YIELD MEASUREMENT SYSTEMS

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COURSE OVERVIEW

INTRODUCTION

Picture this: You awake to a warm August sun rising above the eastern horizon, sending rays of golden sunlight through your open window. You check the clock and roll out of bed. Before breakfast you pop into your home office and check your automated farming system. One computer screen shows all of your self-guided tractors are fully functional and ready to be sent out to work. A blinking icon in the corner of one screen reminds you that mini-auto-combine number three still requires a replacement GPS antenna. A map on a second screen shows you the current status of all your crops, analysed by remote sensing satellites. Still another displays overlapping windows containing weather reports, and commodity prices. As you watch an email message appears announcing that parts have arrived for mini-auto-combine number three. Returning from the kitchen a few minutes later you prepare to get down to serious work. You email your broker with your latest investment instructions, run an analysis on the current status of your crops, and determine that Field 13A should be harvested immediately. Before walking out to the machine shed to do a visual inspection on your two operational combines, you download the harvest program for Field 13A to their internal control systems. You ensure that their GPS, yield monitor and auto-navigation systems are set to go and then turn them loose. After overseeing a couple of rounds of their progress on the field you head to town for parts. The console in your pickup truck displays the combines' progress and status as you travel. . .

Far-fetched, you say? Maybe. But none of this is beyond our technological ability at the present time. Perhaps we cannot accomplish these tasks well, or economically, yet, but the day is not that far off when this could be your reality.

What is the point? The point is that what was science fiction only a few years ago is now a distinct possibility. We do not yet have automated combines or fully integrated information systems on every farm. But we do have global positioning system (GPS) receivers and guidance systems. We have powerful personal computers and software that assists in analysing our operations. We have access to vast amounts of information via the Internet. And we have data acquisition and control systems that provide us with information and control capabilities that have the potential to revolutionize the productivity and management of our agricultural operations.

The fact that you are reading the overview of a course on Yield Measurement Systems shows that you have an interest in the possibilities of using technology to enhance agricultural processes. These possibilities are part of the emerging field of Precision Agriculture, also known as Site-specific Agriculture, or Target Farming. This course will not deal with the automation mentioned above, but it will introduce you to one of the most exciting agricultural technologies that has been developed in recent years: yield measurement. Precision agriculture is about information, its acquisition, its presentation, its analysis and its application to farm management. Yield measurement promises to provide you with one of the key types of information, which can open new doors to understanding what is happening in your farming operation. This holds out hope, not of a better way to farm, but of a way to farm better.

WHAT IS PRECISION AGRICULTURE?

Precision agriculture, or site-specific farming, as some have called it, is an emerging approach to agriculture, which makes use of several of the latest technologies with the intent of improving efficiency in agricultural operations. Precision agriculture is technology-enabled, information-based, knowledge-centred and management-oriented. In the broadest sense, precision agriculture is a cycle, which includes:

- acquiring various types of data (yield, moisture, topography, soil nutrients, etc)
- manipulating and presenting that data in forms that are meaningful (mapping)
- analyzing the relationships between various data to obtain their true meaning and significance
- making management decisions based on knowledge, experience and wisdom
- implementing those management decisions (e.g. variable rate application of inputs)
- repeating the cycle to obtain feedback on the effectiveness of those decisions

Yield measurement is the process of determining the amount of product taken off the field during the harvesting operation. In its simplest form yield measurement provides totalised product volumes or weights. For example, it can tell us how many bushels, pounds or tonnes have been harvested since the last time the combine grain tank was emptied, or it can totalize the amount harvested in a given field. Yield monitors also display yield rates on-the-go. The ability to see instantaneous bushels per acre displayed while harvesting has proven to be enlightening.

Taking yield measurement applications even further, instantaneous yield can be linked to the location the data was obtained. This process is called *geo-referencing* and is accomplished by the addition of GPS technology. (Although we will briefly discuss the use of GPS in this course, for a more complete coverage of the subject you may wish to enrol in another course, *Applications of Global Positioning Systems In Agriculture.)* Geo-referenced yield data can be used to produce *yield maps*, which use multiple colours to indicate the ranges of yield values. When combined with other site specific map layers, such as topography, rainfall, weed and insect pressures, salinity, and fertility, important relationships can become evident. Analysis of these maps can lead to more efficient and effective management decisions based on smaller zones than earlier methods allowed. The next step is to use GPS positioning and electronic controllers to accomplish *variable rate application of* seed, fertilizer and chemicals. Strategic application of inputs allows us to optimize their effectiveness while minimizing costs, with the goal of improving our bottom line.

