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CARE AND HANDLING OF CARNATIONS

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A man who devoted most of his life to the development of the carnation made a statement in 1903 which still holds true today. Charles Willis Ward, author of *The American Carnation,* said "Superior methods of placing an article upon the market in the shape that will prove most attractive to the purchaser are sure to bring their reward in increased prices, other things being equal. In no business do cleanliness and artistic handling of goods play a more important role than in the florists' business; and the grower, commission man, and retail dealer must each do his part if the greatest degree of success is to be attained" (1). Seventy-six years later persons devoted to the floral industry are reemphasizing the importance of a cooperative effort of growers, wholesalers, and retailers to present the consumer with a long-lasting high quality cut flower. Dr. Harold F. Wilkins states, "I feel poor keeping quality is the reason cut flower use has not expanded in relation to green plants and the reason cut flowers lag behind our expectations for developing the industry." More and more consumers are purchasing flowers in accordance with the keeping life longevity as well as the quality of beauty. A survey on consumer preference indicated that flowers with a better post-harvest lasting quality rated higher. At the time of purchase, roses were preferred by 51% of the consumers while carnations were preferred by 41%. After five days of home use, roses were preferred by 20% of the consumers while 34% preferred carnations (2). This is one of many indications that the keeping life of the carnation is just as important for purchasing preference as is color, flower size, fragrance, and overall appearance. If the cut flower industry is to maintain repeat sales, the keeping quality must become a goal of all persons involved in production, transportation, and sales.

How can the grower, wholesaler, and retailer put keeping quality into the carnation? Utilize effective techniques of care and handling throughout the chain of life of the carnation. It is estimated that one-third of the cut flower life is influenced by the preharvest environment and the other two-thirds by the handling and postharvest environment (4).

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Why Flowers Deteriorate

"Cut flowers are living, actively metabolizing plant parts subject to the same basic aging phenomena as are entire plants. But since they are cut off from their natural sources of raw materials for metabolic functioning, efforts to supply these necessities exogenously are seldom completely successful." Anything that florists do to prolong the vase life will be related to one or more of the five factors causing deterioration. These factors are desiccation, the exhaustion of respirable substrates, maturation and continued development of the flowers, diseases, and ethylene gas (3).

Techniques of handling the preharvest and postharvest carnation can be better utilized if the fundamental causes of the deterioration and death of fresh cut flowers are understood.

Desiccation Or Drying

Plants are 80-95% water; therefore, their first and foremost need is water. Turgidity in flowers is dependent upon a balance between the rate of water loss and water supply (6). Moisture is supplied by absorbing water into the vascular system through the cut stem opening. Desiccation may occur if this opening is blocked by air bubbles, microbial organisms, or callous formation. Moisture is lost through the openings in the leaves called stomates. Water vapor moves from a region of high concentration to a region of low concentration; therefore, water vapor normally moves out of a plant if the external relative humidity is less than one hundred percent (2). The drier the surrounding air the more moisture will be lost from the plant.

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Exhaustion Of Respirable Substrates

A flower is still a metabolizing entity after it has been severed from the rooted plant; therefore, it is still losing food through respiration. The cut flower cannot effectively synthesize food materials and will die when the stored supply is exhausted. Floral preservatives can substitute for the otherwise synthesized food materials and, therefore, can prolong the keeping life of a carnation cut from the rooted plant.

Maturation And Continued Development Of The Flowers

In order for the consumer to enjoy the look of a freshly harvested flower for the longest possible time the rate of respiration, petal expansion, and overall floral development must be lowered. Any technique which can decrease the rate of respiration in a flower will increase its keeping life. Respiration is the main process that utilizes sugars for energy production. One of the most effective means of lowering the rate of respiration is by lowering the temperature surrounding the flower. For example, carnations stored for fourteen days at 32°F had seven days of vase-life upon removal compared to two days for those stored at 41°F (2).

Diseases

Diseased plants are distinguished from normal plants by changes in their structure or physiological processes which are brought about by unfavorable environment or by one or another parasitic agency (5). One of the most prevalent fungi which attack the flower in storage and shipment is *Botrytis* or Gray Mold. Warm, moist environments promote *Botrytis;* therefore, ventilation and cool temperatures can inhibit its development. White varieties of carnations are especially susceptible to *Botrytis* and should be carefully observed for any symptoms. The affected flowers turn brown and frequently petals are matted together by the mycelium of the fungus (4). All diseased plant parts should be destroyed to prevent spread of the fungus. During shipments, *Botrytis* can sometimes be controlled by suspending brominated activated charcoal over the flowers.

