spray grapefruit trees with low amounts of lead arsenate for legal maturity of the fruit in midseason. These low rates of lead arsenate not only promote legal maturity in midseason but also produce sweeter and more palatable grapefruit than unsprayed fruit (4). In this experiment grapefruit trees sprayed with the low rate of lead arsenate were relatively effective in growing fruit with passing legal standards (7). From the viewpoint of maturity, the low rate produced fruit which matured about 1½ months earlier, while the high rate matured fruit about three months earlier than fruit from unsprayed trees. In other words the 0.4 lb. rate was about half as effective as the 1¼ lb. rate in producing fruit with passing ratios. Of course, the low rate sprays matured grapefruit during the midseason, while the high rate produced early legal maturity in the fall.

It does not follow that borax be omitted from a spray program since it delays maturity. In some groves where boron deficiency is suspected borax sprays should be used to correct this deficiency. It should be used also on trees producing gummed grapefruit. In this study borax sprays tended to reduce but not eliminate the amount of gummed fruit (2). For these two reasons leaving out borax from a spray program cannot be recommended.

Summary and Conclusions

This experiment consisted of a study of the effect of borax and lead arsenate sprays, alone and in combination, on the total acid content and the ratio values of Marsh grapefruit. Borax sprays raised the total acid content and lowered the ratio values and thus delayed the legal maturity of grapefruit. On the other hand lead arsenate sprays decreased the total acid content and increased the ratio values with consequent early maturity of the fruit. The 0.4 lb. rate of lead arsenate was efficient in producing legal maturity during midseason, while the 1¼ lb. rate was effective in hastening legal maturity in the early fruit season. When lead arsenate was used in a spray program with borax, grapefruit matured approximately 10 days later than fruit sprayed only with lead arsenate. In general lead arsenate sprays on Marsh grapefruit produced the highest ratio values of all the treatments, while borax sprays produced the lowest values. Borax and lead arsenate in combination produced fruit with ratios intermediate between these two extremes.

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SPRAY PROGRAMS, VARIETIES, AND WEATHER CONDITIONS IN RELATION TO SIX-SPOTTED MITE AND PURPLE MITE INFESTATIONS

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To be able to forecast scale and mite infestations, it is necessary to know as much as possible about the conditions which govern the severity of such infestations. Investigations into these factors are an important part of the survey and forecasting work in which the writers are engaged (1, 2). Some of the information which has been collected on the occurrence of major infestations was reviewed last year at this meeting (3), but no explanation of any of the conditions affecting the infestation cycles was offered.

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In the present paper, some of the conditions which affect the abundance of two important mite pests will be discussed. The set of conditions which regulates the abundance of any insect or mite is extremely complex. Not only must the life cycle of the insect itself be considered, but also the life cycles of the parasites, predators, and diseases which affect it. The control measures applied and the condition of the host plant are important man-controlled factors. Most important of all seem to be the weather conditions, which not only may affect the pest insect or mite directly, but may also regulate the abundance of important predators, parasites, or diseases.

These factors are by no means fully understood, and many years of work will be required to obtain a reasonably satisfactory understanding of them. However, some relationships have been discovered, which have already been found useful in preparing long range forecasts.

In two of the past three seasons the six-spotted mite (*Tetranychus sexmaculatus*) has caused considerable damage in Florida citrus groves. This was particularly true of the spring of 1951, when the damage was said to have been the most severe since 1938. According to figures obtained by surveying 130 representative groves each month for nearly three years, this mite has been most abundant in the West Coast District, and has also been common in the northern central districts (Table 1). Infestations have been common in the Indian River District but populations have remained light.

