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GENESIS AND EVOLUTION OF THE SOIL AND REGIONALIZED CROP PLANTS IN THE LOWER REACHES OF AMU DARYA REGION, UZBEKISTAN

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SUMMARY

The presented manuscript deals with the issues of genesis and evolution of soil structure and crop plants in the Lower Amu Darya Region. The pertinent investigation also elaborates on wild plant characteristics in the desert zone and details of cultivated plants grown in the Lower Amu Darya region. The paper also discusses soil-forming processes and the structure of soils, which is the external appearance involved in specific changes from the vertical direction of its layers. Horizons always differ in color, structure, composition, and other morphological features. The article also describes the mechanical composition of the soils of these regions, including the formation of plants grown on highly saline soils, the morphology and characteristics of these plants, and the effective use of arable land to ensure food security in the country. Likewise, the most urgent problems today are increasing soil productivity and its protection and raising economic efficiency to obtain high-quality and ecologically clean products from every agricultural crop. The soils distributed in the lower Amudarya regions, including Karakalpakstan and Khorezm regions, are more or less saline. For the soils' future effective use, salt-resistant and phytomeliorative crops, especially alfalfa, white corn, beets, melons, watermelons, and pumpkins, and oil crops, such as sesame, will give a high and high-quality harvest. As a result of the sand and dust-salty mixture rising from the dry bottom of the Aral Sea under the influence of the wind in the spring months, crops are drying up. Therefore, to prevent this, it is most practical and scientifically imperative to carry out phytomeliorative work in these areas to establish saxovull farms.

Keywords: Strategy, plant, land, soil mechanical elements, structure, natural meliorator, endemic, food, agriculture, Aral Sea Region, environmental protection

Key findings: The article discusses the issues of the genesis and evolution of plant and soil cover in the lower reaches of the Amu Darya River and the zoning of agricultural crops to develop ecological conditions and reclamation soils.

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INTRODUCTION

Nowadays, the action strategy for the development of the Republic of Uzbekistan for 2017–2021 defines the crucial tasks of "Mitigating the negative impact of global climate change and the drying up of the Aral Sea on agricultural development and the population life." Therefore, it is vital to recognize the processes of degradation and desertification in the areas along the island to mitigate the effects of existing harmful activities, enhance, maintain, and manage the soil fertility, and conduct research aimed at the effective use of land, while protecting it and developing scientifically based operative measures.

The Decrees of the President of the Republic of Uzbekistan are № PD-2731 dated January 18, 2017, on the "State Program for the Development of the Aral Sea Region in 2017–2021" and № PD-3975 dated October 16, 2018, on the "Establishment of the Aral Sea International Innovation Center under the President of the Republic of Uzbekistan." In addition, the implementation of the tasks defined in other regulatory legal documents related to this activity and the 80th goal of the new development strategy of Uzbekistan for 2022–2026, developed based on the principle "From the strategy of actions to the strategy of development is Ecology and environmental protection, urban and improvement of the environmental situation in the districts, implementation of the national project 'Green Space,' became the main goal (Muminov *et al*., 2023; Ramazonov, 2020).

The soil is divided into genetic horizons and attains only its intrinsic morphological and external features. The main morphological features of the soil include the structure and thickness and its individual horizons, color, mechanical composition, neoplasm, and inclusions (Amanov *et al*., 2020; Fayziev *et al*., 2020; Ramazonov, 2020). The following horizons are usually identifiable as Ap (arable), A (humus-accumulative), B (alluvial or transitional in humus), Cr (gley – waterlogging of the soil), C (parent breed), and D (underlying rock). For a more detailed description of the features of the genesis and soil composition, the main horizons further divide into sub-horizons (A_1B_1) (Amanov *et al*., 2022; Ramazonov, 2020). Soil genesis, evolution, and morphology have a close link with each other and are of great importance in the evolutionary development of soils.

