IN COOPERATION WITH COLORADO STATE UNIVERSITY
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The Influence of Depth of Planting and Soil Drainage on the Development of Lily Root Rot

by

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(Authors note: The following paper describes results of experiments which indicate that planting lily bulbs at the bottom of standard pots may eliminate losses due to root rot. While these results were noted over a 2-year period, it must be emphasized that they do not imply a formal recommendation for control. Large scale tests are planned which should form a basis for recommendations.)

In 1957-1958 a cooperative study of the causes and control of root rot of Croft lilies was undertaken at many experiment stations in the United States. One objective of these tests was to determine whether any of the bulb and/or soil treatments recommended in certain localities were of value as control measures. The results in most cases were inconclusive.

In addition to the chemical treatments of bulbs and soil, the test at Colorado State University included experiments designed to determine the influence of soil drainage conditions and depth of planting of the bulbs on the development of lily root rot. The results indicated that a well-drained potting medium or deep planting was effective in control. Accordingly experiments reported in this paper were initiated in 1958-1959 to test further the influence of these factors.

Materials and methods

Eight to 9-inch Croft lily bulbs from a homogenous lot were potted in 6-inch pots. Twenty-five bulbs were used in each treatment and divided into 5 replications.

Soil drainage was varied by the addition of peat and sand to a base soil or through the use of a volcanic scoria. By this means potting media having 3 different drainage characteristics were developed: (1) a base soil with no amendments, very poorly drained, (2) a mixture of 1/3 peat, 1/3 sand, and 1/3 base soil by volume, and (3) a well drained medium consisting of volcanic scoria. Water was added to the pots each day in excess of that required to bring these media to field capacity.

Bulbs were planted at 2 different depths in the pots. In some treatments about $\frac{1}{2}$ inch of volcanic scoria was placed in the bottom of each pot, a handful of soil was placed on this drainage material, the bulb was placed in position, and soil was added and firmed to within $\frac{1}{2}$ inch of the rim of the pot. This position of the bulb will hereafter be referred to as the conventional depth of planting. In other treatments, the bulb was placed at the bottom of the empty pot and soil was added and firmed to within $\frac{1}{2}$ inch of the rim.

Nutrients supplied by a liquid injecting system were added each time the plants were watered at the following rates per 1000 gallons of water: 6 lbs. of calcium nitrate, 0.5 lb. phosphoric acid, 0.25 lbs. sodium nitrate, 1.75 lbs. muriate of potash, 0.5 lb. epsom salts, and 0.5 ounce borax. In addition 2 tablespoons of treble super phosphate and 5 tablespoons of limestone were added and thoroughly mixed with each cubic foot of volcanic scoria.

Captan was added and thoroughly mixed at the rate of 5 grams of the 50% wettable powder per cubic foot of soil in some treatments. When the volcanic scoria was treated with a drench, Terraclor at the rate of 1 tbl./2 gallons of water was applied at the time of planting.

Pots were placed on Cuprinol-treated boards in the greenhouse. A night temperature of 60° F was maintained. Day temperatures ranged from 60 to 85° F.

All the bulbs were planted on December 19, 1958. When the first bud of a plant had opened, the date was recorded. At the same time the height was measured in inches from the rim of the pot to the junction of the bases of the pedicels. The extent of the root system was estimated (0 = no roots, 3 = extensive roots) and the number of good buds was recorded. Disease severity was determined by noting the number of plants with foliage symptoms and/or wet rot of the roots.

Results and discussion

There were no differences between treatments with regard to height of the plants or bud counts (table 1). There were differences in the extent of the root systems. Bulbs planted at conventional depths in volcanic scoria or in the base soil produced blooms 2 to 3 weeks earlier than those in the soil mix at the same depth.

Symptoms of root rot were evident in plants originating from bulbs planted at conventional depths in the base soil or soil mix as indicated in table 2. In contrast, there were no foliage symptoms of root rot on plants originating from bulbs planted in the bottom of the pot in the same soils. When bulbs were planted at this depth, captan added to the soil mix aggravated symptoms.

Table 1.--The general characteristics of Croft lilies originating from bulbs planted at 2 depths and grown in potting media having various drainage characteristics.

Depth of planting and type of potting medium[a]	Average height of plants inches	Average Extent of root system[b]	Average bud count	Average days to bloom
Conventional depth				
Soil mix[d]	9.5	2.3	4.6	120
Base soil	11.0	1.8**[c]	3.5	109**
Volcanic scoria	14.0	1.8**	4.3	107**
Volcanic scoria--Terraclor drench[e]	15.0	2.1	4.3	107**
Deep planting				
Soil mix	9.5	2.6**	3.8	119
Soil mix-captan[f]	10.5	2.3	3.6	118*
Base soil	9.5	1.8**	3.4	119
Base soil-captan	10.5	2.3	3.9	114**

[a] Total number of plants in each treatment was 25. Each treatment was divided into 5 replications.

