Soil treatment - factors determining quality

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Summary: *The main groups of factors / soil-climatic, agrotechnical, technological and organizational / influencing the quality of the main and pre-sowing tillage of the soil and the relationships between them are examined.*
The results obtained show that compliance with the main groups of factors and good organization of work improve the quality of the main and pre-sowing tillage, reduce the costs of their implementation and increase yields.
KEY WORDS: *TILLAGE, PLOUGHING, CULTIVATION, DISKING, TRACTOR, HUMIDITY, HARDNESS*

Tillage is a basic and effective way to preserve and increase soil fertility. Its main task is to improve the water-physical parameters of the arable layer, creating a favorable environment for germination, growth and development of cultivated plants.

Tillage improves the nutritional regime, ensures better burial of plant residues, organic and mineral fertilizers, intensive microbiological activity and mineralization of organic matter.

Tillage is also a way to combat weeds, enemies and pathogens. It destroys growing weeds, suppresses perennial weeds and slows down the germination of weed seeds from the entire arable layer.

The various types of operations (turning, loosening and mixing the arable layer, compaction and leveling of the soil surface) are carried out with soil tillage machines - plows, cultivators, harrows, mills, rollers, in the various methods of soil cultivation - plowing, loosening, discing, harrowing, rolling, etc.

The qualitative implementation of the various methods of soil cultivation depends mainly on several groups of factors such as soil-climatic, agrotechnical, technological, organizational, etc.

The aim of the study is to establish the influence of agrotechnical, technological and organizational factors on the quality of soil cultivation under certain soil-climatic conditions.

The study was conducted in a complex field experiment with testing of various methods and machines for soil cultivation, separated into complete systems in a four-field crop rotation of the trench-wheat-trench-wheat type. The field experiment was conducted on a leached tar field in the Sofia region. The following processing options were tested: plowing at 25 - 30 cm; loosening at 25-30 cm and discing at 8-10 cm. The studied indicators were determined according to generally accepted methodologies.

The studied technologies for soil processing using different methods, terms, soil processing machines and number of work operations create different water-physical conditions for the grown crops.

For the quality of processing, the condition of the soil at the time of processing and its technological properties (cohesion, plasticity and stickiness) are of decisive importance.

Soil moisture, determined by weight, is a determining factor for the quality of processing. Very dry and overmoistened soil increases energy consumption and reduces the productivity of machines. Soil plowing is best carried out at a certain humidity interval, at which the soil is best broken up and does not offer much resistance. This condition is called physical maturity of the soil and represents 70-90% of the Maximum Field Moisture Capacity. Therefore, early spring cultivation of the soil as a pre-sowing soil preparation is preferable to discing, and in dry spring - discing.

The data from our studies on the moisture content of leached pitch, determined before sowing corn in a field experiment, show that it is suitable for pre-sowing treatments. No significant differences are observed between the three tested treatment options /Table 1/. After harvesting the corn, the soil moisture content decreases significantly, which requires some waiting until the moisture content reaches values suitable for the main treatment..

Soil moisture for corn in percent, (%)

Table 1

Processing options	Layer depth, cm				
	0-10	10-20	20-30	30-40	40-60
	Before sowing				
1. Ploughing	32,80	33,44	33,57	34,35	36,28
2. Loosening	33,15	33,31	34,35	34,87	36,75
3. Disking	33,92	34,24	35,00	35,26	37,58
	After harvesting				
1. Ploughing	17,60	22,37	24,77	26,93	27,92
2. Loosening	19,00	23,69	26,28	27,42	28,58
3. Disking	20,07	24,70	27,15	28,04	29,79

Soil density and hardness are the main indicators that determine the requirements for soil tillage machines. Soil density, determined by the Kaczynski method (with rings, with a volume of 100 cm3), changes more significantly until the sowing of crops, while during the vegetation of plants there is a certain equalization of the volumetric and equilibrium density of the soil. From the studies conducted on leached tar, the optimal density for the cultivated crops was established - 1.0-1.4 g/cm3, its further increase above these limits hinders growth and development and reduces the yields obtained from them, /Table 2/. After harvesting the corn, a higher density is observed in all processing options, and it is higher in the disking option compared to plowing.

Soil density for corn, g/cm^3

Table 2

Options for Spring processing	Layer depth, cm 10	20	30	40
	Before sowing			
1. Ploughing	0,90	1,00	1,03	1,16
2. Loosening	1,01	1,04	1,16	1,18
3. Disking	1,09	1,11	1,18	1,23
	After harvesting			
1. Ploughing	1,18	1,31	1,36	1,38
2. Loosening	1,22	1,34	1,39	1,41
3. Disking	1,29	1,36	1,38	1,41

The hardness of the soil, determined with a hardness tester with a falling weight (type "Dornii") expresses the mechanical resistance and against the deforming action of tillage machines, agricultural machines, the emergence of sprouts and roots of plants. It changes layer by layer and depends on the humidity and density of the soil. The soil hardness before sowing, in the three tested methods of soil cultivation, is highest in the disking variant, followed by the loosening variant, and lowest in plowing.

