

# AGRI-FACTS

Practical Information for Alberta's Agriculture Industry

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## Commercial Greenhouse Vegetable Production

This factsheet introduces greenhouse vegetable production as a potential business opportunity. The focus of this profile is on the key management issues associated with producing and marketing greenhouse vegetables in Alberta.

The overview in this factsheet is not intended to be a substitute for individuals making their own thorough assessment of all the key factors that would influence the success of their individual operation.

### Topics

- Industry highlights
- Business considerations
- Regulatory basics
- Market basics
- Structure and start up basics
- Production basics
- Economic/finance basics

### Industry highlights

In Alberta, the greenhouse industry is comprised of about 230 greenhouses covering some 137 hectares. Of these 230 greenhouses, 51, or approximately 22 per cent, are vegetable producers. Even with less than a quarter of the greenhouses in the province, these vegetable producers make up approximately 46 per cent of the production under cover in Alberta at 63 hectares.

Greenhouse vegetable production in Alberta is comprised of three main crops: tomatoes, cucumbers and peppers. Other greenhouse crops grown in the province include lettuce, arugula, basil, eggplant and snap beans, but typically on a much smaller scale.

The following table provides a brief crop overview of the greenhouse industry in Canada and Alberta.

Table 1. Greenhouse industry in Canada, 2015

	Total number of greenhouses	Total greenhouse area (m <sup>2</sup> )	Total greenhouse area (m <sup>2</sup> )	Glass (m <sup>2</sup> )	Other (rigid plastic, etc.) (m <sup>2</sup> )	Poly film (m <sup>2</sup> )
Ontario	1,000	14,019,833	14,019,833	4,513,588	217,616	9,288,629
Quebec	685	2,522,154	2,522,154	376,614	33,838	2,111,702
B.C.	525	5,153,339	5,153,339	3,999,721	160,930	992,688
Alberta	230 <sup>1</sup>	1,370,000 <sup>1</sup>	1,370,000 <sup>1</sup>	1,160,423 <sup>1</sup>	33,084 <sup>1</sup>	1,160,423 <sup>1</sup>
Canada	2,978	23,797,404	23,797,404	9,162,561	512,332	14,122,511

Data from CANSIM 001-0046

<sup>1</sup> Data taken from "Profile of the Greenhouse Industry in Alberta 2014"

**Table 2. Greenhouse vegetable production, 2015**

Location	Tomatoes	Cucumbers		Lettuce	Peppers
	Kg	Kg	Dozen	Heads	Kg
Ontario	178,968,106	144,436,581	42,457,087	---	92,153,552
Quebec	---	1,648,970	484,714	26,250,668	782,752
B.C.	55,690,027	23,706,063	6,968,390	---	40,392,648
Alberta	10,272,452	9,351,061	2,748,741	523,332	1,242,695
Canada	266,844,897	180,194,102	52,879,693	36,505,919	134,638,065

Source: Statistics Canada CANSIM 001-0006

Of the greenhouse vegetables grown in Alberta, the majority are destined for domestic consumption. This domestic customer base makes access to retail markets a critical issue for vegetable producers.

While a large amount of Alberta's greenhouse vegetables are produced to supply the co-operatives in the province, many growers are also active in farm direct sales. Table 3 illustrates this point with data from the "Profile of the Greenhouse Industry in Alberta 2014" (Emmanuel Laate, Profile of the Greenhouse Industry in Alberta, 2015). Note: percentages do not add up to 100 per cent as many producers sell into more than one market channel.

**Table 3. Method used for majority of sales in greenhouse vegetable growers**

Marketing method	Percentage
Own retail shop	9%
Farmers' markets	18%
Wholesale/co-op	47%
Supermarkets/grocery stores	18%
Independent garden centres	3%
Mass merchandisers/box stores	6%

Percentages do not add up to 100% - many producers sell into more than one market channel.

## Business considerations

Recent years have seen tremendous growth in the greenhouse vegetable industry in Alberta, with renewed optimism for the future. However, potential growers need to consider some basic requirements before entering the industry:

- Do you have a site that offers access to markets, labour, good quality water, utilities and room for future expansion?
- Are you able to work from a high level of production management while still being able to apply intensive management skills at the crop level?

- Can you assess market potential?
- Do you have the financial resources to invest in the development and operation of the business?
- Are you able to juggle several activities at once?
- Can you manage labour and employees?
- Can you keep control of the business financial affairs as well as the production operations?

