

Cultivation of *Xanthosoma Sagittifolium* (L.) Schott or "Makue" in the Loyalty Islands

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Abstract

Makue is becoming popular as a cash crop and as food in the Loyalty Islands. The general soil and climatic conditions in the Islands is suited for the cultivation of Makue. However, it is still grown at a small scale level.

The major diseases and pests observed on makue in the Islands are tuber rot, dry rot and the giant African snail, respectively.

Cultivation methods employed in the growing of makue in the Islands is reviewed and the need for research trials for improvement of variety and methods is shown.

Introduction

New Caledonia and its dependencies constitute a French Overseas Territory lying in Melanesia between latitudes 18° and 22° South and longitude 163° and 168° East. Isolated in the Southwestern Pacific, this group of islands is 20,000 km from metropolitan France, 1,700 km from New Zealand, 1,500 km from Australia and 5,000 km from Tahiti. It comprises the "Mainland," the Loyalty Islands (Ouvea, Lifou, Mare, Tige), the Northern Islands (Belep, Huon, Surprise, Chesterfield) and the Isle of Pines.

The Mainland features an impressive mountain range running Northeast Southwest, which is approximately 400 km long and 50 km wide.

Unlike many Pacific Islands, New Caledonia is not predominantly volcanic. It consists mainly of sedimentary and metamorphic soils and of massive formations of ultra-basic rocks called peridotites.

Mare is the only one of the Loyalty Islands to have volcanic rocks (basalt), which appear to have acted as foundations for the reefs.

The Loyalty Island group lies roughly 130 km from the Mainland in a line parallel to its East Coast. The Islands of Ouvea, Lifou and Mare are separated from one another by stretches of ocean about 50 km wide and up to 1,000 meters deep.

In their physical features, the Loyalty Islands are very different from the Mainland. They are raised atolls whose low coral platform is at no point more than 100 meters above sea level and drops sharply into the sea; where a coastal belt exists it is generally very narrow.

On 1 January 1978, New Caledonia had a total of 137,000 people, of whom 2,800 lived in Ouvea, 9,000 in Lifou, and 4,000 in Mare.

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The "New Hebrides taro" or "makue"

Strictly speaking, taro is an Araceae with edible leaves and tubers belonging to the genus *Colocasia*. By extension however, the term "taro" has come to refer also to other plants of the same family which some people may find confusing.

The *Xanthosoma* are indigenous to Central America (New Mexico), but are now very common throughout Africa, Asia and the Pacific. The variety of names by which this food plant is known in the Pacific Islands gives an idea of the complexity of its introduction routes: a) "Kang-Kong taro" (or "Chinese taro") – Papua New Guinea; b) "Fiji taro" – New Hebrides; c) "New Hebrides taro" (or "mountain taro") – New Caledonia; d) "dalo-ni-tana" – Fiji; e) "Papalagi talo" – American and Western Samoa; f) "sawah-n-avai" – Ponape, Caroline Islands; and g) "tarua" – Cook Islands, French Polynesia.

In New Caledonia the "New Hebrides taro" (also called "Tiwaka" taro) was introduced during the last century by Roman Catholic missionaries. First grown only in the Amoa valley, it then spread to the neighboring Tiwaka valley. It has a variety of names in the local dialects, but its Loyalty Islands name "makue" is recognized everywhere.

In English-speaking countries this tuber is known as "tannia," "cocoyam," "new cocoyam," and by other names.

The importance of "makue" in the Loyalty Islands

This Araceae is not widely used in the diet of the Ouvea islander who much prefers the water taro *Colocasia* sp. In Lifou on the other hand, this species is becoming more popular, although it is still only grown at family level: usually associated with other crops on deep fertile soil, the tubers being dug up as needed. Lastly, in Mare, while not of enormous economic importance, it is nevertheless grown on quite a large scale and even exported, as yet in modest quantities, to the Noumea market.

General conditions for "makue" cultivation in the Loyalty Islands

Temperatures. The monthly average of the minimum temperatures recorded at Ouanaham (Lifou) over a period of 15 years (1960-1975) is 15.1° in July and 15.2° in August, during the cool season. The monthly average of maximum temperatures is 28° in December, 28.9° in January and 29.2° in February, during the hot season. Temperatures can thus be regarded as ideal for "makue" in the Loyalty Islands, particularly as the average temperature ranges from 19.6° (July) to 25.7° (February).

