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## Impact of Climate Change on Crop Production

(\*Abdullah Zaid)

Department of Fruit Science, College of Horticulture, Banda University of Agriculture and Technology, Banda

\*Corresponding Author's email: [abdullahzaid265@gmail.com](mailto:abdullahzaid265@gmail.com)

In recent years, an increasing importance has been given to the study of climate change, due to the negative effects generated on natural ecosystems, human health and the economy. The global warming, manifested by the increase in average and extreme temperatures of the air has been demonstrated by numerous studies carried out in different regions of the globe, during several decades. This has resulted in an increase in the humidity level of the atmosphere, increasing the intensity and frequency of negative events related to extreme precipitation, which is one of the most variable climatic elements. The monitoring of extreme climatic events at the annual and seasonal scale is particularly important for the creation of protection or intervention means to reduce the losses caused by such manifestations. In countries where agriculture is one of the main branches of the economy, as is the case of India, extreme climate phenomena have a profound impact.

In our country, about 60 % of the storms that occur between March and September are accompanied by hail falls. The occurrence interval coincides with the vegetation period of most crops and the intensity of the phenomenon determines the degree of their calamity. Fruits and Vegetables play an important role in ensuring food and nutritional security, being one of the richest sources of vitamins and minerals. fruits and Vegetable crops are highly perishable and sensitive to unpredictable as well as extreme climate changes, which affect them in terms of quantity and quality of production, as well as the severity of environmental stress.

Depending on the vegetation phase of vegetable crops, hail can cause not only a drop, but even a complete loss of crops. Also, compared to other crops, vegetables are highly sensitive to weed attack, which is a top concern among organic vegetable producers. Crop protection and weed control in organic vegetable crops are major challenges for farmers. Increasing level of CO<sub>2</sub>, rising of earth temperature, rising of mean sea level, air pollution and soil pollution results in poor yield and quality of fruits and vegetable.

### Climate

Climate is the average weather in a place over many years, climate change is a shift in those average conditions the rapid climate change we are now facing is caused by humans activity such as using oil, gas, coal, deforestation, urbanization and establishing factories. Climate is an important determinant of the abundance and distribution of biological species. Climate change is expected to have significant impacts on the distribution, phenology, and abundance of many species over the next few decades. Change in the global climate may, thus, affect the crop yields and quality, occurrence of severe diseases, incidence of pests, and economic loss of agricultural production

### Effect of carbon di oxide

The earth atmosphere basically consist of nitrogen (78.1%), oxygen (20.9%), argan (0.93%) and carbon di oxide (0.031%). Nitrogen and oxygen does not play a significant role in global warming because both gases are virtually transparent to terrestrial radiation. The greenhouse effect is primarily a combination of the effect of the water vapor,  $\text{CO}_2$ , and minute amount of other gases such as methane, nitrous oxide and ozone. That absorb the radiation leaving the earth surface. The warming effect is explained by the fact that  $\text{CO}_2$  and other gases absorbs the earth infrared radiation trapping heat. Since a significant part of all the energy emanated from earth occur in the form of infrared radiation, increased  $\text{CO}_2$  concentration mean that more energy will be retained in the atmosphere which result in global warming.

### Effect of Temperature

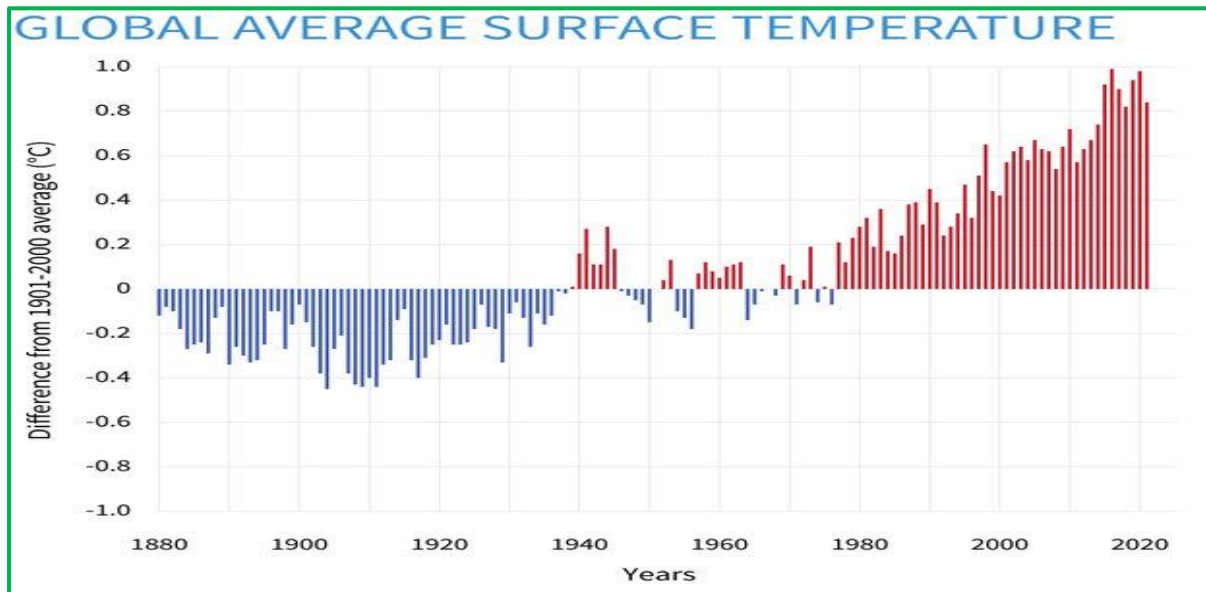
During growth and development period of fruits and vegetables high temperature can affect photosynthesis, respiration, and membrane stability as well as production of plant hormone, primary and secondary metabolites. Seed germination can be reduced or even inhibited by high temperatures depending upon the species and stress tolerant level. For plants that are subjected to water deficit, temperature is a physical facilitator for balancing sensible and latent heat exchange at the shoot which is modulated by relative humidity and by wind. Most of the physiological processes go on normally in temperatures ranging from  $0 - 40^\circ\text{C}$ . However cardinal temperature for the development of fruit and vegetable crop are much narrower and depending on the species and ecological origin it can be push towards  $0^\circ\text{C}$  for temperate species from cold regions such as carrots and lettuce. On the other hand they can reach  $40^\circ\text{C}$  in species from tropical regions such as many cucurbits and cactus species. A general temperature effect in plants involves the ratio between photosynthesis and respiration.