TABLE 1. DISTRIBUTION OF SIX-SPOTTED MITES

District	Population Index
West Coast	10.0
Indian River	2.5
Upper East Coast	7.4
Gainesville	5.7
Orlando	2.2
Brooksville	5.9
Ridge	1.2
Bartow	2.1
(January 1951 through May 1953)	

In checking the survey groves, six-spotted mite infestations are not counted, but are estimated as light, medium, or heavy; or class 1, 2, or 3. In Table 2 the effects of different spray programs on infestation are given. It will be noted that all the unsprayed groves, and nearly all of those receiving sulfur treatment only, have been reported as infested in at least two months of the 2½ year period, while less than half of those on a modified or complete program have been infested. The infestation score, which was calculated by averaging the sums of all the monthly class ratings, is four times as high in unsprayed groves as in those receiving a complete control program. This is of interest to growers using a limited or biological control program, because their groves are liable to serious defoliation in years when six-spotted mite infestations are severe.

TABLE 2. SIX-SPOTTED MITE INFESTATIONS IN RELATION TO SPRAY PROGRAMS

Program	No. Groves	Infested 2 or More Months	Infestation Score
None	9	100%	10.8
Sulfur	13	92%	8.8
Modified	15	47%	2.6
Complete	93	41%	2.7
(January 1951 through May 1953)			

Grapefruit trees tend to be more commonly infested and more severely damaged than are orange groves (Table 3). This is true all over the state, and is not merely a reflection of the fact that there are more grapefruit than oranges in the heavily infested West Coast District.

TABLE 3. SIX-SPOTTED MITE INFESTATIONS IN RELATION TO VARIETY

	No. Groves*	Infested 2 or More Months	Infestation Score
Oranges	63	38%	2.3
Grapefruit	25	56%	3.8

* Complete Spray Program

It has become evident that the same groves tend to become infested year after year. Probably the location, the spray program, and the kind of tree are all factors in this situation. When warnings that six-spotted mite is expected to be more severe than usual are released, groves with a history of infestation with this mite should be carefully watched, and control measures applied promptly and thoroughly when the mites appear.

When six-spotted mite became a serious problem in 1951 (Fig. 1), a study was undertaken to learn something about the factors regulating the abundance of this pest. Since it is one which is a general problem only in occasional years (six out of the past 19), it lent itself to this type of investigation.

As a basis for study, the available notes and records were searched for reports on this mite. Records of heavier-than-average infestations were found for four years of the preceding 16. Although these records were incomplete, it was apparent that each of the seasons in which heavy infestations were reported was preceded by a cold winter.

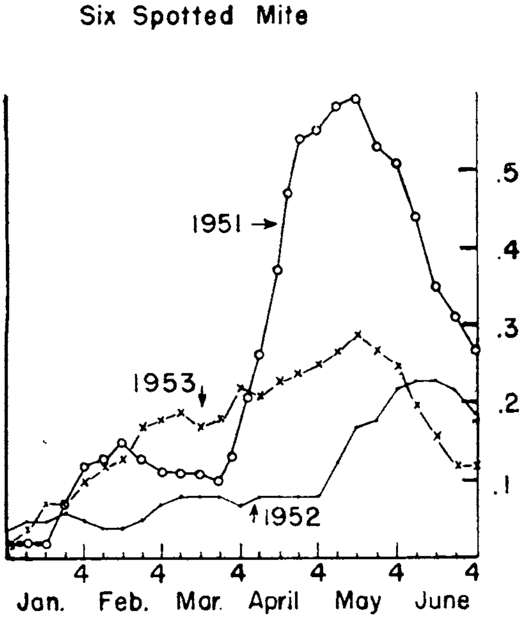

Fig. 1. Six-spotted mite infestations, 1951-1953.

After some preliminary studies, it was decided that the amount of cold weather occurring could best be analysed on the basis of "Heating Degree Days". This value as used by the U.S. Weather Bureau is computed by subtracting the mean temperature for each day from 65. The daily values are added to give the heating degree days for the month or for the period being studied. The climatological station at Avon Park was found to have the most nearly complete record of those in the central citrus area for the period in which six-spotted mite records were available. Consequently, analyses were based on the records from that station. The year 1943-44 was omitted from the calculations because of missing data.

Heating degree days for the cool months, November through February, are given in Table 4 for the years 1934 through 1953. It will be noted that the average for each month, as well as for the four-month period, was higher for the six years in which these mites were abundant than for the 12 intervening years. The difference is much greater for December than for any other month.

