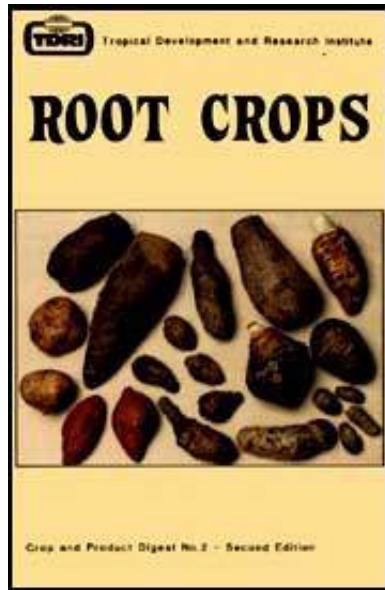


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 **Abbreviations**

 **African yam bean (*Sphenostylis stenocarpa*)**

 **Au (*Tropaeolum tuberosum*)**

 **Arracacha (*Arracacia xanthorrhiza*)**

 **Arrowhead (*Sagittaria sagittifolia*)**

 **Arrowroot (*Maranta***

arundinacea)



Cassava (*Manihot esculenta*)



Chavar (*Hitchenia caulina*)



**Chinese water chestnut
(*Eleocharis dulcis*)**



Chufa (*Cyperus esculentus*)



**East Indian arrowroot (*Tacca
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spp.*)**



**False yam (*Icacina
senegalensis*)**



**Giant taro (*Alocasia
macrorrhiza*)**



**Hausa potato (*Solenostemon
rotundifolius*)**



**Jerusalem artichoke
(Helianthus tuberosus)**



Kudzu (Pueraria lobata)



Lotus root (Nelumbo nucifera)



Maca (Lepidium meyenii)



Oca (Oxalis tuberosa)



Potato (Solanum tuberosum)



**Queensland arrowroot (Canna
indica)**



Radish (Raphanus sativus)



Shoti (Curcuma zedoario)



**Swamp taro (Cyrtosperma
chamissonis)**



**Sweet potato (Ipomaea
batatas)**



Tannia (Xanthosoma spp.)

Taro (Colocasia esculenta)



Topee tambo (Calathea allouia)



Ullucu (Ullucus tuberosus)



Winged bean (Psophocarpus tetragonolobus)



Yacn (Polymnia sonchifolia)



Yam (Dioscorea spp.)



Yam bean (Pachyrrhizus erosus)



Appendixes

African yam bean (Sphenostylis stenocarpa)

Common names

AFRICAN YAM BEAN, Wild yam bean.

Botanical name

**Sphenostylis stenocarpa (Hochst. Ex A. Rich.) Harms
syn. Sphenostylis ornata A. Chev.**

Family

Leguminosae, sub-family Papilionoideae.

Other names

Akitereku (W. Afr.); Diegemtenguere (Mali); Girigiri (W. Afr.); Haricot igname (Fr.); Kotonosu (W. Afr.); Kulege (W. Afr.); Norouko (Sud.); Okpu dudu (W. Afr.); Pempo (W. Afr.); Pomme deterre du Mossi (Fr.); Roya (Sud.); Sese (W. Afr.); Yam pea.

Botany

A vigorous, herbaceous, climbing vine, reaching 1.5-2 m in height, with trifoliolate leaves, the leaflets being up to 14 cm in length and 5 cm broad. The conspicuous flowers are mauvish-pink, purple or greenish-white in colour, about 2.5 cm in length and borne on stout axillary peduncles. The glabrous seed pods are linear, flat, with both margins raised, 25-30 cm long and 1-1.5 cm broad, containing 20-30 seeds which may be ellipsoid, rounded or truncated, and show considerable variation in size and colour; the largest are usually about 1 cm long and 0.7 cm wide. Seed colour may vary from creamy-white or brownish-yellow to dark brown, sometimes with black marbling, and there appear to be a number of 'types' according to seed colour. The plant produces small spindle-shaped tubers, about 5-7.5 cm long. There is some evidence that yields of seeds and tubers are inversely related.

