THE WINSTON CHURCHILL MEMORIAL TRUST

CHURCHILL FELLOWSHIP 2003

INVESTIGATING THE JALAPENO CHILE INDUSTRY IN THE UNITED STATES.

Report by - Jo Sheldrick - 2003 Churchill Fellow

Signed: Jo Sheldrick Dated: 14th December 2003

Contents Page

1. Introduction and Acknowledgements

This report details the findings from a 2003 Churchill Fellowship visit to the USA and Canada, investigating the Jalapeno Chile industry. Specific areas of study included:

- Growing Practices
- Mechanical Harvesting
- Bulk Pickling Processes
- Bulk Storage
- Packaging

My fellowship study tour included taking along my husband Paul and young children Meg and Macklin and the invaluable experiences we all gained would not have been possible without the support of the Sheldrick family. To Michael and Josie, Joy and Graham, thank you for everything – we would not have been able to do this without your support and hard work back at home. We are truly grateful. To my family, thank you for all your love support and encouragement. To Caroline Welsh (Churchill Fellow herself!), Marion Domaille and Rob Sonogan, and other members of the DNRE in Swan Hill, thank you for planting the seed, helping me through the application process and all your support and best wishes. To my friend Talia, thank you for your support and keen eyes in proof reading this report.

Thank you to the Winston Churchill Memorial Trust, without whom none of this would have been possible. The incredible people who make up this organization are truly inspirational and I feel lucky to be included within your family. Thank you especially to Meg for all your help and encouragement.

Thank you to all those involved in the Chile Industry in New Mexico, Texas, Arizona, Michigan, and to the researchers in Canada. Your willingness to share your experiences and information was very much appreciated. Thank you for showing us your corner of the world and all things chile!

2. Executive Summary

Name: Joanne Sheldrick
Address: "Oban" RSD Mallan
Via Swan Hill, VIC 3585
Contact: Ph/Fax: 03 50340533
Email: obanlabs@hotkey.net.au

Fellowship objective:

To investigate the Jalapeno Chile industry in Southern USA. To study growing practices, mechanical Harvesting, bulk pickling processes, bulk storage and packaging of Jalapeno.

Fellowship Highlights

1.Las Cruces Farmers Markets, Las Cruces NM.: These are held twice a week in the city and allowed us to meet with many different farmers and get an understanding of the current state of the chile industry according to people similar to ourselves, farmers and businessmen and women.
2. New Mexico State Fair, Albuquerque, NM : Met with David Lucero from the New Mexico Dept Agriculture at the Fairs' Country Store. He is a marketing and development officer, in charge of helping producers to market their various products. This store at the two week agricultural fair, enables everyone to sample the hundreds of different ways chile are used in New Mexico. A wonderful introduction to the world of chile.
3. New Mexico State University Chile Institute Las Cruces, NM: Joined Danise Coon, Assistant Director of the Institute in a tour of the teaching garden facilities and administration office and cultivar test plots. Our second visit included the opening of the new Institute head office, and a meeting with the fiery foods guru Mr Dave DeWitt.
4. Border Foods, Deming NM: A brief and heavily edited look at one of the countries biggest chile processors. Including a visit to Cass Keelers farm where Jalapeno were being machine harvested for a Border Foods contract.
5. Hatch Chile Express, Hatch NM: Visit to one of the worlds most famous suppliers of green chile, mail order business that crosses the globe. Suppliers of all things chile, edible and non!
6. Chile Task Force, New Mexico State University: Rich Phillips and Joel Diemer detailed the workings of this fantastic group which is working to revitalize the New Mexican Chile Industry. Also met with plant pathologist Natalie Goldberg, and fellow Task Force member, filmmaker Jeannie Gleason.
7. Curry Seed and Chile Company, Pearce, Arizona: Chile Breeder and farmer Ed Curry invited us to stay for a few days and experience first hand, life on a chile farm. Including pivot irrigation, breeding techniques, cultivation technology, canning and processing of red chile, drying of red chile and more.
8. Centre for food Development, Brooks and Leduc Alberta Canada: Murray Fierheller led a tour of this amazing facility whereby ordinary people with a dream to create good food products are guided and assisted in making dreams a reality! This amazing centre

fosters smaller business and also continues to work for large food companies in research and development. Victoria has a similar centre in Werribee but sadly this is not made available to those just starting out in the food industry or working on a small scale.
9. Boese Machinery Company, Saginaw Michigan: Tour and demonstration of mechanical harvesting equipment in action at the family company. Also included a tour of a local pickling processing plant (very brief and again heavily edited – but still a highlight!)

