

## TECHNICAL-ECONOMIC ANALYSIS ON FORAGE MOWERS

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### **Abstract**

*One of the most important stage in the agricultural process is harvesting. In this particular stage, the mower machines are some of the most important machines for harvesting forages used in agriculture, that is why we made this study. These machines are usually attached to tractors for a better efficiency. The paper presents some studies on mower machines, which are analysed after their cutting apparatus and their work width. Thus, are presented the mower with cutting apparatus through shearing, with cutting apparatus with back and forth motion of the knife, then rotary mowers. Also, in the paper are presented and analysed some technical characteristics of mowers, which influence their economic performances. From the economic point of view, considering the engine mowers, we concluded that the mowers with 2 knives have a better work capacity, at the same width of mowed furrow, compared to borne mowers.*

*Key words:* cutting apparatus, mower, technical-economic characteristics

### **INTRODUCTION**

In modern agriculture, almost all stages of production are mechanized, thus the labour productivity is much increased, so agriculture can be one of the most profitable branch of economy. In this respect, the harvesting process is one of significant importance. Mowers are some of the most important machines for harvesting forage plants, that is why their technical and economic characteristics must be competitive.

In a market economy, the correct allocation of factors of production is the basis for effective management. Analysis of the world's agricultural diversity indicates the existence of some general regularities, based on which the proportions of the factors of production are arranged, determining the level and structure of agricultural production costs. In each country there are in a particular historical moment some resources of production factors, which determine their supply and prices. This in turn affects the way the management of enterprises by the choice of the optimal production techniques. Pricing system makes the combination of factors of production in each country and in all circumstances different.[6].

Technological structure of agriculture is

expressed by farmers' access to the intensification factors referring to: the means of mechanization (tractors, machinery, equipment, facilities and equipment for mechanization of various work processes), biological means also chemical means. The means of mechanization have a direct and indirect labor productivity growth through working on the optimal time and quality (compared with simple manual means) and represent a production factor of economic growth. Quantifying the endowment level of a territory or an enterprise is achieved by analyzing the following indicators: a. structure of the tractors and agricultural machinery. Direct factors influencing the level and structure of the tractors and agricultural machines are: crop structure and the area occupied by each crop; each crop technology (optimal period of works, the possible mechanization of agricultural operations etc.); production and distance to be transported; types of existing manufacturing equipment; mechanization cost per hectare with different types of aggregates. b. degree of equipping with agriculture machinery needed for the works at the right time has the following values: tractors 58%; combine harvesting crops 94%, plows 49%, seeders 80%. [7]

The general indicators, influencing factors and economic efficiency of the tractors park and agricultural machinery, are: total production value units for a conventional tractor and physically; average annual yield per the tractor, plowing hectares, normal hours of actual use. The factors affecting the economic efficiency of mechanization are: construction and operating skills for tractors, agricultural machinery, facilities and parts; framing the optimal operating limits for the mechanical means; professionalism of exploitation; price of mechanical means - tractors, agricultural machinery, installations; the price of fuel, lubricants and spare parts. The efficiency of the tractors and agricultural machinery depends on the following factors: provision of effective technical means; rational use of technical means.[7]

To increase labour productivity, it is needed to assure a modern technical endowment, the knowledge transfer to farmers, the increase of their training level and managerial skills, the intensification of the extension system services, the stimulation of young farmers and women to develop business in agriculture and traditional activities and services, the assurance of funding for investments and modernization, the creation of jobs and new income sources for the agricultural employees and rural population. Only in this way, profitability and competitiveness could be grown in agriculture.[10]

Generally, mowers are used for harvesting through cutting of forage plants and leaving them in continuous furrows. Mowers are different by the type of cutting apparatus, the work width and the way of coupling to energy source.

If we want to classify mowers after cutting apparatus, there are the following categories:

-Mowers with cutting apparatus with back and forth motion of the knife (cutting through shearing), which are the most used in present

-Mowers with rotating cutting apparatus

The mowers are frequently made with work widths of 1,5 - 2,1 m and are laid sidewall in the back of tractor or sidewall between the front wheels and the back wheels of tractor.

## MATERIALS AND METHODS

The study was made on the existing mowers from the Agriculture machines laboratory of our department. We studied different types of mowers, concerning the cutting apparatus and functioning, after which we compared the technical characteristics of each of them. These studies were made by comparing the functioning diagram of each of mower machines presented in the paper.

