CAN THE CONVERSION TO ORGANIC APPLE PRODUCTION IMPROVE ECONOMIC AND ECOLOGICAL VIABILITY IN THE OKANAGAN? A CASE STUDY

by

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Abstract

The viability of commercial apple production in the central Okanagan is threatened by high input costs, high land cost, restrictions on operations due to perceived and real environmental damage, and a historically oversupplied free market for apples. This paper documents the conversion of a Kelowna apple orchard to certified organic status in 2006 to 2008 and analyzes the potential of the conversion to counter some of the threats to viability of the farm.

Economic factors compared for conventional and organic farm systems are input costs, market returns (historical and projected) and changes occurring in market access for organic produce. Environmental factors discussed are differences in pest control methods, orchard nutrition, water use, and the potential environmental impact of organic philosophy on Okanagan apple production.

Organic food production and marketing in Canada is regulated by the federal government. The importance of regulation and identification of organic foods is discussed and evaluated.Study results show that conversion of a conventional apple orchard to organic production has significant potential for improving economic viability for an Okanagan apple orchard but does not conclusively demonstrate environmental improvement. Government and infrastructure support systems for organic production and marketing are limited in capacity to promote significant growth in Canada's organic production. A threat to the observed improvement in Orchard viability by converting to organic production is the fact that the organic market is small. If a large number of producers in the Okanagan and Washington state were to convert to organic production, premiums for organic apples would likely shrink and the improved viability noted in the study might disappear.

Several recommendations are made for further research and an outline of necessary steps for those planning conversion of an Okanagan apple orchard to organic production is included.

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Chapter 1. Introduction

1.1. The Project

This thesis assesses the economic and environmental aspects of converting a family run apple orchard from conventional to organic production during the years 2006 to 2008. The regulatory and policy support for the conversion was also evaluated.

The project involved documenting the changes to the orchard management system required to become certified as organic by a licensed certification body (Pacific Agricultural Certification Society). Certification requires a three year transition period when the management of the farm is organic but the fruit must still be sold as conventional. Differences between organic and conventional apple prices were measured during the period of the study and changes in the farm environment were observed.

The term “organic” is used as both an adjective and a noun in this paper. As an adjective, organic refers to either production methods which conform to the Canadian Organic Standards Regulations or to products raised according to those standards. As a noun, Organic refers to the system and philosophy surrounding the production and marketing of organic products.

This thesis is presented as a traditional scientific study with 6 chapters that include an introduction to the topic, study area and purpose (Chapter 1), a literature review (Chapter 2), methods (Chapter 3), analysis (Chapter 4), discussion (Chapter 5) and conclusions (Chapter 6). The conclusions of the study are presented with several recommendations for further research and an outline of necessary steps for those planning conversion of an Okanagan apple orchard to organic management.

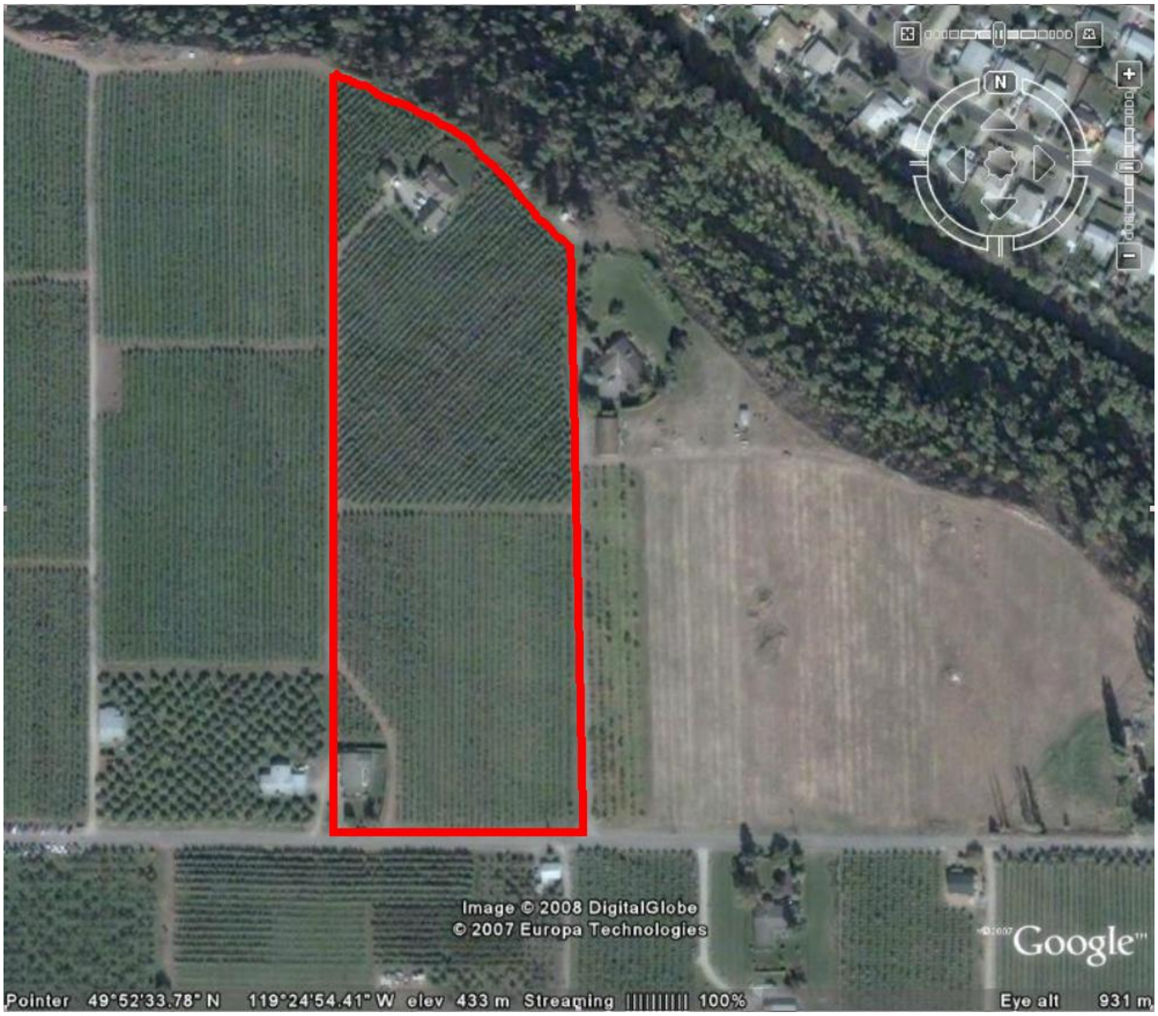
1.2. Thesis Statement

Conversion of a central Okanagan apple orchard from conventional to organic management can improve the viability of the farm by creating an economically and environmentally viable enterprise.

1.3. Background of Study

1.3.1. Description of the Study Area

The farm under study is shown in satellite imagery in figure 1.1. It is owned by Richard and Robyn King and is located on Dunster Road in East Kelowna and has been operated by the owners using conventional management techniques since 1994. The farm is 10.5 acres in size and has been entirely replanted to high density apples (1000 trees per acre). Half of the orchard is planted to Gala, 20% to Fuji, 20% to Honeycrisp and the remainder equally split between Ambrosia, Jonagold and Pink Lady. Geographically, the land is at 1300 feet above sea level with near flat landscape bordered by a steep drop into Mission Creek on the North Side, Dunster Rd on the South, a new vineyard on the East and a conventionally managed orchard on the West boundary. There are two homes on the property, one of which is occupied by the orchard operator. Soil type is coarse textured glaciofluvial deposit consisting of gravel and boulders with a thin layer of organic matter overlay giving very well drained soil which requires significant addition of plant nutrients to maintain productivity. The land has been used for the conventional production of tree fruits since early in the 20th century. Ditch irrigation in early years was replaced by sprinkler irrigation of various types by 1950. The area is considered by local horticulturists to be among the best apple growing areas in the Central Okanagan due to the combination of soil conditions and microclimate. In 2006 the farm began the 3 year conversion process to become BC certified organic.



Source: Google maps

Figure 1.1 A satellite image of the property subject to conversion (outlined in red)

1.3.2. Background of the Operators

Richard King is a professional agrologist who has been involved in various facets of agriculture for more than 40 years. He retired as General Manager of BC Fruit Packers in 2005 after a 32 year career in tree fruit storage, packing and marketing to operate the farm on a full time basis. He has since returned to university to complete a Master's Degree in Interdisciplinary studies and based his thesis on the management of the farm. In addition, Richard is a Director of the Fruit and Vegetable Dispute Resolution Corporation (a NAFTA organization) and the Chair of the BC Egg Marketing Board.

Robyn King is a Social Worker specializing in Geriatrics and is keenly interested in the marketing aspect of the farm operation.

1.4. Origins of the Organic Conversion Study

Organic food production worldwide has been increasing for the past 2 decades but is still only a very small part of the food system. 2006 figures indicated only 1% of Canadian food sales are organic (Kendrick, 2008).

The operators of the study orchard believe that organic market share in Canada will continue to grow and there are several aspects of organic production which are attractive to producers, which include:

- Modern pesticides and non-organic fertilizers have been much improved but many are still unpleasant to use and are widely credited with causing health problems to farm operators and consumers.
- Modern conventional farming practices have been blamed for significant environmental degradation.
- Economic returns for conventional apple crops have not been high enough to sustain the farm operation whereas prices for organic apple crops in the past have been much higher. The farm had been losing money for a several years as shown in table 4.4 and organic prices as shown in table 4.2 indicated that profitability might be restored.

There is much discussion in professional agriculture about the benefits or lack thereof attributed to organic food production. Studying and documenting the results of a conversion of a commercial apple orchard from conventional to organic in the central Okanagan will provide additional information for resolution of the debate.

The food production system in Canada is generally supported by government policy and regulation in areas such as food production standards, phytosanitary regulations and trade agreements. Attitudes of government toward organic apple production is discussed and evaluated as an important factor in the potential for long term growth of organic agriculture. Studies on consumer purchase decisions usually cite perceived health benefits as the most important factor to people choosing to purchase organic food. Evaluating such perceived health benefits is beyond the scope of this paper. However, the interest in organic food production from the governmental to consumer level provides the impetus for this study.

1.5 Goals of the Study

The study is intended to document the organic conversion experience and to assess the economic and environmental implications of a change in orchard management system within the current policy - environment surrounding organic production.

Chapter 2. Literature Review

2.1. Economic Background Literature

2.1.1. Base Levels of Organic Production and Markets

Three components in combination drive the economics of organic farming. These are:

- Price received per unit of production sold
- Number of units of production sold
- Production cost of each unit of production sold

As with conventional farming, these factors are not static from year to year. As technology, level of supply and other factors change, productivity, costs and product prices also change. Establishing a base level of current organic production and assessing the rates of growth is important in assessing future potential for organic marketing. Literature cited in this section is intended to address these factors.

A 2008 Statistics Canada Report indicated that organic products had a Canadian market share of 1% in 2006 (Kendrick, 2008). This figure is consistent with the author's experience with the food business.[1] The 2008 report shows that the Canadian and British Columbia organic production of all commodities can be estimated by the number of farms certified as organic in the 2001 and 2006 Canadian census of agriculture (table 2.1). Based on farm census numbers, 1% of Canada's farms produced organic products in 2001 (BC 1.5%) with the number of organic farms increasing to 1.5% of total farms in 2006 (BC 2.3%). Further growth at the same rate would indicate that the number of organic farms in Canada might increase to 2.4% by 2011 (BC 3.2%).

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[1] Richard King has been involved with the marketing of tree fruits in an executive capacity for more than 30 years.