In addition to these considerations, individuals thinking about establishing a greenhouse vegetable enterprise need to determine which marketing methods will provide the best fit for their operation. New entrants to the greenhouse vegetable industry need to assess each market carefully for each vegetable crop they might produce to determine if there is room for more production.

Time should be spent researching potential customers, identifying target markets and identifying different products/growing methods that can be used to differentiate the producer and the product.

Setting up a greenhouse operation is an expensive endeavour given the need for a substantial amount of land, the correct structure and inputs. Given the modest margins in the industry, as expressed in the Table 4, many of the greenhouses in Alberta tend to be family-owned businesses rather than corporate businesses. This pattern is starting to change, due in part to diversification in market channels amongst producers and further development of the grower co-ops within the province.

Given Alberta's climate, heating fuel is an important consideration that can also have a substantial effect on both short and long term expenses. While the majority of greenhouse operations are heated using natural gas (82%), propane, coal and wood are also popular options for heating.

Historic lows for natural gas prices have decreased the number of growers switching to alternative fuels in recent years; however, the potential for high fuel prices

**Table 4. Greenhouse vegetable production operating revenues and expenses**

	<b>Cucumber production \$ per square metre</b>	<b>Tomato production \$ per square metre</b>	<b>Pepper production \$ per square metre</b>
Average gross revenues	115.33	116.06	111.43
Average operating costs	109.06	101.01	114.67
Capital costs	9.17	9.02	10.19
Cash costs <sup>1</sup>	109.03	100.81	113.86
Average total production costs	118.22	110.03	124.86

<sup>1</sup> Cash costs is equal to total operating cost less unpaid labour.

continues to be a concern for growers and should be for new entrants as well. To decrease production costs further, attention should be paid to energy conserving practices and energy efficient production methods. A greenhouse energy and materials best management practices assessment guide has been put together by Alberta Agriculture and Forestry and can be found at the following web link. [http://www1.agric.gov.ab.ca/\\$Department/deptdocs.nsf/all/green16108](http://www1.agric.gov.ab.ca/$Department/deptdocs.nsf/all/green16108)

## Regulatory basics

Individuals who are thinking about building a commercial greenhouse should investigate the municipal requirements (such as business licence, by-laws, land use requirements, etc.). Requirements differ from municipality to municipality and can range from little in the way of regulation to complete environmental impact reviews.

Zoning or the determination of how land can be used in a given area is done at the county/municipal level. Subsequently, zoning will affect the building code applied to the structure and operation. Always check with the local government to determine what sort of licences and permits are required for an operation.

Given the dependence of greenhouse crops on irrigation to meet their water needs, access to an adequate supply of good quality water is a critical component of any greenhouse operation. Depending on the size of the proposed operation and the water source, an irrigation licence may be required.

Individuals considering developing a greenhouse operation should contact a farm water specialist with Alberta Agriculture and Forestry by calling 310-FARM (3276) before development to ensure water is available and of good quality.

The roadside sale of vegetables within a town or city is largely unregulated, but may require a peddler's licence or business permit depending on your local government. Somewhat similarly, farmers' markets and those who wish to sell at them are often governed by boards with rules set down by the board. Vendors must abide by the rules of the market and any regulations that entails.

In Canada, the marketing of some vegetables through wholesale channels is regulated under the *Canadian Agricultural Products Act* (CAPA). This Act governs the marketing of common greenhouse crops such as tomatoes, cucumbers and lettuce. The Act provides for national standards and grades that apply to vegetables sold inter-provincially or to wholesalers.

As of November 2012, a new Act called the *Safe Food For Canadians Act* received Royal Assent and consolidated several pieces of legislation including CAPA. While the new Act will have relatively little effect on those who sell into farm direct marketing channels, those selling across provincial borders or online will be affected and should stay informed as the regulations continue to develop.

More information and a copy of the Act can be found on the Government of Canada's Department of Justice website (<http://laws-lois.justice.gc.ca/eng/acts/C-0.4/>). Information on the regulations surrounding produce and food sales can also be found with Alberta Agriculture and Forestry ([http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/agdex3482](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex3482)).

## Market basics

Many growers say that it is one thing to grow a good crop, but another thing entirely to sell it. To ensure a consistent market for the product(s), market research is strongly advised before any production activities are started.

