

Lime and Phosphorus Fertilization on Tulips

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Introduction: The general recommendation for soils and fertilizers for tulip bulb forcing are to use a well-drained soil with a low nutrient content since nutrient levels are not important. Limited studies have shown that certain nutrient elements applied during the forcing stage have an effect on flower quality and forcing of tulips. There is little information available about the use of artificial soils-peat-lite mixes and bulb forcing.

In an early experiment, Bould (3) using Tulip var. Farncombe Sanders in silica sand culture and fertilizing with complete nutrient solution (N, P, K), minus N, minus P, minus K and water only as control, found that there was no difference between those plants receiving complete nutrient solution and minus potash. The plants that received no phosphorus did not quite make such good growth but the difference was very small; also there were no significant effects on bulb weight. The growth of the plants without nitrogen and with water only was much inferior. The leaves were smaller, more upright in growth and yellowish green in color and the flowers were slightly smaller.

Hewitt and Miles (4) also studied the effects of deficiency of these elements, and also of calcium, magnesium and of excess of manganese on the growth of the bulb and the visual symptoms produced on the plants. Using tulip bulbs var. Rose Copland, they found that the plants were most sensitive to deficiency of nitrogen, magnesium and calcium in the first year but phosphorus deficiency had a marked effect in the second year. Amaki and Hagiya (1) in similar experiments found that the greater the amount of each element supplied, the greater the plant height. The flowering time was delayed with increasing amounts of nitrogen or potassium fertilizer and was hastened with increasing phosphate fertilizer. In a recent experiment Stromme and Oudvin (5) using peat moss and sawdust as a rooting medium for tulips var. "K and M's Triumph", "Trance" and "Levand", found better results with the medium in which 6 or 12 grams of lime were added per liter (about 7.5 and 15 oz per bushel) than in unfertilized treatments.

The question of the need for fertilization during forcing of the bulbs is not yet answered. If fertilization has an effect on timing of tulips, flower size, stem length and

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keeping quality, then research is needed to find out what fertilizers are best and if such treatments are economical.

The objectives of this study were to determine the effect of lime and superphosphate fertilization on growth, flowering and quality of tulip bulbs when grown in an artificial medium.

The advantage of using an artificial medium such as peat-lite mix is that it is readily available, uniform in quality and light weight.

Materials and Methods: Tulip bulbs that were given a 41°F (5°C) precooling treatment in Holland were received December 18, 1965 and held at 41°F until planting December 20, 1965.

Ten varieties of 50 bulbs each were used in five different growing media that were as follows:

- #1 Straight soil, unfertilized
- #2 50% peat moss and 50% vermiculite No. 4, unfertilized
- #3 50% peat moss and 50% vermiculite No. 4, plus $\frac{1}{4}$ lb (114 gram) ground limestone per bushel
- #4 50% peat moss and 50% vermiculite No. 4, plus $\frac{1}{8}$ lb (57 gram) superphosphate per bushel
- #5 50% peat moss and 50% vermiculite No. 4 plus ground limestone and superphosphate at the above rate.

Two five-inch pots were used per growing medium and variety with five bulbs in each pot. In total there were 10 pots per variety. The pots were put in a greenhouse at 50°F night temperature and approximately 60°F day temperature and watered in well.

Results and Discussion: The collected data contain information about the quality of flowers, the blooming date and the percentage that did not flower. The flowers were cut and recorded when they had reached the salable stage; that is, partly or entirely colored.

The results are shown in table 1.

The varieties "Karel Dorman", "K and M's Triumph", "Pax" and "Van den Eerden" were also used but the percentage that were blind was so great, around 90% blind, that these results are not presented. The phenomenon was very common last year and appeared in many cultivars of "five degree" tulips (2).

The percentage of bulbs that were blind in the other varieties appears in the seventh column of table 1 and it seems that it was not influenced by the treatment, but more closely associated with variety.

Blooming date: The different treatments did not significantly affect the blooming date, but in some varieties the first flower appeared 2 or 3 days earlier in the treatment #3.

Effect on flower quality: The quality and color of flowers were very high in every case. The flower size was affected only slightly depending on the treatment used. There were greater differences that could be attributed to the variety of tulip used rather than treatment.

Stem length: The greatest differences due to the treat-

ment used appeared in the stem length of plants.

The most favorable media were the peat-vermiculite mixes with lime or superphosphate and the unfertilized peat-vermiculite mix. With three varieties the highest stem was obtained in treatment #3 and in two varieties with treatment #4 (Figures 1 and 2).

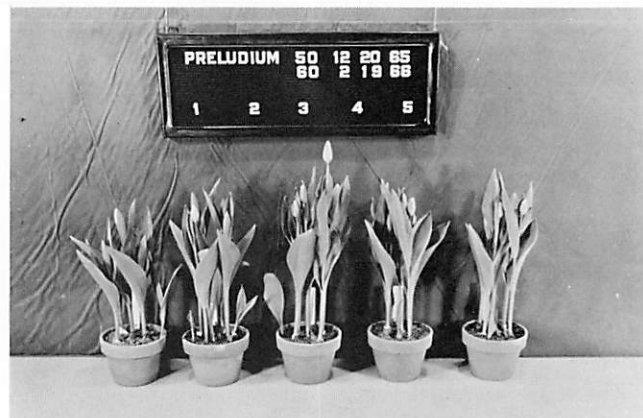


FIGURE 1 The effect of growing media on variety "Preludium." The numbers indicate the treatment (see text).



FIGURE 2 The effect of growing media on variety "Bellona." The numbers indicate the treatment (see text).