Table 2.1 Certified Canadian and British Columbia organic farms 2001-2006

Number of Farms	Canada 2001	Canada 2006	% change	BC 2001	BC 2006	% change
All farms	246,923	229,373	-7.1	20,290	19,844	-7.1
Farms reporting certified organic products	2,230	3,555	59.4	319	452	41.7
Type of certified organic product:						
Hay or field crops	1,442	2,462	70.7	70	110	57.1
Fruits, vegetables or greenhouse products	614	916	49.2	267	358	34.1
Animals or animal products	381	673	76.6	53	86	62.3
Maple products	129	299	131.8	0	0	…
Other (herbs, etc.)	211	190	-10.0	45	63	40.0

(Kendrick, 2008) [2]

The US Department of Agriculture 2007 census of agriculture reported similar results for organic farms showing 20,000 organic farms of a total 2,400,000 farms in the US (Just under 1%)(NASS, 2009). A US study indicates a growth rate for organic produce production of 20- 30% per year in the United States which is similar to growth rates in Canada (Delate et al., 2008).

Data presented at the Pacific Agriculture Show in Abbotsford BC on January 28, 2010 provide a general update to the state of organic food sales in Canada (Neilsen, 2010). The presentation highlighted the following information:

- 2009 organic fruit sales in Canada accounted for 3 % of total fruit sales by revenue and 2%of total sales by volume. This indicates a 50% average premium for organic fruit.
- 16% of people surveyed in 2009 indicated that they were prepared to pay a premium for organic products. This figure is unchanged from 2008.
- Sales growth of organic fruit was 15% in 2009 compared to market growth of 26% in 2008 indicating a reduction in the rate of growth in sales of organic possibly due to recession in 2009.

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[2] The farm numbers showing type of production (hay, fruit etc) are a breakdown of organic farm type are included in total organic farms.

- Growth in consumer purchases of fruit from farms and farmer's markets is increasing and is an important marketing channel for organic food. 33% of Canadian consumers surveyed indicated that they purchased organic fruit from these outlets, up from 31% in 2008. Most consumers (72%) still purchase organic fruit from conventional grocery stores.

All of the literature reviewed indicates significant growth in North American production and sale of organic food but this growth is occurring from a very small initial base.

2.1.2. Nature of Organic Demand

With increasing organic production in Canada, prices for organic might be expected to drop if markets do not grow at the same pace. Evaluating the nature of demand for organic is important to determine the long term potential for increasing organic production.

Private health benefits for consumers are often cited as the primary reason for purchasing organic. Swedish studies conducted as part of Sweden's "Food 21" project to examine and improve food production sustainability found that most consumers did not consider organically produced to be an important purchase criteria in their food choice (Shepherd et al., 2005). Price, appearance and taste were much more important than organic status in purchase decisions for most consumers. Those consumers that did purchase organic did so with more concern for health benefits than for environmental concerns. Organic foods were not judged to surpass conventional foods with respect to taste and shelf life so that consumers' expressed positive attitudes toward organic are based on factors difficult to quantify. If growth in organic production were to accelerate too rapidly, demand may not keep pace with production based on this study.

Existing price premiums for organic may also indicate strength of demand for organic and opportunities for increased organic production. An Italian study used contingent valuation from questionnaires to determine potential price premiums for organic (Canavari et al., 2005). Consumers of organic products were asked what their major reason was for buying organic and what level of premium they were prepared to pay. They were also asked if they would support a tax to pay for increased food costs if government were to ban pesticides. Avoiding pesticide exposure was the main motivation for these consumers buying organic and the mean premium they were prepared to pay for organic apples was 130% of conventional apple prices. The mean value of a tax the survey participants would support in exchange for a government pesticide ban was 204 Euro per year.

A Canadian and international literature review done by staff at the Nova Scotia Agricultural College in 2002 identified many of the issues which are involved with price premiums for organically produced food (Bonti-Ankomah and Yiridoe, 2006). The general theme of the papers reviewed indicate that the most important factors for the vast majority of consumers in food purchase decisions are nutritional value, taste, food safety and appearance. Price and perceived impact on the environment were generally stated to be less important factors in purchase decisions.

The implication of the works cited in this review is that a significant portion of consumers believe that that organically produced food is superior to conventional food in attributes important to them even though the categorical evidence that this is so is limited. The “credence” nature of organic is therefore highly important to the growth of the organic market in future. “Credence” is defined in Webster’s dictionary as “mental acceptance that something is true or real” (www.merriam-webster.com, 2011).. This is a critical concept in valuing organic food since without clear scientific evidence that organic products have health or nutritional benefit, people must believe that there are benefits to choosing Organic.

The literature review done by the Nova Scotia Agricultural College includes a useful reference list summarizing some of the conflicting research on organic compared to conventional food and illustrates the importance of the credence nature of organic production systems. .

There also are differences in perception of organic values in different cultures as shown in a 2005 study which surveyed mean price premiums by country. (Yiridoe et al., 2005). The findings in this paper are summarized in table 2.2 and indicate that belief in additional value of organic may be greater in Europe than in North America. Price premiums shown in the table are obtained by dividing observed organic retail food prices by observed conventional retail food prices.

Table 2.2 Price premiums for organic by country

Market country	**Price premium for organic over comparable conventional food**
Australia	20-40%
France	25-30%
Italy	35-100%
Germany	20-50%
UK	30-50%
Japan	10-20%
USA	10-30%

(Yiridoe et al., 2005)

Given the fact that organic food is not visually distinguishable from conventional food, labelling and audits are a critical factor for those consumers who believe that organic food is superior. A 2006 study found that monitoring and audit was very effective in achieving compliance with set standards. This is very important to the marketing of Organic food. The study also found that labelling of the product showing compliance with the audit was critical to the marketing of credence goods (Engel, 2006).

A US study in 2005 used surveys of Neilsen data to determine price premiums for organic and is summarized in table 2.3 (Lin et al., 2008). Neilsen is accompany which tracks sales of food products in Canada and the US identifying prices, volumes and other information useful to industry.

Table 2.3 Price premiums for organic produce in USA

Commodity	**Organic mean price ($/lb)**	**Conventional mean price ($/lb)**	**% difference**
Apple	1.35	1.01	34
Banana	.62	.45	36
Grape	1.81	1.48	22
Orange	1.07	.90	19
Strawberry	2.78	2.08	34
Carrot	1.26	1.10	15
Onion	.96	.81	18
Pepper	1.98	1.47	35
Potato	.92	.51	82

The results of this study reinforce the concept that some consumers believe that organic food offers more value than conventional food (A credence good as discussed on page 9 of this paper).

The importance of belief and trust in the marketing of organic food is emphasized in a study which examined quality attributes such as firmness, color, and storage life and could find no measurable difference in quality attributes between apples grown organically and conventionally (Róth et al., 2007). Taste is an important criteria for purchasers of food products. Taste differences between organic and conventional fruit were evaluated in a 2008 study and no measureable difference was found. (Schenk et al., 2008).

An extensive comparative trial with organic and conventional apple production was done in Washington State from 1994 to 1999 with results published on both economics and environmental comparisons. The research was conducted on a new planting from establishment through the first four seasons of operation and found that production costs were 32% more for the organic block than for the conventional block. After accounting for higher organic prices, net income for the organic block was 12% better than for the conventional block. Cumulative yield for the two systems was not significantly different (Reganold et al., 2001).

2.1.3. Summary of Economic Literature Review

- Organic products are a credence good with perceived benefits to a significant number of consumers. These perceived benefits generate a price premium of approximately 30% when organic products are clearly labeled and identified with credible audit.

- Growth in organic production without eroding premiums will require that an increasing number of consumers recognize value in organic.

- Costs of production are generally higher for organic than for conventionally produced crops, but increased costs have been less than premiums generated.

2.2. Environmental Background Literature

The environmental impacts of organic farming may include health benefits to people and animals, improved soil and water management and the creation of a knowledge based food production system which is sustainable in areas not easily served with modern pesticides and fertilizers. However, health benefits of organic food have been difficult to demonstrate conclusively. Part of the reason for this difficulty is demonstrated by a 2002 study which defined the foods which would require analysis and testing for comparative health or nutrition. 5722 foods were identified as being consumed by American consumers in a US Department of Agriculture survey conducted in 1994. From this information foods were grouped into 304 "core" foods in the American diet. These core foods would be more manageable number to be analyzed for nutrition and residues in health recommendations but the trials necessary to demonstrate health benefits in such a diverse diet are still a massive undertaking (Pennington & Hernandez, 2002).

An article published in the Canadian Journal of Public Health outlines some of the public concerns around pesticides and the evaluation and approval process for those pesticides in Canada and provides some insight as to why many people perceive benefits from consuming organic food even when it may be difficult to categorically demonstrate consumer health benefits from organic food. Variables such as vulnerable populations, various levels of exposure, additive effects of pesticides, and the sheer number of pesticides in use today are all concerns to the medical community. This paper clearly supports a reduction or elimination of pesticide use on the medical principle "do no harm". In this context , do no harm refers to the possibility that pesticide use may contribute to human health problems and if pesticides can be avoided it is reasonable to do so even if the risk of harm is small (Arya, 2005).

Conventional food production methods may also cause effects on the environment which do not directly affect humans. A 2006 publiction reported more harmful environmental effects when synthetic fertilizers are used than when organic fertilizers are used. The study was performed in the apple growing region of the Yakima Valley of central Washington State, and found nitrate concentration in water collected 40 inches below the conventionally treated trees was 4.4 to 5.6 times higher than in the water under organically treated trees. These high nitrate levels can be harmful to public health according to the study. The Environmental Protection Agency (EPA) has found that 10% of drinking wells in the Yakima Valley exceed EPA maximum allowable level for nitrates in drinking water. (Kramer et al., 2006).

Organic food production does not mean that no pesticides are used. Rather only materials which are biological in nature or naturally occurring may be used in the necessary process of organic pest control. Development of organically acceptable insecticides, fungicides and fertilizers are a key factor in improving the organic industry.

Granulosis virus treatments have been shown to be an effective organic control for Codling Moth and a 2004 study provides an example of how effective organic materials are developing. The study found that granulosis virus applied at egg hatch (~250 degree days) was effective in controlling codling moth damage in apples. The material remained effective for 72 hours (compared to as much as 21 days for conventional codling moth control) so multiple applications may be necessary if commercial control is to be achieved (Arthurs & Lacey, 2004).

Pheremone disruption and sterile insect release are also being used for organic codling moth control but there are circumstances where a material such as Granulosis virus is necessary to assist these methods in controlling codling moth.

One of the issues around organic agriculture is whether organic techniques can maintain production at a level necessary to feed the world's population. This ambitious topic was addressed by a study which tested the principal objections to the view that organic production can contribute significantly to the world food supply. The study compared yields of organic versus conventional or low-intensive food production for a global dataset of 293 examples and estimated the average yield ratio (organic: non-organic) of different food categories for the developed and the developing world. For most food categories, the average yield ratio was slightly less than 1.0 for studies in the developed world and greater than 1.0 for studies in the developing world. The authors conclude that increased production in the developing world from organic farming methods would offset the reduction in the developed world. A complete transition to organic farming could therefore feed the world population without an increase in agricultural land base (Badgley et al., 2007).

Impacts of organic production on wildlife are an important factor in assessing environmental benefits of converting production systems. Most wildlife impact studies have been done measuring impacts of materials such as DDT which are now obsolete. One modern French study found that more young birds were produced by pairs of adults nesting in organic orchards than pairs nesting in conventional orchards. The authors believe that the improved population is due to the reduced pesticide use as well as a greater population of insects for food in the organic orchard (Bouvier et al., 2005).

Organic management techniques can also have a control effect on pests and disease without application of control as demonstrated by a trial that that removed leaf litter from the orchard floor after harvest in an attempt to control apple scab. Removal of leaf litter resulted in a 70% reduction of apple scab lesions in each of two years (Gomez et al., 2007).

Weed control without herbicide use is a major challenge to organic producers. A 2007 trial comparing tilling, bark mulch and a living cover crop found that none of the systems produced ideal weed control but that tree growth was best with the tilling treatment (Hoagland, 2007).

