Заключение. Курс "Информационные технологии в АПК" читаются во многих университетах, особенно в Российской Федерации. Имеется и соответствующая литература.

Следует отметить, что в РБ мало учебной литературы, по информационным технологиям в АПК даже в национальной библиотеке вообще нет литературы, и учебников в частности, хотя такие книги, как выше было сказано, в РФ издаются. Методические материалы университетов, а также учебники, по которым читаются в конкретных университетах дисциплины, в Интернете обычно закрыты – доступ к ним предоставляется только в локальных сетях учебных заведений. Конкретные запросы в Российские университеты о данной дисциплине не находят отклика. Отсутствие литературы по данной тематике провоцирует учебную, и в дальнейшем технологическую отсталость.

Когда будут сделаны новые производственные разработки, тогда можно будет существенно расширить курсы по использованию информационных технологий в АПК. Но это дело будущего.

Если рассматривать положение дел в БГАТУ, то имеет смысл расширить существующий курс по информационным технологиям, включив в него апробированные в других университетах соответствующие материалы.

Также следует обратиться к руководству национальной библиотеки с предложением о расширении закупок учебников по прогрессивным технологиям, в том числе и по использованию информационных технологий в АПК.

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APPLICATION OF MODERN SATELLITE TECHNOLOGY IN MANAGEMENT OF WORK OF MACHINERY PARK AND QUALITY OF PRODUCTION IN AGRICULTURAL FARMS (ПРИМЕНЕНИЕ СОВРЕМЕННЫХ СПУТНИКОВЫХ ТЕХНОЛОГИЙ В ОРГАНИЗАЦИИ РАБОТЫ МАШИННОГО ПАРКА И КАЧЕСТВО ПРОДУКЦИИ В СЕЛЬСКОХОЗЯЙСТВЕННЫХ ПРЕДПРИЯТИЯХ)

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Представлено использование спутниковых технологий в управлении производством в сельском хозяйстве. Современные системы на базе спутниковой технологии являются инструментами, которые поддерживают принятия решений по управлению производством на ферме. Системы на основе спутниковых технологий позволяют улучшить качество продукции и снизить затраты на производство.

Introduction

Precision agriculture is an important part of modern agriculture. Munack [2004] defines precision agriculture as leading the agricultural production to ensure execution of appropriate treatment in a timely manner, using appropriate and possible minimum number of inputs (especially chemical), which can increase economic efficiency and production with minimum environmental load [9].According to the European Commission [6], precision farming is agricultural production system that uses information technology to adjust the dose of inputs (fertilizers, plant protection) to the potential demand of cultivated plants. Precision agriculture is a farming system that adjusts the individual agricultural components to the changing technology on individual fields. The use of the system is possible in the entire vegetation period [2]. Using precision farming relies on high dose of information and its processing ability. Therefore, it requires a practical application of the principles of knowledge-based economy [1]. Satellite technologies are the base of functioning of precision farming.

Satellite navigation

The American GPS NAVSTAR (Global Positioning System-Navigation Signal Timing And RangIt is accompanied by the Russian GLONASS and the Chinese Beidou and the European GALILEO, COMPASS Chinese, Indian and Japanese QZSS IRNSS [3,7] are at the stage of development. Currently in Europe you can receive signals from three navigation systems: the American GPS and Russian GLONASS and European-- GALILEO with the fact that GPS and GLONASS have the largest number of active satellites. These two systems have 24 satellites, 5 of which are always visible [4].

The structure of GPS and GLONASS consists of three parts. The first element is the space part which contains satellites orbiting s the Earth's. The second element is the control part , consisting of ground stations. The third part of the user segment are receivers receiving signals from satellites [5.13].

The signal provided by these systems allows for the location of objects on the ground with an accuracy of 3 to 12 meters. Such accuracy allows for navigation in the land and sea transport, and in agriculture it allows only for documenting field work and logistics, including fleet management of machines and means of transport. Reliable yield and soil characteristics and crop mapping starts with positioning accuracy of about 1 m, and the automatic control of agricultural machinery requires precision in the order of 1-2 cm [3].

Obtaining such navigation accuracy requires the GPS signals to be adjusted by an external support systems, called differential systems, DGPS (Differential GPS) [3,4]. The most popular and free DGPS signal is WAAS (Wide Area Augementation Service), which covers North America and the Atlantic Ocean. The European equivalent of WAAS EGNOS is a signal which is free of charge [4]. It provides accuracy at the level of 10-30 cm. A significantly higher accuracy is provided by payable signal of Omni Star XP (accuracy to 20 cm), Omni Star HP (10 cm) and Omni Star G2 (2.5-5 cm) [4,8]. The most accurate signal (2.5 cm) is offered by mobile and fixed RTK stations [8].

Systems of parallel driving

An important factor affecting the performance of the tractor-machine unit is to use the operating width. Based on practice, in traditional systems, in many cases the working width of units is not fully utilized, which affects the amount of work. Satellite technology offers solution to this problem. Parallel running systems offer maintaining full width. There are three types of systems: driving support system, the system that will assist the operator when driving and automatic driving system [8]. The first system operator indicates the deviation to the right or left side of the track by optical characters shown on the screen of the terminal. The operator must respond to the signals himself and direct the vehicle on the right track. The accuracy of the system is in the order of 10-30 cm. These systems are classified as: GPS Copilot's Claas Agrosystems:, Easy Drive (Helm), Lightbar (John Deere), Track-Guide (Mueller-Elektronik), Centerline 220 (Teejet), PCS 110 (Topcon) and EZ Guide 250 (Trimble) [10].

