Root Crops in Papua New Guinea

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Abstract

Root crop production in Papua New Guinea is reviewed. Crops considered are the major ones (*Ipomoea batatas, Colocasia esculenta, Dioscorea alata, D. esculenta, Xanthosoma sagittifolium*), other significant root crops (*Manihot esculenta, Psophocarpus tetragonolobus, Cyrtosperma chamissonis, Alocasia macrorrhiza* and *Solanum tuberosum*) and 27 minor crops. For the major and significant crops, aspects covered are: introduction to Papua New Guinea, significance, ecological place, distribution, number of cultivars, cultivar collections, yield, time to maturity, major pest and disease problems, research input and future prospects.

Introduction

Root crops are extremely important in Papua New Guinea (PNG). Traditionally sweet potato, taro, yams, sago (*Metroxylon* spp.) and bananas were the staple foods, either singly or in combination. Together with *Xanthosoma* taro, these remain the staple crops. In this paper I wish to discuss production of the major and significant crops. Root crops used as condiments, such as ginger, will not be considered. The country may conveniently be classed into four major altitudinal zones, viz., lowland (0-600 m), intermediate (600-1200), highland (1200-1800) and high altitude (1800-2900). Most of the people live in either the lowland or the highland zone. Mean annual rainfall ranges from 1000 mm to over 7000 mm, with the most places receiving between 1500 and 4000 mm a year.

Major Crops

Sweet Potato (*Ipomoea batatas*). It is generally accepted that sweet potato was introduced in PNG sometime in the past 400 years, following European exploration in the New World. Yen (1974 p259) has proposed that it reached PNG via Indonesia, India and Africa from the West Indies. Golson (1977) suggests that it may have reached PNG some 1200 years ago, but this remains unproven.

Sweet potato is the most important crop in PNG (Table 1). It is the staple food for most highlanders. Various authors have calculated that it provides between 60% and 95% by weight of food eaten by various groups of highlanders. The crop's importance is increasing rapidly in the lowlands. In some areas, such as on Bougainville, it has replaced the staple taro. More commonly, sweet potato production is increasing, together with *Xanthosoma* taro and cassava, at the expense of the traditional staples. It is a significant cash crop in both the highlands and lowlands. It is grown at an altitude of about 2600 m to as high as 2900 m. In the highlands a large proportion of the crop is fed to domesticated pigs which are slaughtered periodically in massive numbers. There is an extensive literature on the crop's role in subsistence systems and the effect of its introduction on the highland people.

Yen (1974 p247) suggests that more cultivars could be collected in PNG than from any other area in the world. The Highlands Agricultural Experiment Station collection contains 380 cultivars (including duplicates), but this is certainly a small proportion of the available germplasm. Typically a highland group will maintain about 30 cultivars, although individual gardeners plant a third to half that number. The largest number recorded for any area is from Mount Hagen where 40-50 are available (Powell *et al.*, 1975). In the lowlands, the number of available cultivars for any group of people is generally smaller. This reflects perhaps the crop's recent increase in importance in the lowlands (since the Pacific War) and its role where agricultural intensification is occurring with a concomitant decline in diversity. Spontaneous germination of true seed gives rise to potential new cultivars, some of which are retained and may eventually replace existing cultivars. This process, and cultural isolation of growers, explains the large number of cultivars in PNG (Yen, 1974; Powel et al., 1975). Replacement of traditional cultivars by ones from other areas is now common.

Both experimental and subsistence farmers' yields are generally high (Table 2). The maximum recorded experimental yield of 71.2 t/ha for a 27 week crop was recorded for a single variety only (Enyi, 1977). However high yields have also been recorded from large scale plantings. A fertilizer trial near Goroka (c. 1500 m) yielded 68.9 t/ha for a 34 week crop. Time to maturity is 5-6 months in the lowlands, 6-8 months in the highlands and 12 or more months at high altitudes. There are varieties that mature earlier and later than these periods.

