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STUDIES REGARDING MINIMUM SOIL TILLAGE

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Abstract

Research goal was to gather data regarding soil tillage, operations with agricultural implements and machines to alter soil features and to guide vegetation factors (water, air, heat, nutrients and biological activity) thus developing optimum conditions for crop development. Research objective was unconventional soil tillage on vertisol. Soil tillage has been integrant part of agriculture since times immemorial and it has helped preparing the germination bed, reducing soil compaction (to increase soil aeration and improve root system development), reducing weeding, incorporating fertilisers and amendments, and managing plant debris.

Key words*: *soil, fertilisers and amendments, vertisol

INTRODUCTION

Soil conservation covers a set of activities, measures and technologies competing to maintain soil fertility without sensibly reducing crops or cropping costs. [13]
This concept developed from the fact that soil is the most important asset of human existence ensuring food production, raw matter for the various industries, energy etc. [5]
Therefore, maintaining soil biological capacity is a must for social life.
For a long period of time, agriculture and soil tillage have been seen as synonyms. [4]
Soil tillage have been an integrant part of agriculture since the very beginning and it has helped preparing the germination bed, reducing soil compaction (to increase soil aeration and improve root system development), reducing weeding, incorporating fertilisers and amendments, and managing plant debris. [2]
Maybe the most deeply negative effect of soil tillage in the world has been soil degradation because of wind and water action.
About 80% of agricultural area at world level suffer because of moderate erosion with soil losses of 30-40 t/ha/year. [7]
Incorporating plant debris and leaving the soil uncovered allow wind and water to move soil particles as dust or sediments.
Increasing apparent density and reducing porosity in degraded soils makes difficult soil penetration by the plant root system and its access to nutrients. [1]
Applying soil tillage widely in Romania aims at conserving soil fertility; it is extremely important particularly because arable areas are increasingly cultivated without a specialist's opinion and without a system that takes into account short-, medium- or long-term consequences. [9]

MATERIALS AND METHODS

Research was conducted on a vertisol. The soil work system consisted in minimum or low soil tillage.
It involved basic soil tillage without furrow turning, keeping 15-30% of plant debris as mulch on soil surface or superficially incorporated.
Mouldboard ploughing is accepted once in 3-5 years.
Depending on the implements used in the basic tillage, this system can have several variants:
-disc harrowing;
-chiselling;
-paraploughing;
-rototilling;

-milling;
-shanking;
-combined aggregates.

a. Disc harrowing

One can say that disc harrowing has been the most researched tillage due to the relatively good machine park.

Heavy disc harrows are sued.

Their active parts have concave discs set sidelong the advancing direction and inclined vertically.

They penetrate the soil up to 10-12 cm, cutting and mincing the soil and then partially turning it over.[3]

It is known that the disc contributes the most to deteriorating soil structure, which recommends avoiding excessive use; when use, it need optimum soil moisture time.

Disc harrowing alone is followed by rhizome weeding (rhizomes are fragmented).[15]

Photo 1.Harrowing equipment.

b. Chiselling

Chisel is an implement that aerates the soil up to 16-20 cm deep (maximum 40 cm for deep aeration). The working organ (rake) is an arch sheet with a claw-like cutter.

Chiselling aerates the soil without mixing, turning over or reversing soil layers.

High clay-content soil recovers its initial state quickly.

Photo 2. Chiselling equipment.

Tillage is high quality when the soil is relatively dry.

It is recommended particularly in cereal crops.[17]

c. Paraploughing

Paraploughing is a plough in which mouldboards are replaced by active parts that aerate the soil without turning it over.

When used on a soil with plant debris, they also use a corrugated disc to mince them.

Tillage depth is 22-25 cm (maximum 30 cm).

Using paraploughing is adequate on slope lands for anti-erosional protection, on soils with a short arable horizon, on sandy soils subjected to wind erosion, on salty soils etc. [6]

Photo 3.Paraploughing equipment.

d. Rototilling

Rototillers are meant to prepare the germination bed at depths between 8 and 18 cm.

