DEPARTMENT OF AGRICULTURE
SOUTH AUSTRALIA

Plant Industry Division Report

HORTICULTURAL PLANT IMPROVEMENT PROGRAMME

PROGRESS REPORT

Report No. 8

Published February, 1982

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HORTICULTURAL PLANT IMPROVEMENT PROGRAMME

PROGRESS REPORT

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CONTENTS.

1. INTRODUCTION

The current horticultural plant Improvement Programme commenced in a small way in May, 1967, with the investigation of virus diseases of citrus and grapevines in South Australia. Citrus and stonefruit selection had been carried out by the Renmark Bud Selection Society in the late 1950's-early 1960's and citrus indexing of the selected clones had been commenced by Messrs. J.R. Botham and J. Randles, but no result was obtained due to the transfer of these officers. Grapevine selection had been commenced on a small scale by Mr. H. Tulloch in 1966.

Selection and the indexing of selected cherry clones had been carried out by Dr. N.C. Crowley of the Waite Agricultural Research Institute following a serious decline problem in the variety William's Favourite and a programme of producing virus tested mazzard rootstocks had been implemented by the Department in an endeavour to provide virus tested planting material.

This report has been compiled to bring up to date, the progress made in the programme and the future projects pertaining to the programme with respect to the Horticultural Research Unit, Northfield Research Centre. Other regions and Research Centres (Lenswood, Nuriootpa and Loxton) are involved in the State Plant Improvement Programme, but only the work programmes and work carried out at the Horticultural Research Unit at the Northfield Research Centre are described in this progress report.

It is divided into the seven crops which have been investigated and for which improvement programmes have been implemented at the Horticultural Research Unit.

2. CITRUS IMPROVEMENT PROGRAMME

2.1 Indexing

The selection of improved clones of the major citrus varieties grown in South Australia was carried out by the Renmark Bud Selection Society and 43 clones were submitted for virus indexing in 1967 (Appendix 1). These clones were indexed for psorosis, tristeza, xyloporosis, exocortis, seedling yellows, tatter leaf, woody gall and infection variegation diseases using the procedures determined by the New South Wales Department of Agriculture.

Since 1967, a further 31 clones have been submitted by the citrus industry groups in South Australia and the Victorian and Western Australian Departments of Agriculture for indexing (Appendix 2).

The clones which have produced negative results on indexing are listed in Appendix 3, and most have been established on the Loxton Research Centre, in a registered Mother tree block.

2.2 Budwood and Seed Source blocks

After the initial indexing of the Renmark Bud Selection Society's selections, it was evident from nurserymen and industry demands that blocks of selected virus tested clones needed to be established to provide the large quantities of seed and budwood required by the citrus industry in South Australia.

To date, a number of budwood blocks and seed source blocks have been established on growers' properties as listed in Appendix 4. The trees were produced at the Horticultural Research Unit, Northfield, taking particular care to retain the identity of the budlines and their virus tested status.

Inspections of the source blocks are carried out once a year by departmental officers and committee members to ensure trueness to type, and that management and tree health are satisfactory.

2.3 Improvement Committees

Two citrus Improvement Committees have been established with assistance from Messrs. J. Jennings and G. Botting in the Waikerie and Berri Districts to provide rules and procedures for administering the budwood source areas.

The Waikerie committee is a sub-committee of the Waikerie Agricultural Bureau and was formed in 1975 with Mr. G. Swanbury as Chairman. The Berri committee is a sub-committee of the Berri Branch of Murray Citrus Growers Association and was formed in 1976 with Mr. J. Phillips as Chairman.

The Committees are responsible for the selection of source block growers, management of the registered source blocks, collection and distribution of registered seed and budwood, inspection of registered source blocks, determining what budlines and rootstocks are required for the registered source blocks and nominating budlines for virus indexing by the Department of Agriculture.

The District Horticultural Adviser and Dr. van Velsen are ex-officio members of the Committees.

2.4 Current Indexing Programme

Due to industry demand, further citrus indexing is planned for the following selected rootstock lines - Benton citrange, *Poncirus trifoliata*, rough lemon, parramatta sweet orange, Carrizo and Troyer, and the common orange selections in 1982/83. The common orange selections are Maltese Blood (3206N-55) Mediterranean Sweet (3127N-55), Joppa (3159N-55), Pineapple (3199N-55), Parramatta (3137N-55), Common (3144N-54), White Siletta (3170N-54), and Paterson (3166N-55), which have been selected by the N.S.W. Department of Agriculture.

2.5 Interstate Co-ordination/Co-operation

2.5.1 Indexing procedures/programme

At present there are two citrus virologists in Australia, Mrs. P. Barkley and R. van Velsen and hence common indexing procedures have been developed and are used for all citrus indexing. The citrus virus indexing procedures are described in Appendix 5.

Each year indexing results are compared and indexing programmes compared to eliminate duplication and to ensure the citrus industries needs for budlines and seedlines are met. Attendance at the annual interstate budwood meetings has assisted greatly to determine industry needs and the problems regarding budline performance and budwood demand.

All South Australian virus tested selections are established in the National Fruit Variety Foundation at Dareton and also in a registered mother block at the Loxton Research Centre.

3. CHERRY IMPROVEMENT PROGRAMME

3.1 Introduction

Although the Cherry Industry is a small one in South Australia, it has given strong support to the improvement of cherries in regard to virus status and improved varieties due to the decline in William's Favourite. In 1967, the Department was propagating virus tested rootstocks for distribution to the industry with the seed for such propagation imported from virus tested sources in California. A number of scion varieties had been selected and virus tested by Dr. N.C. Crowley and were to be the source of improved budwood. By 1968 most of these tested trees were dead or the field labels lost.

Due to the uncertainty in seed supply from California and the extreme variations in seed germination, virus-tested seed trees of Mazzard and Mahaleb have been established at the Lenswood Research Centre and the Horticultural Research Unit, Northfield, to provide seed for rootstock propagation.

