ABSTRACT

Keywords: *combine harvesters, cereal crops, technical plants, automation.*

The PhD thesis entitled ”**Research regarding the performance increasement obtained by the cereals and technical plants combine harvesters using the automation elements**” aims to highlight the influence of the elements automation on the combine harvesters’ performances in grain and technical plants crops.

The work is structured in two parts, "***State-of-the-art***" and "***Personal contributions"***, made up of six chapters. The first part of the paper refers to the current state of addressed knowledge issues, including the introduction and two chapters, and in the second part are presented the own research structured in two chapters followed by conclusions and references.

Chapter I of PhD thesis “*Harvest technologies of the cereal and technical plants*” deals with aspects regarding the technological flows and the structure of the combine harvesters machines built by different firms, aspects regarding construction and function of different types of threshing devices, as well as aspects regarding the most common automation elements on the combine harvesters.

In this chapter it is shown that cereals harvesting is an important work in the assembly of production processes from agriculture, over passing 50% from the total production costs of those crops. Cereals harvesting machines and technical systems used in modern agriculture allow a dramatic decrease of workers number involved in agriculture and their orientation for other sectors of activity.

What mainly characterizes the major differences between technological flows of the actual combines is the type of gathering system of the material from cropland and the construction of threshing devices. The great majority of the combines used, nowadays, traditional threshing devices (tangential) with a single beater, but the actual tendency is to use combines equipped with axial threshing devices or with more beaters/rotors for threshing and separation, which allow the increase of working capacity.

Technological flows of the combines with tangential threshing devices. Are presented models of combines manufactured by different companies (firms), indicating on figures the main

component parts of them: dividers, pickup reel, cutter bar, rotating auger, oscillating conveyor, tangential threshing device, straw walker, blower, cleaning system, unloading tube, engine, grain tank, cabin. The presented models are built by the following companies: LAVERDA, MASSEY FERGUSON, FENDT, DEUTZ-FAHR, VASSALI FABRIL, SAMPO ROSENLEV, CLAAS Group, CNH-CASE NEW HOLLAND, JOHN DEERE, NIVA, SEMĂNĂTOAREA S.A.

Technological flows of the combines with axial threshing devices. Are presented models of combines manufactured by different companies (firms), indicating on figures, commonly, main component parts of them: dividers, pickup reel, cutter bar, rotating auger, oscillating conveyor, axial threshing device, straw walker, blower, cleaning system, unloading tube, engine, grain tank, cabin.

The combines' models belong to the following companies (firms): ALLIS-CHALMERS GLEANER, GLEANER, CHALLENGER, MASSEY FERGUSON, FENDT, CNH-CASE NEW HOLLAND, CASE-IH, LAVERDA, JOHN DEERE, SAME DEUTZ-FAHR.

Threshing devices used in construction of cereals harvesting machines. Are presented two categories of threshing devices: tangential devices (with a commonly transversal placement, sometimes longitudinal) and axial devices with a commonly longitudinal placement, sometimes transversal). Are presented the tangential threshing devices from combines: JOHN DEERE (series 1100, 2200, CWS, WTS), FIAT (series L), Massey Ferguson 825, Deutz-Fahr 2780H, Sampo (series Optima), Sampo SR 2075 TS, Laverda (series L, LX), New Holland TC 55, Massey Ferguson (series 20 and 40), Claas Mega, Deutz-Fahr TopLiner 8 XL, Claas Dominator 116 CS, New Holland series TF, John Deere CTS and Claas Lexion 480. Also are presented axial threshing devices (with helicoidally flow): Allis Chalmers Gleaner, Laverda MX 300, IHC 1440, Case IH 1680, Case IH series 2100 and 9000, New Holland CR 9090, John Deere 9880 STS.

In the second chapter entitled "*Current state of the research on the automation of the cereal and technical crops' combine harvesters*" with aspects relating to general concepts about industrial automation and automation aspects relating to existing automation elements in the construction of various types of combine harvesters.

Currently, the workload on the combine's operator is reduced even more by introducing the automation routines, such as start routines with the implementation of operations, engine and transmission control routines based on different work, automatic harvester control settings routines strategies,etc.

The agricultural machines assisted driven by human operators helps reduce the complexity and difficulty of operating in the field, as well as to improve the efficiency of

operations by keeping overlapping and omissions to a minimum in various field works.