Origin and distribution

The African yam bean originated in Ethiopia. Both wild and cultivated types now occur in tropical Africa as far south as Zimbabwe, throughout West Africa from Guinea to southern Nigeria, being especially common in the latter and in Togo and the Ivory Coast, and in East Africa from northern Ethiopia (Eritrea) to Mozambique, including Tanzania and Zanzibar.

Cultivation conditions

Small-scale cultivation is practiced throughout tropical Africa: the plant is especially suited to lowland conditions, though it can be grown up to 1800 m. Climates ranging from savannah to rainforest are tolerated provided there is a combination of adequate rainfall (100 cm or more during the growing season)

and reasonably good drainage. It is often planted along with yams and beans, using the same stakes as the yam for support, though sometimes left to trail on the ground. It is sometimes stated that plants perform better when interplanted than when grown alone.

Planting procedure

Material-both seeds and tubers can be used for propagation; planting is usually at the start of the rainy season.

Method-planting is done by hand, often two seeds to a hole (or one tuber).

Field spacing-varies considerably, often according to the crop with which they have been interplanted. One spacing quoted is 45 cm apart alternated with yam in 120 cm rows.

Pests and diseases

Fungal diseases reported are powdery mildew (due to *Oidium* sp.), which is parasitised by *Cincinnobolus cesati*; leaf spot (caused by *Phoma* sp.) and stem rust (caused by *Aecidium* sp.). Virus mosaics have also been reported. Pests have not been defined in detail but include Orthopterous and Lepidopterous insects. Leaf rolling caterpillars and leaf miners have been described as causing serious damage to the foliage, and thrips damage the flowers. Nematodes may attack the root system leading to reduction in yield.

Growth period

The tubers are ready for harvesting 5-10 months after planting.

Harvesting and handling

The crop is dug by hand usually towards the end of the dry season.

Primary product

Tubers-these are small and spindle-shaped, externally rather similar to sweet potatoes, usually about 5-7.5 cm long and weighing on average 50-150 g, although under favourable conditions they can weigh up to 300 g. The flesh is white and watery.

Yield

On a basis of 24 200 plants/ha, yield has been calculated at 1 452-2 904 kg/ha, depending upon variety. (Seed yield on the same basis ranged from 3 461-3 872 kg/ha.)

Main use

The tubers are cooked and eaten in the same manner as potatoes, which they resemble in flavour.

Secondary and waste products

The seeds also are eaten, but must be soaked in water for about 12 hours before being cooked. They are said to cause giddiness if eaten in excess, but to cure drunkenness when mixed with water.

Special features

Tubers-the tubers are rich in starch and protein. Dry matter is approximately 35 per cent, of which starch is about 80 per cent and protein about 14 per cent, ranging from 12.5 to 19 per cent for six varieties; however, some analyses have indicated that the non-protein

nitrogen can be 50 per cent of the crude protein nitrogen.

Seeds-analytical figures for the seeds showed dry matter about 90.5 per cent; the dry matter composition was: protein 24-28 per cent; fat 1.5-2 per cent; total carbohydrate 74.1 per cent; fibre 5.2-5.7 per cent; ash 2.8-3.2 per cent; calcium 61 mg/100 g; phosphorus 437 mg/100 g. The amino acid content of the protein was very similar to that of soya bean, though rather higher in histidine and iso-leucine. The energy content of the seeds per 100 g dry matter was 1,640 kJ.

The plants have beautiful flowers and are grown as ornamentals in European and other countries.

Major influences

The tubers of African yam bean are regarded as an important source of starch and protein in tropical Africa, and the plant is potentially important also as a food legume. It appears likely to remain a valuable constituent of African peasant agriculture.