3.2 Indexing

For all stonefruit crops, a major virus problem is that of pollen transmission of prune dwarf and prunus necrotic ringspot viruses. Due to practical problems of being unable to grow cherry scion and seed trees in an isolated area in S.A., it is necessary to index seed and scion wood trees annually for these two viruses. In the 1980/81 summer season over 50 cherry trees were indexed for these viruses resulting in a number of scion and seed trees having to be destroyed because of virus contamination. The virus indexing results for pollen borne viruses is listed in Appendix 6. A programme was implemented in 1981, where the scion varieties for budwood production were de-blossomed to prevent entry of pollen-borne viruses. A separate planting is to be established for the evaluation of new varieties on the Lenswood Research Centre.

The production of virus free seed of the varieties Mahaleb and Mazzard for rootstock production cannot be achieved by deblossoming and vegetative propagation techniques are currently being investigated, to eliminate the loss of seed trees due to infection by pollen borne viruses.

As most of the local selections of scion varieties are virus infected, little selection work and indexing has been carried out. However extensive selection is planned when virus elimination by heat therapy/meristem tissue culture techniques have been developed.

3.3 Rootstock Production

In the late 1960's and early 1970's virus tested imported seed of Mahaleb and Mazzard was used to propagate rootstocks for distribution to the cherry industry in South Australia. Since 1970, most of the rootstocks had been propagated by the Horticultural Research Unit at Northfield. In the last few years, propagation has been carried out at the Lenswood Research Centre and Northfield using local virus tested seed. The number of virus tested rootstocks propagated at Northfield and distributed to the Cherry Improvement Committee is given in Table 1.

TABLE 1: Virus tested cherry rootstocks propagated at the Northfield Horticultural Research Unit

Variety	Number of stocks	Year
Mahaleb	5470	1975
Mahaleb	1045	1976
Mahaleb	5300	1977
Mahaleb	2650	1978
Mahaleb	4350	1979
Mahaleb	900	) 1980
Mazzard	708	)
Mahaleb	394	1981

An extension and development programme has been developed by Mr. B. Windle of the Lenswood Research Centre to develop and encourage nurserymen to propagate virus tested rootstocks. However, until, 1981, seed was always in short supply and industry demand exceeded supply, resulting in only small quantities of seed being available to commercial nurserymen.

In 1980/81, a procedure was developed at Northfield for the vegetative propagation of Mahaleb rootstocks using summer cuttings. A commercial size trial is to be carried out in 1981/82 at Northfield and also with a commercial nurseryman in an endeavour to remove rootstock production from the Department.

A similar propagation trial is to be undertaken in 1981/82 using the variety Mazzard.

3.4 Cherry Improvement Committee

The S.A. Cherry Improvement Committee is a sub-committee of the cherry section of the S.A. Fruit Growers and Market Gardeners Association with similar terms of reference to the Citrus Improvement Committee.

The committee was first formed in 1974 with Mr. P. Bungay as the Chairman. Mr. B. Windle of the Lenswood Research Centre and Dr. R. van Velsen are ex-officio members of the Committee.

3.5 Cherry Introduction

Since 1972, a number of cherry scion varieties and one rootstock have been introduced into S.A. to broaden the range of varieties present and to test for tolerance to rain damage which is a major problem of fresh fruit production. These varieties have been established on six different properties in the Adelaide Hills and most of the varieties have commenced bearing.

The varieties introduced are as follows:

Stella	Richmorency
Vista	Montmorency
Victor	English Morello
Windsor	Stockton Morello
William's Favourite	Kansas Sweet
Napoleon	Colt
Venus	
Lyons	
Vega	
Summit	
Sam	

The majority of these varieties have been placed in the National Fruit Variety Foundation to ensure their virus tested status and to provide fvf status budwood for other cherry growing states.

3.6 Budwood and seed source blocks

The original aim of the programme was to establish virus tested budwood and seed source blocks on growers' properties, but due to the pollen-borne virus situation, this aim has been dropped in favour of the budwood block being planted on the Lenswood Centre with possible financial support from the industry. Seed production for Mahaleb stocks may not be necessary should vegetative propagation be economically feasible. From results in Victoria, it may be possible to propagate Mazzard from root pieces as well as cuttings, thus reducing the cost of seed production.

3.7 Meristem/heat therapy research

Since most of the local varieties and selections are infected with viruses which affect fruit production as well as nursery tree production, vigorous attempts have been made to heat treat such infected lines. However, the treatment has killed the trees before heat treated buds could be removed. Investigations are currently

underway to use a lower temperature of heat therapy in conjunction with meristem tissue culture. The results of meristem tissue culture experiments conducted by Mrs. E. Materne using Mazzard cherry are most encouraging. In 1982, it is planned to experiment with scion varieties.

3.8 Interstate Co-ordination/Co-operation

The attendance at the Australian Cherry Growers Federal meeting each year enables exchange of research/development programmes between S.A., N.S.W. and Victorian Departmental officers with respect to overseas imports, indexing procedures and experimental results. Also research staff become aware of the industry's major problems.

4. GRAPEVINE IMPROVEMENT PROGRAMME

The Horticultural Research Unit at Northfield has provided mainly the indexing input into the grapevine improvement programme with smaller inputs into propagation techniques and source area propagation. The major inputs in the propagation of source area planting material and investigation of propagation techniques have been carried out at Loxton and Nuriootpa Research Centres under the supervision of the senior Viticultural Research Officer, Mr. R. Cirami.

4.1 Indexing

Uniform indexing procedures for the detection of grapevine viruses have been established by the fruit variety foundation committee and are used in S.A. The grapevine virus indexing procedures are described in Appendix 7.

Since 1968, over 250 selected clones have been indexed using six indicator varieties for the detection of deleterious virus diseases at the Horticultural Research Unit, Northfield.

Leaf roll virus has been the major virus detected in the selected clones, yellow speckle to a lesser extent and only 3 recordings of the fan leaf complex from unthrifty selections. Of, the clones for which indexing has been completed the incidence of leaf roll and yellow speckle viruses are given in Table 2.

The indexing period is two years, but due to failure of indicator grafts and deaths of vines in the field plots, a four year recording period is used. The clones indexed to date are listed in Appendix 8.

TABLE 2: The number of clones found infected with grapevine leafroll and grapevine yellow speckle viruses from 1977 to 1981

Year	Number of Clones infected	
	Leafroll virus	Yellow speckle
1977	33	23
1978	34	30
1979	22	25
1980	7	5
1981	19	2

4.2 Heat Therapy

With several varieties, the best selected clones have been found to be infected with leaf roll virus which for most varieties affected production and fruit quality. For such clones heat therapy treatment has been used to eliminate leaf roll virus. Potted vines are subjected to 38°C for a minimum of 100 days before taking tip cuttings for the establishment of heat treated clones. To date, seven clones have been treated and subjected to re-indexing to determine whether leaf roll virus elimination has been successful. The clones treated are noted in Appendix 9.