Traditionally, the three main greenhouse crops (cucumbers, tomatoes and peppers) are sold wholesale, whether directly to a wholesale client or through one of the marketing co-ops in the province.

Over time, interest has grown substantially in niche crops such as herbs (basil, cilantro, etc.) and leafy greens (leaf lettuce, arugula, mustard greens, etc.); however, these crops tend to move in smaller volumes and are often sold direct-to-market. Generally though, these niche crops command a higher price and are quicker to produce (reduced days from seed to harvest).

Furthermore, some trends to watch for in produce include such things as heirloom varieties, snap peas, chef-inspired greens and salad mixes as well as further value-added products.

Regardless of the approach chosen, here are some specific questions individuals should ask when considering commercial greenhouse vegetable production:

- Is there an excess supply of this product in the market (shown by lower prices and “blowing out” of product)?
- What products do consumers buy?
- Who buys the product(s)?
- Where are the buyers located?
- What is the market size?
- What, when and where do the buyers buy?
- What are the packaging requirements of each market?
- What are the market prices?
- How much do prices fluctuate?
- Is the market mature or growing?
- Does the market have room for additional production?
- What will it cost to ship product to this market?
- Do you have access to a main transportation corridor?

In the world of wholesale greenhouse vegetables, Alberta continues to be a price-taker. This phrase means that growers compete on pricing with those from Ontario, British Columbia, California, Mexico and, to some extent, the Netherlands and Spain.

Prices fluctuate throughout the year depending on factors such as production in competing areas, season and field vegetable production. Furthermore, most wholesale buyers will only deal with operations of a certain size who have an established track record of production. Relationships with these buyers are crucial as is staying aware of their needs and trends in their sales and consumer preferences.

Farmers’ markets continue to grow in popularity; however, historically, they tend to move relatively small quantities of greenhouse vegetables. Still, there are many advantages to selling at a farmers’ market such as higher prices, ability to interact with your client, increased visibility for new operations and greater flexibility on product grade.

However, farmers’ markets can be expensive ventures for the producer given that the markets are often spread out geographically. A grower must attend numerous markets to sell even a fraction of what they could with wholesale.

Thanks to the increased demand for local food, there has been an increase in the number of producers selling to chefs and restaurants in their geographic location. Often, these buyers are higher end dining establishments looking for a premium product in niche or different varieties.

Similar to wholesale marketing, the relationships and expectations of management are key in these arrangements, which can often move higher volumes of produce than a farmers’ market, but at a price slightly greater than wholesale.

## Structure and start up basics

Greenhouse vegetable growing currently looks little like it did in the past. The need for ever more efficient production and increased yields has resulted in increasingly scientific production that is monitored by computers and an almost constant analysis of information.

New entrants to greenhouse vegetable production should be prepared to study existing operations and relevant material to gain the knowledge needed to succeed. Continuous improvement is required to remain competitive, so growers should be prepared to also do their own on-site research to determine the growing techniques that give them the best results.

When considering a potential greenhouse location, a number of different factors need to be considered:

Slope of the land and exposure to the sun

- How does the land drain?
- Is your structure oriented for maximum sun exposure?

Access to adequate amounts of good quality water

- Do you have sufficient water? “Sufficient” can mean up to 8 cubic metres of water per square

metre of greenhouse space per year.

- Are your irrigation system and pump designed to handle this quantity?
- What is the quality of your water? Electrical conductivity (EC) and sodium absorption ratio (SAR) are used to measure water quality. If the SAR is greater than 4.0 and/or the EC greater than 0.8, either special management will be needed, or you will have to find an alternate water source.

#### Access to utilities

- Is there natural gas on the property? If not, do you have access to propane? Coal? Wood? How will these fuel costs affect your bottom line?
- Do you have access to electricity? Three-phase power is more efficient for greenhouse production, but can be costly to obtain.

#### Access to labour

- Is there a local labour force that can be accessed? Will you employ seasonal workers? Temporary Foreign Workers?
- Do you comply with all the legislation/regulation required for hiring these types of workers?

#### Structure and room for future expansion

- What are your expansion plans?
- How many acres of land do you have?
- Do you have enough appropriate space in which to expand?
- What are the zoning requirements or limitations for the land?
- What building codes do you have to adhere to?
- What permits or business licenses do you need?

