Soil cultivation efficiency in pasture management of the arid zone of Central Asia and Kazakhstan

B Mukhambetov, R Abdinov, Zh Kadasheva, R Alzhanova, S Doskaliyeva and Y Kabiyev
Kh. Dosmukhamedov Atyrau University, Atyrau, Republic of Kazakhstan
E-mail: abdinov.r@gmail.com

Abstract. Research work on the radical improvement of pastures with the sowing of prostrate rods (Kochia prostrata) against the background of plowing the soil to the depth of 20-22 cm has been carried out in the CIS countries since 1936 to this day. Despite the long-term study, in modern conditions, there are no industrial sowing of prostrate rods in Kazakhstan. The repeated attempts to introduce rods into production have failed. The long-term experiments (more than 50 years) have shown that Kochia prostrata does not sprout every year (approximately, two years out of five years, and then in places and sporadically). In one place full-fledged seedlings are provided, and in another place they are absent. That is, tillage does not provide the required efficiency. In this review, on the basis of original studies, the development of soil conditions for the growth of Kochia prostrata during soil cultivation is detailed. As known, when plowing, the upper fertile soil horizon is thrown down and it is buried by the less fertile, more structureless soil of the lower horizons. This, firstly, leads to the development of a hard crust impenetrable by Kochia prostrata sprouts and, secondly, when dry, solid soil blocks are formed under the seeds, impermeable by hypocotilny roots of Kochia prostrata. Therefore, sprouts of either die during dump plowing, or full-fledged shoots are not formed on it. The current dead-end situation with soil cultivation can be corrected by developing a new theoretical concept and, on its basis, developing a technology for soil cultivation and Kochia prostrata cultivation.

1. Introduction
Arid areas are considered to be areas with an arid climate, where evaporation exceeds the annual amount of precipitation and where the cultivation of traditional field crops is excluded due to the aridity of the climate.

The areas of arid pastures in Kazakhstan and in the republics of Central Asia are 212 million hectares, of which in Kazakhstan 165 million hectares, Turkmenistan 29 million hectares and Uzbekistan 18 million hectares, and they are the basis of the fodder base of sheep breeding, the leading branch of animal husbandry above of the indicated republics and countries [1].

Kazakhstan, as a republic with highly developed sheep breeding in the recent historical past, was given a task to bring the number of sheep to 50 million [2], to increase the feed capacity of pastures by expanding the area of their radical improvement to and more than 20-30 million hectares [3,4,5 ], and the costs of tillage were carried out through the use of state budget funds [6].

Pulling funds from the state budget most clearly emphasizes the primary role of soil cultivation in improving and increasing the productivity of pastures.
However, this task was failed in all respects: the number of sheep in the republic in the best years did not exceed 34-36.0 million [1], and the area of radical improvement of pastures amounted to no more than 5.4 million hectares. Judging by the growth on their exclusively wheatgrass, we can safely say that in Kazakhstan only pastures of steppe and dry steppe zones were improved [7,8].

Arid fodder plants, including the most thoroughly studied among them Kochia prostrata turned out to be staunchly not introduced into production.

Over the 85-year period from the date of its cultivation, it was cultivated in the republic on an area of 0.3-0.5 million hectares [5]. Currently, there are no crops in the republic. For comparison, it can be noted that the area of grain crops in the republic since the beginning of plowing virgin lands for 10 years amounted to 25.4 million hectares [9].

In any farming system, soil cultivation is of priority; when cultivating a rod stand, the effectiveness of moldboard plowing on loamy lands was established [1,5,3,11]. It soon became clear that the Kochia prostrata does not emerge annually, but approximately twice out of five years of sowing, and then sporadically; in one place full-fledged seedlings are provided, and in another place they are absent [10].

This fact in itself clearly indicates the unjustifiability and inexpediency of cultivating the soil to epy depth of 20-22 cm until technological techniques are developed to ensure the production of annual full-fledged seedlings.

This review details the development of growing conditions during tillage and their impact on the growth and development of the prostrate rod and its seedlings [12]. In our opinion, the disclosure of the reasons for the non-cultivation of arid plants, including Kochia prostrata, brings more valuable scientific information and knowledge to science than setting up endless, but at the same time useless field experiments in breeding and seed production, crop production and other areas.

2. Hard core

In Kazakhstan, scientific research on phytomelioration has been carried out since 1865, since the right-bank part of the Ural River of the Atyrau region before the formation of the Kazakh Autonomous Republic was part of the Astrakhan province, where for the first time in Kazakhstan by the mining engineer A.M. Dreyer [13], crops of Elymus giganteus, Agriophyllum, kapkanchik were successfully sown in the Astrakhan province.

After four years of work, more than 800 hectares of broken moving sands have been consolidated and the possibility of quick and cheap consolidation of sands by sowing grasses has been proven.

Then more fruitful work on fixing the sands was carried out by the Astrakhan sand-ravine party.

For nine years (1904-1912), Elymus giganteus (partly Agriophyllum) was sown on an area of 60,509 hectares, and from 1919 to 1929, similar work on an area of 875.0 thousand hectares on the sands of the Astrakhan, present-day Atyrau region was done by the sand-strengthening organization “Krapo” [13].

