SOIL AND FERTILITY MANAGEMENT OF EASTER LILY

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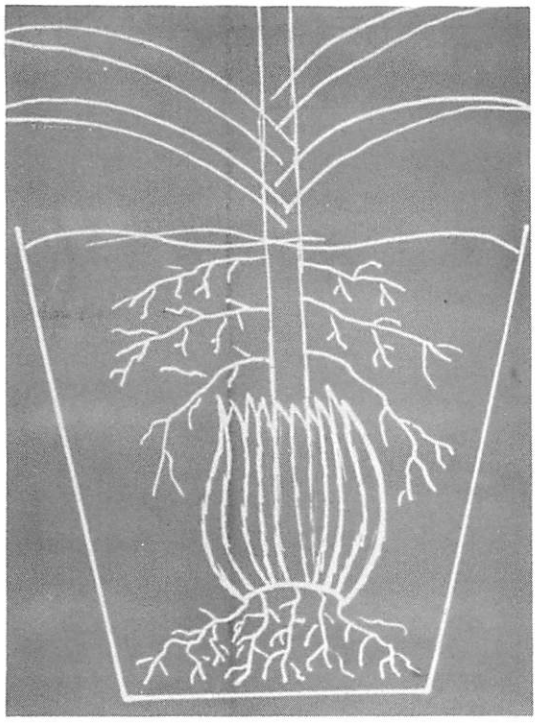
ROOT MEDIA

Root Development.

The Easter lily has a unique form of root development. Actually, it develops two sets of roots; basal roots originating from the basal plate at the base of the bulb and stem roots originating from the stem above the bulb (Figure 1). Since roots grow downward for the most part each set occupies its own area within the pot for a considerable time. This places an extra burden on the grower who must ensure that physical conditions are correct in both regions. To provide adequate space for each set of roots it is important to place the bulb 1 to 1.5 inches up from the bottom of the pot for the basal roots. This will also provide the required 1 to 2 inches of root medium above the top of the bulb for the stem roots.



Tigure 1. The Easter lily develops two sets of roots, basal roots from the basal plate at the base of the bulb and stem roots from the stem just above the bulb.

The physics of root media make it difficult to achieve adequate aeration in both zones. After a pot of root medium is thoroughly watered and allowed to drain one finds that the medium at the bottom of the pot contains much more water per cubic inch than the medium at the top of the pot. This means that medium at the top is well aerated and will support good root growth while medium at the bottom is poorly aerated and does not support good growth. Most other plants cope well with this situation because their roots have access to all locations and are able to locate in the most desirable zones. In the case of the Easter lily, one set of roots must develop in the most poorly aerated zone. However, both sets of roots are required to achieve expected plant quality.

Root Media Formulations.

Make it Coarse. The principle rule when selecting a root medium for Easter lilies is to select a coarse, well drained medium. Such a medium will maximize aeration, particularly at the bottom of the pot. If formulating the root medium yourself, use coarse components such as a coarse grade of vermiculite or sphagnum peat moss with good structure. Contrary to opinion, it is permissible to use perlite if the pH level is suitably high and superphosphate has been omitted from the root medium. The concern over perlite has been its fluoride content. But this does not pose a problem if the aforementioned conditions have been met.

Gravel? A question often asked is, Whether to use gravel in the bottom of the pot or not? It is not necessary and generally not done today. If done, the bulb should be set directly on top of a

1 to 1.5 inch layer of gravel at the bottom of the pot. In this way, basal roots will develop completely in the well aerated gravel. If there is a shallow depth of root medium between the top of the gravel and the bottom of the bulb, the basal roots will develop at the very bottom of the column of root medium where it is the wettest and has least aeration. This would be the worst possible situation for the basal roots. The interface between gravel and root medium is effectively the bottom of the pot. It is here that the maximum water holding capacity of the root medium exists. To make matters worse, the height of the root medium has been reduced by the depth of the gravel. Thus the water holding capacity of root medium at the top of the pot has also increased (aeration has decreased).

Nutrient Amendments. Nutrient additions which should be incorporated at the time of making root media are presented in Table 1. It is important that the pH level be higher than for most crops in order to tie up fluoride. A pH level of 6.5 to 7.0 for soil-based media (20% or more soil) and 5.8 or higher for soilless media is safest. Note that superphosphate is not used in root media. It is a source of fluoride. It is desirable to add 2 pounds of gypsum (calcium sulfate) to soilless media to increase the calcium content without further raising the pH level. The extra calcium helps to tie up fluoride. Several sources of micronutrients are suggested. Each contains all of the needed micronutrients.

Table 1. Suggested pH and nutrient additions for Easter lily root media.

		Soil-based media	Soilless media
pH		6.5–7.0	5.8 & up
dolomitic limestone	(lbs per cubic yd)	5–10	12
gypsum	(lbs per cubic yd)	---	2
micronutrients:			
Frit-F-555	(oz per cubic yd)	2.5	2.5
OR			
Esmigran	(lbs per cubic yd)	5	5
OR			
Micromax	(lbs per cubic yd)	1.5	1.5

FERTILIZATION PROGRAM

Fluoride Toxicity.

Symptoms. Fluoride toxicity symptoms, known as scorch, begin in the lower leaves. Light tan lesions, half circular in shape, form along both sides of the leaf a short distance from the tip of the leaf (Figure 2). The tan necrotic areas increase in size to encompass the leaf tip and ultimately the whole leaf. Symptoms progress up the plant. Although fluoride toxicity can occur at any time, it is more common during late stages of plant development, most often occurring 3 weeks before flowers open.

