[Article ID : 01/X/03/1021]

HEAT: SOLUTION LIES IN THE CORE OF A PROBLEM FOR QUALITY MAINTENANCE OF FRUITS

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Abstract

The quality of fruit determined by different biotic and abiotic factors. Pre harvest and even post harvest management of fruit is the utmost need of the hour. Among the different abiotic factors, heat is an important driven factor which causes numerous problems on fruits quality. However, this same heat can be utilized in appropriate manner to save the fruits from different biotic threat and help in maintaining fruit quality. So, in a nutshell, the heat posing as a setback can also be a solution of different problems. In this article we will try to summarize this contradictory role of heat on fruits in both pre and post harvest stages.

Key word: Heat, Fruit, Biotic and abiotic factors, Quality.

Introduction

With the increasing temperature of the environment due to global warming, the fruits cultivation is facing different negative impact like reduced fruit yield and quality. Nevertheless, plants have various natural mechanisms to dissipate the increased temperature by 1) long-wave radiation, 2) heat convection into the air and 3) transpiration. Transpiration can be interrupted by the stomatal closure due to the unavailability of adequate water uptake which induces the Abscisic Acid (ABA) production in roots leads to the closure of stomatal guard cells. Under very high temperature generally the radiated heat builds the high temperature around the crop environment. This also leads to stomatal closure and reduce heat convection. Hot and dry wind helps in heat build up by increasing the dehydration of leaves and limiting the water movement.

Effect of heat

Generally it was a common observation that photosynthesis rate decreases dramatically at temperature above 94 ºC. Many disorders have been reported on various fruits which occur due to the imbalance of heat. Other than the reduction of photosynthesis rates generally the pollen production also impaired in high temperature which indicates the less fruit set. Heat injury in plants induces sunburn and sunscald on fruits, leaves and stem along with leaf and fruit drop and rapid leaf death.

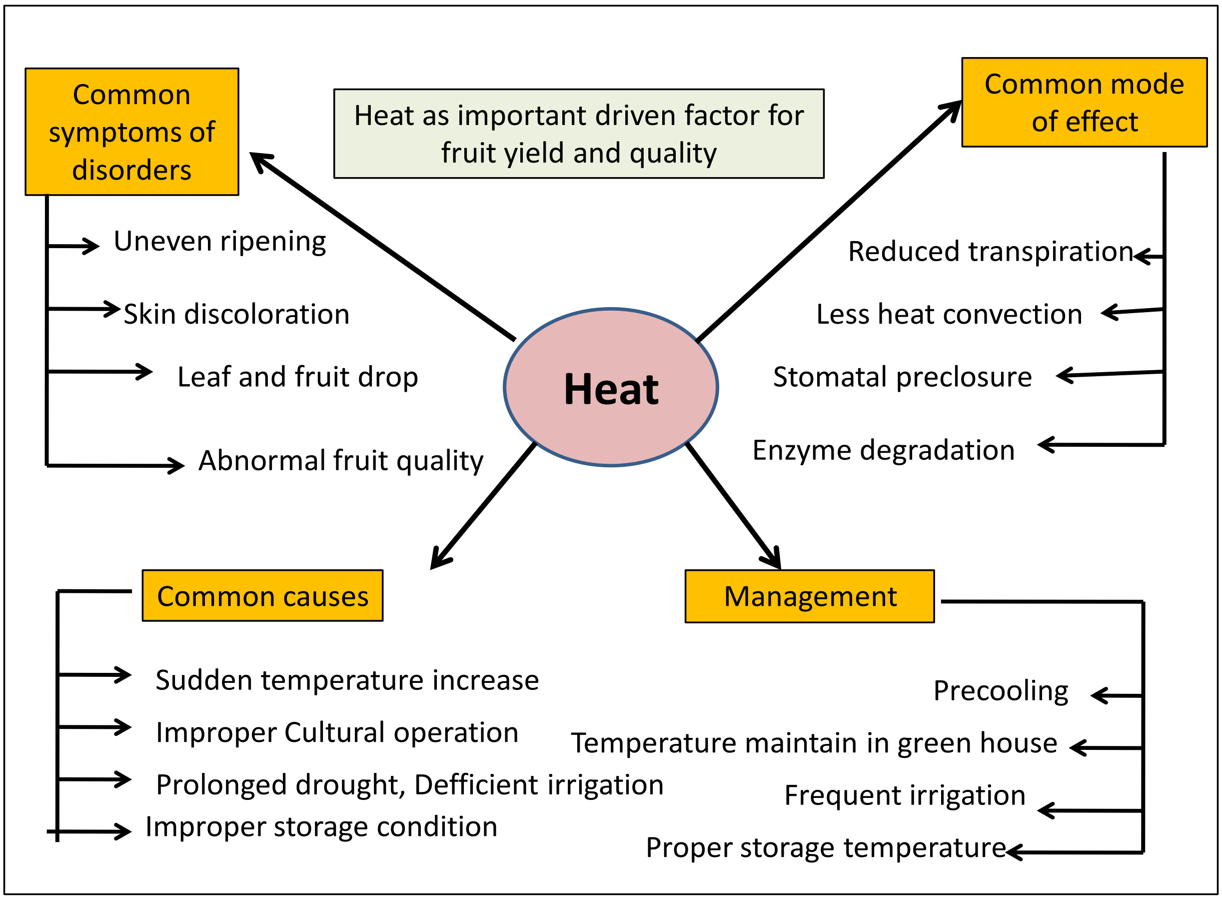
Table-1 : Disorders occurred due to the excessive heat