Findings

As Australians get more of a taste for all things chile, there is an opportunity to develop the local industry, and perhaps look at breaking into the nearby asian markets. Firstly however; the main concerns include accessing and improving on current mechanical harvesting equipment, researching and improving on best management practices - including irrigation technologies, plant cultivars suitable for mechanical harvesting and disease issues. Processing technologies can be improved upon, particularly in terms of machinery used and cost effectiveness of producing a top quality product for market, in particular any overseas markets. Of equal importance to all the above is ascertaining what trends the market may follow and growing a product to match.

There may be opportunities here but they are perhaps outweighed by the fact that the foreign product already coming into the country is priced almost too low to challenge for our farmers and processors. More research and development is clearly needed to ascertain the viability of this industry in Australia.

The information and knowledge gathered from my fellowship will be disseminated to all interested parties, mainly through state agricultural departments via publications. I have been speaking at various functions and will continue to do so throughout the year and welcome any queries and or engagements in the coming year.

3. Programme.

Sept 3rd	-Las Cruces NM: Farmers markets, La Posta Chile shop
Sept 4th	-Albuquerque NM: New Mexico Dept Agriculture, Marketing and development office.
Sept 5th	-New Mexico State Fair – Country Store.
Sept 7th	-Las Cruces NM: Farmers Markets, La Mesilla.
Sept 8th	-Las Cruces NM: New Mexico State University – Chile Institute Teaching Garden
Sept 9th	-Deming NM: Border Foods, chile processing plant. Cass Keeler, farmer: demonstrating mechanical harvesting of Jalapeno.
Sept 11th	-Hatch NM: Hatch Chile Express, worldwide mail order shipping of green chile and chile product.
Sept 12th	-Las Cruces, NM: New Mexico State University Chile Institute Official opening and meeting with the Chile Task Force.
Sept 15th – 17th	-Pearce, Arizona: Curry Seed and Chile Company and Curry Farms Tour.
Sept 18th	-Las Cruces, NM: New Mexico State University – Mechanical Harvest Research Unit
Sept 19th – 21st	-El Paso Texas and Ciaud Juarez, Mexico
Sept 21st	-Flights to Canada
Sept 22nd	-Brooks Alberta, Canada: Centre for Food Development, Satellite Research Farm
Sept 25rd	-Leduc, Alberta, Canada: Centre for Food Development.
Sept 29th	-flights Chicago USA
Sept 30th	-Princeton, Illinois: Agri Energy headquarters
Oct 1st	-Valpariaso, Indiana: Urschel Enterprises, Food Processing Equipment suppliers and developers.
Oct 2nd – 4th	-Saginaw, Michigan: Boese Machinery company, developers of mechanical harvest equipment.

4. Fellowship Report

4.1 Introduction

My Churchill fellowship took my family and I to Las Cruces, New Mexico, USA from September 1st to 21st 2003, to study the chile.…in particular the Jalapeno chile. For New Mexicans, the chile pod is a cultural icon. The state has chile festivals, a Chile Commission , a chile taskforce, a Chile Institute, a university rugby team called the Chiles, mail-order businesses that specialize in shipping chile worldwide, a monthly publication about chile, and countless restaurants that specialize in the chile theme.(Diemer, Phillips & Hillon, 2002) Added to this, New Mexico is the only US state to have a State Vegetable – the Chile!, and a State Question….. "Red or Green?".