Rainfall. Rainfall is evenly spread out through the year, with a slight drop in August, September and October, i.e., at the end of the cool season. In Lifou, the number of rainfall days is always over 12 (September), total yearly rainfall being 1,740.2 mm. Mare is slightly drier: records covering a period of 22 years (1956-1978) show a total yearly average of 1,587.1 mm, but rainfall is well distributed throughout the year. Except under very exceptional circumstances, "makue," which is almost everywhere grown under light shade and in good soil, is therefore unlikely to suffer from drought in the Loyalty Islands. Relative humidity in Lifou ranges from 58% (minimum) to 95% (maximum) and would be very similar in Mare.

Soils. According to Marc Latham, Soil Scientist with ORSTOM, Noumea (personal communication), the major part of the soils on Lifou were formed from deposits of

pyroclastic materials (floating volcanic pumices). They are of medium depth (from 25 to 40 cm), reddish-brown in color, poorly structured, very friable and extremely porous. With regards to the chemical properties, their organic matter content is very high (8% to 12% on the surface, 3% to 4% underneath) and their exchange capacity is linked solely to the organic component, as the mineral component contains virtually no clay, only alumina and iron sesquioxides whose exchange capacity is nil. The phosphorus content is very high (from 2% to 5% of phosphoric acid) but, apart from surface calcium, the other elements (potassium in particular) are present in small quantities only. To sum up, the soils are physically very fragile (lack of structure) and chemically of medium fertility (ascribable to their organic matter and phosphorus content only).

The soils in Mare are identical with those in Lifou, especially on the major part of the central plateau: ferralitic and allitic soils.

"Makue" is grown on freshly cleared land, rich in organic matter and in privileged areas reputed for their fertility. In crop associations, its position in the garden is chosen with care at time of planting.

"Makue" as a subsistence crop in Lifou

As stated earlier, "makue" is grown in Lifou only at family level. A few specimens can be seen here and there in the gardens around the houses and in the village fields where the traditional staples and other subsistence crops are grown, particularly yam, water taro, sweet potato, banana, cassava, pawpaw, onion, etc. "Makue" is planted in positions where the soil is deep, fertile and often enriched with rotting organic matter or ash.

Planting material. Various parts of the plant can be used for planting: a) the top of the main root, cut just below the base of the leaf stalks; b) the whole main root or part of it; c) the lateral tubers growing off the main root; and d) any suckers that may appear on the main plant.

The leaves of the main stem or of the suckers are cut off and the roots trimmed before planting. The village farmers in Lifou consider that, for their particular planting method and the fairly wide spacing which they favor (2 m x 2 m), the *main root* (or part of it) constitutes the best planting material, for young plants and lateral tubers develop all around the parent plant.

Planting time. Generally speaking, "makue" is planted at the same time as yam, that is in June/July; but in the gardens adjacent to each hut, planting is done all the year round.

Position in crop rotation. There is no crop rotation to speak of. "Makue" is planted on cleared land in places which the village farmer regards as fertile, and is thus associated with other traditional food crops. Occasionally, however, "makue" is planted straight after the yam harvest and in exactly the same spot; but in such cases the soil is previously enriched with organic matter and carefully prepared.

Planting method. The planting hole is never more than 30 cm deep; if it were, the main root would develop at the expense of the tubers. Planting of the cuttings and suckers does not present any particular problem; on the other hand, when pieces of the main root are planted they are turned upside down before being buried, so that the rootlets point upwards. This procedure is said to cause buds, hence tubers, to emerge more speedily and in greater numbers. "Makue" is always planted under light shade.

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Plant maintenance. One cannot speak of "plantation" maintenance since "makue," in Lifou, is always grown in association with traditional food crops, particularly yams and bananas. Not much maintenance is necessary around the plants, moreover, since their very broad leaves give heavy shade which impedes weed growth. However, as the buds appear and develop into tubers on the main root, the soil is pushed up around the parent plant and the farmer has to "earth up," i.e., make a little hill around each plant, taking great care not to damage the young lateral tubers.

Harvesting of tubers, yields. In the family garden, tubers are harvested gradually, as needed. Harvesting can begin 9 to 12 months after planting. The soil around the parent plant is carefully removed and the tubers broken off by hand. The hole formed is filled in again with well prepared soil. At the same time, a light earthing up is done at the foot of the parent plant from which the tubers have just been removed, and of any surrounding suckers. Such harvesting can go on for at least two or three years, and for this reason, it is difficult to estimate the yield per plant per year; a rough approximation would be 1.5 to 2 kg.