4.3 Introductions

Since the lifting of restrictions of grapevine importations into South Australia, 313 clones have been quarantined either at the Horticultural Research Unit, Northfield or under supervision by Dr. R. van Velsen before release for research purposes.

4.4 Limited Multiplication

In 1973, a definite policy was made to establish source areas of the major grapevine varieties on growers' properties for the provision of adequate propagation material to meet future industry demands.

Production of rootlings and cuttings of the major varieties and clones was carried out at the Loxton and Nuriootpa Research Centres as well as the Horticultural Research Unit, Northfield.

The contribution to this project by the Northfield Horticultural Research Unit is shown in Table 3.

TABLE 3: Planting material for grapevine source areas from 1973 to 1975 produced at the Northfield Horticultural Research Unit.

Year	Clone	Total Number of Rootlings	Total Number of Cuttings
1973	Rhine Riesling 114; 140; 170 Shiraz 712; 1654; 2412	2 500	10,000
1974	Cabernet sauvignon 74; 125 Rhine Riesling 170; 114; 138; 173 Grenache 139 Shiraz 1654 Chenin Blanc	7 000	24,000
1975	Ruby Cabernet Cabernet sauvignon Heat treated 72/1; 72/2; 88/1-8; 85/1; 85/8 Pinot Blanc Chardonnay Pinot Noir Chenin blanc Grenche 139 Semillon 82; 45; 143, 147; 142; 67	6 590	19,800

4.5 Propagation techniques

Due to industry demand for newly introduced varieties and the interest in the use of rootstocks, investigations were carried out into rapid methods of grapevine multiplication and methods of budding grapevines.

The procedure for the rapid multiplication of grapevines from single node cuttings which has been widely used by the grape industry in Australia was published in 1971. The green budding technique which was used in the virus indexing procedure was published in 1974 and is still used by industry to a limited extent being superseded by the dormant or green grafting procedure for the top working of rootstocks.

4.6 Interstate Co-ordination

Extensive interstate co-ordination is carried out in selection and indexing by the Interstate Grapevine Co-ordination Committee. The clones and varieties indexed at Northfield are selected by Mr. R. Cirami, the Senior Viticultural Research Officer and the indexing procedures used are those adopted by the National Fruit Variety Foundation sub committee.

The S.A. indexed selected clones are to be submitted to the National Foundation on completion of the necessary clonal comparison trials being conducted throughout the State under the control of Mr. R. Cirami..

5. POTATO IMPROVEMENT

Prior to 1970, a potato certified seed programme and clonal selection work had been conducted by the Senior Potato Adviser, Mr. H. Diestel-Feddersen. By 1970, the S.A. Potato Industry was concerned with the performance of S.A. produced certified seed potatoes. With industry support a virus testing programme was established at Northfield to screen clones selected from performance trials with the ultimate objective of upgrading the quality of certified seed. The number of potato clones indexed is given in Appendix 9.

From glasshouse virus indexing research conducted at Northfield it was obvious that clones free of potato leaf roll virus were becoming reinfected during field multiplication prior to bulking up by seed producers.

In 1975, a feasibility study was carried out to determine costs and labour inputs of a certified seed potato production system to meet 60% of South Australia's certified seed potato requirements.

From this study (Appendix 10) industry financial support in the order of $100,000 would have been needed to produce 60% of S.A. seed requirement. The Industry Committee considered this financial support to be beyond their means and that the S.A. potato industry should obtain supplies of certified seed from Victoria.

6. AVOCADO IMPROVEMENT

6.1 Introduction

The avocado improvement programme commenced in 1971, with the private introduction into S.A. of seed of the variety 'Waldin' with a Departmental undertaking by the Chief Quarantine Officer that this material would be virus indexed while in quarantine. No avocado indexing was being carried out in Australia at that time and no certified sunblotch free seed nor Hass sunblotch free indicator graftwood was available in Australia. Virus tested seed and Hass graftwood had to be imported and established to carry out the necessary quarantine testing.

Following the importation of registered virus tested seed and Hass graftwood, the Horticulture Branch was alerted by Mr. J. Steed, Senior Horticultural Adviser, Renmark of a small group of avocado growers in the Riverland with an interest in obtaining certified avocado propagation material.

Thus an investigation was carried out to determine the interest and enthusiasm for the introduction and support of an avocado improvement scheme. An avocado improvement group was formed in 1973 with Mr. J. Gordon as chairman.

6.2 Introductions

To conserve labour and financial resources of the Department, it was determined that it was more economical to import selected virus tested seed and graftwood of possible commercial varieties from the University of California, Riverside than to carry out a selection and indexing programme in young, mainly non-bearing orchards in South Australia. Up to 1980, 21 selected varieties have been introduced directly into S.A. following nomination by the S.A. Avocado Growers Assoc. (prior to 1980 S.A. Avocado Plant Improvement Committee). A list of the introductions and source of origin is given in Table 4.

TABLE 4: Avocado varieties introduced into S.A. from 1971-1980

Variety	Type of material	Source of import	S.A. Clone Number
Fuerte	Graftwood	Riverside	IS.73.5010
Zutano	"	"	IS.73.5011
Duke	Seed	"	IS.75.5023
Ganter	"	"	IS.75.5024
Hass	Graftwood	"	IS.75.5025
Susan	"	"	IS.76.5040
Reed	"	"	IS.76.5041
Horshim	"	California	IS.77.5043
Everett	Seed	Riverside	IS.73.5014
No Le Hace	Graftwood	California	IS.77.5045
Nordshtein	"	"	IS.77.5046
Maoz	Seed	Israel	IS.77.5047
Walter Hole	"	Riverside	IS.78.5086
Waldin	"	Israel	IS.78.5116
Healani	Graftwood	Hawaii	IS.79.5107
Beardslee	"	"	IS.79.5108
Fujikawa	"	"	IS.79.5109
Itzamna	"	"	IS.79.5110
McDonald	"	"	IS.79.5111
Masumi	"	"	IS.79.5113
Kahaluu	"	"	IS.79.5114
GA-13	"	Israel	IS.81.5228

6.3 Improvement programme

In November 1973, a meeting between horticulturists interested in growing avocados and two officers of the Department (Mr. J. Steed and Dr. R. van Velsen) was held with the aim of setting up an avocado improvement group with similar aims to the citrus and cherry improvement committees. The Department's role in the improvement programme is to import varieties and rootstocks, establish budwood and seed source blocks, index of nominated trees and inspect trees for trueness to type, as requested by the Committee.

