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Precision Agriculture

Quick Facts [vi]

- Yield maps are most valuable when several years of data are used
- Precision farming can be used to maximize profit, and/or reduce environmental impact
- Most fields contain two or more types of soil

Interesting Stats [v]

- 23.2% of farms in Canada were using GPS in 2006
- Use of GPS is highest in Manitoba (31.4%), Saskatchewan (27.8%) and Alberta (26.1%); use is lowest in British Columbia (9.9%) and Quebec (10.7%). 24.6% of Ontario Farmers use GPS
- The majority of farmers (77.9%) use GPS as a guidance system to eliminate overlaps and misses in field operations
- Around 1 in 4 farmers use GPS to assist with Variable Rate Applications

Imagine that as you or a family member is cutting your front lawn, you could know how many blades of grass were being cut, where the weeds were located, and which areas had the most moisture. Then imagine you could create a digital map on your I-pad, and there was an application that showed you the spots which need fertilizer, or where there is a large tree root that you need to avoid…

Farmers have this kind of technology available to them, and are using it to change the way they farm.

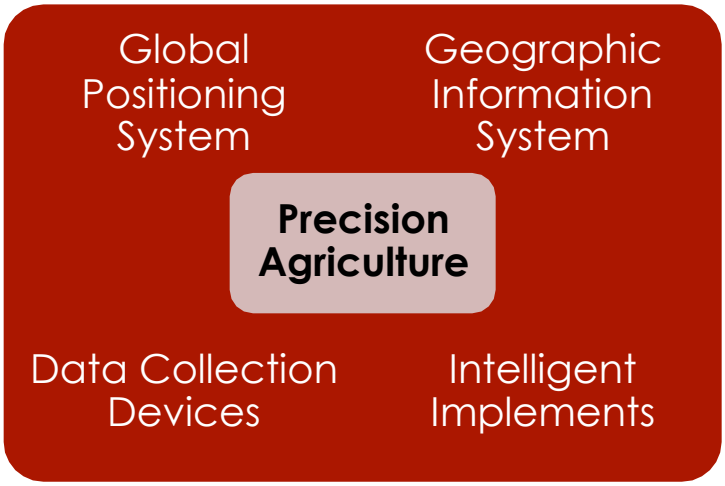
Every field has variation in soil type, slope, moisture levels, and other characteristics. When a producer uses precision agriculture they are able to make decisions on a micro-level within different areas of their farm. This is also referred to as **site-specific farming**.

By utilizing the tools of precision agriculture, producers gain a better understanding about strengths and needs of their land, and can make more informed decisions about planting, managing and harvesting their crops. Resources are utilized more efficiently and the producer is able to maximize the potential of their fields.

Brought to you by Farm Credit Canada and Canada's Outdoor Farm Show

The Tools of Precision Agriculture

The four areas of Precision Agriculture are used together to form a complete system. The information which is gathered helps the producer to make decisions which improve their farm management. Some producers only use one or two of the tools, depending on personal need and financial situation.



GPS, or the Global Positioning System, is a collection of satellites that transmit precise location information. Receivers on the earth can determine their location to within 100m using signals from these satellites. Some differential GPS units can determine their location within 1 cm!

Data Collection Devices are pieces of technology and software that help to collect data about a particular field. Some examples include yield monitors, which determine how much crop is being harvested in specific areas of a field. Producers may also collect data on moisture levels, weed levels, soil conditions, etc.

Intelligent Implements are the pieces of equipment that a producer uses to make applications to their field. Examples include sprayers (for pesticide, herbicide, etc.), planters, and harvesters. The implements are hooked into the device that holds the data and the map of the field. They are then controlled automatically by the software (prescription mapping), or manually by the driver of the equipment, according to the management plan which was decided upon.

GIS, or Geographic Information Systems, are used in coordination with GPS to create maps using data collected about specific fields. Maps can be viewed in layers to see the relationships between them. Producers use the data and maps to make decisions about how to improve their crops.

