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9. ABSTRACT
This report presents the author's assessment of current testing and use of clonal rootstocks at the Las Brujas Experiment Station in Uruguay. His activities included advising on present and future propagation methods involving rootstocks in nursery tree production, and suggesting procedures that would improve the quality of nursery products. Some of the major points in the report: Dwarfed fruit trees have become increasingly important throughout the world, because more trees can be managed more economically per acre. Dwarf apple trees can start to produce commercial crops four to eight years earlier than standard apple trees. Dwarfed trees are made by budding or grafting any desired variety on dwarfing rootstocks. Fruit tree rootstocks to control tree size in high-density plantings are not used in Uruguay, but Las Brujas has initiated testing of some apple rootstocks. However, no research has been started to test dwarfed trees under various experimental conditions. Thus an experiment was designed for trees to be planted in the spring of 1976. Short-term research tests related to fruit production from compact trees were initiated. Tests of methods of rootstock propagation were also initiated. At various meetings with nurserymen and farm owners, the author stressed the importance of getting new-orchard production off to the best possible start by planting high-quality trees and providing high-quality orchard management.

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AN EVALUATION OF FRUIT TREE ROOTSTOCKS AND ORCHARDS, AND SUGGESTIONS ON FUTURE FRUIT PRODUCTION IN URUGUAY

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INTRODUCTION

The primary objective of my assignment in Uruguay was to assess the current testing and use of clonal rootstocks and to evaluate their possible adaptability to this climate and those soils. I also was requested to advise on present and future propagation methods involving rootstocks in nursery tree production as well as to suggest procedures that would improve the quality of nursery products and lead to a nursery certification program. Several growers have asked my solution to their general production problems.

ACKNOWLEDGEMENT

First I would like to acknowledge the fine support of AID personnel, facilities, material and equipment. Much credit also should go to the Consortium group who served at the same time for their cooperation and assistance, and to chief of party Dr. Chester W. Hitz for his valuable suggestions toward accomplishing the objectives of this assignment.

I also wish to acknowledge with thanks the cooperation and respect of personnel at the Las Brujas Experiment Station. From Director Curotto to the men in the field, all have been most helpful in obtaining research data, in planning meetings and aiding in the several activities in which I have participated.

The short term here was made interesting, pleasant and valuable through the cooperation of the pomology staff Ings. Tálice, Borsani, Spínola, Formento and Menéndez. Special thanks go to Ricardo Menéndez for serving as translator of several talks and during travel to many fruit farms and work at Las Brujas.

FRUIT TREE ROOTSTOCK SITUATION

During the past 20 to 30 years dwarfed fruit trees have become of increasing importance in fruit areas of the world, because more trees can be managed more economically per acre. Furthermore, due to increased cost of land and labor, higher productivity must be achieved from this costly land and labor. This is being accomplished through the use of dwarf trees which start to produce commercial crops 4 to 8 years earlier than the old standard apple trees.

Dwarfed trees are made by budding or grafting any desired variety on dwarfing rootstocks to yield precocious, compact trees predictably uniform in size.

Fruit tree rootstocks to control tree size in high density plantings are not utilized in Uruguay. Some growers have planted a few trees on dwarfing rootstocks in order to evaluate the combinations. Too often, identification of the rootstock was unknown or not recorded when planted.

The Experiment Station at Las Brujas has initiated testing of some apple rootstocks, especially as related to a project on propagation of trees. However, no research has been started testing dwarfed trees under various experimental conditions. For this reason an experiment, discussed later, was designed for trees to be planted in the spring of 1976.

The rootstock propagation beds used for making new trees at Las Brujas contain a number of dwarfing rootstock clones. Unfortunately, the best and proven rootstocks are very limited and some are not in the stooling beds. Those limited are: M. 9, M. 26, M. 7A, M. 13 and F. 12/1 (a cherry stock). Those not currently in test plantings: MAC 24, M. 27, M. 20-3 (a plum stock), and P. Callyriana (a pear stock).

In order for the rootstock research program to succeed clean rootstocks should be ordered at the earliest opportunity from U. S. A., England or other source known to be virus free. Although trees propagated on virus infected rootstocks will grow and crop, tree yields are less than from clean rootstocks and scions.

