Chapter LIII
Role of Telecommunications in Precision Agriculture

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ABSTRACT

Precision agriculture has been made possible by the confluence of several technologies: geographic positioning systems, geographic information systems, image analysis software, low-cost microcomputer-based variable rate controller/recorders, and precision tractor guidance systems. While these technologies have made precision agriculture possible, there are still major obstacles which must be overcome to make this new technology accepted and usable. Most growers will not do image processing and development of prescription maps themselves but will rely upon commercial sources. There still remains the challenge of storage and retrieval of multi-megabytes of data files for each field, and this problem will only continue to grow year by year. This chapter will discuss the various wireless technologies which are currently being used on three proof-of-concept farms or areas in Mississippi, the various data/information intensive precision agriculture applications which use wireless local area networking and Internet access, and the next generation technologies which can immensely propel precision agriculture to widespread use in all of agriculture.

INTRODUCTION

Multispectral image-based precision agriculture technology is beginning to have widespread use in row crop production agriculture in the United States, particularly in the cotton belt. Companies such as InTime, Inc.[1] (InTime, 2007), located in Cleveland, Mississippi, USA, are providing image-based products from which clients have access to scout maps derived from multi-spectral images. InTime uses Geospatial System's Inc. multispectral image cameras mounted on fixed-winged aircraft to obtain their image information (GSI, 2007). Specific scout maps target different plant or soil characteristics such as overall plant biomass, differences in soil type, and differences in fertilizer nitrogen uptake. The scout maps are used to determine rates of plant growth regulators, insecticides, defoliants, herbicides, or fertilizer to apply to the plants. Utilizing InTime's Web-based Crop-Site, growers and consultants can easily transform their scout maps into vehicle/controller prescription files that allow for chemical rates to be varied automatically with minimal operator inputs.

The information products generated by such activity, as described previously, can easily be expressed as multi-megabyte sized data files, especially when geographic information system (GIS) technology is used. In almost all situations, multispectral-image based maps are geo-referenced with pixel sizes in the 0.5 meter to 1 meter range generating large data files for the applications derived from these maps. The application maps are also generally geo-referenced for use by the geographic positioning systems (GPS)-based controllers on the farm equipment. For a 500 ha field, application maps can easily be generated which are from 1 to 5 megabytes in size or larger.

Many controller manufacturers today use PC cards or similar technology which has to be hand-carried from the farm base of operations to the equipment in the field and inserted into the controller (Raven Industries, 2008). Conversely, after the application has been made by the equipment (planting, fertilizer application, pesticide application, etc), the PC cards have to be manually collected and taken to the operations base to have the as-applied map uploaded into the farm computer. While many medium and small farms are not affected by this information movement process since the farm manager/owner is also the equipment driver, larger farms which have many pieces of equipment are often scattered over 50 km from one side of the farm land to the other, or even greater distance. The distances involved from the farm base station to the equipment in the field presents an operations problem for growers since when they are involved with precision applications not only must they travel to and from the fields where the equipment is located they must also find the equipment in the field which can often be two or more kilometers across to deliver and pick up the PC cards containing information. This type of operation can easily take a person three or more hours per day just to deliver and/or pick up the data cards.

When time critical operations are involved in delivery of pesticide application maps to the spray equipment controller, this problem becomes even more exacerbated. Our research in early-season plant bug control has shown that from the time the multispectral image is taken by the airplane to the time the spatially variable insecticide is delivered to the spray equipment no more than 48 hours should elapse (Willers et al., 1999). The optimal time is no more than 24 hours. Obviously, there is a better way to solve this time constraint/labor problem than using people for hand carrying PC cards.

Wireless local area network technology is a practical solution to movement of information to and from farm machinery which use GPS-guided precision application controllers. Low-cost wireless network solutions are available and are beginning to see widespread use in the United States. Commercial cell telephone networks are beginning to offer medium–speed Internet access via their cellular telephone towers.

Another technology which is becoming very widely used in the United States is the use of precision guidance on farm application machinery. This technology has proved it worth in labor savings alone by removing the tedium from equipment operators so that they can monitor the application operation to ensure seeds or chemicals are being applied as the equipment moves across the field,

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