Sweet potato weevil (*Cylas formicarius*), rats and pigs are the principle pest problems. Widespread serious damage is the exception rather than the rule. Leaf miner (*Bedellia somnulentella*) and hawkmoth (*Herse convolvuli*) have been recorded as serious pests on occasions. The crop is free of major disease problems. A little leaf condition, caused by a mycoplasma, has been very severe on New Britain and in the Central Province at times, but outbreaks have been restricted in an area. Leaf scab caused by *Elsinoe batatas* is widespread, especially in the highlands, but it is not believed to cause serious yield loss in most cultivars.

Research has concentrated on area cropped and annual production (Table 1). Agronomy trials have covered a wide range of investigation, but unfortunately much of the work is unpublished. Expansion of production in both the subsistence and cash economy sectors is likely. Its agronomic superiority over taro and yams is widely appreciated. In addition, cultural factors act to increase its popularity. These include its widespread use by institutions such as schools and the general lack of associated ritual.

Taro (*Colocasia esculenta*). Taro is an ancient crop in PNG. It is, or was, the staple food in lowland and intermediate altitude areas where rainfall is well distributed throughout the year. It is grown in all lowland environments except the very driest areas and where most land is flooded. It is a staple in the Telefomin-Star Mountains region, and in a number of areas on the outer slopes of the Central Cordillera. Elsewhere in the highlands it is often an important supplementary staple. It is planted in areas as high as 2750 m, but is not commonly cultivated above 2100 m (Clarke, in press). Clarke argues that it was the staple crop in the highlands between 1400 and 2000 m before the arrival of sweet potato.

It is widely recognized among farmers that taro requires a fertile soil to produce a worthwhile crop. Thus it is generally grown following a long forest fallow or, in grassland areas, in the best soil available. Irrigation has been noted in at least six areas, but this is a minor practice and is probably dying out. It is commonly grown in ditches or swampy areas in the highlands, sometimes in stagnant water.

Cultivars are all of the dasheen type (*C. esculenta esculenta*), that is, where the corm is the main product. The Lowlands Agricultural Experiment Station (LAES) collection contained some 200 cultivars at times, but most have been lost to virus diseases. Among people whose staple is taro, 40 to 70 cultivars are typically available. The highest recorded number is for the Longueinga of New Britain who have over 200 cultivars (Panoff, 1972). Even where taro is a co-staple or supplementary crop, 20 to 30 cultivars are often available within a group. Taro sets seed in PNG, and gardeners obtain new cultivars from self sown seedlings (Panoff, 1972; S. Rangai, pers. comm.). Corm yields are not high (Table 2). The highest recorded yield of 38 t/ha in a subsistence garden was for irrigated taro. The next highest subsistence yield is only 13 t/ha (Conroy and Bridgland, 1950). In many areas, gardeners say that taro does not yield as well as it used to, a statement not generally made for other staples. Taro generally takes 7 to 9 months to mature in the lowlands, but maturity can be as quick as 4 months (Malinowski, 1935). It takes longer in the highlands, and as long as 18 months at high altitudes (Clarke, in press).

Taro is afflicted with a number of serious pests and diseases. Taro beetle (*Papuana* spp.) damage is widespread and is often severe. Various leaf eating larvae commonly occur at low infestation levels and occasionally defoliate crops. Virus diseases are the most serious disease problems. The diseases are widespread at apparently low incidence in gardens, but at times are serious enough to kill significant portions of a crop. Taro blight caused by *Phytophthora colocasiae* is very widespread in the lowlands. It was introduced about the time of the Pacific War. It is a serious disease and severely reduces yield at times, especially during periods of high rainfall. A modest amount of agronomic work has been done (Table 1), but has been hampered by problems of virus disease and an inadequate supply of planting material. Other research has concentrated on taro blight, virus diseases and taro beetle.