Obviously, not as a memory of the great khan, but with his outstanding achievements in grass-sowing on the sands, the organization of the Bukeevsky experimental field in the village of “Urda” in Zhangir's homeland, which existed until 1932, where Salin and Zhugina proved the possibility of improving ashiks with wheatgrass and alfalfa (Medicago sativa) [14], is connected. They also studied the comparative productivity of wheatgrass and sweet clover, which respectively amounted to 1.23 and 13.68 c / ha of hay. It should be noted that, in contrast to the earlier works carried out in the Atyrau region to improve the sands by Elymus giganteus, Agriophyllum and Agropyron fragile (Roth) P. Candargy, later work here was carried out by Kochia prostrata, that did not give a positive result.

For example, in the region in 1981-1990 Kochia prostrata was sown on an area of 26.0 thousand hectares, it grew on an area of 5.0 thousand hectares, and a satisfactory herbage was obtained only on 500-600 hectares [15].

Describing the results of the work of the sand-ravine party, F.I. Gotshalk (1915) reports that “Stocks of hay from sandy oats (Elymus giganteus) per tithe range from 80 to 100 pooods of hay. 400 pooods is 1 stack, formed from 4-5 tithes. Harvesting one drain costs 9-12 rubles, the selling price is 22-25 rubles”.

To remember and know, and multiply the achievements of those who mastered and sowed grasses on millions of hectares of sand, in a red line we quote the statement of Gotshalk (1915) on this score “the
seeds of sandy oats are harvested on natural thickets. Over the past four years, the cost of harvesting fell by 50%, since the Kyrgyz have shown a skill for this work and they take it willingly”.

Similar scientific data were obtained in 1944 when improving the clay soils of Betpak Dala in the Karaganda region. Here, in the second year of life, alfalfa (Medicago sativa) provided 3.74 c/ha of hay, and white clover – 14.1 c/ha [17].

In the desert conditions of the Karaganda region, A.M. Gabbasov obtained satisfactory yields of Kochia prostrata.

When conducting research in the Urda sands in 1865-1925, the types of soil treatments used were not specified, but already in 1926-1931, in the Bukeevsky experimental field, the grasses were sown in an original way: with a disk seeder equipped in front of the disks with two ploughshares that made shallow grooves.

Comparing the growing conditions of wheatgrass, alfalfa (Medicago sativa) and melilotus (Melilotus) in two extremely oppositely located corners of Kazakhstan (the northwestern and southeastern parts respectively, in the Bukeevsky experimental field of the Urdinsky district of the West Kazakhstan region and the Taukum experimental field of the Ili district of the Almaty region, A. Kashirina noted “In 1923-1931 interesting experiments on sowing forage grasses on sandy massifs were carried out by the former Bukeevsky experimental field in the Urdinsky district of the West Kazakhstan region. When sowing on sandy soils, the sowing method is a crucial moment, since here two opposing points should be coordinated: the first is to close up the seeds shallow because the seeds of perennial grasses do not germinate with deep seeding and the second is to provide the seeds with sufficient moisture during their germination, which means, that the seeds should be placed not in the upper dry horizon of the soil, but deeper” [18].

On the Bukeevsky experimental field, this was achieved by sowing with a disc seeder equipped in front of the discs with a device in the form of two ploughshares that made grooves. The main thing when sowing is to obtain and maintain seedlings during the first year.

Since 1927, scientific work on grass sowing on clayey lands was started at the Temir experimental station of animal husbandry, later renamed the Aktobe experimental station of feed and pastures, which is located in the semi-desert zone of the Aktobe region [19].

Here, for eight years of testing (1927-1934), an advantage in the yield of hay was revealed with a mixture of wheatgrass + campfire (Brómus) + alfalfa (17.85 c / ha), then their double mixtures; clean sowing of wheatgrass provided 10.19 c / ha of hay, slightly lower than alfalfa and fire (6.52 and 5.88 c / ha, respectively), while the yield of all tested grasses was 2-3 times higher than that of natural pastures (3.0 c / ha). Of the annual crops, the Sudanese grass (Sorghum) turned out to be the most resistant crop, and of the two-year crops, the white melilotus (Melilotus albus), which showed high productivity against the background of moldboard plowing to the depth of 20-22 cm.

A.G. Gael, M.S. Kolikov, E. Malyugin report about 15 years of experience in the cultivation of forage crops in the Priaralskaya experimental station (station Chelkar), located in the desert zone of the Aktoe region with an annual precipitation of 100-150 mm [20].

Here, from 1935 to 1950, against the background of spring plowing of sandy loam soils, 11-12 centners per hectare of wheatgrass hay and 8 centners per hectare of alfalfa hay were obtained.

Research work to improve the pastures of the Aral Sea region (sands small Barsuki, Tereskent station of the Institute of Botany of the Academy of Sciences of the Kazakh SSR) was continued by B.A. Bykov and A.P. Savinkin in 1967 to 1978 [21].

