Ngā Rīwai Māori - Māori Potatoes.

A thesis presented in partial fulfilment of the requirements for the degree of Master of Philosophy in Ethnobotany at Massey University, Palmerston North, New Zealand.

Graham Francis Harris

2001

Dedication

This thesis is dedicated to my mokopuna –

***Meremaihi Raana Jackson** and*

Te Rauhina Gray Jackson

Riwai with Kete

Abstract

It is generally accepted by scholars, that potatoes were first introduced to New Zealand in the late 18th century by Captain James Cook and the French explorer, Marion du Fresne. Further introductions of potatoes from a variety of sources, including possible direct introductions from South America, followed into the 19th century. Māori were quick to recognise the advantages that these new introductions had over their traditional food crops including *kūmara (Ipomoea batatas)* and *taro (Colocasia esculentum)* both of which they introduced from east Polynesia some 800-1000 years previously. Potatoes soon became a staple item in the Māori diet and an important trade commodity, and by the mid 19th century they were growing thousands of hectares of potatoes for that purpose. The various cultivars that were introduced were given Māori names and many of these early types are still grown by Māori today, having been passed down through families for many generations. With their deep set eyes, often knobbly irregular shape, "open" leaves and colourful tubers these "Māori Potatoes" are quite distinctive in appearance from modern potatoes and some retain many of the features of *Solanum tuberosum* subsp. *andigena* types.

This thesis introduces a brief history of the development of the potato in South America and in Europe prior to its introduction to New Zealand and adoption by Māori. The effects and consequences that the potato had on Māori society are investigated and Māori potato production techniques and associated cultural operations such as storage methods are examined. Relict potato cultivars still grown today by Māori communities and individuals are described from observations made by the author of a cultivar collection maintained over several years. The claim by some Māori that potatoes were introduced to Aotearoa by their ancestors is examined and evidence is presented to indicate the possibility that several potato cultivars were developed by Māori by

selection from seedlings and somatic mutations from cultivars introduced by Europeans.

Key words: Māori potato, relict potatoes, *riwai*, *Solanum tuberosum* subsp. *andigena*, foliar index.

Acknowledgements

I am extremely grateful to Poai Pakeha (Sonny) Niha who first interested me in this subject and also to his *whānaunui* at Motatau in Northland - in particular the late Ema (Nanny Ema) Tipene who contributed much useful *mātauranga*. Also a special thanks to the many other Māori people including my parents-in-law Paratene and Rauhina Carter who contributed to this study in many ways.

Nā koutou i hōmai ki āhau ngā purapura

mātauranga o rātou kua wehe ki te pō.

Tēnā koutou me ēnei taonga whakamāharahara.

A special thanks to my supervisor, Professor John Flenley who provided useful guidance and comments during the writing of this thesis and also to Associate Professor Peter Matthews of the National Museum of Ethnology, Japan for a detailed and extensive commentary on my working paper from which this thesis evolved.

For encouragement and critical comment I would like to thank numerous colleagues at the Open Polytechnic including Dr Raymond Young, Richard Drummond, Solomon Tipene, Wayne Taurima, Mike Burtenshaw, Bruce Treeby, Dr Jane Clendon and Dr Claire Matthewson.

Useful comments and advice were also contributed by Dr Harry Orsman of Victoria University, Professor Jack Garrick, formerly of VUW, Dr Foss Leach and Dr Janet Davidson of Te Papa Tongarewa, Museum of New Zealand.

Other individuals who provided valuable input include Kevin Prime, Ngāti Hine, Dr Doug Yen, University of Hawai'i, Dr Gavin Ramsay and George Mackay,

Scottish Crop Research Institute, Dr Ellen Förch, Auckland University, Dave Para, Department of Conservation, Sue Scheele, Landcare Research, Professor Margaret Purser, Sonoma State University, Dr Murray Parsons, Landcare Research, Kay Baxter, Koanga Nurseries, Russell Genet, Crop and Food Research, Nick Roskruge, Massey University, John Keating, Agriculture and Food Development Authority, Ireland and Professor Massimo Angelini, University of Genova, Italy.

Thanks also to the following people who sent me potato tubers - John Maddocks, J. J. Nichols, Betty Wilton, Russell Smith, B. L. Brasell, Kerry Marshall, Ann Montague, Ernie Day, Dave Hapuku, Eleanor Jolly, Jock Edwards, L. S. Mayhew, Matt McGhie, Tori Tuhaka, Bill Blaine, Jack Garrick.

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Chapter 1.

Introduction.

Introduction

While the term "Maori Potato" is in common usage in New Zealand, little research has been undertaken to determine or define exactly what a "Maori Potato" is or to establish the relationship and association of this crop with Maori people.

Dr Douglas Yen (2000 pers. comm.)

Aim of the thesis

This thesis aims to provide a definition of *Māori Potatoes* and to define the relationship and association of the crop with the Māori people. Although Māori Potatoes are often referred to by both Māori and Pākehā, a search of the literature showed that no serious attempt has been made to define the term and very little has been published on the subject, although a general-interest paper on Māori Potatoes was published by Yen in the Potato Journal (Yen 1961/62: 2-5). Orsman (1997:686), in *The Dictionary of New Zealand English*, referred to *Māori Potatoes*, giving a selection of situations in which the term has been used. However, he has since requested a definition from the present author for inclusion in a revised edition of the dictionary.

This study of a crop plant and its intersection with an indigenous people is essentially an ethnobotanical study which, in addition to its botanical and anthropological foci, includes elements of *mātauranga Māori* (traditional Māori knowledge) history, geography and horticulture. The common thread that is woven through each of the chapters outlined below is the need to provide a definition of the term *Māori Potato* that incorporates a range of perspectives.

The lack of academic research and an apparent wide general interest in the subject which, until now, has been a conceptual impasse, presented an opportunity for an exploratory study that would provide a definition of the term *Māori Potato*. Such a study must necessarily be multi-faceted and interdisciplinary and needs to

examine the subject from a range of different perspectives including a brief history of the development of the potato prior to its introduction to New Zealand, its introduction to New Zealand and its adoption and production by Māori. The impact of the potato on Māori society is investigated as are Māori attitudes to the potato and the strongly held belief of some Māori that the crop was introduced by their ancestors prior to settlement by the Pākehā. An examination of the generic and varietal names conferred on potatoes by Māori was undertaken to provide further insights into the significance of the potato to Māori. Establishment and maintenance of a collection of Māori Potatoes provided an opportunity for close examination of the morphological features and characteristics of each cultivar and allowed observations from a botanical and horticultural perspective to be made.

Background

I have long been interested in ethnobotany - the scientific study of the relationship between plants and people. This interest stemmed from my background in horticulture and my close association with Maori communities over many years, which initially arose through family and ancestral links. I have previously published several papers and articles on Māori food crop plants.

At a conference in Whangarei in April 1996, I met Poai Pakeha (Sonny) Niha. We discussed food plants of the Māori as, at the time I was undertaking studies of the *huperei, (Gastrodia cunninghamia)* a leafless orchid, the rhizomatous tubers of which were considered to be a delicacy by Māori and of *rengarenga (Arthropodium cirratum)*, a lily with fleshy rhizomes which provided a source of nutrition for Māori when other food sources were scarce.

Sonny's whānau, who are Ngāti Hine, had been growing Māori Potatoes in Tai Tokerau (Northland) for many years. Sonny sent me a selection of the types that his family were growing and my interest in these vegetables was kindled.

The potatoes were planted in Martinborough in the Southern Wairarapa and they

created considerable interest among the Māori community in the district. Two additional cultivars were given to me by an elderly man from Pirinoa. He said they had been grown by Māori in the district for many generations.

I maintained contact with Sonny Niha and his whanau and we continued to exchange information about Māori Potatoes and other traditional food crops of the Māori and in April 1997, we travelled around Northland and talked with Māori people who were growing these potatoes. We listened to their stories and collected several more varieties. Many of the older people we visited preferred to speak in *Te Reo Māori*, and Sonny provided the translation. I continued to collect information about Māori Potatoes and added to the cultivar (cultivated variety) collection which I maintained by growing annual crops. In 1998 I sent Sonny, tubers of all the cultivars I had collected so he could maintain an identical collection.

Publication and response

In order to publicise the study and obtain feedback and information for inclusion in this thesis, general interest articles (see appendices) on Māori Potatoes were published by the author in the *New Zealand Gardener*, *The Garden* (the journal of the Royal Horticultural Society) and *Te Karaka* - the Kai Tahu magazine. The response to these articles from Māori and Pākehā in New Zealand, and also from overseas, indicated that there was wide general interest in the subject. Some of the people responding to the articles sent in potato tubers to add to the collection or for identification. An article, published in July 1998 in the *Dominion* newspaper, illustrated with photos of 16 of the cultivars that were collected, prompted a large number of responses. In 1999, information that had been accumulated, was written up as a "work in progress" which was published by the Open Polytechnic of New Zealand in its Working Paper series - *Te Whakatū Kōrero*. Sonny Niha was invited to be a co-author of the paper.

Previous knowledge and understanding of the subject

Prior to this study, what was known about the Māori Potato and what was the

general understanding or perception of the term? The limited published information available and anecdotal evidence indicated that the generally accepted explanation is that they are potato *(Solanum tuberosum)* cultivars that were introduced by European explorers, settlers and sealers and whalers in the late eighteenth and early nineteenth centuries and perpetuated by Māori. However the term also appears to have a wider usage, and the term *Māori Potato* is also used to refer to more "modern" potato types that have been "adopted" by Māori in more recent times. Some of these have a particular association with specific Māori communities or can be related to an event such as the "modern" potato cultivars which were distributed by the New Zealand Government Native Affairs Department to Māori in the North Island following the potato blight epidemic in 1905 which destroyed their crops and had a devastating effect on Māori communities. Some Māori use the term to refer to old types of potatoes that they believe were brought to Aotearoa by their ancestors.

The term *Māori Potato* has also been used to refer to the edible bulbs or rhizomes of two orchid species; *Gastrodia cunninghamia* (Given 1959:1) and *Orthocerus novae-zealandiae* (Batley nd: 52), and often the kūmara or sweet potato *(Ipomoea batatas)* is referred to as a Māori Potato.

Research objectives

To more accurately define the Māori Potato and to determine its significance and relationship to Māori, the following research objectives formed the basis of this study:

1. To investigate the cultural and social significance of the potato to Māori from the time of its introduction to New Zealand and adoption by Māori to the present day. This includes an investigation of anecdotal evidence that Māori introduced potatoes to New Zealand prior to European arrival and the possibility that Māori developed potato cultivars from European introductions. A study of the generic and varietal names that Māori gave to potatoes is undertaken to provide further evidence of its cultural significance.

2. To review historical and ethnological literature relating to the introduction of potatoes to New Zealand and their impact on Māori society, and to put this literature into context, to review the origins and early history of the development of the potato prior to its introduction to New Zealand.

3. To establish and maintain a cultivar collection of Māori Potatoes in order to collect data and record information about each cultivar and compare their characteristics with those of modern potatoes, and to determine which are likely to be relicts of early introductions and which are likely to be more "modern" types.

4. To investigate the extent to which Māori Potatoes are grown today and determine reasons for their continued production when much higher yielding "modern" cultivars are available.

Thesis outline and relationship of the chapters

The first of the eight chapters in this thesis that follow this Introduction, is a *Methodology* chapter which details methods used to obtain and interpret the information and data included in this thesis. This chapter includes a section which explains how matters relating to *mātauranga Māori* (traditional Māori knowledge) were considered and complied with according to established guidelines relating to the intellectual and cultural property rights of indigenous peoples.

Chapter 3 is titled *The origin and history of the potato.* Thousands of years of development of the potato had taken place before the potato was first introduced to New Zealand in the late eighteenth century by European explorers. The potato originated from wild tuber-bearing *Solanum* species in the Andes of South America and was developed by indigenous people of that region prior to its introduction in the late sixteenth century to Europe and Britain, where it was further developed. By the time the potato reached New Zealand it was a complex hybrid defined by botanists as a "compound species". Chapter two reviews the origin of the potato

in South America and its evolution in Europe, including the development of the cultivars that were available in Britain at the time of the first potato introductions to New Zealand. The potato blight epidemic that devastated the Irish in the mid 19th century and the subsequent development of new "blight resistant" potato cultivars is briefly discussed in order to clearly show that the earlier potato introductions to New Zealand in the late eighteenth and early nineteenth century were substantially different from those introduced from the mid to late nineteenth century.

This discussion provides a perspective and background for Chapter 4, *Introduction of potatoes to New Zealand* which investigates the first reported introductions of potatoes in the late eighteenth century by European explorers and the further introductions in the nineteenth century from numerous sources, including whalers, traders and colonists. The widely held belief by Māori that their ancestors introduced potatoes along with the kūmara, yam and taro is examined. The possibility that some cultivars were developed by Māori by selection from seedling and somatic mutation variants of European-introduced potatoes is also discussed.

Chapter 5, *The adoption of the potato by Māori*, details the very significant effects of the potato on Māori society. It looks at the spread of the potato throughout Māori commiunities in New Zealand and its adoption as a staple food by Māori - supplanting the kūmara and aruhe (bracken fern rhizome). Māori gardening methods and potato production systems are described, as are storage systems and cooking methods. Māori resourcefulness and enterprise in the development of the potato as a trade commodity is examined in detail. This enterprise, at its peak in the mid 1800s, saw thousand of hectares of land in production, to supply developing European communities as well as markets in Australia. Reasons for the demise of Māori horticultural enterprise in the mid to late nineteenth century are considered, as is the dependence of Māori on the potato as a major food source into the early twentieth century.

Chapter 6, *The Māori potato today*, looks at the characteristics and features of the Māori Potatoes which are still grown in Māori communities today. It looks at the

extent to which they are grown and at reasons for their perpetuation and continued production when modern cultivars which produce a much greater yield are available. The chapter concludes with a discussion of the generic and varietal names that were conferred on the potato by Māori and are still in use today.

Chapter 7, *Observations of a collection of cultivars*, describes how the various cultivars in the author's collection were acquired and provides a description of each cultivar. The most widely and commonly grown cultivar, 'Urenika', is described in more detail and its relationship to the British cultivar 'Congo' is investigated. Yields of several cultivars are compared with that of a modern cultivar, and the tendency of each cultivar towards either the relatively undeveloped subspecies *andigena* or the modern subspecies *tuberosum* is determined using a foliar index as a discriminant function. Corroborative evidence is provided by an analysis and correlation of stolon length data. This investigation provides empirical data which, together with the other information and evidence gathered and collated during the course of this study, is necessary to provide a botanical perspective in the process of determining an accurate description and definition of the Māori Potato.

The penultimate chapter, *Relict potato cultivars in other countries*, gives an overview of other countries or regions in other countries where similar types of relatively undeveloped potatoes have been perpetuated and recorded in the literature.

The final chapter is a summary and conclusion which, in addition to surveying the topic again in the light of the research undertaken, looks beyond the bounds of this work to possible directions for future research.

Cooperation and support

This project provided a unique opportunity to study a subject in which no previous academic work had been undertaken. The interest generated by the study was particularly rewarding and stimulating. The dialogue and often

thought-provoking exchange of information with people in New Zealand and also from overseas provided encouragement and motivation to complete this study, and the cooperation and support from the Māori community was particularly gratifying. Kevin Prime, a Ngāti Hine kaumatua who is a well-known environmentalist and conservationist, wrote in a letter of support - "I would like to encourage Graham Harris to preserve remnants of our cultural heritage, which modern technology is causing us to abandon."

Chapter 2.

Methodology.

Methodology

As discussed in the previous chapter, this is a multi-faceted study which explores the subject of *Māori Potatoes* from several different perspectives, and in order to obtain the information included in this thesis, several different methods were used. Much of what could be described as "methodology" is described and detailed in the *Introduction* and in Chapter 8 which details and discusses observations of a cultivar collection and the collection and analysis of data.

In undertaking this research, I was aware of the principles and ethics of cultural and intellectual property rights. The principles of ethical conduct as stated in *He Tikanga Whakaaro - Research Ethics in the Māori Community* (Te Awekotuku 1991) were followed as well as those stated in *The Mataatua Declaration on Intellectual Property Rights of Indigenous Peoples 1993*. I recognise that some of the information in this thesis is *Mātauranga Māori* (traditional Māori knowledge) and hence the aims of this study and the intention to include the information in a thesis and for publication were conveyed to the informants at the time it was collected. Some of the potato tubers were given to me on the understanding that they were not to be commercially exploited but were solely for the purpose of academic research. This principle has been applied to all information gathered in the course of this study.

The key methods used to obtain and process information were -

Kōrero kanohi ki te kanohi or "face to face" discussions.

Information such as the extent to which Māori potatoes are grown today, the cultivars grown, their names and meanings and traditional knowledge associated with the potato could only be gathered by personal communication with Māori individuals and communities. Because this project involved

collection of *mātauranga* Māori it was necessary and appropriate to talk to Māori people face to face. This concept was discussed by King (1999:110) who, in writing about his frequent contacts with older Māori people while undertaking research, explained that many Māori trust and absorb information conveyed by oral discussion rather than by correspondence. He quoted Koro Dewes - 'A face seen is an argument understood - a letter is simply a piece of paper.'

The initial contacts were with iwi in Northland where many cultivars of Māori Potatoes are still grown by Māori communities. As mentioned earlier, I was assisted in this by Sonny Niha who accompanied me on a journey around Northland in April 1996 to visit Māori people and listen to their stories and observe their potato crops. It was appropriate that we should first meet with Sonny's Ngāti Hine people first since he had first interested me in the subject. Because Sonny had family connections to many of the people we visited, they were much more responsive and forthcoming than they were likely to have been if I had attempted the undertaking on my own. For many of the older people we visited, *Te Reo Māori* was their first language and Sonny was able to translate. My own family and ancestral links with Māori and a long association with Māori people also helped in establishing a rapport with the people and establishing a trust which gave them an assurance and confidence that the information they were sharing with me was not being used for inappropriate purposes. To ensure that all those people we visited were asked similar questions, the following standard set of questions was prepared.

1. What is the general name you use for potatoes?
2. How many varieties do you grow?
3. What are their names?
4. Do these potatoes have any special significance to you in addition to their value as a food item?
5. Where did you get them from?

6. Why do you grow them?

7. How do you grow them?

8. How do you store them?

9. Do you also grow modern varieties?

These questions were not presented as a questionnaire - their function was more of a checklist to ensure that key questions were not overlooked during the course of conversation. In most situations it was appropriate to have *kōrero* (discussion/ conversation) about other matters first before these questions were included in the discussion. Most of the information gained this way was from a limited number of mainly elderly people. It was obvious that much of this *mātauranga* relating to crops and traditional gardening methods was becoming lost. Care was taken to ensure that all those people who were "interviewed" were informed as to the purpose of the study, and permission was sought from them to publish information. In addition to personally visiting Māori people, some were contacted by telephone or by letter and some responded to articles about Māori Potatoes published in newspapers and journals.

Literature and archival search and review.

While there is little written information available about the Māori Potato *per se*, the adoption of the potato by Māori and its dramatic effects on Māori society and culture are well documented in the literature and archival material, and are reported and discussed in this thesis as is other relevant historical material concerning the evolution and early development of the potato prior to its introduction to New Zealand.

Publication of articles and papers.

As detailed in the previous chapter, several articles were published in the media including newspapers and magazines and in trade, professional and tribal journals, to encourage dialogue on the subject of Māori Potatoes. Later in 1999 part of the study was published as a "work in progress" in the Open

Polytechnic's working paper series *Te Whakatū Kōrero*, once a significant proportion of the work had been completed. There were several reasons for publishing in this format -

1. Considerable information on the subject had been gathered and it was thought necessary to publish a much more detailed paper than would be likely to be accepted by a journal.

2. For maximum effect it was necessary to publish numerous coloured photographs which a journal would be unlikely to publish.

3. Because one of the aims of publication was to promote discussion and feedback, it was necessary to circulate the paper widely and to target recipients representing Māori communities, and academics from a wide range of disciplines including agricultural/horticultural science, anthropology, geography, botany, history and Māori studies. It was also important to send copies to members of the general public who had responded to earlier published articles.

4. As no academic work had been published before on the topic, it was important to publish quickly as publication in a journal could take over 12 months from acceptance.

This method of obtaining information by stimulating discussion and feedback about Māori Potatoes proved to be effective as outlined in the *Introduction*.

Interviews with newspaper reporters on the subject were avoided after an article published in the *Evening Post* 1997, incorrectly stated that I believed that it was likely that Māori brought potatoes to New Zealand prior to their introduction by Europeans, however the article while creating some embarassment, did have the benefit of a reaction from the public which stimulated useful discussion. A summary of correspondence on the subject, mainly generated by publication appears in the appendices.

Chapter 3.

The origin and history of the potato.

Observation of a collection of cultivars.

From 1996, an annual crop of Māori Potato cultivars was established, maintained and added to so the plants could be examined from a botanical and horticultural perspective. Accessions to this collection were obtained from numerous sources. By 1998 there were 18 named cultivars in the collection. Each cultivar was described and key morphological features and characteristics were recorded. A range of data for each cultivar was collected and comparisons with "modern" cultivars were made. Observations and comparisons including methods of analyses are described and discussed in chapter 7.

Fig. 1 *Some of the Māori Potato cultivars collected by the author.*

Origin of the potato

Salaman (1987) and Hawkes (1990) have written extensively on the origins of the potato. They agree that the potato originated in the Andes of South America, from Peru and Colombia. Hawkes (1990:11) noted that at the time of the Spanish conquests of the Americas (in the sixteenth century), the potato was widely distributed throughout the Andes from Colombia to Peru. Salaman (1987:159) wrote that in South America, the original home of the potato, a great variety of potatoes are cultivated today (see Fig. 2). He noted that there were almost as many varieties in cultivation at the time of the Spanish conquest, which is not surprising considering that there is evidence that the potato was being cultivated 2,000 years ago in Peru (Wilson 1995:11). Prior to cultivation, tuber-bearing Solanum species were being utilised as a food source by people in Peru and Chile. Ugent and Peterson (1988:3) wrote that the dwellers of the Pleistocene coastal lands in Peru probably made use of the several wild relatives of the potato and Ugent (1997:903) wrote of the remains of wild potatoes *(Solanum maglia)* that were excavated at Monte Verde in Chile and dated at approximately 12,500 years old.

Hawkes contended there is little doubt that the first potatoes introduced to Europe were *Solanum tuberosum* subsp. *andigena* from the Andes, and that they were very probably from Colombia. Howard (1970:3) wrote that an earlier hypothesis proposed by the Russian botanists Juzepczuk and Bukasov in 1929 suggested that they came from the coastal regions of southern Chile. Their main reason for proposing a Chilean origin was that potatoes from this latitude tuber well under long-day conditions such as exist in the European summer. It was pointed out by Salaman (ibid) however that the potato was known to be in Spain by 1570 and that at this date Chile had not been settled by the Spaniards. He therefore suggested that the first introductions to Europe came from the Andes region of Peru or Columbia.

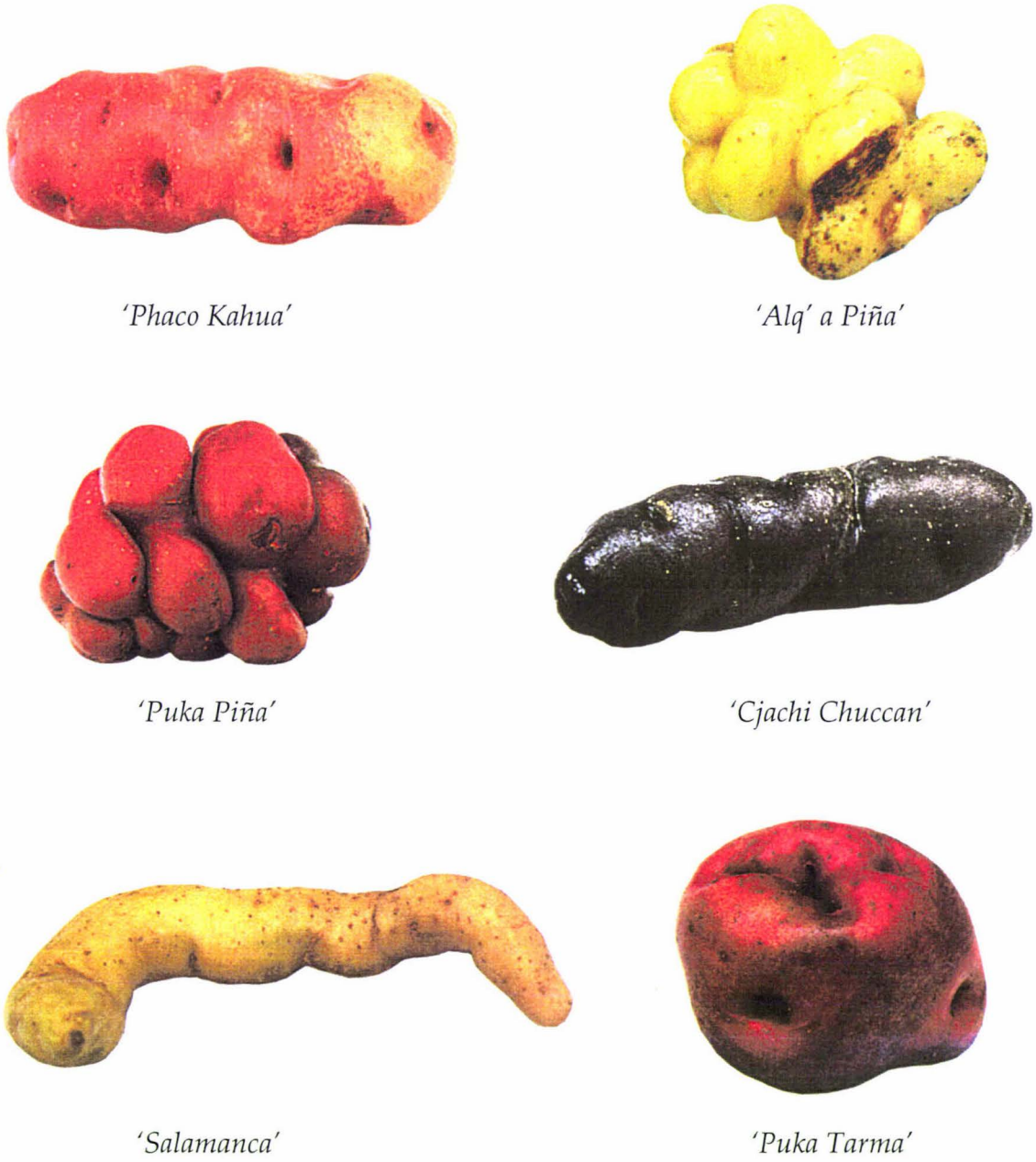


Fig. 2 *Papas nativas (native Andean potato cvs) labelled with their Quecha Indian names.*

International Potato Centre

Salaman (1985:160) noted that the original potatoes which reached Europe were themselves varietal hybrids or compound species, while Mackay (1997:564) stated that the potatoes which reached Europe were the culmination of thousands of years of evolution in South America. He recorded 'It is now believed that the first introductions [to Europe] were of a species (still cultivated in the Andes) known as *Solanum tuberosum* subsp. *andigena*.'

Sauer (1993:147), wrote that *Solanum tuberosum* (including subsp. *andigena*) is tetraploid, (4x=48) having four times the haploid number of chromosomes. He described *S. tuberosum* as a 'genetic sponge' because of its capacity for hybridising with other species and Hawkes (1990:495) considered that it was 'highly likely that it absorbed genetic diversity from other wild species through hybridisation and introgression.' Ugent (1970:1162) considered *S. tuberosum* arose from two diploid ancestors - *S. stenotomum* which is a primitive cultigen derived by human selection from *S. leptophyes*, and *S. sparsipilum* which is an aggressive weed occuring naturally in the potato fields of Peru and Bolivia. He was also of the opinion that a number of other species contributed to the genetic makeup of *S. tuberosum* and that - 'there were probably a number of independently acting, but genetically interconnected, lines of evolution that were simultaneously involved.' Johns (1990:122-123) noted that wild species of potatoes have long been exploited for food although the toxic levels of glycoalkaloids in many species limited their usefulness. On this basis he suggested the progenitor of the potato may well be *Solanum cardiophyllum* - a species naturally low in glycoalkaloids.

Under prehistoric Indian cultivation, *Solanum tuberosum* evolved into two geographically widely separated subspecies, a highland low latitude subspecies in the tropical Andes and a lowland subspecies in cool temperate Chile. The Andean potato was called *S. tuberosum* subsp. *andigena* while the Chilean potato was called subsp. *tuberosum*. Sauer (1993:148) considered this nomenclature to be untenable because Linnaeus gave the name *Solanum tuberosum* (with no subspecific epithet) to the Andean cultigen, however the classification seems to be generally accepted. Of the origin of the Chilean subspecies Sauer (ibid) wrote -

> The derivation of the Chilean subspecies is something of a mystery. There is a gap of about 800km between the northern limit of its cultivation and the southern limit of highland potato cultivation. In the center of this gap are the world's driest desert and some of the world's highest mountains.

It is possible that several thousand years ago, migrating Indians simply carried the Andean potato south (Hawkes 1990:14) and the Chilean subspecies evolved by natural and artificial selection with the end result that the subspecies became

adapted to long day conditions similarly to the process by which the Andean potato evolved and adapted after being introduced to Europe. It is considered however (Sauer ibid) that the Chilean subspecies has additional germplasm from an unidentified diploid - possibly *S. chacoense* or *S. maglia.*

Over time, by unconscious and conscious selection for higher yield, the short-day tubering forms of *Solanum tuberosum* subsp. *andigena* that were originally introduced to Europe from South America were gradually developed into the day-neutral, high-yielding European *Solanum tuberosum* subsp. *tuberosum* (Mackay 1997:563). This transformation was compared by Swaminathan (1958:13) to the evolution of the domesticated horse from the shaggy, sturdy pony of paleolithic times. The origin and development of the potato can be summed up in this statement by Genet (1983:49) -

> It is now generally agreed that *S. tuberosum* originated in the Andes of Peru and Bolivia. These potatoes are short-day types and constitute the subspecies *andigena.* Man subsequently introduced them to Chile and after many generations of selection, long day types evolved which are now classified as subspecies *tuberosum.* The early introductions to Europe were most likely subspecies *andigena* and as in Chile, seedlings more adapted to the long day conditions of Europe were selected.

The long-day adapted *Solanum tuberosum* subsp. *tuberosum* which developed independently in Chile and in Europe from *S. tuberosum* subsp. *andigena,* is comprised of two separate types with the Chilean subsp. *tuberosum* having distinct genetic differences from subsp. *tuberosum* which developed in Europe, however under the generally accepted nomenclature system for the potato, no distinction is made between the two types.

Both Salaman and Hawkes (1949: 82-83) and Simmonds (1964: 54) have attempted to estimate the time at which selection in Europe changed the *andigena* introductions into *tuberosum* types. Simmonds from an examination of herbarium specimens and old varieties and using a method of leaf shape analyses suggested a date of about 1850. Salaman and Hawkes suggested an earlier date and were of the opinion that the process was well advanced by the mid-eighteenth

century. Simmonds wrote that Salaman and Hawkes' opinion was 'no longer tenable' and that the evidence he produced 'strongly suggests that the European potatoes changed very little from Andigena for 200 years and then, during the nineteenth century, changed very rapidly indeed, being transformed into modern potatoes in about 100 years.'

While the natural home of the potato is in the region of the tropics (Salaman 1987:68), Wilson (1995:11) pointed out that tropical heat and high humidity are unfavourable to the potato plant. Indigenous potatoes are grown in the Andes at very high altitudes (c.2,800-4,500m) where temperatures and humidity are much lower than at sea level (Hawkes 1990:11). This meant that while it was able to grow in the climatic conditions of Europe, the haulms were damaged or killed by frosts and until the potato was adapted to tuberising in long day conditions, the tops were often killed before tubers had formed.

This apparent dichotomy whereby the potato, originating in a region where frosts are frequent yet the plant being damaged by frosts when introduced to Europe was explained by Salaman (1926:130) who noted -

> In its native Andean home, although within the tropical zone, the great altitude at which it is found renders the climate quite temperate. The potato is cultivated at La Paz at a height of 3730 metres and the mean temperature is 10° C. The nights are very cold, the temperature sinking below freezing point, but owing to the extreme dryness of the atmosphere, the growing plants do not freeze.

Fig. 3 *Quecha Indian farmers tending their potato crop in the high Andes.*

International Potato Centre

History of the potato in Europe and the United Kingdom

Introduction of the potato to Europe and the United Kingdom

Of the introduction of potatoes to Europe, Hawkes (1990:30) noted -

> It is a generally accepted fact that the potato arrived in Europe some time towards the end of the sixteenth century. Nevertheless, the exact time of its introduction and the details of its arrival remain obscure and will probably never be fully elucidated.

He went on to state that the available evidence suggests that there were two early introductions of the potato into Europe. The first was into Spain about 1570; the second into England between 1588 and 1593, with a strong suggestion that the actual year might have been 1590. Wilson (1995:11) noted:

> the arrival of the potato in Britain remains shrouded in mystery with legends involving Raleigh and Drake however most authorities agree that the date of introduction was likely to have been in the 1590s.

Phillips and Rix (1993:136) noted that there is a suggestion that the English potatoes were probably a separate introduction from those which reached Spain.

Early development of the potato in Continental Europe and the United Kingdom

Because the *Solanum tuberosum* subsp. *andigena* potato that was introduced to continental Europe and the United Kingdom was of tropical origin, it was adapted to the short day conditions[1] that are normal near the equator. The reaction of these plants to growing in the long summer days of northern Europe and the United Kingdom was to set tubers very late in the season, as the days shorten in late autumn (Mackay 1997:563). Other characteristic features were very small tubers which developed at the end of long stolons, numerous inflorescences and occasional shoots growing up above ground from the stolons (Hawkes 1990:39). All these characteristics which distinguish early introductions from the potato of today were described by Salaman (1987:67) as 'the reactions of a short-day plant doing its best to survive in a long-day environment.' He also noted 'a constant feature of these early potatoes was the irregular knobbly appearance of the tubers and the great depth of their eyes'.

The potato was not readily accepted as a food source in Europe and the United Kingdom. Rhoades (1982:687) wrote: 'When introduced to Europe, the potato was cursed as an evil food. The Scots refused to eat it as it wasn't mentioned in the bible.' Wilson (1995:12) noted: 'For several years the only potatoes growing in Britain were in the gardens of botanists interested in the plants, rather than the small knobbly tubers.' It was recognised that the leaves of the potato were poisonous, and that the tubers became green and bitter when exposed to light. Wilson (1995:13) noted that these features caused much consternation and that 'much illness and sickness was attributed to the potato.'

