A PRELIMINARY STUDY OF TANNIER CLONES

by

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D.T.A. Report

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INTRODUCTION.

The genus *Xanthosoma*, cultivated clones of which are locally termed tanners, has so far received very little attention in the West Indies, though tanners are potentially a very useful crop. Tanners constitute a valuable source of starch, and may be used in the same variety of ways as are potatoes. In addition, they can be made into a flour, which is reported by Quisumbing (16) to be more palatable than that of cassava, and has no trace of hydrocyanic acid. The leaves may be used in salad, preferences being for young unopened leaves, and stalks may also be used if they are first peeled (19). Analysis of proteins, fat, starch and sugar, indicate that the food value of tanners does not differ greatly from that of other tropical root-crops, or from Irish Potatoes (17).

In addition to the above qualities, tanners are resistant to drought and other adverse climatic conditions, will store for much longer periods than dasheens, and produce a high yield of tubers, which may be as much as two to four times that of the potato. (3), (1) (14).

A genus so potentially valuable to the West Indies is worthy of attention. Collection, description and classification of the clones growing in the islands of the Eastern Caribbean has been started, and disease resistant, heavy yielding clones bearing good quality tubers and suitable to local environment are to be selected.

THE BOTANY OF THE TANNIER.

The important genera *Xanthosoma* and *Colocasia* and the genus *Alocasia* are included in the family Araceae.

*Xanthosoma* and *Alocasia* both have sagittate leaves and open sinus and are difficult to distinguish on leaf characteristics. They differ markedly from the genus *Colocasia*, which
has peltate leaves and a closed sinus. Inflorescences, though they are quite distinct (Cf. Fig. 1) are uncommon in some regions. O.W. Barrett (3) reports that most varieties of tanners seldom or never produce flowers, though this is not the case in Trinidad.

The names tanner and tanier are corruptions of the Carib taia (12). A common spelling given in the West Indies is tannia or tania. Coco is the name used in Jamaica. The name eddo, though it should strictly be confined to members of the genus Colocasia, is often used for tanners, as is the Arawak word Yautia. Malanga (Cuba, Venezuela and Guadeloupe, for yautias and dasheens), chou caraibe (Martinique), tayonne, tayove, taye, coco yam (Guiana), taioba (Brazil), ocumo (Venezuela), mafaffa (Columbia), oto (Panama), and quequeste, texicamote, rejalgar, colomo, lampaza, macal (Mexico), are some of the names used for tanners in other countries (11), (3) (7). A list of local names, used in the Gold Coast, N. Nigeria, S. Nigeria and the Cameroons is given by Dalziel. (7).

Tanner plants are upright to spreading, and succulent, with sagittate or more rarely, hastate leaves. Some clones are very vigorous, and may reach a height of 6 - 7 ft., while others do not exceed 4 ft. in height. Cultivated varieties are stemless, though the rhizome may grow up above the surface of the ground for a short distance. In the species Xanthosoma jacquini (Schott), which grows wild in Trinidad, but is cultivated in Mexico, Florida, Ecuador and Venezuela (11), the rhizome may grow to a height of 10 ft. or more.

The petiolate leaves arise in whorls from the rhizomes or from the tubers. New leaves are formed continuously in the centre of the whorl, and as they mature and grow older, they move out to the periphery of the whorl (due to new leaves being formed in the centre), where they later wither and are discarded. The venation of the leaf blade, consists of a central midrib, 2 main veins extending into the basal lobes of the leaf, usually 10 main lateral
FIG. 1. INFLORESCENCES OF XANTHOSOMA AND ALOCASIA SP. SHOWING STRUCTURE OF SPADIX.

Sterile appendage

Staminate part of spadix

Infertile part of spadix

Pistillate part of spadix

Xanthosoma sp. - 16796 - 'Chougrenade'

Alocasia sp.
veins, and an intermarginal vein which is a short distance in from the leaf margin and connects the main side veins. The intermarginal vein is present in all clones, though in some it is more distinct than in others. The margin of the leaf blade is purple in colour in some varieties.

The petiole is grooved for \( \frac{2}{3} \) to \( \frac{2}{3} \) of its length from the rhizome. This groove is termed the petiolar sheath, and in every newly emerged leaf its margins overlap and protect the younger unrolled and unexpanded leaves, which in turn protect the main axis of the plant and the growing point. The colouration of the petiole, especially the pigmentation of the margins of the petiolar sheath, forms a very useful character for distinguishing groups of clones. Faint to heavy bloom is present over the petioles and leaf blades of most cultivated varieties, and is absent, or almost so, on wild forms.

At the onset of flowering, in addition to the emergence of the next new leaf in the centre of the whorl of leaves, a spongy linear acuminate bract is produced. When the margins of the petiolar sheath of the newly emerged leaf diverge, the unopened inflorescences appear. The bract encloses the main axis of the plant and the growing point, which continues to produce new leaves.

The number of inflorescences produced in the axil of the leaf varies from 1 - 6. Inflorescences open in succession and seldom more than one flower in a cluster is open at any one time. Each inflorescence is subtended by a bract. These bracts usually wither when the inflorescence opens, but in some clones the bracts are persistent. Photographs 1, 2 and 3 show three stages in the emergence of the inflorescence.
Photograph 1. 27th January
Appearance of bract enclosing main growing point.

Photograph 2. 6th February.
First inflorescence appearing, and young leaf emerging from enclosing bract.

