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В збірнику представлені тези доповідей науково-педагогічних працівників, наукових співробітників, аспірантів та студентів НУБіП України, провідних вітчизняних і закордонних вищих навчальних закладів та наукових установ, в яких розглядаються завершені етапи розробок.

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MACHINE USE OF MINERAL FERTILIZER SPREADERS

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The problem of low-quality distribution of granular fertilizers on the surface of the fields is known [1]. This is, in particular, the clogging of the output holes on the distribution disks [2]; incorrect dosage of granules as a result of electronic failures and other factors [3]; demolition of granules at high speed of work or due to the influence of weather factors [4], for example, strong wind [5]. Moreover, this is influenced by the often low quality of domestically produced fertilizers [6].

The design of Kuhn Axis fertilizer spreaders involves the use of a number of precise technologies. First of all, we are talking about EMC electronic dosing technology. The EMC measures the torque of each spreading disc and determines the amount and weight of fertilizer spread by a specific disc. The risk of clogging the holes, regardless of the application rate, is reduced to a minimum, because even with a low flow of fertilizers supplied to the disc, the electronics automatically open the metering valve, controlling the emptying rate of each section of the hopper.

An important feature of EMC is that this parameter does not depend on the type of fertilizers, size and density of granules. From the very beginning, the EMC electronic metering system continuously monitors and adjusts the degree of opening or narrowing of the opening to ensure maximum accuracy. Accordingly, depending on the programmed application rate, the EMC system accurately calculates the proper fertilizer consumption and torque.

A special sensor continuously measures the torque index. If the fertilizer flow on one of the discs becomes less or more powerful, the technology automatically adjusts the degree of opening of the outlet opening. The range of fertilizer dosing here can be from 3 to 500 kg/ha for a spreading width of up to 42 m. The working speed of these units can reach up to 20 km/h, and the volume of the hopper is 4,000 kg or more.

The brain center of Kuhn Axis mineral fertilizer spreaders is the CCI 200 ISOBUS terminal, designed for integration with tractors and additional equipment of all well-known global manufacturers. The maximum efficiency of the SSI 200 with the Kuhn Axis spreader is achieved by using maps of differentiated application of mineral fertilizers. The CCI Control special application on the CCI 200 monitor

directly controls the rate of fertilizer application according to the maps. In turn, the machine operator only enters data into the system from a USB drive.

The Optipoint system calculates the degree of opening and closing moments of each outlet, depending on the working width, for any type of fertilizer, regardless of the shape, size and density of the granules. In turn, at the extreme areas of the field, the Varispread system automatically opens and closes the exit holes at the most favorable moment, calculated by the Optipoint system.

The leading German manufacturer of a wide range of agricultural machinery offers the new generation ZG-TS spreaders on the market of Ukraine, in the design of which unique precise solutions are integrated. First of all, it is the ProfisPro weighing system with online calibration, which allows you to continuously monitor the settings of the gate valves. At the same time, an automatic check of the fertilizer balance in the bunker is carried out with automatic calculation of the number of hectares and working time. Thanks to this, the accumulation of granule residues in the hopper and the possible mixing of different types of fertilizers are also excluded.

Amazone Argus Twin is a system for determining areas of fertilizer distribution, which is based on the registration of transverse distribution by radars that work regardless of the presence of dust and pollution. Argus Twin changes the lateral distribution with the help of 14 radar sensors. In Argus Twin, the left and right distribution zones are controlled by 7 radar sensors mounted on two semicircular brackets. They are installed at a short distance above and beyond the spreader discs, but inside the protective frame. Each sensor detects volatile fertilizer granules at a distance of 40–90 cm; thus, they scan the entire scatter fan. Signal processing takes place several times per second in the spreader's working computer. You can activate the Argus Twin automatic cross distribution optimization mode on a terminal, for example CCI 100 or Amatron 3. For several years in a row, the German manufacturer has been improving another unique function – WindControl. The fact is that during the application of fertilizers, the oncoming or accompanying wind stretches or flattens the distribution arc of the granules, but this does not affect the transverse distribution. The side wind, on the contrary, significantly changes the picture of the transverse distribution: the arc flattens on one side, and stretches on the other. This is how an asymmetric pattern of distribution of granules is formed. Instead, AMAZONE has a solution that reduces the impact of the wind - the optional WindControl system.

The Amazone WindControl system ensures optimal lateral distribution even in crosswinds. Also, with the help of a high-frequency wind sensor, new value parameters for the fertilizer spreader are continuously calculated and automatically adapted. And in the work menu, in addition to all the important parameters of fertilizer application, the operator always sees the current wind parameters. The ZG-TS FlowCheck outlet control system in the mounted distributors also deserves special attention, which continuously scans for possible clogging of the channel or idle operation of the mechanism.

