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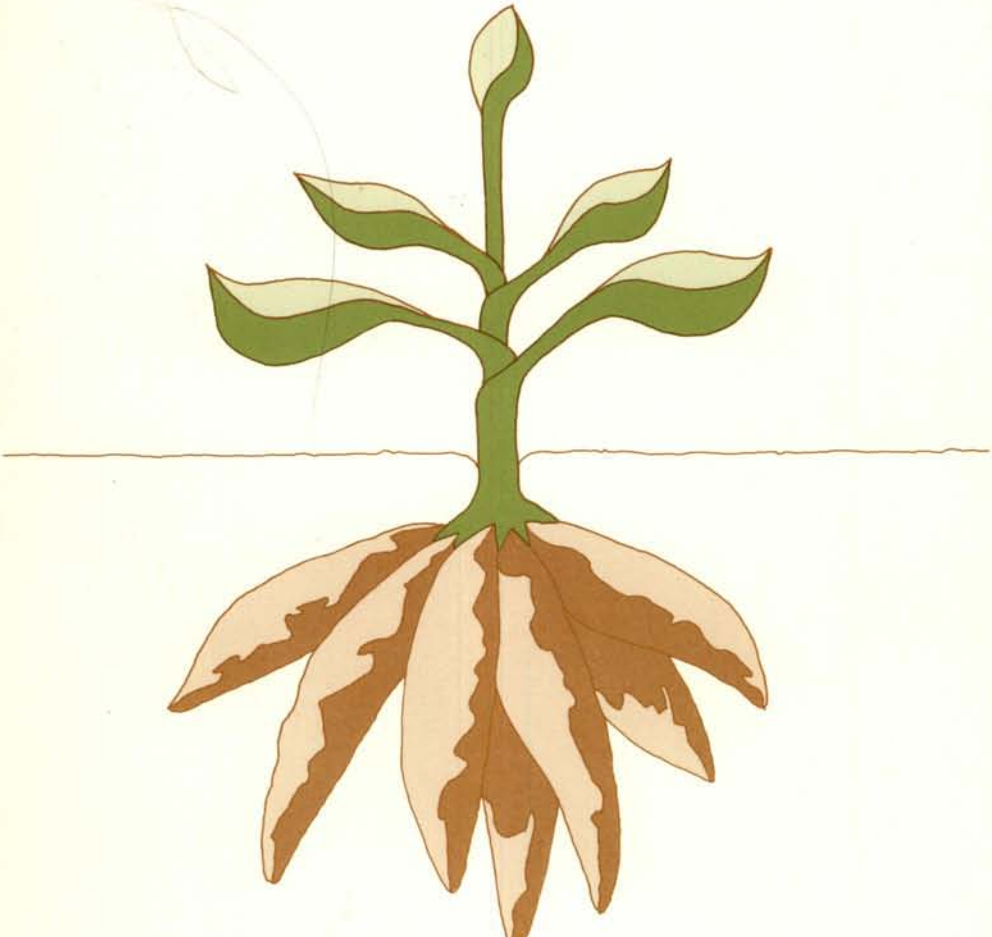
Held at CIAT, Cali, Colombia, 1-7 August 1976

Edited by James Cock, Reginald MacIntyre, and Michael Graham



The International Society for Tropical Root Crops in collaboration with
Centro Internacional de Agricultura Tropical
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Giant Swamp Taro, a Little-Known Asian-Pacific Food Crop

Donald L. Plucknett[1]

Cyrtosperma chamissonis (Schott) Merr., a member of the *Araceae* and probably native to Indonesia, has now spread eastward to become a minor crop in the Philippines, Papua New Guinea, and some Pacific Islands, but a major crop on coral atolls and low islands of the Pacific. A hydrophyte, and extremely hardy perennial, it grows in coastal marshes, natural swamps, and man-made swamp pits in conditions unsuitable for other staple crops. Yields vary, but 10–15 metric tons of the large edible corms per hectare per year have been produced. There is a great need to collect and evaluate cultivars now in use for salinity and flooding limits, short crop duration, superior food value and acceptance, and other factors, before they are lost through neglect.