Economic incentives for improvement to environmental conditions for wildlife have been used successfully by Ducks Unlimited and the Rocky Mountain Elk Foundation in Canada but more wide ranging schemes have been attempted in Europe with varying results. Promotion of organic production may provide an effective method of improving farm environments than direct financial incentives.

European agri-environment government programs were analyzed for effectiveness in a 2003 study. The report describes some of the direct payment programs to farmers for considering environmental factors in the operation of their farm. 26 of 44 European countries have attempted such schemes. The main objectives of these agri-environment schemes include reducing nutrient and pesticide emissions, protecting biodiversity, restoring landscapes and preventing rural depopulation. In virtually all countries the uptake of schemes is highest in areas of extensive agriculture where biodiversity is still relatively high and lowest in intensively farmed areas where biodiversity is low. Approximately $24·3 billion has been spent on agri-environment schemes in the European Union (EU) since 1994 but limited evaluation of these programs has been attempted and where even minimal evaluation was done, the results were inconclusive as to whether the payments had any environmental benefit (Kleijn & Sutherland, 2003).

Research which categorically proves damage to consumers from properly applied pesticides on foods is limited. However, pesticide risk to applicators is more evident. Conventional pesticides commonly carry warnings which indicate significant immediate risk to applicators if improperly handled. Long term health impacts to applicators from low acute toxicity pesticides are suggested by a study of turf pesticides found a weak association between dogs developing canine lymphoma and 2-4-D use on lawns. Owners who used 2-4-D on lawns where the dogs were active developed canine lymphoma 1.3 times more often than dogs whose owners did not use 2-4-D. (Knopper, 2004)

Orchard nutrition under organic management is a very important factor in success or failure of the organic enterprise. Orchard floor management was discussed in a study which evaluated the effectiveness of various cover crops in improving soil organic matter in organic orchards. From an initial level of 1.5% organic matter increased to 3.1% with strawberry clover as cover crop, to 2.8% with alfalfa as cover crop, to 2.3% with vetch as a cover crop and to 1.9% with the control.

This study also found that disking was detrimental to orchard growth and recommended mowing only (Sánchez et al., 2006).

A Washington state trial tested soil quality, environmental impact and energy use of an organic plot compared to a conventional plot of apples.

Soil quality was measured using a soil quality index made up of measurements of physical, biological and chemical properties of the soil. A rating of one is ideal for tree fruit production and environmental quality. The rating for the organic plot in this trial was .83 compared to .7 for the conventional plot.

Environmental impacts of the two systems were evaluated using an index of adverse effects of pesticides. The conventional block in this trial showed adverse environmental effects six times greater than the organic block.

An evaluation of energy use using a ratio of input energy to output volume of production. There was very little difference in energy use with organic having a ratio of 1.18 and conventional having a ratio of 1.11 (Reganold et al., 2001).

As energy costs rise and carbon dioxide emissions become more important, establishing a position for organic production compared to conventional production with respect to energy use is important.

Environmental study on energy use was evaluated in an Australian study which found that direct energy use was higher on organic farms than conventional farms. Further calculation of indirect energy use from manufacture of pesticides and fertilizer for a conventional farm and adding this to the direct energy use resulted in a significantly higher total energy footprint for a conventional farm. (Wood et al., 2006)

2.2.1. Summary of Environmental Literature Review

- Organic farming avoids the use of synthetic pesticides and fertilizers and is demonstrated to reduce the negative impacts that these materials have on wildlife, groundwater quality, and health of farm people and pets.
- Organic materials and techniques can be effective in controlling pests and diseases as well as improving soil quality.
- Total energy use is less with organic production than with conventional production.

2.3. Organic Policy Literature Review

Agriculture is one of the three areas (the others being immigration and pensions) within the Canadian constitution with both federal and provincial jurisdiction. Section 95 of the constitution provides that provinces may enact legislation relating to agriculture and immigration but if the legislation is in conflict, the Federal laws shall take precedence over provincial laws. This is referred to as the Doctrine of Paramountcy (Hogg, 2008; McConnell, 1977).

Regulations governing organic production are contained in the Organic Products Regulations published by the Government of Canada. These regulations define materials and methods which are allowable in the production and processing of organic food in Canada. The allowable materials and methods available to organic producers are substantially less than those available to conventional producers. An important provision of the regulations is the requirement that organic farm and processing operations must be audited annually for adherence to the regulations in order to use the term organic for interprovincial sales. The audits are generally an extensive review of farm records along with a site visit by an auditor.

There is no similar audit system in Canada for conventional food. Instead, adherence to pesticide application regulations is monitored by random product testing on samples generally taken at processing facilities or at market. The number of samples taken is very small.

The organic process audit is time consuming and expensive but highly effective in terms of ensuring that regulations are being followed (Government of Canada, 2006).

The government and the broad organic community have rejected the concept that organic claims should be audited by residue testing rather than by process audits on the basis that residue testing is less effective. This point is discussed in published editorial which points out that differences in food quality can be impacted more by handling and distribution than by production method. In this author’s view field trials and observation are more effective in product quality testing than samplingat market (Harker, 2004).

Government land use planning decisions have a major impact on agriculture. Growing organically can be more difficult when surrounding production is conventional. An outline of policy options for the creation of organic regions found that edge effects from conventional farms had a negative effect on organic farms and recommends that specific organic regions be encouraged by policy makers to reduce conflicts between the two systems (Parker & Munroe, 2007).

The origins of organic production are rooted in social aspirations of farmers as well as health and economic benefits and are described in a paper published in the UK.. Organic production and markets are changing as large producers and retailers become involved in the production and distribution of organic food. Some of the original lifestyle and social aspects of the organic movement are being diluted as these changes in organic participants occur and these changes may in fact reduce the attractiveness of organic to consumers (Reed, 2009).

A Canadian parliamentary report on organic farming credits the origins of organic to an Austrian named Steiner who founded a “Biodynamic “ movement in 1928 and to Sir Albert Howard of the British Soil Association who wrote on “Organic Agriculture” in 1940. Both of these movements advocate composting, development of soil fertility and contain a substantial ideological component. The report contains a good definition of Organic in Canada.

“Organic farming is based on the principle of strict respect for the links and natural balances among soil, plants and animals. To this principle is added a prohibition on synthetic chemicals.

From this principle and constraint follow a number of agricultural practices which distinguish organic from conventional farming.

- A prohibition on chemical fertilizers and pesticides, plant and animal growth regulators, hormones, antibiotics, and preservatives.
- A prohibition on GMOs.

- A prohibition on soil-less culture.
- The requirement in the case of animal production, to allow free range practices, to use organically produced feed and to limit animal density in buildings.
- There is a conversion period in crop production which must be observed before any products can be marketed as organic.
- Supporters of organic farming add a social and ethical aspect to the definition of organic farming because they see it as a means of preserving a human dimension in agriculture that is respectful of the environment and in touch with the consumer."

This report goes on to outline the impact of government policy on organic production. (Forge, 2004)

A summary of the state of organic production in BC is provided by Pacific Agricultural Research Centre scientists in a 2009 report. The authors conclude that research effort on organic production in BC is inadequate to develop the industry and more funds should be allocated by government for organic research. (Neilsen et al., 2009)

2.3.1. Summary of the Policy Environment Surrounding Organic Production

- Organic production of crops has a history and background based on a low environmental impact lifestyle. There is a significant philosophical component to organic production and the system has in the past been largely self regulated. As such it has generally been defined as a process of food production rather than a results oriented regulatory system such as conventional food production.
- As organic has grown, government involvement in the development of regulations has become more important and the system is becoming regulated in a similar manner to conventional production with a rules based environment more important than the ideological base that was the origin of Organic.

2.3.2. Overview of Literature Review

The literature available on organic production provides a basis for decision making for a producer who is considering a conversion to organic production. The major points to consider are:

- There is some portion of the population at least which is prepared to pay a premium of approximately 30% for the perceived heath and other benefits of organic food.
- There are increased production costs and /or yield losses for organic farms approximating 30%.
- Positive environmental impacts of organic are relatively minor but there are no indications of negative impacts of organic production on the environment in the literature reviewed compared to conventional production.
- Organic production has a strong component of lifestyle belief and social consciousness which may be important in the marketing of the product. The value of organic may be diluted if consumers judge that producers are growing organically strictly for profit.
- Increased research on health and quality benefits to organic are important to the development of the organic movement.

Chapter 3. Methods

3.1. Economic Measurements

The test farm fruit was sold as conventional fruit for the years 2005 to 2009 and compared to organic returns for the same variety, quantity and quality of fruit for the same years. Conventional returns are those actually received from the Okanagan Tree Fruit Cooperative. Comparative organic returns are calculated by multiplying Okanagan Tree Fruit Coop organic prices by the pounds of test farm fruit. Expenses were calculated from tax records with operator labour added at $20/hour from a time log. Comments relating to the 2009 crop are also included.

3.2. Environmental Effects of the Conversion

Soil tests were taken and analyzed for 2007 2008 and 2009. The soil samples were taken using commercial sampling methods. Trees at four locations in the orchard were marked and composite soil samples were taken from the top 12 inches of soil(about 0.5 kg.). Observations of insect disease damage were kept as well as a log of observed issues with respect to changes in the operation as a result of the conversion. Several tests were conducted with various materials for weed control and fertilizer.

3.3. Policy Assessment Relating to Organic Conversion

As noted by several studies in the literature review, organic apples are a credence (an acceptance that the products have value without obvious attributes) good with no visible differences from conventionally produced fruit (Bonti-Ankomah & Yiridoe, 2006). This creates the necessity of standards which are different from conventional and a publicly accepted certification scheme if the fruit is to be sold as a different product than conventional fruit.

Organic is an established term arising in Britain in the 1940s and is well accepted worldwide as a descriptor of apples grown according to a set of rules which prohibit the use of synthetically produced pesticides and herbicides (Forge, 2004).

In order to market apples as organic in Canada, two options are available[3]:

1. If apples are to be marketed internationally or interprovincially, the fruit must have been produced under the Canadian Organic Products Regulations effective June, 2009(Government of Canada, 2006) and certified by a federally approved certification agency.

2. If apples are to be sold only within the province of British Columbia, they may be sold as organic if they have been grown to a broader (Government of BC, 1993)set of standards and certified by a provincially approved certification agency. {{117 Government of BC 1993}} The provincial government does not have monitoring or enforcement capability on this issue so there may be people using the word organic when the product has not have been certified to any standard. The organic industry continues to encourage the provincial government to strengthen and enforce organic certification standards for products grown and sold within the province.

The King orchard organic conversion was conducted according to federal standards and certified by the Pacific Agricultural Society (PACS) of Vernon, B.C.

The process required for conversion to organic after making the decision to convert required the following steps:

1. Selection of a certification body. In this case PACS. January, 2007.

2. Application with management plans and a history of chemical treatments. January, 2007.

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[3] The reason that two sets of rules exist for the production and marketing of organic products arise from the concurrent provincial and federal powers to regulate agriculture contained in section 95 of the Canadian Constitution.

3. An initial audit to confirm history and chemical inventory. March, 2007.

4. Disposal of prohibited substances still in inventory from the previous year to a conventional grower. April, 2007.

5. Annual filing of documented input use and management plans. January, 2008, 2009.

6. Annual audit of operations. March 2008, 2009.

Fruit produced during the 2007 and 2008 crop years was marketed as conventional fruit. Certification was granted in October, 2009 and part of the 2009 crop was marketed as organic.

Chapter 4. Results

4.1. Economic Impact of the Conversion

One of the issues always raised with respect to organic management is the increase in operator time required. An exact comparison is not possible because operator time was not charted when the orchard was conventionally managed. It is, however possible to estimate the increase in operator time by looking at items which were not required or required at a lesser level during conventional management.