During driving the operator assist system automatically maintains the vehicle on a given track, interfering with the operation of the system drive via electric motors mounted on the steering wheel or its column. This system achieved an accuracy of 5-10 cm. The highest accuracy (1-3 cm) is provided by automatic driving system, which interferes directly in the work of the steering system[5, 8].

The benefits of using a parallel drive systems are visible in the application of fertilizers and plant protection products. These systems eliminate the overlapping of working fields and formation of "empty" space which significantly improves the quality of fertilization and chemical protection treatments. With the increased precision of the treatments time savings are clearly apparent.

Precise application of mineral fertilizers

Mineral fertilization is a very important factor that affects the amount and quality of crop plants and farm production costs. The use of satellite technology in fertilization techniques enables marginal and border fertilizer sowing and their variable dosage. The technology using the signal from the satellite mounted in fertilizer spreaders allow for automatic change of the width of the spreading of mineral fertilizers [12]. Such systems include GEOSpread by Kverneland, GPS Control (Rauch) and also GPS-Switch (Amazone) [12]. Such solutions allow for avoiding fertilization outside the field and prevent fertilizers from entering surface waters. This is important for farms, whose job is to follow the Cross Compliance rules set by the European Union [14].

The main objective of the satellite technology in fertilizer technology is variable dosage of fertilizers. The purpose of variable dosage of fertilizer is to rationally use and distribute the mineral wealth by the variable fields and the needs of each plant species [12]. VRC (Variable Rate Control) is based on a compact system that uses data from GPS units, numerical maps and digital data from soil samples. Properly conducted and precise GPS measurements of the soil samples are the basis of VRC.

Based on these data models numerical fields models are developed. This model has adequately prepared samples of each underlying zoning wealth. Each zone has an abundance of the asset value assigned dose to be administered by the VRC system. The zones are calculated and oriented with GPS coordinates from previous measurements and places of soil sampling. Shedding set with the correct data in each assigned zone applies assigned doses during the actual fertilization. This modern technique of precise application of fertilizer allows for a significant reduction of mineral fertilizers. It results from the fact that the plants in the various sectors of the field are provided by the VRC system with as much ingredients as they need [12].

Smart Farming - Intelligent Agriculture

The advent of precision agriculture has forced a significant progress in agriculture. Modern solutions based on satellite techniques allowed for the creation of new farm and crops management strategies. The next stage of precision farming, which enables optimization of production processes and supports decision-making at the farm is called Smart Farming [11].

Smart Farming means primarily the possibility of obtaining and processing data collected from various sources including sensors placed on the machines. With the aid of special programs such as Topcon SGIS or Farm Works programs (a division of Trimble) it is possible to create a full documentation of production processes on the farm as well as data processing. With these programs, you can create yield maps for each field on the farm followed by maps of fertilization. These programs offer costing functions with the possibility of their optimization. On the basis of the information it is possible to create plans of operations carried out on the farm and to prepare guidance for machine operators [11].

Machine park management

Solutions that are part of Smart Farming allow for monitoring of machine operation and adjusting the settings for each of their subassemblies. With wireless data transmission the machinery can be controlled from anywhere in the world, enhancing the quality and efficiency of its work. Special systems based on satellite technology and specialized software such as the Connected Farm (Trimble), JD Link (John Deere), TELEMATICS (Claas) or AGROCONTROL (Agroszturman Russian company) allow for tracking the movement of machine units and means of transport [11]. With the ability to collect data from a number of sensors mounted on machines and tractors can control the parameters of machines and tools, including fuel consumption. Using special software, you can optimize the operation of machines and tractors, so as to increase their work efficiency and reduce fuel consumption and with the use of wireless communications guidelines can be sent directly to the operator [11]. In addition, these systems allow for creating operation statistics of machinery (equipment performance, quality and quantity of work done, fuel consumption) and keep it for many years.

Modern control systems also allow for checking whether technology working in the field moves within the selected area of the farm. This protects the owner of a farm or agricultural enterprise against unauthorized performance of work by the employees off-farm, and reduces the risk of theft of machinery and tractors.

Subsequently, these systems allow you to create lists, calculations and computations useful in the functioning of the farm and its management [11].

Consulting at a distance

Some decisions on the farm requires constant farmer's contact with the counselor. Modern advice is based on Geographic Information System. GIS is an information system used to acquire process and analyze spatial data obtained from satellites, which can be supplemented by geodetic data, aerial photographs or descriptive data. Based on these data, you can predict the development of diseases and pests in field crops and horticulture. Thanks to this advisors can provide farmers with the necessary information on the nature and timing of the implementation of spraying. Such information can be supplied to the manufacturer via various media: desktop computer, laptop, mobile phone or a PDA devices [11].

A significant step forward in advising are special Data or Advisory Networks, which provide advisors with direct access to farm data, which of course is defined by its owner. Thanks to that crop advisor, on request, within a few seconds can have access to customer data and thus give him a swift and effective advice [11].

Summary

Information systems based on satellite techniques supported by ground equipment provide vast opportunities for agricultural production. Due to its efficiency and rapidity of the information they are well rated by agricultural producers. Their advantage is that they provide accurate and useful information in a manner understandable to the recipient. Precision agriculture and especially Smart Farming gives significant benefits, allowing production that is optimal for a given target and saves natural resources. The decision-making farmer is kept informed of all the processes and effectively supported in his decisions to optimize production results depending on the strategy of the farm.

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