[1] the "short days" referred to are in fact 12-13 hour days and are in reality, neither long or short

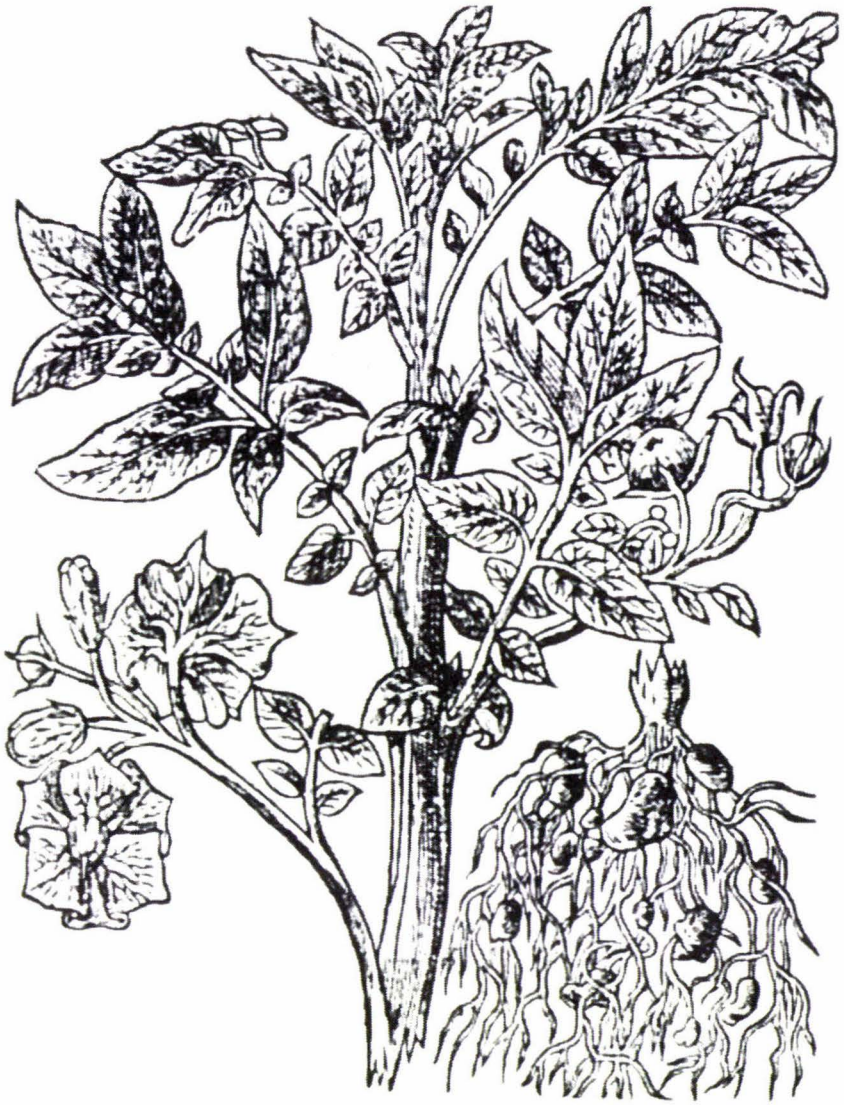


Fig. 4 *The first potato picture to be published. (John Gerard 1597) Note the small tubers and numerous roots which indicate a short-day adapted plant grown in the long summer days of England.*

Hawkes 1990

Phillips and Rix (ibid) noted that the European potatoes were selected and bred from those forms that happened to arrive in Europe at an early date, not from forms that were selected for being either generally superior or likely to do well in northern Europe. It was because these potatoes were not well suited to cultivation in northern Europe that the potato was slow to become an important crop. Because these types set tubers late in autumn, crops grown in England and northern Europe often had their top growth killed by frosts before tubers had fully developed. By the early eighteenth century some development had been undertaken to improve the potato as a food crop. Salaman (1987:160) wrote -

> In the early days of the potato in Europe, fortuitous methods at first held sway, but it was not long before skilled cultivators purposely planted the seed from the naturally formed berries, selecting from the resultant seedlings those plants possessing the characters they sought, early or late maturity, long or round, coloured or colourless tubers.

Wilson (1995:13) noted that although the potato was considered to be less important than the radish in 1716, it later came to be accepted as an exotic vegetable for luxury use. By the mid-eighteenth century it was a well-established and accepted food crop. By this time the potato had adapted to the long European growing days and offered real commercial potential. Phillips and Rix (ibid) referred to records showing that growers in the Manchester region in the 1760s repeatedly raised new varieties from seed and competed with one another to get saleable tubers earlier in the summer. By 1770 there were a number of named varieties available but, as noted by Salaman (1987:163), the practice of giving several local names to the same variety meant there were actually fewer different types available than the range of names indicated.

One of the consequences of this fairly rapid evolution from limited initial importations was that the European potato of the eighteenth and nineteenth centuries had a narrow genetic base (Mackay 1997:564). When late blight, a fungus disease, arrived in Europe in the mid-nineteenth century it decimated potato crops in Belgium, Holland, France and southern England. It then wiped out most of the crop in Ireland in 1845, and almost the entire crop the following year, and again in 1848. These catastrophic events occurred because there was insufficient genetic variation within the available cultivars for some to resist infection. Consequently, the entire crop was uniformly affected. Keating (1996:8) noted that the effects of the blight in Ireland were particularly tragic because the majority of the population depended almost entirely on the potato as a food source. Almost total dependence on the potato is possible as Balick and Cox (1996:90) noted that the potato, when eaten in sufficient quantities, supplies a complete complement of amino acids including lysine which is absent in grains such as maize.

Potato cultivars available in the United Kingdom in the eighteenth and early nineteenth centuries

By the latter part of the eighteenth century, at the time when the first introductions of potatoes to New Zealand were recorded, the following eight named cultivars were recorded as being available and commonly grown in the United Kingdom. These were listed and detailed with the year of their introduction in the United Kingdom by Wilson (1995:15):

> 'The Howard' 1765; 'White Kidney' c.1765; 'The Irish Apple' 1768; 'Red Nosed Kidney' c.1775; 'The Manly' c.1776; 'The Yam' c.1771; 'Early Champion' c.1787; 'Ox Noble' 1787.

Keating (1996:26) recorded, with their year of introduction, the following potatoes as the main cultivars grown in Ireland at the time of the famine resulting from the potato blight in the mid-nineteenth century. 'The Block (pre 1730); 'The Apple' 1768; 'The Cup' (pre 1808) and 'The Lumper' 1808.

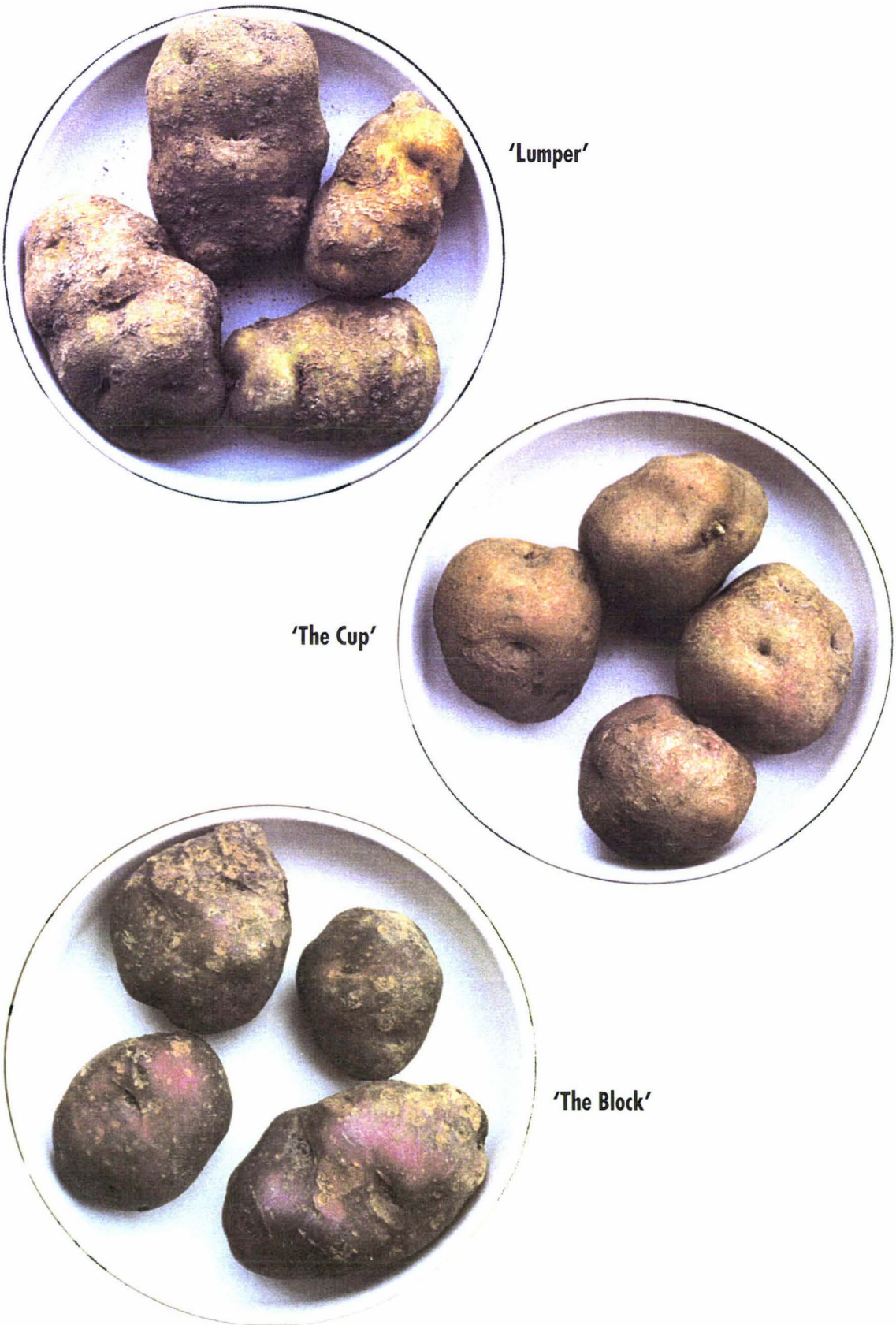


Fig. 5 *Three of the common potato cultivars grown in Ireland at the time of the famine in the mid-nineteenth century.*

Photographs reproduced courtesy of the Agriculture and Food Development Authority, Dublin, Ireland.

Post-blight development of the potato

The catastrophic potato blight epidemics which affected the crops of Ireland and much of Europe in the 1840s and the subsequent famines stimulated the scientific world's serious interest in the cultivation of the potato and in the creation of new varieties. Salaman (1987:164) noted -

> No spectacular development took place in variety raising until after the crisis caused by the pandemic blight *(Phytophthora infestans)* of 1845 and 1846. The failure of any of the existing varieties to exhibit the least resistance to this new and devastating disease gave both the stimulus and directive force to a new era of plant breeding.

The collapse of practically all of the most used varieties led to a search for new and resistant varieties and it was the Chilean subspecies that provided the crucial source of new germplasm during this period. The best documented and most consequential potato introduction did not arrive direct from Chile however, it arrived in North America via Panama. Salaman (1926:7) wrote that in 1851 the Reverend Chauncey Goodrich of Utica, New York obtained clones of Chilean origin from the U.S. consul in Panama. From the original clone which Goodrich named 'Rough Purple Chili' he raised in successive generations a series of offspring which Sauer (1993:153) described as "astonishly successful". These included 'Garnet Chili', 'Early Rose' and 'Beauty of Hebron' and Salaman (ibid) wrote that the "blood" of these soon found their way into the British breeds. Hosaka (1993:55) wrote that at this time a great turnover occurred and that 'almost all previously existing varieties were lost by the late blight attack and then replaced by Chilean subsp *tuberosum*, namely 'Rough Purple Chili' and its descendants.' Hosaka described a method of determining which of the potato cultivars in the Japanese heritage collections were relicts of early (pre 1850) introductions (from Europe) by using Chloroplast DNA (ctDNA) restriction analysis. He determined that A type ctDNA is present in the pre-blight types of Andean subsp andigena origin while those with T type ctDNA are of the later Chilean subsp. *tuberosum* origin.

Chapter 4.

Introduction of potatoes to New Zealand.

Introduction of Potatoes to New Zealand

There are a number of reported introductions of potatoes to New Zealand in the late eighteenth century, and while scholars often disagree as to the most likely *first* successful introduction, from the available evidence it is probable that there was at least one successful introduction during that period. Listed below are details of reported introductions between 1769 and 1793. These are summarised in table 1 at the end of the section.

de Surville 1769

It is often reported (Yen 1961/62:2; Smith 1995:85) that potatoes were first introduced to New Zealand by the French explorer, Jean de Surville, who arrived in Hokianga Harbour on 12 December 1769 on his ship *Saint-Jean Baptiste*. However, journals of that voyage (Dunmore 1981:43) indicate that while he introduced wheat, rice and peas as well as pigs and hens, there is no reference to potatoes. This fact was noted by Best (1925:279).

Cook 1769

Thomson (1859:158) reported that during his first voyage to New Zealand in 1769, Captain James Cook gave two handfuls of potatoes to a chief in Mercury Bay, and that Māori recollection of this event indicated these were planted for three consecutive years before being distributed. Leach (1984:98), noted that 'this gift may well note the first successful introduction of a European food plant to New Zealand'. However, Best (1925:282) stated: 'there is no word of Cook having introduced the potato on his first voyage to New Zealand', and in the same paper he further observed 'Dr Thomson's [Thomson 1859] statement that Cook left potatoes with North Island natives during his first voyage is probably an error. He did not provide any further explanation.

Thompson (1988:182) wrote: 'We know the potato was introduced by James Cook and the recorded reminiscences of Te Horeta Taniwha gave an eye witness account of this introduction at Whitianga in 1769.' He also noted that at least one Pākehā historian (presumably Best) disputes the veracity of this record but that other scholars accept it.

Marion du Fresne 1772

Leach (1984:98) noted that 2 years after Cook's visit, Crozet of the Marc Marion du Fresne expedition established the first European garden on Moturua Island in the Bay of Islands in March 1772. In Roux's journal of that expedition (in McNab 1914:399) it was recorded -

> As the natives are extremely intelligent, we were able to make them understand that the plantations we had made on Marion Island [Moturua Island], of wheat, maize, potatoes and various kinds of nuts, might be very useful to them... All these plants had grown very well, although it was winter. The natives seemed highly pleased, and informed us that they would take care of our cultivations, but I do not know whether they have preserved all these plants, which would be all the more valuable to them seeing that they have only the sweet potato and fern root.

Leach commented that even though the Bay of Islands was going through a turbulent period, the fact that the potatoes were growing in a model garden would have improved their chances of survival. An early French missionary at Hokianga from 1838 to 1842, Father Catherin Servant, recorded that Māori of that time considered the potatoes they grew came from Marion du Fresne's introduction.

Cook 1773

Several authors recorded and commented on the gardens established at locations in Queen Charlotte Sound during Cook's second visit to New Zealand in 1773. (Bayly in McNabb 1914: 207; Begg and Begg 1969: 117,122; Beaglehole 1969: 287; Burney in McNab 1914: 197 and Barrat 1979: 38, 44, 83). On Cook's instructions, the crew of the *Adventure* (captained by Furneaux), planted potatoes along with other European vegetables and grains at several locations in Queen Charlotte Sound. Cook recorded -

> These potatoes were first brought from the Cape of Good Hope and had been greatly improved by the change of soil, and with proper cultivation would be superior to those produced in most countries.

The potatoes that Cook's expedition procured from South Africa while en route to New Zealand were likely to have been of Dutch origin as stated by E. Joubert 1999 (pers. comm.) 'It can be accepted, with an amount of certainty, that the first potatoes for planting purposes at the Cape came from Holland and were in fact planted here as food for mariners.'

When Cook revisited Queen Charlotte Sounds during his third visit in 1777, Best (1925:281) reported that he found 'not a vestige of the gardens remained and with reference to potatoes that 'though the New Zealanders (Māori) are fond of this root, it was evident that they had not taken the trouble to plant a single one.'

However, this was disputed by Best who wrote -

> it is by no means assured that these potatoes were not perpetuated. Any natives seen at the Sound by Cook must have been acquainted with the arts of agriculture and the potato would assuredly appeal to them more than any other of the new food plants. We cannot positively state that the potatoes planted by Crozet in 1772 at the Bay of Islands, and by Cook at Queen Charlotte Sound in 1773 were preserved and propagated by the natives, but it seems highly probable that at least those planted in the northern port were so perpetuated.

W. Harris (1997 pers. comm.) noted that the timing of the Queen Charlotte Sounds plantings by Furneaux (April) would not have been conducive to the production of a potato crop in the Marlborough Sounds. However, Leach (1984:99) pointed out that the potato did survive in the Sounds - as in 1820 the Russian explorer Bellingshausen found that the Māori community at Ship Cove were growing potatoes for their own consumption. Leach also referred to a garden planted in 1773 at Pickersgills Harbour, Dusky Sound, on the instructions of Cook, although less than 20 years later Dr Archibald Menzies reported no signs of introduced European plants at this spot.

Anderson (1998:74) supported the view that the potatoes planted at Queen Charlotte Sound were unlikely to have survived and referred to Cook's observation. He also referred to Taylor 1959:191 who recorded that 'Heaphy was told by one of the few survivors of Ngāti Tumatakokiri, who had inhabited much of the Nelson area at the time of Cook, that they did not obtain the potato until after the arrival of the Northern tribes in the 1820s.'

Lt Governor King 1793

During his visit to New Zealand in 1813 the Rev. Samuel Marsden commented on the extent to which potatoes were cultivated by Māori, and stated that the official introduction of the potato was credited to Lt King, Governor of Norfolk Island, who visited the far north of New Zealand in 1793 and gave the natives various seeds and implements (Elder 1932:526). However, according to Best (1925:282), King's journals do not mention potatoes at all.

Stivers?

In a paper published in the *Journal of the Polynesian Society*, Richards (1993:27-34) wrote of a "Captain Stivers" who was reported by Kendall (1820:107) to have visited New Zealand before Cook and introduced potatoes. Richards considered that Kendall may have heard of Stivers from the missionary Samuel Marsden, who met an old Māori chief who claimed he had met Stivers many years earlier. Kendall was also thought to be responsible for the following comment about Stivers recorded in French by Duperrey (1826:405). 'Tasman does not seem to have had [land] contact at all, and this country was not visited [again] for a long time until a man named Stivers, probably Dutch, anchored at the Bay of Islands around 1766.'

Richards (ibid) considered the possibility that Stivers was a Dutchman with the name Stuyvers or Stuivers. He also provided another explanation - that Stivers may have come after Cook and that he was an American or more likely an English whaling captain. He noted that 'Stavers' was a well known name in British whaling early in the 19th century and that it was often pronounced as "Stivers".

The Māori recollection of Stivers, reported by Kendall noted that Stivers gave to Māori in the Bay of Islands, a distinctive type of potato called *taewa* by the Māori after the name 'Stivers'.

In his *Dictionary of the Māori Language*, Williams recorded the name *taewa* and its variants and wrote 'It is not improbable the word represents the name of one Stivers who is said to have visited the Bay of Islands before Cook'. He also wrote that the name means - 1. a foreigner; 2. a cold or catarrh; or 3. a potato, and that 'both the potato and a cold were introduced by the foreigner and named after him.' (Williams 1971:357).

Richards however, considered that if Stivers' potato was in New Zealand before Cook, it would be unlikely that they would have evaded the close investigations of Māori gardens made by the competent botanists in Cook's crew. Three years later when Marion du Fresne visited the Bay of Islands no mention of potatoes was made in his journals - evidence that if Stivers did indeed introduce a potato to Māori in Northland, it would have been after 1772.

Richards concluded that it would seem to be highly "probable" that Marsden's and Kendall's "Stivers" was not Dutch, nor before Cook but rather, an English whaling captain named "Stavers" on an otherwise unrecorded visit, probably sometime before 1798 and that 'The key tangible evidence from Māori sources, the naming of the potato, definitely favours a visit by an English "Captain Stivers".

Table 1

Eighteenth-century introductions of potatoes to New Zealand, as reported by Leach 1984, Best 1925, Elder 1932.

Year	Name	Location of reported introduction
1769	de Surville	Doubtless Bay, Far North.
1769	James Cook	Mercury Bay, Whitianga.
1772	Marion du Fresne	Moturua Island, Bay of Islands.
1773	James Cook	Marlborough Sounds and Dusky Sound, Fiordland
1793	Lt Governor King	Bay of Islands
1766-1798?	Stivers	Bay of Islands

Following these early introductions (or possible introductions) it is likely that many more potatoes of many cultivars and types were introduced well into the 19th century. Genet (1996:30) wrote that whalers and sealers introduced potatoes and often, because of the plant's ability to perpetuate itself and provide nutritionally good food, planted them as a food source for shipwrecked sailors. Yen (1961:2) noted that there were opportunities for considerably more introductions of potatoes from '...diverse and interesting directions' during the early settlement period in the nineteenth century and that -

> This South American plant travelled many routes to reach New Zealand. Not only could they have come with the settlers who would have brought established Western European varieties, but also some from South Africa (Cook's early introduction is recorded as being of South African stock). Perhaps the whalers who ranged the Pacific at this period had the opportunity of bringing the most interesting material. As ship's stores, potatoes could have been brought from North, South and Central America since Callao in Peru and Acapulco in Mexico were provisioning ports for whaling vessels, many of whose home bases were in the eastern U.S.A. Records of their chance introductions may never be discovered.

Potatoes were frequently brought as stores on ships bringing colonists to New Zealand. While these potatoes were usually sourced in England from districts near to the ports of departure, often additional provisions including potatoes were obtained *en route* from ports such as Cape Town in South Africa. Buick (1928:59) wrote about the settlement of Akaroa on Banks Peninsula by the French in 1840. One of the ships - *L'Aube* which brought supplies for the colonists, was provisioned at Brest in France. Buick wrote - 'A full supply of potatoes was taken in, a portion to be used against scurvy and a portion intended for planting in the new colony.' Buick recorded that the potatoes were planted on arrival at Akaroa resulting in a successful crop.

Leach (1984:127), in writing of edible plants that have had a long association with New Zealand, wrote: 'Although potatoes are residents of a mere 200 years standing, they are intrinsically interesting survivors of the days of exploration, whaling and sealing.'

Pre-European potato introductions

While it is generally accepted that potatoes were introduced to New Zealand by Europeans, some Māori maintain that they were introduced to New Zealand by their own ancestors along with the kūmara, although there is no firm evidence that this was so. Hammond (1894:237-8) recorded that Māori on the Pātea coast said they had several varieties and referred to an ancestor, *Te Reke Tatairongo*, who obtained a tuber from the 'hidden world' which he cultivated and distributed among his people. Hammond noted that the Tatairongo potato was still cultivated (1894) at Pātea and Waitōtara. He also listed 15 named varieties which were cultivated before the introduction of European varieties. In a footnote to Hammond's paper (published in the *Journal of the Polynesian Society*), the editors noted that they had been told by *Te Karehana Whakataki* (living at Porirua) and by *Rangipito* (living in the Hutt Valley) that Māori possessed potatoes before the arrival of Europeans. Both men gave the names of several varieties of pre-European potatoes grown by Māori. The editors however, noted -

> In giving this information, these old men intended to imply that the Maoris possessed these varieties before the times of Captains Cook and De Surville, but it seems to us questionable if they are not varieties produced from those brought here by those two navigators.

Best (1925:284) recorded -

> In the Bay of Plenty district it is a popular belief that the araro and rokoroko varieties of the potato *(Solanum)* were cultivated there prior to the arrival of Europeans, but old Tutakangahau of Maungāpohatu stated that they were obtained during the early years of intercourse with Europeans.

In *'Song of Waitaha'*, a collection of the teachings of Iharaira Te Heihana, Brailsford (1994) recorded several references to the Waitaha people's claim to have introduced the potato to New Zealand/Aotearoa from Waitangi ki Roto, their ancestral

homeland. Along with the kūmara and other introduced plants, he refers to '... peru, the potato which went happily to new soils' (p. 136) and he recorded descriptions of several varieties (p. 143) -

> In the fine soils below makomako we planted the small black potato, the old one named peruperu that needs less water than the others. Its neighbour was the little yellow potato, the taewa that gave great energy to those doing heavy work. On the middle slopes were the small kumara and the big red potato called parete.

This work of Brailsford's appears not have been taken seriously by many academics including King (2000:29-32) who referred to the book as a 'serious misrepresentation of tangata whenua culture that it is not being promoted by professional historians' and that 'people such as Anderson [Atholl], Te Maire Tau and Tipene O'Regan have already demolished it'. Anderson (1998:8) described the book as a 'daft cryptohistory', while Tau (1995:6) in *Song of Waitaha - a descendants point of view*, was highly critical of the book and noted that 'The writer could find little that could qualify as authentic tradition.'

Best (1925:284) doubted that Māori possessed potatoes before the arrival of Europeans and commented -

> If the potatoes planted in Queen Charlotte Sound by Cook in 1773 were perpetuated, then the tribes of Cook Strait must have cultivated them for nearly fifty years before the coming of whalers and traders. Little wonder they claim a pre-European potato.

Biggs (2000) also doubted the presence of potatoes in New Zealand prior to those introduced by Europeans and wrote -

> There is a persistent belief that potatoes (Solanum) were present in New Zealand prior to 1769 but I do not know of any traditional references that would support this. The belief that Solanum was here before contact may have its origin in the transfer of indigenous names for other root-crops to varieties of potato.

While claims of pre-European potatoes persist, and there is some anecdotal evidence as to their existence, some facts that indicate Māori were unlikely to have possessed potatoes prior to their introduction from Europe include:

1. The introduction of the potato from Europe in the late eighteenth century had an immediate and profound effect on Māori society (see 'Adoption of the potato by Māori').

2. There is no scientific evidence (such as pollen records or the discovery of remnants of early carbonised potato tubers) to indicate pre-European potatoes. (B. F. Leach 2000 pers. comm.)

3. Early European explorers, whose expeditions included competent botanists who kept detailed records, found no evidence of pre-European potatoes.

4. There are no old *waiata* (songs) which make reference to potatoes. Roskruge (1999 pers. comm) wrote 'Another key fact which supports the later introduction of taewa to this country is the lack of old waiata which make any reference to them. So we can be pretty sure they did not arrive during the period of the migrations here...'

5. Other plants introduced by Māori, including kūmara *Ipomoea batatas*, taro *Colocasia esculenta*, yam *Dioscorea alata*, hue *Lagenaria siceraria* and aute *Broussonetia papyrifera* were from the warm, humid tropics (H. M. Leach 1984: 53). The potato, however, although of tropical origin, was a high altitude plant which would not have grown successfully in the warm humid conditions of a tropical east Polynesian homeland from where it is generally agreed that Māori migrated to New Zealand, some 900 years BP. (Irwin 1992:6; Davidson 2000). P. M. Matthews (1999 pers. comm.) noted that the potato has never been recorded archaeologically in tropical Polynesia nor in the accounts of early European explorers.

There are several factors which would have precluded successful prehistoric potato production in the lowland tropical conditions that are found in the islands of east Polynesia and it is only relatively recently, through work undertaken by organisations such as CIP (International Potato Centre) and Cornell University, that it is becoming possible to grow potatoes at all under tropical conditions. In 1926 Salaman (1926:130) wrote - 'No variety of the potato flourishes under

tropical conditions. In its native Andean home, although within the tropic zone, the great altitudes at which it is found renders the climate quite temperate.' However Flenley (2000 pers. comm.) considered that the tropical montane climate of the Andes is not temperate - 'it is unique, with summer every day and winter every night with large daily temperature variation but small seasonal variation.'

Midmore and Rhoades (1987:103) wrote - 'The introduction of the potato to the warm tropics is a recent innovation that has been gaining acceptance over the last decade' and Williams *et al* (1991:139) noted that despite recent work to develop the potato for production in the lowland tropics 'it remains essentially a crop of temperate or sub-tropical regions and high-elevation sites (1000-3000m) in the tropics'.

Recent work which has made it possible to grow potatoes in the warm tropics includes: the development and selection of cultivars that will produce tubers under warm conditions. (Manrique 1989:277); the development of "true seed" production methods to avoid storage rots to which potato tubers are highly susceptible in the tropics (Malagamba and Monares 1988:27-31), and the development of programmes to control those tropical pests and diseases that affect the potato plant including the tubers, (Manrique ibid).

Māori-developed cultivars

It seems likely that Māori developed some cultivars[1] by sowing true seed of the potatoes that were available to them and making selections from the seedlings. This was reported by Colenso (1880:14), who noted -

> The northern tribes, especially the Ngapuhi, had more than forty years ago, obtained several new varieties of potatoes by sowing its seed; to which, however, they were first led by accident, having noticed some young plants which had sprung from self-sown seeds of the ripe potato berries and from them they had obtained several good and prized sorts.

Yen (1988:39) also referred to the Māori development of cultivars. He noted that, while the many potato varieties grown by Māori are regarded as simply relicts of direct and early European introduction, a Mrs Henare spoke of 'potato apples with seed' in reference to her plantings of potatoes at Motatau in Northland. He suggested that, through Māori selection, these potato seedlings produced the Māori varieties. He described this as 'a redomestication'. Salaman (1987:159) noted that this practice by native cultivators of intentionally raising new potato varieties by sowing true seeds from the potato berry, has been undertaken for many years, and referred to Colombian native people who collect potato berries, from the Andes mountains, 'selecting from the seedlings the better types and the heavier yields'.

Raising potato plants by true seed also appears to have been a practice undertaken by Taranaki iwi, as Roskruge (1999 pers. comm.) referred to *taakuru* as the name for true potato seed and *monemone* - the name for plants raised by sowing true seed, as names used by Māori in that district.

[1] In this thesis, the *International code of nomenclature for cultivated plants* (1980) is followed , in enclosing cultivar names, including those with Māori names in single quotes and leading upper case letter.

Observations by the present author while growing 18 varieties of Māori potatoes for three seasons indicate that few of these types actually set seed. While all varieties except 'Kowiniwini' produced flowers each year only four varieties ('Māori Chief', 'Māori', 'Poiwa' and 'Raupi') set seed during this period.

Fig. 6 *Potato berries and seed. It is possible that some of the potato cultivars grown by Māori were selections from seedlings.*

Salaman (ibid.) noted that in Europe (the source of potatoes introduced to New Zealand) fruit-bearing varieties were not common due to a dominant mutation which occurred after its introduction (to Europe and the United Kingdom), which inhibited the full development of the anthers while Howard (1970:90) wrote - 'The lack of pollen fertility in many established varieties can be a serious handicap in that many desirable crosses cannot be made.' An examination of the anthers of the cultivar 'Urenika' shows a complete absence of pollen, so in order to produce seed, this variety would need to be pollinated by a pollen producing cultivar and it could not be used as a pollinator.

While it is possible that some of the potato varieties perpetuated by Māori resulted from intentional seedling selection, Yen's apparent claim that all or most of these varieties were produced by this method is unlikely, as there are no

records of the practice being widespread (it has been recorded as having been undertaken only by northern iwi and in Taranaki) and few seed-bearing varieties would have been available. The fact that crosses between Tuberosum varieties yield about one useful variety for every ten thousand seedlings raised (Howard 1970:92) adds weight to this argument. In a recent letter Yen (2000 pers. comm.) noted that he hadn't meant to imply that all Maori varieties arose from seedling selection.

One cultivar that is very likely to have been selected and perpetuated by Māori is 'Kowiniwini' - a cultivar that has a purple skin with very clearly defined bright yellow patches around the eyes, giving rise to the name, which means "many windows". A Northland kuia (Mrs E. Tipene 1997 pers. comm.) said that 'Kowiniwini' was one that was that was selected by Māori for its very striking appearance and that 'it arose from another variety' which suggests it may have arisen from a somatic mutation or "sport" rather than from seedling selection.

Fig. 7 *The cultivar 'Kowiniwini' is possibly a "sport" which arose from 'Peruperu'.*

It is well known that Māori had an appreciation of art and things that were aesthetically pleasing. This is evidenced by whakairo (carving), tukutuku panels, kōwhaiwhai rafter patterns, tāniko weaving, and other art forms used to decorate buildings, weapons, utensils and moko designs to ornament their bodies. Many of these forms of decoration represented aspects of the natural world such as the many forms of plants represented in kōwhaiwhai patterns. (Harris and Lucas 1998: 50-52)

'Kowiniwini' has a particularly striking and almost "unreal" appearance as evidenced by comments when tubers have been displayed as part of presentations by the author at seminars, and it is not surprising that the appearance of these tubers made an impression on Māori.

The cultivar shows the typical "spectacle pattern" described by Simmonds (1965:272-288) and Howard (1967:57-64; 1970:28-29). Salaman (1926:6) described the pattern as "parti-coloured". Other Māori potato cultivars which display less well defined spectacle patterns are 'Peruperu' and 'Karuparera'.

Howard described spectacled tubers as 'having areas of periderm [outer skin or epidermis] and phelloderm [inner layer of skin derived from the cortex] around the eyes without pigment, the remainder of the periderm or phelloderm being intensely pigmented.' He noted that 'in some clones, spectacle is variable both in frequency and intensity of expression'. Heiken (1958:320) described this coloration pattern as a *periclinal chimera* arising from somatic mutation[2] and Howard (1970:70) estimated the frequency of origin of this kind of aberration as approximately 1 in 180,000. Simmonds (1965:288) suggested that spectacle frequencies may be maintained by selection at various levels between 0 and 90 percent, which means that expression of the spectacle pattern is unstable to varying degrees.

Experience with growing 'Kowiniwini' over a four year period has shown that approximately 20% of plants produce tubers that are less distinctly spectacled, with some reverting to a coloration pattern that looks very similar to 'Peruperu' giving rise to the possibility that 'Kowiniwini' arose as a sport of that cultivar particularly as many of the other morphological features of the two cultivars are similar. Plants tend to produce tubers that are either all typically patterned or all less distinctively patterned - they generally do not produce both types of tubers on the one plant. The cultivars 'Peruperu' and 'Karuparera' appear from Howard's descriptions of skin colour (1970:86-87) to be somewhere between the "splashed"

[2] mutation of vegetative or asexual tissue

and the spectacled colour types. He recorded that the spectacled types have genes for "splashed' and "hidden-spotted" types and that reversion to the original phenotypes is common so the possibility of 'Kowiniwini' arising from 'Peruperu' and having a tendency to revert to that type lends credence to its possible origin.

Because of the tendency of 'Kowiniwini' to revert to the less distinctive type, Māori must have maintained the cultivar by practising continuous selection - planting only the distinctively patterned tubers.

'Kowiniwini' is a cultivar which produces an inferior yield[3] and it has poor culinary qualities[4] so it appears likely that the main reason for its perpetuation by Māori was for its aesthetically pleasing appearance.

[3] this may be partly due to virus infection
[4] 'Kowiniwini' flesh is floury and disintegrates when boiled

Chapter 5.

The adoption of the potato by Māori.

Adoption of the potato by Māori

Effects on Māori society

Māori were quick to recognise the advantages of the introduced potatoes over the kūmara. They were easier to grow, yielded more heavily and were easier to store. Yen (1961:4), in referring to the introduction of the potato, considered that agriculturally the impact of the plant must have been spectacular.

Best (1925:284), in reporting accounts of the voyage of the *Venus* (1836-39), wrote -

> the Maori certainly appreciated the potato and it is at the present time his most favoured food supply. When he found that it not only suited his palate, but was also most prolific and was capable of being cultivated to advantage at all altitudes and at all places occupied by the native people, he recognised its great superiority over the kūmara, which requires much more care in its cultivation.

The significant impact of this introduction on Māori society was recorded by Firth (1929:488), who wrote -

> The results of the introduction of the potato bring out with clarity, the manner in which new culture items affected the economic life and even the environment of the native. The potato is of such hardy nature that it can be grown in all districts and moreover it is prolific, yielding a plentiful return for the labour expended. Hence it was speedily introduced into districts which like Tuhoe had formerly possessed no cultivated foods and also tended to replace the kumara among other tribes. Again it effectively supplanted the aruhe, the fern root *(Pteridium esculentum)* as one of the staple vegetable foods.

(a) The kūmara cultivar 'Taputini'

(b) Aruhe or bracken fern rhizomes

Fig. 8 *The kūmara and aruhe (bracken fern rhizome) were the main food plants of the Māori before the introduction of the potato.*

Firth also considered some negative aspects of the introduction of the potato on Māori society and on the environment. He noted that formerly the forest had been strictly conserved as a source of wild foods such as berries, birds and rats. However, following the introduction of the potato, this care became unnecessary and year after year more forest was destroyed to make way for potato plantations. Cameron (1964:98) wrote of destruction of indigenous forests by Māori agriculturalists of the nineteenth century -

> The introduction of the potato to New Zealand at the end of the eighteenth century caused considerable changes in Maori agriculture. There was a great expansion in shifting cultivation over forest land and there are records of Maori fires having destroyed very large areas of forest.