In the early years of the Committee numbers of registered trees were provided to the committee but were lost to the industry due to owner neglect or the owner withdrawing from the programme.

The number of registered budwood and seed sources owners still in the programme and the varieties planted in those source blocks are listed in Table 5.

TABLE 5: Registered avocado budwood and seed source blocks presently involved in the avocado improvement programme

Location	Variety	Number of trees
Cooltong	Zutano	12
	Hass	4
Renmark	Nordshtein	72
	Ganter	3
	Hass	1
	Fuerte	2
	Everett	2
	Topa Topa	3
	Reed	1
	Susan	2
	Horshein	2
	Rincon	2
	No Le Hace	1
	Waldin	2
	Duke	2
Kingston-on-Murray	Rincon	3
Belair	Susan	1
	Nordshtein	1
	Rincon	1
	AVI	1
	No Le Hace	1
Renmark-Tarcoola	Horschim	2
McLaren Flat	Horschim	2
	Nordshtein	2
	Rincon	4
	No Le Hace	2
	Walter Hole	2
	AVI	5
	Waldin	2
	Susan	2
	Topa Topa	2
Renmark	Horschim	2
	Susan	2
	Nordshtein	2
	Rincon	2
	No Le Hace	3
Loxton	AVI	2
	Horschim	2
	Susan	2
	Topa Topa	3
	Rincon	2
	No Le Hace	2
	Waldin	4
Murtho	AVI	2
	Nordshtein	2
	Waldin	1
	Ganter	2
	Duke	2
	Everett	1

TABLE 5 (Cont'd)

Location	Variety	Number of trees
	Hass	2
	Reed	1
	Horschim	1
	No Le Hace	1
	Topa Topa	1
	Susan	1
	Fuerte	2
9		191

All the trees listed in Table 5 have been propagated at the Horticultural Research Unit, located on the Northfield Research Centre.

6.4 Evaluation of introduced varieties and stocks

In addition to the nine registered source blocks of scion varieties all introduced varieties and rootstocks have been established in a foundation planting on the Loxton Research Centre. These plantings using different rootstocks and planted on different soil types in different climatic areas are inspected twice yearly to check growth, fruit set and cropping performance.

Essential information concerning rootstock performance and variety suitability is being obtained by the S.A. avocado growers from the registered source blocks in addition to quality propagation material.

Twice yearly inspections are carried out by Dr. van Velsen in collaboration with a committee member of the S.A. Avocado Growers Association.

6.5 Indexing

The indexing of avocado trees has to date been restricted to importations of seed and scion varieties requiring indexing under the Commonwealth Quarantine Act, to selected trees nominated by the S.A. Avocado Growers Association and trees of suspect disease status. No indexing is carried out for private requests since the demand would far exceed the total glasshouse resources at the Horticultural Research Unit. The indexing process requires 10 Hass seedlings to be patch budded with candidate buds and the seedlings to be observed for at least two years in a glasshouse.

To date, 13 introductions have been indexed, 7 field selections and 25 field trees reindexed.

6.6 Interstate Co-ordination

To avoid duplication of importations, and research efforts, regular contact is made with Dr. R. Allen of the N.S.W. Department of Agriculture and Mr. D. Alexander C.S.I.R.O. on indexing procedures, propagation techniques and variety evaluation techniques.

6.7 Propagation techniques

Investigations have been carried out to determine efficient methods of propagation in respect to seedling rootstock production, grafting, marcotting and container growing of trees. The findings have been published in propagation journals or duplicated sheets for grower information.

7. ALMOND IMPROVEMENT

7.1 Almond Improvement programme

In 1975, Mr. B. Baker, Horticultural Adviser had achieved a high level of acceptance and respect by the almond growers in South Australia. The almond varieties Mission, Fritz, Peerless and a supposedly improved strain of Non-Pareil had been released from quarantine and the almond industry was interested in the first three varieties as pollinators for Non-Pareil and Chellaston varieties.

With assistance from Dr. van Velsen an almond improvement programme was implemented with grower membership on the Improvement Committee being elected from the membership of the S.A. Almond Co-operative. The aims and objectives of the Committee are similar to those of the Citrus Improvement Committee with Messrs B. Baker, F. Gathercole and R.J. van Velsen ex officio technical advisers to the committee.

7.2 Introductions

Due to the uncertainty of the origin, trueness to type and performance of the private introduction of the varieties Mission, Fritz and Peerless, another importation was made in 1977 from the University of California, Davis. Clones were imported which were known to be true to type and for which performance data was known under Californian conditions. The almond varieties and clones imported and released from quarantine at the Horticultural Research Unit, Northfield since 1977 are listed in Table 6.

TABLE 6: Almond varieties and clones imported in South Australia and released to the S.A. Almond Improvement Committee since 1977.

Variety and Clone	Origin	S.A. Clone Number
Nemaguard -480-1	IR-2	IS.73.5001
Mission -5031	unknown	IS.78.5031
Mission -126-1	Davis	IS.77.5050
Fritz -5032	unknown	IS.76.5032
Non-Pareil -5033	unknown	IS.76.5033
Non-Pareil -15-1	IR-2	IS.77.5048
Non-Pareil -R4T4	Davis	IS.77.5065
Peerless -532-3	IR-2	IS.77.5049
Peerless -R4T7	Davis	IS.77.5066
Milow -	Davis	IS.76.5036
Drake -R14T9	Davis	IS.77.5063
Kapareil -R13T2	Davis	IS.77.5064
Titan -R12T5	Davis	IS.77.5067
Thompson -R15T17	Davis	IS.77.5068

Currently there are eleven almond varieties and rootstocks in quarantine being screened for diseases and pests.