Recently, interest in subsistence tropical food crops has increased. Root crops have benefited from this new emphasis on indigenous staple foods.

Some roots crops, however, are so poorly known or understood that they continue to be neglected. *Cyrtosperma chamissonis* (Schott) Merr., commonly called giant swamp taro, is such a crop. The only cultivated member (if *C. merkusii* is a separate species, then there are two cultivated species) of a pantropic genus of

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Araceae found in Africa, Asia, and America, *Cyrtosperma* is grown mostly in the Pacific Islands and in some parts of Indonesia, the Philippines, and Papua New Guinea. It is most important as a food crop in the atolls and islands of the Pacific, where intricate systems have been devised to grow it (Massal and Barrau 1956; Barrau 1961; Kay 1973). Because it is extremely hardy and can be grown in fresh or brackish water swamps, it fulfills a need to find crops suitable for suboptimal conditions on marginal lands (Plucknett 1970, 1975, 1976).

Despite its importance, little is known of *Cyrtosperma*, and probably only ethnobotanists, anthropologists, and a few local agriculturists have studied its management. This paper will summarize the state of knowledge about the crop as well as to suggest some research needs.

Early History

Cyrtosperma chamissonis probably originated in Indonesia, from where it spread eastward in prehistoric times to the Philippines, Papua New Guinea, and the islands of the South Pacific, to become a minor crop in Melanesia and Polynesia, but a major crop in Micronesia (Plucknett 1976). It is probably the most important staple food crop of the coral atolls. Although probably introduced to French Polynesia in the post-European discovery era (Barrau 1971), it is now grown in the following countries or islands: Indonesia, Philippines, northern coasts of Papua New Guinea, Solomon Islands, Fiji, Tahiti, Cook Islands, Tokelau Islands, Samoa, Palau Islands, Yap, Truk, Ponape, Marshall Islands, Caroline Islands, Gilbert Islands, and the Marquesas Islands (Brown 1931; Parham 1942; Massal and Barrau 1956; Barrau 1957, 1971).

Botany

A member of the Araceae, *Cyrtosperma* is classified as follows: Tribe *Lasiodeae*, and Sub-Tribe *Lasieae*. Like most edible aroids, the taxonomy of the species is confused; synonyms or incorrect names for *C. chamissonis* are: *C. merkusii* (Hassk.) Schott (this may be the correct name for the large Asian species, whereas *C. chamissonis* is thought to be the Pacific species; personal communication, Dr Dan Nicolson, Smithsonian Institution, Washington, D.C., USA), *C. edule* Schott, *C. nadeaudianum* Moore, *Apeveoa esculenta* Moerenhout, *Arisacontis chamissonis* Schott, and *Lasia merkusii* Hassk. (Barrau, 1957, 1959). It is often confused with *Alocasia*, and has sometimes even been confused with *Xanthosoma*.

Cyrtosperma chamissonis is a giant perennial herb (Fig. 1), ranging from 1 to 6 m (mostly 2 to 3 m) in height; the erect leaves, 6–8 at a time, are hastate-sagittate, with long acute basal lobes, dark green, and shiny; the petioles are thick, long, cylindrical, tapering toward the tip, often spiny near the lower parts, attached at the base in a spiral arrangement to the large corms; the spadix is purplish, tubular, covered with an open spathe which tapers near the tip; the flowers on the spadix are hermaphroditic; the fruit is a berry, and seeds are sometimes fertile; the main stem is a short, thick, branched, somewhat cylindrical corm resembling a banana rhizome that is large, ranging in size to as much as 1–2 m in length and 0.3–0.6 m in width, and in weight from 4 to as much as 100 kg or more; the cormels, which produce sucker shoots, arise from buds on the large central corm (Brown 1931; Barrau 1957; Massal and Barrau 1956; Pancho 1959).

The Crop Itself

Cultivars vary widely in size, leaf shape and size, spininess of petiole, time to maturity, and colour or colour patterns of various plant parts, including the flesh of corms.

