Sustainability of Wheat Crops in the Context of Climate Change

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Abstract
The sustainability of wheat crops is an important challenge in the context of globalization and climate change. Wheat is one of the most important food crops worldwide, being used for the production of bread, pasta, cereals, but also for animal feed. Globalization has led to an increase in the demand for food products, which has led to an intensification of agricultural production and an increase in the area under wheat cultivation. This intensification can have negative effects on the environment, such as soil erosion, pesticide and fertilizer pollution, and biodiversity degradation. In addition, climate change can have a significant impact on wheat production through changes in temperatures, precipitation, moisture levels and other meteorological factors. To ensure the sustainability of wheat crops, an integrated approach is needed, which includes the use of more environmentally friendly agricultural practices, such as organic farming, crop rotation, the use of organic fertilizers and the protection of biodiversity. In addition, it is important to promote research and development of wheat varieties adapted to new climatic conditions and able to provide sustainable, cost-effective production with minimal environmental impact.The present work aims to present the sustainable wheat production technologies such as: maintenance of soil health, mechanical works, fertilization systems.

Keywords: Wheat, Sustainability

Introduction

The idea of a sustainable agriculture consists in raising its productivity, with the obtaining of certain and constant profits with minimal negative effects on the environment and at the same time ensuring the food security of the population. Sustainable agriculture is a broad concept that foresees the complexity of this production system, the biological stability of cultivated plants and varieties, the conservation and protection of natural resources, but also the introduction and generalization of modern technologies as productive as possible.

Sustainable agriculture requires economically viable technologies over a long period of time, with high yields, obtained at lower costs. Any agricultural system must have a long-term productivity as high as possible, which is conditioned not only by the quality of the resource base, but also by the social and economic framework (Mănescu B., et al., 2005). It must take into account the following aspects: maintaining production potential over a long period of time, using rational agricultural practices, managing and protecting natural resources, maintaining agricultural biodiversity, ensuring the profitability of the specific activity of farmers, achieving sufficient and quality nutrition for the entire population, social and human equity, promoting ethics. Thus, sustainable agriculture must be based on the tasks, requirements and aspirations of the farmers themselves, as well as on the restrictions they face, not only in agricultural activity, but also in domestic and non-agricultural activities. (Răuţă C., 1997) Sustainable agriculture involves agricultural systems that are ecological, profitable, productive and compatible with socio-economic conditions. A critical role in the development of sustainable agriculture is represented by fragmented exploitation areas, which are approximately 85% smaller than 2 ha, worldwide.

Since 1925 in Romania, Ionescu Siseşti has been concerned with the optimal utilization of soils, without damaging them, emphasizing the idea of "not sacrificing the existence of future generations for a momentary use" (Mănescu B., et al., 2005). Currently, the meetings of specialists who propose to discuss the future of agriculture have as their subject sustainable agriculture, without including in their theme the notion of performance, although only sustainable but non-performing agriculture cannot ensure the daily bread of today's generations and those of tomorrow (Hera Cr., et al., 2003).

Wheat is the most important cereal that occupies the largest areas on the globe, having a large food share, but also in Romania, with approximately 2 million hectares cultivated every year. The vast areas occupied by wheat, as well as the people's interest in the cultivation of this plant, are due to certain factors, namely: the high content of the grains in carbohydrates and proteins, the ratio between these substances, corresponding to the requirements of the human body; the long shelf life of the grains and the fact that they can be transported without difficulty; high ecological plasticity, the grains being grown in areas with very different climates and soils; as well as the possibility of full mechanization of culture (Bîlteanu Gh., 2003). Thus, wheat is the most important cultivated plant, from which bread is mainly obtained, a staple food for approximately 40% of the world's population. By grinding wheat grains, bran is obtained. They represent a valuable fodder especially for dairy cows, youth and breeding animals, being rich in sugars (40-45%) and crude protein (14-15% - surpassing corn in terms of protein content). The straw resulting from wheat harvesting can be used both for animal feed or as bedding in the stable, as well as for fire or in the pulp and paper industry. Wheat can be cultivated successfully in different pedoclimatic conditions ensuring stable and quality harvests. At the same time, wheat grains have the advantage that they present different alternatives for capitalization, they can be easily transported over long distances and represent an important source of commercial exchanges on the world market (Ion V., 2010).

