

ESTABLISHING QUALITATIVE INDEXES, ENERGETIC AND EXPLOATATION INDEXES FOR HARVESTING MACHINES TO FODDER PLANT AND SILO

STABILIREA INDICILOR CALITATIVI DE LUCRU, AI INDICILOR ENERGETICI ȘI DE EXPLOATARE PENTRU AGREGATELE DE RECOLTARE A CULTURILOR FURAJERE PENTRU FÂN ȘI SILOZ

BĂRBIERU V., SÂRB V., GHERMAN V., MORAR M.

University of Agricultural Sciences and Veterinary Medicine from Cluj-Napoca, Romania

The experiments were focused on testing fodder harvesting machines in order to establishing qualitative index, energetic and exploitation indexes for these units with Romanian tractors U-445 and U-651M. Researches were done on different fields, fodder, climate and soil slopes, effective realization of experiments and experimental data recording were made using the methodology approved by M.C.T. respecting ASAE and ETAMA norms. The effective productivity for rotary mower GMD-44 and rotary rake GRS-24 with U-445 tractor are bigger then Romanian agricultural machines for fodder plant harvesting. Self loading machine LW-220T Pico and Silo-harvesting combine Vicon MH-90S Twin with U-651M tractor eliminate handling operations, a high quality of maize silo, but for Silo combine is recommended to use a tractor with a higher power (up to 80 HP).

Key words: Fodder harvesting machines, qualitative index, energy and exploitation indexes

Introduction

An essential condition for cattle farms success is to have a good fodder quality at low costs. In this context a research team from Mechanization Department USAMV Cluj-Napoca, has carried during several years, studies of work qualitative index and energy index to four fodder harvesting machines which will be presented in this work paper. The tests were made for different fodder on many plots with soil slopes until 8°, using the methodology approved by M.C.T. for experimental data.

Materials and Methods

The fodder harvesting was made on two different plots of natural meadow, one of “Alfa-Alfa” and one of maize silo:

- Plot “summer camp”, slope until 4°, average plant height 1.28 ± 0.25 m, green mass 50.6 to/ha, with floristic compound: Dactyllis glomerata 70%, Alopecurus pratensis 10%, Festuca pratensis 6%, Trifolium repens 5%, other plants 9%;
- Plot “pe dos”, slope 6 - 8°, average plant height 0.62 ± 0.3 m, green mass 31.2 to/ha, with floristic compound: Dactyllis glomerata 30%, Poa pratensis 25%, Festuca sp. 40%, Nardus stricta 2%, trifolium repens 2%, other plants 1%.
- The “Alfa-Alfa” called “Florești Hill” plot, with slope 5-6°, have average plant height 0.67 ± 0.1 m and green mass 36.4 to/ha;
- Plot “Ferma didactică” with corn silo, have average plant height 1.93 ± 0.2 m, green mass 52 to/ha.

➤ For hay crops were used next units:

- Tractor U-445 with rotary mower with discs GMD-44, for fodder harvesting;
- Tractor U-445 with rotary rake GRS-24, for scattering and gathering;
- Tractor U-651M with self loading machine LW-220T Pico for gathering and transport.

➤ For maize silo were used unit composed by Tractor U-651M with Vicon MH-90 S Twin silo harvesting combine and for transport RM-2 trailer.

To establishing all indexes were measured the length and large of the breadth, working times and fuel consumptions measured with a special device (debitmeter), in order to calculate: work productivity (W_{ef}), working index (K_{07}), specific fuel consumption (l/ha).

Results and Discussions

The experimental results will be presented synthetically in graphics and tables for each unit:

❖ **Tractor U-445 + rotary mower with discs GMD-44.** The working breadth large, accidental deviation of working breadth and the deviation index are in normal limits (fig. 1)

The working speed of mowing (table 1) was between 5.4 and 9.0 km/h with step velocity III Medium (III M) and I Rapidly (IR). The fuel consume fluctuated between 2.70 and 5.37 l/h and specific fuel consume (l/ha) were between 4.00 – 8.07, depend by green mass yield, soil slope and plot dimensions, as well as effective productivity which are between 0.63 and 1.081 ha/h.