Chile is similar to many other horticultural niche crops grown across the US. Viewed from a global perspective, it represents only a small fraction of worldwide production.(Gore 1998) yet, chile production ranks first in horticultural crop cash receipts for New Mexico, with annual direct contributions to the state's economy of up to $250 million dollars (Ford 2000). North Americans tend to identify chile and related products with New Mexico. Chile salsas have replaced tomato sauce (ketchup) as the US leading condiment and the demand for chile pepper products continues to grow. This phenomenon generates millions of dollars for the state's economy both directly through sales of chile and indirectly through the sale of related goods and services by the state's hospitality and tourism industries. But, this infamous vegetable, and the State that has been so closely tied to it for over 400 hundred years are in trouble.

In the 1990's after the introduction of the North American Free Trade Agreement (NAFTA), and the General Agreement on Tariffs and Trade (GATT) - an influx of cheaper imports from neighboring Mexico, distant Zimbabwe, India and South Africa poured into the state. The industry also attracted competition from China, Pakistan, Peru, Spain, Chile and Israel. (Ford, 2000) Meanwhile the New Mexico chile pepper acreage declined by 54%, and local processors were ready to relocate closer to their sources. (Diemer, Phillips, Hillon, 2002). Processors are even sourcing their raw chile from Mexico itself…much cheaper than the US product. In the last five years New Mexico lost 70% of its Jalapeno crop to Mexico and other importers, yet according to Steve Moore at Border Foods, the chile industry is still growing…..the opportunities are there but major changes will have to be made. For New Mexico farmers, this is good and bad news. Chile is what holds agriculture together in New Mexico. It is a key rotation crop for farmers and one of the only crops to have a margin that makes it worthwhile. (Clary, Marvin, 2001). However; the move towards making this crop viable once again is a costly exercise that goes against 400 years of tradition.

The New Mexico Chile Industry has come together to meet this challenge head on. In November 1998, the New Mexico Chile Task Force was formed to identify and implement ways to keep chile pepper production profitable in New Mexico and to maintain and enhance the research and development partnership between the New Mexico Chile industry and the New Mexico State University. (Diemer 1998) By

developing techniques and technologies to improve their industry competitiveness in the 21st century global trade environment, they hope to revive and revitalize this very important industry. Participants in the task force come from all sectors of the chile industry; the New Mexico State University researchers and extension specialists, the New Mexico Department of Agriculture (NMDA) representatives and various agricultural supply sector representatives. (As an interesting note they are using facilitation techniques and strategic planning models based on Australian design!)

The primary goals identified by the task force are to modernize the industry by;

1. Improving mechanical harvesting and cleaning equipment, as a very large portion of the cost of producing chile is tied up the hand harvesting and weeding (a whopping 40% – 60% of production costs!).

2. They are also addressing best management practices and aiming to improve production efficiency, to find ways to improve stands and increase yields.

3. Drip irrigation technologies are being researched to tap the technology for healthier, more productive plants.

As prospective growers, this research and previous learning is invaluable, and the remainder of this report will focus on the best practices for growing, harvesting and processing chile, in particular Jalapeno.

4.2 Jalapeno
Capsicum annuum cv. "Jalapeno"

The Jalapeno chile is named for its association with the Mexican city of Xalapa in Veracruz, where the chile was grown in ancient times, but is no longer found.(DeWitt, Gerlach, 1990)

The Jalapeno is probably one of the most famous chile peppers. They are instantly recognizable, and their unique combination of taste and heat has ensured their ongoing popularity. Jalapeno are often used fresh to make salsa, and are used in both homemade and commercial salsas, hot sauces, stews, breads, dips and omelettes. However; Jalapeno are most commonly used and best known as a snack food, either pickled or as a topping for nachos or pizza (nacho rings).

Newer varieties of Jalapeno are helping the non chilihead population to sample this delicious chile without the pain!! There are many new varieties ranging from heat free to mild and so on. A few of the varieties we came across during our fellowship include:

*NuMex Primavera -1997. Developed by Dr Paul Bosland and his team in the New Mexico State University Chile Breeding and Genetics program. This is a "no spice"

Jalapeno, with only one tenth the heat of a regular Jalapeno. Nu Mex primavera is a high yielding cultivar.

