Kumara (Sweet Potato) in the Cook Islands

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Abstract

This paper is the first measure of an effort to record and describe the various varieties of kumara (sweet potato) found in the Cook Islands.

The main objectives are as follows:

1. To identify varieties grown in the Cook Islands.
2. To publicize the overall characteristics of every variety.
3. To give the Cook Islands growers a better source of information to assist them in the selection of suitable varieties to grow.
4. To promote the production of kumara in the Cook Islands as an important food crop, a factor which cannot be ignored, especially at this time of spiralling food prices and increasing food shortages.

Through continuous research work on kumara, we hope to collect and publish additional information, primarily, for the benefit of the Cook Islands growers.

Introduction

Although it is believed that kumara was introduced in the Cook Islands by the islanders themselves, some anthropologists disagree over the responsibility for this introduction. Some claim that the Polynesians at some time visited the Western Coast of America and brought the plant back with them. Others, believe that American Indians migrated to the Pacific Islands and brought the kumara with them. Some believe that kumara seed-capsules were carried by sea currents from Tropical America to Polynesia (Purseglore, 1974).

In spite of the controversies on how the kumara reached the Pacific or the Cook Islands, the most important factor is that nowadays its cultivation is becoming increasingly important for its yield, short production period and the fact that it is easy to grow.

However, more introductions of kumara varieties into the Cook Islands have been taking place since the arrival of Europeans to these islands and no doubt it will continue.

Two varieties of kumara were cultivated in the Cook Islands before the arrival of Europeans. According to Cheeseman "The Flora of Rarotonga", 1901, two varieties were grown – "Kumara-rea" possessing white skin and yellowish flesh and "Kumara-tea", having white skin and white flesh. *Chief Taraare* also stated that after the arrival of Europeans, other kumara varieties were introduced from Tahiti, Samoa and other places. Stephen Savage, in his "Dictionary of the Maori Language of Rarotonga" written in the very early 19th century, 9 varieties of kumara were listed which are:

Kumara muramura, Kumara Oi, Kumara Raupipi,
Kumara Rea, Kumara Rengarenga, Kumara Ti,
Kumara Vanu, Kumara Vavai, Kumara Vai'i (supposed to have been introduced from Hawaii) and the Kumara Vareau. Apart from the list of names, there was no description of the varieties.

Uses

Kumara is grown in the Cook Islands for its tubers and rarely for its young leaves as cooked greens. This food crop is normally considered as another starch food but in reality it is also rich in other nutrients. In the Southern Group of the Cook Islands, kumara is one of the most important root crops apart from taro and cassava or arrowroot. Kumara is also commonly cultivated at times when food shortages are anticipated as in the recent case of Mitiaro where crops were extensively damaged by "Hurricane Charlie". The local people boil or roast kumara as in the case of taro or potato and sometimes they make some kind of pudding or "poke" from it and recently as substitute for potato chips by take-away bars. At times, starch is also extracted from kumara.

Materials and methods

Selection of Soils. In Rarotonga, kumara or sweet potato is usually grown on "heavy soils" such as loam, clay-loam etc., during the drier months of the year and on "sandy soils" such as Muri-beach (coral) sand during the wet months of the year.

The trial crops were planted on these two types of soil. Beginning in July 1977, two kumara crops were planted each month, one on "coral sand" and one on "heavier soil" – the plantings were planned to continue until enough information has been obtained.

Varieties Used. Five varieties of kumara were selected for the first part of this work and these selections are some of the most commonly cultivated in the Cook Islands. One of the objectives of the present study was to identify (name) varieties cultivated and to publicize characteristics. This fore-runner publication, deals in detail, only with kumara varieties listed below:

Kumara Selection		I	Rokini
"	"	II	Tiara
"	"	III	Ti
"	"	IV	Araia
	"	V	Konopi

Selection Standards. In order to be able to recommend any kumara variety to growers, the following standards were used as a guideline in determining the qualities of each. Though none of the varieties used posses all these qualities, some, however, come very close to it.

i. Yield of at least 8 tons per acre.
ii. Early maturity.
iii. Sparse vine growth.
iv. Tubers without furrows or ridges.
v. Shallow-rooted or tight bunched tubers.
vi. Good keeping and storage qualities.
vii. Good cooking quality and palatability.
viii. Resistance to disease.
ix. Resistance to pests.
x. High contents of Vitamins A and C.

