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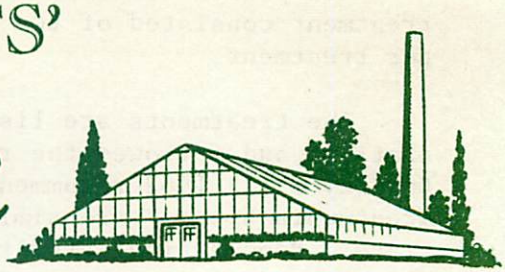

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1964 ACE EASTER LILY FERTILIZATION STUDY

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Seeley (4), Stuart (5) and Roberts (3), with their coworkers and Widmer (6) have reported that Easter lily fertilizer practices and materials affect plant height, flower number, plant habit and foliage quality. In his 1963 study, Widmer (7) reported that the best quality plants were those fertilized with a mixture of ammonium sulfate and sodium nitrate. Second best plants were those fertilized with potassium nitrate and calcium nitrate as recommended by Boodley (1).

Easter lilies frequently respond differently from year to year because of weather variations where the bulbs are produced in the field, and variations in handling after digging and prior to arrival at the greenhouse. The 1964 study was conducted to (1) confirm the 1963 findings and (2) determine the effect of additional fertilizer treatments.

Materials & Methods

Pre-cooled Ace lily bulbs of 7 to 8-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 23, 1963. The potting soil was a mixture of equal parts of composted soil, muck, peat moss and sand. Pots and soil were steam sterilized. Bulbs were planted midway from top to bottom in the pot. The pH of the starting soil was 6.9, nitrate-nitrogen and potassium levels were medium, phosphorus was low and calcium was high.

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All plants were maintained at a 60°F. night temperature following potting. 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 used commercial preparations and followed the recommendations of the manufacturer. Treatment 4 was Boodley's (1) 1962 recommendation. Treatment 5 was Boodley's (2) 1963 recommendation. Treatments 6 and 7 are similar to 4 and 5 but sodium nitrate replaced the calcium nitrate. Boodley indicated that either material was acceptable. Treatments 8 through 11 employed slowly released metal ammonium phosphate fertilizers at rates suggested by the manufacturer. Treatments 15 through 17 utilized heavy-coated, slowly released ammonium nitrate. The medium rate was considered optimum, based on previous studies. Treatments 12 through 14 provided equivalent quantities of nitrogen in regular ammonium nitrate. The differences in quantities of total material were to allow for the weight of the coating. Treatments 18 and 19 each received one watering with plain water before application of the fertilizer solution was initiated. Treatment 20 was the best in the previous year's study. Treatment 21 was based on earlier work by Widmer (6). Treatments 22 and 23 were also recommended by Boodley (2). In all treatments where potassium was incorporated in the potting soil, the heavy-coated material was used.

Plants were properly spaced as growth progressed.

Results and Discussion

Plants in all treatments were fairly uniform in breaking through the soil surface. Soil samples taken on January 16, 1964 indicated that the nitrate-nitrogen levels in treatments 18 and 19, which were watered with an ammonium nitrate solution, were excessive. The nitrate level was lowered by leaching, and plain water was substituted for the fertilizer solution in these two treatments from January 20 to February 3. Midway through the forcing period, plants in treatment 20, which were scheduled to receive applications of ammonium sulfate and sodium nitrate every two weeks, appeared pale and underfertilized. A further check showed that because of an oversight, the fertilizer had been applied only once. Hence this treatment was disqualified.

Table 1. 1964 Ace Easter lily fertilizer treatments

#	Treatments Fertilizer and application schedule	Quantity (grams) actual nitrogen applied /10 pans
1.	Unfertilized check	
2.	12-31-14 (+ vitamin B , chelated iron and secondary nutrients) at 1 oz. per 4 gal. when planted, then 25-0-15 (+ 3% Ca, 1% Mg, chelated iron and secondary nutrients) at 1 oz. per 6 gal. every 2 weeks once shoots are 2 in. above nose of bulb.	5.8
3.	Similar to #2 but alternate 12-31-14 and 25-0-15 once shoots are 2 in. above nose of bulb.	5.3