The foundation for a sound fruit tree rootstock program for high density commercial plantings lies with enthusiastic nurserymen who are knowledgeable of plant material and methods of propagation. Along with good nursery management, grower confidence in the nurseryman should be established. At the beginning or development of a good fruit tree nursery, it is essential that the nurseryman work closely with staff members at Las Brujas. The staff there should be qualified to give guidance on such items as plant identification, methods of efficient and practical propagation and tree production, equipment needs, suitable soils for fruit tree production, pest identification and control measures, etc. At present, the station personnel may not be qualified to provide all of this assistance; however, with experience and educational updating of staff members, this information and help should become available to nurserymen in the future.

ROOTSTOCK AND CULTIVAR CERTIFICATION

Plant materials used to construct young fruit trees often carry insects and disease with symptoms unrecognized or ignored by nurseryman and buyer. Possibilities exist of the introduction of latent viruses which can cause reduction in tree growth and productivity into nurseries carelessly managed. The production of good nursery stock requires careful attention to source of materials, to propagation, plant management and pest control.

To prevent further planting of unsatisfactory nursery fruit trees a plant certification program should be implemented at an early date in Uruguay. This will require time, effort and cooperation of personnel at Las Brujas, nurserymen, fruit growers and government regulatory agencies. A publication outlining a true certification program has been prepared (2).

Progress in the use of dwarfing rootstock by the fruit grower in Uruguay will of necessity be slow because 4 to 6 years are required to obtain clean plant material from which trees are produced and sold to the grower. During this 4 to 6 year period both rootstocks and cultivars will be inspected and checked for trueness to name before certified for sale (8).

SOILS FOR NURSERIES AND ORCHARDS

Most soils utilized for nursery tree production in Uruguay are of rather heavy sticky clay. This condition is far from ideal; however, the production of both nursery trees and of fruit in orchards apparently warrants continuation on this land. For best growth and production of dwarfed trees, the best possible orchard sites should be selected.

Observations during three months indicate that better orchard soils are located west of Montevideo toward Ecilda Paullier and south of highway one. The pomology staff at Las Brujas are hoping to develop an orchard test site in that area (1).

The most successful fruit tree nurseries throughout the world are found on well aerated loamy soils, high in organic matter, and also on sandy loam with irrigation. The management of rootstock stoolbeds for finished trees is a new venture in Uruguay and requires an understanding of rooting processes, transplanting and all steps in growing quality fruit trees.

IMPROVING SOILS FOR DWARFED TREES

In order for dwarfed compact trees to live, grow and produce, the conditions inherent to clay soil should be improved. Or, an alternative is to choose a new site with lighter loam soil more suitable for fruit trees, but this is expensive and often not practical. The poor drainage of clay soils can be countered by installation of subsurface drainage tile, and by taking full advantage of slopes permitting surface drainage of the planting. The aeration and tilth of clay soils can be improved by incorporating organic matter, artificial or green, into soils. . A land rotation system permitting the production of annual crops will improve soil structure.

A deep preplanting plowing done when soil moisture is right for plowing will stimulate best root penetration of newly planted dwarf trees. Level land should be avoided in preference to land with some slope.

ORCHARD MANAGEMENT

Generally, orchards in Uruguay are well managed according to the system prescribed decades ago. However, from the viewpoint of today's modern orchard management systems, the orchards here are outdated. Fortunately, labor, horsepower and equipment are available to work the orchards practically year around. How long man is willing to work hard, tilling by hand the soil around fruit trees and grapevines remains to be seen.

In the system practiced with fruit trees it appears that much bearing surface within reach is lost due to the fact that both animal and tractor power must go near the tree trunk for plowing, disking and dragging between the rows. In modern orchards, trees have spreading branches near the ground allowing for bearing surface within easy reach.

Very few of the fruit growers visited in Uruguay use sod culture with herbicides applied in the tree row to control competitive weeds. Research data compiled for many years in experimental and growers' orchards, in other parts of the world, has convincingly revealed that sod culture will improve tilth and aeration of the soil as well as maintain moisture if well managed. With this modern orchard system, the grower can more easily operate the sprayer during rainy periods thus giving better pest control. Also, much time, labor and equipment is saved since no soil tilling is needed with this newer system.

