Impact of climate change among the fruit growers of the north

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Abstract

India's many agro-ecological regions boast a wide variety of soil types and climates, providing ideal conditions for cultivating a wide range of horticultural crops. These include not only food staples like fruits and vegetables, but also medicinal and aromatic plants, root as well as tuber crops, decorative and flowering plants, spices, mushrooms, and plantation crops (Reddy et al., 2017). Accurate data on the physiological reactions, effects on production, growth, growth, and taste of fruit crops are required for assessing the impacts of climate change on agricultural production. In order for the horticulture business to prepare for the looming challenges of climate change, it is crucial to have accurate information on the cultivated crop's numerous affects that need to be dealt in a coordinated and thorough manner. The most significant threats to agricultural productivity, including annual or perennial horticulture crops, come from a climate shift or its fluctuation. Especially in the case of fruits and vegetables, a shorter growing time will have a detrimental effect on growth and development, especially in the form of terminal heat stress and lower water availability, leading to a fall in output. Rainfall unpredictability will have the greatest effect on agricultural crops cultivated in rainfed locations.

Keywords: Agro-Ecological, possibilities, horticultural crops, aromatic, medicinal plants, production

DOI Number: 10.48047/nq.2019.17.02.1993 NeuroQuantology2019;17(02): 140-146

Introduction

Emerging issues such as global warming, water and soil pollution, water scarcity, urbanisation, etc., all play a role. When high temperatures are paired with minimal precipitation, many crops may experience water stress. Irrigation levels may drop and evapotranspiration levels may rise. In addition, the length of growth season, livestock or agricultural production, the likelihood of food shortages, and the prevalence of pests and illnesses would all be negatively impacted by climate change, putting people's health and ability to provide

for themselves at greater danger. It has been shown that (Neely et al., 2009)

Apple growing and snowfall patterns in Himachal have been confirmed. The yield per acre of apples dropped from 10.8 to 5.8. A simple illustration of global warming (Awasthi et al., 2001). Many horticultural fruit crops, as well as their physiological, anatomical, morphological, and biochemical properties, are affected by the many abiotic variables that develop due to climate change. The largest impact on fruit production comes from environmental conditions including temperature, drought, salt, floods, an increase in Concentration of co2, and an epidemic of insect-pests.

"The morphology, anatomy, and physiology of plants are altered by elevated temperatures, which has negative effects on seed germination, plant growth, flower shed, pollen viability, gametic fertilisation, fruit setting, fruit yield, size, and quality." Because of the extreme heat and cold, several fruit harvests have suffered significant damage (Malhotra, 2017). Directly or indirectly, extreme temperatures affect crops, such as by reducing the number of pollinating insects when temperatures are very high. This prevents fertilisation and reduces fruit production.

Effects of Decreased Low Temperature Area

Low temperatures during pollination may affect crop yields for cross-pollinated fruits like pistachios and walnuts. Temperatures between 20 and 25 degrees Celsius are ideal for pollination and fertilisation of temperate fruits like plum, apple, cherry, pears, etc. It was discovered that weather circumstances such as fog, rain, or low temperatures have a detrimental effect on sour cherry pollination in the United States. Extreme cold waves produce a reduction in yield for horticultural crops of 10–100%, depending on the crops and kinds (Hazarika, 2013).

Issues with fruit drop, size decrease, and cracking in longan fruit emerge throughout the winter. Temperatures lower than 15 degrees Celsius during the developing fruit stage inhibit both maximum and ultimate fruit size. Extreme fruit drop is brought on by stressful cold or rapid temperature changes. Extreme fruit cracking is associated with cold or dry conditions during the immature fruit stage (Yang et al., 2010). In the instance of mandarins, cold temperatures have a double effect: they both induce blooming and break bud dormancy. It seems that the early steps of floral initiation begin before to the winter rest period, and that inflorescences have deeper hibernation than green buds.

Colder weather reduced the acidity of Navy oranges (Peng et al., 2000). Thus, only the kinds of crops that thrive in that environment should be planted. Papaya, for example, is not suited to the climate of Punjab since it is very frost sensitive. "Rising temperatures stress is the root cause of physiological abnormalities and their consequences in horticultural crops. List of important physiological disorders and their relative cause in fruit crops" are as follows:

Table 1: Impact of Climate Change-List of important physiological disorders and their relative cause in fruit crops are as follows

Fruit crop	Disorders	Caused due to
Mango	Spongy tissue	High Temp.(Convection Heat)
Aonla	Unfruitfulness	Temperature

Loquat	Purple spot	Temperature
Bael	Fruitcracking	Deficiency of Nutrients
Citrus	Granulation	Watermoisture
Mango	Black tip	Harmful Gases like CO and SO2
Mango	Fruitdrop	Lack of pollination
Mango	Jhumka	Lack of pollination
Pomegranate	Fruitcracking	Variation in day & nighttemp.
Grape	Flowerandberrydrop	Hightemp, Lack of pollination

Source: (Mishra *et al*., 2016)

Adverse Impact of Drought Conditions

Drought is a term used to describe the absence of precipitation, which is a common occurrence in arid or semi-arid regions that experience variable rainfall. Planning irrigation within substantial water limit zones is crucial during phenological stages when water stress may have a large impact on the yield response.