#### Potential environmental hazards: industrial pollution, contaminated water

- Are there neighbouring operations that may affect your production?
- Will these operations affect the quality of your water/air?
- How will you mitigate the potential risk of water contamination and air pollution?

#### Greenhouse layout

- How large a structure will you build?
- What glazing material will you use?
- Will the structure allow for growth over time or will you fill it in one season?
- Do you have an appropriately sized packing shed/header house?
- Will you need to consider cooling equipment?
- Have you looked at the efficiency of your layout?
- Will production and post-harvest flow in a time

and resource efficient manner?

- Have you consulted experts in this field?
- Have you developed a plan with your construction company?

## Production basics

Once you have answered the above questions and dealt with the concerns around site layout, construction and workflow, it is a good time to think about the crop you will be producing. Regardless of the crop you choose, there will be multiple varieties available from multiple companies, all of them varying in qualities and traits.

Talk to other growers who grow similar crops for recommendations on varieties and take into consideration the issues that may make your operation unique (for example reduced access to water/varieties bred for dryer climates, production method, produce qualities, etc.) when making a decision.

Once a crop and variety have been picked, future growers will need to consider their own production process. Oftentimes, beginning growers will use processes much more basic than established growers who have access to capital and other resources. This basic approach is perfectly acceptable but must be considered when looking at all aspects of production from labour to equipment and markets.

While growers with more experience or capital may have access to more labour saving technology or increased yields, these technologies will often require markets capable of accepting larger volumes of produce, which may, in turn, require more investigation.

### Crop scheduling

Scheduling of crops is critical in Alberta where light levels decrease substantially in the winter months. Advances in lighting and changing methods of production have had dramatic effects on yield quality and quantity, meaning the information contained Table 5 is subject to change.

It is estimated that approximately 90 per cent of a crop's quality and yield are dictated by appropriate control of the greenhouse environment. Aspects such as carbon dioxide levels, light, relative humidity, temperature and water quality (EC, pH) all have to be managed to reduce plant stress and optimize yield.

Currently, these aspects are primarily monitored by computers; however, growers should have enough knowledge of the correct crop conditions to interpret these readings and be able to address issues before problems appear in the crop.

**Table 5. Crop scheduling for commercial greenhouse vegetables**

<i>Crop</i>	No. of cycles/year	Months typically produced			Seed to harvest (days)	Crop density (plants/sq. m)	Yield Kg/m <sup>2</sup>
		<i>Seeded</i>	<i>Planted</i>	<i>First harvest</i>			
Cucumbers, long English	2	Nov	January	February	45 (summer)	1.25-1.50	110-130 <sup>1</sup>
		June	July	August	60 (winter)		
	3	Nov	January	February			
		April	May	June			
		July	August	September			
Cucumbers, mini		Similar to above but potential for 4 crop cycles in a year					70-90
Tomatoes	1	November	January	February	110	2.5-3.2 <sup>2</sup>	50-70
Peppers	1	October	December	March	130	3.3-3.5 <sup>3</sup>	22-26
Eggplant	1	November	January	March	120	1.67-1.75	40-45
Lettuce	12-50 <sup>4</sup>	Seeded and harvested weekly			42-70	38-97	5.7

<sup>1</sup> Measured in cucumber/m<sup>2</sup>

<sup>2</sup> In many systems, every fourth plant is twin-headed come late March, bringing the density closer to the 3.2 plants/m<sup>2</sup>

<sup>3</sup> Each of these typically will have two stems, resulting in density of 6.5 to 7.1 stems/m<sup>2</sup>

<sup>4</sup> Given the short seed to harvest time and advances in lighting, these crops can be grown and harvested nearly every week of the year

### Growing media

Most greenhouse vegetables in Alberta are grown in a hydroponic system, which typically refers to any method of production that does not require the use of soil. Even without soil, plants still require some sort of substrate in which to anchor themselves and begin growing.

This substrate, often called media, comes in a variety of different forms, shapes and qualities. Most common is rockwool, a spun mineral product, followed by coir (coconut fibre) or peat. Regardless of material, all media have a few main characteristics:

- well drained
- uniform in particle size and texture
- disease-free
- good moisture/air-holding capacities

A variety of different considerations will affect the media selected, such as crop grown, production system used or production designation.

