Table 5. The average concentration of Ca, Mg, P, B, Cu, and Fe in "Tropicana" rose leaves at several sampling dates.[a]

Sampling date	% dry wt.			ppm of dry wt.		
	Ca	Mg	P	B	Cu	Fe
8/6/65	0.51	0.40	0.12	89.7	22.8	50.3
4/12/66	0.78	0.29	0.17	68.9	--	67.7
6/1/67	0.45	0.27	0.19	79.4	11.6	78.1

[a]Tissue samples composed of uppermost five-foliate leaf from stems with buds showing color.

tained considerable quantities of K and has a fairly high exchange capacity which may have further contributed to the lack of response from the K_2O rates. Yet, the K percentages of the first five-foliate leaves were somewhat lower than those reported by others (1,3,10); however, it should be emphasized that the leaves were still quite immature when sampled. Young *et al* (11, 12) reported quadratic yield response to K_2O as the rates were increased from 300 to 2700 lbs/A/year. Estimated maximum response was near 1500 lbs/A/year; however, it should be emphasized that the K_2O was applied once annually under plastic mulch.

Consistent differences in vase-life of roses similar to that reported for chrysanthemums (8, 9) were not associated with pre-harvest nutritional practices. This is attributed partially to the fact that potential vase-life of chrysanthemums is several times that of roses.

The P content of the leaves increased with time. This is attributed to annual applications of superphosphate. The Ca and P levels were lower than those reported by others (1, 3, 10); however, differences in age of tissue analyzed may have existed. No deficiencies or growth retardation could be attributed to Ca or P. The Mg, B, Cu, and Fe contents were within the range reported by others (1, 3, 10).

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ABSORPTION OF P^{32} BY CATTLEYA 'TRIMOS' FROM FOLIAR AND ROOT APPLICATIONS

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ABSTRACT

Cattleya 'Trimos' plants were treated with P^{32} derived from phosphoric acid both as a foliar spray and drench to the growing medium to study the absorptive capacity of leaves and new and three to four year old roots. Plants were fractionated ½, 2, 12, 24 and 120 hours after application and analyzed for P^{32} content.

P^{32} applied to the foliage was readily absorbed by *Cattleya* 'Trimos' plants and roots three to four years old absorbed as much P^{32} as younger roots. There was an increase in P^{32} content in the tissue with time.

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INTRODUCTION

Fertilization has long been a controversial subject among orchid growers. Many feel foliar application of fertilizer is excellent while others contend that foliar applied fertilizer merely runs off the plants to be absorbed by roots. This latter group feels fertilizer should be applied only to the medium since they believe the heavy cutin layer found on many orchid leaves makes foliar application almost useless.

Another controversial cultural practice of orchid growers concerns removal of most of the roots when repotting orchids. Most growers are convinced that old roots are inactive and should be removed since orchid plants produce roots with each new growth, while some growers believe older roots are still functional and should be retained when repotting.

Foliar absorption and translocation experiments with N and radioactive P, Ca and K have been reported for many crops, but there is no record to date of macro-element absorption through orchid foliage. Many environmental factors affect absorption of P^{32} by leaves, and Thorne (10) found percentage of P^{32} uptake in *Brassica napus* increased as relative humidity around plants increased. He also found shading usually decreased foliar absorption and translocation and that about 90% of P^{32} applied to foliage was absorbed when applied at 10 microcuries per milliliter using a wetting agent.

Asen *et al* (1) demonstrated that P^{32} applied as a dip to *Chrysanthemum morifolium* leaves was absorbed and translocated basipetally to other plants parts. Norton and Wittwer (8) found strawberry leaves and roots readily absorbed P^{32} when applied as a dip solution and translocated P^{32} to all plant parts including stolon-connected runners. Little transport occurred before 2 hours, but after 6 hours P^{32} had moved to all meristematic regions, particularly root tips and new foliage. Silberstein and Wittwer (9) quick dipped leaves of tomato, corn, bean and squash, grown in a P deficient sand medium in a 25 millimolar solution of O-Phosphoric acid and reported rapid absorption. Within 48 hours after application, 5 to 6% of the total P in developing tomato fruit came from the application. Highest concentrations were found in young leaves, lateral buds, nodes, root tips and root nodes.

