Proceeding VII International Conference «Industrial Technologies and Engineering» ICITE – 2021, Volume I

M. Auezov South Kazakhstan University

Shymkent, Kazakhstan
November 10-11, 2021

ISSN 2410-4604

All papers have been peer reviewed

To learn more about ICITE 2021www.icite.ukgu.kz

DEVELOPMENT OF TECHNICAL MEANS FOR LAYING A DRIP IRRIGATION HOSE FOR COMB CULTIVATION OF COTTON

Bakhtiyar. P. Shaimardanov[1], Paragat. T. Berdimuratov[1], Berdiyar.Ye.Kalimbetov[2]
[1]*Tashkent Institute of Irrigation and Agricultural Mechanization Engineers, 39, Street Kari Niyaziy, Tashkent, Uzbekistan*
[2]*M. AuezovSouth Kazakhstan University, Shimkent, Kazakhstan*

Abstract

The article presents the results of research on the development of technology for comb cultivation of cotton with targeted and uniform moistening of the root system of plants, which together contributed to the creation of optimal conditions for machine harvesting of raw cotton by ensuring early ripening (for 2-3 weeks) and high yield. In the complex of measures aimed at reducing the labor intensity of cultivating raw cotton, a significant role is assigned to further improving the technology and means of mechanization of cotton sowing. Studies have established that when cultivating cotton on the ridge, in accordance with the theoretical foundations of tillage, a favorable condition is provided for the addition of the arable layer for a long growing season of cotton. This contributes to the production of friendly seedlings, good plant development and obtaining a high yield of raw cotton with early maturation, the accumulation of moisture on the ridge is also excluded, which leads to pollination of the soil, destruction of the structure and the formation of a soil crust. In recent years, the so-called "drip irrigation system" has become widespread, which allows you to provide plants with water and fertilizers where necessary, at the right time and in the right amount. The use of "drip irrigation" guarantees higher yields, as well as provides savings in labor, water and energy resources. For the use of drip irrigation systems in farms with the laying of flexible perforated irrigation tapes in the upper part of the bed along its entire length, it is performed simultaneously with the sowing of cotton seeds, which eliminates manual layout of irrigation hoses, i.e. labor-intensive manual operation to start urgent irrigation works.

Keywords: *soil fertility;comb; cotton; root system; humidification; microclimate; milling cutter; shaper; coulter; hose drum; hose stacker.*

INTRODUCTION

Creating conditions for machine harvesting of raw cotton by ensuring early ripening (for 2-3 weeks) and high yield.

With the existing agricultural technology of cotton cultivation and sowing on a smooth field, as a result of early spring and pre-sowing treatments, the top layer of soil is strongly sprayed and a dense soil crust is formed when heavy precipitation falls. This is due to spring rainy weather (risky farming) and dries with elevated air temperatures in summer and autumn. In order to create an soil fertility of cotton under machine harvesting, it is necessary to develop an soil fertility management system. Based on the theoretical foundations of tillage, in order to create an optimal density of the arable layer and maintain it during the growing season, a new technology for cultivating cotton on beds and ridges was developed..

EXPERIMENTAL PART

The physical bases of temperature regulation are the following processes based on changes in the components of the thermal balance and thermophysical properties of the soil: -change in the albedo of the soil surface; -decrease in soil heat loss; -increase in soil thermal conductivity.