Kverneland Exacta TL Geospread mineral fertilizer spreaders belong to the category of machines that, already in the basic equipment, are primarily designed for

work using precision farming technologies (Fig. 1). The machine already has a GPS tracker in the base, and this allows the owner to outline the contours of the fields. Moreover, the saving of fertilizers will be the higher, the more irregular the contours of the fields are. On average, due to the lack of overlaps, it will reach 10%. Also, Kverneland Exacta fertilizer spreaders are already equipped in the basic version with the possibility of differentiated introduction, unlocking of sections in 1 m increments, an automatic weighing system and other elements of precision farming.

The Kverneland Exacta TL Geospread spreader has two actuators on each of the dispensers. The first controls the application rate (kg/min), the second controls the spreading pattern and working width. Thanks to this, all settings of the spreader are performed from the tractor cab. In addition, they can be changed in the field manually or automatically using the GEOCONTROL system. In the case of using the Kverneland Exacta TL Geospread spreader in precision farming systems (by activating the Geocontrol system), the machine will automatically change the application rate according to the electronic task map, thus the spreading overlaps are turned off, because the spreading width will also change automatically section by section. All settings and adjustments are made in the Isobus terminal.



Fig. 1. Precision farming technologies.

This problem can be complicated by a well-known problem – the generally not very high quality of some types of granular fertilizers. They can stick together, clump, turn into dust, etc. Sometimes it is physically possible to pour them from the big-bag to the spreader's hopper, using the last argument – good flour. Accordingly, special attention should be paid to the work of the stirrer, which should not grind, namely, clearly separate the granules from each other. Otherwise, the outlet holes on the plates will be clogged or dust will pour out, which will be thrown not the specified 12-14 m in both directions, but literally a couple of meters behind the machine.

A particularly unpleasant problem can be the influence of various extraneous factors on the accuracy of scattering. So, if the machine works normally in windless weather and even at a moderate speed, then with an increase in the wind literally by a couple of meters per second or an increase in the speed of operation by 2-3 km/h, the spreader can produce an error of 20-30% or more. Frankly speaking, this problem does not exist with an ordinary car. But today, a number of well-known manufacturers of this segment of equipment offer quite effective solutions that make it possible to compensate for the influence of extraneous factors on the accuracy of spreading. Frankly speaking, it makes sense to pay attention to them.

However, the biggest financial losses are facing the owners of these machines, if the combination "tractor - spreader" is not equipped with elementary equipment for precise guidance in the folds along with shutdown. And at the same time, if the spreader is not set up properly, it does not throw pellets 1–2 m from both sides. The combination of these negative factors leads to the appearance of permanent gaps and overlaps only with the scattering of expensive pellets on the surrounding forest strips, if the work is carried out on the edges of the field. Such "little things" can be extremely expensive. World-renowned manufacturers of spreaders confidently claim losses of mineral fertilizers at the level of 100 euros/ha and above. Therefore, they say, if you scatter like that, it is better not to do anything.

Indeed, today it makes sense to buy a fertilizer spreader with integrated systems for precision farming and various technical solutions to control the flow and distribution of granules. You will have to overpay a little for this, but with the right settings, the farmer will see the difference in fertilizer consumption literally after 100 hectares of fields. The main thing to pay attention to here is the accuracy of settings and high-quality service provided by sellers. Customization is such a thing that 50% of success and even more depends on it. If we take a normal modern model of a fertilizer spreader and immediately adjust everything correctly, of course with the help of the manufacturer or seller, then soon we will get a tangible result.

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ENGINEERING MANAGEMENT OF GRAIN SAMPLER WITH MOISTURE AND TEMPERATURE SENSOR OF GRAIN HARVESTER

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Let's start with the Trimble Harvest yield monitoring system, designed to simultaneously determine crop yield and grain moisture [1]. The principle of its operation is that the GPS tracker in real time links the indicators of the yield sensor to an electronic map that contains data from all combines equipped with such software [2]. The optical sensor located on the conveyor, through which the cleaned grain enters the hopper [3], is directly responsible for measuring the yield [4]. The principle of calculating the volume of grain is based on the length of time that the vanes of the conveyor cover the light beam: the higher the layer of grain on the conveyor, the longer the light beam will be covered [5]. At the same time, Trimble equipment allows you to view maps, yield records and moisture data in real time, making the necessary corrections if necessary [6]. It is also possible to compare the performance of different varieties of seeds throughout the territory (Fig. 1).

Trimble equipment can be integrated into the already existing equipment of the combine (installed from the factory [7]), and it is also possible to choose a complete set for s/s combines that are not prepared for yield monitoring and mapping systems. Trimble's displays are multi-tasking and, in addition to building an interactive map of the crop, can simultaneously be active in auto-driving mode [8]. This combination