Stock, Mr. Van Rensselaer invited Mr. Fred Petersen, who is with the Soil and Plant Laboratory, Inc. of Orange, California, to present a talk on the methods used in producing standardized quality nursery stock and procedures, with the various methods at our disposal now, to keep these registered and certified clonal selections healthy and disease-free for our customers.

I would like to introduce to you Mr. Fred Petersen, who is a graduate from the University of Utah, having specialized in plant physiology, chemistry, and experimental biology. He has been with the Soil and Plant Laboratory since 1958. When recently it was decided to open a Central California office, Mr. Petersen was selected as the man to manage that office. I now call on Mr. Fred Petersen.

Current Methods in the Selection and Production of Nursery Stock

Fred H. Petersen

Central California Office
Soil and Plant Laboratory, Inc.

Without prescribed systemetized methods, the production of any item of commerce, be it an intercontinental ballistic missile or Juniper Tam, could be a chaotic unpredictable, uneconomic and unrewarding procedure. The pressing need of a guide for the systematic production of nursery stock was seen several years ago by Dr. Kenneth F. Baker in the Department of Plant Pathology at the University of California in Los Angeles. The outgrowth of this awareness was the UC Manual 23, The UC System for Producing Healthy Container Grown Plants. This Manual, edited by Dr. Baker, provides practical guides and a realistic basic philosophy upon which many present-day successes in the California Nursery Industry are based. The authors, both explicity and implicity, convey the thought that systemetized growing and the adoption of standardized methods and procedures can lead to the production of nursery stock with a higher degree of standardization than some thought ever possible. The successes of the system in the production of standardized plant material are largely the result of the fact that plant material grown under this system is provided with as near optimal conditions for growth and development as are possible. These conditions primarily depend upon freedom from plant disease caused by pathogenic fungi, nematodes and/or chemical damage.

The philosophy and methods suggested by our Organization are founded in the UC System. In extending this system into the nursery industry, our Organization would make the following suggestions as far as methods and procedures are concerned, particularly as they affect the propagation aspect within the industry. If we acknowledge that systemetized growing is pre-requisite to success, we must accept principles and follow plans. The procedures in propagation and production within the nursery should be detailed in writing by highly trained personnel, particularly in view of the fact that many simple procedures can be carried out by inexpensive and not highly skilled labor. These

procedures should be broad enough to have universal applicability for plant materials. Heading the list of cardinal procedures would be a profound acknowledgement for the requirement for cleanliness. This cleanliness aspect cannot be over-emphasized, and should be extended to include the personal cleanliness habits of all employees handling plant material as well as the proper care and treatment of all tools and equipments used in propagation and production. In addition to the universal procedures, specific procedures should be detailed for the particular plants propagated and produced. Ideally, records of each cycle of propagation should be kept in the form of card files. These cards should contain the following information, all of which serves as a basis upon which programs are to be evaluated and procedures either accepted, rejected or modified. This information should include:

1. Source of Material.

   We suggest that cuttings be taken from healthy, vigorous growing stock plants. This is not always possible and in many instances, the propagator is obliged to depend upon field grown material of questionable background.

2. Degree of Maturity.

   This information would presumably be observations as to the softness, hardness and the general vigor of the plant material being propagated.

3. The Propagation Treatment.

   To be included, should be the type of cutting, the method of cutting, the specific fungicides, bacteriacides and insecticides which were used in this particular cycle of propagation.

4. The Propagation Medium.

   Which of the several generally successful materials were used? A peat-perlite mix, a sand mix, a vermiculite mix or combinations of these or other materials? We have seen high degress of success with *each of these materials*.

5. Pretreatment of Propagation Medium.

   Was the medium steamed, methyl bromide treated, or untreated? We suggest that all propagation media be steamed within the propagation flat. Treatment here provides a measure of protection against possible re-contamination in filling the flats. Where steam is lacking, methyl bromide should be used. We do not suggest that any propagating medium be used without treatment.

