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Post - Harvest Management Practices for Quality Retention in Cut Flowers

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Abstract

Cut flowers are very sensitive horticultural commodities whose market value and market appeal to consumers are largely reliant on quality, freshness, and vase life. Losses on cut flowers may be as high as 20 to 50 percent, mostly caused by the rapid senescence, contamination with microbes, aging caused by ethylene, mechanical damage and poor storage and transportation conditions. Post-harvest management practices are thus very important in maintaining quality, shelf life, and profitability in the domestic and export markets. This article gives an in-depth summary of the main post-harvest management processes and new technologies in retaining quality in cut flowers. Pre-harvest and post-harvest conditions determine the quality and long life of cut flowers. Such factors as pre-harvest, variety used, harvesting at the right stage of maturity, nutrient management, irrigation and alleviation of stress are important factors that can influence post-harvest performance. The methods of harvesting and handling, including attentive stem trimming, de-leafing, and sanitation requirement are crucial to reduce mechanical damage and contamination with microbes. Post-harvest management, such as hydrating, pulsating with sugar and biocide, and application of ethylene inhibitors, such as 1-MCP and silver thiosulfate, prevents turgidity loss and senescence. One of the innovations that have transformed the floriculture industry is the use of post-harvest technology such as cold chain management, controlled atmosphere storage, modified atmosphere packaging, smart packaging with real-time monitoring, etc. These kinds of technologies are able to maximize the temperature, humidity and gas mix during storage and transportation to minimize losses and preserve the freshness of

flowers at the long range. Preservatives, biodegradable finishes, and antimicrobial treatments are also becoming eco-friendly as a way to decrease the use of chemicals and support environmentally-friendly practices. Quality retention of cut flowers requires incorporation of contemporary technology, sustainability and careful management through the pre-harvest, harvest and post harvest stages. Through integration of the old and new technologies, the manufacturers are able to increase longevity of the vases, beautify them, decrease wastages, and maximize earnings. This article highlights the need to pursue an integrated approach to post-harvest management in order to ensure that consumer expectations are achieved, competitive pressures in the markets are enhanced, and in the long run, the commercial floriculture industry is given a chance to grow sustainably.

Introduction

Floriculture industry is also an important aspect of the economy that relies heavily on cut flowers as part of its revenue and employment as well as livelihood to rural areas. They are grown to be used in domestic, religious and cultural celebration, decorations, as well as international trade. The consumer preferences changed, the disposable incomes were increasing, urbanization was growing, people became aware of esthetics and lifestyle tendencies, thus worldwide demand on high quality flowers increased significantly. Floriculture has emerged as a lively industry in India with the central place in the domestic as well as export-driven production being taken by cut flowers like roses, chrysanthemums, gerberas, lilies, orchids, and marigolds. Nevertheless, the extreme perishability of the cut flowers poses challenging problems in preserving quality, freshness and marketability of the product between the field and the consumer.

Losses after harvest of cut flowers may amount to 20 percent to 50 percent comprising of losses in species, handling, and environmental circumstances. Rapid senescence, contamination by microbes, aging caused by ethylene, loss of water and mechanical damage are some factors that decrease the aesthetic and commercial value of flowers. Poor quality storage and transportation does not only change profitability but also consumer confidence and competitiveness. Thus, proper post-harvest management strategies are crucial in maintaining flower quality, increasing

vase life, and are relevant in attaining economic returns to growers and traders.

Pre-harvest activities, such as selection of the variety, harvest timing, management of nutrients, irrigation and stress alleviation, determine the post-harvest quality of cut flowers. The harvesting methods and subsequent immediate post harvest management are critical in order to reduce physical, microbial and drying harm. To delay senescence and preserve freshness, hydration, pulsing sugar solutions and biocides, ethylene inhibitors, and temperature are used extensively as post-harvest treatments. The post-harvest handling has been transformed by the advancements in technology such as cold chain infrastructure development, modified and controlled atmosphere storage, smart packaging and digital monitoring systems. The innovations allow ensuring the preservation of the best possible temperature, humidity, and gaseous structure during storage and transportation of products and minimize losses and extend the storage of cut flowers in vases. Moreover, preservatives that are environmentally friendly, biodegradable coating, and antimicrobial treatment are also being utilized to provide sustainable and safe handling procedures.

Physiological and Biochemical Underlying of Flower Senescence

The process of senescence in cut flowers is a complicated physiological and biochemical process that causes the degradation of floral quality such as petal wilting, color loss, loss of fragrance and decreased turgidity. The processes that surround senescence are important to learn about since they help in coming up with effective post-harvest management practices that may help in increasing the length of the vase life and marketability. The senescence of flowers is mainly controlled both by internal factors such as hormonal variations and metabolic and external environmental factors like temperature, humidity, light, and handling.

1. Role of Respiration:

One of the most important physiological processes that contribute to energy to cellular functions is respiration and also leads to senescence among flowers. Once harvested, cut flowers do not stop their respiration processes, which use carbohydrates to generate carbon dioxide, water, and energy. Increased respiration rates enhance the rate of stored sugars depletion that results in

lower turgor, wilting, and premature petal abscission. The gerberas, carnations, and lilies are also the types of flowers that have high rates of respiration and therefore, they are highly prone to the rapid loss of quality. It is thus necessary to control respiration by controlling temperature and employing pre-harvest conditioning to reduce senescence.

