

**Farm and Forestry  
Production and Marketing Profile for**

# **Tannia**

*(Xanthosoma spp.)*

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## USES AND PRODUCTS

The lateral tubers, or cormels, of tannia (*Xanthosoma* spp.) are consumed as a starchy food. This species is very widely used in the islands. By the 1970s, it was more important than *Colocasia* taro in the dryland areas of New Caledonia (Doumenge 1982), the second most important crop in Tonga after cassava, and more important than *Colocasia* in shifting gardens in the Cook Islands (Thaman 1984).

Tannia is considered by some to be inferior to *Colocasia* taro (Smith 1979). The central or primary tuber is acrid and not used for human consumption. However, tannia is often grown because of the higher yield per unit labor, larger tuber size, taste and other factors. As its yields are higher than *Colocasia* taro, it is increasingly being adopted by island peoples.

Drying of the tubers for the production of starch powder can be easily done. As with *Colocasia* taro, tannia leaves can be used for silage.

The leaves of *X. brasiliensis* are cooked as a favored spinach.

## BOTANICAL DESCRIPTION

### Preferred scientific names

*Xanthosoma sagittifolium* (L.) Schott

*X. brasiliense* (Desf.) Engl.

*X. nigrum* (Vell.) Stellfeld

*X. undipes* Koch

### Family

Araceae (aroid family)

### Non-preferred scientific names (after Fosberg et al. 1987 and Smith 1979)

#### *X. sagittifolium*

*Arum sagittifolium* L.

*Arum xanthorrhizon* Jacq.

*Xanthosoma atrovirens* Koch

*X. violaceum* Schott

#### *X. nigrum*

*X. violaceum* Schott

*Arum nigrum* Vell.

#### *X. undipes*

*Xanthosoma jacquini* Schott

*Alocasia undipes* Koch

### Common names

In English, *Xanthosoma* species are known as American taro, cocoyam, new cocoyam, tania, tannia, and yautia. Unfortunately, there has been much confusion over the use of the



Top: About 1 kg of corms were harvested from a mature (14 month old) giant taro plant. *Xanthosoma* has become a popular aroid in some places because it gives very high yields. Note the pinkish “eyes” growing tip on the fatter end of the corm. May 2010. Bottom: The leaves of *X. brasiliense* make a delicious spinach when cooked.

term cocoyam, which has been applied to two widely grown taros, *Colocasia esculenta* and *Xanthosoma sagittifolium*.

Morton (1972) suggested that cocoyam be used as a group term for *Xanthosoma* taros. Furthering the confusion is the use of *X. sagittifolium* as a group term for many of the cultivated species of this genus (Morton 1972). Similarly, on Rota Island, Commonwealth of the Northern Mariana Islands (CNMI), all *Xanthosoma* taro species are known collectively as white taro and in the vernacular *sunin hinalulu*.

### ***X. sagittifolium***

For *X. sagittifolium* and *Xanthosoma* in general, or those not differentiated, common names throughout the Pacific include:

Chuuk: *woten sapan, oten japan, wotopwu wa, oni sapan*

Cook Islands: *tarua, taru'a, taro taru?, tarotaru?, taru?*

Maori

Fais Island: *menado* (a modification of the word Mindanao, from where it is believed the species was introduced)

Fiji: *ndalo ni tana, ndalo ni kana, ghuya* (Hindi)

French: *chou caraïbe, malanga marron, taye, tayove, tanier*

Futuna: *talo fiti*

Guam: *yautia*

Kiribati: *te taororo*

Kosrae: *kutak mokil*

Marshall Islands: *alöklök, kälöklök*

Nauru: *de taro*

New Caledonia (Mare Island): *makue*

New Caledonia: New Hebridean taro

New Guinea and Solomon Islands: kong-kong taro, Chinese taro, Singapore taro

Niue: *pulaka*

Okinawa: *taro imo, yabane-imo, seiban imo*

Palau: *saibal, bisech ra ruk, eball*

Pohnpei: *savahn awai, sawahn awai, savahn analulu, sawan*

Rakahanga-Manihiki: *taro taru*

Rota Island, CNMI: white taro, *sunin hinalulu, sunin honolulu*

Saipan, CNMI: *sunin honolulu, sunin hinalulu*

Samoa: *talo papalagi, talo palagi*

Satawal: *yigalulu*

Spanish: *malanga, ocumo, otoy, tanier, tisquisque, tiquisque blanco, yautía blanca*

Tahiti: *taroua, tarua*

Tikopia: *talo papalagi*

Tokelau: *taro*

Tonga: *talo Futuna*

Tuvalu: *talo palagi*

Vanuatu: *taro fiji, taro de fidji, taro de tiwaka*

Wallis: *talo fila, talo Numea*

West Indies: *chou caraïbe*

Yap: Honolulu taro

### ***X. nigrum***

Guam: *yautia, suni-n-honolulu*

Hawai'i: blue 'ape, blue or purple taro

Jamaica: *badu*

Niue: *talo pulaka uli*

Panama: *oto*

Samoa: *ta'amu papalagi, talo papalagi, talo palagi*

Trinidad: *tanier*

Ulithi: *yothol minedo*

Wallis: *talo fiti*

### ***X. brasiliense***

English: belembe, Tahitian spinach

Palau: *zuiki*

Morton (1972) lists many vernacular or local names for the different species of tannia that are cultivated for food in the Americas.