It is noteworthy that the more fertile the soil is, the longer it takes for vegetative development, but the tuber yield will of course be correspondingly higher too.

Storing. Since tubers are dug up only when needed, they are practically never stored. They do, however, keep very well for at least two or three months in a clean, dry, dark and slightly ventilated place. Some village farmers even claim that they keep as well as yams.

"Makue" as a cash crop in Mare

Soils. As stated earlier, Mare has ferralitic and allitic soils, just like Lifou. However, commercial cultivation of "makue" does not take place on these, but on rich, deep soils.

Marc Latham, Soil Scientist with ORSTOM, Noumea, stated in a personal communication that the soils in the Rawa area (where cultivation of "makue" is mainly practiced) are not representative of the island as a whole. They are derived from basalt rocks and their exchange capacity is linked not only to the organic matter content but also to a certain percentage of clay. The presence of clay in the soil gives it a good fine structure, together with an apparently high permeability. These are crucial differences when it comes to agricultural utilization. From the chemical viewpoint, the Rawa soils are well endowed with organic matter, and their phosphorus content while lower than the Lifou soils (6%) is quite high nonetheless; what fraction of this can be assimilated by the plant remains to be determined. They are poor in exchangeable cations, apart from calcium.

Soil preparation. "Makue" is grown mainly in Rawa on a fair scale since plantations cover a total area of over 2 hectares.

Before planting, land is cleared with axe and bush knife; bushy undergrowth is slashed and burnt; large trees are killed through ring-barking; big surface roots are hacked up and dug out. The Erythrina trees (*Erythrina indica*) are left standing however, because light, constant shade is necessary for successful "makue" growing. To achieve more uniform shading of plantations, Haitian blackwood trees (*Albizia lebbek*) are also planted. The land is not plowed and planting holes are dug not more than 30 cm deep, since experience has shown that the main "makue" root becomes overdeveloped at the expense of the lateral tubers, if the hole is too deep.

Planting material. Since the aim here is to establish pure (single crop) plantations over comparatively large areas, a lot of planting material is needed. Plant parts used are: a) the top of the main root; b) the suckers growing around the parent plant (or on roots deliberately left lying around the ground); and c) lateral tubers. The latter are considered to be the ideal planting material, giving the best results.

When a large supply of suckers is required, main roots are simply left lying about in the field; the suckers will be ready to be cut off and use a few weeks later.

Planting method and planting time. The planting holes are dug 1.50 m apart each way (square layout); they are fairly large, at least 40 to 60 cm a side.

The farmer puts 2 to 4 suckers in each hole, depending on their size. Planting density is sometimes higher than indicated above (1.50 m x 1 m, or even 1 m x 1 m) in an obvious attempt to restrict weed growth.

"Makue" can be planted all the year round, but the best period is said to be June, July and August.

Plantation maintenance. Virtually no maintenance is necessary on forest clearings and deep soil, because very soon the young "makue" leaves screen out the sun and prevent weed growth.

No disease problem exists for the time being, but the Giant African snail (*Achatina fulica*) can cause a lot of damage. Snails have to be collected, or destroyed with bait and metaldehyde-based blocks.

Harvesting and yields. The length of the vegetative cycle varies both with the planting material used and with soil fertility the more fertile the soil is, the lusher the plant's vegetative development will be, and the higher the yields. On the other hand, under these conditions, the vegetative cycle can be up to 2 months longer (14 instead of 12 months). The harvesting date must be worked out carefully. If harvesting is delayed too long the tubers can become fibrous; in any case their taste will deteriorate with the cultivation practices described above, the yield was found to be 3 to 4 kg of tubers per plant, which gives a yield per hectare of 25 to 30 tons. This figure may vary however, with climatic conditions and planting density.

Marketing. After being pulled out, the tubers are left on the ground for one or two days, after which they are collected into 50 kg jute or plastic bags and shipped to the market in Noumea.

In July 1979, "makue" sold for 25 CFP/kilo in Mare (price paid to the producer) and for 35 CFP/kilo on arrival in Noumea (US\$ = 80 CFP francs).