Harvesting & Recording. Each trial crop was harvested monthly beginning three months after planting up to seven or eight months of age. The tubers of each plant were counted, weighed and recorded. Other obvious characteristics were also noted. Then the weights were averaged out to per plant basis and the figures of the last harvest of each crop were used to develop the enclosed graphs. Apart from trying to determine the best varieties, particular attention was also put on variations of yields of crops on "Heavy Soils" as against yields or crops on "Coral Sand Soils", including variations of yields of crops planted in a certain month as against yields of crops planted in other months of each year.

Starch Extraction. A simple processing trial, based on local practice, was carried out to extract starch from kumara so as to be able to supply useful data for the following reasons.

i. Price of starch have gone up in the Cook Islands, from $1.99 to $2.50 per pound.
ii. When kumara are harvested there have always been some unmarketable or unconsumable tubers which could have been used for starch production.

Result

Of the total weight of kumara used 7.8% was starch.

Production Characteristics. Based on the results and observations of four different trial crops planted in the year 1977. (Table 1).

Selection I – "Rokini"

1. This variety's average production of 27 ounces per plant gives it a 10.9 tons tuber production per acre. However, many tubers were very irregular in shape and sizes hence a considerable loss due to unconsumable tubers and to wastages during peeling.
2. This variety is not early maturing. At four months, only a couple of tubers at the most are consumable, therefore, the crop should be harvested at five months or more but not earlier.
3. The variety is very prolific grower which on one hand is an advantage because it smothers weed growth quickly but too much growth may inhibit tuber formation.
4. Only the very big tubers are furrowed but many tubers, especially the smaller slender ones are lumpy possibly caused by some kind of nematodes.
5. The tubers of this variety are both shallow and deep, therefore, it is not all that easy to harvest.
6. Without subjecting the tubers to any curing process, they may only be stored for a few weeks because by that time the tuber will start to sprout and quality start to decline.
7. This variety stands boiling and roasting well and in regards to palatability it is above average.
8. It is most susceptible to "leaf-curl disease", possibly nematode infestation and if the tubers are left in the ground for too long after maturity they can be attacked by weevils and then fungal diseases.

Selection II – "Tiara"

1. The average production, 17 ounces per plant give a 6.8 ton tuber production per acre which is lower than the optimum satisfactory production of 7 to 8 tons per acre. This variety seem to have peculiar characteristics where it initiates a few tubers and then these put on weight separately one after the other rather than at the same time.
2. Because of the slow tuber weight increase, this variety have only 2 or 3 consumable tubers at 5 months so it is not advisable to harvest before 5 months.
3. The variety does not really posses the quality of "sparse vine growth". Although it can easily be smothered by other more prolific varieties, however on its own it can grow extensively.
4. Some of the tubers produced are furrowed or ridged and bulky.
5. The tubers of this variety are located close to the crown as well as deeper in the ground which indicates that harvesting will not always be easy.
6. Like the variety Rokini, the tubers of this variety may only be stored for a few weeks (that is without any curing) because for a longer period, it will start to sprout and then the eating quality declines.
7. This variety also stands boiling and roasting well and palatability is above average.
8. The variety is also most susceptible to "leaf-curl" disorder and if left in the ground far too long after maturity it can get attacked by weevil and fungal diseases.

III – "Ti"

1. The average production of 13 ounces per plant gave a 5.2 ton tuber production per acre, which is very low.
2. This variety produces tubers almost in the same manner as for variety "Tiara" in that, the tubers are slow in putting on weight and so it should not be harvested

before five months because at five months very limited consumable tubers can be obtained.

