

ISSN 2181-9408

Scientific and  
technical journal

# Sustainable Agriculture

№1(21).2024



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The journal "Sustainable Agriculture" is registered in the Press Agency of Uzbekistan on the 12<sup>th</sup> of February in 2018 (license № 0957).

In 2019, the journal is included in the list of recommended scientific publications by the Higher Attestation Commission of the Republic of Uzbekistan.



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# EFFICIENCY OF MODERN TECHNOLOGIES IN INCREASING YIELD AND IMPROVING SOIL FERTILITY

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## Abstract

Measures to ensure high standards of agriculture, improve soil fertility, and increase crop yield are an important part of the system of rational tillage, which improves its air, water, heat, and nutrient regimes, regulates biological processes, and the rate of mineralization of organic matter at the required level. Consequently, it destroys weeds, diseases and pests of agricultural plants. At the same time, conditions are created for soil erosion protection and quality planting. The history of agricultural development goes back to the distant past, about 10-15 million years, and is closely related to the moldboard system of soil cultivation. Tillage is the most energy-intensive and economically expensive process in agricultural production. On average, 40% of the total volume of field work is energy and 25% labor costs. In this case, each method of tillage should be reasonable, the profitability of costs should be maximum.

**Keywords:** soil, soil fertility, water, mineralization, plant, moisture, soil erosion, crops, weeds, herbicides, field work, vegetative weeds, "conservative" agriculture, diversity of microflora, plowing, agrochemicals and fertilizers.



**Introduction.** There is no ideal soil, that is, any soil will dry out over time, that is, it is natural that it will degrade. No matter how fertile the field is, if it is exploited year after year, if its productivity is not maintained, sooner or later it will stop giving a high yield. It should be remembered that restoring soil fertility is much more difficult and expensive than maintaining it. It is not a secret to all of us that it is possible to improve soil fertility, first of all, by knowing how to use fertilizers correctly. But we must not forget that in this case the principle "The more the better" is not effective.

Alternatively, the amount of fertilizer used should be optimally balanced, which will prevent negative consequences. For example, an excessive amount of nitrogen makes the plant develop well, grows quickly, but delays fruiting. It has been scientifically proven that chemical fertilizers not only "burn" crops, but also pollute the environment.

An integrated approach is important in combating soil erosion, which includes:

- fertilization;
- increase the ability of the soil to retain moisture;
- improvement of the structure;
- prevention of erosion;
- crop rotation and other methods of increasing productivity.

The idea of planting in uncultivated soil is not new, it goes back to the distant past. For example, in ancient Egypt, farmers made a hole in the ground with a stick, threw in the grain, and covered the hole by pressing the soil with their feet. It is natural to ask how to fight weeds that damage crops without mechanical tillage. It was no secret to all of us that the plow is the most effective means of fighting weeds in this regard, although for the development of cultivated plants (in rare cases - sugar beets, potatoes) there is no need to loosen the soil deeper than 3-5 cm. With the advent of herbicides, he had an opportunity to rethink weed control measures. However, for many years, the choice of chemicals was limited - many of them remained in the soil for a long time and could damage the planted seeds and young shoots of cultivated plants. By the 1960s, the English company Imperial Chemical Industries (ICI) developed herbicides that controlled the growth of weeds. These substances are absorbed almost instantly upon contact with the soil, so they could be used against vegetative weeds. The cleared field was ready for

planting almost immediately without risk of seed damage from residual herbicides.

This process gave birth to No-Till technology. Since then, other fast-degrading, broad-spectrum herbicides have appeared, further expanding the capabilities of the technology. Brazilian farmers adopted No-till technology primarily to counteract soil erosion that occurs during conventional tillage, as well as to conserve moisture and increase crop yields.

Translated from English, No-till means "not to drive". No-till technology eliminates this problem by protecting the soil from wind and rain erosion. After all, this technique involves gentle treatment of the soil. When using this technology, straw is not burned or introduced into the soil. The remaining organic residues are brought to certain sizes, turned into mulch and evenly distributed over the field surface. Mulch spread across the field creates a thick layer that preserves and restores fertile topsoil.