In talks presented before technical staff, pomology group and fruit growers, modern fruit tree cultural systems have been explained. Since the older orchard trees cannot be appreciably changed, emphasis has been placed on how to plan and plant new orchards. A manuscript entitled "Establishing New Orchards" (Manejo de Montes Frutales Nuevos y Establecidos) has been prepared. It is available for publication as an extension information bulletin (3).

Information on improving the culture of older established orchards has been discussed at various meetings and with pomology staff. The orchard floor of these can be changed from clean cultivation to sod cover. However, changing the upright vase forms of the trees is not practical especially if the trees are over 10 years old. An information bulletin on how to manage the established orchard should be prepared.

In many cases land is not efficiently and economically utilized because trees are spaced too far apart in both directions and the tree form used is not an efficient one. However, most fruit production, especially apple, comes from older trees, which obviously cannot be removed at one time and replaced with new plantings. Therefore, an orchard rotation system should be established, particularly on farms having extra land suitable for new plantings. Essentially, this practice should consist of removing a portion of the old trees, then work and crop this land for 2 or 3 years before again planting fruit trees on the same soil.

USING DWARF TREES TO UPDATE ORCHARDS

Success with compact (dwarfed) trees depends on good orchard management, proper soils, quality nursery trees and use of correct tree training and pruning methods. All these factors have been explained in both research and extension publications. For example, the publication "Developing Dwarfed Fruit Trees" describes in detail the correct methods of dwarfing and performance of compact trees (6).

Although dwarfing rootstocks have not been tested in Uruguay, some growers will be planting apple trees on such stocks in the near future. Due to possibilities of crown and root rot developing on trees planted on poorly drained soils, the grower should be careful of which rootstock he chooses. The Las Brujas Experiment Station will continue the testing of most promising stocks for apple in order to make recommendations to growers.

The one rootstock most likely to tolerate clay soils if they are well managed is MM 111. This rootstock is also resistant to wooly aphid, an insect plaguing most apple trees in Uruguay. On somewhat lighter soil MM 106 should be tried. M. 7 and M. 26 are excellent rootstocks, but they are not resistant to wooly aphids. These latter two rootstocks should be used in Uruguay only where moisture control-drainage and supplementary watering-- can be provided. When these are grown, a good wooly aphid control program should be followed (3).

TABLE 1. Several graft combinations of standard Delicious and spur Delicious with some of the leading and most tested rootstocks.

Varieties	Rootstocks	Percent Standard Size 1/
Delicious	Seedlings	100
Spur Delicious	Seedlings	90
Delicious	M. 7	55
Spur Delicious	M. 7	45
Delicious	M. 26	40
Spur Delicious	M. 26	35
Delicious	M. 9	30
Spur Delicious	M. 9	25
Delicious	MM 111	70
Spur Delicious	MM 111	60
Delicious	MM 106	60
Spur Delicious	MM 106	50

TABLE 2. Delicious and spur type Delicious dwarded by using 10 cm. or 20 cm. interstems of M. 7, M. 26 or M. 9 with MM 111 as the rootsystem.

Varieties	Interstem	Percent Standard Size 1/	
		10 cm	20 cm
Delicious	M. 7	65	55
Spur Delicious	M. 7	55	45
Delicious	M. 26	50	40
Spur Delicious	M. 26	40	35
Delicious	M. 9	30	28
Spur Delicious	M. 9	28	25

1/ Percent dwarfing is based on a standard tree with seedling rootstock being 100. For example: Delicious/10 cm. M. 9/MM 111 = 30% of 100 or about 1/3 size of a standard tree.

Planting an orchard of dwarf trees requires a new consideation of tree spacings and densities. Tree spacing depends on igor of the rootstock and the cultivar. The more dwarfing the ootstock, the more trees should be planted per hectare (5, 6, 7). The number of trees per hectare in higher tree densities can vary from 400 to 800 depending on the scion/rootstock combination. Before planting the new orchard, a plan should be made (and a map) of varieties and rootstocks and tree spacing.

There are many combinations of various varieties and rootstocks that can be propagated into quality trees. Also, when a dwarfing interstem is grafted between the variety and the rootstock specifically sized dwarfed trees can be produced. (See Tables 1 and 2).