In the following table (table 4.1), Pruning, mowing, thinning, and picking by the operator would be the same under both management regimes. Office work doubles with organic management due to increased record keeping. Pest control spraying time doubles because organic materials generally require that every row be sprayed rather than every second row and more applications of material may be required due to materials having less residual effect than conventional materials. Weed control hours increase by four times because mechanical tilling is much slower and needs to be done more frequently than weed spraying in a conventional orchard. Irrigation management doubles due to increased time adjusting raised microsprinklers during the growing season to ensure that nozzles are not blocked. Monitoring increases by four times to assess insect and disease populations for treatment early with any infestation. Other work increases by four times primarily due to increased rock picking after tilling.

Table 4.1 Owner hours by job category

	Office	Prune	Spray	Mow	Weed	Irrigate	Thin	Pick	Monitor	Other	Total
2007	87.5	350	107	49	94	84.5	30	204	22	37	1065
2008	67	331	58	39	209	46	35	233	24	172	1214
Mean Increase	38.6	0	41.25	0	113.6	31.1	0	0	17.25	78.4	290.2

Using estimated increase in hours discussed earlier, average owner hours (or skilled labour hours if using hired help) spent on farm work are estimated to be 34% greater with the organic operation than with conventional. Using $20 per hour for operator wages, increased operator wages are estimated to be $5800 annually due to organic management.

4.1.1. Revenue Comparisons

Total revenue by year for King conventional fruit compared to organic is shown in Table 4.2. Conventional figures are actual returns for the King orchard while organic returns are calculated by multiplying actual King pounds (by grade and size) times the organic price (by grade and size) for the year paid by the Okanagan Tree Fruit Cooperative in Kelowna. 2009 revenue figures are not included because the orchard was damaged by hail in 2008 and most fruit was unmarketable. Prices for 2005 - 2008 were projected to be significantly better for organic than conventional fruit.

Table 4.2 Actual conventional revenue compared to projected organic revenue (in dollars)

Year	Conventional	Organic	Difference
2005	47,227	76,218	28,991
2006	51,896	86,411	34,515
2007	65,641	113,433	47,792
2008	46,791	82,122	35,331

Farm expenses are shown for 2005 through 2009 in table 4.3.

Table 4.3 Farm expenses for 2005 to 2009 in dollars

Item	2005	2006	2007	2008	2009
Wages	13232	13192	20121	17733	17848
Hauling	1456	1368	1860	1793	766
Insurance	3863	4528	4633	5011	4531
Fuel	1289	1854	2321	2628	1841
Pesticides and fertilizer	5784	8510	8682	8305	10730
Accounting	1498	1230	1961	1058	1155
Property tax	3207	3394	3604	3802	4073
Repair and maintenance	2356	3042	5186	1616	4520
Irrigation	1129	630	1364	661	2928
Plant material	0	299	746	4172	6201
Worker's Compensation	344	346	339	406	351
Interest	2961	1092	1006	1645	1281
Vehicle expense	1352	1141	1211	1102	1107
Office expense	1290	2274	1941	1698	1360
Packing house charges	419	568	621	670	675
Professional fees	300	300	442	397	300
Organic fees	0	0	567	618	233
Depreciation	14784	14784	18112	20374	15176
Total	**55264**	**58552**	**74717**	**73689**	**75076**

Increase in cost for the 3 years, when the orchard was managed organically, averaged $17,586 plus $5,800 in operator increased labour for a total increase of $23,386 annually. The total increased costs were $70,158 for the period of transition to certified organic with no offsetting organic premium for fruit sold. Total investment in achieving organic status is therefore $70,586 which will need to be recovered from future organic premiums.

Tables 4.4 and 4.5 shows actual and projected revenue less cost from 2005 –2006.

Table 4.4 Comparison of conventional net revenue and projected organic net revenue

	2005 Actual	2005 Organic Projected	2006 Actual	2006 Organic projected	2007 Actual	2007 Organic Projected	2008 Actual	2008 Organic Projected
Revenue	47,227	76,218	51,896	86,411	65,641	113,433	46,791	82,122
Expense	55,264	55,264	58,522	58,522	74,717	74,717	73,689	73,689
Net	-8,037	20,954	-6,626	27,889	-9,076	38,716	-26,898	8,433

Farm operations produced an actual average loss of $12,659 from 2005 through 2009 (Note that average loss would have been approximately $8,000 less if conventional management expenses were used).

Projected organic gross revenue averaged $36,657 more than average actual gross revenue for the study farm

Table 4.5 Net economic benefit of organic production

Year	Projected organic net revenue ($)	Difference in projected organic net revenue compared to conventional ($)	Operator increased labour due to organic management ($)	Net total increased net revenue from organic sales ($)
2005	20,954	28,991	5,800	23,191
2006	27,889	34,515	5,800	28,715
2007	36,716	47,792	5,800	41,992
2008	8,433	35,331	5,800	29,531
Total	93,992	146,629	23,200	123,429
Average	23,498	36,657	5,800	30,857

The figures for the period of the study indicate a very substantial benefit to changing the operation to organic. An annual average increase in net revenue of $30,857 calculated from all years is projected for the farm under organic management compared to revenue generated under conventional management. This increase changes the farm from a loss producing to a profitable enterprise. Projected annual organic revenue from the farm averages $17,698 net of additional operator labour. This covers the roughly 800 hours of base operator labour ($16,000) plus a small return on invested capital.

4.2. Environmental Observations

Details of orchard treatments for 2007 and 2008 are shown in Appendix 2, Soil Analysis Details.

4.2.1. Soil Impacts of the Conversion

One of the concerns about organic apple production on the light soils of East Kelowna is getting enough nutrients into the soil to sustain high quality fruit organic fruit production over time. Nitrogen is particularly problematic as most commercial nitrogen fertilizers are chemically produced and thus prohibited for organic production. Several nutrient management systems were tested with varying results.

An early small scale trial of on farm composting of available horse manure was attempted with poor results in that pathogen killing high temperatures were not achieved in the compost pile. This fertilizer system was abandoned immediately for food safety reasons.

Organic Advantage granular fertilizer from poultry waste was tested in year 1 on the basis that it was approved, safe and easy to apply. Nutrient content of this material is 8% nitrogen, 4% phosphorous and 5% potassium compared to the most commonly used chemical orchard fertilizer having 34% nitrogen and 0 phosphorous and potassium. Phosphorous and potassium are not generally required on Okanagan orchard soils. To achieve the recommended 55 pounds of actual N per acre 688 pounds per acre of Organic Advantage had to be applied compared to 162 pounds per acre of chemical 34-0-0.

Composted chicken manure from Natures Nutrients was tested in year 2. This material has 4% N, 1.3% P and 1.5%K requiring 1375 pounds per acre to get 55 pounds of actual N on the soil. Composted chicken manure is very difficult to spread unless the farm has access to a manure spreader. This compost also has a very unpleasant smell and will burn the trunks of young trees if significant volume touches the bark. It seems reasonable that if the problems associated with manure application are overcome, there would be long term soil improvement due to the addition of organic matter.

White clover has soil nitrogen fixing properties and inoculant free seed was planted in part of the orchard as a nitrogen generator. Results of this initiative are too early to evaluate but examination of alfalfa (also nitrogen fixing) plantings in an organic orchard at the Pacific Agriculture Research Centre at Summerland, BC show promising results both for grown in place N and weed suppression. Other producers have been concerned about increasing rodent habitat with increased cover crop usage but that has not been a problem with this trial. Certainly cutting and tilling the cover crop along with other control techniques described in this paper help with rodent control

Future fertilization in the case orchard will involve grown in place nitrogen fixation (clover and alfalfa), commercial pelletized animal waste fertilizers and composted chicken manure in combination.

4.2.2. Soil Analysis Comparisons

Soil analysis comparisons were conducted over 4 years and a summary is shown in Table 4.6. Although an effort was made to collect samples from the same locations and have the testing done by the same laboratory in the last three years, the intent of the testing was not to provide a rigorous evaluation of soil changes under organic management but to show how commercial testing can be used in management of an organic orchard. Soil test comparison details are found in Appendix 2.

Table 4.6 Soil sample results 2005-2009

Year	Ph	Organic Matter	P	K	N	Ca	Mg	Zn	Fe	Mn	B	Cu
2005	6.0	3.5	M	M	VL	M	M	VH	M	L	L	M
2007	6.6	3.5	H	M	VL	M	H	VH	VH	L	L	M
2008	6.8	3.9	H	H	L	M	H	VH	VH	M	L	M
2009	6.6	3.4	H	H	M	M	H	VH	VH	L	M	M

Note-VL-Very Low, L-Low, M-Moderate, H-High, VH-Very High [4]

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[4] No soil samples were taken in 2006

With the exception of Nitrogen which has increased due to fertilizer application, nutrients have stayed fairly stable. The analysis suggests that it is possible to maintain nutrient levels with organic fertilization and orchard floor management.

More work is needed on grown in place legumes for nitrogen fixation and incorporation of organic matter through tilling influence on soil quality.

The soil on the test orchard is extremely rocky causing major problems with tilling. Soil without rocks would mwke the conversion much easier.

4.2.3. Weed Control Methods and Impacts

Weed control has proved to be one of the biggest challenges in this organic conversion. Grass and weeds compete very well with apple trees for water and nutrients and with a dwarf orchard, leaving the grass and weeds unchecked has a detrimental effect on tree growth and production. An Agrofer tiller with both a disc attachment and a rototiller attachment was used to clear a one meter strip in the tree row with mixed success. The soil is very rocky and each tilling raised numerous rocks which had to be picked up. This seems to be an endless process. Tilling with the Agrofer tiller is very slow with about 3 acres being done in an 8 hour day. Tilling needs to be done 4 times per season so for the 9 acres involved in the conversion a total of 12 days for tilling and 8 days for rock picking is required. Tilling also damages shallow tree roots impacting growth and production.

Bark mulch was applied to a small section of young trees in a one meter strip 4 inches thick around the trees in an attempt to control weeds. This process had a short term beneficial effect but within 3 weeks weeds grew through the mulch and within 6 weeks tilling was necessary.

More research on grown in place mulches of alfalfa and other legumes is needed to determine weed control properties.

4.2.4. Water Usage Impacts and Management Problems

Conventional orchards on the gravel soil of East Kelowna do not do well on trickle irrigation so either overhead sprinklers or ground based microsprinklers have been used in the area for irrigation for many years. Half of the test orchard is irrigated with overhead sprinklers (12 foot risers) which required no adjustment for organic production. The other half of the orchard had ground based 1-inch poly pipe with microsprinklers which had to be lifted and attached to wires 2 feet from the ground so that weeds could be controlled in the tree row. Adjustment and maintenance of this system is time consuming. Overheads work very well on an organic conversion but waste much more water than microsprinkler systems. More development of trickle irrigation systems for coarse soils would be very useful to allow organic producers to irrigate crops more efficiently.

4.2.5. Insect Pests and Diseases

Insect and disease pests have been relatively easy to control. Records of the pesticides and fertilizers used in 2007 and 2008 are shown in tables 4.7 and 4.8. Research information and resources available for control of pests is greater than for most other organic challenges. The dry climate of the Okanagan and the fact that pest populations are low in the surrounding area may be helpful in organic pest control. Note that, as discussed earlier in this paper, organic farming is not chemical free but only approved natural materials may be used.

Control methods used on the test orchard for the major potential pests are discussed below.

- Codling moth is controlled adequately to less than 1% fruit damage by a combination of pheromone mating disruption, sprays of Granulosis virus (Virosoft) and release of sterile male moth by the regional district Sterile Insect Release program. The impact of the government run Sterile Insect Release Program is difficult to assess but at this time the additional control measures described above are required to control codling moth.

