LOCATIONS FOR COMMERCIAL CITRUS PRODUCTION IN PAPUA NEW GUINEA

By R. Michael Bourke and Tevo N. Tarepe,
Principal Horticulturist and Horticulturist,
Highlands Agricultural Experiment Station, Aiyura, E.H.P.

INTRODUCTION

All types of citrus fruit grow well in different parts of Papua New Guinea. The main types grown are orange, mandarin, and pomelo. Other types are lime, lemon, grapefruit and kumquat. Even though all of the citrus grow very well, Papua New Guinea is still importing a lot of citrus fruit each year. The quantity and value of the imports are shown in Table 1.

It can be seen from Table 1 that Papua New Guinea is importing about 760 tonnes of citrus a year with a value of over K300,000. The cost to the consumer is about twice this because K300,000 is the value of the fruit as it leaves Australia or New Zealand. The value of imported orange and lemon juice and cordials is even more than the value of imported fresh fruit!

In this article we will be talking about commercial citrus production. Commercial means growing things for sale. This includes sale through local markets as well as wholesale or direct to large buyers.

The citrus industry is poorly developed in Papua New Guinea.

TABLE 1. IMPORTS OF VARIOUS CITRUS FRUIT INTO PAPUA NEW GUINEA IN 1981

Fruit	Quantity (kg)	Value (kina)
Oranges	590,000	K207,000
Mandarins	106,000	70,000
Lemons and limes	26,000	14,000
Grapefruit	24,000	13,000
Other citrus	11,000	8,000
ALL CITRUS	757,000	K312,000

Source: National Statistics Office

Note: This is the value of the fruit on the boat in Australia or New Zealand (FOB) value. The cost to PNG is higher because of shipping and insurance. The cost to the consumer is about twice this value.

These are the reasons why it is not developed:

1. People have not recognized the correct environments (places) for growing the best fruit.

2. Transport from places where citrus grow well is often difficult. Transport to urban markets can cost more than the freight on imported produce.

3. Improved varieties are not available as budded seedlings to growers.

4. The level of crop husbandry is poor. This includes pest control and fertilization.

5. Growers have little understanding of quality and packaging standards needed to supply an acceptable product for urban markets.

Papua New Guinea could be self-sufficient in all types of citrus. Already citrus are important cash crops for some people. On the Kokoda Trail in Central Province and in parts of Kainantu District in the Eastern Highlands, mandarins are the major cash crop. Oranges are an important cash crop on the Lelet Plateau of New Ireland and in the Snake River area in Morobe Province. They could be a cash crop for many more people in Papua New Guinea.

The physical environment determines where crops can be grown and how well they will grow. The most important aspects of physical environment in Papua New Guinea are altitude, rainfall (total and seasonal distribution), soil texture and fertility. Altitude is the most important factor for good citrus production. This has not been recognized in Papua New Guinea up till now.

ALTITUDE

The altitudinal range of the seven types of citrus are given in Table 2. The usual altitudinal range shows the altitude where each species is usually grown at the moment. The extreme range shows where they are grown under special conditions. (Extreme range means the very lowest and the very highest). The usual altitudinal range for oranges, mandarins, limes and grapefruit is from sea level to 1800 metres (m). The bottoms of the main valleys in the highlands are at 1500-1750 m, so these citrus will all grow in the highlands.

Pomelo is a lowland species, but it grows up into the lower valleys of the highlands, such as the Baiyer River Valley or the lower Asaro Valley. Kumquat do not grow as high as pomelo. Lemons are more suited to cooler climates. They grow near sea level, but only poorly. They do best above an altitude of 400 m and grow up to 2150 m. (Wabag town is at 2100 m). All species can grow and bear fruit a little higher under extreme conditions.

The figures given in Table 2 tell us where the crops can be grown. They do not tell us the best places to grow them or how well the crops are growing there. This is important for commercial production. Oranges and mandarins grow well in a more narrow range of altitudes in Papua New Guinea. In Table 3 we give a list of some places in Papua New Guinea where we have seen or heard about good quality oranges and mandarins being produced.

An orange tree (left) and a mandarin tree (right) in a highland village. The best quality oranges and mandarins are grown between 800 and 1400 metres above sea level in Papua New Guinea.

Oranges

It can be seen from Table 3 that good quality oranges are mostly grown between 800 and 1400 m a.s.l., although some are grown at up to 1600 m in the Eastern and Western Highlands. The best altitude zone for growing good oranges seems to be between 1000 m and 1400 m. Good quality oranges are sometimes grown in the lowlands, but this is the exception not the rule.

