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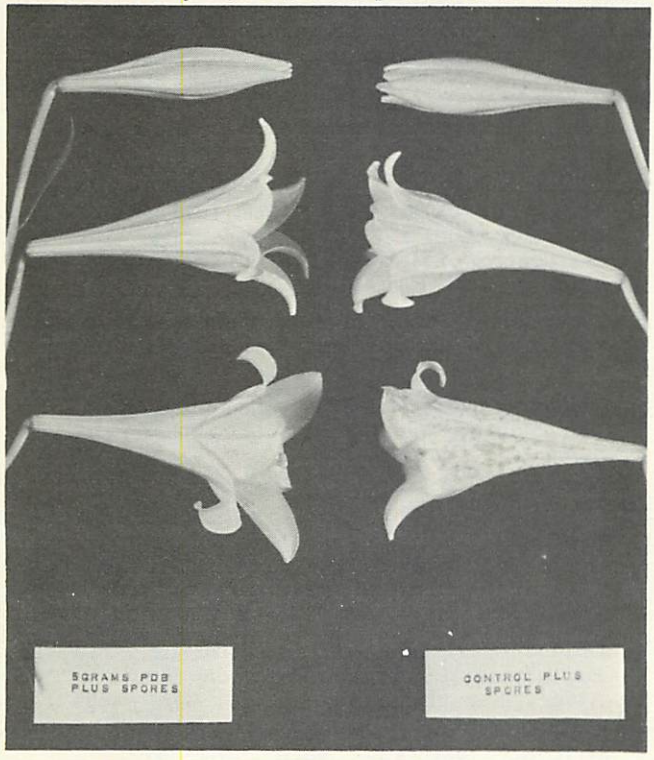
Para-dichlorobenzene Controls Botrytis on Lily Blooms at Low Temperature

by

Alfred Gianfagna*

Two important aids in preventing disease during holding are low temperature (31°F) and disease-free blooms. While the low temperature is no guarantee against fungus infection, it will greatly retard the fungus development even on artificially inoculated blooms held at low temperature. During the past two years of long term cut flower conditioning at Cornell, flowers very rarely became infected. Until April 1951, prior to the holding of lilies, disease control under refrigeration was not essential. Lilies have been especially susceptible to fungus infection in low temperature, even though the blooms are held dry and without any apparent infection at the start. Three weeks after lily flowers were placed at 31°F, numerous brown lesions were observed on the lily buds. The cause of these lesions was traced to a species of Botrytis** capable of rapid infection at 31°F. While lilies will hold in excellent condition for six weeks, their susceptibility to Botrytis infection makes this practice impossible. As a result, the following investigation was undertaken to develop methods of preventing infection on lily flowers held at 31°F.



Para-dichlorobenzene fastened to the inside of the cover to the container almost completely prevents injury from Botrytis infection of lily blooms. The rate of application is approximately 1/4 to 1/2 oz. of Para-dichlorobenzene flakes per cubic foot of air space. (1 to 2 grams per gallon).

Control of Botrytis on carnation flowers and Ascochyta on chrysanthemums was obtained by Fischer and Keller (1) with vapors of brominated activated charcoal (BAC) when used at 50°F. Ohlander and Watson (2) found that para-dichlorobenzene flakes (PDB) completely controlled the fungal growth of Alternaria humicola on peonies held at 35°F for over 73 days. PDB, however, caused objectionable injury to the foliage after 59 days. Newton and Bosher (3) found Botrytis "measles" would occur on packaged tulips within 24 hours after being placed at 45°F. Feder (4) controlled transit rot of Vanda orchid blossoms caused by Botrytis with atomized sprays of natriphene.

Description of Disease

The first indication of infection at low temperature was observed on Croft and Creole lily buds which had been at 31°F for two weeks. Twenty-four hours after the lilies were removed from low temperature, numerous brown, sunken lesions about 2mm. in diameter appeared on the buds. Subsequently, it was found that whenever Croft, Creole, Floridii or Erabu lilies were held longer than two weeks, the lesions were visible on the buds in the holding container. The source of the inoculum is probably from previously infected blooms in the greenhouse which yield spores of the fungus. A species of Botrytis was isolated from the lesions and cultured on potato dextrose agar. When a spore suspension of this organism was sprayed onto uncontaminated blooms, the characteristic spotting occurred at low temperature, indicating that this organism was in all probability the causal agent of the disease. Potted lilies held at 31°F in a walk-in refrigerator for three weeks failed to develop the characteristic symptoms of the disease. Moisture was found to favor the disease but the primary cause is

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** The author is indebted to Dr. John Keller for providing cultures of the organism and for assisting in the studies with brominated activated charcoal.