*NuMex Pinata – 1997. Also developed by Dr Paul Bosland, NuMex Pinata is a multicoloured jalapeno. The fruit changes from bright green to bright yellow then to orange and finally to red, it is tipped to be a favourite of home gardeners who want a colorful salsa

*Jalapeno Dulce – all flavour NO heat.
*Perfecto (short plant, hard to pick by machine, but one of the best for nacho rings)
*Tam No 1, old variety, not great
*Grande (similar to our Largo variety. Good all round perfomer)
*Coyame – number one in the processors books! Not as hot as other varieties and picks well.

4.3 Agronomy.

The Jalapeno varieties are very diverse in appearance and growth habit. From the regular small green (typically New Mexican) varieties to pear shaped orange fruits. However; generally speaking the Jalapeno plant grows from between 2 to 3.5 feet tall, has a compact single stem or upright multi-branched habit and has light to dark green foliage. The pods are conical and cylindrical, growing pendant, are very blunt to pointed and measure about 2 ½ inches in length. The colour is generally medium green to red and purple (although there are yellow to orange varieties), and the yield is around 25 to 35 fruits per plant. (DeWitt, Gerlach 1990). (In New Mexico in 2001, Jalaepno yields were around 10 tons to the acre). Jalapeno plants flourish best in semi arid climates – ones with dry air combined with irrigation. The typical growing period is 80 days.

Chile pungency levels are the result of two factors; the plants genetics and the environment in which it is grown. A medium spice Jalapeno can end up very hot if little water is available and the heat is dry and extreme. Jalapenos, depending on variety and environmental conditions, can range on the Scoville Heat Unit Scale anywhere from 5,000 Scovilles to 60,000. They are on average around 20,000 units. (or on a heat scale of 0 – 10, they lie between 4 and 8! Of course the new heatless varieties are a 0!)

So far out of all the chile varieties, the Jalapeno has been most easily harvested using machines. The growth habit necessary for mechanical harvesting includes an upright plant structure with pods off the ground, easily detachable stems, taking little trash from the plant, yet not allowing pods to fall on the ground, flexible branches, strong fleshed pods and high yielding. Also, large pod size, and little crazing or corking on the flesh. Many of the newer Jalapeno varieties are fulfilling this wish list and proving to be excellent performers in terms of mechanical harvesting for processing.

The biggest growing chile ‘taste’ in the US and beyond is the Chipotle…this is the smoked dried jalapeno…which is a delicacy and very expensive. Chipotle needs to be

rehydrated before use. It is in a lot of different chili mixes such as dips, sauces, soups, jams, salsas and more. The Mexicans are the experts in smoking it using mesquite wood. The US has never been able to replicate it to get the authentic taste as such.

BEST PRACTICE METHODS

4.4 Mechanical Harvesting

Mechanical Harvesting is a crucial element in the survival of the chile industry in New Mexico. They simply cannot afford to continue to tie up to 60% of production costs in hand picking. However; it is suggested that until a grower is producing at least 1500 short tones (US), they cannot justify the enormous financial commitment to convert to mechanical harvesting. Most chile producers are smaller growers on family farms who cannot afford to make this move. Of those who have tried, many lost farms due to a single year of low yields….the machine still sitting unused. For those who can entertain the idea of machine harvesting, there is still a mindset to overcome. Those voting for change are working against 400 years of history. There is a mindset about handpicking, trash levels and pod quality, and a difficulty in accepting 20% loss of pods left behind by the harvester (Mechanical harvest is typically about 80% efficient, hand picking is about 95%.). Therefore; the larger farmers are moving with the changes and cornering the big contracts with the major processors, and the smaller farmlets are becoming a thing of the past.

Chile peppers are typically harvested two to three times in a season depending on the decision to grow for green or red or both. Mechanical harvesters therefore must be effective enough to remove most of the crop, yet gentle enough to allow the plant to continue to grow and thrive to produce more pods.

