Development of combined aggregate for improvement of meliorative condition of saline gypsum soils

Masharip Khajiev*, Mubarakhan Atadjanova, and Jakhongir Dusiyoro

Tashkent Institute of Irrigation and Agriculture Mechanization Engineers» National research university, Tashkent, Republic of Uzbekistan

Abstract. Rapid growth of population of the republic, reduction of sown areas for various reasons and removal from agricultural works make necessary improvement of melioration of low-productive saline gypsum lands and require introduction into practice. Areas of saline gypsum lands in Uzbekistan make 320-480 thousand hectares. Among these lands special place is occupied by soils containing gypsum $\text{SaSO}_4$ and $2\text{H}_2\text{O}$. Such soils are found practically in all regions of our republic, and improvement of their amelioration requires a separate complex and is considered one of the tasks of state importance. Before sowing in spring on saline gypsum soils are washed and applied in farms, and for re-sowing on harvested wheat the soil is prepared and laid in two layers (10-12 cm and 24-25 cm deep). It is recommended to fill it with a mixture of fertilisers (dolomite or slaked lime, cattle manure, nitrogen, phosphorus and other microfertilisers). As a result of its practical use the ameliorative condition of saline gypsum lands is improved, the yield of cultivated crops increases by 20-30 per cent, the quality of products is brought up to the level of the state standard.

1 Introduction

Currently, 7.4 billion people live on the Earth. ensuring food security of a large population has become one of the most important problems. This situation requires effective use of available resources of irrigated lands in our country, and rapid population growth, reduction of sown areas for various reasons and removal from economic activity, low productivity requires use of saline gypsum lands for sown areas. agricultural crops, practical works on improvement of reclamation of these lands and their regular introduction into agricultural production.

The solution of these problems is of state importance and is stipulated by the Presidential Decree "On measures for effective use of land and water resources in agriculture" (17.06.2019 No. PF-5742). Tasks of designing, testing and organisation Disturbed industrial production of agricultural, irrigation and land reclamation machines and devices on the basis of the most advanced modern technologies, which are reflected in our republic and create the possibility of economical and rational use of land and water resources.

* Corresponding author: khajie48@mail.ru

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In the Decree of the President "On Approval of the Concept of Water Sector Development of the Republic of Uzbekistan for 2020-2030" (10.07.2020 #PF-6024) global climate change due to the growth of population, economic sectors and export of agricultural products in our republic, the need for land and water resources is increasing from year to year, their efficient use, improvement of ameliorative condition of irrigated lands, ensuring stability, increasing land productivity, the tasks of continuous established reduction of land salinisation (including saline gypsum) and prevention of secondary salinisation, as well as reduction of the area of land and water resources.

2 Materials and methods

At present, the total irrigated arable land of our republic is 3.2 million, and about two thirds of these lands are saline to different degrees, and gypsum soils make up 320-480 thousand ha. Among these soils, soils containing gypsum CaSO4 and 2H2O occupy a special place. Such soils are found practically in all regions of our republic, and improvement of their melioration requires a separate complex and is considered one of the tasks of state importance. The main agricultural crops (cotton, corn and maize, beetroot, sunflower, etc.) are grown on these lands [1].

Gypsum accumulation in the soil profile and its amount have been established on the basis of many scientific and research works [1-6].

Gypsum soils occupying the major part of lands in agriculture and crop cultivation cause a lot of difficulties to agricultural workers. First of all, it is determined by low level of productivity of gypsum soils, different degree of salinisation, low reserves of humus and other nutrients, unfavourable agrophysical properties and low biological activity. At the same time, another negative aspect of this type of soils is that irrigation and feeding methods with organic and mineral fertilisers, developed for alluvial soils and used in production practice for many years, are unsuitable for these soils [1, 5].

From the point of view of production efficiency, qualitative indicators of gypsum soils are low, at the same time these soils are very difficult to desalinise, and their unsatisfactory physical and chemical properties, situations related to the amount, type and depth of gypsum embedding, significantly reduce soil productivity [1, 5].

