DEPARTMENT OF PRIMARY INDUSTRIES

MANGO GENETIC IMPROVEMENT

FINAL REPORT

DPI
QUEENSLAND

HRDC PROJECT FR035
QFVG 4.74
PROMIS 443

QUEENSLAND FRUIT AND VEGETABLE GROWERS/
HORTICULTURAL RESEARCH AND DEVELOPMENT CORPORATION

I FINAL REPORT

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1. PROJECT TITLE: Mango Genetic Improvement

QFVG Ref. No: 4.74 **HRDC Reference No:** Fr035

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2. ORGANISATION: Queensland Department of Primary Industries

ADDRESS: GPO Box 46, BRISBANE Q 4001

ADMIN. CONTACT: Mr C.W. Winks
Manager, Production Research
Phone: (07) 239 6012
Fax: (07) 239 3379

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3. PROJECT CHIEF INVESTIGATOR: Ian S. E. Bally
PO Box 591
AYR Q 4807
Phone: (077) 832 355
Fax: (077) 833 193

LOCATION OF RESEARCH: Burdekin, Bowen, Rockhampton, Townsville and Atherton Tableland districts.

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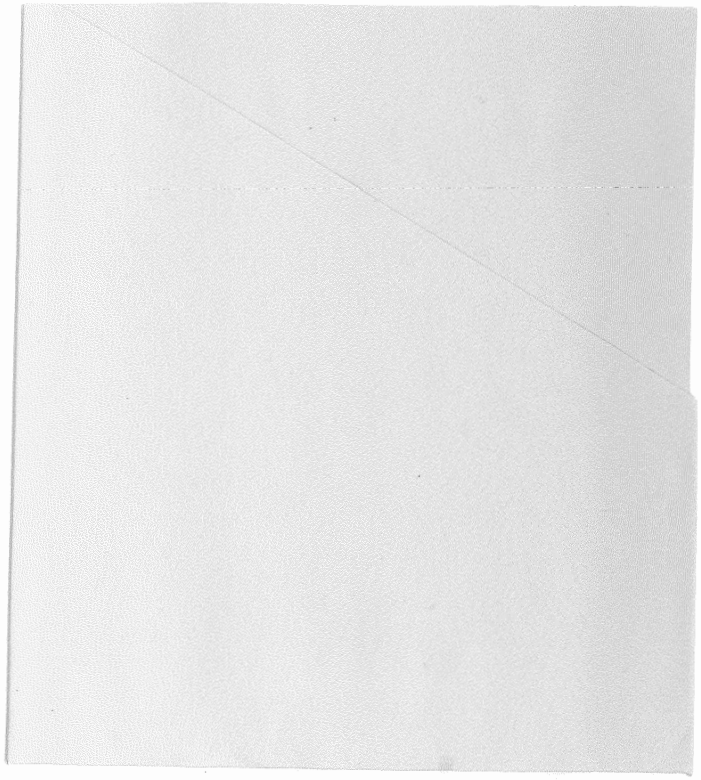
4. COMMENCEMENT DATE: July 1990

COMPLETION DATE: June 1993 - but assessments will continue beyond this date



1. Summary

(a) Industry summary.

The Queensland mango industry has been in the past and will be for the foreseeable future based on the cultivar Kensington Pride. This cultivar has traditionally been propagated by seed, a situation that has produced a large variation in Kensington types, all using the name Kensington Pride. Although a few selections among Kensington Pride types have been made, none of them has been quantitatively evaluated or identified as superior.

This project selected 36 of the industries best lines and established them at a uniform growing site for quantitative evaluation. Selection and evaluation of the trees will be done in the 1994, 1995 and 1996 fruiting seasons. A indication of which of the selected lines are superior should be available by 1997, when they will be released to industry. Clonal propagation of these lines will be recommended to preserve the genetic uniformity of the lines.

Adoption of these lines will benefit the industry by improved quality, consistency and uniformity of production and fruit appearance.

(b) Technical summary

The cultivar Kensington Pride currently makes up over 90% of all trees planted. Two of the major problems of this cultivar are its irregular bearing habit and variability of fruit type. These problems can be seen in commercial orchards, most of which are not clonally propagated but established from seedlings.

This project has identified and is evaluating superior Kensington Pride selections and other promising varieties with a view to obtaining consistently high-yielding types of good quality.

