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Ethylene Gas a Problem in Cut Flower Storage

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Present methods of cut flower storage were reviewed in a previous article. Refrigeration equipment for flowers has changed radically in the past years, but the basic principles of our antiquated storage methods still remain. The general pattern, now as before, is to cut the flowers, transfer them to the 40-50° refrigerator and try to move them before they deteriorate.

New storage methods should enable us to keep flowers more efficiently and in better condition for a few days or a few weeks. Successful storage of flowers for a few weeks would indicate the methods for holding them in better condition for shorter periods. Therefore, our attention has been given to making possible the long-term storage of cut flowers. Our typical problems, -----holding roses for 2 or 3 weeks, carnations and chrysanthemums for a month or more, and bulb crops for perhaps even longer periods.

Successful long-term storage is not "pickling"

Flowers stored incorrectly mold, discolor, become "sleepy" or generally age. They mature and die rapidly after removal to room temperature. These are "pickled" flowers. They are always inferior to the fresh product and are a poor buy for the customer. But these are the flowers that are often sold at holiday times to meet the huge seasonal demands. Their poor quality and high prices discourage potential year-round buyers. But with our prèsent practices, "pickled" flowers and high prices are our only means of meeting and regulating seasonal peaks.

There are storage techniques that can satisfy the needs of the industry. Methods can be found to successfully accumulate flowers for times of heavy demand and also to remove flowers from the market at times of oversupply without resort to dumping. <u>But the only criterion of successful storage is that the flowers at the end of the storage period be essentially equal to those at the start.</u> "Pickling" never has and never will accomplish this.

Ethylene injury a cause of "pickled" flowers

One limitation in the storage of flowers is the presence of ethylene, either from a source such as manufactured gas or from the flowers themselves. Toxicity of manufactured gas has long been recognized, but dangers of plant produced ethylene were only recently suggested. Workers in fruit storage have given us the basic information in this field. Smock and others of Cornell's Pomology Department found that certain apple gases reduce the storage life of fruit. Among these is ethylene. Its accumulation in confined apple storage causes more rapid ripening and breakdown of the fruit than would otherwise be expected. Air purification removes some of the toxic gases and prevents much of the injury.

Denny and Miller (1935) showed that leaves of hollyhock and calla and stems of peony produce ethylene. Denny (1935) continued the work, identifying ethylene produced by petals of geranium, verbena, hollyhock, petunia, and leaves of <u>Rosa rugosa</u>. Lindner (1946) was first to propose that ethylene produced by flowers might be toxic to the plant material itself. He suggested that fading and wilting of Vanda orchids in air-tight cellophane packs might be a result of accumulated ethylene produced by blooms. Fischer (1949) showed that calceolarias and snapdragons produce ethylene gas, which causes their own flower drop.

Recently, further trials were conducted in the laboratory to investigate ethylene production by other cut flowers. Room temperature experiments show that Better Times roses, larkspur, Dendrobium, Phalaenopsis orchids (Cattleyas have not been studied), carnations, pompon chrysanthemums, tulips, lily-of-the-valley, lilac, gardenias, gladioli and marigolds all produce ethylene. The first three flowers are visibly affected by the gas they produce. Roses and larkspur drop their petals and the Dendrobiums show a characteristic water soaked appearance of sepals and petals, followed by a sleepiness of the flowers in extreme cases. Carnations, although ethylene producers, do not give off enough gas to cause their own sleepiness, at least in short term lab trials. The other flowers show no marked response to the accumulated gas, but presumably the ethylene causes an increase in their rate of aging.

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Seasonal Variations in Wholesale Prices of Roses

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For over a decade wholesale prices of flowers have been published weekly for various markets by several trade journals. The prices published by the Florists' Exchange have been used to construct an index of seasonal variation in wholesale prices of roses (Table 1).

The United States seasonal index for roses varied from a high of 128 for January to a low of 77 for July. Seasonal prices are relatively high during the winter months of December, January, and February and low during the late summer and early fall months. This pattern is followed fairly consistently on most of the leading markets.

This was, however, only a slight seasonal movement on the Los Angeles market. Seasonal prices in Seattle were fairly uniform from December through the month of April, ranging from 14 to 20 per cent above the yearly average price. Regardless of the cause, there was less seasonal variation in prices on the three far western markets than on the other large markets of the country.

On the eastern and midwestern markets rose prices seasonally declined sharply during March, May, and June and increased rapidly during November and December. During May, rose prices remained relatively high on the Detroit and St. Louis markets and during the late fall seasonal prices revealed a relatively early recovery on the far eastern markets of Boston, New York, and Philadelphia. Seasonal prices were higher during August than either during July or September on five of the nine markets. Thus, on a majority of the markets there appears to be a slight rise in seasonal prices during August.