**Materials and methods.** Comparative and comparative analysis, complex assessment methods were used in the study of the problem.

**Result and discussion.** When working with no-till technology, costs for plant protection products usually increase. As we move to no-tillage, chemical treatments are increasing and agrotechnical methods are decreasing. Argentinian consultants advise not to be afraid of high costs for agrochemicals and fertilizers, because if you develop the technology correctly and follow crop rotation, the need for pesticides and fertilizers will decrease, unlike working with traditional methods, the component of direct seeding technology is a specialized fertilizer.

Depending on the specific production goals, direct seeds of any type and of different productivity can be used. These are expensive cars and it is very important to make the right choice when buying them. For this, it is necessary to take into account the existing requirements for the operation of the main units of the seeder. Planting should always be done diagonally in relation to the direction in which the previously planted crops grew, so that the soil on the site does not get used to the same planting direction and is not compacted. It is recommended to plant at an angle of 300 to the previous planting direction. This will allow you to prevent the accumulation of furrows and grease. It is possible to leave residues in certain areas of the field and thereby ensure good quality of planting.

In addition, productivity increases, the soil is less

deformed compared to the soil processed under the pressure of moving vehicles or animals. With fewer passes across the field, the area affected by the running devices of agricultural equipment is reduced, the compaction of the soil layer is reduced, and the structure of the soil is kept constant. Mulch on the surface of the soil retains moisture and promotes better plant growth during droughts, so the yield is always higher than in a conventional system.

Using No-Till technology, the following results were achieved:

- production costs were reduced by an average of 5 times;
- the park of agricultural machinery was reduced by 90% (one tractor, one planting complex, one sprayer and five combines are used for 12,000 hectares of land);
  - fuel consumption decreased by 70% (from 93 l/ha to 24 l/ha);
  - the processing time of arable land decreased by 80 percent (from 3.87 m-hours/ha to 0.6 m-hours/ha);
  - fertilizer consumption decreased by 30%;
  - labor costs have been reduced (12 mechanized workers process 12,000 hectares of land)
  - productivity has doubled (from 27 s/ha to 50 ts/ha);
  - increase grain quality (protein content increased by 10%);
  - managed to stop the degradation of the fertile soil layer.

When implementing conventional cultivation systems, certain agricultural practices (hulling) lead to weed germination. Mulching with no-till technology delays the penetration of seeds into the soil, lowers the temperature on the surface, and creates unfavorable conditions for the germination of weed seeds. Refusal of layer exchange allows to reduce the possible contamination of the soil. With no-till technology, thanks to the mulch layer, the soil has a low temperature in summer and a high temperature in winter. Mulch keeps snow from blowing away. Snow, in turn, provides effective thermal insulation of the soil and is able to keep its temperature 10-150C higher.

Due to crop residues, the change in soil temperature during the day is reduced, which has a positive effect on the absorption of water and nutrients by plants. As for insect pests, No-till can have both negative and positive effects on their population. It depends on the type of pests and climatic conditions. The number and diversity of hymenoptera, spiders, earwigs, and springflies increases and creates more favorable conditions for reproduction under the mulch layer. As a result, many beneficial insect predators develop.

This leads to an optimal biological balance in which the population of insect pests is effectively controlled by insect predators. Plant residues accumulate on the soil surface. Under the influence of bacteria, fungi and other microorganisms, they break down into simpler organic substances and become part of the complex of organic substances in the soil. The amount of organic matter in the top layer of the soil reaches the highest level in no-till. No-till protects the soil from erosion better than other technologies invented by man: these are the factors that preserve the soil structure and plant residues that protect the soil surface from destruction and washing.

Additional soil moisture increases yields, especially during seasons with below-normal rainfall. But any mechanical processing of the soil will cause it to dry out. In addition, plant residues help water penetrate better into the soil. Infiltration rate depends on soil pore size as well as soil types. For example, clay soils are less permeable to

moisture than sandy soils. If the porosity of the upper soil horizons is low, the penetration of rainwater is limited, it goes with the surface water and is lost to the soil and vegetation.