Reduced fruit set and cell loss in the surviving fruit are two ways in which pre- and post-flowering stress on perennial fruit plants reduces yields (Powell, 1974). Banana's photosynthetic ability decreases when there is a drought, which has a profound effect on the plant's growth, yield, and productivity.

In tomatoes, moisture stress reduces both fruit size and yield. Blossom terminal rot and sunscald were more common in the severely stressed plants. Plants growing in sandy soils, which have a lower water holding capacity, are more susceptible to drought stress than plants growing in clay soils.

As leaves lose water quickly, a plant with a lot of them is more likely to experience water stress than one with a smaller root mass. Newly planted orchards are especially vulnerable to the effects of drought stress in their early phases since their root systems have not yet fully developed and their leaf growth is rapid.

Impact of Rainfall Proportions

Changes in precipitation are also important because of climate change. Lack of rain or inconsistent rainfall reduces agricultural yields, particularly in rainfed regions. When it rains heavily in places with poor drainage, the soil loses oxygen, which stunts the development of beneficial microorganisms, and numerous insect-pests and illnesses spread, lowering agricultural output.

Table 2: Effect of Climate Change on Nutritional Quality of Apple Fruits and Citrus

Sr. No.	Fruit crop	Climatevariable	Nutritional quality variable	Observations
1	Apple	Humidity, Temperature and solar radiation	"Sugar-acid ratio, Anthocyanin and Vitamin C content"	"Rising temperatures and decreased sunshine have increased the apple's nutritional quality by increasing the concentration of anthocyanin, the vitamin C content and the sgar-acid

				ratio."
2	Citrus (Orange)	Soil salinity	"Content of micro nutrients in leaves"	"The micronutrients conc. in the leaves of sour orange on different rootstocks varied as the soil salinity increased. Like Na^+ and Nconc. increased, while Ca^{2+}, K^+, Mg^{2+} conc. decreased and P conc.did not change."
3	Citrus (Orange)	Frost	"Proteomic and metabolic profiles"	"The frost has impacted protein levels, primary and secondary metabolites. Because of the frost, there has been increase dexpression of some components of the fruit, decreased expression of others and varied as time went by after freeze."

Source: Compiled by Researcher.

Changes in precipitation patterns have the potential to diminish the attractiveness and quality of ripe mangoes. Rainfall during the blooming stage has a negative impact on fruit formation, development, and production. In certain regions, increased growing season and bloom drop happen because of intense and prolonged precipitation. The insect population increases due to the untimely rainfall, which leads to a lower fruit harvest.

Diseases like anthracnose in fruit are more common in areas with heavy rainfall during fruit maturity (Ploetz, 2003). A lack of or poor quality fruit set may be attributed to rain falling on flowers when they are in bloom. Climate change has impacted the typical pattern of precipitation, the extent to which arable land floods, and agricultural crop output.

Increases in temperature will have a negative impact on budding. Yet, in places with low temperatures during blooming, rising temperatures will have a favourable influence on pollen and fruit set viability, and also on the rapid development of mango fruits. Fruit proline accumulation in pomegranates is enhanced by periods of warm, dry weather throughout development. As a result, the value of certain fruit harvests may rise as a result of climate change. As a result of the temperature rise in the apple belt from 30 kilometres up, farmers in the temperate zone reaped economic benefits from global warming (north). Farmers in the lower zone have shifted from growing apples to growing pomegranates, kiwis, and other fruits and vegetables, while new apple orchards have been established in Lahaul & Spitti and the higher portions of Kinnaur Himachal Pradesh district (Rajatiya et al., 2018).

Strategies to Overcome the Effect of Climate Change

In order to mitigate the potentially disastrous effects of climate change, farmers use a strategy known as

adaptation. In order to keep horticultural crops productive and profitable in the changing climate scenario, a synthesis of existing information is needed to design adaptation and mitigation methods for climate-resistant horticulture.

(i) Crop Improvement Strategies – Diversification : The effects of global warming may be mitigated by using the strategy of diversification. While big yields from a single crop are possible in ideal climates, a more diverse cropping strategy may help prevent the spread of disease and the intrusion of pests. Communities of farmers all throughout the globe employ a diverse crop system to weather the inevitable fluctuations in development, and fruit trees are an integral part of that system. Olive trees, kiwis, peaches, walnut trees, and apricot trees would all be welcome additions to a diversified fruit farming operation. Generating strains that can withstand a variety of environmental stresses, such as those caused by drought, salt, moisture stress, insects, and disease.