According to the size of the soil aggregates, three different groups of the aggregate structures are distinct, i.e., blocky (lumps and individual soils larger than 10 mm in size), macrostructure (soil aggregates and lumps with a diameter of less than 0.25–10 mm the most valuable in agronomic terms), and microstructure (lumps with a diameter of 0.25 mm). In the structural state, the soil is divided into separate parts of various shapes, while in an unstructured state, the mechanical elements that form the soil have non-interconnection into larger units, separately located (Baboev *et al*., 2017; Ramazonov, 2020). The soil's regular composition is its relative content with particles of perfunctory fractions of different sizes, regardless of their mineralogical and chemical composition, expressed in weight percentage. Particles of rocks, minerals, organo-mineral, and organic substances that form the solid phase of the soil are characteristic of fragmented particles of various sizes to varying degrees (Ramazonov, 2020, 2021; Baboev *et al*., 2021).

Soil is a diverse and polydisperse medium consisting of particles (mechanical elements) of various diameters - from a few centimeter particles (stones) to nanometers (colloids). Mechanical elements that are familiar in size bear combination into specific fractions (Table 1.). The soil's regular elements of various sizes differ sharply in the mineralogical and chemical composition of the fractions (Buronov and Xamroev, 2022; Buronov *et al*., 2023). Knowledge of the automatic structure and composition of the soil makes it possible to attribute it to one or another soil group. In doing so, this needs to summarize the content of the fraction in connection with their physical properties. The sum of fractions with a particle diameter greater than 0.01 mm is called 'physical sand,' and less than 0.01 mm is 'physical clay.' The classification of the soil's mechanical composition according to the scale accounted

Table 1. Classification of soil mechanical elements according to N.A. Kachinsky.

Size of mechanical elements (mm)	Mechanical fractions
>3	Stones (crushed stone, gravel)
3–1	Gravel (cartilage)
1–0.5	The sand is coarse
0.5–0.25	Sand medium
0.25–0.05	The sand is small
0.05–0.01	The dust is large
0.01–0.005	Dust medium
0.005–0.001	Dust small
<0.01	Clay (Il)

Table 2. Classification of the mechanical composition of soils.

Content of physical clay (particles)	The content of physical sand - particles with d > 0.01 mm (%)	Soil name by mechanical composition
0-5	100-95	The sand is ploose
5-10	95-90	Connected sand
10-20	90-80	Sandy loam
20-30	80-70	Light loam
30-40	70-55	Loam medium
45-60	55-40	Heavy loam
60-70	40-30	Clay light
70-80	30-20	Clay medium
>80	20	Clay heavy

for its zonal characteristics (Table 2) (Mutalov *et al*., 2020; Ramazonov, 2020; Ramazonov and Kuziev, 2020; Muminov *et al*., 2023). Land use correlates with water, physical and mechanical properties of soils, and agricultural technology of cultivated crops; however, loamy soils are the best for agricultural use (Baboev *et al*., 2017; Fayziev *et al*., 2020; Ramazonov, 2020).

MATERIALS AND METHODS

The pine tree is an ornamental plant belonging to the Cypress family of deciduous trees. It grows mainly in Central Asia and Azerbaijan. Pine is light-loving, drought- and frost-resistant, and can live 80–120 to 400–500 years. It can also exist in mountainous regions up to 1500 m high (Ramazonov *et al*., 2020a, b; Ganiev *et al*., 2021). The height of this tree is 1015 m, with thick, spherical branches and leaves arranged in an egg-shaped row. It blooms in March-April, its flowers are bisexual, and the seeds come as nuts or kernels. (Ramazonov, 2020, 2021).

The mulberry tree is a natural meliorator, and residents in areas planted with mulberries do not get tuberculosis. The mulberry is a very ancient perennial tree, and cocoons span from its leaves mainly by feeding silkworms. The mulberry tree belongs to the mulberry family, Moraceae. According to historical sources, its spread began in China 5000 years ago, with eventual growth for food in Uzbekistan (Ramazonov *et al*. 2020a, b). In addition, the chief reason our ancestors planted mulberry trees around historical monuments was to use the underground water near the surface of the earth in those areas to keep the critical depth level of these waters at a standard level, thereby preventing the deterioration of historical buildings. Today, mobile laboratories for soil analysis have been established directly in the fields, with soil analysis carried out in mobile laboratories. We also intend to use these methods in the future.