Firth suggested that, because cultivation and production of the potato crop required less care and attention, there was more time for other less energetic pursuits. He considered that 'this contributed to a general decline in physical

fitness of the race[1].' Belich (1996:159) in writing of Māori warfare, considered that the introduction of the potato (and the pig) gave Māori a reliable surplus, helped in feeding long-range expeditions and meant that because less labour was required for food production, warriors were available to take part in warfare expeditions. He suggested that in 1818 acreages of potatoes and other crops may well have become really substantial and reliable among the Northland groups and noted that - 'Potato wars might therefore be more accurate than musket wars' - a suggestion that the potato's part in Māori warfare was at least as significant as the musket.

Introduction of the potato to the South Island

Potatoes were particularly welcome in the southern regions of the South Island where kūmara would not grow. Records show that initially, potatoes grown by Māori in Otago and Southland were grown on mounds according to traditional kūmara culture, and it was suggested (Leach 1984:99) that they were introduced to the south by Ngāi Tahu from the Kaikoura region who were known to raise kūmara. Leach wrote -

> If the potato introduction had been made through the non-horticultural Fiordland Māori families, it is most unlikely to have been treated as kumara. I suspect that the original source was one of the Queen Charlotte Sound gardens from which the potatoes had been removed. Taken in hand by kumara gardeners of Marlborough, and with their hardiness rapidly recognised, they were probably distributed to the south through the kinship links of the mobile Ngai Tahu who occupied much of the eastern and southern coasts of the South Island.

Anderson (1998:73-74) disagreed with this explanation, describing it as 'a provocative and widely held hypothesis developed by Otago scholars particularly in the 1960s.' He wrote that while it was possible that potatoes reached the south

[1] In modern anthropological and biological understanding the Māori are not considered to be a "race".

from Marlborough 'there is no evidence that this occurred, let alone in the 1770s' referring to the reported failure of the potatoes planted at Queen Charlotte Sound by Cook in 1773 (refer to page 28). Anderson considered that it was more likely that potatoes were introduced to the south by Europeans. He wrote -

> It is more probable, then, that potatoes were introduced to Murihiku [Southland] when the seal colonies in newly-discovered Foveaux Strait, which was first mapped in 1804 by Owen Folger Smith, were opened to exploitation. Sealers were expected to spend long periods living on their own resources and habitually carried seed potatoes. A gang from the *Fox*, stranded on Solander Island in 1808 for four years, grew potatoes and cabbages and there were large potato plantations on the Snares by 1817.

By whatever means the potato reached and was distributed around the South Island all European observations from the early nineteenth century onwards mention the cultivation and availability of introduced potatoes and Anderson (ibid) noted that the prolific and adaptable "white" potato had a profound effect on Māori economics in general. He recorded (pg 72) -

> This was especially so south of Waihora (Lake Ellesmere) where, until its arrival, Māori had lived beyond an agricultural frontier defined by prehistoric kumara cultivation. Some consequences of potato cultivation can be reasonably assumed. Seasonality of potato cultivation and harvesting required that cultivation occur in summer foraging territories, or that a greater proportion of village populations remained at home during the planting and harvesting seasons. In the 1840s, at least, both strategies were employed. There were potato gardens around villages, but also isolated gardens along uninhabited coasts or in the interior which were tended to as foraging parties passed to and fro. The food yield and value of potatoes especially in relation to labour expenditure, greatly exceeded that available from fern root and cabbage tree, so there was a substantial increase in the productivity of vegetable foods. Since these had been the limiting factor in prehistoric diets, especially in the south, nutritional status and population growth probably both increased during the early nineteenth century in southern New Zealand.

The potato as a staple food

In writing of acceptance of new crops in Polynesia, Leach (1983:145) stated -

> Forty years after the Maoris' first exposure in Northland to European plants, the five pre-European food plants were still grown but had been joined in Maori gardens by two other root crops, potatoes and turnips, by a green crop cabbage and by the tall maize. The most successful introduction of all was the potato...

While it is well documented that by the early part of the nineteenth century, the potato was grown extensively by Māori, some writers contend that at this period they still relied principally on traditional food crops. Shawcross (1967:333) asserted that it was not until after 1820 that introduced food crops displaced fernroot *(Pteridium esculentum)* as the principal staple food item in the diet of the Māori. By the 1830s Hargreaves (1963:104) considered the potato was the basic food crop of New Zealand, 'preferred by the Maoris above all their traditional crops.'

In writing of the introduction of new foods which subsequently became staples, to cultural groups unfamiliar with that type of food, Leach (1999:132) wrote 'It is hard to assess the extent to which the Māori valued Solanum potatoes as food, given the importance of the crop in trade throughout the country.' The same author (1969:56) recorded that fernroot remained in use into the 1840s in areas where large acreages of potatoes were grown and suggested that 'the potato was not the preferred staple for some 40-70 years after its introduction despite the ease with which it could be gathered and prepared.' Leach suggested that it became the staple source of starch not because of taste preference but because it was technologically undemanding and economically important. She noted that unlike potatoes, wheat was not accepted initially because the necessary equipment to process it into flour was not provided at the same time.

By the late 1840s fernroot was not much eaten except (Anderson ibid pg 176) when potatoes were unavailable which sometimes occurred in early summer.

Māori gardens and production systems

Because the method of propagation and production of the potato was similar to that of kūmara, it was able to fit into the existing agriculture system of the Māori with little modification. Best (1925:99) described methods of planting potatoes that were identical to those used for kūmara. He noted that the implements used for cultivation, and the ceremonial rituals, were also the same. It is however, unlikely that Māori initially accepted that the potato was a new variety of kūmara rather than a new crop as suggested by Driver (1966) as there is no evidence to support this opinion.

Māori traditionally planted tuberous roots[2] of the kūmara as a means of establishing a crop which is similar to the usual method of planting tubers to establish a potato crop. The modern commercial method used to grow a kumara crop is to plant "slips" or cuttings in the field from the previous year's crop. (Lewthwaite 1998:32)

While Best and others have said that Māori adapted kūmara production methods to growing potatoes, Cameron (1964:102) pointed out that this is not strictly correct. He noted that the two vegetables require different soil conditions with kūmara growing best on warm, well-aerated soils while potatoes prefer cool moist soils. Māori horticulturalists soon discovered that potato crops grew best on freshly cleared land and would not grow well on the same soils year after year. For potato production new land was used at least every second year, and this made greater inroads into the forest than had kūmara production which involved using the same piece of land for several years.

The need to use new land for potato production was partly due to Māori refusal to use animal manure to fertilise the soil. Many aspects of gardening and crop production were regarded by Māori as sacred and Leach (1984:109) wrote that for this reason 'the use of animal dung was totally abhorrent to nineteenth century

[2] The tuberous roots of the kumara are modified (tuberous) roots which differ from tubers of potatoes which are modified (tuberous) subterranean stems. Kumara tuberous roots produce adventitious shoots

Māori gardeners.' Leach recorded that William Williams of Poverty Bay had this to say of a poor potato crop he saw on the Wairarapa coast in March 1848 -

> The ground is poor and the potatoe crop has failed in consequence of the long drought. This would have been in great measure remedied if manure had been used in the culture, which would have advanced the crop before the dry weather came on, but the natives are indisposed to depart from their old customs.

Colenso (1880:11) commented on this aspect of Māori gardening and wrote -

> One striking peculiarity, however should not be omitted - in which too, I think, they differed from all agricultural races - their national non-usage of all and every kind of manure... But their whole inner man revolted at such a thing; and when the early missionaries first used such substances in their kitchen-gardens it was brought against them as a charge of high opprobrium. And even in their own potato planting in after years they would not use anything of the kind, although they saw in the gardens of the missionaries the beneficial effects arising from the use of manure; and, as the potato loves a virgin, or a strongly manured soil, the Maoris chose rather to prepare fresh ground every year, generally by felling and burning on the outskirts of forests, with all the extra labour of fencing against the pigs, rather than to use the abominated manure.

Edward Wakefield who visited Kotukutuku in the central North Island in 1841 described a method (Wakefield 1908:418) by which Māori cleared forest and prepared the soil for potato cultivation -

> The underwood has been cut away, but the tall forest trees, chiefly matai or mai remain standing and still alive; the plantations and villages are disposed among their trunks, on the acclivity of which rises from the side of the lake to Pihanga. They grow all their potatoes here by throwing up the soil in heaps, about four feet in diameter, and a foot high; so the whole cultivation takes place above the soil in artificial beds.

Māori often cleared areas of forest and scrub in preparation for potato gardens by burning the vegetation and Hargreaves (1963:103-105) recorded numerous instances of large areas of forest destroyed by fire for this purpose. Burning was also a practice used earlier in preparing areas of land for kumara gardens.

Gallagher (1986: 580) noted that burning in preparation for gardening was a well-established practice in prehistoric agricultural production systems and recorded the benefits of burning existing vegetation and crop remnants -

> Burning kills surface insects and removes dead crop residue, weeds and litter from the previous season. The removal of this litter plays an important role in warming the soil by removing the layer of materials which block solar radiation. Burning also blackens the surface of fields, increasing the ability of the fields to absorb solar radiation ...increasing the absorption of radiation by as much as 15 percent. Working ash into the soil adds nutrients such as phosphorus and potash.

Roberts (1913:231) in writing of Māori potato production in the 1850s in Southland described production of a commonly grown purple-fleshed cultivar which he named 'Mangamunga'. - 'They yielded the best crop when planted in bush land, on the surface of the ground, and held up with loose soil. We called the heaps "Maori hills". The yield was 'many tons to the acre.'

Holmes (n.d.) wrote of Māori potato gardens in the Chatham Islands in the early 19th century noting that of the two classes of land on the islands - clear land and bush land, the latter was best for potato production. He described the method of establishing potato gardens -

> The bush land being the best and the natives having no implements other than axes and spades, the method used in growing potatoes was a bush garden. To clear an area of bush by felling all trees in the area selected, the fallen trees were cut up and built around the outer side for a fence, any big tree trunks were left lying where they fell, the tops and limbs being cut off and piled on the fence, the ground surface was cleared of sticks, chips and rubbish etc and planting began. These gardens were of all shapes and sizes. The planting was done with a spade or whatever they had. A hole was chopped through the tree roots wherever possible and a seed potato planted, they were not planted in rows as that was not possible because of the tree stumps. As the ground had no weed seed the potatoes grew with little attention until the garden was a mass of potato tops and continued to grow until they ripened in the autumn. The potatoes were then dug by or harvested by whatever means available, very often with a stick and hands.

Māori also developed innovative cultivation methods. Best (1925:285) recorded that the Māori became adept in the cultivation of the potato and adopted some methods not employed by European settlers. He wrote -

> in order to obtain a very early crop he planted seed tubers as early as June in scrub land or light bush, then felled the bush which was burned in early spring. The fire destroyed the haulm of the plants that had grown up through the felled timber, but a new growth soon followed, whereas exposure to frost would have spoiled the crop. This method is called *whakapara* in the Bay of Plenty and *whakaota* at Taupo.

Leach (1984:109) in referring to new plant introductions including the potato, noted that by the nineteenth century Māori were using the new plants to great

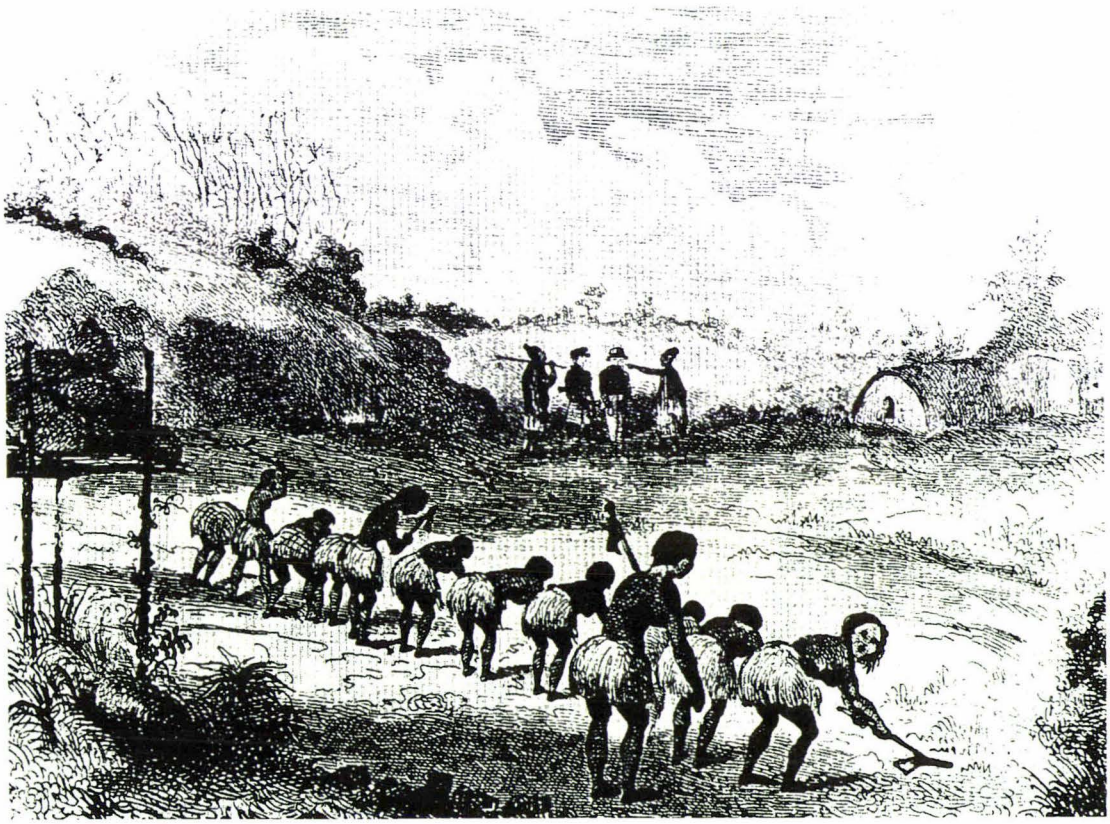


Fig. 9 *'Défrichement d'un champ de patates' ('Digging a field of potatoes'). Women working with the kō, digging sticks. This lithograph by Louis de Sainson, published in 1839, derives from the voyage of the corvette* L'Astrolabe *to New Zealand in 1826–27. Note the seed potatoes stored on a whata to the left of the picture.*

The Hocken Library.

advantage and that the new plants and tools were slotted into place within the traditional systems. She described Māori gardening of the time as 'a robust and adaptable tradition.'

By the early 1800s Māori were growing large crops of potatoes, and an area of 50 hectares in potato production was not uncommon. An article titled 'Historical records of New Zealand South,' in the *Sydney Gazette*, September 1813, records the visit that year of a flax dresser, named Williams, to the Bluff. Best (1925:285) quoted this article -

> The natives attend to cultivation of the potato with as much diligence and care as I have ever seen. A field of considerably more than 100 acres presented one well cultivated bed, filled with rising crops of various age, some of which were ready for digging, while others had been newly planted. Dried fish and potatoes form their chief support.

Iron tools

Initially potato gardens were prepared as for kūmara by cutting and burning the forest, digging the ground with the traditional digging stick (kō) and then planting the seed (tubers) in small hillocks (Anderson ibid pg 77).

Of the introduced agricultural tools, the axe, spade and hoe were probably the most commonly obtained and used by Māori (Hargreaves 1963:109). Grey (1994:138) wrote that only those metal tools such as hoes, spades, axes and mattocks that fitted the types and functions of the old wooden gardening implements were readily adopted. The availability of these more efficient iron tools in comparison with the former wooden ones was of great significance. The spade and hoe permitted efficient cultivation of the soil while with the iron axe, the Māori was able to clear much greater areas of forest than was previously possible for cultivation of the potato.

In 1823 Marsden (quoted in Elder 1932:371) commented -

> The introduction of tools of agriculture...has encouraged very extensive cultivation in every district, and it is extending more and more every day...To give a man a spade is not like giving him 100lb of potatoes to supply his immediate wants, but it is furnishing him the means of raising many hundreds.

In the same year Marsden estimated that cultivation had increased forty-fold as compared with a decade previously when the traditional wooden implements were still mainly in use. Hargreaves (ibid) expressed the opinion that this was not solely due to the new tools although they did greatly assist the increased production desired for trading with Europeans.

Fencing

The introduction of domestic animals and particularly the pig made it necessary to fence the potato crops. Best (1925:38-40) described the two types of fences that were used by Māori to protect crops. The first was a series of close vertical stakes set into the ground and lashed by a horizontal rail while the second type consisted of fewer uprights and many horizontal pieces (see fig. 10). Best observed that fences to exclude pigs needed to be very strong and stated - 'fences that effectually bar horses, cattle and sheep may be no protection against free lance pigs left to shift for themselves.'

Hargeaves (ibid) wrote that Māori in the Bay of Islands were fencing against the pig as early as 1814 and some tribes initially refused to have pigs in the vicinity to avoid the need for fencing. Cruise (1824:31) recorded observations of Māori potato production in the Bay of Islands in 1820 and wrote - 'We passed some small patches of cultivated ground, in which were planted common and sweet potatoes, and which are fenced in with a coarse kind of paling'. He also noted that pigs ran wild in the nearby woods.

Earle (1832:85) wrote of vast expanses of cropland at Taimai in Northland in 1827 which was unfenced and required constant vigilance to ensure the crops were not destroyed by pigs. He commented on the great waste of labour which would have been more suitably employed in erecting fences.

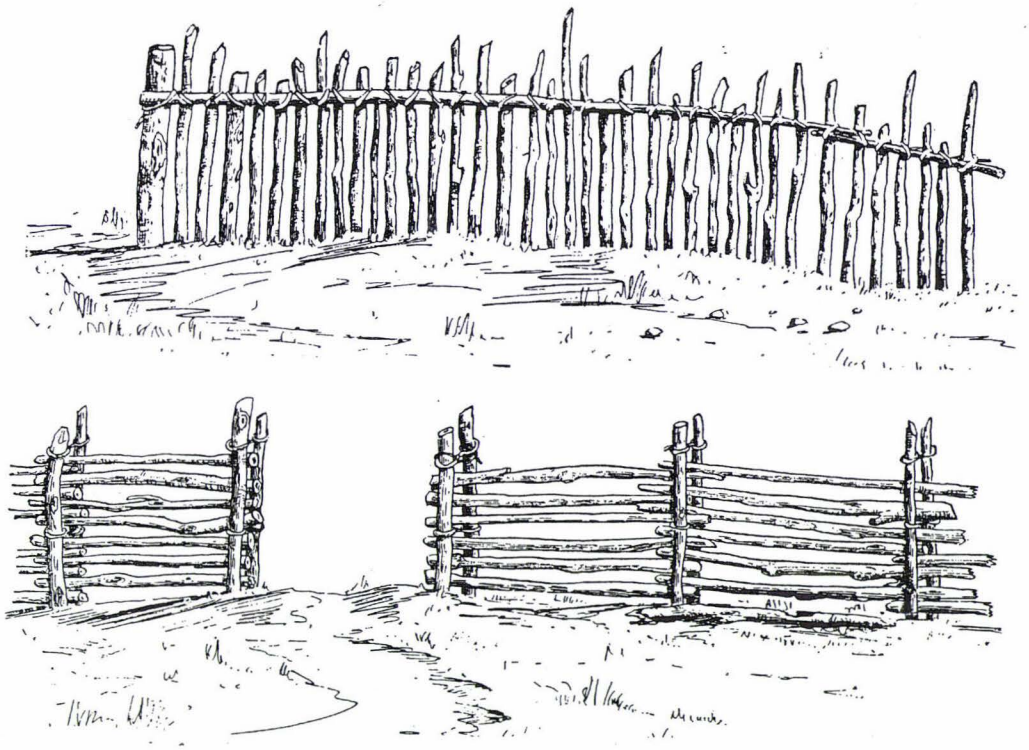


Fig. 10 *Two types of fences used by Māori to protect gardens from pigs.*

Best 1925.

Figure 11 shows a fenced potato garden.

Fig. 11 *A fenced potato garden adjacent to a fortified pa (1845).*

Alexander Turnbull Library, Wellington A-079-031.

Storage methods

Māori found that potatoes were easier to store than kūmara in that they were less susceptible to storage rots. In writing of storage of the kūmara Best (1925:226) recorded 'It was a vegetable that did not keep well. Mould grew quickly, owing to the presence of sugar; the ordinary potato was not so affected, owing to the absence of glucose.' Spoilage of sweet potatoes in storage was explained by Weimer and Harter (1921:189-190) who noted that because of the high content of sugars in sweet potato they are susceptible to a range of storage rot fungal organisms.

Similar storage methods to those developed for kūmara were initially used for overwinter storage of potatoes. Leach (1979:112-113) described a circular raised-rim storage pit on a bank of the Mākotukutuku stream in Palliser Bay. He interpreted this as a potato store that was probably in use in 1840 when it was recorded that potatoes were grown in the area. A layer of fern stalks was found on the floor of the pit. Leach noted 'the use of fern as a floor covering suggests a continuation of an earlier practice designed to keep tubers off the damp floor of storage pits.' Describing numerous potato storage pits at Waimate, Marshall (1836:21) recorded they were 'found in all directions as to completely honeycomb the whole of the ground.' He described these potatoes as being for consumption, while seed potatoes were put in baskets covered with fern.

The practice of covering stored seed potatoes with fern leaf is interesting as the practice is still undertaken today by Māori in Northland (see fig. 12). The following explanation was given by a kuia (elderly woman) at Motatau. 'The dust from the fern leaves keeps the riwai healthy.' She further explained that the fern must be mamaku *(Cyathea medullaris)* and that wheki *(Dicksonia squarrosa)* should be used for kūmara storage. Presumably the 'dust from the fern leaves' she referred to is fern spores. Another Northland informant (G. Clayton 2000 pers. comm.) described a traditional method of storage of potatoes (for consumption rather than for seed) used today by Māori which involves storing tubers between alternate layers of ponga fern *(Cyathea dealbata)* and the introduced herb pennyroyal *(Mentha pulegium)*. It is suggested that this method deters rats and mice.

Fig. 12 *Fern covering potatoes in storage*

Best (1916:92) compared storage methods of kūmara with those used for potatoes. In describing kūmara storage he wrote 'a slight dampness or bruise or abrasion would cause these tubers to decay, and such decay was quickly communicated to surrounding tubers.' He noted that the crop was handled very carefully and each tuber was stacked separately. 'A crop of kumara stacked in a pit is the very height of elaborate neatness.'

In writing of potato storage Best recorded -

> When, however the Maori obtained the common potato he soon found it needed much less care in handling and storage, that it could be thrown carelessly into a basket, and poured out in a heap in the store; also that it might be kept for a considerable period in ordinary huts or elevated stores.

Māori also stored potatoes on raised platforms called *whata*. Savage (1807:56) remarked 'their mode of preserving them is upon a platform erected on a single pole, about ten feet in height.' Marshall (1836:170) made similar observations and referred to 'several wata or stages, supporting baskets of seed potatoes carefully sewn up with dried grass and covered with fern leaf.

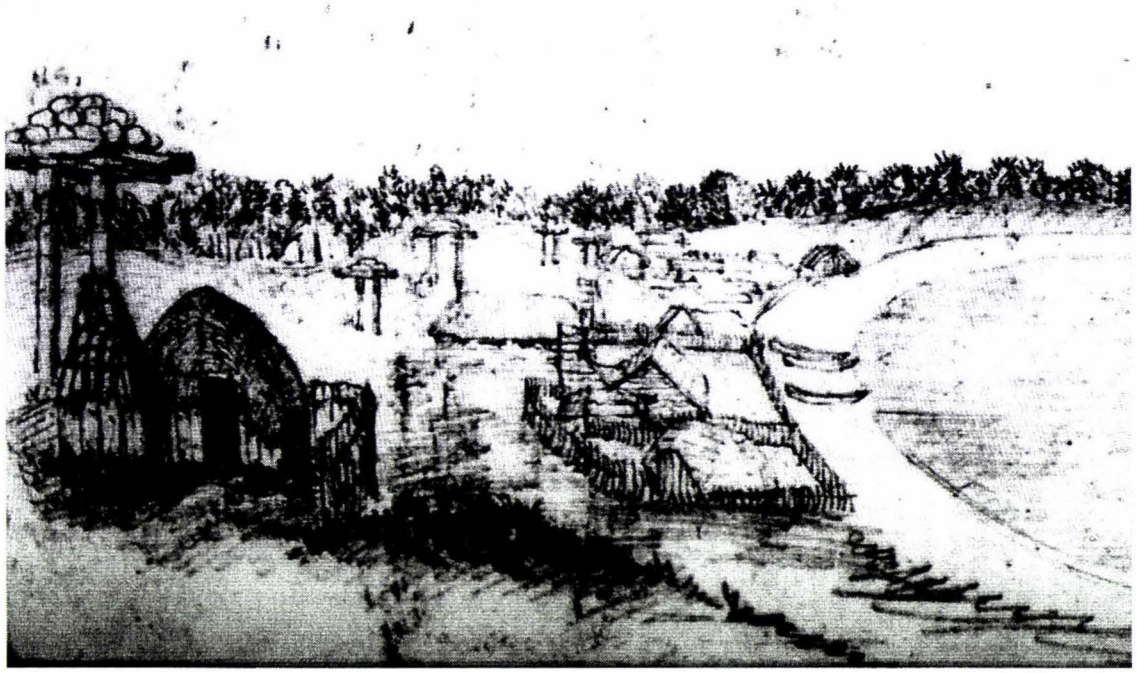


Fig. 13 *Ruapuke village in 1844, showing numerous whata or raised food stores — often used for potato storage.*

Alexander Turnbull Library, Wellington F-11578-1/2

By the mid 1830s Māori potato production was extensive and Anderson 1998:173 wrote that the tubers were stored either on *whata* or in *clamps*. He noted (pg 212) that *whata* were particularly common in the Ngāi Tahu settlements in the southern parts of the South Island and were 'almost a defining feature of southern settlements.' Roskruge (1999 pers. comm.) noted that his people (Atiawa from Taranaki and Ngāti Toa from the south west coast of the North Island) believe that *whata* or *w'ata* evolved because of rats and pigs, which had a habit of interfering with *rua* (storage pits) because they were accessible from ground level however B. F. Leach (2000 pers. comm.) said there is some archaeological evidence that *whata* were used in prehistoric times. It is possible that their use became more widespread following the introduction of pigs and rats[3] introduced from Europe.

Whata were usually erected in the bush to keep the stores out of sunlight. Early *whata* were usually very basic and purely functional structures however over time

[3] Māori also introduced a rat from Polynesia - the kiore (*Rattus exulans*) which was not recognised as being a particularly troublesome pest of stored crops. (Walsh 1902:20)

they became more elaborate and were decorated. Some had a single supporting pole whereas others had two or four poles. Types of *whata* are illustrated in figures 14 and 15.

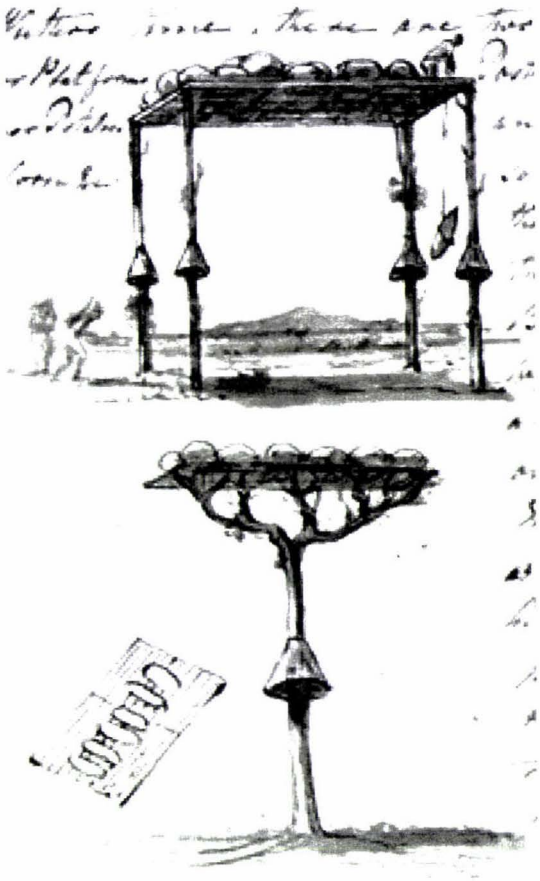


Fig. 14 *2 sketches of whata showing conical attachments for protection against rats. c1834.*
Alexander Turnbull Library. MS-1550-036

Fig. 15 *A Māori storage platform (whata) in dense bush with seed potatoes stored in kete. c1840-1850.*
Alexander Turnbull Library A-189-019.

The use of *clamps* by Māori, for longer term storage of potatoes was also common in the South Island (Anderson pg 120) although at the same time (1830s-1840s) kūmara were still stored traditionally in roofed-over pits. Clamps were also used by Māori in the North Island and Jones (1994: 251) gave the following description of a potato clamp -

> A potato clamp was made by burying a crop of potatoes under a low flat-topped mound, thus sealing them off from the effects of light and frost. The earth came from a ditch, circular in plan, which was dug around the mound of potatoes. The ditch also served as to keep the base of the clamp well drained.

He went on to note that today, remnants of such clamps can be recognised by a characteristic ring-shaped ditch up to 10 metres in diameter.

The practice by Māori of clamping potatoes could well have been learned from Europeans soon after the time of their introduction as this method was commonly used at the time as a method of over-winter potato storage in Europe and the UK and continued to be used until relatively recent times. Watson and Moore (1956:337-338) described the use of potato clamps in England -

> The principles of clamping are the same throughout the country, the construction being designed to protect the potatoes from frost and rain and at the same time allow a certain amount of ventilation.

They went on to describe how to construct a clamp by placing a mound of potatoes on a well drained base, heaping them up as steeply as possible and then covering the mound with wheat or rye straw to a depth of a foot. The mound is then covered to within a foot of the top with about six to eight inches of soil. The straw along the ridge is arranged so as to shed water and allow ventilation.

Jones (ibid) suggested that 'Māori practices in the storage of white potatoes were probably not dissimilar to European, although the crop may also have been stored in variants of the traditional pits.'

In the Chathams during the mid 19th century potatoes were stored using a variety of methods and Holmes (n.d.) describing storage of potatoes for trade wrote -

> When all the potatoes were dug, they were sorted and conveyed to where they were to be stored, sometimes in a pit covered with rushes etc or a potato house, which was a house or shed raised off the ground with a batten floor, like a sheep pen, punga leaves were spread over the floor, battens to keep out light, the potatoes were then tipped on the floors and the whole lot covered with punga leaves or whatever was available to keep them dark, this way potatoes kept well.'

Holmes (ibid) also wrote of *whata* for potato storage and described them as a raised platform some 3ft or more off the ground and made from split bush timber.

The *whata* he described must have been in use in the mid 19th century rather than earlier as the upright posts had tin around them to keep out rats. He said they were of all sizes; some held many tons.

Māori stored seed potatoes differently from those for consumption or for long-term storage for trade. Seed potatoes were usually stored in open *kete* or baskets and placed on a *whata* and probably protected from frost with a layer of fern. Those stored for later consumption or trade, were stored in pits or clamps and protected from light. Māori were aware of the principle of exposing seed potatoes to diffused light to reduce premature sprout growth. One Northland kuia (Mrs E. Tipene 1997 pers. comm.) said that riwai "seed" were placed in shallow *kete* or baskets and only covered with a thin layer of fern so that light could reach them.' Rhoades (1984:23) noted that the technique of exposing potato tubers to diffused light has long been used by farmers in Peruvian villages and in developing countries and that besides controlling sprout growth, exposure to low light levels lessens pest and disease damage to the tubers. Similar principles for storage of seed potatoes are adopted by Māori today in areas where the old cultivars are still grown.

Cooking methods

Iron pots were not common in Māori villages until the 1830s (Leach 1984:106) so potatoes were initially cooked using traditional methods. Leach noted that until the iron pot was commonplace 'vegetables which most appealed to cooks were those that could be prepared in traditional ways, either roasted over embers, eaten raw or steamed in the earth oven'. The method of cooking using an earth oven was described by Leach (1982:152-154). Thomson (1859:159) considered that prior to the introduction of iron pots -

> The science of cookery was in a primitive state among the New Zealanders, for being destitute of vessels capable of resisting fire, the cookery of the whole race, except for those living near the boiling springs at Taupo or Rotorua was limited to steaming and roasting.

He went on to describe the earth oven. He also described the method of roasting - 'Roasting was effected by placing the articles near fire, but the New Zealanders despise this mode of cooking, and called it a make-shift, a dinner for slaves or men in a hurry'.

By the 1830s, boiling in iron pots appeared to have become a common method of cooking potatoes. Marshall (1836:70) observed a couple of women boiling potatoes on an English swing pot and commented -

> ...the lately savage inhabitants of a savage country, not only feeding on a root for which they were indebted to an Englishman, but also cooking it after the English fashion in a vessel of English manufacture.

In writing of cooking of potatoes in the Chatham Islands in the 1830s, Holmes (n.d.) wrote 'In early times the potatoes were mostly boiled in pots, mostly not peeled for a big gathering in a hangi. Sometimes the big ones were grated and the grated potato patted into cakes and fried in fat, the juice from the gratings was boiled in a pot and made into a sort of porridge.

Riley (1994:425) described a unique water steeping method used as an alternative method of preparing potatoes for eating -

> The potatoes remain submerged for five or six weeks, depending on the quality of the water and the variety of potato. They became very white and pulpy in this time, and if correctly treated would have no offensive smell. After the skins had been peeled off, they were made into cakes and cooked in the ashes of a fire. Wild honey was sometimes added to these *kotero taewa* or *kopi taewa*.

Holmes (ibid) also referred to this method being used in the Chathams. 'Sometimes potatoes were put into flax kits and placed in running water and left to rot, they were drained and dried and made into cakes and fried. They had a rather strong smell.'

The potato as a trade commodity

As well as becoming the staple item in the diet of the Māori, it is well documented that potatoes became an important trade commodity, not only within Māori communities but for European colonists and for provisioning European ships. (Cameron 1964; Grey 1994; Hargreaves 1959, 1963; Watson and Patterson 1985; Belich 1996). Evison (1993:28) noted that up until the 1840s, Māori agricultural production was based mainly on potatoes; wheat was thriving in Otago and Southland and several Māori groups were operating their own sailing vessels to transport their crops. Murihiku (Southland) potatoes were regarded as being of particularly good quality and were in demand in the population centres further to the north. Anderson (1998:129) wrote -

> Potatoes which were the primary item of trade with Europeans, cropped prolifically in the south, at rates of seven to fourteen tons per acre, so that even large shipments represented only modest areas under cultivation. Initially the price of European supplied items was high in the early years of contact with a single spike nail costing about 55 kg of potatoes in 1813 at Bluff and an iron adze as much as 1600 kg of potatoes as late as 1827.

Anderson considered that the potential for trade with the many Europeans settled around the Foveaux Strait area early in the 19th century was the primary inducement for Ngai Tahu to settle in Murihiku rather than the popular belief that potatoes made it possible to settle in a region that previously had limited food resources. As Anderson noted 'There was infinitely more land to grow potatoes further north than was ever used.'

In the early nineteenth century when Māori realised that potatoes were a valuable trade commodity, it appears that they would store them for this purpose rather than eat them. Savage (1807:56) -

> Though the natives are exceedingly fond of this root, they eat them but sparingly, on account of their great value in procuring iron by barter from European ships that touch at this part of the coast. The utility of this metal is found to be so great that they would rather suffer almost any privation, or inconvenience, for the possession

> of it particularly when wrought into axes, adzes or small hatchets: the potatoes are consequently preserved with great care against the arrival of a vessel.

