RESEARCH ON SOIL QUALITY AND SWEET CORN PRODUCTION IN BLACK CRIȘULUI MEADOW, ROMANIA

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Abstract*: This study delves into the relationship between natural conditions and sweet corn cultivation in the Black Crişului Meadow. The research meticulously examines the environmental factors of this region and their impact on sweet corn production, which are crucial for implementing sustainable agricultural practices aimed at improving quality and yield. The investigation primarily focuses on the physical and chemical characteristics of the soil within the study area and sweet corn production*.

Keywords: soil, pH, sweet corn, hybrid

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1. Introduction

The Black Crisului Meadow is an area of distinct agricultural significance, given the importance of soil quality in the agricultural production process. Since soil plays a fundamental role in supporting and thriving agricultural crops, this study focuses on a detailed analysis of soil quality and its influence on sweet corn production in the Black Crisului Meadow.

Agricultural research has highlighted the importance of adapting crops to local specifics, and sweet corn is a prime example of this. Our goal is to identify and understand the soil quality within the studied area and how this aspect influences the growth, development, and yield of sweet corn crops.

A detailed understanding of these aspects is essential for implementing sustainable and efficient agricultural techniques, resulting in the improvement of both the quality and quantity of agricultural production. Therefore, this article focuses on highlighting soil quality and its impact on sweet corn production in the Black Crișului Meadow, providing relevant and practical information useful for farmers and researchers in optimizing agricultural processes.

2. Materials and methods

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To obtain a detailed understanding of the pedological characteristics in the Black Crișului Meadow and evaluate their impact on sweet corn cultivation, we conducted a comprehensive study using rigorous scientific methods. In this research, we obtained the following relevant results, which will be discussed in the results and discussion section:

Soil pH: The soil pH value was determined through precise measurements using standardized equipment and techniques [1]. We analyzed the level of acidity/neutrality, and the obtained results, with a pH value of 6.90, were essential for understanding the chemical parameters of the soil.

Base saturation: The 84.9% base saturation indicates a significant proportion of exchangeable cations in the soil occupied by soluble bases such as calcium, magnesium, potassium, and sodium. This suggests an adequate soil fertility potential, considering that a base saturation at this level is generally associated with good nutrient availability for plants. A high degree of base saturation can also indicate good soil capacity to maintain structure and chemical stability, thereby contributing to supporting healthy growth of agricultural crops, including sweet corn.

Humus content: A humus content of 3% in the soil within the studied area indicates a moderate amount of decomposed organic matter. The presence of this level of humus can be beneficial for soil fertility, as humus serves as an important source of nutrients for plants and contributes to improving soil structure and texture. Furthermore, humus can enhance the soil's ability to retain water and maintain nutrient balance, which is essential for the healthy development of agricultural crops [2].

Assessing and maintaining this adequate level of humus is essential for sustaining sustainable agricultural production [3].

Nitrogen index: A nitrogen index of 3% in the soil within the studied area indicates a moderate amount of nitrogen available for plants [6].

Nitrogen is one of the three essential macronutrients for plant growth and is crucial for the healthy development of agricultural crops, including sweet corn [7].

The presence of this level of nitrogen in the soil can contribute to adequate plant growth, protein formation, and the development of other vital substances [4].

Mobile Phosphorus (mg P_2O_5/100g soil):

A mobile phosphorus content of 14 mg P_2O_5/100 g soil within the studied area indicates a moderate availability of this essential nutrient for plants. Phosphorus is one of the basic macronutrients required for healthy plant growth, contributing to metabolic processes and root system development. The presence of an adequate

amount of mobile phosphorus in the soil plays an essential role in ensuring efficient absorption by plants and optimizing agricultural crop yield [10].

Mobile Potassium (Al ppm): A mobile potassium content of 167 indicates a value close to the optimal range for this essential nutrient. Potassium is a crucial macronutrient for plants, involved in numerous physiological processes such as osmotic pressure regulation, growth and development of plant tissues, and tolerance to abiotic stress. The recorded value falls within a favorable range, close to the recommended optimal range for potassium absorption and efficient utilization by plants.

Through the detailed analysis of samples collected from selected areas, we identified the taxonomic soil unit: Weakly gleic Fluvisol.