Covering the surface with dark substances (peat) leads to a significant decrease in albedo, and, accordingly, to an increase in the absorption of energy by the soil. Let's remember, albedo is the ratio of reflected short-wave energy to the received one. To reduce the albedo means, first of all, to reduce the reflection of radiation by the soil, to increase the flow of heat into it. These are traditional techniques that are often called surface mulching. Mulching the surface during warm periods leads to a decrease in soil temperature, to its shading. Thus, in the broadest sense, mulching reduces the amplitude of soil surface temperatures, "smoothes" its dynamics. Another technique based on a change in the balance components is associated with a decrease in the amount of heating of the surface layer of air. More precisely, using the heat radiation of the soil to heat the soil itself. It sounds paradoxical, but this is a very effective technique: combing the soil surface. This technique leads to the fact that the soil from the side surfaces receives solar

radiation and with the same side surfaces of the ridges radiates heat to the side surfaces of nearby ridges. This radiated by the lateral surface of the ridge is not lost, but is acquired by those adjacent to it. In total, the soil loses less heat and accumulates. And, in addition, when combing the soil surface increases, it again consumes more solar radiation energy in total than the leveled soil surface. This is schematically shown in Fig. 4.

In recent years, with changing weather conditions, it has been possible to harvest raw cotton with more than 90% of the boxes opening. At the same time, the MX-1,8 cotton harvesting machine removes up to 90% of cotton in one pass, and horizontally spindle - more than 90%. In the last 2015-2017 years, research was conducted at the landfill of the State Center for Testing and Certification of Agricultural Technology and Equipment of the Republic of Uzbekistan on the management of the soil fertility of cotton cultivation using irrigation with flexible perforated hoses on the beds. Knowing the advantages of comb sowing, when using the results of a study on the development of technology for bed cultivation of cotton with targeted and uniform moistening of the root system of the plant, it is possible to create an even more favorable microclimate of the root system of cotton and conditions for machine harvesting of raw cotton by ensuring early ripening (for 2-3 weeks) and high yield and technical means for their implementation.

The work experience of researchers of the M. Auezov South Kazakhstan University, as a result of the implementation of the scientific and technical program for 2018-2020, shows that the formation of ridges of a given shape on the surface by raking and compacting the soil with simultaneous laying of a flexible drip irrigation tape in the center of the ridge and behind mulching with covering materials allows maintaining the moisture rate and the temperature regime of cultivation of crops. The application of the fertigation method - the use of a complex of mineral fertilizers with a drip irrigation system allows you to accelerate the growth and ripeness of crops and obtain a high crop yield [6]

RESULT AND DISCUSSION

The tasks are achieved by rigidly attaching the coulter to the shaper-sealer, completing the seeder with a device for applying fertilizer and a drip irrigation hose stacker, the indicator of sustainable irrigation is improved, the service life of the irrigation hose is increased and the use of the contact of the hose outlet with the soil to reduce the pressure of the irrigation water jet.

The seeder for sowing row crops has the advantages of straightness of sowing seeds and the formation of a compacted bed with simultaneous laying and sealing of irrigation hoses on the ridge of the bed, cultivation of crops with drip irrigation of fields using irrigation hoses equipped with water outlets for targeted and uniform moistening of the root system of the plant.

The essence of the method [4,6,8,15,16] is that the seeds are sown on the ridge of the bed above the layer of mineral fertilizers applied simultaneously with sowing, the beds are formed directly during sowing with soil compaction, and watering is carried out through drip irrigation hoses laid on the ridge of the beds in specially pressed and soil-filled recesses.

The scheme of the device is shown in Fig.1, where the relative positions of the working bodies of the seeder are presented. The seeder consists of a sequentially arranged working body 1 for fertilizing, a container 2 for fertilizers, pipeline 3, a bed sealer consisting of a visor 4, a housing 5 having the shape of mirror-mounted pre-lugs at the entrance, and a trapezoid at the exit. Visor 4, smoothly passes into the upper roof 6. The side flaps and the housing cover gradually narrow. A coulter 7 is rigidly connected to the shaper-sealer, which ensures straightness of seeding by eliminating the influence of the coulter relative to the shaper-sealer. A seed jar 8 is installed above the coulter, followed by a plug 9 for sealing seeds, a roller 10 and a device for laying an irrigation hose, including a drum 11 for winding the hose 12, guide rollers 13, a pressure roller 14, and a plug 15 for sealing the laid hose, seeds 16 are located above the applied fertilizers 17.

