MACHINERY AND TECHNOLOGIES USED IN SOIL CONSERVATION SYSTEMS FOR SUSTAINABLE AGRICULTURE

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Abstract. *Soil degradation processes involve the need for conservation, maintenance and improvement of soil quality. Soil properties, as well as soil formators, such as climate, land use or soil management, determine the degree of soil degradation. Certain agricultural systems and practices are targeting one or more soil degradation processes and can contribute to better protection and preservation of edaphic resources, which has led us to carry out a series of studies and research directly in the field, using certain agricultural machines and technologies so that the soil does not suffer deep transformations and do not spoil its state of current fertility but, on the contrary, to apply those conservation methods that lead to preservation, to maintaining and retaining water in the soil, getting some high quality good yields with low production costs. Agricultural practice has highlighted that soil production capacity in the case of modern agricultural technologies (machines, fertilizers) increases with the necessary works for land improvements, prevention and control of erosion, a positive or balanced ratio of organic substances in the arable soil layer. Following the use of these machines and technologies, the first to win are farmers that implement them. In Romania, there are currently several farms that use and apply modern soil work technologies and in areas where soils and crops are suitable for them.*

Keywords*: soil, preservation, machinery and technologies, sustainability*

INTRODUCTION

Agriculture is one of the most important branches; it occupies a large part of Romania's area. It therefore has an important role in preserving natural resources and cultural landscapes and is a prerequisite for other human activities especially in rural areas. During the centuries, agriculture has contributed to the creation and preservation of a variety of landscapes and habitats. (AUNGURENCE N., 1994; DĂNILĂ I., 1981; LETOȘNEV M.N., 1959; TONEA CORNELIA, 2003; TOMA D., 1981). However, agricultural practices may also have adverse effects on the environment. Soil degradation, water, soil and air pollution, habitat fragmentation and wildlife destruction, all together can be the result of inappropriate agricultural practices. Since 2007, when Romania joined the European Union, a new stage in the Romanian agricultural economy has begun, and with this, a development of rural agriculture. In this context, our country has begun to quickly adapt its agricultural and rural development economy in order to integrate into the European Union's internal market and adopt the Common Agricultural Policy (CAP). The European model of agriculture is based on a competitive, market-oriented sector that pays particular attention to protecting the environment, to provide decent conditions for the population in rural areas and not only, as well as the integration of agriculture within the environment and forestry. (MIHUȚ CASIANA, RADULOV ISIDORA, 2012; OKROS ADALBERT, PIRSAN PAUL, BORCEAN ADRIAN, MIHUT CASIANA, NITA SIMONA, MIRCOV VLAD DRAGROSLAV, HAMDAMOV SHAHZOD, GOZIBEKOV ABDUMANON, 2019; SAIDA FEIER DAVID, NICOLETA MATEOC –SÎRB, TEODOR MATEOC, CRISTINA BACĂU, ANIȘOARA DUMA COPCEA, CASIANA MIHUȚ, 2020). This common agricultural policy goes from direct subsidies for agriculture (Pillar I CAP) to an integrated development of the rural economy and to the protection of the environment (Pillar II of the CAP). (NAGHIU AL., 2008; NECULĂIASA V., DĂNILĂ I., 1995; SCRIPNIC V., BABICIU P., 1980; ȘANDRU A., CRISTEA I., 1983). According to MADR data. (https://www.madr.ro/agriculture.html) Lately, in order to prevent a series of shortcomings, a series of agricultural machinery and equipment

have been widely used, which through only one passage carries out more works, so all soil properties (physical, physical-mechanical, chemical, biological and hydric) will not suffer. (DUMA COPCEA ANIȘOARA, MIHUȚ CASIANA, ARSENE O., 2017; DUMA COPCEA ANIȘOARA, ILEA R, POPA D., 2018; BRÎNDEU L., 1980; ILEA R., 2009; RIPEANU A., 1982; SILAȘ GH., GROȘANU I., 1981)

MATERIAL AND METHODS

The overall objective of sustainable development for the coming years is to ensure a sustainable growth of the agricultural sector, as well as improving the quality of life by increasing the productivity and competitiveness of the sector, while maintaining the long-term soil quality.

The soils studied belong to a farmer from Chisinau Criș, Arad County, Romania. The total area is 28 ha and the agricultural machinery used in this study is from Maschio Gaspardo. Studies were made for a period of 5 years (2015-2020).

RESULTS AND DISCUSSIONS

Conservative agriculture is normally applied in 4 stages, each of which has a period of at least two years, namely:

• The first step: It refers to the inversion of the layers that is stopped by applying a small soil works system or the sowing directly in the stubble. At least one third of the soil surface remained covered with residues from the preceding harvest (straw, cobs), and the covering crops were introduced after the harvest of the main culture. At this stage, disk harrows, with rotary teeth and harrows, were used, i.e., the sowing was directly in the stubble.

• The second step: The fertility status of the soil was considered. At this stage, there was a natural improvement in fertility by incorporating organic matter from the natural degradation of residues. Weeds and pests tend to multiply, and this is chemically or mechanically controlled (hoeing).

• The third step: It refers to crop rotation. If, in 2015 and 2016, most of the land was cultivated with maize and wheat, starting with 2017, a rotation of crops was considered by the introduction of legumes (soy and rape).

• The fourth step: It has increased the production by decreasing the use of chemicals.

In support of the above-mentioned details, there are some of the technologies that support farmers for sustainable use of agricultural land. The equipment used are from Maschio Gaspardo. Sowing was done directly in the stubble (the low soil works) with the help of the new GIGANTE PRESSURE cultivator.