The harvesters themselves have been around since the first experimental machine in the 1970's. Many different picking mechanisms have been tested. Marshall and Boese (1998) reported that 230 machines have been built worldwide, using 30 different pepper removal concepts to harvest at least 20 different pepper types. Use of the open double helix, rubber-finger rake and forced-balanced shaker harvester types is expanding in the Southwest. The different picking mechanisms all work fairly well, depending on crop condition and machine adjustments. Equipment is constantly being improved to reduce the number of fruits dropped on the ground during harvest. (Wall, M. Walker, S. Wall, A. Hughs, E. Phillips R. 2001) Removing leaves, stems, trash and undesirable fruit from machine-picked product remains the greatest barrier to farmers accepting mechanical harvesting. Improved de-stemming equipment will help advance mechanical harvest, as many pepper types need de-stemming during the pickling operation. (Marshall & Boese, 1998)

We were fortunate to see two different harvesters in action. A John Deere cotton harvester that had been altered to go over a Jalapeno crop, in Deming, New Mexico, and

a Boese Machine, based on the open double helix concept, developed by the Boese family in Saginaw, Michigan.

Both of the harvesters looked quite successful in terms of removing a large percentage of pods from the plants, and did not appear to damage the plants as much as we had expected.

The John Deere sold for around $100,000 US as a modified version and around $350,000 for a new one. The fingers on the machine are similar to a duck-plucker, but a little bit stiffer, and longer. The one we saw was going a lot quicker than we had imagined and seemed very rough, but the plants coming out the other side looked a little beaten but mostly intact..

The Boese Machine is built as a single row harvester to tow behind a tractor (around $70,000 US) or a standalone 3 or 6 row self propelled machine. (around $300,000US). This is a costly exercise for local farmers here to consider in terms of importing such machinery and is a limiting factor in the decision to grow chile on a large scale.

4.5 Best Management Practices for growing Chile

Current Breeding Programs are heavily focused on producing chile plants and pods well suited to mechanical harvesting.

Plant habit growth significantly influences machine harvest efficiency. Several chile cultivar characteristics improve machine harvest. These include an upright plant habit with narrow branch angles and a well spaced fruit set placed higher on the plant, away from the inside of the plant. (Machines are often unable to get the pods right in the centre of the plant, close to branches.) Cultivars that have large, thick stems are less susceptible to lodging, and fewer branches at the base of the plant near the soil surface, reduces branch breakage during mechanical harvest. (Hughs et al. 2001)

Higher planting densities, which result in taller plants with narrow branch angles, improve mechanical harvest. Higher planting density can reduce yield per plant, but increase yield per acre. It also removes the expense of thinning plants, and results in better weed competition. Research has shown that there is no significant increase in disease as a result of higher plant densities. (Wall, M. 2001)

The issue of direct seeding versus transplanting is also pertinent. Direct-seeded plants have deeper root systems, fewer branches and less lodging and uprooting than transplants (Kahn, 1992). Well rooted plants are important for machine harvest efficiency. Hilling soil around the base of plants during weed cultivation also reduces lodging and uprooting during machine harvest. (Boese & Marshall, 1998)

4.6 Weed Control.

Historically, work crews were brought in to weed several times in the growing season, but again such a cost is not bearable. Chemical and mechanical methods are favoured now.

Treflan is used on some farms, others choose to use Dual Magnum. A pre-emergent is sprayed two-three weeks before laying the plastic, they have found the blue plastic which bleaches to white has been the most effective as it doesn't generate heat as much as the black plastic and the pods tend not to be burnt.

There are various cultivating implements that hill soil around the base of the plants, providing a dual purpose of inhibiting weed growth and also increasing stability of the plant, helping to prevent lodging and uprooting as mentioned above.

Mostly a combination of these techniques, along with high plant densities, is utilized to control weed problems.

