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INFLUENCE OF CLIMATE CHANGE ON MANAGEMENT OF BULGARIAN AGRICULTURAL CROPPING SYSTEMS

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Abstract. Bulgaria is a part of EU market. For our country, along with the main agriculture crops as wheat, corn, sunflower, vegetables crops give a look of intensive agricultural production. Horticulture is situated at the interface between agroecosystem and society. In this point of view is very important to establish the relationship between change of climate conditions, management of agricultural cropping systems and soil quality with special emphasis on soil biota. Soil food web includes plants and other organisms that occupy different positions in the food chain which are linked by multiple ecological networks. The climatic conditions of the arable land in Plovdiv region were determined since the beginning of this century. A trend towards a lasting increase in the average monthly temperature in summer and fall of absolute minimum air temperatures during the winter months was established when it is compared with the climatic norms of the 20th century. We determined an increase in annual rainfall and dynamic change in their distribution seasons and in different years, for example 2014 there is an increase of 400 mm to the annual amount of rainfall. On the base of scientific knowledge about a new trend of challenges in sustainable agricultural production mitigating climate strategies could be promoted.

Keywords: climate, managing cropping systems, soil biota, agroecosystem.

AIMS AND BACKGROUND

Bulgaria is a part of EU market. For our country along with the main agriculture crops as wheat, corn, sunflower, vegetables crops give a look of intensive agricultural production. Horticulture is situated at the interface between agroecosystem and society.

The wide variety of crops creates a precondition to look for relationship between technological capabilities and technical support for their growing in conditions of constantly changing characteristics of climatic change. Formation of the yield and quality of the final production are in direct dependence on the main

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climatic elements change – temperature, rainfall, soil moisture, relative humidity, amount of effective temperatures.

Scientific research and depth analyses have been conducted in many countries[1–11]. For Bulgaria studies are limited.

Soil health or soil quality is defined as the continued capacity of soil to function as a vital living ecosystem that supports and sustains directly crop growth and indirectly animals, and humans.

Soil-borne pathogens are responsible for about 50% diseases that affect major crops in Bulgaria and together with plant-parasitic nematodes cause enormous loss to agriculture each year. In this review we pay attention to soil biota diversity and function influenced of combination of climatic factors and cropping systems.

Climate change impact is likely to have a significant influence on growth and productivity of plants and the spread of pests, soil-borne pathogens and diseases. These factors can contribute to the reduction of agricultural production and threaten food security.

The main aim of this review is to analyse current level and different aspects of agricultural production and to put this into the context of global climate change.

EXPERIMENTAL

The information from literature references and field work was used[3,5,6,11–17].

For analysis and evaluation of the areas used for growing agricultural crops used data of the 'Agricultural Statistics' MAF and BANCIK for the period 2007–2012 (Ref. 18).

Based on the presently studied literature and personal research on soil health the aim of the study is to summarise data and pay attention on soil biota diversity influenced of combination of climatic factors and cropping systems.

For monitoring of climate change are used data reported in Standard Air Station Class I in Experimental Field of the Agricultural University of Plovdiv during the period 2000 – 2014 years. The data are processed by an approved methodology of Word Meteorological Organisation.

The main agro-climatic indicators that are crucial for the normal development of crops in a changing climate at Agroclilmatic Plovdiv region were established for the period from 2000 to 2014.

From the graph of the annual air temperature, built based on the data of the average monthly temperature relative to the 15th of the month assuming ramp determined the average date of transition temperatures of spring and autumn than 5, 10 and 15°C during the study period, and compared those with climate norms of the same agricultural region in the 20th century[12].

RESULTS AND DISCUSSION

The structure of agriculture in Bulgaria is determined by geographical location, soil type, climate and specialisation of different regions. For the period 2007–2012 the distribution of occupied areas in some of the main agricultural crops are shown in Table 1.