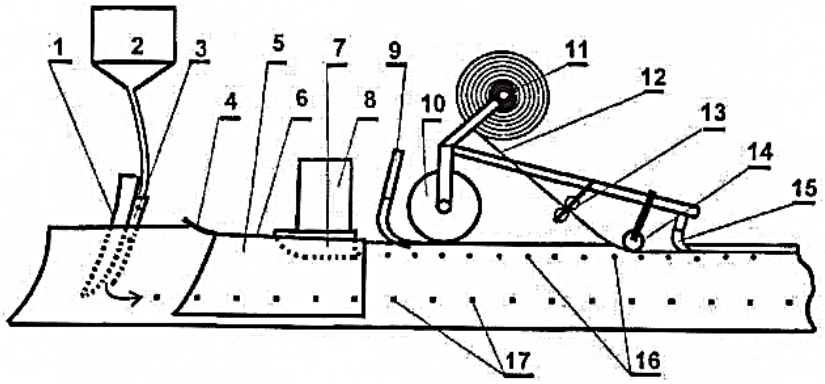

Figure 1 - Diagram of the technological process of the seeder

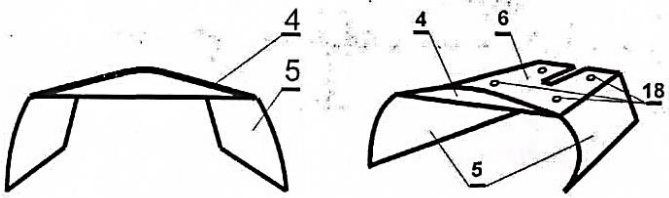

Figure 2 - Diagram of the shaper. Figure 3 - Mounting diagram

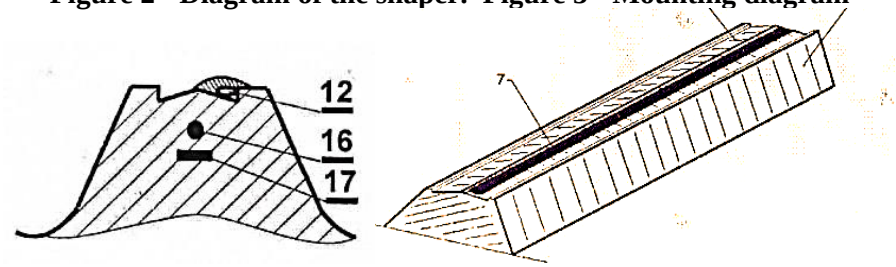

Figure 4 - Diagram of the ridge with the location of the irrigation hose, seeds and fertilizers

Fig.2 shows the front view of the bed sealer; Fig.3 shows the sealer in isotherm with holes 18 for the bolts of the rigid attachment of the coulter to the shaper.

The technological process of the seeder and the functional tasks of its elements are as follows.

With the progressive movement of the seeder, the working body 1 introduces mineral fertilizers into the soil, the dumps of the shaper-sealer 5 are raked, and the soil ridge previously prepared before sowing is compressed in the horizontal direction and given a predetermined shape. Due to the narrowing of the section of the body of the shaper, the beds are pressed to a given amount of soil density.

As with a conventional seeder, the coulter 7 sows seeds on the ridge of the bed, the seed cutter 8 seals the seeds, the rolling roller 9 seals the soil over the sown seeds to ensure reliable contact of seeds with the soil and squeezes out the recesses on the ridge of the bed for laying the drip irrigation hose. In these recesses, the irrigation hose 12 is laid, winding it from the drum 11, passing it through the guide rollers 13 and the rolling roller 14, and the zagortach 15 fills the hose with a layer of soil. Thus, in one pass of the seeder, the entire cycle of work is provided for the creation of a compacted bed, local and targeted application of fertilizers 17, sowing seeds 16 and laying the irrigation hose.

The cross-section of the bed after the passage of the seeder with the sown seeds 16, the introduction of fertilizer 17 and the laid irrigation hose is shown in the figure 4.