Cyrtosperma is primarily a tropical plant, its limits as a crop being about 18°N (Mariana Islands) to 20°S (Cook Islands). Probably originally a plant of coastal swamps or lower elevation rain forests, it is grown mostly near sea level in coastal marshes, natural swamps, or man-made swamp pits. It requires abundant water, but can grow under moderate rainfall in deep swamps with partial shade (Sproat 1968). Under year-round high rainfall it may be grown as a rainfed crop to elevations of 150 m or so; however, it is in the low swamps that the crop is most important, for its relatives — *Colocasia*, *Xanthosoma*, and *Alocasia* — are more successful as rainfed upland crops.

Cyrtosperma can withstand flooded conditions unsuitable for other food crops and grows better under continuous flooding than most varieties of *Colocasia* or rice. Additionally, it tolerates brackish water, although it is not

Fig. 1. Farmers and a Cyrtosperma chamissonis plant on Yap Island in the Pacific; in the centre of the picture are setts or cuttings of Cyrtosperma (right) and Colocasia (left) which have been prepared for planting. The cylindrical corm, large petioles, and characteristic hastate-sagittate leaves of Cyrtosperma are clearly illustrated (Photograph courtesy of Edward De la Cruz).

certain just what its limits of tolerance to salinity are. Cultivars should be studied to determine their salinity tolerance.

On Malaita in the Solomon Islands *Cyrtosperma* is grown in coastal swamps just behind the fringing mangrove swamps (Barrau 1958). It is grown on some of the high islands of the Pacific, but it is on the low islands or coral atolls that the crop reaches its maximum importance, mostly because it is one of the rare food plants that can grow and yield under the difficult conditions prevailing there. Here the soils, if any, are shallow and consist mostly of sand or partially decomposed coral rock. To create a suitable environment, the people dig pits or trenches down through the coral to the freshwater lens. They haul in soil, sand, and compost — coconut leaves, refuse, green manures, animal manure, and other vegetative matter — to create a growing medium. Over the years these man-made pits develop a soil of sorts in which, when supplemented with further vegetative mulches, crop residues, and garbage, *Cyrtosperma* and *Colocasia* are grown. Such pits are found in the Mortlock Islands, the Gilbert Islands, the atolls of the Ponape District, Yap, Palau, Truk, and the southern Marshall Islands (Sproat 1968).

Sproat (1968) states: "Ideal growing conditions would be natural swampland rich in humus about two to four feet in depth with slow running irrigation water."

Planting

Cyrtosperma is propagated vegetatively, using setts (cuttings) and young cormel shoots (suckers) that are separated from the base of the mother plant. Setts (sometimes called stalks) are prepared from the tops of harvested plants; these consist of the upper 3–5 cm of the tip of the corm, plus the lower 0.3–0.5 m of the petioles (Fig. 1). In Ponape, the people consider that setts should not be cut from plants in which the base of the clustered petioles is less than 4 cm or so in diameter. Larger setts are considered stronger and more vigorous.

Cyrtosperma can be planted year-round, provided that satisfactory growing conditions prevail. Planting is done by hand, by inserting the setts or suckers into the soft mud of the swamps. Planting depth varies, but 10–15 cm is probably fairly standard.

For nonpuddled or firmer soils, planting holes or furrows may be prepared using a digging stick to prepare individual holes, or shovels or similar tools to prepare furrows. Furrows may be 15–25 cm to as much as 1 m deep. After emplacing the setts or suckers in the furrows, the furrows are partially filled with soil to the desired depth for the planting material used.

Spacing

Growing conditions and cultivar size greatly influence the plant spacings that are used. *Cyrtosperma* is a large plant, and it requires a fairly large area in which to grow. Also, because the crop may require from 2 to 6 years to mature, two or three crops of *Colocasia* are often intercropped with *Cyrtosperma* while the latter crop is growing.

Spacings vary; from 1.2 × 1.2 m (Palau); 0.4–0.6 × 1–1.3 m (Ponape district atolls); 1 × 1–1.1 m (Truk); 0.6 × 1 m (Ponape); to as close as 0.6 × 0.6 m in Yap where corm yields are highest and the crop is very important.