Table 1. Agriculture lands cover (ha) in Bulgaria by years (2007–2012)

Main categories	2007	2008	2009	2010	2011	2012
Wheat	1120510	1114427	1254151	1095703	1152999	1194141
Barley	193840	223004	264689	250640	174010	175556
Rye and triticale	12030	15296	17034	16116	17841	24303
Maize	408880	348402	303881	360046	430914	525412
Sunflower	686692	723962	687209	734314	795319	854738
Tobacco	31144	16742	27865	31652	21710	24857
Potatoes	21890	21648	14068	13824	16852	17465
Fresh vegetables	41088	30001	28715	29420	27227	24778
Arable land	3057740	3060543	3122516	3162526	3227237	3294685

Source: MAF, Agrostatistic Department, Survey of land cover and land use in Bulgaria (BANCIK).

Regardless of the relatively low percentage of open space for growing vegetables (Fig. 1), horticulture is an important sector of agriculture in Bulgaria. It is a representative example of dependence and sensitivity to the impact of climate on plants grown in open areas.

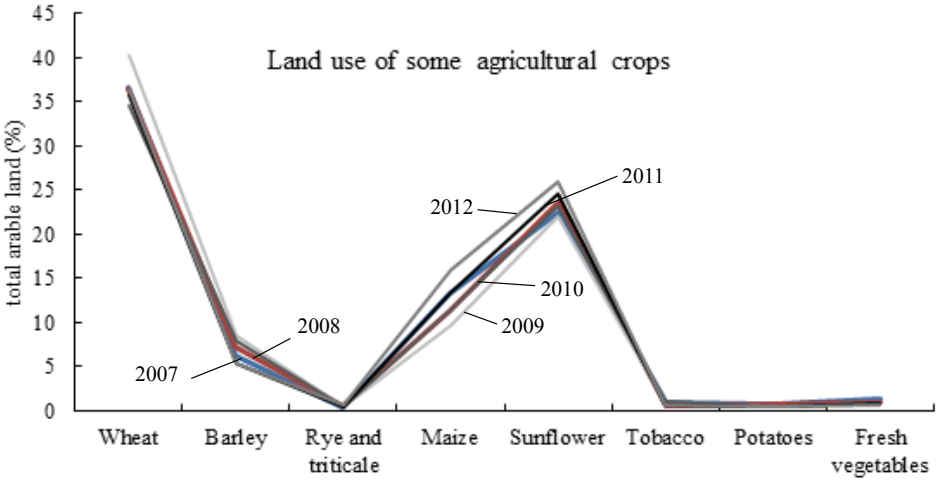

Fig. 1. Relative portion of some of the main crops, compared to the total area of arable land in Bulgaria (Source: MAF, Agrostatistic Department, Survey of land cover and land use in Bulgaria (BANCIK))

Referring to the analyses and defined specialisation in agricultural areas in Bulgaria[13,14,,19]. South Central Region is defined as the leading, with the centre – Plovdiv city. Over 50% of the areas planted with vegetables are concentrated on it. The characteristic feature of the region can be regarded in several aspects. On the one hand the large number of vegetable species with different demands on the ambient conditions and on the other – the variability of the basic parameters of the change.

Agro-climatic resources of Bulgaria allow growing different crop groups from the frost-resistant to highly thermophilic grown in our country bordering the subtropical zone.

Particularly important for the normal development of vegetable crops under field conditions is the transition of the average day and night temperature above 5°C – for growing at low temperatures crops over 10°C – for the main growing season and over 15°C – the most growing at high temperatures crops. In relation to those features in this paper changes in the occurrence of these periods for the region with concentrated production of vegetables with centre Plovdiv from 2000 to 2014 are shown.

Increasing temperature over 5°C has an average date of last century 05 March. That date is changed dynamically during the study period, with significant differences in separate years – from 06.01 in 2007 to 10.03 in 2003. Total for the period lasting rising temperature 5°C, took place 20–25 days earlier. The period of such temperature conditions continues to 25.12 (2014). Compared to the established climate norm (28.11), the difference is up to 10–13 days later. The main growing period for our country with temperatures above 10°C have climatic norm of 04.04 to 30.10. For the first 15 years of the 21st century there was displacement of this period with 10–15 days earlier. Frequent and extreme events by 20–30 days early cause occurrence of this period, respectively 01.02 for 2002 and 01.03 for 2007 and 2008.