The advantages of drip irrigation (saving irrigation water, fertilizers, reducing the cost of weed control) are well known, thanks to which the method is widely used on a global scale mainly in plantation cultivation of agricultural crops.

The task of the irrigation hose design is to improve the irrigation stability indicators and increase the service life of the irrigation hose.

In the design of the irrigation hose made of elastic plastic, the water outlets are arranged in a line on one side of the irrigation hose with flanks at the edges of the holes to give them strength against ruptures at the edges of the holes. The outlets are round holes, the ratio of their holes to the diameter of the irrigation hose is d / D = 1/ (30... 40), the holes are made in the wall on one side of the hose at a distance of L = 80 ...400 mm.

The design of the irrigation hose is shown in Figure 5, a transverse section of the hose 2 filled with water 8 and a water outlet 3, along the edges of which is made from the side 4.

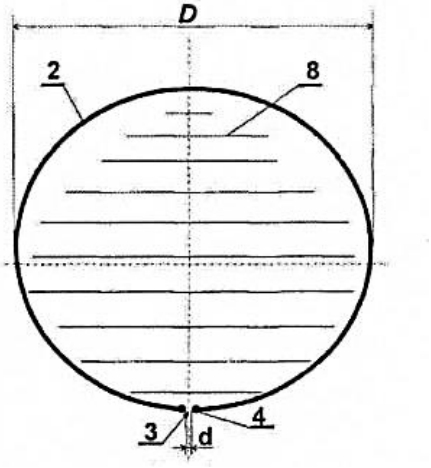

Figure 5-Irrigation hose design

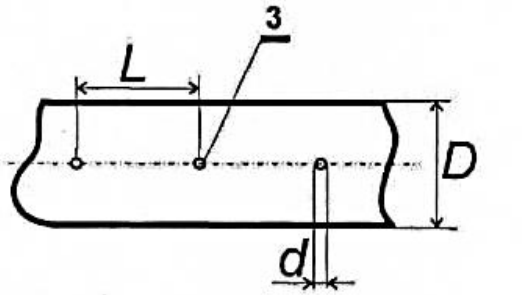

Figure 6-A piece of irrigation tape

Figure 6 shows the location of the water outlets 3 on the hose segment.

As can be seen, the irrigation hose has a relatively simple design, the ratio of the diameter of the holes to the diameter of the hose 1 / (30 ... 40) allows for uniform water flow along the irrigation hose at low pressure. Due to the fact that the hose filled with water is located with water outlets down, the irrigation water jet reduces the pressure due to soil resistance and the irrigation effect turns out to be adequate for watering drops, that is, the soil in contact with the dropper compensates for the pressure of the jet.

The task of the method of laying the irrigation hose is the contact of the water outlets. As a result, the soil, due to direct contact with the outlet, acts as a pressure compensator for the water jet, and a thin layer of soil on top of the hose protects it from sunlight, thereby prolonging its service life.

The irrigation hose is placed on the ridge of the bed for drip irrigation with water outlets to the soil surface and is covered with a layer of soil; the angle of deviation from the axis of the water outlet to the soil surface should not exceed 15^0.

The best option for laying the hose is considered to be with the location of the outlets normal (perpendicular) to the soil surface. At the same time, experiments carried out in the Yangiyul district at the testing ground of the State Center for Certification and Testing of Agricultural Machinery and Technologies under the Cabinet of Ministers of the Republic of Uzbekistan showed that the contact of the outlet with the soil (due to deformations of the soil and the hose) is also achieved when the outlet axis deviates to the soil surface by 150. In the experiments, we used a GRANDFAR-1 water pump with a capacity of 30 cubic meters per hour per hectare. All irrigation hoses are locally sourced. Irrigation hoses are flexible, have a thickness of 250-300 microns, a certain diameter and size of the hole for irrigation, during irrigation, the hose expands in diameter, and if not, it narrows, and thus self-cleaning from the silt layers inside the hoses occurs. The length of the irrigation hoses is from 100 to 250 meters, the distance between the holes is from 7 to 10 cm. By this method, irrigation can be organized immediately after sowing as in agricultural technology. In the studies, it was determined that the water consumption for furrow surface irrigation was 6000 m3, and with the proposed method of irrigation on the ridge - 2000 m3. Irrigation furrow openings and manual thinning were not performed.

