Colocasia esculenta (taro, yam, keladi) as a small farm crop in the Kinta Valley of Malaysia

Colocasia esculenta is one of the iconic farm products of the Kinta Valley.

By P.S. Tong

A field of the 'white' variety grown in Kampar on tin-mine tailings.

Colocasia esculenta, commonly known in the literature as taro or cocoyam, is a herbaceous plant that grows to a height of one to two meters. In Malaysia it is usually called 'yam' or 'keladi'. In this article, we refer to it as 'taro' following the practice in PROSEA, or simply as 'yam', but readers should be aware that there are other native yams in tropical Asia (including Malaysia) such as those in the genus *Dioscorea*.

The taro plant consists of a central swollen starchy underground stem known as a corm or tuber, developed just below the soil surface, bearing at its apex a rosette of large heart-shaped leaves. Slender fibrous roots arise from the sides of the corm. The leaves are borne on succulent erect leaf stalks or petioles. There are hundreds of varieties world-wide.

The taro rarely flowers, and is mostly propagated by baby corms (cormels), suckers, or stolons arising from lateral buds at the sides of the central corm. The leafy top of the central corm can also be used in propagation.

Taro is cultivated all over the tropics and subtropics. It is wild or semi-wild in a wide region that extends from eastern India through

'White' yams in the Malim Nawer market.

the whole of Southeast Asia, to New Guinea, hence this large region is accepted as the ancestral home of the species.

There is a report of taro in archeological sites in New Guinea that date back to 10,000 years ago and this has been used as evidence that agriculture began in New Guinea over 10,000 years ago, but since taro is one of the edible root crops that hunter-gatherer societies collect from the wild, its presence in archeological sites in areas where it is known to grow wild, cannot be proof of cultivation.

Taro is referred to in AD 304 in Chi Han's account of *Dioscorea* in his book on plants of what is now North Vietnam and southern China. The Polynesians, who colonized Samoa over 2000 years ago, took the taro to all parts of Polynesia, including Hawaii and New Zealand. In the West, taro was already cultivated in Egypt over 2000 years ago and the corms were consumed in ancient Rome, according to the Roman writer Pliny (AD 23 - 79). The scientific name *Colocasia* is derived from its ancient Egyptian name of 'kulkas'. The taro was taken to America after Columbus, by the Spanish.

All parts of the plant contain tiny sharp calcium oxalate crystals that can severely irritate the skin, especially the sensitive membranes lining the mouth, lips and throat. During food preparation, the skin of the hands may also experience irritation. The crystals are formed in bundles with their sharp points facing outwards and are released when the cells walls are broken. With prolonged cooking, the cell walls are softened and the bundles of crystals are broken up, making

'Pink' yams in the Malim Nawar market.

the plant parts edible. The crystal-bearing cells are concentrated in the skin and outer layers of the plant, so removal of the skin and outer layers also helps to reduce acridity. In cultivation, the problem has been eliminated by selection and propagation of non-acrid types.

Two types of taro are recognized according to differences in corm development. In the 'dasheen' types the corm develops as a single central large structure. In the 'eddoe' types the central corm is relatively small and many cormels are developed laterally. Pursglove has applied the botanical varietal name *C. esculenta* var. *esculenta* to dasheen and *C. esculenta* var. *antiquorum* to eddoe but this application has been generally ignored because the botanical nomenclature for varieties is inapplicable to plants like taro that are propagated clonally.

In general, eddoes are hardier than dasheens and can be grown with less rainfall and in colder climates. Perhaps because of its ability to grow in colder climates, Purseglove has suggested that eddoes originated in China and Japan through selection under cultivation. The origin of the word 'eddoe' is not known. The word 'dasheen' is derived from the Portuguese 'da China' meaning 'from China'.

Taro in Malaysia

In Burkill's time (1920s and 1930s) taro in the Malay Peninsula was of minor importance. He described the taro and its various varieties or 'races' as follows: "As regards races, some produce no side tubers, others produce many. The shape of the main tuber, the shape of the side tubers, when present, including the length of their stalks, the colour of the skin and flesh, and

the palatability are the chief racial characters, but other characters are to be found in the shape of the leaf blades, their size and colour, and the colour of the petioles. No complete account exists of the races in Malaya, where the irritant properties of the local 'keladi' are proverbial. In fact, Malays grow it little. The Chinese domiciled in Malaya grow it more; but there are primitive tribes in Pahang who plant it and nothing else; their cultivation, however, is very restricted. The Chinese are often relatively indifferent to the value of the race which they adopt, because they use it mostly for feeding pigs. The tubers are full of starch."

"There are different names for the different races of the plant in countries where they are much eaten. Among the Malays, a name such as 'keladi telur' indicates a race with egg-shaped tubers which are eaten boiled; 'keladi udang', one with pink flesh; 'keladi china', that commonly found in ditches, which the Chinese feed to pigs, and consequently called 'keladi babi'; 'keladi hitam', one with dark foliage." [Editor's note: telor=egg, udang=prawn, babi=pig, hitam=black.]