3. Compared with other selections, this variety is not a strong grower, it can easily be smothered by other more vigorous varieties – the vines do ramble but it can not stand competition for space and sunlight. If the variety must be grown then it should be planted on its own.
4. Some of the tubers produced are furrowed or ridged and bulky.
5. Like the variety "Tiara", the tubers are located both near the surface and deeper in the soil.
6. Again without any curing, the tubers may only be stored for a few weeks.
7. This variety stands boiling and roasting well and palatability is excellent – it is sweet and most acceptable – perhaps it is one of the best for the table.
8. This variety is also most susceptible to "leaf-curl" disorder which inhibits tuber formation considerably.

Selection IV – "Araia"

1. The average production of 42 ounces per plant gave a 17 ton tuber production per acre. In all trials, this variety proved to be the best producer out of the 5 varieties used.
2. This variety initiates tubers very quickly and these put on weight very quickly too. At 3 months one can expect many consumable tubers but for maximum production the crop should be harvested at 4 to 5 months.
3. This variety produces fast growing vines which rambles extensively. The vines however are much thinner than other prolific varieties.
4. The tubers are usually tapering, smooth, well-shaped and sometimes ridged.
5. This variety is easy to harvest because most of the tubers are very close to the crown, in other words it is tight-bunched.
6. Like other varieties, the tubers should not be stored for too long without curing.
7. It stands boiling and roasting well and palatability is above average.
8. So far there have been no signs of the "leaf-curl" disorder on this variety, but it is susceptible to weevil and fungal attack if left in the ground for too long.

Selection V – "Koropi"

1. The average production of 28 ounces per plant gave a 11.3 ton tuber production per acre. In all trials, this variety performed well and according to overall production data it is the second best variety.
2. This variety initiates tubers quickly and this put on weight quite well too. At 3 months, one can expect to find some consumable tubers, but for maximum production, the crop should be harvested at 4 to 5 months.
3. The variety has a strong, rambling habit of growth which smothers or suppresses weeds effectively. It has also been noted that on fertile soil, excessive vine growth seems to have inhibited tuber weight increase.
4. The tubers are usually long and tapering and are sometimes ridged.
5. The tubers are very close to the crown or is tight-bunched which makes harvesting easy.
6. Again, like other varieties, the tubers should not be stored for too long without curing.

7. Although it stands boiling and roasting well, care must be taken to ensure that it is not overcooked when boiled because it can become mushy. Palatability is good but at times it can be stringy.
8. Like the variety "Araia" no sign of the "leaf-curl" disorder have been observed. However, it can be attacked by weevil and fungal diseases.

Recommendations for Kumara Production

Several factors determine the yield of kumara or sweet potato. In addition to varietal productivity, yield is influenced by climate, soil type, fertilizers, planting method, plant materials, pest control and management.

Growth Requirement. Because kumara is a tropical plant, it grows all year round in the Cook Islands. Kumara will grow on a wide range of soils but to produce quality roots of acceptable shape, skin color and texture with high yields, the best results are obtained from soils which have not been grown with kumara crop before. Well drained sandy loam with firm but porous sand clay subsoil, friable and moderately fertile is ideal for kumara production.

Coral sandy soils produce kumara with smooth skin and good color but to obtain high yields, fertilizer and water are most essential. Heavy soils seem to produce rough, misshapen roots of poor color, and very fertile soils with high nitrogen content will very often produce excellent vine growth but very little tubers. For kumara production, the soil pH range should be between 4.5 and 7.5.

Land Preparation. The initial plowing of the land should be done 1 to 3 weeks before planting. Because of the prolific weed growth in the Cook Islands, the final tilling of the soil and the making of the ridges should be done just prior to planting.

According to other authorities on kumara culture, higher yields are normally obtained if this crop is planted on mounds or ridges rather than on flat land. However, it seems more economical to plant kumara on well cultivated flat-land and then ridge for the first and the last time one month after planting. This will assist fertilizer application and weed control.