Historically, Alberta growers planted directly into the soil of the greenhouse and continued to do so for crop after crop after crop. The build-up of soil-borne diseases and nematodes from repeated cropping necessitated the move to hydroponic methods of production, first in straw, then sawdust and finally to the materials of today.

While different methods of sterilization such as steam and chemical sterilization were used quite regularly in the past, these methods became less effective over time. Disease-causing organisms became resistant to chemical controls or began to move away from the sources of steam, removing these options for control.

Some Alberta growers who wish to produce in a certified organic production system are now returning to soil-based production (hydroponic production is not eligible for organic certification) but are using better soil and disease management techniques.

### Obtaining seedlings

Nearly all commercial vegetable producers in the province will contract a propagator to grow their plants from seed to the three to four-leaf stage for them. These propagators, of which there are only a few in Canada, are set up to ensure consistent germination on a large scale.

Growers interested in obtaining these seedlings should contact a propagator early in their planning process to find out any critical dates in the production of their seedlings. Potential growers should also talk to neighbouring growers and try to time the delivery of their products together, where possible, to reduce freight costs.

### Crop nutrition and irrigation

Crop nutrition and irrigation are two factors that require constant vigilance and quick correction when things go wrong. Failure to correct problems with these factors not only has the potential to reduce yields, but can also decimate a crop if not dealt with quickly.

For vegetable crops, the amount of nutrients, the pH and electrical conductivity (EC, or more simply, the amount of salts in the solution) required by the crop depend on a number of factors:

- **Temperature**

Most greenhouse vegetable crops grow best at a daytime temperature of 20 to 24°C. Lower temperatures will decrease photosynthesis and respiration, which will decrease the amount of water taken up by the plant.

- **Intensity/hours of sunlight**

Increased hours of sunlight or intensity increases photosynthesis as well as respiration and, subsequently, plant growth, meaning a higher amount of nutrients are required. The general rule of thumb is that a 1 per cent increase in light levels leads to a 1 per cent increase in growth.

- **Crop stage**

Fruiting is a biologically expensive process requiring much water and a significant amount of nutrients. When the plant is in a vegetative state, these needs are substantially less, and therefore, water and nutrient use will correspond with these demands.

- **Time of year**

Quantity and quality of sunlight changes throughout the year and the changing of the seasons. Just as with “crop stage” above, these changes will dictate the proportion of nutrients and water required by the plant.

- **Humidity**

As greenhouse humidity increases, a plant’s ability to evapotranspire or move water from inside the leaf to outside the leaf decreases. This concept, termed vapour pressure deficit, will affect the speed at which water and nutrients are taken up by the plant and, subsequently, the rate at which they are required.

Each of the crops discussed in this factsheet will have different needs regarding the above variables throughout the crop life cycle, and inattention to these factors can detrimentally affect yield.

For example, some cucumber varieties are bred to perform better in low light conditions rather than in high light situations. Therefore, a prospective grower would consider growing these low light varieties very early in the year as opposed to over the summer as yield will be better in Alberta’s relatively darker winters than in the very bright summers.

Commercial growers typically use a drip-stake style system to deliver water to the plant when required. Good commercial growers will monitor water for properties such as pH, E.C. and nutrient levels, not only before the water goes to the crop, but after it has gone

through the media (the leachate) and will compare the two results. Advanced growers will even have a section of their crop on a scale so as to monitor water uptake and loss by the media, total weight of the plant and water use over time.

As fresh water becomes more scarce, increased emphasis will be put on re-using the crop leachate. In some jurisdictions (for example Ontario), the discharge of this nutrient and salt-heavy water is severely limited and must be dealt with in retention ponds, approved sewage treatment operations or adequately sized municipal waste systems.

In constructing a greenhouse, cost should be factored in for storage and re-use of leachate as well as rainwater capture and retention systems. Emphasis should be placed on re-using leachate as much as possible to reduce drawing on fresh water sources. Treatment of the leachate should be considered to reduce disease and insect pressure and can be done through methods such as filtration, ultraviolet light treatment or pasteurization.

### **Supplemental lighting**

To compete on a global scale and obtain the highest yields possible for the longest periods, many growers are now using supplemental lighting in their operation. The three most common forms of supplemental light:

- fluorescent
- high intensity discharge (HID)
- light emitting diode (LED) lamps

Only the latter two are being used in a large scale commercial context in the province. In Alberta, the overwhelming majority of growers (71%)( Laate, Profile of the Greenhouse Industry in Alberta, 2015) who use supplemental light use high pressure sodium (HPS), a form of HID lighting.

