WORKING CAPACITY OF GRAIN HARVESTERS

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Abstract *Given that the technique of mechanization of grain harvesting has advanced a lot in time globally, the most important aspect to be addressed relates to the choice of optimal operating regimes that allow productivity and quality increases and cost reduction of mechanized harvesting. For this reason, a major aspect studied refers to the current state of agricultural grain harvesters. The analysis of specialized bibliographic sources reveals concerns in scientific research to improve self-propelled grain harvesters in order to bring them to the level of ever-increasing requirements on the qualitative and quantitative aspects of their working process. From the point of view of threshing, two variants of self-propelled combines for grain harvesting are distinguished: combines with tangential thresher (conventional combines) and combines with axial thresher (axial flow combines). For the proper functioning of self-propelled combines during work and for the reduction of grain losses, a series of technological adjustments is required. These adjustments are done before starting working and during the work, both in header and thresher. In order to highlight the importance of the study and to make it effective in the paper, a detailed documentation of the last types of threshers and cleaning systems is made below, taking into account that the productivity of the combines depends largely on the threshing flow and the separation capacity of the cleaning system. The study focuses on current upgrades in the construction of grain harvesters, which are fundamentally different from those previously manufactured.*

Keywords*: grain harvesters, productivity, quality, mechanized*

INTRODUCTION

A retrospective look highlights that the last century will be remembered by mankind primarily as a period of development of science and technology including the development of agriculture.

In recent years, Romania's agriculture has seen numerous transformations, one of them being the transition from state-owned agriculture to privately-owned agriculture. [NIȚĂ, L., NIȚĂ SIMONA, PANAITESCU LILIANA, MIRCOV V.D., 2009, CRISTA F., BOLDEA M., RADULOV ISIDORA, LATO ALINA, CRISTA LAURA, DRAGOMIR CORNELIA, BERBECEA ADINA, NITA L., OKROS A., 2014]

Like all developed countries, we also aim to increase labour productivity through the mechanization of agriculture and the scientific practice of agriculture generating a both environmentally friendly and high production-effective agriculture.

The intensive use of agricultural machinery ensures the increase in labour productivity in agriculture, makes it possible in parallel with the expansion of mechanization, so that each agricultural producer can feed, through the products obtained, an increasing number of people. [CASIANA MIHUȚ, ANIȘOARA DUMA-COPCEA, AURELIA MIHUȚ, 2018 TUDOR V, MAZĂRE V, TUDOR CLARA, 2003, NITA SIMONA, TABARA, V., DAVID, G., NITA, L.D., ALDA, S., DRAGOS MARCELA, BORCEAN, A., 2012]

For a better organization of mechanic works in agriculture, the following aspects should be considered:

- Choosing and using optimal methods and procedures that ensure high production with minimal expenses;

- Connecting all works and operations within the agricultural production cycle in such a succession and correlation that it ensures optimization of production processes.

Due to the emergence of agricultural machines with a superior technique, it is now possible to increase agricultural production and reduce its costs.

A primary objective of modern agriculture is the intensive development of agricultural production as an essential condition for achieving as high production in the surface unit and as low as possible per product unit.

In order to practice modern agriculture, it is necessary, among other things, to achieve complex mechanization leading to the improvement of technical and economic parameters for the use of agricultural machinery and equipment.

The harvesting of grains is a particularly important work to be carried out in due time and with minimal losses. [LUCIAN NITA, ADIA GROZAV, GHEORGHE ROGOBETE, 2019, L NIȚĂ, D ȚĂRĂU, GH ROGOBETE, GH DAVID, D DICU, SIMONA NIȚĂ, 2018].

The dynamics of agriculture with mechanical means is continuously ascending, current concerns being aimed at increasing and improving the number of agricultural machinery and equipment. The modern technical equipment of agriculture claims thorough training and high professional levels of all those using them. [POPA D., ILEA R., BUNGESCU S., ALEXANDRA BECHERESCU, 2015, OKROS A., POP GEORGETA, 2014]

MATERIAL AND METHODS

Self-propelled combines for harvesting grains are made up of a header (cutting platform), thresher, thermal engine, transmission, rolling system, steering system, braking system, cab, electrical equipment, etc. [ILEA R., BUNGESCU S., POPA D., CABA I., 2013, POPA D., ILEA R., BUNGESCU S., ALEXANDRA BECHERESCU, 2015]

Self-propelled combines for full harvest in the form of grain cereals concurrently execute harvesting, threshing, cleaning of the grains and collecting them in their own bunker.

