

ARTICLE ID: 43

Impact of climate change on subtropical fruits

Dinesh Kumar Kuldeep¹, M.S. Bhooriya², Neelendra Singh Verma³

¹Ph.D. Research scholar: Jawaharlal Nehru Krishi Vishwavidyalaya,
Jabalpur, MP

²Ph.D. Research scholar: Jawaharlal Nehru Krishi Vishwavidyalaya,
Jabalpur, MP

³Technical Consultant: State Forest Research Institute, Jabalpur, MP
Mail- dineshkuldeep88@gmail.com

Introduction

A significant change in climate at global and national level is certainly impacting our fruit production and quality. But understanding of impact of climate change on perennial horticultural production system and the potential effects on fruit quality have drawn a little attention of researchers. The consequences of such rapid change are - global warming, change of seasonal pattern, excessive rain, melting of ice cap, flood, rising sea level, drought etc. leading to extremity of all kinds. Decrease in potential yields is likely to be caused by shortening of the growing period, decrease in water availability. High humidity (85-90%), moderate temperatures (maximum temperature of 25-26°C and minimum of 18-20°C) provided favourable condition for the initiation of disease.

Climate change

Evidence have shown that human activities are changing the climate. The main human influence on global climate is likely to be emission of greenhouse gasses (GSG) such as carbon dioxide (CO₂) and methane (CH₄). The global increase in carbon dioxide concentration is due primarily to fossil fuel use and land use change, while those of methane and nitrous oxide are primarily due to agriculture.

How this changing climate effect on fruit crops

Temperature

- Higher temperature speed plant growth and development in annual crops
- In perennial crop, being grown in a climate near its optimum, a temperature increase of several degrees could reduce photosynthesis and shorten the growing period affecting the productivity e.g. banana.
- In areas where current temperatures are below optimal for specific crops, there will be a benefit, while in areas where plants are near the top of their optimal range, yields will decrease.
- Even a minor climate shift of 1-2o C could have a substantial impact on the geographic range of these crops. As fruit crops are perennial moving production area is difficult.

Carbon dioxide

- It is accepted that the atmospheric CO₂ is increasing exponentially and will likely to double i.e. about 700 ppm within the next century.
- This has a beneficial effect on plants and increase productivity.
- This is not universal as the biochemistry of photosynthesis differs among plant species.
- C₃ plants benefit much more from increase in CO₂ than C₄.
- Build up of sugar in the leaves giving a negative feedback on photosynthesis and benefits from elevated CO₂ become minimal.

Precipitation

Rainfall

Changes to India's annual monsoon are expected to result in severe droughts and intense flooding in parts of India. This change creates problems for field operation, more compaction of soil, and possible crop losses due to lack of oxygen for roots and disease problems associated with wet condition. Trend over the decreased amounts of annual rainfall in kullu valley the attribute on which the colour of an apple mostly depends and regulation of moisture stress.

Snowfall

Onset of early snow in December and January had occurred more infrequently overtime and extended through the months of Feb. and March. Early snow contributes nitrogen for plant use, replenish soil moisture and prevent humidity build up. Amount of snow determines the number of chilling hours and thereby the time of bud breaks.

Citrus

Citrus fruit plants are considered to be better equipped to deal with a changing climate than other fruit crops. That's largely because they flourish in the heat. Lemon cultivation area will shrink by around 10 percent which is a small setback in comparison to other plant. Citrus greening, for example, is a bacterial disease that is primarily spread by two types of psyllid insects. It turns a citrus plant's leaves and shoots yellow and makes the fruit bitter, often cause the wither away of entire plant. "Climate change is one major factor affecting the fruit crop. We are facing problems on this count for the last eight to ten years. It's not raining in time because of which, plants are not getting proper nutrition and fruiting is declining gradually. High temperature and high evaporation during flowering and fruit set result in low yield due to flower and fruit drop. The fruits have poor colour if the temperature during fruit maturation is high. In Navel oranges the content of acidity was affected by low temperature leading to low TSS content. Among other climatic factors the rainfall in September and October had an obvious effect on the fruit soluble solids content where less rainfall in this period increased the soluble solids.