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believed due to the presence of spores of this organism on the blooms prior to cutting. In low temperature the spores undoubtedly germinate and infect the buds.

Control Measures

Control measures studied were: (1) spraying the developing buds in the greenhouse at weekly intervals with Dithane D-14 until they were mature, (2) dipping mature buds in a solution of natriphene or in Puratized Agricultural spray and (3) exposing the buds while in the storage container to vapors of 20% Brominated Activated Charcoal or Para-dichlorobenzene.

Each treatment contained 10-12 stems with a total of 15 buds which were about two days from full bloom. The buds were held dry at 31°F for a period of two to six weeks in 23 liter tin cans which were sealed with adhesive tape. In the dip treatments the buds were atomized with the Botrytis spore suspension, air dried completely at room temperature and then dipped into the solutions following which they were again air dried and then stored. The buds of the vapor treatments were inoculated in the same manner and placed in tin cans containing BAC or PDB. Buds sprayed with Dithane D-14 were not sprayed with the spore suspension after cutting since it was believed that they would become contaminated naturally in the greenhouse.

Results

No control was obtained by dipping the inoculated buds in natriphene solution used at the rate of one tablespoonful per 2 1/2 gallons of water or in 1:800 Puratized Agricultural spray or by exposing the buds to as much as 30 grams of BAC per 23 liter container. The lack of control with BAC at 31°F is believed due to its low volatility at this temperature. Weekly sprayings with Dithane D-14 gave good control of the disease but left an objectionable residue on the foliage. Satisfactory control was obtained with PDB flakes.

PDB was used at the rate of 1, 2 1/2, 5 and 10 grams per 23 liter container. The flakes were placed on 2 layers of cheesecloth and tied into a sack which was attached to the inside of the container cover. After sealing the cans with 1 1/2 inch adhesive tape, they were placed immediately at 31°F. After thirty days in storage the lilies were removed and "hardened" by removing 2 inches of the base of the stem and placing them in a 1% Floralife solution at 40°F for 6 hours. Following the hardening period the flowers were then brought to room temperature ranging between 65-75°F. After three days a count was made of the number of lesions present in 1.5 square inches of the blooms. Three areas of each bud were examined 2 inches from the apex. The average number of lesions for 15 flowers is given in Table 1.

Table 1. The Number of Lesions Occurring on Lily Buds Stored with PDB at 31°F for 30 Days.

Treatment	Lesions Per 1.5 Sq. In.	Descr. of Lesions
Control	2.56	pin point, barely visible
Control plus spores*	58.9	1 to 2mm. in diameter
2 1/2 grams PDB to 23 lesions plus spores*	27.0	0.5mm.
5 grams PDB to 23 lesions plus spores*	8.7	pin point, barely visible
10 grams PDB to 23 lesions plus spores*	9.2	pin point, barely visible

* Inoculated with Botrytis before placing in containers

The data from Table 1 show a marked decrease in the number of lesions which develop when PDB is added to the storage container. Compared with the control plus spores treatment, there is about 1/2 as many lesions with 2 1/2 grams of PDB and approximately 1/7 as many with 5 or 10 grams of PDB. The excellent control with 5 grams of PDB is illustrated in Figure 1 in which the lesions are pin point in size and for all practical purposes insignificant. In several repeated trials with PDB complete absence of spots was obtained. In addition PDB not only gave excellent control of Botrytis on inoculated buds but also arrested development of lesions on pre-infected blooms placed in storage. The mode of action of PDB and similar fumigant fungicides takes place according to Wolf, et al. (5) by a dissolution of the vapors in and on the leaf and buds. This aqueous solution of the fumigant is a necessary condition to its fungal effectiveness, concentrations that are effective against the pathogen being lower than those that are toxic to the host.