Indexes of seasonal variation in wholesale prices were computed for five grades of roses on the New York City, Chicago, and Los Angeles markets (Table 2). The grade of roses was determined by measuring the length of stems, which ranged from 9 to 24 inches.

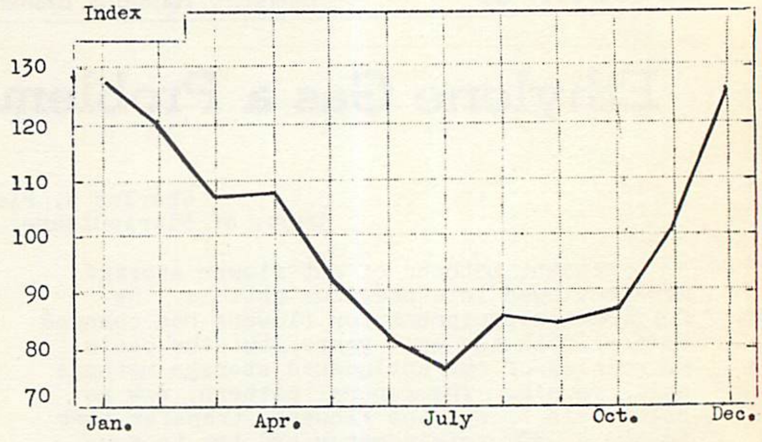

FIG. 1. UNITED STATES INDEX OF SEASONAL VARIATION IN WHOLESALE PRICE OF ROSES (GRADE EXTRA), 1940-49.

New York showed the most pronounced seasonality and Los Angeles the least for all grades of roses studied. At New York and Chicago rose prices were lower during the summer months mainly because of competition from outdoor flower production, especially gladioli, lower demand due to fewer social occasions where flowers are used, high production and poor quality due to high night temperatures. On the Los Angeles market, rose prices were lower during the summer months for about the same reasons.

The seasonal variation in the Los Angeles prices of all grades of roses was not as great as that for New York and Chicago. The exception was that the production of good quality roses was high owing to low night temperatures and to the high humidity.

TABLE 1. INDEXES OF SEASONAL VARIATION IN WHOLESALE PRICE OF ROSES (GRADE EXTRA) FOR 9 MARKETS, 1940-49*
(Yearly Average = 100)

Market	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Boston	130	119	102	109	97	77	80	91	82	83	101	129
New York	133	119	105	108	84	77	71	88	89	86	109	131
Philadelphia	130	125	115	109	93	78	73	83	81	84	100	129
Detroit	135	129	106	108	107	83	73	78	75	86	92	128
Chicago	133	127	112	108	94	80	76	74	78	91	97	130
St. Louis	128	124	113	105	113	88	79	81	77	81	90	121
Los Angeles	104	105	101	104	102	99	96	96	96	95	95	107
San Francisco	108	111	106	106	101	94	87	95	90	94	94	114
Seattle	120	119	117	114	104	89	77	79	82	87	98	114
United States	128	120	107	108	93	82	77	86	85	87	101	126

* The index was computed by expressing the actual price of the 27th week of the 53-week moving average as a percentage of the moving average over the 10-year period 1940-49. The weekly index was then converted to a monthly index. The United States index was computed by weighting each market by its metropolitan population.

TABLE 2. INDEXES OF SEASONAL VARIATION IN WHOLESALE PRICE OF 5 GRADES OF ROSES, 3 MARKETS, 1940-49.
(Yearly Average = 100)

Grade	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
New York City												
Special........	120	115	103	103	84	78	83	95	97	92	110	120
Fancy..........	125	118	104	104	84	77	77	94	97	91	107	124
Extra..........	133	119	105	108	84	77	71	88	89	86	109	131
#1.............	145	130	117	115	85	75	57	72	74	79	111	140
#2.............	167	141	128	128	85	70	36	51	55	69	114	156
Chicago												
Special........	125	126	107	105	95	83	82	78	83	92	96	128
Fancy..........	128	126	107	106	96	82	80	77	82	91	96	129
Extra..........	133	127	112	108	94	80	76	74	78	91	97	130
#1.............	139	132	116	111	95	78	73	70	72	87	95	132
#2.............	148	137	119	115	95	73	67	63	67	82	94	140
Los Angeles												
Special........	103	103	100	103	102	99	95	97	97	97	98	106
Fancy..........	102	103	101	103	102	100	96	97	97	96	96	107
Extra..........	104	105	101	104	102	99	96	96	96	95	95	107
#1.............	106	107	101	103	101	98	94	95	95	94	96	110
#2.............	108	109	105	105	104	98	90	92	92	94	95	108

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Surely You Know This

Hydrangeas Should Bud Well

Our temperatures at Ithaca dropped to that required for budding of hydrangeas on September 16. It has remained sufficiently low since that date and yet to October 8 no frost of importance has occurred. Precursor for bud formation is present in the plants and excellent bud formation should result this fall if the plants are in full sunlight, are not crowded together, and mildew hasn't injured the foliage. By November 1, the plants will be in excellent condition for leaf removal.