Photograph 3. 14th February.
Opening of the first inflorescence and appearance of second inflorescence and subtending bract.
Photograph 4 shows 6 inflorescences of the cultivar 04/56 'Red Chaguana', and illustrates clearly the bracts subtending each inflorescence.

The following accessions produced inflorescences between 7 and 10 months after planting 04/56 'Red Chaguana', 01/56 semi-cultivated type, 16/56 'Chougrenade', 07/56 'Button', 12/56 'Charanelle', 10/56 'Mama's Enfant', 17/56 'wild type', 08/57 'South River', 15/56 'White' and 13/56 'Checkelle'.

Each inflorescence, consisting of an almost sessile spadix, surrounded by the spathe, is borne on a leafless radical stalk, or scape, which is usually about 2/3 the length of the petiole. Inflorescences of three differently named clones are illustrated in photograph 5. The closely crowded flowers are small, unisexual and apetalous, the male flowers being borne in the upper (staminate) part of the spadix, and the female flowers in the lower (pistillate) part. The staminate and pistillate parts are separated by a region of sterile cells. The spathe may be ovate, oblong ovate or oblong lanceolate, and is divided by a transverse constriction, into a lower 'tube' surrounding the pistillate and sterile regions of the spadix, and an upper 'blade', which is usually more highly coloured than the tube and encloses the staminate part of the spadix. The staminate part of the spadix is made up of synandria, each consisting of a central column surrounded laterally by anthers, commonly 10 in number in the clones so far studied. The pollen is yellow in colour and is liberated in triads or tetrads, each group of 3 or 4 pollen grains, being surrounded by a thick viscid hyaline layer. *X. cubense* and *X. robustum*, described by Erdtman (9) also have pollen grains liberated in tetrads. Synandria and pollen grains typical of the clones so far studied at I.C.T.A. are illustrated in Figures 1 and 2.

Each flower in the pistillate part of the spadix, consists of a syncarpous ovary of four or five carpels, with a very slightly lobed stigma. The ovaries (Cf. Fig. 5) are white in colour, and
the erect ovules are borne in axile placentation. A resinous juice which attracts insects is exuded in the pistillate region of the spadix. None of the clones so far studied has been observed to produce seed, with the exception of the wild species *X. iaccuinii* (Schott), which regularly sets seed.

In the clones studied, it was observed that very often the scape bends over at the base soon after the opening of the inflorescence. Inflorescences were self pollinated, cut and placed in water, in an attempt to produce seed. Although the ovaries swelled considerably, no seed was produced.

Occasionally the inflorescence does not open at all and withers without emerging from the protecting petiolar sheath. This is commonly the case under dry conditions.

Barrett (3) reports teratological monstrosities in tanners. Such monstrosities as double spathe, fused scapes, double spadices, have been observed in Trinidad (Cf. Photographs 6 and 7).

The subterranean tubers or cormels which are budded from the rhizome, may be rounded or elongated, and are covered with fibrous scale leaves, borne in concentric rings. Large numbers of adventitious buds, locally termed 'buttons', develop on the tubers of some cultivars, giving a warty appearance, while other cultivars have relatively smooth skinned tubers. Flesh colour of tubers may be pink, red, cream, orange or white. Tubers may be 'hard' or 'soft' when cooked, and are described as 'scratchy', if they cause irritation at the back of the throat when they are eaten. Evidence presented by Clarke and Waters (5) indicates that a sapotoxin is present in the tubers of *X. atrovirens*. They were not able to make even a rough estimate of the toxic content of the tubers. It is thought that this toxin, like the glyco-alkaloid in the potato tuber, is destroyed when the tubers are cooked, but it is clear that detailed work needs to be done on this subject.
Photograph 6

Photograph 7.
FIG. 2. XANTHOSOMA SP. 04/56. 'RED CHAGUANAL' - SINGLE MALE FLOWER.
**Actual Diameter - 2mm.**

**HORIZONTAL SECTION OF SINGLE MALE FLOWER THROUGH CENTRAL CYLINDER AND ANTHERS.**

**FIG. 3. XANTHOSOMA SP.**

04/56 - "RED CHAQUANAL?"

**POLLEN GRAINS**

**Actual Diameter - .15mm**

**TETRAD**

**TRIAD**
LONGITUDINAL SECTION OF
OF SINGLE FEMALE FLOWER
OF 01/56 SEMICULTIVATED TYPE.

Actual Length - 3 - 4 mm.
PREPARATION OF A PRELIMINARY FIELD KEY AND NOTES ON CLONES COLLECTED.

Twenty five named accessions are planted in an observation and multiplication plot at I.C.T.A., and of these, 17 are grown fairly widely in Trinidad and Tobago. Between 6 and 20 plants of each accession are so far available.

In addition to plants grown in this plot, there have recently been introductions from Jamaica, Barbados, Grenada, Montserrat, St. Vincent and Dominica, and a single introduction from British Guiana. High yielding varieties from the University of Puerto Rico Expt. Station are to be obtained in the near future. Each newly introduced clone is given an accession number, which indicates the number of the clone, and the year that the clone was obtained. 10/56, would be the accession number of the 10th clone collected in 1956. The new accession is then grown in a greenhouse for a period, prior to transplantation into the field.

It was suggested that a key to the clones, based on leaf, petiole, and tuber characters should be prepared, and that this key should be extended in the future, as more tannier varieties growing in the islands of the Eastern Caribbean, are collected and grown under field conditions at I.C.T.A.