Source. The source of fluoride in Easter lily crops can be municipal water. Some municipalities incorporate fluoride, often at 1 ppm, to help prevent tooth decay. This level is sufficiently high to cause toxicity in most members of the lily family (Figure 3). A more common source of fluoride is superphosphate, including the regular (20%) and the triple (45%) forms. Rock phosphate, the parent material from which superphosphate is made, contains high levels of fluoride. Processing which yields superphosphate does not remove a sufficient amount of fluoride. However, further processing to produce water soluble phosphate salts, such as mono and diammonium phosphates which are used in soluble greenhouse fertilizers and in the slow-release fertilizers Osmocote and MagAmp, does remove sufficient fluoride. Soluble and slow-release greenhouse fertilizers containing

Figure 2. The fluoride toxicity symptom known as "scorch" on a leaf of Easter lily 'Ace'.

Figure 3. Easter lily plants which were watered and fertilized with municipal tap water containing 1 ppm fluoride. The plant on the right is the cultivar Ace and shows moderate scorch on the lower leaves from fluoride in the water. The plant on the left is the cultivar Nellie White and is free of scorch due to a higher level of natural resistance. The second and third plants from the left are the cultivar Ace which were grown in a root medium containing 3.75 and 6.0 lbs single superphosphate per cubic yard. Scorch on these plants is heavy and very heavy, respectively. The plants on the extreme left and right were grown in a root medium without superphosphate.

phosphorus may be safely used on Easter lilies.

Prevention. Four preventative measures can be taken.

❶ Fluoride can be precipitated in the root medium as calcium fluoride by additions of relatively high amounts of calcium. In the solid precipitated form it is not available for uptake by the root.

❷ A high root medium pH also results in fluoride tie-up because high pH is generally synonymous with high calcium. Note in Table 1 that relatively high pH levels are recommended and that gypsum is added to soilless media to raise the calcium level.

❸ A third method of prevention is to avoid the use of superphosphate in the root medium.

❹ If the root medium pH should become low during crop time, switch the nitrogen source to calcium nitrate plus potassium nitrate. This will add calcium and it will also result in a gradual rise in root medium pH.

Phosphorus.

The recommendation to avoid the use of superphosphate does not imply that no phosphorus is necessary for Easter lily. If phosphorus is omitted throughout the crop, plants will become deficient. Lower leaves develop chlorosis across the whole leaf followed by necrosis. These phosphorus deficiency symptoms progress up the plant.

Phosphorus needs to be included in the continuous liquid fertilization program throughout crop production. As previously mentioned, the purer forms of phosphorus used in soluble greenhouse fertilizers are sufficiently free of fluoride to safely be used.

Maintenance Fertilization.

Timing. The continuous maintenance fertilization program should begin after plants have emerged and shoots are 0.5 to 1.5 inches tall. Fertilization should be discontinued two weeks before bloom.

Rates. Easter lilies may be fertilized with every watering or on a weekly basis. When fertilized with every watering, a nitrogen concentration of 200 to 300 ppm should be used. Barring any prior experience, a good starting concentration would be 300 ppm. For a weekly schedule a nitrogen concentration of 350 to 600 ppm should be applied. A good starting point is 450 ppm. When a high percent of excess water or fertilizer solution is applied, it is necessary to use the higher concentrations. Although recommendations usually call for 15% excess fluid at each watering or fertilization, many growers actually apply 50% or more excess

Table 2. Quantities of fertilizer to dissolve in 100 gallons of water to make solutions containing nitrogen (N) and potassium (K_2O) each at 50 to 600 ppm concentration.

Fertilizer	% ammonium	Concentration of N and K_2O						
		50	100	200	300	400	500	600
		oz/100 gallons*						
20-10-20	40	3.3	6.7	13.3	20.0	26.7	33.4	40.0
16-4-12**	38	4.2	8.3	16.7	25.0	33.4	41.7	50.0
15-0-15	13	4.4	8.9	17.7	26.6	35.5	44.4	53.2
ammonium nitrate +	40	1.2	2.5	4.9	7.4	9.9	12.3	14.8
potassium nitrate +		1.5	3.0	6.0	9.0	12.0	15.0	18.0
monoammonium phosphate		0.5	1.1	2.2	3.2	4.3	5.4	6.5
(20-10-20)								
calcium nitrate +	0	3.0	6.0	12.0	18.0	24.0	30.0	36.0
potassium nitrate		1.5	3.0	6.0	9.0	12.0	15.0	18.0
(15-0-15)								

*To determine the amount of fertilizer to use to prepare a concentration not in the table, such as 350 ppm from 20-10-20, add two or more numbers togeter, i.e., 3.3 oz for 50 ppm plus 20.0 oz for 300 ppm = 23.3 oz to make 350 ppm.

**Potassium will be 75% of the nitrogen level.

solution. The concentration of fertilizer required in a program diminishes as the amount of leaching decreases.

Formulation. Two popular commercial formulations used for Easter lilies are 16-4-12 and 20-10-20. The amount of phosphorus supplied by each relative to the quantity of nitrogen is 25 and 50%, respectively. These amounts are adequate. Later in the crop, when reserves of phosphorus have built up in the root medium and the likelihood of declining pH levels is greater, growers are sometimes forced to shift to a calcium nitrate plus potassium nitrate base fertilizer such as 15-0-15. Quantities of each of these fertilizers to use to achieve various concentrations are presented in Table 2. Along with the three commercial fertilizers are formulations for making your own 20-10-20 and 15-0-15 fertilizers.