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BOOK OF PROCEEDINGS I

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Content

Article

Climatic Change and Agricultural Production

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Abstract: Climatic extremes demonstrated that agriculture is sensitive to climate change. Climate changes shifting climate variables: temperature, precipitation, humidity, evaporation, sunlight, wind speed, etc. Climatic change has created challenges for the agricultural sector and added pressure on global agricultural and food systems. On many crops there are negative impacts from extreme weather as droughts, floods, higher temperatures and season shifts that climate change brings. Rising temperatures and water stress have already led to lower crop yields for maize, wheat, soybean, sunflower, buckwheat, millet, flax, potato, phacelia and other crops which typically relies on precipitation instead of irrigation. The rising temperature has adverse effect on flowering and leads to pests and disease buildup. Flood and excess rain over a short duration of time cause extensive damage to crops.

For one country a decrease yields bring a high decline in production and therefore reducing the budget i.e. economic weakening. Climate change therefore threatens global food supply as certain crops become more expensive due to a decrease in production and supply. In such situations, should be introduced into production alternative crops like sorghum and millet, which can be grow at conditions where the dry season prevails during the crop vegetation. The agriculture also has to take place and in adverse climatic conditions and produce enough food by sowing tolerant varieties in changed environmental conditions.

Keywords: climate change, temperature, precipitation, agricultural production.

Introduction

Climate change predictions over this century are: warmer (at least 1–2°C) and drier conditions, with increased extreme weather events and increased CO_2 levels, in the regions where the cereals, oil crops, legume and vegetable mainly grown. The most important global debate of this century is on climate change. It is predicted that by 2050 there will be significant impacts of climate changes, including rising temperature, increasing drought due to higher evaporation and changing rainfall distribution, and increased levels of CO_2 due to greenhouse effect and agriculture gas emissions. Thus, it is predicted that present levels of field crops productivity and agricultural production itself, will be in a big way affected, in different environment and regions (Popović, 2015; Glamočlija *et al.,* 2015; Maksimović *et al.,* 2018).

Climatic extremes demonstrated sensitivity of agriculture to climate change. Climate changes shifting climate variables: temperature, precipitation, humidity, evaporation, sunlight, wind speed, etc. Climatic change has created challenges for the agricultural sector, adding pressures on global agricultural and food systems (Popovic *et al.,* 2019a). Many crops suffer negative impacts of extreme weather, droughts, floods, higher temperatures and season shifts that climate change brings. Rising temperatures and water stress have already led to lower crop yields for maize, wheat, soybean, sunflower, buckwheat, flax and other crops which typically relies on precipitation instead of irrigation. Temperature is one of the most important ecological factors, which allows and determines the basic processes in plants and their spread from the equator to the poles and from the base to the top of the mountain. Basic physiological and biochemical processes - photosynthesis, respiration, transpiration, growth, development and reproduction, depend on the thermal factor (Popović *et al*., 2018; Šarčević – Todosijević *et al*., 2018; Šarčević-Todosijević *et al*., 2019a). The rising temperature has adverse effect on flowering and leads to pests and disease buildup. Flood and excess rain over a short duration of time cause extensive damage to crops.

Effect of Climate Change for Agricultural Production

Ecological factors represent all the effects of the environment by which organism is surround. Ecological factors are the basic determinant of ecology and, depending on the nature of their activity and extent of variation, the life of all biological species, populations, individuals and communities in ecosystems depends. Although almost all factors are equally important for the life of cultivated plants, in open field ecological conditions impact of light, temperature and water prevail (Popović *et al*., 2017; Šarčević-Todosijević *et al*., 2019a). Crop growth is greatly dependent on climate as plant physiological processes respond directly to changes in air and soil temperature, solar radiation, moisture availability and wind speed (Monteith, 1981; Andrews and Watson, 2010; McKenzie and Andrews, 2010). Climate can also influence the incidence of weeds, pests and diseases which can affect crop growth and yield (Oleson and Bindi, 2002; Aggarwal *et al.,* 2004; McKenzie and Andrews, 2010). However, secondary metabolites play an important role in protecting plants from biotic and abiotic stress. It is believed that precisely these secondary metabolites are the mechanism of adaptation for plant species to different ecological factors and that they are exactly those who enable a survival of species. It is undisputably proved that secondary metabolites have a protective role for a plant which is manifested in various ways, from preventing bacteria, fungus and viruses to infect tissue (function of phytoalexins), to protecting from excessive doses of ultraviolet radiation, excessive transpiration or from other unfavorable effect of ecological factors. These metabolites are also the places for inactivating and depositing harmful products of plant metabolism (Popović *et al*. 2019b, Popović *et al*., 2019c; Šarčević – Todosijević *et al*., 2018; Šarčević – Todosijević *et al*., 2019b, Šarčević – Todosijević *et al*., 2019c).