There was an overwhelming response to newspaper articles and radio interviews and announcements about the Mango Genetic Improvement Project, with 78 reports of superior trees being received. Following field trips by Project officers to these trees to verify these reports, a total of 38 selections have been grafted onto uniform rootstock in a replicated field trial at Ayr Research Station. One of the selections is the progeny of a coloured "banana" mango, the rest are all offspring of the "Kensington" type. Almost all selections are known to have had a history of consistently and exceptionally high yields, and fruit are generally of the roundish-ovate form rather than elongated, with very good blush colour. Some selections have other important properties eg. early ripening, later maturing, resistance to bacterial black spot disease, resistance to anthracnose, absence of any "jelly seed" internal flesh breakdown and absence of stem-end cavity. Comparison of these lines will not be complete until after the 1996 fruiting season when three cropping seasons of mature trees will have been evaluated.

With such an encouraging array of high quality initial selections, this project should eventually result in the release of one or more "superior" lines which could dramatically stabilise the currently predominantly seedling-based Queensland mango industry, lifting productivity and improving efficiencies of mango production in the next century.

2. Recommendations

(a) Extension/adoption by industry

Because this project is on going, recommendations of superior lines of Kensington Pride can not be made at this point in time. However, after the 1996 season superior selections will be identified and recommended to industry. When released a recommendation of clonal propagation only by grafting will be perused to maintain the consistent quality of any released selection. This will prevent the genetic drift in any line due to zygotic embryo selection through seedling propagation.

(b) Directions for further research

Full evaluation of the trees in this project has not yet started because the trees have not reached mature bearing age. The first crop is expected in November 1994 when evaluation will begin and consist of yield assessments, postharvest fruit quality assessments, pest and disease assessments and fruit shape and colour assessments.

If the interest by industry is as great in the final selections as it was in the identification process during the 1990 and the 1991 seasons, adoption of identified superior lines will not be a problem.

(c) Financial/commercial benefits

The major commercial benefit to be gained from this selection process and adoption of superior lines will be the growers ability to supply uniform high quality lines to both the domestic and export markets. This is especially of interest to suppliers of export markets that looking for quality assurance packages. Maximising orchard yields by clonal plantings of high yielding high quality selections will improve on farm profitability. Clonal plantings have the further advantages of behaving more uniform

making by coordination of on farm management operations such as picking, packing, spraying and pruning easier.

3. Technical report

(a) Introduction

Until recently the Queensland mango industry has almost entirely been based on the cultivar Kensington Pride. Kensington Pride is severely prone to irregular flowering and bearing (Beal, 1981), it is susceptible to diseases such as bacterial black spot (*Pseudomonas mangiferaeindicae*), Anthracnose (*Colletotrichum gleosporodies*), Stem end rot (*Dothoriella dominicana*) and has a relatively short shelf life. Despite these problems the fruit is highly flavoured and sought after by buyers. This cultivar is likely to remain the most widely grown and demanded for the foreseeable future.

Kensington Pride, first grown in Bowen, is thought to have been introduced from the East Indies or India on the horse trading ships that visited that port in the late eighteen hundreds (Stephens 1969). Like many other cultivars derived from South Eastern Asia Kensington Pride is polyembryonic, that is the seeds have nucellar embryos that are genetically identical to the mother plant (Sturrock 1967). Because of this fact polyembryonic cultivars have generally been propagated by seed and Kensington Pride is no exception to this rule.

Some polyembryonic cultivars of mango also have a viable zygotic embryo (Sturrock 1967). Schnell and Knight (1991) report the number of zygotic off types in seedling populations can be as high as 64% in the cultivar 'Golek' and as low as 0% in the Israeli cultivar '13-1'. The percentage of zygotic off types in Kensington Pride seedling populations is unknown however large variations are seen in Kensington Pride through out the country. Just what percentage of the observed variations are due to zygotic seedlings, mutations or environmental influence is unclear.

A separate study of the genetic similarity of this Kensington Pride collection is currently being studied using DNA and RAPD techniques.

Selection of so called better Kensington types has been done by many farmers and nurseries in the past but only a few of these selections have been described or comparatively tested. The most widely planted of these named selections, 'Bambaroo' and 'Spooner' were described and compared to other cultivars by Winston (unpublished manuscript) and Bally (personal work).

This project aimed to identify and select some of the better types of Kensington Pride growing in Queensland by establishing them in a single replicated trial block on a uniform soil type under uniform management. This approach was used to minimise the influence of environment on the genetic expression.

(b) Materials and methods

Trees in the Kensington Pride evaluation trial were selected in several ways. During the lead-up to the mango harvest in the 1990/91 and 1991/92 seasons, requests were made to growers via newsletters, newspapers, magazines, radio announcements and interviews for indications of "superior" mango trees. Responses to the advertisements were investigated initially by telephone and then in person.

A second approach for selection of superior trees was visits to orchards by the research team, selecting trees on current performance and confirming past performance with the orchard managers.

Selection of trees was mainly done in the three major production areas, Mareeba, Dry tropics and the Rockhampton district. However some responses and selection of trees came from out side these areas (see table 1).