## RESULTS AND DISCUSSIONS

### Mower with cutting apparatus through shearing

This type of mower consists of a frame on which is mounted the cutting apparatus and actioning mechanisms, of lifting and adjustment. The mower frame is mounted directly on tractor chassis.

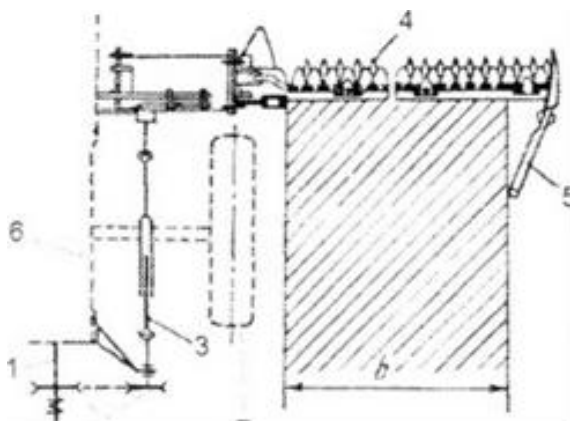


Fig. 1. Mower with cutting apparatus with back and forth motion knife

1- transmission through belt wagaş 2- straight axle ;3- cutting apparatus; 4- furrow limiter; 5- tractor transmission case; 6- tractor wheel roata tractorului; b – furrow width

Source: [3]

As it can be observed from fig.1, the working part of this mower is the cutting apparatus, which is formed of a steel support bar of trapezium shape, which has at the ends 2 supporting slides.

On the support bar are placed the fingers, which have the purpose of dividing the field in narrow slides, as well as to support plants during cutting. On the cast fingers are placed, through riveting, countercutting steel plates

[1]. The knife consists of a steel bar, on which are layed through riveting the cutting slides of trapezium shape, with side tags sharpen.

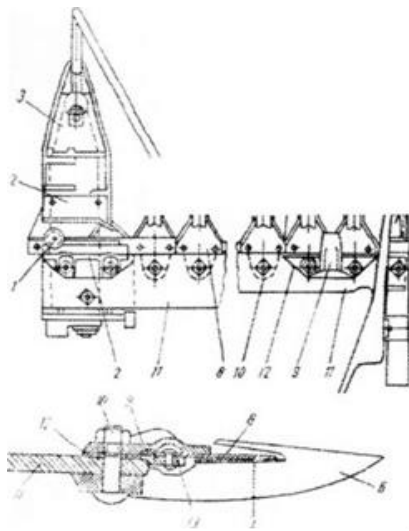


Fig.2. Mower cutting apparatus

1- the sphere joint of bear-knife bar; 2 - knife guideway; 3- interior slide; 4- cutting counter-plate; 5- fingers shoulders; 6 - fingers 7 - exterior slide; 8- knife blade; 9 - pressure plates; 10- support bar of fingers; 11 - guideway plate; 12- bear-knife bar  
 Source: [4]

The knife actioning is made from the connecting rod-crank mechanism or mechanisms with oscilation pulley. These mechanisms are acted from the power of tractor, throught some transmissions adequate to mower position toward this [11].

The work widths of the cutting apparatus depends on the energy source and the degree of land unevenness and is situated between 1,5 - 3 m.

### Rotary mowers

Rotary mowers have a rapidly rotating bar, or disks mounted on a bar, with sharpened edges that cut the crop. When these mowers are tractor-mounted they are easily capable of mowing grass at up 32km/h in good conditions. Some models are designed to be mounted in double and triple sets on a tractor, one in the front and one at each side, thus able to cut up to 6 metre swaths.

In rough cutting conditions, the blades attached to the disks are swivelled to absorb blows from obstructions. Mostly these are rear-mounted units and in some countries are

called scrub cutters. Self-powered mowers of this type are used for rougher grass in gardening and other land maintenance.



Fig. 3. Rotary mowers  
 Source: en.wikipedia.org

These type of mowers are formed by an fullcrum frame, which has actioning transmissions. On this frame are placed 2-4 rotating tambours, which have articulate knives, which rotate with peripheral speed of 60-80 m/s.