Materials and Methods

Experimental area description. The area where the tests were carried out (experimental field-center) is located in Brailei Plain, in the perimeter of Chiscani commune, 11 km from Braila Municipality.

Natural test conditions. The soil, characteristic of the area, is a weak moderately calcium-supplied chernozem in the upper part of the profile and strongly carbonated in the lower part (19.3%), with a medium humus content (2.4–3.1%) in the upper horizons and only 1.6% in the transition horizon. Total nitrogen content varies between 0.14–0.25, mobile phosphorus content 174–225 ppm, and mobile potassium 24.0–26.0 mg/100 g soil in the arable layer and with a PH of 7.9–8.4.

As physical and hydrophysical indices, the soil has an apparent density of 1.10–1.31 g/cm3, with a field capacity of 22.9–25.2%, a wilting coefficient of 6.7–10.2 %, a hygroscopicity coefficient of 3.7–6.4 % and a minimum ceiling of active humidity of 13.8–17.4 %.

Climatic Conditions of Experimentation

The Brăilei Plain is the most vulnerable area due to the climatic conditions manifested by the change in the pluviometric and thermal regime.

The testing experiments of the different wheat varieties were carried out in the period 2010-2021, with the monitoring of the pedoclimatic data continuously, in order to highlight the genetic potential of the varieties in the conditions of the Braila Plain.

Climatic conditions were monitored daily, respectively minimum and maximum air and soil temperature, precipitation, sunshine, wind, wind orientation.

Periodic soil analyzes were performed to establish the fertilization plan, according to the nutrient requirements for the optimal wheat cultivation technology.

The wheat varieties tested were different from year to year, depending on the results of the previous year and the requirements of the seed suppliers to be tested and zoned.

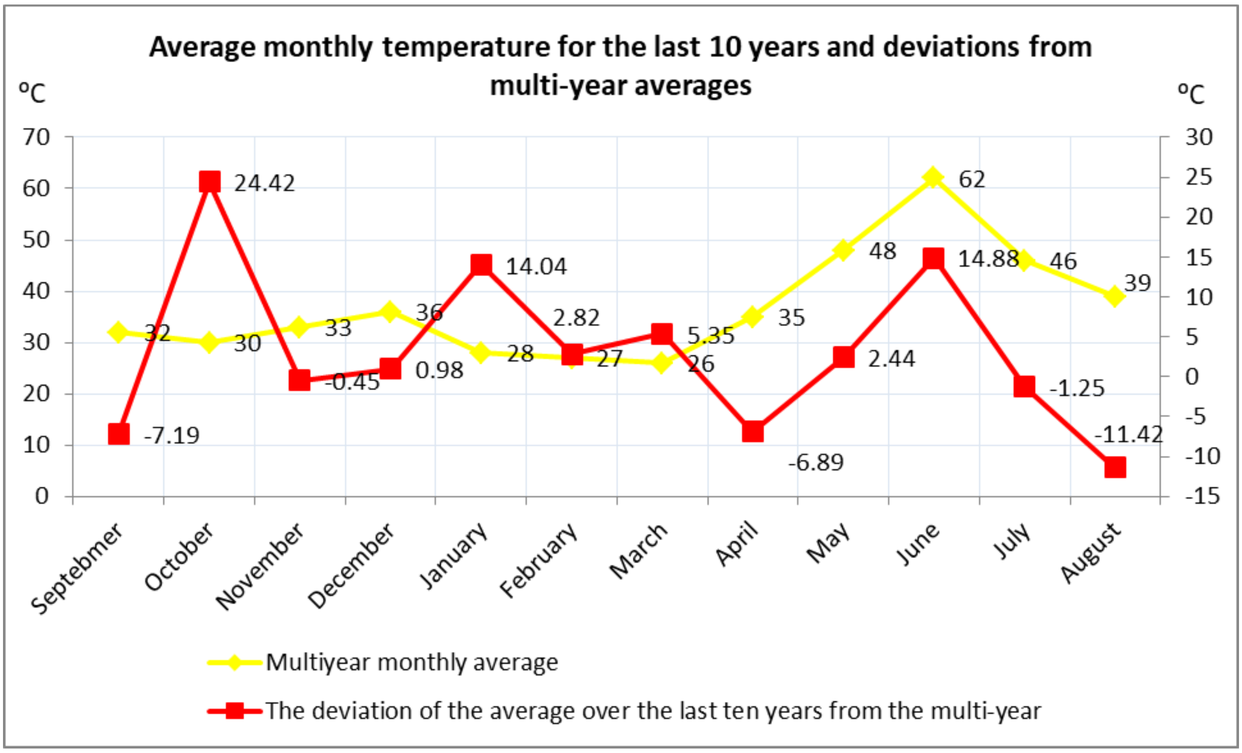
Therefore, we will include in our evaluation a series of evolving indicators that we will analyze further, namely:

