UDC 681.785.55

INTEGRATED MANAGEMENT OF AUTOMATIC
The technological process in plant

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Formulation of the problem.

New technology in advanced countries today practically not available without certain operational assets (automated) control and management of technological operations in the plant, and in some countries intensively ecological foundations and precision farming.

Analysis of recent research. Based on previous studies and reviewed the literature [1-5] identified existing methods and technical means affecting the quality of the processes in modern crop technologies; Expediency of complex hardware for action on soil signifies our strong working environment of modern agricultural machinery; developed mathematical tools for the implementation of the proposed technology.

The technical nature of the implementation of new technologies related to crop production with a new level of obtaining information on

agrobiological parameters and phytosanitary status of agricultural land and operational adoption of best management solutions in process plant [2, 3, 5].

The purpose of research. Formalize the main provisions and determine technical and economic performance of the integrated use of automatic control of technological processes to ensure the quality of technological operations in the plant.

Results. Analysis of possible ways to further enhance crop prospects indicates the introduction of new technologies based on the controlled plant growth [1]. In this case we are talking about the need to transfer controlled conditions to obtain a real yield of multivariate phase state to another state specified in the implementation of any technological operation. Solving this problem requires the following: obtaining information about the state of the managed object impact (soil,

plant pests, weeds) per basic and additional parameters; determining the vector changes phase state controlled terms, taking into account factors influence; formalization of the desired parameters of the facility management; development of optimal control algorithm for the transition phase object in a given state; implementation of a given algorithm implementation process.

It is obvious that the current system "man - machine - right" can not ensure the implementation of the task and the need to create the fifth technological level technology that provides saturation of information technology facilities, computerization and electrical systems with controlled quality performance processes.

The quality of implementation of the basic processes in the plant is ensured by integrated automatic performance management processes in plant (monitoring of agricultural land and agricultural production information support), as well as increased driving precision and operational management of working bodies of machines.

Traditionally, monitoring land reduced to analyzing soil samples to determine the chemical composition and properties of soil in the laboratory [5], which only gives a partial values controlled process even with a significant delay in time.

One of the ways to improve monitoring of soil by conventional technologies is automated mode control sampling and analysis of their chemical composition, and the prevalent use of optical sensor and electrical systems. To study the properties of the soil used conductive contact-destructive and non-contact method of monitoring conductive properties of the soil.

In Table. 1 shows some monitoring system that can be used to ensure the quality of technological operations.

1. Monitoring Technology in modern technologies of plant growing.

Technological process	The newest technology	monitoring systems
fertilizer	Locally-dosed introduction doryv	Technical systems for monitoring conductive properties of soil spectrometric monitoring
Cultivation ground	Strip-Till technology	Monitoring of soil depth, modes of working of agricultural machinery, soil moisture sensor, the sensor density of soil
Sowing	Differentiated sowing crops	Technical systems for monitoring conductive properties of soil spectrometric monitoring
Adding chemicals	Locally-dose-making chemicals	Inspection systems

	Harvesting	Monitoring productivity	Bulk grain sensor, humidity sensor

Significant efficiency improvement of crop can be achieved in the transition from a solid to a locally-dosed or differentiated tillage and plants. Thus each process operation performed by operational information received (when on-line, when data are collected simultaneously with the execution of technological operations), or related program (when off-line, previously being developed based on diverse information).

Today waste and can be used as components of complex systems to ensure the quality of technological operations in a number of plant and facilities [1-5].

Systems of precise positioning of the unit on the field. Positioning system includes an antenna tuner global positional system GPS (USA) and GLONASS (Russia), which is installed on the machine and pelenhuye signals from satellites that are in the reception area. The accuracy of the location of the object ranges from a few meters to one centimeter. Examples of devices on the positioning of the units that are most often used in Ukraine, are given in the Table. 2.

2. Automatic positioning units on the field.

number	Brand	Short description
1.	The GPS 252	Positioning accuracy 3-30 cm, Dvohchastotnyy mode
2.	332 AG GPS Receiver	Used on any agricultural operations. Mounted in the cab. Precision regulated
3.	Agronov «Grotec»	Positioning accuracy ±10 cm. It consists of a GPS-receiver and terminal
4.	Receiver StarFire iTC company «John Deere»	Compatible with signals: SF1, SF2, EGNOS

Automatic hruntoprobovidbyrachi. Advantages of using automatic hruntoprobovidbyrachiv shown in Table. 3, and specifications in the table. 4. For automatic taking of soil samples hruntoprobovidbyrachi mounted on various energy vehicles. According to the analysis of selected samples developed distribution map substances in the field. Such cards are used to create flow charts differentiated technological materials and making management decisions.