- Aphids are controlled with a spring application of dormant oil and an increase in natural predators over time. In areas where aphid populations are high, summer application of insecticidal soap will keep fruit fairly clean. A release of commercially grown ladybugs was tried in year 1 of the conversion without noticeable impact on aphid populations

- Leafroller is controlled by 1 or 2 spring sprays of BT or Spinosed followed by 1 early August Spinosed. Experimental work is being done with mating disruption but conclusive results are not yet available.

- Budmoth is controlled with leafroller sprays, particularly the most important spring application of BT.

- Powdery mildew and apple scab are reduced to commercially acceptable levels (no fruit damage and limited leaf and shoot damage) with minimal use of irrigation in spring, keeping grass short and mulching dead leaves and prunings early in spring. Several sprays of Sulphur are applied early in the growing season.

- Rodents such as mice, voles and pocket gophers are controlled by allowing coyotes easy access (no fencing), keeping pets with rodent hunting instincts and mechanically trapping at the first sign of rodent presence.

Management issues which are impacted by an organic conversion are an increase in fuel usage due to more tractor work being required for tilling and general maintenance, more labour because of an increase in hand work, and better relations with neighbours owing to less application of pesticides.

Wildlife populations seem unaffected by the organic conversion, possibly because the organic acreage concerned is small compared to the total area of orchard in East Kelowna.

Table 4.7 Record of pesticides and fertilizers applied 2007

Date	Product Used	Rate	Purpose of Treatment	Notes
8-Apr	Organic Advantage 8-4-5	350 lb/acre	Fertilizer	Towed spreader @5 K/hr with maximum opening
24-Apr	Guardsman Dormant Oil	24 litres/acre	Aphids and scale	Open cluster- almost pink
25-Apr	Isomate C codling moth andleafroller mating disruption	400 lures per acre	Codling moth andleafroller control	Hung lures every second tree an outside rowsand every third tree on inside rows
6-May	Lime sulphur and Crockersfish oil	L S- 2% CFO- 2%	Blossom thinning mildew and nutrition	80% bloom and warm weather
10-May	Dipel	600 g/acre	Leafroller and green fruitworm	Warm weather. 23 degrees.Sprayed at dusk
25-May	Epsom salts	10 kg /acre	Magnesium deficiency	sprayed alternate rows
25-May	Kumulus	2.8 kg/acre	mildew	mildew showing on honeycrisp
29-May	Ladybugs	35000/acre	Rosey and green aphids	Spread by hand every tree every second rowin evening .Warm and dry.
8-Jun	Virosoft and vinegar	85 ml acre	Codling moth	Applied in evening on every row.warm and cloudy
9-Jun	Briners choice calciumchloride	3.6 kg/acre	Bitter pit and other calcium deficiency disorders	applied every row.Rain immediately after
25-Jun	Virosoft and vinegar	85 ml acre	Codling moth	every row
27-Jun	Safers Soap	6 lt /acre	Aphids	sprayed every row
3-Jul	Virosoft and vinegar	85 ml acre	codling moth	Sprayed every row in early morning
29-Jul	Briners choice calciumchloride	2.2 kg/acre	Bitter pit and other calcium deficiency disorders	sprayed every second row
End of 2007Spray record				

Table 4.8 Record of pesticides and fertilizers applied 2008

Date	Product used	Rate	Purpose	Note
28-Mar	Dolomite lime	1 cup/tree	marking tree holes	
1-May	Kumulus	2.8 kg/a	mildew and apple scab	Rows 17-35 of southblock sprayed diluteat 6 kg /a
4-May	Guardsman dormantoil + solubor	oil 20 L/aboron 2 kg/a	Mite and aphid control	tight cluster
11-May	Organic advantage8-4-5	.5 lb/tree	Nutrition	
13-May	Isomate c lures	400 lures/a	Codling moth	
15-May	Lime sulphurCrockers fish oil	2% solutioneach	Blossom thinning and scabprevention	South block 60% bloomNorth block 100% bloom
15-May	Dipel + vinegar	575 g dipel/a3 L vinegar/tank	Leaf roller	spray in evening
24-May	Entrust + EsotopMgSO4	Entrust 44 g/aMgSO4 8 Kg/a	leaf roller	
24-May	Kumulus	3 Kg/a	mildew and apple scab	
25-May	Bark mulch Gorman	20 yards	weed and moisture control	
12-Jun	Virosoft +vinegar	virosoft 100ml/a vinegar4 L/tank	Codling moth	
12-Jun	Esotop MgSO4Kumulus	4 Kg400 g/100L	mildew and nutrition	
12-Jun	Briner's choice CaKumulus	4 Kg/a400 g/100L	mildew and bitterpit	
24-Jun	Virosoft +vinegar	100 ml/a Virosoft4 L Vinegar/tank	codling moth	
24-Jun	briner's choice CaCl	4 Kg /a	bitterpit	
4-Jul	Virosoft +vinegar	100 ml/a Virosoft4 L Vinegar/tank	Codling moth	
10-Jul	Entrust	44 g/a	leafroller	
21-Jul	Entrust	44 g/a	leafroller	
31-Jul	Briners choice Cacl	4 Kg/a	bitterpit	
Nov-22to24	Natures NutrientsComposted chickenmanure	3 lb/tree	Nutrition	
End of 2008 treatments				

A similar program was followed in 2009 and 2010 and with good success (pest damage at levels similar to a conventional program) at controlling insects and fungal disease. Colour and fruit quality has generally improved but size is generally smaller than with conventional production. Observation and measurements comparing King fruit to conventional neighbours indicate a 10% reduction in size due to organic management but a significant improvement in red colour development. This observation was made by the author comparing fruit of the same variety in a neighboring conventional orchard(with permission).

Pest control became more effective each year over the period of the trial as predator populations built up and operator experience increased.

Chapter 5. Discussion

The study conducted on the King orchard has assessed the effectiveness of an organic conversion in improving environmental viability of the farm, analyzed the impact of the regulatory environment on organic conversion and measured the improvement of the farm economics due to the conversion. This has all been done in the context of Canada's current industrial agriculture policy which has both provincial and federal components as allowed under section 95 of the Canadian Constitution.

5.1. Discussion with Respect to the Economic Benefits of Conversion to Organic Production

This conversion resulted in fruit produced under organic management costing more but receiving greater revenue, something that previous studies have found.

The increase in cost for the 3 year period of the transition to organic was an average of $23,286 including increased operator labour (average % increase of 41% compared to pre organic expenses) or a total of $70,154. This cost is not offset by any increase in income since the fruit produced during the transition period was sold as conventional fruit and becomes the cost of the conversion.

Comparing the value of King conventional fruit with the corresponding value of organic fruit applied to King production (both sold by the Okanagan Tree Fruit Co-op) shows an average annual added value for organic of $30,857 in net revenue. If organic price premiums, farm expenses and productivity remain similar to the values of 2005-2008, it will take 3 years of organic production to recover the initial investment of $70,154 and start to show an economic benefit to the farm from the organic conversion. With the long time period (more than 5 years) between the decision to convert to organic and projecting a net benefit, uncertainty surrounding the future economic benefit is substantial. With this conversion, 2010 cost and revenue figures are not final at time of writing but preliminary indications are that cost levels and organic premiums are similar to those projected so the risk of serious loss has been reduced.

In view of the fact that seasons and other issues are variable and this study did not attempt to measure the impact of organic management on yield in a controlled fashion, it is not possible to make a categorical statement on the impact of organic management on yield or quality. However, after 40 years of producing fruit and observing neighboring farms during the conversion period, it is evident to the author that, at best, equivalent yields to conventional production might be reached. Certainly organic management will not result in greater yields than conventional management in Okanagan conditions.

An unexpected economic result of this organic conversion was that there was considerably increased interest from Kelowna area consumers and local retailers in purchasing organic fruit directly from the farm. This increased interest was directly attributable to the organic status of the farm since there has been very little interest in direct purchase of conventionally produced apples from the farm in past years. 2010 (the first year of certification) was outside the period of the study but it is interesting to note that from a total crop of 160,000 pounds of apples, 30,000 pounds were sold directly from the farm during September and October at prices considerably higher than prices received from the packing house. Average farm sale prices were $ 1.00 per pound compared to $ .30 per pound from the packing house in 2010.

5.2. Discussion with Respect to Environmental Viability

Organic management of the farm creates some improvements in environmental viability but may in fact also create some negative impacts.

Positive factors include the author’s experience that commercially acceptable levels of insect control can be achieved using the soft materials allowed under an organic regime. This benefits the health of the operator, reduces neighbor complaints and creates a more pleasant environment for people, pets and wildlife. The close attention to the orchard biosphere required to make organic management work improves the operator's understanding of relationships among the organisms on the farm. Beneficial organisms can then be encouraged to the detriment of unwanted organisms.

The use of fertilizers made from poultry waste recycles a product which is a problem for poultry producers to dispose of.

The study did not identify evidence soil quality has improved but there is no evidence of decline either. Over the long term there should be an increase in organic matter which results from mowing and tilling in the tree row rather than using herbicides to eliminate weed growth. Increased organic matter will benefit the orchard by more effective retention of water and nutrients available for tree use. No attempt was made in this study to develop a sophisticated analysis of soil changes.

Not all of the study experiences were positive. Fuel use increased due to increased tractor use in the spraying and weeding operations. Tractor hours for these operations increased by 155 hours from a conventional management base level of 123 hours to a total of 278 hours or an increase of 125%. This fairly consistent with what other studies have found.

Water use may increase due to competition from weeds and grasses if the tree rows are not effectively tilled. Mowing around trees is not a good option for weed control for this reason. The farm is not as tidy in appearance with organic management as with conventional management, primarily due to difficulties with weed management, again solvable with effective tilling.

5.3. Discussion with respect to Organic Policy and Regulatory Environment

The results of this study are discussed in terms of a major debate taking place among Canadian agriculture policy makers today. This debate is well summarized in a Globe and Mail article entitled A Warning to Canada: Start Growing published on February 8, 2011(Leeder, 2011).

In the article, Canada's declining food exports are discussed along with the failure of Canada's Agricultural policy to stop the decline in farm incomes in spite of massive infusions of government subsidies. An industry think tank has stated that the solution lies in improved productivity through research, improved access to export markets through tariff reduction and reduced regulation of the food system. An alternative view expressed in the article is that the way forward is to move away from the industrial model of agriculture and develop a system based on sustainability and environmental balance. Such a system would concentrate on producing food for Canadians and exporting only surpluses.

The conversion of the King farm to organic management was done with the initial goal of improving sustainability of the farm within the current industrial model of agriculture as described above. Efficient organic production and marketing through established distribution systems to customers throughout Canada and in other countries was the environment in which this study was conducted. As the Leeder article points out, there may be other more effective options for Canada's food policy and organic producers may provide some leadership in new production and marketing systems which could benefit all of Canadian agriculture.

The regulatory environment surrounding organic is complex and can be confusing and uncertain. Results for this farm are outlined as they apply to the current policy environment with comment on some alternative policies which may help to improve Canada's food policy.

There is a 3 year period of organic management required on an existing farm before the products can be sold as organic. Products must be sold as conventional during this period while costs are at an organic level. Operating costs including operator labor increased $23.586 annually (up approximately 40%over conventional costs) for a total cost of the conversion of $70,158 not including forgone revenue due to losses in production and quality from insect and disease during the adjustment period.

Good records are now required for all food production but record keeping required for organic is more onerous than with conventional fruit. This is onerous and would be made much easier with a template provided by an extension service.

Standards for Organic are now determined by the Federal government so there is national consistency for all products certified under the federal system. The main difference between conventional and organic standards is that conventional standards are categorical. If a material or process is approved by the federal government for use in the food system, it may be used by producers. If the product is not approved, it may not be used. Federal organic standards clearly prohibit the use of some products legal for use in conventional production but there is no nationally approved list of substances which may be used in organic production. Usage lists are often ambiguous in that some products may be used if justification is documented while other may be used in some formulations but not others. This system is challenging for farmers trained in the conventional system. A national registry of approved products for use in organic agriculture would improve the organic system dramatically. This would require agreement from the various organic associations in Canada.