Fluvisols are defined by the presence of an A horizon (Am, Au, Ao) followed by the parental material with a thickness of at least 50 cm, consisting of recent fluvial, fluvio-lacustrine, or lacustrine deposits, including gravels, with any texture [7].

Fig. 1. Weakly gleic Fluvisol.

The pedological characteristics of the weakly gleic Fluvisol are represented in Table 1.

Table 1. Pedological Characteristics of the Soil in the Crișul Negru Meadow

ANALYZE	VALUE
pH	6.90
The base saturation degree (V%)	84.9
The humus content (%)	3
The nitrogen index (IN)	3
The content of mobile phosphorus (mg P_2O_5/100 g sol)	14
The content of mobile potassium (Al ppm)	167

By using these standardized methods and techniques, we obtained precise and relevant data regarding the pedological characteristics within the studied perimeter in the Black Crișul Meadow. This will enable us to conduct a detailed analysis and draw fundamental conclusions in the following section, results and discussions.

For this research, the Dessert R78 hybrid was used. Dessert R78 produces cobs with a length of approximately 20-21 cm.

Each cob features between 16 and 18 rows of kernels, arranged symmetrically and uniformly. This regular distribution of kernels ensures consistent quality and an aesthetic presentation of the cobs.

One notable advantage of the Dessert R78 hybrid is its ability to tolerate lower temperatures than most other varieties of sweet corn. This characteristic makes it ideal for early planting or in regions with cool springs.

The soil processing technology consisted of the following steps:

The first stage was the autumn plowing, an essential step in the soil processing process [5].

The benefits of autumn plowing include: soil aeration, mixing of plant residues, weed control, pest elimination, soil structure improvement, and preparation of the land for sowing [8].

Fig. 2. Autumn Plowing

After autumn plowing, the next step was disc harrowing, which was carried out in the spring of 2023. The use of the disc harrow helped prepare a uniform seedbed. This is crucial for uniform seed distribution and efficient germination.

Sowing in the open field was only planned once the soil temperature reached the threshold of 12°C [13], carefully monitoring the weather forecast to ensure favorable meteorological conditions. This measure was adopted to promote healthy plant growth [12].

Inorganic fertilization with NPK was carried out at the time of sweet corn sowing. NPK fertilization, combining nitrogen (N), phosphorus (P), and potassium (K), is vital for the healthy and productive development of sweet corn crops. Nitrogen stimulates vegetative growth, phosphorus supports root development and flowering, and potassium contributes to plant resilience and crop quality [4].

A quantity of 200 kg per hectare was administered [11].

Fig. 3. Disc Harrowing

Fig. 4. The sowing and fertilization of sweet corn

At 6 weeks after sowing, according to the illustration in Figure 4, a post-emergence herbicide operation was conducted. In this process, an herbicide approved for sweet corn crops, namely Laudis, was used at a dosage of 2 liters per hectare.

This intervention aimed to control weeds and ensure a conducive environment for the healthy development of the crop.

An approximate yield of 60,000 pieces of sweet corn was obtained, which were sold on the local markets. Some sweet corn plants even developed two cobs per plant. The average weight of a sweet corn cob obtained is 300-400 grams.

Climatic data for the year 2023 in the Black Crișul Meadow, Petid village:

Figure 5 illustrates the average air temperature (in degrees Celsius).