Plant Material and Planting. In cold countries, kumara is normally propagated from tubers and in the Cook Islands planting materials are taken from the terminal part of healthy vines because these are generally disease-free. Recently, however, some grower claimed that they got good results from shoots which sprouted off tubers left on the ground after a previous crop has been harvested. However, the use of good quality cuttings has a considerable influence on the rate of survival, the speed of growth and yield of roots. Therefore, it is very important to select the best cuttings for planting. The best cutting is normally vigorous, large and strong with many short nodes towards the base of the cutting where the roots or tubers are normally formed.

There are three ways of planting the cutting: vertical planting, flat, and horizontal planting. Generally, horizontal planting gives better results than the other two methods under Rarotonga conditions.

Plant spacing is about 8 inches between (single) plants and 3 feet between rows.

Cultivation. As mentioned before, cultivation and hilling up should be carried out at about one month after planting for the purpose of loosening the soil and encouraging

aeration. This work encourages the development of new roots and also the appropriate time to apply the fertilizer by using the following techniques: during cultivation, the sides of the rows are opened up with the plow in which the fertilizer is applied and during weeding, the fertilizer is then buried while the crop is earthed up or hilled up.

Water (irrigation). Kumara is made up of about 68.5% water and this shows that adequate water is essential for good yield. Therefore, insufficient water especially during the middle of the growing period will greatly inhibit growth of roots and yields will be considerably reduced. On the other hand, however, too much water will not be very good for a kumara crop in which drainage is necessary in order to get rid of excess water. Some authorities who have done a lot of work on this crop suggest that the crop should not be irrigated when it is mature – too much water at this time can ruin eating quality of the tubers and cause cracking and rotting.

Weeding. Weed may be defined as any other plant that may be growing in the wrong place and which competes with the crop for nutrients, sunlight, space, etc., and so adversely affecting yield of the crop.

If the land is well prepared before planting, usually only one cultivation is needed to control the weeds in a kumara crop before the vines begin to run and smother weed growth. In the Cook Islands, kumara crops are normally weeded manually because the sizes of the plots are normally small. However, horse-plows and cultivators and rotary-hoes are also commonly used.

Pruning. In one of our trials, continuous pruning of vines seemed to increase the yield of the crop but this remains to be further proven. The fact that excessive vine growth can adversely affect the yield of kumara, seems to support strongly the idea that pruning of the vines can be most beneficial to root or tuber formation.

Crop Harvesting & Marketing. A kumara crop usually requires at least 3-4 months growth before harvest. Common knowledge is that during harvest, not all roots will be of the same size and growers should inspect their plants as often as possible to determine the right time of harvest.

In the Cook Islands we harvest a limited number of plants only for domestic use and a portion of the crop if it is for the market depending on how much the grower thinks he can sell at any one time.

Careful harvesting will ensure that you get most of the tubers from the soil and that most tubers will not be bruised and damaged. Probably, more kumara tubers are lost by the growers as the result of careless handling than from all other causes.

Nowadays, our kumara have never been sold outside of the Cook Islands. We only sell kumara on the local market. On the "Growers' Market," kumara is normally sold in baskets made from coconut leaves, at $6.00 per 26 lbs kit or 23 cents per pound.

Often our people can easily tell good quality from poor quality kumara even before they are cooked. Therefore, for a grower to be able to sell his kumara quickly at the best price, he must make sure that he sell only the best tubers.

Leaf Curl. In the Cook Islands, one of the common problems associated with kumara is the "Leaf-Curl" or "Terminal Scab". This problem is not caused by a disease organism but rather by an insect known as *Delphacodes muirella* related to "Leaf-hopper" but distinguished by having a movable spur on the hind tibia.

The damage is done by the nymph, rasping and sucking the juices of the terminal buds of kumara. As a result, the terminal buds become twisted and deformed, hence the common term of "Leaf-curl". As a result of the damage, the plant growth and its

functions become reduced thus a reduction in yield.