Grape

Grapevines are damaged by frost if it occurs during their active growth but resting vines during winter are not affected in north and central India. However, in peninsular India, where occasional frost is expected during winter, there is adverse affect on the growing vines.

Similarly, high temperature above 115°F causes thick skin of berries. Rainfall quantity and duration and season influence discernible. Rainfall during flowering and fruiting is detrimental.

Increased humidity due to prolonged rainfall makes fruits tasteless and there is skin cracking.

High night temperature reduces anthocyanin accumulation in berry skin which is due to low expression of anthocyanin biosynthesizing genes and enzymes.

Reduced number of berries per cluster due to high root temperatures (seen in Cabernet Sauvignon).

Earlier fruit maturation (short term conditions).

Delayed fruit maturation and a reduction in fruit quality (excessive and long term conditions).

Reduced colour development (anthocyanins) in red berries.

Increase in sucrose concentrations in all vine organs.

Decreased glucose and fructose concentrations in fruit.

Mango

- High humidity, rainfall and frost during flowering are harmful.
- Water stress is known to increase the fruit drop in mango.
- Mango phenology is highly influenced by variations in temperature like most of tropical and sub-tropical trees fruit crops, mango has a vegetative bias, which becomes stronger with increasing temperature.
- Early flowering under the subtropics may result in low fruit-set because of abnormalities arising from prevailing low night temperatures.
- High temperature by itself is not so injurious to mango, but in combination with low humidity and high winds affects the growth of the trees adversely. Higher temperature during fruit development hasten fruit maturity and improve fruit size and quality. However, prolonged exposure of fruits at time at near maturity to the summer sun when temperatures exceed 35°C may cause sun burning.
- the current equation: high temperature + low soil moisture + high evaporative demand = low yield

Guava

Red colour development on the peel of guava requires cool nights during fruit maturation. Varieties like Apple Colour, which have attractive apple skin colour under sub-tropical conditions of North India, have red spots on the skin under tropical South Indian conditions. An increase of 0.2°C in temperature resulted into dramatic reduction in the areas suitable for development of red colour in guava; an increase of 0.5°C in temperature will reduce the areas drastically with the suitability probability of more than 97% to a very low level. Based on a future climate database, predictions show that areas with suitability percentage of less than 70% will be available for red colour guava development. Areas suitable for red coloured guava cultivation will be reduced dramatically because the minimum temperature during the coldest month may increase up to 1.9°C, whereas, the mean temperature of the coldest quarter will be 3.2°C higher than the existing temperature resulting in less red colour development in guava fruits.

Litchi

Litchi is essentially a sub-tropical fruit which require protection from frost free winter and dry hot summer. The young plants of litchi require protection from frost and hot desiccating winds otherwise their growth and survival is affected. Bearing litchi trees are affected by hot winds causing fruit skin cracking and sun bum. The observed temperature trends in the region of litchi production (Bihar) showed a general increase in temperature in order of 2-3°C over the base period of 50 years. The unusual impact of climate change has been witnessed in litchi production system as noted in flowering pattern (shifted early), fruit growth and harvesting periods. The occurrence and the extent of damage by physiological disorders and resurgence of pest are very much dependent on the temperature and humidity variations in the atmosphere.

Ber

Ber can be successfully grown under varying climatic conditions but temperature below freezing is injurious to fruits as well as young plants.

Papaya

In papaya, higher temperatures have resulted in flower drops in female and hermaphrodite plants as well sex changes in hermaphrodite and male plants. The promotion of stigma and stamen sterility in papaya is mainly because of higher temperatures.

Low chilling fruits

LC fruits being cultivated in sub-tropics are also under the threat due to non-availability of required chilling hours which has adverse effect on their flowering and the abrupt rise in temperature after fruit set is causing excessive fruit drop as well as there is poor sugar accumulation in the fruit due to steep rise in temperature during fruit development.