TABLE 4. COLD WEATHER IN RELATION TO SIX-SPOTTED MITE INFESTATION

	Degree Days—Avon Park 6 Years Mites Abundant	12 Years Not Reported	Odds
Nov.	40	39	N.S.
Dec.	154	63	99:1
Jan.	120	92	N.S.
Feb.	92	82	N.S.
Total	406	276	N.S.

On the basis of the data available in 1951, the differences between the two groups was found to be significant at odds of 19:1 for the month of December, but not significant for any other month or for the total. On this basis it was proposed that the amount of cold weather in December was the most critical factor regulating infestations of the six-spotted mite, and that this might provide a useful basis for forecasting infestations the following spring. It was also noted that in 1951, the first year in which quantitative population data were available, an increasing trend was evident early in January (Fig. 1).

December of 1951 was warm (33 degree days at Avon Park) and in 1952, the six-spotted mite population index remained low through January and February and increased only slightly in March. On the basis of these facts, a forecast was made in March that a general infestation would not occur.

While there was a late increase in May and June, the peak infestation did not approach that of the year before.

December of 1952 was cold (143 degree days at Avon Park) although there were no important frosts. Six-spotted mite infestations increased rapidly in January 1953. A forecast that this mite would be a problem in the coming spring was released in mid-January.

Infestations continued to increase more or less steadily until mid-May. While the severity of the infestation at the peak did not equal that of 1951, infestations were sufficiently wide-spread and severe to support the hypothesis of critical December temperatures.

With data available for two additional years, a new analysis of variance was run on the data of Table 4. The additional data were sufficient to increase the significance of the difference in December cold weather to the 99:1 level, while the difference in November, January, or February did not approach the level of significance.

While no linear relationship has been found, it is apparent that moisture conditions also have an important effect on six-spotted mite infestations. Following the abundant rains of late March and early April 1953, considerable mortality was observed in the field. It seems evident that this reduced the extent of the infestation at the peak.

