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## APPROACHES TO FORMATION OF PARK OF HIGHLY PRODUCTIVE GRAIN HARVESTING COMBINERS

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Today, almost all the world's leading manufacturers present and actively advertise, in particular on the Ukrainian market [1], new models of high and ultra-high productivity combines [2]. It can be said that large combines are in demand today like never before, and this trend is increasing [3].

Introducing super-powerful models of grain harvesters to the market (Fig. 1) is not a whim of equipment manufacturers, because it is farmers who dictate the pace of the market [4]. Customers tend to buy the most powerful machines possible, and these are usually rotary harvesters [5]. Although there are high-performance keyboard models on the market, it is better to harvest grain in fields with a stable high yield using rotary or hybrid machines [6]. Therefore, almost every manufacturer of grain-harvesting equipment has at least one model of a rotary combine in its line.



Fig. 1. A unified row of the interior of the combine harvester cabin.

Thus, the amount of grain that needs to be collected is increasing, in connection with which reapers with a wider grip are used and the need for more powerful and more productive machines is increasing. The limiting factor in the design of keyboard combines for grain harvesting in high-yield fields is the capacity

of the harvested mass. Therefore, it is advisable to use keyboard combines for harvesting fields with a yield of up to 5 t/ha.

In contrast, rotary harvesters can pass mass along the entire length of the rotor. However, this does not mean that keyboard combines are uncompetitive - manufacturers are constantly improving threshing and grain separation systems, responding to the growing demands of farmers.

The processes of threshing and grain separation in the construction of rotary combines are carried out once in one working body. In addition, the grain here is mainly "wiped" from the spikelets, which allows to minimize damage to the grain and preserve its marketable characteristics. Due to the high intensity of separation in the rotor, this condition is met even with high crop yields and high moisture content of the harvested grain. However, in the presence of a large amount of straw, this can lead to a noticeable overconsumption of fuel.

How can you choose the optimal model of a grain harvester for the farm, if we take into account first of all its characteristics of productivity and economic operation?

First, it is worth abandoning the outdated system of calculating fuel costs per hectare, because fuel costs per ton of harvested crop are taken into account all over the world. The fuel consumption will not be the same on a hilly and flat field, on wet and dry soil, and, finally, with a yield that is twice as different.

Secondly, everything must be considered in the complex. After all, you can harvest, for example, wheat twice as fast as usual and spend 10-20% more/less fuel. Is it good or bad? After all, with every additional day of early grain harvesting, grain losses increase more or less in geometric progression. They did not make it in time - consider that part of the harvest, which can be thousands and tens of thousands of dollars, remained in the field. It was collected on time, therefore, it was safely transported, the stubble was peeled on time, sown, etc. On the other hand, evaluating combine harvesters only from the point of view of fuel consumption is unlikely to be correct. And all the more, it is worth deciding on an approach to the formation of a fleet of harvesters in the farm. Should it be, relatively speaking, three large cars or eight smaller ones?

The fact is that if we use many small and medium-sized combines, and not a smaller number of high-performance models, then we are largely dependent on the human factor. It is necessary to find and maintain a large staff of mechanics, to ensure working conditions for everyone, to establish high-quality operational maintenance of machines - there is no shortage of trouble. And in the end, it will take no less fuel.

Therefore, many agricultural holdings rely on powerful machines with wide-reaching reapers in order to harvest as quickly and calmly as possible in the fields of a particular unit.

For example, you can compare two combine harvester models: the first one with an engine volume of 9 l and a header width of 9 m, and the second one with an engine volume of 13 l and a header width of 14 m. Working under equal conditions on a field with a high yield, the engine the smaller model will be loaded at 110% and,

of course, will consume more fuel. Instead, the loading of the engine of a larger combine will be 50-60%, it will not "stress", and the productivity of its work will be much higher. Fuel consumption in both cases will be practically the same.

The additional bonuses of using high-performance machines are obvious. It is necessary to maintain not two harvesters, but only one, and also to keep fewer operators. It is also possible to reduce the number of refueling, i.e. significantly save on maintenance and operation.

At first glance, the best option seems to be that it is better to have one or two reliable high-performance machines than several times smaller models. But it can also have its disadvantages. Far from all regions have a service network that allows the combine to be launched into the field within a few hours after a breakdown.