Systematic work along the lines of selection and development of desirable varieties, will be greatly aided by classification of the clones present, and elimination of synonyms, where possible.

The following data, was taken from 5 - 8 plants of each accession, at intervals throughout the growing season - length of mid rib and leaf blade, width of leaf blade at base of mid rib and half way up midrib, leaf colour and numbers of veins, length of free portion of petiole, (between tip of petiolar sheath and base of midrib), petiole diameter and pigmentation. Observations on inflorescences when they occurred were made, in order that descriptions of the clones should be more complete. The majority of tubers were
harvested after 10 months, though plants of each accession were harvested at 8 months, in order to get some information on time of maturity. The main tuber characters, tuber shape, flesh colour, skin colour, and presence or absence of buttons, were recorded for each accession. It is appreciated that actual measurements have a limited value in a varietal key, and where possible clones have been distinguished on other characters. Leaf ratios have been found to vary only very slightly from clone to clone. Young plants of different clones are extremely difficult to distinguish, and it is essential that observations on leaves and petioles, should be made on plants which are at least 5 months old.

A preliminary key based on vegetative characters has been prepared, and this will be useful in distinguishing the clones described in this report. It can be extended to include other clones when further information becomes available.

A Leaves sagittate.

B Basal veins naked for short distance from junction of petiole and leaf blade. Basal wings do not reach junction of petiole and leaf blade.

C Rhizomes may grow out of the ground for a considerable height (6" - several feet). Latex grey in colour, with strong evil smelling pungent odour. Tubers absent, or if present very small and few in number . . . X. jacquini Schott . .

CC Rhizome may grow out of the ground, but only for a very short distance. Latex white in colour, not strong smelling. Tubers always present.

D More or less strong, uniform purple pigmentation of margins of petiolar wings.

E Purple pigmentation of margins of petiolar wings pronounced, margin of leaf blade deeply pigmented. Tuber flesh colour pink.
F Purple pigmentation absent within petiolar sheath. .............................................. 2

FF Some purple pigmentation present within petiolar sheath. ........................................ 3

EE Purple pigmentation of petiolar wings very slight (confined to feint narrow line along the margin of the petiolar wings of the first leaf). Margin of leaf blade not purple pigmented. Tuber flesh colour white.

F Tubers rounded .............................................. 4

FF Tubers elongated.

G Large numbers of 'buttons' present on the tubers. Skin surface rough and warty. Flesh colour of tubers white. .............................................. 5

GG Few 'buttons' on the tubers. Skin surface smooth. Flesh colour of tubers white.

H Bloom on blade and petiole of leaf very slight. Tubers very long and thin; length considerably greater than 3 x maximum width. .............................................. 6

HH Bloom on blade and petiole of leaf not slight. Tuber length 3 - 4 x maximum width.

I Ratio of the midrib length to length of free portion of petiole of the first mature leaf, (usually the third leaf down from the apex), is normally less than two.
J Plant height when fully grown (from 5 - 6 months onwards) may reach 6 - 7 ft. Leaves large, length of midrib and maximum width of blade may reach 90 cms. ......................... 7

JI Plant height does not exceed 4 ft. Maximum midrib length and width of blade about 65 cms. ......................... 8

II Ratio of midrib length to length of free portion of petiole of first mature leaf is normally greater than 2. ......................... 9

D Strong purple pigmentation of margins of petiolar wings is not uniform, but is markedly blotched. Incomplete purple line round margin of leaf blade. ......................... 10

BB Basal veins not naked within sinus. Basal wings of leaf blade do reach junction of petiole and leaf blade.

C Purple pigmentation where present confined to margin of petiolar wings. No pigmentation within the sheath. Margin of leaf blade does not have purple pigmentation. Tuber flesh colour, yellowish orange, cream or white.

D Marginal veins indistinct. Bloom almost absent on leaves. Very few suckers, rarely more than one per plant. Flesh colour of tubers (which are very small) is yellowish orange. ......................... 11

DD Marginal vein clearly marked. Abundant bloom on leaves and petioles. Suckering common. Tuber flesh colour cream or white.

E Flesh colour of tubers cream. ......................... 12

EE Flesh colour of tubers white. ......................... 13

CC Uniform deep purple pigmentation over the petiolar wings (not confined to the margin), and within the petiolar sheath.
Leaf blades and petioles deep purplish green, somewhat faded in older leaves. Narrow purple margin to leaf blade. Tuber flesh colour cream.


1. X. jacquinii Schott (1832)
   (Caladium xanthorrhizon Willd. (1816); Alocasia undipes C Koch and Bouché (1854); Xanthosoma undipes C. Koch (1856); X. sagittifolium Liebm. non (L.) Schott.)
   17/57 'Palma Yautia' (Trinidad).

During the last 150 years this yautia has been classified in three different genera, but is now included in the genus Xanthosoma.

Leaves sagittate, dark green in colour, bloom absent. Rhizome is caulescent and may grow as high as 10 ft. When the plant is damaged, latex ducts liberate strong grey acid latex, which has an unpleasant pungent smell.

During flowering, clusters of inflorescences appear in the axils of the leaves. Rarely more than one inflorescence opens at a time. Blade of spathe oblong ovate, white on inside surface, green on outside surface. Tube of spathe green on outside surface, deep purple on inner surface. Spadix almost as long as spathe. Staminate part of spadix white in colour, sterile region white or greenish white, and pistillate region with yellow or orange stigmas and white ovaries. Pollen sulphur yellow in colour.