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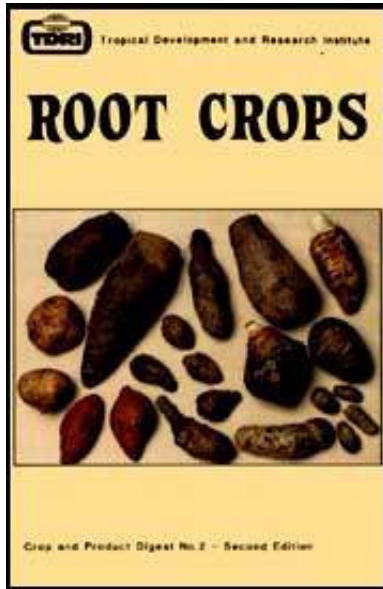
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Abbreviations



African yam bean (*Sphenostylis stenocarpa*)




Au (*Tropaeolum tuberosum*)



Arracacha (*Arracacia xanthorrhiza*)



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-  **Arrowroot (*Maranta arundinacea*)**
-  **Cassava (*Manihot esculenta*)**
-  **Chavar (*Hitchenia caulina*)**
-  **Chinese water chestnut (*Eleocharis dulcis*)**
-  **Chufa (*Cyperus esculentus*)**
-  **East Indian arrowroot (*Tacca leontopetaloides*)**
-  **Elephant yam (*Amorphophallus* spp.)**
-  **False yam (*Icacina senegalensis*)**
-  **Giant taro (*Alocasia macrorrhiza*)**



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Maca (*Lepidium meyenii*)



Oca (*Oxalis tuberosa*)



Potato (*Solanum tuberosum*)



Queensland arrowroot (*Canna indica*)



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Shoti (*Curcuma zedoario*)



Swamp taro (*Cyrtosperma chamissonis*)



Sweet potato (*Ipomoea*)

-  **batatas)**
Tannia (Xanthosoma spp.)
-  **Taro (Colocasia esculenta)**
-  **Topee tambo (Calathea allouia)**
-  **Ullucu (Ullucus tuberosus)**
-  **Winged bean (Psophocarpus tetragonolobus)**
-  **Yacn (Polymnia sonchifolia)**
-  **Yam (Dioscorea spp.)**
-  **Yam bean (Pachyrrhizus erosus)**
-  **Appendixes**

Au (Tropaeolum tuberosum)

Common name

AU.

Botanical name

Tropaeolum tuberosum Ruiz and Pav.

Family

Tropaeolaceae.

Other names

Cubio (Col.); Isao, Isau (Bol., Peru, Arg.); Mashua (Peru, Bol.); Navis, Navo (Col.); Ysao (S. Am.).

Botany

A herbaceous climber, resembling the garden nasturtium to which it is closely related, although it is

more compact and has smaller flowers. The stems are green or reddish-green and the leaves show a considerable variation in form, but are normally 5-20 cm long, peltate, with 3-5 lobes.

The flowers have long peduncles 10-19 cm long; the red calyx forms a spur, sometimes two, and there is considerable variation in the size and shape of the orange petals. The tubers are conical or ellipsoid in shape, generally deeply furrowed, each furrow containing a bud. Over 100 clones are recognised and some authorities consider that two separate species should be recognised: Colombian species, characterised by long deeply furrowed white tubers or white with pink extremes, and numerous rootless; and Peruvian/Bolivian species, with yellow tubers, often with dots and lines on them and without rootless. Chemical examination and cytological evidence have both suggested that there are two distinct types and

subspecies status has been suggested, namely *T. tuberosum* ssp. *tuberosum* and *T. tuberosum* ssp. *silvestre*.

Origin and distribution

The au is native to the high Andes of South America and is confined to this area where it is cultivated in the Andean valleys of Peru and Bolivia.

Cultivation conditions

This crop requires cool and moist conditions and is tolerant of frost; it is normally grown at altitudes of 3 000 m or above, frequently in rotation with ullucu. It is considered to require approximately 12 hours day-length for successful growth.

Planting procedure

Material-au is propagated vegetatively from tubers. Method-au is usually cultivated in small plots on terraces on hillsides; for good yields it must be kept free from weeds and earthed up. Field spacing-planting is usually in rows 70-100 cm apart with 40-70 cm between the plants.

Growth period

The tubers reach maturity in approximately 7 months.