All imported clones which have been released from quarantine are held in a mother block planting at Northfield and in the National Fruit Variety Foundation.

7.3 Budwood and Seed source areas

The Horticultural Research Unit at Northfield has been responsible for the propagation of scion varieties and seed source trees required by the S.A. Almond Improvement Committee for the establishment of registered budwood and seed blocks. This had been necessary due to the lack of expertise of almond nurserymen in the initial stage, but in future it will be carried out by nurserymen under the control of the committee.

The number of trees distributed to the Committee is listed in Table 7.

TABLE 7: The number of registered almond trees distributed to the S.A. Almond Improvement Committee since 1978

Year	Number of trees	Varieties
1978/79	396	Non-Pareil Nemaguard Fritz Mission Peerless Titan Kapareil Drake Milow Thompson
1979/80	349	As above
1980/81	208	Non Pareil Nemaguard Titan Fritz Mission

The registration and inspection of the scion variety and seed source blocks is carried out by Mr. B. Baker and the S.A. Almond Improvement Committee.

7.4 Interstate and Roseworthy Agricultural College Co-ordination

South Australia is the largest almond producing state in Australia and interstate requests for registered budwood are fulfilled by the Almond Improvement Committee. Roseworthy Agricultural College has been conducting research into the clonal selection of the almond variety Chellaston and is represented on the Almond Improvement Committee. The Horticultural Research Unit, Northfield will virus index the improved selections from the Roseworthy programme.

8. Pome fruit Heat treatment

In 1970, there was an awareness amongst apple growers in South Australia of virus tested and improved clones of apple varieties available interstate. A major problem confronting the local industry was the lack of an available source of virus tested Northern Spy rootstock material.

A selected clone of Northern Spy was obtained from the Victorian Department of Agriculture and heat treated at the Horticultural Research Unit, Northfield. At the end of the heat treatment period, 14 heat treated plants of Northern spy were established and indexed over the next 11 years for leaf, branch and fruit inducing viruses using 12 different indicators replicated 5 times in a field plot.

Only one heat treated plant was found to be free of all deleterious pome fruit viruses.

This clone is currently being propagated at the Lenswood Research Centre for the establishment of rootstock stool beds for commercial nurserymen.

The clone is also established in the National Fruit Variety Foundation pomefruit planting.

9. FUTURE RESEARCH/DEVELOPMENT ACTIVITIES

The future activities in research and development in the S.A. horticultural improvement programme to be conducted at the Horticultural Research Unit, Northfield are dependent on financial and workforce availability. At the time when this report was prepared the research priorities were as follows (based on the direct economic importance of the various industries in South Australia).

1) Grapevine-virus indexing of clones selected from clonal trials under the responsibility of the Senior Viticultural Research Officer.

2) Citrus-virus indexing of selected clones and rootstocks as required by the citrus industry in collaboration with the N.S.W. Department of Agriculture.

3) Cherry-virus indexing of meristem clones of selected local varieties as determined by the S.A. Cherry Improvement Committee.

4) Cherry-meristem tissue culture research and research into the vegetative propagation of Mazzard rootstocks.

5) Almond-virus indexing of selected clones as determined by the S.A. Almond Improvement Committee.

6) Avocado-virus indexing of selected clones and varieties as determined by the S.A. Avocado Growers Association using the C-DNA technique in collaboration with Dr. R. Symons of the Department of Biochemistry at the University of Adelaide.

10. ACKNOWLEDGEMENTS

Since 1967 the following staff have participated in the S.A. Plant Improvement scheme at the Horticultural Research Unit, Northfield.

Dr. R.J. van Velsen
Miss J.M. Niejalke
Miss H. Diestel-Feddersen 1969-70
Mr. J. Tunis 1973-75
Mrs. E.H. Materne 1970-
Mr. M. McDonnell 1975-
Mr. G. Howse 1977-

A number of other Departmental officers have assisted in the overall programme particularly the District Extension officers with the operation of the various Industry improvement committees.

Mr. J. Steed
Mr. J. Jennings
Mr. G. Botting

Mr. D. Shaw
Mr. B. Baker
Mr. B. Windle
Mr. I. Lewis
Mr. F. Gathercole
Mr. R. Cirami
Mr. M. Harwood
Mr. R.T.J. Webber

APPENDIX 1: Renmark Bud Selection Society

No.	Variety and Rootstock	Accession Number	Origin (Owner)	Infection Status	Remarks
	Mandarins				
1	Imperial R/L	T39030	Tolley	Leaf Rolling XC	
2	Dancy S/O	T.19019	Tolley	Unknown XC	
3	Dancy R/L	T.17019	Tolley	Declining (Yellows).	
4	Satsuma S/O	T.50072	Tolley	Unknown XC	
5	Emperor	C/22020	Old Line Challenge Grove	Unknown X	
6	Hansen R/L	BSS.1	Treloar	Unknown XC	
7	Hansen R/L	BSS.3	Treloar	Unknown XC	
	Lemons				
8	Eureka	Not numbered	Nixon	Shellbark	
9	Eureka S/O	T.51071	Tolley	Unknown XC	
10	Lisbon R/L	T.50071	Tolley	Unknown XC	
11	Lisbon R/L	BSS.1	Phyllis	Shellbark	
12	Eureka	Not numbered	Nixon	Unknown	
	Grapefruit				
13	Marsh	B/207	Challenge Grove	Mild Stempit X	
14	Marsh	B/206	" "	Severe Stempit	
15	Marsh R/L	T.55060	Tolley ex (Curlwaa)	Unknown XC	
16	Marsh (Nucellar S/O)	EX NSW T.37012	Tolley	X	Inoculated Mild Strain
17	Marsh (Nucellar S/O)	Ex NSW T.37011	Tolley	X	Not Inoculated
18	Marsh	T.3709	Tolley ex Bridley	Unknown X	
	Thomson Navel				
19	" R/L	T.2013	Loxton, Moorook	Blind Pocket X	
20	" R/L	T.409	" "	Unknown X	
21	" R/L	T.101	" "	" X	
22	" R/L	T.2012	" "	" X	
	Washington Navel				
23	" S/O	BSS.1	Hockney	" XC	
24	" S/O	109	"	" XC	
25	" ?	A/13013	Challenge Grove	Psorosis Mild	
26	" S/O	T.35033(BSS.1)	Tolley	Unknown XC	
27	" S/O	T.34034(BSS.2)	"	" XC	
28	" S/O	T.33034(BSS.3)	"	" XC	
29	" S/O	T.34021(BSS.4)	"	" XC	
30	" S/O	T.34018(BSS.5)	"	" XC	
31	" S/O	T.34026(BSS.6)	"	" XC	
	Leng Navel				
32	" S/O	T.40062(BSS.1)	Tolley	Unknown XC	
33	" S/O	T.41063(BSS.2)	"	" XC	
34	" S/O	T.40063(BSS.3)	"	" XC	
	Valencias				
35	" S/O	B/6010	Challenge Grove (Old line)	" XC	
36	" S/O	Not numbered	Malcolm (Rankin) (Old line)	" XC	
37	" ?	Not numbered	Nixon	Severe Psorosis	
38	" R/L	T.2302(BSS.1)	Tolley	Unknown XC	
39	" R/L	T.2407(BSS.2)	"	" XC	
40	" R/L	T.2206(BSS.2)	"	" XC	
41	" R/L	T.701(BSS.1)	"	" XC	
42	" R/L	T.407(BSS.2)	"	" XC	
43	" R/L	T.4010(BSS.3)	"	" XC	