(ii) Strategies Based on Development of Agro-Techniques

- Creating efficient adaptation measures for agriculture to lessen output losses due to climate change.
- In order to adapt to a changing climate, it is important to track the phenology of nuts, pome, and stone fruits.
- Drought mitigation efforts that make use of indigenous technical know-how and in-situ soil water management are supported.
- Adjusting the planting season and boosting the usage of the linked farming method.
- Using cutting-edge methods of crop production and energy conservation (e.g. "bagging of fruits, fertigation etc").
- Agriculture that makes use of water-harvesting technology and recycles waste water or solid wastes is a model of sustainability.
- Water conservation technology has to be improved.
- Use of composts rises

(iii) Use of Anti-Transpirants : Anti-transpirants, such as chitosane, kaolin, etc., reflect radiant heat from plant parts, lowering surface temperatures of fruits and leaves and so reducing water losses by transpiration. As compared to other treatments, bananas subjected to anti-traspirantchitosane at a concentration of 2% produced the heaviest bunches, hands, and fingers. As terra alba and kaolin are effective treatments for reducing sunburn in pomegranate fruit, they are used on the highest proportion of premium-quality pomegranate fruits. As compared to certain other frost prevention methods, using chemicals such Bordeaux mixture to protect grapes from frost was the most effective.

(iv) Establishing Windbreaks : As well as protecting the soil and orchard against wind erosion as well as other natural disasters, shelter belts and wind breaks, which alter the orchard's microclimate, provide protection to pollinating insects and a safe haven for them. Fruit trees of

tropical fruits surrounded with wind breaks saw a decrease in the proportion of frost-related plant deaths (2.97 - 30.81%), whereas orchards without such barriers saw a rise in the percentage of frost-related plant deaths (up to 91.43%).

Future Strategies for Ameliorating Impact of Climate Change

- The physiology, phenotypic expression, growth, yield, and quality of fruit crops subjected to high temperatures, CO2, and excess water or water deficiency stress must be studied urgently.
- Plants that can withstand intense temperatures, water shortages, and other climatic conditions need to be identified and developed for use in a wide range of agroecological settings.
  - Development of cutting-edge methods to handle the chilling needs of temperate fruit crops.
  - To halt the sleep cycle, we need to create substances that won't harm the environment.
  - Planting thick, tall, growing wind barriers is essential throughout the first stages of an orchard's development.
  - Producers should prioritise heat-, drought-, and photo- and temperature-resistant cultivars. Leaf shredding "(pomegranate, lasoda), stem thorns (Karounda, ber), lower side stomata (custard apple), leaf orientation (aonla), sunken stomata (custard apple), and leaf hair (aonla)" are desirable characteristics in the types to be chosen (fig, ber, phalsa and lasoda).

Conclusion

Global warming and climate change are real phenomena, and there is strong evidence to suggest that emissions of greenhouse gases are to blame. Normal development and growth, blooming behaviour, fruit quality, and pest and disease incidence have all been impacted by the shifting climatic factors. Low winter temperatures have an effect on tree behaviour, including blossoming and a lack of uniformity. More attention must be directed to the creation of drought and heat tolerant genotypes because of the possible impact of climate change. Since a variety that thrives in the present environment may not thrive in the future climate, variety selection is a crucial step in developing a new orchard.

References

1. Awasthi RP, Verma HS, Sharma RD, Bhardwaj SP, Bhardwaj SV. Causes of low productivity in apple orchards and suggested remedial measures. Productivity of Temperate Fruits. Solan: Dr. YS Parmar University of Horticulture and Forestry 2001,18
2. Hazarika TK. Climate change and Indian horticulture: opportunities, challenges and mitigation strategies. International Journal of Environmental Engineering and Management 2013;4(6):629-630.
3. Malhotra SK. Horticultural crops and climate change: A review. Indian Journal of Agricultural Sciences 2017;87(1):12-22.
4. Mishra DS, Tripathi A, Nimbolkar PK. Review on physiological disorders of tropical and subtropical fruits: Causes

and management approach. International Journal of Agriculture, Environment and Biotechnology 2016;9(6):925-935.
5. Neely C, Bunning S, Wilkes A. Review of evidence on drylands pastoral systems and climate change. Rome: FAO 2009.
6. Peng L, Wang C, He S, Guo C, Yan C. Effects of elevation and climatic factors on the fruit quaity of Navel orange. South China Fruits 2000;29(4):3-4.
7. Ploetz RC (Ed.). Diseases of tropical fruit crops. CABI 2003.
8. Powell DBB. Some effects of water stress in late spring on apple trees. Journal of Horticultural Science 1974;49(3):257-272.
9. Rajatiya J, Varu DK, Gohil P, Solanki M, Halepotara F, Gohil M et al. Climate Change: Impact, Mitigation and Adaptation in Fruit Crops. Int. J Pure App. Biosci 2018;6(1):1161-1169.
10. Reddy AGK, Kumar JS, Maruthi V, Venkatasubbaiah K, Rao CS. Fruit production under climate changing scenario in India: a review. Environment and Ecology 2017;35(2B):1010-1017.
11. Yang WH, Zhu XC, Deng SC, Wang HC, Hu GB, Wu H et al. Developmental problems in over-winter off-season longan fruit. I: Effect of temperatures. Scientia horticulturae 2010;126(3):351-358.