Spraying the crop often or when the infestation begins with any recommended insecticide, will solve the problem. Growers should remember, however, that reinfestation of the crop can happen, so just keep a good watch out.

Problems and Future of Kumara in the Cook Islands

In the Cook Islands "kumara" is considered as a minor crop and a filler for times when there are insufficient supplies of the major crops like taro, bananas, etc. In other words, we should recognize "kumara" as another major root crop which deserve some serious attention in regards to research on all aspects.

"Kumara" should have a definite place in the nutrition of the people of Cook Islands in the future both in the fresh form or processed, preferably as substitute for some imported foodstuffs.

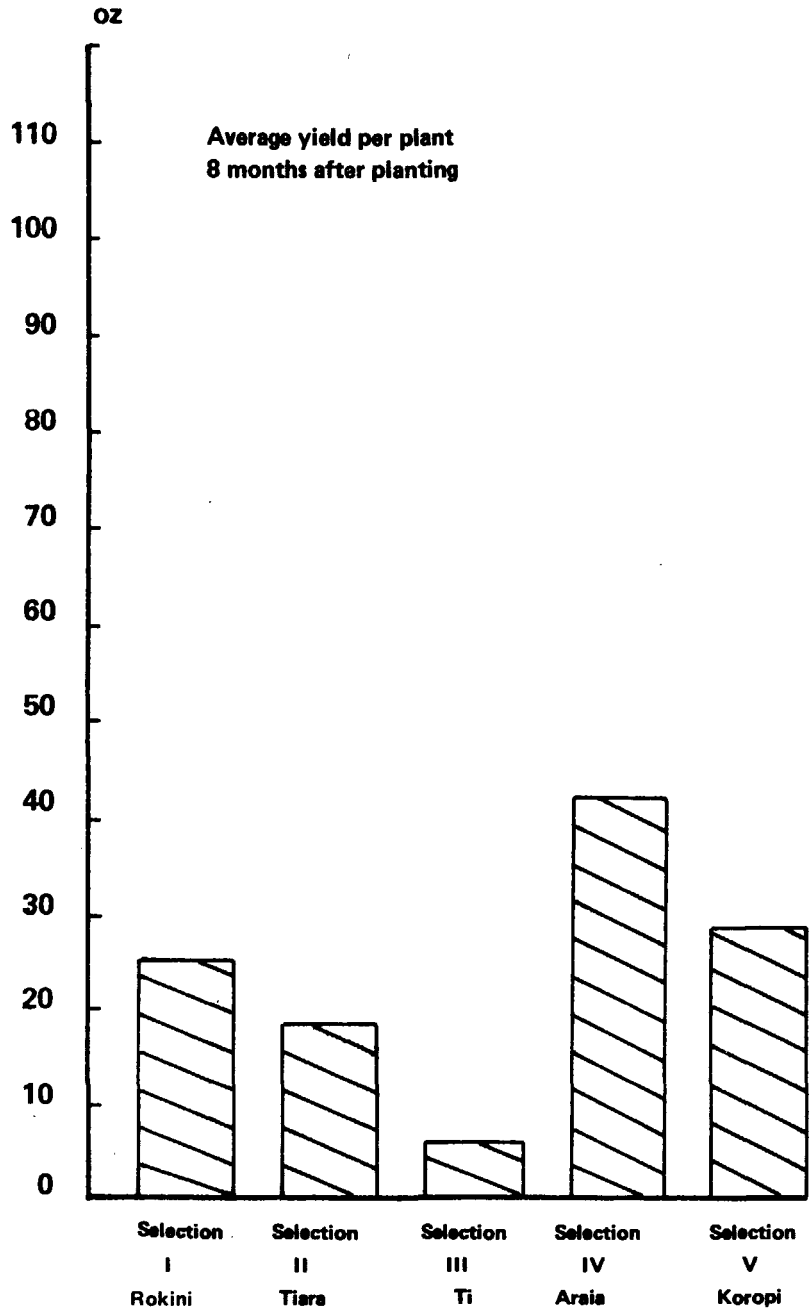

Fig. 1. Kumara Varietal Production Trial – Heavy Soil
8th July 1977 – 8th March 1978