The methods of soil cultivation were studied, seeds of local wild-growing plants were used for sowing - various types of wheatgrass, prostrate prunus and their mixture. Their yield in the seventh and eighth years of life, respectively, was: 1.17; 1.21; 0.98 & 0.88; 0.88; 1.11t / ha.

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The virgin lands in the strips were plowed to the depth of 22-25 cm with harrowing. The best option turned out to be the one in which, after harrowing, the cultivator cut rows with a depth of 10-15 cm. The yield of sown grasses turned out to be 2-2.5 higher than that of the vegetation of virgin areas.

Research work on rods in the Aral Sea region continued until 2010-2015 [22], however, Kochia prostrata were not introduced into industry in these years, since the press and scientific literature did not mention the successful cultivation of rods in the fields of farmers and cooperatives.

The results of grass cultivation carried out in the dry-steppe and semi-desert zone of Kazakhstan are reflected in the monograph by K.D. Postoyalkov [4]. This work describes the results of research work on grass sowing on loamy lands from 1933 to 1972, that is, for 39 years. The work was carried out in zones with an annual precipitation of 211-250 mm.

The author concludes that “if, in terms of radical improvement (plowing), the average yield of sown grasses for the tinning period is taken as 100 points, then for the surface (disking) we will have 55 points, and for the surface without sowing grasses 25 points. These ratios remain approximately the same in any year and throughout the entire zone”.

A radical improvement, according to the author, “is acceptable wherever the soil (any) by its physical qualities (mechanical composition, moisture, cohesion) is suitable for plow plowing with a skimmer to a depth of 20-22 cm. The degree of fertility does not really matter, because it is not an obstacle to productive grass cultivation”.

If the quality of the soil and the degree of fertility are not limiting factors for productive grass planting, then the question is why the practitioners are not engaged in grass planting in Northern Kazakhstan, because the areas of land under fodder crops from the day of the independence of the Republic of Kazakhstan to the present time remain constant, no more than 4.0-4.5 million hectares.

The author lists the types of soils, where the use of plowing is excluded: solonetzes, coarse sandy, gravely, pebble, washed away and underdeveloped soils with outcrops to the surface of bedrock, salt marshes, swamps and slightly saline automorphic soils.

The author emphasizes that the experiments on radical and superficial improvement of pastures in Northern Kazakhstan are unique “in the sense that only 3-4 of them have been installed on an area of 60 million hectares”. Among the 3-4 experiments carried out, the study of the effectiveness of soil cultivation at the Karabalyk experimental station, and the Lvov experimental field in the Kostanay region and at the All-Russian Research Institute of Grain Farming in the Akmola region is included. They studied the options: 1) without processing, 2) disking in 2 tracks, 3) disking to subsidiary, 4) plowing to the depth of 10-12 cm, 5) plowing to the depth of 12-14 cm, 6) plowing to the depth of 20 22 cm 7) natural meadow without improvement.

In the experiment, the cereal-legume mixture in two contrasting variants (plowing by 20-22 cm and a natural meadow without improvement) provided, respectively, 19.0 and 3.64 centners / ha of hay on average for five years and with two crops in time (1958, 1959).

It is impossible not to cite the author's remarks regarding the use of seeded pastures “If the tinned area is used for chaotic grazing, the tinning period is reduced from about 8 to 5 years, and if grazing begins on grasses of the first year of life, then the entire effect of tinning will be zero. This follows from the data of all studies devoted to the issue of sown pastures in Kazakhstan”.

As you know, seven crops are cultivated in Northern Kazakhstan (sainfoin (Onobrýchis), alfalfa, sweet clover, wheatgrass, hairy, wheatgrass (Elytrigia) and Brómus), which are high-yield crops. When the plants of the first year of their life are grazed, if they completely fall out and do not grow in the next year, then what can be said about the grazing Kochia prostrata of the first year of life growing in the desert?

But it's not a secret that leading scientists - experts in Kochia prostrata propose to use Kochia prostrata for pasture from the first year of its life [23,24]! Isn't that nonsense?

Research work on Kochia prostrata in South Kazakhstan and Central Asia began much later than in Kalmykia and Western Kazakhstan since 1948. On the Bozoi experimental field in the semi-desert of the Alma-Ata region (A.V. Nezhevikova, 1957), since 1952 All-Russian Research Institute of Karakul Breeding (Samarkand Region, Uzbekistan), 1951-1953 in Tajikistan (L.P. Sinkovsky 1959), since 1958
at the Kyrgyz Research Institute of Livestock and Veterinary Medicine (A.N. Klyushkin, 1968, V.L. Portnykh, 1967, according to Balyan, 1972), since 1965 in the Kazakh Research Institute of Karakul Breeding (S.A. Abdaimov, 1983), since 1980 in Turkmenistan (E.A. Kurbanov, K.A. Annaev, Kh.Khanchaev, 1986).

The first researchers (A.V. Kashirina, A.D. Nezhevleva, 1948), who studied the productivity of Kochia prostrate in comparison with other forage crops, obtained an average result over 10 years: wheat grass - 12.1 centner / ha, alfalfa - 2.8, grass mixtures - 10.4, Kochia prostrate - 16.9, natural grass stand mown - 2.3.