The Palauan names for tannia (*saibal, bisech ra ruk, eball* for *X. sagittifolium* and *zuiki* for *X. brasiliense*) are unknown to most of the Palauan taro farmers on Guam. These Palauan expatriates refer to tannia as *beseech* which according to Fosberg et al. (1980), is the Palauan word for *Alocasia macrorrhiza* and other *Alocasia* species. This loss of species knowledge over one or two generations suggests the volatility of traditional knowledge and how easily it can be lost.

### **Brief botanical description**

Large herbs with erect above-ground or tuberous rhizomes. Leaves are large, approximately 20 cm in length, 15 cm in width, hastate (saggitate-ovate) in shape, with the anterior lobe twice as large as the posterior lobe, with distinct marginal vein, basal lobes are rounded. Leaves of *X. sagittifolium* are dark green above and paler green beneath. The spathe (a leaf-like part that encloses a flower cluster) consists of two parts: a longer, usually withered upper spathe (15 cm) and a shorter 7 cm persistent lower spathe.

*Xanthosoma* taro can be easily distinguished from *Colocasia* taro by the place where the petiole meets the leaf. In *Xanthosoma*, the petiole attachment is at the margin of the leaf while for *Colocasia*, the petiole attachment is peltate or more middle-leaf. A simple way to distinguish *Xanthosoma* from *Alocasia* is to compare the angle of the leaf to the petiole (stem). In *Alocasia*, the leaf blade and the petiole are in the same plane. For *Xanthosoma*, mature leaves are angled about 30 degrees off the petiole. Furthermore, the leaf surfaces of *Alocasia* are usually shiny, while those of *Xanthosoma* are less so. Smith (1979) differentiates *X. undipes* from *X. sagittifolium* as follows: For *X. undipes*, the petiolar sheath as an undulate margin and the posterior midribs are partially denuded for several cm from the petiolar attachment, while for *X. sagittifolium* the petiole sheath has a smooth margin and the leaf blade completely covers the posterior midribs all the

petiole attachment. The inside lower spathe of *X. undipes* is dark purple (atropurpureous) in color.

Both *X. sagittifolium* and *X. undipes* have an erect above-ground stem approximately 1–1.5 m high while *X. nigrum* does not. *X. nigrum* is easily distinguished by its violet to purplish color and the lack of an aboveground trunk. The stems and leaves are coated with a white powder (pruinose) at least when young. Leaf color is green and paler green beneath, with nerves, ribs, and margins purplish to violet. The petioles are purplish. The bract tube is pale to dark violet while the blade is yellowish-white (Neal 1965).

*X. brasiliense* is characterized by having very small albeit edible tubers with a yellow flesh. This tannia is the smallest of the four *Xanthosoma* spp., reaching a height of 1 m.

Smith (1979) and Acevedo-Rodrigues and Strong (2005) have suggested that a revision of this genus is needed because of the variability of cultivated species.

## DISTRIBUTION

### Native range

The original range is unclear although most authorities suggest that it is native to the Neotropics, mainly Central America or northern South America. The West Indies and S. America have also been suggested.

This genus originates in tropical rainforest ecosystems. Outside its native range the species has naturalized along stream banks.

Staples and Herbst (2005) suggest that while the literature states that *X. violaceum* (= *X. nigrum*) is native to Guadeloupe, Puerto Rico, and Jamaica, they believe that “it is more likely native to northern South America.”

### Current distribution worldwide

The genus is now distributed worldwide. It is considered to be the most important aroid in Africa. For the continental



Left: Three-week-old spathe of an 11-month-old *Xanthosoma taro*. The upper spathe is usually withered while the lower spathe is persistent. Top right: Four-month-old planting of *Xanthosoma sagittifolium* in the breadfruit-banana agroforest on Romonum (Ulalu) Island, Chuuk Lagoon, FSM. This species was introduced to the island after 1965. March, 2010. Bottom right: *X. nigrum* being propagated at Tongo Jungle, an agroecotourism development on Rota Island. This species is relatively rare on Rota where it is collectively named as *sunin hinalulu* along with *X. sagittifolium*. January, 2009.