Sometimes, Māori were so anxious to conduct trade that potatoes were often dug before the tubers were fully developed (Hargreaves 1963:105). Some idea of the importance to Māori of the potato as a trade commodity was given by Cruise (1824:174) who recorded the following incident when his ship was anchored in the Bay of Islands on 18 July 1820 -

> At noon three canoes filled with people who had got some potatoes to dispose of, were swamped alongside. The prompt assistance that was given by the ship not only saved the lives of the sufferers, but also their property, which seemed to them a matter of greater consideration.

By the beginning of the nineteenth century McNab (1914:108) considered that Māori agriculture was becoming commercialised and 'losing its wholly subsistence nature'. He noted that extensive fields of potatoes were being grown in the Thames area and he referred to the purchase by a trading vessel from New South Wales of some seven to eight tons of 'very fine' Māori-grown potatoes.

Māori production of potatoes continued to increase into the nineteenth century, and in 1834 Edward Markham (a naval officer and adventurer) saw a store of 4,000 bags of potatoes in one Hokianga village which Cameron (1964:103) estimated to be about 100 tons. Hargreaves (1959:61) wrote that Māori-grown produce played a significant part in feeding the European population of Auckland Province and provided an important contribution to exports. While no statistics are available for the Auckland region for the period, in 1857 the *New Zealander* (Hargreaves 1959:5) recorded that 3,050 acres of potatoes were grown in the Lakes (Rotorua) and Bay of Plenty districts. Watson and Paterson (1985:525) recorded that in the Wellington region in 1847 'Maoris dominated the market for pigs, potatoes and sea food.' Māori-grown produce from all over the region was transported to Wellington, and in 1841 pigs and potatoes from inland Wanganui were canoed down river then transhipped to Wellington.

Fig. 16 *Māori bargaining with a Pākehā for a kete of potatoes at Kororareka (Russell) c1845.*

Alexander Turnbull Library A-079-017

The Chatham Islands also became an important region for potato production. When the Taranaki tribes, Ngāti Tama and Ngāti Mutunga, sailed on the ship *Rodney* to colonise the Chathams in November 1835, 78 tonnes of seed potatoes were included in their provisions (King 1989:59), however potatoes may have already been on the islands as Holmes (n.d) recorded 'When potatoes first came to the Chatham Islands is not known though it is possible some may have come with the sealing gangs from Tasmania in the late 1820's or early 1830s.'

Holmes wrote extensively of Māori potato production in the Chathams and noted that potatoes were planted in large amounts on the Chathams once the Māori were established. He recorded this account of early trade in potatoes -

> The first trade was bartering potatoes for cloth mostly blue denim or dungaree. The early system was (in Waitangi) at the meeting house at the pa a line was drawn along the wall the same height as the width of cloth in the roll. All the potatoes were in flax kits fairly large holding 20-30lbs each and the top laced or sewn with flax. The

> people wanting to trade placed their kits on the ground under the line on the wall, patting them up to reach the line quickly. The Captain of the ship trading would pat them down so as to take another row of kits, when the kits reached the line, the whole lot was covered with cloth, which was then cut off the roll. Then it was the next mans turn to barter.

Later in the 1840s the Māori wanted horses and on several occasions a ship from Australia was loaded with potatoes, on a promise that a ship would return bringing horses in payment and for another load of potatoes. It is said there were many splendid horses landed on the Chathams by this system.

In the 1850s Holmes (ibid) recorded several shipments of potatoes bound for California and that by the 1860s potato exporting was well established and loads of 100 tons were common. In 1864 prices paid to Māori by ships' captains were $6 a ton though $12 was paid[4] when quantities were hard to get. Chathams potatoes fed the miners of Otago and Melbourne in the gold rush days and it is recorded that 7,000 tons of potatoes left the Chathams in three years in the early 1860s.

Māori food production (of which potatoes were the major commodity) peaked in the late 1850s and declined precipitously thereafter (Grey 1994:204). Potato production in the south appears to have declined earlier and Anderson (1998:73) noted that 'Commercial cultivation [in the south] was declining by 1840' and that 'the large potato gardens which had existed in the Dunedin area were abandoned by 1842. The land wars of the 1860s and subsequent loss of productive land is often regarded as the cause. However, Hargreaves (1959:76) wrote -

> Although the Maori Wars of the early 1860s are often regarded as the cause of the decline of Maori agriculture, particularly in the Waikato and Bay of Plenty, it is suggested here that in reality they only gave the final death blow to an already waning industry. This decline was in part, due to a lower quality product less efficiently prepared for the market than that which the European farmer was

[4] In referring to $s per ton, Holmes may have been writing of trade with American ships

producing or which could be imported relatively cheaply; and in part due to a general disillusionment and loss of interest in the European's ways, including his agriculture, in the rising tide of Maori nationalism.

Māori potato production declined more gradually in the Chathams and Holmes (ibid) recorded - 'some small quantities were exported to Auckland and Wellington in the 1870s but growing potatoes gradually reduced as an export item in the 1880s.'

Roskruge (1999 pers. comm.) considered that other reasons for the decline in Māori commercial horticultural production at this time included European land tenure and the Māori Land Court which brought about dispossession and the imposition of the European economic system which saw a gradual breakdown of communal working structures and the tenure system which allowed individual title to land.

Another probable reason for the decline in Māori potato production and trade was the gradual degeneration in the quality of the tubers and crop yields. Hargreaves (1963:105) wrote that the Māori-grown potato was of large, excellent quality in the early years and that it kept well however of the decline in its quality by the 1840s, Hargreaves recorded -

Over the years the Maori rarely changed his stock nor saved his best potatoes, but rather the poorer, smaller potatoes were left in the ground when the crop was harvested to provide seed for the subsequent crop. As a result Maori potatoes in one or two areas (as for example some localities near Wellington) were small and partly degenerated by 1840.

In writing of Māori agriculture after the wars in the period 1871-1886 Hargreaves (1960:359) suggested that the declining yield of Māori grown crops including potatoes was in part due to the inability to shift their cultivation to different areas as had been the previous practice. This was due to confiscation of much of their fertile land. Hargreaves wrote -

> Continual cropping of the one piece of ground soon exhausted its fertility, for the Maori never used manures. With the expansion of European settlement and the siting of many tribes on special reserves, the Maori agriculturist was becoming restricted in the area he could use.

Hargreaves (ibid) noted that by 1886, most tribes produced little more food than was necessary for their immediate needs.

The early 20th century

In 1905, potato crops in the North Island were badly affected by potato blight. Letters on file at National Archives Wellington (MA 21/3-17) indicate the devastating effect this event had on Māori communities, many of which appeared to be dependant on the potato. Māori in Northland, Bay of Plenty, East Coast and Hawkes Bay were particularly badly affected as were communities in Whanganui and King Country. In 1906, the government made large quantities of seed potatoes available to the Māori communities. These were distributed by the native schools in each region. Most letters on file (MA 21/4,12) were requests for seed potatoes written by teachers on behalf of local Māori. Several letters described Māori communities as being "devastated" or "reduced to poverty". The same year the government purchased 20 tons of sweet potato from a merchant in San Francisco for the sum of £ 200. These were also distributed through the native schools. (MA 21/8/211) It was apparent to the then Department of Agriculture, that those Māori communities which were still growing the kūmara had the advantage of having at least one surviving crop. The distribution of the imported sweet potato was to re-introduce a higher yielding cultivar of a traditional crop to avoid what in some Māori communities was a very high reliance on the potato.

It is useful to draw comparisons with the plight of the Māori communities reduced in some instances, to near starvation by potato blight, with the similar but more widespread catastrophic event in Ireland, which occurred some 60 years earlier. It is likely that many of the potato cultivars grown by Māori at the time

were similar to those which succumbed to the blight in Ireland (see page 23). It is likely that some of the early relict cultivars grown and being perpetuated by Māori at that time were wiped out.

Fig. 17 *Preparation of potatoes for cooking at a Maori community on the Whanganui river. Note that one woman is sitting on a sack of potatoes, an action which is considered to be culturally inappropriate. c1920.*

There appear to be few records of the specific potato cultivars that were distributed by the government to replace those decimated by the blight, however it is likely that they were of the newer, more blight resistant types developed in the latter part of the 19th century. A Mr A. H. Cotton, a teacher at Omarumutu native school near Opotiki, in a letter dated July 19, 1906, referred to the cultivar 'Northern Star' (see page 91 under 'Māori Chief') as one of those distributed in his district.

The potato blight arrived in the Chatham Islands in 1903 - two years earlier than on the mainland and Holmes (n.d) wrote that most crops on the islands were

ruined. Unlike on the mainland where Māori potato production for trade had collapsed by the 1880s, the potato continued to be grown for trade and export by Māori on the Chathams for a further twenty or more years until the blight destroyed the crops. Holmes recorded - 'that finished potato growing on the Islands for export, though a lot were grown for the peoples' own use...'

Fig. 18 *Group outside a cookhouse in Parihaka preparing potatoes for cooking. Early 20th century.*

Alexander Turnbull Library.

Chapter 6.

The Māori Potato today.

Characteristics of Māori potatoes

In the *Dictionary of New Zealand English* Orsman (1997:480) described Māori potatoes as -

> Any of several varieties of mealy potatoes with reddish or purple skins and some interior coloration, grown originally and traditionally by the Maori, the present varieties possibly descended from stock introduced in the late 18th or early 19th centuries.

There appear to be very few descriptions in the literature of the appearance of the potatoes that were introduced in the late 18th and 19th centuries and grown by Māori, although Anderson (1998:72) wrote that the "white" potato grown by Māori in Otago early in the nineteenth century were actually blue or black fleshed while Leach (1984:99) referred to 'large deep red mealy potatoes' grown in the Foveaux Strait area in 1826. Harwood (n.d.) regarded the potatoes he was buying from the Māori in the 1830s as sufficiently different to describe them as the "blue" or "Māori" potato. They were certainly not different enough from those known in Sydney to be unsaleable.

Yen (1961:4) in describing Māori potatoes noted 'In such characters as plant habit and vigour, flower colour, tuber shape, colour and texture, the Māori varieties exhibit a considerable range in variation.'

Flesh type varies greatly, and ranges from the hard waxy 'Huakaroro' which remains firm when boiled, to the floury textured 'Urenika' which tends to disintegrate when boiled. Howard (1963: 296) related texture to dry matter content of the tuber and wrote -

> Tubers with a low dry matter content do not disintegrate when boiled or steamed; they have a firm consistency and are waxy rather than mealy. On the other hand,

tubers with a high dry matter content disintegrate completely when boiled, have a soft consistency and are very mealy, dry and coarse.

Figures 27 and 28 show that the tubers of the various Māori potato cultivars vary. They range from spherical, through flat oval, to elongated shapes, and they generally have a knobbly appearance with many having very deep-set eyes. Skin colour varies greatly while the colour of the flesh includes white, yellow and purple. Some cultivars have such as 'Karupoti' have coloured flesh inside the vascular ring (see fig. 42) and white outside it (see fig. 19) while 'Urenika' has purple flesh - often with white flecks (see fig. 20).

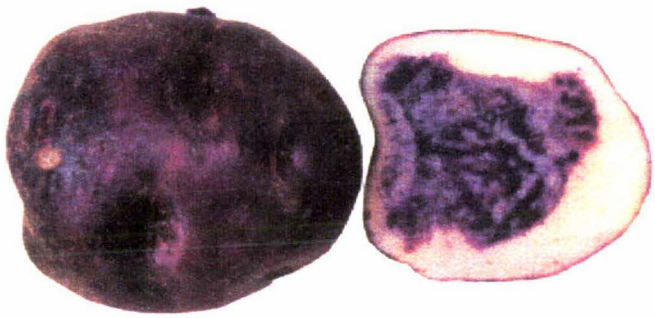


Fig. 19 *Karupoti flesh*

Fig. 20 *Urenika flesh*

Blue is the most common flower colour, ranging from the light blue of 'Moemoe', through to the mid-blue of 'Māori', to the dark blue of 'Raupi'. 'Karupoti' has very large white flowers. 'Pāwhero' and 'Urenika' have cream flowers. Those of 'Pāwhero' have grey/brown striations on the inner parts of the petals while the striations of 'Urenika' are yellow and purple. (see fig. 26) Many cultivars develop tubers at the ends of long stolons and many tend to set tubers in autumn when days are shortening.

Some, such as 'Uwhi', 'Whataroa' and 'Urenika', set small tubers in the axils of the leaves at the same time as they are developing subterranean tubers (see Fig. 32). The haulms (tops) of the plants vary in appearance; and some cultivars develop short upright stems while others have long and prostrate stems.

Māori potatoes appear to have some resistance to certain diseases which affect "modern" potato cultivars and Yen (1961/62:5) wrote -

> The Maori claims that their potatoes are resistant to diseases appear to have some foundation since their perpetuation has been accomplished to the present day without the aid of any form of disease control. In preliminary experiments, the potato and vegetable sections of this division [*Crop Research Division of the New Zealand Department of Scientific and Industrial Research*] have found that varying degrees of resistance to blight and some viruses exist in over 20 of these varieties.

Rooney (1983:15) reported that Dr J. Mitchell of the then *Crop Research Division* of DSIR (New Zealand Department of Scientific and Industrial Research) with reference to the Māori potatoes in their collection, stated - 'The ancient potatoes have an obvious inherent hardiness...without this they could not have survived. Many of them have good resistance to blight and some are resistant to nematodes.'

A clue as to the possible disease resistance qualities of Māori potatoes was given in these comments by Salaman (1937:327 who was referring to the possible loss of useful genes in the potato during the process of "improving" the potato -

> We eliminate let us say, let us say, deep eyes, long stolons and highly coloured skins. How do we know that the genes responsible for these are not also of material importance in the maintenance of a successful symbiosis or the tolerance towards the active agents of virus disease? We eliminate late maturity, numerous and upstanding stems, fibrous roots and long stolons; are we sure that much of the plant's vigour or its resistance to frost may not have gone with them?

In referring to Māori potatoes, Genet (1985:23) noted that 'early introductions were of diverse origins; often of *andigena* types, and some still survive.' Certainly, from the characteristics described above it is apparent that the Māori potatoes have many similarities to the *andigena* types grown in the United Kingdom in the late eighteenth and early nineteenth centuries, at the time when many of those cultivars were likely to have been introduced to New Zealand.

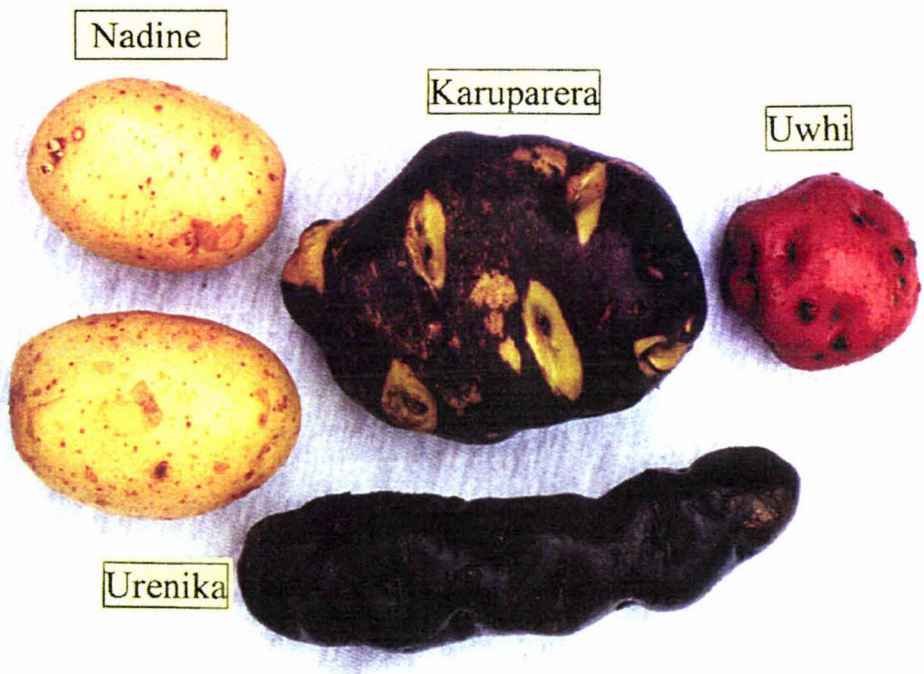


Fig. 21 *Three Māori potato cultivars shown with a "modern" cultivar — 'Nadine'. Note the smooth skin and shallow eyes of 'Nadine' compared to the Māori Potato cultivars.*

The Māori potato today

A wide range of Māori potatoes are still grown today in many parts of New Zealand. Orsman (1997:480) observed that they are still found growing in some home gardens, more especially in the rural areas of the north. While they are mainly grown by Māori families, there are numerous Pākehā enthusiasts maintaining Māori potato collections, and a collection is maintained by the *New Zealand Institute for Crop and Food Research* at Lincoln. Part of the justification for maintaining this collection is to provide a broad gene pool for possible use in potato breeding programmes (Genet and Anderson 1985:28). A collection is also being established at Massey University in Palmerston North under the guidance of the *Kaitautoko Māori* (Māori support person) within their College of Sciences.

Fig. 22 *Jayden Whetu Carter with a kete of riwai grown by his grandfather.*
Martinborough. April 1999

While Orsman's selected quotations tend to show that these potatoes are mainly grown in the rural north, they are also grown by numerous Māori families on the East Coast of the North Island-mainly in the East Cape/Gisborne/Hawkes Bay areas - but also in the Bay of Plenty and, to a lesser extent, on the west coast from Taranaki to Wellington. They are also grown in some rural areas in the Waikato. Some are grown in the South Island and there are Māori families on the Chatham Islands still maintaining the old cultivars. In fact, in any rural area where there are groups of Māori people, these potatoes can be found in their vegetable gardens.

Māori potatoes, many of which appear to be relicts of cultivars introduced from Europe in the late eighteenth and early nineteenth centuries (with some possibly having been developed by Māori selection from seedlings and mutations), have been maintained within *whānau* (families) for possibly over 200 years - perhaps eight to nine generations. Most of the Māori families visited as part of this study who were growing the old cultivars, were also growing "modern" cultivars for their greater yield. Various reasons were given for maintaining the old cultivars but the main reason appeared to be that, because these tubers had been passed down through the generations, there was a responsibility to maintain them and continue to pass them on. Several people referred to them as a *taonga* (something highly prized or treasured) that had been left to them by their *tipuna* (ancestors). Obviously these plants have a value to some Māori that is more than their value as a food source. There is precedence in history for this concept, and Leach (1989:35) in referring to the low yield provided by the kūmara in pre-European Māori horticulture, noted -

> Value may be a measure of religious significance, of social or ceremonial meaning, or of sentimental importance... to the Maori, the kumara's non-economic values so clearly outweighed its poor yields that they persisted in growing it.

In this context, it is obvious that the old potato cultivars have at least sentimental value.

Roskruge (1999:3) reported that *taewa* (Māori potatoes) are grown (by Māori) as a regional speciality to show a host's hospitality, as a reason for *whānaungatanga* - working together as a community. He also considered that, in addition to their importance in Māori culture, they could be of commercial value. Certainly today there are numerous community and marae-based groups growing the old varieties for sale at markets and roadside stalls, and growers have reported that they have no problems in selling all they can produce - usually at a considerable premium above that paid for "modern" potatoes.

Yen (1961/62:4) in writing of the present-day survival of Māori potatoes, stated -

> They are grown annually in small household garden plots and many varietal names are known. They form a minor part of the diet but are regarded to be of better culinary quality than modern commercial varieties.

Some Māori consider that the old potatoes have a better taste than "modern" types and as the many cultivars still grown have a range of culinary properties, it is likely that some may well be considered to be superior in this regard. Certainly the hard waxy types such as 'Huakaroro' are considered to be better than modern types for boiling with meat such as pork, and greens such as puha *(Sonchus oleraceus)* and watercress *(Nasturtium officinale.)*

Some of the early varieties of potato have also been perpetuated by Pākehā families for many generations. One example is a potato brought out from England in 1842 by a family immigrating to Nelson on the ship *Phoebe*. (see fig. 23) The potato is still grown today by branches of the family in Nelson and Wellington. The tubers have a shiny, almost metallic purple skin, white flesh and very deep eyes. Other examples are mentioned by Rooney (1983:15) who wrote - 'One of the more interesting finds came from a family in Riverton. Labelled 'Riverton Rocks,' it was a potato that had been picked up by a local resident on the seashore near Riverton in the 1880s. His descendants are still growing it.' He also wrote of another Southland family who are still growing a potato brought out from Devon in 1862 by an ancestor on the ship *Tiptree*.

Fig. 23 *An unnamed potato cultivar brought out from England in 1842 on the "Phoebe".*

Commercial exploitation

Some "up-market" restaurants in the cities are now offering "Māori potatoes" on their menus. The purple fleshed cultivar 'Urenika' is the one most commonly offered and it is usually presented as a gourmet food item - often under a variety of names. There has been considerable interest from restauranteurs and growers in producing and offering a wider range of Māori potatoes and numerous requests have been made to the present author for tubers. These requests are denied when the obvious intention is to use them for commercial purposes. This is essential to keep faith with the commitment made to those Māori who gave plant material on the understanding that it was to be used for academic research and not for commercial exploitation. Of even more concern is the occasional suggestion that these potatoes should be "patented" with the intention of obtaining exclusive control over those cultivars. Advice on this matter was sought from the Plant Variety Rights Office. Following are the key points in a letter received from the Commissioner of the Plant Variety Rights (Whitmore 2000 pers. comm.). The full letter appears in the appendices.

Your letter raises a question of some interest. In my view, existing recognised Māori potato varieties or cultivars would not be eligible for plant variety rights. An application for PVR for any such cultivar would probably be refused on the following grounds.

- Newness. To be eligible, a cultivar must be new. Under the Plant Variety Rights Act 1987 a cultivar is new if it has not been sold for more than one year before the date of application. In my understanding the cultivars concerned would have been in commerce for many years.

- Distinctness. To be eligible for PVR, a new cultivar must be distinct from all cultivars of common knowledge. I believe that we should recognise the cultivars to which you refer as cultivars of common knowledge if they been identified according to their descriptive characteristics and their name and if tubers of each are available. To take a specific example, if an application was made for a cultivar which we could not distinguish from 'Whataroa' we would refuse rights on the ground that the cultivar was not distinct from 'Whataroa.'

I have had a number of queries over the years about the possibility of protecting existing Māori Potato cultivars and have responded with essentially the answer given above.

While such cultivars would not be eligible for Plant Variety Rights, there is nothing to stop someone from developing a new, distinct cultivar from an existing one or using Maori Potato cultivars in a breeding programme. Any cultivar emerging from such breeding activities would be eligible for Plant Variety Rights providing it met the criteria under the Act. Should we receive an application for such a cultivar it would be helpful when we evaluate the cultivar to be able to identify existing Māori Potato cultivars and to obtain tubers. We therefore appreciate receiving the copy of your paper as it will provide a useful starting point to identify the cultivars of common knowledge.

It is interesting to note as an alternative point of view, that one Pākehā scientist wrote that he "resented" the term "Māori Potato" for a vegetable that was 'clearly of European origin' and that the definition could imply proprietal rights over some cultivars of the potato for Māori.

Names of Māori potatoes

In writing of the adoption of the potato by Māori, Yen (1961/2:4) stated - 'Further evidence of the adoption of the potato by Maori may be seen in the conferring of varietal names by the Maoris.' Some conferred names were descriptive, while others were names of traditional root crops which were transferred to varieties of the potato as the people saw similarities (M. Parsons 1996 pers. comm.) In the preface to his dictionary, *A Dictionary of the Maori Language*, Williams (1971) justified the large numbers of names of flax, kūmara and potato varieties in the dictionary by saying -

> Many of these words are purely fanciful, or of limited local use; at the same time some are interesting, and in the case of the potato, afford examples of the habits practised by the Māori in giving names, apparently of Polynesian form, to introduced objects.

Richards (1993:29) noted that - 'the Māori were already meticulous gardeners and gave Māori names to each new species[1] of potato, taro, kumara and yam as they arrived from Europe, America and the Pacific.'

Generic names

Several generic names were also given to potatoes and Te Rangi Hiroa (1949:111) wrote - 'Being a new introduction, the Irish potato[2] was given a Māori name by various tribes, but as the name potato did not find favour, a number of different names were coined...'

[1] "species" is an incorrect term in this context. "cultivar", "cultigen" or "variety" are more accurate terms.
[2] writers of this era often incorrectly referred to "Irish potatoes" to distinguish them from the kumara.

Richards (ibid) considered - 'That there were many different varieties, probably explains why the name used today for potatoes, in general, varies from district to district.'

In the north of the North Island potatoes are generally known by Māori as *riwai* or *peruperu* (P. Niha 1996 pers. comm.) and Richards (ibid) considered that this name is commonly used as far south as Rotorua. Orsman (1997:686) referred to *riwai* (often spelled *rewai*) as a possible loanword. *Peruperu* is named after the white throat feathers of the tui. *Kapane*[3] is another general name for the potato which was once used in Northland.

On the East Coast potatoes are known as *parareka* (D. Para 1999 pers. comm.) This name is also applied to the starchy rhizomes of the horse-shoe fern *Marratia salicina*, which was cultivated by Māori as a food source - an example of the name of a traditional root crop being applied to a potato variety. In this context the prefix *para* usually means an "edible tuber" (it is often applied to those of various edible fern tubers or rhizomes) while *reka* means "sweet or palatable". 'Parareka' is also a name given to a specific Māori potato cultivar.

Taylor (1858:37) recorded that in the Cook Strait region potatoes were known as *taewa*. Hammond (1894:238-238), in writing of Māori potato production in Taranaki and Porirua, also referred to potatoes as *taewa*. Today, this name appears to be used from Taranaki to the Cook Strait region and also on the Chatham Islands - perhaps reflecting the colonisation of these islands by iwi from Taranaki in 1835. Richards (1993:29) noted that it is also used by Tuhoe and for a specific variety in Northland. *Taewa* means "foreigner" which may indicate the foreign origin of the potato.

Another explanation (Orsman: ibid) is that the word represents the name of one Stivers, (see "Stivers" page 15) who is said to have visited the Bay of Islands before

[3] Editors footnote. Roberts.1913. Journal of the Polynesian Society

Cook. Stivers is also mentioned by Elder (1932:208) in his letters and journals of Samuel Marsden. He recorded in a footnote: 'Staivers *(sic)* - hence another name for the potato, taewa, since he apparently supplied some seed.'

The Ngāi Tahu people of the South Island refer to the potato as *māhētau* (Potiki 1996:30; Beattie 1920:463). *Māhētau* means 'like a string of fishing sinkers', referring to the numerous tubers on the ends of long stolons which are apparent when the plants are lifted at harvest time. Maika Mason (1999 pers. comm.) however, wrote that his people (the Ngāti Waewae hāpu of Ngāi Tahu) of Te Tai Poutini (west coast of the South Island) refer to the potato as *repe*.

There are other names used as generic names by Māori for potatoes, but those described above appear to be the most common.

Fig. 24 *Generic names of Māori Potatoes in New Zealand.*

Varietal names

Māori gave numerous varietal names to potatoes, and the same potato was often given different local names. Biggs (1987:146), listed 53 Māori varietal names for potatoes although some of these may well be synonyms. Some of the early cultivar introductions, like 'Early Rose', and 'Skerry Blue' have been grown for many years by Māori families, and in some instances they appear to have retained those names although it is likely they were also given Māori names. Beattie (1920:462) recorded that the English cultivar 'Derwent' became 'Kopara' or 'Katote', 'White Rock' became 'Waitaha', 'Old Red' became 'Pāwhero' and 'Red Rock' (one of the potatoes grown in Ireland at the time of the blight in the 1840s) became known as 'Wherei'.

Some of the names were descriptive, for example 'Karupārera' means "eye of the duck" as does 'Kanohi Pārera'. 'Karupoti' is "eye of the cat" (*poti* is a transliteration of 'pussy'). When this potato is cut in half, it has a purple centre within the vascular ring with creamy white flesh around the outside. It has the appearance of a cat's eye. Similarly the cultivar 'Putuhoiho' or "horse shoe", a type which has pink skin and is widely grown by Māori in Taranaki and King Country, has a horse shoe shaped marking within the vascular ring. (C. Koroheke 2000 pers. comm.) 'Huakaroro' or "egg of the seagull" is often abbreviated to 'Karoro' and is sometimes called 'White Māori'. The very distinctive 'Kowiniwini' (also known as 'Kaupari') which has very clearly delineated yellow markings around the eyes means "of many windows" referring to the window effect of the eyes (Roskruge 1999 pers. comm.).

The name of the cultivar 'Moemoe' means "to sleep" which possibly refers to planting the tubers in the soil. 'Raupi' is to "cover up" which may have similar connotations. 'Whataroa' may be derived from the *whata* or platform on which potatoes were placed for short-term storage (see 'Storage methods' earlier in this paper). Some names may refer to an incident. An example is the name 'Whānako' which means "stolen" and Morton (1982:187) considered that this potato was likely to have been stolen from a visiting ship.

The name of the very commonly grown 'Urenika', which has elongated tubers with dark purple skin and flesh (see Fig. 20), is derived from *ure*, (penis), and *nika* (a Māori transliteration of the derogatory name "nigger" used by crew on American whaling ships to refer to fellow crew members of African descent). This name is thought to originate from the early to mid-nineteenth century when African-Americans were often members of American whaling ship crews (W. Harris 1997 pers. comm.). 'Urenika' is also known as 'Keretawha', 'Tuarua', 'Waikato' and 'Ringaringakatira' (Genet 1996:32). Roberts (1913:231) described a potato commonly grown in Southland in the 1850s which from its description, appears to be synonymous with 'Urenika'. He described it as a "Maori potato" which had a rough dark brown skin and purple flesh with an occasional whitish streak which he said was called 'Kapana Mungamunga' and that it was delicious for eating. In a footnote to the article, the editor of the journal *(Journal of the Polynesian Society)* noted that the name 'should be mangumangu as that is the word for black.' Anderson (1998:72) confirmed that this was a commonly used name for the purple potato grown by Māori in Otago in the early 19th century.

There are numerous other examples of synonyms, as Māori often gave different "local" names to the same cultivar. But some cultivars that may appear to be the same when the most obvious morphological features are compared can be quite distinct types. For example, 'Poiwa' and 'Ngā Oti Oti' have very similar tubers, leaves, flowers and growth habit. However, the tubers of 'Ngā Oti Oti' have white flesh which becomes floury when cooked, while those of 'Poiwa' have a slight yellow tinge to the flesh, are more waxy and remain quite firm after boiling. 'Moemoe' also appears to be similar to 'Poiwa' and Ngā Oti Oti' although it grows more vigorously and produces larger tubers.

'Uwhi', a potato grown through the winter in Northland in the early nineteenth century was a name transferred from the yam *Discorea alata* - a pre-European introduction. 'Uwhi' is similar in shape and colour to the yam. It is often referred to as 'Uwhiwhero' and sometimes as 'Whero'. (*whero* means red). 'Ngāngārangi' (another name for yam) was also transferred to a potato cultivar. Some potatoes

were named for the way they resembled pre-European kūmara varieties. Two examples are 'Katoto' and 'Pōranga' (Williams 1971:104; 293).

The meanings of some commonly grown cultivars such as 'Poiwa' and 'Ngā Oti Oti' are not known. K. Prime (1999 pers. comm.) noted that some words relating to potato varieties and to potato culture are slowly dying out and becoming lost because many Māori no longer have gardens and the words are no longer used.

In general, the names Māori gave the various potato varieties they acquired, related to some aspect of the tubers, such as their size, shape, colour or their similarity to some aspect of a bird or animal, or a name was transferred from a traditional root crop where some similarity or relationship was perceived. Matthews (1984:164) considered that it is characteristic of folk-taxonomies of cultivated plants that varieties are distinguished on a great wealth of plant detail, including size, taste, internal texture and colour as well as external shape and colour. In South America, the many thousands of varieties of potatoes grown by the indigenous Indian peoples were similarly named and Hawkes (1947:221) wrote - 'Almost without exception the South American cultivated potatoes are named according to their tuber characteristics, the haulm and flower being of no account in identification.' Johns (1990:155) wrote that the Aymará people have various nomenclatural categories concerned with potato quality, particularly relating to culinary properties, frost resistance and precociousness.

The names given to potatoes in South America are almost exclusively confined to three languages - the ancient indigenous Quechua and Aymará languages and the introduced Spanish language. Hawkes considered that a detailed study of the potato from a linguistic and associated indigenous taxonomic perspective would be likely to yield important information about the evolutionary history and phylogenetic relationships of the potato and also contribute to knowledge of the early Indian cultures. Because the potato in New Zealand was a relatively recent introduction from Europe, such an etymological study of its Māori names is unlikely to yield similar information. It is nevertheless, important that the names

and words associated with the potato and its culture are retained as they represent a significant part of the culture and history of the Māori people and *Te Reo Māori* - the indigenous language of this country.

Chapter 7.

Observations of a collection of cultivars.

Establishment of a cultivar collection

The present collection of 18 named Māori potato cultivars and several unnamed types was acquired over 3 years from a variety of sources. The first three cultivars were contributed in 1996 by Poai Pakeha Niha from Whangarei. The following year, Poai Pakeha accompanied me on a journey around Northland, during which we visited several elderly Māori people who grew Māori potatoes. On that journey several more cultivars were collected and information was gathered. Further cultivars were obtained from Dr Russell Genet at the *New Zealand Institute for Crop and Food Research* at Lincoln in Canterbury. Some cultivars were purchased from roadside stalls and from weekend markets.

Articles published in the *New Zealand Gardener*, *Te Karaka* and the *Dominion* (see appendices) prompted numerous responses and a number of potato tubers were contributed to the collection by both Māori and Pākehā people as a result. Tubers of some unnamed acquisitions were compared with those in the collection and matching types were grown alongside named cultivars to compare other morphological features. Tubers were acquired from all over the country including the Chatham Islands and Stewart Island. Most of the potatoes that were sent were the same as those already in the collection but some were new types. Observations indicated that the most commonly grown Māori potato cultivar is 'Urenika', followed by 'Moemoe', 'Huakaroro' and 'Peruperu'.

It is important to note that some cultivars contributed by Māori were given on the condition that they were not to be used for commercial purposes and not to be given to others without consultation. These conditions have been respected and complied with.

Because some of the tubers ('Māori', 'Māori Chief', 'Karupoti', 'Raupi' and

'Poiwa') were obtained from *Crop and Food Research* it is appropriate in this chapter to record some history of the establishment of their collection.

The nucleus of the *New Zealand Institute for Crop and Food Research* collection was established in the 1950s and early 1960s by Dr Douglas Yen, a scientist with the then *Crop Research Division* of the *Department of Scientific and Industrial Research* (DSIR). A collection of letters kept by National Archives (Crop Research Division DSIR files, CH 252, 31/5 NA - Christchurch) records information relating to the collection of some cultivars. One letter of particular interest from C. T. Williams, a grain and produce merchant of Kaiapoi to Dr. C. M. Driver (Crop Research Division, DSIR) dated 31 May 1951, records and provides details of a potato collected at Ship Cove in the Marlborough Sounds, the site where Cook planted potatoes during his second expedition to New Zealand in 1773. Following is an extract from that letter -

> Ship Cove Potato. Collected at Ship Cove, Queen Charlotte Sound on Jan. 1. 1950. Found growing in grassy strip between the bush and the beach. There were no new tubers at this date. Old setts were collected although they had already grown fairly large tops, some of them with flowers. They still retained enough vitality to grow again and produce tubers...there is of course, nothing to prove that the potatoes found growing there in 1950 were the original kind planted by Captain Cook. A great variety of potatoes must have been introduced to New Zealand by explorers, whalers, missionaries and settlers and not necessarily from Europe. Whaling vessels operating in the Pacific may sometimes have taken in stores at South American ports.
>
> Description:-
>
> Habit:- haulm tall, branching and open. Stem:- wings not prominent. Moderate amount of colour. Leaves:- small, light green. Flowers:- light purple, tipped white, no scent, apparently male sterile, fairly numerous. Tubers:- tend to be small and numerous and are produced on moderately long stolons. Tubers will grow up to 12oz in weight under good conditions and may total up to 6lb at a root. Skin parti-coloured purple and white. Colour avoids the eyes. Shape:- rough, eyes very deep. Flesh firm and yellow in colour. Flavour and cooking (boiling) quality exceedingly good. Maturity:- very late.

