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Pre-Harvest Factors Affecting Quality on Post-Harvest Shelf Life of Fruits and Vegetables

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INTRODUCTION

Though India produces large quantity of horticultural produce in the world, per capita consumption is very low for our over a billion population. Major portion is being wasted at various stages of from production till it reaches end-user and its mainly due to inadequate facilities for processing. Extending the PH life of horticultural produce requires knowledge of all the factors that can lead to loss of quality or generation of unsalable material. The field of study that adds to and uses this knowledge in order to develop affordable and effective technologies that minimizes the rate of deterioration is known as postharvest technology. The pre-harvest factors that affect the quality of fruits and vegetables with respect to their post-harvest shelf life are as follows.

I. Genetic factors/ variety: Varieties with shorter shelf-lives are generally prone to higher post-harvest losses. Varieties with thick peel, high firmness, low respiration rate and low ethylene production rates would usually have longer storage life. The cultivars that have ability to withstand the rigors of marketing and distribution will have lesser losses after harvest. Varieties with resistance to low temperature disorders and/or decay-causing pathogens can be stored well for longer duration with minimum storage losses. Hence, while growing horticultural crops, one must choose such varieties that inherently have got good quality and storage potential in addition to the higher yields and pest resistance.

II. Environmental factors

Light: Light regulates several physiological processes like chlorophyll synthesis, phototropism, respiration and stomatal opening. The duration, intensity and quality of light affect the quality of fruits and vegetables at harvest. Most of the produce needs high light intensity (3000-8000 foot candles). Absorption of red light (625-700 nm) through pigments, phytochrome, is essential for carbohydrate synthesis which determines the shelf life of the produce.

Citrus and mango fruits produced in full sun generally had a thinner skin, a lower weight, low juice content and lower acidity but a higher TSS. Citrus fruits grown in the shade may be less susceptible to chilling injury when subsequently stored in cold storage.

In tomatoes, leaf shading of fruits produced a deeper red color during the ripening than in the case of those exposed to light. The side of the fruit that have been exposed to sun will be generally firmer than the non-exposed side. In general, the lower the light intensity the lower the ascorbic acid content of plant tissues. In leafy vegetables, leaves are larger and thinner under condition of low light intensity.

2. Temperature: All type of physiological and biochemical process related to plant growth and yield are influenced by the temperature. The higher temperature during field conditions decreases life and quality of the produce. At high temperature, stored carbohydrates of fruits, vegetables and flowers are quickly depleted during respiration and plant respires at the faster rate. For example- high temperature during fruiting season of tomato leads to quick ripening of fruits on and off the plant. Orange grown in the tropics tend to have higher sugars and TSS than those grown in sub tropics.

3. Humidity: High humidity during growing season results in thin rind and increased size in some horticultural produce and this produce is more prone to high incidence of disease during post-harvest period. Humid atmosphere may cause the development of fungal and bacterial diseases, which damages produce during storage and transport. Damaged produce remove water very quickly and emit a larger concentration of ethylene than healthy ones. Reduced transpiration leads to calcium and other elemental deficiencies.

4. Rainfall: Rainfall affects water supply to the plant and influences the composition of the harvested plant part. This affects its susceptibility to mechanical damage and decay during subsequent harvesting and handling operations. If root and bulb crops are harvested during heavy rainfall, the storage losses will be higher.

III. Cultural factors

1. Mineral nutrition: Balanced application of all nutrient elements is necessary for maintaining growth and development of plants. The application of fertilizers to crops influences their post-harvest respiration rate. Excess or deficiency of certain elements can affect crop quality and its post-harvest life. Numerous physiological disorders are also associated with mineral deficiencies which ultimately lead to post harvest losses.

a. Nitrogen: High N fertilization reduces while moderate to high K improves PH life and quality of horticultural produce. Application of K in water melon tends to decrease the PH respiration. High levels on N tend to decrease flavor, TSS, firmness and color of the fruit and in stone fruits it increases physiological disorders and decrease fruit color.