X Interested XC Used commercially or wish to.

APPENDIX 2: Budlines submitted for indexting

Variety	Accession No.	Origin
Valencia	B/3010	Challenge Grove
"	B/6011	Challenge Grove
"	Keenan	
	Frost	Irymple, Vic. D. of A.
	Olivewood	" Vic. D. of A.
	R4T4	Lill, Renmark
	Jenner	Irymple, Vic. D. of A.
Navel		
Leng	-	
Leng	-	Fulwood, Waikerie, S.A.
Lane's Late	-	
Thompson	109	Loxton, Moorook
Grapefruit		
Ruby Blush	9E	Gascoyne, W.A. D. of A.
	9A	" W.A. D. of A.
	13E	" W.A. D. of A.
Marsh	Pericoota	Pericoota, N.S.W. D. of A.
"	550 62	Tolley, Renmark
Mandarin		
Kara		Katekar Renmark, SAGRIC
Dancy		Arnold, Waikerie
Lemon		
Rix	-	
Seed trees		
	307, 3702, 3703, 3704, 3705, 3706, 3707, 3709	Tolley, Renmark
Washington Navel	15014	Tolley, Renmark
" "	15015	" "
" "	15016	" "
Tangelo		
Orlando	-	N.S.W. D. of A.

APPENDIX 3: Citrus budlines which have given negative indexing results to deleterious viruses except tristeza virus

Variety	Accession No.	Origin
Mandarin		
Imperial	39030	Tolley
Dancy	19019	Tolley
Dancy	17019	Tolley
Satsuma	50072	Tolley
Emperor	22020	Tolley
Grapefruit		
Ruby blush	9E	Gascoyne, W.A. D. of A.
	9A	" " " " "
	13E	" " " " "
Marsh	B/207	Challenge Grove
Marsh	37012	Tolley
Thompson Navel	T2013	N. Loxton
" "	409	"
" "	2012	"
Washington Navel	BSSI	Hockney
" "	33035	Tolley
Valencia		
Valencia	6010	Challenge Grove
"	3010	" "
Frost	-	Irymple
Olivewood	-	"
Jenner	-	"

APPENDIX 4: Budwood and seed source blocks established in the Murraylands Region

S.A. Clone Number	Variety	Rootstock	No. Trees	Committee Responsible
AS.78.5124	Valencia, Frost	Citrange	40	Waikerie
AS.78.5127	Valencia, Keenan	Sweet Orange	80	"
AS.75.5089	Valencia, 75/5089	Rough lemon	77	"
AS.75.5095	" 75/5095	Sweet Orange	40	"
AS.78.5121	" 78/5121	Sweet Orange	45	"
AS.75.5095	" 75/5095	Citrange	44	"
AS.78.5120	Jenner	Sweet Orange	70	"
AS.75.5088	75/5088	Rough lemon	40	"
AS.72.5108	Navel, Lane's Late	Rough lemon)	37	"
	" " "	Citrange)	38	"
AS.72.5107	" Leng	Rough lemon)	48	"
		Citrange	19	"
AS.75.5076	Thompson	Rough lemon	50	"
	Lane's Late	Rough lemon	45	"
AS.75.5077	Washington	Rough lemon)	20	"
	"	Troyer)	20	"
AS.75.5077	Washington	Rough lemon	40	"
AS.72.5106	Lemon Taylor eureka	Sweet Orange	50	"
AS.72.5104	" Villa Franca	Rough lemon	42	"
AS.75.5119	Prior Lisbon	Sweet Orange	40	"
AS.72.5105	Lambert Eureka	Rough lemon	40	"
AS.72.5103	Grapefruit Wheeny	Sweet orange	40	"
AS.72.5115	" Marsh	Sweet orange)	27	"
	"	Rough lemon)	13	"
AS.75.5099	+Rough lemon	Rough lemon	4	"
AS.75.5098	+Troyer	Rough lemon	4	"
AS.75.5101	+Parramatta sweet orange	Rough lemon	4	"
AS.75.5117	+Carrizo	Rough lemon	4	"
AS.75.5097	+Cleopatra mandarin	Rough lemon)	2	"
		Troyer)	2	"
AS.75.5118	+Symons Sweet Orange	Troyer)	2	"
		Rough lemon)	2	"
AS.78.5128	Mandarin, Ellendale	Sweet Orange	42	"
AS.75.5095	Valencia 75/5095	Sweet Orange	40	Berri
	Keenan	Sweet Orange	40	"
AS.78.5121	Newton	Rough lemon	54	"
	Jenner	Sweet Orange	40	"
AS.75.5088	75/5088	Troyer	40	"
	Mandarin Ellendale	Sweet Orange)	21	"
		Troyer)	20	"
AS.75.5064	Imperial	Sweet Orange	40	"
AS.80.5143	Grapefruit Ruby Blush	Troyer	42	"
	Navel Thompson	Sweet orange	54	"
	" Leng	Troyer	40	"
	Leng	Rough lemon	40	"
	Washington	Rough lemon	40	"
	Lane's Late	Troyer	40	"
	Lemon Taylor Eureka	Sweet orange	54	"