Description of cultivars

Following are descriptions of the 18 named Māori potato cultivars collected as part of this study. This information is summarised in table 1. at the end of this section.

'Moemoe'

One of the more commonly grown of the Māori potatoes, this cultivar is also known as 'Mui Mui' and 'Ngā Toko'. Tubers are round-to-slightly-elongated and have a yellow-and-reddish mottled flesh and deep-set eyes. The flesh of the tubers is yellow and there are often purple flecks around the vascular ring. They are a waxy potato which remains firm after boiling. The plants have small, dark green leaves and the flowers are light blue.

'Karupoti'

This potato has round-to-oval tubers which have a dark red skin and moderately deep-set eyes. The flesh colour within the vascular ring is a dark reddish purple surrounded by white flesh (see Fig. 19). The name 'Karupoti' ("eye of the cat") is derived from this feature. The potatoes become floury when cooked, indicating they are low in moisture and sugar content, and high in starch. They tend to disintegrate when boiled. The plants grow larger than average and produce large white flowers.

'Whataroa'

The slightly elongated tubers are usually wider at one end, with most of the deeply set eyes concentrated towards the narrow end. The skin colour is pink, mottled with yellow. The flesh is yellow and when boiled the tubers remain reasonably firm. The petals of the flowers are white with light purple margins, and the main stems of the plant are red. Small tubers develop in the leaf axils on the stems in autumn when the subterranean tubers are developing.

'Peruperu'

This cultivar is very commonly grown in Northland. The slightly elongated tubers are a creamy-yellow splashed with purple while the flesh colour is creamy-white, sometimes with yellow streaks. The potatoes tend to become floury when cooked. Flowers are a mid-blue.

'Karupārera'

Another cultivar common in the North, this is also known as 'Kanohi Pārera'. Both names mean "the eye of the duck" (pārera is the grey duck). The eyes of the purple tubers are usually surrounded by yellow, giving rise to its names. The flesh of the tubers is white and they tend towards becoming floury when boiled. The flowers are a mid-blue and appear to be similar to those of 'Peruperu'.

'Huakaroro'

This potato has a yellow skin which is often splashed with pink and usually covered in numerous small brown dots. It is sometimes called 'White Māori'. It has a very knobbly, slightly elongated shape and the eyes are set very deep. It yields more heavily than most of the other Māori cultivars, and the tubers are often very large. When boiled, the hard waxy tubers, which have yellow flesh, remain firm. It is a favourite for "boil ups" (that is, potatoes boiled with pork bones or other meats and puha or watercress). The large flowers have lilac coloured petals with yellow and green rays or striations. The tips of the petals are white.

'Kowiniwini'

The tubers of 'Kowiniwini' are very distinctive. The medium deep-set eyes are surrounded by bright yellow while the basic colour of the tubers is a deep purplish-red. The plants in the collection produced a much lower yield than other cultivars (see "Yields of Māori potatoes" earlier in this paper) probably because the plants appeared to be virus-infected. The flesh of the tubers is creamy-white and they tend to disintegrate when boiled. This cultivar is also known as 'Kaupari'. The flowers which are mid blue and small are seldom seen. Apart from a difference in culinary quality, this cultivar appears to have similarities to the "Ship Cove potato" described in the previous chapter.

'Ūwhi'

Also known as Ūwhiwhero' or 'Whero' this is another cultivar commonly grown in the north. It produces good yields compared with most other Māori cultivars. The pink to orange-pink tubers have moderately deep eyes with white flesh. The waxy tubers have a pleasantly distinctive taste when cooked. Like 'Whataroa', the plant produces small tubers in the leaf axils in autumn. The flower petals are a mid-lilac colour with a white stripe which runs from the centre to the tips of the petals.

'Māori'

With their shallow eyes and uniformly round shape, the tubers of this potato are quite different in appearance from most of the other Māori potatoes and it is possible that this cultivar is a more "modern" type. The skin of the tubers is red with a rough texture. When they are boiled, the potatoes become floury even after they have been stored for several months. The plants have mid-blue flowers and produce a good yield of tubers.

'Ngā Oti Oti'

Sometimes called 'Ngā Outi Outi', this potato has yellow and pink mottled tubers with deep-set eyes. It has white flesh which sometimes has red flecks outside the vascular ring. The potato is not suitable for boiling as the tubers very quickly disintegrate. The plant produces a relatively small haulm, and has very small dark green leaves and light blue flowers.

'Poiwa'

This cultivar has features that are very similar to 'Ngā Oti Oti' including very small darkgreen leaves and light blue flowers, the main difference being that the tubers have white flesh and are more waxy, remaining relatively firm when boiled.

'Pāwhero'

Also called 'Old Red', this potato produces long red tubers which tend to be rather narrow at one end. They have relatively few, shallow eyes and are often

mistaken for a kūmara. They have white flesh which sometimes has red flecks in the centre of the tuber. The plant grows vigorously, and has red stems and cream flowers with grey-brown striations on the inner parts of the petals. The flowers have very large prominent anthers. The potatoes remain reasonably firm when boiled.

'Māori Chief'

Sometimes known as 'Rangatira', this potato has oval shaped yellow tubers which are splashed with red, and it has shallow eyes. Hadfield (1929:22) stated that 'Māori Chief' is a New Zealand selection of 'Northern Star' to which it is similar in all respects except that the tubers of 'Northern Star' lack the purple flecks on the skin which is typical of 'Māori Chief'. 'Northern Star' is a relatively modern cultivar that was released in the United Kingdom in 1902, and was described by Salaman (1987:169) as being a variety of little merit while Hadfield (ibid) described its cooking quality as "inferior". The flesh of the tubers (of both types) is white with purple flecks. Being a floury type, they are not suitable for boiling. The cultivar 'Parihaka' is likely to be the same as 'Māori Chief'. (R. Genet 2000 pers. comm.) The small white flowers of this cultivar are seldom produced and they usually drop before the petals open.

'Raupi'

The tubers of this cultivar have a yellow skin, often with purple blotches or splashes. The eyes are deep-set and the flesh colour is yellow, often with purple dots around the vascular ring. When boiled the tubers remain relatively firm. The plants have dark blue flowers and small crinkled leaves.

'Parareka'

This cultivar produces small elongated tubers with shallow eyes. They have pink skin with yellow markings. The flesh colour is white, and they have a floury texture. The very large white flowers have yellow striations in the centre of the petals.

'Whānako'

With its smooth skin, shallow eyes and regular round shape, this cultivar appears to be a more modern type. It has white flesh and remains firm when boiled. No flowers have been observed.

'Rokeroke'

This potato has tubers that are similar in appearance to 'Whanako'. It also has white, waxy flesh. The flowers are a mid-lilac with a white centre stripe to the petals.

'Urenika'

By far the most widely planted of the Māori potatoes, this cultivar is grown by Māori communities all over New Zealand. It is a potato that will persist in the ground for long periods without being cultivated, and is sometimes found growing "wild" on old Māori occupation sites and on the sites of abandoned gardens. The present author has located this potato growing wild on an old pa site at Doubtless Bay in the far North, at Turangi on wasteland and T. Batley (2000 pers. comm.) located 'Urenika' growing along bush margins at Hihitahi near Waiouru. It is also known as 'Tuarua Waikato', 'Keretewha', 'Rongo Blue', 'Kapana Mangumangu' and 'Tutaekuri'.

Fig. 25 'Urenika' plants growing wild near Turangi.

With its elongated tubers with dark purple skin and flesh (see fig. 20) which sometimes has white flecks, 'Urenika' is quite different to the other Māori potatoes and was described by Thomson (1988:182) as a cultivar 'that shows what are probably ancestral characters of the potato.' The tubers look similar in appearance to types grown by indigenous people in the Andes of Peru (See Fig. 2), and it was possibly introduced directly to New Zealand from South America by early sailors and traders who often provisioned their ships at South American ports. It appears to have been the most common potato grown by Māori in the southern half of the South Island in the early 19th century. (Anderson 1998:72) The plants have purple stems, and small aerial tubers are produced in the leaf axils in the late autumn.

Tubers are produced at the ends of long stolons (see fig. 33) and W. Sykes (n.d. pers. comm. to T. Batley) reported that they can be up to 2 metres from the photosynthesising parts of the plant.

The flowers of 'Urenika' are white with purple and yellow striations at the base of the petals (see fig. 26). The tubers have a very floury flesh, and they will almost totally disintegrate if they are boiled when newly dug. The dark purple colour of the flesh lightens to a blue colour during cooking.

Fig. 26 *Flowers of 'Urenika'.*

Parareka

Rokeroke

Māori

Whanako

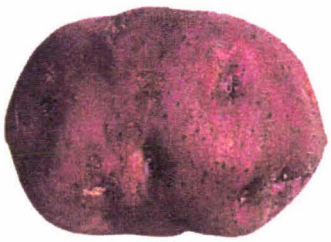
Peruperu

Huakaroro

Urenika

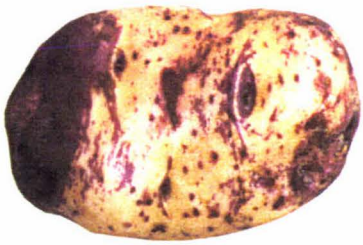
Whataroa

Fig. 27 *Māori potato cultivars*



Karupoti

Kowiniwini

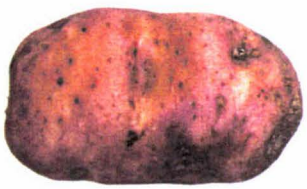


Māori Chief

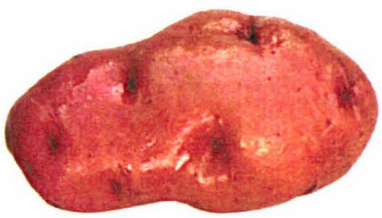
Raupi

Pāwhero

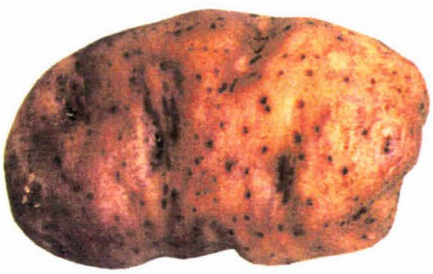
Ngā Oti Oti



Moemoe



Ūwhi



Poiwa

Karupārera

Fig. 28 *Māori potato cultivars*

Table 1. *Characteristics of Maori potato cultivars*

Cultivar	Synonyms	Skin colour	flesh colour	eye depth	flowers	texture*	Tuber shape
Moemoe	Mui Mui, Ngā Toko	yellow/red mottled	yellow	deep	light blue	waxy	slightly elongated
Karupoti	-	dark red	white/purple centre	medium	large white	floury	round/oval
Whataroa	-	yellow/pink mottled	yellow	deep	white/purple	waxy	slightly elongated
Peruperu	-	creamy yellow with purple splashes	creamy white yellow streaks	deep	mid-blue	floury	slightly elongated
Karupārera	Kanohi Pārera	purple with yellow around eyes	white	deep	mid-blue	floury	round
Māori Chief	Rangatira, Parihaka	yellow, red splashed	white purple flecks	shallow	(seldom flowers)	floury	oval
Raupi	-	yellow with purple splashes	yellow	deep	dark blue	waxy	round
Parareka	-	pink/yellow mottled	white	shallow	very large white	floury	oval
Whanako	-	brown, pink tinge	white	shallow	no flowers observed	waxy	oval
Rokeroke	-	pink, yellow blotches	white	shallow	mid-blue	waxy	oval
Kowiniwini	Kaupari	purple/red with yellow eyes - distinctive	creamy white	medium	mid-blue (seldom flowers)	floury	oval
Uwhi	Uwhiwhero	orange-pink	white	medium	lilac with white centre stripe	waxy	oval
Māori	-	red russeted	white	shallow	mid-blue	floury	round
Ngā Oti Oti	Ngā Outi Outi	yellow/pink mottled	white, red flecks	deep	light blue	floury	round
Poiwa	-	yellow/pink mottled	white, red flecks	deep	light blue	waxy	round
Pāwhero	Old Red	red	white, red flecks	shallow	cream, grey stripes	waxy	elongated
Huakaroro	Karoro, White Māori	Yellow, with pink blotches	yellow	deep	lilac with white tips on petals	waxy	round knobbly
Urenika	Tuarua Waikato, Keretewha, Rongo Blue, Tutaekuri.	Purple	Purple, sometimes with white blotches	medium	white, grey stripes	very floury	very elongated

** Tubers tested had been in storage for 90 days after harvesting.*

Rooney (1983:15) reported that there were several clones of this cultivar, which differed in the size of their tubers, while Millar (1996 pers. comm.) suggested that there are two forms of 'Urenika' with one producing much larger tubers than the other. The present author has collected or has been sent tubers of this cultivar that have been grown or collected from many locations including Doubtless Bay, Whangarei, Tauranga, Patea, Hastings, Turangi, Marlborough Sounds, Geraldine, Chatham Islands and Muttonbird Island. When grown together under the same conditions, they generally produced plants with identical features. Tubers from plants that were growing "wild" were much smaller than those from cultivated plants, however when the "wild" tubers were cultivated they produced tubers that were of a similar size to those from cultivated plants. There seemed to be no provenance effects apart from those tubers collected from the two Northland locations. These tubers were similar in appearance to other 'Urenika' tubers, however when first cropped in the southern North Island (Upper Hutt and Martinborough 1996) the tubers were small and round rather than elongated and the haulms died down approximately two weeks later than those from other locations. The following year, the plants of Northland origin were dug three weeks later and the tubers had elongated. Because tuberisation in potatoes occurs over a relatively short period (2-3 weeks) under normal field conditions

Fig. 29 *Tubers from 'Urenika' plants growing "wild" (top) are much smaller than those from cultivated plants.*

(Lis-Kaczynska and Listowski 1977:51) any comparisons or observations made of tubers should be undertaken once they are fully developed as indicated by the senescence or dying back of the haulms. It seems that 'Urenika' collected from Northland, tends to form tubers later than those collected from more southern locations. The reasons for this are not clear although Matthews (1999 pers. com.) suggested photoperiod and temperature differences could be responsible.

The 'Urenika' - 'Congo' relationship.

Genet (1996 pers. comm.) considered that 'Urenika' is possibly synonymous with 'Congo' a United Kingdom cultivar introduced "pre-1900" (P. Haddon 1999 pers. comm.) and known in France as 'Vitelotte Negresse' or 'Truff de Chene' and in Sweden as 'Bla Potatis' and 'Svartptet'. (P. Coleman 2000 pers. comm.) Yen (1961/62:5) noted that 'Urenika' resembles the storied (iodine) potato of Ireland, used as a talisman against illness. In Australia a cultivar known as 'Purple Congo' is popular with the Italian communities, where it is used to make *gnocchi*, a type of "potato pasta".

There appears to be little information in the literature about the origins of the cultivar 'Congo' although Salaman (1926:5) noted that black tubered varieties of potatoes were mentioned as established varieties [in the UK] in 1795 and Salaman and Hawkes (1949: 74) referred to a potato with deep purple tubers described by Caspar Bauhin in 1620 in the printed herbal *Prodromos*.

'Congo' plants grown by the author (the donor reported that these were imported from Tasmania "many years ago") showed identical morphological features[1] as well as a similar foliar index value (see pg 112) to plants of 'Urenika'. Descriptions and photographs of 'Urenika' plants and tubers were sent to the Scottish Agricultural Science Agency[2] and D. Turnbull (1996 pers. comm.) confirmed that

[1] Morphological features were compared using UPOV "guidelines for the conduct of tests for distinctness, homogeneity, and stability" (potato *Solanum tuberosum*)

[2] SASA maintains a large collection of potato cultivars for genebank and identification purposes.

'Congo' and 'Urenika' are very similar and at least have a common stock. One difference observed by the present author, was that 'Congo' tubers were consistently larger than those produced by 'Urenika' plants (see fig. 30) suggesting that 'Congo' and the other European synonymous cultivars may have been selected for this trait. This is a possible explanation for the two "forms" of 'Urenika' described by Millar (ibid).

Fig. 30 *'Congo' tubers are generally larger than those of 'Urenika'.*

Salaman (1911:11) reported that 'in the Congo potato the anthers are entirely devoid of pollen'. Observations by the current author confirmed that similarly there was no pollen[3] in the anthers of 'Urenika' or in those of the type reported to be 'Congo' of recent Tasmanian origin, further confirming the similarity between the two cultivars. One of the most striking features of 'Urenika'/'Congo' is the purple skin and flesh of the tubers. Simmonds and Harborne (1965: 316-317) reported that the purple colour of 'Congo' is due to a derivative of the highly methylated anthocyanidin, malvidin and that it is only known in this tetraploid clone. He noted that the pigment genetics of the tetraploid potatoes is not well understood. Howard (1970:26) wrote that because most modern varieties of potatoes have white tubers and there is no commercial interest in potatoes with coloured tubers, little recent work has been done on the inheritance of anthocyanin pigmentation in the cultivated tetraploids.

[3] Urenika' flowers from a range of sources were inspected.

Crop observations

Yields of Māori potatoes

The yields obtained from Māori potatoes are generally low compared with those from modern potato cultivars. Genet (1996:32) noted -

> yields are usually quite low by today's standards but some of this can be attributed to viruses contained in many of these varieties. Grown in good free-draining but well watered soils, yields are acceptable.

The same author (1999 pers. comm.) commented -

> I suspect some of the differences [in yield] can be attributed to genetics but disease is probably a major factor too, especially virus. It would be good to compare yields of clean material. The cost of heat treatment probably precludes this but we have utilised a cold treatment here on most of our collection which has cleaned out some virus and reduced loadings of others.

Most of the Māori potatoes appear to be relicts of European cultivars dating from the eighteenth and nineteenth centuries, and Burgess (1987:21) noted that in 1894 the yield was only 15 tonnes per hectare compared with around 40 tonnes per hectare today. Williams (1993:142) considered that, today, yields of over 100 tonnes per hectare are possible. This is due to more productive varieties and improved growing techniques.

To compare the yield of Māori potatoes with that of a modern cultivar, an informal trial was conducted over three seasons. Eight Māori cultivars were grown in a plot alongside a "modern" cultivar. The "modern" cultivar selected was 'Rua', which was certified in 1962 (Genet 1983:55). It was selected because it is a "late" type - setting tubers in autumn at a similar time to most of the Māori types. Six plants of each cultivar were grown. A formalised random layout was

not used as the purpose of the experiment was to be indicative only. The first trial was planted at Upper Hutt, on a clay loam soil, on September 28 1996, and the tubers were harvested on 28 March 1997. At the time of harvest the haulms were still green and had not died down. The reason for this early harvest was that the land on which the crop was growing was unexpectedly sold. The second planting was at Martinborough, in the Wairarapa, on a silt loam soil. Tubers were planted on September 25 1997, and harvested the following year on 26 April once the haulms of most of the plants had died down[4]. The final planting was at Moiki, near Greytown, in the Wairarapa on a silt loam soil. Tubers were planted on September 26 1998, and harvested on April 28 1999. Results (yield in kg per plant) are summarised in the following table. For the purposes of calculating average yield, the Māori cultivar 'Kowiniwini' was not included as these plants showed obvious signs of virus infection (mottling, crinkling and slight yellowing of the leaves - typical symptoms of potato virus Y) and the yield per plant was much lower than that of the other cultivars.

Fig. 31 *Informal trial plots.*

[4] Lis-Kaczynska and Listowski (1977:65) concluded that tuberisation is stimulated as a result of stress conditions which check the growth of the haulm and leaves and hasten the senescence of the plant. Senescence of most cultivars usually occurs in autumn however this depends on whether the cultivar is an early or late type.

Table 2

Yield per plant (kg) averaged over 3-yearly crops of 8 Māori cvs and one 'modern' cv.

Cultivar	1997	1998	1999	average yield
Karupoti	0.75	0.64	0.82	0.73
Kowiniwini	0.31	0.36	0.41	0.36
Pawhero	0.94	0.87	1.08	0.96
Poiwa	0.62	0.79	0.59	0.67
Ngā Oti Oti	0.50	0.61	0.48	0.53
Raupi	0.88	0.93	0.82	0.88
Urenika	0.58	0.69	0.60	0.62
Moemoe	0.75	0.93	0.79	0.82
Rua	1.40	1.79	1.39	1.52

Results indicate that 'Rua' consistently produced a considerably greater yield than the Māori cultivars over the three seasons. The average yield of the Māori cultivars was 0.74 kg per plant while the average yield for 'Rua' was more than twice that at 1.52 kg per plant. The early harvest in 1997 did not appear to reduce the yield as those from the subsequent crops which were left in the ground for a further four weeks were similar. This is interesting because tuberisation in potatoes under normal field conditions occurs over a period of only 2-3 weeks at the end of the season. While these results appear to provide evidence that the yield of Māori potato cultivars is much lower than that produced by a modern cultivar, they cannot be considered to be conclusive as the Māori cultivars were likely to have varying degrees of virus infection, while the "modern" cultivar 'Rua' to which they were compared, was grown from certified seed tubers meaning the plants were less likely to be virus infected.

Aerial axillary tubers

Observations of the crops over four years showed that one cultivar - 'Urenika', regularly produced large numbers of aerial tubers in the leaf axils (see fig. 32). Two other cultivars, 'Uwhi' and 'Whataroa' produced aerial tubers in 1997 and 1998 while the only other cultivar to exhibit this characteristic was 'Pāwhero' on which a small number of aerial tubers formed on plants grown in 1997. Aerial tubers formed in autumn when the leaves were beginning to senesce and subterranean tubers were beginning to form. The first three cultivars are all late tuberising types and all have very deep eyes and long stolons - all characteristics which distinguish relatively undeveloped potato types which exhibit some features of *S. tuberosum* subsp. *andigena* from "modern" potatoes. It is unclear however whether this characteristic is a common feature of relatively undeveloped potato types or whether it occurs more commonly in late tuberising cultivars. Production

***Fig. 32** Some Māori potato cvs such as 'Urenika' develop small tubers in the leaf axils.*

of aerial axillary tubers does not appear to occur spontaneously in modern cultivars and Percival *et al* (1999:768) in discussing the formation of these tubers in modern cultivars wrote -

> Occasionally, potato plants form between one and several tubers in the leaf axils, which vary in size and shape and are usually intense green to purple in colour. Aerial tubers develop in response to restrictions of carbohydrate source-sink exchange from the haulm to tubers resulting from insect or mechanical injury to basal areas of the stem.

This was confirmed by Paiva *et al* (1982:425) who also noted that when stem cuttings taken from plants are placed in moist sand or vermiculite and exposed to short days, the axillary buds grow out as small tubers. The apparent short day requirement for the stimulation of aerial tuber formation may partly explain why spontaneous aerial tuber appears to be limited to those types which tuberise late in the season when day length is becoming shorter.

G. Yoder (2000 pers. comm.) wrote -

> Axillary tubers do occur in modern cultivars, but only under stress or atypical environments. Axillary tubers tend to form when the phloem is damaged or the tuber sinks are removed or insufficient to accommodate supply. This can occur in the field when the vines fall into the furrow and the phloem is constricted.

He also noted that the degree of axillary tuber formation was variety and environment dependant and also high light levels during short days can encourage the development of these tubers.

Axillary tuber formation in the four listed cultivars in the collection did not seem to be in response to any unusual conditions and appeared to be spontaneous. The fact that the cultivar 'Urenika' regularly produces large numbers of aerial tubers may help to explain why it is able to persist for long periods in uncultivated ground and apparently spread and grow "wild" more successfully than other cultivars.

Stolon length

One of the features of some of the Māori potato cultivars is that they develop tubers at the ends of long stolons. Stolons of 'Urenika' are reported to have been located up to two metres from the central structure of the plant. (W. Sykes. n.d. pers. comm. to T. Batley) Very long stolons were a feature of the early *S. tuberosum* subsp. *andigena* potatoes introduced to Europe in the 16th century and this feature was described by Salaman (1987:67) as one of the reactions of a short day plant when subjected to a long day environment. Booth (1963:99) noted that normal tuber development in the potato plant can be regarded as the summation of two separate processes, stolon development and tuberisation at the stolon tip. He recorded -

> The evidence for this view is that in certain varieties of *Solanum andigena*, stolon growth continues indefinitely under long photoperiods, whereas tuberisation commences within 7 to 14 days after transfer to short days. Conversely, tuber formation in *S. tuberosum* has frequently been recorded in the absence of stolon formation.

Kratzke and Palta (1992: 561) studied variations in stolon length of eight "modern" potato cultivars and found that the length of the stolons did not appear to be related to time of tuber maturity and the length of individual stolons varied considerably among cultivars. The mean stolon length of the eight cultivars varied from 30-122mm. They concluded that since stolon length was consistent for each cultivar over three years, it appeared to be a consistent genetic trait. From the available evidence it appears that the stolons of the relatively undeveloped *andigena* types of potatoes tend to continue to increase in length until the onset of short days in autumn stimulates tuber formation and as a result their stolons are generally much longer than those of "modern" cultivars - some of which develop tubers on very short stolons or even in the absence of stolons.

Field observations

To observe and measure stolon lengths of the cultivars collected by the present author, one tuber of each of the 18 named Māori cultivars and one "modern"

cultivar - 'Desiree' were planted in a garden plot. This was a separate garden plot from the main cultivar collection. Tubers were planted on 26 September 1999 and harvested on 28 April 2000 once all the haulms had died down. The reason for a different garden plot rather than simply lifting and taking measurements from a plant within a row was to ensure that plants were sufficiently separated so that that roots, stolons and tubers of adjacent plants did not intermingle. This allowed each plant to be lifted easily and the tubers that were furthest from the parent plant could be readily located.

Tubers were planted in a quincunx[5] pattern with 1.5 metres between each. Plants were lifted carefully to ensure as many stolons as possible remained intact. The soil around each plant was forked over to locate any detached tubers.

Plants were placed on a tarpaulin and the soil was hosed away from the root/ stolon system. The ten longest stolons on each plant were measured. The length of some stolons where the tubers had become detached, was calculated by measuring their position in relation to the centre of the parent plant. The ten longest stolons were measured rather than stolons selected at random because some of the shorter stolons appeared to be still in a growth phase.

The results are shown in Table 3 and discussed in conjunction with the data collected on *leaf indices* in the following section.

[5] Based on a pattern of 5 as on a dice

Fig. 33 *Stolons of 'Urenika'.*

Table 3

Stolon lengths of 18 Māori cultivars and one "modern" cultivar.

Cultivar	10 longest stolons (cm)										average
Urenika	23	31	39	22	19	29	23	25	33	36	28.0
Uwhi	27	24	19	17	29	21	24	28	26	23	23.8
Whataroa	25	24	17	27	29	25	27	18	26	15	23.3
Huakaroro	19	19	25	27	22	17	23	26	19	28	22.5
Ngā Oti Oti	19	22	23	24	24	17	19	22	24	17	21.1
Parareka	23	27	19	24	18	15	27	15	19	24	21.1
Kowiniwini	17	18	19	17	16	19	20	15	12	18	17.1
Pāwhero	18	19	12	18	17	12	19	21	16	11	16.3
Poiwa	17	14	11	16	19	18	19	12	13	14	15.3
Moemoe	17	15	17	14	13	19	17	11	10	19	15.2
Peruperu	16	18	9	16	23	24	19	13	12	17	14.5
Karupoti	16	18	14	16	13	16	13	10	16	18	14.2
Karupārera	13	14	12	9	16	17	12	15	16	14	13.8
Raupi	17	14	19	12	16	12	11	14	10	9	13.1
Whanako	14	16	12	11	10	9	9	12	10	8	11.1
Rokeroke	12	9	8	15	13	16	8	13	9	10	10.4
Māori Chief	10	11	8	12	8	10	7	11	9	7	7.1
Māori	7	8	11	6	10	7	6	8	12	7	7.0
Desiree	7	4	3	7	3	9	5	3	4	6	5.1

Foliar Index

Salaman and Hawkes (1949:72) undertook a study of the evolution, in Europe, of the "modern" potato from *Solanum tuberosum* subsp. *andigena*. They observed a change in leaf type from the "open" leaves of the earliest *andigena* types introduced in the late 16th century (which were preserved as herbarium specimens) to the more modern types in which the leaflets and secondary leaflets (folioles) increased in area and in many cases overlapped to give a greater chlorophyll bearing area. This allowed for more efficient photosynthesis which was necessary to support the heavier, earlier maturing crops of the modern *tuberosum* cultivars.

They devised a *foliar index* designed to indicate the relative photosynthetic area of potato leaves. They found this to be a useful guide for determining the degree to which a cultivar tended, in the transition between the *andigena* and the *tuberosum* subspecies. This index was the ratio between the length of the second left lateral leaflet and the distance between the points of attachment on the rachis (leaf petiole) of the first pair of leaflets and that of the fourth pair. (see fig. 34) To ensure uniformity they recommended that the leaves selected for measurement should be either the third from the apex or a leaf below it with the object of measuring an adult expanded leaf. Using this method they found that the index of any cultivar was constant within a few points. Salaman (1954:190) calculated that the mean foliar index of the modern British potato of the time was 84 compared to a mean index of 58 for the *andigena* types introduced to Europe in the 16th century. Swaminathan (1958:9) used this index as a method of confirming that the *desi* potatoes (see following chapter) were relicts of early *andigena* potatoes introduced to India early in the 17th century.

Simmonds (1964:43-56) investigated the evolution of the *tuberosum* potatoes by undertaking a series of experiments conducted over several years, in which he attempted to recreate the *tuberosum* group potatoes from their *andigena* ancestors. He found that one of the most conspicuous differences between the two groups was in their relative leaf size. He noted -

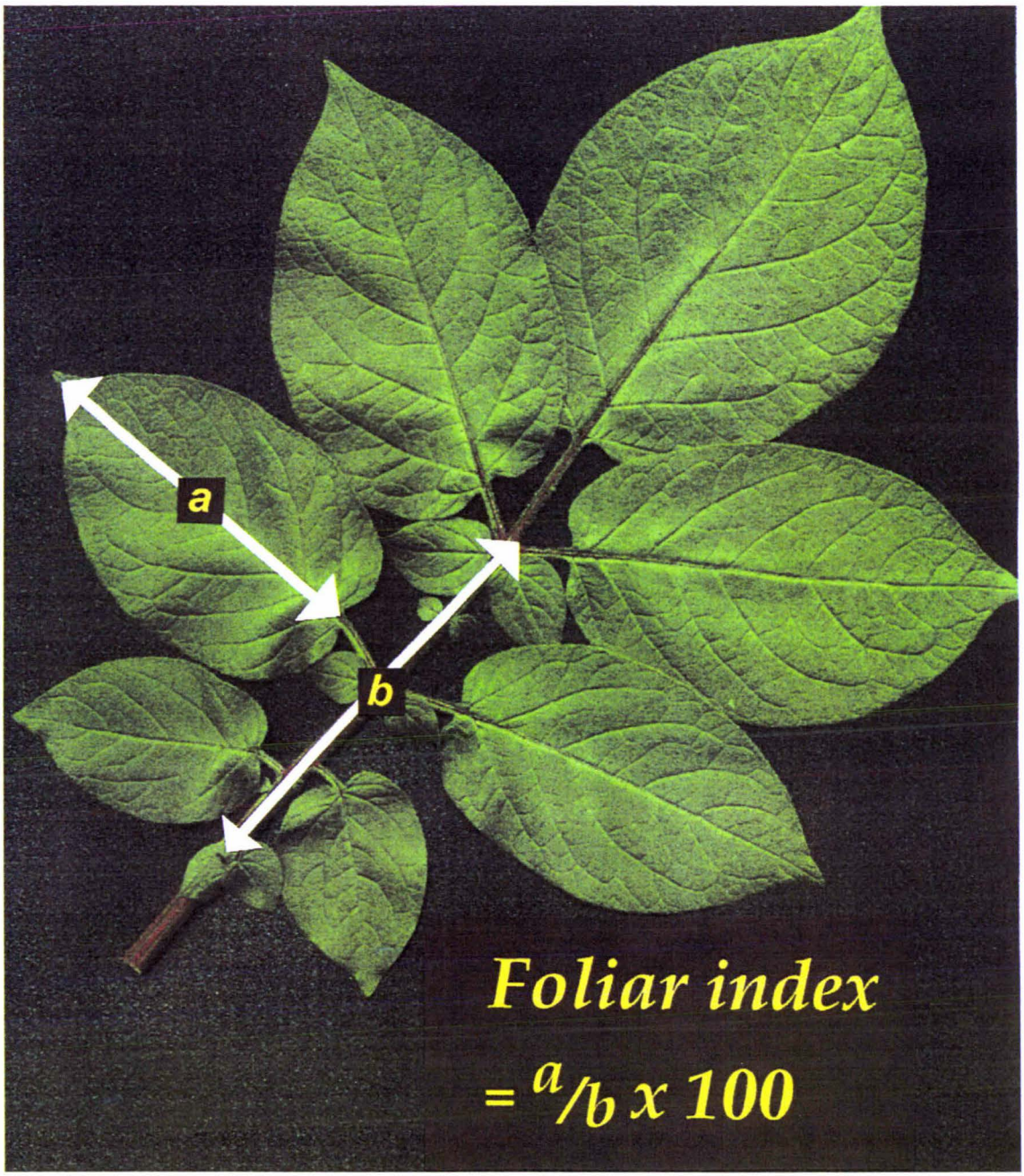


Fig. 34 *Foliar index.*

The leaves of Andigena potatoes are to casual inspection, smaller and appear to be more "open" than those of Tuberosum. It is natural then, to look for leaf measurements which would reflect these differences and which could be used both for discrimination and to provide an evolutionary scale.

He acknowledged the earlier work of Salaman and Hawkes, however he doubted the accuracy of their index and devised a discriminant function based on several measurements of a potato leaf which he considered to be more accurate. Later, he

found (Simmonds 1968:504-506) that a simple linear measurement (from the tip of the distal leaflet to the point of attachment of the first pair of leaflets) gave as good an account of the difference.

Field observations

In order to attempt to classify the cultivars in the collection of Māori Potatoes maintained by the present author, according to their tendency towards the *andigena* or *tuberosum* subspecies, foliar index measurements from the plants were taken in the 1999 and 2000 seasons. It was decided to use Salaman and Hawkes' foliar index rather than Simmonds linear measurement for several reasons.

1. Informal observations of linear measurements of potato leaves taken from the author's 2000 crop using Simmonds' method did not provide the degree of uniformity of leaflet size within a cultivar as indicated by Simmonds.

2. Foliar index data had already been collected from the 1999 crop prior to the present author becoming aware of Simmonds' work.

3. Because data from the 1999 crop had already been collected, there was an opportunity to test Simmonds' assertion that Salaman and Hawkes' foliar index was too variable between seasons to provide accurate discrimination.