The value placed on taro by the Malaysian Chinese has changed dramatically since Burkill's time. Malaysian Chinese cuisine now includes many favorite dishes made with the starchy corms. One favorite is made by steaming slices of taro inter-layered with slices of fatty pork. There is a sweet desert made by boiling small cubes of taro with sweet potato and served with coconut milk. Among the many delicacies in dim sim cuisine is a fried yam dumpling made with mashed taro and a savoury filling.

A small yam, weighing 800 gm, of the 'pink fragrant' variety.

In contrast, Malay consumers favor the petioles, used in a range of vegetable dishes. The cultivars consumed as vegetables are collectively known as *keladi sayur* (vegetable taro); these bear small corms that are cooked together with the petioles.

Farm production of taro in the Kinta Valley

This story is about the production of taro for their corms by farmers in the Kinta valley, based on interviews with farmers. The Kinta Valley used to be one of the largest producers of alluvial tin in the world. The largest city is Ipoh, which is also the capital of the state of Perak. The Kinta valley is densely dotted with small towns like Kampar and Malim Nawar and many villages or kampongs. The mining industry went through many cycles of high and low demand and collapsed finally in the 1980s. The mining community, almost entirely ethnically Chinese, had taken up farming as an alternative source of

income since the late 1800s and had learnt, by trial and error, how to grow crops on the sand and silt left behind after the allivial tin has been extracted. Their efforts have resulted in a rich legacy of local agricultural innovation waiting to be documented.

The corms that are grown are non-acrid dasheen types of which several cultivars are recognized. It is not known where they originally came from. Non-acrid types were not known to Burkill in the 1930s and were uncommon even in the 1950s. Farmer-selection for non-acrid types may have begun after the 1950s. Several varieties are grown in the Kinta Valley. White and pink fleshed cultivars are recognized and great value is attached to those with a strong taro flavor. The pink-fleshed variety is said to taste better than the white fleshed variety. The crop thrives in moist places where flooding and waterlogging may occur. Dry conditions tend to reduce growth and result in dumb-bell shaped corms. The crop requires full intensity sunlight.

To start a yam farm, propagules have to be obtained. The preferred propagules are suckers (plantlets) that arise naturally from the sides of the corms. Suckers are obtained at a cost of RM0.20 or RM0.30 each (1 USD is roughly RM4.00.) Mother plants start producing suckers at around the fourth or fifth month when corm formation begins or in the second month in case of the pink-fleshed variety. Throughout the planting cycle, suckers need to be removed at timely intervals to avoid nutrient competition with the mother plants and corms. Potential yam farmers have to source for suckers from existing yam farmers by giving two weeks' notice in advance, so that existing yam farmers will save the suckers for them. The suckers that are sold are one foot tall, preferably with thick petioles. Sucker quality is determined by the thickness of its petioles—the thicker the petiole, the better is the quality of sucker.

Suckers need to be planted within a week after separation from the mother plants preferably by the third day. When there is no demand for suckers as planting material, yam farmers still need to get rid of suckers. For about seven months in the crop cycle, farmers need to remove suckers three or four times.

Taro can be grown on flat land. Some farmers plant taro on raised beds but it is not necessary for the beds to be raised. The reason for the raised beds is that such beds were previously planted with other vegetable crops such as okra and chili. After harvesting the vegetables, the raised beds are used to plant taro. Plastic sheets used to cover soil beds during vegetable planting may be left untouched when taro is planted. The left-behind features, especially plastic sheets, come with an advantage of providing weed control.

Farmers can plant 10,000 plants on 1.5 acres of land at a spacing of 3 ft between plants. This is equivalent to about 16,500 plants per hectare. The potential yield is therefore 16,500 corms per hectare. A large yam weighs about 2 kg. Average yams weigh 1 kg.

Weeding starts from the beginning of planting until harvesting. Non-selective herbicide Basta® with active ingredient of glufosinate-ammonium is sprayed to control weeds.

Suckers sold in the Malim Nawar market, used as vegetables or for planting.

Pesticides are applied when there are signs and symptoms of pests and diseases. The symptom of rotting leaves is an indicator of soil borne disease, so farmers will apply Rizolex® 50WP. This fungicide with an active ingredient of tolclofos-methyl is used to control soil borne diseases by inhibiting spore germination and growth of fungal mycelia. If not treated, these soil borne diseases will result in holes in the corms. The corms will be degraded in appearance and value although taste and texture are not affected.

When insects are found feeding at the base of the petioles, near to the corms, Nurelle™-D505 EC is applied as treatment method. The two active ingredients involved are chlorpyriffos and cypermethrin. If insects are left unattended, they will continue feeding from the petioles to the corms.

An insecticide to control ants is applied every two weeks after corms start forming. This is because small red ants are found feeding on corms. Pyrifos 75 with an active ingredient chlorpyrifos is used as a preventive measure. Timely insecticide treatment on the corms is critical to prevent losses in yield.