If we take into account that two thirds of all irrigated lands of our republic in the coming decades will have different degrees of salinisation, and the number of medium and highly saline lands increases every year due to drying up of the Aral Sea and dispersion of salts accumulated in its upper part under the influence of strong winds and storms to different regions of Central Asia. We are witnessing how this problem is turning from an economic problem into a social one [2]. Thus, the Decree of the Republic of Uzbekistan "On the strategy of Uzbekistan-2030" (PF-158 of 11.09.2023) provides for the reduction of irrigated areas of strong and medium salinisation to 430 thousand [7].

S.S. Virk, K.S. Stone abroad to study the rates, timing and methods of fertiliser application into the soil, to study the processes of interaction of fertiliser and soil with working bodies, as well as to develop a theoretical and practical basis for the creation of technologies and devices that ensure the application and distribution of fertiliser into the soil with low energy inputs..., Camp S.R., Shillito R.M., Timlin D.J., Reed A.R., Klaus H.G., Vasilenko P.M., Nazarov S.I., Shmonin V.A., Vaselenko P.V., Sablikov M.V., Mukhamedjanov. G. M. Rudakov, F. A. Sokolov, A. H. Khadzhiev, S. Khusainov, A. Shadiev, E. A. Yashhev, I. A. Atadjanov, F. Mamatov, T. S. Khudoyberdiev, A. T. Tokhtakoziev, A. N. Khudoyorov, Z. L. Botirov, B. U. Toshpolatov and others. As a result of these studies, fertiliser dosing systems, fertiliser application devices and machines preparing the soil for sowing together with fertiliser application have been applied in agriculture and certain positive results have been achieved.
Mineral and organic fertilisers (solid and liquid) are applied to the soil before autumn ploughing on saline gypsum soils on the basis of "Approximate technological charts on crop care and production" developed by the Ministry of Agriculture and Water Resources of the Republic of Uzbekistan. The soil is scattered with the main dose of powdered chemical ameliorants (dolomite flour and lime). Sowing them into the soil by open method does not always give good results. Fertilisers and ameliorants scattered on the field have a negative impact on the environment and air, lose their useful physical and mechanical properties in the field, in open and changeable weather, are less effective due to wind and rain erosion. These fertiliser mixtures do not reach the gypsum layer of 10-30 cm under the soil where plant roots develop, so crop yields and product quality are reduced [1, 5, 6].

It is important to ensure that the machine-tractor aggregates are not subjected to the risk of being used as a source of waste, minerals and organics, the modernisation of the unumdorligi pasayadi, the sarf-xarajatlari materials and materials with a high level of quality, and the use of technology to improve the quality of life of farmers [5].

The republican farmer's economic policy is based on the principle of a specialised farming system (e.g., the farming industry), which is based on the principle of a specialised farming system (e.g., the farming sector) and on the principle of a specialised farming system (e.g., the farming sector is based on a specialised farming system). A rusumli cheesel-cultivator - ügitlagich ügit aralashmasini 12-18 cm kenglikda tuprokni humshatuvchi panzhalarga biriktirilgan makhsus tines, 15-18 cm chukurlikkada tasma kurinishida solish ishlari amalga ogrilidi. Bunda tasmalar orasi 40 cm should be used [5]. It is important to note that this is an important factor in the development of the social and economic development of the region and in the development of technology.

Introduction of mineral and organic fertilizers, chemical ameliorants and their mixtures into the soil in the form of granules and liquid in special machines (cheesel-cultivator CHKU-4A, unit AVV-F-2,8, machine MZhT-10, etc.) are provided in technological maps, and this technological operation is carried out in certain regions and farms. In this method, fertilisers and their mixtures are not always effective due to the fact that fertilisers and their mixture are not suitable for the depth of the seeds applied by the seeder [6-14].

3 Results and discussion

In order to eliminate the above disadvantages, a combined aggregate for improving the reclamation of saline gypsum soils was developed in TDTU in 2020-2023 (Figure 1). In this unit, the front (first) boom softener softens the soil at a depth of 10-12 cm, the second boom softener softens the soil at a depth of 10-12 cm, while a mixture of fertilisers (dolomite or slaked lime, nitrogen, phosphorus, cattle manure and other microfertilisers) is applied to the soil. After that, the motor cultivator loosens the soil to a depth of 24-25 cm and applies the fertiliser mixture.

