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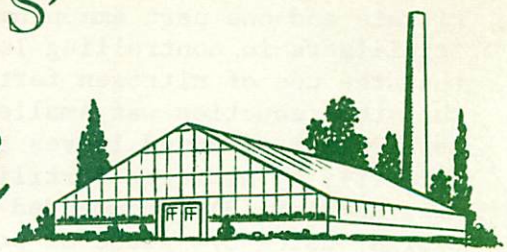

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Institute of Agriculture
St. Paul 1
December 1, 1963

1963 ACE EASTER LILY FERTILIZER STUDY[1]

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Nutrient fertilization of the Easter lily has been the subject of numerous investigations in recent years because of (1) the effect of nutrition on flower number, plant habit and foliage quality, and (2) the susceptibility of the variety Croft to leaf scorch. Currently, Croft and the newer variety Ace, which resembles Croft in many respects, account for the major portion of the Easter lilies forced in the Upper Midwest greenhouses. Ace variety is less susceptible to leaf scorch than is the variety Croft, however, and accounts for more than half of the local crop.

Roberts (6), Stuart (11) and Seeley (8), with their coworkers, reported that in some experiments Croft lily plants fertilized with nitrogen during forcing produced more flowers than did unfertilized plants, but that in other experiments the reverse was true, or there was no significant difference. Bald et al. (1) found that plants grown with a high nitrogen level in the soil had an average of one less flower than did plants grown in soil with a low nitrogen level.

Stuart (10), Roberts et al. (6) and Widmer (12) reported the effectiveness of nitrogen fertilization in controlling leaf scorch. Haney (4) showed that calcium, supplied by gypsum, plus a nitrogen fertilizer applied during forcing was effective in eliminating leaf burn of Croft lilies. Shanks and Link (9) reported that applications of calcium to the soil resulted in a reduction in the amount of leaf scorch. Stuart et al. (11), Roberts et al. (1) found that leaf scorch was caused or controlled by a number of factors in addition to the nitrogen and calcium content of the soil.

1. 12/18/63 Paper No. 1172, Miscellaneous Journal Series, Minnesota Agricultural Experiment Station, University of Minnesota.

Widmer (13) reported that a nitrogen fertilizer consisting of four parts sodium nitrate and one part ammonium sulfate was more effective than numerous other nitrogen fertilizers in controlling leaf scorch development in Croft lilies. He further stated that the use of nitrogen fertilizer reduced bud count up to 1/2 flower per plant, but that the reduction was smallest with the aforementioned fertilizer mixture. In addition development of dried leaves at the base of the plants did not appear to be controlled primarily by nitrogen fertilization.

Boodley (2) recommended beginning fertilization of Croft lilies as soon as plants emerge, using 3/4 pound of potassium nitrate and 1-1/2 pounds of sodium or calcium nitrate per 100 gallons of water every two weeks, or alternating weekly at the indicated rates, until buds are 1/2 inch long. Then apply calcium nitrate weekly at 2 pounds per 100 gallons of water until the plants are in bloom. A preliminary report specificed calcium nitrate at the 1-1/2 pound rate after the buds were 1/2 inches long.

Many commercial greenhouse operators now use fertilizer injectors to apply a dilute fertilizer solution every time the plants are watered. The primary objective with this system is to provide a steady flow of nutrients to the plant. Caldwell and Kiplinger (3) stated that a solution containing 148 ppm. nitrogen produced good lilies at Ohio State. They also stated that a 200 ppm. nitrogen level in the solution should be satisfactory for a wide variety of crops, including lilies, provided the soil is watered adequately.

Kofranek and Lunt (5) reported the production of excellent quality potted chrysanthemums when nutrients were provided by incorporating a medium coated (slow release) experimental 20-10-5 fertilizer in the soil before planting at the rate of 10 grams per 6-inch pan. A growing medium of 50 percent peat moss and 50 percent sand fortified with gypsum and dolomitic limestone was used. The objective here, as with the fertilizer injector, was to provide a steady flow of nutrients to the plant.