Method

Foliar index measurements were taken from ten plants of each of the eighteen cultivars in the collection as well as from ten plants of 'Desiree' - a modern cultivar introduced in 1961. (Wilson 1993:111). Plants from which leaves were selected, were not chosen at random because the annual crop consisted of only ten plants of each cultivar and also because Salaman and Hawkes found the index was constant within a few points and they saw no need for random selection or replication in the use of the index. The leaf selected from each plant for measurement was the third from the apex as recommended by Salaman and Hawkes. Measurements were taken from the 1999 and the 2000 crops on

24 December in both years. Foliar indices were calculated from this data. The results are shown in Table 4.

Foliar index data recorded in 1999 and 2000 for the cultivar 'Urenika' was from plants grown from tubers sourced from Whangarei however foliar indexes were also calculated in 2000 from 'Urenika' plants collected from Geraldine (68), Turangi (68) and Tauranga (70). A foliar index was also calculated from leaves of the cultivar reported to be 'Congo' of Tasmanian origin, which returned a foliar index of 70. Foliar indexes of 70 and 71 were also calculated from two photographs[6] of leaves of 'Urenika' (of Whangarei origin) grown in 1997.

Fig. 35 *"Open" leaves of 'Urenika'*

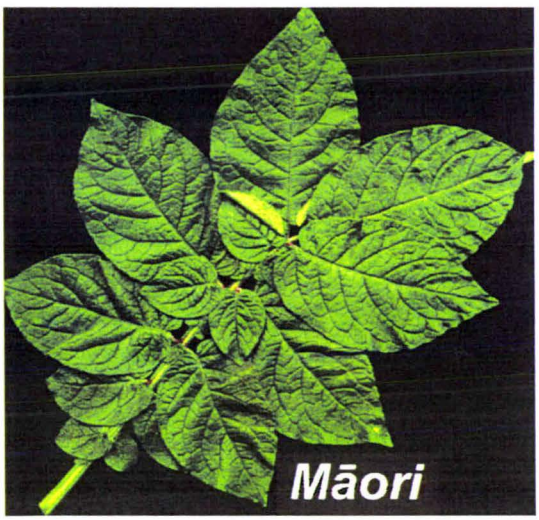


Fig. 36 *"Closed" leaves of 'Māori'*

[6] Because the index is a ratio, actual life-size measurements are not necessary.

Table 4.

Foliar indices of 18 Māori cultivars and one "modern" cultivar.

Cultivar	Foliar indices (top row 2000, bottom row 1999)										Average	
											1yr	2yr
Urenika 2000	68	70	67	71	72	66	71	66	73	69	69.3	
1999	70	69	66	67	72	67	72	72	65	68	68.8	**69**
Huakaroro	69	68	72	70	72	73	70	72	69	70	70.5	
	73	72	69	68	71	70	69	72	72	71	70.7	**71**
Uwhi	72	73	69	74	75	75	70	73	76	73	73.0	
	69	75	71	76	71	71	73	74	70	72	72.2	**73**
Ngā Oti Oti	77	71	77	77	71	74	79	77	73	76	75.2	
	70	79	72	74	75	77	78	73	73	72	74.3	**75**
Whataroa	77	77	79	78	71	79	72	79	70	76	75.8	
	79	79	75	75	76	78	75	76	75	75	76.3	**76**
Peruperu	77	70	72	71	74	78	78	71	77	76	74.4	
	78	79	74	78	75	77	78	75	78	74	76.6	**76**
Kowiniwini	78	80	81	80	77	76	80	78	77	77	78.4	
	75	77	79	76	79	82	73	78	73	72	76.4	**77**
Karupārera	75	74	77	79	78	75	79	79	76	75	76.7	
	77	79	78	74	79	76	78	79	78	76	77.4	**77**
Parareka	83	84	80	79	78	84	79	78	80	81	80.0	
	83	79	78	78	81	78	82	82	80	78	79.9	**80**
Moemoe	80	80	78	77	78	81	82	78	78	83	79.5	
	79	82	83	79	79	79	82	80	78	82	80.3	**80**
Poiwa	80	81	85	84	83	86	79	84	85	80	82.7	
	83	86	82	81	79	84	82	81	85	83	82.6	**83**
Raupi	82	89	83	86	83	80	87	84	88	82	84.4	
	86	88	84	88	86	87	85	86	82	89	86.1	**85**
Pāwhero	80	81	84	87	87	85	81	83	85	85	83.8	
	84	88	86	89	88	87	85	84	89	88	86.8	**85**
Whanako	89	88	82	84	88	89	89	89	84	88	86.9	
	87	86	89	82	87	88	83	84	89	85	86.0	**86**
Rokeroke	88	89	84	82	81	86	85	88	83	83	84.9	
	86	88	90	85	86	85	87	89	85	86	86.7	**86**
Karupoti	87	86	88	89	83	84	86	89	85	83	86.0	
	89	90	91	89	87	87	89	88	87	87	88.4	**87**
Māori Chief	87	86	91	92	90	86	92	86	92	92	89.4	
	94	92	89	92	93	92	92	90	91	93	91.8	**91**
Desiree	99	99	97	99	98	99	102	97	98	98	98.6	
	101	98	102	98	103	98	103	99	104	94	100.0	**99**
Māori	101	98	104	97	103	97	101	99	98	97	99.5	
	103	100	99	101	98	101	103	102	93	102	102.0	**100**

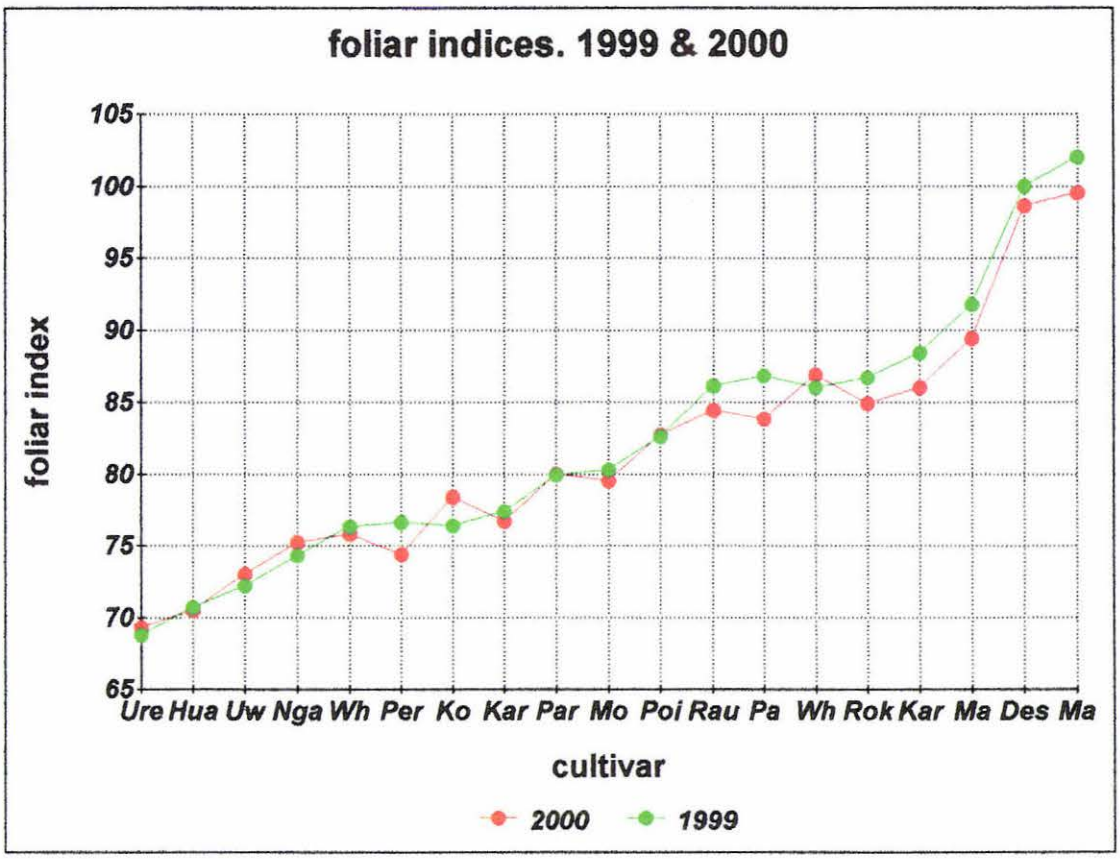


Fig. 37 *Foliar indices of 18 Māori cultivars and one "modern" cultivar taken from the 1999 and 2000 crops.*

Discussion

The average foliar index ranged from 69 ('Urenika') to 100 ('Māori') and figure 37 indicates clearly that there was little variation in foliar index between cultivars from leaves taken from the 1999 and 2000 crops. Those cultivars which showed the greatest variation in foliar indices between the two seasons were, 'Peruperu' 2.9%, 'Kowiniwin' 2.6%' 'Pawhero' 3.5% and 'Karupoti' 2.8%. Overall the average variation of all cultivars between seasons was 0.9%.

The results show little variation in foliar indices between two seasons, providing support for the accuracy of this method of discrimination despite Simmonds' doubts about its precision. This was also supported by foliar indices calculated from photographs of 'Urenika' leaves from the 1997 crop.

The foliar index data that was collected, indicates that those cultivars at the lower end of the scale - 'Urenika' (69), 'Huakaroro' (71), and 'Uwhi' (73) are most likely to be relatively "undeveloped" types and tend towards the *andigena* subspecies while at the other end of the scale two known "modern" tuberosum types, 'Desiree' (99) which was released in 1961 and 'Māori Chief' (91) (introduced as 'Northern Star' in 1902), have high foliar index values as expected. The highest index was that of 'Māori' (100) indicating it is likely to be a "modern" cultivar. The data provides an indication of the tendency of the cultivars towards the *andigena* or *tuberosum* ends of the scale however it is unlikely to be accurate enough to categorise those cultivars whose indices lie in the middle ranges of the scale. While the index was developed to provide an indication of the tendency of a cultivar it does not provide definitive evidence.

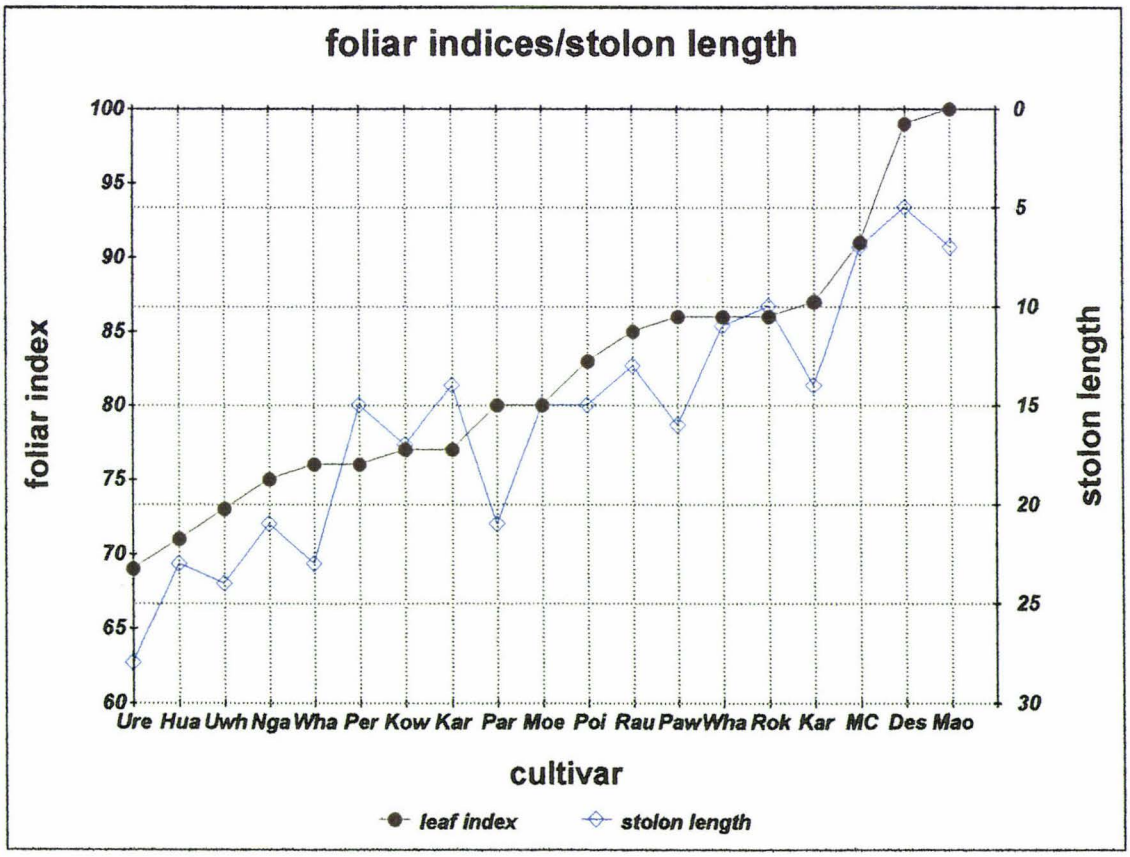


Fig. 38 *The relationship between leaf indices and stolon length.*

Cultivars which tend towards *andigena* types generally have long stolons while "modern" *tuberosum* types usually have shorter stolons. When stolon length data for each cultivar is plotted against stolon length data as shown in Figure 38, the results show that at the extremes of the scale, a low foliar index coincides with long stolons and a high foliar index coincides with short stolons. In the middle of the scale there is less uniformity of coinciding values although a general trend between the foliar index and stolon length relationship is evident. This data reinforces the probability that the cultivars 'Urenika', 'Huakaroro' and 'Uwhi' and possibly 'Ngā Oti Oti' are likely to be *andigena* types while indicating that 'Māori' is likely to be a "modern" type. The two known "modern" *tuberosum* cultivars have coinciding high foliar indices and short stolons as expected.

Another feature that indicates whether a potato cultivar is likely to be a relatively undeveloped type is the presence of deep eyes, with modern *tuberosum* types usually having very shallow eyes. Those cultivars identified above using foliar/ stolon data, as being likely to be *andigena* types, all have deep eyes while the "modern" types and the cultivar 'Māori' identified as likely to be a "modern" type, all have shallow eyes.

While *andigena* types generally produce tubers late in the season in response to the onset of short days and 'Urenika', 'Huakaroro' and 'Uwhi' all tuberise in autumn, this factor cannot be considered to be a reliable indicator on its own as Wilson (1993:15), showed that as early as the late 18th century, a number of cultivars that formed tubers relatively early in the season had been developed.

While the spontaneous formation of aerial axillary tubers does not appear to have been used as an indicator of the degree of development of potato cultivars, it is useful to note that 'Urenika' and 'Uwhi' - two of the cultivars identified as being likely to be *andigena* types, exhibit this characteristic which appears to be related to the short day requirement for the stimulation of subterraneum tubers in "late" cultivars.

Chapter 8.

Relict potato cultivars in other countries.

Relict potatoes in other countries

New Zealand is not the only place where relict potato populations have been maintained. The literature describes similar populations of relatively "undeveloped" potatoes, many of which exhibit characteristics of the potato subspecies *andigena*, that exist in other countries including India, Japan, the Canary Islands, Italy and Basutoland in southern Africa. It is possible that similar relict populations that have not been recorded or reported, could exist in other countries.

India

While little is known about the history of the introduction and spread of the potato in India, Swaminathan (1958:8) who wrote extensively on relict potato populations in India suggested that they were likely to have been introduced either by the Portuguese or later by the British. The first mention of the potato in India occurred in an account of a banquet given by Asaph Chan for Sir Thomas Roe at Ajmer in 1615. Swaminathan (ibid) referred to 16 distinct *desi* varieties which have been maintained by farmers on the Indian plains, and are considered to be relics of early introductions from Europe. He noted that the *desi* varieties largely resemble the unselected *andigena* types growing in South America with respect to characteristics such as growth habit, depth of eyes, stolon length and the fact that they set tubers very late in the season.

Japan

It is generally recognised (Hosaka 1993:56) that the Dutch first introduced the potato to Nagasaki via Java during the Keicho period (1596-1614). Hosaka noted that they soon spread over the country, particularly to the cooler mountainous regions in central and northern parts of the country where they were soon recognised as being a useful hardy crop. They were introduced to

Hokkaido in the far north in 1706. For two hundred years after their introduction, Japan was effectively closed to trade with the outer world and no other potato cultivars were introduced.

Using a method of chloroplast DNA restriction enzyme analysis which is capable of detecting those "later developed" potatoes which have genetic material from Chilean subspecies *tuberosum*, Hosaka identified four cultivars carrying characteristics of subspecies *andigena* which he considered to be relicts of the early introductions. Two of those cultivars, 'Murasaki-imo' and 'Nemuro-murasaki' were described as having purple tubers ("murasaki" means "purple").

Canary Islands

Hawkes (1990:39) recorded that potatoes were directly introduced to the Canary Islands from Peru in about 1622. He noted - 'These potatoes were *S. tuberosum* subsp. *andigena* and still remain very close to that subspecies at the present time.' Quiros (1999 pers. comm.) reported that the relict potatoes on the Canary Islands include both tetraploid and triploid types.

Italy

Angelini (1999:7-8) reported on recovery strategies for heritage potato varieties in the Genovese mountains in northwest Italy. He found that farmers in this region had been producing old varieties for many generations without importing new varieties from outside the region. Concerned about genetic erosion and the monopoly of new hybrid cultivars in the market, he became convinced that the protection of heritage varieties and the associated cultures, dialects and ideas was a moral imperative, especially as the mountainous areas where these potatoes were traditionally grown were becoming abandoned and the local varieties were becoming extinct.

As a result of an extensive survey of the region, Angelini located two distinctive varieties - 'Quarantino Bianca' and 'Cannellina Nera' which despite their relatively low yields, have an excellent taste and their culinary qualities are

highly acclaimed. Angelini provided the following descriptions of the two varieties as -

'Quarantina Bianca' - an early potato with round tubers, deep pink eyes, good skin finish, white flesh and flowers and very good culinary qualities.

'Cannelina Nera' - a very firm white fleshed variety, with long shaped tubers, very deep eyes, leather coloured and resistant skin, light purple and white flowers. Excellent culinary characteristics with a strong typical taste.

With assistance from the local provincial government of Genova, Angelini established a recovery programme to promote the recovery and regeneration of these heritage varieties. He concluded -

> 'The discovery and diffusion of local knowledge and local tastes are additional benefits of this project - benefits which contribute to the conservation of genetic resources and which highlight the value of these historical, environmental and, not least of all, economically important resources.

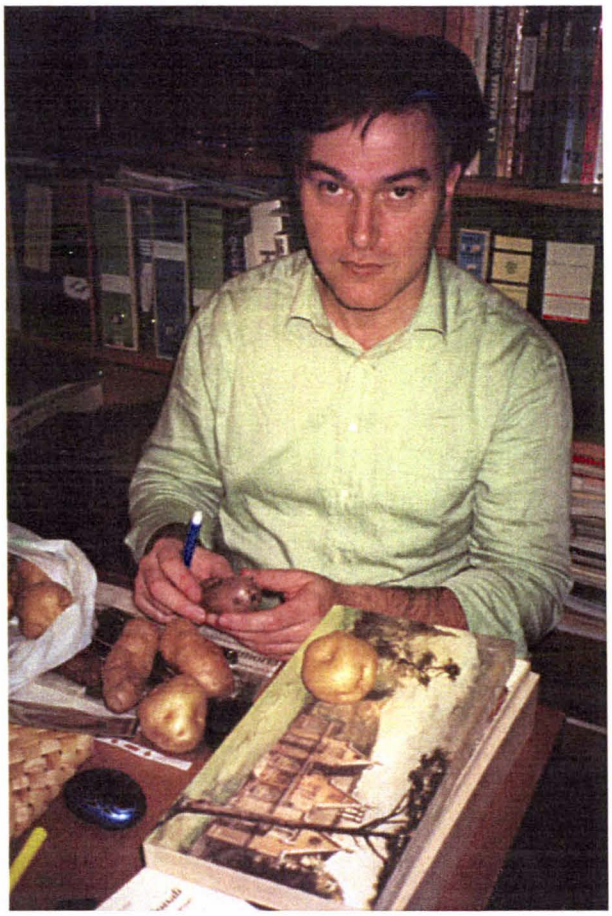


Fig. 39 *Professor Massimo Angelini with relict potatoes collected in the Genovese mountain of Italy.*

Basutoland

As a result of studying a number of varieties of potatoes grown by the Basuto people in southern Africa, Van der Plank (1946:504) concluded that the characteristics of these potatoes indicated they were relics of the potato types that existed in Europe before the blight pandemics of the 1840s. He noted that potatoes were introduced to the region in 1833 by Rev E. Casalis, who obtained them from Phillipolis in the eastern Cape Colony where there was a flourishing potato industry. Van der Plank described the Basuto as a tribe which was isolated from white civilisation. He noted that because they only regarded potatoes as a minor food item, they never attempted to make selections and improve them. He wrote that 'at least a dozen varieties have survived' and that 'All of them showed primitive characters like deep eyes or long stolons.' Van der Plank went on to say -

> Morphologically, the varieties have strong affinities with the European potato; they would not have been out of place among the varieties which were described in Europe early last century and which we know from contemporary records to have been numberless. Where they differ from the few survivors of that period now still grown in Europe, is that the Basuto with their general indifference to the potato as a food, have kept the poor varieties as well as the good, whereas the European has long since discarded the poor. Which to judge from the literature of 100-150 years ago, were far too common.

Van der Plank was particularly interested in the short day reaction of many of these varieties and he was of the opinion that this indicated that a short-day reaction existed in the domestic potato well into the nineteenth century.

Chapter 9.

Summary and conclusion.

Summary and conclusion

The potato is of South American origin, from the Andes region that extends from Peru to Colombia, where it has been cultivated for over 2000 years. While its natural habitat is in the region of the equator, it is found at high altitudes where the temperature range and humidity are moderate.

Under prehistoric Indian cultivation, *Solanum tuberosum* evolved into two geographically widely separated subspecies, a highland low latitude subspecies in the tropical Andes and a lowland subspecies in cool temperate Chile. The Andean potato was called *S. tuberosum* subsp. *andigena* while the Chilean potato was called *S. tuberosum* subsp. *tuberosum*. It is thought that the Chilean subspecies evolved from the Andean potato which was carried south several thousand years ago by migrating Indians, and by a process of natural and artificial selection it became adapted to long day conditions.

The potato introduced to Europe and the United Kingdom in the late sixteenth century was a *Solanum tuberosum* subsp. *andigena* type, and being a "short-day" plant because of its origins near the equator, its reaction to growing in the long day conditions of the European summer was to set tubers late in autumn as days became shorter.

By the time the potato was introduced to New Zealand in the late eighteenth century, it had become adapted in Europe, to forming tubers under long day conditions (by a similar process to which it had earlier evolved in Chile), and a number of named cultivars had been developed which were classified as *Solanum tuberosum* subsp. *tuberosum*. These potatoes still retained many of the features of the *andigena* subspecies, such as irregular shaped knobbly tubers with very deep-set eyes and long stolons - and they still tended to set tubers fairly late in the

season. Potatoes at this stage had a very narrow genetic base, having been developed from a very limited number of types introduced from South America two centuries earlier.

Following the catastrophic blight epidemics which affected the potato crops of Ireland and much of Europe in the 1840s and led to the decline of almost all of the cultivars grown at that time, new cultivars were developed using the Chilean subspecies as a source of germplasm.

Several introductions of potatoes to New Zealand were recorded as being made between 1769 and 1773. While de Surville is often credited with being the first to introduce potatoes to New Zealand, journals of his expedition record that while he introduced wheat, rice and peas, potatoes are not mentioned. Potatoes given to a Māori chief at Mercury Bay by Captain James Cook in 1769 are thought by some scholars to have possibly been the first successful introduction, but the evidence is not conclusive. Further introductions of potatoes were made by Marion du Fresne's expedition in 1772 and by James Cook's second expedition in 1773. While there is considerable debate about the early European introductions of potatoes it seems likely from the available records that at least one successful introduction was made between 1769 and 1773. During the late eighteenth century there were opportunities for considerably more introductions of potatoes from a variety of locations. It is significant that these early introductions were made before the European blight epidemic and the development of the cultivars based on Chilean sourced germplasm.

While it is generally accepted that potatoes were introduced to New Zealand by Europeans, some Māori maintain that they were first brought by their ancestors along with the kūmara. However, there is no scientific evidence that this was so. Other factors that suggest this was unlikely include the profound effect that European-introduced potatoes had on Māori society, the absence of any documentation by early botanists recording the existence of potatoes, and the fact that the other plants introduced by Māori were from the warm humid tropics

whereas the potato was adapted to a much more temperate climate and was most unlikely to have grown successfully in tropical Polynesia. It is more likely that Māori developed some of their own cultivars by selection from seedlings of European-introduced varieties and from selection of somatic mutations or "sports" that arose spontaneously from the cultivars they were growing. The cultivar 'Kowiniwini' which has very distinctive markings, is likely to have been such a selection - possibly arising from 'Peruperu'.

The effect of the introduction of potatoes on Māori society was dramatic. They were easier to grow than the kūmara, could be grown over a greater range of conditions and yielded a much greater return for the effort expended in their production. Several authors have stated that the methods of propagation and production of the potato were similar to that of the kūmara and hence it was able to fit into the agricultural system of the Māori with little modification. However, the two crops require different soil conditions, and while a number of kūmara crops could be produced from the same piece of cultivated land, for potato production new land was used at least every second year. Māori developed some innovative cultivation methods for potato production which were not used by European growers for the production of early crops.

By the early nineteenth century, Māori had extensive areas of land in potato production - much of which was grown for trade. Māori-grown potatoes and other crops played an important part in feeding the European populations of the major cities in New Zealand and a significant proportion of the crop was exported to Sydney. Māori production of potatoes peaked in the late 1850s and then declined rapidly following the land wars, although several scholars have suggested that the land wars only gave the final death blow to an already waning industry.

By the end of the 19th century and in the early 20th century Māori were only growing potatoes for their own needs, however the widespread potato blight epidemic of 1905 devastated many Māori communities and indicated they had abandoned growing many of their traditional crops and depended on the potato.

It also indicated that Māori at the time were probably still mainly growing the earlier potato cultivars which were more susceptible to the blight fungus than the newer types developed after the catastrophic potato blight famines which swept through Europe in the 1840s and had particularly disastrous consequences for the Irish.

Many of the old potato varieties are still grown by Māori today - especially in the rural communities. With their deep-set eyes, irregular shape, long stolons and often colourful tubers, and the tendency of many cultivars to tuberise in the autumn, many of these "Māori potatoes" exhibit the characteristics of the potato cultivars that were developed in the United Kingdom and Europe in the late eighteenth century. It appears likely that some of these cultivars have been grown by Māori whānau and passed on through many generations. They have been referred to as a *taonga* or something precious that has been passed on by their *tipuna* (ancestors) and this, in spite of the fact that they generally produce a much lower yield than "modern" potatoes, provides justification for their continued production. In addition, many Māori claim that the old varieties have a better taste than modern types. This claim is likely to have some justification, as a wide range of cultivars with differing culinary characteristics are still being grown.

Māori potatoes appear to have some commercial value, and occasionally they can be found for sale at roadside stalls and at weekend markets where they are sold at a considerable premium above that paid for "modern" potatoes. However, because their yields are generally low it is unlikely that their production would be commercially viable.

Māori conferred numerous generic and varietal names on potatoes. In the north, potatoes were generally known as *riwai* or *peruperu* whereas they were called *māhētau* by the Ngai Tahu people of the South Island. On the east coast of the North Island, *parareka* was the most common generic name, while *taewa* was used from Taranaki to the Cook Strait region. Numerous varietal names were given to the potato and the same potato was often given different varietal names. Some of

these names were descriptive while others were names of traditional root crops which were then transferred to varieties of the potato as people saw similarities among them.

During the acquisition of a collection of Māori potato cultivars as part of this study, it became apparent that the cultivar 'Urenika' is the most widely and commonly grown, followed by 'Huakaroro', 'Moemoe' and 'Peruperu'.

An analysis of leaf index data and stolon length combined with observations of eye depth, indicated that 'Urenika', 'Huakaroro' and 'Uwhi' and possibly 'Ngā Oti Oti' are likely to be *andigena* types while indicating that 'Māori' is likely to be a "modern" type. The two known "modern" *tuberosum* cultivars 'Desiree' and 'Māori Chief' (which was found to be synonymous with 'Northern Star') had coinciding high foliar indices and short stolons as expected. The other "Māori" cultivars are at various positions on a continuum between the relatively undeveloped *andigena* types and the modern tuberosum types.

From discussions and correspondence with many people, both Māori and Pākehā it became obvious that the term "Māori Potato" is in wide general usage to refer to older types of potatoes which have some historic association with Māori families or communities. While many of these are likely to be relicts of very early introductions, others appear to be more modern types.

The Māori potatoes, especially those that are relicts of relatively undeveloped types introduced from United Kingdom and Europe in the late eighteenth and early nineteenth centuries, represent an important part of New Zealand's history. In perpetuating these old potato cultivars, Māori gardeners have preserved a valuable genetic resource, however the value of this resource should not be seen purely in terms of their possible commercial value, or their value for breeding. They also represent part of a broader social/cultural phenomenon in the realms of employment, nutrition, koha (gift giving), conservation of *Te Reo Māori* (the Māori language) associated with traditional crop production practices, and the transfer of knowledge between generations.

Ugent (1970:1165) in writing of the introduction of modern potato varieties to the Andean potato fields and subsequent loss of native populations wrote -

> Although it is inevitable perhaps that some native potato populations will be lost in future years, it is vital that we at least preserve the more critical or ancient centers of potato variability and guard against the encroachment of modern varieties.

Similarly it is vital that the Māori Potatoes are preserved and maintained particularly as many varieties appear to have been lost over the last 40-50 years. Yen (1993) in a letter to Rhys Richardson wrote of some 26 varieties of Māori potatoes he collected in the 1950s and noted - 'During a short revisit to Northland field sites of my earlier work, I found that most of the Māori varieties had disappeared...' In a later letter in response to papers he had received from the present author about present-day interest in the Māori potato, Yen (2000 pers. comm.) wrote (from the University of Hawai'i). 'It is gratifying to note (1) that the Māori varieties of potato survive and apparently thrive, (2) that there is such interest in work such as yours in my homeland.'

It is encouraging to find that many varieties are still perpetuated by both Māori and Pākehā throughout the country, and that now, there is wide general interest in these potatoes.

To ensure the preservation of these cultivars, a project that co-ordinates the efforts of those people, organisations and communities currently maintaining collections of Māori Potatoes should be initiated. Such a project should be adequately funded and include involvement and input by Māori. It should be recognised that if it were not for the Māori communities, many of the old cultivars would no longer exist. Because most, if not all of the Māori Potato cultivars are infected with a complex of viruses which reduce their vigour and yield, the project should include the production of *FKV* (free of known viruses) plant material. It is essential that as many people as possible are growing the old cultivars to ensure their survival. Tubers should be distributed to interested individuals and organisations once sufficient numbers of healthy tubers are produced.

As part of a continuing study of Māori Potatoes, it would be useful and interesting to determine which of the cultivars have subspecies *tuberosum* genetic material using Hosaka's chloroplast DNA (ctDNA) restriction enzyme analysis procedure (Hosaka 1993). This would accurately determine which were "modern" cultivars developed after the potato blight epidemics of the 1840s and which were relicts of earlier introductions. It would also be useful to characterise each cultivar using *random amplified polymorphic* DNA (RAPD) assay. This would provide a precise description of the genetic identity of each cultivar and allow comparisons and possible matches to be made with cultivars in overseas collections.

This thesis has examined the *Māori Potato* and its relationship with the Māori people from a range of perspectives and the term has been defined morphologically, genetically and historically.

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Yen, Doug. 2000. Emeritus Professor. Department of Anthropology, University of Hawai'i at Manoa. 242 Maile Way, Honolulu, Hawai'i 682–2223.

Yoder, Greg. 2000. Correspondent, World Potato Congress Inc, Farm Centre, Suite 101, 420 University Avenue, Charlottetown, Prince Edward Island, Canada, C1A 7Z5.

Appendix 1 Botany and morphology of the potato

Botanical classification

The potato is classified on the basis of floral characteristics as -

Family	*Solanaceae*
Genus	*Solanum*
Section	*Petota*

This section is further subdivided into Series, Species, and Sub-species and all cultivated and wild potato species are classified within Section *Petota*. Several systems of classification exist however a system which considers there are eight cultivated species is most widely used.

Potatoes are classified into *ploidy* levels. Ploidy is defined by the number of chromosome sets present in a somatic (vegetative) cell which normally contain at least two sets of chromosomes. The chromosome set of the potato consists of 12 chromosomes (x=12). Cells of cultivated potato species may carry between two and five sets of chromosomes, ranging from the diploid to pentaploid level.

Of the eight cultivated species of potatoes, only *Solanum tuberosum* subspecies *tuberosum* is grown worldwide. This and the subspecies *andigena* are tetraploid (2n = 4x = 48). The other species are restricted to the Andean countries in South America where many thousand of primitive cultivars are still grown. In addition there are about 200 wild potato species, all of which occur naturally only on the American continent.

Morphological features of Solanum tuberosum.

Growth habit.

The potato is an herbaceous plant and while it is often regarded as an annual plant it is classified as a dicotyledonous perennial because it persists underground as a tuber. The habit of growth of the haulms (stem growth) varies greatly between cultivars from upright erect stems to prostrate or trailing stems.

Tuber formation

Depending on the cultivar, tuber formation can take place early or late in the season. On this basis, cultivars are categorised as early, maincrop or late with early types producing tubers in early summer and late types forming tubers in the autumn. *Andigena* types tend to set tubers very late in the season as day length shortens.

Stems

The stem system consists of stems, stolons and tubers. Tuber-grown plants usually have a number of main stems, while those grown from true seed tend have one main stem. Stems are round to angular in cross section. Wings or ribs which often form on the stems below the junction of lateral stems, vary from straight to wavy. While stem colour is usually green, they may be red or purple in some cultivars. Stems may be solid or partly hollow. Buds in the axils of leaves may grow out to form lateral stems, stolons, inflorescences or aerial tubers.