If climate change is substantial in regions of crop growing, it could greatly affect growth and yield of crops grown there. Parry *et al*. (2004; 2005) and IPCC (2007a, 2007b) assessed the effects of projected climate change from 2010 to 2060 on crop/food production and risk of hunger in different regions of the world: different climate change scenarios developed by the IPCC were considered. Generally, the scenarios predicted yield increases in developed countries at mid and high-mid - latitudes but yield decreases in developing countries in the tropics and sub-tropics with the risk of hunger particularly high in Southern Asia and Africa (Parry *et al.,* 2004; 2005; Aggarwal *et al.,* 2004). Aggarwal *et al. (*2004) argued that assuming a medium growth scenario, the population of South Asia will increase by 700 million people from 2005 to 2035 (see also United Nations Population Division, 2009) and that the demand for grain legumes will increase by 30% between 2010 and 2030. In relation to cool season grain legumes in the major areas of production highlighted above, climate change would be expected to result in increased yields in North America and Northern Europe but decreased yields in Ethiopia, Southern Asia and possibly Australia (Australian Government Bureau of

Meteorology, 2009) and Turkey (Oleson and Bindi, 2002; Yano *et al.*, 2007). Parry *et al.* (2004; 2005) and IPCC (2007a, b) emphasized that there will be exceptions to the generalizations. For example, yields are projected to increase in areas subjected to increased monsoon intensity or where more northward penetration of monsoon leads to increases in available moisture. They also emphasized that the effectiveness of adaptation strategies to counter the negative effects of climate change is difficult to predict. Possible adaptation strategies highlighted that are relevant to cool season grain legume production include crop relocation, changes in sowing date, use of more stress tolerant genotypes, genetic adjustment of crops to increase their tolerance of stress, increased nutrient and plant protection inputs and intercropping with other crops, to lower the risk of total crop production failure under adverse conditions. Genetic adjustment of grain legume for cool season crops should also include consideration of the rhizobial symbiont (Andrews *et al.*, 2009; Stevanović *et al.*, 2018).

Legumes have a strategic role in the food and feed economy, as a high protein source and as inputs nitrogen fixation in the soil for subsequent cereal and oil seed crops. They also act as a break crop for facilitate control of weeds, pests and diseases that appear under, predominantly cereal cropping (Yadav *et al.*, 2007a, 2007b; Đorđević *et al.*, 2015; Lakić *et al.*, 2018).

