

Impact of climate change vulnerabilities on horticultural production

Abstract

Climate changes and global warming is the gigantic concern of world. Due to rising of carbon dioxide concentration, temperature, ozone, raining and drought are among the most important issues associated with climate changes. These issues could directly or indirectly impact on production and quality of fresh fruits, vegetables and other crops. The establishing of commercial agriculture varieties performed poorly in an unpredictable behavior due to abnormality of climate that influence plant growth, flowering, fruit setting, ripening and product quality. High level of green houses gases in atmosphere has directly or indirectly effects on postharvest quality and causes different physiological disorders agriculture products. Climate change also influence on plant diseases, comprehensive analysis of how climate change will affect plant diseases in agricultural systems is presently limited information available. This review present information about the potential impact of climate on fresh fruit and vegetable production, food contamination, food safety and adaptation strategies. There is a need for uses of hi-tech horticulture and advanced management of natural recourses, changing food safety situation, developing new resistant varieties which as well tolerant to high temperature will be the key adaptation strategies to address emerging risks associated with climate change.

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Introduction

Climate change is one of the most leading environmental problems which is facing the modern world, and directly or ultimately to human action that changes the arrangement of the global atmosphere. Emission of increasing amount of greenhouse gases, carbon dioxide, methane, chlorofluorocarbons and nitrous oxide are responsible for generating changes to global climate. These changes are responsible for rise in sea level, rainfall sequences and movement of climatic regions due to increased temperatures.^{1,2} With the rapid development in the industrialization, increasing level of carbon dioxide from 280 ppm to 380 ppm due to deforestation and substantial use of fossil fuels.³ It has been projected that to the end of this century CO₂ will top 700 ppm or more, whereas global temperature will increase by 1.8 to 4.0°C with an overall average increase of 2.8°C in temperature.⁴ The global warming affected plant vigor, fruit bearing ability, decrease in size of fruits, low colour development, less juice content, decrease shelf-life, and increased pests attack resulting in poor quality and low production in apple crop.⁵

Climate change has also adverse effect on Pakistan agriculture, and 47 percent of people directly or in directly depends on the earning form agriculture which contributes 21 percent to the GDP.¹ It has been projected that a rise in 3 degrees by 2040 and up to 5-6 degrees by the end of the century. Pakistan rank 28th among those countries which are highly influenced by climate change, while listed at 12th highly exposed countries in the World Bank report.⁶ Currently, Pakistan is facing floods due to heavy and irregular rain patterns.^{7,8,4} There is need to study the how climate variable affects the agriculture production, profitability, and need to adapt the new tools to avoid the odd impact of climate change.¹ Allen et al.⁹ observed that elevated CO₂ increased the biomass growth of plant about 2.6 fold with increasing temperature to the large growth enhancements in sour orange trees. Garg et al.¹⁰ investigated 60 F1 hybrids, 15 parent lines with four mutant homozygotes and observed quality attributes and nutritional

quality under high temperature conditions. Quality attributes found higher in mutant homozygotes, whereas significantly higher lycopene content observed in 60 hybrids than their respective mid-parental values. Four mango cultivars were exposed to low temperature to induce flowering and transferred to controlled conditions for 20 days in glasshouse. High temperature increased the inflorescence in four cultivars, whereas low temperatures caused morphological changes in flower structures in all cultivars, and significant changes observed in 'Kensington'.¹¹ Chmielewski et al.¹² observed potential effect of climate change on the phenological phases of natural vegetation, fruit plants and field crops in the last decade of 20th century. Plant growth and development has been strongly shifted. Increased temperature showed lower changes of development phases in late spring and summer. A change in plant development is still moderate so less impact on yield processes. In the future, climate change may show strong impact on low yield production. Olesen et al.¹³ found that climate change produced positive effects on agriculture with introduction of new crop species and varieties with higher crop production and expansion of suitable areas for crop cultivation in northern areas. Plant protection, nutrient leaching and the soil organic matter may be required more for higher production. However, possible increase in water shortage and extreme weather which may cause low yield, higher variability and reduction in traditional crops in southern areas. Potential impact of climate change (high temperature, elevated carbon dioxide and ozone) which directly and indirectly effect the fresh fruit and vegetable production. High temperature, carbon dioxide and high accumulation of ozone can potentially affect photosynthetic rate and changes in physiochemical properties and quality attributes, and causing tuber malformation and scabs on potatoes.¹⁴

The plant phenology is significantly changed by global climate change because temperature affects the timing of development, both through interactions and alone with other cues, such as photoperiod.^{15,16} Quick climatic changes ability to change the adaptability of temperate crops and fruit in the future, and might increase severe production

problems.¹⁷ Climate change has adverse effect on insect population in pollination. If there is very low temperature or either very high there is no fertilization, thus disturbing fruit setting. For cross pollinated fruits such as pistachios and walnuts, inadequate chilling can decrease pollination directly to reduced crop yields.¹⁸ It revealed that changes in rainfall supply can affect year-to-year differences at flowering, quality and productivity in tropical fruits.¹⁹ In some cases, crop failures may frequently occur, and also observed lower yield and early senescence of trees.²⁰ Fruit and vegetable growth and development are impacted by several environmental aspects. Moretti et al.²¹ presented that hot temperatures disturb photosynthesis ultimately causing changes in C₆H₁₂O₆, flavonoid contents, organic acids, antioxidant activities and firmness. The biochemical reactions fundamental for normal cell function in plants will be disrupted by high temperature stress. It primarily affects the photosynthetic functions of higher plants.²² Maximum temperatures could be caused significant losses in productivity of tomato, reduced fruit set, lower and smaller quality fruits.^{23,24}

Climate change reduces the quality of fruit and vegetables as well. Major problem in the tropics is rind color of low carotenoid development and harm of chlorophyll contents due to severe temperatures. Therefore, fruit in the tropics stand pale and greenish, mandarins and oranges, in particular, do not achieve their beautiful rind color. In fall decline in air and soil temperatures scripts the start of color changes in subtropical regions.²⁵ Fruit peel showed less H₂O content, tender and hardening due to moisture loss under drier climate when compared desert grown fruit and coastal in California.²⁶ For effective ecosystem, there is need for the identification of appropriate genetic resources for use in climate change areas. It might be better to develop good production systems, which can improve their economic power.²⁷ Diverse genetic resources can play an important role in this for adaptation to changing conditions through natural selection or human interventions. It is very important to understand how climate changes will effect on agriculture production in future.^{28–33}

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Conflict of interest

The author declares no conflict of interest.

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