Because of its simplicity in application and effectiveness as a low temperature, volatile fungicide, the tolerance of other cut flowers to PDB was studied. Carnations and snapdragons were found quite tolerant to large quantities of PDB in the container. No injury occurred to these flowers when held with 5, 10 and 30 grams of PDB per 15 liter tin can for 10 days at 40°F or for eighteen days at 31°F. Injury resulted if these flowers were held with 1/2, 1 or 2 1/2 grams of PDB at 70°F. Roses, asters, gladiolus and pompon chrysanthemums were severely injured by PDB when treated at the same temperatures and concentrations used on carnations and snapdragons. Additional investigation is necessary on the relation of temperature, volume of container and flower tolerance to PDB before its potentialities can be ascertained.

Summary

1. Fungal infection of Croft, Creole, Floridii and Erabu lily buds at 31°F was associated with spores of a species of Botrytis present on the buds before placing in 31°F.
2. Successful control of the disease was obtained by adding para-dichlorobenzene flakes to the container.
3. The number and size of lesions occurring on inoculated buds was greatly diminished by the PDB treatment.

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Packaging Flowers for holding at Low Temperature

by

John W. Mastalerz*

The primary objective of the grower producing cut flowers for holding at 31°F is a product of the highest quality possible in relation to maximum production. Temperature conditioning will not improve the quality of poor flowers.

Disease-free Flowers

Disease-free flowers are essential since the high humidity in the storage container is optimum for disease development. Only flowers free of rot producing organisms will be unaffected during the holding period. Botrytis is particularly serious. Sanitation and humidity control during production will help to eliminate infection.

Soil Nitrate Levels

Cut flowers should be grown at soil nitrate levels that are recommended for highest quality and greatest production. Flowers grown at low and high soil nitrates keep equally well and no adjustment in soil nitrate levels need be made in anticipation of holding at 31°F. No differences in the life before and after holding carnations, chrysanthemums and snapdragons were observed in a number of trials with various soil nitrogen levels.

Light Intensity

Occasionally, growers shade a crop of chrysanthemums with cheesecloth. If chrysanthemums or other flowers are to be held, no reduction in the prevailing light intensity should be made because any such reduction, previous to cutting, reduces the holding period possible, decreases the room-temperature life, and increases the incidence of problems such as "brown centers" of chrysanthemums. Most flower "burning" is caused by disease. The grower should water the soil adequately to avoid a water deficiency in the flower tissues and be certain conditions are not favorable for disease.

Afternoon Cutting

Flowers cut in the afternoon keep longer than flowers cut in the morning. The carbohydrate content of flowers cut in the afternoon is higher than in flowers of the morning cut. Carbohydrates are manufactured during the daylight hours; while they are utilized in respiration and translocated to other parts of the plant during the night.

Temperatures

A careful control of the growing temperatures previous to cutting is essential for best keeping. The keeping time of cut flowers after holding will be reduced by high temperatures previous to cutting. If possible, a reduction in temperature for three or four days before cutting or careful control of recommended temperatures will enhance the keeping time of flowers during and after a holding period.

Package Directly

The recommended procedure for holding flowers is to package directly after cutting without a hardening treatment. Direct packaging is essential for Better Times roses to avoid blue color in the petals.

Even though flowers wilt before packaging, no benefit from hardening has been observed in a large number of temperature conditioning experiments. Hardening flowers before packaging is an extra operation which increases the cost; the stems and foliage are moistened making them untidy to work with and moisture is present for the development of disease organisms; a delay in placing the flowers at 31°F reduces the keeping time for the customer. Contamination with Botrytis spores during hardening may occur.

Contamination during the hardening period occurred several times in the experiments with Better Times roses at Cornell because of unsanitary conditions in the refrigerator used for hardening. The effect was not evident until the flowers were removed when brown spots developed on the petals due to infection with Botrytis.

Speed is Essential

To avoid excessive moisture loss, speed is essential in packaging and placing at 31°F. It may be necessary for the grower to adjust his handling and grading operations to meet these desirable conditions. Some are packaging flowers without grading to shorten the period from cutting to 31°F. Trays of flowers might be supplied with cracked ice and covered to reduce moisture loss.

Stage of Cutting

Over mature flowers should not be held. For optimum results, flowers should be cut at the youngest possible stage of full development.