The primary purpose of this study, which was conducted during the 1963 forcing season, was to determine the effect of various types and methods of fertilization on Ace Easter lilies.

Materials and Methods

Pre-cooled Ace lily bulbs of 8-9 inch size were used. All bulbs were soaked for 30 minutes in a parathion, ferbam, PCNB solution before planting in 6-inch pans on December 22, 1962. The potting soil was a mixture of equal parts of composted soil, muck, peat moss and sand, plus a 4-inch potful of pulverized limestone per three bushels of soil. Pots and soil were steam sterilized. The pH of the starting soil was 6.6 and nutrient levels were medium low except for phosphorus which was low and calcium which was medium.

All plants were grown at a 60°F night temperature. Each treatment consisted of two replicates of 5 plants each making a total of 10 plants per treatment.

The treatments are listed in Table 1. Treatments 2 and 3 use commercial preparations and follow the recommendations of the manufacturer. The 25-0-15 ♦ formulation approximates Haney's (4) recommendations. Treatment 4 is Boodley's (2) recommendation. Treatment 9 utilized the experimental heavy coated slowly released ammonium nitrate at a rate considered preferable in preliminary studies. Treatments 5-7 and 8-10 supplied actual nitrogen in equivalent quantities. The differences in quantities of total material were to allow for the weight of the coating. Treatments 12 and 13 each received one watering with plain water before application of the fertilizer solution was initiated.

Plants were properly spaced as growth progressed.

Results and Discussion

Plants in all treatments were fairly uniform in making an appearance above the soil line. Plants in the coated fertilizer treatments were quite full and stocky by mid February.

Table 1. Ace Easter lily fertilizer treatments

#	Treatments Fertilizer and application schedule	Quanity (grams) actual nitrogen applied/10 pans
1.	Unfertilized check	0
2.	12-31-14 (+ vitamin B_1, chelated iron and secondary nutrients) at 1 oz per 4 gal. when planted, then 25-0-15 (+ 3% Ca, 1% Mg and .02% chelated iron and secondary nutrients) at 1 oz per 6 gal. every 2 weeks once shoots are 2 in. above the nose of the bulb.	5.0
3.	12-31-14 + at 1 oz. per 4 gal. when planted, then alternate the above 25-0-15 + and 12-31-14 + every 2 weeks once shoots are 2 in. above the nose of the bulb.	4.4
4.	Potassium nitrate (13-0-44) at 1 oz. per 8 gal. when shoots emerge from soil, then alternate calcium nitrate (16-0-0) at 1 oz per 4 gal. and 13-0-44 weekly until flower buds appear, then 16-0-0 is applied weekly.	6.6
5.	Ammonium nitrate (33-0-0) at 12.5 grams and heavy coated muriate of potash (0-0-60) at 7.5 grams per 10 pans mixed in starting soil.	3.8
6.	Ammonium nitrate (33-0-0) at 25 grams and heavy coated muriate of potash (0-0-60) at 7.5 grams per 10 pans mixed in starting soil.	7.6
7.	Ammonium nitrate (33-0-0) at 50 grams and heavy coated muriate of potash (0-0-60) at 7.5 grams per 10 pans mixed in starting soil.	15.2
8.	Heavy coated ammonium nitrate at 12.8 grams and heavy coated muriate of potash at 7.5 grams per 10 pans mixed in starting soil.	3.8
9.	Heavy coated ammonium nitrate at 25.6 grams and heavy coated muriate of potash at 7.5 grams per 10 pans mixed in starting soil.	7.6
10.	Heavy coated ammonium nitrate at 51.2 grams and heavy coated muriate of potash 7.5 grams per 10 pans mixed in starting soil.	15.2
11.	Ammonium nitrate solution of 150 ppm applied whenever plants needed water, plus 7.5 grams heavy coated muriate of potash per 10 pans mixed in starting soil.	7.5*
12.	Ammonium nitrate solution of 200 ppm applied whenever plants needed water, plus 7.5 grams heavy coated muriate of potash per 10 pans mixed in starting soil.	10.0*
13.	Mixture of 1 part ammonium sulfate (20-0-0) and 4 parts sodium nitrate (16-0-0) at 1 oz per 2 gal applied every 2 weeks after shoots are 2 in. high plus 7.5 grams heavy coated muriate of potash per 10 pans mixed in starting soil.	9.6