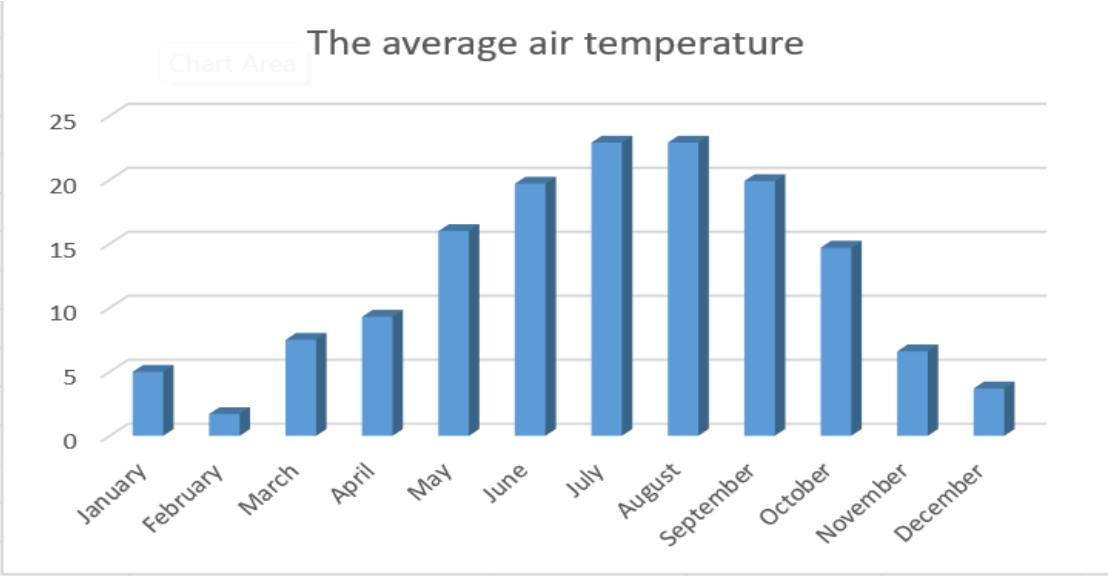

Fig. 5.The average air temperature by month

Figure 6 illustrates the amount of precipitation (in liters).

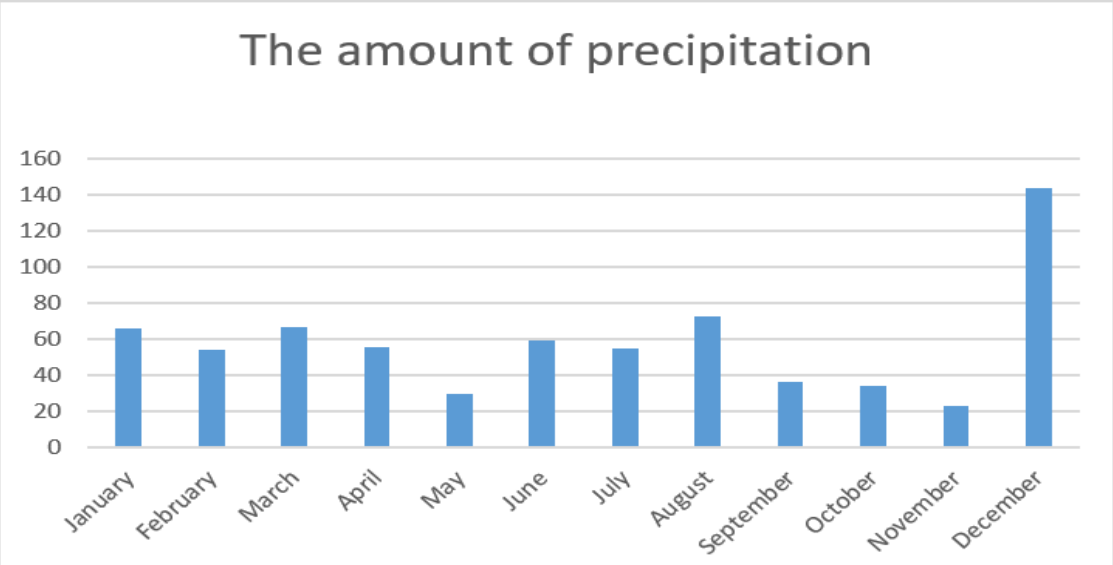

Fig. 6. The amount of precipitation by month [13].

One of the significant challenges faced by sweet corn crops in the Black Crișul Meadow is the various stress factors that can affect development and production. In this study, we paid special attention to monitoring and managing stress, understanding that this is an essential component for ensuring optimal crop yield.

The major topics of interest included water stress, thermal stress, nutritional stress, and challenges caused by diseases and pests [9].

Thermal Stress:

Monitoring extreme temperatures: we analyzed data on extreme temperatures to assess the impact of thermal stress on the plants.

Optimal scheduling: we adjusted the sowing schedule to avoid periods with extreme temperatures and to minimize plant exposure to thermal stress.