Another disease which can attack plants at any time from the cutting stage to maturity is carnation rust. The affected plant has small blisters containing powdery brown spores on the lower or upper sides of the leaves and rarely on the stems or flower buds. The spores remain alive for long periods of time on greenhouse glass and may be spread by splashing water. Greenhouses using a pad and fan cooling system can spread the spores rapidly throughout the greenhouse. Carnation rust can be controlled by lowering humidity and using a fungicide (4).

Ethylene Gas

Ethylene is a gas of low molecular weight which hastens the process of respiration and maturation. It has been estimated that thirty percent of all floral crops die prematurely because of ethylene-induced disorders (2). Carnations are especially sensitive to ethylene. An irreversible wilting or sleepiness occurs when carnations are exposed to 100 parts per billion or more of ethylene gas (7). Ethylene gas is a problem for grower, wholesaler, retailer, and shipper because it can originate from many sources. It is produced by floral crops, especially plants with diseased or dead parts; fruits; vegetables; improper combustion of coal or natural gas; or exhaust fumes from gasoline engines.

Deterioration Of Flowers Can Be Controlled

Research in the area of plant physiology has provided information on the probable causes and possible controls of floral deterioration. This knowledge can be implemented into the market channel to provide the consumer with a floral product of high quality. From harvest to the floral arrangement or vase, steps can be taken to control deterioration and, thus, increase vase life. The grower, wholesaler, and retailer can mutually benefit by using methods of deterioration control at their level of production.

Harvest

The grower is responsible for the preharvest environment of the cut flower, which influences one-third of the cut flower life; therefore, the responsibility of producing a long-lasting carnation begins with the grower. After producing a healthy, beautiful carnation plant, the grower must decide on an appropriate harvest date. The time of harvest can have a great influence on the keeping quality of a cut flower. Flowers with the longest vase life are those with the highest sugar content of the stems at the time of harvest. The greatest influence on this level of sugar content is temperature, light, and carbon dioxide. Generally, the highest sugar content in the stems occurs in mid to late afternoon due to photosynthates produced that day (2). Each grower must calculate the most beneficial harvest date and time; depending on stage of maturity, distance to market, customer characteristics, consumer demands, and time of year. It is becoming more feasible to meet a fluctuating market by a method of controlled bud opening — the harvesting of cut flowers as immature buds and then opening them off the plant under a controlled environment. It is easier and more economical to ship flowers for long distances in the bud stage than as fully opened flowers (6). Carnations in the bud stage have been successfully stored for up to eight weeks with normal opening upon removal (8). This method can add several days to the life of the flower in home use. Growers can also extend vase life by using good irrigation practices prior to harvest. The entire soil mass should be watered thoroughly and uniformly. Flowers from plants grown in "dry spots" on the bench have been shown to keep one or two days less (4). Also plants under water stress from low humidity prior to harvest have shown lessened keeping and handling qualities. If the flower is cut in a state of moisture stress, air bubbles may be pulled into the stem which block the movement of water. This type of stem-plugging can sometimes be corrected by recutting the stem under water.

After the flowers have been removed from the plant, the postharvest environment becomes of upmost importance since it influences two-thirds of the cut flower life.

Storage

Generally there are two types of storage — wet or dry. Type of equipment and length of expected storage will determine which method is more advantageous. A recent storage method, which is proving to be a success in the areas of meat, vegetable, and flower storage, is hypobaric or low pressure storage. This process consists of placing a

perishable commodity in a flowing stream of air which is saturated with water at a low pressure and a controlled low temperature (9). The advantages of a low pressure storage is precise temperature control with a rapid cool-dry period, no need to leave space between stacking products, and no danger of ethylene gas damage. Carnations have been successfully stored for six weeks in the fully open stage (9).

If the wet method of storage is used, particular attention must be given to the quality of water. Water for carnations should not have a salt content above 100 parts per million. Never use "softened" water. Well water may have a higher bacterial count than treated domestic supplies. There are many types of deionizers which are suitable for lowering the salt content. Boiler condensate water can be used if there is no possibility of boiler water itself getting into the condensate. The condensate should be removed before it returns to the boiler feed water tank. The containers which hold the water should be free of all bacteria which may block the stem opening. Hot soapy water should be used to scrub clean all containers. A bactericide, such as Amphyl® or Lysol®, can be used where it is not possible to scrub the containers. Plastic or glass containers are easier to clean and do not rust as metal containers do; therefore, it is preferable to use non-metallic containers whenever possible. It has been shown that a floral preservative added to the water can double vase life if it is added immediately following harvest and continued through the market chain to the customer. It is important for the grower to be the first to use a preservative, because the cut flower will absorb the greatest percentage of water in its lifetime during the first few hours after being cut from the rooted plant. Also the effects of a preservative are little to nil if the flowers are placed in plain water for any period of time before using a preservative. There are many floral preservatives available commercially; however, one may be formulated on location. This preservative known as the "Cornell Solution" is made of the following ingredients: 5% granulated sugar, 200 ppm 8 — hydroxyquinoline citrate, and 50 ppm Silver nitrate.