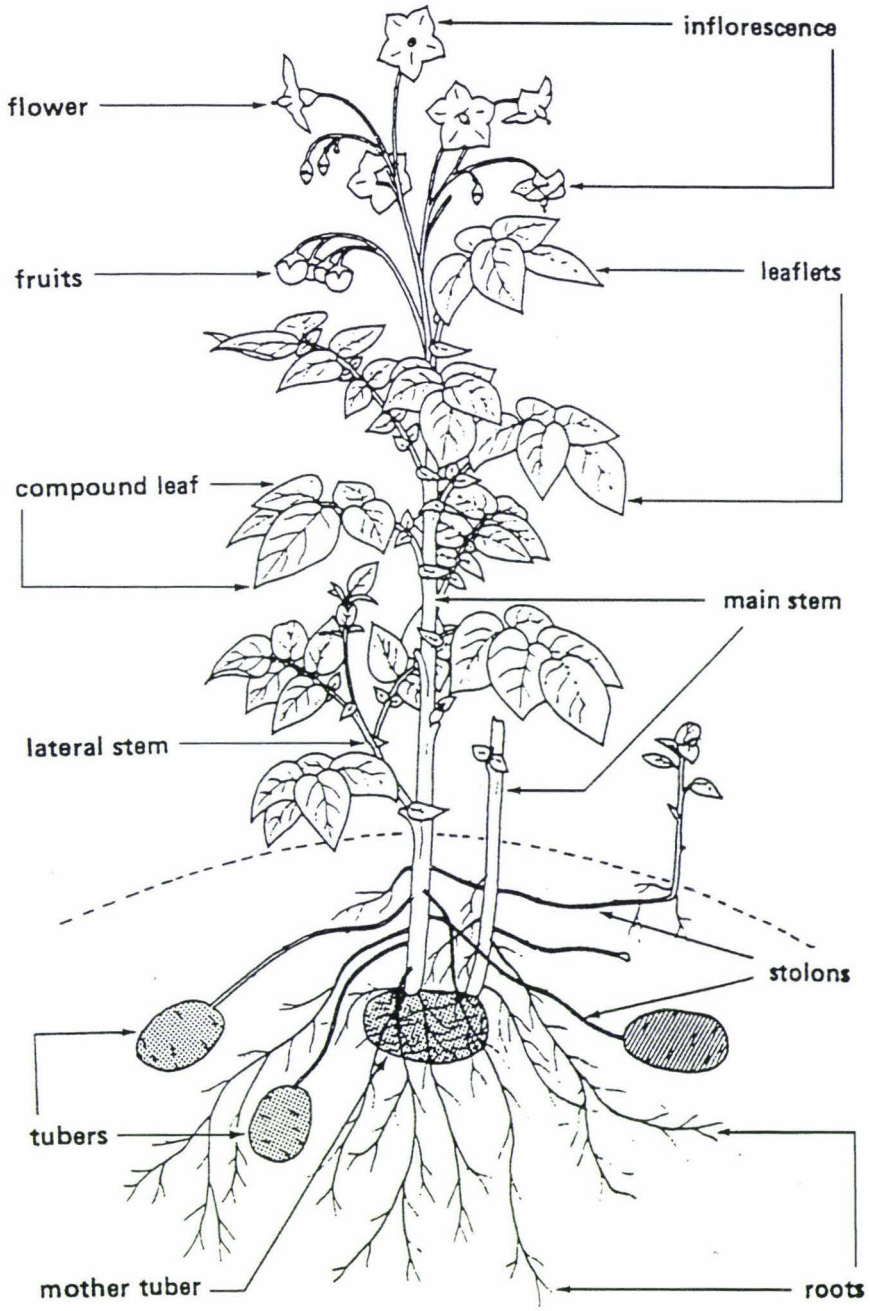


Fig. 40 *Morphology of the potato plant. (from Huamán 1986)*

Stolons

These are lateral stems which grow horizontally below the ground from buds of the underground parts of stems. The length of stolons varies greatly, with those of most modern cultivars tending to be short while those of relatively undeveloped *andigena* types tend to be very long. Stolons eventually form tubers by enlargement at their terminal end. A stolon that develops above ground, usually develops into a vertical stem with normal foliage.

Tubers

Tubers are modified stems and are the main storage organs of the potato plant. A tuber has a *heel* or *basal* end which is attached to the stolon and the opposite end is called the *apical, rose* or *distal* end. The eyes which are spirally arranged on the tuber surface are concentrated towards the apical end. They are located in the axils of scale-like leaves or the "eyebrows". Depending on the cultivar, the eyes may be shallow or deep set. Each eye contains several buds. The eyes of a potato tuber correspond to the nodes of stems with eye buds representing axillary buds. At tuber maturity, eye buds are usually dormant. After a period of time the apical eye buds break dormancy first and develop initially into sprouts and then shoots and stolons. The shape of the tubers ranges from round to oval and oblong depending on the cultivar.

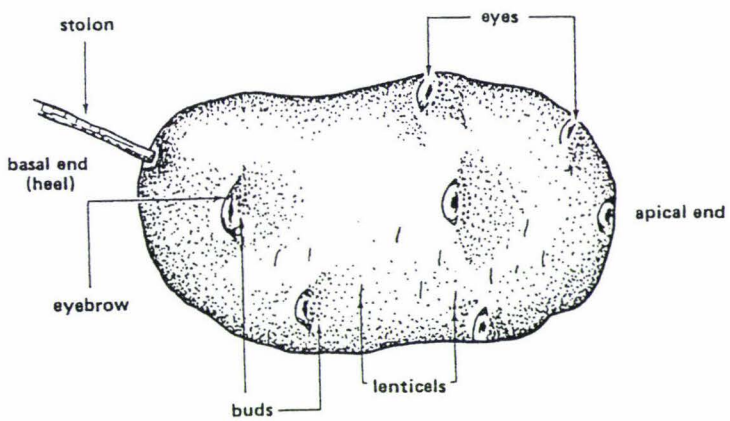


Fig. 41 *External appearance of a potato tuber.*

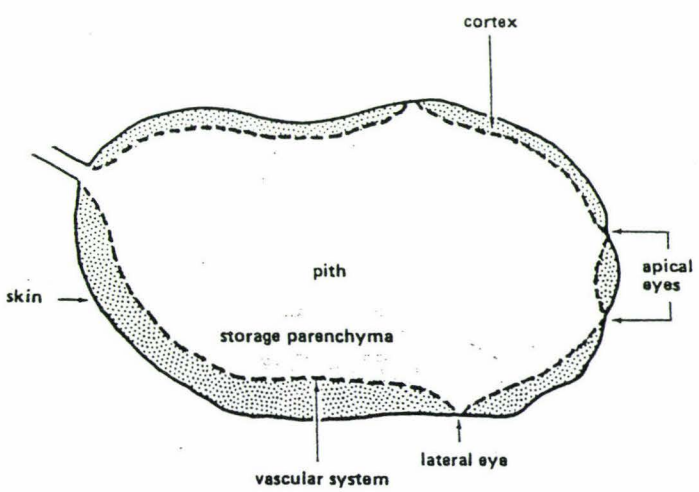


Fig. 42 *Longitudinal section through a tuber.*

In longitudinal section the tuber consists of skin, cortex, vascular system, storage parenchyma and pith. The skin is a thin protective layer on the outside of the tuber and consists of several layers of *peridermis* immediately below the *epidermis*. Depending on the cultivar, its colour can range from white-cream through yellow, orange, red and purple with some being bicoloured. Anthocyanins are the pigments that colour the periderm of red and purple varieties. Lenticels or breathing pores are distributed on the surface of the skin. These allow gaseous exchange in the tuber. The *cortex* which is a narrow band of storage tissue containing protein and starch is located directly under the skin while the vascular tissue connects the tuber eyes with other parts of the plant. The storage *parenchyma* or *outer medulla* which is the main storage tissue, is found inside the vascular ring while the *pith* or *inner medulla* is in the centre of the tuber. The flesh of the tuber is usually white or creamy yellow in modern commercial cultivars however some earlier *tuberosum* cultivars and many *andigena* types produce tubers with deep yellow, red, purple and bicoloured flesh.

Tuberisation is affected by many environmental factors and depends largely on translocation and storage of carbohydrates in excess of that needed by other parts of the plant in its growth and metabolism. Contrary to popular belief, tuberisation is not dependent on flowering.

Roots

Potatoes are usually propagated or planted as tubers. These form adventitious roots at the base of each developing shoot (sprout). Occasionally roots grow on stolons. Plants grown from true seed usually form a slender taproot with lateral branches.

Leaves

Leaves are arranged spirally on the stem. They are normally compound, consisting of a midrib *(rachis)* and several leaflets. Each rachis may carry several pairs of primary leaflets and a terminal leaflet. The part of the rachis below the lowest pair of primary leaves is called a *petiole*. Leaflets may be attached directly (sessile) on

the rachis or by small stalks *(petiolules)* or secondary petioles. The leaves of many cultivars also have secondary or interjected leaflets. At the base of the petiole there are two small *pseudostipular* leaves. Older potato cultivars and *andigena* types tend to have "open" leaves whereas the leaflets and secondary leaflets of more modern cultivars tend to be larger and overlap to allow more efficient photosynthesis.

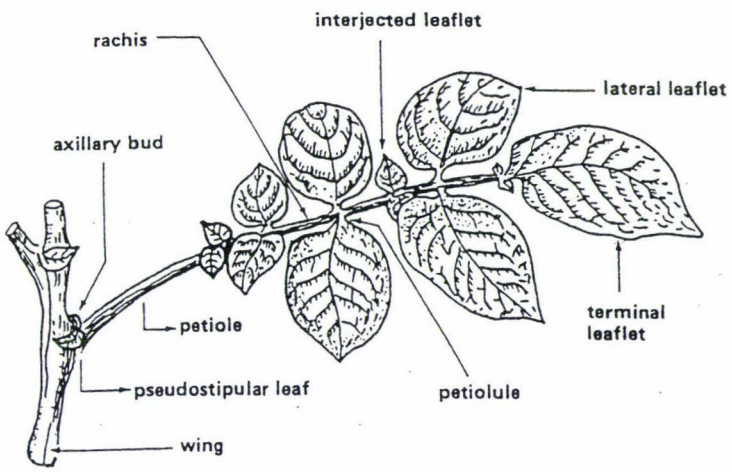


Fig. 43 *A typical potato leaf.*

Flowers

The main stalk or peduncle of the inflorescence is normally divided into two branches each of which is further divided into two other branches to form a *cymose* inflorescence. The flower stalks or *pedicels* arise from the branches of the inflorescence and there is a *calyx* at the base of the flower. The pedicels have a joint or *articulation* where the flower or fruit detaches.

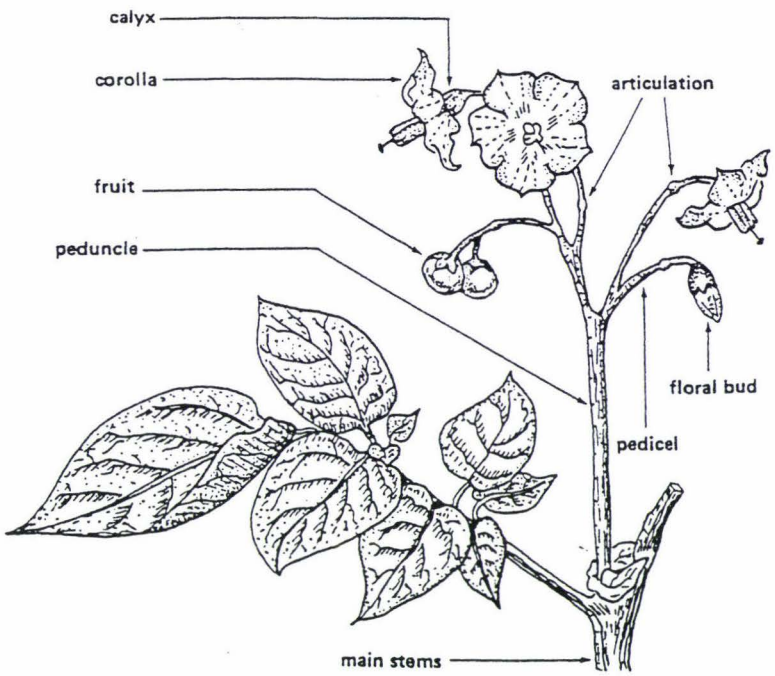


Fig. 44 *The cymose inflorescence of the potato*

Potato flowers are perfect, possessing stamens (*androecium* or male parts), a pistil (*gynoecium* or female parts) and a *calyx* and *corolla* (petals). The calyx consists of five sepals that are partly joined at their base forming a bell-shaped structure below the corolla. The corolla consists of five petals that are joined at their base to form a short tube with a flat five-lobed surface. Each lobe has a triangular point or *acumen*. The colour of the petals ranges from white to blue through to purple and often the petals have central rays or striations of different colours and often the acumen is a different colour from the rest of the petal.

The androecium is made up of five stamens, each of which is composed of an *anther* and *filament* that are joined to the corolla tube. Anthers are usually fused in a column surrounding the pistil. The colour of the anthers varies from light yellow to deep orange. Pores at the tips of the anthers allow pollen to be shed. The anthers of some cultivars such as 'Congo' are sterile and do not produce pollen.

The gynoecium consists of a single pistil made up of the ovary, style and stigma. The ovary is superior with the calyx, corolla and stamens being attached to the receptacle below the ovary. The ovary is *bilocular*, having two *locules* or cavities

where many ovules are arranged around the periphery of the placenta *(axile placentation)*. The style is the elongated part of the pistil which connects the stigma and ovary. The length of the style relative to the stamens varies between cultivars.

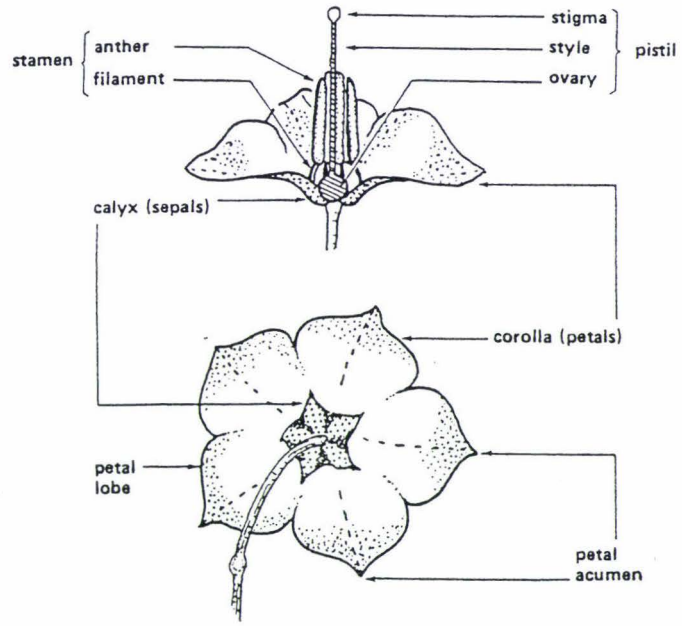


Fig. 45 *Parts of the potato flower.*

Fruits and seeds

Following fertilisation the ovary develops into a fruit (berry) which encloses numerous seeds. The fruit is usually spherical and green in colour although some cultivars may have pigmented spots or stripes. Each fruit can contain up to 200 seeds which are flat-oval in shape and small (1000 to 1500 seeds per gram). Seeds are known as true or botanical seed to distinguish them from tubers which are often referred to as "seed" or "seed tubers".

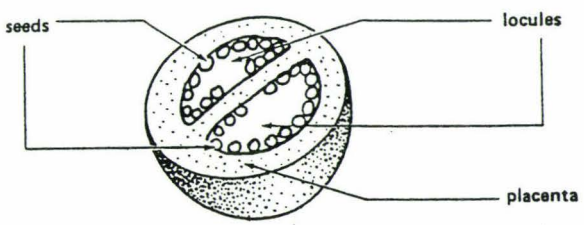


Fig. 46 *The ovary of the potato flower has two locules.*

Appendix 2 Correspondence

In this appendix, correspondents of the period 1996 to 2000 are listed alphabetically, together with a brief explanation of the subject of correspondence. It is hoped that access to the correspondence made during the present research will help in any future investigation of Māori Potatoes.

Angellini, Prof. Massimo	Professor, Dottore di Ricerca in Storia Urbana e Rurale. via Alessandria, 33 15060 Voltaggio (AL) Italy. angelini@busalla.it 16/1/00. Interested in relict potato cvs and conservation of biodiversity. Prof. Angellini has undertaken a similar project - to conserve and ,maintain relict potato cvs in Italy.
Batley, Tony.	The Homestead, Moawhango, RD2, Taihape 5457. 20/12/99. Location of early Māori potato gardens. Free-growing potato plants near Taihape. Location of old Māori potato store pit.
Baxter, Kay.	Director, Koanga Gardens, RD2, Maungatoroto. 22/10/99. Request for information about Māori Potatoes. Information about cvs in her collection.
Biemond, Chris	Potato breeder, Holland. crisbiem@hotmail.com 18/4/00. Possibility of using Māori Potato cvs in Dutch potato breeding programme.
Benham, Steve.	Collections curator, Auckland Regional Gardens, 102 Hill Rd, Manurewa, Auckland.23/8/00. Interested to establish a collection of cvs at the Botanic Gardens. Request for tubers.
Blaine, Bill.	Box 33, Factory Rd, Ruatoria. Rec'd 15/8/98. Has some 'Waikato' and 'Whanaako' tubers.
Brasell, Bert.	Thomas Rd, PO Box 160, Carterton. 9/6/97. Description of Māori Potatoes he grows.
Brosnan, Stephanie.	Production Associate, TVNZ. PO Box 3819, Auckland. 11/11/97. Enquiry as to interest in filming an article on Māori Potatoes for *Maggie's Garden Show*.
Cherfas, Jeremy.	Agricultural journalist, The Garden, UK. Apex House, Oundle Rd,Peterborough PE29NP, England jcherfas@cix.co.uk 19/7/00. decline of production/ acceptance of potatoes with coloured skin/flesh in the UK.

Clayton, Ginny.	Director, Ginny's Herbs. Box 35, Maungakaramea, Northland. 8/11/99. Request for information on Māori potatoes and for tubers of 'Uwhi'.
Close, Dr Ron.	Plant Pathologist. 38 Hinau St, Christchurch. closer@plantwise.co.nz Descriptions of early potato cultivars
Coleman, Paul.	Technical Manager, Greenvale AP Pty Ltd, UK paulcoleman@ukonline.co. 22/3/00. Sources of cv 'Congo' for the UK market
Cox, Vicki.	whaea@ihug.co.nz 7/3/00. Has three cvs of riwai and is keen to obtain others. Interested in traditional knowledge associated with culture of food crops.
Davidson, Dr Janet.	Archaeologist. Te Papa Tongarewa, Museum of New Zealand. PO Box 467, Cable St, Wellington. Janetd@tepapa.govt.nz 6/10/99. Provided some sources of information re introduction of potatoes to New Zealand.
Day, Ernie.	503 Ferguson St, Palmerston North. 9/7/98. Will send me 'Urenika' and 'Moimoi' tubers sourced from Chatham islands
Edward, Jock.	39 Russell Rd, Wainuiomata 9/6/97. Has Māori Potato cvs from Muttonbird Island. 10/6/97. description of his attempts to grow potatoes in the Pacific Islands - related this to the unlikelihood of Māori bringing potatoes to NZ from East Polynesia.
Fellows, Russell.	PO Box 456 Paraparaumu. 5/8/98. His friend Joe Tuanui has three cvs of Māori Potatoes from the Chathams. Willing to send me some.
Gabites, Isobel.	Ecologist, Boffa Miskell. igabites@xtra.co.nz 27/9/99. Rotational cropping of potatoes. Interest in coloured potato cvs.
Garrick, Dr Jack.	Retired Professor of Botany, VUW 50 McFall Rd, RD3, Ohaupo. 24/2/00. Origins of Māori Potatoes in his collection. Yield data. 11/4/99. Information on Irish potato famine. 4/5/99. Description of Māori Potatoes in his collection. 5/6/99. Information on names of Māori Potatoes.
Genet, Russell.	Scientist, NZ Institute for Crop and Food Research, Private Bag 4704, Christchurch. GenetR@crop.cri.nz 17/2/00. Information on flower colour and frequency of flowering of a range of Māori Potato cvs. 8/5/00. 'Old Red' likely to be synonymous with 'Parihaka'. 15/10/99. Interested in my yield comparisons. Speculation on virus infection effects on yield. 26/6/96. Origin of Māori Potatoes in Crop and Food collection. 11/10/96. Sending some Māori Potato tubers from their collection. 'Congo' likely to be synonymous with 'Urenika'. 14/8/97. Enquiry as to progress of my projects. 'Kowiniwini' unlikely to be synonymous with 'Fortyfold'.

Gould, Dr Ashley.	Historian, Crown law Office, Wellington. 16/4/00. Information on Māori potatoes in National Archives.
Griffiths, Aaron.	Horticultural Supervisor, Horizon Gardens, NZCCS, Auckland. comp1@ro.nzccsauck.co.nz Request for advice identifying Māori potato cvs in the NZCCS collection .
Harris, Dr Warwick.	Scientist, *Manaaki Whenua* Landcare Research, PO Box 69, Lincoln. 31/7/97. Information about early introductions of potatoes to New Zealand.
Hart, Roy.	Research coordinator, NZ Tree Crops Assn. 87 Trewavas St, Motueka. 18/10/99. Suggestion that Māori Potato cvs should be freed of virus infection. Commercial potential of cvs.
Higgins, Sarah.	Features Editor, *The Garden*. Apex House, Oundle Rd, Peterborough PE29NP, England. 14/11/98. Invitation to write an article on Māori Potatoes for *The Garden*.
Hones, Vicky.	20 Bolton Place, East Tamaki, Auckland. patia@ihug.co.nz 13/3/00. Grows 'Urenika' - sourced from Te Kuiti.
House, Sheila.	7 Tuatara Drive, Kamo, Whangarei. 11/3/00. Whanau growing Māori Potatoes in the vicinity. Has observed purple potatoes like 'Urenika'. for sale at the Bedarieux market in L'Herault.
Huaman, Dr Zosimo	Curator, potato collection, International Potato Research Centre, Lima, Peru. z.huaman@cgnet.com 20/8/98. Request for information on potatoes in my collection. Details of Maori potatoes in the CIP collection, Lima, Peru.
Lutton, Betty.	Postal Delivery Counter, Okato, Taranaki. 29/6/98. Grows Maori Potatoes for her whanau. Regards them as *taonga*.
Jolly, Eleanor.	Totaranui, Kalaugher Rd, RD 21 Geraldine.9/6/97. Sent some tubers of 'Urenika'.
Joubert, Estia.	ARC-Roodeplaat vegetable and ornamental plant Institute. Private bag x293, Pretoria 0001, SA. Estia@IGS1.AGRIC.ZA 4/6/99. Information on introduction of potatoes to South Africa.
Keating, John.	The Agriculture and Food Development Authority, Ireland. jkeating@hq.teagasc.ie 19 Sandymount Ave, Dublin 4. Ireland. 3/8/99. Sent photos and descriptions of Irish potato cvs which were grown at the time of the 1860s famine.
Ka'ai, Professor Tania.	Dean, School of Māori Studies, Otago University. PO Box 56, Dunedin. 12/10/99. Group working on nutrition training found my research interesting and useful and suggested it should be widely publicised amongst the Māori community.

Kell, Dr Fran.	Conference organiser, *Biodiversity Now* conference, Editor, *NZ Journal of Botany*. VUW. PO Box 41072, Eastbourne. 12/6/97. Invitation to present poster display of Māori Potatoes at conference.
Kenning, A. C.	10 McKay St, Paraparaumu Beach. A.Kenning@xtra.co 30/5/97. Has a collection of Māori Potatoes. Description of some of the cvs he has.
King, Dr Michael.	Historian. PO Box 109, Whangamata. 16/4/00. Information and contacts about Stivers.
Lackner, Vicki.	Te Atiawa, 1 Rimu St, Masterton. 27/9/99. Information on Māori Potatoes grown by her whanau.
Leach, Dr Helen.	Assoc. Professor, Department of Anthropology, University of Otago, PO Box 56, Dunedin. 4/10/99. Information on Māori Potatoes she grew. Enclosed a copy of her paper. *Food processing Technology*. References to production of potatoes and other introduced crops by Māori.
McKay, Margaret.	22 Scott St, Gisborne. 26/8/97. information about growers of Maori potatoes on the East Coast.
Maddocks, John.	Horticultural Consultant. 18/5/98. Descriptions of Māori Potatoes grown on Chatham Islands.
Manuera, Eru.	Tumuaki, Kaupapa Atawhai. Department of Conservation. PO Box 10-420 Wellington. 24/9/99. Linked tasks of planting, tending, harvesting and storing riwai.
Marshal, Kerry.	Mayor, Tasman District Council. PO Box 3491, Richmond, Nelson. 5/5/00. Information about a potato that has been grown in his family since the 1840s. Enclosed some tubers.
Mason, Maika.	Department of Conservation, Private Bag 4715 Christchurch. n.d. Has been growing Māori Potatoes for 40 years. His Ngāti Waewae hapu of Ngai Tahu refer to potatoes as *repe* rather than *mahetau*.
Matthews, Dr Peter.	Ethnobotanist, National Museum of Ethnology, Osaka 565, Japan. pjm@ minpaku.ac.jp 9/10/99. Detailed comments on working paper. 20/10/99. List of potato references
Mayhew, L. S.	32 Rimutaka St, Upper Hutt. 6/6/97. Has been growing 'Urenika' and 'Moemoe' for several years - also has 'Tasmanian Purple Congo"
Meredith, Dr Peter.	Botany Dept. Canterbury University. PO Box 31-004. Christchurch. P.Meredith@botn.canterbury.ac.nz 6/12/99. Resilience and growth characteristics of the cv 'Urenika'.
Millar, Lyle.	Farmer/potato enthusiast Moyola Farm, RD, Waimana 3088 11/10/96. Description of Māori Potatoes in his collection and an offer to send me some tubers.

Montague, Ann.	3 Korimako Rd, Days Bay. 27/9/97. Has potatoes that have been in their family since 1842. Brought to NZ on the *Phoebe*.
Moreno-Mendoza, José	Programa Regional Agricola. C.A. 240142 Las Palmas Santafe de Bogata. Colombia. jdmoreno@corpoica.org.co 15/2/00. Enquiry as to my interest in receiving photos of potato tubers in their germplasm collection. Many have highly colourful tubers.
Nicholls, J. J.	n.d. 36 Poole Crescent, Wainuiomata. Description of several Māori Potato cvs and meanings of their names.
Niha, Poai Pakeha (Sonny).	Māori Potato grower, Ngāti Hine. RD4 Heads Road, Whangarei. 11/6/96. Description of Māori potatoes grown by his whanau.
Orsman, Dr Harry.	Emeritus Professor, VUW and author of NZ Dictionary. 10/10/98. Information on origins of the potato. Photo of painting of Clusius potato 1589.
Parata, Hori.	Resource Management Unit Convenor. Ngatiwai Trust Board. PO Box 1332 Whangarei. 20/10/99. Note that my research has promoted interesting discussion and a request for further information.
Parsons, Dr Murray.	Herbarium curator/ethnobotanist. Manaaki Whenua Landcare Research, Lincoln. 242a Main Rd, Moncks Bay, Christchurch. 9/6/96. Transfer of names to potatoes from traditional root crops. 12/9/96. Information on Māori Potatoes grown by Pu Hao Rangi Trust.
Pieterse, Lukie.	Director, Global Potato Focus. info@potatonews.com 21/12/99. Discussion on myths and legends relating to potatoes. Request to publish a resume of my research on the potatonews web site.
Pretty, Ruth.	Ruth Pretty Catering. 10/7/98. Wants information on culinary properties of Māori Potatoes.
Prime, Kevin.	Kaumatua, Ngāti Hine. Ti Pene Rd, Motatau, RD1 Kawa Kawa. 18/7/99. Translations of some words associated with Māori potato culture and preface for working paper. (full copy of letter follows this list)
Quiros, Dr Carlos.	Professor of crop plant genetics and breeding, Department of Vegetable Crops, University of California, Davis, CA 95616, USA. cfquiros@ucdavis.edu 2/12/99. Similar relic potatoes in Canary islands which are both triploid and tetraploid.
Ramsay, Dr Gavin.	Scientist, Scottish Crop Research Institute. gramsa@scri.sari.uk 22/9/97. Information re potato genebank meeting at SCRI. 29/9/97. Permission to mention SCRI in article for *The Garden*.

Recher, Professor Harry.	Editor, *Pacific Conservation Biology*. Edith Cowan University. Joondalup, WA 6027. Australia. 25/10/99. Invitation to write a paper on Māori Potatoes for the journal.
Rhoades, Dr Robert.	Professor, Dept of Anthropology, University of Georgia. Athens, GA 30602-1619 rrhoades@uga.edu 24/6/00. Has worked on relict potatoes in Nepal, Noted that Norio Yamamoto at the Museum of Ethnology, Japan has an interest in relict potatoes.
Richards, Rhys.	Maritime Historian. 73 Seaview Rd, Paremata, Wellington. 24/4/00. Information on Stivers - possible earliest introduction of potatoes to NZ.
Roskruge, Nick.	Kaitautoko Māori. Massey University, Private Bag 11 222, Palmerston North. N.Roskruge@massey.ac.nz 16/5/00. Willing to provide information on yields of Māori Potato cvs. 30/9/99. Outline of his work with Taewa (Māori Potatoes) Information on pre-European introductions, Māori developed cvs, storage methods, yields, varietal names.
Scheele, Sue.	Ethnobotanist, Manaaki Whenua Landcare Research, Lincoln. ScheeleS@landcare.cri.nz 22/9/99. Evidence against pre-European introduction of Potatoes.
Sheridan, Dr Edmund.	Plant Doctors Ltd. 108 Park Rd, Carterton. 3/6/99. Grows 'Urenika' potato - perhaps the botanists can give it a correct name?
Smith, Russell.	6a Nelson Place, Renwick. 6/6/97. Description of various Māori potato cvs he has grown and locations where they were sourced.
Swan, George.	1371 Devon Rd, New Plymouth. 21/10/99. Interested in growing Māori Potatoes. Request for tubers. Has ideal soils in Taranaki.
Taylor, Lennie.	The Bennet Group, 431/4 London Fruit Exchange, Spitalfields, London E1 6EL. lennie_taylor@bennett-group.co.uk 9/3/00. Working with several *Solanum* species and *tuberosum* clones selecting for attractive appearance and good culinary properties.
Turnbull, Dave.	Scientist. Scottish Agricultural Science Agency. turnbull@sasa.gov.uk 23/9/96. Use of UPOV descriptors to identify potato cultivars. List of cultivars in SASA collection.
Voss, Dr Ron.	Extension vegetable specialist, University of California, Davis, CA 95616, USA. voss@vegemail.ucdavis.edu 1/12/99. Familiarity with 'Purple Congo' potato.

Watanabe, Dr Kazuo.	Department of Biotechnology, Kinki University, 930 Nishi-mitani, Uchita, Wakayama 649-6493, Japan watanabe@bio.waka.kindai.ac.jp 14/12/99. Interested in the evolutionary and ethnobotanic aspects of potatoes and their genetic traits.
Whitmore, Bill.	Commissioner, Plant Variety Rights Office, PO Box 130, Lincoln. 15/3/00. Probable ineligibility of Māori Potatoes for Plant Variety Rights. (full copy of letter follows this list)
Yen, Dr Doug.	Ethnobotanist/ Emeritus Professor. Department of Anthropology, University of Hawai'i at Manoa. 242 Maile Way, Honululu, Hawai'i 9682-2223. 24/4/2000. Outline of his work collecting Māori Potatoes in the 1950s. Suitability of the topic as the basis for a thesis.
Yoder, Dr Greg.	Scientist. Director, World Potato Congress. http://www.potatocongress.org (interactive site) Information about axillary tuber formation.

Kevin Prime (MBE)

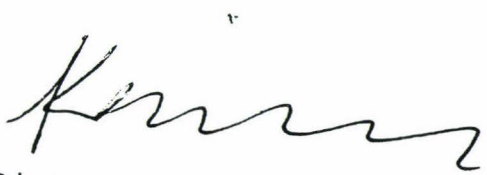
I was somewhat intrigued when thumbing through Graham Harris's paper on riwai Maori to see words that I had not seen for several years. As the only person in our district with a large tractor and heavy duty rotary hoe in the 1960s, 70s and 80s, I was often called upon by the elderly to hoe up their land for gardens in early spring.

The competitiveness of supermarkets in recent years has resulted in the provision of vegetables to Maori far more economically than was previously possible. But eliminating the need to cultivate, plant, weed, harvest and store garden produce has resulted in the loss of another chapter of our Maori language. Words like 'peruperu' and 'kanohi parera' brought back memories of other Maori words that are not heard any more in daily conversation because we no longer practice the culture of mahinga kai. These are examples that come to mind:

paahika	the act of clearing away weeds, prior to cultivation
koomiri	the act of sorting out or selecting suitable seeds or seedlings for planting
matahina	a seed potato with long shoots that was discarded
kaakati	small bundles (for example, of kumara plants)
ahuahu	the raised mounds of soil on which pumpkins or melons were planted
ahuahua	the raised mounds of soil on which pumpkins or melons were planted
kawaka	the furrow between rows of planting
karawhaea	scarifiers
kaapahu	the main 'breakout' tine of a plough
huahake	taking or digging up root crops

I would like to encourage Graham Harris to continue to preserve remnants of our cultural heritage, which modern technology is causing us to abandon.

Kia ora



Kevin Prime

Ti pene Road, Motatau, RD1, Kawa Kawa. Phone (09) 404 0651 Fax (09) 404 1727

PLANT VARIETY RIGHTS OFFICE
Canterbury Agriculture & Science Centre
Gerald Street, Lincoln
Telephone (03) 325 6355
Fax (03) 325 2946
Please address correspondence to:
Plant Variety Rights Office
P.O. Box 130
Lincoln
Canterbury, New Zealand

COMMERCE
MINISTRY OF COMMERCE
Te Manatū Tauhokohoko

15 March 2000

Graham Harris
Senior Lecturer
The Open Polytechnic of New Zealand
Private Bag 31914
LOWER HUTT

Dear Mr Harris

MAORI POTATOES AND PVR

Thank you for your letter of 6 March 2000 raising a question of some interest.

In my view existing, recognised Maori potato varieties or cultivars would not be eligible for plant variety rights. An application for PVR for any such cultivar would probably be refused on one of the following grounds.

- Newness. To be eligible a cultivar must be new. Under the Plant Variety Rights Act 1987 a cultivar is new if it has not been sold for more than one year before the date of application. In my understanding the cultivars concerned would have been in commerce for many years.
- Distinctness. To be eligible for PVR a new cultivar must be distinct from all cultivars of common knowledge. I believe that we should recognise the cultivars to which you refer as cultivars of common knowledge if they have been identified according to their descriptive characteristics and their name and if tubers of each are available. To take a specific example, if an application was made for a cultivar which we could not distinguish from 'Whataroa' we would refuse rights on the ground that the cultivar was not distinct from 'Whataroa'.

I have had a number of queries over the years about the possibility of protecting existing Maori potato cultivars and have responded with essentially the answer given above.

While such cultivars would not be eligible for plant variety rights there is nothing to stop someone developing a new, distinct cultivar from an existing one, or using Maori potato cultivars in a breeding programme. Any cultivar emerging from such breeding activities would be eligible for plant variety rights providing it met the criteria under the Act. Should we receive an application for such a cultivar it would be helpful when we evaluate the cultivar to be able to identify existing Maori potato cultivars and to obtain tubers. We therefore appreciate receiving the copy of your paper as it will provide a useful starting point to identify the cultivars of common knowledge.

In case you have not seen it I enclose for your information a copy of the UPOV test guideline for potato. It may be of interest as an internationally accepted set of descriptors for the crop.

Yours sincerely

Bill Whitmore
Commissioner

Appendix 3 Articles and papers

1. Harris, G.F., 1997a. Māori potatoes. The Garden. 123(1): 8.

2. _____, G. F., 1997b. Māhētau: the introduction of the potato to Te Waipounamu and its adoption by Māori. *Te Karaka*. 8: 36-38.

3. _____, G.F., 1997c. Riwai: the Māori potatoes. *New Zealand Gardener*. August. 8: 54-55.

4. _____, G.F., 1998. Digging the real dirt on potatoes. *Dominion*, 3 July p.10.

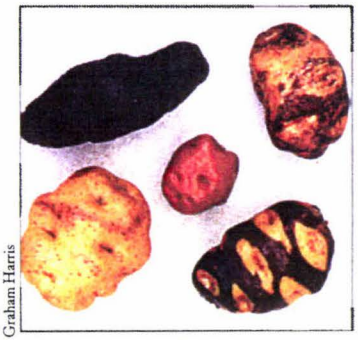
5. _____, G.F., 1998. Digging for facts about Maori potatoes. *http://www.potatocongress.org/articles* p.10.

Maori potatoes

IT IS a coincidence that in August 1997, when *The Garden* published a feature on South American potatoes, by George Mackay, pp 562-565, an article appeared in the *New Zealand Gardener* on Maori potatoes.