Harvesting and handling

The tubers are dug by hand and are reported to keep better in the fresh state than the other Andean tuber crops, oca and ullucu, with a storage life at ambient temperatures of up to 6 months.

Primary product

Tubers-au produces small conical or ellipsoidal tubers approximately 5-15 cm long and 3-6 cm wide, with a wide range of colouring which can vary from dirty-white or yellow to red or purple. In the fresh state they have a disagreeable odour.

Yield

Yields are reported to lie between 20 and 30 t/ha.

Main use

Au tubers are eaten boiled as a vegetable and are said to resemble turnips. In some communities at high altitudes in the Andes, where potatoes and other tubers cannot be grown, au is the staple foodstuff.

Subsidiary uses

It has been suggested that au could be grown for use as a feedingstuff for pigs. In some areas the tubers are valued for their medicinal properties and are used in the treatment of kidney and liver diseases, sores on the skin, and head lice. Traditionally, they are regarded as having anti-aphrodisiacal properties. Planting among other crops is reported to bring protection against nematodes.

Special features

Published figures give the composition of the edible portion of the tubers as: energy 218 kJ/100 g; water 86 per cent; protein 1.6 per cent; fat 0.6 per cent; carbohydrate 11 per cent; fibre 0.8 per cent; ash 7 per cent; calcium 7 mg/100 g; iron 1.2 mg/100 g; phosphorus 42 mg/100 g; vitamin A 0.015 mg/100 g; thiamine 0.06 mg/100 g; riboflavin 0.08 mg/100 g;

niacin 0.6 mg/100 g; ascorbic acid 67 mg/100 g. The exceptionally high ascorbic acid content is noteworthy.

The plant contains isothiocyanates and thiourea; differences in composition correspond with the cultivated form and wild form and a division into two subspecies, *Tropaeolum tuberosum* ssp. *tuberosum* and *T. tuberosum* ssp. *silvestre*, has been proposed.

The traditional medicinal uses have been examined:

(i) Effect on reproduction: no effect was found on the male capability of impregnating females, though animals fed extracts of the plant showed a 45 per cent drop of testosterone/dihydrotestosterone in their blood; a similar effect in man would be expected to reduce libido.

(ii) Antibiotic activity: both subspecies contain p-

methoxybenzyl glucosinolate, and both show strong antibiotic activity against *Candida albicans*, *Escherichia coli* and *Staphylococcus albus*.

(iii) Kidney diseases: isothiocyanates are diuretic.

(iv) Nematicidal effect: this has been demonstrated and is believed to be due to isothiocyanates.

(v) Head lice: similarly, it is believed that isothiocyanates are effective against head lice.

Production and trade

Little information has been recorded; Peru is stated to have approximately 4 000 ha under cultivation.

Major considerations Au is reported to be grown rather less than formerly, but continues to be an important

crop, especially for remote Indian communities where its medicinal value and food value both find favour. A germplasm collection is being made, to be maintained at Cusco and Puna in Peru.

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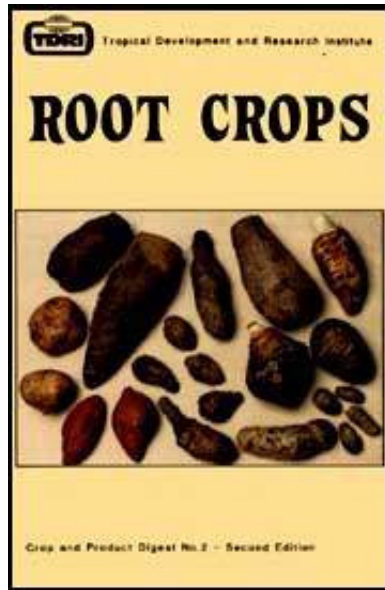
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-  **Appendixes**

Arracacha (*Arracacia xanthorrhiza*)

Common names

ARRACACHA, Peruvian carrot, Peruvian parsnip.

Botanical name

***Arracacia xanthorrhiza* Bancroft syn. *A. esculenta* DC.**

Family

Umbelliferae.