The proportions of the various parts of the inflorescence are recorded below.

```
Blade  11cm x 2cm
Spathe
Tube  7.5cms x 2.5cms
Spadix -- Sterile part  4cm long
Staminate part 10cm x 1.1cm
Pistillate part  2.5cms long
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Very much larger inflorescences than this have been observed. A single inflorescence is illustrated in Photograph 8. This species commonly sets seed.

Tubers are often absent; when present, they are small, and few in number. The tuber flesh is yellowish orange in colour. Rhizomes are not suitable for human consumption, though they can be used as a pig food.

Hardicourt (11) reports that this species is sometimes sown and cultivated in Mexico, Florida (where it is known as yautia hereca), Ecuador and Venezuela. It is not cultivated in Trinidad and is commonly found growing wild in damp forested regions.

Photograph 8.

2. *Xanthosoma sp.* 04/56 'Red Chaguanal' (Trinidad).

Leaf width at base of midrib, approximately equal to length of midrib (25 - 55 cms). Leaves are more or less flat, and the margins of the young leaves and also the petiolar sheaths show pronounced purple pigmentation. Veins on the abaxial surface of the young leaves, also show purple pigmentation. In older leaves purple pigmentation is almost entirely absent.

A single plant flowered after 7 months. 6 inflorescences were
produced, each subtended by a bract. Blade of spathe not highly
coloured, glaucous green surface on outside, yellowish green on
inside, margin purple. Tube of spathe same colour as outside of
blade. Staminate part of spadix pale pink at apex, the remainder
white, with occasional areas of pink. Pollen yellow in colour.
Neutral part of spadix, orange brown, stigmas disc-like, ovaries
white. Region below pistillate region pink in colour. Bracts
subtending the inflorescences, retain their colour and turgidity
during the development of the inflorescence, finally withering,
when the inflorescence dies.

The following measurements indicate the proportions of the
various parts of the inflorescence.

- Blade 26cm x 6cm
- Staminate part 16cm x 1.5cm
- Spathe
- Tube 11cm x 5.5cm
- Spadix—Sterile part 7cm long
- Pistillate part 4.5cm long.

The tubers are elongated and smooth skinned. Flesh colour is uniform
pink.

3. Xanthosoma sp.  11/56 'Molkon' (Trinidad).

   Length of midrib 43 - 60 cms. Petiole of first leaf deep
   purple in colour. Veins on undersurface of young leaves purple
   pigmented and margin of leaf fringed with narrow deep purple line.
   Purple pigmentation reduced in older leaves, but never absent.

   No inflorescences observed.

   Clone shows pronounced suckering if not harvested at about
   7 or 8 months. Tubers are elongated, smooth skinned, and have a
   central region of pink flesh which is surrounded by white flesh.

4. Xanthosoma sp.  12/57 'Nut Eddoes' (Barbados)

   Midrib of leaf blade may reach 50 cm in length. Purple
   pigmentation of the margin of the petiolar sheath is very slight
and confined to the first young leaf. No inflorescences produced. Tubers are rounded like the corms of e.g., *Colocasia esculenta*, and in contrast to the typically elongated tubers of most tannier clones. Large numbers of small tubers are budded from larger tubers, to which they remain attached. One plant may produce 80 or 90 tubers in this way, which is considerably more than would be expected from most other clones. Tubers are however small. Tuber flesh colour is white.

5. *Xanthosoma sp.* 07/56 'Button' (Trinidad)  
08/57 'South River' (St. Vincent)  
16/56 'Chougrenade' (Trinidad)

07/56. Length of midrib 31 - 47 cms. Purple pigmentation of petiolar wings very slight.

After 7 months, one plant on the observation plot, produced a single inflorescence. Blade of spathe ovate, creamy white in colour on inner and outer surface. Tube of spathe glaucous green. Staminate part of spadix white at the apex, and pink lower down until the anthers dehisce, when it becomes buff in colour. Pollen yellow. Neutral part of spadix yellow brown, stigmas disc-like and not clearly lobed. Ovaries greenish white in colour.

The following measurements show the proportions of the various parts of inflorescences growing under different environmental conditions A and B. The two measurements recorded for B indicate the difference in size of inflorescences of plants growing under similar conditions.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tube</td>
<td>8cm x 4cm</td>
<td>7cm x 5cm</td>
</tr>
<tr>
<td>Spathe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blade</td>
<td>12cm long</td>
<td>17cm x 6cm</td>
</tr>
<tr>
<td>Stamine part</td>
<td>8cm long</td>
<td>11cm x 1.6cm</td>
</tr>
<tr>
<td>Sterile part</td>
<td>3cm long</td>
<td>3.5cm long</td>
</tr>
<tr>
<td>Pistillate part</td>
<td>3.3cm long</td>
<td>3.0cm long</td>
</tr>
</tbody>
</table>
A is at the observation and multiplication plot at I.C.T.A. and B is near Platanal in the Northern Range, where the land is very suitable for tanner growing, and where good quality tanners are produced.

Tubers are elongated and have rings of white 'buttons' on the surface, making the skin very rough and warty. Flesh colour of the tubers is white.

08/57. Morphologically very similar to 07/56. One inflorescence was produced but due to the very dry conditions it did not open. It withered while still enclosed within the petiolar sheath. Tubers are identical to 07/56.

16/56. This clone produces very much larger plants than 07/56. Plants may be 6 -7ft. tall, and midrib length from 38 -67 cms.