[b] Extent of root system estimated visually on a 0-3 scale, with 0 = no roots, 3 = extensive roots.

[c] Single and double asterisks indicate that differences between averages as compared with plants growing in the soil mix from bulbs planted at the conventional depth are significant at 0.05 and 0.01 levels, respectively.

[d] Soil mix consisted of 1/3 peat, 1/3 sand, and 1/3 base soil by volume.

[e] Terraclor applied as a drench at the time of planting at the rate of 1 tbl./2 gallons of water.

[f] Captan thoroughly mixed with the soil at the rate of 5 grams of 50% wettable powder per cubic foot of soil.

Table 2.--Symptoms of root rot on Croft lilies originating from bulbs planted at 2 depths and grown in potting media having various drainage characteristics.

Depth of planting and type of potting medium[a]	Number of plants with foliage symptoms	Number of plants with wet root rot
Conventional depth		
Soil mix[b]	7	13
Base soil	12	18
Volcanic scoria	0	2
Volcanic ash-Terraclor drench[c]	0	5
Deep planting		
Soil mix	0	3
Soil mix-captan[d]	3	10
Base soil	0	1
Base soil-captan	0	2

[a] Total number of plants in each treatment was 25. Each treatment was divided into 5 replications.

[b] The soil mix consisted of 1/3 peat, 1/3 sand, and 1/3 base soil by volume.

[c] Terraclor applied as a drench at the time of planting at the rate of 1 tbl./2 gallons of water.

[d] Captan thoroughly mixed with the soil at the rate of 5 grams of 50% wettable powder per cubic foot of soil.

When bulbs were planted at conventional depths, the most root rot occurred in the poorly drained base soil and the least in the well drained volcanic scoria. In contrast, there was no effect on the symptoms of root rot due to drainage, if the bulbs were planted in the bottom of the pots.

The results of this experiment are in substantial agreement with the data collected in 1957-1958. In these earlier experiments, 13 of the 75 plants originating from bulbs planted at the conventional depth had foliage symptoms; none of the 75 lilies from bulbs planted in the bottom of the pot had foliage symptoms. Thus the depth at which Croft lily bulbs were planted in pots had a profound effect on the development of symptoms of root rot.

In some cases roots did not grow from the plates of bulbs planted at the bottom of the pot; in many instances, if the plate roots developed they collapsed later. Adventitious roots, however, always grew from the stems and wet rot seldom developed in these. Investigations are underway which will attempt to explain more fully the reasons for these phenomena.

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Recent Publications You May Have Missed

Poinsettia Culture. James B. Shanks. The Maryland Florist. No. 60. Complete and up-to-date information on every phase of poinsettias. This bulletin is the result of several years of research at the University of Maryland. Dr. Shanks can now grow poinsettias on a precision schedule and tells you how. We have a few extra copies of this bulletin for those who would like it.

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Petunia--- Study on Petunia Hybrida. A. A. Piringer and H. M. Cathay. Florists' Review, June 11, 1959. Results of experiments on the effects of temperature, day length, type of light, and the additions of phosphonium on the growth habit and flowering time of petunia are noted. This is must reading for all who are interested in bedding plants. "Extremely desirable, early-flowering, branched petunia plants can be obtained in late spring by using the following procedures: Germinate seeds and maintain seedlings on days shortened to 10 hours to induce branching. When branching is apparent (on Ballerina, six weeks from sowing seeds), place the plants on natural days or days longer than 12 hours to accelerate the time of flowering-- the longer the day length, the earlier the flowering. Use incandescent light in preference to fluorescent to provide

the long days. Phosphonium added to the potting soil shortened internodes and dwarfed the plants without affecting branching habit or time of flowering. Short days and cool temperature (50°F) induced base branching early but delayed flowering.

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Soil Aeration--- James W. Boodley. New York State Flower Growers Bulletin 162. An excellent and complete discussion of this all important factor in growing plants. "The effects of poor soil aeration on plant growth are generally a reduction in growth followed by death, or merely a general reduction in growth. These conditions are brought about by: 1, death or reduction of the root system; 2, modification of the root system to one which is less active in its absorbing capacities; and 3, effects of anaerobic conditions on the metabolic processes within the plant which in turn affect the absorption and accumulation of ions." This article is basic to good culture of all crops.

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In the June 20, 1903 issue of The Florists' Exchange, The Flexible Glass Company of Jackson, Michigan, proposed to the trade a substitute for greenhouse glass. It was not called "plastic" nor any hint given of its chemical composition. The material was colorless and said to admit as much light as ordinary glass. Apparently unbreakable, the material could be laid in continuous strips from ridge to eave and bent to any curve without breaking.

The company also offered a clouded grade of the flexible glass for glazing palm and other foliage houses. No prices were quoted as it was not available in large quantities. Up to that time it had not been widely tested, and there remained some doubt as to its practicability. We haven't come so far after all, have we?

your editor,
W. D. Holley

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