**Table 1. Elevation, rainfall, and temperature for Hawai'i**

Elevation range	<b>lower:</b> 0 m <b>upper:</b> 1,500 m depending on cultivar (Kay 1987)
Mean annual rainfall	<b>lower:</b> 1,000 mm if evenly distributed (Kay 1987) <b>upper:</b> 5,000 mm. Excess precipitation should not be a problem if soils drain freely.  The FAO (2007) suggests that the optimum rainfall is between 1,500 and 3,000 mm per year, and absolute minimums and maximums as 1,000 and 5,000 mm per year.
Rainfall pattern	Weightman and Moros (1982) state that in areas where the annual rainfall is between 1,000–2,000 mm, tannia should be planted just before the start of the wet season. In areas where the rainfall is 2,000–3,000 mm, it can be planted at any time.
Mean annual temperature	In "Puerto Rico they are successfully grown where the mean annual temperature is 24°C with maximum variations ranging from 13 to 29°C" (Kay 1987).

U.S., Morton (1972) states that the genus is cultivated as far north as the coastal plain of South Carolina.

Elsewhere, as in Florida, the Caribbean and Central America, the main cultivated species of *Xanthosoma* are *X. sagittifolium*, *X. caracu*, *X. atrovirens*, *X. nigrum*, *X. undipes*, *X. brasiliense*, and *X. belophyllum* (Morton 1972).

Its wide distribution in the Pacific is reflected in the list of common names above.

## ENVIRONMENTAL PREFERENCES AND TOLERANCES

### Climate

It prefers humid tropical rainforest climates and naturalizes well along stream banks and in moist, shady areas.

### Soils

Tannia is grown in a wide range of soils except hard clays or pure sands (Kay 1987). It does not tolerate waterlogged soils. It does best on deep, mulched, and well drained soils. While the species is grown in sandy soils, it does better when these soils contain a high amount of organic matter as moisture retention, nutrient supply, and aeration are improved. A soil pH of 5.5–6.5 is preferred (Kay 1987). FAO (2007) states that the minimum and maximum pH are 4.5 and 6.5. However, on Fais Island, Yap, Federated States of Micronesia (FSM), the species is cultivated on sandy soils derived from limestone (high pH) and low in organic matter and nutrients.

Tannia seems better adapted to the sandy soil conditions of atolls and raised limestone islands than *Colocasia taro*.

## GROWTH AND DEVELOPMENT

Tannia matures 9–12 months after planting. Yellowing of older leaves indicates maturity. Corms can be harvested as needed after 5 months of growth. On Rota Island, mature plants are uprooted, the stem stripped of cormels and then replanted for another year's growth. Elsewhere, Kay (1987) notes that "sometimes the soil is dug away from the plant and the exposed cormels separated from the parent plant which is covered up with soil and left to produce a new crop. In this way the plant may continue to crop for several years and it is usually at least 6 years before there is a noticeable decline in vigour and quality of the cormels." Inflorescences appear after planting in 5–8 months depending on soil fertility (Morton 1972).



The author and *X. sagittifolium* at the Agana Swamp, Guam, January, 2009.



Stem and cormels of *X. sagittifolium* at a coastal subsistence garden near the Rota Hotel, Rota Island. Whole plants are uprooted from the sandy soil, the cormels removed and the plant replanted. January, 2009.

### Advantages associated with cultivation of tannia

In most islands of Polynesia and Micronesia, tannia is second or third most important aroid after *Colocasia* and *Cyrtosperma* taros. According to Thaman (1984), "...*Xanthosoma* offer probably the greatest potential for the intensification of taro cultivation in dryland or forested areas...as it is more drought-tolerant and possibly more shade-tolerant than *Colocasia*. It is a food esteemed by Pacific peoples, and probably of greatest importance, it is affected by relatively fewer diseases and pests than *Colocasia* and is resistant to taro leaf blight..."

### Scale of commercial production worldwide

The FAO has worldwide production data on both *Colocasia* and *Xanthosoma* taros. However, the data are questionable. Both genera are known and reported as cocoyam (a.k.a., tannia), raising the possibility that the production of *Colocasia* taro for Africa and South America has been exaggerated,

while that of *Xanthosoma* taro under-reported. Because of the increasing production of *Xanthosoma* throughout the world, most of the taro production from Africa is quite likely *Xanthosoma*. However, the FAO has no production data of *Xanthosoma* from Africa or the other regions of the world. The only FAO production data for *Xanthosoma* is from Central America which is presented in Table 1. In 2007, this region produced 350,700 MT on 40,945 ha with Cuba accounting for more than 50% of the region's production.

In Puerto Rico, the 1964–65 season's crop amounted to 16,057 MT (Matienzo and Santiago 1970 cited in Morton 1972). USDA data show that in 1998 Puerto Rico and the Virgin Islands harvested 1,459 and 0.9 MT of tannia, respectively (NASS 1997a, b). In 2007 these amounts were 951 and 1.3 MT respectively, harvested from 182 ha on 464 farms on Puerto Rico and 0.4 ha on 11 farms on the Virgin Islands (NASS 2009a, b).