Taro production is declining in many areas and this trend is likely to continue. This is occurring both where it was the traditional staple and where it was a supplementary crop. Figures published in the *Papua New Guinea Statistical Bulletin* indicate that retail prices are generally much higher than for other staples and prices have risen faster than for other staples since 1971. The partial or complete decline of the crop since the Pacific War is attributed by most commentators to leaf blight, particularly on Bougainville (e.g., Clarke, in press). My observation is that the effect of blight has been overstated and other problems ignored or understated. It is suggested that the following factors may be contributing to the decline of taro cultivation: Unavailability of land of adequate soil fertility, high labor inputs relative to yield returns, virus diseases, taro beetle, leaf blight, availability of planting material, decline in spiritual values associated with the crop and the availability of alternative easier to grow staples. The major reasons for the crop's decline vary from area to area. On Manus Island (S. Rangai, pers. comm.) and amongst the Kol of New Britain, virus diseases are the most significant. In the Gazelle Peninsula of

New Britain the major factor is insufficient land of high fertility because much of the accessible land is devoted to plantation crops (Bourke, 1976).

Greater and Lesser Yams (*Dioscorea alata* and *D. esculenta*)

The two main yam species grown in PNG are considered by most authorities to be of Asian origin, although Martin (1977) suggests that PNG is the possible center of origin. *D. alata* and *D. esculenta* are staples in lowland areas with a marked seasonal rainfall distribution or where rainfall has a high coefficient of variation (islands of Milne Bay Province). Yams are co-staples with bananas in very dry areas. *D. esculenta* is the more important yam in the lowland areas of the New Guinea north coast (Maprik, Bogia, Madang, Rai coast), the Morehead region (Williams, 1936 pp17, 216) and Rigo area of the south coast, the Namatanai area of New Ireland, and the Trobriand Islands (Malinowski, 1935).

In the lowlands where yams are a minor staple or of minor significance, *D. alata* is generally more significant and *D. esculenta* may be absent. Where yams are the staple food, *D. alata,* rather than *D. esculenta,* is generally, but not always used for ceremonial purposes. Together with the wider distribution of the *alata* yam, this suggests that *D. alata* is a more ancient crop in PNG than *D. esculenta. D. alata* is grown at 2300 M in the highlands (Powell, 1976 p129) but it is only important below 1800 M. It is a secondary staple in highland areas with a marked dry season, such as the Obura (1400-1600 M and Buang (900-1500 M) areas. *D. esculenta* is occasionally grown in the highlands but it is insignificant in this zone.

The largest number of cultivars recorded for any group is from the Maprik area where 59 cultivars of *D. esculenta* and 43 of *D. alata* and *D. nummularia* are available (Lea, 1966). Except for the Maprik area, people have more *alata* cultivars than *esculenta* in all areas where the number of cultivars has been reported. Only limited yield data is available, particularly for *D. alata.* The available data suggests that *D. esculenta* outyields *D. alata* (Table 2). Time to maturity is 7 months for *D. alata* (Lea, 1966) and 6-8 months for *D. esculenta.* Prior to the Pacific War various agronomic trials were conducted. The only research since the war has been on cultivar evaluation and tuber protein content determination (Table 1).

Production of ceremonial yams (mostly *D. alata*) is declining in the Maprik area (Lea, 1966) and in other areas. It is likely that production of ceremonial yams will decline faster than yams grown as a staple, but these too will decline in importance slowly as crops which yield more food for the labor inputs replace them.

Xanthosoma Taro (*Xanthosoma* spp.)

Xanthosoma was probably introduced in PNG since the European settlement, that is, in the last 100 years. Several species are present. *X. sagittifolium* is the main one grown, but *X. violaceum* and *X. brasiliense* are also planted for their edible leaves. *Xanthosoma* taro is now an important crop in the lowlands, and is also grown in the highlands altitude of 1850 m (Table 1). *Xanthosoma* grows in the same broad ecological zone as *Colocasia* taro except that it does not grow under flooded conditions, it is shade tolerant and it produces well under lower soil fertility than *Colocasia.* It has become the staple crop in parts of the Gazelle Peninsula of New Britain and in the Finschhafen area. Significant quantities are produced in other lowland areas, including the Hoskins Oil Palm Settlement Blocks. It is grown under shade, especially under bananas, as well as in full sunlight. Together with diploid bananas, it is used as a temporary shade for young cocoa on the Gazelle Peninsula (Bourke, 1976).

