



Influence of Climate Change on Citrus Growth and Productivity (Effect of Temperature)

Waleed Fouad Abobatta*

Citrus Research Department, Horticulture research Institute, Egypt

***Corresponding author:** Dr. Waleed Fouad Abobatta, Horticulture research Institute, Agriculture Research Center, Egypt, Email: wabobatta@yahoo.com

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Abstract

The aim of this work is to discuss the effect of climate change on citrus trees, particularly temperature as important factors affecting citrus growth and productivity, the optimum temperature for citrus growth is 25-30°C, while the highest level of photosynthesis occurring at 30°C. The fluctuation in temperature during growth season effect on vegetative growth and productivity of citrus trees, there are various negative effects of low temperature on citrus tree including dropping flowers and fruitlets, disorder in mature fruit, also, new flushes and main branches are deleterious under cold weather, also, freezing and cold temperatures are the determining factor for citrus cultivation. High-temperature has adverse effect of on different growth stages and citrus fruit particularly when reaching 40°C or above, also, warming weather delays flowering and reduce crop yield, also, there are negative effects of temperature on fruit quality and harvesting.

Keywords: Citrus; Climate change; Temperature; Flowering; Fruit quality

Introduction

Citrus occupy the first rank in international fruit trade and occupied the third position between fruit crops after grapes and apples throughout the world, also, citrus one of the imperative fruit crops worldwide, more than seven million hectares are planted with citrus particularly, under warm temperate regions [1].

Citrus consider being one of the most important fruit crops in the world, Citrus are produced in a wide range of climates in tropical, subtropical and temperate regions comprising humid, semi-arid or arid conditions, as a warm climate tree fruit crop, performs best in subtropical

climates and in Mediterranean climate where there is a slight change of season.

Citrus trees adapted to a wide variety of soil types, it's grown on clay, Loamy, and sandy soils in Egypt and is more tolerant of high or low pH [2]. Also, citrus tolerate various growth conditions, but, cannot tolerate cold or freezing weather; citrus trees cannot tolerate soil flooding for longtime without injury particularly in clay soil [3]. However, Citrus fruits obtain the best fruit quality in Mediterranean climate, on the other hand, citrus species are susceptible to a different disease and insect infestation [4].

Citrus Trees and Climate Change

Citrus, a warm climate fruit tree in the Rutaceae family, Citrus require specific temperature between 10-35° C without freezing nights to produce its yield, however, there are a few varieties could tolerate low temperature as low as 3°C for short time, like Mandarin oranges, and Poncirus trifoliata could tolerate freezing due to it is the only deciduous variety in Citrus, therefore it's the proper rootstocks for citrus cultivation in cold regions, also, fruit quality is very sensitive to temperature.

From the last decades the climate in Mediterranean region changes and expecting by 2050 increase temperature up to 2.5° C and increasing aridity due to decreasing rainfall by 10-15% which increase salinity and may cause negative effects on agricultural productivity particularly in the southern countries [5].

Climate change increase effects of different abiotic and biotic stresses on citrus production, such as salinity, high temperature, drought, and rising carbon dioxide levels, also, climate change increase spreading diseases, pests, and weeds, also, reduce flower pollination, and the crop was low quality, Climate is the most important factor in determining where citrus trees will grow, therefore, these threats of climate change affecting the development of citrus orchards.

In the temperate climates like Mediterranean with typically hot summers and cold winters, warm temperature in the day and cool in the night, citrus trees usually flowering in spring in North hemisphere [6].

In general, global warming will decrease the productivity of fruit trees in the Mediterranean climate, also, climate change has an impressive effect on flowering, total yield and fruit quality of citrus.

Effect of Temperature

Citrus producing regions are commercially located in between 40° north and south latitude where the minimum temperature is generally more than -4 °C. The optimum temperature for citrus growth is 25-30°C with the maximum rate of photosynthesis occurring at 30°C.

Effect of low temperature

Freezing temperatures are the most restrictive factor for citrus cultivation, therefore, citrus cultivation must be avoided in any region with winter frosts and low temperatures to (-4° C) [6].

Negative Effects of low temperature on citrus tree:

1. At (-1.7° C) young fruits and flowers have died,
2. Mature fruits are damaged at (-2° C).
3. Most citrus trees are defoliated at (-4.4 to -5.6° C).
4. Main branches are deleterious at (-6.7° C).

Effect of high temperature

High-temperature effect on different growth stages of citrus trees, the adverse effect of temperature on citrus fruit occurs when crosses its limits (above 40° C), Under conditions of high day temperature (more than 40° C) with low humidity the vegetative growth of citrus trees reduced to minimum levels or stopped completely [7].

