IMPACT OF CLIMATIC CONDITIONS IN HORTICULTURAL CROP PRODUCTION

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ABSTRACT:Climate change has emerged as a serious global environmental issue having impact on all forms of life. It increases the greenhouse gases like carbon dioxide, nitrous oxide, ozone and methane which may cause impact in terms of increased temperature, more demand for water and increase in biotic and abiotic stresses. It has direct impact on agriculture and horticulture. Due to climate change, low production of horticultural crops is featured. The established commercial varieties of fruits, vegetables and flowers will perform poorly in an unpredictable manner due to aberration of climate. Melting of ice cap in the Himalayan regions will reduce chilling effect required for the flowering of many of the horticultural crops like Apple, Saffron, Rhododendron, Orchid, etc. Commercial production of horticultural plants particularly grown under open field conditions will be severely affected.

Keywords: Climate, global environment, horticultural crops and mushrooms.

INTRODUCTION

India with diverse soil and climate comprising several agro-ecological regions provides ample opportunity to grow a variety of horticultural crops which form a significant part of total agricultural produce in the country comprising of fruits, vegetables, root and tuber crops, flowers and other ornamentals, medicinal and aromatic plants, spices, condiments, plantation crops and mushrooms. The sensitivity of individual crop to temperature depends on inherent tolerance and growing habits. Indeterminate crops are less sensitive to heat stress conditions due to extended flowering compared to determinate crops. The temperature rise may not be evenly distributed

between day and night and between different seasons (Hazra*et al.,*2007).Horticultural crops play a unique role in India's economy by improving the income of the rural people. Fruits and vegetables are also rich source of vitamins, minerals, proteinsand carbohydrates etc. which are essential in human nutrition. Hence, these are referred to as protective foods and assumed great importance in nutritional security of the people. Thus, cultivation of horticultural crops plays a vital role in the prosperity of a nation and is directly linked with the health and happiness of the people. India with more than 28.2 million tonnes of fruits and 66 million tonnes of vegetables is the second largest producer of fruits and vegetables in the world next only to Brazil and China. However, per capita consumption of fruits and vegetables in India is only around 46kg and 130g against a minimum of about 92g and 300g respectively recommended by Indian Council of Medical Research and National Institute of Nutrition, Hyderabad (Bose and Mitra, 1996). Theknowledge about the impact of climate change on horticulturalcrops compared to annual food crops. The issues of climate change and solution to theproblems arising out of it requires thorough analysis, advance planning and improvedmanagement. The crop productivity is subjected to number of stresses and potential yields areseldom achieved with stress. Climate change is predicted to cause an increase in average airtemperature of between 1.4^0C and 5.8^0C, increases in atmospheric CO_2 concentration, andsignificant changes in rainfall pattern (Houghton *et al.,* 2001). Vegetable production isthreatened by increasing soil salinity particularly in irrigated croplands which provide 40% ofthe world's food. Fruits, vegetables, flowers, medicinal plants and tubers are grown fromtropical to temperate, some horticultural crops like spices and plantation crops are locationspecific. In order to sustain our horticultural production with present day challenges we haveto have packages to manage abiotic stresses. The nature and magnitudes of stress vary.Climate change poses serious challenges to human and places unprecedented pressure on the development of horticultural crops that withstand stress will be can the single most important step we may take to adapt the changes we have faced today and will face in the future.

IMPACT OF CLIMATIC CONDITION

• 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.

• The per capita availability of freshwater in India is expected to drop from around 1900 cubic meters currently to 1000 cubic meters by 2025 due to a combination of population growth and climate change.

• More intense floods, especially in the flood plains of the eastern Himalayan Rivers, their major tributaries, and the delta regions.

• Coastal flooding and salinity intrusion from sea level rise in combination with the amplification of storm surges from more intense tropical cyclones in the Bay of Bengal.

• Rapid melting of Himalayan glaciers, leading initially to greater river flow 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.