APPENDIX 4: (Continued)

S.A. Clone Number	Variety	Rootstock	No. Trees	Committee Responsibl
AS.72.5104	Lemon, Villa franca	Sweet Orange	54	Berri
AS.75.5119	" Prior Lisbon	Sweet Orange	54	"
	- Frost Eureka	Sweet Orange	54	"
AS.72.5105	Lambert Eureka	Sweet Orange	54	"
	- Rix Lisbon	Rough lemon	54	"
AS.75.5117	+Carrizo	Rough lemon	2	"
		Carrizo	2	"
AS.75.5118	+Symons Sweet Orange	Troyer	2	"
		Rough lemon	2	"
AS.75.5097	+Cleopatra	Troyer	2	"
		Rough lemon	2	"
AS.75.5101	+Parramatta Sweet Orange	Troyer	4	"
AS.75.5098	+Troyer	Troyer	4	"
AS.75.5099	+Rough lemon	Rough lemon	4	"

+ Seed trees for rootstock seedling production.

APPENDIX 5: Virus indexing procedures for citrus

Virus	Indicator and number per test ( )	Observation Period
Exocortis viroid	Etrog citron - 6013 (10)	2 years
Citrange stunt	Troyer citrange (10)	2 years
Psorosis	Homosassa sweet orange (10)	2 years
	Ruby Blood sweet orange (10)	2 years
Tatter leaf	*Citrus excelsa* (10)	2 years
Infectious variegation	Rodwell Eureka (10)	2 years
Tristeza	West Indian Lime (10)	2 years
Xyloporosis	Ellendale/trifoliata (10)	3 years
	Orlando tangelo (10)	8 years
Vein enation	*Citrus jambhiri* (10)	3 years
Woody Gall	*Citrus jambhiri* (10)	4 years

For the detection of citrange stunt, psorosis, tatter leaf, infectious variegation, tristeza, vein enation, woody gall and xyloporosis by Orlando tangelo, each seedling of the indicators are patch budded with two buds from the candidate which is under test.

For the detection of exocortis, Etrog citron, 6013, is budded onto Rangpur Lime seedlings. Two buds of the candidate under test are budded onto the Etrog citron branchlet.

For the detection of Xyloporosis using Ellendale/trifoliata, Poncirus trifoliata seedling stocks are budded with heat treated Ellendale mandarin and these buds are allowed to develop. These trees are then patch budded with two buds from the candidate tree under test.

APPENDIX 6: Cherry Indexing using Shirofugen for the detection of pollen-borne stonefruit viruses

Year	Number of trees tested
1978/79	15 seed trees
1979/80	21 seed trees
1980/81	20 seed trees 35 scion trees

APPENDIX 7: Indexing procedure for the detection of grapevine viruses

Virus	Indicator	Observation Period
Corky bark	LN33	2-4 years
Fan leaf	*Vitis rupestris* var. St. George	"
Flavescence Doree	Baco 22A	"
Fleck	*V. rupestris* var. St. George	"
Leaf roll	LN33	"
	Mission seedling	"
	Cabernet franc	"
Yellow Speckle	Esparte	"
Legno Riccio	*V. rupestris* var. St. George	"

For each test, two indicator plants are used and kept under observation in a field plot at the Horticultural Research Unit, Northfield.

Cuttings of the candidate under test are rooted in a glasshouse and when sufficient top growth is present each candidate is top grafted with the appropriate indicator variety.

APPENDIX 8: Grapevine Indexing

Years	Variety	SAGRIC Viticulture Research Clone Number
1971/73	Trebbiano, false - 4 clones Madeira, white - 5 Doradillo - 7 Trebbiano - 3 Palomino blanco - 2 Grenache - 2 Semillon - 4 Muscat frontignan white - 2 Temparano - 2 Malbec - 3 Sauvignon blanc - 2 Grenache, false - 5 Tokay, white - 1 Pedro - 4 Cabernet sauvignon - 4 Verdeilho - 1 Carignan (false) - 1 Clare, Riesling - 1 Pedro, false - 5 Chardonnay - 1	
1973/76	Rhine Riesling	2 : 3 7 : 8 14 : 17 18 : 19 20 : 22
	Shiraz	1 : 2 5 : 8 9 : 14 30 : 33 36 : 44
	Tokay	13 : 19 24 : 31 39 : 48 56 : 57
1974/78	Semillon	1 : 3 4 : 6 8 : 14 17 : 18 19 : 25 32 : 143
	Trebbiano	Rod I : Rod II Spur I : Spur II 12 : 33 64 : 69 98 : 138 147 : 172

APPENDIX 8: (Continued)

Years	Variety	SAGRIC Viticulture Research Clone Number
1974/78 (cont.)	White Grenache	39 : 60 49 :
	Trebbiano (heat treated)	J52-5
	Shiraz	1654
	Grenache	139
	Muscat Gordo Blanco	173
	Rhine Riesling	140
	Cabernet Sauvignon	74
	Grenache false (heat treated)	M58-1
1975/79	Cabernet Sauvignon	3 : 5 9 : 11 12 : 14 17 : 22 25 : 41
	Cabernet Sauvignon (clone 126 heat treated)	1 : 2 3 : 4 5 : 7 8
	Salt Creek	502 : 508 518 : 521 530 : 602 607 : 614 619 : 627 631 : 635 702 : 705 710 : 717 725 : 728 737
	Dog Ridge	802 : 1613
	Harmony	
	Schwarzmann	A : B
	Doradillo	140

APPENDIX 8: (Continued)

Years	Variety	SAGRIC Viticulture Research Clone Number
1980/84	Tokay (32 heat treated)	92/1 92/2 92/3 92/4 92/5 92/6 92/7 92/8 92/9 92/10 92/11 102/1 119/1 119/2
	Cabernet Sauvignon	LC 7 LC 10 LC 14 LC 30 LC 40 LC 44 LC 46 CA 51
	Grenache	5 : 16 23 : 26 27 : 28 33 : 38 41 : 46
	Shiraz	12
	White Frontignan	3 : 7
	Touriga	E6 V12
	Tinta Madeira	F2 V14
	Colombard	F13 V8
	Shiraz	112 5-H6
	Doradillo	123-H6

APPENDIX 9: The potato virus indexing programme carried out at the Horticultural Research Unit, Northfield

Year	Number of Clones tested	Detection for
1970	32	Potato Virus X Potato Virus Y Leaf roll
1971	66	as for 1970
1972	140	as for 1970
1973	84	as for 1970
1974	166	Leaf roll only

APPENDIX 10: Certified Seed Potato Production

AIM: To determine the logistics of certified seed potato production

MATERIALS:

1. Screen House:-

(a) Specifications of cloth - 400 metres of 3.6 metre width knitted "Terylene" queenscord fabric. 13 x 6.9 metre lengths were cut at Northfield and sent to W.A. Young, Edwardstown for stitching the seams. The cover was fabricated with seams running transversely to the length of the structure for easier handling of the material bulk and also in the event of partial seam failure the fault would be confined to one section.