There was an overwhelming response to newspaper articles and radio interviews and announcements about the Mango Genetic Improvement Project, with 78 reports coming from a wide array of locations, (table 1), climates and soil types; from which QDPI project officers have now selected 36 trees for further evaluation.

Selections made in 1990/91 were grafted on to one year old potted stocks and field planted in October 1991 when the grafts had taken. Those selected in the 1991/92 season were field grafted on to stocks of the same age also planted in October 1991. All stocks used were seedlings of the Kensington *Stock* selection used as a standard rootstock for all trials on the Ayr Research Station.

The Field planting site is on the Queensland Department of Primary Industries Ayr Research Station in the Burdekin delta, $19^0.37'$S, $14^0.22'$E. This site has uniform soil of the McDesme type which has a 0.15 -0.45 m dark clay loam fine sandy to light clay A horizon over a neutral brown to brown silty clay to light medium clay B horizon (McClurg 1986). The trees were planted at a spacing of 10 X 10 meters in mounded rows with windbreak tree species planted on all four sides of the block.

The statistical design of the block is a 3 X 36 randomised block using single tree plots.

Budwood from trees reported to DPI by growers was collected and propagated at Ayr Research Station. Selections deemed not of sufficient merit to warrant inclusion in the replicated field trial have been kept as single tree additions to the Australian Mango Collection at Ayr Research Station. Although the field trial has now been planted and will not be expanded further, any promising

trees reported to the DPI in the future will be propagated and a single tree added to the Mango Collection on Ayr Research Station.

(c) Results

36 selections were selected by QDPI project officers from 78 reported superior types from a wide array of locations, climates and soil types. In addition to the 36 new selections, 3 Kensington types (Bambaroo, Spooner and Grossman) selected in the past decade and now adopted to some extent in the mango industry have also been included in the evaluation trial.

Table 1. Locality of reported and selected trees.

Locality	No. of Reports of Good Trees	No. of Trees Selected
Atherton Tableland/Mareeba	10	5
Innisfail/Wet Tropics	4	1
Abergowrie	2	1
Townsville/Alligator Creek	3	1
Horseshoe Lagoon and Ayr District	7	5
Home Hill District	6	2
Gumlu	5	2
Bowen	14	6
Mackay	5	1
Sarina District	4	1
Yeppoon	9	5
Mount Morgan	9	6
Total	78	36

Although it was not intended to restrict selections to Kensington types, one (ROYN1) a banana mango seedling is not the progeny of a Kensington seed. R2E2, a cultivar bred by DPI from Kent and Kensington was also included in the field trial as it is becoming widely grown in the industry. The major reasons for selection and lines selected, are as follows:

1.	RORNT	Consistently productive tree, round, highly coloured fruit. Reputedly anthracnose resistant. (Selected in Ayr)
2.	RAHNT	Round-ovate fruit, good size for packing, excellent blush colour. Clean fruit even in wet tropical high rainfall areas. (Innisfail district)
3.	REHNT	Consistently prolific yielding. Roundish fruit, very good background and blush colour. (Townsville district)
4.	NUCNT	High yielding tree, every year. Very good blush colour. (Gumlu)
5.	TE1NT	Very large, rounded fruit. Tree has very thick leaves, could be polyploid. (Horseshoe Lagoon)
6.	TE2NT	Excellent size and roundish shape for packing, reasonable blush colour. (Horseshoe Lagoon)
7.	MA1NT	Large fruit with bright red blush colour, bears heavily every year. (Home Hill District)
8.	MA2NT	Excellent fruit shape, colour, taste. Bears extremely well every year. Large old tree reputed to possibly be a seedling from one of the early "Bowen Special" trees at Bowen. (Home Hill District)
9.	TOBNT	Consistent, prolific bearer. Good shape, reasonable colour. (Tableland/Mareeba)

10. WALNT Bears well every year, never failed. Reasonable blush colour and shape. (Tableland/Mareeba)

11. BNAN1 Consistently high yielding, with good fruit shape and colour. (Tableland/Mareeba)

12. KANNT Reputed to have large fruit, with extremely high yields every year. Locally renowned for its consistency and productivity. (Abergowrie)

13. WI1NT Enormous ancient tree with very roundish fruit. Reportedly a seedling from one of the original "Bowen Specials". (Bowen)

14. WI2NT Huge old tree reputed to be a seedling from one of the original Bowen Special Mango trees. (Bowen)

15. WI3NT Giant tree which yields very highly every year; reputedly the progeny of one of the original Bowen Special mango trees. (Bowen)

16. PMKN2 Very attractive fruit, good shape, size, colour, and taste. (Mackay)

17. Bambaroo "Industry standard". Previously selected from a tree near Ingham by DPI horticulturists and now adopted by many nurserymen in Queensland.