/Fig. 1/. A similar trend is observed after harvesting the corn.

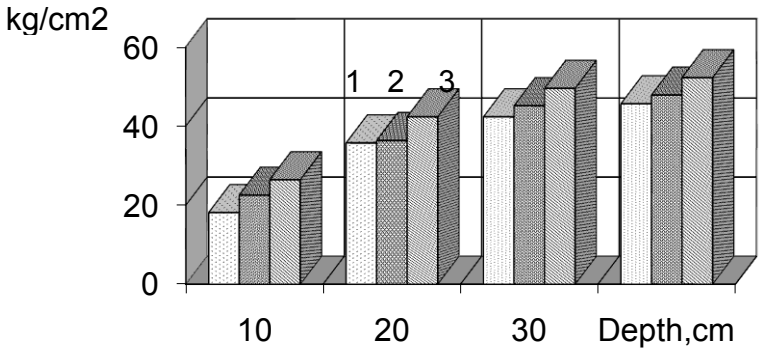


Fig.1. *Soil hardness in different tillage methods: 1- plowing; 2 – loosening; 3 – disking.*

The characteristics of the crops grown, the choice of predecessor and the compaction of the soil after its harvest, the quality of the previous treatments, the amount of plant residues, the weediness of the areas and the different species composition of the weeds, fertilization and irrigation of the crops, etc. Are the agrotechnical factors that have a significant impact on the quality of the treatment. The obtained average values for the influence of individual agrotechnical factors on the quality of the main treatment are given in fig. 2. The greatest influence on the quality of the treatment is exerted by the predecessor and the amount of plant residues that remain after it. The quality of each previous treatment is also important for the quality of the current treatment. The technological factors on which the quality of the various soil treatments depends are related to the choice of a suitable unit and its preparation for work. The choice of a tractor and a plow with a certain number of plow bodies, with a suitable shape and length of the sweep board, skimmers, etc. Depend on the working conditions and the tasks that need to be solved with plowing. When plowing soils with a light mechanical composition, for better burying of post-harvest residues and chaff, a plow with a front plow is used to obtain high quality, while in heavy, highly dried soils, stubble left high and highly developed weeds, the use of a front plow does not give satisfactory results.

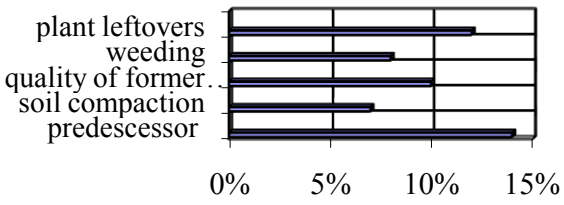


Fig. 2. Degree of influence of agrotechnical factors on the quality of soil cultivation

The key to obtaining high quality of the processing is the compliance of the values of the parameters of the technical condition of the machines with those recommended by the manufacturer. In the case of plows, these are the requirements for the plow bodies to be of the same shape and working width, the sharpening of the share, knives, the condition of the adjusting mechanisms, the automatic machine, etc. To ensure the same depth of plowing, the plow must be pre-adjusted at the work site so that all plow bodies lie on one horizontal plane.

The speed of movement of the unit is also important for the quality of processing. When the speed increases, the depth of processing decreases by 1-2 cm, the ridge coefficient - also, the soil is better crushed, but at the same time, fuel consumption increases with increasing speed.

The influence of the working speed on fuel consumption is shown in Fig. 3 when plowing with a Belarus 952-2 machine-tractor unit with PN-3-35.