## AGROFORESTRY AND ENVIRONMENTAL SERVICES

### Agroforestry/interplanting practices

Tannia is probably the most shade tolerant of the edible aroids and does very well as an understory species in traditional agroforestry systems of the Pacific where it is often planted under coconut, young cacao, coffee, banana, and rubber (Weightman and Moros 1982). However, Morton (1972) reports research that found that "50% shading by trees or interplanted bananas or plantains has been shown to reduce yield by 66.67%."

**Table 2. Production, area harvested and yield of *Xanthosoma* taro for 2007 (FAO, undated)**

Country	Quantity (MT)		Area harvested (ha)		Yield (kg/ha)	
Belize	1550	F	150	F	10333	F
Cuba	176000	F	17500	F	10057	F
Dominica	4550	F	620	F	7339	F
Dominican Republic	32500	F	4400	F	7386	F
El Salvador	5200	F	2800	F	1857	F
Mexico	490	F	130	F	3769	F
Panama	8000	F	1300	F	6154	F
Peru	32100	F	5600	F	5732	F
Puerto Rico	2400	F	340	F	7059	F
Saint Lucia	210	F	35	F	6000	F
Trinidad and Tobago	1700	F	170	F	10000	F
Venezuela	86000	F	7900	F	10886	F
World	350700	A	40945	A	8565	F

\* = Unofficial figure; A = May include official, semi-official, or estimated data; F = FAO estimate

In slash and burn gardens at East Efate, Vanuatu, tannia is part of a polycultural complex that includes yam, banana, maize, onion, papaya (Weightman and Moros 1982).

### Environmental services

Shading from closely planted tannia suppresses weedy growth (Weightman and Moros 1982). Amargos and Siembra (1963) cited in Morton (1972) says, “After 35 days, growth of the crop should be so rapid as to shade out weeds and make further weeding unnecessary.

### PROPAGATION AND PLANTING

Tannia is easily planted using corm setts (from 5 cm sections of the corm divided into two pieces across the diameter), cormels, or plant tops that have about 5 mm of the corm and about 20–30 cm of the petiole with the central newly formed leaf intact. Corm setts produce a quicker and higher yielding crop, while plant tops are the slowest and

lowest yielding (Weightman and Moros 1982). Kay (1987) states that corms or cormels make the best planting materials.

### Recommended outplanting techniques

Before planting, the land should be weeded clean to reduce weed competition and dug, plowed or harrowed to a depth of 15–20 cm, followed by a second round of weeding a few weeks later, then planted to *Xanthosoma*. Propagules “should be planted 7–10 cm deep with the growth bud pointing downward.” Growth is quicker if planted “on ridges or mounds with organic material worked into their base. If planted on the flat, a hole 30 cm deep and 30 cm wide should be dug and half filled with compost or other organic material before planting” (Weightman and Moros 1982).

For Caribbean soils, Morton (1972) recommends: if soils are red clay or dark sandy clay, work in sugarcane waste at a rate



Top left: A mixed tree garden along a Palauan driveway includes sugarcane, *Colocasia taro*, tannia (beneath the bananas), papaya, and cassava (tapioca, *Manihot esculenta*) on the right. A 4 m tall breadfruit tree can be seen on the far right. June, 2006. Bottom left: Tannia and bananas in the hillside agroforest clearing at the Agana Swamp taro *dechel* on Guam, which is cultivated mainly for its leaves. January, 2009. Right: A Palauan backyard agroforest or mixed tree garden composed of sweetpotato (*Ipomoea batatas*), tannia, betel nut (*Areca catechu*), banana, and noni (*Morinda citrifolia*). June, 2006.

of 25 MT/ha; if soils are light and sandy, work in 50 MT/ha. The plant responds well to potassium and nitrogen.

While soils are variable in their fertilizer requirements, in the Pacific, applications of N and K have given good results. Weightman and Moros (1982) have suggested applying 110–150 kg K per ha and 110–120 kg N per ha. For Caribbean soils, a 7-4-13 formula has been recommended in the following formulation for 1,000 kg of fertilizer: 120 kg of 46% urea; 230 kg tankage; 210 kg bone meal; 110 kg 20% superphosphate; 140 kg potassium chloride; 100 kg potassium sulphate; 65 kg magnesium sulphate; 10 kg manganese sulphate; 10 kg copper sulphate; 3 kg boric acid; 2 kg zinc sulphate (Amargos and Siembra 1963 cited in Morton 1972).