S.N. Pryanishnikov (1967) notes that when creating seeded hayfields and pastures in the desert and semi-desert (the Bozoi experimental field), sowing of perennial grasses should be carried out on well-plowed soil to the depth of 20-22 cm, especially in pairs. However, not in all cases the conducted sowing of the cannabis gave good results. In the crops of 1961, 1963, 1966 on loamy soils, for example, only single shoots were obtained. As a rule, poor germination of twig is observed in years with snowless winters, when there are no favorable conditions for seed germination in early spring. According to the author, the urgent task now is to develop agricultural techniques for obtaining its annual seedlings. These methods include thickened sowing in rows with wide-row sowing, as well as mulching crops in rows with humus [28].

How important is the problem of obtaining year-to-year sprouts of the cane can be understood by how S.N. Pryanishnikov again, how the spell refers to it in his other work [29]. “To obtain sustainable shoots of the cane, agricultural technology should be improved: to study furrow crops, mulching rows with humus, granulating seeds with manure”.

The author pays special attention to the soil condition for germination of cannabis seeds - in snowless or little snowy winters, the surface layer of the soil quickly dries up and the seeds of Kochia prostrate do not have enough moisture for germination. This was the case, for example, in 1967 and 1968 in areas where the snow cover was preserved only until February. In areas where the snow melted in March, the seedlings were good.

Sowing in time for a long time showed that in the Bozoi experimental field, out of eight years, the sprouts of Kochia prostrate were obtained in three years, in two years unsatisfactory, and in three years, no shoots were obtained. That is, plowing the soil does not guarantee a stable annual sprouting of Kochia prostrate. If so, then the development of pre-sowing treatment techniques with or without plowing is the main direction of further research on the cultivation of Kochia prostrate in the desert zone.

Another remarkable fact should be pointed out.

In 1963-1966, in the Cholak-Espe tract (Alma-Ata region), located in the peripheral part of the sands of Sary-Tau-Kum, A.F. Nezhevleva [3] studied the effectiveness of three main soil treatments (moldboard plowing to a depth of 20.5 cm, tillage to a depth of 20.4 cm and the same tillage, but to a shallower depth of 16.5 cm) and found that the most effective method of basic tillage for sowing Kochia prostrate in the desert zone of the Alma-Ata region is moldboard plowing to the depth of 20.5-23 cm.

It should be noted that since 1948, that is, for 73 years in the desert zone of Kazakhstan, covering not a lot and not a little 165 million hectares, no other studies have been carried out to study the effectiveness of basic soil cultivation, although scientific research on breeding and seed production, agricultural technology have not been interrupted to this day.

In Uzbekistan, the development and implementation of scientifically grounded systems for improving pastures began to be engaged in since 1931, at the Katta-Kurgan experimental station of karakul breeding (P.M. Moskvin, 1981). According to Z.Sh. Shamsutdinov (1971), they did not give practical results [31]. In 1935-1937 wild fodder plants were tested in the nursery of the southwestern Kyrgyz desert by the Kenimeh expedition of HKZ of the Uzbek SSR (I.I. Granitov, 1960). Here for the period 1935-1946 in sowing and under-sowing, only black saxaul and a few specimens of Kochia prostrate were fixed [31].

Experience of the All-Russian Research Institute of Karakul Breeding (A.N. Bakhrenkov) on harrowing desert pastures in the state farm “Mubarak” in 1936. He showed that the collection of forage mass the next year turned out to be about 65% more than on virgin soil.
In similar experiments by B.A. Udnikov on adyrs of the Samarkand region, the increase in yield from harrowing virgin lands was 50-64%, and from disking 60-70%. But such a superficial improvement (according to L.S. Gaevskaya, 1971) of natural grass stands is quite effective only in years with sufficient precipitation [32].

After analyzing the results of the surface improvement of pastures, I.S. Amelin (1944) concluded that “it is currently not possible to recommend production of other methods of agrotechnical and simple reclamation of pastures in the desert and semi-desert” [33].

The methods of tillage for sowing *Kochia prostrata* and other arid crops in Uzbekistan were studied mainly by two research institutions: from 1949-1950 by the Institute of Botany of the Academy of Sciences of the Uzbek SSR and since 1955 by the All-Russian Research Institute of Karakul Breeding.

I.F. Momotov, A.M. Temnikov, M. Sultanov (1971) report that “the first attempts to improve the pastures of Ustyurt by sowing seeds of wild plants on the background of continuous plowing and on virgin lands were undertaken in 1949-1950 by the Institute of Botany of the Academy of Sciences of the Uzbek SSR (Burygin, 1954). However, the results of these experiments were unsatisfactory and further work was discontinued [34].

The crops of 1961-1962 were also unsuccessful for black saxaul on plowed plots of 140 hectares in the area of the Kosbulak well.