The Jiyda tree (*Elaeagnus* L.) is a deciduous or evergreen shrub and small tree belonging to the Elaeagnus family. There are about 40 species that grow in Southern Europe, Central and Eastern Asia, and North America. In Central Asia, particularly in Uzbekistan, it is typical. *Elaeagnus angustifolia* grows wild, as well as species of oriental mulberry (*Elaeagnus orientalis*), thorny mulberry (*Elaeagnus pungens*), silver mulberry (*Elaeagnus argentea*), and bread mulberry (*Elaeagnus culls*). The leaf of the sharq jiyda is simple, narrow, and silver-colored. The tree is 8–10 m tall; the branches are sparse with or without thorns; and the flower is bisexual, yellow, serous, and fragrant with essential oil. The fruit is yellow, has seedless flesh (31.2%–88.7%), and is floury sweet, containing sugar (46%–65%), protein (10%), acid (1.3%), and vitamin C (200 mg). The Jiyda fruit consumed may be fresh or dried. As a medicine, it can treat gastrointestinal diseases. Various byproducts come from the wood, with the essential oil obtained from the flower benefiting the perfumery industry (Ramazonov and Kuziev, 2020; Ramazonov *et al*., 2020a, b).

The Jiyda fruit has a calming effect on humans; if consumed with sleeping pills, it increases their activity. In addition, it normalizes the nervous system activity, preventing anger and irritability. Along with its calming activity, Jiyda promotes good health considerably (Ramazonov and Kuziev, 2020; Shavkiev *et al*., 2020, 2021). Its freshly picked fruits can add as ingredients to various desserts and can also become jams when cooked. The Jiyda fruit and its use in diverse treatments has several benefits. It is a widely used folk medicine. Aside from its fruits, flowers, leaves, and stem barks also have medicinal uses. For example, the tincture of its fruit can heal digestive problems, while using it as a mouth gargle can remove oral diseases. The Jiyda leaves help treat rheumatism, gout, and radiculitis (Ramazonov *et al*., 2019).

A clover phytomeliorative plant, the agro-remedial values of alfalfa are fundamental in saline soil conditions, and its cultivation technology is vital in such settings because it reduces the soil surface temperature due to its covering the soil surface with green biomass. However, as the soil surface temperature decreases, the water evaporation from the soil's upper layers also lessens. Reduced evaporation from the soil surface will lower the rise in groundwater levels, hence, its importance in preventing soil salinization. As a result, the reduction of moisture evaporation from the alfalfa soil also moderates salt accumulation. Secondly, alfalfa improves the structure of the soil and its water-physical properties, activating the movement of water in the soil, penetrating deeper and desalinating the soil (Ramazonov and Kuziev, 2020; Qulmamatova *et al*., 2022). However, alfalfa produces flat seedlings after planting, and the young seedlings are extremely salt-intolerant. Considering this, alfalfa irrigation twice had the rate of 600–700 m^3/ha before the formation of stems and tillering, and after establishing the alfalfa bushes, watering twice occurred between harvests.

Sorghum cernuum is an annual plant belonging to the sorghum family. The name is a synonym of *Sorghum bicolor* (L.) Moench by Poaceae. A type of sorghum, Sorghum Persian, is a group of annual and perennial plants belonging to the family of cereals, grains, and fodder, with about 50 wild and cultivated sorghum species. Cereals, *Sorghum cernuum*, white sorghum, sweet sorghum (*Sorghum saccharatum*), broom sorghum (*Sorghum technicum*), and grassy sorghum (*Sorghum sudanense* and *Sorghum almum*) are the most planted species. Central Africa is their homeland, and their cultivation dates back to the 4th–3rd millennia BC. Their dominant cultivation includes Iran, India, China, the USA, South Africa, Oceania, Australia, Central Asia, and Ukraine. Its productivity is 14.4 t/ha, grown on 43.6 million ha with a gross yield of 68.2 million tons. In Uzbekistan, its cultivated area was around 9,000 ha. The root network of sorghum is a tap root, the prime part of which develops in the arable layer of the earth, and some roots penetrate to a depth of 2.5 m. The stem is a straw stem, 0.5–7 m tall, 2–3 m on average; the inside of the stem contains porous parenchymal tissue. The stem piles up to eight, and the leaves are broad (10–25 cm). A ball-shaped cypress, 15–60 cm long, produces two spikes at the end of its lateral branches, with one producing the fruit

(Ramazonov *et al*., 2020a, b; Ramazonov, 2020, 2021).

