Methods of managing the agricultural background of cotton and technical means for their implementation

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Abstract. In the complex of measures aimed at reducing the laboriousness of cultivating and growing high yields of raw cotton, a major role is given to further improving the technology and means of mechanizing cotton sowing. In recent years, rainy weather has been observed during the period of sowing cotton, as a result of which the germination of cotton seeds is significantly delayed. When showers, puddles form on the traces of the seeder, which leads to rotting of the seeds, as a result of which repeated sowing is carried out. When cultivating cotton on the ridges, in accordance with the theoretical foundations of soil cultivation, a favorable composition of the arable layer is ensured for a long period of cotton growing. This contributes to friendly shoots, good plant development and a high yield of raw cotton with early ripening, moisture accumulation on the ridges eliminates soil pollination, destruction of the structure, and formation of soil crust. Using the drip irrigation system allows to provide plants with water and fertilizers, where necessary, at the right time and in the right amount.

1. Introduction

When creating new machines and modernization in the production of the company-manufacturers pay increased attention to soil conservation (soil protection) and give relevant recommendations [1]:

- it was found that the deviation from the given seed placement depth is more than ± 10 mm results in a loss about a quarter of the crop;
- with compacted soil, grain yield decreases to 19 %;
- each centimeter of the gauge is about 10% of the fuel overrun;
- when introducing high-precision technologies with 1 kg of seeds, you can get 40-70 kg of grain (versus 12 kg with extensive technologies) at a fuel cost of 1 kg for 7-9 kg of grain (against 2-3 kg);
- Xpress system (Amazon company) provides an opportunity to increase productivity by 50%;
- the use of multifunctional machines provides an increase in labor productivity up to 60-65% and a decrease in fuel consumption by 1.5-2 kg/ha.

Cotton is the most important technical culture, the product which is used in many sectors of the national economy. More than 150 types of products, materials, and products used for technical, food, feed, and other purposes are produced from cotton fiber, seeds, and other parts of plants. The demand for cotton fiber is especially great, the share of which among all fibrous materials used in the national economy is 60 – 70%.

To plant cotton seeds in to the soil modern cotton seeders, several working bodies are used that perform various technological operations following specified agrotechnical requirements. However, when sowing on a smooth field after passing the seeders of various designs, a triangular comb remains (Fig. 1). The indicated advantages of accurate sowing of cotton have been established by numerous
researchers of scientific institutions and confirmed by the practical experience of advanced cotton farms.

![Figure 1. Scheme of the trace of the sowing working body of the seeder on a smooth field; b is the row spacing](image)

In the literature [2, 3, 4] there are indications that a convex roller over the seeds is needed to drain rain moisture from it to avoid the formation of a soil crust, and therefore its surface should be compacted. The compaction of the soil with the roller should also be sufficient to ensure that the seed comes into contact with moist soil. The requirement for dripping water from the roller formed by the roller can be fulfilled if the roller is triangular and the corners of the base are sufficient to drain the water. At the same time, the angle is limited by the permissible rate of water runoff, at which the soil does not erode and its structure is not destroyed, which is especially important for the structureless soils of Central Asia. By A.N. Kostyakova [2, 5], this value should be 0.1 - 0.2 m/s. For nesting sowing, the corners of the base of the roller are 300.

The purpose of the work is to determine how to control the cotton agricultural background using drip irrigation on ridges and technical means for their implementation.

2. Methods

Based on the theoretical foundations of soil cultivation, to create the optimal density of the arable layer and maintain it during the growing season, Soyuz NIIHI developed a new technology for cultivating cotton on ridges and crests [7, 8].

Crests with a height of 28-30 cm and row spacing of 90 cm are made in the fall against the background of autumn plowing pre-aligned. When the optimum time for sowing cotton is reached, it is carried out with a conventional cotton seeder of various modifications, adapted for passage through deep furrows.

With the existing agrotechnology of cultivating cotton and sowing on a smooth field as a result of early spring and pre-sowing treatments, the top layer of soil is heavily sprayed and with heavy rainfall, a dense soil crust is formed.

On crests made since autumn, as crests of variable weather factors during the autumn-winter period, the topsoil acquires a finely crumpled structure with favorable physical properties.