Several plants produced inflorescences, from seven months onwards. Commonly six inflorescences are produced in a cluster. Colouring of the inflorescences is identical to 07/56, and they are of similar size to those of plants growing under environment B. Tubers are elongated, white fleshed and rough skinned, with 'buttons'.

6. Xanthosoma sp. 01/56 Semi cultivated type (Trinidad).

Plants of this clone are very small, 1 -2ft tall. Blade of leaf is markedly triangular. Leaves small, midrib length 26 -38cms. Purple pigmentation of the margin of the petiolar sheath, is very slight. Very little bloom present on blade and petiole of leaf. Petioles very thin in comparison with other varieties.

Plants of the clone began to flower 7 months after planting. All 8 plants produced inflorescences. 3 or 4 inflorescences are borne in each cluster. Blade of spathe ovate, white on inside
surface with marked purplish margin, greenish white on outside surface. Tube of spathe, glaucous green, with purple margin at overlap. Stamineate part of spadix, white in colour, later turning to pink and then brown, after the anthers have dehisced. Pollen sulphur yellow in colour. Neutral part of spadix pink for upper \( \frac{3}{4} \) of its length, white for lower quarter. Pistillate part of spadix greenish cream. The following figures, show the proportions of the various parts of the inflorescence.

<table>
<thead>
<tr>
<th>Part</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blade</td>
<td>14 x 6.5 cm</td>
</tr>
<tr>
<td>Spathe</td>
<td></td>
</tr>
<tr>
<td>Tube</td>
<td>7.5 x 4.5 cm</td>
</tr>
<tr>
<td>Stamineate</td>
<td>9 cm x 1 cm</td>
</tr>
<tr>
<td>Neutral part</td>
<td>5.5 cm long</td>
</tr>
<tr>
<td>Pistillate</td>
<td>2.5 cm long</td>
</tr>
</tbody>
</table>

Bracts wither and become brown a short time after the emergence of the inflorescence from the petiolar sheath. It was noticed that during very dry conditions inflorescences were formed in several plants, but did not emerge from the petiolar sheaths and withered without opening.

7. Xanthosoma sp. 10/56 'Mama's enfant' (Trinidad)

17/56 'English' (Trinidad)

The leaves are fairly large, the midrib length being as much as 80cms. Both the clones are characterised by the Ratio of midrib length to length of free portion of petiole of newly matured leaf being greater than 2. Flowers occurred on 8 plants of 10/56, nine months after planting. The inflorescences differ from all others so far described in the report, in that the spathe is considerably longer than the spadix. The blade of the spathe is yellowish green in colour on the inner and outer surfaces. The tuber is glaucous green in colour. The stamineate part of the spadix is white turning to pink after the yellow pollen, has been liberated. The pistillate region of the spadix is brown in colour, and the ovaries are white.

The following measurements indicate the proportions of the
various parts of the inflorescence and also the differences in size of inflorescences of plants in the observation plot, and plants growing near Platanal in the Northern Range.

<table>
<thead>
<tr>
<th></th>
<th>Obs. Plot.</th>
<th>Near Platanal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tube</td>
<td>8 x 5.5cm</td>
<td>12 x 6.5cm</td>
</tr>
<tr>
<td>Spathes</td>
<td>23 x 6.5cm</td>
<td>29 x 7cm</td>
</tr>
<tr>
<td>Blade</td>
<td>10 x 1.2cm</td>
<td>13.5 x 2.2cm</td>
</tr>
<tr>
<td>Staminate</td>
<td>4.5cm</td>
<td>6cm</td>
</tr>
<tr>
<td>Spadix</td>
<td>3.0cm</td>
<td>3.5cm</td>
</tr>
<tr>
<td>Sterile</td>
<td>3.0cm</td>
<td>3.5cm</td>
</tr>
<tr>
<td>Pistillate</td>
<td>3.0cm</td>
<td>3.5cm</td>
</tr>
</tbody>
</table>

Tubers elongated, smooth skinned, and with white flesh. 17/56 differs from 10/56 in that suckering is rare, whereas 10/56 produces large numbers of suckers. In addition leaves are slightly smaller and no flowering occurred. Tubers are similar.

8. *Xanthosoma* sp. 12/56 'Charanelle'
14/56 'Chobutton' (Trinidad)
13/56 'Chackelle'
15/56 'White'

The clones in this group are very similar morphologically. All are very vigorous and have reached 6-7ft in height, even under poor growing conditions. The leaf blades are large, the midrib being as much as 90 cm. in length.

The basal veins are naked for a short distance from the junction of the petiole with the leaf blade. Purple pigmentation, present only on the margins of the petiolar sheath of young leaves, is very slight.

Inflorescences were produced 10 months after planting on plants of 15/56, 13/56 and 12/56. 14/56 did not flower. Blade of spathe is creamy yellow inside, with slight margin of green, and is greenish cream on the outside. Tube of spathe is glaucous green. The staminate part of the spadix is creamy yellow and pollen is yellow in colour. Sterile part of spadix white. In the pistillate
region of the spadix, the yellow stigmas are not clearly lobed and the ovaries are white. In pigmentation and general appearance the inflorescences closely resemble those of clones 06/56 'Chougrenade' and 07/56 'Button'.

Proportions of the various parts of the inflorescences of 12/56 are shown below.

<table>
<thead>
<tr>
<th>Observation</th>
<th>Near Platanal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plote</td>
<td></td>
</tr>
<tr>
<td>Spathe</td>
<td>12cm long</td>
</tr>
<tr>
<td>Blade</td>
<td>10cm long</td>
</tr>
<tr>
<td>Tube</td>
<td>11cm long</td>
</tr>
<tr>
<td>Pistillate part</td>
<td>4cm long</td>