Sr. No.	Disorder	Symptom	Associated fruits
1	Sunburn	Fruit surface temperature (FST) of 126 ˚F for 10 minutes causes necrotic (dark brown or black) spot on pill.	Apple, Peach, Apricot
2	Sunburn browning	Skin colour changed to dull brown reduces the marketability.	Apple
3.	Lenticels marking	Lenticles on fruit skin become prominent produce numerous dot like symptom	Mango, Apple, Pear

4	Hard lumps in pulp	Formation of much firmer mesocarp due to the inactivation of enzyme in the cell wall in response to heat stress.	Papaya, Banana
5	Water core	Uneven softening of fruits fleshy core due to the increase in temperature during ripening.	Japanese pear
6.	Fruit drop	Excess temperature and lack of soil moisture induced the dropping of fruits in different stages of maturity.	Citrus, Mango
7	Russeting	High temperature at night causes irregular cell division, cracking and formation of cork tissue.	Apple and pear
8	Abnormality in pistil development	Underdeveloped pistil development in higher temperature	Almond and sweet cherry.
9	Spongy tissue	Convective heat leads to development of white corky patches with or without air pocket in fruit pulp.	Mango
10	Pink berry	High temperature variation in day and night (Diurnal temp variation) leads to pink colour berry formation	Grape

Management

Heat management in field and storage condition is the main challenge to control all the heat interfered disorder in fruits. Although in field, heat management is more tedious job. The management of these kind of disorders are graphically represented here :-



Heat as protector and solution of biotic threat and fruit quality maintenance

As described the heat as both be the problem and savior in both pre and post harvest stages of fruits, here we will depict how heat can be a solution for controlling the threat, thereby helps the farmer to protect valuable produce. On the whole, postharvest heat treatments are useful for the control of insect and disease disinfestations, modifying fruit responses to cold stress, delay ripening and maintaining fruit quality during storage.

Mode of action of heat treatment

1. Protection from chilling injury : Chilling injury at low temperatures induce uneven ripening, lack of flavor and aroma, skin discoloration, internal or surface browning, development of a grainy texture, and increased susceptibility to microbial infections. Heat treatments are reported to delay or prevent the development of chilling injury (Lurie; 1998). Yun *et al.* mentioned that mandarin during storage after a 2 min dip at 52 °C successfully suppressed *Penicillium italicum* development, and reduced chilling injury during storage. While, Hot Air Treatment of 39 °C for 3 days found to delay internal breakdown development in stored peaches, although it enhanced the red coloration in both peel and flesh (Zhang *et al*., 2011).

2. Reduction of decay : Heat treatment of fruit generally control decay by different mechanism like 1) direct germicidal effect of the pathogens, 2) inducing defense mechanisms in host and 3) limiting the sites of pathogen penetration by melting and spreading the cuticular waxes on the fruit surface. Karabulut *et al*. (2010) examined hot water immersion of stone fruits with temperatures ranges from 24 to 70°C for control of *Monilia fructicola* and concluded that treatments at 60°C for 60 s reduced the incidence of brown rot from 80% to less than 2% in plums.

3. Effect on physico-chemical and nutritional quality : Hot air and hot water treatment have the ability to increase the fruit quality also. Chen *et al*. reported that hot air at 40°C for 2 days prior to 40 days of storage at 10°C increased higher concentrations of fructose and glucose and lower citric acid in citrus and enhanced the better flavor quality. Whereas, Jacobi *et al*. (2001) explained, heat treatments improved the marketability of the fruit by acceleration of certain ripening processes, such as increased skin yellowness and uniformity of ripe skin colour in mango.

4. Protection from insects : Vapour heat treatment (VHT) and Hot water immersion (HWI) quarantine treatments have been developed to disinfest fruit flies (*B. dorsalis*, *B. papayae* , *B. carambolae* and *B. cucurbitae*) in mangoes, where 47 °C fruit core temperature will be held for 10-25 min depending upon the different varieties of mango (Jacobi *et al*., 2001).

5. Delay fruit ripening : Some heat treatments can also delay or inhibit ripening in certain mango varieties. This helps to fetch better market price when there is higher demand. 'Tommy Atkins' cv. of mango given a vapour heat treatment (VHT) at 50°C for up to 240 min had a reduction in ACC oxidase activity, colour development and softening in the inner mesocarp tissue (Mitcham and McDonald, 1997). However, after 3 days of treatment, the ACC oxidase activity recovered in most treated fruit and continue to ripen.

Conclusion: It is comprehensible from the above points that the same factor *i.e* heat; although being responsible factor of numerous disorder, can be a solution of some basic problems like fruit quality parameter, insect damage and decay. It is the beauty of creation that whenever one problem occurred naturally, the solution also centralized in the core of problem. Scientific aspect to this natural way of solution should come under more experimental outlook and it should also be popularized. This will reduce the harmful chemical dependency for the protection of fruit and can be economical also.

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