IMPACT OF CLIMATIC CONDITION ON HORTICULTURAL CROPS

Impacton fruit crops: The extreme weather events of hot and cold wave conditions have been reported to cause considerable damage to many fruit crops. In perennial crops like mango and guava, temperature is reported to have influence on flowering. Mango has vegetative bias, and this becomes stronger with increase in temperature, thus influencing the flowering phrenology. The percentage of hermaphrodite flowers was greater in late emerging panicles, which coincided with higher temperatures (Singh and Agarwal, 2016, India is the second largest producer of Fruits after China, with a production of 82.04million tonnes of fruits from an area of 6.72 million hectares. A large variety of fruits aregrown in India, of which mango, banana, citrus, guava, grape, pineapple and apple are themajor ones. Due to rise in temperature, crops will develop more rapidly and mature earlier.For example, Citrus, grapes, melons etc. Delay in monsoon, dry spells of rains and untimely dry spells of rains, and untimely rains during water stress period, supra-optimal**.** Temperatures during flowering and fruit growth, hailstorms are some of the most commonly encountered climatic conditions experienced by the citrus growers over the past decade or so. The climate during flowering and fruit growth, hailstorms are some of the most commonly encountered. Temperature has a big influence on the rate of fruit growth, thus use of bunch covers, which are though, to warm the fruit, increased the growth rate. Higher temperature (31-32^{0}C), in general increase the rate of plant maturity in banana, thus shortening the bunch development period (Pachauri and Reisinger, 2007). Higher air temperature (>38^{0}C) and brighter

sunshine cause sunburn damage on exposed fruits. Choking of bunches is also caused by high temperatures (above 38^0C) and drought. Delay in monsoon,dry spells of rains, and untimely rains during water stress period, supra-optimal temperaturesduring flowering and fruit growth, hailstorms are some of the most commonly encounteredclimatic conditions experienced by the citrus growers over the past decade or so. The climatechange increases the atmospheric temperature and change of rainfall pattern, as a result,banana cultivation may suffer from high temperature, soil moisture stress or flooding / waterlogging. In mango flooding simultaneously reduced net CO_2assimilation and stomata conductance after 2-3 days. However, flooding did not affect leaf water potential, shoot extension growth, or shoot dry weight, but stem radial growth and root dry weight were reduced. Mortality of flooded trees ranged from 0 to 45%. Hypertrophied lenticels were observed on trees that survived flooding but not on trees that died The studies conducted in apple show that, the productivity will continue to decline up to 1500 m msl to the tune of 40-50% due to warmer climate and lack of chilling requirement during winter and warmer summers in lower elevations resulting into shifting of apple production to higher elevation (2700 m msl). Winter snowfall affects flowering. In spring, low fluctuating temperatures during bloom results in poor fruit set while warm temperatures result in desiccation of floral parts. Mild winter temperatures followed by warmer springs advanced bud burst and exposing buds to frost damage in almond and apricot. The changes in climate in the form of erratic precipitation, increase in temperature, lesser days serving as the chilling period have started affecting the mountainagricultural production systems and ultimately the food security of the people. Immediately after the frost period, the survey was conducted in the Bikaner and adjoining areas in order to assess the effect of frost on the survival and severity of damage on arid fruit crops. Study revealed that the crops could be classified on the basis of severity of damage into four groups viz. severely affected which included crops such as aonla, gonad, phalsa, moringa, ber, ficus sp. etc. It was also observed that few crops such as pomegranate was moderately affected, sapota and bael less affected and crops such as date palm wasunaffected by the frost

Impact on vegetable crops: The current production level is over 136 MT and the total area under vegetable cultivation is around 9.2 million hectares which is about 5% of the total area under cultivation in the country. Environmentalstress is the primary cause of crop losses worldwide, reducing average yields for most majorcrops by more than 50% (I.P.C.C. 2007).

