Application of energy and resource engineering software in cotton fields

Kh Kh Olimov, A N Juraev, S J Imomov, S S Orziev, T O Amrulloev

Bukhara branch of the Tashkent Institute of Irrigation and Agricultural Mechanization Engineers. Bukhara City. Gazli ave. 32. 200100. Uzbekistan

E-mail: asliddinj688@mail.ru

Abstract: This article is devoted to the mechanization of agriculture and is aimed to achieve resource savings through the effective use of machinery and technology in lightening the burden on farmers in field farming. Rainfall or irrigation water tends to melt down the weak bonds between these soils particles and allow those individual particles to lodge closer together. Then, when the soil dries, those same particles form a tight bond that creates a soil crust. We have developed tools for breaking up the soil crust. The structure of the new device will consist of the following. A metal profile with a total length of 3.5 meters (1), 4 handles (2) are welded, one (3) working body is mounted on each handle. This means that when each working body processes cotton seedlings sprouted from one row, it is possible to further increase the number of rows with a total processing capacity of up to 5 rows. We determine the width of the unit depending on the power of the tractor and diameter of the toes. Tractors with 80-100 horsepower can handle up to 8 rows Therefore, on the basis of the above data, it can be said that the diameter of the toes should be in the range of 200-250 mm for quality softening of the layer at the required level with minimal damage to cotton seedlings.

1. Introduction

Have you ever walked out into your garden after a rain or an irrigation and noticed a hard crust on the surface of the soil? These soil crusts can have a huge impact on the success or failure of both young seedling plants and established plants alike. If we are going to garden in the desert, it is important to know about soil crusts and how to deal with them.

Any time that water touches the soil, it can have an effect on its structure, or the way that the soil particles are arranged one against another. For good plant growth, we like a loose soil that accepts water and air easily. Rainfall or irrigation water tends to melt down the weak bonds between these soils particles and allow those individual particles to lodge closer together. Then, when the soil dries, those same particles form a tight bond that creates a soil crust.

These crusts are particularly damaging to seedling crops trying to poke their way through to the outside light and air. If they can not push their way through, they die. In addition, soil crusts can slow down the penetration of air into the spaces between soil particles, especially after an irrigation. Air in the pore spaces accomplishes many things, but most importantly, it slows down the development of high populations of root disease organisms which do their best thing when the spaces between the soil particles are filled with water. In these ways, soil crusts can damage not only new seedlings, but existing plants as well.

We consider the bottom of a pond or lake when it dries. The soil tends to separate into crust segments with large cracks in between. Though often not so dramatic, we often see the same kind of
conditions in our gardens when soil crusts form. I believe that we can agree that plants placed into those growing conditions might struggle a bit.

Local farmers deal with soil crusts all the time. Take the cotton crop as an example. The first step in planting cotton is to work up the furrows and fluff the soil well so that it will absorb water. Then, it is time to pre-irrigate, or add water to the soil. This is done early in the spring before they ever think about putting seed into the ground. Pre-irrigation stores water down deep in the soil so that when the plants need it most during the summer, their deep roots can find it and pick it up. One of the after effects is the hard crust that develops in and over the furrows where water meets the soil. If a rain comes, the crust will extend over the entire field.

This crust will be broken up just before planting time. When seed is placed into the ground, the surface of the soil is generally thoroughly tilled using various pieces of equipment so that the seedlings can have the best possible start. Just when the seeds are about to emerge, the crust over the top of the seed bed is again broken up so that the new seedlings can pop through the surface of the soil to the sunlight and air so valuable to the new plant. Then, just before the first irrigation which comes later in the season, a tractor will again pass through the field dragging some type of implement to break up the crust down in the furrows. If these key management functions are not carried out, the seedlings could suffer. A reduced payday at the end of the season could be the result.