Based on the experience of the Kyzylkum desert station (Momotov, 1965), where the usual plowing of compacted gray-brown soils did not improve, but worsened the reclamation state of the soil, I.F. Momotov, A.M. Temnikov, M. Sultanov (1971) developed only for Ustyurt the methods of soil cultivation together with the staff of the Ustyurt desert station of the Karakalpak branch of the Academy of Sciences of the Uzbek SSR and experiments were laid since 1965 at the experimental and reclamation sites of the Ustyurt desert station located in the area of the Kosbulak well. Five options were studied: 1) harrowing, 2) plowing without bed turnover, 3) turnover plowing, 4-5) holes, respectively, covered with sand and own soil.

As a result of the studies carried out, it was found that the soils under the biyurgunnik, where readily soluble salts lie at a shallow depth, cannot be improved by loosening the soil with a seam turnover, since horizons more saturated with salts move to the surface, which worsens the growth conditions for juvenile plants.

The best indicators were obtained in the variants of soil loosening without seam turnover.

I.F. Momotov (1971), lists in detail the soil factors that have a negative impact on the growth and development of arid crops, in particular, notes that “there were fewer seedlings in the plow furrow and they were often flooded with water, which negatively affected their preservation in subsequent periods of development. The highest preservation of saxaul seedlings (83%) was found on the plowing zone without bed turnover (4-7%), in the latter, by the end of summer, all the seedlings fell out” and an increased concentration of water-soluble salts in the horizon of the root systems of young saxaul. Young saxaul, preserved in the dump in the deep loosening zone with a turnover, is less developed. The height of its best specimens does not exceed 5-10 cm, and the most unsatisfactorily developed ones are only 2-3 cm [34].

In addition to Ustyurt, the soils of which are represented by loams in varying degrees of salinity, employees of the Institute of Botany of the Academy of Sciences of the Uzbek SSR under the scientific supervision of Doctor of Biological Sciences I.F. Momotov and Academician of the Academy of Sciences of the Uzbek SSR D.K. Saidov from 1960 to 1988 studied the effectiveness of the methods tillage at the Kyzylkum desert station in the following soil types:

a) sandy gray-brown soil;

b) loamy gypsum-bearing gray-brown soil;

c) loamy solonetzic-solonchak gray-brown soil in the vicinity of the Kulzhuktau piedmont plain.

The results are such that on sandy loamy gray-brown soils, ordinary plowing to a depth of 22-25 cm ensures good absorption of moisture from atmospheric precipitation, therefore, on this option, rather high yields of black saxaul (15-20) and izen are obtained - 8-11 c / ha.
The authors note that on “loamy gypsum-bearing soils of the Boyalych-Keireuk sagebrush, a deep plowing of 30-35 cm is necessary, which deepens the bare and saline horizons, which prevents the formation of a crust on plowing” [35]. On strongly compacted, gravelly, loamy, gray-brown soils of tasbyurgunnik and clay takyr soils of tytrnik (ass.salsola gemmascens), positive results were obtained only when creating sand-accumulating furrows [36,37,38]. The authors cite the yields of green mass of black saxaul and sagebrush, which averaged 1.62 and 0.13 t/ha, respectively, over 15 years (from 1962 to 1976).

As far as is known, during plowing with a seam turnover, the removal of salty and alkaline lower horizons to the day surface of the soil is not prevented, therefore it does not improve, on the contrary, it worsens the conditions for germination of plants, in particular seedlings, so much that, as noted by another researcher from Kazakhstan, K.D. Postoyalkov [4], a dead zone is created, since plant seedlings die under these conditions.

In Uzbekistan, a team of scientists from the All-Russian Research Institute of Karakul Breeding has carried out significant work on the radical improvement of pastures with the sowing of izen since 1952.

However, this work was preceded by numerous studies on superficial pasture improvement. Z.Sh. Shamsutdinov (1971) reports in this regard that “in 1944-1948 the first experiments on improving pastures by overseeding wormwood and other wild-growing forage plants were laid by L.P. Sinkovsky in the state farm “Karakum” on wormwood-ephemeral pastures. Soils are light gray soils, sandy loam. During the years of the experiments, the average annual precipitation was 120 mm. The seeds were sown in the grass pasture without embedding, with the embedding of seeds by harrowing and in a furrow 6-8 cm deep and 10 cm wide at a distance of 1 m from each other.

The largest number of seedlings was obtained in the furrows, especially of such wild plants as kandym, chogon, rhubarb, ferula and wormwood. However, the density of seedlings was still insufficient, since most of them died already in the first growing year. And only the experiments laid in the same years on sowing wormwood and other wild-growing forage plants on plowed soil gave good results. Against the background of plowing, the number of seedlings was normal, and the survival rate of plants was high”.

The studies we carried out in 2018-2020 fully confirmed the conclusions obtained by L.P. Sinkovsky that when furrowing to a depth of 6-8 cm, i.e. at which the fertile soil layer is removed by 0-8 cm, and when sown on a solid soil bed, full-fledged friendly shoots of the cane are formed, which at the end of the first year of life and in subsequent years experience an acute lack of nutrients and therefore develops depressed - lagging behind in growth, little leaves, etc. Therefore, it was decided to leave the fertile soil horizon A on the surface, building up this horizon with the adjacent near-surface horizon A, raking them with the formation of a shallow furrow to a depth of 8-10 cm.