</tr>
<tr>
<td>Spadix</td>
<td>4cm long</td>
</tr>
<tr>
<td>Sterile part</td>
<td>11cm long</td>
</tr>
</tbody>
</table>

As can be seen, under the better growing conditions at Platanal, inflorescences are much larger. Similar measurements were recorded for 13/56.

Due to very dry conditions, many inflorescences did not emerge from the petiolar sheaths, and withered without opening. Inflorescences which did open were small in size.

Tubers of 12/56, 14/56 and 13/56 are elongated, smooth skinned and of good quality. Flesh colour is white. 12/56 Charanelle is said to yield from 6 months onwards, and is thought to be the best type growing at Platanal, where 'castration' of tubers involving removal of tubers as they mature, without harvesting the entire plant, is practiced 16/56 though vigorous and producing a considerable amount of leaf, yielded small inferior tubers.

9. Xanthosoma sp. 05/56 'White Chaguanal' (Trinidad)
08/56 'Hammer' or 'Hamma' (Trinidad)
09/56 'Dearies' (Trinidad)
22/57 - (Barabdos)
Clones of this group, are similar to those of group 8, but considerably smaller in height (max. height about 4 ft) and in leaf size. None of the accessions produced flowers. All produced fairly smooth skinned, white fleshed tubers, with good shape and size. 05/56, 08/56 and 09/56 are morphologically identical, 22/57 differed in that suckering was very rare.

10. Xanthosoma sp. 01/58 'Long finger' (Jamaica).
   36/57 'Chouribon' (Dominica).
   04/58 'Blotched type' or 'Left Man' (Jamaica).

Group 10 is readily distinguished from other groups, by the blotched purple pigmentation of the margins of the petiolar wings, and the incomplete purple line around the margin of the leaf blade. As these clones are only recently introduced, little further information on them is at present available.

04/56 is reported to have an inflorescence with a creamish pink spathe, the young spathe being greenish and faintly purple striped. It is a hard tannier, with red tubers, and in Jamaica will reach maturity in six months.

01/56 is said to be a hard white fleshed tannier, which will reach maturity in six months.

11. Xanthosoma sp. 03/57 'Demerara' (Tobago)
   20/56 - (Montserrat)
   03/58 'Toya' or 'Wadgaa' (Jamaica).

03/57 has very vigorous growth, plants reaching 6ft. or more in height. Leaves are dark green in colour and large, the midrib being as long as 80cms in some plants. The basal veins are not naked within the sinus, and intermarginal veins, which are very close to the leaf margin, are not as clearly marked as in other accessions. Leaf shape resembles very closely that of the Alcasia; the blade is flat and has a shiny appearance, bloom being almost absent. Pigmentation of the margins of the petiolar wings
is light brown. No flowering has so far occurred.

Tubers when harvested 10 months after planting, were small and had orange flesh, with a narrow layer of cream flesh below the skin. The rhizomes are used as pig food.

20/56 - morphologically identical to 03/57.

03/58 - This is a new introduction and has now yet been planted out into the field. Leaves are identical to those of 20/56 and 03/57. It is reported that the rhizome may grow out of the ground to a height of five feet. Rhizomes are usually boiled and fed to pigs, they may however be used for human consumption after boiling to remove the toxic principle. They are said to be very scratchy. Leaves are never eaten.

12. Xanthosoma sp. 01/57 'Leadlow' (Tobago)

Little information at present available.

No flowering observed. Tubers slightly elongate, smooth skinned and late in maturing. Reported to be a soft tannier. Flesh colour of tubers cream.

13. Xanthosoma sp. 06/57 'Nut Eddoe' (St. Vincent).

No flowering observed, skin colour of tubers white.

14. Xanthosoma sp. 10/57 'Grande Bay' (St. Vincent)

Plants may be up to 4 ft. in height. Young leaves are erect, very triangular and dark purplish green in colour, with intense bloom. Deep purple pigmentation of basal wings of petiole is of uniform intensity within the petiolar sheath. Margins of the leaf blade are also deeply purple pigmented. Pigmentation of petiole and dark purple-greenness of leaves fade as the leaves grow older, and leaves at the base of the plant are therefore much less deeply pigmented.

The clone suckers very rarely, and no flowering has so far been observed.
Tubers are late maturing, rather rounded, smooth skinned and have yellow flesh.

15. Xanthosoma brasiliense Engl.

(Caladium brasiliense Desf. 1829; Arum sigittifolium Linte 1822; Philodendron fontanesii Kunth 1841; Xanthosoma hastifolium C Koch. 1854).

04/57 'Belembe yautia'

It is known locally as Indian kale, in Guadeloupe as zebe a calalou (calaloo bush) (1), and in Hawaii as Tahitian spinach (2). Plants usually 1½ - 2ft high with hastate leaves. It is grown exclusively for greens, being one of the main ingredients of the creole dish called Calalou soup. Young leaves not yet open are preferred, but fully expanded leaves are also suitable.

Flowering is recorded by Hardicourt (11), but no flowering has so far been observed in Trinidad.

Tubers are very small and on account of this they are not eaten. Flesh colour is orange on the inside with a white outer margin.

INFORMATION ON SOME MORE RECENTLY COLLECTED CLONES.

11/58 } very vigorous growing clone, similar to 12/56 Charanelle.

Bochov } It is used as a ground shade for bananas and cocoa. Flesh colour of tubers white.

07/58 } Very similar to 04/58 Red Chaguanal, but has deeper Red.

