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THE MAIN TILLING

N. S. Bibutov,
Bukhara Engineering-Technological Institute, Uzbekistan
E-mail: bibutov50@mail.ru

A. Kh. Khojiev
Bukhara Engineering-Technological Institute, Uzbekistan

ANNOTATION

The article covers materials related to the main tilling of the cotton-growing zone, reasons for the appearance of a dense soil layer, measures to eliminate the compacted soil layer by deep loosening of subsurface horizon. This improves soil fertility and thereby increases the yield of cotton.

Keywords: soil, main tilling, wrapping, plowing, structure, compaction, deep loosening, subsurface horizon, fertility, productivity

INTRODUCTION

In frame of the complex of agronomic measures included in farming system, soil cultivation is of great importance, and helps to increase effective fertility, its preservation and ensures high yields of agricultural crops.

The general principle of tilling is that it must change the composition and structure of the soil. The task of tilling should be considered to give the arable layer a composition favorable for cultivated plants, which is achieved by using appropriate technological methods (loosening, wrapping, mixing, etc.).

The main tilling is provided for:

- To give the soil friability and fine lumpiness, in which it could hold as much water as possible;
- To move the top layer of soil down to restore the lost structure, to extract more aggregated soil layers to the surface;
- To close up the seeds of weeds, pests and pathogens wintering on crop residues and in the surface layer of the soil to the greatest possible depth;
- To close up fertilizers applied before plowing into the soil layer from which plants can use them most efficiently;
- To create favorable conditions for the rapid implementation of early-spring and pre-sowing work in order to carry out sowing in the best land treatment terms, to get young growth earlier and to ensure the accelerated development of cotton.

The dual-level plowing most fully met these requirements. With it, the soil layer is divided into two parts, of which the upper one is laid on the bottom of the furrow, and the lower one covers it from above. This ensures a complete turnover of the arable layer of soil, deep incorporation of seeds and weed rhizomes. At the same time, the infestation of the fields decreases, since deeply planted weed seeds do not give growth, but its appearance is delayed for 40-60 days. During this time, cotton has time to get stronger. The dual-level plowing, compared to

conventional plowing, significantly activates microbiological processes, improves plant nutrition, and contributes to a higher and earlier yield.

The variety of soil and climatic conditions of the cotton cultivation zone led to the differentiation of technology and the depth of plowing, taking into account the characteristics of individual zones. On soils with favorable physical, mechanical and chemical properties of the arable and subsurface layers, the dual-level plowing is used to a depth of 30 cm, and on old-irrigated gray soils and other soils with powerful agro-irrigation deposits to a depth of 40 cm. On soils with unfavorable physical and chemical properties of the subsurface horizon (shingle, waterproof and gypsum interlayers), dual-level plowing is used to a depth of 30 cm with simultaneous loosening of the subsoil layer 10–15 cm thick.

There are soils with a subsurface horizon in the cotton-growing zone, which is so heavy in mechanical composition and strongly compacted that it is practically waterproof and sharply reduces the efficiency of vegetative irrigation. In addition, in places with very close standing of groundwater, there are soils, under the plow layer of which lies a gley horizon with a bluish tint, very strongly compacted and with low water permeability. Turned to the surface, this horizon has a detrimental effect on cultivated plants. On such soils, it is necessary to apply a processing technology in which the upper, fertile layer is processed with a complete turnover of the layer, and the lower sub-surface is loosened to a predetermined depth without turning it to the surface. This processing technology is commonly called combined plowing, which is performed by dual-level plows with subsoil ploughs. With combined plowing, the plow simultaneously performs two technologies for tillage: dual-level plowing to a depth of 30 cm (depending on the thickness of the arable layer) and soil deepening up to 40–45 cm [1].

MATERIALS AND METHODS

Significance of soil density in formation of cotton harvest. The value of soil density is very large and versatile. The choice of methods of soil cultivation, and consequently the selection of implements for creating a cultivated plow and sub-surface horizon, is determined mainly by the density of the soil, the requirements of the cultivated crops, and the possibilities of applying the appropriate set of tillage methods.

The structure of the soil (loose or dense) determines the water-air mode and the biological activity of the soil, and ultimately the condition for the growth and development of cultivated crops.

There are three typical cases of soil compaction [2]:

1. When the soil consists of primary elementary mechanical particles, and pores are only between these particles, the density of the soil can reach up to 18-20 kN/m^3, and the porosity barely reaches 26% of the entire volume of the soil. Such a density is observed in alkaline lands, as well as in gley layers of clayey soils and in some over-dried horizons.
2. When the soil consists of macroaggregates, along with the pores of primary particles and between microaggregates, pores between macroaggregates appear in it. Then the density is the lowest (1.1–1.3 g/cm^3), and the porosity is the highest up to 60% of the total volume.

Under natural conditions, in addition to the listed cases of compaction, it is known that any loosened soil self-compacts under the influence of gravity: precipitation, the impact of animals, humans, tools and machines, drying, and other factors.

When cultivating crops, it is necessary to perform from eight to twenty-five operations: plowing, leveling, chiseling, harrowing, thinning, sowing, looking after crops, applying organic and mineral fertilizers, harvesting, etc.

