

PRACTICAL ADVICES TO CHOOSING APPROPRIATE SOIL TILLAGE MACHINES

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Abstract: The main physical soil properties are considered highly important for soil fertility. Measuring soil moisture, in-depth soil hardness and soil density can help in choosing an appropriate soil tillage method. The paper shows a practical handbook, which can be used with addition to soil moisture meter and a hardness meter to reach these conclusions. The selection of the tillage method is done by using a paper disk, provided in the handbook, showing good tillage practices.

Keywords: SOIL MOISTURE, SOIL IN-DEPTH HARDNESS, SOIL DENSITY, RECOMMENDED TILLAGE TYPES

1. Introduction

The main stage of crop cultivation is the mechanical treatment of the soil, which changes physical properties of the latter in such a way that they will be favourable for the development of the crops.

2. Main physical soil properties

The general physical properties of the soil are: density, relative bulk density, porosity, water permeability and aeration. Soil bulk density (mass) is considered to be one of the most important factors for fertility. It affects not only the development of the plant root system, but also their water, air and nutrition regime. It has been found that for different type of plants and soils there exists optimal density and any deviation from it could lead to complete depletion of organic matter, and hence, lack of fertility.[1,4] The farmers get a realistic idea about the physical properties of the soil usually when they are investigated in specialised laboratories, which takes time and resources. Due to various reasons they often do not pay attention to soil's physical properties, relying too much on available equipment to keep them within certain limits. Equipment, inappropriately chosen and used, can have subsequent adverse effects on the yield [2,3].

Well-structured soil predetermines good indexes of its physical properties (see Fig.1).

In this sense a good practice in agriculture is the one that

considers soil's physical properties when selecting the type of tillage.

A solution is provided by the handbook with guidelines for good practices in soil treatment (see Fig. 2) [5]. It has been developed by the project team and is designed for use by farmers directly in the field. The Handbook consists of instructional disk for measuring the bulk density of the soil in a user-friendly way and a table with recommended types of tillage.



Fig. 2. Handbook with instruction for good practices in tilling

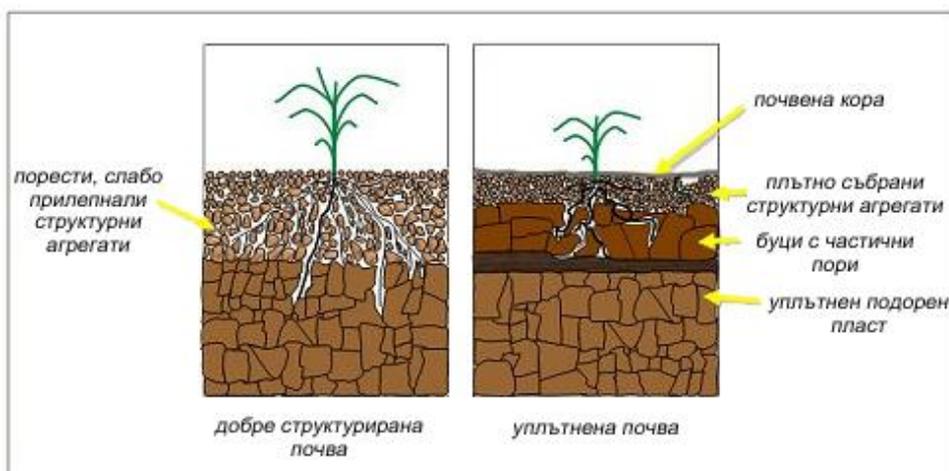


Fig.1. Well-structured and compacted soil

The Handbook can be used before and/or after tillage. In both cases it is recommended the soil to be "mature". The measurement before tilling helps to select the appropriate way for its implementation while the measurement after can be used, for example, for devising the irrigation regime.

The use of the Handbook requires two measuring devices: moisture meter and hardness meter for the soil. The meters can be digital or analogue, but for practical needs it is recommended that they be of the first type (see Fig.3 a).



a) - digital b) - analogue
Fig.3. Soil hardness meters

On the inside of the Handbook you will find the instructional disk and the table with recommended types of tillage (see Fig.4). The disk consists of a moveable and a stationary part. The stationary part is divided into semicircles, each of which has 9 sectors with a colour scale. The rotating part has two opposed open sectors and belts, representing the layers of soil.

3. Four steps in determining recommended tillage method

Working with the Handbook before tilling takes four consecutive steps.

3.1. Evaluating soil moisture

With the first step the absolute soil moisture is measured, which

is one of the indicators on the disk. Using the moisture meter (see Fig.5), the reading is done in the field and the value displayed will be used for adjusting the disk.



Fig. 5. Analogue soil moisture meter

3.2. Measuring soil in-depth hardness

The second step is related to measuring the soil hardness in-depth. With the devices shown this depth could be 0.80 m. The analogue hardness meter has a colour scale divided into three sectors - green, yellow and red. The scale in the upper part of the disk is arranged in the same way, where the soil hardness is the next indicator. The scale is read in the following way: green sector – good condition; yellow – satisfactory; red – deteriorated condition of the soil.



