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STUDIES ON THE FARM MACHINERY MANAGEMENT

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Abstract

The paper presents studies and researches made on machines performance, which is one of the most important component of the economic performance of a farm. We made measurements for determination of work quality and energetic index for tractors, considering that tractors are the main energetic power used in modern agriculture anywhere, that is why the improving of the quality and energetic index of tractors and machines is very important. The aim of the research is to improve power performances and to increase the efficiency of tractors and agricultural machines. The productivity is one of the most significant characteristics of tractors and agricultural machines, especially of harvesting machines, which are the most important machines for harvesting cereals. We wanted to emphasize that designing and making these complex agricultural machines has much evolved in the last years, from the productivity point of view and from the design and interior comfort as well.

Key words**:** *productivity, fuel consumption per hour, effective work speed, tractor efficiency, machine performance, machinery management*

INTRODUCTION

In present days, farm machinery management is a section of farm management that deals with the optimization of the equipment phases of agricultural production. The importance of this part of farm management is increasing more and more, because a modern agriculture is based on performing machinery.

As a result, the quality management of agricultural products represents the activity of planning, organization and control undertaken by one or more persons in order to combine the factors that lead to the increasing quality of the obtained products, in the conditions of internationalization of human activity. Quality management of agro-food products is required to start from two premises: is an area of management, and as a result, the basics of management, including the theoretical foundations, are found in quality management of agro-food products; has a high specificity in relation to the classic management that comes from the nature and content of the quality of the agro-food products. [1]

The 3 components of economic performance are: machine performance, power performance and operator performance [4]. From these 3 components, in this paper we shall refer especially to machines performance. When we refer to machines in an agricultural farm, we refer first to tractors, which are indispensable to any farm and then to agricultural machines.

From all agricultural machines that operate all over the world, the cereal harvesting machines are the most complex machines, which make all the technological operations in the technological process of harvesting the main product of cereals: the grains. They were at first designed only for harvesting grain cereals, but later these were endowed with work equipment for harvesting other weeds, such as: corn, sun flower, peas, beans etc.

The cereal harvesting machines can be classified after many criteria, being such complex machines as they are. In this paper we shall present only particular aspects of classifying these machines and the main adjustments that can be made to them in order to improve one of their most important characteristic, which is productivity.

In what concerns the way in which we can increase machine productivity, it is very important to introduce innovation in the domain of agriculture, because it is considered that in the following decades the agricultural production must increase with approx. 70 %, in order to satisfy the world's food necessities. [2]

MATERIALS AND METHODS

In order to determinate the work index of tractor, a few trials were made in the experimental field. Different work was made on sandy soils after corn harvesting. There were established quality work index such as: work depth and widening with respective deviation, the establishing in vertical and horizontal plane of the aggregates, the mincing degree of the plowed soil, the covering degree of vegetal waste, the plowing profile, etc.
In what concerns the harvesting machines, we tried more adjustments to be made on these machines for increasing productivity. Generally, any adjustments are made in order to improve a certain characteristic of the machine. In our case, we wanted to made adjustments in order to improve, if possible, the productivity of these machines. The technological adjustments are made depending on weeds, density, humidity, the state of the field etc. Their role is to achieve an optimal harvesting process, without loss of harvest and thus, to increase productivity.

RESULTS AND DISCUSSIONS

The determination of quality work index
A first index determined in our researches was the medium depth of work. This parameter was determined with a precision under 1 cm, from 5 to 5 m, on the whole length of the lot, from 10 trials.
$a_m = \sum a / n$ [cm], [5]
where
a_m = medium depth of work [cm]
a= the depth measured in furrow [cm]
n = the number of measurements.
The medium deviation of work depth was calculated as an arithmetic medium of the deviations of measurements, considered in absolute value towards the medium depth.
The covering degree with vegetal waste was determined through dividing the quantity of vegetal waste remainedon the surface of the lot to the total existing quantity established before the beginning of plowing. Each sample consisted of determining the vegetal waste berried in furrow on a surface of 10 cm^2 of plowing. The covering degree with vegetal waste must be over 90 %. Between the work quality index determined, it was the medium widening of the plow. This parameter was determined through dividing different plow widening to the number of measurements. The widening of the plow was lots were chosen, thus the ground should not have significant slopes.
The trials on the lots were made on determined through the difference between 2 measurements made in the spots, in which the depth of the work was determined too. The measurements were made from the furrow wall to the determined points from the un-plowed field, marked through sticks with a distance of 15 cm between them.
The determination of energetic index was made measuring the specific resistance to plowing.
The specific resistance to plowing, K
$K = R / S$ [kgf/cm^2] [5],
where:
R = the resistance to traction force of the plow [kgf]
S= the furrow section [cm^2].