The porosity of the surface layer of the soil can be reduced due to the clogging of the pores by particles released from the soil aggregates under the influence of raindrops or the formation of an impermeable crust on the soil surface. The porosity of the surface layer of the soil is preserved if the soil is not mechanically cultivated and is protected from the destructive effects of raindrops by a pre-created protective layer of residues from previous crops and cover (intermediate) crops.

**Conclusion.** With no-till technology, the soil remains untouched from harvest to planting and from planting to harvest. Tillage occurs only when the seed drills are cut.

How does no til technology work in agriculture?

In agriculture, no-till technology is a method of cultivating the soil without plowing, leaving straw on the surface of the land, and this technology is a technologically complex model that is traditionally made. In this case, costs are significantly reduced, valuable resources are saved, and as a result, income increases.

At the same time, the soil is protected from water and wind erosion, and weeds do not sprout. Active microflora with a large number of micro and macroelements is formed, as a result of which high productivity is achieved.

As crop residue accumulates on the surface of the field, the soil gradually builds up large amounts of humus and accumulates bioavailable phosphorus. This will definitely improve soil fertility. The demand for fuel and lubricants will also decrease and the cost of their purchase will decrease.

Ecologically, the negative impact on the environment is reduced, as a result of which the emission of carbon dioxide and other fuel products into the atmosphere is reduced. There is a decrease in the release of carbon compounds from the soil, which normalizes the carbon balance in the atmosphere and prevents soil degradation. A significant saving of resources occurs due to the reduction of depreciation costs, which in turn significantly increases the profit of the enterprise.

**Table 1.**  
**Advantages and disadvantages of no till technology**

Advantages	Disadvantages
reduces labor costs by 1.6 times	highly qualified agronomists and special equipment are required
saves fuel 2.2 times	Strict adherence to technology is required
saves equipment costs by 1.5 times	the need to take into account the climate and weather in the region
increases productivity 3 times	the need to take into account the characteristics of the soil
reduces production costs by 12%.	presence of pests and other factors.

Based on this technology, it creates balanced biological systems that self-regulate the population of insects or microorganisms in nature. With no-till, the spread of pests or diseases does not occur. In the process of using no-till technology, we only need the original seed drill. This is the only technical change in the use of technology. And the application of innovations includes direct planting in the ground and compliance with all other requirements and principles of the system. This process excludes inter-row tillage, discing and cultivation.

In order to correctly solve the problems of soil cultivation, it is necessary to have deep theoretical knowledge about the requirements of plants for the growing environment,

the laws of the processes occurring in the soil, and changes under the influence of certain processing methods. In recent years, practical and theoretical work is being carried out to improve soil fertility in a natural way. The laws of movement of moisture in the soil, its evaporation are studied in detail, the parameters of the optimal soil structure for agricultural crops are determined, and the issues of differentiating different parts of the arable layer according to their productivity are determined.

Considerable work has been done to create new efficient processing systems adapted to specific soil and climate conditions. Pre-planting tillage and crop care systems have been improved, and along with the importance of tillage in crop rotations, a soil protection system has been developed for water and cropland.

For example, the problem of protecting the top layer of soil from wind and solar erosion remains urgent. Consequently, all adaptive tillage systems have one common drawback, which is that they require a lot of energy.

Well, if we answer the question of what kind of technology is No-till and what are its advantages, then after the harvesting period, the crop residues are evenly distributed across the field. As a result, a natural, special soil protection coating is created that resists wind and water erosion, ensures moisture retention, prevents the growth of weeds, renews the fertile layer and increases the yield of crops.

The harvesters used in the harvesting company are adapted to ensure that the crop residues are distributed as evenly as possible over the entire area of the harvesting line. In this process, domestic harvesters should be additionally equipped with straw spreading devices. The soil should not be compacted by car wheels. The radial tires of the harvesting equipment should exert as little pressure as possible on the soil.

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