18. Spooner "Industry standard". Previously selected from Cape Tribulation by DPI horticulturists because of its capacity to consistently bear high yields of very clean fruit in a high-rainfall area. Has been reasonably widely adopted in some quarters of the Queensland mango industry.

19. FITN2 Good roundish-ovate fruit shape with good blush colour and excellent background colour. (Yeppoon)

20. Grossman "Industry standard". Previously selected by QDPI horticulturists in southern Queensland because of its reported resistance to bacterial black-spot. Has been adopted to some extent by nurserymen.

21. KRAN1 Slightly smaller rounded fruit, good blush colour, seems earlier than other trees in the district. (Bowen)

22. ML1N1 High yields every year, good shape, reasonable colour. (Bowen)

23. ML2N1 Prolific bearer; never known to have failed. Good shape and excellent blush. (Bowen).

24. ROYN1 Large pleasant tasting fruit, bright red colour, mostly thin monoembryonic seed with high flesh recovery and excellent shelf life. Many large fruit per panicle. Tree seems to be completely resistant to scale. This tree was the progeny of

seed from a highly coloured wild creekside "banana" mango tree, but fruit is different in shape from parent. (Horseshoe Lagoon)

25. WEAN2 Late season selection, ripening after other Kensington trees in the district. (Tableland/Mareeba)

26. GR1N2 Regular bearer, good fruit shape and colour. Locally renowned for its consistently high yields. (Yeppoon).

27. HA2N2 Exceptional taste and flavour. Roundish fruit, highly blushed, reputed to have a good shelf-life. (Yeppoon)

28. VC4N2 High yielding, outstanding blush colour. Good size and shape for ease of packing. (Horseshoe Lagoon)

29. M18N2 Resistant to bacterial black-spot. (Mount Morgan)

30. HA1N2 Outstanding taste. Renowned locally for its flavour. Rounded-ovate shape with reasonable blush. (Yeppoon)

31. MG1N2 Consistently high yields. Good blush colour, roundish-ovate shape. (Mount Morgan)

32. WH1N2 Smallish "peach", excellent colour, good taste. Reputedly never shown any incidence of "jelly seed" or stem end rot. (Sarina)

33. NU2N2 Very attractive fruit shape and colour, with consistently high yields. (Mount Morgan)

34. GAMN1 Prolific bearer, good fruit shape and blush colour. (Tableland/Mareeba)

35. NU1N2 Consistently heavy cropping and early (two weeks before all other trees in that orchard). (Mount Morgan)

36. GR2N2 High yields every year of fruit slightly smaller than the Kensington "norm". Attractive reddish blush on beautiful yellow background colour. (Yeppoon)

37. MG3N2 Reputedly completely free of stem-end cavity. Excellent flesh quality; uniform texture and ripeness. Reasonably consistent yields. (Mount Morgan)

38. MG2N2 During one season when the rest of the grower's orchard had an extremely high incidence of stem-end cavity, this tree did not have any sign of any stem-end cavity. (Mount Morgan)

The trees in the Ayr Research Station field trial are not expected to begin to provide useful yield data until the 1995/96 season; however the young trees will be observed for differences in growth rates and resistance to attack from insect pests diseases etc and fruit quality.

Three other field trials with a small subset of the selected material are to be planted in the Rockhampton district in late 1994.

(d) Discussion

Almost all selections are known to have had a history of consistently and high yields, and fruit are generally of the "roundish-ovate" form rather than elongated, with very good blush colour. The round-ovate shape is typical of the earlier trees reported to be seedlings of the original tree in Bowen. Some selections have other important properties eg. early ripening, later maturing, resistance to bacterial black spot disease, resistance to anthracnose, absence of "jelly seed" internal flesh breakdown, and absence of stem-end cavity.

With such an encouraging array of high quality selections, this project should eventually result in the release of one or more "superior" lines which could dramatically revolutionise the currently predominantly seedling-based Queensland mango industry, lifting productivity and improving efficiencies of mango production in the next century.

The report covers the first three years of a long-term plant improvement activity in mango which will take some seven or eight years to reach a reasonable conclusion.

Through the difficult financial circumstances, experienced by the Queensland Fruit and Vegetable Growers it was not possible to secure additional funding support to take the project through to a more definite set of conclusions and recommendations. Until the evaluation of these superior selections is completed the industry will continue to depend on individual options of growers and nurserymen in the selection of Kensington Pride clones for new plantings. These may not give the industry the best chance of producing the most productive, best fruit quality selections, best able to meet market needs.

QDPI will continue to provide limited operating support to this project and the national mango germplasm collection with the exception that these costs are considered part of a national mango plant improvement project being developed by CSIRO in Darwin.

References

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