain more than 35% pure protein. It is an excellent use for healthy alternatives to meat products. Currently, most fields in America, Europe, Argentina, Asia, and Australia grow soybeans. The main characteristics of this annual plant that have made it valuable are the following: high yield and numerous possible different products from it; it contains a lot of protein, contributing to the prevention of cardiovascular diseases, osteoporosis, and heart attack; and contains essential vitamins, polyunsaturated fatty acids, calcium, and potassium.

The main advantage of soybeans is protein, with a ratio of more than one-third of the total mass. Various sugars comprised 10% of the total nutritional value, and fats consist 40%. Soya contains almost all irreplaceable trace elements, i.e., nickel, manganese, aluminum, iodine, cobalt, and molybdenum. Most macronutrients are magnesium, potassium, calcium, silicon, phosphorus, and sulfur. In addition to the above substances, other components also include starch, folic acid, retinol, tocopherol, pectins, riboflavin, enzymes, phospholipids, choline, and lecithin (Ramazonovich and Ramazon, 2018; Amanov *et al*., 2022).

The beneficial properties of the dish made from soy help the functioning of all body systems. The advantageous properties soybeans contain are natural antioxidants, which accelerate the metabolic process, lower the level of bad cholesterol, and restore the nervous system cells. It also cleans the body, removes the heavy metal salts, improves the pancreas' functions, helps to produce insulin, and is favorable in diabetes mellitus. The phytic acid found in soy helps to break down and absorb protein (Figure 1).

**Figure 1.** Soybean plant cleans the body, removes heavy metal salts, improves the functioning of the pancreas, helps to produce insulin, helps in diabetes mellitus, and the phytic acid found in soy helps to break down and absorb protein.

Sorghum (*Sorghum bicolor* L.) belongs to the Paceae family of cereals. Sorghum has a wide variety of species and types, leading to the development of their proper classification. However, it took a long time before it reached a single classification due to the multitude of cultivars and their intermediate types. The scientific name *Sorghum bicolor* L. means two-colored, often to designate a composite species with several forms. The study only referred to the general designation of different types of sorghum to prevent confusion in misusing its names. The research referred to sorghum's economic uses, distinguishing four types, i.e., sugar sorghum, broom sorghum, grass sorghum, and grain sorghum.

Other genera and species of millet also belong to the millet subfamily, *Pennisetum* (pearl barley millet) and *Panicum* (common millet). Other subfamilies, such as *Chloridoideae,* are crucial for agriculture and the crabgrass millet. There are also weeds, referred to as barnyard millet. It shows that sorghum is only a part of the millet species. The grain sorghum sp. has different kinds. *Sorghum bicolor* identification as common sorghum relies on its importance in agriculture. Producing molasses syrup from sugar sorghum was economically valuable before the use of sugar beets and sugarcane in the 19th century. The United States is currently the largest producer of sugar sorghum syrup (Ramazonov, 2020; Amanov *et al*., 2022; Sobirova *et al*., 2023).

Besides a food product, sorghum is also a notable forage crop. Grassy sorghum is primarily suitable for green forage, feed, and straw. It has a similar nutritional value to corn, but it needs twice the water requirement of corn. Moreover, using broom sorghum traditionally produces brooms as a building material, for papermaking, or as a combustible material. Sorghum's popularity as an energy and plant raw material has risen in industrial areas. In the United States, sugar sorghum mainly serves to make bioethanol. The sugar required for this comes from the stems of the plant.

In addition, in Germany, such attempts are proceeding to obtain a biogas substrate, and they are trying to achieve a methane yield similar to corn fermentation. By-products of starch production are protein feed, oil, and wax. Developing new cultivars of sorghum advances to increase their nutritional value. However, creating a concentration to raise the content of vitamin A, zinc, iron, and amino acids is ongoing.

Sugar beet (*Beta vulgaris* L.) is a root crop widely used globally for beet sugar production. With ordinary purple beets, sugar beets are white and contain more pulp and sucrose. Processed production residues of beets – pulp, and molasses, serve as food additives in animal husbandry. Today, in white beet cultivation, most of the production capacity exists in France, Russia, and the United States. In Kazakhstan, the most favorable environment for sugar beet cultivation is in the southern and southeastern regions of the country. In the Almaty region alone, more than 440,000 tons of sold crops occur annually. However, the harvest from the whole country does not cover even half of the total demand. This factor compels buyers to purchase raw materials from abroad, causing Kazakhstan to place in the world list of sugar beet's largest importers.

Sugar beet is a biennial plant, and its full growth spans two growing phases. In the first phase, the active formation of the root system and rosette leaf arrangement occurs, and in the second, the plant begins to form a root crop and starts flowering shoots. The first growing phase depends on the type of cultivar and hybrid, weather conditions, which usually take 135–155 days on average. Although culture tolerates saline soil, it positively manifests in slightly alkaline, drained, and aerated chernozem, with massive nutrients. Sugar beets are intolerant of prolonged drought; therefore, the relative humidity (about 60%–70% HB) is an obligatory condition in the soil.