Table 1 - continued

4.	After shoot emergence from soil, alternate potassium nitrate (13-0-44) at 1 oz./8 gal. and calcium nitrate (16-0-0) at 1 oz./4 gal. weekly until flower buds ½ inch long, then 16-0-0 applied weekly at 1 oz./3 gal.	8.1
5.	Similar to #4, but potassium nitrate and calcium nitrate applied at 1 oz./3 gal.	12.0
6.	Similar to #4, but sodium nitrate (16-0-0) in place of calcium nitrate.	8.1
7.	Similar to #5, but sodium nitrate (16-0-0) in place of calcium nitrate.	12.-
8.	Metal ammonium phosphate (8-40-0) fertilizer at 80 and coated muriate of potash (0-0-53.4) at 7.5 grams per 10 pans mixed in starting soil.	6.4
9.	Metal ammonium phosphate (8-40-0) fertilizer at 120 and coated muriate of potash (0-0-53.4) at 7.5 grams per 10 pans mixed in starting soil.	9.6
10.	Metal ammonium phosphate with potassium (7-40-4) at 90 grams and coated muriate of potash (0-0-53.4) at 7.5 grams per 10 pans mixed in starting soil.	6.3
11.	Metal ammonium phosphate with potassium (7-40-4) at 130 grams and coated muriate of potash (0-0-53.4) at 7.5 grams per 10 pans mixed in starting soil.	9.1
12.	Ammonium nitrate (33-0-0) at 13.5 grams and coated muriate of potash (0-0-53.4) at 7.5 grams per 10 pans mixed in starting soil.	4.0
13.	Ammonium nitrate (33-0-0) at 27 grams and coated muriate of potash (0-0-53.4) at 7.5 grams per 10 pans mixed in starting soil.	8.3
14.	Ammonium nitrate (33-0-0) at 54 grams and coated muriate of potash (0-0-53.4) at 7.5 grams per 10 pans mixed in starting soil.	16.5
15.	Coated ammonium nitrate (29.7-0-0) at 14.3 grams and coated muriate of potash (0-0-53.4) at 7.5 grams per 10 pans mixed in starting soil.	4.0
16.	Coated ammonium nitrate (29.7-0-0) at 28.5 grams and coated muriate of potash (0-0-53.4) at 7.5 grams per 10 pans mixed in starting soil.	8.3
17.	Coated ammonium nitrate (29.7-0-0) at 57 grams and coated muriate of potash (0-0-53.4) at 7.5 grams per 10 pans mixed in starting soil.	16.5

Table 1 - continued

18.	Ammonium nitrate solution of 150 ppm nitrogen applied whenever plants needed water plus 7.5 grams coated muriate of potash (0-0-53.4) per 10 pans mixed in starting soil.	15
19.	Ammonium nitrate solution of 200 ppm nitrogen applied whenever plants needed water plus 7.5 grams coated muriate of potash (0-0-53.4) per 10 pans mixed in starting soil.	20
20.	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 (0-0-53.4) per 10 pans mixed in panning soil.	9.6
21.	Ureaform (38-0-0) at 29 grams and coated muriate of potash (0-0-53.4) at 7.5 grams per 10 pans mixed in starting soil.	22
22.	Artificial soil media of 2 parts sphagnum peat moss, 1 part vermiculite, 1 part horticultural perlite with 6 oz. dolomitic limestone and 1 oz. ammonium nitrate per bushel mixed in; then fertilized same as #5.	12
23.	Similar to #22 but 1 oz. superphosphate (0-20-0) per bushel also incorporated.	12

At the termination of the study, all plants were checked for number of days to first bloom, plant height, diameter at the middle of the plant, number of nodes, plant shape at the base and other significant factors. Most of the observations are presented in Table 2.

Days to bloom ranged from 98 to 106. The first plants to bloom were those in the unfertilized check and those in treatments 2 and 4. Plants in these treatments were not the most desirable, however, in that they were a little taller than desired and they also showed some leaf scorch. In addition, check plants were pale and thin in appearance. Actually, plants in all treatments bloomed within an acceptable period of time.

Plant height is one of the most critical factors in the eye of the consumer. Average plant height ranged from 54 to 72.7 centimeters with the most acceptable considered to be under 60 cm. The shortest plants were those in treatment 7 which were fertilized with the higher rate of potassium nitrate and sodium nitrate. These plants displayed a few yellow leaf tips but were highly acceptable in general. Treatment 5 produced the next shortest plants which had a less full plant base, some yellow leaf tips, and a slightly smaller flower count. These plants were also highly acceptable. Plants in treatments 22 and 23 were not acceptable because of lack of uniformity, excessive dried foliage at the plant bases, and leaf scorch in #23. Treatment 19 plants were slightly taller and had an open base, but were of very good quality in all other respects. Plants in treatments 6 and 8 were of similar height, but were less desirable because of a low flower count and an excessive number of yellow leaf tips, respectively.