It marked contrast to the other root crops, a very limited number of cultivars appear to be present. The LAES collection contains three cultivars of *X. sagittifolium* and one each of the other two *Xanthosoma* species. Only limited yield data are available, but yields per crop of *X. sagittifolium* are high (Table 2). *X. violaceum* yields considerably less. The typical experimental yields quoted are for a 12 month crop. The crop is harvested between 10 and 18 months after planting in the lowlands.

Taro beetle (*Papuana* spp.) attacks *Xanthosoma*, but damage is in general not as a serious as on *Colocasia* taro. A root rot has been causing severe yield loss and crop deaths in New Britain and in the highlands. The cause of the root rot is not known but it appears to be a fungal disease. The crop has received very little research attention except for several trials to determine the cause of the root rot (Table 1). Cultivation has expanded greatly since the war. Provided the root rot does not become a limiting factor, prospects for further expansion are good, particularly in traditional taro producing areas.

Other Significant Root Crops

Cassava (*Manihot esculenta*). Cassava was probably introduced some time between the European exploration in the Americas and European settlement in PNG (1500-1870 AD). It is widely grown especially for pig food and as a food reserve and has been recorded to grow in areas as high as 2050 m (Table 1). In general, it is not a popular food. In areas with strongly seasonal rainfall patterns, it is of greater significance and may attain the status of a co-staple, particularly on the New Guinea south coast including Port Moresby and in the Korofeigu area of the highlands (c. 1500 m).

Cultivars seem to be fairly numerous. The LAES collection contains some 30 local cultivars but, as for most of the root crops, collection has not been very wide ranging or systematic. Subsistence gardeners typically grow a few cultivars only, a reflection of the crop's generally minor significance. Yields are high (Table 2). Crops may be harvested from 10 months after planting in the lowlands. The figures for experimental yields in Table 2 are for 12-14 month crops. The crop is apparently not free of major pest or disease problems. Various insect pests damage foliage but none have been reported as severe. Pig or rat damage to tubers can be significant. Leaf spot caused by *Cercospora henningsii* is widespread and pink disease caused by *Corticium salmonicolor* has been recorded as serious. A limited research programme in recent years has concentrated on identifying superior cultivars (Table 1).

A modest but steady increase in production is likely, particularly in situations where soil fertility has been severely reduced and where traditional food preferences are being eroded, such as in urban areas or institutions. Its role as a stockfeed, and possibly an alcohol source, is likely to expand as the crop's potential is fully realized.

Winged Bean *(Psophocarpus tetragonolobus).* As a root crop, the winged bean is of special interest because of its high protein content of the tuber. Analysis has found tuber protein contents of 5 to 11% on a fresh weight basis (A. Claydon, pers. comm.; Unpubl. DPI records).

Khan (1976) suggests that winged bean was introduced in PNG via the New Guinea north coast long before first European contact. Cultivation for tuber production is confined to the highland and high altitude zones where it is an important seasonal field crop and the tubers are a popular food. Tubers are produced in the lowlands, but yields are low and people are generally unaware that they are edible. Winged bean is most popular in the Eastern and Western Highlands and Simbu Provinces. It is cultivated for its tubers at elevations between 1400 and 1850 m, but Khan *et al.* (1977) have recorded cultivation at elevations as high as 2300 m. As with most subsidiary crops in the highlands, production is seasonal. Most of the crop is grown between July and February. Cultural techniques to encourage tuber rather than pod production include use of special cultivars, flower, shoot and pod pruning, and use of short stakes.

PNG is a center of genetic diversity for winged bean (Khan, 1976). Some 180 pure local lines are maintained in the University of PNG (UPNG). In general, cultivars are good producers of pods or tubers, but not both. Tuber yields are low compared with other root crops (Table 2). In all experiments where tuber yield has been recorded, grain has been harvested as well. If flower pruning had been practised, tuber yields would probably have been higher. A tuber crop requires 5 to 7 months to mature. The root knot nematode (*Meloidogyne incognita*) is a widespread pest and may cause considerable damage. False rust (*Synchytrium psophocarpi*) is a widespread disease. There is a major multi-disciplinary research on crop botany, agronomy, nutrient composition and false rust based at UPNG. (Table 1).