Per recommendations, in conditions of compliance with crop rotation, after winter wheat, it is necessary to carry out a procedure for cleansing the soil from stem residues of the grain crops, peeling, and disking. Then, under autumn plowing, organic fertilization at 20–30 t $ha^{-1}$ is necessary, and most of the planned mineral fertilization is about 250–300 kg $ha^{-1}$.

The depth of winter plowing varies around 22–25 cm. In case of excessive soil density, pre-plowing irrigation can be helpful. Before the onset of winter, it is necessary to plow deep. In early spring, after soil harrowing, applying herbicides follows, then pre-sowing cultivation, with sowing carried out at an inter-row spacing of 60 cm and, in some cases, 45–50 cm. After sowing the seeds, the most crucial moment in the culture development begins. However, at this stage, it is necessary to be vigilant and carefully look after the crops to carry out the following procedures, i.e., rolling, harrowing before and after germination, treating with plant protection products, cultivation, and periodic watering at least five times per growing season (Ramazonovich and Ramazon, 2018; Amanov *et al*., 2022).

By cultivating sugar beets, the crop rotation process requires great attention. Violating the alternation of farm crops will inevitably lead to soil degradation and infection with fungal diseases, which will entail a loss in weight and sugar content of the fruits. Returning to its original place when growing beets is permissible only after 3–4 years, after winter crops. Therefore, invaluable measures for the culture include fertilizers, pesticides, and herbicides.

Based on the above discussion, the following recommended nutrition program requires implementation.

Unfortunately, regular feeding of sugar beets with fertilizers does not guarantee a high-quality harvest. Without pesticide treatment, the culture's immunity cannot cope by itself, and the infection of the culture with a fungal disease is the most terrible ailment it can face. Sadly, this is not a rare problem for Kazakhstani farmers. In the Southeast, the fields cultivated with sugar beet have reached massive fungal disease infestations. Reversing this process is impracticable. It refers to the developed immunity of the different pests to pesticides. The suspension of infection is possible only by introducing large amounts of chemicals and pesticides, which is also unaffordable with the farming community. It is also a risk for environmental pollution. The government intends not to slow down the already-gained momentum; therefore, it believes that the most optimal solution is to develop new areas (Ramazonov *et al*., 2020; Sobirova *et al*., 2020; Muminov *et al*., 2023).

Sugarcane is a tall perennial grass belonging to the genus *Saccharum* of the tribe Andropogoneae, used for sugar production. Plants are two to six meters tall with strong, articulated, fibrous stems rich in sucrose that accumulate in the internodes of the stem. Sugarcane belongs to the Poaceae grass family, an economically important flowering plant family that includes corn, wheat, rice, sorghum, and various forages. It grows in the warm temperate and tropical regions of India, Southeast Asia, and New Guinea. Sugarcane is the world's largest crop by volume, with 1.9 billion tons produced in 2020, with Brazil accounting for 40% of the global production. In 2012, the Food and Agriculture Organization (FAO) estimated that it had an area of about 26 million hectares in more than 90 countries (Shavkiev *et al.,* 2020, 2021)*.*

About 70% of the sugar produced in the world comes from the cultivars and hybrid sugarcane species *Saccharum officinarum*. All types of sugarcane are crossable, and the main commercial cultivars are complex hybrids. Sugarcane accounts for 79% of the sugar produced, with the rest made from sugar beets. Sugarcane grows predominantly in tropical and subtropical regions, while sugar beet tends to grow in temperate areas (Baboev *et al*., 2017; Fayziev *et al*., 2020; Sattorov *et al*., 2020; Jovlieva *et al*., 2024).

The irrigated takyr meadow soils distinguished the arable horizon with a 25–30 cm thickness, with this layer characterized by gray and dark gray light, sometimes a brownish tint. Based on the mechanical composition of soils, it is different from clay to sandy loam. Based on the granulometric composition, the soil structure is lumpy-clumpy. The routines of the arable horizon are usually weak, with remains of fragrant vegetation. Below the arable horizon reveals slightly altered layers by the irrigation. Their humidity is somewhat higher than virgin and more radicular. The lithological structure of the profile is distinctive by sharp and random layering. With a heavy mechanical composition, the profile is always dense. With strong salinization of soil along the profile, especially in the zone of dispersal of capillary moisture, the salt accumulation has a morphological expression of white spots (Ramazonov *et al*., 2020; Ramazonov, 2021; Makhmudov *et al*., 2023).

For the soils in these areas to be beneficial rationally and efficiently, it is necessary to plant crops suitable for each soil type. Only then will a massive and high-quality harvest be attainable from these plants. In turn, this satisfies the demand and need of the country's population for food products and ensures abundance in the country.

## CONCLUSIONS

In general, to grow salt-tolerant flora in the natural conditions of this region, it is necessary to develop the most favorable conditions for crops. Additionally, to obtain high quality and environmentally friendly crops in this region, it will be essential to zone more salt-tolerant and low-water-loving crops. Based on the presented results, the researchers continue to conduct large-scale research to search plant species for saline soils in this region.

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