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

Treatment - nitrogen source	Days to bloom	Height[1] (cm)[2]	Diameter (cm)[2]	No. of nodes	No. of flowers	Shape of plant base[3]	Soil pH April 16	Leaf Scorch[5]
1. Unfert. Check	98	62.6	29.6	75.2	5.3	2.2	8.0	2
2. 12-31-14 & 25-0-15	98	65.5	32.4	81.9	5.8	2.5	7.5	3
3. 12-31-14 & 25-0-15 alternating	101	72.5	34.0	80.7	5.5	2.0	7.7	0.5
4. 13-0-44 & 16-0-0	98	60.5	32.1	74.2	5.2	1.9	8.0	1
5. 13-0-44 & 16-0-0 higher rate	103	54.0	30.1	71.5	5.3	1.8	8.3	0
6. Similar to #4 but sodium nitrate	104	59.5	29.0	80.4	4.0	1.6	8.4	0
7. Similar to #5 but sodium nitrate	102	51.2	31.0	76.9	5.6	3.2	8.3	0
8. 8-40-0	101	59.9	34.5	76.0	5.9	2.0	7.4	1
9. 8-40-0 higher rate	99	70.7	34.0	76.8	5.2	1.6	7.1	1
10. 7-40-4	104	71.7	36.1	75.1	4.8	1.4	7.4	0
11. 7-40-4 higher rate	101	64.2	34.6	75.3	5.9	1.7	6.8	0.5
12. 33-0-0 low	106	72.7	32.7	77.4	4.9	1.3	8.1	1
13. 33-0-0 med.	102	65.3	32.5	73.5	4.2	1.2	7.9	1
14. 33-0-0 high	106	63.7	30.1	72.8	3.7	1.2	7.2	0
15. Coated 33-0-0 low	102	67.9	32.8	75.2	5.0	1.5	7.4	0.5
16. Coated 33-0-0 med.	103	70.6	34.0	76.9	5.4	1.5	7.4	0
17. Coated 33-0-0 high	103	62.5	32.1	73.2	5.1	1.5	7.7	2
18. 33-0-0(150 ppm N. sol'n)	102	61.5	32.5	76.4	5.4	1.5	6.8	0
19. 33-0-0(200 ppm N sol'n)	100	59.0	32.6	73.5	5.3	1.6	7.0	0
20. 20-0-0 and 16-0-0 mix[4]	103	67.7	31.6	81.2	5.6	2.2	8.0	0
21. 38-0-0	102	62.5	28.4	75.9	3.8	1.4	7.4	0
22. Synthetic mix	101	57.8	31.1	80.9	5.0	2.1	7.1	0
23. Syn. mix + 0-20-0	102	57.9	35.0	79.2	5.8	2.3	7.4	3.5

[1] Height above pot rim.
[2] 1 inch = approximately 2.5 cm.
[3] Rated 1 to 5 with 5 signifying best.
[4] Received only a fraction of the fertilizer intended.
[5] Rated 0 to 5 with 0 signifying no leaf scorch.

Plant diameter ranged from 29.0 to 36.1 cm. Unfertilized plants were among the narrowest, and almost all fertilized plants were satisfactory in diameter. Plants in treatments 8, 9, 10, and 11 which received metal ammonium phosphates were the broadest and were also among the strongest and tallest plants in the study. The broadest plants were usually correlated with the inclusion of phosphorus in the fertilizer program.

Node or leaf number ranged from 71.5 to 81.9, but leaf size, foliage color, and distribution of the foliage were more important in determining plant appearance.

Flower count is a critical factor because it governs sale price and the useful life of the plant. The low count was 3.7 blooms per plant in treatment 14 which received a large quantity of ammonium nitrate, and the high 5.9, blooms in treatments 8 and 11 which were fertilized with metal ammonium phosphates. The inclusion of phosphorus in the fertilizer usually coincided with a higher flower bud count. Many treatments resulted in relatively good flower counts. This factor was considered when plant height results were discussed earlier in this report.

Shape of plant base (length of internodes and of bottom leaves) was less than ideal, but the shortest plants (treatment 7) also had the fullest plant bases.

Soil pH increased in most treatments, reflecting the alkaline water supply. The degree of rise in pH varied with the fertilizer treatment. When calcium or sodium nitrate was applied, the final soil pH was higher than that of the unfertilized check. In all other treatments the lower pH indicated that the fertilizers used had an acid reaction.

Leaf scorch was found on plants in 12 of the 23 treatments. A check of root quantity and quality showed that the incidence of leaf scorch did not appear to be associated with root damage. The presence of leaf scorch appeared to be correlated with treatments which provided smaller quantities of nitrogen, although there were exceptions such as treatments 9 and 17. The incorporation of phosphorus in the starting soil in treatments 11 and 23 probably encouraged the development of leaf scorch.

Foliage color was acceptable in all treatments which received fertilizer. The palest fertilized plants were those in treatments 15 and 16 which received the low and medium rates of coated ammonium nitrate. The plants with the darkest green foliage were those in treatments 8 and 10 plus 18 and 19 which were fertilized with the metal ammonium phosphates at the lower rates and with solutions of ammonium nitrate respectively.