The laying of the irrigation hose is shown in Figure 7, where the cross section of the bed 1, irrigation hose 2, water outlet 3, trace 5 from the sealing roller of the seeder, soil layer 6 to cover the hose from solar radiation, contour 7 of the humidification zone, root system 8 of the plant, angle α of the deviation of the axis of the water outlet to the soil surface is schematically presented.

The irrigation hose is laid out in the field along the rows of plants on the ridge of the bed on the trail of the curly rolling roller (rolling) of the seeder with water outlets down. One end of the hose is hermetically sealed, and the other is connected to a source of irrigation water with a pressure (0.1 ... 0.3 atm.). Water entering the hose fills it and flows out through the holes. Meeting the resistance of the soil reduces the pressure, providing irrigation in a similar way to watering with drops. Thus, the soil serves as a jet pressure compensator. At the same time, water seepage does not occur along the side surfaces.

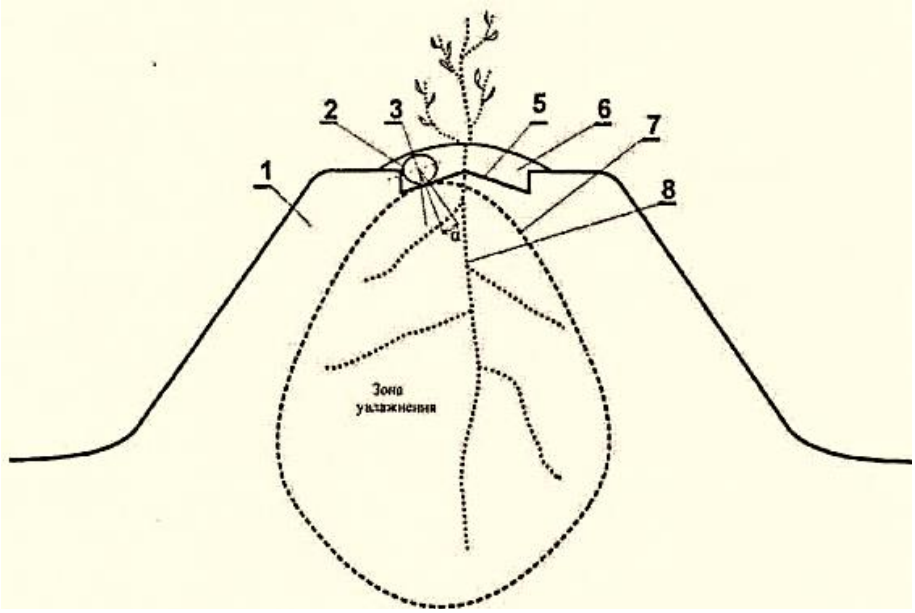

Figure 7- Laying scheme of flexible drip irrigation tape

CONCLUSION

1.This method of laying makes it possible to organize feeding watering of seeds with simultaneous supply of herbicides of a selective nature for the destruction of weeds in the protective zone of the plant. During the growing season, it is possible to organize watering with fertilizers as needed and in the right amount together with watering. At the end of the vegetative period, with the last watering, a liquid desiccant is supplied for desiccation of the plant, thereby ensuring the completeness of defoliation of the plant leaves, and this provides the possibility of full disclosure of the boxes and creating conditions for machine harvesting of raw cotton by ensuring early ripening (for 2-3 weeks) and high yield.