The certification and audit process is generally well organized and effective. Fees are relatively low ($900 in 2010 for the King farm) but as is the case for any audit system there is a considerable level of preparatory work and stress involved for the farm operator. The audit and certification system is critical to organic producers due to the credence nature of organic food.

Organic extension services for organic producers are not easily available. The provincial government funded a province wide organic extension agent until late 2010 but has now ended the funding. The Okanagan Tree Fruit Coop employs Field Service representatives who are very helpful to member organic growers but their main focus is conventional production which constitutes the majority of the fruit handled by the co-op. There are private consultants available to organic producers but they may be hard to find and can be expensive. There is no dedicated Production guide for organic growers outlining recommended and approved growing techniques for Organic. The Tree Fruit Production Guide has some organic information but it is scattered and incomplete. Organic supplies are available from agricultural supply distributors but are handled as an addition to their regular supplies and constitute a minor part of the distributor’s business. The possibility for confusion and error at this level is significant but if the standards were published more clearly, distributors could sell products to organic producers with more confidence.

Marketing and distribution through farm markets and direct contact between farmers and retailers offer potential for improving returns to producers and product quality to consumers. Climate limitations mean that the concept of locally produced fresh produce must be expanded beyond miles but for development of systems to more closely connect producers and consumers has significant potential to improve the sustainability of Canada’s food system.

Chapter 6. Conclusions and Opportunities for Further Study

The key conclusion from this study is that producing apples organically is more viable in the Okanagan than producing apples conventionally. The environmental benefits of an organic conversion are subjective in nature and, at least with this conversion not quantifiable. Family members, farm sale customers and neighbors are more comfortable with the organic regime and, with the exception of increased fuel use and an untidy orchard appearance, there do not seem to be any adverse environmental impacts from the conversion. The improved viability would apply to any size orchard in the Okanagan with the caution raised earlier in the paper that it may be possible to produce too much organic fruit for the market to absorb at a premium.

The regulatory framework surrounding an Organic conversion creates a very significant barrier to entry. Modern organic production requires a significant application of input materials and management techniques to achieve quality and production levels approaching conventional production. Application of materials and management techniques creates a major requirement for the organic producer to review and interpret regulations governing organic farming. Extensive record keeping is also a requirement for organic farmers and can be very difficult for many of those interested in an active outdoor career in farming. Improvement of extension services to organic producers would be very helpful to those wishing to enter the organic business.

The issue of permitted substances and techniques is very confusing . Federal standards contain guidelines and a list of prohibited substances but do not contain a list of approved products. Certification agencies are trying to develop lists of approved products but are short of resources to accomplish this job in a timely fashion. It would be very helpful if there were to be a national list of materials registered for use on organic crops.

This organic conversion was conducted during a period of very low prices for BC apples. Competitive US imports became cheaper as the value of the US dollar declined and Canadian fruit marketers had to reduce prices to remain competitive. Average conventional returns have not come close to covering production costs for several years and many producers are exiting the industry. Organic premiums have also declined but are still at a level which will allow a producer to cover costs and make a modest income provided yield and quality levels are kept close to those achievable with conventional production.

The potential for attracting Canadian consumers to Canadian grown Organic appears larger than to try to attract consumers to conventional Canadian fruit. This provides an opportunity for growth in organics but will take better support from government in regulation and promotion. Significant increases in organic production in Canada will require substantial investment in research and promotion but the improvement in economic health of Canada’s agricultural community could be substantial. Lessons learned from successful organic marketing and distribution innovation may be extended to conventional produce.

Without improvement in government regulatory and research support for the organic produce industry, a farmer wishing to convert to organic should plan on having to do much of his own research into effective organic methods for his particular farm . The organic farmer should also plan to be much more involved in the marketing and promotion of his production than he would with conventional farming if he is to be successful.

This study documents the commercial transition from conventional to organic management of the test orchard. As the conversion took place, so did learning and identification of problems which did not have readily available solutions. Many of the issues touched on in this thesis would provide opportunity for in depth study using controlled scientific techniques.

Some opportunities for useful research in organics are listed below.

- Weed control in organic orchards can be very difficult. Research into improved tilling machinery, using cover crops which are competitive with weeds and not with the food crop or other innovative weed control methods would be very helpful to organic producers.
- Environmental benefits of organic farming over time are not well defined and research in this area would be useful to help establish values for organic conversion.
- Long term health impacts for the consumer are similarly ill defined and may similarly establish a more solid base for organics.
- Marketing systems which connect the consumer more directly with the producer are desirable on many fronts. Research into effective farmers markets, direct delivery systems and local markets would be helpful as society struggles to develop an effective food policy for the future.
- Research on development of nutrition schemes using grown in place nutrient producers would support organic principles and dramatically increase the sustainability of organic farms.

For producers planning to enter the organic world in apple production the following steps are critical:

- Make the commitment to organic principles.
- Establish a financial plan which allows for an increase in operating cost of approximately 40% compared to conventional operation for the transition period.
- Plan marketing and distribution of the fruit. Having an established marketer handle and sell the fruit is easier than selling it directly but the premium for the producer may be limited as organic premiums drop. If a producer is inclined to work at farmer’s markets and invest in storage and handling infrastructure at the farm level, there is an opportunity to increase the share of the retail price of apples which the producer keeps. The possibility for direct sale of organic apples is greater than direct sale of conventional fruit because they are currently in short supply. Producer

premiums for directly sold organic apples can be as much as 5 times institutionally sold conventional apples.

- Record keeping and research skills are vital to successful organic farming. Before embarking on the conversion learn how the production and marketing of organic products are regulated in Canada. Federal standards are developing and still confusing and complex but they are an improvement over the patchwork of local and provincial standards which existed in the past. Develop a record keeping system which works and maintain it from the beginning of the organic conversion.
- Find a Consultant with organic experience and use their advice early in the development of the organic enterprise. The consultant should be able to help with setting up a record keeping system and a management plan for the operation.
- Plan to measure results and conduct practical research on the farm so that techniques which work can be reinforced and those with no positive impact can be abandoned . Constant monitoring of the conditions on the farm will allow for adjustment of management to avoid problems before they impact the enterprise.
- Participation with associations of people in similar areas of business is important in any endeavor and organic farming is no exception. Active involvement in as many organic associations as possible will significantly contribute to the success of the operation.
- Be prepared for frustration. Organic farming is by nature a developmental process. Soil and management improvements take time and the bureaucracy surrounding certification can be difficult to negotiate at times.
- As organic production grows the infrastructure and bureaucracy problems will gradually decrease and organic production techniques improve. Canada’s agricultural policy makers should consider

whether organic principles and production are an attractive alternative to the industrial model of agriculture presently in place.

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Appendices

Appendix A: Comparison of Revenue 2005-2008

Table A.1 Comparison of revenue 2008

King fruit quality (as denoted by average unit price) was less than packing house average in 2008 and that if fruit had been sold as organic returns would have been substantially better .

Variety	King pounds	King price/lb ($)	King Total revenue ($)	OKTF Average conven-tional price/lb ($)	OKTF average price * King pounds ($)	OKTF average organic price/lb ($)	OKTF average organic price * King pounds ($)
Ambrosia	2432	0.2112	513.59	0.2998	729.21	0.4943	1202.14
Fuji	60598	0.118	7148.75	0.1123	6802.73	0.4192	25402.68
Jonagold	2426	0.088	213.56	0.1034	250.78	0.2549	618.39
Royal Gala	135165	0.2367	31996.26	0.2434	32901.86	0.3659	49456.87
Honeycrisp	19980	0.3463	6919.27	0.3563	7118.87	0.2724	5442.55
Total value	**220601**		**46791.4**		**47803.5**		**82122.6**

Table A.2 Comparison of revenue 2007

King fruit averaged slightly better than packing house average for quality but would have earned significantly more if sold as organic.

Variety	King pounds	King price/lb ($)	King Total revenue ($)	OKTF Average conven-tional price/lb ($)	OKTF average price * King pounds ($)	OKTF average organic price/lb ($)	OKTF average organic price * King pounds ($)
Ambrosia	2514	0.3033	762.52	$0.38	964.09	0.53	1330.16
Fuji	96412	0.225	21692.7	$0.21	20324.61	0.48	46701.97
Jonagold	2447	0.2552	624.45	$0.17	406.81	0.28	672.93
Royal Gala	147517	0.2596	38289.51	$0.25	36326.06	0.39	58092.19
Honeycrisp	10584	0.4037	4272.34	$0.47	4958.29	0.63	6636.17
Total value			65641.52		62979.87		113433.4

Table A.3 Comparison of revenue 2006

King fruit averaged virtually the same quality as packing house average but would have generated far more revenue had it been sold as organic

Variety	King pounds	King price/lb ($)	King Total revenue ($)	OKTF Average conven-tional price/lb ($)	OKTF average price * King pounds ($)	OKTF average organic price/lb ($)	OKTF average organic price * King pounds ($)
Ambrosia	0		0	0.43	0	$0.64	
Fuji	79027	0.2126	16802.72	0.19	15366.8	0.46	36715.94
Jonagold	11506	0.152	1748.8	0.11	1254.96	0.17	1944.51
Royal Gala	100731	0.2588	26068.18	0.28	28075.74	0.40	40473.72
Honeycrisp	16132	0.4511	7277.15	0.44	7046.62	0.45	7277.14
Total value	207426		51896.84		51744.12		86411.31

Table A.4 Comparison of revenue 2005

King fruit was of better average quality than the packing house average but would have earned significantly more if it had been sold as organic.

Variety	King pounds	King price/lb ($)	King Total revenue ($)	OKTF Average conven-tional price/lb ($)	OKTF average price * King pounds ($)	OKTF average organic price/lb ($)	OKTF average organic price * King pounds ($)
Ambrosia	0		0	0.40	0	0.48	0
Fuji	86872	0.1485	12903.97	0.13	11487.08	0.31	26661.02
Jonagold	8958	0.0693	620.79	0.06	578.78	0.12	1047.19
Royal Gala	150795	0.2235	33702.68	0.20	30250.98	0.32	48510.75
Honeycrisp	0		0	0.18	0		0
Total value	246625		47227.44		42316.85		76218.96