With "Apeldoorn" the greatest stem length was obtained in the peat-vermiculite mix that received no fertilizer. However, the difference in stem length between this treatment and #3 and #4 treatments was very small. The best medium seems to be that in which the lime was added (#3), with second best the peat-vermiculite mix with superphosphate (#4). The straight soil gave the poorest growth with all varieties and the appearance of plants was inferior in comparison with the other media. Under the conditions of the experiment, the straight soil was the poorest for forcing tulips.

In treatment #5, with peat-vermiculite plus lime and superphosphate the height of plants, in almost every case, was lower than the other peat-vermiculite treatments. In this case it is possible that the presence of calcium in a low pH (6.2) medium increased to a higher degree the solubility of nutrient elements. The soil also showed a lower percentage of soluble salts in the media #3 and #5 in which lime was added, than the other material (table 2).

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Table 2. Soil test of used media after experiment.

Treatment	ppm				pH	Sol. Salts K x 10 ⁻⁵
	NO ₃	P	K	Ca		
#1	13	trace	5	125	7.3	32
#2	1	"	20	100	5.6	24
#3	1	"	15	100	6.8	24
#4	trace	2	15	100	5.4	46
#5	trace	3	15	100	6.2	36

Fresh weight: The fresh weight of stem plus flower in the salable stage follows almost the same row as the stem length, but the differences were very small and these did not affect the flower quality.

Effect on toppling: Tulip topple or water-neck appeared in varieties "Paul Richter" and "Preludium" before cutting or after 2-3 days storage of cut flowers at 70°F temperature. The percentage of toppling is shown in table 3. The addition of lime in the growing medium resulted in less toppling as may be seen from table 3.

Table 1: The effects of media and fertilizer treatment on the growth and flowering of six varieties of 41°F storage tulips.

Variety	Treatment	Blooming date	Average length stem plus flower cm	Flower length cm	Fresh Weight grams	Percentage blind
No. 849 Apeldoorn	#1	3/ 5 - 3/10	43.7	5.6	33.4	40%
	#2	3/ 5 - 3/14	52.1	5.7	36.9	30%
	#3	3/ 6 - 3/12	49.5	5.8	34.5	30%
	#4	3/ 8 - 3/14	48.7	5.6	32.9	70%
	#5	3/ 7 - 3/ 9	39.9	5.3	30.5	30%
	Average	3/10	46.8	5.6	33.6	40%
No. 1733 Bellona	#1	2/17 - 2/27	29.7	4.7	19.0	10%
	#2	2/21 - 3/ 2	36.9	4.7	21.2	0
	#3	2/22 - 3/ 1	35.3	4.5	19.1	0
	#4	2/21 - 2/28	39.3	4.8	20.5	0
	#5	2/22 - 2/26	29.1	4.7	18.7	10%
	Average	2/24	34.0	4.7	19.7	4%
No. 2168 Lustige Witwe	#1	2/18 - 3/ 3	20.7	3.6	14.9	40%
	#2	2/14 - 2/22	28.9	4.0	18.1	20%
	#3	2/13 - 2/22	31.5	4.0	20.5	10%
	#4	2/17 - 2/22	22.7	4.0	15.9	20%
	#5	2/17 - 2/19	21.2	3.9	14.4	50%
	Average	2/18	25.0	3.9	16.7	28%
No. 613 Paul Richter	#1	2/20 - 3/ 1	32.7	4.3	26.7	40%
	#2	2/22 - 3/ 1	38.7	4.8	31.2	40%
	#3	2/22 - 2/27	38.4	4.8	28.8	40%
	#4	2/23 - 3/ 1	39.9	4.6	29.0	50%
	#5	2/22 - 2/28	39.1	4.7	27.5	30%
	Average	2/25	37.7	4.6	28.6	40%
No. 1517 Paris	#1	3/10 - 3/16	38.0	4.9	28.0	40%
	#2	3/10 - 3/14	35.7	4.5	24.1	50%
	#3	3/ 8 - 3/18	41.4	4.8	28.6	10%
	#4	3/11 - 3/15	39.2	4.8	24.8	60%
	#5	3/ 8 - 3/15	35.5	4.8	26.3	80%
	Average	3/14	37.9	4.7	26.3	48%
No. 932 Preludium	#1	2/20 - 2/28	29.1	3.9	18.5	30%
	#2	2/24 - 2/28	39.0	4.3	20.9	40%
	#3	2/20 - 2/28	42.9	4.4	24.8	20%
	#4	2/22 - 2/28	38.9	4.3	22.4	10%
	#5	2/21 - 2/27	38.8	4.2	21.7	10%
	Average	2/24	37.9	4.2	21.6	22%

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Table 3. Effect of fertilizer treatment on Tulip Topple with 2 varieties. Figures are averages of the plants that bloomed.

Treatment	Paul Richter	Prelidium
#1 Straight soil	None	14%
#2 Peat 50% and Vermiculite 50%	66%	83%
#3 Peat-vermiculite plus lime	33%	12%
#4 Peat-vermiculite plus superphosphate	80%	44%
#5 Peat-vermiculite plus lime, plus super'phate	14%	11%

Summary: 1) To determine the effect of growing medium and fertilization in tulips, an experiment was established with straight soil, peat and vermiculite mix alone, plus lime, superphosphate and lime and superphosphate.

2) Then varieties of 41°F precooled in dry storage tulip bulbs were used but only the results for six varieties are presented.

3) The best results in most cases were in the peat-vermiculite mix plus lime, with second best the peat-vermiculite mix plus superphosphate.

4) The straight soil was the least favorable growing medium and the unfertilized peat-vermiculite gave the best result with one variety but the difference from those media in which lime and superphosphate were added was very little.

5) Medium #5 gave the poorest results among the peat-vermiculite mixes, perhaps from the interaction between lime and other nutrient elements in this medium.

6) The addition of lime in the growing medium, had a favorable effect against toppling.

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