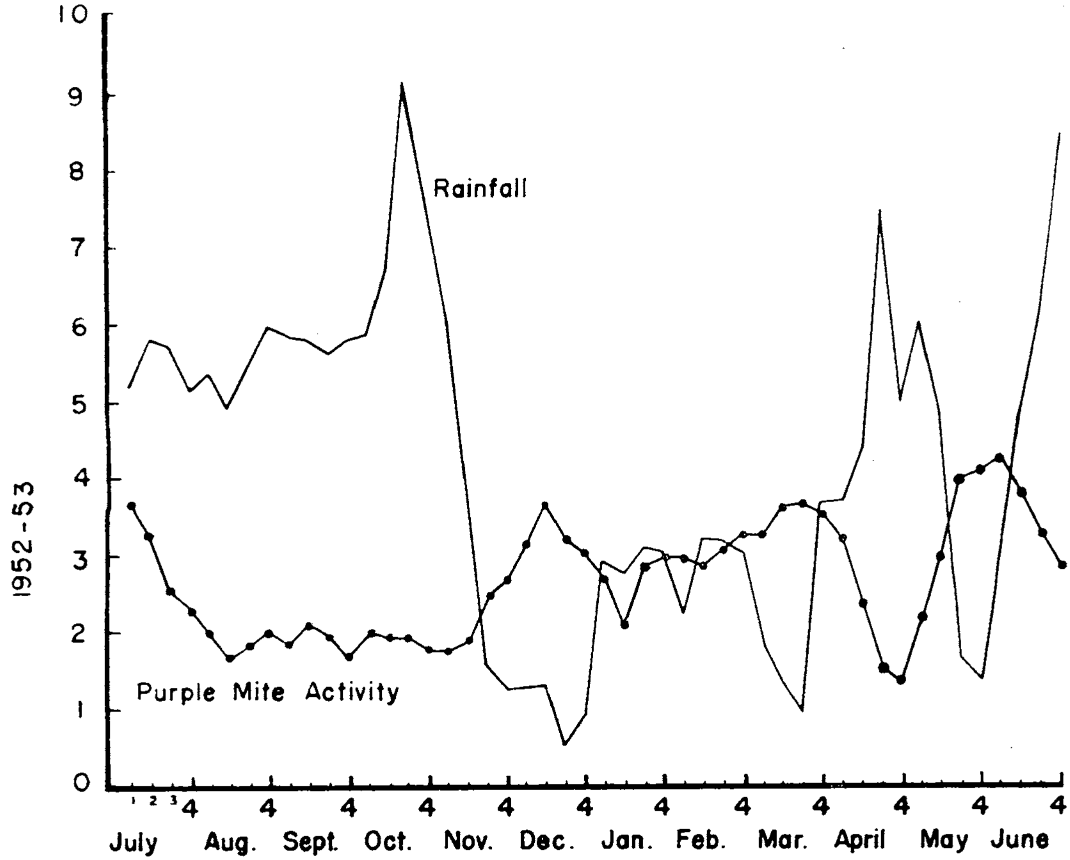

Fig. 2. Rainfall in relation to purple mite activity.

Moisture in Relation to Purple Mite Infestations

General observations over a period of three years have indicated that purple mite (*Metatetranychus citri*) activity is strongly affected by moisture conditions. Recognition of this influence has made possible a high level of accuracy in forecasting this mite.

Recently the average inches of rainfall for stations in the area covered by the project have been compiled from the Weekly Weather and Crop Bulletin released by the United States Weather Bureau. From 15 to 28 stations are reported, usually about 20. The weekly averages for the first half of this year are compared with purple mite activity in Figure 2. Each point on the graph represents the value for the preceding four weeks.

It will be seen that in almost every instance, an increase in rainfall is followed by a reduction, or at least a leveling off, in purple mite activity. Conversely, a dry period is usually followed by an increase in activity, or an interruption of an increasing trend. This negative correlation is significant at the 99:1 level.

It is unlikely that the effect of rainfall on purple mite infestations is a direct one. At least one fungus disease is known to affect purple mites in Florida, and it seems reasonable to assume that the mortality of mites occuring in wet weather is caused by such a disease. Temperature also appears to be a factor in regulating the level of infestation but the relationships have not been clearly defined.

Comparison of Purple Mite and Six-Spotted Mite Infestations

It will be seen from Fig. 3, 4, and 5 that the curves for six-spotted mite and purple mite populations indexes have paralleled one an-

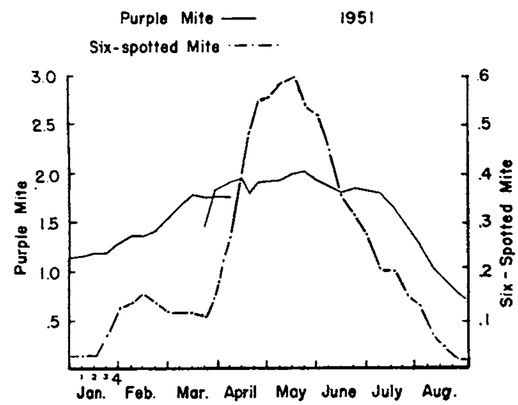

Fig. 3. Comparison of purple mite and six-spotted mite infestations, 1951.

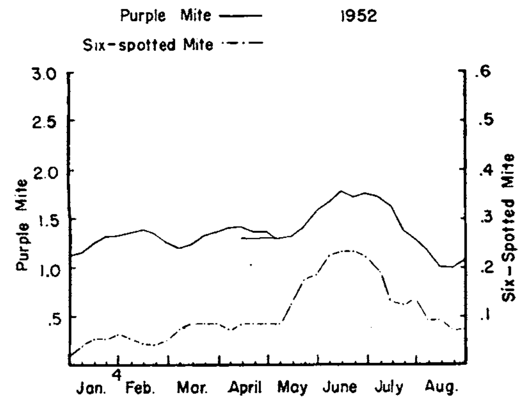

Fig. 4. Comparison of purple mite and six-spotted mite infestations, 1952.