Other names

Apio (criollo) (Venez., P. Rico); Arrecate (Lat. Am.); Batata baroa, Mandioquinha salsa (Braz.); Pomme de terre cleri (Fr.); Racacha, Virrac (Peru); Zanhoria blanca (Ecu.).

Botany

A stout semi-caulescent herb, somewhat resembling celery but one of the largest of the cultivated umbellifers. Its coarse stems and leaves usually attain a height of 0.6-1.2 m, and the leaves are dark green or purple. The flowers are small, typical of the family, and usually purplish or yellow, but seldom seen because the crop is harvested before flowering. The subterranean portion of the plant is a compound structure consisting of a large, more or less cylindrical rootstock, indistinctly

marked with a number of horizontal nodose rings, and with a coarse central core: from this root stock 6-10 irregularly spindle-shaped secondary tubers arise as off-shoots.

These are smooth skinned and resemble parsnips in texture, colour and odour. The crown of the rootstock gives rise to a number of shoots which arise from enveloping sheaths to form the stems and leaves. Three main varieties are recognised depending upon the colour of the flesh of the roots-white, yellow or purple-but several cultivars have been developed.

Origin and distribution

Arracacha originated in the Andes in Peru, Ecuador and Colombia but cultivation has now spread to Venezuela, parts of Brazil, Puerto Rico, Mexico and to parts of

Africa.

Cultivation conditions

Temperature-for optimum results an equable temperature of 15-20°C throughout the year is required. In Colombia, for example, high yields are obtained in the Andes, where the annual mean temperature is 16°C; in savanna areas where the mean temperature is slightly lower, about 14°C, the vegetative cycle is lengthened. Some varieties are sensitive to frost and are grown only at the lower altitudes but those adapted to the higher altitudes are resistant to occasional light frost.

Rainfall-arracacha requires a moderate, evenly-distributed rainfall of at least 60 cm but preferably 100 cm, and if the natural rainfall is insufficient it should be supplemented by irrigation.

Soil-deep, fertile, well-drained sandy soils with a pH of about 5-5.5 are ideal, and the application of a 12:24:12 or 10:30:10 complete (NPK) fertiliser at the rate of 500-600 kg/ha has been recommended. The application of phosphorus has been found to increase yields considerably, while heavy applications of nitrogen have an adverse effect.

Altitude-arracacha yields a crop at elevations above about 600 m in the northern Andes: in Colombia it grows best at elevations between 1 800 and 2 600 m; in Brazil it is successfully grown in the state of Sao Paulo at altitudes of 1 000-1 200 m.

Day-length-there is some evidence that arracacha requires short day-lengths in order to produce economic yields.

Planting procedure

Material-although it is possible to obtain fertile seed with a good rate of germination, arracacha is traditionally propagated vegetatively by the use of offsets or shoots produced on the crown of the main rootstock. Only the basal portion of the shoot actually possessing a bud with leaves is used; this is cut to a piece 2-3 cm in length and the leaves are cut off to 10-20 cm above their points of attachment to the stem. After the offset is detached from the rootstock, the basal end is cut several times to stimulate sprouting of the shoot, and to ensure that secondary roots begin to form and are well-distributed laterally on the primary rootstock. After the offsets are cut they are left to dry for 2-3 days before planting. It is important to use only material from virus-free stock.

Method-arracacha is cultivated in a manner similar to potatoes, with which it is often interplanted. Although it may be grown throughout the year, the main crop is usually planted at the beginning of the rains in April and September. The normal procedure is for the offsets to be put in holes along furrows, with fertiliser placed in each hole before planting. Often the offset is positioned in such a way that the basal portion is covered and the shoot is left slightly above the soil level, but in some parts of the Andes the traditional method is to cover the offsets completely to a depth of 2-3 times their own length. After planting, the rows are mulched with trash and kept earthed up and free from weeds. Subsequent hand-weeding is usually carried out 2 months after planting and again after 5 months, but in Colombia the use of the herbicide linuron at the rate of 0.75 kg/ha has been found to give excellent control over broad-leaved weeds if applied 40-50 days after planting.