2. Water Relations: Transpiration:

Water homeostasis is also essential in preserving petal turgidity and freshness of flowers in general. Stress in the form of post-harvest of water decreases the uptake or excessive transpiration, causing drooping, wilting, and causes shorter vase life. Water uptake is affected by such factors as stem blockage, growth of microorganisms in water, and environmental conditions. Pulsing treatments, handling and clean water are used to maintain optimal hydration, which inhibits water stress and delays senescence.

3. Biosynthesis and Action of Ethylene:

One of the major regulators of senescence in most cut flowers is the plant hormone, ethylene. It hastens chlorophyll degradation, abscission and wilting of petals. Flowers may either be ethylene-insensitive (e.g., lilies, tulips) or ethylene-sensitive (e.g., carnations, orchids, gerberas), and this is the basis of choice of the type of post-harvest treatments needed. An increase in ethylene production occurs as a reaction to stress, mechanical injury, or high temperature and leads to biochemical mechanisms that hasten senescence. One of the commonly used techniques in post-harvest management of cut flowers is to manage ethylene using inhibitors like 1-MCP or silver thiosulfate.

4. Biochemical Changes:

There are a number of biochemical processes during senescence. Proteins and nucleic acids are broken down causing cell structure breakdown. Green and colored petals respectively undergo chlorophyll and carotenoid or anthocyanin degradation resulting in fading. Lipid peroxidation causes harm to the cell membrane, and oxidative stress is caused by the accumulation of the reactive oxygen species (ROS), which causes an additional tissue degradation. Protective roles are taken by antioxidant compounds (ascorbate, phenolics) and their concentration may be

controlled by pre- and post-harvest interventions.

5. Interaction of Physiological and Biochemical Factors:

The process of senescence is a product of a complex interaction of respiration, water relations, ethylene action, and biochemical changes. These processes occur at a faster rate due to environmental factors, like high temperature, low moisture, mechanical damage, and microbial contamination to decrease the quality of flowers and the life span of the vase. The knowledge of these interactions enables the establishment of combined post-harvest management, such as temperature, hydration, ethylene inhibition, and application of antioxidants to retain flower quality.

Preharvest Factors that influence Postharvest Quality

Pre-harvest factors have a significant effect on the quality of post-harvest and vase life of cut flowers. Management of the cultivation phase can be used to increase the longevity, color, fragrance, and senescence resistance of flowers and vice versa. These are genetic selection, maturity at harvest, management of nutrients and water, environmental factors and cultural practices. These parameters are essential to comprehend and optimize to preserve the high-quality of flowers in the harvest.

1. Variety and Genetic Factors:

The genetic composition of a flower defines its natural quality characteristics such as vase life, color, fragrance, stem strength and ethylene sensitivity. There are cultivars which inherently possess a longer shelf life and are less susceptible to senescence, and there are also cultivars that tend to deteriorate rapidly. An example is that ethylene sensitive such as carnations and gerberas should be handled with care and subjected to after-harvesting techniques but on the other hand, lilies and tulips are ethylene insensitive. The first step towards ensuring an excellent post-harvest performance is selection of appropriate cultivars to particular markets and environmental factors.

2. Flower Maturity during Harvest:

Harvesting is a key determinant to post-harvest quality. Early harvested flowers can end up having poorly developed petals and fragile stems, and over-mature flowers end up with a short

senescence and short vase life. Preferably, the flowers are to be collected when they are at the bud, or half open, depending on the species, in order to maximize the flower life and price. Standardization of harvesting guarantees consistency of quality and storage and transportation shelf life.

3. Nutrient Management:

Balanced fertilization determines flower size, stem strength, color and longevity after harvest. Nitrogen, phosphorus, potassium, calcium, and micronutrient levels need to be adequate in order to produce flowers that have firm stems and healthy petals. Especially calcium fortifies cell walls, decreases petal wilting and delays the senescence. Excessive nitrogen fertilization can also result in excessive vegetation at the flower cost, and can decrease vase life. Flower quality and longevity can also be improved by foliar application of nutrients and growth regulators at pre-harvest stages.

4. Water Management:

Regular irrigation is also essential in preserving turgor, stem strength, and metabolic balance. Pre-harvest water stress may result into wilting, early petal abscision and decreased vase life. Under- irrigation and over- irrigation may have a negative impact on flower quality. It is important that the soils are kept at optimum moisture levels and the irrigation timetables are followed to the letter so as to make sure that flowers are harvested in the physiologically healthy condition.

5. Climate and Socio-cultural customs:

The direct effects on flower development and post-harvest performance are temperature, the intensity of light, humidity, and stresses protection. Increase in temperature or sudden change in temperature increases respiration and ethylene production resulting in premature senescence. Correct spacing of plants, pruning, staking and pest control help produce strong stems, petals which are healthy and evenly developed flowers. Environmental stresses can be alleviated by using shade nets, mulching, and greenhouse cultivation, which improve the quality of the harvest.