Soil Nutritional Stress:

Soil nutrient analysis: we examined the nutrient content of the soil to assess their availability for sweet corn crops.

Strategic fertilization: we implemented tailored fertilization strategies, ensuring an adequate supply of nutrients and preventing nutritional stress.

Stress caused by diseases and pests:

Disease and pest monitoring: we identified and monitored the presence of potential pathogens and pests in the sweet corn crops.

Integrated management: we adopted integrated management approaches, combining preventive practices and curative treatments to minimize stress and protect plant health.

Use of resistant hybrids: we cultivated sweet corn varieties resistant to certain stress conditions, contributing to more efficient adaptation to the specific environment.

These strategies and measures were implemented in our study to ensure an effective approach to managing stress in sweet corn crops in the Crișul Negru Meadow. In the following sections, we will explore the results obtained and discuss the impact of these factors on the production and quality of sweet corn in this specific region.

The main pests encountered in sweet corn crops include the wireworm and the western corn rootworm. These pests have the potential to negatively impact the yield and health of the plants.

The main diseases found in the Crișul Negru Meadow affecting sweet corn crops are corn rust and gray leaf spot, both of which have the potential to compromise the health and yield of the harvest.

3. Results and discussions

Soil pH: the results indicate a pH of 6.90, highlighting a slight acidity, which is optimal for the soil's chemical parameters.

A base saturation degree of 84.9% indicates a significant proportion of the cation exchange capacity in the soil occupied by soluble bases such as calcium, magnesium, potassium, and sodium.

A humus content of 3% in the soil within the studied perimeter indicates a moderate amount of decomposed organic matter.

A nitrogen index of 3% in the soil within the studied perimeter indicates a moderate amount of nitrogen available for plants.

A mobile phosphorus content of 14 mg P_2O_5/100 g soil in the studied perimeter indicates a moderate availability of this essential nutrient for plants.

A mobile potassium content of 167 mg/100 g soil indicates a value close to the optimal range for this essential nutrient.

Nutrient elements: the detailed analysis results indicate the optimal availability of macro and micronutrients, which are fundamental for the development of sweet corn.

Attributes of the cobs: the hybrid produces well-structured cobs with 16-18 rows of kernels, ensuring consistent quality.

Tolerance to low temperatures: Dessert R78 demonstrates remarkable resistance to lower temperatures, especially in regions with cool springs.

NPK fertilization: the application of 200 kg per hectare ensured an adequate supply of nitrogen, phosphorus, and potassium.

Herbicide application: the intervention with herbicides, such as Laudis, contributed to weed control and created a conducive environment for crop development.

Thermal stress: adjustments in the sowing schedule minimized plant exposure to extreme temperatures.

Nutritional stress: ongoing soil nutrient analyses facilitated tailored fertilization strategies, preventing nutritional stress.

Stress caused by diseases and pests: monitoring and integrated management were essential in protecting the crop.

Conclusions

(1) The detailed study of agricultural conditions and practices implemented in sweet corn production within the studied perimeter of the Black Crișul Meadow reveals significant conclusions regarding the optimization of yield and maintenance of crop health. The main findings include:

(2) A detailed understanding of soil pH and nutrient content led to the adaptation of agricultural practices to meet the specific requirements of sweet corn cultivation.

(3) The hybrid demonstrated success in producing uniform and well-developed cobs, successfully adapting to varying temperatures and soil conditions.

(4) The stages of autumn plowing and disc harrowing significantly contributed to improving soil structure and creating a favorable environment for germination and development.

(5) Soil nutrient analysis and the appropriate application of NPK ensured the optimal availability of essential nutrients for healthy plant growth.

(6) Proper interventions, such as herbicide application and the management of thermal, nutritional, and disease stress, contributed to maintaining crop health and minimizing the negative impact of stress factors.

(7)The results of this study provide a foundation for continuous improvement and optimization of agricultural practices to maximize the yield and quality of sweet corn production in the Crișul Negru Meadow.

(8)In conclusion, applying a well-defined set of agricultural practices, tailored to local characteristics, is essential for achieving sustainable and high-quality sweet corn production.

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