The future of winged bean as a root crop is uncertain. Labor inputs are relatively high. There are increasing pressures on subsistence agriculture tending to reduce diversity and traditional values. Production has declined in the Southern Highlands in recent years (Khan *et al.*, 1977). In the continued absence of significant government support for subsistence agriculture, this may happen in the rest of the highlands.

Swamp Taro *(Cyrtosperma chamissonis).* Swamp taro is the staple on certain coral atolls, such as the Mortlock Islands (Boag and Curtis, 1959), where it is grown in man-made pits. It is grown on swamps on high islands, such as on New Ireland and Manus, where it is a supplementary and a reserve food. There is a little information on the agronomy or culture of the crop. Boag and Curtis state that time to maturity is three to four years depending on type of planting material. The only yield data is for a 7-1/2 year old crop in New Britain that yielded 48.1 t/ha (Table 1). Research input is confined to a recently planted time to maturity trial. Swamp taro appears to have potential for expansion as it requires minimal labor inputs when planted in natural swamps. Difficulty in harvesting may be a barrier to further utilization, however.

Giant Taro *(Alocasia macrorrhiza).* This crop is a subsidiary crop throughout the lowlands and highlands. In certain places larger areas are cultivated, often for ceremonial purposes. These include the ranges south of Lae (Conroy and Bridgland, 1950), the Bereina area and parts of the Gazelle Peninsula. It is cultivated at an elevation of about 2100 m to at least 2500 m. It may have been more significant in the past in both the lowlands and highlands. The only yield data is from a recent survey on the Gazelle Peninsula where corm yield varied from 8.5 to 40 kg in village plantings of unknown age. Giant taro seems to be grown as much for its ceremonial significance as for its agronomic value. As this significance is eroded, cultivation is likely to decline.

Potato *(Solanum tuberosum).* Potato was most likely introduced since the beginning of the century following expatriate penetration into the hinterland (Graham, 1976). Annual consumption is about 5000 tons of which less than half is grown within PNG (Table 1). Potatoes grow best in the 1500-2500 m altitude zone, and are grown to the altitudinal limit of agriculture. Most of the production is restricted to the five highland provinces. Potatoes are especially important at high altitudes in the Enga Province. They are basically grown as a cash crop for the urban market, and in certain high altitude locations, they provide the major source of cash income. Increasingly, potatoes are grown for subsistence but consumption levels are very low compared to sweet potato.

The Department of Primary Industry (DPI) has introduced 37 cultivars for evaluation since 1954 (Graham, 1976). A mixture of cultivars is grown but the industry is now based on the cultivar Sequoia using certified seed from Australia. With disease free seed and under good soil fertility conditions, yields are high (Table 2). As the growth period for Sequoia at 1500-1800 m is only 100 days, daily productivity greatly exceeds any other root crop. The comparison is not strictly valid as high potato yields are the product of intensive breeding and special measures of reducing disease problems whereas the other root crops have not benefited from such inputs.

Tuber moth (*Phthorimaea operculella*) is the most serious pest and taro beetle (*Papuana* spp.) has been serious at times. Bacterial wilt (*Pseudomonas solanacearum*) is the most serious problem of the industry and precludes potato production in certain areas. Target spot (*Alternaria solani*) is widespread and can cause serious yield reduction (R. Nitschke, pers. comm.). A large amount of agronomic research has been conducted relative to the scale of the industry (Table 2). While the seed multiplication scheme is working, prospects for further expansion to meet the growing urban market demand are good. Expansion of subsistence cropping is undesirable. Yield per unit time is very high but the crop's susceptibility to complex of diseases make it an unstable base for subsistence systems.

Minor Root Crops

Traditional Species

Potato yam. (*Dioscorea bulbifera*) is widely grown in small quantities at altitudes of up to 1850 m, particularly where *D. esculenta* or *D. alata* are the staples. It is commonly gathered from the forest (Powell *et al.*, 1975). The largest number of cultivars reported is seven from the Maprik area (Lea, 1966).