## CULTIVATION

### Variability and known varieties

There is little information on tannia varieties for Pacific islands. Recent field work by the author on Fais Island noted two varieties of *X. nigrum* (*Menado cha* [red petiole] and *Menado hawaii*) and four varieties of *X. sagittifolium* (*Menado faluyach*, *Menado hawaii* [yellow flesh], *Yothol menado*, and *Menado yap*). Some of these varieties are named according to their place of origin. As tannia is an American species, there is much more information about its varieties in that region. Morton (1972) following the opinion of Matienza and Santiago (1970) wrote that *X. caracu* (as distinguished from *X. sagittifolium*) was the most important cultivated species in Puerto Rico, Cuba, and Florida. Acevedo-Rodri-



Top left: A line of *X. sagittifolium* serves as the border of this coastal subsistence garden of *Colocasia* taro near the Rota Hotel, Rota. The tannia was replanted after the cormels were removed. January, 2009. Top right: Mixed taro and sweetpotato slash and burn garden in Buma Village, Malaita, Solomon Islands with *Alocasia macrorrhiza* on the left, *X. sagittifolium* in the center, and *Colocasia* taro toward the right back. January, 1980. Bottom left: *X. sagittifolium* growing together with cassava, and banana in Kona, Hawai'i. September, 2008. Bottom right: *X. nigrum* growing in agroforest of jackfruit (*Artocarpus heterophyllus*), banana, and jaboticaba (*Myrciaria cauliflora*) in Kona, Hawai'i. September, 2008.



guez and Strong (2005) do not list *X. caracu* as a separate species and current small-scale online maps by the USDA indicate that the most dominant species in the U.S. are *X. sagittifolium* and *X. nigrum*, rather than *X. caracu* (NRCS 2010 b, c, a respectively). *Rolliza*, a cultivar of *X. caracu*, has white, non-acrid flesh while the cultivar *Viequera* is drought resistant. For *X. nigrum*, the cultivar *Dominicana* yields poorly but has firm flesh even after cooking. Another Central American species, *X. atrovirens*, has many well known cultivars: *Rascana* tubers keep well in storage and ship well and *Martinica amarilla* corms are firm when cooked. A more extensive discussion of the variability of these species can be found in Morton (1972). The presence of any of these cultivars in the Pacific is not known.

### Basic crop management

In slash and burn systems of the Pacific, tannia is often one of the first crops planted, either in pure stand blocks or interplanted with other crops which require fertile soils. Simple tools such as a bush knife, crowbar or digging stick, and spade are used for cultivation. Unlike *Colocasia* taro, tannia is often replanted after an initial harvest. No special horticultural techniques are required for commercial production although fertilizers and pesticides could be applied if cultivation is continuous and the plots are not fallowed. A full discussion of the techniques used in cultivating this species for commercial production can be found in Morton (1972). Further help may be available from the nearest agricultural extension agent.

### Recommended planting density

The most commonly used planting density is 1 m × 1 m when tannia is planted as a monocrop (Weightman and Moros 1982). Other densities used range from 0.6 m × 0.6 m to 1.8 m × 1.8 m. Based on research on *Colocasia*, the closer spacings will result in a higher yield per area while larger spacings will lead to more work for weeding until the leaf shade of tannia depresses weed regrowth. On Fais Island, tannia is grown in small plots for subsistence at an average spacing of 1.37 m between plants. In one sample 25 m<sup>2</sup> quadrat, there were 45 plants (1.8 plants per m<sup>2</sup>) (Manner, pers. comm.).

Using 1 m × 1 m spacing in the Sabana area of Rota Island, this species is planted commercially as a three to four row fringe around *Colocasia* taro.

Wider spacing will give a higher yield per plant, but result in a greater weeding effort. Closer spacings will give a higher yield per unit area and result in less weeding, as the shade from leaves will suppress weedy growth. For Puerto Rico, Abruna-Rodriguez et al. (1967) cited by Morton (1972) states that a population of 15,720 plants per ha produced 75% more than 11,955 per ha and the yield increased with density up to 31,944 plants per ha.



Top: A three-row fringe of *X. sagittifolium* bordering a field of *Colocasia* taro on Rota Island. January, 2009. Bottom: *X. nigrum* grown for subsistence on Ulithi Atoll, Falalop Islet. June, 2008.

### Advantages and disadvantages of polycultures

The advantages of growing tannia in polycultures are similar to those of growing *Colocasia* taro in mixed gardens. Polyculture affords better protection of crop loss from pests and diseases, an extended harvest period (because of the different rates of maturation), more efficient use of vertical space, more efficient use of soil conditions, and greater weed suppression, among others. As different crops have different nutrient requirements, polyculture makes more efficient use of soil nutrients and provides farmers with greater nutritional and dietary diversity from the same garden site. In mixed gardening, tannia is fairly well adapted to the lower light conditions of the ground canopy. Disadvantages may include suppression of other ground crops due of shading effects, reduced yields per unit area of cultivated land, and a more complicated management system. Unfortunately, there is little specific information on these topics for tannia.