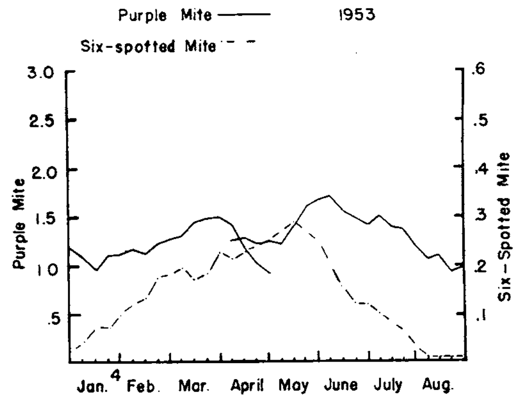

Fig. 5. Comparison of purple mite and six-spotted mite infestations, 1953.

other closely during the past three seasons. This correlation is significant at the 99:1 level.

This suggests that populations of both of these closely related mites may be influenced by the same climatic factors. It is possible that the winter temperature effect described for six-spotted mite also applies to purple mites, but the period of the record is too short for analysis. Since purple mite occurs every year as an economic problem, there are no old records of sporadic infestations available.

While purple mite appears to be much more sensitive to moisture conditions, this factor cannot be overlooked in analysing population trends for six-spotted mite.

Summary

Over a period of three years, it has been found that six-spotted mites tend to recur in the same groves. The abundance of mites in these groves is influenced by location, spray program, and variety.

Severe spring infestations of six-spotted mites occur in seasons when the winter temperatures, particularly those of December, are low.

Moisture conditions influence purple mite infestations more strongly than those of other major citrus pests, and an increase in rainfall is usually followed by a reduction in mite activity.

Peak infestations of six-spotted mite and purple mite tend to occur at the same time and to be of similar magnitude.

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AIDS IN THE DETECTION OF TRISTEZA IN FLORIDA CITRUS

Theodore J. Grant[1]

In view of the fact that the causal agent of a virus disease can not be isolated and studied in culture media, as is the case with many bacterial and fungus diseases, it is necessary to employ other methods of study. The first general observations on tristeza, or quick decline, made under field conditions in South Africa

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lead to the knowledge that sweet orange tops on sour orange rootstocks showed decline symptoms while tops of the same sweet orange variety on some other rootstocks did not show disease symptoms. This then was the first method of recognizing the disease in the field. As a result of anatomical studies by Schneider et al. (9) in California of bark at the bud union of infected sweet orange on sour orange rootstock, there is not only a better understanding of the effects of tristeza, or quick decline, on the phloem tissues but there has developed an anatomical method of identifying this disease in the field.

The discoveries that tristeza, or quick decline could be transmitted by buds (10) and by the *Aphis citricidus* (Kirk) (1, 7), furnished evidence that the disease is caused by a virus. The knowledge of transmissibility of quick decline virus by means of buds led to the establishment of rootstock tests in California (2), where buds from diseased trees were used as sources of inoculum. The knowledge that tristeza virus could be transmitted by an aphid in Brazil was followed by extensive rootstock tests carried out cooperatively by the Instituto Agronomico of Sao Paulo and the United States Department of Agriculture (5) in which scion-rootstock combinations were inoculated by means of the aphid vector. This cooperative work resulted in classification of the rootstocks as tolerant or non-tolerant to the tristeza virus. Inoculated seedlings of some 50 different citrus varieties were found to express disease symptoms. The cooperative investigations also led to the knowledge that there are strains of the tristeza virus and that some strains cause severe disease while others cause milder disease symptoms (6).

The inoculation of citrus seedlings in Brazil by means of viruliferous aphids led also to the finding of vein clearing symptoms on *Aeglopsis chevalieri* Swingle and on West Indian type limes such as Key and Beledy (*Citrus aurantifolia* (Christm.) Swingle) (4).

