Some degeneration occurred in the dyad and tetrad stages of megaspore formation and slightly more occurred during the 2-nucleate embryo sac stage. However, most degeneration occurred during the 4-nucleate embryo sac stage, when the fruit was approximately 8 mm in diam. The delayed development of the embryo sac also contributed to the lack of seeds.

The extensive degeneration of developing seeds would make variety improvement of this clone difficult through normal breeding procedures. This degeneration would also preclude the embryo excision technique for culture on nutrient medium. Until a physiological means of preventing degeneration prior to fertilization is discovered, fertilization cannot be effected and cultivar breeding will be limited to selection of superior clones resulting from either mutations such as bud sports or chance zygotic seedlings (8).

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ROOTSTOCK EFFECTS ON TREE SIZE AND YIELD OF 'TAHITI' LIME (CITRUS LATIFOLIA TANAKA)

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Abstract. **An experiment was begun in 1967 with 'Tahiti' ('Persian') lime trees on 12 different seedling rootstocks. Tree size measurements and fruit yield records were started in 1970. Trees on alemow** (Citrus macrophylla), **kalpi** (C. webberii) **and rough lemon** (C. jambhiri) **have given the greatest yields. Trees on Cleopatra** (C. reshni), **shekwasha** (C. depressa), **Ichang** (C ichangensis), C. taiwanica **and Rangpur** (C. limonia) **have given only fair yields. Trees on 'Sampson' tangelo, 'Troyer' citrange, 'Leonardy' grapefruit, and 'CRC 1452' citrumelo have given very poor yields or none. So far the yield of fruit has been directly related to tree size.**

Two kinds of tree predominate in the 'Tahiti' lime orchards of Florida. Trees budded on rough lemon rootstock are by far the greatest in number, and rough lemon can be called the "standard" rootstock for 'Tahiti' lime in Florida (1, 2, 3, 4). The other type of tree is produced by marcottage (air layering). Marcot trees are relatively easy to produce, come into bearing early (2, 3, 4) and have been widely planted in the past decade; however, there is evidence that as marcot trees become mature, they do not yield as well as trees on rough lemon rootstock (2).

Rootstocks such as 'Cleopatra,' grapefruit and sour orange have been used for 'Tahiti' lime in Florida but only to a limited extent (4).

In 1962 Campbell and Lincoln (3) summarized results of several rootstock experiments at the University of Florida Sub-Tropical Experiment Station (now Agricultural Research and Education Center, Homestead). The most promising rootstocks included rough lemon, Cleopatra, shekwasha, and marcots. These experiments were complicated by the presence of lime blotch disease (wood pocket), which was such an important limiting factor that it probably masked many of the differences between rootstocks.

Colburn, Gardner and Horanic (5) reported results of a rootstock experiment begun in 1959 in Dade County. Of the 20 rootstocks included, the most promising were 'Rangpur,' alemow, 'Leonardy' grapefruit, rough lemon and marcots.

Some rootstocks have been reported to do well in other parts of the world under conditions similar to those of southern Florida. For example, Wester (6) indicated that *Citrus webberii,* the

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kalpi, was a good rootstock in the Philippines, even in highly calcareous soils.

The objective of the present experiment was to compare the performance of rootstocks which have shown promise under Florida conditions, or under similar conditions elsewhere.

Materials and Methods

The 12 rootstocks used in the experiment (Table 1) were grown in the nursery at the University of Florida Agricultural Research and Education Center, Homestead, and budded with scions of the disease-free 'Tahiti' lime clone Li 37-1-8. The trees were planted in July, 1967, except for those on 'Leonardy' grapefruit rootstock, which were planted in September, 1968. The Rockdale soil had been previously scarified and trenched in 2 directions at intervals of 20 ft. The trees were planted at the intersections of the trenches, making the tree spacing 20 ft. by 20 ft., or approximately 109 trees per acre, a spacing which allows the keeping of individual tree yield records for the life of a 'Tahiti' lime orchard with very little or no pruning to separate the trees. The experimental design was a randomized block with single tree plots replicated 15 times.

The orchard has been given routine care, including uniform fertilizer application, irrigation and weed and pest control. No pruning has been done except for removal of sprouts from the rootstocks.

Tree size measurements (canopy height and width) were begun in 1970. Individual tree yield records were begun in 1971. The fruit was picked and placed in 1-bushel (55 lb.) field boxes, and yield was estimated to the nearest tenth of a bushel.

Results and Discussion

In general, yield of fruit was directly related to tree size. Trees on alemow and rough lemon rootstock grew faster than any others at the beginning, and are the largest trees at this time. However, trees on kalpi, Cleopatra, shekwasha, Ichang, *C. taiwanica*, Rangpur and 'Sampson' tangelo have made strong growth during the past year and are beginning to catch up to the alemow and rough lemon trees.

Some of the trees bore fruit in 1970, but the yields were small and erratic and are not reported here. Yields and tree size measurements for 1971 are given in Table 1. Obviously strong conclusions cannot be made from the results obtained in this experiment thus far, but some things are evident. Three rootstocks—alemow, kalpi, and rough lemon—have been outstandingly better than the others.