They are attached to the power take-off shaft of the tractor.

There are several variants of rototillers with different tillage widths and tillage organs.

It allows simultaneous sowing and germination bed preparing.

Photo 4. Rototilling equipment.

Soil tillage is done without bringing up moist soil layers, thus preserving soil moisture for better seed germination.

The Packer roller ensures supplementary mincing and slight settling and levelling of the soil.[10]

g. Milling

Agricultural mills are meant to mince and aerate the soil to prepare the germination bed 6-25 cm deep in field crops, orchards, truck farming, vineyards, grasslands and haymaking fields, on marshy and peaty lands.

The main uses of the mills are preparing the germination bed by mincing, aerating and mixing soil layers with organic debris on soil surface.

Their inconvenient consists in a high energy consumption compared to other tillage machines.[11]

Photo 5.Milling equipment.

f.Shanking

Cultivators are used to till soil superficial layers aiming at aerating them and killing weeds.

Soil aeration cultivators can be equipped with shanks that are fixed on a 2-3-row frame flexibly or rigidly.

In general, these cultivators also have support wheels to regulate tillage depth.

They operate like chisel-cultivators but only 10-15 cm deep, mainly on light soils. [12]

Photo 6.Shanking equipment.

g.Combined aggregates

Combined aggregates used in minimum tillage allow a single passage in the following soil works[8]:

-aerating the soil without furrow turning up to 40 cm deep;

-preparing the germination bed;

-sowing and rolling.

Usually, these combined aggregates operate on non-aerated soils.

Optionally, one can use them only to aerate the soil and prepare the germination bed on non-aerated soils (without a sowing equipment) or only to prepare the germination bed and sow on ploughed lands (with no aerating organs).

During the tillage process, aeration organs split and dislocate the soil at the depth and the cutter rotor tills the soil by crushing and mincing dislocated soil fragments.

The cutter rotor minces and aerates by breaking down soil fragments, not by cutting, which maintains soil natural structure.[1]

Photo 7. A combined aggregate.

RESULTS AND DISCUSSIONS

Conservative soil tillage differs from the conventional low-tillage in the area covered by plant debris after sowing, which should be over 30%, and by the less frequent and intense aerating tillage.

Among conservative low-aerating soil tillage there is also *minimum till*.

This name generated significant confusion in the definition and delimiting of conservative and conventional tillage systems.

It has been considered synonym of low-tillage, without differentiating between conventional and conservative.

Minimum tillage is defined as minimum soil tillage to ensure normal growth and development of crops.

However, the name *minimum soil tillage* meant to meet the normal plant requirements depending on soil features through different mechanical soil works – from direct sowing to ploughing by completely turning the furrow – is terminologically rather evasive since it covers a rather wide range of technological possibilities. [14]

Minimum tillage could also mean stripe tillage or just reducing ploughing depth or giving up secondary works in the preparation of the germination bed.

CONCLUSIONS

The main conclusions of Romanian research generally meet references in world literature and they concern:

-a sensitive growth of indicators of compactness (apparent density, resistance to penetration) in the superficial soil layer without reaching values that could damage soil quality or crop growth and development;

-often important reduction of compactness in the layer beneath the superficial one, i.e. a tendency to remove the plough sole and its negative effects;

-an increase of water seepage speed into the soil with positive consequences for soil water regime and avoidance of water excess;

-on sloppy lands, it sometimes reduces significantly the amount of eroded soil, hence soil protection and prevention of degradation through erosion;

-higher accumulation of organic matter in the superficial soil layer with direct effects on physical degradation processes through de-structuring and crust formation;

-improvement of biological activity by increasing nutrient resources as a result of larger amounts of plant debris and of less soil tillage;

-lower energy consumption and costs despite the sensitive increase of costs to control weeds, diseases and pests.

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