2. The economic effect of the proposed method is determined by reducing labor costs and costs of replanting, combining targeted fertilization and sowing operations, increasing yield and quality of harvesting due to a better agrophone (straightness of bushes in a row).

3. The implementation of the proposed irrigation method will allow, along with saving irrigation water and fertilizers inherent in drip irrigation, significantly simplify the design of the irrigation hose and increase its service life, which will naturally have a beneficial effect on the production efficiency of the irrigation hose and agricultural products.

References

1. Khudayarov B.M., Kuziev U.T., Sarimsakov B.R. The dependency of the distance of throwing soil to the size of the working body // International Journal of Research Culture Society. – India, 2019. –Volume-3, Issue-10, Pages:45-49.
2. Khudayarov B.M., Kuziev U.T., Sarimsakov B.R. The local aggregation of diluted fertilizers to gardens and the constructive scheme of the working part // International Journal of Research Culture Society. – India, 2019. –Volume-3, Issue-10, Pages: 111-116.
3. Khudayarov B.M., Kuziev U.T., Sarimsakov B.R., Khudaykulov R.F. The resistance to pulling the working part where the manure juice is poured locally// International Scientific Conference "Construction Mechanics, Hydraulics and Water Resources Engineering" CONMECHYDRO-2020. – April 23-25, 2020 in Tashkent, Uzbekistan.
4. Khudayarov B.M., Kuziev U.T., Sarimsakov B.R., The dependency of the distance of throwing soil to the size of the working body//International Journal of Research Culture Society (India) 3 (10), 45-49.
5. Berdirasul Khudayarov, Ajargul Mambetsheripova, Ulugbek Kuziyev, Bakhtiyar Sarimsakov. Free movement of mineral fertilizers and their mixtures in air//IOP Conference Series: Materials Science and Engineering 1030 (1), 012159.