08/58 } pigmentation of tubers and inflorescences.

09/58 } Said to yield poorly. Flesh colour white, tubers Deecorn rounded.

09/58 } This accession is a 'button' tannier with red flesheed tubers. Petioles are strongly purple pigmented.
Reported as bearing very good quality tubers.

In addition to the five mentioned above, some 38 further clones from various territories have been collected, and are soon to be planted out into the field. When further information is available, these clones can be included in the preliminary key.

A museum plot has been started, and when completed will contain two labelled plants of each clone.

DETERMINATION OF CHROMOSOME NUMBERS.

Very little cytological work on the genus Xanthosoma, is recorded in the literature. The chromosome numbers of the three species X. violaceum, X. sagittifolium and X. helleborifolium, recorded by Darlington and Wylie in the 'Chromosome Atlas of Flowering Plants' (8) are 24, 26 and 39 respectively. It is questionable whether the recorded X. violaceum was correctly identified, as it is reported to be a horticultural plant and there is no mention of its value as a source of tubers.

It was thought important to determine whether there was any difference in the chromosome numbers of the clones so far collected.

Using a slight modification of the acetic orcein squash technique, recommended by J.H. Tjio and A. Levan (18) for root-tips, the chromosome numbers of 20 clones, including 17/57 X. jacquinii Schott, and 04/57 X. brasiliense Engl., have been determined.

Root tips were collected in the early morning, and immersed for 40 minutes in 0.002m oxyquinoline, with the exception of 17/57 which required a longer immersion period. The root-tips were then warmed to near boiling in a few ccs. of a combined macerating...
staining fluid, consisting of 4.5 parts saturated orcein in glacial acetic acid, 4.5 parts water, and one part N\textsubscript{3}HCl. Thin root tips were collected for the earlier squashes, but it was found later, that satisfactory preparations could be obtained, using the more common, thicker roots. These thicker root tips were cut into two halves, and the root-cap removed, before putting the tip into the macerating stain. Stained root-tips were mounted and flattened in a solution of orcein in 45% glacial acetic acid, to which a few drops of glycerine had been added.

In the wild species 17/57 \textit{X. jacquinii} Schott, a chromosome number of 78 was recorded, but in every other clone so far studied, the diploid chromosome number was found to be 26.

Chromosome numbers of the following clones have been established.

<table>
<thead>
<tr>
<th>Acc. No.</th>
<th>Local Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/57</td>
<td>'Grande Bay'</td>
</tr>
<tr>
<td>07/56</td>
<td>'Button'</td>
</tr>
<tr>
<td>05/56</td>
<td>'White Chaguanal'</td>
</tr>
<tr>
<td>04/56</td>
<td>'Red Chaguanal'</td>
</tr>
<tr>
<td>30/57</td>
<td>'Sans sans'</td>
</tr>
<tr>
<td>27/57</td>
<td>'Pink Bruce' Dominica</td>
</tr>
<tr>
<td>35/57</td>
<td>'Jamaica'</td>
</tr>
<tr>
<td>10/57</td>
<td>'Nut Eddoe'</td>
</tr>
<tr>
<td>17/56</td>
<td>'English'</td>
</tr>
<tr>
<td>13/56</td>
<td>'Chackelle'</td>
</tr>
<tr>
<td>17/57</td>
<td>'Palma yautia' (\textit{X. jacquinii} Schott).</td>
</tr>
<tr>
<td>22/57</td>
<td></td>
</tr>
<tr>
<td>15/56</td>
<td>'White'</td>
</tr>
<tr>
<td>16/56</td>
<td>'Chougrenade'</td>
</tr>
<tr>
<td>14/56</td>
<td>'Chobutton'</td>
</tr>
<tr>
<td>08/56</td>
<td>'Hammer' or 'Hamma'</td>
</tr>
<tr>
<td>09/56</td>
<td>'Dearies'</td>
</tr>
<tr>
<td>11/56</td>
<td>'Molkon'</td>
</tr>
<tr>
<td>10/57</td>
<td>'Mama's Enfant'</td>
</tr>
<tr>
<td>04/57</td>
<td>'Belembe yautia' (\textit{X. brasiliense} Desf.)</td>
</tr>
</tbody>
</table>
REMARKS ON NOMENCLATURE.

Confusion in nomenclature in the genus *Xanthosoma* is due mainly to synonymy and to inadequate species descriptions.

It is probable that different local names are often used for the same clone. It may be that some of the morphologically similar, but differently named clones described in this report are in fact identical. 12/56 'Charanelle', 14/56 'Choubutton' and 13/56 'Chackelle' are three morphologically very similar clones. It may be that when further information as to yield and quality of tubers is obtained these three accessions may prove to be identical and can then be grouped together as a single cultivar.

Hardicourt (11) describes 7 cultivated species of *Xanthosoma*, including *X. jacquinii* Schott and *X. brasiliense* Desf. These two with marked diagnostic characters, are easily identified. It is extremely difficult, confidently to identify, any of the clones so far collected with the five other species as described by Hardicourt. The five other species are *X. sagittifolium* (L) Schott., *X. caracu* C Koch and Bouché, *X. mafaffa* Schott., *X. violaceum* Schott., and *X. atrovirens* C. Koch and Bouché.

In the description given of *X. sagittifolium* (L) Schott tubers are not mentioned and the leaves and inflorescences are much smaller than those of clones observed in Trinidad. In addition the basal ribs are described as not bare at the sinus. If this is a diagnostic character, very few of the Trinidad clones can belong to *X. sagittifolium* (L) Schott.

The inflorescence colouration of 04/56 'Red Chaguanal' resembles that described for *X. mafaffa* Schott. Tuber characteristics are omitted from the description, so that no comparison can be made and the number of main lateral veins in 04/56, differs markedly from the number described for *X. mafaffa* Schott.