Field spacing-the furrows are normally about 1 m apart with 50-60 cm between the plants.

Seed rate-approximately 16 700-20 000 offsets are required to plant one hectare.

Pests and diseases

Among the pests reported to attack arracacha are the flea beetles *Epitrix* spp. and *Systema s-littera*, the swallow-tail butterfly *Papilio polyxenes* and the moths *Automeris* spp., whose larvae feed on the foliage, the leafhopper *Erythrogonia quadriguttata*, the tree-hopper *Amastris simillima*, the mole cricket *Tridaclylus minutus*, the scarab beetle *Ancognatha scarabeoides*, spider mites *Tetranychus* spp., nematodes, in particular *Pratylenchus penetrans* which may cause necrosis of the whole plant, and slugs.

Diseases include those caused by *Cercospora* spp., *Cercosporidium depressum*, *Septoria apii*, and *Gloeosporium* sp. The last is the most serious, though control can be effected by copper-based fungicides or thiabendazole. A bacterial necrosis, first appearing as yellow leaves and stunted growth, is caused by *Erwinia amylovora*. The disease is transmitted by infected buds of diseased plants used in planting, or the organism may penetrate from the soil into the root system. Two viruses-arracacha virus A and arracacha virus B-have been identified as causing yellow mosaic symptoms and poor growth. Neither appears to be transmitted by vector and spread is apparently by infected planting material. A strain of virus B has been found in oca (*Oxalis tuberosa*). The only known control measure for the bacterial and virus infections is avoidance of infected planting material. The symptoms are easily recognised in the growing crop and therefore rogueing

can greatly minimise this danger.

Growth period

The secondary tubers usually mature in about 10-14 months after planting; sometimes an early harvest of immature roots is taken after 4-8 months.

Harvesting and handling

The crop is judged to be mature when the leaves begin to yellow and production of new shoots ceases. Some growers accelerate the onset of maturity by breaking the petioles, often by twisting or doubling them over. Harvesting is usually accomplished by digging up the whole plant, detaching the offsets for the next crop, and collecting the tubers and main rootstocks. Harvesting cannot be delayed, because if the roots are left in the

ground they become fibrous and tough, and develop a strong unpleasant flavour. After harvesting, the tubers have a very short storage life, and in Colombia were considered unmarketable after 3-4 days at 25°C and 40 per cent RH. However, after storage at 10°C and 90 per cent RH, or at 3°C and unspecified humidity for about 1 month, the roots maintained good condition. Irradiation with doses of 10-11 head has also been found to extend the storage life. Deterioration of the tubers is due mainly to fungal and bacterial rots and desiccation, and it has been shown that wrapping of individual tubers in plastic cling or shrink film of low moisture penetrability within 24 hours after harvest extended shelf-life to 7 days or more at 17-20°C and 68-70 per cent RH, and was economically advantageous for tubers that were to be marketed.

Primary product

Tubers-the edible secondary tubers are the primary product and under good cultural conditions each plant can produce 6-10 tubers, weighing 2-3 kg. These tubers have a delicate flavour and a crisp texture, and the flesh may be white, creamy-yellow or purple, depending upon the cultivar; in many areas the yellow tubers are preferred.

Yield

Yields range from about 3 to 18 t/ha, depending mainly upon growing conditions, and in Colombia the best yields are obtained at altitudes of over 2 000 m in the northern Andes.

Main use

The secondary tubers are used as a source of

carbohydrate, boiled, fried or as a constituent of stews, eg along with cassava in the Colombian sancocho. They are regarded in Venezuela as especially important for children because of their easy digestibility.

Subsidiary uses

The tubers and main rootstock can be used as a source of an easily digestible starch, suitable for the preparation of invalid and baby foods.

Secondary and waste products

The coarse main rootstocks and mature leaves are used for livestock feeding; they have a higher protein content than alfalfa. In certain Andean communities the tubers are used in traditional medicine. The young blanched stems are utilised as a salad ingredient or as a

vegetable.