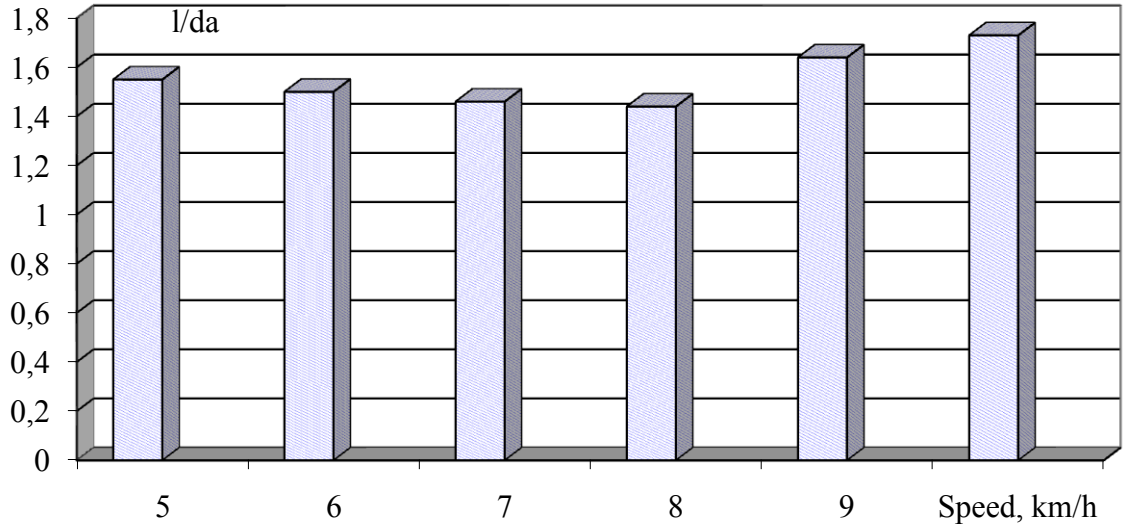


Fig. 3. *Influence of operating speed on fuel consumption when plowing with a machine-tractor unit (Belarus 952-2 with PN-3-35).*

Depending on the tasks to be solved with cultivation, the type of cultivator is also selected. In combined cultivation, the best quality of work is obtained with mounted cultivators with universal working bodies. In order to ensure more complete weed cutting and better loosening of the soil, their working bodies must be of appropriate shape, well sharpened and arranged in a staggered manner in two rows, ensuring an overlap of 2-3 cm between adjacent working bodies. It has been established that high-quality cultivation is obtained when working at a speed of 6-8 km/h and the distance between the working bodies is approximately equal to its depth, or the ratio of the distance to the depth is 1:1.5.

To achieve the required quality of disking, i.e. depth, degree of crushing and mixing of the soil, the spherical disks must be sharpened and the harrow in good condition, and the sections placed at an angle of 15-22^0 to the line of movement.

Quality processing also requires preliminary organizational work. Of these, the following are of greater importance: preliminary cleaning of the fields from plant residues, adjustment of the movement of the unit to the length and configuration of the field, the size of the field, the relief of the area in which the field is located, weeding the fields with annual and perennial weeds, etc. Fig. 3 shows the change in the productivity of the plowing unit under different operating conditions.

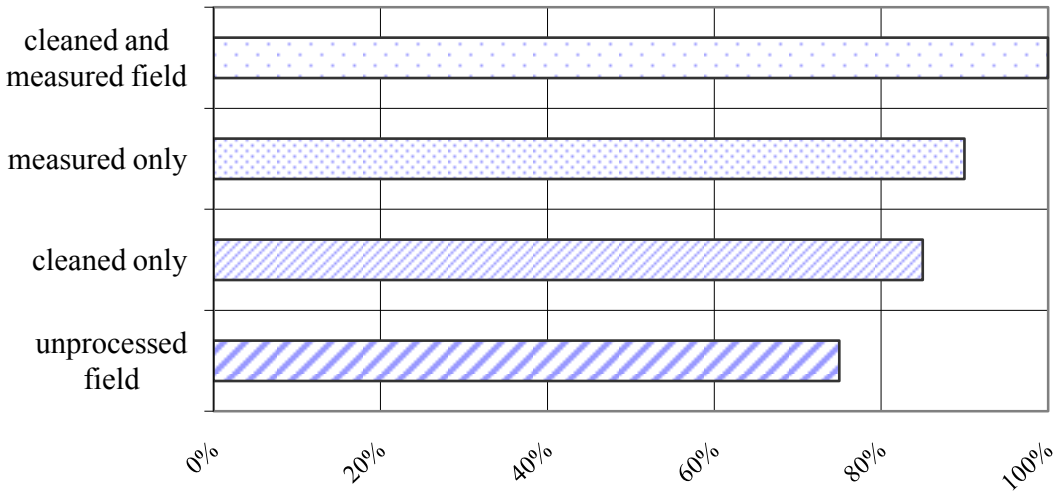


Fig. 4. Change in the productivity of the plowing unit under different operating conditions.

CONCLUSIONS

The main groups of factors influencing the quality of the main and pre-sowing soil cultivation and the relationships between them are examined.

The results obtained show that compliance with the main groups of factors and good organization of work improve the quality of the main and pre-sowing cultivation, reduce the costs of their implementation and increase yields.

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