Sugar beet (*Beta vulgaris*) is a herbaceous plant belonging to the family Amaranthaceae. It is rampant around the Mediterranean Sea from countries in Asia, the Caucasus, India, France, Great Britain, and Scandinavian countries. In agriculture, the common beet (*Beta vulgaris*) consists of beets, sugar beets, and the leafy beet orchard, beet Betacica, a variety of sugar beet used for food. Wild beets have served as food since ancient times. Planting verdant beets started in 2–1 millennia BC, with cultivated root and fruit forms planted at the beginning of AD. In the 18th century, sugar beet resulted from hashaki beet hybrids. At the end of the 19th century and in the 20th century, the said crop spread into all the continents.

Beetroots, red beetroots, and vegetable beetroots in the first year after planting produced 0.4–0.9 kg of tubers and leaves. A moisture-loving and light-loving plant, resistant to cold and drought, grows in all agricultural regions. In Uzbekistan, Bordeaux-237, a Bicoress variety since 2002, and Ross bore regionalization with other varieties. Its productivity is around 300–400 t/ha and above. The Aft beet produces 10–12 kg of tubers and leaves in the first year, as succulent feeds for livestock. The 100 kg of roots contained 12.2 nutritional units and 0.9 kg of digestible protein; the 100 kg of leaves contained 10.2 nutritional units and 1.8 kg of digestible protein. Aft beet is moisture-demanding, light-loving, and cold-tolerant. It has extensive cultivation in the USA, Canada, Brazil, New Zealand, Africa, Algeria, Tunisia, and Europe, including Belarus, Ukraine, and the Baltic countries.

Sugar beet is a raw material for the sugar industry. Its waste becomes fertilizer to increase the productivity of livestock feed crops. In the year of planting, the average weight of the root fruit containing 14%–20% and sometimes up to 24% sugar is 300–600 g. Sugar beet is heat-loving, moisture-loving, and drought-resistant. The temperature for seed germination should be 10 °C–12 °C, and for better development, 20 °C–22 °C. It dies at a temperature of 4 °C–5 °C. Sugar beet growing began in the USA, Russia, Ukraine, Kazakhstan, and Uzbekistan in the 40s of the 20th century and in the Khorezm region and the Republic of Karakalpakstan from the beginning of the 90s (Fayziev *et al*., 2020; Sattorov *et al*., 2020; Sobirova *et al*., 2020).

Liquorice or licorice (*Glycyrrhiza glabra*) is a flowering plant of the bean family Fabaceae, where a sweet, aromatic flavoring extract comes from its roots. The saccharine plant licorice has been a medicinal plant since ancient times, and in Chinese folk medicine, this plant treated various diseases before 3000 BC. Also, there is information about the healing properties of the licorice plant in Indian and Tibetan medicine. Our great-grandfather Abu Ali ibn Sina, a famous scientist and healer of the Middle Ages, used the underground parts of Shirminiya on a vast scale in his treatment practice. In particular, it served as a treatment for stomach and intestinal ulcers, lung and respiratory diseases, and also as a diuretic. The role of this plant in modern medicine is incomparable. Various medicines undergo processing and manufacture in the pharmaceutical industry. At the same time, it is one of the primary components of different medicinal preparations.