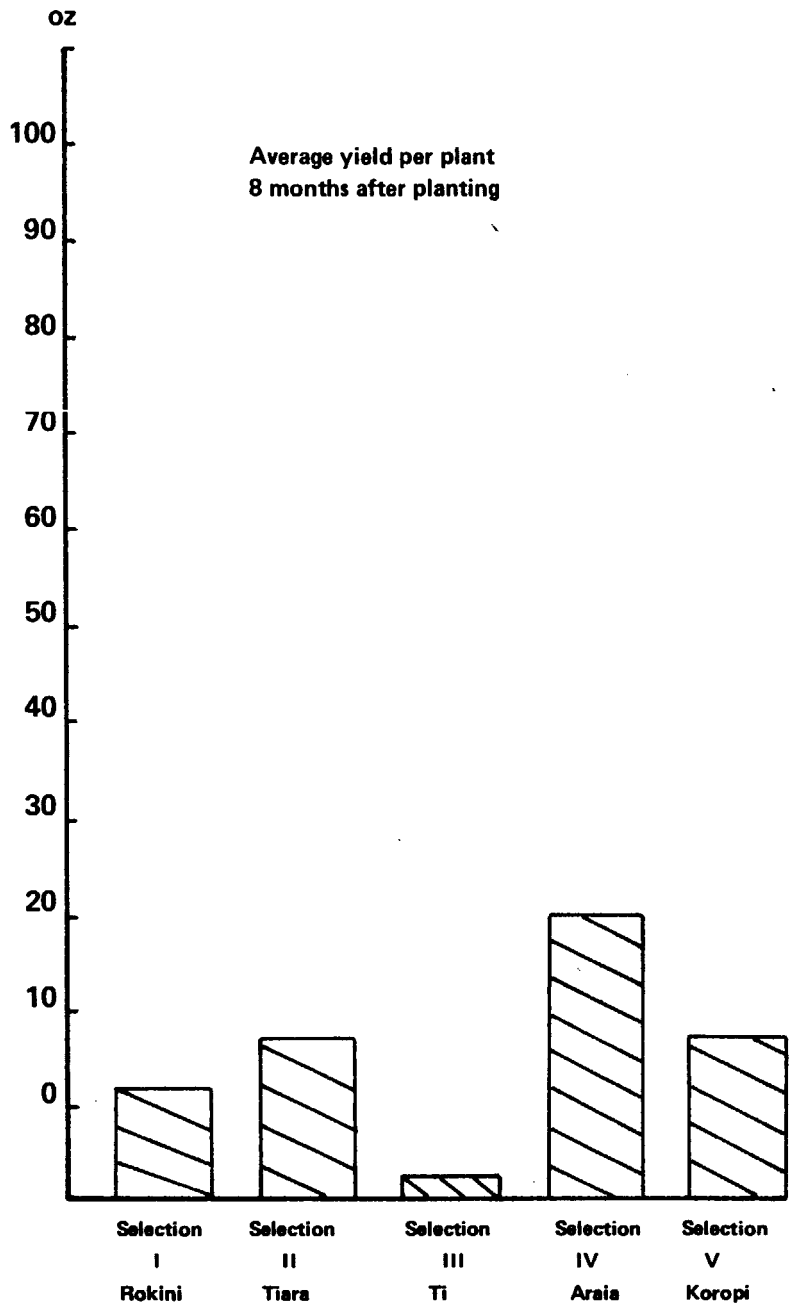

Fig. 2. Kumara Varietal Production Trials – Heavy Soil 8th October 1977 – 8th June 1978