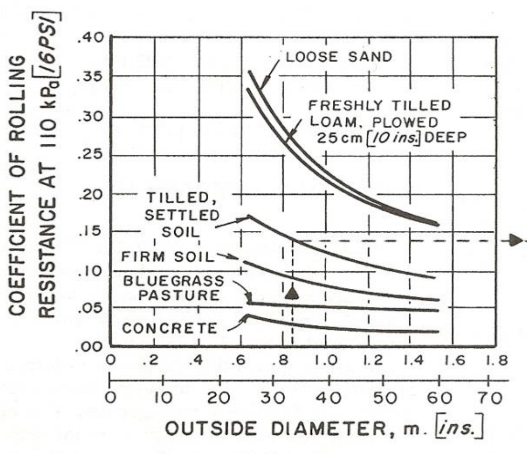

Fig. 1. Specific resistance of tractor rolling depending on the type of soil
Source: own determination based on [7].

The results obtained at samples for 2 aggregates were read and, based on the medium obtained through reporting to furrow section, we obtained the specific resistance of plows at plowing (Fig.1).

Other parameters which were determined were: the fuel consumption per hour, the effective work speed, the technical efficiency per hour, the fuel consumption per ha and tractor efficiency. The results concerning the fuel consumption, depending on the type of the engine of tractor are presented in Table 1.

Table 1. Fuel efficiency

Loading % max.	Gasoline	Diesel		
		Natural aspirated	Turbo	Turbo and cooled
100	2.17	2.90	3.07	3.09
80	1.96	2.84	2.82	2.86
60	1.63	2.60	2.55	2.59
40	1.28	2.13	2.10	2.15
20	0.83	1.38	1.36	1.42

Source: own determination.

Particular aspects of harvesting machines

Considering the supplying output of the threshing machine the combines can be divided in 2 categories: with small output of supplying (< 3 kg/s), with medium output (3-8 kg/s) and with high output (> 8 kg/s).

Considering the technological flows point of view, the cereal combines can be divided in: combines with tangential threshing machine and combines with axial threshing machine. In the first case, the threshing machine is positioned transversely, the material flow entering perpendicular on it. The material is taken from the central transporter and put in the threshing machine, where it is stricken by the beater bars approximately tangential.

The combines with axial threshing machine has the threshing apparatus put axial on the longitudinal axe of the combine, the flow of material moving after a helicoidally trajectory and is separated due to centrifugal forces and friction and not due to stricken. They have small supplying output and a working widening of 1.5-2.2 m.[7]

Considering the technological flow geometry, the cereal harvesting machines can be divided in 2 categories: with direct flow (the moving direction of material is not modified) and with indirect flow (material from technological flow modifies its moving direction). From the form of the technological flow direction point of view, combines with indirect flow can be divided in : combines with flow in L shape and with flow in T shape (self –propelled with supplying output over 15 kg/s and with working widening of 2.1-7.3 m. The most frequent are combines with indirect flow in T shape, because they can enter the field without needing access ways, need small turning zones and have a good stability [3].

The grain cereals combines can be equipped with a device for pressing and balloting straws. The bales have a volume mass of 50-100 kg/m3, a length of 900-1,200 mm, wide of 250-800 mm and height of 250-300 mm. The engines used for combines are with internal combustion, usually with ignition through compression.

Their nominal power can be situated between 30 and 170 kW at a nominal speed of 1,500-3,000 rot./min. The new harvesting machines cabins are completely automatized and computerized and the design of the cabin is impressive (for example, Massey Ferguson combines and Claas combines).

