

ABSTRACT

Globally, corn (*Zea mays* L.) plays a crucial role in food security, agricultural practices, and economic stability. Its importance is underlined by its cultivation over large areas, with production exceeding 1 billion tons annually, which places it at the top of the cereal ranking in terms of production volume. After wheat, corn ranks second in terms of cultivated area worldwide.

Soil cultivation is essential for preparing the seedbed and controlling weeds, but the conventional system has led to the degradation of this resource and a decrease in organic matter content, requiring the implementation of sustainable soil tillage systems that address conventional agriculture shortcomings. The emergence of the no-tillage system, starting in 1980 in South America, represented a major change in agricultural practices.

Since the no-tillage system concept was introduced, there's been a lot of research on how it affects soil conditions and crop yields. Given the need to investigate this conservative soil tillage system in the climatic conditions of northeastern Romania, it was considered appropriate to start a doctoral thesis entitled ***“Conservative corn cultivation technologies and their influence on soil condition and yield levels at the Ezăreni Farm, Iasi”*** structured in two parts. The first part presents a bibliographic study on the topic under investigation, comprising two chapters. The second part presents the aim and objectives of the topic, the materials and methods of analysis, the characterization of natural framework, the results obtained during the three years of research at the Ezăreni Farm in Iasi County and the conclusions, comprising six chapters.

Chapter I presents the history, importance and the spread of corn crop both in Romania and worldwide. Also, the history, importance and spread of conservation agriculture are presented.

Chapter II presents the current state of research in Romania and abroad on the influence of tillage systems on soil condition and production levels. Studies from the scientific literature, mainly from the last 10 years, are presented, regarding the impact of conventional, minimum and no-tillage systems on the physical, hydro-physical, chemical properties and on the yields of corn.

Chapter III presents the aim and objectives of the research, the experimental factors, the tillage technology applied, the materials and research methods.

The aim of the research was to conduct a comparative study of conventional and conservative (no-tillage, minimum) systems after eight years of continuous implementation, by determining their influence on soil quality and crop yields.

The main objective was to determine the effect of conservative tillage technologies on yields and soil physical, hydro-physical and chemical properties.

To achieve the proposed goal, the research started in 2022, eight years after the experimental was set up and ended in 2024. The experiment is single-factor, with the factor studied being the soil tillage system. The experimental field covers an area of 16 ha, tilled both conventionally (8 ha) and conservatively (8 ha). Corn crop is cultivated on four hectares, two for each soil tillage system. In the third year of the study, 2024, deep loosening of the soil was carried out on 4 hectares of the 8 hectares cultivated using the no-tillage system, on half of the area of each plot. The crop rotation practiced in the experimental field is 4 years long and consists of winter wheat, corn, sunflower and winter peas.

Chapter IV describes the natural setting of the research.

The experimental field is placed on regraded cambic chernozem soil at the Ezăreni Student Research and Practice Station. The Station is located at the southwestern extremity of the Lower Jijia Plain and Bahlui, also known as the Moldavian Plain, which is part of the Moldavian Platform and from a geomorphological point of view, it is located on the Transition Coast of Iasi.

Between 2022 and 2024, there was an increase in the average annual temperature of 1.31°C in 2022, 2.37°C in 2023, and 2.55°C in 2024 compared to the multi-year average temperature (1961-2021) of 10.02°C. Precipitation also showed a deficit in the first two years of research of -141.8 mm and -117.4 mm, respectively and an increase of 50.2 mm in the third year, compared to the multi-year average (1958-2022) and an unequal distribution throughout the year.

Chapter V presents the results regarding the influence of tillage systems on the physical and hydro-physical properties of the soil and the Pearson correlation between these properties. Thus, the bulk density of conventional tillage soil showed large fluctuations over time and depth, while no-tillage soil had higher values but with reduced variations.

Saturated hydraulic conductivity was higher in the conventional tillage system in spring at a depth of 0-20 cm due to soil loosening caused by cultivation, but this did not persist over time. Conservative systems, due to the absence of soil disturbance, create a network of pores made by plant roots and soil organisms that help increase the speed and amount of water infiltration.

Under conservative systems the percentage of water-stable aggregates was higher during the entire study due to the more intense activity of fauna and microorganisms, but also due to the retention of plant residues on the soil surface.

In terms of soil moisture, conservative systems retained a greater amount of water and showed less variation throughout the year.

The surface soil temperature was lower under the plant residue layer in conservation systems, by 59 to 72%, compared to the conventional tillage system during hot summer days. At depth, the soil in the no-tillage system warms up more slowly in spring compared to the conventional system where, due to tillage, soil-atmosphere air exchange is more intense and moisture content is reduced.

The research confirmed the results reported in scientific literature, which indicate that soil penetration resistance and moisture content are negatively correlated. The conventional tillage system showed lower penetration resistance values at a depth of 0-30 cm in the first two months after sowing, due to tillage operations, but during the growing season, a compacted soil layer (hardpan) was observed at a depth of 30-40 cm. In conservative systems, a relatively constant penetration resistance was observed at depth and the increase in this index during the growing season is due to the decrease in soil moisture content.

Pearson correlation of the results obtained during the three years of research revealed some consistent and statistically significant trends between the physical and hydro-physical properties of the soil.

Chapter VI presents the results of the influence of tillage systems on soil chemical properties, respective on the pH, the main macro and microelements, humus content, nitrogen index and electrical conductivity.

In conservative systems, the pH was moderately acid to neutral, with a tendency toward acidification of the topsoil as a result of annual chemical fertilization without incorporation, while the conventional system showed a pH ranging from slightly acid to slightly alkaline during the investigation period.

In terms of available phosphorus content, the soil was poorly to very well supplied, with a pronounced decrease in the conventional system between the arable layer (0-30 cm) and the 30-40 cm layer, while in the conservation systems, there was a decrease between the surface layer (0-10 cm) and the 10-20 cm layer due to the very low mobility of this nutrient. The humus content showed a similar soil supply trend as available phosphorus.

For microelements, there wasn't a clear general trend on the impact that conservation systems had on soil supply.

Soil electrical conductivity at a depth of 30 cm was higher in conservation systems, mainly due to higher moisture content and reduced fluctuations over time.

Chapter VII presents the results regarding the influence of tillage systems on yields and Normalised Difference Vegetation Index (NDVI).

Analysis of the three years revealed a significant variability in tillage system performance depending on annual local climatic conditions. Thus, in 2022, under no-tillage the yield was about 6504.81 kg/ha, with 590.64 kg/ha higher than the conventional system, in 2023 the conventional system exceeded no-tillage with about 1881.58 kg/ha, yields being 7952.00 kg/ha and 6070.42 kg/ha, respectively, and in 2024 the conventional system recorded 5703.84 kg/ha, the minimum tillage 5667.41 kg/ha and the no-tillage 4233.44 kg/ha.

The mean values of NDVI in 2023 were higher in conventional system in July (0.860 vs. 0.700) and in no-tillage system in August (0.749 vs. 0.716). In 2024, minimum tillage system recorded the highest mean NDVI values in both July (0.880) and August (0.672).

Chapter VIII presents the conclusions and recommendations drawn based on the results during the research, followed by 365 bibliographical references, which were analyzed for elaboration of this thesis.