Table 3. Assessment of Varieties

Varieties	Tons per Acre	Ratings	Months to Maturity	Ratings	Root Formation Zone	Ratings	Storage	Ratings	Resistance to Leaf-Curl	Ratings	Total Ratings	Overall Ratings
Rokini	10.9	3	5-6	3	Irregular	4	Good	3	Poor	5	18	3
Tiara	6.8	4	5-7	4	Irregular	4	Fair	4	Poor	5	21	4
Ti	5.2	5	5-7	4	Irregular	4	Good	3	Poor	5	21	4
Araia	17.0	1	4-5	2	Bunched	1	Fair	4	Good	3	11	2
Koropi	11.3	2	4-5	2	Bunched	1	Fair	4	Very good	2	11	2

N.B. 1 = Best 2. = Very good 3. = Good 4. = Fair 5. = Poor

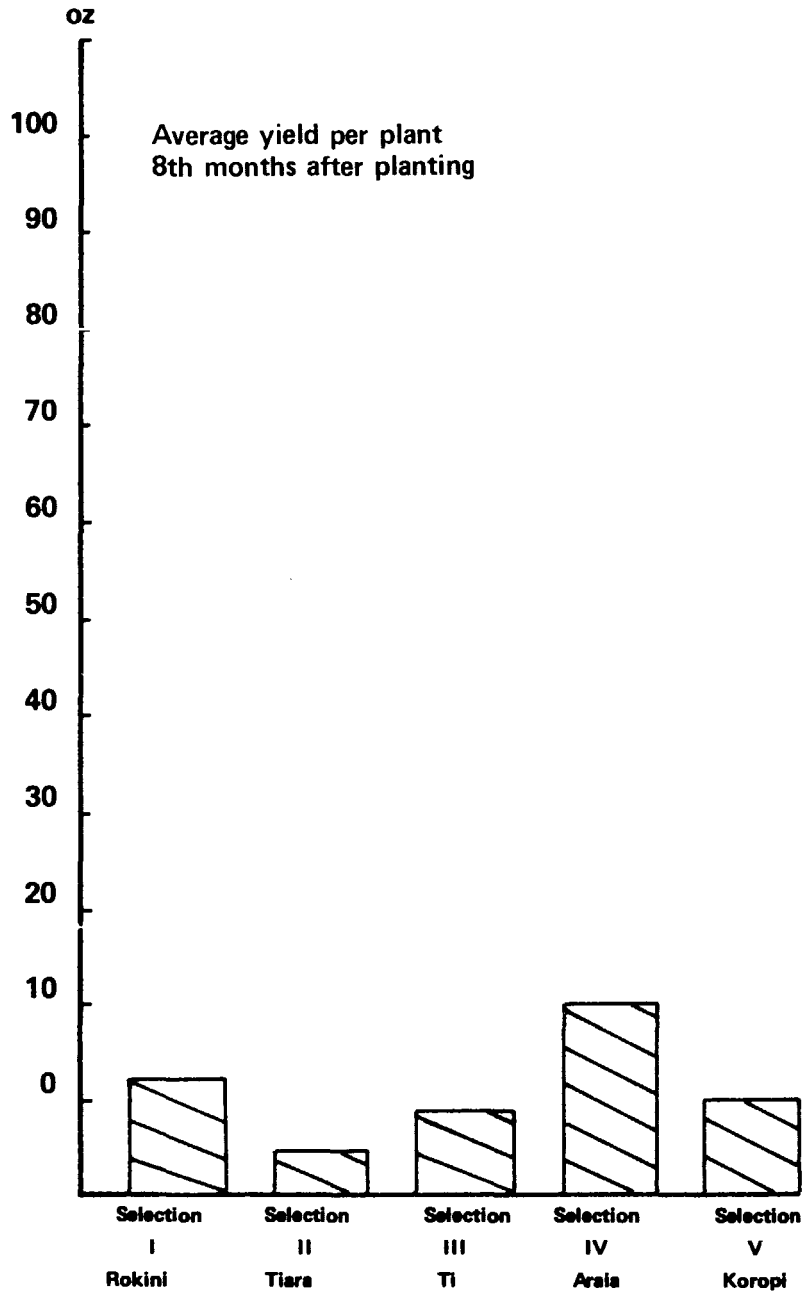

Fig. 3. Kumara Varietal Production Trial-Coral Sand Soil
8th September 1977 – 8th May 1978