From the most used adjustments made, we can remind: the cutting height adjustment, the cutting apparatus adjustment, the creeper transporter adjustment, the adjustment of turation of the beater, the adjustment of the distance between beater and counter-beater, the adjustment of the recovery circulation, etc.

At the present time, the biggest combine of the world is John Deere STS, having a power of 465 HP, with cylinder capacity of 12.5 L and a very small specific consumption.

This combine has a tank of 11,000 L capacity, cu cabin Ultra-deluxe, with a special comfort, including a system of monitoring and charting through satellite, using GPS position satellites.

In Fig. 2 is presented the cereal combine JOHN DEERE 2266 E. Its working process is presented in Fig. 3.

Fig. 2. Cereal combine JOHN DEERE 2266 E
Source: [5]

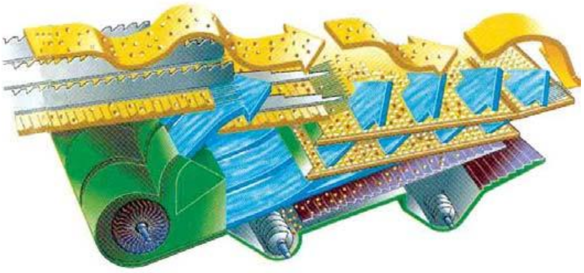

Fig. 3. The working process of cereal combine JOHN DEERE 2266 E
Source: [5]

In Fig. 4 is presented the most recent product of the American firm New Holland, the combine CX 880 de 375 CP, launched in 2002, provided with control system through satellite, with central commands to a single hand lever.

In the latest years, the designing of the component parts of the cabin is realised on computer, with the aid of special designing programs (fig.5). The threshing process simulation can also be made on computer. As a result, these harvesting machines are very performing.

Fig. 4. The cereal combine NEW HOLLAND Seria CX
Source: [5]

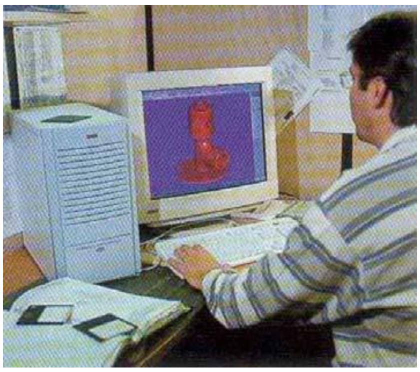

Fig. 5. Designing of the component parts of combine with computer
Source: [5]

CONCLUSIONS

In any farm, the machinery management is a very important part of this business. Among the machines used in farm, in this paper we referred to tractors and harvesting machines, because we considered them the most representative for machinery park of a farm.

The harvesting machines, especially the combines, are some of the most complex machines used in modern agriculture, that is why the increasing of their productivity is very important in farm machinery management. The paper presents some new aspects concerning these machines, taking in consideration the latest development at world level. These machines are designed by computer and the manufacture technology has been changed very much, using robots in some parts of the manufacture technological process.

It is very clear that agriculture is of great importance , not only to the people, but in the country as a whole. Steps and measures should be taken to improve agriculture ways, thus making it a powerful sector to trade for. Special attention should be given to this sector so that farmers use the latest technology for agriculture that results in higher yield. Better the agriculture, higher will be the growth of the nation. [6]

Farms are characterised by a dual structure. In our country, there are about three million small scale and semi-subsistence oriented farms on the one side and just about 13,000 farms cultivating 100 ha and more on the other. These large farms cultivate about one half of the total utilised agricultural area. Medium-sized farms cultivating 5 – 50 ha are almost missing. This fragmentation of agricultural producers prevents efficient operation of small-scale farms. In general, these farms operate in isolation and lack adequate access to financial services, marketing channels, input supply and extension services [8]. These differences between farms are given, mostly, by the size of machine park which the firm has. A large farm can be considered so, only if it has a proper machine park, which is also well managed. So, in order to have in our country a performing agriculture, we must give a bigger attention of the farm machinery and of the way it is used and managed.

The extent to which mechanization is possible depends not so much on engineering technology, as on the economics of applying the machinery. Each year, however, the cost of labour rises and its availability decreases, thus bringing ever closer the time when all crops will be mechanized.

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