The amortization of investments made in precision agriculture has the shortest period in the equipment's acquisition that implements GPS technology. In most cases, the initial investment is recovered in less than one crop year, given that, the use of these technologies greatly reduce losses. Auto Guidance conducted using GPS technology can reduce successive crossings over the rows which have been already passed over, thus saving fuel and reducing unnecessary wear and tear of the combine harvesters.

The **Chapter III** of the work "*The purpose and objectives of the thesis*" presents the issues to be pursued in the paper. The importance and objectives of the thesis are presented. We established the machinery that will be experienced, the qualitative indices which will calculated the energetic and operating indices, as well. It will also be calculated the optimal driving speed for each type of combine and for each crop. The most important objective is to establish the influence of the automation elements on the performances obtained by the combines in cereal and technical plants crops.

The **fourth chapter** of the thesis "*Material and research method*" presents the organizational and institutional framework for the conduct of research and experimental protocol, then makes the description of machinery, equipment, systems, devices and field crops used in the experiments.

The "Balta Ialomiţei (FACAENI)" farm where the experimental research took place, belongs to "SC Zimbrul SA" and is located about 55 km from the city of Slobozia, approximately.

The experimental research studied the behavior of two combine harvesters: the Claas Lexion 750 combine - the standard equipped model and the Claas Lexion 750 combine – the automated model, equipped with the following automated elements: CEMOS AUTOMATIC ™, CAM PILOT ™, GPS PILOT ™, LASER PILOT ™, AUTO PILOT™ and CRUISE PILOT ™. These combines were used to harvest the following field crops: winter wheat, corn grain, winter rape and sunflower.

The tracked work quality indices were presented (the total loss of seeds, the injury of the seeds degree, the purity of seeds degree, comparing each one with the imposed agronomic requirement), the energetic indices (the working speed, the hourly fuel consumption, the power required to operate the combine) and the operating indices (17 indices, of which the most important are: the shift time usage coefficient, the safety in operation coefficient, the 8 hour shift work capacity, the specific fuel consumption expressed in liters / tone of seed).

The established experience is a multifactorial one, the variants are represented by

different combinations of factors' graduations, in which we pursued the concomitant influence of three experimental factors on the performances of combines in cereal and technical plants crops harvesting.

In the **fifth chapter** of the thesis "*Researches regarding the evaluation of the quality, energetic and working indices of the combines in cereal and technical crops' harvesting*" we are presenting the experimental results obtained by determining the work quality indices, the energetic and operation indices of the both combines while harvesting the following crops: winter wheat, corn grain, winter rape and sunflower.

Analyzing the results obtained when the safety operating coefficient was calculated, is noted that the order in which the two combine lies, starting with the the best one, is: the Claas Lexion 750 – the automated model, in technical plants harvesting (1st place), the Claas Lexion 750 - the automated model, in grain crops harvesting (2nd place), the Claas Lexion 750 - the standard model, in grain crops harvesting (3rd place) and the Claas Lexion 750 - the standard model, technical plants harvesting (4th place). It should be noted that in the Claas Lexion 750 combine - model automated case, the technical safety coefficient (K42) has reached the maximum value possible of 1,000 on both of grain crops and of technical plants harvesting processes.

Based on the results' analysis when talking about the 8 hours shift work capacity, it was established that the position order of both combines, starting with the best one was as follows: the Claas Lexion 750 – the automated model, in technical plants harvesting (1st place), the Claas Lexion 750 – the automated model, in grain crops harvesting (2nd place), Claas Lexion 750 - the standard model, in technical plants harvesting (3rd place) and Claas Lexion 750 - the standard model, in grain crops harvesting (4th place).

Considering the results presented on the specific fuel consumption, we established that the order in which the two combines fall in grain and technical plants crops' harvesting, starting with the best one, is: the Claas Lexion 750 - the standard model, in grain crops harvesting (1st place), the Claas Lexion 750 – the automated model, in technical plants harvesting (2nd place), the Claas Lexion 750 - the automated model, in grain crops harvesting (3rd place) and the Claas Lexion 750 - the standard model, in technical plants harvesting (4th place).

The **Chapter VI**, entitled "*Final conclusions*" is a summary of the conclusions that ends each chapter of the thesis, grouped into general conclusions and conclusions over the experimental research results.