The use of increasing number of high-speed and heavy equipment on the fields of irrigated agriculture has led to the compaction of both arable and sub-arable horizons.

The experiments [3] carried out on medium loamy gray soil showed that compaction of 2 and 3 multiple passes of wheeled tractors extends to a depth of 0.20–0.30 m. With an 8-fold pass of these tractors, compaction reaches a depth of 0.5 m or more. In the latter case, the density in the 0.20–0.40 m layer was 16.0–17.8 kN/m^3. In the area where the soil was compacted eight times by tractors, a higher density (14–14.5 kN/m^3) in a layer of 0.10–30 m was stably maintained in the next year despite the plowing of the soil. The smallest soil compaction is obtained during the passage of T-4A arable tractor, and the largest soil compaction is obtained during the passage of row-crop wheeled tractor.

Moreover, annual shallow plowing of the soil to a depth of 0.3 m led to the formation of a dense layer, which is called "plow sole" and extends to a depth of 0.4–0.45 m. The density of the subsurface horizon of the soil of old irrigation reaches 1600–1700 kg/m^3, and porosity decreases by 5–6%, compared with the soil of the arable layer.

The compacted subsurface horizon negatively affects the growth of plants and the harvest of raw cotton. When the compacted layer occurs at a depth of 0.2 m, the main root does not develop in most cotton plants, and only 25% of the total number of plants per hectare, at a depth of 0.3 m only 50%, with deep tillage to a depth of 0.4 m, about 75% are able to form the main root which penetrates into the depths. At the same time, the infiltration of water into the subsurface layers is greatly hindered, therefore, the moisture reserves in the soil decrease, the air exchange in it worsens, and, in general, the nutrition of cotton worsens and the yield decreases [1,3,7,8].

Studies [1,2,3] have established that the most favorable conditions for the development of roots and the growth of the aerial part of cotton are created at a density of subsurface horizons of 1200–1300 kg/m^3, since the root system is able to use nutrients to the fullest extent and subsurface water. Encountering with dense layers, the main and lateral roots in most cases are forced to change the direction of growth towards less compacted layers. With an increase in the depth of processing, the cotton root system develops under favorable conditions, deforms little, does not squeeze, bends less and is covered with lateral processes along its entire length.

RESULTS

Deep loosening of subsurface layer as agricultural method for increasing the harvest of cotton.

Studies [1,2,3,4,5,6,7,8], as well as the practice of advanced farms, have established that one of the ways to increase the depth of the root-inhabited soil layer is to loosen the subsurface horizon without bringing it to the day surface. This will create favorable water-physical and microbiological conditions, nutrient and air regimes, which will ensure the powerful and deep development of the cotton root system and, consequently, the accumulation of a high yield.

Therefore, according to [4], when plowing to a depth of 30 cm with loosening up to 55 cm, the number of taproots directed vertically downwards without any deformations was four times greater than when plowing to a depth of 30 cm without loosening, and loosening to 50 cm in combination with plowing to 30 cm destroyed the dense layer and contributed to the emergence

of cotton roots beyond the arable horizon, and in the thickness of 0–120 cm accumulated 27–36% more roots, better root development boll accumulation and increased cotton yield.

Great importance is given to deep loosening in Germany, where there are more than 50% of sandy soils with a close occurrence of a clay subsurface horizon, which impairs the development of the root system of plants. Therefore, methods for loosening dense subsurface horizons have been developed here, which makes the soil well permeable to water, air and roots. This method of tillage is quite widespread in the USA, Canada, Romania and Hungary.

With deep loosening, under the influence of accumulated plant residues, the soil is gradually enriched with nutrients, which leads to an increase in the fertility of the subsurface horizon (4). Deep loosening of the soil, reducing the density, in turn, provides an increase in the overall duty cycle due to porosity, the total porosity in the layer of 30–60 cm before loosening was 45.8, after loosening - 50.3%, which increased the water permeability of the soil, compared with conventional plowing by 3.5 and 15.2%, respectively, with loosening by 40 and 55 cm. In addition, with a decrease in density, the moisture capacity of the soil increases. After the destruction of the subsurface, the moisture reserves on saline gray soils increased by 300–350 m^3/ha, and in the conditions of meadow soils by 185 m^3/ha.

With an increase in the moisture reserve in the soil at the beginning of the growing season, firstly, there is no need for a recharge irrigation, and secondly, it is possible to delay the start of the first vegetation irrigation for 6–12 days. By this time, the height of cotton allows cutting irrigation furrows to the maximum possible depth.

Moisture reserves are most effective in dry years. It is known that during normal plowing, the less developed root system of cotton uses moisture mainly from a soil layer 30–40 cm deep, and during deep loosening, due to the powerful development of the root system, plants are able to consume moisture from a meter layer. Thus, loosening the dense subsurface horizon, first of all, reduces the density of the soil, as a result of which its total porosity, water permeability and moisture capacity increase, which positively affects the growth and development of the main and lateral roots, the fruiting of cotton, as well as the formation of a greater number of full-fledged bolls.