6. The Number of Cuttings Stuck.

7. The Rooting Environment.

8. The Time to Root.

9. The Percentage of Take.

10. The Time that Rooting Cuttings were Potted On.

11. The Production in the Liner Stage.

    Here, should be included notes as to any fungicides, insecticides used as well as the fertility levels maintained in Liner production.

12. Production Achieved.

    Precisely, what per cent of cuttings initially made actually resulted in a healthy, vigorous growing Liners?

13. And most importantly, Review Notes by the propagator suggesting changes in procedure or possible explanations of losses incurred. Here the dynamic aspect of propagation enters. We should never be so tied to a system that we are not willing to accept change, but only by careful review through thorough record keeping can we have a logical basis upon which to make conclusions.

A mainstay of propagation depends upon the physical facilities and procedures followed. We encourage nursery management not to negate the propagation facility. The facility should not be a spare room, a multi-purpose room or a storage area. It should, rather, be a specific entity within the nursery. It should be dust-tight, be well-lighted and have hot and cold water facilities for personal and mechanical hygiene. We prefer cement floors with drains so that the entire facility can be cleaned daily with a disinfectant such as dilute Purex or Chlorox. This requires that all bench tops and working surfaces be constructed of a material inert to these materials. Daily practices should include a thorough cleaning of all tools and equipment, presumably by dipping in dilute Chlorox or Purex and storage in plastic bags injected with a fumigant such as propylene oxide. Periodically the entire propagation facility should be cleaned from top to bottom with dilute formaldehyde. Such a treatment, of course, requires that all plant material be removed from the facility.

The design of the facility should be such that materials flow in only one direction. A long rather narrow structure would seem ideal. The flow pattern should then be like the production line in a factory. The idea here is to prevent re-contamination at various steps within the propagation facility. Certain areas within the facility should be designated.

1. The Admission Area. Overhead misting should be provided with a drain facility. Here, all plant material should be washed free of outside contamination and debris. Continuous overhead mist will prevent dessication.

2. The Preparation Area. Work should be done on clean, pre-treated and routinely cleaned benches. We prefer the use of sharp knives for preparation of cuttings, but shears are used successfully by many of our clients, though a worn pair of shears can, by crushing tissue, inflict serious damage. Whatever choice of tool is made, the tools should be cleaned repeatedly throughout the working day by dips in dilute Chlorox or Purex.

3. The Cutting Area. The cuttings, once prepared, should be placed in a slotted poly-ethylene basket or some other container which will drain well, then washed in clear running water in a deep sink. An adjoining deep sink can then be used for dipping the cuttings. The so-called "Triple-Dip" of 2 cups Captan, 1/4 cup Terraclor, and 1/4 cup Agrimycin 100, per 5 gallons is acknowledged as an excellent method of disinfecting the cuttings of disease organisms. Many propagators, particularly recently, have successfuly used a solution of Morton Soil Drench C diluted 1 to 10,000, for the general clean-up dip. This material is a mercury fungicide of broad spectrum activity. Included in the dip might be an insecticide, depending upon local immediate problems. After draining, the material is considered "clean", and is then treated with hormone if required. In this regard, we suggest using the very minimum amount of hormone solution or dust suspension in disposable containers -- this to preclude the re-contamination of cuttings if perchance some disease organism entered the hormone material.

4. The Sticking Area. This is considered a scrupulously clean area. Here, flats of pre-treated media enter the facility, ideally, on rollers which can be cleaned daily. Here, the actual sticking of cuttings takes place and rigid standards of personal hygiene are required. Overhead misting is ideal to prevent dessication.

5. The Shipment or Transfer Area. This area is considered "clean" and meticulous cleanliness is necessary. This is probably the easiest place to re-contaminate propagation material as the material is transferred from one building to another. The flats should be placed only on copper naphthenated treated surfaces or other clean surfaces, and should never be allowed to come in contact with the floor.