Uses of Precision Agriculture [ii]

- **GPS to determine location and to navigate**
- **Data collection devices for sensing and collecting**
- **GIS to map data collected**
- **GIS to analyze data**
- **GIS to create charts and presciption maps**
- **GPS to determine location within field**
- **Data devices and implements to control the application/harvesting**

Precision Agriculture is benefitting the environment

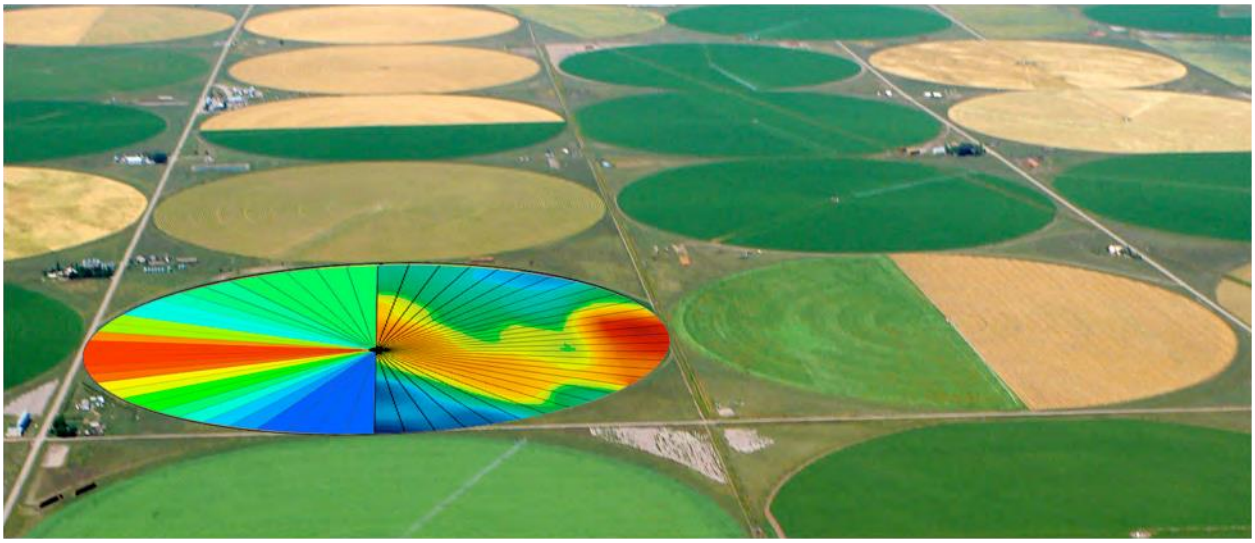
Many studies have been done to determine the effect which precision agriculture has on the environment. A literature review of several studies indicates precision agriculture has decreased the amount of herbicide sprayed on fields by significant amounts (up to 94% in some cases). The studies also found that crop resistance to herbicides was reduced, and the amount of run-off from fields was significantly lower than farms that did not use precision agriculture.[iii]
The technology of Variable Rate Application allows farmers to target their application of sprays and fertilizers, which cuts down on over-application on crops. This helps to keep crops healthier, and also benefits the environments and ecosystems that surround the fields.

No two rows are alike…

Producers are using Variable Rate Technology / Variable Rate Application (VRT/VRA) in all aspects of their farming practices. When planting, the data and equipment can modify the depth and density of seeds based on the needs of that area. VRA is also used when applying fertilizer, and other treatment for the crop. Not all areas of the field need the same type of management, and VRA makes that differentiation. Special equipment is needed (Intelligent Implements) to apply the treatments at a variable rate.

Check this out!

Videos on Precision Agriculture:
http://www.farms.com/ContentPage/PrecisionAgricultureVideoFeature/tabid/289/Default.aspx



Variable Rate Application: Seeds, fertilizer, and *water* too![iv]

Some producers are now incorporating Precision Irrigation into their crop management plans. At the InfoAg Conference in July 2011, a company called CropMetrics gave a presentation on their new Center Pivot VRI (Variable Rate Irrigation).

When they compared the typical irrigation practices of irrigating for the driest point in the field with the optimized practice of site specific irrigation, they found a potential increase in profits of 30%. In field trials they conducted the results showed that water use was reduced by 12-13%.

Given the importance of using our natural resources in the most sustainable manner possible, the addition of irrigation to the precision agriculture lineup is exciting news.

Costs and Benefits of Precision Agriculture for Producers[viii]

