Japanese Taro, a New Zealand Perspective

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INTRODUCTION

Taro (*Colocasia esculenta*) is a member of the Araceae family and a native of Northeast India or mainland Southeast Asia (Matthews et.al , 1992). It has been widely naturalised and is now a common food source throughout the tropics and warm temperate zones. Taro was also widely used by Northland pre-European Maori (Matthews, 1985).

Taro is primarily grown for the corm or swollen stem base it produces, although the stems and leaves of some cultivars can also be eaten. The corm and stem contain calcium oxalates so they must be peeled and cooked before eating There are two main types. the common taro (*C. esculenta* var. *esculenta)* which produces one large corm and is imported into New Zealand from the tropics, and Japanese taro *(C esculenta* var. *antiquorium)* which produces many smaller corms (Purseglove, 1974) and is tolerant of a more temperate climate and therefore likely to be more suited to production in New Zealand Japanese taro can grow to heights of 1.0 to 1 5 m with the parent corm producing as many as 30 daughter corms over a season. On a high-producing plant a number of granddaughter and sometimes great granddaughter corms can be produced. Some plants are used in ornamental plantings because of their leaf colour which varies and can range from green to red-violet depending on the density and distribution of anthocyanin. This paper reviews Japanese production methods and preliminary results from Crop & Food Research's programme to evaluate Japanese taro for commercial production in New Zealand.

ENVIRONMENTAL REQUIREMENTS

In Japan, taro is grown on a wide range of soil types from heavy clay to free-draining sandy soils. Production can be improved on most soils by adding organic matter. The soil should be reasonably fertile and slightly acidic. Taro will tolerate highly acidic soils but reduced growth can be expected Soils which are prone to temporary waterlogging can also be suitable for taro production (O'Hair, 1990) In Japan, taro is sometimes grown in paddy fields. Taro is normally grown in a highly humid environment and does not tolerate dry conditions. High rainfall during the growing season or access to irrigation is essential for the commercial production of this crop. Dry soil conditions result in low yields, corm cracking, dry rot, and subsequent storage rotting. Fluctuations in soil moisture can also cause cracking

Taro prefers high temperatures, a long growing season and full sun. A minimum temperature of approximately 15C is required for sprouting with maximum growth

occurring at 18 to 25C. Any environment which experiences out-of-season frosts is unsuitable for growing taro. In New Zealand, we have found Pukekohe, South Auckland to have a suitable climate for taro while the Waikato, because of its occasional out-of-season frost, is marginal. Some shelter is also required to prevent excessive wind damage to the large leaves.

PROPAGATION

In Japan, daughter and granddaughter corms from healthy, virus-free parent plants weighing 30 to 60 g are used for "seed" These corms are broken off the parent plant and dusted with fungicide. At Pukekohe, we have found that all corms, regardless of size, can be successfully used for propagation. Generally, larger corms produce higher yields. At Pukekohe, corms are planted directly into the field if the soil moisture is adequate, or pre-sprouted before planting by placing them in potting mix in well-drained polystyrene boxes in a warm situation with frequent watering. Pre-sprouting, which can take from 6 to 8 weeks, is used primarily to extend the growing season. Corms are planted out when they have three leaves and the plants are approximately 20 cm high. Damaged or misshapen corms are discarded.

PRODUCTION IN JAPAN

Crop Management. In Japan, main crops are planted in April and early May (October and early November in New Zealand). Early production is possible by pre-sprouting the corms in cold frames, by planting on sandy soils which warm earlier in the spring, by covering planted corms with a black mulch, or by growing the crop under cloches or in greenhouses.

In Japan, potassium and nitrogen are considered the most important fertilisers. A typical Japanese farmer would apply 400 kg ha^{-1} lime, 100 kg ha^{-1} N, 180 kg ha^{-1} P and 100 kg ha^{-1} K as a basal dressing. Excessive fertiliser use can cause excessive foliar growth and may inhibit corm swelling. When the first leaf has opened, 20 kg ha^{-1} of K as a side dressing is applied and the soil mounded up by approximately 5 cm. When four leaves have formed, 40 kg ha^{-1} of a compound fertiliser is applied and the soil is mounded up a further 10 cm. In Japan a third application of a compound fertiliser is applied at the end of the rainy season (late summer in New Zealand) and the crop mounded up a further 15 to 30 cm. Mounding encourages tuber swelling. However, excessive mounding causes the tubers to become elongated. Generally, taro is planted 30 to 50 cm apart in rows 1.0 to 1.2 m apart If the climate is dry, mulching and either inter-row irrigation or sprinklers can be used. In Japan, weed control is achieved by hand weeding, mulching, and the use of the pre-emergence herbicides simazine, linuron, trifluralin, or pendimethalin. The desiccant, paraquat, is also commonly used for weed control in taro in the tropics (O'Hair, 1990).