3. Comparative table operations taking samples of soil and fertilization in traditional and modern farming systems.

num	Operation	Traditional agriculture	Precision agriculture

ber			
1.	The total soil sample for analysis	Selected from 5-20 ha	Selected from 1-5 ha
2.	sampling	Hand drill	automatic hruntoprobovidbyrachem
3.	cartographic basis	Soil Map and Land Use	E soil map, satellite imagery georeferenced
4.	Place of sampling	Determined surveyors stake, theodolite, seat selection is not exactly fixed	Determine the Global Positioning System. Sampling fixed with accuracy30 cm
5.	Drawing cartograms	Manually	Using the software

Continued Table. 3

number	Operation	Traditional agriculture	Precision agriculture
6.	Calculation of doses of fertilizers	On the average for all fields manually	Differentiated for each section of the field, the program automatically
7.	fertilizer	On the established areas with excessive and inadequate nutrient content	Each site limed fields as needed, according Cartogram

4. Automatic hruntoprobovidbyrachi.

number	The manufacturer name	Depth of sampling, cm	Characteristic
1.	Nitfeld Duohrob-60 universal	0-30 30-60	Mounted on tractor, car, pickup, trailer. Equipped with a GPS-receiver. Software "Heoplan" or KB "Panorama". The time sampling 20-25 seconds. Equipped with a field notebook
2.	Nitfeld MultiPROB 120	0-30 30-60 60-90	Parts tests on three horizons. Mounted on kvadrytsykl. Software "Heoplan" or KB "Panorama"
3.	Amity Concord 9800A / Agricultural	0-122	Automatically takes 10 samples. Time taking a sample of 25-30 seconds
4.	Fritzmeier	0-90	Complete machine with precise reference to the terrain. Time taking one sample - 15-20 seconds. The preparation of soil maps used

Systems of parallel driving (avtopilotuvannya). Integrated avtopilotuvannya embedded in the hydraulic system of self-propelled vehicles. Special controller receives signals from GPS / GLONASS receiver and converts them through an additional hydraulic (or electric) in the corresponding contour changes of the unit. This movement can be pryamo- or curved. Overlap and gaps between adjacent passes are minimized (to20 cm) And when using base stations RTK - to 5 cm. The system provides the opportunity to work at night, in poor visibility, reduces fatigue tractor, increases productivity, reduces fuel consumption and technological materials.

Features a number of parallel driving self-propelled agricultural machinery are given in Table. 5.

Systems for mapping yields. The result of the system are detailed map harvested crop yield field, where different colors isolated areas (sites) with different yields. In Table. 6 shows the characteristics of existing mapping yields.

5. Systems of parallel driving units.

number	The system of parallel driving	Characteristic
1.	Ag GPS EZ - Guide Plus	Precision driving from rut to rut 15-30 cm. Goes well with any tractor. Increases productivity by 13-20%
2.	Autopilot E-Drive	Precision passing adjacent passes 10 cm. Allows you to drive a tractor on the slopes. Mounted on any imported tractor with power steering
3.	Trimble EZ-Guide 500 (OnPath b HP | XP)	Precision driving 7-25 cm. The antenna range L1 / L2. Tracks flaws, measure the area of the field. Connects to the Thruster Trimble EZ-Steer
4.	Auto Track Universal company «John Deere»	Set universal, installed on any machine. There are features avtopilotuvannya and correction provisions on the slopes. Since Green Star system

6. Systems for mapping yields.

number	Designation (Mark) system	Specifications
1.	HrinstarTM Harvest Dok	Ingredients for the combine «John Deere»: Navigation System StarFire (precision driving30 cm) display; processor; key card; weight sensors and Moisture; yield mapping program; flatbed printer; memory card HCMCJA
2.	claas Lexion	Installed on combines CLAAS. The system is equipped with a multifunction controller
3.	Universal yield	Mounted on any combine harvesters. Defines yield

	mapping system (Heomir)	and grain moisture of the single area considering location and inequalities combine field
4.	Agrotronix S.A. France	Defines yield and grain moisture in real time

Touch sensors. Various types of systems and sensors (tab. 7), which are installed on units that perform mainly the operation of liquid fertilizers and plant protection products.