Wittwer and Ludahl (11) sprayed tomato leaves with 25 millimole solutions of P^{32}, using dreft as a wetting agent, and reported rapid absorption and translocation to all parts of the plant, particularly to meristematic regions. Eggert, Kardos and Smith (6) sprayed water-soluble radioactive P salts on apple tree foliage and found it was absorbed and translocated to other tree parts. The largest accumulations were found in cores, seeds, and sub-epidermal fruit tissues.

Biddulph (3) reported P^{32}injected into *bean* plants migrated upward and downward. Colwell (4) found that P^{32} moved to other plant parts through the phloem in the direction of food movement. Harley *et al* (7) noted that P^{32} applied to apple roots could not be detected in leaf samples until at least one square centimeter sample material was taken. P^{32} was transported to leaves through phloem with a 92% reduction resulting from ringing the bark.

Barrier and Loomis (2) found P^{32} was absorbed and translocated downward throughout soybean plants. After 2 hours 16% of applied material had been absorbed in sufficient amount to be detected. Absorption and movement of P^{32} from leaves in significant amounts required more than 2 hours, whereas absorption alone required less time.

Davidson (5) predicted the wax cuticle and few stomates on orchid leaves would prevent or reduce their absorption of foliarly applied fertilizers.

Methods and Materials

A 3 x 5 factorial experiment in randomized block design with 4 replications was initiated July 23 and terminated August 15, 1965 to determine extent of absorption of P^{32} through leaves and roots of *Cattleya* 'Trimos' orchids. One orchid plant per 6 inch pot constituted an experimental unit. Variables included P^{32} applied as a foliar spray to the second mature leaf, as a drench to the growing medium and as a drench to the growing medium after the plants rhizome was severed between the third and fourth pseudobulbs. A piece of rigid plastic was inserted into the cut to prevent movement of P^{32} across the cut (Fig. 1). Fertilizer had been withheld from plants 6 weeks prior to treatment.

Fifty microcuries of P^{32} derived from phosphoric acid were added to 5 ml of distilled water and applied to the second mature leaf using a pump atomizer without use of a spreader-sticker. Each leaf was sprayed within a plastic bag (Fig. 2) which was then tied to enclose the leaf and prevent contamination of greenhouse atmosphere, pseudobulbs or potting medium with radioactive material. The same concentration of P^{32} was applied as a pot drench in 50 ml of distilled water. Fifty milliliters of solution wet the medium and did not drip through, but as an additional safety factor, all pots were