## PESTS AND DISEASES

### Susceptibility to pests/pathogens

According to Weightman and Moros (1982), *Xanthosoma* does not suffer from any severe pests or diseases in the Pacific islands. The giant African snail (*Achatina fulica*) is a problem on Mare Island, New Caledonia. In all likelihood, the number of pests and diseases affecting this genus will increase as they diffuse into the Pacific from other parts of the world. For example, Dasheen mosaic potyvirus (DsMV) has been recently identified as a disease affecting *Xanthosoma* species in Hawai'i (Nelson 2008).

Elsewhere (e.g., in the Caribbean), pests include nematodes, a hairy caterpillar, mealybug, and cotton lacebug, woolly aphids, scale insects, and red spiders. In Ghana, *Cladosporium colocasiae* and *Phyllostica colocasiae* have caused leaf spotting (Morton 1972). Other pests include wireworms, white grubs, and a smooth, black or dark brown boring caterpillar (Morton 1972). Viruses do not appear to be a serious problem (Kay 1987), although Castro (2006) states that DsMV is the most important virus problem in Nicaragua.

Morton (1972) suggests that, "Currutaca, a soft rot of the rhizomes and tubers is caused by the fungus *Pythium ultimum* Trow. It is believed to be induced by excessive soil moisture, high acidity, potash deficiency, and lack of crop rotation. *X. jacquini* is highly resistant to this disease. *X. atrovirens* is less disease-resistant than other species."

In Trinidad, Venezuela, and Guyana, a dynastid beetle, *Li-gyrus ebenus*, has been reported to attack the corm, but can be effectively controlled by spraying with malathion. Other infrequent pests include *Aphis gossypii* in the Antilles and Surinam, *Eutheola bidentata* in Surinam, *Graphocephala propior*, *Quinta cannae*, and *Cacographis ortholatis* in Venezuela, *Aspidiotus destructor* in the Antilles and Polynesia, and *Pentalonia nigro-nervosa*, *Tetraleurodes ursorum*, and *Corythucha gossypii* in the Antilles. These may all be controlled by insecticides (Kay 1987).

In New Caledonia, *P. irregulare* is reported occasionally to cause serious losses. In Venezuela, tannia is sometimes infected by *Cercospora chevalier*, *C. verruculosa*, and *Punctellina solteroi*.

### Pest and disease prevention

In New Caledonia, tannia is planted under shade to control root rot by caused by *Pythium irregular*. Hand picking of snails is also practiced there. Kay (1987) suggests that the relative lack of pest damage to tannia may be "due to the fact that the crop is mainly grown on a small scale and not as an extensive monoculture." In Puerto Rico, for example,

951 MT of tannia was harvested from 182 ha on 464 farms (NASS 2009a).

## DISADVANTAGES

### Potential for invasiveness

The Pacific Islands Ecosystems at Risk database (PIER 2006) lists *Xanthosoma sagittifolium* but not *X. brasiliensis*, *X. nigrum*, or *X. undipes* as potentially invasive species. While the four species have been widely introduced in many islands of the Pacific, PIER lists *X. sagittifolium* as an invasive only in Norfolk Island, Fiji, Solomon Islands, Galapagos Islands, Raiatea, Tahiti, and Puluwat Atoll.

## COMMERCIAL PRODUCTION

### Postharvest handling and processing

The handling methods and techniques are similar to those used for *Colocasia* taro corms. For example, careful handling and storage can extend shelf life, as mechanical injury during harvesting is known to predispose the corm to pathogens in storage. Good air circulation and treating corms with fungicides can reduce storage rot caused by bacteria and fungi. Kay (1987) notes that bruising the cormels during harvest should be avoided, because bruises significantly decrease storage life due to rots.

As with *Colocasia* taro there are no internationally recognized commercial standards for tannia. However, clean, disease-free and unblemished corms command higher prices and proceed through quarantine inspections more readily.



Left: Giant African snail feeding on *X. sagittifolium* at Sabana, Rota Island. February, 2009. Right: Dasheen mosaic potyvirus on *X. sagittifolium* in Yap. June, 2007.

## Product storage requirements and shelf life

Experiments in Trinidad (Morton 1972) showed that certain tannias of good keeping quality can be kept on wire racks in dry, well ventilated storage at an average temperature of 26.1°C and relative humidity of 76% for 9 weeks. In refrigerated storage at 7.2°C with 80% relative humidity, they will remain in good condition for 18 weeks or more.

Tubers of *Rolliza*, a variety of *X. caracu*, sprouted and produced healthy plants after being stored for 7 months in an office (Barrett 1905 cited by Morton 1972).

Tubers can be kept buried and moist in the ground or several months without dehydration. Sliced and sun-dried tubers will keep for a season for use as flour (Morton 1972).

