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Study Investigated the Effect and Strategies for Climate Action and Sugarcane Cultivation

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Abstract

An essential crop for both sugar and bioenergy, sugarcane (Saccharum officinarum L.), is grown all over the world. Extreme weather events become more frequent and more intense as a outcome of rising greenhouse gas emissions and global warming brought on by climate change. Due to the world's relatively low adaptive capacity, high vulnerability to natural disasters, inadequate forecasting systems, and inadequate mitigating strategies, climate change is expected to have significant effects on sugarcane production worldwide, particularly in developing countries. The frequency and severity of extreme environmental conditions are likely to increase due to climate change, which could have had a negative impact on sugarcane production and will likely continue to do so.

Geographical location and adaptation capacity influence how much climate change will affect sugarcane. In order to better understand the effects of climate change on sugarcane production, we reviewed sugarcane response to climate change events, sugarcane production in several different countries, and challenges for sugarcane production in climate change in this paper. We then proposed strategies for mitigating the negative effects of climate change and enhancing the sustainability and profitability of sugarcane production.

Keywords: Geographical; Climate change

Introduction

Agriculture has been impacted by and will continue to be impacted by major environmental issues that may outcome from a combination of long-term changes in weather patterns around the world (i.e., global climate change), caused by both natural and anthropogenic processes. Since the middle of the 18th century, increased fossil fuel combustion, industrial processes, and deforestation have caused an increase in atmospheric CO2 concentration ([CO2]) of about 30%. By the end of the 21st century, atmospheric [CO2] is predicted to climb to approximately 550 ppm in a low emission scenario or double (800 ppm) from current levels in a high emission scenario. As atmospheric [CO2] and other greenhouse gases rise, global warming is closely correlated (GHG) [**1-3**]. According to projected GHG emission levels, regions, and geographic locations, global surface mean temperatures would rise by 1.1 to 2.9°C (low emission) or 2.0 to 5.4°C (high emission) by 2100 relative to 1980–1999, up from 0.55 to 0.67°C and 1.1 to 0.67°C, respectively, over the last century [**4**].

In some regions, rising temperatures and atmospheric [CO2] levels may be advantageous for some crops, particularly C3 plants. It is anticipated that changes in sea levels, rainfall patterns, the frequency of extreme high- and low-temperature occurrences, floods, droughts, and other abiotic stresses, as well as tornadoes and hurricanes, would be brought on by climate variability and climate change [**5, 6**]. One of the main problems affecting agricultural production and economic effects around the world is the combination of high temperatures and drought stress. Providing food security for a growing global population while preserving the environment and the health of its ecosystems is a problem for the agriculture sector under climate change scenarios. These difficulties could be made worse for the majority of nations that rely heavily on rainfall and have inadequate mitigation mechanisms, little or no irrigation, or both. Agriculture is susceptible to climate change due to both direct effects of changing climate conditions (such as changes in temperature and/or precipitation) and indirect effects outcomeing from changes in the severity of pest pressures, the availability of pollination services, and the performance of other ecosystem services that affect agricultural productivity. Most status assessments on the consequences of climate change forecast that crop productivity will decrease. Due to the sensitivity of agricultural productivity and the costs associated with enhancing growth environmental conditions, climate change presents agriculture with never-before-seen difficulties. By changing agricultural activity patterns to take advantage of new possibilities and reduce the costs associated with adverse effects, adaptive action has the ability to control the effects of climate change [**7-9**].

The Impact of Climate Change on Sugarcane

An important industrial crop, sugarcane is used to make both sugar and bioenergy. It is one of the principal C4 crops grown mostly in tropical and subtropical areas of the world. The main determinants of sugarcane output worldwide, particularly in many developing nations, are weather and climate-related events, such as the growth environment of atmosphere, temperature, precipitation, and other extreme weather. Chandiposha has examined the potential detrimental effects of climate change, particularly in terms of temperature and rainfall, on the production of sugarcane in Zimbabwe. The extreme climate events, such as drought and tropical cyclones, have caused changes in sugarcane and sugar output. Due to good weather, Fiji had a record sugar production (516,529 tonnes) in 1994; nevertheless, production fell in 1997, 1998, and 2003 by 47, 50, and 43%, respectively. Marin found that using crop simulation models, climate change increased sugarcane yield and water use effectiveness in several regions of Brazil. According to their predictions, the average cane output in 2050 could increase by 15 to 59%. Studies have also shown that sugarcane photosynthesis,