- The evolution of the average monthly temperatures during the vegetation period;
- The evolution of the average monthly precipitations during the vegetation period;
- The productions obtained by the different wheat varieties tested in the period 2010-2021.

Results and Discussions

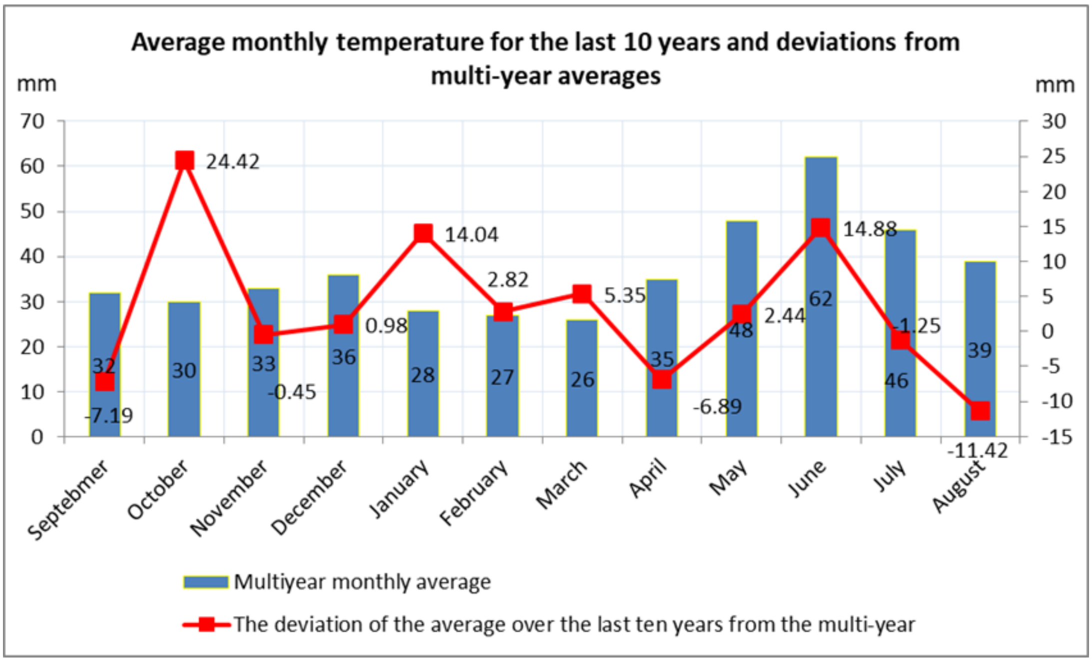
If we analyze the climatic changes of the last 10 years, it can be seen that: in Brailei Plain, compared to the multi-annual monthly average calculated for the last century, a positive deviation is observed in each calendar month, with values between the minimum deviation of +0.5° C per month October and +1.75° C in March (Figure 1).