## SMALL SCALE PRODUCTION

Throughout the world, *Xanthosoma* is generally not grown on a large scale, but in smallholdings and farms. This plant is widely grown in urban plots and small gardens throughout the Islands. In Nuku'alofa, Tonga, *Xanthosoma* and *Alocasia* taros are the second and third most frequently found cultivated species in homegardens, while in Port Moresby, Papua New Guinea (PNG), *Colocasia* and *Xanthosoma* taros were present in 56% and 30% of 79 sample house gardens, respectively (Thaman 1984).

## Nutrition

Haddock and Hernandez (1952) cited by Morton (1972) state that tannia, particularly the yellow types, are more nutritious than taro and Irish potatoes, but less nutritious than sweetpotatoes, plantains, and pumpkins.

Kay (1987) states that there is considerable variation in the composition of tannias and starch contents of 17–34.5% have been reported. Average approximate composition of the edible portion has been quoted as: energy 556 kJ/100 g; water 70–77%; protein 1.3–3.7%; fat 0.2–0.4%; carbohydrate 17–26%; fibre 0.6–1.9%; ash 0.6–1.3%; calcium 20 mg/100 g; iron 1 mg/100 g; thiamine 1.1 mg/100 g; riboflavin 0.03 mg/100 g; niacin 0.0005 mg/100 g; and ascorbic acid 6–10 mg/100 g. About 10 kg of tannia corm yields 3 kg of flour. Tannia has larger starch grains (average diameter of 17–20 microns) that are less easily digested than *Colocasia* taro starch grains. However tannia starch is as palatable as cassava flour and more nutritious (Kay 1987). Noodles made from mixes of soy, wheat, and tannia flours have been made experimentally (Kay 1987).

Terra (1966) cited by Morton (1972) states that *X. brasiliense* leaves are reported to be “an excellent source of carotene, a good source of ascorbic acid and a fair source of thiamine. The protein content of young leaves is 2.2–4.1% as compared with that of tubers which is 1.1–1.7%.”



Top: A small patch of *X. sagittifolium* growing under a breadfruit tree with bananas and crotons on Fais Island. June, 2008. Middle: Two-month-old planting of *X. sagittifolium* in a recently cleared subsistence garden. Tannia is planted at a spacing of 0.73 plants per m. Fais Island. June, 2008. Bottom: *X. sagittifolium* and *X. nigrum* grown for subsistence. Often these species are grown in small plots amid agroforests of breadfruit, coconut, and banana. Ulithi Atoll. June, 2008.

## Import replacement

The cultivation of taro is fairly well understood and practiced throughout the Pacific islands. Tannia production is less intensive than that required for *Colocasia* taro and could reduce labor requirements. It is an excellent source of starch and could reduce rice imports.

## YIELDS

According to Weightman and Moros (1982), at the traditional spacing of 1 × 1 m, the yield is about 20 MT/ha. At closer spacing and higher fertilizer applications, yield could be nearly doubled.

Experiments in Trinidad have given yields of 30–32.5 MT/ha and Puerto Rico has reported yields of 25–37 MT/ha of tubers (corms plus cormels) (Kay 1987). In mixed cultivation in traditional agriculture, yields of 5–7 MT are common (Kay 1987).

At Keravat, PNG, *X. sagittifolium* yields between 15 to 25 MT/ha of cormels, with an average yield around 17 MT/ha. Under 6–8-year-old coconuts, interplanted tannia yielded 10 MT/ha per crop (Weightman and Moros 1982).

## MARKETS

### Local markets

Tannia is very well suited for local market sales given the small size of the corms and its long shelf life. Very little of the corm flesh is exposed upon harvesting; thus corm rot is minimized. In Colonia, Yap, subsistence farmers sell surplus tannia at the farmer's market for \$1.65/kg. In Puerto Rico and other Caribbean countries the corms are commonly sold by roadside vendors and markets.

The tubers are a common ingredient in the dough for pasteles (a meat and vegetable fritter), stew, and other preparations in Central American and Caribbean food.



Peeled and washed, these giant taro corms are ready for steaming or boiling. This variety turns a pinkish violet upon cooking. It is very palatable after cooking for less than an hour. May 2010.

## Export markets

There are no reliable export data for Pacific islands. Puerto Rico imports both *Colocasia* and *Xanthosoma* taro from Costa Rica, Panama, and the Dominican Republic. In 2002/3, tannia imports into Puerto Rico were valued at \$272,760 and roughly 4 times the value of *Colocasia* imports (AgroExpert 2009).

## Specialty markets

In addition to its utility as an ethnic specialty food, tannia is hypoallergenic and easily digestible because of its relatively small starch grains.

## Potential for Internet sales

There are a number of businesses advertised on the Internet that export or import tannia. The potential is greatest on the Eastern and Southeast coast of the USA where there are large number of residents of Central American or Caribbean heritage. These businesses specialize in the trade of tannia varieties such as *Lila* and *Madre*, to name a few.