Cost: Obtaining and installing hardware & software

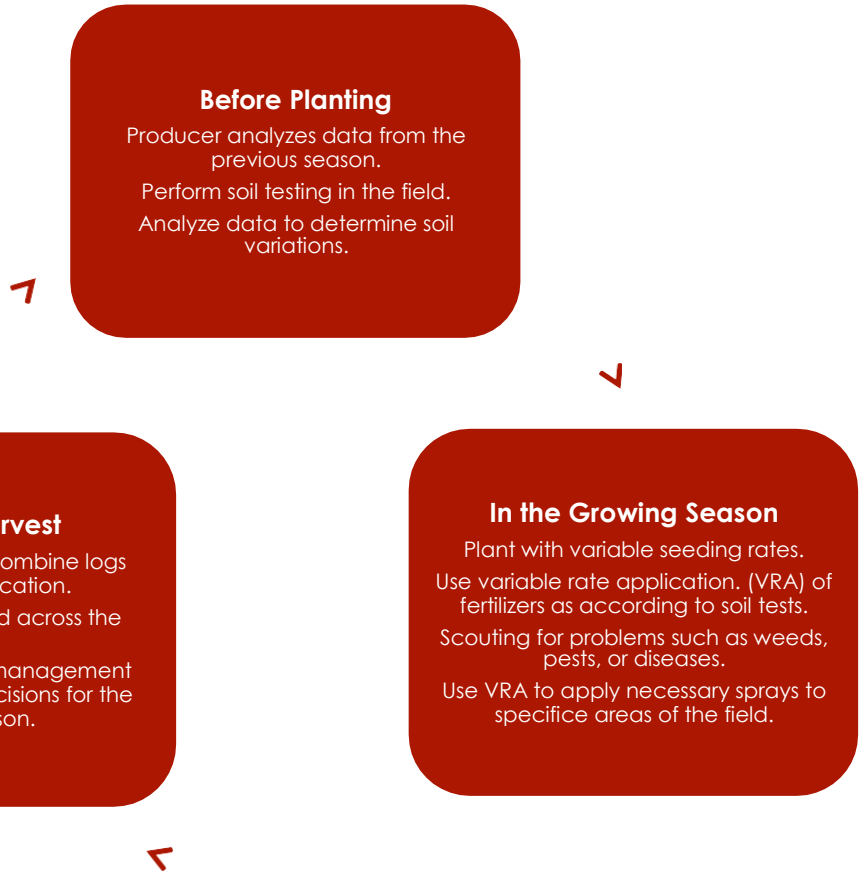
Cost: Time of the producer (training, evaluating data)

Benefit: Economic output from improved farm management

Benefit: Environmental - better use of natural resources; allows more efficient application of products

Benefit: Personal - less fatigue from driving, ability to work at night, etc.

Steps in the Precision Agriculture Management Process [vii]



Careers

Precision Agriculture is becoming a mainstream in the way farming is done, from the planting, through to the harvesting of crops and everything in between. Thus, there are many areas of precision agriculture that present unique and interesting opportunities for employment.

There are several companies in various countries that develop their own systems of Precision Agriculture, both in terms of programs/technology and instruments/equipment. Each of these companies is comprised of teams that sell and market the products to producers, service the products, and who communicate with the producers about best practices and suggestions for use. Every one of these areas contains a wealth of potential job positions!

The technologies of GPS, and data collection software both require innovative minds to engineer and develop equipment and programming. Skills in computer programming, a strict attention to detail and the ability to think analytically are key in this sector. These same abilities are needed in positions that service the instruments and computers that comprise the Precision Agriculture systems found on farms around the world.

Sources

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Precision Agriculture Teacher's Guide

The curriculum expectations outlined in this document are intended as an overview of potential connections between Precision Agriculture and learning in the classroom. This is by no means an exhaustive list, and we acknowledge that there are several subjects outside of science, which can be touched upon when teaching about Precision Agriculture. However, we hope that this list will inspire you to think about how science and agriculture fit together, in ways that you may not have thought about before. We encourage you, the educator, to extend the activities based on your preference and the learning needs of your students.

Curriculum Links

Science All Strands

Scientific Investigation Skills and Career Exploration

A2. identify and describe careers related to the fields of science under study, and describe the contributions of scientists, including Canadians, to those fields.

Biology

SBI3U

Plants: Anatomy Growth, and Function

F1. evaluate the importance of sustainable use of plants to Canadian society and other cultures.

F2. investigate the structures and functions of plant tissues, and factors affecting plant growth.

SBI3C

Plants in the Natural Environment

F1. analyse the roles of plants in ecosystems, and assess the impact of human activities on the balance of plants within those ecosystems.

F2. investigate some of the factors that affect plant growth.

Chemistry

SCH4U

Organic Chemistry

B1. assess the social and environmental impact of organic compounds used in everyday life, and propose a course of action to reduce the use of compounds that are harmful to human health and the environment.

SCH4C

Matter and Qualitative Analysis

B1. evaluate the effects of chemical substances on the environment, and analyse practical applications of qualitative analysis of matter.

Organic Chemistry

C1. evaluate the impact on society, human health, and the environment of products made using organic compounds.

Chemical Calculations

E1. analyse processes in the home, the workplace, or the environmental sector that use chemical quantities and calculations, and assess the importance of accuracy in chemical calculations.