In Mediterranean climate the High temperatures combined with low humidity increase fruit sunburn particularly in outer canopy of trees, also, high day temperature broken pigments such as anthocyanin and carotenoid in pericarps of fruits particularly late varieties like Valencia orange which reduce fruit quality.

The effects of high temperature have been noted during both vegetative and reproductive growth stages in various citrus varieties occur as direct injuries or indirect effects through disturbance of metabolic processes [8] as follow:

1. Reduced vegetative growth
2. Fluctuation flowering time and longevity.
3. Decreased total yield through increases fruit drop.
4. Reduce fruit quality (affect total sugars/ acidity ratio).
5. Disorders (sunburn and regreening in late varieties).
6. Metabolic processes (broken pigments like anthocyanin)

Fruit sunburn: the sunburn is a result of a rising in the fruit surface temperature rather than the extension of the fruit development period.

Effect on flowering

Under Mediterranean conditions, citrus trees flowering from March as one time yearly, however flower induction, flowering intensity, and duration are correlated with temperature during the flowering period. Warming weather in autumn and winter delaying the budding and flower initiation, consequently delay flowering, reduce flower number, and fruit set. High temperature during flowering stage increased abortion of fruit set in mandarin (*Citrus unshiu*) due to the negative effect of high temperature on type of inflorescences and growing of different parts of flowers [7].

It is well documented that cooler temperature during winter produced more leafless floral shoots, however, high soil and air temperature produce more leafy floral shoots.

In general, air and soil temperature affect the longevity of flowering and rate of flowering, also, influence on the growth of different parts of flowers, cold air temperature (15° C) produce flower number more than warm temperature (30° C) [9].

Effect on crop yield

Due to climate change and rising day temperature, consequently increased night temperature which negatively affect citrus productivity by decreasing photosynthetic function with reducing dry matter production, also, climate scientist expected increase night temperature at a quicker rate than day temperatures in the next decade due to less radiant heat loss because of increased cloudiness [6].

Effect on harvesting

Due to climate change the harvesting period of citrus changed, some varieties earlier and another later. Cold night temperature increase anthocyanin and carotenoid in pericarps which accelerate peel coloring, however, warm days in autumn delay peel coloring, so, the harvesting period delayed than optimum time [8].

Negative effects of climate change on fruit quality: There are various negative effects of climate change on fruit quality as follow:

1. Reduce total sugars acidity ratio.
2. Fruit rigidity decreased and increased pulp softening.
3. Spread sunburn particularly in easy peeling varieties like mandarins.
4. Reduce fruit quality.

Conclusion

Climate change has different effects on citrus trees, temperature considered the most limiting factor for planting citrus, the optimum temperature for citrus growth is 25-30° C, and the optimum rate of

photosynthesis occurring at 30° C, while, fluctuation in temperature affect on vegetative growth and productivity of citrus trees, there are various negative effects of low and high temperature on citrus tree including dropping flowers and fruitlets, also, warming weather delaying flowering, reduce crop yield, and affect fruit quality.

References

1. United States Department of Agriculture (USDA) (2016/2017) statistics.
2. Abobatta WF (2018) Improving Navel orange (*Citrus sinensis* L) productivity in Delta Region, Egypt. Adv Agr Environ Sci 1(1): 36-38.
3. Li H (2009) Citrus Tree Abiotic and Biotic Stress and Implication of Simulation and Modeling Tools in Tree Management. Tree and Forestry Science and Biotechnology 3 (Special Issue 1): 66-78.
4. Bevington KB, Castle WS (1986) Annual root growth pattern of young citrus trees in relation to shoot growth, soil temperature and soil water content. J Amer Soc Hort Sci 110(6): 840-845.
5. Frantz JM, Cometti NN, Bugbee B (2004) Night Temperature has a Minimal Effect on Respiration and Growth in Rapidly Growing Plants. Annals of Botany 94(1): 155-166.
6. Ahmed S, Firdous I, Jatoti GH, Rais MU, Mohsin A (2017) Economic impact of climate change on the production of citrus fruit in Punjab province of the Pakistan. Sci Int (Lahore) 29(2): 413-415.
7. Kumar K, Rashid R, Bhat JA, Bhat ZA (2011) Effects of high temperature on fruit crops. Elixir Appl. Botany 39: 4745-4747.
8. Sugiura T, Sumida H, Yokoyama S, Ono H (2012) Overview of recent effects of global warming on agricultural production in Japan. JARQ 46(1): 7-13.
9. Syvertsen JP, Hanlin EA (2008) Citrus tree stresses: Effects on growth and yield. Document HS1138. University of Florida, Granville, FL, pp: 6.