Appendix B: Soil Test Details 2005-2009

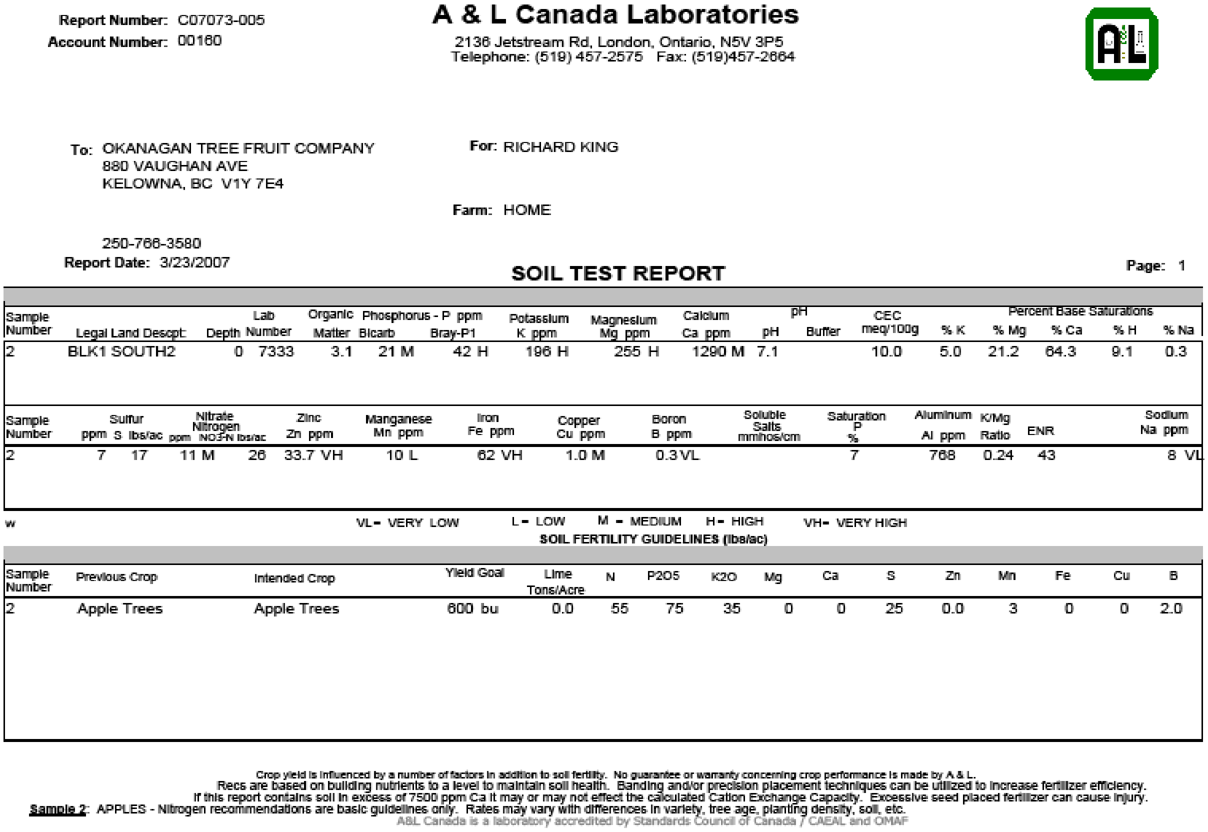
2005 Soil test

To: Okanagan Tree Fruit Company
Date: 23/11/2005

Nutrient	Ca	Mg	K	P	Zn	S	Fe	Cu	B	Mn
PPM				35	77.5	10	73	.9	.3	12
Level	Good	Good	Good	Good	Very High	Low	Good	Good	Low	Low

pH 6.0
Recommendation
Apply 304 lb/acre Ca, 78 lb/acre Mg and 2 lb/acre B

2007 soil test –sample 1



Report Number: C07073-005
Account Number: 00160

A & L Canada Laboratories
2136 Jetstream Rd, London, Ontario, N5V 3P5
Telephone: (519) 457-2575 Fax: (519)457-2664

To: OKANAGAN TREE FRUIT COMPANY
880 VAUGHAN AVE
KELOWNA, BC V1Y 7E4

250-766-3580

For: RICHARD KING

Farm: HOME

Report Date: 3/23/2007

SOIL TEST REPORT

Page: 1

Sample Number	Legal Land Descpt.	Depth	Lab Number	Organic Matter	Phosphorus - P ppm		Potassium K ppm	Magnesium Mg ppm	Calcium Ca ppm	pH		CEC meq/100g		Percent Base Saturations			
					Bicarb	Bray-P1				pH	Buffer		% K	% Mg	% Ca	% H	% Na
2	BLK1 SOUTH2	0	7333	3.1	21 M	42 H	196 H	255 H	1290 M	7.1		10.0	5.0	21.2	64.3	9.1	0.3

Sample Number	Sulfur		Nitrate Nitrogen		Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Soluble Salts mmhos/cm	Saturation P %	Aluminum Al ppm	K/Mg Ratio	ENR	Sodium Na ppm
	ppm S	lbs/ac	ppm	NO3-N lbs/ac											
2	7	17	11 M	26	33.7 VH	10 L	62 VH	1.0 M	0.3 VL		7	768	0.24	43	8 VL

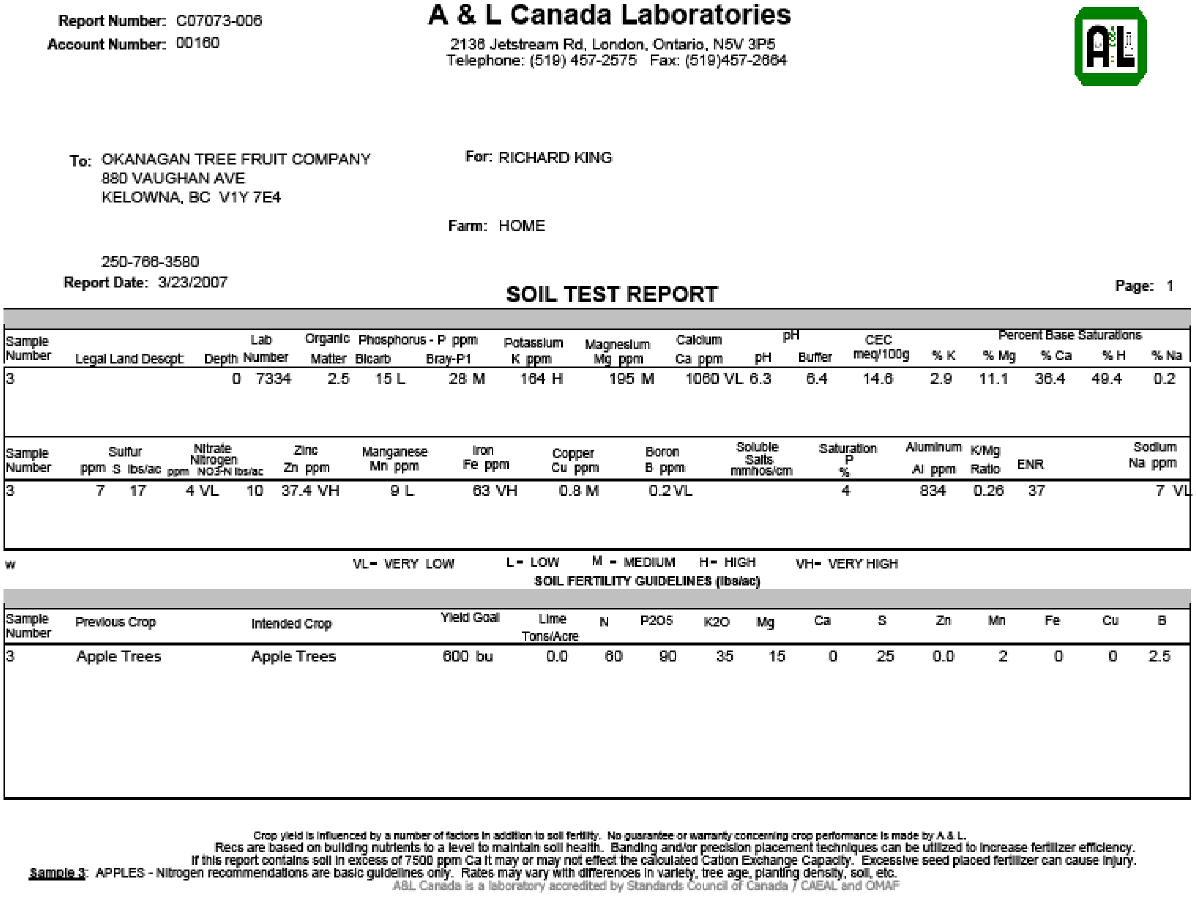
w VL= VERY LOW L= LOW M = MEDIUM H= HIGH VH= VERY HIGH

SOIL FERTILITY GUIDELINES (lbs/ac)

Sample Number	Previous Crop	Intended Crop	Yield Goal	Lime Tons/Acre	N	P2O5	K2O	Mg	Ca	S	Zn	Mn	Fe	Cu	B
2	Apple Trees	Apple Trees	600 bu	0.0	55	75	35	0	0	25	0.0	3	0	0	2.0

Crop yield is influenced by a number of factors in addition to soil fertility. No guarantee or warranty concerning crop performance is made by A & L.
Recs are based on building nutrients to a level to maintain soil health. Banding and/or precision placement techniques can be utilized to increase fertilizer efficiency.
If this report contains soil in excess of 7500 ppm Ca it may or may not effect the calculated Cation Exchange Capacity. Excessive seed placed fertilizer can cause injury.
Sample 2: APPLES - Nitrogen recommendations are basic guidelines only. Rates may vary with differences in variety, tree age, planting density, soil, etc.
A&L Canada is a laboratory accredited by Standards Council of Canada / CAEAL and OMAF

2007 soil test – sample 2



Report Number: C07073-006
Account Number: 00160

A & L Canada Laboratories

2136 Jetstream Rd, London, Ontario, N5V 3P5
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To: OKANAGAN TREE FRUIT COMPANY
880 VAUGHAN AVE
KELOWNA, BC V1Y 7E4

250-766-3580

For: RICHARD KING

Farm: HOME

Report Date: 3/23/2007

Page: 1

SOIL TEST REPORT

Sample Number	Legal Land Descpt	Depth	Lab Number	Organic Matter	Phosphorus - P ppm Bicarb	Phosphorus - P ppm Bray-P1	Potassium K ppm	Magnesium Mg ppm	Calcium Ca ppm	pH	pH Buffer	CEC meq/100g	Percent Base Saturations % K	% Mg	% Ca	% H	% Na
3		0	7334	2.5	15 L	28 M	164 H	195 M	1060 VL	6.3	6.4	14.6	2.9	11.1	36.4	49.4	0.2

Sample Number	Sulfur ppm S	Sulfur lbs/ac	Nitrate Nitrogen ppm NO3-N	Nitrate Nitrogen lbs/ac	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Soluble Salts mmhos/cm	Saturation P %	Aluminum Al ppm	K/Mg Ratio	ENR	Sodium Na ppm
3	7	17	4 VL	10	37.4 VH	9 L	63 VH	0.8 M	0.2 VL		4	834	0.26	37	7 VL

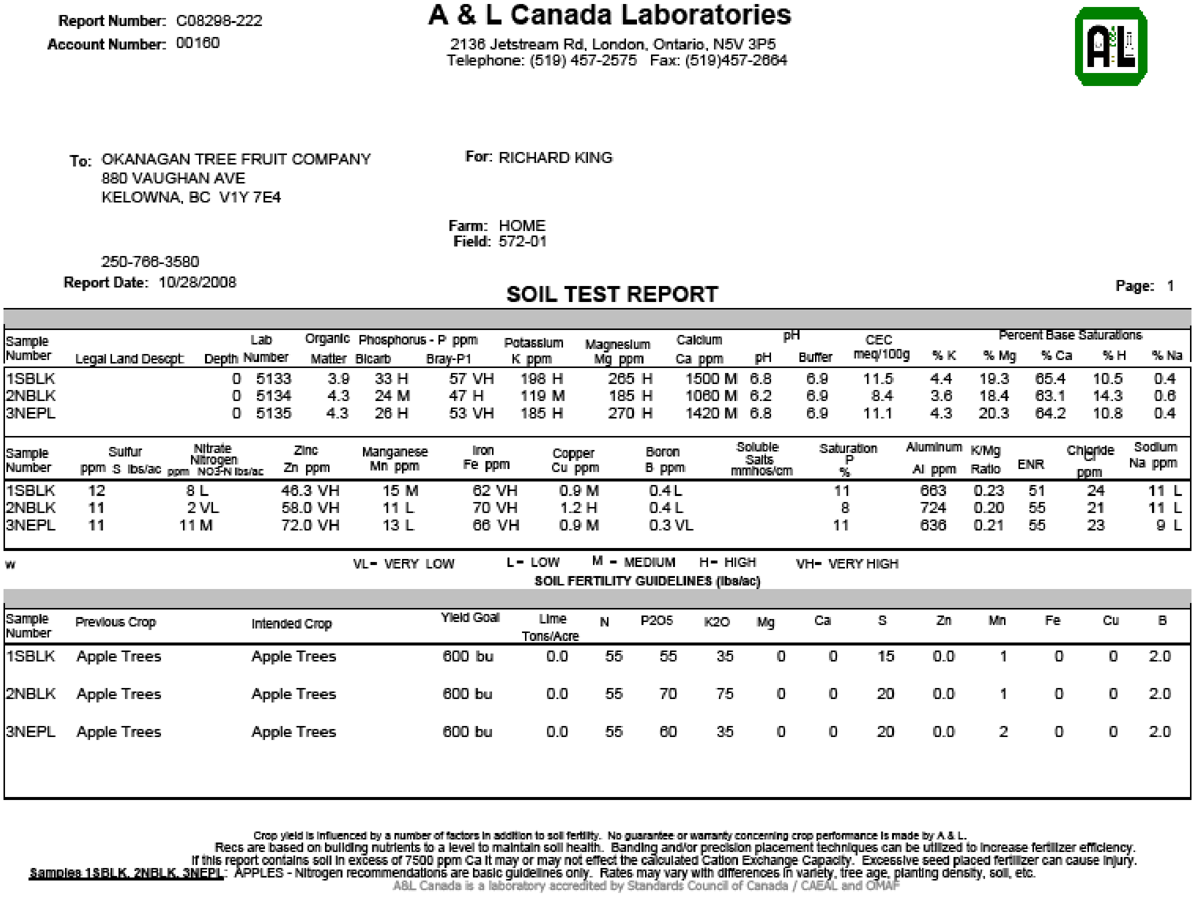
w VL= VERY LOW L= LOW M = MEDIUM H= HIGH VH= VERY HIGH