HID lighting comes predominantly in two forms: HPS, noted above, or metal halide (MH). HID lighting is often differentiated by colour (HPS emits a yellow/orange light, MH a blue-tinged light), and the colour ultimately affects the end use.

MH lights are often used for vegetative growth, thanks to light produced in the blue/green (440 to 510 nm) range of the light spectrum. Alternatively, HPS is often used for fruiting crops, given its ability to stimulate flowering and fruit production with its output in the 600 to 700 nm range.

Both types of light fixture use large volumes of power and waste a substantial amount of that power in the production of the desired light through heat

production. During the winter months, this heat can be used to offset heat required from the boiler; however, such heat production limits use during times of the year when temperatures are more moderate. Furthermore, both MH and HPS bulbs are relatively short-lived, operating efficiently for approximately 20,000 and 30,000 hours, respectively.

Growing in popularity because of its greater potential for electrical efficiency, decreased amount of heat produced and longer lamp life is LED lighting. LED fixtures can be placed substantially closer to the crop without concern for burning the plants. In a number of operations, LEDs are actually placed inside the canopy to stimulate growth.

The LED light spectrum can be tailored and tweaked to precisely what is required, which can reduce waste. The relatively slim LED profile means that these fixtures block less natural sunlight.

However, even given all these benefits, LED lights are still relatively unproven in the greenhouse environment. Much work needs to be done as to how these lights will affect pest pressure, plant productivity, etc. Furthermore, given their relatively lower output of light compared to HID units, more lamps are required (on the order of 2 LED lamps to every 1 HID lamp) to ensure adequate amounts of light reach the crop.

For the above reasons, growers are encouraged to engage with their selected company early in their greenhouse development process to ensure they are fully aware of the limitations and merits of such a lighting system.

### **Carbon dioxide (CO<sub>2</sub>)**

Carbon dioxide (CO<sub>2</sub>) is an essential component of plant life, and the practice of enriching the greenhouse atmosphere with it is becoming increasingly common. While most greenhouses are at an ambient CO<sub>2</sub> level of 340 ppm, research has shown that increasing this level to 1,000 ppm can increase photosynthesis by approximately 50 per cent. This increase in photosynthesis directly contributes to plant growth and also increases yields of marketable material as well.

Enrichment is typically accomplished through either the burning of natural gas, propane or kerosene or the use of compressed, purified gas from a supplier. Each of these methods has advantages and disadvantages, including increased cost, so growers who are considering enriching their greenhouse with CO<sub>2</sub> should weigh all pros and cons before making a decision on its use.

### **Climate control**

Climate control and crop monitoring systems have eliminated much of the guesswork associated with analyzing the many points of data generated in a greenhouse (water and nutrition for light levels, hours of sunlight and temperature); however, these systems come with their own set of challenges.

These systems have extremely high upfront costs and will often require substantial technical skills to keep them running. Furthermore, they are primarily reporting systems, not decision-making systems. Someone will still have to decide how best to adjust electrical conductivity, pH, etc. to obtain the desired outcome.

### **Pollination**

Depending on the crop chosen, pollination may be required. Many varieties of long English cucumbers and mini cucumbers (the most commonly greenhouse-grown cucumbers) are parthenocarpic. This term means that pollination is not needed for the plants to produce fruit.

Tomatoes, peppers and eggplants, while all self-pollinating, will benefit with higher yields from being pollinated. Pollination can be done by hand with an electric vibrator, with air blasts or the more common method, by bumble bee. Bumblebee colonies are widely available and need to be maintained properly to continue their viability and benefit. This maintenance information is available from the supplier and should be considered when making a decision on pollination method.

### **Pest management**

Integrated Pest Management, or IPM, is common practice in varying forms in greenhouses throughout Alberta. IPM is a broad-based approach of integrating different methods of pest control to maintain pest levels below what is considered the “economic threshold” (the maximum amount of pest damage that can be tolerated before intervening with control methods).

The foundation of this crop production method is a rigorous, consistent scouting program to ensure that growers remain on top of problems and correct them early. With very few chemicals registered for pest control in greenhouses, growers must extremely vigilant of pests to mitigate the damage caused by them.