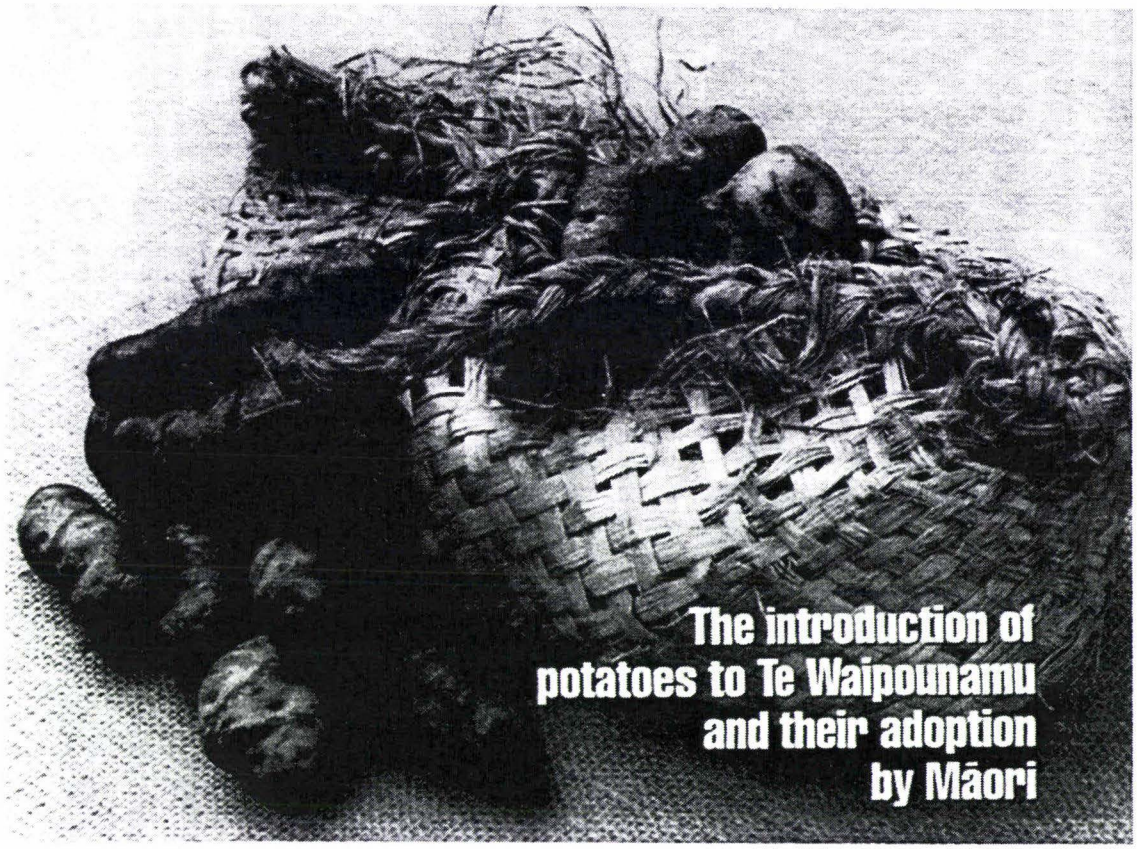
The introduction of potatoes to New Zealand is generally attributed to the French explorer de Surville in 1769 and to James Cook during his second expedition to New Zealand in 1773. These were followed by further introductions from a variety of sources.

The Maori believe that some of their potatoes pre-date the European introductions, and there is anecdotal, but not scientific evidence, to support this. Potatoes were soon a staple item in the diet of the Maori and replaced other traditional food sources. They also became an a trading commodity. Cultivars were selected and named, passing down through families for many generations. Many are still grown today – some are *Solanum tuberosum* var. *andigena* types, with deep eyes that set tubers when days are becoming shorter. In many cases the connection between the original European variety names has been lost. The names of the potatoes in the picture clockwise from top, are 'Urenika', which is widely grown and some think might be synonymous with the early European cultivar; 'Congo', 'Peruperu', and 'Kowiniwini', which was also known as 'Karuparera', which means the eye of the duck, 'Karoro' and 'Uwhiwhero' (centre). Graham Harris, a lecturer in the Natural Resources Centre at The Open Polytechnic of New Zealand has set up a collection of 18 varieties of Maori potatoes. In co-operation with the Scottish Crop Research Institute in Scotland, he aims to compare them with European varieties of the 18th and 19th centuries.



Graham Harris

DNA 'fingerprinting' will be used to establish possible matches which will gives clues as to whether the New Zealand cultivars are derived from European sources, or whether they came direct from Peru. See *The Garden*, pp790-792 for an explanation of the method.



The introduction of potatoes to Te Waipounamu and their adoption by Māori

Mahetau

Potatoes were first reported to have been introduced into New Zealand by the French explorer de Surville in 1769. However, it appears that the first successful introduction may have been those planted in the Bay of Islands by members of Marion du Fresne's expedition in 1772. The first recorded planting of potatoes in the South Island where those made by the crew of the *Adventure* captained by Furneaux, the ship that accompanied Cook during his second expedition to New Zealand in 1773. It is recorded that they made several plantings of potatoes (brought from the Cape of Good Hope) at Queen Charlotte Sound and also at Dusky Sound in Fiordland. Following these early introductions many more were introduced by sealers, whalers and colonists.

Māori were quick to recognise the advantages of the introduced potatoes over the kumara. They were easier to grow, yielded more heavily and were easier to store. Because the method of propagation and production of the potato was similar to that of the kumara, it was able to fit into the existing agricultural system of the Māori with little modification. Potatoes were particularly welcome in the southern regions of the South Island where kumara would not grow. Records show that the early potatoes grown by Māori in Otago and Southland, were grown on mounds according to traditional kumara culture, and it is suggested they were introduced to the south by Ngāi Tahu from the Kaikōura region who were known to raise kumara. It seems that Cook's earlier plantings at Dusky Sound were not

successful, as European explorers who visited the area in 1893 could find no evidence of European plants.

Potatoes soon became the staple item in the diet of the Māori and also became an important trade commodity, not only within the Māori communities, but also with European colonists and for provisioning European ships. By the early 1800s, Māori were growing large crops of potatoes and an area of 50 hectares in potato production was not uncommon at the time.

In *Historical Records of New Zealand South*, the Sydney Gazette, September 1813 records the visit that year of Williams – a flax dresser, to the Bluff who noted:

> *The natives attend to cultivation of the potato with as much diligence and care as I have ever seen. A field of considerably more than 100 acres presented one well cultivated bed, filled with rising crops of various age, some of which were ready for digging, while others had been newly planted. Dried fish and potatoes form their chief support.*

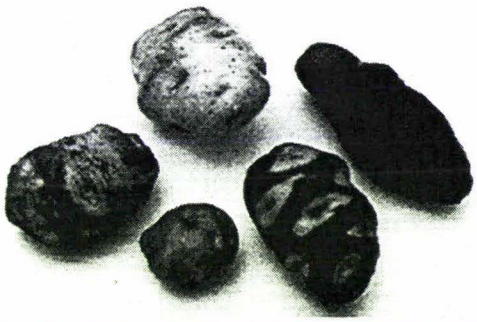
By the 1840s, Māori agricultural production, based mainly on potatoes and wheat, was thriving in Otago and Southland and several Māori groups were operating their own sailing vessels to transport their crops. Murihiku potatoes were regarded as being of particularly good quality and were in demand in the population centres further to the North.

The Chatham Islands also became an important region for potato production. When the Taranaki tribes, Ngāti Tama and Ngāti Mutunga sailed on the ship *Rodney* to colonise the Chathams in 1835, 78 tonnes of seed potatoes were included in their provisions. During the 1850s and 1860s they were producing "hundreds of tons" – much of which were exported to Australia.

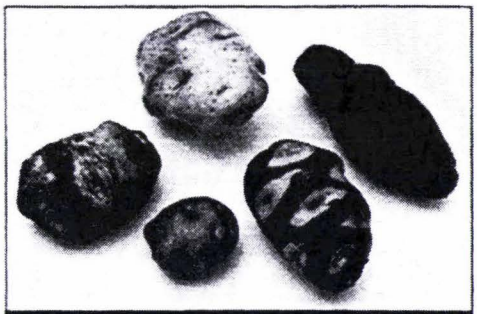
Further evidence of the adoption of the potato by Māori was in the conferring of generic and varietal names. In the South Island they were generally known as *Mahetau* – (like a string of fishing sinkers), while in the North Island they were referred as *Riwai* or *Taewa*. In Muriwhenua another general name for potatoes was *Peruperu*, although this name is now used for a specific variety. *Peruperu* means – the white feathers at the throat of the Tui, although some believe it may refer to Peru – the country of origin of the potato.

Individual varieties were also named. Some with European cultivar (cultivated variety) names were given Māori names, for example the English variety 'Derwent', which was popular in the South island, became 'Katote' and 'Old Red' became 'Pawhero'. Some, like 'Early Rose' and 'Skerry Blue' – an early Irish variety – retained their original names. Some varieties became known by different names in different areas, for example, the commonly grown 'Urenika' is also called 'Keretewha', 'Tuarua', 'Waikato' and 'Ringaringakatira'. Many of the names are descriptive, for example, 'Karupararera', a variety which has a chocolate brown skin and yellow eyes – means 'the eye of the duck'. Other common grown varieties include 'Moemoe', 'Poiwa', 'Nga Outi Outi' and 'Raupi'. Some variety names that appear to be specific to the South Island include 'Kopara', 'Papaka', 'Kariparoa' and 'Waitaha'. In many cases, the connection between the original European variety names and the given Māori names has been lost.

Some of the early potato introductions appear to be *Solanum tuberosum* var. *andigena* types which are characterised by very deep set eyes compared to the modern *S. tuberosum* var. *tuberosum* cultivars which have smooth skins. Varieties such as 'Urenika' which have been



Māori who are growing the old varieties claim that they have a better taste than modern varieties and there is some evidence to suggest they are more disease resistant than modern types.



... sixteen varieties of Māori potatoes are being grown in the Wairarapa and in Whangarei.

described as 'undeveloped' types, tend to set tubers late in the season when days are becoming shorter.

Many of the original varieties which were selected and perpetuated by Māori, are still grown today, even though modern varieties produce a significantly greater yield. Some have been passed down through families for many generations. Māori who are growing the old varieties claim that they have a better taste than modern varieties and there is some evidence to suggest they are more disease resistant than modern types. 'Urenika' appears to be the most widely grown variety – it is grown by Māori people from Northland to the Bluff and on the Chatham Islands.

It is generally accepted that many of the so-called Māori potatoes were introduced to New Zealand via Britain and Europe. It is possible that others were selected and developed by Māori from seedlings raised from these introductions. It is, however, a widely held belief among Māori that they grew some varieties of potatoes before the arrival of Europeans and while there is some anecdotal evidence passed down in proverbs and oral history, this has not been scientifically proven. In *Song of Waitaha*, Brailsford records Māori as bringing the potato to Aotearoa with the kumara, taro, karaka and other introductions.

He refers to – '*the small black potato, the old one named peruperu, the little yellow and the big red potato called parete.*' Other publications refer to the variety 'Tatairongo' that was said to have been grown by Māori in South Taranaki before the arrival of Europeans. Because of the existence of such a weight of anecdotal evidence, the possibility must be seriously considered.

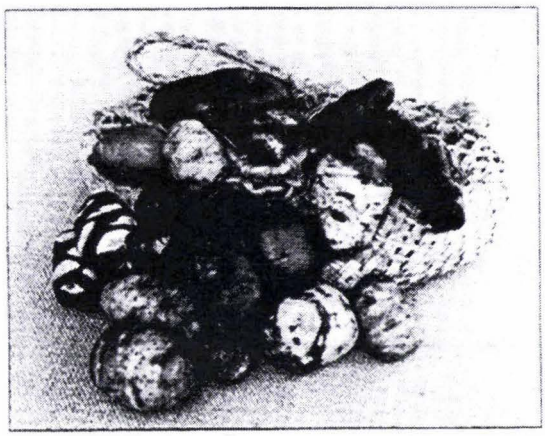
Some Māori believe that the widely grown 'Urenika' is of pre-European origin. This potato appears to be similar to a type grown in the Andes of Peru. The growth habit and appearance of the plant and the long purple tubers with purple flesh, set them apart from most of the others grown by Māori. 'Urenika' is sometimes found growing wild on uncultivated ground – possibly remaining from those grown in old Māori gardens. In Northland, it has been found growing in the vicinity of old Kāinga sites.

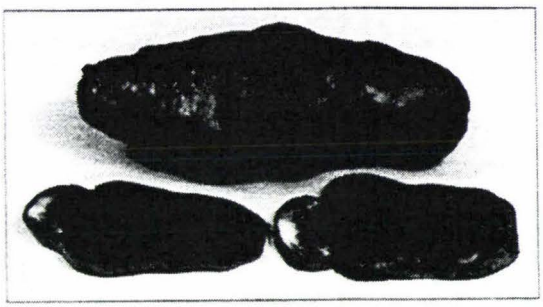
Some scientists believe that 'Urenika' could be synonymous with the early European variety 'Congo'. Another possibility is that it could have been brought directly from South America, as the port of Callao near Lima in Peru was one of the main provisioning ports for early whaling vessels. Other varieties that are grown by Māori today that some believe could be of pre-European origin are: 'Kowiniwini', 'Uwhiwhero', 'Peruperu' and 'Karoro',

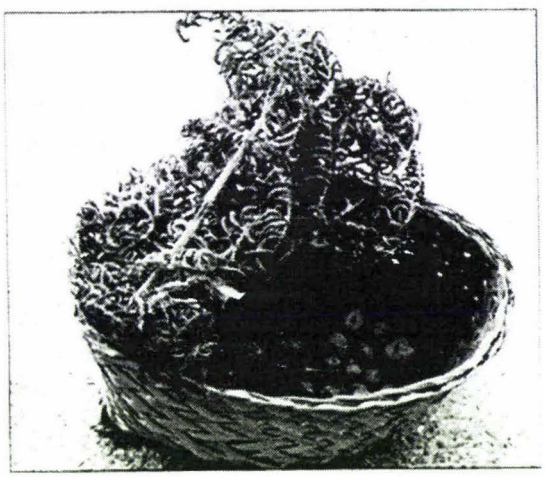
In cooperation with the *Scottish Crops Research Institute*, Open Polytechnic staff are undertaking a project to attempt to match some of the Māori potato varieties with 18th and early 19th century European varieties that are grown in the Scottish collections. As part of the project, a collection of 16 varieties of Māori potatoes are being grown in the Wairarapa and in Whangarei. The project will also compare acquisitions of the variety 'Urenika' collected from various parts of the country, as it appears to be a very variable type with some strains producing much larger tubers than others, while some produce better crops if the tubers are planted late in the season.

Matching of varieties will be done by DNA 'fingerprinting' after initial possible matches are made from historical records, anecdotal evidence and by comparing and matching botanical characteristics from descriptions published by UPOV (Union for the Protection of Plant Varieties). 'Urenika', 'Uwhi' and 'Kowiniwini' are three that are being tested initially. While this procedure won't necessarily provide evidence of pre-European potatoes, it may well provide some useful leads.

The writer, Graham Harris, is a lecturer in the Natural Resources Centre at the Open Polytechnic of New Zealand and is currently undertaking research on the history and origins of the Māori potato. He is being assisted by Sonny Niha from Whangarei. Graham's wife Lexie is Ngāi Tahu, Ngāi Tuahuriri (Te Karaka Issue 4).







TOP: Some Maori potatoes the author has collected and is growing in the Hutt Valley and the Wairarapa. They are photographed with a Kete riwai (potato kit).

CENTRE: 'Urenika' has purple flesh with white flecks.

ABOVE: Maori stored potatoes in pits in the ground. Layers of ponga (*Cyathea dealbata*) fronds were placed amongst the tubers. They found that the spores from the fern helped keep the potatoes free of some pests and diseases. For kumera storage, wheki (*Dicksonia squarrosa*) was used. Nowadays potatoes are usually stored in baskets or bags, but ponga fronds are still used to keep the tubers healthy.

Riwai - the Maori Potatoes

By Graham Harris

POTATOES were first reported to have been introduced to New Zealand by the French explorer de Surville in 1769. However it appears that the first successful introductions were made by Cook during his second expedition to New Zealand in 1773 where it was recorded that he made several plantings at Queen Charlotte Sound and also at Dusky Sound in Fiordland. Following these early introductions many more were introduced by sealers, whalers and colonists.

Maori were quick to recognise the advantages of the introduced potatoes over the kumara. They were easier to grow, especially in cooler areas, yielded more heavily and were easier to store. Because the method of propagation and production of the potato was similar to that of kumara it was able to fit into their existing agriculture system with little modification.

Potatoes soon became the staple item in the diet of the Maori and also became an important trade commodity not only within the Maori communities but also with European colonists and for provisioning European ships. By the early 1800s Maori were growing large crops of potatoes and an area of 50 hectares in potato production was not uncommon at the time.

Further evidence of the adoption of the potato by Maori was in the conferring of generic and varietal names. In the North, potatoes were referred to by Maori as Taewa (foreigner) or Riwai, and in the South as Mahetau (like a string of fishing sinkers).

Individual varieties were also named, for example the English variety 'Derwent' became 'Katote', while some like 'Old Red' and 'Early Rose' retained their original names. Some varieties became known by different names in different areas, for example the commonly grown 'Urenika' is also called 'Keretewha', 'Tuarua', 'Waikato' and 'Ringaringakatira'.

Some of the names are descriptive. For example 'Karuparerera', a variety which has a chocolate brown skin and yellow eyes, means 'the eye of the duck'. Some other commonly grown varieties include 'Moemoe', 'Poiwa', 'Nga outi outi' and 'Raupi'.

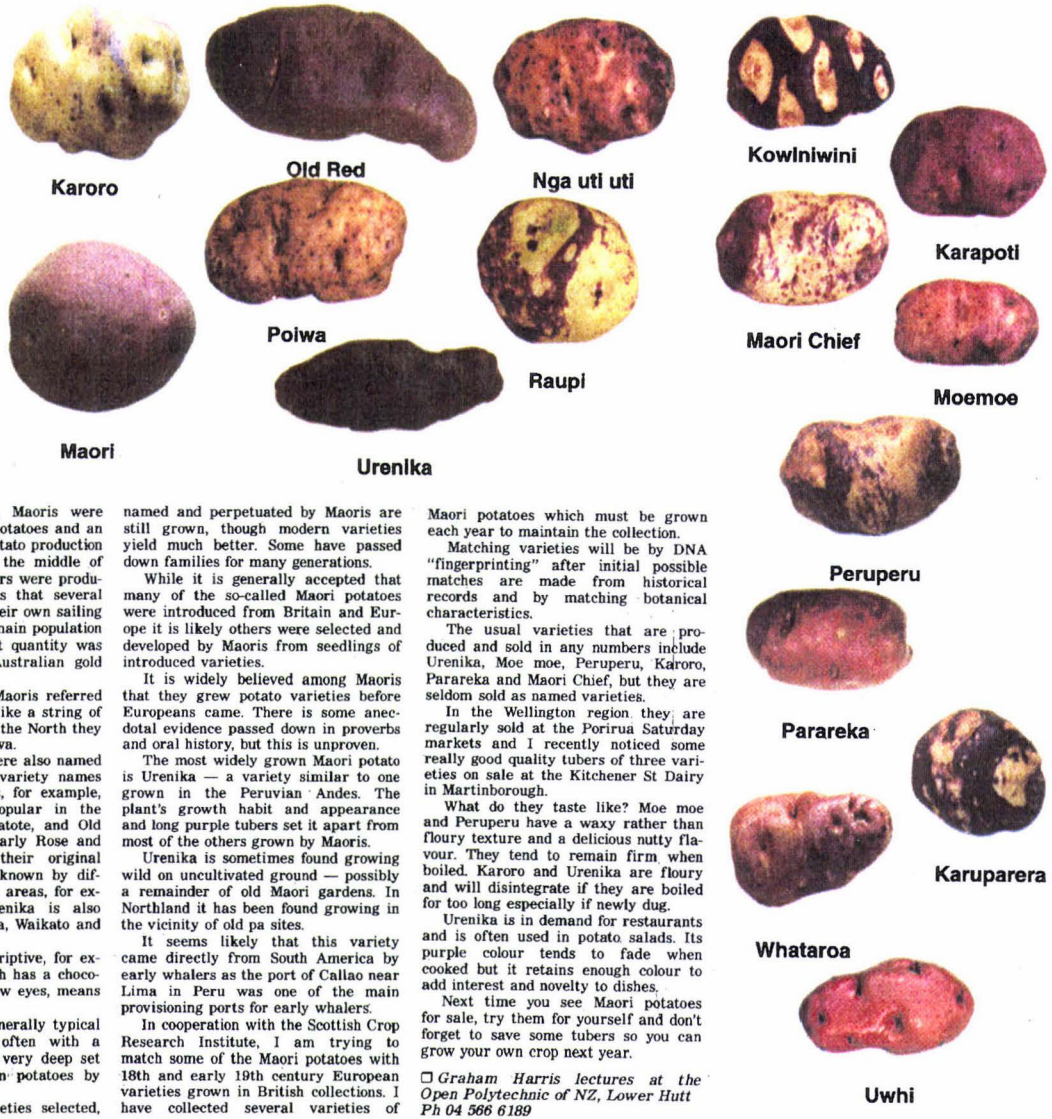
In many cases, the connection between the original European variety names and the given Maori names has been lost.

Some of the early introductions appear to be *Solanum tuberosum* var. *andigena* types and are characterised by very deep set eyes compared to the modern *S. tuberosum* cultivars which have smooth skins. Varieties such a 'Urenika' which have been described as "undeveloped" types, tend to set tubers late in the season when days are becoming shorter.

Many of the original varieties which were selected, named and perpetuated by Maori are still grown today, even though modern varieties produce a significantly greater yield. Some have been

Digging the real dirt on potatoes

They look odd but taste good. ***Graham Harris*** *is studying Maori potatoes*



WITH their colourful knobbly tubers and deep-set eyes, Maori potatoes are often offered for sale at roadside stalls, markets, greengrocers and even dairies.

The introduction of potatoes to New Zealand is generally attributed to the French explorer de Surville who planted some at Doubtless Bay in 1769 — about 200 years after they were taken to Europe from the Andes in Peru. Further introductions were made by Marion du Fresne's expedition in 1772.

The following year the crew of the Adventure, the ship that accompanied Cook during his second expedition to New Zealand, made several plantings of potatoes (brought from the Cape of Good Hope) at Queen Charlotte Sound. Many more were introduced by sealers, whalers and colonists.

Maoris were quick to recognise the advantages of the introduced potatoes over the kumara. They were easier to grow, yielded more heavily and were easier to store. Propagation and production of the potato was similar to that of kumara so it fitted into the Maoris' agriculture system with little modification and was particularly welcome in the south of the South Island where kumaras would not grow.

Potatoes soon became a staple in the Maori diet and an important trade commodity not only among Maori communities but also with colonists and for provisioning European ships.

By the early 1800s, Maoris were growing large crops of potatoes and an area of 50 hectares in potato production was not uncommon. By the middle of the century Maori farmers were producing such large tonnages that several groups were operating their own sailing vessels to take crops to main population centres and a significant quantity was regularly sent to the Australian gold fields.

In the South Island, Maoris referred to potatoes as mahetau (like a string of fishing sinkers), while in the North they were called riwai, or taewa.

Individual varieties were also named and some with English variety names were given Maori names, for example, Derwent, which was popular in the South Island, became Katote, and Old Red became Pawhero. Early Rose and Skerry Blue retained their original names; yet others were known by different names in different areas, for example the common Urenika is also called Keretewha, Tuarua, Waikato and Ringaringakatira.

Many names are descriptive, for example, Karuparera, which has a chocolate brown skin and yellow eyes, means "the eye of the duck".

Maori potatoes are generally typical of early potato types often with a knobbly appearance and very deep set eyes, removed in modern potatoes by selective breeding.

Many of the old varieties selected, named and perpetuated by Maoris are still grown, though modern varieties yield much better. Some have passed down families for many generations.

While it is generally accepted that many of the so-called Maori potatoes were introduced from Britain and Europe it is likely others were selected and developed by Maoris from seedlings of introduced varieties.

It is widely believed among Maoris that they grew potato varieties before Europeans came. There is some anecdotal evidence passed down in proverbs and oral history, but this is unproven.

The most widely grown Maori potato is Urenika — a variety similar to one grown in the Peruvian Andes. The plant's growth habit and appearance and long purple tubers set it apart from most of the others grown by Maoris.

Urenika is sometimes found growing wild on uncultivated ground — possibly a remainder of old Maori gardens. In Northland it has been found growing in the vicinity of old pa sites.

It seems likely that this variety came directly from South America by early whalers as the port of Callao near Lima in Peru was one of the main provisioning ports for early whalers.

In cooperation with the Scottish Crop Research Institute, I am trying to match some of the Maori potatoes with 18th and early 19th century European varieties grown in British collections. I have collected several varieties of Maori potatoes which must be grown each year to maintain the collection.

Matching varieties will be by DNA "fingerprinting" after initial possible matches are made from historical records and by matching botanical characteristics.

The usual varieties that are produced and sold in any numbers include Urenika, Moe moe, Peruperu, Karoro, Parareka and Maori Chief, but they are seldom sold as named varieties.

In the Wellington region they are regularly sold at the Porirua Saturday markets and I recently noticed some really good quality tubers of three varieties on sale at the Kitchener St Dairy in Martinborough.

What do they taste like? Moe moe and Peruperu have a waxy rather than floury texture and a delicious nutty flavour. They tend to remain firm when boiled. Karoro and Urenika are floury and will disintegrate if they are boiled for too long especially if newly dug.

Urenika is in demand for restaurants and is often used in potato salads. Its purple colour tends to fade when cooked but it retains enough colour to add interest and novelty to dishes.

Next time you see Maori potatoes for sale, try them for yourself and don't forget to save some tubers so you can grow your own crop next year.

❐ *Graham Harris lectures at the Open Polytechnic of NZ, Lower Hutt Ph 04 566 6189*

January 2000

Digging for facts about Maori potatoes

by
Graham Harris
About the author
About the article

With their colourful knobbly tubers and deep-set eyes, New Zealand's Maori potatoes are often offered for sale at roadside stalls, markets, greengrocers and even in dairies. Still grown by many Maori families today, the history of Maori potatoes can be traced back to varieties introduced by early European explorers of the 18th century and possibly before. Graham Harris looks at their botanical and cultural history.

The introduction of potatoes to New Zealand is generally attributed to the French explorer de Surville who planted potatoes at Doubtless Bay in 1769 - some 200 years after they were first brought to Europe from the Andes region of Peru. Further introductions were made by Marion du Fresne's expedition in 1772. The following year the crew of the Adventure, the ship that accompanied Cook during his second expedition to New Zealand made several plantings of potatoes (brought from the Cape of Good Hope) at Queen Charlotte Sound. Following these early introductions many more were introduced by sealers, whalers and by colonists.

Maori were quick to recognise the advantages of the introduced potatoes over the kumara (sweet potato). They were easier to grow, yielded more heavily and were easier to store. Because the method of propagation and production of the potato was similar to that of kumara it was able to fit into the existing agriculture system of the Maori with little modification. Potatoes were particularly welcome in the southern regions of the South Island where kumara would not grow.

Potatoes soon became the staple item in the diet of the Maori and also became an important trade commodity not only within the Maori communities but also with European colonists and for provisioning European ships. By the early 1800s Maori were growing large crops of potatoes and an area of 50 hectares in potato production was not uncommon at the time. By the middle of the century Maori farmers were producing such large tonnages of potatoes that several groups were operating their own sailing vessels to transport their crops to the main population centres and a significant quantity was regularly exported to the gold fields of Australia.

In the South Island, Maori referred to potatoes as Mahetau - (like a string of fishing sinkers) while in the North they were called as Riwai, or Taewa . Individual varieties were also named. Some with English variety names were given Maori names, for example the English variety 'Derwent', which was popular in the South Island became 'Katote', and 'Old Red' became '*Pawhero*'. Some like 'Early Rose' and 'Skerry Blue', retained their original names. Some

varieties became known by different names in different areas, for example the commonly grown 'Urenika' is also called 'Keretewha', 'Tuarua', 'Waikato' and 'Ringaringakatira'. Many of the names are descriptive, for example, '*Karuparera*', a variety which has a chocolate brown skin and yellow eyes means - "the eye of the duck".

Maori potatoes are generally typical of early potato types with their often knobbly appearance and with their very deep set eyes. These characters have been removed in modern potatoes by selective breeding over many years.

Many of the original varieties which were selected, named and perpetuated by Maori are still grown today, even though modern varieties produce a significantly greater yield. Some have been passed down through families for many generations.

While it is generally accepted that many of the so-called Maori potatoes were introduced to New Zealand via Britain and Europe it is likely that others were selected and developed by Maori from seedlings raised from these introduced varieties. It is however, a widely held belief among Maori that they grew some varieties of potatoes before the arrival of Europeans and while there is some anecdotal evidence passed down in proverbs and in oral history, this has not been scientifically proved.

The most widely grown of the Maori potatoes is "*Urenika*" - a variety which is similar to a type grown in the Andes of Peru. The growth habit and appearance of the plant, and the long purple tubers set it apart from most of the others grown by Maori. 'Urenika' is sometimes found growing wild on uncultivated ground - possibly remaining from those grown in old Maori gardens. In Northland it has been found growing in the vicinity of old *pa* (traditional village) sites. It seems likely that this variety was brought directly from South America by early whalers as the port of Callao near Lima in Peru was one of the main provisioning ports for early whaling vessels.

In cooperation with the *Scottish Crop Research Institute*, I am undertaking a project to attempt to match some of the Maori potato varieties with 18th and early 19th century European varieties that are grown in the UK collections. As part of the project I have collected a number of varieties of Maori potatoes which must be grown each year to maintain the collection. Matching of varieties will be done by DNA "fingerprinting" after initial possible matches are made from historical records and by matching botanical characteristics. Another procedure I hope to undertake, providing funding can be obtained, is to use a technique reported by Hosaka (Jpn. J. Genet. 1993 68, pp 55-61) in Japan to determine which of the heritage potatoes in the Japanese collections were from genuine early introductions. This was done by studying chloroplast DNA. The relict cultivars have andigena type chloroplast DNA whereas more modern types developed after the potato blight epidemics in the 1840s have the same type of chloroplast DNA as Chilean ssp. tuberosum (from 'Rough Purple Chilli' parentage).

What varieties are available for sale? The usual varieties that are produced and sold in any numbers include '*Urenika*', '*Moe moe*', '*Peruperu*', 'Karoro', *Parareka*' and '*Maori Chief*' however they are seldom sold as named varieties.

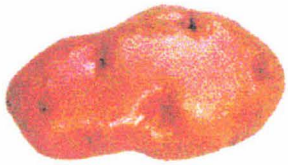
What do they taste like? Some varieties such as 'Moe moe' and 'Peruperu' tend to have a waxy rather than a floury texture, and have a delicious nutty flavour. They tend to remain firm when boiled. Some such as 'Karoro' and 'Urenika' are floury and will disintegrate if they are boiled for too long especially if they are newly dug. 'Urenika' is in demand for restaurants and is often used in potato salads. Its purple colour tends to fade when cooked, however it retains enough colour to add interest and novelty to dishes.

Variety images

Variety images

Urenika

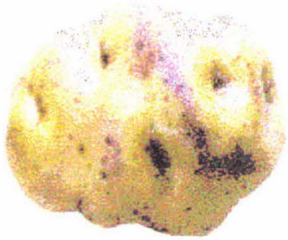
Uwhi



Whanako

Kowiniwini

Huakaroro



Karupoti

Maori Chief

Maori

Moemoe

Nga oti oti

Parareka

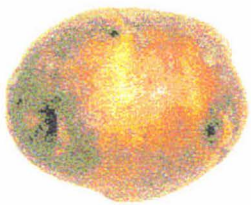
Pawhero

Peruperu

Poiwa

Raupi

Rokeroke



Karuparera

Whataroa

About the author

Graham Harris is a senior lecturer in the Natural Resources Centre at the *Open Polytechnic of New Zealand*.

About the article

This article is based on a 65-page Working Paper by the author, entitled *Nga Riwai Maori - Maori Potatoes*. Requests for printed copies of the Working Paper can be addressed to Graham Harris.

Appendix 4 PremioSlowFood Award

This study was nominated for a *PremioSlowFood* Award for its contribution to conservation of biological diversity. The award was presented at the Aula Magna, University of Bologna, Italy on 24 October 2000.

1. Brief detail of the award from the Global Potato News website.

2. Copy of the award citation.

News Headlines

Top Stories

NZ researcher nominated for award: Collecting and studying relict potato cultivars

Graham Harris is a senior lecturer at the Natural Resources Centre of the Open Polytechnic of New Zealand. He returned home on November 1 after spending time in Italy as a shortlisted finalist for a *PremioSlowFood* award. Mr Harris was nominated for the award for making a contribution to conservation of Biological Diversity in collecting and studying relict potato cultivars in New Zealand. Slowfood is a big Europe-based organisation which aims to conserve traditional cuisine, food production methods and traditional food crops and to counter the encroachment of "fastfoods" into everyday life. There were 13 finalists for the award selected from 350 nominations from around the world - all of whom (and their partners) were hosted in Italy for 7 days for the award ceremony at Bologna University (the oldest university in the world) . The award ceremony was attended by about 1500 people - about 500 of whom were members of the Slowfood international jury made up of journalists, cuisine writers, academics and food producers. The supreme award was won by Marija Mikhailovna Girenko, a Russian woman who has lived the last 45 years of her life at the Vavilov Institute of Research (VIR). She was responsible for saving many fruit and vegetable seeds, including potatoes, during the seige of Stalingrad during WW2. After the official part of the programme Mr Harris stayed with Prof Massimo Angelini (who is an agricultural historian) and visited peasant-folk in the Ligurian mountains who have been perpetuating early potato cvs for centuries. More information can be found on *this page* of the Slowfood web site. Information about Graham Harris' research re: Maori potatoes can be found on *this page*. He can be reached at toadflax@paradise.net.nz

Fish oil remedy against late blight

Prof Yigal Cohan of Bar-Ilan University in Israel registered a patent to protect a potato or tomato crop against infection by the late blight fungus "Phytophthora infestans" - using *fish oil*. Plants sprayed with 0.25-1% emulsion of fish oil become 80-95% resistant to late blight. More information is available on *this page*. Prof Cohen can be contacted at this e-mail address for more information: coheny@mail.biu.ac.il

Chambal Agritech to market techni-tuber potato seeds in India

According to a PTI news article (Nov 2), India-based Chambal Fertilizers and Chemicals Ltd has entered into a joint venture with Southern Highlands-based Technico Private Limited to carry out production and marketing of techni-tuber seed and early generation seed potatoes in India. The techni-tuber is an 'enabling technology' delivering affordable early generation seed for all potato varieties. The process is based on tissue culture taken from an existing variety or a new variety of potato. Technico claims that the "secret" process produces miniature seed potatoes significantly cheaper and faster than anyone else in the world. The size of the potato is between 10-15 millimetres and can be produced at a volume of 13,000 per square metre, compared with 5,000 to 8,000 by conventional means. Chambal Agritech Limited, the joint venture by the two companies having a 50 per cent share each, is finalising construction of a state-of-the-art techni-tuber seed production facility located at Chandigarh in the northern Indian state of Punjab at a cost of USD 3.6 mn.

http://www.potatonews.com/news_other.htm

PremioSlowFood

"Il dono principal di natura, cioè **libertà**", *Leonardo da Vinci*

A Graham Harris

Senior Lecturer del Centro di Risorse Naturali dell'Open Polythechnic, Wellington (Nuova Zelanda)

per l'azione svolta secondo natura

e per i meriti acquisiti nel lavoro e nella ricerca

è conferito il Premio Slow Food per la biodiversità

Carlo Petrini

Bologna, 24 ottobr