Creating systems with controlled quality performance processes involves the creation of a new generation of agricultural machinery and is adding to the basic structure of the system "man - machine - field" operational control circuit (Fig. 1).

Additional operational control circuit should perform the following functions: obtaining current information on the state of the field IPi (t), modes of working body IMi (t) and in the implementation of technological operations; formation of information received the Quality Score; comparing the actual Quality Score IAj (t) of the desired (calculated) and the calculation of the basis of appropriate control actions UTi (t), or signal the operator to modify the working body (Controller) UOi (t) to achieve the desired quality score.

7. Touch sensors.

number	Mark manufacturer	Specifications
1.	Greenseeker Hundro Agri	Set in fertilization with working width18 meters (30 sensors of step 0,6 m). Measure the amount of light reflected from plants in the range of 600-780 nm. After calculating computer vegetation index is fed a certain dose of working fluid through each jet particular portion. Fertilizer is made locally
2.	Grop-Sensor Hundro Agri	Apply for metered introduction of fungicides and growth stimulants to Kolosov cultures that are not hatched. Front tractor mounted pendulum which measures the force of resistance of plants moving and sends a signal to make a certain amount of liquid.
3.	YARA N-Sensor	Used to determine the nitrogen content in plants, proper nitrogen fertilization and introduction of plant growth regulators
4.	Agrocom VRA (Grop-Meter)	The system continuously measures the biomass of plants and provides the appropriate variable dosing of plant protection products in the course of the unit

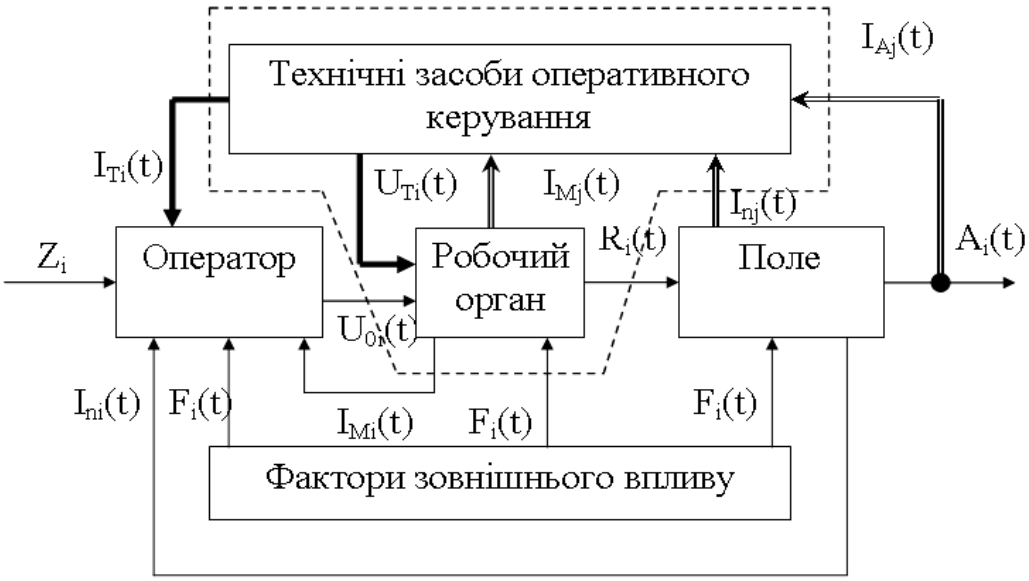

Fig. 1. Model of "man - means operational control - the car - the field" with controlled quality work.

The problem of synthesis of systems with controlled quality performance of the process is to determine the algorithm operation control device, ie its structure and parameters with known equations of the base system and the characteristics of the input signals. This optimal control to be found in the form U = = U (t), but in the form U = V (x), ie, optimal control in every moment depends on which point of space is currently phase point object exposure. For example, if it comes to making optimum dose of fertilizer, then the formation of the management actions necessary to consider not only the effective operation of the rule of fertilizers on the culture in a particular field, but also the dynamics of providing soil these nutrients over time each characteristic areas of field.