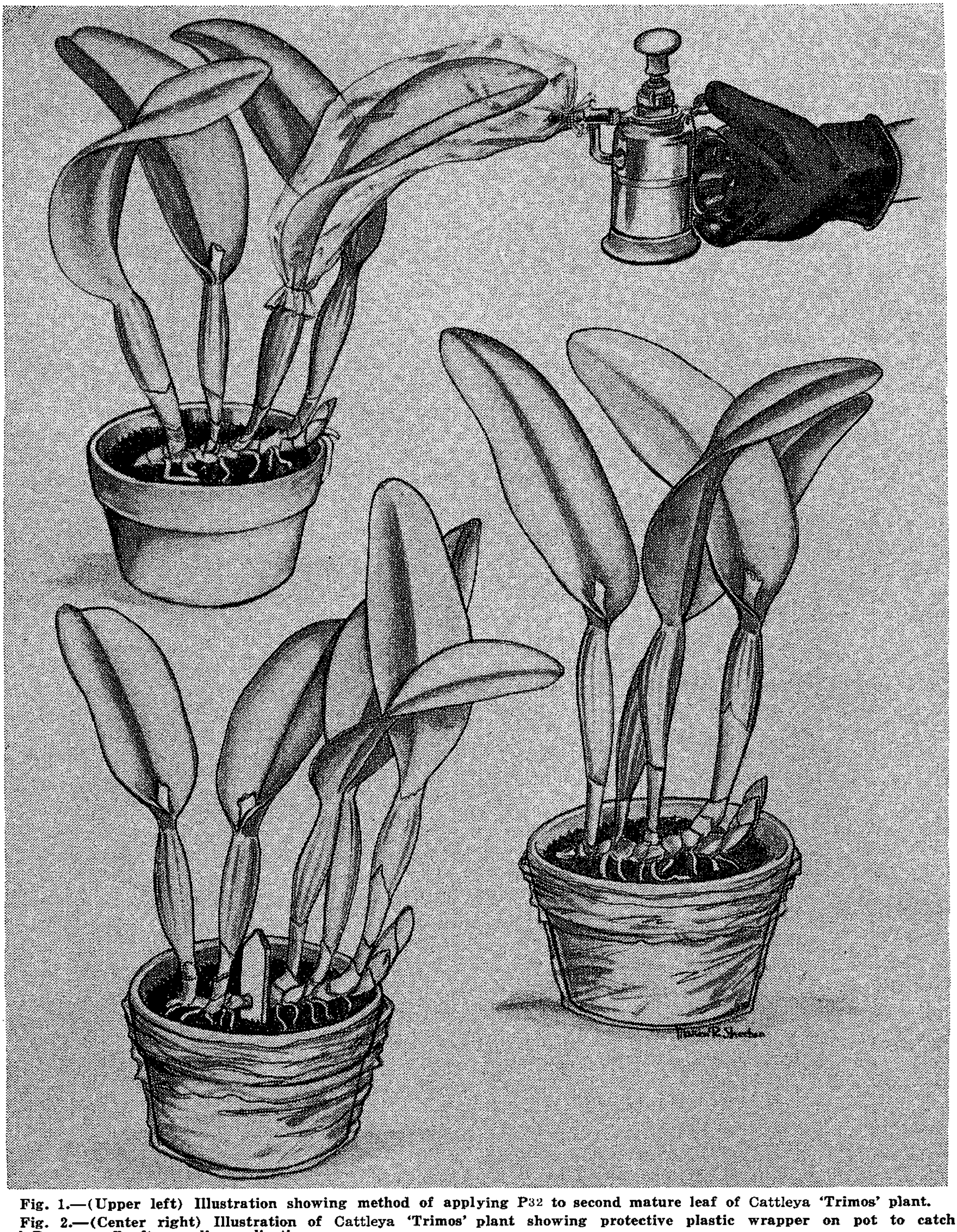

Fig. 1.—(Upper left) Illustration showing method of applying P^{32} to second mature leaf of Cattleya 'Trimos' plant.

Fig. 2.—(Center right) Illustration of Cattleya 'Trimos' plant showing protective plastic wrapper on pot to catch and P^{32} run off after media applications.

Fig. 3.—(Lower left) Illustration of Cattleya 'Trimos' plant showing plastic insert, between 3rd and 4th pseudobulbs, to prevent translocation of P^{32} across the cut surfaces.

enclosed in polyethylene bags to catch possible run off (Fig. 3).

Samples were taken by harvesting the first and third mature leaves and second and third mature pseudobulbs at treatment intervals (½, 2, 12, 24 and 120 hours) after application. Plants with severed rhizome were sampled 12, 24 and 120 hours after application taking the leaf and pseudobulb immediately anterior and posterior to the cut.

Samples were dried for 3 days in a forced air oven at 72°C, cut into small pieces and ashed at 500°C for 5 hours. The ashed material was digested in 5 ml of 18M HCl and 20 ml distilled water added. Samples were then counted using a Baird Atomic Timer (Model 960-R) or a Nuclear Scaling Unit (Model 172). A standard of 5 microcuries of P^{32} in 50 ml distilled water was read daily to determine decay rate.

Results and Discussion

Effects of various methods of application and translocation of P^{32} in *Cattleya* 'Trimos' plants are summarized in Tables 1 and 2.