Aktavsky feather grass, *Stipa aktabensis*, belongs to the bluegrass family *Poace*ae. A perennial, dense, bushy, and turfy herb, the height of this wild medicinal plant reaches 25–30 cm tall, and the leaves are narrow but widen at the upper ones, embracing the inflorescence. The inflorescence is 6–10 cm long, slim, and with spikelets. The axis of the caryopsis is about 13.5 cm, geniculate-bent, feathery along the entire stretch, and feather hairs are 4–5 mm long. Propagated by seeds, it blooms and bears fruit in April-June. Listed in the Red Book of Uzbekistan, the status of the Aktavsky feather grass is a very rare, narrow endemic of Central Kyzyl Kum, Uzbekistan. The distribution of this plant is in the remnant low mountains of Central Kyzyl Kum, in the Republic of Karakalpakstan and Bukhara regions. In the Karakalpakstan region, it occurs near Sultanuizdag, Uzbekistan.

Poplar Aryan (*Populus ariana*) belongs to the Willow family (*Salicaeae*), a tall tree reaching 10 m in height with a 30–40 cm trunk diameter. Turanga is a dioecious plant, where, on some trees, there are only male staminate flowers, and on others only female pistillate flowers. Leaves on branches crowns have rhomboid to oval shapes, with a different number of teeth. The presence of different leaves is due to age variability. Turanga leaves are leathery, rough, dense, and green or green-gray. In nature, the tree blooms before the leaves bloom in late March-April, sometimes in early May. Collection of flowers occurs in cylindrical earrings. Anthers and stigmas are claret-red with a purple tint; however, the green-flowered forms are also visible (Ramazonov, 2020).

The leafless Juzgun (*Calligonum aphyllum*) plant belongs to the Buckwheat family Polygonaceae. The Latin name of the genus comes from the Greek words 'Callos' - beautiful and 'gonos' – knee, reflecting the peculiar appearance of the branches, which are connected. Shrubs are 0.5 to 4 m tall, attached to more branches, with curved old branches and stems. Young shoots are long, sinuous-curved, and segmented, as if leafless. Leaves are inconspicuous, linear, or acicular and 3–7 mm long (Ramazonov *et al*., 2020a, b; Ramazonov, 2020, 2021).

The *Salsola chiwensis* plant belongs to the family Chenopodiaceae. The botanist M.G. Popov first described it in 1914 in his collection of plants from Sultanuizdag. The plant is a semi-shrub 30–60 cm high, glabrous, leaves are alternate, fleshy, semi-lumpy, spike-shaped inflorescence, with fruits translucent kidney-shaped or broadly obovate wings develop on the leaves. It blossoms in July, bears fruit in September, and propagates by seeds. It occurs both singly and in thickets and grows on gray-brown gypsum and marly soils. *Cherkez richter* (*Salsola richteri*) plants belong to the family Chenopodiaceae. Considered a tall shrub or small tree, typical psammophyte, 2.5 to 3.0 m tall, with a trunk up to 15 cm thick, a light bark, with thin annual branches, flexible, almost white, glossy varnished, and leaves alternate and linear. The arrangement of flowers is one at a time, forming a spike-shaped inflorescence in the aggregate (Ramazonov and Kuziev, 2020).

The multi-branched Tamarix (*Tamarix ramosissima*) plant belongs to the Tamarix family Tamaricaceae. This large plant grows up to 2.0–2.5 m. In Karakalpakstan, Uzbekistan, it is widespread but does not withstand soil salinity and does not grow on sand. It develops better in the floodplain of the Amu Darya, in Tugai along the banks of channels and canals, and on fallow lands, often forming clean, dense thickets. Leaves are small, sessile green or gray scale-like, secreting salt on their surface. The flowers are small, with a calyx and a pink corolla of four to five petals (Ramazonov and Kuziev, 2020).

In the 1960s and 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 the reed is 70,000 ha. In the next 20–30 years, its portion in the irrigated area will decrease sharply, leading to the opening of the upper soil layer and the intensification of the desertification process. The species Jungar-*Solis songaria* and *Solis Wilhelmsiana-Vilgelma* are very rare to this day. Currently, the plants of the Turangil Formation—Badai-Tukai and Nurimtubek—are in good condition (Ramazonov and Kuziev, 2020; Ramazonov *et al*., 2020a).