8. Key indicators processes and factors controlled impact on the quality of their performance.

The process and its impact on the weight of the crop	quality	The main factors influence the effectiveness of controlled process	The weight of influence factors on the quality of	Potentially, the possible effect
Fertilizing 0.09	Application rate Uniformity making	Position dispenser The direction of movement MTA Frequency of rotation of working	0.37 0.32 0.31	Reducing the cost of fertilizer by 50-70%
Plowing 0.07	The depth of the soil Plowing of crop	provisions working of The direction of the unit	0.51 0.23	The reduction in fuel costs 5-30%

	residues			
		provisions working	0.24	
	sowing depth	of		
Sowing 0.20	seeding	Position dispenser	0.45	The increase in yield to 15%
	straightness of lines	The direction of the unit	0.09	
	sifting	Failures and violations	0.22	
		Position dispenser	0.37	
Adding chemicals 0.09	Application rate	The direction of the unit	0.32	Reducing overall costs by 10-30%
	Uniformity making	Failures and violations	0.31	
		Failures and violations	0.73	
Harvesting 0.22	Loss and damage	The direction of movement of the harvester	0.08	Reduced to 25% loss of grain
		Regulation of working	0.16	

Ratios of quality, exposed to management, general management object can be described by the following equation:

$$y^{(n)} + \sum_{i=0}^{n-1} a_i(t) y^{(i)} = \sum_{j=0}^{m} b_j(t) x^{(j)},$$

where: s - performance management; y - coordinate output indicator of quality; ai (t), bj (t) - time-variable coefficients.

In the course of the research to create a new generation of vehicles [2] obtained practical results (tab. 8) improve the efficiency of manufacturing operations.

Thus, as can be seen from the table. 8, the use of technical systems for monitoring agricultural land at certain manufacturing operations enables to provide adequate quality manufacturing operations. However, there are no clear guidelines and reliable sensors for measuring agrobiological partners of farmland in the performance of manufacturing operations and communication between a fundamentally different monitoring system for further use in the following technological operations. Missing, and in many cases not even invited to the principles of the system for rapid measurement of many specific agrobiological parameters for operational quality management implementation technological operation, and therefore the efficiency of agricultural production.

Under the proposed model we found that the use of integrated systems of automatic control of technological processes in the plant with controlled quality performance processes for [2, 3]

- tillage spiral without breaking the process (By changing the cutting width depending on the change of direction of the arable unit) - makes it possible to increase the productivity of the unit to 18%, reduce

fuel consumption up to 10% and reduce the negative impact of soil erosion;

- seed crops - Carried out without the participation of workers - sowers and the length of sifting with shovels pile is reduced almost 20 times and no more than 5,9 m;

- Making solid fertilizers (By joining adjacent aisle wide-units with accuracy of ±0,4 m

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Conclusions

To achieve a fundamental increase in the yield of agricultural production per unit area can be processed with the introduction of new advanced manufacturing technologies through the use of a new generation of machines.

Providing the required quality of technological processes possible through the use of means of operational control and technical state machine workflows (weight ratio 0,22-0,73), precision driving mobile units (0,08-0,32), operational management working bodies machines for rational algorithm (0,37-0,51).

Developed and tested engineering samples of the new generation of quality-driven execution processes allow for increased productivity - up to 20% fuel cost reduction and process materials by 15-20%, to obtain economic benefit - more than 350 UAH / ha and reduce harmful anthropogenic impact of technology on the environment.

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Formalyzyrovanы Basic Situation and opredelenы technical and Economic indicators of application of yntehryrovannыh avtomatyzyrovannoho tehnolohycheskymy management processes required to implement quality nadlezhascheho tehnolohycheskyh perform operations in rastenyevodstve.

Ahrotehnolohyy, tochnoe zemledelye, sredstva automation, sensor, System Monitoring, promptly and management.

Formalize guidelines and determine the technical and economic characteristics of integrated systems of automated control of technological processes to ensure the quality of performance of technological operations in crop production.

Agrotehnology, exact agriculture, facilities of automation, sensor, system of monitoring, operative management.

UDC 631.3: 620,172

LEAKS AND CORROSION RESISTANCE COMPOUNDS USING IN ELIMINATING CRACKS

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The paper presents the methodology and results of comparative tests for leaks and corrosion resistance of joins used in elimination of