Indeed, this aspect can turn into a serious problem if a farm bets on one or two harvesters without adequate insurance options. There are quite a lot of such farms.

Therefore, it seems to us that it is optimal to have one or two high-performance flagship machines in the household and two more smaller ones for insurance. In addition, giant combines must have an effective service program from the selling company, these are not bicycles, after all. There will be a guarantee of an instant response of the service department - and you can calmly plan your work. If this is impossible for one reason or another, then it is better to look for some intermediate option.

### References

1. Nazarenko I., Dedov O., Bernyk I., Rogovskii I., Bondarenko A., Zapryvoda A., Titova L. Study of stability of modes and parameters of motion of vibrating machines for technological purpose. *Eastern-European Journal of Enterprise Technologies*. 2020. Vol. 6(7–108). P. 71-79. <https://doi.org/10.15587/1729-4061.2020.217747>.

2. Rogovskii I. L. Analysis of grain losses by the classic threshing-separating device of the combine harvester. *Scientific reports of NULES of Ukraine: electronic edition*. Kyiv. 2021. № 4(92) (2021). <https://doi.org/10.31548/dopovidi2021.04.012> file:///C:/Users/Ivan/Downloads/15140-35724-1-PB.pdf.

3. Rogovskii I. L. Analyticality of complex criteria for estimating grain production in agricultural enterprises by intensification of engineering management. *Machinery & Energetics. Journal of Rural Production Research*. Kyiv. Ukraine. 2021. Vol. 12. No 4. P. 129-138. <http://dx.doi.org/10.31548/machenergy2021.04.129>.

4. Rogovskii I. L. Methodology of performance of technological operations of restoration of working capacity of agricultural machines at limited resources. *Collection of abstracts of the XXII International Scientific Conference "Modern Problems of Agricultural Mechanics"*. October 16-18, 2021. Kyiv. Nizhyn. 2021. P. 122-125.

5. Rogovskii I. L. Models of formation of engineering management alternatives in methods of increasing grain production in agricultural enterprises. *Machinery & Energetics. Journal of Rural Production Research*. Kyiv. Ukraine. 2021. Vol. 12. No 1. P. 137-146. <http://dx.doi.org/10.31548/machenergy2021.01.137>.

6. Rogovskii I., Titova L., Novitskii A., Rebenko V. Research of vibroacoustic diagnostics of fuel system of engines of combine harvesters. *Engineering for Rural Development*. 2019. Vol. 18. P. 291-298. <https://doi.org/10.22616/ERDev2019.18.N451>.

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## **SELF-PROPELLED SPRAYERS: DESIGN COMPARISON**

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The chemical method of plant protection is the most popular and effective in protecting plants from both pests and diseases [1]. The main advantages of this method can be identified: instant effect after the first application, versatility and fairly quick payback [2]. With the correct agrotechnical norm for the introduction of plant protection chemicals, the crop does not lose its nutritional value and can be consumed by humans without harm to health. In order to achieve yield increases in both physical and monetary terms, many agrarian farms spend numerous resources in order to obtain a large return on these investments [3]. One of the main components of achieving such a result is a properly selected technique for the introduction of chemical plant protection products [4]. As a rule, sprayers of various types (trailed, mounted or self-propelled) are used, depending on the cultivated areas (Fig. 1). It should be noted that with regular and high-quality maintenance of agricultural sprayers, it increases their performance, which affects compliance with agrotechnical standards [5].

Greater productivity, high-quality work while using fewer machines and completing agricultural tasks in a short time - these are the requirements of modern agriculture. And this is what today allows agricultural enterprises to remain successful in the market in the face of fierce competition. This is increasingly forcing farmers to use more powerful and versatile machines. Therefore, engineers developing agricultural machinery are faced with the task of achieving maximum productivity of agricultural work using the minimum number of technical units. In particular, this requirement of modern farming has prompted the emergence of large heavy-duty field liners, namely self-propelled sprayers. For farmers, when choosing such complex modern machines as self-propelled sprayers, an important criterion is their cost, quality of work, reliability, availability of service from the manufacturer or dealer of equipment. Given the relevance of this issue, we present the main characteristics and advantages of some self-propelled sprayers on the Ukrainian market, which will help farmers navigate the variety of market offers and choose the unit that will best meet the needs of your particular farm.