The combination of vein clearing and stem pitting symptoms on West Indian type limes such as the Key lime inoculated with tristeza, or quick decline, virus has been observed in tests carried out in South America (4), South Africa (8), and California (11). This combination of vein clearing and stem pitting of inoculated Key lime plants was the initial means of detection of a mild strain of the tristeza virus in Florida. Later a combination of Key lime plant inoculations, and the bark-sampling technique worked out by Schneider was employed by the Florida State Plant Board and cooperating organizations (3) to determine the distribution of the tristeza virus in this State.

In the latter part of August 1952, Dr. J. F. L. Childs of the U. S. Horticultural Station found, in Florida, some Persian, or Tahiti, limes with distinct vein clearing. Collection of branch material from these vein-cleared Persian lime plants and bottle-grafting to Key lime test plants showed that they were carrying the tristeza virus. This initial test for presence of the tristeza virus in vein-cleared Persian limes was repeated. When positive vein clearing and stem pitting were obtained on the inoculated Key lime plants, the State Plant Board officials were advised. They then gave the information to their grove inspectors, who proceeded to look for these symptoms on Persian limes. It was thought that in this way further information as to tristeza virus distribution might be obtained. Each grove inspector, upon finding what he thought to be vein-cleared Persian lime leaves, collected scionwood and forwarded it to the U. S. Horticultural Station at Orlando. The budwood thus received was bottle-grafted to Key lime test plants. In tests of 35 samples budwood of 7 samples failed to make positive unions; of the remaining 28 samples 14 from Persian limes transmitted the tristeza virus to Key lime plants.

The State Plant Board grove inspectors also found and collected samples of what they considered to be vein clearing and stem pitting on 8 limequat trees. However, only one of these proved to be carrying the tristeza virus. Likewise the inspectors collected budwood from a few lemon trees showing vein clearing symptoms and one of these, a Meyer lemon, proved to be carrying the tristeza virus.

The proof that the tristeza virus was the cause of vein clearing would require that healthy Persian limes, limequats, and Meyer lemon be inoculated with a pure strain of the tristeza virus. The development of vein clearing on these inoculated plants would then be evidence that the tristeza virus alone was the cause. However, the fact that the virus was recovered from 14 of the 28 Persian limes constitutes good evidence of a definite association.

On the other hand, the finding of only one limequat with positive tristeza virus out of 8 samples tested is considered very poor evidence of a definite association of tristeza virus and stem pitting on limequat. Likewise, the finding of one Meyer lemon with vein clearing that gave positive transmission of tristeza virus to Key lime is of considerable interest but is inconclusive until samples from other similar trees can be tested and found infected.

Vein Dashes on Sour Orange and Grapefruit

Study of the tristeza disease of Florida citrus is being carried out under controlled conditions in the greenhouse and screenhouses at Orlando. Healthy seedlings of several citrus varieties as well as Key limes have been inoculated. Three sources of tristeza virus have been used. The origin of two of the virus sources was a mandarin lime, and an Orlando tangelo. Scionwood from these field trees was bottle-grafted to Key lime plants, and the presence of tristeza virus was judged by the development of typical vein clearing and stem pitting symptoms. These infected Key lime plants were used as two of the sources of tristeza virus. The third source of inoculum was a potted Key lime seedling exposed for a ten day period to natural infection by placing it under a known infected tree in the field. This seedling lime was naturally infected, presumably by an insect vector, and was therefore considered to be free of psorosis-type viruses, which are not known to be insect-transmitted.

Tristeza virus from all three of these sources produced vein clearing and stem pitting on Key limes. The insect-inoculated virus source produced the mildest symptoms. When sour orange seedlings were inoculated by means of scionwood bottle grafts, it was noted that in some cases the young top leaves of the sour orange became yellow but that subsequently new normal growth appeared. All inoculated sour orange plants were somewhat stunted, but they continued to live and produce new growth. Transfers by bottle grafts to Key lime showed that the tristeza virus had lived and multiplied in the sour orange without killing the plants. Careful examination of the new young sour orange leaves revealed the presence of occasional tiny vein-cleared dashes in the lateral veins. This symptom has been called vein dashes as distinct from the more conspicuous and general vein clearing characteristic of tristeza-virus-infected Key lime. Similar vein dashes were noted on young leaves or Duncan grapefruit seedlings inoculated with scionwood from the same three sources of tristeza virus.