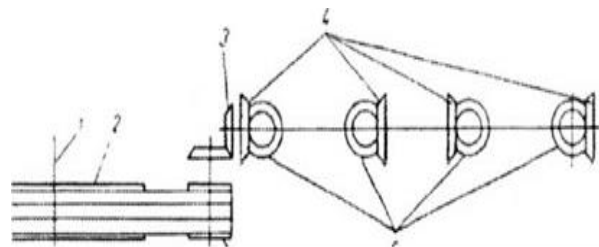


Fig. 4. Rotary mower  
 1 - power axle 2 - transmission through belt wedge; 3, 4, 5- transmissions with gear cone  
 Source: [4]

În fig. 5 a is presented the diagram of a rotary cutting apparatus with cutting blades of trapezium shape. The knives (1) (fig. 5b) are placed on disk (2), mounted straight on axle (3).

In the lower part, on axle (3), is mounted free the supporting disk (4). On disk (2) is placed a cylinder with blades (5).

The cutting apparatus cuts the plants through beating, without a counter-cutting part [2]. The absolute trajectory made by a point on the knife is an elongated cycloide (fig. 4.5, c), in which:  $r$  - the distance from the rotating axle

of the disk to the considered point;  $\omega$  – the angle speed of the disk;  $h_a$  – the space covered by the machine;  $v_m$  – machine speed. The rotary cutting apparatus functions with 3000 - 3500 rot/min and plants cutting is made with speeds of 45 - 80 m/s.

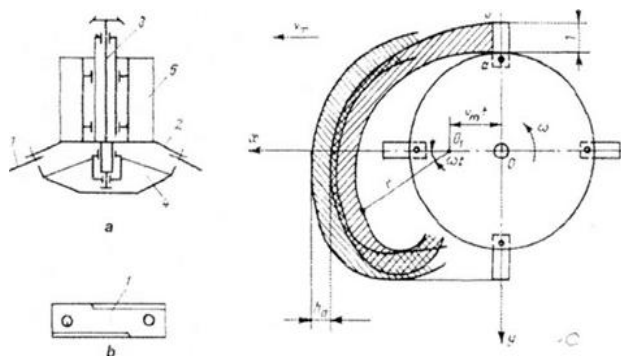


Fig.5 . Rotary cutting apparatus  
 1- knife; 2 - plate; 3 – vertical axle; 4 – supporting disk  
 ; 5 – cylinder with blades  
 Source: [5]

### Engine mowers

In order to mow plants on small surfaces or lands with an angle of elevation over 15 %, engine mowers with thermal engines are used, usually engines in 4 times, with a power of 4-10 kW [2]. The engine mowers frame is supported on small tire wheels, because the weight center is wanted to be as close to earth as possible. The cutting apparatus is the type of middle cutting, which has a widths of 0,9 - 1,6 m and is actioned from the center or by sidewall [8].

Table 1. Technical characteristics of mowers

No. crt.	Technical characteristics and work index	Types of mowers	
		Borne mower HP-40	Mowers with 2 knives CDC - 1,8
1	Work width (m)	1,8	1,8
2	Actioning	U-445	U-445
3	Knives joint (mm)	76,2	38,1
4	Knives number of motions per minute (motions/minute)	735	1035
5	Machine weight (kg)	145	156
6	Cutting height (mm)	50-60	40-60
7	The width of mowed furrow (m)	1,5	1,5
8	Work capacity (ha/day)	8,0	10,0

Source: Own calculation.

In table 1 are presented some mowers and engine mowers used in our country with their main characteristics.

From Table 1 it can be observed that from the 2 different types of mowers analised, at comparable machine weight, the mowers with 2 knives have a better work capacity, at the same width of mowed furrow, compared to borne mowers, that is why they are preferred to be used for a better efficiency.

### CONCLUSIONS

In this paper we have studied the technical characteristics of different types of mowers, considering the fact that technical characteristics are those which determin the efficiency of an agriculture machine. Thus, mower with cutting apparatus through shearing are the most used in present. They have a cutting apparatus with back and forth motion knife. The knife is actioned from the connecting rod-crank mechanism or mechanisms with oscilation pulley. This type of mower is recommended when the degree of land unevenness and is situated between 1,5 - 3 m.

Rotating mowers have a rotating cutting apparatus, which enable machine to cut plants with a with speeds of 45 - 80 m/s.



Fig. 6. Forage mower  
 Source: en.wikipedia.org

On the other hand, if we have to mow plants on small surfaces or lands with an angle of elevation over 15 %, engine mowers with thermal engines are recommended to be used. From the economic point of view, the mowers with 2 knives have a better work capacity, at the same width of mowed furrow, compared to borne mowers, that is why they are

recommended to be used in order to obtain a better productivity.

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