This year an early Easter will make you want to remove leaves and place plants in storage at 53 degrees soon after November 1. They should force easily and make Easter with no extra pushing if you start them after Christmas.

For pink flowers, you should have a soil pH above 6.3 before the leaves fall. You can blue them by dropping the pH when you start forcing the plants.

Be Insect-free for Winter

Fall is the time to clean out all the insects before you start winter production. Insects develop slowly at low temperatures and if you are free of all of them by November, you may not have to treat the plants during the winter. Parathion gets practically all of them. Early fall treatment is less likely to injure plants than winter treatments.

Plan Your Mums for Next Year

When chrysanthemums are in bloom, make your plans for 1951. Select the varieties you wish to grow and work out your complete timing program. Don't save your stock unless you are absolutely free of stunt or know how to propagate and eliminate it.

Failure of early black cloth treatments to produce early flowers was doubtless due to the low temperature in May and June. This caused many growers to have a double cut during the first half of September and it gave a small cut in early August. Cool weather about the 15th of September slowed production to give a good market after the 15th.

In your plans for 1951, take into account the possibility of a cool late spring. Don't give short day treatment until the night temperature is running above 50 degrees most of the time.

The complexity of a controlled production necessitates making out a daily working schedule for the entire year. This allows you to get your crop started on time and prevents missing some treatment. This schedule should include date of propagation, pinching, tying, spraying, short day treatment, and even the date of cutting.

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Several factors affect ethylene production

Carbon Dioxide

Denny (1935) observed that ethylene production by plant material was retarded or completely repressed in atmospheres of high carbon dioxide. Our laboratory trials have shown that increased carbon dioxide, decreases the apparent ethylene production of flowers, or at least decreases their response to the gas. On the other hand, high oxygen increases the severity of the response. This is an indication that ethylene production is related to the respiration of plant material.

Diseases of Plant Material

Williamson (1950) of Cornell's Plant Pathology Department found increased ethylene production by plant materials that were diseased in comparison to the production by healthy material. This is a particularly important observation because often some flowers among stored materials are infected with botrytis or a similar storage organism. The ethylene produced by these flowers may be sufficient to damage other flowers in the storage unit.

Brominated Charcoal

The use of brominated charcoal has been found to prevent or neutralize ethylene production or self-injury effects with cut flowers (Fischer 1949). This observation came following the lead of the pomologists who successfully utilized brominated charcoal in removing ethylene from fruit storage units. In our laboratory work, brominated charcoal proved effective in preventing such self-injury effects as flower drop of snaps, larkspur, and roses. Water soaking and "sleepiness" of Dendrobium and Phalaenopsis were also controlled. The use of this material may have practical application in the solution of storage and transit problems. But a simpler answer, temperature control, is already available.

Temperature

After ethylene production by flowers at room temperature had been demonstrated, some preliminary observations were made at lower temperatures.

At 50°F, the storage temperature still maintained by many florists, ethylene is still given off by flowers; but the rate is lower than that at room temperature. Somewhere in the range of 40°-50°F, there appears to be a sharp drop in the evolution of ethylene. As plant processes slow down at lower temperatures, the ethylene output or effect of the gas also is reduced. Further observations indicate that at temperatures below 40°F ethylene production by flowers is no longer a serious problem. Storage trials also have shown that these lower temperatures retard mold growth very considerably. Since molds increase ethylene evolution by cut flowers (Williamson 1950) the added benefit of this control is apparent.

The selection of proper low temperature storage conditions appears to be the most practical approach to the ethylene problem. Later work may still indicate the value of carbon dioxide or air purification as added refinements in storage practice. But the low temperature principle is one that any florist with refrigeration (and that should include every grower, retailer and wholesaler) can apply simply by changing his thermostat. The initial big step in the solution of the problem need not require fancy gadgets and added expense. A change in the thermostat dial can accomplish a lot more.

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Your Editor,

Kenneth Post