6. Kalimbetov B. E. Report research on scientific and technical program BR05236680: "the intensification of the production of vegetables through the implementation of agricultural activities receiving 3 meals a day of harvest and the development of a s et of agricultural machines and devices for this purpose in the southern Kazakhstan region" – Shymkent, 27-35 (2018-2020).
7. Khudayarov Berdirasul, Kuziev Ulugbek, Sarimsakov Bahtiyor, Abdiyev Navruz. The Technology of Opening a Furrow and Creating a New Garden Bed in Cotton Stalk Fields//International Journal of Engineering and Advanced Technology 9 (1), 4847-4849.
8. Mamatov F.M., Eshdavlatov E., Suyunov A. The Shape of the Mixing Chamber of the Continuous Mixer // Jour of Adv Research in Dynamical & Control Systems, Vol. 12, 07-Special Issue, 2020. DOI: 10.5373/JARDCS/V12SP7/20202318 ISSN 1943-023X.
9. Mamatov F., Ergashev I., Ochilov S., Pardaev X. Traction Resistance of Soil Submersibility Type "Paraplau" // Jour of Adv Research in Dynamical & Control Systems, Vol.12, 07-Special Issue, 2020. DOI: 10.5373/JARDCS/V12SP7/20202336 ISSN1943-023X.
10. Aldoshin N., Mamatov F., Ismailov I., Ergashov G. Development of combined tillage tool for melon cultivation // 19th international scientific conference engineering for rural development Proceedings, Jelgava, 20.-22.05.2020. Volume 19.ISSN 1691-5976.
11. Umurzakov U., Mirzaev B., Мамatov F., Ravshanov H., Kurbonov S. A rationale of broach-plow's parameters of the ridge-stepped ploughing of slopes // XII International Scientific Conference on Agricultural MachineryIndustry IOP Conf. Series: Earth and Environmental Science 403(2019) 012163 IOP Publishing. doi:10.1088/1755-1315/403/1.
12. Mirzaev B, Mamatov F, Chuyanov D, Ravshanov X, Shodmonov G, Tavashov R and Fayzullayev X. Combined machine for preparing soil for cropping of melons and gourds // XII International Scientific Conference on Agricultural Machinery Industry. doi.org/10.1088/1755-1315/403/1/012158.
13. Mirzaev B, Mamatov F, Ergashev I, Ravshanov H, Mirzaxodjaev Sh, Kurbanov Sh, Kodirov U and Ergashev G. Effect of fragmentation and pacing at spot ploughing on dry soils // E3S Web of Conferences 97. doi.org/10.1051/e3sconf/201913501065.
14. Mamatov F, Mirzaev B, Shoumarova M, Berdimuratov P, Khodzhaev D. Combformer parameters for a cotton seeder// International Journal of Engineering and Advanced Technology (IJEAT) Volume-9 Issue1 October/ DOI: 10.35940/ijeat.A2932.109119.
15. Mamatov F., Mirzaev B., Batirov Z., Toshtemirov S., Tursunov O., Bobojonov L. Justification of machine parameters for ridge forming with simultaneous application of fertilizers // CONMECHYDRO – 2020 IOP Conf. Series: Materials Science and Engineering 883(2020) 012165 IOP Publishing. doi:10.1088/1757-899X/883/1/012165.
16. Mirzaev B, Mamatov F, Avazov I , Mardonov S. Technologies and technical means for anti-erosion differentiated soil treatment system // E3S Web of Conferences. doi.org/10.1051/e3sconf/20199705036.
17. Aldoshin N., Didmanidze O., Mirzayev B., Mamatov F. Harvesting of mixed crops by axial rotary combines // Proceeding of 7th International Conference on Trends in Agricultural Engineering 2019. 17th-20th September 2019 Prague, Czech Republic. – pp.20-26.
18. Mirzaev B, Mamatov F, Aldoshin N and Amonov M. Anti-erosion two-stage tillage by ripper// Proceeding of 7th International Conference on Trends in Agricultural Engineering 17th-20th.September 2019 Prague, Czech Republic. – pp.391-396.
19. Mirzaev B, Мамatov F Ergashev I, Islomov Yo, Toshtemirov B, Tursunov O. Restoring degraded rangelands in Uzbekistan // Procedia Environmental Science, Engineering and Management 2019. № 6. – pp 395-404.
20. Uzakov Z.U., Mamatov F.M., Begulov O. Implementation of object-oriented Programming technology in the one-dimensional oil displacement problem // International Conference on information Science and Communications Technologies: ICISCT 2019/0012008.
21. Mamatov F., Mirzaev B., Berdimuratov P., Turkmenov Kh., Muratov L., Eshchanova G. The stability stroke of cotton seeder moulder // CONMECHYDRO – 2020. IOP Conf. Series: Materials Science and Engineering 883 (2020) 012145 IOP Publishing.
22. Mamatov F., Mirzaev B., Tursunov O. A Justification of Broach-Plow's Parameters of the Ridge-Stepped Ploughing // E3S Web of Conferences 97, 05035 (2019).
23. Ahmedov, B.J., Mirzaev, B.S.,Mamatov, F.M., Khodzhaev, D.A., Julliev, M.K.Integrating of gis and gps for ionospheric perturbations in d- And f-layers using vlf receiver // InterCarto, InterGIS 26, c. 547-560.
24. F Mamatov, B Mirzaev, O Tursunov, S Ochilov and D Chorieva. Relief, physico-mechanical and technological properties of soil in the cotton growing area // ICECAE 2020. IOP Conf. Series: Earth and Environmental Science 614(2020) 012169. IOP Publishing. doi:10.1088/1755-1315/614/1/012169.
25. Z Shamsutdinov, ShUbaydullaev, N Shamsutdinov, B Mirzaev, F Mamatov, and N Chorshabiyev. The concept of the phytogenic field: theory, research experience and practical significance // ICECAE 2020. IOP Conf. Series: Earth and Environmental Science 614(2020) 012164. IOP Publishing. doi:10.1088/1755-1315/614/1/012164.