Method of application had no effect on the amount of P^{32} in the first mature leaf (Table 1) and, generally, the amount of P^{32} increased with time. This movement would be expected since experiments by Silberstein and Wittwer (9) indicated movement of P^{32} was toward the growing points and younger leaves.

More P^{32} was found after 24 hours in the second pseudobulbs of plants having P^{32} applied to the foliage than those having it applied to the medium. Obviously, P^{32} was absorbed foliarly by *Cattleya* 'Trimos' and since the entire 5 microcuries were applied to the leaf surface just above this pseudobulb, it would tend to become concentrated in this storage organ whereas the P^{32} applied to the medium was spread over a larger area and not all of it was in immediate contact with plant roots. Work by Thorne (10) indicated that P absorbed foliarly increased as relative humidity increased around the plants. Enclosing the sprayed leaf in a polyethylene bag increased the humidity around treated leaf and, thus, probably helped increase absorption of P^{32}. Thorne also indicated that 90% of P^{32} applied to the foliage was absorbed, while in this experiment only about 40% was recovered (Table 1). This is not necessarily in disagreement with the work

Table 1

Percentages of P^{32} absorbed by Cattleya 'Trimos' orchids as effected by time and method of application

Time	Hours After Application 1/2	2	12	24	120	LSD for Means within table
First Mature Leaf						
Foliar application	.025	.036	.038	.034	.077	.05=NS
Medium drench	.035	.061	.237	.123	.960	.01=NS
Second Pseudobulb						
Foliar application	6.023	3.892	10.565	34.450	37.730	.05=15.91
Medium drench	.036	.023	.150	.143	2.440	.01=22.04
Third Leaf						
Foliar application	.018	.021	.028	.052	.042	.05=00.12
Medium drench	.024	.025	.103	.138	.480	.01=00.16
Third Pseudobulb						
Foliar application	.028	.069	.265	.163	.337	.05=00.35
Medium drench	.032	.072	.065	.128	2.160	.01=00.49

Foliar application = Second leaf application
Medium drench = Pot drench

of Thorne, since plants had 8-10 pseudobulbs with leaves, and only 2 leaves and pseudobulbs were analyzed for P^{32}. The leaf on which the material was applied was not analyzed and this should have been high in P^{32}.

The third leaf and pseudobulb (Table 1) also contained P^{32} which increased in the tissue with time between ½ hour and 120 hours. There was more P^{32} in both tissues at 120 hours from foliar application.

Effects of root age on P^{32} absorption are summarized in Table 2. Concentration of P^{32} was the greatest in the pseudobulb behind the cut 24 hours after application of the material. These data indicate that roots 3 to 4 years old are actively absorbing nutrients from the medium. There was no difference in the amount of P^{32} in the leaf immediately in front of or behind the cut rhizome after 120 hours.

One-half hour after application, sufficient P^{32} had been absorbed and translocated throughout the areas sampled to be analyzed. These findings agree with the work of Wittwer and Ludahl working with tomatoes, however, in the case of chrysanthemums and soybeans P^{32} could not be detected until 2 hours after it had been applied. This variation between plant genera can be expected due to taxonomic variations.

Summary

An experiment was initiated to determine whether *Cattleya* 'Trimos' plants could absorb P^{32} through foliage and roots 3-4 years old.

Results indicate that *Cattleya* 'Trimos' leaves can absorb P applied as a foliar spray. Roots 3-4 years old absorbed P as rapidly and in equal amounts to younger roots.

These studies indicate that foliar fertilization of *Cattleya* 'Trimos' is effective and that the old roots remaining healthy in appearance should not be removed when repotting.

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Table 2

Percentages of P^{32} absorbed by Cattleya 'Trimos' orchids as effected by root age

Time	Hours After Application 12	24	120	LSD for Means within table
Pseudobulb				
Roots 1-2 yrs old	.071	.230	.760	.05=.66
Roots 3-4 yrs old	.064	1.422	.362	.01=.92