Mandarins

There are only a few areas where good quality mandarins are grown at the moment. As with oranges, these are all in the altitudinal range of 800-1400 m a.s.l. Mandarins are the main cash crop on the Kokoda Trail in Central Province and in parts of Kainantu District of the Eastern Highlands. On the Kokoda Trail, the Mountain Koiari people grow many mandarins for the Port Moresby market. Mandarins are the main cash crop in this area. They are grown between 800 and 1200 m, but the best quality fruit are from about 1200 m. Family groups charter light aircraft to fly the harvest to Port Moresby.

In the eastern part of Kainantu District just near the edge of the main highlands valleys, the Gadsup and Binumarien people grow many mandarins. The trees are mostly grown at 1300-1400 m, but they are grown as high as 1500-1600 m. The fruit are sold in large numbers in Kainantu market in the season, especially in May, June and July. These mandarins come from a type introduced by German Lutheran missionaries many years ago. The trees are propagated by seed or by root cuttings. With this tecnnique, people cut the root tips and place the root above the ground to stimulate sucker growth. The suckers are later separated and planted.

TABLE 2. THE USUAL AND EXTREME ALTITUDINAL RANGE OF CITRUS IN PAPUA NEW GUINEA (1)

Species	Usual altitudinal range (m a.s.l.)	Extreme altitudinal range (m a.s.l.)
Orange *(Citrus sinensis)*	0-1800	0-2000
Mandarin *(C. reticulata)*	0-1800	0-2250
Pomelo *(C. grandis)*	0-1300 (2)	0-1650
Lime *(C. aurantifolia)*	0-1800	0-2250
Lemons *(C. limon)*	0-2150 (3)	0-2200
Grapefruit *(C. paradisi)*	0-1800	0-2000
Kumquat *(Fortunella japonica)*	0-1150 (?)	

Notes: 1. Source: unpublished observations of R.M. Bourke.

2. Pomelo by grapefruit crosses grow up to 1850 metres.

3. Lemons usually do poorly at sea level. They grow better at altitudes above 400 m.

TABLE 3. SOME LOCATIONS IN PAPUA NEW GUINEA WHERE GOOD QUALITY ORANGES AND MANDARINS ARE PRESENTLY GROWN

Location	Approximate altitude (m a.s.l.)	Approximate rainfall (mm)
ORANGES		
Kokoda Trail, Central Province	1200	3800 (?)
Asaro and Benabena Valley, E.H.P.	1400-1600	1900
Kainantu area, E.H.P.	1550	2000
Teptep area, Madang Province	1200	2800 (?)
Snake River Valley, Morobe Province	1250-1450	1500
Wau area, Morobe Province	900-1100	1700
Lelet Plateau, New Ireland Province	950	2800 (?)
Karimui Plateau, Simbu Province	1150	3400
Lake Kutubu area, S.H.P.	800	4700
Baiyer River Valley, W.H.P.	1300	2600
Waghi Valley, W.H.P.	1400-1600	2600
Fatima area, Lumi District, W.S.P.	850	2600
MANDARINS		
Kokoda Trail, Central Province	800-1200	3800 (?)
Arona Valley, E.H.P.	1300-1400	2000
Asaro Valley, E.H.P.	1400	1900

As with oranges, good quality mandarins are sometimes grown in the lowlands, for example, near Rabaul. But good quality fruit are generally to be found at higher altitudes.

Other citrus

Pomelo grow best in the lowlands, although they can be grown up to an altitude of about 1300 m. There are many pomelo trees on the Gazelle Peninsula, but they could be planted much more widely in the lowlands, as they are very popular.

Limes can be grown up to an altitude of 1800 m. They do best below 1500 m. There is a limited market for limes, mostly for hotels and expatriates.

Lemons grow above 400 m and as high as 2150 m. They do best in the cooler highlands.

Grapefruit grow from sea level to 1800 m. The best quality fruit are probably grown in the same range as for oranges and mandarins (800 to 1400 m). However sweetness is not so important for grapefruit, so they can be grown at higher and lower altitudes as well.

RAINFALL

The approximate rainfall of locations where good quality oranges and mandarins are presently grown in Papua New Guinea is shown in Table 3. There is a big range in the rainfall of these locations. It is surprising that good oranges can be grown at locations such as Lake Kutubu which receives as much as 4700 mm of rain a year. We expect that the best quality oranges and mandarins would be grown at locations with lower rainfalls.

SOILS

The locations given in Table 3 have a wide range of soil types. In the highlands it is possible to grow good oranges and mandarins only on well drained soils. However at lower altitudes, good citrus are sometimes grown on heavy clay soils. For example, oranges grow well on the Lelet Plateau of New Ireland on a clay soil. We expect that best growth would occur on deep, well drained sites and recommend the use of these sites.