These vein dashes tended to disappear as the sour orange and grapefruit leaves matured. Although this symptom was transitory and could be found only by careful examination of the young leaves in strong sunlight, it was considered important to determine whether it could be used under field conditions to identify tristeza-infected trees. Two State Plant Board inspectors, A. C. Crews and H. M. Van Pelt, were shown the diagnostic vein dashes and asked if they would bring in from the field material that showed this symptom. Within a short time these men brought in four samples of grapefruit and one sample of sour orange. Bottle-grafts of branches from these samples to Key lime test plants all showed that the tristeza virus was present in the samples collected.

The value and practical importance of this work have yet to be demonstrated, but it does open up the possibility of detection of tristeza in grapefruit trees by inspection of the young foliage. The application of this knowledge may be especially helpful in determining distribution of tristeza in the Florida Ridge section, where grapefruit is grown on Rough lemon rootstock and where the bark-sampling identification technique is not yet applicable.

Discussion of Practical Applications

The citrus grower may question the practical value of information concerning vein clearing on limes and vein dashes on grapefruit. However, as a means of detecting presence and distribution of tristeza virus in his grove they give the trained State Plant Board inspector and the scientist, additional methods of determining the presence of the disease. Increase in our knowledge of this disease has been arrived at slowly, but each step has led to greater accuracy and to reduction in the number of plants that have to be tested in detail in order to be sure that the tristeza virus is present.

In the survey (3) for presence and distribution of tristeza in Florida many tests of virus transmission have been made from diseased field trees to Key lime plants. Results indicate that in many instances not only tristeza virus but also psorosis and other virus-like disease agents were present in the scionwood from the declining field trees. This information, combined with field observations of declining sweet orange on tristeza-tolerant rootstocks such as Rough lemon with no evidence of recognized cause, indicates that other virus or virus-like diseases in Florida present a complex picture. The obtaining of a detailed understanding of these diseases and the action or interaction of their causal agents will require appreciable time and study. In the meantime the grove owner wants to know what can be done. The answer at this time must of necessity be based on a knowledge of general behavior of virus diseases and on precautionary measures of sanitation.

In plant disease as in human disease outbreaks one of the first steps to be taken is that of practical common-sense sanitation. If the source of a human disease infection is the water or milk supply these should be cleaned up. In the case of virus diseases of citrus, budwood can be a definite carrier of the infectious agents. The grower's active cooperation in the State Plant Board's bud-certification program is an important first step toward freedom from virus diseases. This program for a supply of healthy budwood can not be accomplished overnight. As knowledge increases, the methods of detecting the virus diseases can be improved so that eventually the State Plant Board may be testing for more viruses than are now recognized and thus may be able to eliminate them or reduce their occurrence in budwood supplies. In the future it may also be advantageous to establish certified sources of seed as well as of budwood. The advantages of certified seed sources would be to insure, for example, that the particular Rough lemon is one known to have the desirable horticultural characters and tolerance or resistance to disease.

A sanitation measure that also can be taken is that of removing declining citrus trees from the groves. When a grove owner has citrus trees in a state of decline that do not respond to fertilizer or spray treatments it would be well to get rid of them. This is especially true where these trees are observed to occur singly or in scattered small groups. The fact that these trees are scattered might well indicate that some infectious agent is being spread. Certainly these trees are of little economic value, and they are a potential hazard for further disease spread. Replanting of spots, where declining trees have been removed, with healthy scions on tristeza-tolerant rootstocks is recommended wherever possible.

The nurseryman and the grove owner can also take effective precautions with respect to multiplication of budwood. In the past a common method for rapid multiplication of budwood was topworking it into old trees. Such a procedure is a sure way of introducing into the budwood any viruses that may be present in the stock tree. The subsequent use of buds from such sources can result in a grand-scale distribution of the viruses that are the causal agents of disease. The safest procedure for establishing a source of budwood is to bud it into young seedling stocks which have never had a bud inserted in them.