The flats, once prepared, are then transferred to the rooting facility which should be an area of absolute isolation with no through traffic allowed. Here, of course, rigid cleanliness standards must be observed. All wood surfaces should be coated with copper naphthenate. The floors should be kept meticulously clean. A cement floor with center drain is ideal. The construction of the rooting facility should be tight enough to prevent dust as a re-contaminate. As soon as material arrives in the rooting facility, it should be drenched with a fungicide such as Morton Soil Drench C as a final clean-up precaution.

Upon rooting and hardening, the material is transferred to the Liner facility. Cleanliness, here again, is paramount. Two systems of potting on are generally used successfully:

1. With a Head House Unit at the Liner House, potting is conducted on scrupulously clean benches ideally equipped with an overhead hopper containing the steamed pre-treated soil mix. This would prevent the accumulation of a soil pile in the bench. The soil mix we suggest would be patterned after the UC type mixes. These mixes provide optimum physical characteristics and fertility for the rooted cutting. We suggest that potting be done in peat transplanter pots, these to be preferred over either clay or plastic. We find that more normal root development takes place in the peat pots, there is no re-cycling of clay pots in the nursery and there are no leftover pots. The re-use and/or storage of clay pots, we feel, serve as sources of re-contamination. We suggest that the peat pots be placed into copper naphthenated treated flats for transfer to the growing area. The flats should be placed on raised benches of treated wood in the Liner House.

2. With no Head House System, the pre-treated soil mix is brought in unitized boxes directly to the Liner Benches and potting is conducted into the peat pots which are lined out on the surface of the bench. This system has the advantage of reducing labor by less handling of the material, and also tends to preclude a possible source of re-contamination in the Head House.

The Liner facility should be equipped with suitable fertility management equipments. We find that Liner production generally requires a slightly different fertilizer program than container growing, and for this reason, where possible, we suggest the installation of a separate fertilizer injector for the Liner facility. Without hesitation, we suggest the Smith Measuremix Injector, as, in our experience, this has proved to be the superior injector available. We maintain fertility according to methods of interpretation based on our Laboratory experience. Best results are obtained when fertilizer is applied

in dilute quantity on a "constant feed" basis. The finished Liners are then cycled into the container growing area.

In conclusion, production of nursery stock would seem to be dependant upon two things: system and facilities. The system should be such that it is reproducible yet alterable for improvements, and records should be kept at every stage in propagation. The facilities should be such that they are complete and are specifically designed for the use of the propagator.

The relative success of production, by and large, will depend upon the degree of care taken in selection of the system for propagation and of proper propagation facilities and equipments.

MODERATOR SPRING: So we strive on for our ideals. While Mr. Petersen has described a very ideal facility, I know that it will be a long while before many of us can attain this ideal, but it certainly has proven itself, I understand, in the profits returned on assured methods of plant propagation.

Our next speaker will be Mr. Paul W. Moore, who is Director of Research and Development for Willits and Newcomb Citrus Nursery, Thermal, California. In preparation for this position Mr. Moore obtained a degree, specializing in sub-tropical horticulture, at the University of California. From there he worked for a while at the University of California at Los Angeles as a Technician in Sub-tropical Horticulture. He was a Farm Advisor, both in San Bernardino County and in Los Angeles County. For seven years he was chairman for the Citrus Grove Rejuvenation Research Group at the University of California Citrus Experiment Station, Riverside. Since 1960 he has been with Willits and Newcomb in his present capacity. This is one of the larger citrus nurseries in California, specializing in the propagation and distribution of virus-free budwood -- Mr. Paul Moore --

CURRENT METHODS IN THE SELECTION AND PRODUCTION OF CITRUS NURSERY STOCK

Paul W. Moore

Willets and Newcomb Citrus Nursery
Thermal, California

The objective of the reliable citrus nurseryman is to produce trees which are typical of the variety, have a high yield potential, and which will be long lived. To accomplish this requires a thorough knowledge of variety and strain characteristics, careful scrutiny of budwood sources for mutations, acquaintance with the known virus diseases which affect production and longevity, and a knowledge of rootstock-scion interactions and adaptations.

The prosperity and success of the citrus industry, and the financial solvency of individual growers, depends in no small measure upon the integrity, the knowledge, and the sound judgement of the nurseryman.