Another soil work is sub-soiling, which has been achieved with the new FOLDABLE ARTIGLIO scarifier without turning the ground layer.

In the first work done, i.e., sowing directly in the stubble, a number of agricultural, economic and environmental benefits were observed, namely:

- Increased soil fertility;
- Increased organic matter and humus;
- Increased microbial activities favourable to culture;
- Reduced soil compaction;
- Low oxidative stress of the soil;
- Lower risk of surface water stagnation;
- Minimum soil erosion.

Of the economic benefits, we list the following:

- Reduced working time required for soil processing;
- Significant fuel economy for soil processing;
- Increased interval;
- Reduced number of machines;
- Smaller economic risks in extraordinary climate events.

As for environmental benefits:

- Maximum expression of conservative agriculture;
- Soil as a stock of CO_2;

- Reduced gas emissions in climate change;
- Prevented soil degradation and erosion (for slope soils);
- Reduced destruction of structural soil colloids.

The use of Gigante Pressure in agriculture has a series of strengths:

- Lower centre of gravity;
- Distribution system for seeds and fertilizers;
- Seeding element with high pressure on the ground;
- Ability to work in almost any conditions.

Another advantage is the fact that, by a single movement, it ensures both the seed and the fertilizer that is needed, the passages are reduced, the soil does not tamp, it does not destroy its structure, it reduces the time and consumption of fuel, but it also wears machines and installations, etc. By placing the fertilizer together with the seed, the germination rate is higher and there is maximum fertilizer effect. The seed and fertilizer transport system is unique in simplicity and low weight. A close contact between seed and fertilizer takes place, in the sense that the two are mixed, being transported together in the furrow, with the fertilizer being in the immediate vicinity of the seed and having an independent dosage of both the seed and the fertilizer.

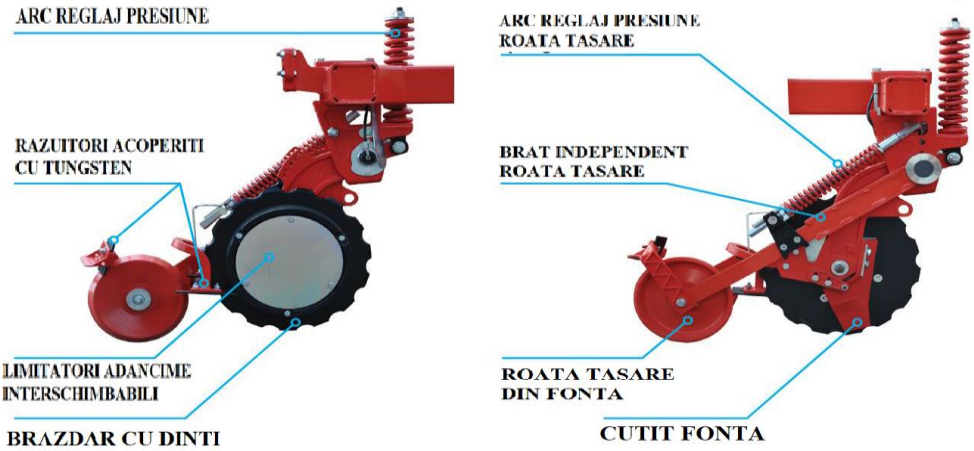

Fig. 3. Direct sowing unit from Gaspardo

Innovations of this system consist of deep-cut limits through a sowing depth adjustment. This system is composed of (Figure 3): cast iron disk, resistance, toothed coulter, interchangeable limits (3 screws), conical profile and a very stable unit on the ground.

Land sliding towards the outside

• The disk rotates without blocking;

• The friction effort is lower.

CONCLUSIONS

There are a number of agricultural systems and practices targeting one or more soil degradation processes and which, together, can contribute to better protection and conservation of soil resources. Thus, following studies and research in the last 5 years (2015-2020), directly in the field, we used a range of agricultural machinery and technologies so that soil does not suffer deep transformations but we tried to keep and even improve fertility status applying those conservative methods that lead to its preservation, to maintain water in the soil, to obtain a large, good quality, low-cost production.

Following the studies carried out on the farm in Chisinau Cris, on an area of 28 ha, we used agricultural machinery from Maschio Gaspardo and we have followed the following steps:

- Step 1, when a ground layer inversion was performed, applying a low system of soil works (or sowing directly into the stubble). At this stage, at least 1/3 of the soil surface remained covered with residues from the preceding harvest and used discs, tooth and rotary harrows, that is, the sowing in the stubble was used.
- Step 2, when there was an improvement in fertility by incorporating organic matter from natural degradation of residues.
- Step 3, when we made a rotation of crops by introducing legumes (soy and rape).
- Step 4, when we aimed at higher production, without using chemicals or using them in infinite amounts.

As technologies used to support farmers, the sowing was made directly in the stubble (using low soil works) with the new Gigante Pressure seeders, as well as the soil work with the new Artiglio Folding scarifier without turning the ground layer (sub-soiling).

During the sowing directly in the stubble, a number of agricultural benefits were observed: increased soil fertility, increased content in organic matter and humus, intensification of microbial activity, reduction in soil compaction, and a lower risk of stagnation of water and erosion.

Among the economic benefits, we listed reduced working time, fuel economy, reduced number of machines.

For the environment, there are a number of benefits: conservative farming, stock of CO_2 in the soil, reduced gas emissions, reduced soil degradation and erosion, reduced structural state of the soil.

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