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## **TECHNICAL AND TECHNOLOGICAL SOLUTIONS FOR DIMINISHING SOIL PACKING IN THE AGRICULTURAL LAND OF BULGARIA**

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### **ABSTRACT:**

Soil packing is a serious deteriorating process which affects negatively the Bulgarian agriculture. The present development recommends some technical and technological rules for diminishing this phenomenon as well as suggests particular tillage systems at growing winter grain crops and spring agricultural crops for surmounting it.

### **KEY WORDS:**

soil packing, soil erosion, technological solutions.

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## **1. INTRODUCTION**

Soil packing is a process of straining and increases in density and compactness at which there is decrease in porosity aeration and water permeability and increase in hardness as well as fragmentation of the soil structure and change in soil texture [2]. It occurs as a result of natural factors such as rainfall (especially in lack of vegetation on the soil surface) and gravity forces as well as under the mechanical impact of the running gear of tractors, grain harvest combines, transportation means and agricultural machinery. Along with that, soil packing is bound up with tillage mainly carried out in inappropriate moisture conditions. The negative impact of this deteriorating process on the agriculture in our country finds expression in the worsened water-and-air and thermal conditions of the soil as well as in the plants fertilization, slower development of the root system and decrease in the yields, increase in soil erosion, plants overgrowing with weeds and pest infestation, lowering the fertilization effectiveness and higher operation costs on tillage.

The problem with this phenomenon and its harmful consequences calls for utilization of different techniques and means for surmounting it.

The goal of this research is to set forth some technical and technological solutions for diminishing soil packing in the agricultural land of Bulgaria as well as to suggest particular tillage systems at growing winter grain crops and spring agricultural crops.

## **2. EXPOSITION**

The permissible pressure of the agricultural equipment on the surface of the various soil types at different moisture conditions has been determined (from the point of view of preserving the soil balancing bulk density and porosity) and summarized based on the research of Cherepanov G.G. and V.M.Chudonovskih (1987).

Table 1. Permissible pressure on the soil surface

Season	Moisture, %	Soil type	Permissible pressure, MPa
Spring	07 – 09 ППВ	light	0,04 – 0,06
		medium	0,06 – 0,07
		heavy	0,07 – 0,08
Summer and autumn	06 – 07 ППВ	light	0,07 – 0,08
		medium	0,08 – 0,15
		heavy	0,15 – 0,20

It is impossible to diminish packing through tillage at relatively low moisture conditions due to the seasonal and imperious nature of the performed technological operations. Therefore the efforts for diminishing soil packing should be focused on the agricultural equipment.

The courses of action for obtaining relatively low pressures, specified in Table 1, can be as follows:

- ✚ improving the running gear, mainly for tractors, through utilizing rubber-crawler running gear;
- ✚ utilization of self-propelled agricultural machinery whenever possible;
- ✚ utilization of combined machinery and equipment;
- ✚ utilizing tractors of lower weight;
- ✚ utilizing the overall weight of the tractor as traction one through two or more axles;
- ✚ lowering the tire pressure;
- ✚ utilizing radial tires which create less pressure and have better traction and self-cleaning;
- ✚ utilizing double radial tires;
- ✚ attaching extensions on the pneumatic wheels;
- ✚ utilizing broad-section tires;
- ✚ utilizing multi-wheel off-road vehicles;
- ✚ utilizing combined machinery and equipment of greater effective width;
- ✚ utilizing equipment with active tools;
- ✚ utilizing super-light equipment for pest control and other operations;
- ✚ utilizing breaking and loosening tools behind the tractor's running wheels, attached to the working tools.

Besides, diminishing the packing of the arable and sub-arable layer with the tillage systems at growing crops in our country can also be achieved at adhering to the following technological requirements [3]:

- ✚ appropriate crop rotations within short periods;
- ✚ deeper main tillage of different depths;
- ✚ better tillage;
- ✚ good water lead off;
- ✚ optimum tillage period;
- ✚ combination of the operations;
- ✚ optimum fertilizing, liming and applying more manure;
- ✚ tillage minimization;
- ✚ maintaining optimum soil density and moisture content;
- ✚ using the same tracks for all agricultural equipment of same working width during the whole period of crop growing;
- ✚ improved organization of the optional operations and transport servicing mainly.

Taking into consideration all these technological principles for diminishing soil packing and in this respect having in mind the above-mentioned management and technical requirements, the following particular systems for diminishing soil packing at tillage of winter grain crops and spring crops are suggested for mass utilization in the agricultural practices in Bulgaria.