G.A. Sergeeva in 1951-1953 in the foothill zone on the adyr pastures of the karakul-breeding state farm “Ulus” tested various options for sowing seeds of wormwood, izen, chogon, black saxaul against the background of plowing to a depth of 20-22 cm. As a result, it was found that that black saxaul does not take root on adyrs, chogon is preserved only by 25%, wormwood and izen provide a fairly stable productivity 4.2 and 5.0 c / ha of air dry mass in the second year of life.

The works of G.A. Sergeeva showed the enormous importance of plowing in the matter of radically improving pastures and creating full-fledged wintering grounds on them by sowing forage shrubs: wormwood, izen, keireuk, chogon, teresken. The yield of forage mass on such artificially created pastures exceeds the yield of natural pastures by 2-2.5 times (according to Z.Sh. Shamsutdinov, 1963).

In 1956, I.A. Keyser carried out overseeding and sowing of twigs at the Ayak-Agitminskaya experimental station of the Uzbek Research Institute of Animal Husbandry, which is located in the southern part of the Kyzylkum desert near the city of Bukhara. The yield of the fodder mass of the twig here turned out to be 5-6 times higher than on natural lands [40]. Black saxaul, izen, wormwood, keireuk, chogon, cherkez and kandym were tested.
“The most effective were the sowing of black saxaul on pastures and sowing it on the plowed section of the station, sowing and overseeding of izen and wormwood on uncultivated soil. The rest of the shrubs and semi-shrubs have not yet shown themselves to be quite promising in the conditions of the station”.

Z.Sh. Shamsutdinov [30,41] notes that plowing improves the water, air and nutrient regimes of the soil. Compared with virgin soil, the content of total nitrogen in plowed soil (in the 0-20 cm layer) is 60% higher, the content of available phosphorus is 10% higher.

Plowing eliminates the competitive force of sedge-bluegrass vegetation and contributes to a greater accumulation of moisture in the soil and its longer preservation [30], all this significantly improves the conditions for seed growth, ensures the receipt of normal seedlings, their safety in the critical summer period and accelerated growth of sown plants, not only in the first, but also subsequent years of life [41].

In Turkmenistan, the improvement of pastures with the sowing of arid crops was started in 1934-1940. Butovsky (1934), Morozova (1938), later continued by N.T. Nechaeva, S.Ya. Prikhodko, A.N. Bashkatova, R.I. Kiyakova [42] and G. Mukhammedov [43] and others.

Until 1980, in the adyr (bairnaya) part of the Southeast with an annual rainfall of 260 mm and in the Karakum (rainfall of 120 mm per year), the efficiency of sowing and overseeding of arid plants was studied, only since 1980 there have been works on the study of a prunus in the western part of Turkmenistan.

E.A. Kurbanov, K.A. Annaev, Kh.Khanchaev in 1980-1983 on the territory of the state farm named after the XXII party congress of the Kazandzhik district of the Krasnovodsk region, where the annual precipitation is 148 mm, the productivity of arid crops was studied.

The authors report that in the first year of the growing season, clayey izen 7.4 c / ha, stony izen 4.9 c / ha, and teresken 6.6 c / ha of air-dry mass were distinguished by rather high productivity. By the end of the third year of vegetation, their yield reached, respectively, 14.2, 14.9 c / ha, and for white saxaul and Richter's saltwort, 8.6 -9.0 c / ha. Chogon and wormwood have the lowest yield of 2.9-5.3 c / ha.

In 1982-1983, the spring-summer time fell an insignificant amount of precipitation (27 mm), but despite this, in the third year of life, there is no decrease in productivity in the third year of life, on the contrary, in this extremely dry year it provided in comparison with the first and second years of life, high productivity (14.2 versus 7.4 c / ha). By the third year of life, Kochia prostrate manages to form a deeply penetrating (up to 237 cm) root system, which, in the absence of atmospheric precipitation, absorbs the moisture of the lower horizons, thereby successfully resisting any form of drought, increasing productivity in accordance with the biological rate of growth and development, almost without reacting to the absence atmospheric precipitation.

The authors emphasize that “with the radical improvement of pastures by sowing wild forage plants in the harsh environmental conditions of Western Turkmenistan, it is of decisive importance to obtain their mass seedlings. Therefore, along with introduction research, it is necessary to conduct research work to study the agricultural background of sowing in order to establish the most acceptable methods of pre-sowing soil cultivation and sowing methods for each type of introduced species”.

E.M. Ershova (1958) draws attention to the exceptional drought resistance of izen, who notes that “in an exceptionally dry year 1955, when from November 1954 to August 1955, only 49.8 mm of precipitation fell, and 15.6 of them fell in June, when completely the majority of local forage plants did not vegetate, the izen developed satisfactorily. Izen also behaved in the dry year 1957” [44].