In order to harvest other cultures with these combines, equipment is mounted for adaptation to specific conditions:

-Equipment for the harvesting of sunflower;

-Equipment for harvesting grain maize;

-Equipment for harvesting soybean culture.

Harvester combines provided with the above-mentioned equipment and with a number of simple adaptations and adjustments may harvest in optimal conditions the following crops: wheat, barley, oats, rye, sunflower, grain maize, soybeans, rape, beans, flax, clover, lucerne, etc.

The most widespread grain harvester combines are T-shaped indirect-flow self-propelled combines because they can enter the field directly without requiring access paths (work width is greater than gauge).

These combines are produced in a very wide range of sizes, with working widths ranging from 2.1 to 7.3 m, are easy to handle, have low return radius, can work on both plane and slope land, etc.

From the point of view of the threshing process, two variants of self-propelled combines are distinguished for grain harvesting:

- Combines with tangential thresher (conventional combines);
- Combines with axial thresher (axial flow combines).

For the proper functioning of self-propelled combines during work and to reduce grain losses, a series of technological adjustments is required. These adjustments are done before starting working and during the work, both in header and thresher. [BUNGESCU S., 2016,

VLĂDUȚ V., BIRIȘ S.ȘT., BUNGESCU T., HERIȘANU N., 2013, VOICEA, I. PIRNA, V. VLADUT, M. MATACHE, S. BUNGESCU, 2011]

Cereal harvesters are delivered with a set of sieves for harvested crops.

Within the cleaning system, the fan has a key role which, due to the characteristics of the air current, must provide certain distributions of the gearboxes on the length and width of the sieves so that seed recovery is more efficient and seed loss as low as possible. Adjusting the volume of air produced by the fan is performed by changing the fan speed.

RESULTS AND DISCUSSIONS

Experimental studies in grain harvesters were performed under working conditions, at wheat harvesting, on a number of four self-propelled combines, at a working group in Moşniţa, Timis County, Romania. The four types of combines on which measurements were made were:

- The GLORIA-1420 combine: 105 hp/2,100 rpm engine, working width 5 m;
- The CLAAS-98SL Maxi combine: 160 hp/2,100 rpm engine, working width 5 m;
- The MDW-525 STS combine: 268 hp/2,170 rpm, working width 7 m;
- The John Deere-Hydro 4-1174 S combine: 150 hp/2,100 rpm, working width 7 m.

The four combines harvested in the same formation under identical working conditions, thus having identical technological settings. The mechanism of actuating the sieves of the connecting rod-crank type imprints them a plan-parallel movement.

In each combine, the parameters of the cleaning system were measured, namely:

- Eccentric shaft speed operating the cleaning system;
- Crank radius;
- Connecting rod length;
- Oscillating arm length;
- Sieve size;
- Sieve tilt angle;
- Sieve direction oscillation angle;
- Air flow direction angle.

In order to determine the hourly work capacity (t/h), the actual time for filling the bunker, the hopper volume and the hectolitric weight of the harvested wheat (780 kg/m^3) were taken into account.

In each combine, there were four effective bunker timings, and the arithmetic mean of these timings has been taken into account for determining the hourly work capacity.

CONCLUSIONS

Based on centralized data, following measurements and experimental determinations carried out in the four self-propelled combines, the following conclusions can be drawn:

The average hourly productivity is proportional to the separation surface, the power of the actuator, and the feed rate, respectively;

- Fuel consumption per t of cereals decreases with the increase in hourly productivity.

However, there are important differences in hourly productivity related to the session separation surface. Thus, in the combines MDW-525 STS, CLAAS-98SL and JOHN DEERE-1174S compared to combining GLORIA-1420, productivity reported to the sieve separation surface is almost double compared to the combine GLORIA-1420.

The lower hourly productivity of the combine GLORIA-1420 compared to other combines can be explained by the fact that this combine uses a classic thresher and classic sieve and fan cleaning systems.

The threshers of the MDW-525 STS, CLAAS-98SL and JOHN DEERE-1174S combines are for forced power, their working process directly influencing the separation process and the dynamics of separation activity.

By the fact that the power supply flow rate and the percentage of grains separated from ears is greater in these combines compared to those encountered in classical combines, the percentage of unthreshed ears decreases and the percentage of grains that reach the sieves increases.

Another feature explaining the increase in the productivity of these combines consists in the preservation of leaves and light particles by the fan's air current before reaching the upper sieve of the cleaning system. In this way, increasing the percentage of grains on the same area of the sieves, the productivity of hourly sieving increases compared to that encountered in classical systems.

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