**A tillage system for growing winter grain crops with diminishing soil packing**

The following can be included to these systems:

- ✚ updated conventional tillage system;
- ✚ minimum tillage system;
- ✚ soil conservation tillage system;
- ✚ breaking and loosening tillage system.

The choice of a tillage system for diminishing soil packing at growing winter grain crops depends on the type of the precursory crop and the condition of the land after harvesting mainly as well as on the soil composition. The latter is very important at choosing the equipment to be utilized.

**The updated conventional tillage system at growing winter grain crops** was developed at the end of the twentieth century [4; 5], however, there have been some technical improvements to it nowadays. It can be applied in soils of light, medium and heavy composition and at different precursor crops and includes all known conventional technological operations utilized at growing these types of agricultural crops.

**The minimum tillage system at growing winter grain crops** is applicable in soils of light composition and free from weeds or roots. It is appropriate only for cases of winter grain crops precursors without deep tillage carried out the previous year. With this system the technological process includes the operations of pre-sowing loosening at a depth of 0.35 m, direct sowing and spraying with insecticides and fungicides for controlling insect pests and plant diseases.

**The soil conservation tillage system at growing winter grain crops** is appropriate for water erosion control and for diminishing soil packing on slopes. It is applied in soils of water resistant alluvial seams after hoed or stubble (winter grain crops) precursors with plant residues shredded and spread on the surface. With all soil types and regardless of the precursor the technological process of this tillage system includes the conventional technological operations and the soil conservation method of mulching (prior to sowing) as well as breaking with dead-furrowing (after plant germination at shallow frozen soil in winter).

**The breaking and loosening tillage system at growing winter grain crops** can be applied in soils of light, medium and heavy composition, at hoed as well as at stubble precursors. A peculiarity of this tillage system is that the operation of breaking with dead-furrowing in winter, regardless of the precursor and pre-sowing combined tillage at hoed precursor is carried out besides the conventional technological operations. At droughts and secondary packing of light soils, the combined pre-sowing tillage is carried out with cultivators with sweeps of KPS-9 type cutting to a depth of up to 0.18 m and disk harrows, operating at a depth of 0.08-0.10 m. Cultivator-looseners of KRN-1.75 type (KRN-2.4) and heavy-duty disc harrows operating at a two-level depth of up to 0.35 m and 0.08-0.10 m are utilized for heavy soils in severely dried up condition.

**Tillage systems for diminishing soil packing at growing spring agricultural crops.**

The following systems fall in this category of equipment:

- ✚ updated conventional tillage system;
- ✚ chisel type minimum tillage system;
- ✚ erosion control soil breaking tillage system.

Also, the choice of a tillage system to be utilized in the agricultural practices in our country depends on the type of the agricultural precursor, the condition of the agricultural land and the soil composition.

**The updated conventional tillage system at growing spring crops** as well as the updated conventional tillage system at growing winter grain crops was developed in the 80-ties of the previous century [4; 5]. However, there have been some technical improvements to it nowadays. It can be utilized after precursors such as winter grain crops, hoed crops and perennial herbaceous crops and includes all known conventional technological operations applied at growing this type of agricultural crops.

**Chisel type minimum tillage system at growing spring crops** is applicable to light and medium type of soil composition as well as to agricultural land which hasn't had annual grains as precursors and is free from weeds and roots. It is appropriate only for land with winter grain crops as a precursor. Its peculiarity is that the main tillage is carried out with chisel type cultivators at a depth of 0.15-0.18 m. Along with that, breaking with dead-furrowing at a depth of 0.40 m with 5 to 10 m interspacing between the cuts is carried out in winter while weed, pest and disease control is carried out mainly through spraying with insecticides and fungicides.

**The erosion control soil breaking tillage system at growing spring crops** is appropriate for soil conservation from water erosion and for diminishing soil packing on slopes in our country. It is applicable to soils of different composition after precursors such as winter grain crops or hoed crops.

With all soil types as well as with the two types of precursors, the technological process of this tillage system includes all conventional technological operations carried out transversely to the slope and the erosion control methods of breaking with dead-furrowing (at main tillage simultaneously with the sowing and the first hoeing of the crop) and furrowing with breaking and dead-furrowing (along with earthing-up the agricultural crop).

### 3. CONCLUSION

Observing the specified technical and technological rules for diminishing soil packing as well as an appropriate choice of tillage systems and technological combination of equipment for its performance can result in surmounting deterioration of the agricultural land in Bulgaria.

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