![Figure 1. Soil crusting in heavy clay soils will often crack open as the soil dries.](image)

Crust is a hard layer that forms on the soil surface after heavy rains and irrigation. In Central Asia, almost all soils in irrigated farming areas are prone to hardening. The main reason for this is the extremely low granularity of these soils and the fact, that the soil aggregates are very resistant to water. After rain or irrigation, the top layer of soil thaws, hardens when it dries, and the surface cracks. Hardening has a negative effect on soil properties and the development of agricultural crops, slows down water permeability and air exchange in the soil, as well as accelerates the evaporation of soil moisture (up to 20-30%). In fields with very thick loam, the germination of grass is delayed for 3-5 days and the number of seedlings decreases.

The process of sediment formation depends on the mechanical composition, type, cultural condition, salinity, and so on. The sediment is mostly formed in irrigated gray and desert soils. Its thickness and hardness depend on the severity of the mechanical composition of the soil. Particularly in heavy sandy, loamy, salty brown soils and bald soils with a mechanical composition, the layer is thick and very hard. Salinization and salinization increase the tendency to form crusts. The thickness of the layer is 0.3-0.5 cm in light gray soils with light sand and loam, 0.8-1.5 cm in light and dark gray soils, 2.4-4.5 cm in weakly saline sandy and loamy soils; the weight of a layer of soil on one m² reaches 50-70 kg. Applying organic fertilizers to crops, sowing of siderite crops, chemical reclamation, crop rotation, granulation of soils, use of artificial polymers and mulching materials, etc. Implement measures to improve the physicochemical properties of soil, prevent stratification. Takes before the seedlings emerge; the field is softened with the help of light storms or rotary mowers. To minimize the effect of tillage, the crop should be treated (mowing or cultivating) with soil compaction between rows.
2. Procedure of research

Research work is being carried out around the world to develop new scientific and technical bases of resource-saving technologies and technical means for softening the crust in the fields planted with agricultural crops. One of the important tasks in this direction is the development of a constructive scheme of working bodies and substantiation of technological processes, quality of work and development of resource-saving working bodies in the process of interaction with the soil. At the same time, it is necessary for the cotton cultivator to develop disk working bodies that soften the layer at the required level without damaging the cotton seedlings. Extensive measures are being taken in the agricultural production of the Republic to save resources, cultivate agricultural crops on the basis of advanced technologies and develop high-efficiency agricultural machinery [1, 2]. The Action Strategy for the further development of the Republic of Uzbekistan for 2017-2021 includes, among other things, “Modernization and accelerated development of agriculture, further improvement of the reclamation of irrigated lands, development of reclamation and irrigation networks, intensive methods of agricultural production, especially water and resources. Introduction of modern saving agro-technologies, use of high-yielding agricultural machinery, one of the important tasks in the implementation of these tasks. In particular, the maintenance of agricultural crops and the technical and technological renewal of mitigation equipment after rainfall is a topical issue today [3].

![Figure 2: Sprouting of cotton in a stagnant field](image)

Irrigated lands in cotton-growing areas are focused on natural-climatic and soil conditions, mechanical composition of soil, tillage technology, machine types and agro-technical requirements. In the early development of agricultural crops should be provided with soil, air, heat environment for the growth of young seedlings. The onset of spring rains prevents the young seedlings from growing, developing, and sprouting, that is, the rain turns the soil into a muddy layer and prevents the sprouting seedlings from developing by squeezing the roots. Our farmers try to create a comfortable environment by mowing the lawn, but it takes a lot of time and physical effort. Mechanized complex cultivation, on the other hand, takes a long time and prevents the fine compaction of the resulting hard soil, as well as the formation of lumps.

3. Results of research

The proposed utility model applies to the field of agricultural mechanization, in particular the process of primary processing between rows. The structure of the new device will consist of the following. A metal profile with a total length of 3.5 meters (1), 4 handles (2) are welded, one (3) working body is mounted on each handle. This means that when each working body processes cotton seedlings sprouted from one row, it is possible to further increase the number of rows with a total processing capacity of up to 5 rows. We determine the width of the unit depending on the power of the tractor. Tractors with 80-100 horsepower can handle up to 8 rows. The main part of the working body is mounted on small frames prepared by welding (4) with soil softening fingers (5). The softening fingers are attached to the small frame by means of rotating hinges or bearings. From the forward motion of the traction tractor, the softening fingers rotate and rub the fold (Figure 2).
As for the technology of operation of the unit, the device aggregated on the tractor TTZ-80 is adjusted for processing the grids by means of adjustable traction. It is necessary to ensure that the working body is parallel to the grid and lies flat on the ground. Otherwise the quality of the processed field will not be good.