Long Holding

The recommended holding periods for individual flowers have been determined to insure results for the grower. The keeping time of cut flowers is reduced considerably if these holding periods at 31°F are exceeded. Higher temperatures or fluctuations in temperature shorten the length of the holding period.

Better Times roses	15 days
Pompon Chrysanthemums	28 days
Carnations	28-30 days
Snapdragons	21 days
Standard Chrysanthemums	28-35 days
Tulips	30 days
Narcissi	21 days
Lily of the Valley	21 days

Hardening for Sale

All cut flowers should be hardened immediately upon removal from the 31°F refrigerator. To insure maximum water uptake and retention, the base of the stems should be cut, the stems should be placed in water of 100-110°F and the flowers then placed in a refrigerator at 40°-50°F for 6 to 12 hours of hardening. After hardening, the flowers may be shipped in the same manner as fresh cut flowers.

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* Work done at Cornell University under the direction of Dr. Kenneth Post. Dr. Mastalerz is now Assistant Professor at Waltham Field Station, Waltham, Massachusetts.

Surely You Know This

Foliar Feeding

The idea of applying fertilizer to plant foliage hoping that the plant absorbs some is not new -- it has received a great deal of publicity. Foliar feeding can be done and plants will absorb nutrients through the foliage. However, it is still much easier to apply fertilizer once a month to the soil than once a week to the foliage. When applying nutrients to the leaf surface there is also the very real danger of injuring the leaves or encouraging disease, insects, etc. Foliar feeding offers a quick way of getting nutrients into the plant. It is used commonly to get iron into azaleas and hydrangeas. It might also offer a way of quickly overcoming nitrogen and related nutrient deficiencies. However, as a general program, it seems to have little merit for the greenhouse as it introduces a new job without replacing an old one.

Geraniums

By this time, most of your geranium cuttings are almost ready for sale and they should be growing vigorously with plenty of water, plenty of nutrients, and plenty of sunlight. If they are diseased, it is probably too late to do anything about it with the existing crop. However, you should keep your eye out now for those stock plants which come through the summer apparently disease-free. These should be selected in preference to those which look a little straggly when hot weather sets in. By selecting stock plants now and through the summer, you can be assured of having a relatively disease-free crop for next spring.

Snapdragons

Be on the look-out, with warm weather coming, for injury due to excess soluble salts or excess nitrogen. This will be most common for those growers who use fertilizers containing organic matter such as manure, or dried manure. At low temperature these fertilizers do not break down readily and tend to accumulate in the soil and become available when bacterial breakdown is hastened by warm weather in the spring. Soil testing, followed by a good leeching if necessary, will solve the problem.

Chrysanthemums

Do not take cuttings for normal season production too early. Generally about May 15 is the earliest cuttings should be taken. Cuttings made much earlier will be harder and generally less satisfactory than those made May 15 or later and grown vigorously with plenty of water and fertilizer until blooming time.

Roses

We are now approaching one of the bad seasons of the year for the rose-grower. With cloudy weather and spring rains, we can expect outbreaks of mildew. With the warm weather to follow we can expect a build-up in the spider mite population. Although some growers have had good luck with sprays for mildew, the best method of control is still the control of humidity. This means that the greenhouse temperature should be at least 5°F above the outside temperature and the ventilators should be open. The effect is that of using your steampipes to pump or force air through the greenhouse rapidly and thus dry it.

Carnations

Think twice before moving your carnations outdoors this year. The diseases of carnations are still serious and are becoming more so. The only way to control carnation diseases is to keep the plants growing always in sterilized soil. It is still impossible to sterilize outdoor soils adequately; therefore, to avoid disease, avoid outdoor soils. The direct benching of carnation cuttings to their permanent locations has much to recommend it--many growers are pleased with results.

Papers Reviewed

Cleaning of Easter Lily Foliage

R. E. Widmer, Minnesota State Floriculture Bulletin. Pages 8-9. February 1, 1953.

Easter lilies were sprayed with "Flora-Glow" at different ages of the buds to remove lime deposits and make them more saleable. Creole and Crofts were not injured and the desired results were obtained if sprayed before the buds were showing. Crofts could be sprayed when the largest buds were one inch long. Bud splitting occurred in both types when sprayed after buds were larger. If sprayed just before the buds opened, 30% of the Croft buds and 48% of the Creoles split.

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Your editor,

Kenneth Post