Special features

Analyses of the edible portion of Colombian tubers (the lateral swollen roots) have been published as: water 71.9-73 per cent; protein 0.8-1.1 per cent; fat 0.1-0.2 per cent; carbohydrate 24.9 per cent; fibre 0.6-0.8 per cent; ash 1.6 per cent; calcium 24 mg/100 g; iron 0.7 mg/100 g; phosphorus 65 mg/100 g; vitamin A 20-60 IU/100 g (in yellow cultivars); thiamine 0.04-0.06 mg/100 g; riboflavin 0.03-0.04 mg/100 g; niacin 2.7-3.4 mg/100 g; ascorbic acid 15-28 mg/100 g.

The starch, which is similar in many respects to that of cassava, is easily digestible and is also suitable for laundry use. The grains are usually spherical or ovoid, ranging from 5 to 27 microns, averaging 14 microns.

Production and trade

Little statistical information is available although production was reported to be increasing in Colombia: average 1960-64, 111 000 t/a; average 1965-67, 123 000 t/a. For 1977 no figures of total production were available but 123 000 t was stated to have reached the markets.

Major influences

Arracacha has been an important staple carbohydrate foodstuff in parts of South America for at least 300 years and today forms an important and popular item of diet, particularly amongst children, but because of its short shelf-life it has been relatively high-priced. However, recent work appears to have demonstrated that the shelf-life can be extended. It is expected to

prove a valuable root crop if introduced into other high altitude areas of the tropics, and a considerable amount of research is currently being undertaken, in particular on the development of new cultivars and in breeding: a germplasm bank has been established at Campinas in Argentina.

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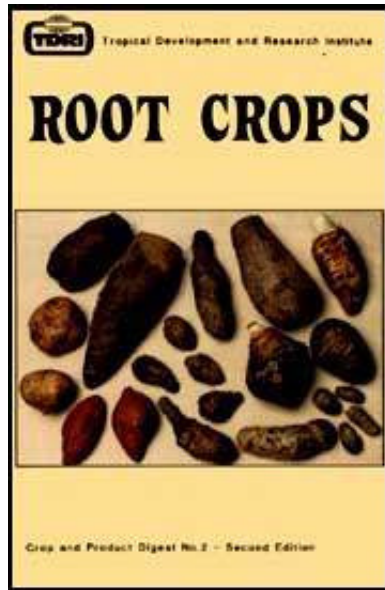
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Root Crops (NRI, 1987, 308 p.)



Root Crops (NRI, 1987, 308 p.)



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Acknowledgments



Preface



Introduction



Abbreviations



African yam bean (*Sphenostylis stenocarpa*)



Au (*Tropaeolum tuberosum*)



Arracacha (*Arracacia xanthorrhiza*)



Arrowhead (*Sagittaria sagittifolia*)



Arrowroot (*Maranta arundinacea*)



**Cassava (*Manihot esculenta*)
Chavar (*Hitchenia caulina*)**



**Chinese water chestnut
(*Eleocharis dulcis*)**



Chufa (*Cyperus esculentus*)



**East Indian arrowroot (*Tacca
leontopetaloides*)**



**Elephant yam (*Amorphophallus
spp.*)**



**False yam (*Icacina
senegalensis*)**




**Giant taro (*Alocasia
macrorrhiza*)**




**Hausa potato (*Solenostemon
rotundifolius*)**



Jerusalem artichoke

 **(Helianthus tuberosus)
Kudzu (Pueraria lobata)**

 **Lotus root (Nelumbo nucifera)**

 **Maca (Lepidium meyenii)**


 **Oca (Oxalis tuberosa)**

 **Potato (Solanum tuberosum)**

 **Queensland arrowroot (Canna
indica)**








 **Radish (Raphanus sativus)**



 **Shoti (Curcuma zedoario)**

 **Swamp taro (Cyrtosperma
chamissonis)**

 **Sweet potato (Ipomaea
batatas)**



-  **Fannia (Xanthosoma spp.)**
-  **Taro (Colocasia esculenta)**
-  **Topee tambo (Calathea allouia)**
-  **Ullucu (Ullucus tuberosus)**
-  **Winged bean (Psophocarpus tetragonolobus)**
-  **Yacn (Polymnia sonchifolia)**
-  **Yam (Dioscorea spp.)**

-  **Yam bean (Pachyrrhizus erosus)**
-  **Appendixes**

Arrowhead (Sagittaria sagittifolia)

Common name

ARROWHEAD.