![Figure 3. Schematic diagram of the solidification device](image)

Figure 3. Schematic diagram of the solidification device

It should be noted that the range of 0.18-0.48% damage to cotton seedlings meets the initial requirements. Therefore, on the basis of the above data, it can be said that the diameter of the toes should be in the range of 200-250 mm for quality softening of the layer at the required level with minimal damage to cotton seedlings (Figure 3).

4. Conclusion
Using this device, the quality of work can be improved by reducing the consumption of metal, energy and fuel consumed in the process of softening the coating. We determine the width of the unit depending on the power of the tractor and diameter of the toes. Tractors with 80-100 horsepower can handle up to 8 rows Therefore, on the basis of the above data, it can be said that the diameter of the toes should be in the range of 200-250 mm for quality softening of the layer at the required level with minimal damage to cotton seedlings.

References
[1] Artikbaev B P Author's abstract of the dissertation of the Doctor of Philosophy (PhD) on technical sciences "Development and substantiation of parameters of disk working bodies on the cotton cultivator for softening of stalks". Tashkent. 2019
[2] Raxmatov B, Ikromova G, Yunusov R, Recommendations on agro-techniques for growing cotton varieties “Bukhara - 6”, “Bukhara - 8” and “Bukhara - 102” for Pakhtakor farms. UzPITI Bukhara branch. Buxoro, 2010
[3] Sergienko V A Technological foundations of mechanization of soil cultivation in cotton aisles. - Tashkent: Fan, 1978
[4] Standard technological maps for cotton growing in Bukhara region for 2019. Buxoro - 2018.
[5] Olimov Kh Kh and Juraev A A, 2020 IOP Conference Series: Materials Science and Engineering, 883(1), 012171
[6] Olimov Kh Kh, Khasanov I S, Imomov S J, 2021 E3S Web of Conferences 264 04070
[7] Murodov N M, Juraev A A and others. Utility model 2021 "Device for forming a longitudinal pawl between rows of cotton in one pass of the unit". Patent FAP 01645 06.21
[8] Olimov Kh.Kh, Juraev A A, Ochilov M.Z, 2020 IOP Conference Series: Materials Science and Engineering, 883(1) 012170
[9] Kuchkarov J J, Turaev B M, Murodov N M, 2020 Int, J. of Critical Reviews 7(12) 198-201
[10] Ermatova D, Imomov S, Matmurodov F, 2020 IOP Conf. Ser.: Earth Environ. Sci. 614 012132
[11] Vafoev R, Vafoev S, Akhmedov S, Imomov S, 2020 IOP Conf. Ser.: Earth Environ. Sci. 614 012093
[12] Marupov I, Imomov S, Ermatova D, Majitov J, Kholikova N, Tagaev V, Nuritov I, 2020 IOP Conf. Ser.: Earth Environ. Sci. 614 012153
[13] Sharipov L A, Imomov S J, Majitov J A, Komilov O S, Sharipov M Z, Pulatova F, Abdisamatov O S, 2020 IOP Conf. Ser.: Earth Environ. Sci. 614 012035
[14] Imomov S, Shodiev E, V Tagaev, T Qayumov, 2020 IOP Conf. Ser.: Mater.Sci.Eng. 883 012124
[15] Khasanov I S, Kuchkarov J J, Nuriddinov Kh 2020 IOP Conference Series: Materials Science and Engineering 883(1) 012174
[16] Khasanov I S, Muratov A 2020 IOP Conference Series: Materials Science and Engineering 883(1) 012217
[17] Muratov H, Imomova N, Ergashev Z, Sultanov M 2020 IOP Conference Series: Materials Science and Engineering 883(1) 012130
[18] Khmidov F R, Imomov S J, Abdisamatov O S, Sarimsaqov M M, Ibragimova G Kh, Kurbonova K I, 2020 J Critical Reviews 7(11) 1021-1023