N.T. Nechaeva [42, 45] and other scientists who have studied the possibilities of cultivating arid crops for more than 30-40 years, have established the effectiveness of surface improvement of sands, which is effective only in wet years of sowing (100 mm in winter and spring). Plowing is carried out with moldboard and non-moldboard plows to a depth of about 15 cm on densely rooted sands densely populated with bulbous bluegrass and sedge. Pay attention that with deeper (from 15 to 22 cm) plowing, the entire turf layer is torn off and the low-nutrient subsoil is brought to the surface, and therefore deep plowing is impractical.

For science, especially for those scientists who have been engaged in the cultivation of arid crops in the desert for many years, the observation and practical results of N.T. Nechaeva's works [42, 45] are of great importance.
Here is what she reports [42], “in Badkhyz, the moisture conditions are more favorable than in the Karakum Desert and the soil contains more nutrients. Thanks to this, on the sands of Badkhyz and plowing, the growth and development of under-sown plants is faster”.

She expressed herself more expressively in another work “The growth of plants and the process of overgrowing of brownish sands is better on the broken sands of the Badkhyz tract than in the southeastern Karakum. This can be explained by the peculiarities of the soils: the Badkhyz sands are richer in dusty particles and, probably, in nutrients than the Karakum sands. Obviously, but not only the lack of moisture and lack of food in the sands (although desert sands are somewhat richer in nutrients in comparison with the sands of the arid regions of the European part of the Soviet Union, as well as Kazakhstan) makes their rapid overgrowth difficult” [46].

The introduction of mineral fertilizers into the soil covered with silt thickets doubled its yield, obviously, when over-sowing on pebbled sands, an increase in the nutrient value of soils would have a beneficial effect on the growth of sown crops, and appropriate experiments should be carried out (N.T. Nechaeva, 1954).

However, subsequent researchers did not take into account N.T. Nechaeva's indication that nutrient-rich soils accelerate the growth and development of arid plants, thereby contributing to more sustainable growth and development in the harsh desert conditions.

According to G.A. Balyan (1980), the area of desert pastures in Kyrgyzstan is 188.0 thousand hectares. They began to study the cultivation of *Kochia prostrata* since 1958 by the Kyrgyz Research Institute of Animal Husbandry and Veterinary Medicine (1972, 1980). With a radical improvement of pastures, wheat grass gave 6.3 lucerne 11.6, sainfoin 15.1, and *Kochia prostrata* 17 kg / ha dry weight. Thus, the productivity of rods was 5.7 times higher than that of natural ones.

Plowing virgin lands in strips 30-35 mm wide. It is carried out in June, leaving unplowed strips of the same width. The plowing depth is 30-35 cm.

In Tajikistan, the first experiments with the sowing of twig were carried out in 1951-1953 in the desert zone of southern Tajikistan (Garauty tract) on light, in places saline, gray soils. Annual precipitation is 217.5 mm. Under these conditions, *Kochia prostrata* gave 3.6 c / ha of dry matter in the first year, 4.8 c / ha in the second year of life.

In this zone, along with *Kochia prostrata*, bulbous bluegrass, wormwood, chogon were tested, annuals (astragalus wormwood, waida, goldvachia smooth, saltwort (salsola tuzkestanica titr. I. S. Selezantha C.A.M) [48,49].

The best results are obtained by overseeding on non-turfed soils on a burrowed surface with rolling, on more or less turfed (broadband overseeding with soil loosening to a depth of at least 10-15 cm. In strips 25-30 cm wide, cut at a distance of 0.7-1.0 m, one from another (1960)).

3. Conclusion

*Kochia prostrata* for the first time in the USSR in 1936 was sown by Professor P.P. Beguchev in Kalmykia and since then it has been continuously cultivated to this day, studied for experimental purposes in the arid zone of Central Asia and Kazakhstan, but its implementation in production is extremely low.

In the western part of the Caspian lowland in Kalmykia, arid plants were sown on an area of 255.5-350.0 thousand hectares [50.51.52] in 1985-1990, and here, as N.I. Reznikov writes, who was entrusted with the arrangement of the assigned lands “*Kochia prostrata* crops have not yet yielded results, with the exception of the easternmost zone (where 350-480 mm of precipitation falls per year) of the region, approximately along the Wormwood-Zenzeli-Ulan-Hall highway. On heavy soils, the existing rod cultivation technology does not give an effect [52]”.

We should focus our attention here, in the Kalmyk SSR, as well as in the Atyrau region, *Kochia prostrata* was sown by plowing, a negative result for which was obtained even earlier when developing desert lands for sowing sorghum crops in the Aral Sea region in 1956-1960.
Continuous plowing of downed pastures, that is, pastures devoid of indigenous perennial vegetation, cannot be carried out because they provide a habitat for spring-summer and autumn ephemerals, which are no less valuable pasture food than the perennial vegetation created (wormwood, izen, teresken, etc.)

When plowing, ephemerals are destroyed once and for all, this just cannot be allowed. Thus, it should be concluded that the economic benefits of radical improvement through the complete destruction of vegetation are illusory, while environmental disasters are inevitable companions. Isn't that why the farmers are in no hurry to go into the desert with a plow!