There are, potentially, many ways that precision agriculture techniques can be used to strengthen our farm management practices. Some of these are still only ideas, while others have already proven their potential. One thing is sure: these technologies provide us with powerful tools, ones that promise much if we can learn to effectively harness their power. But we must remember that they are only tools. As usual, agriculture still requires that old difficult-to-define quality called ‘common sense’. Ongoing efforts to apply these technologies continue on several fronts. Technology must be blended with agronomic knowledge and proven management practices in ways that have never been done before. As we continue to apply the new technology to the age-old field of agriculture, the

challenge, as always, is to acquire the knowledge and skills which will take us where we want to go. This course is a part of that process.

ABOUT THE COURSE

The purpose of this learning module is to provide you with a basic understanding of how yield measurement technology works and how it can be implemented in agriculture. It also provides an overview of existing and emerging products and their features. Yield measurement is based on the application of electronic instrumentation and computer technology to harvesting equipment. Any technical subject contains an element of new concepts and terminology. Despite the technical nature of the topic, this module has been designed to be accessible to the average non-technical learner.

This course manual approaches the subject in two steps. First, the concepts and techniques are presented from a generic perspective; second, actual products are considered. Section One, *Introduction to Yield Measurement* provides the basic concepts of yield measurement. This could be considered the 'who, what, when, where, why and how' of yield measurement, painted in broad strokes to provide the learner with a perspective of the field. Section Two, *Yield Measurement Techniques* continues this process, delving into the technical details of how yield measurement is accomplished. The next section, *Yield Measurement System Components,* provides general information on the 'building blocks' of a yield measurement system, and how they work together. *Yield Measurement System Installation and Operation covers* how the components are installed, calibrated, configured and operated. The next section, on *Yield Data and Mapping Software,* looks at data acquisition and logging, data formats, data interchange, data evaluation and manipulation of data. This section also provides some coverage of mapping and geographic information system (GIS) software, including uses and applications. This section is introductory in nature. The avid learner may wish to pursue further study in the areas of agricultural and GIS software. *Yield Measurement Products and Systems* provides information on several of the currently available yield measurement and mapping systems.

This learning module will be most effectively used in a workshop environment under the guidance of a qualified instructor. No pre-requisites are required, although some experience in agriculture will help you to better understand some of the applications. The module is written as simply as possible considering the technical nature of the subject. Various learning aids have been included to enhance the learning experience. Tables and diagrams are provided throughout the module to support the associated text. Several Self-tests are provided to assist the student in learning the information. Answers are provided in Section 7. Appendix A includes a series of practical exercises, written in a general format, so that they can be modified to work with virtually any yield monitor currently available. The Summary, Self-tests and Exercises are designed to provide the student with an opportunity to reinforce the material learned in each section. To further support the learning experience, a Glossary of Related Terminology has been included in Appendix B. Appendix C contains references used in researching the content of this document, including a listing of Internet websites where additional information can be found. Appendix D contains samples of information relating to various yield measurement and mapping products currently in use in agriculture.

It is important to note that precision agriculture in a new and evolving field. Although a great deal of effort has been expended to ensure that the information contained in this course is accurate and up to date, new developments will certainly occur between its

writing and your reading of it. The motivated learner will undoubtedly have to maintain an ongoing interest to keep up with new developments as they occur.

We sincerely hope that this manual will provide you with the practical assistance you may need in your quest to learn more about applications of yield measurement in agriculture.

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LEARNING OBJECTIVES

GENERAL OBJECTIVES:

For each of the following objectives, upon completion of the course the student should be able to:

1. Explain the significance of yield measurement to precision agriculture.
2. Explain what yield measurement is and how it is accomplished.
3. Describe the principles of operation, installation and configuration procedures, and operation of several types of yield measurement systems.
4. List several typical yield data formats and describe their function.
5. Describe the basic functions and features of several typical mapping and geographic information system (GIS) software programs.

SPECIFIC OBJECTIVES:

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