ROOTSTOCK AND RELATED RESEARCH

The apple rootstock research aimed at propagating rootstock by the hardwood cutting method was partially successful, even though necessary equipment was not available.

In this rooting experiment shoots from five rootstock clones were used, namely M. 9, M. 7, MM 109, MM 106 and MM 104. These were cut into 20 cm. lengths and kept separate as base, middle and tip cuttings. Cuttings were tied into bundles of 30 so that they could stand upright in the previouly prepared propagation bed. The basal 1 cm. ends of cuttings were dipped for 5 seconds in a solution of 2000 ppm naphthalene acetic acid (NAA). Ninety or more cuttings of each clone were treated and randomly placed about 5 cm. into the sand/soil medium in the propagation bed.

Since no heating cables and electricity were available at the propagation bed, a 30 cm. layer of horse manure was placed under the sand/soil medium to generate heat, usually produced by fermentation. The cuttings were shaded from the sun by a layer of reed grass.

Six weeks after cuttings were placed, they were removed to the nursery. At that time records were made of basal callus production and number of roots initiated on different clones. Data will be completed by Ing. Omar Borsani.

The planting plan suggested for testing these and other size-control stocks was designed so that data can be obtained from separate variety, and variety/rootstock combinations. The design was made flexible so that it can be altered slightly according to orchard site and direction of rows for convenience of spraying and obtaining yield data of the various root-scion combinations. The planting plan for one replicate is presented in Figure 1 (next page).

The annual measurements to be recorded over a ten-or-more-year period include: trunk diameters of scion, interstem and rootstock of the various combinations; tree height and spread; current shoot growth and yield data. Other records and observations of this first rootstock trial will include: tree anchorage, tolerance of tree to soil condition; resistance to wooly aphids and collar rot; and examination of root systems in declining trees.

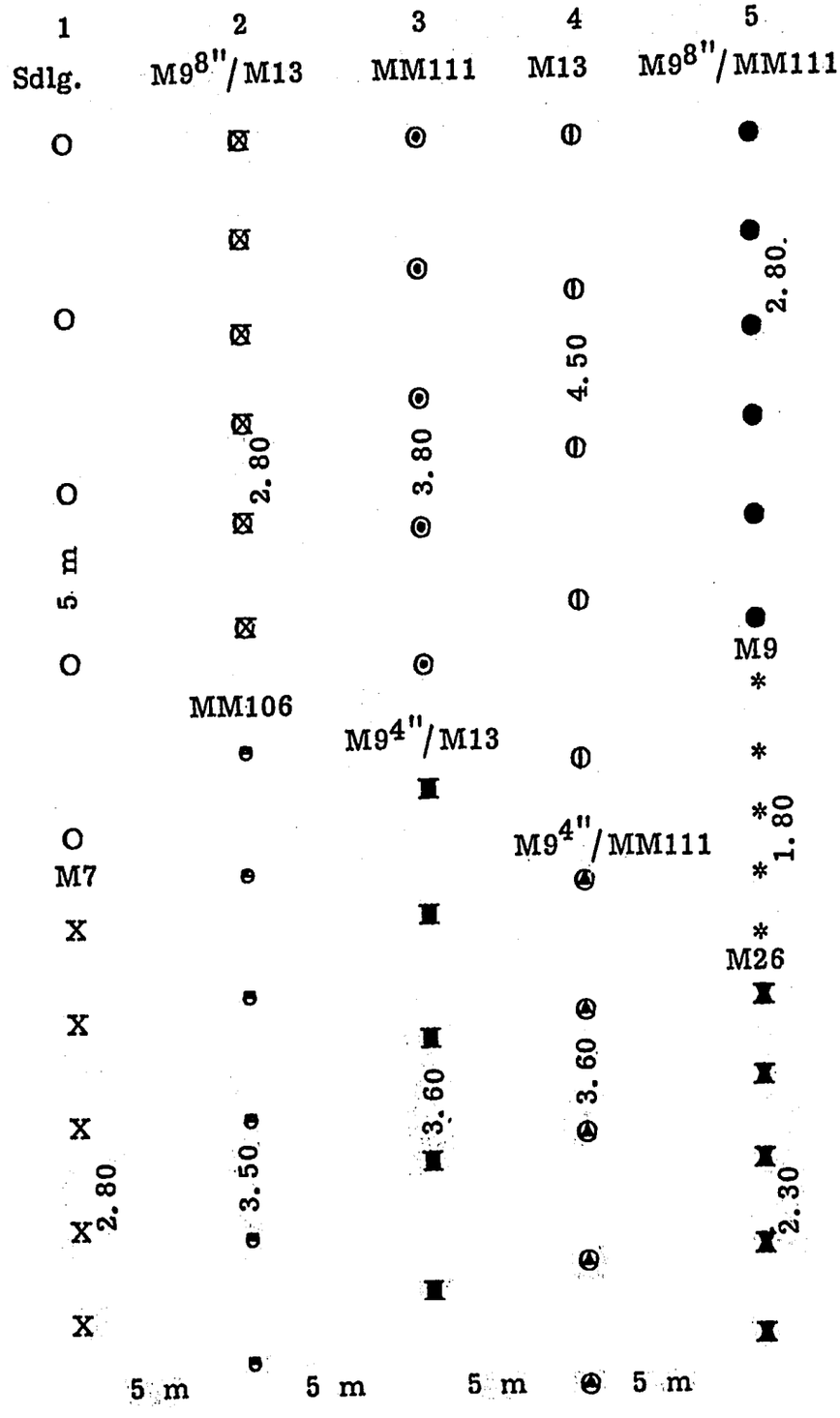
Another experiment was started to test sprout prevention following pruning. In this study, Delicious and spur type Delicious trees were used to evaluate differences in response to the growth inhibiting chemical naphthalene acetic acid (NAA). Ten trees of each were pruned prior to treating by making minor and major cuts normally required in any pruning method. Two trees were used for each inhibiting treatment and these were randomized with non-treated trees.