The physical structure of a soil is more important for citrus than the fertility. Fertility can be improved by adding compost or fertilizer, but the physical structure is more difficult to change.

BEST PLACES FOR ORANGES AND MANDARINS

Altitude seems to be the main thing that decides whether it is possible to grow good quality oranges and mandarins. The best oranges and mandarins are now grown between 800 and 1400 m in Papua New Guinea. We think the very best altitude range is 1000 to 1400 m for oranges and 1000 to 1200 m for mandarins.

Rainfall does not seem to be so important. However we expect the best fruit could be grown in places that have rainfalls of less than 3000 m and a marked dry season. It is also important that citrus be grown on well drained soils of good fertility. This seems to be especially important when oranges and mandarins are grown above 1400 m.

Access to markets is the other

thing that must be considered for commercial citrus growing. It is important that there is good road or air access to urban areas. Access is improving in many parts of the country as roads go into the hills from the coast and go into the lower valleys from the main highlands valleys. Access to places of altitudes of 800 to 1400 m is much better now than it was 15 years ago.

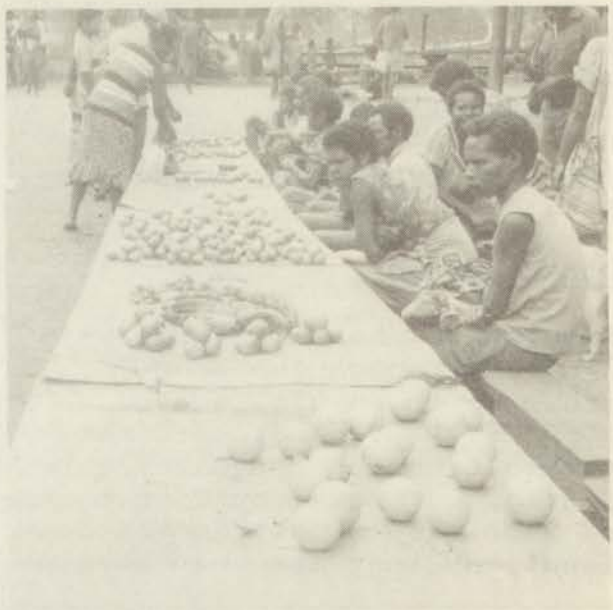
Possible locations

A list of possible locations for commercial production of oranges and mandarins is given in Table 4. The altitude zone that is suitable for commercial orange and mandarin growing in these areas is also given.

The list is not complete and there are other locations not listed. All of the places given in Table 4 do not have equal potential for commercial orange and mandarin production. There is very limited potential anywhere in East Sepik, Manus and West New Britain Provinces. The potential is limited in East New Britain, North Solomons, Western and Milne Bay Provinces. Here, access to areas at suitable altitudes is the main problem.

The locations with the greatest potential for commercial orange and mandarin production are:

- Baiyer Valley in the Western Highlands (very good potential).
- Bulolo, Wau and Snake River areas of Morobe, between 1000 and 1400 m.
- Arona Valley in the Eastern Highlands.
- Lelet Plateau of New Ireland.
- Various locations in Central Province, including Kokoda Trail and Tapini areas.



Oranges (foreground) and mandarins (background) for sale in Kainantu market in July 1982. The price is two oranges or three mandarins for 10 toea. The seller at the end of the bench is from the Binumarien area (1400 m). Their fruit is always very popular because people know that it is sweet. Many more mandarins and oranges should be grown for sale in Papua New Guinea.

DISCUSSION

Papua New Guinea is importing a lot of citrus fruit. These could all be grown within the country. This would provide cash income and employment for people, and save money from going overseas. It would also reduce the dependence of the national economy on changes in prices of a few export crops, such as coffee.

In some towns locally produced oranges and mandarins are much cheaper than imported ones, so the consumer would also benefit. (In Kainantu, locally grown mandarins cost 3-5 toea each. Imported ones of similar quality cost 23-30 toea each. This also applies in Wau. However in Port Moresby, imported fruit are cheaper than locally produced fruit of similar quality.)

The potential market for oranges and mandarins is much greater than the quantity that is presently imported. Mandarins in particular are very popular and very many more could be sold if they were available. The demand at the moment is limited by the high price of the imported fruit. Citrus are useful foods nutritionally, especially for urban people who might not eat a lot of fresh fruit and vegetables.