3. Results and Discussion

The loose addition of the ridges provides high water permeability, and when precipitation even storms, moisture quickly penetrates the lower layers of the soil, and its excess flows into the bottom of the furrow and is infiltrated into the root system. Therefore, moisture accumulation is excluded from the crests, which leads to the pollination of the soil, destruction of the structure and formation of the soil crust. The soil crust on the crops along the crests has less weight and thickness, and its density is two to three times less than on the crops on a smooth field, as a result of which it does not prevent the emergence of cotton seedlings.
In the context of irrigated agriculture of central Asia in spring due to the low temperatures of air and precipitation often warming the soil always insufficient, whereby the cotton seed germination significantly delayed. Therefore, agricultural techniques that contribute at least some increase in soil temperature in spring are very appropriate and deserve attention.

Differences in soil temperature observed on a smooth field and crops along crests show that, at all observation times, the temperature is higher on ridges. Studies have established that the soil temperature at a depth of 5 cm on crests is always higher than when sowing on a smooth field by 1.5 - 4.0°C. The same thing was observed at a depth of 10 and 15 cm.

During the period of cotton seedlings, crests and ridges have two important advantages before sowing along a smooth field: 1) the formation of a powerful soil crust is excluded and 2) a higher soil temperature is ensured. Due to this, the emergence of cotton seedlings is earlier observed on ridges than when sowing on a smooth field.

In the process of making ridges and crests, the soil from the place of the future furrow is removed and superimposed on the place of the ridge and crests. As a result, there is a significant increase in the thickness of the arable layer due to the upper cultivated arable land. This creates in comparison with sowing on a smooth field, where there are great advantages in the content of nutrients on ridges and crests.

On crops on a smooth field, the highest content of humus, total nitrogen, and phosphoric acid is noted in the upper soil layers within 30 cm and sharply decreases deeper. When a hand-made article of ridges and crests humus content of total nitrogen and phosphorus, due soil higher up to a depth of 40 cm. Accordingly, crafts ridges and crests contribute power arable layer in comparison with the smooth sowing field, without increasing the depth of plowing.

The important condition for a high yield of raw cotton along the crests is to ensure early and friendly sprouts of cotton. It was established that sowing on crests, in comparison with sowing on a smooth field due to the small- ply surface of the arable land, lack of soil crust, better warming of the soil, provides a significant run in cotton seedlings and ensures the necessary density of plants. In years with a cold rainy spring, the appearance of cotton seedlings on crests and ridges was ahead of their appearance in comparison with crops on a smooth field by 4-6 days, and under favorable spring conditions by 3-4 days.

Favorable water-physical properties and nutritional conditions on ridges and crests contribute to the race in the development of cotton and the accumulation of more bolls than on crops on a smooth field. Sowing cotton on the crests, due to these conditions, provides a higher yield of raw cotton. The increase in the yield of raw cotton on the ridges was 8.0 kg/ha, and on the ridges – 4 – 5 kg/ha, compared with sowing on a smooth field.
The technology of cultivating cotton on ridges and ridges between rows of 90 cm is fully mechanized on the basis of the existing agricultural machinery of cotton modification. Traction of tractors provides crafts ridges and ridges. For sowing and care, existing seeders and cultivators can be used with some alterations. Harvesting is carried out by ordinary cotton-picking machines. The technology of sowing cotton on ridges and crests allows combining cultivation with cutting furrows to significantly reduce the number of tractor work in the process of caring for plants.

Comb sowing is widely used in the United States. In the article by Ramidovsky Yu.M. “Development of cotton growing in the USA”, it is noted that cotton is widely used in the USA for ridges and crests (J. Cotton Production, No. 5, 1972). In our opinion, writes Ramidovsky Yu.M., the work of scientists L.Kh. Wilkis and P. Hobgud, “Increasing a cotton yield by using a new soil and sowing system” (Texas, 1968). They claim that in a typical cotton field, half of the plants yield less than 25% of the total quantity. If the conventional method of sowing the maximum germination rate ranges from 23.4 to 72.6%, the new technology it is 67-80 %. Cotton harvest using the new soil cultivation and sowing system increased on average by 28.2%. The authors believe that this is achieved by improving the surrounding microenvironment and extremely uniform development of plants in rows and throughout the field. In 1977, the cotton regions of the United States were visited by a delegation led by Deputy Minister of Agriculture A. Chubarov, who also noted that cotton sowing on crests was widely used in the USA (J. Cotton Production, No. 10, 1977). Describing the climatic conditions of the state of California, Chubarov A.T. notes: “The conditions of this zone are most similar to the conditions of the Central Asian republics of the USSR” and further, “Charging irrigation is given before sowing. They sow mainly on the ridges with bare seeds and precision seeders”.