RESULTS AND DISCUSSION

From 1960 to 1968, in the delta region, the area of Tugai forests created a unique microclimate and performed functions, such as, combating erosion, deflation, disruption of relief, and other processes, amounted to 300,000 ha. However, the development of large areas in the delta zone sharply decreased their portion. In addition to cultivated plants on the irrigated lands of the Republic of Karakalpakstan, the flora consists of the following ecological groups: a) The youngest group of aquatic freshwater formations, and this group consists of reed clusters and sedges that grow in areas where the water table is close to the surface; b) In the groups of saline soils, mainly in low-mineralized groundwater, there is a group of arboreal-shrub and saline comb plants, turangil, dzhiyida, Karelenia, reed grass, pig, and sometimes hemp tugai, which provide valuable fibers. Under such a vegetation cover forms relatively high subdivisions of meadow-tugai soils; c) A group of succulent halophytes – salty, fatty grass - plants that grow well on highly saline soils, mainly in highly mineralized groundwater, with the ability to accumulate a large amount of water-soluble salts in their assimilation organs; d) Group of meadow or rootstock grasses - this group includes plant formations that are common in silty meadow soils and form a continuous grass cover, the key representative of which is saline grasses. Groundwater is very close, and in the wetlands and other plants are dominant; e) Group of non-succulent halophytes - this group comprises plants that retain less salt in their mass than oily grass, hodgepodge, which develops in a slightly humid environment in conditions of slightly mineralized groundwater; and f) A group of weeds - slightly moist, vaguely saline, and moderately saline or well developed in wormwood, wastelands, and abandoned soils, developed sedges (Ramazonov, 2020, 2021).

For example, miso soup requires a paste of the same name made from the plant seeds. They are also essential for making soy flour. Soybean oil from pressed soybean seeds can become a frying oil, just like any vegetable oil. Soya milk is white and is part of the tofu cheese dish. Skimmed soy milk is a component of soy meat that resembles meat in appearance. The skimmed soy milk film, called yuba, has many uses, i.e., frozen or dry, dipped in soy sauce, and an excellent 'soy asparagus' snack. Tempeh-pressed soy curd bars served as an addition to soups or as an independent dish. Eastern technologies for processing and preparing various products from soy are similar to the production of dairy products. Soybeans are a waste-free product. Soya is a legume that has shown successful cultivation since ancient times. The fruits of this plant contain more than 35% pure protein. It is an excellent healthy alternative to meat products (Ramazonov, 2020, 2021).

The homeland of soybeans is China. However, today, its cultivation abounds in America, Europe, Argentina, Asia, and Australia. The chief characteristics of this annual plant that make it popular are its high yield and numerous different byproducts. The product contains a lot of protein, contributing to the prevention of cardiovascular diseases, osteoporosis, heart attack, and essential vitamin groups. Various sugars comprise 10% of the complete nutritional value, and fats are 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, starch, folic acid, retinol, tocopherol, pectins, riboflavin, enzymes, phospholipids, choline, and lecithin exist (Ramazonov, 2020).

The beneficial properties of the dish made from soy help all body systems function well. Some of its valuable properties include natural antioxidants, accelerating the metabolic process, lowering the level of bad cholesterol, restoring cells of the nervous system, cleansing the body by removing heavy metal salts, improving the functions of the pancreas, producing insulin, and beneficial for use in diabetes mellitus. The phytic acid found in soy helps to break down and absorb protein. *Sorghum* belongs to the Poaceae family of cereals. Given the numerous species varieties, a decision to develop their classification ensued, but coming to a single classification took a while. It was due to immense varieties and their intermediate forms (Ramazonov *et al*., 2020a).

The specific name, *Sorghum bicolor* L., which means two-colored grains, often served to designate a composite species that includes several forms. For this article, to avoid misuse of names, read only the designations of the different types of sorghum in general here. According to the principle of economic use of sorghum, four types are distinct: sugar sorghum, broom sorghum, grass sorghum, and grain sorghum. Other genera and species of millet also belonged to the millet subfamily: for example, Pennisetum pearl barley millet and Panicum common millet. Other subfamilies, such as Chloridoideae, are vital for agriculture, such as crabgrass millet. There are also weeds, which are also familiar as barnyard millet. It vividly shows that sorghum is only a part of the millet species. For grain sorghum, *Sorghum* sp. belongs to different kinds. Sorghum bicolor is often considered common sorghum because it is crucial for agriculture (Ramazonov *et al*., 2020a).