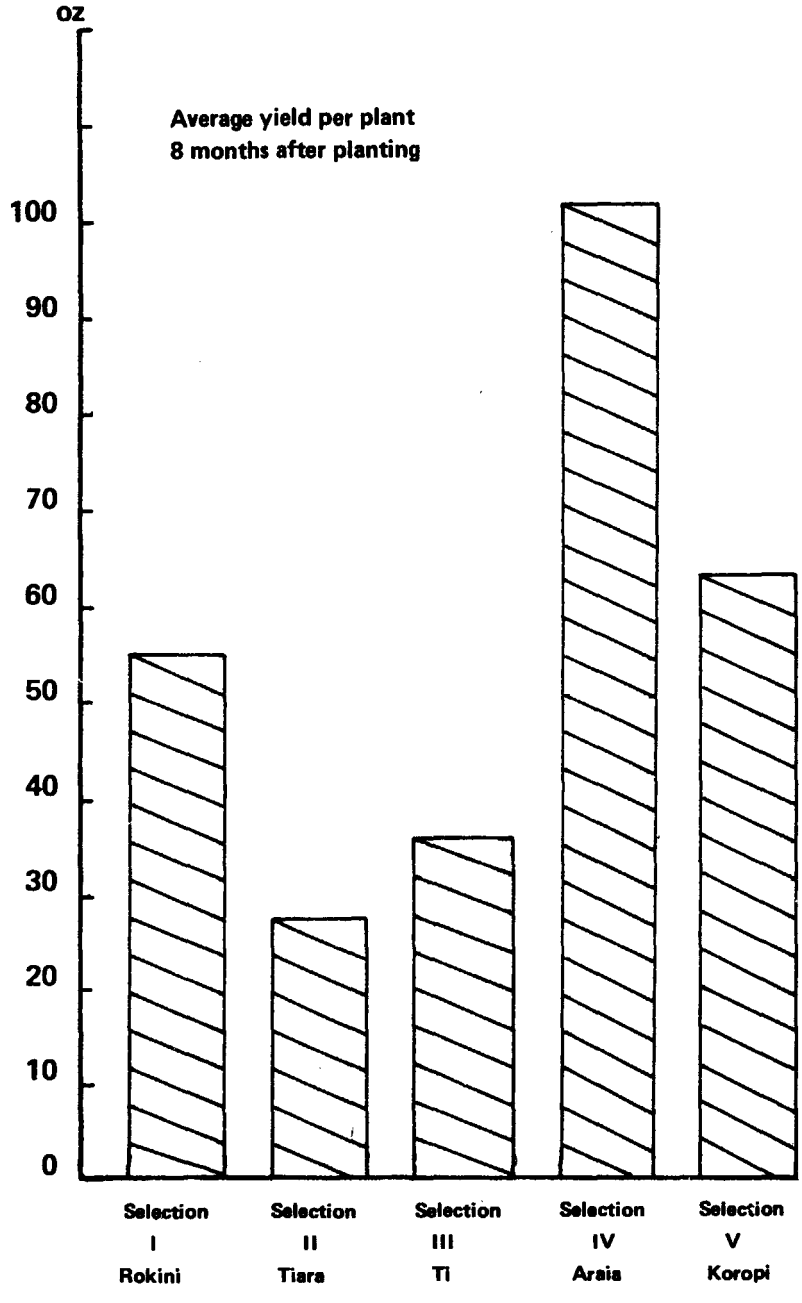

Fig. 4. Kumara Varietal Production Trial-Coral Sand Soil
8th October 1977 – 8th June 1978