The obtained experimental data confirm the legitimacy of the recommendation of L.P. Sinkovsky (1969), that it is impossible to carry out continuous plowing in order to increase the productivity of arid pastures for the following reasons:

- plowing of large areas of pastures is expensive and, moreover, does not always give the expected effect;
- plowed pastures are at great risk of erosion;
- no one has yet studied in detail the water regime of arable land and virgin lands in the desert and semi-desert.

There are data showing that in the conditions of southern Tajikistan, the water regime of the raised virgin land due to the blowing of the arable layer by dry hot winds is less favorable for plants than on the virgin land (on the arable land it is more intermittent, the loose soil is characterized by faster saturation of moisture and its faster evaporation). In this regard, plowing cannot be recognized as a means of mass improvement of pastures in arid regions of Central Asia.

"Without setting up industrial experiments, it is inexpedient to recommend this or that species for introduction into the culture, since in plot experiments it is impossible to foresee all the features of the technology of plant cultivation" [53].

K.D. Postoyalkov [4] draws attention to a very interesting detail. It turns out that only 3-4 experiments were carried out to study the methods of basic soil cultivation for grass growing in Northern Kazakhstan on an area of 60.0 million hectares, and in the desert and semi-desert southern zone of the republic, covering an area of more than 165 million hectares, only one such experiment was performed. (Nezheveleva, 1970). In Uzbekistan, on an area of 18.0 million hectares - 3 experiments (G.S. Sergeeva, 1954; I.F. Momotov et al, 1971, 1978).

In other republics in Kyrgyzstan, Tajikistan and Turkmenistan, the study of the main soil cultivation with the establishment of experiments in space and in time for grass sowing was not carried out. It is reported only about the effectiveness of plowing to a depth of 12-15 cm bluegrass-sedge grassed pastures in comparison with overseeding of arid plants against the background of surface tillage in Turkmenistan and Tajikistan [42]. In addition, in Tajikistan, on the desert light gray soils of dry subtropical steppes of the South Tajik depression, the efficiency of furrow seeding of arid plants has been established [53].

In accordance with the methodology of field experience, the best options with a significantly high yield compared to the control should be introduced and provide the same high yield in a typical soil-climatic zone, that is, in the dry-steppe and semi-desert zone of Northern Kazakhstan on an area of 60.0 million hectares, in arid zone of the republic on 165 million hectares in Uzbekistan 18.0 million hectares.

If we take into account the fact that not only within the Republic of Kazakhstan in million hectares, even within the limits of one or several farms on a small area (10-40 thousand hectares), there is a variegated soil cover in salinity, mechanical composition. Then it becomes quite it is understandable why plowing to a depth of 20-22 cm does not show its effectiveness everywhere and everywhere - the soil conditions on scientific plots and on the production area of hundreds and thousands of hectares are not identical and not the same, and therefore, on the one hand, the main requirement of the method of experimental work is violated. This is the typicality of the experience, on the other hand, the efficiency of the best option being implemented is not always the same throughout the entire area to be implemented. This is natural.
Thus, it can be concluded that the circulation of the lower solonetzic and salt horizons on the day surface of the soil sharply worsen the conditions for the germination of grasses, although the moisture content of the soil increases. The following circumstances should also be taken into account. The lower horizons of brown, gray-brown soils and light gray soils, which do not show solonetzism and lack readily soluble salts, are structureless due to the low content of humus and water-stable aggregates in them. When the upper fertile layer is turned around, it is buried by the less fertile, more structureless soil of the lower horizons. This, firstly, leads to the formation of a hard crust impenetrable by sprouts, and, secondly, when dry and low moisture content in the soil, solid lumps are formed under the seeds, impermeable by weak hypocotyl roots of *Kochia prostrata*, therefore, sprouts of the cannabis or die during moldboard plowing to a depth of 20-22 cm, or full seedlings are not formed on it [54].

Thus, it should be concluded that with moldboard plowing to a depth of 20-22 cm, the condition for obtaining full-fledged seedlings worsens, in this regard, it should be considered that by now science has not developed universal methods of basic soil cultivation, which ensure the best growth and development of *Kochia prostrata*.

In this regard, the warning of Professor L.P. Sinkovsky [39] that “mass plowing of large areas of natural pastures cannot be accepted as expedient” becomes quite understandable. Academician K.A. Asanov spoke even more categorically on this issue [54] “Questions of radical improvement also cannot be viewed one-sidedly. An unreasonable approach to this matter is fraught with great danger. Since the destruction of indigenous pasture vegetation by plowing under the pretext of "the development of deserts and semi-deserts without scientific technology has led to the emergence of vast territories of waste lands, which for many years have lost their former pasture value” [55].

Since the modern theoretical provisions for the cultivation of arid pastures are practically untenable, it will be necessary to replace them with a new paradigm and theoretical concept, and on their basis it is necessary to develop an alternative technology for tillage and cultivation of *Kochia prostrata* in the arid zone of Kazakhstan, this will be discussed in the next article.

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