An important aspect of any type of storage is the temperature. The maturation of all flowers is affected by temperature, as well as, the regulation of ethylene gas and microbial organisms. Carnations store best at 32°-35°F. A±2°F deviation from this temperature range could decrease the quality of the cut flower.

Another important consideration in storage is the relative humidity. In order to prevent unnecessary moisture loss carnations should be stored in an environment of 92-94% humidity. A hygrometer can aid in always maintaining a constant relative humidity.

Temperature and humidity are sometimes influenced by the air circulation within the storage area. Circulation fans should be placed to "pull" the air throughout the storage area instead of "pushing" it through. "Pushing" the air can sometimes result in dead spaces where little air movement exists. It is best to be able to control the velocity of fans in order to prevent damage to floral products from incorrect air circulation. A movement of 400 feet per minute is necessary for pre-cooling, while temperature maintenance only requires 50 feet per minute (2). It is important that commodities be stacked to allow at least one surface exposed to freely circulating air to prevent heat buildup.

Ethylene gas can be controlled in a storage area by the following procedures: use proper aeration, use ethylene filters, remove dead or diseased plant material, lower storage temperatures, use floral preservatives, and never store fruit or vegetables with cut flowers. Ethylene can produce harmful effects in a short period of time; therefore, the storage area should be frequently checked for ethylene-induced disorders of the cut flowers.

Shipping

Most carnations are packaged and transported at some point in their movement from grower to consumer. The requirements for proper storage hold true for shipping also. Any method which will maintain a low rate of respiration and lessen time to consumer is a good method of shipping.

There are numerous types of shipping containers on the market. The kind of transportation used, whether land or air, and the method of storage, whether wet or dry, will determine the type of container most acceptable for packaging. It is most important to reduce the number of times the package exchanges hands and types of transportation. Each new environment means a deviation of temperature, humidity, and circulation. It is important to eliminate or at least reduce lag time on shipping docks where temperatures can become extreme.

When packaging cut flowers, always precool the package before sealing. The internal temperatures can remain high while the external temperature is at the required level, if packaged before being cooled. A standard practice has been to pack with ice. If ice is used in just the middle of the package, the ends (where the flower heads are) sometimes reach high temperatures. Also, care shoud be taken not to pack cut flowers in direct contact with the container itself. Plant tissue will have greater fluctuation in temperature and are more susceptible to injury. A vapor barrier, such as polyethylene, can be effective against moisture loss and temperature change. However, it is necessary to provide pinhole openings in the wrap to prevent a build up of ethylene and to maintain a correct balance of oxygen and carbon dioxide. The requirements for safe shipping are 1) pack to maintain low temperatures, reduce moisture loss, and protect against mechanical damage and 2) know the shipper — insist on quality and speed in handling.

Summary

The responsibilities of the grower, wholesaler, and retailer with reference to increasing the keeping life of carnations are:

Grower

1. Grow healthy, quality plants.
2. Cut when sugar level is high and there is no moisture stress.
3. Immediately place cut flower in water with floral preservative.
4. Place in storage with temperature of 32-35°F, humidity of 92-94%, and adequate ventilation.
5. Do not hold in storage longer than necessary — speed is essential to give consumer longest possible home use.
6. Ship with good packaging and most efficient transportation.

Wholesaler

1. Inspect shipment immediately — report damage immediately.
2. Place cut flowers in water with floral preservatives — do not break the chain of preservative use.
3. Place in storage with temperature of 32-35°F, humidity of 92-94%, and adequate ventilation.
4. Avoid unnecessary and rough handling.
5. Keep delivery vans cool and watch for exposure to ethylene, if local deliveries are made.
6. Pack with proper temperature and moisture.
7. Use speed in moving to retailer.

Retailer

1. Inspect shipment immediately.
2. Place recut flowers in water with floral preservatives and condition for 3 hours.
3. Place in storage with temperature of 32-35°F, humidity of 92-94%, and adequate ventilation.
4. Display with proper lights to enhance colors and avoid chlorosis.
5. Do not force foam block underwater when using in floral arrangement — this causes air bubbles and inhibits water absorption.
6. Use floral preservation with arrangements.
7. Do not use metal containers.
8. Keep arrangements out of drafts to reduce water loss and prevent chilling.
9. Educate the consumer on the care of carnations with care tags.

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