Figure 1: Graph of Average Monthly Temperatures and Deviations over the Last 10 Agricultural Years Compared to Multi-year Monthly Averages



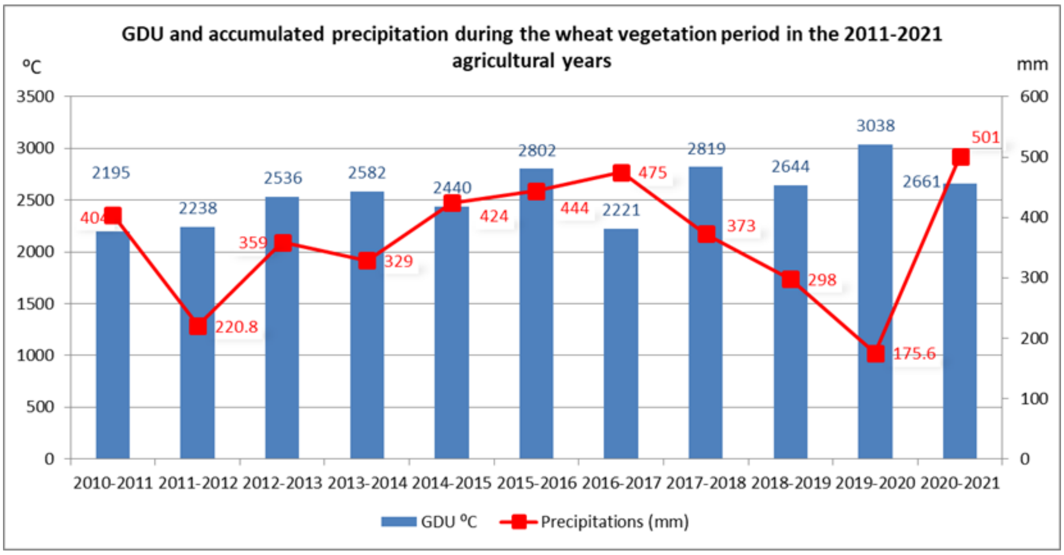
Average monthly precipitation calculated as the average of the last 10 agricultural years recorded negative deviations in the months of September, November, April, July and August, with values between the minimum deviation of -0.45 mm in November and the maximum deviation of -11.42 mm in the month of August, while the significant positive deviations were in the months of October (+24.42 mm), January (+14.04 mm) and June (+14.88 mm) (Figure 2).

Figure 2: Graph of Average Monthly Precipitation and Deviations over the Last 11 Agricultural Years, Compared to Multi-year Monthly Averages



Based on the minimum and maximum daily temperatures, monitored during the wheat vegetation period, respectively between October 7th and July 7th, the GDU index was calculated for each year studied, observing values between 2195° C in the 2010-2011 agricultural year and 3038° C in the 2019-2020 agricultural year, which was the driest year in the last decade, which can also be seen in the accumulated precipitation in 2019-2020 (175.6 mm), with the largest deficit recorded compared to the multi-year normal (442 mm), of 266.4 mm (Figure 3).