Because few chemicals are permitted in greenhouse vegetable production, biological controls continue to



grow in popularity. Biological control methods use parasitic or predatory insects as well as beneficial fungi and bacteria to consume, parasitize or overcome other insects that may cause crop damage. These controls are widely available from commercial producers, and thanks to the products' increasing popularity, have been the topic of much research and best practices work.

## Harvesting

Harvesting greenhouse crops is a labour intensive task that, when the greenhouse is in full production, has to be done almost daily. Frequent pickings ensure that produce is picked at the optimal stage and that the potential risks of disease and insects are mitigated.

Picked produce must be removed from the heat of the greenhouse as quickly as possible to extend its shelf life. Produce should be stored in the correct conditions until delivery or sale to ensure a consistent, quality product.

Packaging requirements can vary depending on market channel and consumer demand. Information on these aspects can be found in the Canadian Food Inspection Agency's Food Labelling Tool (<http://www.inspection.gc.ca/food/labelling/food-labelling-for-industry/en/1383607266489/1383607344939>) or in Alberta Agriculture and Forestry's *Farm Direct Marketing: Know the Regulations* publication series ([http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/agdex13504](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex13504)).

Table 6 lists the optimal post-harvest conditions by crop for greenhouse vegetables.

**Table 6. Optimal post-harvest conditions**

Crop	Temperature (°C)	Relative Humidity %	Shelf life (approx.) days
Cucumbers	7-9	>95	10-14
Tomatoes (green, mature)	13-16	90-95	≤42
Tomatoes (ripe)	10	90-95	Limited
Peppers	10	90-95	8-14
Eggplant	10	90-95	≤14
Lettuce	0	>95	≤21

(Commercial Vegetable Production on the Prairies, 2014)

## Food safety

There is an increasing emphasis on On-Farm Food Safety (OFFS) systems to ensure a safe, reliable product. These systems ensure that appropriate handling and production techniques are followed and

recorded through a rigorous audit and documentation schedule.

The market chosen to sell into will have a direct effect on whether a producer requires some form of OFFS. CanadaGAP is the program available to greenhouse vegetable operators and is operated by CanAgPlus, a non-profit organization originally started by the Canadian Horticulture Council. More on the program can be found on the website listed in the resource section at the end of this factsheet.

Regardless of the production method chosen, growers are strongly encouraged to read and research as much information as possible on the production of their crop. To reduce the cost of production and stay ahead of market and technology trends, growers should place an emphasis on accessing high quality, relevant data and information. If possible, growers should consider employing the services of a knowledgeable consultant, if only for the first number of production cycles.

## Economic/finance basics

As in all facets of agriculture, it is not enough for a greenhouse grower to simply produce a good crop. Growers must now not only produce a high quality crop, but they must also spend time marketing that crop as well as ensuring they have a good grasp of the finances within their business.

Accurate records are a must as these accounts will ultimately be used to determine price. The following budgets in Tables 7 and 8 are provided for information purposes only and are of the three main greenhouse commodity crops in Alberta. The costs to a producer of their own individual enterprise will be different based on size, location, crops grown, machinery, labour and market channel.

Data are based on the 2011 Alberta Agriculture publication *Economics of Production and Marketing of Greenhouse Crops in Alberta* and are adjusted by the farm input price index to reflect 2016 costs.

**Table 7. Capital investment requirement for production of various crops, 2016**

Crop		Tomatoes	Cucumbers	Peppers
		\$	\$	\$
Building	(sq. m.)	9,043	11,374	3,682
	(\$)	592,374	856,625	361,000
Land value	(\$)	23,689	22,309	11,420
Building, equipment and machinery	(\$)	606,895	490,735	172,505
Total investment	(\$)	1,222,958	1,369,669	544,925
Investment/sq. m	(\$)	135.24	120.42	148.00