SOIL FERTILITY GUIDELINES (lbs/ac)

Sample Number	Previous Crop	Intended Crop	Yield Goal	Lime Tons/Acre	N	P2O5	K2O	Mg	Ca	S	Zn	Mn	Fe	Cu	B
3	Apple Trees	Apple Trees	600 bu	0.0	60	90	35	15	0	25	0.0	2	0	0	2.5

Crop yield is influenced by a number of factors in addition to soil fertility. No guarantee or warranty concerning crop performance is made by A & L.
Recs are based on building nutrients to a level to maintain soil health. Banding and/or precision placement techniques can be utilized to increase fertilizer efficiency.
If this report contains soil in excess of 7500 ppm Ca it may or may not effect the calculated Cation Exchange Capacity. Excessive seed placed fertilizer can cause injury.
Sample 3: APPLES - Nitrogen recommendations are basic guidelines only. Rates may vary with differences in variety, tree age, planting density, soil, etc.
A&L Canada is a laboratory accredited by Standards Council of Canada / CAEAL and OMAF

2008 soil Test



Report Number: C08298-222
Account Number: 00160

A & L Canada Laboratories

2136 Jetstream Rd, London, Ontario, N5V 3P5
Telephone: (519) 457-2575 Fax: (519)457-2664

To: OKANAGAN TREE FRUIT COMPANY
880 VAUGHAN AVE
KELOWNA, BC V1Y 7E4

250-766-3580

For: RICHARD KING

Farm: HOME
Field: 572-01

Report Date: 10/28/2008

SOIL TEST REPORT

Page: 1

Sample Number	Legal Land Descpt.	Depth	Lab Number	Organic Matter	Phosphorus - P ppm Bicarb	Phosphorus - P ppm Bray-P1	Potassium K ppm	Magnesium Mg ppm	Calcium Ca ppm	pH	pH Buffer	CEC meq/100g	Percent Base Saturations % K	% Mg	% Ca	% H	% Na
1SBLK		0	5133	3.9	33 H	57 VH	198 H	265 H	1500 M	6.8	6.9	11.5	4.4	19.3	65.4	10.5	0.4
2NBLK		0	5134	4.3	24 M	47 H	119 M	185 H	1060 M	6.2	6.9	8.4	3.6	18.4	63.1	14.3	0.6
3NEPL		0	5135	4.3	26 H	53 VH	185 H	270 H	1420 M	6.8	6.9	11.1	4.3	20.3	64.2	10.8	0.4

Sample Number	Sulfur ppm S	Sulfur lbs/ac	Nitrate Nitrogen ppm NO3-N	Nitrate Nitrogen lbs/ac	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Soluble Salts mmhos/cm	Saturation P %	Aluminum Al ppm	K/Mg Ratio	ENR	Chloride Cl ppm	Sodium Na ppm
1SBLK	12		8 L		46.3 VH	15 M	62 VH	0.9 M	0.4 L		11	663	0.23	51	24	11 L
2NBLK	11		2 VL		58.0 VH	11 L	70 VH	1.2 H	0.4 L		8	724	0.20	55	21	11 L
3NEPL	11		11 M		72.0 VH	13 L	66 VH	0.9 M	0.3 VL		11	636	0.21	55	23	9 L

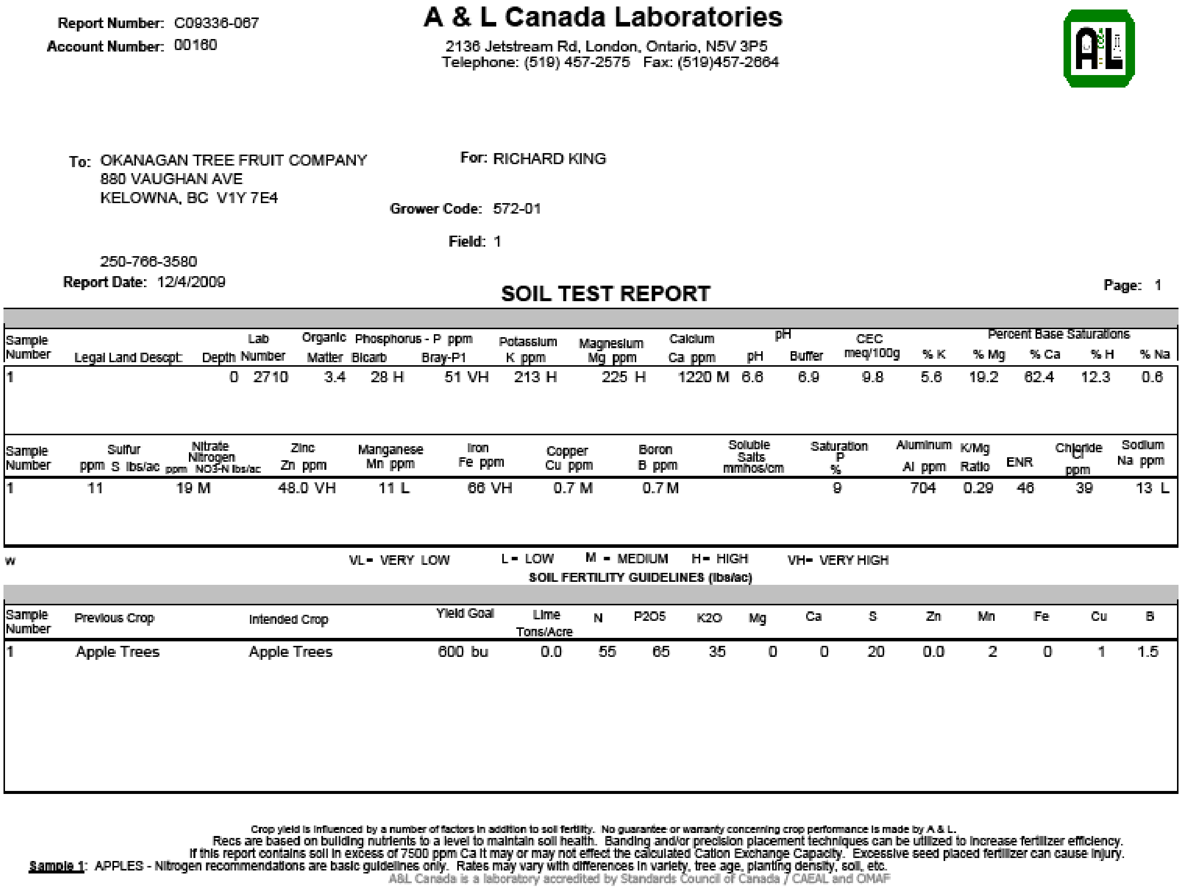
w VL= VERY LOW L= LOW M = MEDIUM H= HIGH VH= VERY HIGH

SOIL FERTILITY GUIDELINES (lbs/ac)

Sample Number	Previous Crop	Intended Crop	Yield Goal	Lime Tons/Acre	N	P2O5	K2O	Mg	Ca	S	Zn	Mn	Fe	Cu	B
1SBLK	Apple Trees	Apple Trees	600 bu	0.0	55	55	35	0	0	15	0.0	1	0	0	2.0
2NBLK	Apple Trees	Apple Trees	600 bu	0.0	55	70	75	0	0	20	0.0	1	0	0	2.0
3NEPL	Apple Trees	Apple Trees	600 bu	0.0	55	60	35	0	0	20	0.0	2	0	0	2.0

Crop yield is influenced by a number of factors in addition to soil fertility. No guarantee or warranty concerning crop performance is made by A & L.
Recs are based on building nutrients to a level to maintain soil health. Banding and/or precision placement techniques can be utilized to increase fertilizer efficiency.
If this report contains soil in excess of 7500 ppm Ca it may or may not effect the calculated Cation Exchange Capacity. Excessive seed placed fertilizer can cause injury.
Samples 1SBLK, 2NBLK, 3NEPL: APPLES - Nitrogen recommendations are basic guidelines only. Rates may vary with differences in variety, tree age, planting density, soil, etc.
A&L Canada is a laboratory accredited by Standards Council of Canada / CAEAL and OMAF

2009 Soil Test



Report Number: C09336-067
Account Number: 00160

A & L Canada Laboratories
2136 Jetstream Rd, London, Ontario, N5V 3P5
Telephone: (519) 457-2575 Fax: (519)457-2664

To: OKANAGAN TREE FRUIT COMPANY
880 VAUGHAN AVE
KELOWNA, BC V1Y 7E4

250-766-3580

For: RICHARD KING

Grower Code: 572-01

Field: 1

Report Date: 12/4/2009

Page: 1

SOIL TEST REPORT

Sample Number	Legal Land Descpt.	Depth	Lab Number	Organic Matter	Phosphorus - P ppm		Potassium	Magnesium	Calcium	pH		CEC	Percent Base Saturations				
					Bicarb	Bray-P1	K ppm	Mg ppm	Ca ppm	pH	Buffer	meq/100g	% K	% Mg	% Ca	% H	% Na
1		0	2710	3.4	28 H	51 VH	213 H	225 H	1220 M	6.6	6.9	9.8	5.6	19.2	62.4	12.3	0.6

Sample Number	Sulfur ppm S	Sulfur lbs/ac	Nitrate Nitrogen ppm	Nitrate Nitrogen NO3-N lbs/ac	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Soluble Salts mmhos/cm	Saturation P %	Aluminum Al ppm	K/Mg Ratio	ENR	Chloride Cl ppm	Sodium Na ppm
1	11		19 M		48.0 VH	11 L	66 VH	0.7 M	0.7 M		9	704	0.29	46	39	13 L

w VL= VERY LOW L= LOW M = MEDIUM H= HIGH VH= VERY HIGH

SOIL FERTILITY GUIDELINES (lbs/ac)

Sample Number	Previous Crop	Intended Crop	Yield Goal	Lime Tons/Acre	N	P2O5	K2O	Mg	Ca	S	Zn	Mn	Fe	Cu	B
1	Apple Trees	Apple Trees	600 bu	0.0	55	65	35	0	0	20	0.0	2	0	1	1.5

Crop yield is influenced by a number of factors in addition to soil fertility. No guarantee or warranty concerning crop performance is made by A & L.
Recs are based on building nutrients to a level to maintain soil health. Banding and/or precision placement techniques can be utilized to increase fertilizer efficiency.
If this report contains soil in excess of 7500 ppm Ca it may or may not effect the calculated Cation Exchange Capacity. Excessive seed placed fertilizer can cause injury.
Sample 1: APPLES - Nitrogen recommendations are basic guidelines only. Rates may vary with differences in variety, tree age, planting density, soil, etc.
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