Botanical name

Sagittaria sagittifolia L.

Family

Aponogetonaceae.

Other names

Beea beea (Mal.); Chee-koo (China); Chotakut (Ind.); Duck potato, Echant (Ger.); Flche d'eau, Flchire (Fr.); Guai-guai (Philipp.); Kuwai (Japan); Muy-muy (Ind.); Pfeilkraut (Ger.); Pijkruid (Nether.); Sagittaire (Fr.); Swamp or Swan potato, T'zu ku (China).

Botany

A perennial robust, aquatic plant, from 0.6 to 1.2 m tall,

with smooth, broad sagittate leaves, raised above the water level, as is the erect inflorescence, which is long-peduncled, glabrous, racemose, simple or branched. The flowers are whorled, usually white, sometimes with a purple spotted base. The carpels are flat and crowded into a globular head. Each plant produces 4-6 small subterranean tuberous rhizomes at the base of the erect stem.

Origin and distribution

The arrowhead is believed to be a native of the more temperate parts of China but has now spread to tropical and subtropical parts of Asia. A closely related species, *S. latifolia* Willd., is native to North America, and there may be some confusion between the species in the literature. Arrowhead is an aquatic plant and is found growing wild or in a semi-wild state in the marshes and

akes of China, Japan, India, Malaysia, the Philippines and certain islands in the Pacific.

Cultivation conditions

The plant will thrive in wet or marshy places in a range of climates from tropical to warm temperate. Where cultivation is undertaken it is often similar to that used for rice.

Planting procedure

Material-propagation is vegetative using pieces of corm with an axilliary bud.

Method-arrowhead is easily established. In some countries the field preparation is similar to that used for rice or lowland tarot This involves ploughing, discing and harrowing to level the surface and providing a well-

puddled soil suitable for flooding, into which the pieces of corm are set by hand at a depth of about 20 cm.

Growth period

The corms mature in about 6-7 months.

Harvesting and handling

The corms are dug by hand.

Primary product

Corms-the starchy corms are hard, with a globular base and an acute apex, approximately 5 cm in diameter, covered with whitish or bluish-white scales, which quickly wither to expose creamy-white or buff flesh, which exudes a milky juice when cut. Each corm weighs about 15-30 g.

Main use

The corms are used as a starchy vegetable after boiling and are a constituent of several Japanese and Chinese meat dishes. In the USA they were formerly much used by Indians, but apparently are now seldom employed as human food in that country, except by some ethnic minorities.

Subsidiary uses

The tubers are sometimes employed as a source of starch in China, or for pig-feed. The plant has also been used medicinally for skin diseases and in childbirth.

Secondary and waste products

The young leaves are sometimes eaten as a green vegetable and are also used for medicinal purposes in

China.

Special features

The composition of the edible portion of the corms has been published as: energy 448 kJ/100 g; water 70.6 per cent; protein 5 per cent; fat 0.3 per cent; carbohydrate 22.4 per cent; fibre 0.9 per cent; calcium 13 mg/100 g; iron 2.6 mg/100 g; phosphorus 165 mg/100 g; potassium 729 mg/100 g; thiamine 0.16 mg/100 g; riboflavin 0.04 mg/100 g; niacin 1.4 mg/100 g; ascorbic acid 5 mg/100 g.

The carbohydrate consists mainly of starch with about 2 per cent of sucrose. The starch grains are large, round, oval or rounded-angular, with a diameter of up to 30-36 microns. An anti-inflammatory principle, sagittariol, occurs in the plant.

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