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The Effect of Climate Change on Horticultural Crops

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The phrases climate change and global warming and more recently global cooling are now part of our life. Climate change has come upon us in a relatively short space of time and is accelerating with alarming speed. It is perhaps the most serious problem that the civilized world has had to face. It is the subject of major international cooperation through the Intergovernmental Panel on Climate Change (IPCC) which was set up in 1988 by the World Meteorological Organization and the United Nations Environment Programme. The Earth's climate has always changed in response to changes in the cryosphere, hydrosphere, biosphere, and other atmospheric and interacting factors. It is widely accepted that human activities are now increasingly influencing changes in the global climate **(Pachauri and Reisinger 2007).**

Drivers of Climate Change

Internal variations in the Earth's climatic system may be caused by changes in the concentrations of atmospheric gases, mountain building, volcanic activity, and changes in surface or atmospheric albedo. These forces will continue to have a major influence on our future climate.

1. Variations in the Earth's Orbit (Milankovitch Cycle)

Milankovitch cycles describe the collective effects of changes in the Earth's movements on its climate over thousands of years. Milankovitch cycles can cause global mean temperatures to vary as much as 5 °C between glacial and interglacial periods. However,

these cycles take many centuries to cause perceptible changes to global temperatures.

2. Role of Greenhouse Gases

Most notable are the concentrations of carbon dioxide and methane, both of which are stored in large quantities in peat, tundra, and ocean sediments in colder climates, and are released into the atmosphere in warmer climates. Any warming due to orbital changes results in more carbon dioxide and methane being released into the atmosphere, leading to greater warming. Carbon dioxide (CO_2) and certain other trace gases, including methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbons (CFCs), and tropospheric ozone (O_3), are accumulating in the atmosphere as a result of human activities too.

3. Volcanism

Volcanic activity is an important natural cause of climate variations because tracer constituents of volcanic origin affect the atmospheric chemical composition and optical properties. A weak volcanic activity results in gas and particle effusions in the troposphere (lower part of atmosphere), which constitute, on an average, the larger portion of volcanic mass flux into the atmosphere.

Climate Change and Its Impact

Key potential impacts include:

- Higher temperatures increasing potential evaporation and duration of heat waves.
- Significant decline in winter rainfall leading to severe water scarcity during early summer months.
- More intense droughts over large areas adversely affecting crop production.
- Rapid melting of Himalayan glaciers, leading initially to greater river flows and hence sedimentation and subsequent reduced flow, especially in the drier months.
- Serious health impacts due to heat-related stress and vector-borne diseases.
- Climate change will intensify other environmental pressures and impinge on sustainable development.
- insufficient chilling greatly influences flower initiation fruit coloration with deteriorating in fruit texture and taste. Further, high temperature and moisture stress is increasing the sunburn and cracking in apple, apricot and cherries in higher altitudes **Rai *et al.* (2015)**
- High temperatures can cause significant losses in tomato productivity due to reduced fruit set, and smaller and lower quality fruits. Pre-anthesis temperature stress is associated with developmental changes in the anthers, particularly irregularities in the epidermis and endothesium, lack of opening of the stromium, and poor pollen formation **Sato and Thomas 2002)**
- symptoms causing fruit set failure at high temperatures in tomato includes bud drop, abnormal flower development, poor pollen production, dehiscence, and viability, ovule abortion and poor viability, reduced carbohydrate availability, and other reproductive abnormalities **Hazra *et al.* (2007)**
- Studies conducted on “Impact of climate change in cashew” at Directorate of Cashew Research, Puttur, India indicated that the rainfed cashew crop is highly sensitive to changes in climate and weather vagaries, particularly during reproductive phase. Cashew requires relatively dry atmosphere and mild winter (15-200C) coupled with moderate

dew during night for profuse flowering. High temperature (>34.40C) and low relative humidity (<20%) during afternoon causes drying of flowers, resulting in yield reduction.

- In pepper, high temperature exposure at the pre-anthesis stage did not affect pistil or stamen viability, but high post pollination temperatures inhibited fruit set, suggesting that fertilization is sensitive to high temperature stress **Erickson and Markhart, 2002.** Plant sensitivity to salt stress is reflected in loss of turgor, growth reduction, wilting, leaf curling and epinasty, leaf abscission, decreased photosynthesis, respiratory changes, loss of cellular integrity, tissue necrosis, and potentially death of the plant.
- Spring bulbs brought indoors and kept in warm temperature after flowering will not bloom again. Such bulbs left in the winter ground under historical changes. Such imposed temperature regimes very precise, there are sharp differences in temperature requirement **Rea and Eccel, 2006**

Effect on Yield and Quality

Yields are also expected to be affected by levels of surface ozone, which can be detrimental to plant growth even at very low concentrations. Ozone creates reactive molecules that destroy Rubisco, an enzyme crucial for photosynthesis.Most crop models do not take into account the potential impact of surface ozone changes and, as a result, may tend to overestimate future crop production for some regions. A temperature increase may be beneficial in areas that are very cold at present. Plants will have to adapt to new climate conditions more rapidly than they have ever had to do so before. Excessive rainfall results in floods. Waterlogged soil causes plant roots to rot and heavy rainfall damages tender young plants.

Conclusion

In view of these problems, horticulturists will have to play a significant role in the climate change scenario and proper strategies have to be envisaged for saving horticulture The most effective way is to adopt conservation agriculture, using renewable energy, forest and water conservation, reforestation etc. to sustain the productivity modification of present horticultural practices and greater use of greenhouse technology are some of the solutions to minimize the effect of climate change. Development of new cultivars of horticultural crops tolerant to high temperature, resistant to pests and diseases, short duration and producing good yield under stress conditions, as well as adoption of hi –tech horticulture and judicious management of land use resources will be the main strategies to meet these challenges.

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