4.7 Diseases.

Chile peppers are susceptible to several diseases which can cause excessive losses, both in quality and in quantity (Goldberg, 1999). Of the many different chile varieties, Jalapeno's are a little better in terms of disease but still can be effected quite badly.

Parasitic Diseases include

- Wilt and Root Rot Diseases such as Phytophthora Root rot (or Chile Wilt), Verticillium Wilt and Rhizoctonia Root Rot.
- Seedling and Leaf Diseases such as Bacterial Leaf Spot, Cercospora Leaf Spot and Powdery Mildew.
- Fruit Rots, such as Phythphthora Pod Rot, Black Mould, Anthracnose (Ripe Rot) and Bacterial Soft Rot.
- Viruses such as Beet Curly Top Virus, Tomato Spotted Wilt Virus, Pepper Mottle Virus, Alfalfa Mosaic Virus, Cucumber Mosaic Virus, Tobacco Mosaic Virus, Mixed Virus Infections (several of the above found together) and the newly identified Pepper Genimiviruses, several different viruses spread by whitefly.
- Nematodes, such as Root-Knot Nematode.

Abiotoc Diseases include

- Blossom end rot
- Sunburn
- Salt Injury
- Wind Injury
- Hail Injury
- Herbicide Injury
- Nutrient Deficiencies and Toxicities.(Goldberg 1999)

Good General Practices for avoiding some disease problems:

A key element in disease control is rotation 3-4 years is usually recommended between chile crops and 5-6 years is better, but for most farmers this time is a luxury they cannot afford. Most of the alternative break crops do not pay well, chile being their most lucrative cash crop and many grow it too often and suffer the consequence of disease problems

Another pertinent issue that echoes for Australian farmers is salinity. Peppers do not tolerate salt!!! They tend to have more problems with drip irrigation than furrow irrigation, this can be avoided by running the drip longer to drain salt out of soil especially early in the season, avoiding short duration irrigation. The catch is that they must irrigate enough to push salt back, yet try to avoid phythophthora at the same time.

Disease resistant cultivars suited to mechanical harvest and local climates is a number one priority for choosing varieties. Also it is imperative to purchase high quality seed or seedlings, a strong crop established quickly will help to reduce problems associated with seedling diseases (Goldberg, 1999).

Avoiding paddocks with a history of disease problems, and using good crop rotations is imperative. Also good irrigation practices is a must, and control of perennial weeds which may serve as reservoirs for many plant pathogens.

4.8 Processing of Chile.

This was by far the most difficult topic to broach with our contacts in the US. We were lucky enough to meet with one of the Agricultural Managers from Border Foods in Deming, New Mexico, but were unable to see the processing plant first hand, nor were we permitted to ask too many specific questions regarding the pickling process itself. Understandably, theses are recipes and secrets tightly guarded in this uncertain business climate! Border Foods is one of the largest chile processors in the US and indeed the world, supplying many of the large fast food chains worldwide with pickled Jalapeno and various chile product, they are well aware of the current problems with the US industry, and they themselves source a large portion of fresh chile from Mexico as it is so much cheaper to do so. They were happy to meet with us, but we gleaned little information from our visit.

(On a more helpful note, there are numerous recipes available on the net, and through the US Dept of Agriculture and various University research bodies, including the New Mexico State University Food Technology department, but converting these to large scale processes is a matter of trial and error.)

The Chile arrives fresh to the plant as soon as possible after picking, and are aimed to be processed within 24 hours of being picked. The fruit, with stem intact can last for 2-3 days but for quality product it requires immediate processing. When the chile arrives at the plant, it must be de-stemmed, washed, sliced, seeds removed, hot filled, can seamed, cooked, cooled, labeled and shipped!

Border Foods also do a cold pickle straight into 55 gallon drums, but the finely tuned ingredients and process to achieve this was not available to us, and upon researching the topic with other "experts" we found a huge difference in opinion as to salt and acid content, pickling time, shelf life and safety precautions. This is a topic to investigate further!