Dioscorea nummularia is cultivated in a number of lowland areas (New Britain, New Guinea north coast); and near Goroka (c. 1500 m). It is also gathered from the forest. Barrau (1965) suggests that *D. nummularia* may have been more important in ancient times.

Dioscorea pentaphylla has been reported to be cultivated in the lowlands from the New Guinea north and south coasts and New Britain. Wild plants are harvested on hunting trips in famine times (Powell, 1976 p119).

Dioscorea hispida is cultivated and gathered in New Britain where both the leaves and tubers are eaten (Powell, 1976 p109).

Pueraria (*Pueraria lobata*) is widely cultivated throughout the highlands as a minor crop (Watson, 1968). It is grown at altitudes as high as 2500 m in the Simbu. Barrau (1965) and Watson (1968) suggest that it may have been a staple prior to the introduction of modern staples. *Pueraria* is used as both a ceremonial and a famine food. Wild tubers are occasionally gathered from the grasslands and eaten (Watson, 1964). The largest reported tuber weighed more than 32 kg (Watson, 1964). Moderately severe infestations of a false rust (*Synchytrium minutum*) are common. There has been a recent rapid decline in the use of *Pueraria* (Watson, 1968). This decline is likely to continue. The ceremonial value will be reduced as the traditional culture of the highlanders is eroded and as the need for a famine food is reduced by access to cash and other food sources.

Amorphophallus campanulatus is occasionally cultivated in the lowland grassland areas, e.g., around Bogia on the north coast and on the south coast south of Bereina. In the latter area it is reported to be a minor staple.

Polynesian arrowroot *(Tacca leontopetaloides)* is used occasionally in islands with Polynesian populations, such as the Mortlock Islands (Boag and Curtis, 1959).

Cordyline (*Cordyline terminalis*) is one of the most characteristic plants in PNG agriculture. It is cultivated in the lowlands to the altitudinal limit of agriculture and is used as plot markers, an item of clothing, a warning to thieves, and has strong spiritual significance. Massal and Barrau (1956) record that cordyline is still eaten in PNG, although present usage as food is uncertain. Some people recognize that the roots were eaten in previous times, for example, in New Ireland. It may have been used more extensively for food in the past (Barrau, 1965).

Nephrolepis biserrata. The roots of this fern are gathered to make flour in Frederik-Hendrik Island off the south coast of Irian Jaya (Indonesian New Guinea) (Massal and Barrau, 1956).

Petris moluccana. The roots of this fern are used to make flour on Frederik-Hendrik Island (Massal and Barrau, 1956) and on the Watut River (Powell, 1976 p111).

Habenaria sp. The small tubers of this orchid are gathered and eaten in the Mumeng area (Massal and Barrau, 1956) and Markham Valley (Powell, 1976 p110) of the Morobe Province.

Banana (*Musa* sp.). Roots of a wild banana are eaten at Hoai village (2100 m) in the Southern Highlands (Harrison, n.d.).

Recently Introduced Species

Choyote (*Sechium edule*) is cultivated for the edible shoots and fruit. Gardeners are generally not aware that the tuberous root is edible. Some people eat the tuber in both the highlands and lowlands, for example, on the Nembi Plateau (c. 1700 m) and in the hills north west of Lae.

Queensland arrowroot (*Canna edulis*) is grown and eaten in the New Guinea south coast in theCentral and Milne Bay Provinces.

Spring onions and shallots (*Allium cepa*) are grown in both the lowlands and highlands. Spring onions are a common component of gardens and have been accepted into the subsistence food pattern as a minor vegetable, in part because they are vegetatively propagated.

Onion *(Allium cepa),* **beetroot** *(Beta vulgaris),* **turnip** *(Brassica rapa),* **leeks** *(Allium ampeloprasum),* and **parsnip** *(Pastinaca sativa).* Very limited quantities are grown in the highlands for sale, mainly to expatriates. Onions have been grown experimentally and commercially in the lowlands. Leeks are mostly grown above 2000 m.

Carrot *(Daucus carota)* and **radish** *(Raphanus sativus)* are grown in both the highlands and lowlands on a very limited scale, mainly for sale to expatriates.