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water use efficiency, biomass, and productivity increased in raised under controlled environments [**10**]. Reduced stomatal conductance is primarily responsible for sugarcane's improved water use efficiency at higher conditions. The stage of plant growth, the severity of the water deficit stress, and the length of the stress all affect how sugarcane grows and develops as a outcome of drought brought on by climate change. Drought generally lowers cane production, which outcomes in a poor sucrose yield, especially in the early and mid-growth stages. Late growth stage moderate dryness can increase stalk sugar concentration. Because more than 80% of sugarcane grows under rainfed conditions, drought is the most significant stress factor for the production of sugarcane in China, which is ranked third globally. Due to the optimum rainfall distribution and other favourable growth environment circumstances, Guangxi saw a high level of sugarcane production in 2007–2008. 83.8tha1, 77.1Mt, and 9.41Mt, correspondingly, were the cane yield, cane production, and sugar production. The majority of the sugarcane, however, suffered catastrophic damage due to a prolonged period of exceptionally low temperatures, rainy weather, and freeze temperatures in the region from January to February 2008. Drought in the early growing season of 2010 (January–June) combined with the excessive freeze temperatures in December led to a significant decrease in sugarcane yield. In December 2009, the extreme freeze temperatures (4 to 6°C) happened again.

Obstacles to the Production of Sugarcane

Due to low adaptive capacity, high vulnerabilty to natural hazards, poor forecasting systems, and inadequate mitigating strategies, sugarcane yields vary greatly across years and regions with varying rainfall and temperature in the majority of developing countries. In these developing nations, high input costs, high production costs, and low cane prices are also very typical, which leaves sugarcane growers with small profits. As an illustration, sugarcane farmers in China's major production regions (Guangxi, Yunnan, Guangdong, and Hainan) have planted some more lucrative crops due to financial considerations. According to the Provincial Sugar Industry Bureau, sugarcane acreage in Guangxi, the country's largest cane-producing province, is predicted to decline by 6% in 2014–15 as farmers develop trees with a low labour need and a rapid rate of growth for industrial usage. According to provincial statistics, Hainan's cane hectarage is predicted to decrease 11% in 2014–15 as a outcome of low profitability. High labour costs have also played a significant role in the low profitability of the business, in addition to low prices. The use of hand labour for planting, field management, and harvesting significantly increases the input of labours because more than half of the sugarcane hectarage is situated in hilly regions where mechanised operation is not possible. Numerous economic, environmental, and social issues need to be carefully considered when evaluating agriculture and crop production systems, as well as climate change and its detrimental effects on crop production. For example, how to (1) balance short-term and long-term goals, (2) increase productivity, profitability, and sustainability, (3) introduce new technologies and transfer them to growers, (4) adhere to environmental regulations, and (5) deal with contradictions between climate change and crop production systems need to be carefully considered. Undoubtedly, these particular problems provide a challenge to sugarcane production systems as well.

Impact Reduction of a Stressful Environment While Maintaining Sugarcane Production

The world's sugarcane production has tripled in the past 41 years due to an increase in demand, despite the fact that climate change increases the frequency and intensity of extreme weather events, as well as the uncertainty and sensitivity of unfavourable effects on agriculture. In most developing nations, as mentioned above, the increasing cane production was linked to increases in both cane yield and hectarage. Under the existing conditions and the projected effects of climate change, much more work needs to be put into focusing on boosting yield and enhancing revenues. Sugarcane yield is influenced by crop varieties (genotypes), biotic and abiotic growing settings (such as insects, diseases, weeds, and other climate-related factors), and management techniques. One of the key methods for coping with climate change is the creation of high-yielding, stress-tolerant sugarcane cultivars. Breeders of sugarcane and other scientists can create computer databases to design hybridization (within or between species) for particular needs in breeding programmes, use growth and physiological traits to screen elite clones for resistance/tolerance to biotic and abiotic stresses, and use tissue culture, molecular biology, and gene transformation technologies to improve breeding and selection efficiencies. According to studies, some genotypes/cultivars are more tolerant to water shortage and low temperature conditions than others, and they also use radiation and nutrients more effectively.