Table 1. Yield and tree size in 'Tahiti' lime rootstock experiment, University of Florida AREC, Homestead, 1971.

Rootstock	Mean yield-55 lb boxes/tree	Mean tree size (ft)	
		Height	Width
Alemow (C. macrophylla)	1.62	7.0	10.3
Kalpi (C. webberii)	1.25	6.5	9.3
Rough lemon (C. jambhiri)	1.14	6.8	9.9
Cleopatra (C. reshni)	0.77	5.7	8.3
Shekwasha (C. depressa)	0.67	5.0	7.2
Ichang (C. ichangensis)	0.62	5.2	7.6
Citrus taiwanica	0.61	6.3	8.5
Rangpur (C. limonia)	0.51	5.5	7.7
'Sampson' tangelo	0.38	6.1	8.8
'Troyer' citrange	0.17	4.6	5.9
'Leonardy' grapefruit (C. paradisi)	0.09	4.9	6.0
'CRC 1452' citrumelo	0	2.4	0.8

Alemow appears to be the most promising new rootstock for 'Tahiti' lime. This is confirmed by previous research and by limited grower experience. Trees on this rootstock produce large yields of fruit. The trees grow rapidly in the nursery and the field, and make very few root sprouts. Phytophthora foot rot has not been observed in 'Tahiti' lime trees on this rootstock. It should be mentioned that the alemow is known to be quite susceptible to the tristeza virus. Although this disease has not been a problem with 'Tahiti' lime in Florida, growers should keep in mind that it could become a problem in the future.

The good performance of the kalpi is interesting and indicates the need for a thorough investigation of this species as a rootstock. Root sprouting appears to be minimal. Susceptibility to diseases has not been determined in Florida.

As usual, rough lemon is among the best rootstocks in tree growth and yield. Disadvantages of this rootstock include susceptibility to Phytophthora foot rot and a tendency to make many rootstock sprouts; however, these flaws have not kept rough lemon from being the most popular rootstock for 'Tahiti' lime up to now.

Three rootstocks have given notably poor performance. Although the 'Leonardy' grapefruit plants cannot be directly compared to the others because they were planted a year later, they still have grown poorly and have had a high incidence of Phytophthora foot rot. The 'Troyer' citrange and 'CRC 1452' citrumelo have grown poorly here also, although they are promising rootstocks in some other areas. Both are hybrids with trifoliate orange as one parent, and like that species they are sub-

ject to severe iron deficiency in the Rockdale soils in southern Florida.

To achieve high yields in the early years of an orchard's development it has become customary in Florida to plant the trees relatively close together, with plantings of 150 to 250 trees per acre instead of the 100 to 150 of the past. Such plantings have the important disadvantage that after a few years the trees grow together and some sort of periodic pruning is necessary to maintain production and permit the passage of people and machinery through the orchard. Some means of limiting tree size would be highly desirable, and dwarfing rootstocks are one obvious solution to the problem. Unfortunately, none of the rootstocks used in this experiment appears so far to have good possibility for dwarfing trees, because yield of fruit is directly related to tree size.

This experiment will be continued and hopefully will give further useful information on new rootstocks for 'Tahiti' lime.

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EFFECTS OF MAGNESIUM NITRATE SPRAYS ON MAGNESIUM DEFICIENT LIME TREES ON CALCAREOUS SOIL

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Abstract. **On 'Persian' lime (Citrus latifolia Tanaka) trees on calcareous soil, with a history of severe Mg deficiency, the deficiency was readily corrected with foliar sprays of magnesium nitrate at concentrations supplying as low as 1.75 pounds of MgO/100 gallons of dilute spray. Two sprays a year at this concentration gave satisfactory commercial control over a 4-year period. Magnesium in leaves increased significantly with increasing Mg in spray from 1.75 to 5.25 pounds of MgO/100 gallons. Juice and acid content of fruit increased with higher Mg level in the tree. There was a definite trend for yields to increase with increased Mg level in the tree and by the fourth year the difference was significant. Soluble solids, juice and acid contents were generally higher and peel thinner for fruit under spray treatment than for fruit from nearby trees receiving Mg only on the soil from magnesium sulfate.**

Foliar sprays containing magnesium nitrate at a rate supplying 1.1 pounds of MgO per 100 gallons of water have been used to control Mg deficiency symptoms on oranges in California (2) and in Florida (1). Magnesium fertilizers have failed to give satisfactory control of Mg deficiency on 'Persian' ('Tahiti') lime trees in Florida on Rockdale soil, especially on marcot trees. Spraying with magnesium nitrate at concentrations somewhat higher than 1.1 pounds of MgO per 100 gallons corrected severe deficiency within 3 months for a period of 15 to 24 months, depending upon concentration used (4). Magnesium level in the trees increased as the spray concentration increased. These sprays not only prevented Mg deficiency symptoms from developing in new leaves but corrected some chlorosis in old leaves as well and reduced leaf shed. Where the soil was fertilized with magnesium sulfate most of the old chlorotic leaves

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