Chemistry in the Environment

F1. evaluate the importance of government regulations, scientific analyses, and individual actions in improving air and water quality, and propose a personal plan of action to support these efforts.

Environmental Science

SVN3M

Scientific Solutions to Contemporary Environmental Challenges

B1. analyse social and economic issues related to an environmental challenge, and how societal needs influence scientific endeavours related to the environment.

Sustainable Agriculture and Forestry

D1. evaluate the impact of agricultural and forestry practices on human health, the economy, and the environment.

D2. investigate conditions necessary for plant growth, including the soil components most suitable for various species, and various environmentally sustainable methods that can be used to promote growth.

D3. demonstrate an understanding of conditions required for plant growth and of a variety of environmentally sustainable practices that can be used to promote growth.

Continued

Conservation of Energy
F2. investigate various methods of conserving energy and improving energy efficiency;.

SVN3E
Human Impact on the Environment
B1. analyse selected current environmental problems in terms of the role human activities have played in creating or perpetuating them, and propose possible solutions to one such problem.
B2. investigate air, soil, and water quality in natural and disturbed environments, using appropriate technology.
B3. demonstrate an understanding of some of the ways in which human activities affect the environment and how the impact of those activities is measured and monitored.

Science
SNC4M
Science and Public Health Issues
E1. assess the impact of scientific research, technological advances, and government initiatives on public health.

SNC4E
Chemicals in Consumer Products
C1. analyse chemical products used in the home and workplace, and issues related to their safe and environmentally responsible use and disposal.

Technology
Green Industries
THJ3M THJ3E THJ4M THJ4E
Green Industry Fundamentals
A3. develop and evaluate designs or processes for a variety of applications related to the green industries.
A4. use mathematical, documentation, research, and communication skills as they apply to the green industries.

Green Industry Skills
B1. demonstrate an understanding of and apply design and production practices that are commonly used in the green industries.
B2. apply management strategies for assessing and controlling biotic and abiotic factors that affect plant and/or animal quality.
B3. demonstrate competence in technical skills related to specific applications and tasks within the green industries.

Technology, The Environment and Society
C1. analyse the impact of the green industries on the environment and describe ways of minimizing harmful effects.
C2. analyse social and economic relationships and issues involving the green industries.

Professional Practice and Career Opportunities
D1. demonstrate an understanding of and apply safe working practices as they relate to the green industries.
D2. demonstrate an understanding of the business and regulatory environment of the green industries.
D3. identify careers in the green industries, and describe the skills, education, and training required for entry into these occupations.

Suggested Activities

1. **Precision Agriculture in a Pot:** ***Carrying out precision agriculture in the classroom.***
   - Collect a variety of different soils and have students assess the soils for water retention, salinity, nutrient content, etc.
   - Students research which crops would suit the various types of soil and plant a sample within the pots.
   - Have students enter the soil and plant data into a computer for each of the 'sites'.
   - Using the various sources of information, students create a management plan for their crop (fertilizer applications, irrigation) that is 'site' specific.
   - Students record applications of fertilizers and growth of plants.
   - Students compare the differences between the various sites and assess the effectiveness of their management plans.

2. **Assessing Precision Agriculture:** ***What is the role of Precision Agriculture in feeding the world?***
   - Have students research the application of precision agriculture in Canada and around the world.
   - Topics of interest may be food production, the environment, the economy, social implications in developing countries.
   - Hold a class debate on the topic of precision agriculture or have students write an article discussing its function in a feeding a growing population.

3. **Tools and Technology:** ***Assessing the impact of Precision Agriculture on workers in the industry***
   - Students evaluate the impact of robotic technology and Intelligent Implements on the lives of Producers, Farm workers, Farm managers, Equipment sales/service people, etc.
   - Sources may include articles in farm publications, interviews, journal articles, etc.
   - Students will prepare an opinion piece, or develop a presentation to share their findings with the class from the perspective of one of those groups on the use of the technology.

4. **Working in the field of/with Precision Agriculture:** ***What are the options?***
   - Students will research the career opportunities in the areas related to Precision Agriculture: GPS, selling Intelligent Implements, servicing equipment, and farming.
   - Contact an individual in one of these positions and interview them about their job.
   - Create a video or radio presentation which highlights that career.

5. **The Lay of the Land:** ***Using the tools of Precision Agriculture***
   - Students utilize various geo-technologies to analyze the geographic features of a piece of agricultural land (preferably one close to their school grounds).
   - Using information gathered from the GPS, as well as soil surveys from Agriculture Canada, students create a map depicting the various features of that site to communicate the findings of their inquiry.

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