Replanting of old plantations. In the Rawa area, one sometimes sees old plantations on deep fertile soil that have been left unattended for some years and where the native bush has more or less taken over again. Replanting of these areas is conducted in much the same way as planting on cleared forest land, with some advantages for the farmer — but also some extra work.

i) *Advantages:* harvesting and marketing of existing tubers; 2) easier digging of holes and planting; 3) availability on site of a good supply of planting material; and 4) easier obtention of uniform light shade.

ii) *Extra work:* 1) destruction of a lot of green plant material, particularly "makue" leaves and stems; and 2) control of "makue" regrowth for several months after planting, as suckers tend to be too numerous.

Pests and diseases of "makue" in the Loyalty Islands

We did not observe any pest or any disease of economic importance on "makue" in the Loyalty Islands. It would take an expert (entomologist or plant pathologist) to refute or confirm this finding. Mainland "makue" is known, on the other hand, to be affected by a very serious disease, which causes extensive damage, and sometimes rules out cultivation altogether. The disease is a root and tuber rot caused by *Pythium irregulare buis*, which was documented in New Caledonia by Bugnicourt and Dadant (R. Dadant, *Premiers resultats dans la lutte contre la maladie du taro dit "des Nouvelles-Hebrides"*. *Revue agricole de la Nouvelle-Caledonie*, 3eme annee, Nos. 11-12, Nov.-Dec. 1952).

On the Mare plantations, signs of a dry rot were seen around the root crown and the flower-stalk base of some plants. The farmers we questioned said that they did not use these as planting material because they produce few or no tubers. Fortunately this disease does not, for the time being, seem to have any economic consequences.

On the other hand, the giant African snail (*Achatina fulica*), introduced into the Loyalty Islands some years ago, can cause very severe damage, for it multiplies at an astonishing rate. Sixty tons of giant African snails were destroyed during a community collection campaign held in Mare early in 1979. Around Rawa village, 15 tons of giant African snails were collected in the months of May and June 1979 alone.

Food preparations

"Makue" tubers are becoming increasingly popular with Loyalty Islanders. They can be prepared just like the roots of cassava, sweet potato water taro, or like cooking bananas. They are considered very tasty, and several Islanders in fact told us that in a traditional or European-type dish they "go for" the "makue" tubers first of all. The following are some recipes for "makue" that are commonly used in the Loyalty Islands:

(a) The tubers are cooked under the ash of a wood fire, and are eaten as they are or with butter.

(b) They are boiled or after peeling, and eaten as above.

(c) They are used in "Irish" meat stews instead of potatoes.

(d) They can be added to chicken or fish curries and also to coconut-milk chicken.

(e) The "bounia" is a traditional dish in the Loyalty Islands (as on the Mainland) cooked in banana leaves on heated stones. The banana leaves are used as a dish in which are placed yams, water taro, "makue," cassava, sweet potato, etc. The chicken or fish is put in the middle and the whole lot generously flooded with coconut milk and sprinkled with spring onions and tomatoes. The tightly wrapped bundles are left to cook on the hot rocks which are covered with sacking and earth. After a few hours the banana leaves are opened up and the contents eaten very hot.

(f) The youngest leaf of the parent plant, still rolled up, is often prepared as a green, something like spinach.

Conclusion

"Makue" is grown as a subsistence crop in Ouvea and Lifou, and as a small-scale cash crop in Mare. It is worth cultivating more extensively, for at the moment, it represents a continuous food supply in Lifou and Ouvea, and is planted almost anytime in the year at Rawa in Mare. It is easy to multiply and does not require any particular maintenance during growth, even in a single crop situation. Being easy to grow, high-yielding and undemanding as regards maintenance, and also because it tastes good, keeps well, and is not affected by pests and disease, it deserves to be developed.

To promote this, some advertising or cooking demonstration should be undertaken in the villages to show housewives how "makue" can best be used in traditional and European food preparations. At the same time, the men could be made aware of its other advantages: easy multiplication and problem-free growth, particularly as, for the time being, neither chemical fertilizers nor pesticides are necessary.

It must be emphasized, however, that planting material should be taken only from the Islands, where it is plentiful, and in no case be imported from the Mainland where, as mentioned earlier, a root rot due to *Pythium irregulare* is widespread. Some agricultural trials to determine the best type of planting material, the best spacing of plants, the action of chemical fertilizers (particularly potash fertilizer), the influence of shading, etc., should perhaps be set up, as all these factors may affect yields.

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LA ROCHE - MARE

CLIMATOLOGICAL AVERAGES

Period 1956 - 1978

Rainfall

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
232.2	173.9	157.4	152.9	133.0	154.6	94.5	109.8	75.5	83.0	102.9	117.6	1,587.1