Plant Nutritional Requirements

Little is known of the nutritional needs of

Table 1. Relative nutritional value, per 100 grams of edible portion of corms, of *Colocasia esculenta* and *Cyrtosperma chamissonis* (Murai et al. 1958).

Nutritional factor	*Colocasia*	*Cyrtosperma*
Calories	153	131
Protein (g)	1	0.9
Carbohydrate (g)	37	31
Calcium (mg)	26	334
Phosphorus (mg)	51	56
Iron (mg)	1.0	1.2
Thiamine (mg)	0.092	0.045
Riboflavin (mg)	0.030	0.074
Niacin (mg)	0.85	0.88

Cyrtosperma, but it is known that the plant responds readily to composts and organic mulches. It is a large plant with a long crop duration, and its nutritional requirements may be high. This needs study.

Crop Duration

Long crop duration is one of the major limitations of the crop, which varies from 1 to 6 years or more in length, with 2 years being about the average harvest date for most South Pacific cultivars. However, shorter-term cultivars exist, and these should be exploited to the extent possible. For example, the island of Kusaie has 4 cultivars in which harvesting may begin as early as 6 to 12 months after planting.

Harvesting

Cyrtosperma is hand harvested. Corms vary greatly in size, from an average 2 kg in Truk and 4.5 kg in Yap, to as high as 20–50 kg or more for the longer-lived giant types. The largest corm recorded appears to be one in Ponape that weighed about 180 kg, and that required 12 men to lift the whole plant from a swamp (Ponape Agriculture Demonstration Station 1950).

Recorded yields in various areas are as follows: general, 10 metric tons/ha/year (Kay 1973); Truk, 15.9 metric tons/ha/crop (unspecified crop period); Yap, 120 metric tons/ha (four year average crop duration, close spacing). This equals 30 metric tons/ha/year; Palau, 42.5 metric tons/ha/crop (unspecified crop periods); and Micronesia, 13.4–16.8 metric tons/ha/year (Sproat 1968).

Pests and Diseases

Cyrtosperma is reputed to be practically free of insect and disease attack (Sproat 1968). It is certainly true that the crop receives little management attention in many places where it is grown, and that it is extremely hardy.

Food Uses

Cyrtosperma is grown mainly for its starchy corms, which are prepared much like *Colocasia.* Corms can be peeled and boiled in water, or peeled, chopped, and cooked with coconut milk. They also may be roasted or steamed. Sometimes corms are peeled, scalded, chopped, sun-dried, and stored for a few months (Massal and Barrau 1956; De la Cruz 1973). Recipes and food uses are given in Owen (1973), Sproat (1968), De la Cruz (1973), Murai et al. (1958), and Gesmundo (1932).

Leaves and young inflorescences are used as vegetables (Kay 1973). The petioles yield a fibre that can be used in weaving.

Food Quality

Colocasia and *Cyrtosperma* are about equal in carbohydrates and calories, although *Cyrtosperma* has about twice as much fiber as *Colocasia* (Murai et al. 1958). Table 1 contrasts the relative nutritional value of *Colocasia* and *Cyrtosperma.*

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A Review of Sexual Propagation for Yam Improvement

Sidki Sadik[1]

The development of methods to germinate seeds now make it possible to improve white yam (*Dioscorea rotundata*) through sexual propagation. Previous difficulties in seed germination resulted from the failure to recognize a 3–4 month dormancy period, and because many seeds lack well developed embryo and endosperm. At the end of dormancy, seeds germinate in 3 weeks. Since 1973, about 40 000 genotypes have been produced through sexual propagation. This provides a wide range of genetic diversity to improve yam by selection for desirable characteristics.

Genetic diversity in white yam (*Dioscorea rotundata*) has been narrow and hopelessly inadequate for plant improvement. This has resulted primarily from lack of hybridization, and continuous vegetative propagation. Yam breeders have long recognized this limitation and its adverse effect on yam improvement. As a result, all improvement efforts have been devoted to selection among the small number of existing cultivars. Attempts to improve the crop by selection, however, have proven futile,

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