We suggest that citrus production should be promoted in many parts of Papua New Guinea to serve the various urban areas. A number of locations have very good potential for commercial production and bigger industries should be encouraged here as well as near the larger towns.

Marketing

This article has considered the best places to grow good quality fruit. But there are other things to consider, especially with transport and marketing. There are a number of types of markets in Papua New Guinea and they have different requirements. These are the types of markets:

1. Supermarkets and large stores. At the moment these sell mostly imported citrus fruit. Fruit sold in these stores must be of the highest quality.

2. Institutions. Some of the large institutions, such as the universities and army centres, are large consumers of imported oranges. Quality is not quite so important for the institution market.

3. Fresh food markets. This is where Papua New Guinea produced citrus are mostly sold. Fruit quality is important, but consumers will accept lower quality fruit in these markets than in the supermarkets and big stores.

The needs of the different types of markets have to be considered. Large scale producers would be producing mainly for the supermarkets and institution markets. However, there is great potential in Papua New Guinea for production for the fresh food markets.

For Papua New Guinea produced citrus to compete with imported fruit, the following requirements will have to be met:

1. Regular supply of fruit. Because oranges and mandarins are seasonal, some cold storage may be needed.

2. Long storage life. This means that careful handling and transport of fruit is essential.

3. Consistent quality. Poor quality fruit that can be sold in fresh food markets cannot compete with imported fruit in the supermarket.

4. Attractive appearance. One of the problems of oranges and mandarins produced in Papua New Guinea is that they do not have the deep orange colour of imported fruit. This colour is made by artificial colouring with gas. Artificial colouring of fruit might have to be done if locally produced fruit is to compete with imported fruit.

This article has been concerned with the best places to grow citrus. It has not considered the economics of production, transport, and marketing. However these are important

TABLE 4. SOME LOCATIONS IN PAPUA NEW GUINEA THAT HAVE POTENTIAL FOR COMMERCIAL ORANGE AND MANDARIN PRODUCTION

Province	Areas	Approximate altitude of areas with potential (m)
Central	Kokoda Trail	800-1200
	Sogeri Plateau	500- 700
	Tapini	1000-1400
Eastern Highlands	Arona Valley	1300-1400
	Asaro Valley	1400-1500
East New Britain	Baining Mountains	600-1000
East Sepik	Prince Alexander Mountains (?)	400- 600
Enga	Sau and Lower Lai Valleys	1000-1400
Gulf	Kaintiba - Kanabea	700-1300
Madang	Bundi	800-1400
	Saidor (inland)	800-1400
	Tauta	1000-1400
	Wanuma (Adelbert Range)	700-1200
Manus	Manus inland (?)	500
Milne Bay	Agaun	800-1200
Morobe	Boana, Bulolo, Kabwum, Snake River, Wantoat, Wau	800-1200
New Ireland	Lelet Plateau	900-1000
North Solomons	Kongalai	600- 800
	Tokarau	600-900
Oro	Managalas Plateau	800-1000
Simbu	Lower Waghi Valley	1400
Southern Highlands	Erave	1000-1200
	Lake Kopiago	1200-1400
	Lake Kutubu	800- 900
Western Highlands	Baiyer Valley	1100-1400
	Lower Waghi Valley	1400
West Sepik	Fatima area, Lumi District	800-1000
	Duramin, Telefomin District	800-1000

considerations before any large scale industry could be established.

CONCLUSIONS

The main thing that didimen and didimeris can do to encourage commercial citrus production is to distribute budded seedlings or seed of selected citrus varieties. Mandarins, oranges and pomelos are the three types that should receive the most attention.

Budded seedlings and seed of limes, mandarins, grapefruit and oranges are available from Laloki near Port Moresby. Aiyura staff distribute budded oranges, mandarins, grapefruit and lemons, Seed of West Indian limes is available at Kuk near Mt. Hagen and Keravat. Keravat staff also distribute pomelo and kumquat seed. Seedlings should be sold to people who live in the best environments for producing good quality fruit and who are able to market their fruit. People should be encouraged to plant trees in well drained locations and to fertilize the trees with organic or inorganic fertilizer.

APPENDIX

The altitude of any location in Papua New Guinea can be obtained by reading the brown contour lines on the 1:100,000 topographic maps. These maps can be obtained from the National Mapping Bureau, P.O. Wards Strip, Waigani. They cost K2 per map for Government Departments or K3 for individuals.

Rainfall data for most locations in Papua New Guinea are given in the book:
Climatic Tables for Papua New Guinea. This book can be obtained free from Division of Land and Water Resources, C.S.I.R.O., P.O. Box 1666, Canberra, A.C.T. 2600, Australia.

FURTHER READING

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