Plants take 9 to 12 months for corms to mature. However, some farmers start harvesting corms at the sixth month even though corms only start forming at the fourth month. According to their planting experience, the shortened maturity period and early maturity of corms are due to sufficient fertilizer application in the first four months of planting. Fertilizer is applied every 15 days from the start of planting to corm formation. 100 kg of YalaMila™ is applied every time for an area of 1.5 acres with 10,000

plants. YalaMila Complex is a compound NPK fertilizer package, which contains 12% nitrogen (5% nitrate – 7% ammonium), 11% phosphorus, 18% potassium, plus 2.65% magnesium, 19.9% sulfur, and trace elements of 0.02% zinc and 0.015% boron.

As soon as corms start forming, farmers will change from compound NPK fertilizer to calcium nitrate fertilizer. 100 kg of fertilizer YaraLiva® Nitrabor™ is applied, which contains 15.5% nitrogen, 18% calcium and 0.3% boron. The end results of applying this particular fertilizer are claimed to be blemish-free produce that will store longer; less susceptibility to disease or rotting; and visibly more desirable, fresher appearance. Believing that corms need EM (effective microorganisms) to grow big, some farmers add locally-produced EM formulations. The rate of application is 6 L of EM mixed in 600 L water for 1.5 acres. The combination of fertilizer and EM is applied until harvesting.

At least three challenges are observed in planting yams. First is crop-rotation. Some farmers observe an interval of four years between crops of yam. Farmers who plant yams in two consecutive cycles without a break find that the corm size becomes smaller in the second cycle.

If the third crop is planted without a break, the yield is very poor. Where a rest interval is observed, farmers plant other crops on that piece of land during the interval.

Second, there is a risk of losing yams because of theft. Some farmers claim that they have to stay on-farm from planting until harvesting to guard off yam thieves. Third is labor shortage. This limits the size of individual yam farms to one to two acres.

Maturity for harvest is signaled by leaf senescence. When leaves turn yellow and show signs of dying, the corms are considered matured and are simply dug up. Within the Kinta Valley, yams are grown and sold in Kampar where the white fleshed variety is sold at around RM8 per kg as retail price in the Kampar market. Yams grown in Gopeng and Simpang Pulai are sold to the wholesale market in Ipoh. The pink-fleshed variety is sold at RM5.50 to RM 8 per kg as wholesale price. Wholesalers arrange for lorries to pick up from farmers to deliver to Ipoh. The price is higher at the approach of Chinese festivals such as Mid-Autumn (Mooncake) Festival and Spring (Chinese New Year) Festival.

The agronomic practices in the Kinta Valley differ quite significantly in some ways from practices reported in the literature from other places. For example, PROSEA says that weeding should not be carried out in the last two months preceding harvest because it may reduce corm quality. It also says that after fallow the next two crops usually do not need fertilizing. In the Kinta Valley, weeding and fertilizer application are both intensive and the yields are correspondingly high.

Corms can be stored under cool conditions. They can also be cleaned, cut into blocks, cooked in an oven and then stored for long periods in a freezer. Unlike leafy vegetables, the yam texture is not altered by freezing.

In the Kinta Valley, the yellowing of leaves when the corms are ready for harvest indicates that these types have to be treated as annuals. Eddoe types seem to be perennial and able to produce cormels continuously. The vegetable types from which petioles are harvested seem to be truly perennial.

Bibliography

Burkill I.H. (1935). *A Dictionary of the Economic Products of the Malay Peninsula*. Reprinted 166 by the Department of Agriculture, Kuala Lumpur.

Furtado, C. X. (1940). The Malayan Keladis and other Edible Aroids. MAHA (Malayan Agri-Horticaltural Association) Magazine 10: 11-17.

Herklots G.A.C. (1972). *Vegetables in South-East Asia*. George Allen& Unwin Ltd. London.

Masefield, G.B., Wallis, M., Harrison, S.G., and Nicholson, B.E. 1969. *The Oxford Book of Food Plants*. Oxford University Press, UK.

Li, H.-L. (1979). *Nan-fang ts'ao-mu chuan: A Fourth Century Flora of Southeast Asia*. Translated into English from the original Chinese of Chi Han (AD 304). The Chinese University Press. Hong Kong.

Loh, Francis K.W. (1988). *Beyond the Tin Mines: Coolies, Squatters and New Villagers in the Kinta Valley, Malaysia*. Oxford University Press.

Onwueme, I. 1999. *Taro Cultivation in Asia and the Pacific*. RAP Publication no. 1999/16. Food and Agriculture Organization of the United Nations, Regional Office for Asia and the Pacific, Bangkok, Thailand.

Purseglove, J.W. (1972). *Tropical Crops: Monocotyledons*. Longman, Singapore.

Roach, J. (2003). Was Papua New Guinea an Early Agriculture Pioneer? National Geographic News. June 23, 2003. http://news.nationalgeographic.com/news/2003/06/0623_030623_kukagriculture.html

Van Wyk, B-E. 2005. *Food plants of the world*. Times Edition-Marshall Cavendish, Singapore.

Wilson J.E. & Siemonsma J.S. (1996). *Colocasia esculenta* (L) Schott in Flach, M. and Rumawas, *F. (eds.) PROSEA (Plant Resources of South-East Asia) No.9: Plants yielding non-seed carbohydrates*. PROSEA Foundation, Bogor,