Fig. 6. Hardness meter scales

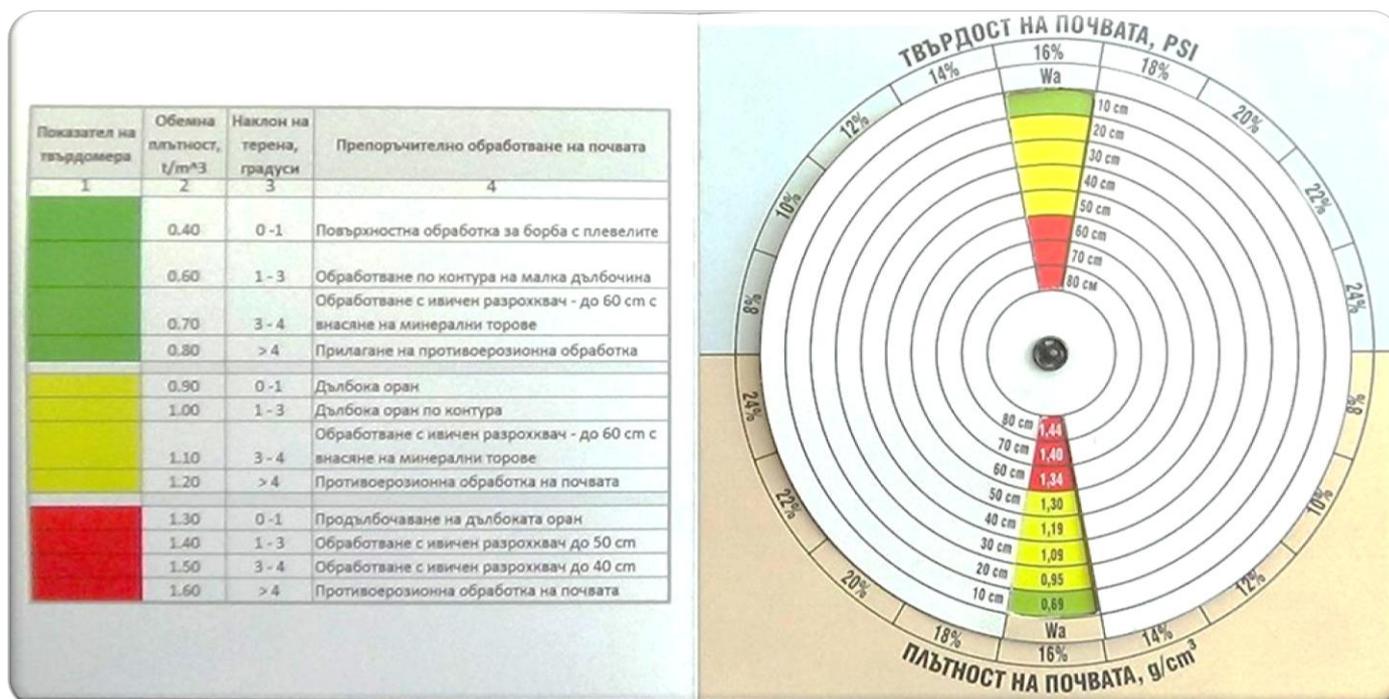


Fig. 4. The inside of the Handbook with instructions for good practices in tilling

3.3. Measuring soil density

Measuring the soil density is done with the third step. For this purpose it is necessary to fix the indicators on the disk first, according to the data from the devices. The adjustment is done in the upper part of the disk, which refers to soil hardness. On the outer belt of the rotating part an indicator for the absolute soil humidity is placed, which is coloured in blue. It has to be set against the moisture sector, which corresponds to the moisture measured by the respective meter. Thus we get a colour scale for soil hardness to open, and there we find the colour indication, measured by the hardness meter at the depth of penetration of the device (see Fig.7). At this setting of the disk, from the scale in the lower semi-circle, the soil density at the specific depth of penetration is indicated. Here, besides colours, the scale has numeric indication, with the colours corresponding to the indications in the upper part and the numbers assumed to be the mean value of soil density in the specific layer.

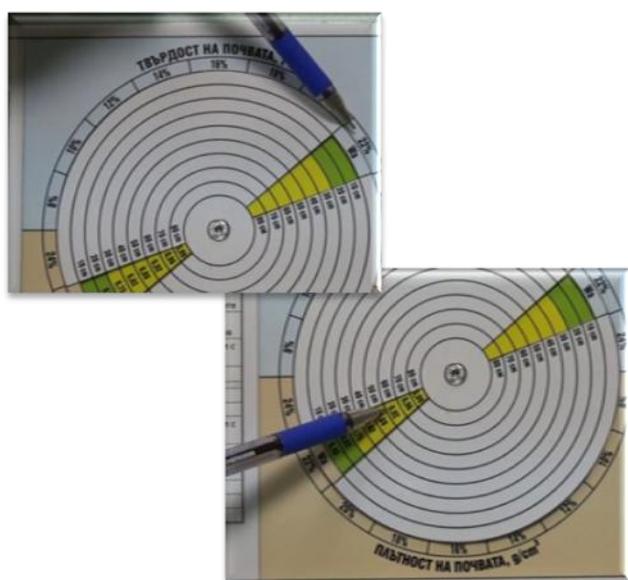


Fig. 7. Indicators on the disk

3.4. Recommending the suitable tillage type

In the example reviewed, the final step is related to recommendations for types of tillage, consistent with the results obtained. The recommended types of tillage are shown in the last column of the table in the Handbook, where, depending on the reported hardness and density of the soil, as well as the inclination of the slope, the most appropriate type of tillage is given, which will ensure both the necessary physical properties of the soil and its resistance in the presence of erosion processes.

4. Conclusion

A practical handbook has been developed to help determine an appropriate method of soil tillage with only the usage of two simple inexpensive tools - soil moisture meter and a hardness meter. The received data is then interpreted and via a provided in the handbook paper disk is determined which tillage type will suit most the condition in which the soil is in and will help prevent erosion processes.

The paper has been developed under project AGR0042.20140328 "Conserving Bulgaria's Soils" funded by America for Bulgaria Foundation.

5. References

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