Harvesting. The use of early production techniques can result in harvesting in mid August (February in New Zealand). However, most of the crop is harvested from mid-September to October (March to May in New Zealand) before the first frosts. The stems are removed with a scythe then the corms are dug either by hand or with a modified potato harvester, the soil is shaken off, and the corms are left on the ground to dry. In a wet season, the tubers are cured under cover. Typically, corms are stored for approximately 100 days in high relative humidify at 10C. Average yields are around 25 t ha^{-1}.

PRODUCTION IN NEW ZEALAND

Plant material was imported from Japan to New Zealand for evaluation in 1992 After a growing season in quarantine to ensure the plant material was free of disease, trials were established in the Waikato in 1993 and in South Auckland at Pukekohe in 1994.

Crop Management. In New Zealand, taro should be planted as early as possible after the last frost to ensure as long a growing season as possible. At Pukekohe, planting should be carried out in early October, or in sites free of frost in late September. This means pre-sprouting in mid-August Taro has been planted by hand in a similar fashion to potato. Corms are planted 5 to 6 cm deep, in 15-cm-wide trenches with fertiliser incorporated with soil in the base of the trench. The trench is then covered and mounded up slightly so the top of the mother corm is 7 to 8 cm deep. Fertiliser mixes recommended for potato have been successfully used on taro in the Pukekohe region although side dressings have not been applied

Generally we have planted taro 30 cm apart in rows 75 cm apart. A recent trial evaluating plant densities ranging from 2 7 to 6.7 plants m^2 found that per plant yields decreased from 1040 to 638 g per plant as plant density increased while overall yield increased from 28 to 43 t ha^{-1}. Japanese experience suggesting that irrigation is important for taro has been confirmed in trials in New Zealand. Corm yields were doubled in one trial at Pukekohe as a result of irrigation during the summer and early autumn. Hand weeding is carried out although this is proving expensive. When canopy closure occurs, shading of weeds by the crop tends to reduce weed growth Mulching has been used to control weeds. An evaluation of chemical weed control in New Zealand is required for large-scale production of this crop.

Harvesting. Trials have indicated that maximum yield is achieved by harvesting corms in May. To date, all harvesting has been carried out by hand, but in other parts of the world modified potato harvesters have been used successfully (Krishnan and Smith, 1983) and should be suitable for lifting this crop when grown on a commercial scale in New Zealand. Lifting and corm cleaning has been a problem at Pukekohe because the clay soil tends to stick to the corms. The storage requirements of Japanese taro in New Zealand have not yet been investigated.

Taro yields of 44 t ha^{-1} have been achieved in our trials. Problems with corm cracks, premature corm sprouting (Scheffer, 1995), and storage rots have caused crop losses of around 50% which would give a comparable marketable yield to that quoted for Japanese growers.

Pests and Diseases. Japanese taro is relatively free of pests and diseases during the production phase. In New Zealand, white fly (*Trialeurodes vaporariorum*) and mites have been the only problems to date, apart from storage rots and rodents which can cause postharvest problems.

DISCUSSION

Trials at the Pukekohe Research Centre have shown that Japanese taro grows well in the South Auckland area (Scheffer, 1995) with one trial producing a maximum per plant yield of 3.4 kg. The plant is relatively easy to grow and has suffered from few pests and diseases It will, however, respond well to good management, i.e planting and harvesting at the appropriate times, correct plant density, nutrition, and irrigation Problems with harvesting when it has been grown in clay suggest

that this crop may be better suited to lighter soils. The eating quality of New Zealand grown Japanese taro has been evaluated and found acceptable (Scheffer, 1995; Matthews pers. comm). The main problem to date has been the low marketable yield as a result of corm cracking, premature sprouting and storage rots.

Crop & Food Research is continuing with its trial programme, is currently evaluating a range of cultivars, and will continue to further define the agronomic requirements of the crop. A programme to select taro cultivars low in oxalate has also been initiated.

Japanese taro is seen as a promising crop for the North Auckland, Auckland, Bay of Plenty, Poverty Bay, and Hawke Bay areas which experience long, frost-free growing seasons Production could initially be for the New Zealand market where locally grown Japanese taro could complement imported taro. In the long term, fresh or processed taro could be grown for the out-of-season supply of the Japanese market.

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