The machinery required to automate this process is expensive and does not always work, hence much is still done by hand. For example the machine used to destem the chile , called a Magrin, is only 85% successful and ends up costing around $20,000 US a year just to maintain!

One of the current issues facing the researchers looking to mechanize the chile industry, is the applications necessary for streamlining the processing of chile, particularly green and Jalapeno. Problems include automating ways to separate green and red pods on the conveyor belt, (They are already working on refining colour recognition machine vision techniques to do this!) automating stem removal effectively, separating stems from the pods after de-stemming, and removing the trash. These are just a few areas being worked on by industry leaders alongside the chile task force group.

4.9 Packaging and Storage

Packaging and Storage of pickled products is dependant on the products end use. Pickled Jalapeno's are stored in a variety of containers from small glass jars for the gourmet export market, 3 litre tins for food trade and up to 55 gallon plastic drums, sold for repackaging or for large scale salsa and sauce production. Fast Food chains in the United states often require a simple package, easily opened, removed and disposed of and plastic pouch type technology is used here with a vacum heat seal. Many companies are using plastic tub type containers, almost like margarine containers, and even large plastic containers with a formed handle and extra large opening and lid for easy access. New packaging technology has provided the industry with many new ideas and ways of presenting their product. As mentioned above this is an area largely governed by the end use of the product and one product that has gone through one process may be packaged in 4 or more different ways for different markets.

5. Conclusions and Recommendations

From our experiences in North America, it became very clear that the opportunity for a growing chile industry in Australia is very much dependant on our ability to develop local markets, embrace and improve mechanical harvesting methods, improve on available processing equipment and farm chile using the best management practices made available to us.

We are basically facing the exact same challenges that face our New Mexican counterparts, without the pressure of 400 years of history and culture! There is much that can be learned, and many opportunities to develop new ideas, equipment, cultivars and much more.

Recommendations for further research in these areas include

- Trials into cultivars, and best management practices. Looking for high yielding, easily harvested varieties with minimal disease and pest problems.
- Water management practices, drip irrigation and fertigation (including Bioagriculture) techniques
- Development of effective mechanical harvesting equipment pertinent to the local produce grown.
- Development of improved processing equipment for de-stemming and quality control within the processing of chile.
- Research into marketing and development of the end product, including packaging options for different markets.
- Availability of government backed food industry facilities made available to ordinary Australians who have an idea for a food product but no place to start with Research and development. The Centre for Food Development in Canada was a fantastic example of this.
- Formation of an Australian Chile Producers Group of some sort could be beneficial in sharing learnings and improved technologies amongst growers.

6. Bibliography.

Diemer, J.A, Phillips, R. and Hillon, M (2001) An Industry-University Response to Global Competition. New Mexico Chile Task Force Report 1.

Diemer, J.A. (1998) Search Conference notes, general session. December 1998. Reprinted in New Mexico Chile Task Force Report 1.

Ford, D'Lyn. (Spring 2000 Ed.) Peppers under Pressure. Preserving the Business of Red and Green. New Mexico Resources. Issue 27. college of Agriculture and Home Economics, NMSU.

Goldberg, Natalie (1999) Chile Pepper Diseases. New Mexico State University, Las Cruces, NM.

Gore, C.E. (1998) New Mexico agricultural statistics 1998. Las Cruces, N.M.: New Mexico Department of Agriculture.

Huhs, Ed. Phillips, R. Wall, A. Wall, M. Walker, S. (2001) Yield and Quality of Machine Harvested Red Chile Peppers. New Mexcio Chile Task Force Report 3: Yield Quality of Machine –Harvested Red Chile Peppers.

Kahn, B.A. 1992. Cultural practices for machine harvested paprika pepper. Acta hort. 318:239-244. From New Mexico Chile Task Force Report 3 2001.

Marshall, D.E & B.N. Boese 1998 Breeding Capsicum for mechanical harvest, Part2 – Equipment. Proc., 10:61-64. 10th Eucarpia Meeting on Genetics and Breeding of Capsicum and Eggplant, Avignon, France. Taken from Chile Task Force Report 3 2001