This is the re-sowing in spring of the main technical crops (cotton, maize and white sorghum, beetroot, sunflower, etc.) and cereal crops on plots of gypsum soil washed and treated with this aggregate, after harvesting before planting crops. , a mixture of fertilisers containing: nitrogen (40-120 kg/ha), phosphorus (120-420 kg/ha), slaked lime (600-420 kg/ha) and manure (80-300 kg/ha). on average from 840 kg/ha to 1260 kg/ha, on arable land, in two layers along the sowing line: with the fertiliser attached to the softener boom to a depth of 10-12 cm (to the first layer), and it is recommended to apply the fertiliser to a depth of 24-25 cm (to the second layer), to the depth where plant roots are actively developing. As a result, ameliorative condition of saline gypsum lands is improved with minimum expenses, and roots of plants planted on these lands develop quickly. As a result of application of the recommended combined aggregate in practice of farms, the yield of crops grown on saline
gypsum lands will increase and it will be possible to bring the quality of products to the level of state standards.

The shape of the cushion made of combined aggregate is shown in Figure 2. The figure shows that the upper and lower parts of the cushion have a parabolic shape, and the side part is made at an angle \( a \) at a height of \( h = 30 \) cm. Since rice can be harvested on ploughed land prepared for planting, the aggregate tractor can also be a three-wheeled version.

The recommended combined machine cultivates the soil with a working width of 5.4 m between rows of 90 cm and simultaneously applies fertiliser to 6 rows of rice and to the lower part of the field, and at the end of the technological process applies a double layer of fertiliser on rice (Figure 2).
Fig. 3. Placement of combined aggregates-softeners, rakes and rakes applying fertiliser in two layers (in vertical plane): 1, 2 - frame; 3-small arrow claw; 4-large arrow claw and bulb; 5-flower and bulb; 6-bracket 7-fertiliser guides; 8-movable support wheel.

The 7 fertiliser conduits installed on the machine are spaced 18-20 cm apart in the first direction. The fertiliser conveyors have a diameter of 52 mm, 3 small arrow-shaped grabs (7 in total installed on the machine) loosen the soil at a depth of 10-12 cm, 4 large arrow-shaped grabs (6 in total installed on the machine) loosen the soil. It softens in a wider circle at a depth of 10-12 cm and opens the way for the hoe, which introduces the fertiliser mixture into the top layer of the pus. A combined unit of 5 cotton pickers (a total of 5 double-sided and 2 single-sided pickers are installed on the machine) harvests cotton covered with fertiliser mixture in two layers of about 30 cm each. At the same time, the first layer of fertiliser mixture is laid at a depth of 10-12 cm, and the second layer of fertiliser mixture - at a depth of 22-26 cm and fully meets the requirements of agrotechnics.

Calculation has shown that on wheeled tractors of 3 class it is expedient to install combined aggregate of books with the help of hydraulic suspension mechanism. In Uzbekistan there is a recommended combined aggregate "Belarus 1802" Nd=132.3 kW with wheel arrangement 4K4; Found "Corpus" MX-240 Nd=205.88 kW with wheel arrangement 4K4 and aggregate "CLAAS 810 and 810 SRM".

4 Conclusion

The practical application of the recommended combined aggregate for the amelioration of saline gypsum lands in Uzbekistan holds significant promise for enhancing agricultural productivity and soil quality. By implementing the proposed methodology, which involves washing and layering soils before sowing, along with the application of a tailored mixture of fertilizers, several key benefits can be realized.

The utilization of the combined aggregate is poised to elevate the meliorative condition of saline gypsum lands to meet the specific requirements of agricultural operations. Through targeted soil preparation and the incorporation of essential nutrients, the soil structure and fertility can be significantly improved, paving the way for sustainable agricultural practices on previously low-productive lands.

The anticipated increase in agricultural crop productivity by 20-30% resulting from the application of the recommended methodology signifies a substantial improvement in the overall output of cultivated crops. This boost in yield not only enhances food security but also contributes to the economic viability of farming operations. Furthermore, the enhancement of product quality to meet state standards underscores the potential for
producing high-quality agricultural goods that meet regulatory requirements and consumer expectations.

In conclusion, the practical application of the recommended combined aggregate offers a comprehensive solution for improving the meliorative condition of saline gypsum soils in Uzbekistan. By enhancing soil quality, increasing crop yields, and ensuring product quality, this methodology not only addresses immediate agricultural challenges but also sets the stage for sustainable and productive farming practices that benefit both farmers and the environment.

References
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