Tuber characteristics are omitted from the description of \textit{X. violaceum} Schott. Hardicourt reports that Engler connects varieties with pink, white and cream tubers, with the species. It is not possible with certainty to identify with \textit{X. atrovirens} C Koch and Bouché or with \textit{X. violaceum} Schott, any of the clones growing at I.C.T.A. 01/57 'Leadlow', with cream tubers and basal ribs not all naked, may belong to \textit{X. atrovirens}.

Several clones including 12/56 'Charanelle', 13/56 'Chackelle' 08/56 'Hamma', and 09/56 'Dearies', would seem to resemble in the main, the description given of \textit{X. caracu} C. Koch and Bouché. Leaf blades are larger than those recorded for \textit{X. caracu}, and inflorescences, which are recorded as unknown, do occur in Trinidad. Other important characters show similarity.

Young (19) does not use specific names for varieties, except where their correctness seems beyond reasonable doubt, and in fact mentions only \textit{X. caracu} C. Koch and Bouché and \textit{X. brasiliense} Engl. Other varieties are recorded under \textit{Xanthosoma sp.}

Reference (20) was made to original descriptions of three species, \textit{X. sagittifolium} (Schott) C. Koch, \textit{X. caracu} Koch and Bouché, and \textit{X. atrovirens} C. Koch and Bouché. Inflorescences and tubers are not mentioned in these descriptions, and differences between species are based on minor petiole and leaf characters.

It is clear that improved and complete descriptions of cultivated \textit{Xanthosoma} species, so that clones can be confidently and correctly identified with the species to which they belong, would greatly help towards lessening the confusion which at present exists.

**VARIETY TRIAL.**

7 promising clones have been put into a trial. They are 22/57 (from Barbados), 13/56 'Chackelle', 14/56 'Choubutton', 12/56 'Charanelle', 09/56 'Dearies', 11/56 Molkon' and 12/57
'Nut Eddoes'.

The first five of these have good tuber shape, are smooth skinned, and out yielded other clones in the observation and multiplication plots. 12/57 'Nut Eddoes', yielded fairly well and though having small tubers was thought worthy of trial. 11/56 'Molkon' is a pink fleshed variety and is early maturing. Several plants of 22/57 were damaged in the observation plots by the Tannier Beetle, *Ligyrus ebenus* De. G. The adult beetles bore into the bud, and occasionally damaged the growing point. It is not reasonable however to assume at this stage that 22/57 is more susceptible to beetle damage than any of the other clones.

Insufficient material was available to include further promising clones 05/56 'White Chaguanal', 08/56 'Hamma' and 17/56 'English'; these and others have been put into further observation and multiplication plots.

The trial is in randomised blocks, with split plots. There are 32 plants in a plot, half of these have originated from 'heads' as planting material and half from tubers. There are 4 replications of the 7 varieties. A plan of the experiment is shown in Fig. 5.

In addition to providing information on the yielding ability of the different varieties, the trial is designed to compare tubers with 'heads' as planting material, and will also provide tubers for cooking tests and a storage trial.
FIG. 5. SINGLE PLOT OF VARIETY TRIAL

T = tubers used as planting material. H = heads used as planting material.
Plants indicated with circled letters are plot plants, the rest are guard plants.

FIG. 6. GENERAL PLAN OF TRIAL.

KEY.

<table>
<thead>
<tr>
<th>Code</th>
<th>Acc. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>22/57</td>
</tr>
<tr>
<td>2</td>
<td>13/56</td>
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<td>12/57</td>
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<td>14/56</td>
</tr>
<tr>
<td>5</td>
<td>12/56</td>
</tr>
<tr>
<td>6</td>
<td>09/56</td>
</tr>
<tr>
<td>7</td>
<td>11/56</td>
</tr>
</tbody>
</table>
SUMMARY

The Botany of the tannier plant is described in detail, and a preliminary key to the morphologically different groups of clones is presented. Description of the different groups of clones distinguished in the key are given, and the source of the clone is noted. Short notes on some more recently collected clones are presented.

The chromosome number of 20 clones, including Xanthosoma brasiliense Engl. and X. jacquini Schott were determined, using the acetic orcein squash technique recommended by T.H. Tjio and Levan, for root-tips. It was established that all the clones have 26 chromosomes, with the exception of X. jacquini Schott, which has 78.

The confusion which at present exists in the nomenclature of the genus, is considered to be mainly due to synonymy and inadequate species descriptions, and evidence for this opinion is given.

A variety trial, primarily to provide information on the yield ability of 7 promising clones, but also designed to compare tubers with 'heads' as planting material has recently been started.
ACKNOWLEDGEMENTS

I would like to thank Mr. H.J. Gooding, who collected most of the clones described and has given help and advice throughout the period during which this work was done.

Thanks are also due to Mr. Richardson, who obtained translation from Latin of the original species descriptions, and to Mr. Tremar Mendez, who was responsible for taking and printing some of the photographs included in this report.
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