(b) Specifications of steel frame:-

18 lengths x 6.5 metre galvanised iron water pipe 25 mm nominal bore.

3 lengths x 6.5 metre galvanised iron water pipe 32 mm nominal bore.

18 sockets, galvanised iron, 25 mm nominal bore.

The 18 lengths (6.5 m x 25 mm bore) were bent into approximately a quadrant. Two of the lengths of bent pipe were joined together to form an approximate semi-circular hoop. Each hoop was stood in larger pipes (0.9 m length x 32 mm bore) previously driven 0.75 m into the ground. Hoops spanned 6.9 metres and were placed at intervals approximately 2.6 metres apart to form a tunnel in an east to west direction.

13 longitudinal high tensile wires joined the hoops together and were attached to a length of pipe driven into ground approximately 2.5 metres out from each end of the house.

(c) Covering the structure:

The completed fabric cover was roughly folded longitudinally on the ground bringing each side into a centre line and the bundle was then tied at intervals along the length. The bundle was drawn over the top of the structure from one end to the other, the ties removed and the material allowed to drop into place on both sides. A trench 0.5 metre in depth was dug around the base of the structure and the bottom of the fabric cover secured in the trench by fence posts, pulled taut, and buried leaving an opening on the northern side at the eastern end.

(d) Irrigation system:-

6 metre x 40 mm u P.V.C. pressure piping.
1 x 40 mm u P.V.C. end cap.
1 x 40 mm x 25 mm u P.V.C. reducer.

Length of 20 mm hose with fittings for connection to mains water. 200 metres plain black polythene tubing 15 mm bore. 500 Uniroyal drippers type 7.035. 9 x 15 mm rubber grommett take off tubes.

A 6 metre length of P.V.C. pressure pipe was placed at the western end of the house and connected to the mains water. 9 dripper lines were attached to the pipe at 0.65 m intervals, and secured to stakes driven into ground at the eastern end of the house. Length of lines were approx. 22 metres and drippers were spaced at 0.45 m distances along the lines.

2. Planting Material:

(a) Source:-

Rooted tip cuttings of four varieties of pathogen free potato clones were received from Victorian Department of Agriculture in January 1975. Tubers harvested from these cuttings were bulked up in the glasshouse July-October 1975.

(b) Varieties and Clones

Variety - Line	Clone	Tip cutting No's.
Kennebec	7c	497, 498
Ke A	10b	510
	10c	511
	11a	514
	11c	538
	12c	552, 554
	13c	571, 573
Sebago	2a	298, 299
Se C	3c	314
	3d	315
	4c	339, 340
	5b	341
	5f	343
	6c	350,351
Pontiac	1a	126
Po A	1b	127
	2c	133, 134, 135, 137
	3b	142, 144
	3d	145, 146
Tasman	1b	311
Ta A	3c	324
	4a	329
	5a	333
	6c	339
	7c	347
	8a	349
	9a	350, 351
	10b	355

APPENDIX 10: (Continued)

(a) Planting treatment:-

Prior to planting the soil was cultivated using Howard tractor and rotary hoe. Small trenches were dug along the length of the dripper lines (i.e. 9 trenches 0.65 m apart). Tubers were treated with the dormancy breaker 'Quik sprout' one week before planting.

Blood and bone fertilizer was sprinkled in the trenches and whole tubers 4-10 cm in size were placed beneath each dripper (approx. 0.45 mm distance apart) along the trenches. The tubers were then lightly covered with soil.

(b) Cultural treatments during growth:

Tubers were planted mid December and all varieties had been harvested by mid May. During this period plants were drip irrigated once a week for approximately 3 hours. In early growth stages weeding and hilling up were carried out approx. every 2 weeks. Malathion sprays were applied once a month and as plants matured approximately every 10 days. One spray each of Lead Arsenate and Metasystox were also applied.

Labour Units Consumed -

Operation	Labour Units
Erection of frames	2.00 man days*
Wiring of frames	1.75 m.d.
Erection of cover	3.00 m.d.
Ground preparation	1.00 m.d.
Trenching	1.50 m.d.
Planting	1.50 m.d.
Dripper Irrigation	1.00 m.d.
Weeding and Hilling up	2.00 m.d.
Spraying	1.50 m.d.
Harvesting	2.00 m.d.
TOTAL	17.25 m.d.

* Man day = 8 hours actual labour

YIELD:

(1) Total yield for screen house

Area 21.8 m x 6.9 m

Kennebec	116.90 kg
Sebago	91.90 kg
Pontiac	192.65 kg*
Tasman	55.05 kg
TOTAL	456.50 kg

* Pontiac - clone 36/142 yield not included in total.

APPENDIX 10: (Continued)

(2) Yields per plant for each variety

Kennebec	1.146 kg
Sebago	0.901 kg
Pontiac	1.386 kg
Tasman	0.540 kg

Screen house Area = 151 sq. metres

1 hectare = 10,000 sq. metres

$$\text{Screen house Area} = \frac{151}{10{,}000} \text{ hectares}$$

$$= 0.0151 \text{ hectares}$$

Approximate yields per hectare assuming 20,000 plants per hectare

(1) Kennebec = 1.146 x 20,000 kgs
= 22.92 tonnes

(2) Sebago = 0.901 x 20,000 kgs
= 18.02 tonnes

(3) Pontiac = 1.386 x 20,000 kgs
= 27.72 tonnes

(4) Tasman = 0.540 x 20,000 kgs
= 10.80 tonnes