Yam bean *(Pachyrrhizus erosus)* is sometimes grown in the lowlands, mainly for sale to Chinese people.

Jerusalem artichoke *(Helianthus tuberosus),* **sugar beet** *(Beta vulgaris)* and **arrowroot** *(Maranta arundinacea)* have been grown experimentally, but not commercially or for subsistence.

Discussion

The food crops of PNG are very diverse at both the species and cultivar levels. For example, some 300 species are used for food (Powell, 1976 p174; Bourke, unpubl. data). On the basis of variation within species, PNG has been claimed to be the possible origin of a number of crops, like, for example, *D. alata* and *D. esculenta* (Martin, 1977). The diversity for any given species must be considered against a background of diversity of most species. Yen (1974- p247) points out that, if number of cultivars was the sole criterion, New Guinea would be considered as the center of origin for sweet potato. The same certainly applies to taro.

Papua New Guinea is experiencing a period of accelerated cultural, economic and social change that is having a profound effect on agriculture. Production of root crops of American origin (sweet potato, *zanthosoma* taro, cassava, and potato) is increasing at the expense of the Asian-Pacific taro and yams. These crops themselves must have replaced earlier inferior crops such as *Pueraria, D. nummularia,* cordyline (Barrau, 1965) and *Alocasia* taro.

At the same time root crops are being replaced in the diet by imported cereal products derived from rice, wheat and barley. These changes are receiving little direction. Government intervention in root crop production is confined to research, and assisting growers to produce potatoes for urban centers, and to a much lesser extent for urban centers. For some crops such as sweet potato, the technology is available to increase production in the subsistence and cash crop sectors, but the will to do so is lacking.

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Table 1. Annual production, area cropped and number of agronomic field trials conducted for major and significant root crops

Crop	Annual production (tonnes) (1)	Area cropped (hectares (1)	Number of agronomic field trials (2)
Sweet potato	1,223,000	72,000	127
Colocasia taro	318,000	18,000	24
Greater yam and lesser yam	237,000	7,000	12
Xanthosoma taro	149,000	4,000	3
Cassava	53,000	900	6
Winged bean	–	1,100	35
Swamp taro	–	–	1
Alocasia taro	–	–	0
Solanum potato	2,000 (3)	200 (3)	65

(1) Walters (1963). Figures are estimates only. They are not accurate enough to derive overall yield levels.

(2) R. M. Bourke, unpubl. data

(3) R. Nitschke, pers. comm.

Table 2. **Experimental and subsistence garden yields per crop and maximum recorded yield for an individual "root" for the major and significant crops**

Crop	Experimental: Typical yield range (t/ha)	Experimental: Maximum recorded yield (t/ha)	Subsistence: Recorded yield range (t/ha)	Individual "root": Maximum recorded weight (kg)
Sweet potato	10-30 (1)	71.2 (2)	7-23 (3) (4)	9.5
Colocasia taro	4-10	17.6 (5)	3-38 (6) (7)	10.0 (8)
Greater yam	15	31.1	16 (9)	63.6 (9)
Lesser yam	20-50	74.0 (5)	10-21 (10) (9)	c. 5 (11)
Xanthosoma taro	20-25	38 (12)	–	3.7
Cassava	20-45	63.7	–	–
Winged bean	1-3 (13)	11.8 (13)	6-12 (14)	–
Swamp taro	48	–	–	15.0
Alocasia tarp	–	–	–	40.0
Solanum potato	20-35	56.3	–	1.8

(1) All figures are unpublished Department of Primary Industry records unless specified otherwise
(2) Enyi (1977)
(3) Mitchell (1976)
(4) Bowers (1968)
(5) Dept. of Agriculture (1941)
(6) Clarke (in press)
(7) Conroy and Bridgland (1950)
(8) includes stem
(9) Lea (1966)
(10) Bureau of Statistics (1965). Includes some *D. alata.* Tao (3-4 t/ha) mixed cropped with yams.
(11) Martin (1977)
(12) Green (1941)
(13) Unpublished UPNG and other records
(14) Khan *et al.* (1977)