The growing of thermophilic crops start in average daily temperature over 15°C. Climatic norm for the Plovdiv region is 02.05 and up to 02.10.

Beginning of the 21st century starts with the temperature stays above 15°C even at 14.04 (2000), 14.04 (2002) 13.04 (2006) 07.04 (2007) 06.04 (2005, 2006). Consistent trend occurrence of the summer season with 20 to 25 days earlier compared to the climatological normal for the region was established.

The duration of the summer is increased by 10 to 20 days. Especially clearly this trend was confirmed in 2001 and 2002, the occurrence of colder weather conditions in the autumn for these years was in the third decade and the end of October (24.10.2001 and 29.10.2002).

Changing the length of free frost time period and the extension of the vegetation period in the course of the study allow to reconsider specific cultivation periods

for vegetable cultivation and create schemes for intensive vegetable growing areas of replacing and second pre-culture crops.

Climate change can have positive and negative effects on vegetable crops. On the one hand, temperatures higher than the optimum during the formation of the product fraction can affect the yield and quality of the production[20]. On the other hand, can create conditions for wider dissemination of the others lower on vegetable species or production areas[4,20].

Despite all these advantages and opportunities for a more rapid adaptation of plants and production to the changing climatic conditions must be taken into account and the possible negative influences. The main physiological effects of climate change include the reduction of the yields of the temperature rise during the critical stages of plant development[4,20,21]. Shorten the growing season, resulting in more rapid passage of phenophases[22,23] and deterioration in the quality of production due to increased rainfall.

According to Jakson et al.[4], horticultural crops growing in the garden are more sensitive to these influences, compared to crops growing on open field. Especially stressful situations related to extreme values of the environmental factors that directly affect the processes of pollination, fertilisation, fructification, synthesis and accumulation of dry matter and nutrient reserve, appearance of the product parts, short preserve trade type or long-term storage of vegetable production.

Our observations and outcomes of this study confirm trends established[15,24–26].

Crop plants grow in now days in areas and climate different to their centres of origin. Often pathogens have migrated with their host, widening their range. Soil food web includes plants and other organisms that occupy different positions in the food chain which are linked by multiple ecological networks. Changing climate will affect soil-born pathogens causing diseases, reduction in productivity, and often death of their hosts As crops respond to changes in climate and plant pathogens that cause diseases adapt to changes, too. Climate change is expected to enhance invasion risk from many crop diseases, pests, and weeds[16,27] ultimately increasing the stress on crop plants and requiring increased emphasis of pest control. It is expected that changes in temperature, precipitation and other environmental factors will have both direct and indirect impacts on host-pathogen interactions. Although the epidemiology of many plant pathogens is now better understood, it is difficult to separate climate change effects on the parameters affecting plant disease from normal seasonal variations. The effects of global climate change on plant diseases are subtle, progressive and difficult to document because of the scarcity of long-term data resulting in uncertainty about possible future scenarios[17]. Recent reviews of the literature inspire that climate change will influence the relative importance, frequency and composition on functional groups in soil food web their trophic interactions and will control its interactions.

CONCLUSIONS

The conditions of Bulgaria, changing environmental factors have a seasonal character, but should be taken into account their direct influence on agro-biological status of vegetable crops.

In view of the seasonality of the cultivation of vegetables, their producers have greater opportunities for adaptation of production to climatic changes. The challenge for the industry is to develop a clear strategy for adaptation of agricultural production to climate change in order to minimise the adverse financial results and harmful impact on agrobiocenosis.

There is the need to improved understanding of soil multitrophic interactions and soil biota biodiversity and how climatic changes influenced it to improve soil health and be the agriculture more sustainable.

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