6. Integrated Pre-Harvest Care:

A combination of all the pre-harvest activities, selection of varieties, maturity to harvest, nutrient and water control and environmental control, produces flowers that are physiologically strong and able to endure handling, transportation, and storing. This combined strategy reduces the stress induced senescence and optimizes the vase life and consumer satisfaction.

Harvesting Techniques and Handling Techniques.

Post-harvest management of cut flowers involves harvesting and handling which are important practices because inadequate practices will result in mechanical damages, microbial damages, water stress and senescence. Even the flowers that have been picked at the ideal pre-harvesting conditions will go bad easily when not treated properly. The aim of the proper harvesting and handling methods is to maintain the quality of the flowers, turgidity, and to retain longevity in the storage, transportation and marketing.

1. Timing of Harvest:

The quality after harvest largely depends on the stage of flower maturity at harvest. The flowers must be picked at the point of full petal formation and not completely open in case they have maximum vase life and are resistant to senescence. Buds picked early do not always open correctly, whereas excessively matured flowers wither away very fast and are more susceptible to microbial infection. Time of day also plays a role as harvest at the dawn of the day or at night when temperatures are cooler and transpiration is reduced, this lowers losing water and stress.

2. Proper Cutting Techniques:

Stem cut is also an important factor in the preservation of the quality of the flowers. Angeled cuts should be made using sharp, clean knives or shears and more surface area is made to receive more water. Do not break or shred the stem because broken xylem vessels may inhibit the uptake of water and increase wilting. In certain species, lower leaves and thorns are removed around the cut end and lower the levels of microbial growth in the vase water, and blockage of the vascular tissues. To avoid air embolism within the xylem, stem cutters should immediately immerse the stems in clean water to help the stems retain turgor.

3. Handling and Hygiene:

Bruising, petal tearing, and premature senescence might be caused by mechanical damage of the fruit during harvesting and handling. The flowers are to be treated carefully not to bend or crush the stems and petals. To reduce microbial contamination of the collected material, workers are expected to engage in good hygiene (clean hands, sanitized tools and disinfected collection containers). Handling of flowers should be done in clean water-filled buckets or containers to ensure that it remains moist even on a short course of time.

4. Pre-Cooling and Hydration:

To reduce respiration and senescence, it is necessary to pre-cool immediately after harvest. Refrigeration of flowers to the best storage conditions lowers metabolism and water loss. Hydration interventions like pulsing stems in water sugar solutions or water with biocides, can be used to restore turgor and supply carbohydrates necessary to provide energy to the vase to extend its life.

5. Packaging for Transport:

Proper packaging minimizes mechanical damage to the transportation process. The flowers have to be bundled together as per the species and then tied or banded and packed into perforated boxes or cartons which allow circulation of air. Abrasion and crushing are avoided by providing adequate support, cushions and spacing of stems. Maintenance of freshness is vital by way of humidity retention and temperature controlled packages particularly in long distance transportation.

6. Post-harvest Management Integration:

The best way to harvest and handle is in combination with other strategies, such as cold storage, the control of ethylene, and preservatives. Sensitive treatment, pre-cooling, adequate hydration and hygiene will guarantee optimal vase performance, visual interest and marketability.

Conclusion

Management of post-harvest is a very important aspect of cut flower industry that has a direct effect on quality, marketability and profitability. Cut flowers are very perishable goods and no

matter the best pre-harvesting procedures, neither the quality deterioration may be fully avoided without proper post-harvest practices. The major secret to prolonging vase life and preserving aesthetic value has to do with the knowledge of physiological and biochemical processes of flower senescence and the implementation of proper pre-harvest, harvest, and post-harvest management strategies. The pre-harvest inputs including variety selection, maturity at harvest, nutrient control, irrigation and environment are the basis of post-harvest quality. The flowers that are harvested at the right stage of maturity and have good stems, bright flower petals and balance in their physiological conditions respond better to hydration, preservatives and storage interventions. The management of the nutrients, especially calcium and potassium, increased the strength of the cell walls, minimized wilting, and delayed senescence. In the same manner, the best use of water and mitigation of stress before harvesting will keep flowers ready physiologically to sustain the stress of handling, storage and transportation. Hacking and management methods are also important. The harvesting of the flowers must be done at the most appropriate time of the day as well as maturity of the flower; this can be done with sharp and clean instruments to prevent mechanical damages. Water stress and microbial contamination are the main causes of post harvest quality, which are reduced by gentle handling, lower leaves removal, instant hydration and hygienic practices. The packaging and transport processes should reduce mechanical damage and ensure that there is proper temperature and moisture. Pre-cooling, adequate hydration and temperature-regulated storage of flowers makes the flowers maintain turgor, color, aroma and general freshness. The vase life is to be prolonged by post-harvest treatments, such as pulsing with sugars, biocides, the use of eco-friendly preservatives and the use of advanced storage technologies, such as cold chain management, modified atmosphere packaging, and controlled atmosphere storage. Other innovations that have increased the efficiency and sustainability of post-harvest management include biodegradable coating, nanotechnology-based treatments, and smart packaging with digital tracking.

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