Generally, grain production from cereals is more reliable. This is in part because cereals have benefited more to a greater extent from modern breeding varieties responsive now used as a input (Mantri *et al.*, 2010). Also, dry matter and carbon gain per unit plant nitrogen or per unit time are generally greater for cereals than for nitrogen fixing legumes. This difference can at least in part be related to the greater specific growth rate of cereals (Andrews *et al.*, 2009). The temperature increase occurred over the globe, but was greater on land than in oceans and greatest at higher northern latitudes and smallest over the Southern (Antarctic) Ocean and parts of the North Atlantic Ocean. From 1900 to 2005, precipitation increased in eastern parts of North and South America, Northern Europe and Northern and Central Asia but decreased in the Mediterranean region, parts of Southern Asia, the Sahel and Southern Africa. In addition, the frequency of extreme weather and climate events, in particular, heat waves, storms and floods due to heavy precipitations and extreme high sea levels increased over most land areas (Meehl *et al.*, 2000; IPCC, 2007a, 2007b). There is considerable evidence that the primary cause of increased global average temperature from 1956 to 2005 was the increase in anthropogenic greenhouse gas concentrations (IPCC, 2007a, 2007b). Gasses made in greenhouse effect absorb a proportion of the heat leaving the earth's surface and re-emit it downward, causing the lower-atmosphere temperature increase and hence global. Carbon dioxide produced in fossil fuel use (and to a lesser extent land change use such as deforestation; Fearnside and Laurance, 2004) is the major anthropogenic gas, but methane (primarily due to fossil fuel use and agricultural practices), nitrous oxide (primarily due to agricultural practices) and chlorofluorocarbons (use in refrigeration systems, fire suppression systems and manufacturing processes) are also important (IPCC, 2007a, 2007b). Global atmospheric CO_2 concentration increased from around 280 ppm in the late eighteenth century to 379 ppm in 2005 (IPCC, 2007a). All countries contribute to global CO_2 emissions but China, the United States (US) and the European Union (EU, twenty seven countries) are responsible for around fifty per cent of global CO_2 emissions (Netherlands Environmental Assessment Agency, 2009).

In 2008, China was the world's largest emitter of CO_2, with the US and the EU second and third respectively. This is in part related to the large number of population in these regions. On a per capita basis, CO_2 emissions are much lower in China than in the US, the

EU or several other countries such as Australia which have substantially lower total CO_2 emissions. In response to increasing greenhouse effect gas production worldwide, the Kyoto Protocol, an international agreement linked to the United Nations Framework Convention on Climate Change, was adopted in 1997 and entered into force in 4 (Andrews and Hodge 2005; Marišovà *et al.*, 2015; United Nations Framework Convention on Climate Change, 2009).

Interestingly, potato production may be positively impacted by elevated CO_2 concentration, as reported by the experts at the Central Potato Research Institute, where they claimed that potato yield will increase by 11.12 per cent at elevated CO_2 of 550 PPM and 1°C rise in temperature. However, further increase in CO_2 with a likely rise in temperature by 3°C will result in decline in production by 13.72 per cent in the year 2050 (Ranadive, 2017). The optimum temperatures for the photosynthesis process of most cultivated plants range from 25 to 35°C. The temperature optimum at low light and reduced CO_2 in air is about 10°C, at slightly higher light and normal CO_2 is about 20°C, and at full light and increased CO_2 is about 30°C (Šarčević – Tododsijević *et al.*, 2019a).

The soybean yield and biomass increased for all treatments in the 2030 s with positive correlation with the climatic variables. The maximum temperature represented the most significant correlation with yield and biomass for almost all treatments. Finally, soybeans might achieve an optimal threshold temperature in the future, leading to yield increases in the 2030s. Climate change impact assessment can facilitate selection of better adaptation strategies related to irrigation water management and agricultural practices in the future (Ahmadzadeh Araji *et al.*, 2018). Many studies show that global maize yields were 3.8 percent smaller than they would have been without warming and that wheat yields were 5.5 percent smaller. A study projected that global wheat yields could drop between 4.1 and 6.4 percent for each global temperature increase of 1°C. Climate change threatens global food supply as certain crops become more expensive due to reduced production and supply. Increasing frequency and duration of droughts require strongly adaptation of agricultural crops and their diversification under changed agro-pedological conditions. In such situations, alternative crops like sorghum and millet should be sown, because they have pronounced resistance to unfavorable abiotic factors and good adaptive capacity towards the dry conditions which prevails during the growing season.

Conclusion

Rise in world population will result in a need to increase food production, despite reducing available arable land and water supply for irrigation conditioned by urban environments growth. Climate change therefore threatens global food supply as certain crops become more expensive due to a decrease in production and supply. Decrease yield causes a high fall in production and thus a reduction in budget and economic decline.

In arid years, should be introduced into production and alternative crops like sorghum and millet, which can be grow at conditions where the dry season prevails during crop vegetation.

The agriculture has to take place and in adverse climatic conditions and enough food will be produced if, in changed environmental conditions, tolerant varieties are grown.

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