* Based on 40 waterings

At the termination of the study, all plants were checked for date of first bloom, height, diameter in the middle of the plant, number of nodes and shape of plant at the base. Averages per treatment are given in Table 2.

Days to bloom ranged from 97 to 116. The unfertilized check plants which bloomed first were otherwise undesirable in that the flower count was low, foliage was pale in color and smaller and plant height was greater than desired.

Plants in more than half of the treatments bloomed within an acceptable range of 103 to 107 days. Although later blooming might not seem a drawback if Easter is late, the longer a plant must be in the greenhouse, the greater the production cost.

Height of plants is a critical factor when consumer acceptance is considered. All treatments produced relatively tall lilies and the plants fertilized with a mixture of ammonium sulfate and sodium nitrate were the most acceptable. Plants in treatment 4 fertilized with potassium and calcium nitrate were the second shortest, but the difference in height made them visually less desirable. Tallest plants were those in treatment 11 which were watered regularly with a solution of 150 ppm nitrogen obtained from ammonium nitrate. Where two or more rates of regular ammonium nitrates were used, plant height decreased as quantity of fertilizer increased indicating the possibility of plant injury, or limitation of growth, by the larger quantities at some time during the forcing period.

Diameter of fertilized plants did not vary appreciably. Unfertilized plants were the narrowest and all fertilized plants were acceptable.

Node (leaf) number was highest in treatment 10 which had the highest rate of coated ammonium nitrate in the potting soil. These plants looked quite full and foliage color was a rich dark green. Foliage color was equivalent in plants fertilized with ammonium sulfate and sodium nitrate, but leaf number and plant height were much lower. Higher node number for plants of similar height signified fuller appearing, more attractive plants. Higher node number did not necessarily improve plant appearance when it was associated with increased plant height. All factors considered, plants in the ammonium sulfate and sodium nitrate treatment were the most satisfactory despite a more open base.

Flower number per plant is especially significant because it greatly influences sale price, provided other factors are within range. In general flower count tended to increase with increases in leaf number. The highest flower count was in treatment 9 which had the medium rate of coated ammonium nitrate in the soil. Unfortunately these plants were too tall and relatively slow in forcing. Plants in treatments 4, 5, 10, 11, and 12 had similar flower counts, but all plants except those in treatment 4 were too tall. The latter, which received potassium nitrate and calcium nitrate also had a full base, but were relatively slow in forcing. Plants in treatment 13 had one half flower less per plant but were the shortest, forced in an acceptable number of days and had a fair plant base.

Shape of the base of the plant, which reflected closeness of the nodes and leaf size, was quite variable. The poorest shape was obtained in treatments 11 and 12 where the plants were watered regularly with an ammonium nitrate solution. Best plants bases developed where medium and high rates of coated ammonium nitrate were mixed in the soil in treatments 9 and 10, and in treatment 4 where potassium nitrate and calcium nitrate were applied.

Soil pH levels, which are shown in table 2, were appreciably higher at the finish than at the start of the study. An alkaline water supply was a factor in increasing the pH levels.

No leaf scorch was evident during the study. Foliage color of all fertilized plants were considered acceptable.