To study the effectiveness of loosening the subsurface horizon of the soil during plowing for cotton with annual loosening to a depth of 50 cm in combination with conventional plowing to a depth of 30 cm, high increase in the harvest of raw cotton is provided (Table 1)

Table 1. Effect of loosening the subsurface horizon on the harvest of raw cotton

Variant of the experiment	Harvest, c/ha	
	medium	addition
Normal plowing at 30 cm	33.98	+0.0
Deep loosening at 50 cm + plowing at 30 cm	38.39	+4.41

According to Mukhamedjanov M.Z., such an increase in the harvest of raw cotton was obtained by improving the conditions for a more powerful development of the root system, which led to an increase in the mass of roots in the subsurface horizon. For example, in a soil layer of 30–50 cm, the weight of the roots during loosening by 40 and 50 cm was, respectively, 14.6 and 32.7% more than in the control.

In experiments, on a powerful grey soil, Rakhmanov A.R. found that after deep loosening, the density of the soil in the horizon of 30–50 cm decreases from 1700 to 1500 kg/m^3, and the porosity increases from 37 to 44%. When plowing to a depth of 30 cm with a turnover of the seam and loosening by 50 cm, the fine-fiber cotton variety 5904-11 forms the bulk of the lateral roots in a layer of 30-55 cm, and when plowing to 30 cm (control) in the surface (15–30 cm) layer. As a result of the better use of food and water in the experiments, the yield increased by 4.8 c/ha compared to the control (Table 2)

The purpose of this experiment was, firstly, to identify the effect of deep loosening on the growth and development of roots, as well as on the yield of cotton, and secondly, to identify the effect of various deep loosening technologies on the yield of raw cotton (Table 2).

Table 2 Influence of different technologies of main tilling on the harvest of raw cotton

Variant of the experiment	Harvest, c/ha	
	medium	addition
Plowing at 30 cm	19.0	+0.0
Plowing at 30 cm + loosening at 50 cm by ripper GR-2.7	23.83	+4.8
Loosening at 50 cm by ripper GR-2.7 + plowing at 30 cm	23.55	+4.5

According to Rakhmanov A.R. loosening the subsurface horizon is not recommended on lands with close occurrence of groundwater, shingle and sands, because the deepening of the arable layer in the presence of a loose addition of the subsurface horizon cannot give an effect. From the data of Table 2, it can be seen that the difference in yield increase in the II and III variants of the experiment is insignificant. However, the difference in the working conditions of the plow in these options is large.

For example, when plowing a loose layer, there is no support for the plow body, which disrupts its stability at depth and width. The turnover of the reservoir and the incorporation of weeds are deteriorating. Therefore, the technology of loosening the subsurface horizon must be determined by the quality and energy indicators of the work of the tool with different sequences of their application [10].

CONCLUSION

Therefore, plowing with a seam turnover to a depth of 30 cm and loosening to a depth of 50 cm compared with conventional plowing by 30 cm increases the cotton yield by 2.0-5.0 centners per hectare. The increase in yield during the loosening of the subsurface horizon occurs mainly due to the improvement of the water-air mode, the powerful development of roots, the enhancement of microbiological processes and, consequently, the better use of the nutrients contained in the subsurface horizons, i.e. through their involvement in agricultural circulation

REFERENCES

1. Bibutov N.S. Substantiation of parameters of the labor body of the subsoil ripper for the cotton-sowing zone. Dissertation of the candidate of sciences. Yangiyul, 1983
2. Revut I.B. Physics of soil. “Kolos” publishing house, Leningrad 1964, pp. 119-131

3. Murodov M.M. Khamraev T., Bibutov N.S. Soil deepening and improvement of soil properties. “Cotton growing” journal, No. 11, 1981, pp. 20-21.
4. Mukhamedjanov M.Z. Root system and crop yield of cotton. “Uzbekistan” publishing house, Tashkent, 1978. p.328.
5. Kenjaev O. Technical and economic advantages of a combined dual-level plow with strip deconsolidation of the subsurface horizon. //Proceedings of All-Union institute of mechanization, Moscow, 1989, vol.123, pp.94-97
6. Nosko B.S., Bakhtin P.U. Soil compaction by tractor and machine track-movers. “Mechanization and electrification of rural economy”, 1981, pp.34-36
7. Bibutov N.S., Baimetov R.I. Technical means for loosening the subsurface horizon. Scientific-technical collection “Mechanization of cotton growing”, No. 7. vol., 1983, pp.7-8
8. V.V. Trufanov. Deep chiseling of soil. Research Institute of Agricultural Engineering. Moscow “Agropromizdat”, 1988, p. 138.
9. Muradov M.M., Bibutov N.S., Baimetov R.I. Mechanical and technological bases and parameters of tools for deconsolidation of the soil. Monograph. “Fan” publishing house, Tashkent, Uzbekistan, 1988, p.102.
10. Bibutov N.S., Sergienko V.A., Baimetov R.I. Rational technology of deep loosening of the soil. “Cotton-growing” journal, No. 10, 1982, pp.18-19.