Ridge and crests crops in the order of experiments started in the Union of the Scientific and Research Institute of Chemical Engineering [9]. Here, after autumn plowing, ridges and crests are made up to 35 cm high, 160 and 80 cm wide, respectively. Experiments have shown that the volumetric weight and soil temperature during ridges and comb crests are more favorable for cotton growth and development than with conventional crops. It is noted earlier than the emergence of seedlings, the crop rises. This is greatly facilitated by the powerfully developed root system. The total weight of the dry mass of the roots in the soil layer 0-40 cm in the cotton planted on the ridges was almost three times, and on the crests - twice as much as when sowing on a smooth field. Accordingly, the average yield of raw cotton for 1970-1972, increased by 8.1 and 4.2 c / ha compared with the control (V.P. Kondratyuk, 1972; Yu.A. Pogosov, 1973).

Experiments in this direction are desirable to continue. It is very important to establish reasonable parameters - the depth and width of ridges and ridges, conditions for pre-sowing and post-sowing treatment, irrigation patterns, and norms; to develop on their basis agrotechnical requirements for the designed machines and implements. The following method of soil preparation and sowing can also contribute to the early germination of cotton. A day or two before the start of sowing, straight furrows with a depth of 18-20 cm every 90 cm are cut in a carefully prepared field for pre-sowing, every 90 cm (for a wide-row method of sowing). After one to two days after cutting the furrows, when the soil moisture is more evenly distributed along the height of the furrow, spend sowing on the crest of the latter. To remove the topmost insufficiently moist soil layer, knives are installed in front of the drill coulters. In this case, the seeds fall into loose moist soil, which ensures the emergence of friendly seedlings of natural moisture.

In areas where there is little atmospheric precipitation and seedlings are obtained by carrying out emergency irrigation, they are carried out on previously cut straight furrows. After the soil has ripened, harrowing is carried out in the longitudinal direction. Harrowing somewhat cuts the soil, destroys the emerging weeds, removes the dried layer of soil. As a result, the best conditions for sowing are created - the seeds are planted in moist and loose soil on the crest of the furrows. A good result could be obtained by combining the described method of sowing with simultaneous mulching of the sowing rows with oil products and other mulching materials, for example, crushed dry manure.

The data obtained [9] by M. Mukhamedjanov clearly show that inter-row cultivation of cotton does not affect on the air regime of the soil and, provided that the fields are cleared of weeds, the plants are...
provided with water, and the upper layer of the soil is maintained in a loose state, long-distance cultivations can be avoided or completely avoided. The root system of cotton during the growing season does not need additional aeration enrichment with oxygen by loosening the upper soil layer. Inter-row cultivation is necessary only for the destruction of weeds, the preservation of moisture in the soil (combating the crust that withers the soil), and sometimes to deepen the middle of the irrigation furrow and where it is necessary to increase the evaporation of moisture from waterlogged soils. In the absence of weeds and soil crust, the number of row-spacings should be minimized. In the absence or deficiency of atmospheric oxygen supply through the soil surface, the root system can function normally due to air oxygen entering the roots through the aerial part of cotton, as well as oxygen released during metabolism and restoration processes in plants and soil.

In recent years, with changing weather conditions, the possibility of harvesting raw cotton has been created with 90% of the opening of the cocks. At the same time, the MX-1.8 cotton picker removes up to 90% of cotton in one pass. This is due to spring rainy weather (risky farming) and dry with increased air temperature in summer and autumn. For: it is necessary to create a cotton agricultural background for machine harvesting, hence, to develop the conditions for managing the agricultural background. In the last 2015-2017 years in the range of the State Center for Testing and Certification of Agricultural Technology and Technology of the Republic of Uzbekistan, studies were conducted to manage the agricultural background of cotton cultivation using drip irrigation on the ridges [11]. Knowing the advantages of raised bed planting, with the use of drip irrigation on the crests, you can create an even more favorable climate in the root system of cotton.