A commercial technical grade of NAA was used to prepare the 1 and 2 percent white latex paint for brushing onto pruning cuts. (A one percent commercial aerosol preparation "Tree-hold" obtained from American Chemical Company was used in another 10-tree row in same orchard. However, since this did no arrive in time for first treatment it could not statistically be included in the experiment. (Separate data will be collected on this small pilot test).

Records will be made of number of shoots emerging at the pruning cut and 1 and 20 cm. below the cut surface to see if the growth regulator is translocated toward the base. Length of shoots emerging from these locations will be recorded and also statistically evaluated in relation to non-treated trees.

Six weeks following treatments both concentrations of paint preparation of NAA growth regulator were showing significant difference when compared to non-treated. Final recording of this experiment will be completed by Ing. Formento.

Figure 1. One replicate of a planting plan designed for treating various tree-size control combinations in Delicious. Rows can be inverted at random and rows 2, 3, 4, and 5 can be randomly located. The large trees of row 1 necessitate that it be put in an outside position in each replicate.



CONCLUDING COMMENTS

The first impressions established when arriving on an assignment in another country often can be misleading. Arriving in Uruguay following spring rains, and seeing water remaining in tractor tracks in orchards and vineyards, one gets the false idea that fruit growing is practically impossible. Then looking at the clay soil one is convinced that it must be difficult to produce fruit on this land. However, following a few days of sunshine, conditions brighten and in checking orchards the rate of growth and tree survival is not that bad.

In viewing the growing conditions for planting dwarf fruit trees, it becomes clear that orchard site selection as to slope and soil of the land is most important. It is evident that with proper management of the better sites and soils, even dwarfed trees can be grown and brought into production sooner than the standard trees now used.

Thus experimental planting plans were developed for testing fruit tree rootstocks. Short term research tests related to fruit production from compact trees and methods of rootstock propagation were initiated. These tests will be of practical use and significance as the program progresses in use of smaller trees for fruit production in Uruguay.

This report also elaborates on the importance of getting new orchard production off to the best possible start by planting quality trees. The importance of best orchard mangement for maximum production throughout the life of the orchard was stressed.

Also discussed at various meetings and briefly in this report is the value of getting practical research information to the grower via regular meetings and extension type publicatio

It is hoped that suggestions made in this report will serve as a guideline for making progress in developing dwarf orchards in Uruguay.

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