The production of molasses syrup from sugar sorghum was highly significant before the use of sugar beets and sugarcane in the 19th century. The United States is currently the largest producer of sugar sorghum syrup. Aside from being a food product, sorghum is also a popular forage crop. For this, grassy sorghum is primarily suitable, serving as green forage, fodder, and straw. It has a similar nutritional value to corn but needs at least twice as much water as corn. In addition, broom sorghum is traditionally a material for producing brooms, as a building material, for papermaking, or as a combustible material. For industrial areas, sorghum's popularity as an energy and plant raw material is growing. In the United States, sugar sorghum helps to make bioethanol. The sugar required for this comes from the stems of the plant. Also, in Germany, such attempts progress to obtain a biogas substrate, and they are also trying to achieve a methane yield similar to that of corn fermentation. By-products of starch production are protein feed, oil, and wax. Pursuits to develop new varieties of sorghum to increase their nutritional value occur. However, making a concentration to raise the content of vitamin A, zinc, iron, and some amino acids emerged (Ramazonov *et al*., 2020a).

Sugar beet is a root crop used worldwide for producing beet sugar. Against ordinary purple beets, sugar beets are white and contain more pulp and sucrose. Processed production residues of beets - pulp and molasses, served as food additives in animal husbandry (Ramazonov *et al*., 2020a, b; Ramazonov and Kuziev, 2020). Before the onset of winter, it is necessary to carry out deep plowing. In early spring, harrowing the soil and herbicide application commence. Then, pre-sowing cultivation and sowing continued with an inter-row spacing of 60 cm and, in some cases, 45–50 cm.

After seed sowing, the most crucial moment in developing the culture begins. At this stage, it is necessary to be vigilant and carefully look after the crops, namely, carry out the following procedures, i.e., rolling, harrowing before and after germination, treating with herbicides and pesticides from plant protection products, cultivation, and periodic watering at least five times per growing season. Cultivating sugar beets requires substantial attention to the crop rotation process. Violation of the rotation of crops will inevitably lead to soil degradation and infection with fungal diseases, which will involve weight loss and reduced sugar content of the fruit, affecting the entire crop. Returning to its original place when growing beets is acceptable only after 3–4 years, after winter crops. Therefore, introducing fertilizers, pesticides, and herbicides are exceptional measures for the culture (Ramazonov *et al*., 2020a, b; Ramazonov, 2020, 2021).

CONCLUSIONS

Unfortunately, regular fertilization of sugar beets does not guarantee a high-quality harvest. Without pesticide treatment, the culture's immunity ceases to cope on its own, and the infection of the culture with a fungal disease is the most harmful ailment it may face. Sadly, this is a common problem for Kazakhstani farmers. Some areas of the fields of the South-East, cultivated for sugar beet, have fungal diseases particularly affecting them. Reversing this process is unfeasible due to the developed immunity of pests to pesticides. The infection suspension is possible only by applying large amounts of chemicals and pesticides, which is unaffordable to the farming community. The government intends not to slow down the already-gained momentum; therefore, it seeks the most optimal solution for the country to develop new areas. Sugarcane belongs to several species and hybrids of tall perennial grasses from the genus *Saccharum*, tribe Andropogoneae, which benefits sugar production. Plants are 2 to 6 m tall with sturdy, articulated, and fibrous stems, rich in sucrose that accumulates in the internodes of the stem. About 70% of the sugar produced worldwide comes from the species *Saccharum officinarum*. All types of sugarcane are crossable, and the chief commercial varieties are complex hybrids. Sugarcane accounts for 79% of the sugar produced, with the remaining production coming from sugar beets. As sugar cane grows predominantly in tropical and subtropical regions, sugar beets grow in colder temperate regions.

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