Climatic changes will influence the severity ofenvironmental stress imposed on vegetable crops. The response of plants to environmentalstresses depends on the plant developmental stage and the length and severity of the stress. Plants may respond similarly to avoid one or more stresses through morphological or biochemical mechanisms. Indian climate is dominated by the monsoon, responsible for most of the region's precipitation, poses excess and limited water stress conditions. Vegetables being succulent are generally sensitive to environmental extremes and high temperature, limited and excess moisture stresses are the major causes of low yields. Soil water stress at early stages of onion crop growth caused 26% yield loss. In tomato, water stress accompanied by temperature above 28^0C induced about 30-45% flower drop in different cultivars. Chilli also suffers drought stress, leading to yield loss up to 50-60%. Most vegetables are sensitive to excess moisture stress conditions due to reduction in oxygen in the root zone. Tomato plants under flooding conditions accumulate endogenous ethylene, leading to rapid epinastic leaf response. Onion is also sensitive to flooding during bulb development with yield loss up to 30-40%. Under climate change scenario the impact of these stresses would be compounded. These stresses are the primary cause of yield losses worldwide by more than 50% plant and the response of plants to environmental stresses depends on the developmental stage and the length and severity of the stresses. In tomato high temperatures can cause significant losses in productivity due to reduced fruit set, smaller size and low quality fruits. Pre-anthesis temperature stress is associated with developmental changes in the anthers, particularly irregularities in the epidermis and endothelium, lack of opening of stromium and poor pollen formation. Optimum daily mean temperature for fruit set in tomato has been reported to be 21-24^0C. The pre-anthesis stage is more sensitive in tomato. Post pollination exposure to high temperature inhibits fruit set in pepper, indicating sensitivity of fertilization process. Such as bud drop, abnormal flower development, poor pollen development, dehiscence and viability, ovule abortion and poor viability and other reproductive abnormalities. In cucumber sex expression is affected by temperature. Low temperatures favours female flower production, which is desirable and high temperatures lead to production of more male flowers. The duration of onion gets shortened due to high temperature leading to reduced yields. Cauliflower performs well in the temperature range of 15-25^0C with high humidity. Though some varieties have adapted to temperatures over 30^0C, most varieties are sensitive to higher temperatures and delayed curd initiation is observed

Impact on plantation crops: Studies conducted on "Impact of climate change in cashew" at Directorate of CashewResearch, Puttur, India indicated that the rainfed cashew crop is highly sensitive to changes inclimate and weather vagaries, particularly during reproductive phase. Cashew requiresrelatively dry atmosphere and mild winter (15-20^{0}C) coupled with moderate dew during nightfor profuse flowering. High temperature (>34.4^{0}C) and low relative humidity (<20%) duringafternoon causes drying of flowers, resulting in yield reduction. Unseasonal rains and heavydew during flowering and fruiting period aggravated the incidence of pests and diseases. Allthese situations resulted in reduction yield upto 50 to 65%. Unseasonal rains at ripening stage leads to blackening of nuts as well as rotting of apples on trees. Cashew experiences severe moisture stress from January to May, which adversely affects its flowering and fruit set. In order to harvest the rainwater and to make it available to the cashew plant during the critical period, in situsoil and water conservation and rainwater harvesting are very important

Impact on flower crops: Plant species requiring high humidity and water may find them under difficult conditions for survival. . Plains of India will also have similar kind of problems and will be affected either by drought or excessive rains, also have similar kind of problems and will be affected either by drought or excessive rains,floods and seasonal variations. Commercial production of flowers particularly grown underopen field conditions will be severely affected leading to poor flowering, improper floraldevelopment and colour. Chrysanthemum is a short day plant. So flowering round the year inopen field condition is not possible. Low temperatures shut down flowering in Jasmine(<19^{0}C) and lead to reduction in flower size. Flowers do not open up fully in tropical orchidswherever temperatures below 15^{0}C. High temperature leads to flower bud drop andunmarketable spikes in tropical orchids when temperature remains >35^{0}C.

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