Generally, crops that have high levels of nitrogen typically have poorer keeping qualities than those with lower levels. High nitrogen increases fruit respiration, faster tissue deterioration thereby reducing their storage life.

b. Phosphorous: Application of phosphorous minimizes weight loss, sprouting and rotting in bulb crops compared with lesser application. The respiration rate of low-phosphorous fruits will be higher than that of high phosphorous fruits during storage.

c. Potassium: Potassium fertilizers improves keeping quality, its deficiency can bring about abnormal ripening of fruits and vegetables. Potassium helps in reducing some physiological storage disorders, e.g. superficial rind pitting in oranges.

d. Calcium: The storage potential of the fruits is largely dependent on the level of Ca and it is associated with produce texture. The higher level of N, P and Mg and low levels of K and Bo lead to the Ca deficiency in fruits and reduce its storage life.

Physiological disorders of storage organs related to low Ca content of the tissue

are bitter pit in apples, cork spot in pears, blossom end rot in tomato, tip burn in lettuce, hallow heart in potato, red blotch of lemons etc.

Calcium inhibits the internal browning, retarded respiration, and reduces the metabolism of endogenous substrates.

e. Zinc: Zn is known to act as vehicle for carrying ions across tissue and increase Ca content of the fruit.

f. Boron: Adequate supply of B improves the mobility of Ca in the leaves and the fruits and subsequently increases fruit firmness, TSS, organic acids and reduces the incidence of the drought, spot, bitter pit and cracking disorders and imparts disease resistance.

2. Water relation and Irrigation: Stress due to excessive or inadequate water in the medium reduce the longevity of the produce. In general, <5 % of water absorbed in the plant system is utilized for the development of different plant components. Moisture stress increases the rate of transpiration over the rate of absorption and irregular irrigation leads to fruit/vegetable cracking (potato and pomegranate cracking). Higher level of moisture stress affects both yield and quality by decreasing cell enlargement.

Crops which have higher moisture content generally have poorer storage characteristics. An example of this is the hybrid onions, which tend to give high yield of bulbs with low dry matter content but which have only a very short storage life. If fully matured banana is harvested soon after rainfall or irrigation the fruit can easily split during handling operations, allowing microorganism infection and PH rotting. Excess water supply to plants results in cracking of fruits such as cherries, plums, and tomatoes.

In green leafy vegetables, too much rain or irrigation can result in the leaves becoming harder and brittle, which can make them more susceptible to damage and decay during handling and transport.

Generally, crops that have higher moisture content or low dry matter content have poorer storage characteristics. Keeping quality of bulb crops like onion and garlic will be poor if irrigation is not stopped before three weeks of harvesting.

3. Canopy Manipulation

a. Fruit thinning: Increases fruit size but reduces total yield. It helps in obtaining better quality produce.

b. Fruit position in the tree: Fruits which are exposed to high light environment possesses higher TSS, acidity, fruit size, aroma, and shelf life compared to which lies inside the canopy. Hence better training system should be practiced to circulate optimum light and air. Eg: Grapes, Mango, peaches, kiwifruits.

c. Girdling: Increases the fruit size and advance and synchronized fruit maturity in peach and nectarines.

4. Seasons / Day and day length: Seasonal fluctuation and time of the day at harvest will greatly affect the postharvest quality of the produce. Generally produce harvested early in the morning or in the evening hours exhibits longer PH life than produce harvested during hot time of the day.

If long day Onions (temperate) are grown during short day (tropics) condition it leads to very poor storage quality.

5. Use of Agro chemicals: Use of chemicals on the plants to prevent the pathogen will have direct impact on extending the postharvest life. Hence, certain pre-harvest chemical applications are found to enhance storage life of fruits and vegetables.

6. Pest and Diseases: Infection by fungi, bacteria, mites and insects reduces the longevity as well as consumer acceptability. Tissue damage caused by them show wilting and produce ethylene which leads to early senescence. Generally, if produce has suffered an infection during development, its storage or marketable life may be adversely affected. Banana which suffers a severe infection with diseases such as leaf spot may ripen pre maturely or abnormally after harvest and in mango, infections results in rapid postharvest loss.