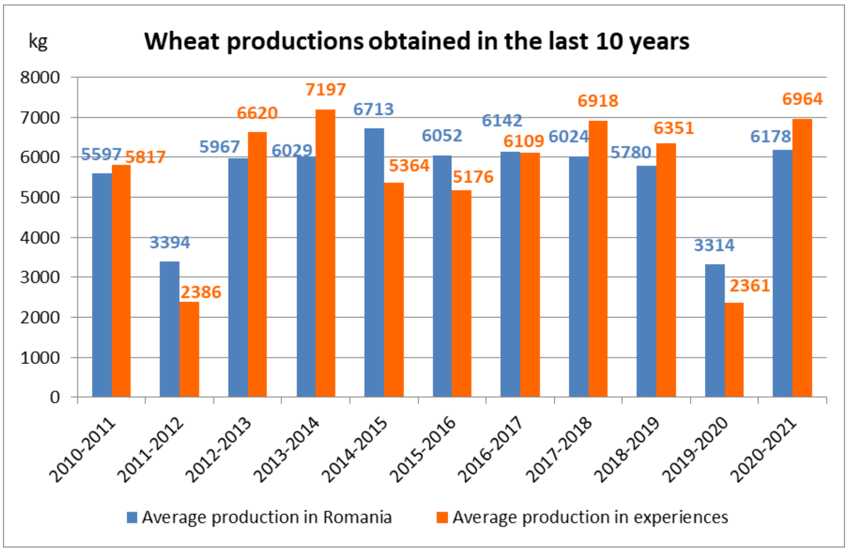
Figure 3: GDU (Growing Degree Units) and Accumulated Precipitation during the Wheat Vegetation Period in the Last 11 Agricultural Years



Wheat productions obtained in the last 10 years in the context of climate change

The production averages of each year were compared to the national productions, during the analyzed period, and positive differences were observed in good agricultural years, i.e. with sufficient precipitation in autumn, while in dry agricultural years the production differences compared to the national average were negative, from 0.7 t/ha with up to 1.3 t/ha (Figure 4).

Figure 4: The Average Productions Obtained within SCDA Braila with the National Average Productions (Red Represents the Lower Productions and Green the Higher Productions)



Conclusions

In conclusion, the sustainability of wheat crops is essential to ensure a sustainable food source and protect the environment. An integrated approach and cooperation of all parties involved is needed to develop sustainable and scalable solutions that meet current and future challenges.

In addition, the development of sustainable agricultural technologies and practices can be beneficial not only for the environment and soil health, but also for the local economy and poverty reduction in rural areas. For example, adopting sustainable agricultural practices such as the use of organic fertilizers and crop rotation can help increase crop productivity and yield while reducing the costs and risks associated with the use of synthetic fertilizers and pesticides.

Also, the promotion of organic farming can be an effective solution for increasing the sustainability of wheat crops. Organic farming promotes the use of sustainable agricultural techniques and reduces the use of pesticides and synthetic fertilizers. This can help protect soil and increase biodiversity, while providing healthier and better quality food.

The development of new wheat varieties adapted to climate change can help ensure higher and more stable wheat production in difficult climates. This may include the use of genetic editing technologies to create wheat varieties resistant to disease and extreme weather conditions, as well as the development of varieties that require less water and can grow in poorer soils.

Finally, promoting fair trade can help ensure a more equitable distribution of the benefits produced by the wheat industry. Fair trade ensures that farmers and workers in developing countries receive a fair price for their products and are treated fairly and equally. This can help reduce poverty in rural areas and promote sustainable and socially and economically responsible agriculture.

Wheat crops are affected by globalization and climate change in several ways. In the context of globalization, the global demand for food products is increasing, which can lead to an increase in the prices of cereals, including wheat. This may be good news for farmers, but it can have negative consequences for consumers living in poor areas who need affordable food.

In addition, globalization can lead to greater dependence of some countries on wheat imports, which can be problematic if imports are interrupted for various reasons, such as trade conflicts or climate change.

Climate change, on the other hand, can have a significant impact on wheat crops. Global warming can lead to changes in weather patterns, such as drought, floods and extreme temperature fluctuations, which can affect wheat production. In addition, climate change may lead to an increase in the incidence of diseases and pests, which may reduce the yield of wheat crops.

To meet these challenges, an integrated approach is needed that includes the development of innovative and sustainable agricultural technologies, as well as investment in research and development of wheat varieties adapted to changing climate conditions. It is also important to raise awareness of the importance of protecting the environment and promoting sustainable and socially and economically responsible agricultural practices.

Finally, global collaboration is essential to develop sustainable solutions to protect wheat crops in the context of globalization and climate change.

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