## EXAMPLE SUCCESS

### Islam Paeda, Sinapalu Village, Rota Island

Among commercial taro growers in the Commonwealth of the Northern Mariana Islands, tannia (mainly *X. sagittifolium*) is known as “white taro,” while *Colocasia* taro is known as “red taro.” The colors are characteristic of tannia cormel and the *Colocasia* petiole. Islam Paeda of Sinapalu Village, Rota Island has been a commercial grower of dryland tannia and *Colocasia* taro and sweetpotatoes since 1990. Mr. Paeda, who migrated to the CNMI from Bangladesh is married to a Rota woman. He became a U.S. citizen in 2003.

Mr. Paeda cultivates 700 tannia plants and 20,000 *Colocasia* taro plants in addition to 2.5 ha of sweetpotato at Sabana. Formerly he had 5,000 tannia plants, but reduced its cultivation because it took 2 years to sell the whole crop. The tannia is planted as a three-row fringe that borders his fields of *Colocasia* taro.

Mr. Paeda uses pesticides in his fields. According to Alejandro Badilles, the College of the Northern Mariana Islands CREES agent on Rota (pers. comm. 2009), Mr. Paeda applies 21 lbs of Sevin per acre and Malathion at a rate of 2 quarts per acre. To control slugs, Islam uses metaldehyde at a rate of 10 lbs per acre. Giant African snails are controlled by handpicking in the morning. He applies 10-10-20 after field discing and 16-16-16 (at a rate of 50 lbs per 500 setts) when “hilling up” 2–3 months after planting. He begins harvesting red taro between 5 and 8 months after planting.

Mr. Paeda and his family operate a roadside stand on the main road to the airport. Customers can buy bananas, bottled chili paste (\$3.00 a bottle), sweetpotatoes (25 lbs for



Top: Alejandro Badilles (CREES College of the Northern Mariana Islands) and farmer Islam Paeda in Sinapalu Village, Rota. Middle: Islam Paeda, a successful taro and sweetpotato farmer, at his roadside stand. Bottom: A farm visitor inspects a fringe of 4–5-month-old *X. sagittifolium* bordering a field of *Colocasia* taro at Islam Paeda’s field. Much of the taro in Rota is now cultivated by Bangladeshi immigrants. All photos: January, 2009.

\$15) and red taro (25 lbs for \$20). Tannia retails for \$1.76 per kg. Many people travelling to Guam stop at one of these roadside stands to buy produce for friends on Guam or Saipan. For entry into Guam, all root crops must be pest free, washed, and cleaned of all soil materials.

## ECONOMIC ANALYSIS

### Expenses of production

No data are available. A general list would include those expenses found in dryland *Colocasia* taro farms. However, the costs of tannia production should be less, as it is less susceptible to diseases than *Colocasia* and requires less labor and other inputs than *Colocasia* does.

### Expected income per plant

In the supermarkets on Guam, U.S. “baby” taro retails for \$5.04/kg (\$2.29/lb). At the recently developed public market in Colonia, Yap, tannia readily sells for \$1.65/kg (\$0.75/lb). Data from market development study by Ames (2008) show that one farmer sold 40 kg (88 lb) of tannia for \$66 over a 6-day period.

## FURTHER RESEARCH

### Potential for crop improvement

Tannia has been described as a neglected crop by Hernádo Bermejo and Leon (1994) and as such there is a lack of research on its “most elementary aspects.” For example, the taxonomic position of cultivated *Xanthosoma* spp., for example, *X. caracu*, is unclear and a taxonomic revision of the genus is needed. In order to do this, live and *in vitro* collections of cultivated and wild forms, including related species are required as a precursor to the genetic improvement of cultivated varieties. Studies of this type are currently underway in Nicaragua (Castro 2006) and Costa Rica (Jiménez et al. 2007).

With research, “tannia production could be considerably improved both as a subsistence food and as a product for commercial export and industrial use” (Hernádo Bermejo and Leon 1994).

### Genetic resources where collections exist

A collection of 75 tannia accessions is maintained at the Tropical Agriculture Research Station at the Mayaguez Campus of the University of Puerto Rico (Riquelme 2001). Another collection is located in Trinidad and Tobago (Hernádo Bermejo and León 1994). The existence of Pacific island collections is not known.

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## OTHER RESOURCES

### Internet

- Food Plants International—"Helping the Hungry Feed Themselves": <http://www.foodplantsinternational.com>
- Food and Nutrition Library:  
[http://www.idrc.ca/en/ev-101738-201-1-DO\\_TOPIC.html](http://www.idrc.ca/en/ev-101738-201-1-DO_TOPIC.html)

Specialty Crops for Pacific Island Agroforestry (<http://agroforestry.net/scps>)

## Farm and Forestry Production and Marketing Profile for Tannia (*Xanthosoma* spp.)

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