Impact of Sugarcane on Local Climate

Modifications to farming practises and crop combinations in a region may have a direct or indirect impact on climatic variables there. In many nations, burning residue before or after sugarcane harvest is a standard management technique for sugarcane production. The main issue with sugarcane production is the emission of greenhouse gases. A recent study found that the sugarcane crop contributed about 2.4 tonnes of CO_2 equivalent per hectare to the atmosphere. Burning residue (44%), using synthetic fertilisers (20%), and burning fossil fuels (18%) were the main causes of the CO_2 emissions from sugarcane. Enhancing green harvest can therefore boost soil organic carbon and lower CO_2 emissions from sugarcane production. The direct impact of perennial bioenergy crops on the climate in the United States. Their findings showed that to fully address significant concerns for local, regional, and global climate change, an extensive evaluation of the costs and benefits of bioenergy-related land-use change must take into account potential impacts on the surface energy and water balance. Sugarcane's ability to fix carbon at the C4 level makes it a plant that can expand relatively more quickly than other plants. A recent study in Brazil found that, for clear-sky daytime conditions, regional conversion of natural vegetation to a crop or pasture warms the region by an average of 1.55 (1.45–1.65)°C, while subsequent conversion of the crop or pasture to sugarcane cools the region by an average of 0.93°C.

Conclusion

It is obvious that climatic changes have had an impact on sugarcane production and will continue to do so. The biggest obstacles to sugarcane production are the escalating frequency and severity of extreme weather phenomena, particularly drought brought on by climate change. Many future effects can be mitigated, but not all, by current adaptation strategies. After 2050, it's very likely that the detrimental effects of climate change on sugarcane production will get worse, especially if greenhouse gas emissions continue to be high. The development of new sugarcane cultivars using breeding and molecular biology, the improvement of best management practises, the enhancement of new technology transfer, and increased productivity and profitability are some of the multidisciplinary approaches that should be used to improve sugarcane yields and mitigate the potential negative effects of climate change on agriculture. Protecting natural resources (particularly water and soil) is necessary for the sustainability of sugarcane production systems in order to increase their resilience to climate change. Profits can be increased even more by increasing the usage of sugarcane products for ethanol, cellulosic biofuel, and other co products.

References

1. Foobi, Ugwuishiwu BO, Nwakaire J N Agricultural waste concept, generation, utilization and management Niger J Technol 35: 40-52.
2. https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=4.%09European+Commission%2C+Paris+agreement%2C+in%3A+E.+Union+%28Ed.%29+International+Action+On+Climate+Change%2C+European+Union2020+-&btnG=
3. European Commission (2020) The European Green Deal, European Union euro 12: 90-99.
4. B Saba, A D Christy, M Jabeen (2016) Kinetic and enzymatic decolorization of industrial dyes utilizing plant-based biosorbents: a review Environ Eng Sci 33: 601-614.
5. Janyasuthiwong S, Phiri S M , Kijjanapanich P, Rene E R , Esposito G, et al. (2015) Copper, lead and zinc removal from metal-contaminated wastewater by adsorption onto agricultural wastes Environ Technol 36: 3071-3083.
6. Mishra A, Malik A (2014) Novel fungal consortium for bioremediation of metals and dyes from mixed waste stream. Bioresour Technol 171: 217-226.
7. Sagarkar S, Mukherjee S, Nousiainen A, Björklöf K, Purohit HJ, et al. (2013) Monitoring bioremediation of atrazine in soil microcosms using molecular tools. Environ Pollut 172: 108-115.
8. Lien PJ, Ho HJ, Lee TH, Lai WL, Kao CM (2015) Effects of aquifer heterogeneity and geochemical variation on petroleum-hydrocarbon biodegradation at a gasoline spill site. Adv Mater Res 1079: 584-588.
9. Qin G, Gong D, Fan MY (2013) Bioremediation of petroleum-contaminated soil by biostimulation amended with biochar. Int Biodeterior Biodegradation 85: 150-155.
10. Claus H (2014) Microbial degradation of 2,4,6-trinitrotoluene in vitro and in natural environments. Int Degrad 15-38.