For a high yield not only photosynthesis should be high but also the ratio photosynthesis/respiration should be much higher than one. At temperature around  $15^\circ\text{C}$  the above mentioned ratio is usually higher. Higher than normal temperature affect the photosynthetic process through the modulation of enzyme activity, photosynthetic activity is proportional to temperature variations high temperature can increase the rate of biochemical reactions catalyzed by different enzymes. However above a certain temperature threshold, many enzymes loose their functions potentially changing plant tissue tolerance to heat stress. Temperature is of paramount importance in the establishment of harvest index, the higher the temperature during the growing season the sooner the crop will mature.

Hall et al. (1996) and Wurr et al. (1996) reported that lettuce, celery and cauliflower grown under higher temperatures matured earlier that the same crops grown under lower temperatures

Temperatures affect morphological properties of vegetables such as periderm formation on potato tubers, shape of carrot roots, and fiber content of celery and asparagus. Radish roots become pithy and artichoke flower heads become open, fibrous and tough in hot weather. Following high temperature potatoes can sprout before they are harvested, many vegetables such as carrots and tomatoes, usually develop poor colour under low temperature. Temperature has been observed to effect concentrations of vitamins, minerals, sugars, pigments, and other compound in vegetables at harvest. A higher riboflavin and thiamine content was found in broccoli and cabbage when grown at  $10-15^\circ\text{C}$  compared with that grown at higher or lower temperature. Tomato fruits from plants grown at  $26^\circ\text{C}$  contained more ascorbic acid than those from plants grown at  $17^\circ\text{C}$ . Tomatoes grown at a day temperature of  $35^\circ\text{C}$  were higher in titrable acidity. Temperature influences size, shape, smoothness, and carotenoid content of carrot roots the optimum temperature range is between  $15-21^\circ\text{C}$

Temperature above 30<sup>0</sup>C inhibit synthesis of lycopene in tomato fruits. Exposure of tomato fruits to temperature above 30<sup>0</sup>C suppresses many of the parameters of normal fruit ripening including colour development, softening, respiration rate and ethylene production (Hicks et al. 1983)



Source : NOAA Climate.gov

### Effect of Frost and hail

Hail damage is sporadic but worldwide more extensive than in generally drought. Hail stone size, crop growth stage and the duration of exposure are critical factors affecting the degree of damage. Hail damage results in direct effect on the physical quality of the product this results in shape deformation of fruits and vegetables. It also increases the incidence of diseases. Radioactive freeze damage in Brussels sprouts often results in smaller vegetable and depending upon the development stage when damage occurs, misshapen sprout obtained from half developed stage

### Effect of pollution

the air and soil pollutants such as gas, liquid or solid interact with fruits and vegetable crops in many ways. For example heavy metal ions like Ag, Cd, Pb, etc. that may be introduced to the plants through soil amendments, run off or contaminated irrigation water can cause undesirable alternations in chemical compositions of cultivated fruit and vegetables. Air pollutants also cause extensive damage to plants during the production phase as well as harvested produce during handling, transportation, and marketing.

Among these primary concern are ozone, sulphur dioxide, fluoride and nitrogen compounds such as nitrogen oxides. Percy et al. (2003) observed that ozone exposure causes reduction in photosynthesis and increased turnover of antioxidant systems. Vegetables especially those of leafy vegetables grown in heavy metals contaminated soils accumulate higher amounts of metals than those grown in uncontaminated soils because of the fact that they absorb these metals through their leaves.

### Effect of harsh Wind

High intensity winds results in leaf damage and defoliation which in leafy vegetables has a disastrous effect on product appearance and marketability. And in fruit crops harsh winds causes uprooting of trees. Use of windbreaks has long been advocated in fruit and vegetables production areas that are subject to excessive wind.

## Conclusion

In general, the only way to mitigate the negative impact of climate change on fruit and vegetable production, especially on their productivity, quality and yield, is to take effective measures. Crop protection against extreme weather events and weed management improvement are also among the efficient adaptation strategies, which include: the development of heat and salinity tolerant varieties, as well as flood resistant, drip irrigation, soil and moisture conservation measures, fertilizer management, etc. Combating harmful plants in organic vegetable crops can be solved only by combining available solutions and adopting an integrated non-chemical weed management strategy. As for specialized equipment, it seems that small innovative companies will develop new weed control technologies, because based on the progress made, the future in this field belongs to automatic systems. It is important for future research to focus on the shortcomings or weaknesses of systems and methods related to reducing the negative impact of climate change on fruit and vegetable crops, in order to provide farmers with viable strategies and solutions.