Soil samples were taken from each treatment and analyzed on February 28 and again on April 25. On February 28 the nitrate-nitrogen level was high in treatment 4; medium-low, medium and high in the treatments receiving low, medium and high quantities of coated ammonium nitrate respectively; and high in the two treatments watered with ammonium nitrate solutions. Nitrate-nitrogen levels were either low or medium low in all treatments. No fertilizers were applied after April 3 at which time some plants were in bloom in all treatments. On April 25, the nitrate-nitrogen level in the soil was medium in treatment 12, which had received a solution of 200 ppm nitrogen regularly,

Table 2. The effect of fertilizers on Ace Easter lilies (means per treatment)

	Treatment Nitrogen Source	Days to bloom	Height (cm)*	Diameter (cm)	No. of nodes	No of Flowers	Shape plant	**of base	Soil pH April 25
1	Unfert Check	97	64.6	30.8	96.0	4.0	2.6		8.4
2	12-31-14 and 25-0-15	103	67.9	34.0	99.3	5.5	2.3		8.4
3	12-31-14 and 25-0-15 alternating	115	68.9	31.7	102.7	5.9	3.4		8.3
4	13-0-44 and 16-0-0	111	59.1	32.5	113.3	6.6	4.3		8.5
5	33-0-0 Low	103	71.4	34.3	106.6	6.6	3.9		8.3
6	33-0-0 Med	105	65.4	33.4	97.8	5.4	3.3		8.2
7	33-0-0 High	107	61.9	32.1	94.3	4.6	2.3		7.9
8	Coated 33-0-0 Low	107	66.3	33.8	102.8	5.9	3.2		8.0
9	Coated 33-0-0 Med	112	67.3	33.1	110.4	7.1	4.8		8.2
10	Coated 33-0-0 High	116	64.6	33.7	116.9	6.4	4.4		8.3
11	33-0-0 (150 ppm sol'n)	107	73.0	32.8	105.9	6.5	1.4		8.6
12	33-0-0 (200 ppm sol'n)	114	68.9	34.4	110.9	6.6	2.0		8.4
13	20-0-0 and 16-0-0 mix	107	55.0	33.9	96.1	6.0	3.0		8.8

* Height above pot rim

** Rated 1 to 5 with 5 signifying the best

and medium-low or low in all other treatments.

Although the high rate of ammonium nitrate incorporated in the soil in treatment 7 limited plant development in most respects, coated ammonium nitrate used at the same rate in treatment 10 did not limit plant development. Foliage color of plants in treatment 10 was slightly darker than that in treatment 9, but the plants in the latter were equivalent or superior in most other respects. Therefore the medium rate of use of coated ammonium nitrate (equivalent to 3.8 pounds of total material or 1.3 pounds of actual nitrogen per cubic yard of soil) is preferable. One application provided all of the supplemental nitrogen needed during the forcing period.

The quantity of supplemental nitrogen required for best growth during the forcing period ranged from 6.6 to 9.6 grams per 10 six inch pans (equivalent to .95 to 1.4 pounds of actual nitrogen per cubic yard of soil). This quantity did not necessarily supply the total plant needs as (1) the organic matter in the soil also provided some nitrogen, and (2) some leaching might be expected with regular watering.

Summary

1. Ace lilies were forced in 13 different fertilizer treatments.

2. Plant averages per treatment ranged as follows:
   (a) days to bloom - 97 to 116
   (b) plant height - 55 to 73 cm.
   (c) node number - 96.1 to 116.9
   (d) flower number - 4.0 to 7.1

3. Plants in most treatments were too tall.

4. Flower number tended to increase in node number.

5. The best rate of use of coated ammonium nitrate was 3.8 lbs. of total material per cubic yard of soil, although the plants were taller than desired.

6. The best quality plants were those fertilized every two weeks with a mixture of 1 part ammonium sulfate and 4 parts sodium nitrate used at the rate of 1 ounce per 2 gallons of water. Second best plants were those fertilized with potassium nitrate and calcium nitrate.

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