Analyzing the existing technologies of cultivating cotton on ridges and crests, about risky weather conditions, we have developed a technological scheme for controlling cotton agrofon using drip irrigation on crests and technical means for their implementation [12] (Fig. 2). Similar technologies are used for other crops, for example, for potatoes [10]. When using the drip irrigation system for sowing cotton seeds during the crest of the formation, perforated tapes are laid at the top of the crests. For these purposes, brackets are mounted on the crest of the imaging plate of the gun for mounting coils with ribbons. In the center of each row, a metal tube is installed on the crest of the forming plate, through which the tape is fed to the top of the crest. The lower end of the tube is directed in the direction opposite to the direction of movement of the unit and is set to 2-4 cm, measured from the top of the crests. This arrangement of the tube provides complete cover with a layer of soil of the tape of the drip irrigation system, which best affects the distribution of moisture in the area where the root system of cotton is located.

Figure 3. Technological scheme of technical means for controlling cotton agrofon using drip irrigation on crests: 1 is crest forming discs; 2 is a mill; 3 is a noise; 4 is shaper comb; 5 is opener; 6 is sealants; 7 is a drum for a drip hose; 8 is drip irrigation hose.

a) the type of location of the drip irrigation hose on the crests; b) a bulbous form of moisture inside the crests; c) the type of arrangement of the comb shaper, the coulter for sowing and the layout of the drip
irrigation hose on the comb; 1 is comb former; 2 is cutting the upper part of the crests to prepare for sowing; 3 is opener; 4 is messengers; 5 is sealant; 6 is drum for laying out a hose; 7 is hose for drip irrigation; 8 is hose guide; 9 is zagortachki to seal the hose; 10 is top of the crest; 11 is prepared crests; 12 is onion-shaped wet layer.

Figure 4 shows the location of the drip hose, while the onion-shaped form of the wet layer, while inside the crests, does not leak moisture sideways. Hence, all the moisture is spent on the root system, which also has a bulbous shape. Literature analyzes show that with crests sowing, the temperature of the root system increases. However, when you consider that the driving force is considered the heat of the body, determined by the formula

$$Q_L = M \cdot c \cdot t_0 \quad \text{kJ}$$

where $M$ is the amount of heat of the root system, $kJ$; $t_0$ is Body heat capacity, $Q_t$/kgf; for air with $v = 1 \text{ kJ/kg gr}$; for water with $v = 4.19 \text{ kJ/kg g}$; $C$ is soil temperature, °C.

Having more heat in the moist layers of the soil, its volume expands, creating a loose layer and a favorable microclimate of the cotton root system. This gives opportunities earlier and even shoots the intensive development of the plant. Since with such irrigation water does not leak out on the sides of the ridge, reusable row-spacing cultivation disappears. Only after rainy weather at the beginning of the sowing season, the resulting crusts and weeds are destroyed, possibly using a cultivator razor set at 135° relative to the sides of the crests or by active working bodies such as mills.

The proposed system of drip irrigation, the pump collects water directly from the irrigation canals through vessels for dissolving organic or mineral fertilizers. In the experiments, we used a water pump of the GRANDFAR -1 type with a capacity of 30 cubic meters per hour per hectare. All hoses of local production according to our orders (Fig. 5). Irrigation hoses have through holes, and since they are located on the top of the ridge under the soil layer of 2–3 cm, they do not spray when pressure is created through the holes, i.e. the soil itself is a pressure compensator. Flexible irrigation hoses [12, 13, 14], have a thickness of 250-300 microns, a certain diameter, and size of the hole for irrigation; when irrigating, the hose expands in diameter, and in the absence, it narrows, and thereby self-cleaning from the layers inside the hoses. The length of irrigation hoses is from 100 to 250 meters, the distance between the holes from 7 to 10 cm. According to this method, watering can be organized immediately after sowing (in areas where there is little atmospheric precipitation and seedlings are obtained by carrying out emergency irrigation), as well as in agricultural technology. In the studies, it was determined that the water flow rate for surface furrow irrigation was 6000 m³, and for drip irrigation - 2000 m³. Opening irrigation furrows, manual thinning were not performed. Productivity increased by 25.6% and labor costs decreased.

4. Conclusions
Thus, based on the results of the study, it is possible to establish reasonable parameters - the depth and width of ridges and crests, conditions for pre-sowing and after-sowing treatment, irrigation patterns, and rates; to develop on their basis agrotechnical requirements for the designed machines and implements.

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