Soil samples were taken from each treatment at the termination of the study on April 16 and analyzed. Nitrate-nitrogen levels were high to very high in all treatments except 1 and 20, unfertilized checks, and 13, which received the lower concentration of ammonium nitrate solution regularly. Treatment 13 had a medium nitrate-nitrogen level.

Discussion

Plants in the 1963 study (7) had more leaves, a higher flower count, and took longer to bloom, but larger (8-9 inch) bulbs were used. In 1964, 7-8-inch bulbs were forced. Check plants were an exception in that the flower count per plant was 1.3 higher in 1964.

A comparison of comparable treatments for the two years showed similar trends in plant height. In addition, there was a tendency toward shorter plants when the total nitrogen applied was increased. This was especially true as the quantity of nitrogen from any particular source was increased.

The shortest 1963 plants were those fertilized every two weeks with a mixture of 1 part ammonium sulfate and 4 parts sodium nitrate. Unfortunately this treatment did not materialize in the 1964 study. The overall similarity of results for the two studies and the high quality of plants grown in another 1964 lily study and fertilized with the ammonium sulfate-sodium nitrate mixture leads to the conclusion that this mixture is probably the most effective fertilizer treatment for limiting plant height without sacrificing plant quality.

Leaf scorch, which was not encountered in 1963, was a problem in 1964. The reason is not known, but may have been caused by treatment of the bulbs prior to forcing.

Plants which received a solution of ammonium nitrate whenever the plants required water were of better quality in the 1964 than in the 1963 study. A recheck of the 1963 calculations indicated that the 1963 plants had received only half of the nitrogen intended. Hence they had received a solution of 75 and 100 ppm nitrogen rather than 150 and 200 ppm.

A comparison of coated and regular ammonium nitrate in treatments 12 through 17 showed that the use of coated fertilizer resulted in better quality plants. The higher rates of regular ammonium nitrate were injurious early in the forcing period as indicated by a reduced flower count. Such was not true with the coated ammonium nitrate. Foliage color was darker where the high rate of coated fertilizer was used, but leaf scorch was also present. Even though plants which received the medium rate of coated fertilizer were considerably taller, the lack of leaf scorch and similarity in other respects made this the preferred treatment rate. Therefore the best rate of use of coated ammonium nitrate for Easter lilies is considered to be close to 4 pounds of total material or 1.3 pounds of actual nitrogen per cubic yard of soil. Other sources of nitrogen are preferred, however, when plant height is a problem.

Good quality plants with rich green foliage developed when an ammonium nitrate solution was applied whenever water was needed. Height was only slightly greater than desired. Time of initiation of the application of the fertilizer solution should be correlated with the nutrient levels in the starting soil, however. Findings in this study indicate that if the starting soil has medium or higher nitrogen levels, the fertilizer solution should be withheld until the plants are visible above the soil surface. Failure to consider the starting soil nutrient levels can result in the development of excessive nitrate-nitrogen levels and plant injury.

Quantity of supplemental nitrogen required for best growth during forcing varied with the source. The quantity required did appear to be higher, however, than the 6.6 to 9.6 grams of actual nitrogen per 10 six-inch pans suggested in the 1963 study. Once again, treatment of the bulbs prior to forcing may have been a factor.

Summary

1. Ace lilies were forced in 23 different fertilizer treatments.

2. Plant averages per treatment ranged as follows:

   (a) days to bloom - 98 to 106
   (b) plant height - 55 to 73 cm.
   (c) node number - 71.5 to 81.9
   (d) flower number - 4.0 to 7.1

3. Plants in most treatments were too tall. Height tended to decrease with increases in the nitrogen supply.

4. The best rate of use of coated ammonium nitrate was close to 4 pounds of total material per cubic yard of soil, although the plants were taller than desired.

5. The application of an ammonium nitrate solution every time water was needed resulted in high quality plants that were slightly taller than desirable.

6. The best quality plants were those fertilized alternately with potassium nitrate and sodium nitrate at 1 ounce per 3 gallons of water weekly until flower buds were ½ inch long. Sodium nitrate only, applied at weekly intervals, was used thereafter. Substituting calcium nitrate for sodium nitrate provided the second best plants and differences were slight.

7. Unfortunately, the best 1963 treatment, which called for 1 part ammonium sulfate and 4 parts sodium nitrate at 1 ounce per 2 gallons of water applied every two weeks after the plants were 2 inches high, did not materialize. Similarity of results in general for the two seasons leads to the conclusion that this mixture is still preferable. The potting soil was supplemented with potassium when this treatment was used.

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