**Table 8. Production costs and returns for various crops, 2016**

Greenhouse production area (sq. m)	Tomatoes		Cucumbers		Peppers	
	8,637		11,374		3,682	
	Total (\$)	\$/Sq. m.	Total (\$)	\$/Sq. m.	Total (\$)	\$/Sq. m.
<b>A. Gross revenue</b>	1,002,379	116.06	1,311,791	115.33	410,294.00	111.43
Variable costs	Total (\$)	\$/Sq. m.	Total (\$)	\$/Sq. m.	Total (\$)	\$/Sq. m.
Growing media, seeds/cuttings	63,118.20	7.31	154,937.84	13.62	47,603.32	12.93
Fertilizer & chemicals	67,390.31	7.80	71,894.90	6.32	27,813.78	7.55
Greenhouse insurance	15,321.46	1.77	21,947.71	1.93	9,140.28	2.48
Trays, boxes, and other packaging	9,960.04	1.15	9,806.54	0.86	4,239.27	1.15
Freight and/or trucking costs	6,281.48	0.73	8,776.70	0.77	5,983.78	1.63
Auto fuel, insurance, registration, repairs	16,544.44	1.92	24,531.41	2.16	6,789.48	1.84
Repairs - Building & equipment	14,549.40	1.68	22,450.98	1.97	12,810.08	3.48
Utilities: natural gas	129,777.75	15.03	145,502.56	12.79	44,966.73	12.21
Utilities: electricity	39,080.25	4.52	160,472.33	14.11	61,340.65	16.66
Utilities: water	7,182.15	0.83	12,343.69	1.09	1,115.10	0.30
Utilities: phone	1,745.05	0.20	4,250.51	0.37	1,100.94	0.30
Custom work and specialized labour	2,294.26	0.27	5,239.20	0.46	1,758.20	0.48
Marketing costs	160,897.21	18.63	178,791.10	15.72	42,609.80	11.57
Assoc. dues, prof fees and promotion	10,898.98	1.26	5,624.84	0.49	2,993.66	0.81
Small tools, supplies and misc. expenses	9,709.38	1.12	24,870.27	2.19	11,167.52	3.03
Operating interest paid	1,006.29	0.12	2,066.40	0.18	918.28	0.25
Labour insurance/benefits	27,755.45	3.21	33,082.04	2.91	2,279.76	0.62
Hired labour	287,164.80	33.25	353,422.98	31.07	134,606.14	36.56
Unpaid labour	1,739.66	0.20	383.50	0.03	2,992.48	0.81
<b>B. Total variable costs</b>	872,386.58	101.01	1,240,407.48	109.06	422,229.25	114.67

**Table 8. Production costs and returns for various crops, 2016 continued.**

Capital costs	Tomatoes		Cucumbers		Peppers	
	Total (\$)	\$/Sq. m.	Total (\$)	\$/Sq. m.	Total (\$)	\$/Sq. m.
Property/business taxes	4,059.20	0.47	10,805.26	0.95	595.19	0.16
Depreciation	59,786.00	6.92	60,470.81	5.32	26,133.90	7.1
Paid capital Interest	14,093.00	1.63	33,000.63	2.9	10,794.00	2.93
<b>C. Total capital costs</b>	<b>77,938.20</b>	<b>9.02</b>	<b>104,276.70</b>	<b>9.17</b>	<b>37,523.09</b>	<b>10.19</b>

D. Total production costs (B + C)	Tomatoes		Cucumbers		Peppers	
	Total (\$)	\$/Sq. m.	Total (\$)	\$/Sq. m.	Total (\$)	\$/Sq. m.
	950,324.78	110.03	1,344,684.18	118.23	459,752.34	124.86

Return over variable costs (A - B)	Tomatoes		Cucumbers		Peppers	
	Total (\$)	\$/Sq. m.	Total (\$)	\$/Sq. m.	Total (\$)	\$/Sq. m.
	129,992.42	15.05	71,383.52	6.27	-11,935.25	-3.24

Return to management* (A - D)	Tomatoes		Cucumbers		Peppers	
	Total (\$)	\$/Sq. m.	Total (\$)	\$/Sq. m.	Total (\$)	\$/Sq. m.
	52,054.22	6.03	-32,893.18	-2.90	-49,458.34	-13.43

\*Returns to management are the funds available after all operating costs, opportunity cost on investment and operator labour and depreciation have been paid.

**Resources**

Here are resources that provide more detail about the commercial greenhouse vegetable industry.

Alberta Greenhouse Growers Association  
 #200, 10331 - 178 Street  
 Edmonton, Alberta T5S 1R5  
 Website: [agga.ca/](http://agga.ca/)

CanadaGAP  
 Website: <http://www.canadagap.ca/>

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 Website: [agriculture.alberta.ca](http://agriculture.alberta.ca)