Topworking of old groves for the purpose of changing varieties similarly offers an opportunity for virus infections from the old stock to spread into the new variety. The subject is mentioned because of the current interest in topworking grapefruit and other old citrus trees to lemons and Persian limes. From a virus-disease standpoint topworking is a hazardous practice especially when the trees selected for topworking are obviously diseased or are in a poor state of growth suggestive of the presence of disease.

The outstanding exception is tristeza-infected trees topworked with acid lemons. In Brazil it was found that topworking sweet orange on sour orange rootstock with acid lemons such as Eureka and Lisbon could be successful even when the trees were showing definite tristeza symptoms. Similar experience in California (2) showed that topworking of quick-decline-infected Valencia orange on sour orange rootstock was successful when the topworking to lemon was complete but that partial topworking to lemon was not satisfactory. The presence of the diseased sweet orange top on a part of the tree greatly inhibited the growth of the lemon scions on the other part.

How this procedure of topworking of old field trees to acid lemon varieties will work under Florida conditions remains to be demonstrated. The strain of the tristeza virus is mild and there are indications that many of the visibly diseased field trees are carrying more than just the tristeza virus.

The vein clearing reactions of the Persian lime in association with the mild strain of the tristeza virus in Florida have been mentioned.

Infected trees of Persian lime on sour orange rootstocks observed under field conditions may not have been quite as vigorous as the surrounding trees in some instances. At the same time these infected trees were not in a serious state of decline. The exact effects of tristeza virus on the acid Persian lime and of other possible virus combinations that may be encountered in any topworking operations have yet to be determined.

It is not expected that this warning as to the virus hazards will stop the practice of topworking citrus, but when the grower does decide to topwork he should take every possible precaution to insure that his source of budwood is healthy and the trees he topworks are as healthy as possible.

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RELATION OF pH AND SOIL TYPE TO TOXICITY OF COPPER TO CITRUS SEEDLINGS

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In a previous study (5) it was shown that the topsoils in most bearing citrus groves in the sandy soils of central Florida have accumulated between 100 and 500 pounds of total copper (calculated as CuO) per acre-six-inches. Natively such soils usually contain between 5 and 20 pounds of CuO per acre in the topsoil. This accumulation results largely from the fixation of copper added in mixed fertilizers and to a lesser extent from that in residues of fungicidal or nutritional sprays containing copper. For the past decade or more it has been common practice to apply 10 to 25 pounds of CuO (from copper sulfate) per acre in the regular fertilizer program each year and in some cases an additional 5 to 25 pounds per acre per year from foliage sprays. In other studies (6) it was shown that under acid soil conditions, copper concentrations well within the ranges commonly found in mature grove soils caused stunted, abnormal root development, and under certain conditions, so-called iron chlorosis of the foliage of young citrus seedlings in pots.

This paper summarizes the results obtained from additional pot studies designed to clarify further the relation of type, cultural history, acidity and zinc and manganese contents of soils to toxicity of copper to citrus seedlings.

Materials and Methods

Soil number 1 described in table 1 was obtained in Lake County from land newly cleared in anticipation of planting to citrus.

Table 1. Description and composition before treatment of soils used in pot studies.

Soil No.	Type	Depth (inches)	Cultural history	Exch.cap. (me./100gms.)	Total CuO (lbs./A)	Total P_2O_5 (lbs./A)
1	Lakeland sand	0 - 4	Virgin	1.51	5.7	690
2	Lakeland sand	6 - 12	Virgin	1.15	1.8	680
3	Orlando fine sand	0 - 6	Old grove	7.22	262.0	7,690
4	Orlando fine sand	0 - 6	Virgin	6.15	3.5	2,640

Similar soil is common in the rolling hills of central Florida, and is extensively used for citrus culture. Soil number 1 is typical of the lighter, sandier phase of the Lakeland series known as "blackjack" land. Soil number 2 is subsoil of a type similar to soil 1, but obtained from a different location.

Soil number 3 described in table 1 was obtained in a 30-year-old Valencia orange grove affected periodically in the past four to five