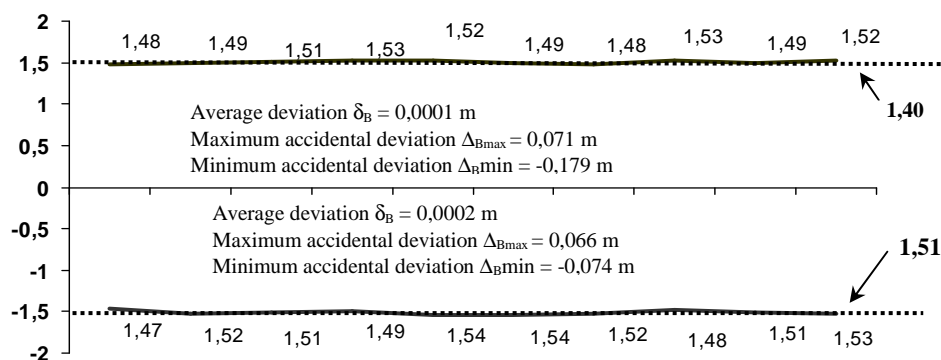


Fig.1 The working breadth mowing

Table 1

Energy and exploitation indexes for U-445 + GMD-44

Velocity step		Velocity [km/h]	Fuel consume [l/h]	Effective productivity [ha/h]	Specific fuel consume [l/ha]	Obs.
1.	III M	6.00	5.09	0.630	8.07	Plot "Summer camp" Green mass 50.6 to/ha,
2.	I R	8.35	4.68	0.931	5.02	
1.	III M	6.54	5.37	0.782	6.84	Plot "Pe dos" Green mass 31.2 t/ha,
2.	I R	8.18	4.75	0.981	4.48	
1.	III M	5.40	2.70	0.645	4.21	Plot "Florești hill" Alfa – Alfa Green mass 36.4 to/ha
2.	I R	9.00	4.32	1.081	4.00	

❖ **Tractor U-445 + rotary rake GRS-24.** To gathering the breadth and the profile of windrow depend by adjusting rake screens, with elevation in the middle part (fig. 2) and to scattering operation the fodder density depend by green mass yield (fig. 3). The fodder losses leftover on stubble are below 1.7%, which is less than admissi

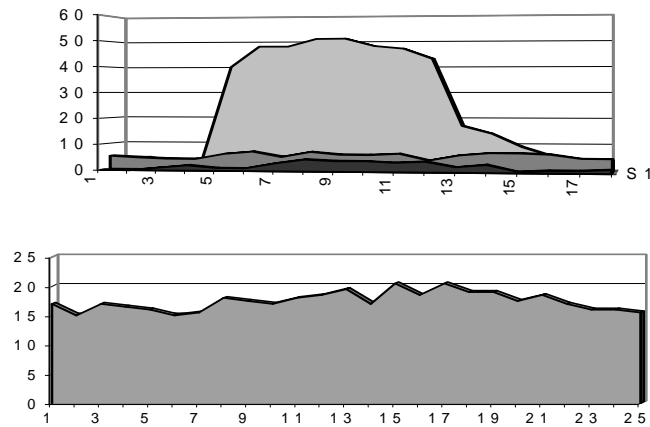


Fig. 3 Scattering windrow profile

Concerning energy and exploitation index (table 2) such as effective productivity to gathering the breadth are between 1.05 and 1.79 ha/h and to scattering are between 1.13 and 2.27 ha/h, with a fairly low consume between 1.50 to 2.55 l/ha at gathering and 1.04 to 1.59 l/ha to scattering. Optimum velocity steps are I Rapidly (I R) and III Medium (III M), but the velocity can be increase if the field is flat without molehills or grooves.

Table 2

Energy and exploitation indexes for U-445 + GRS-24

Velocity step	Velocity [km/h]	Fuel consume [l/h]	Effective productivity [ha/h]	Specific fuel consume [l/ha]	Obs.	
1.	III M	5.47	2.68	1.053	2.55	Gathering, plot "Summer camp", Green mass 50.6 to/ha,
2.	I R	8.15	2.69	1.797	1.50	
3.	I R	6.37	1.53	1.715	1.54	Gathering, plot "Florești hill" Alfa – Alfa Green mass 36.4 to/ha,
4.	I R	6.84	1.56	1.36	1.57	
1.	III M	5.14	1.80	1.13	1.59	Scattering, plot "Summer camp" Green mass 50.6 to/ha,
2.	I R	10.3	2.36	2.27	1.04	
3.	I R	7.0	1.18	1.57	1.18	Scattering, plot "Florești hill" Alfa – Alfa Green mass 36.4 to/ha,
4.	I R	8.9	1.28	1.70	1.28	

❖ **Tractor U-651M + self-loading machine LW-220T Pico**

The breadth at gathering is up to 1.5 m, when green mass is gathering plant losses leftover are very low (0.5%), but to hay gathering the plant losses increases to 1.2 %. The energy and exploitation indexes for U-651M + LW-220T Pico (table 3) were recording for velocity step II Rapidly (II R), which was considerate optimal after other testing for velocity steps. The effective productivity was between 0.96 and 1.5 ha/h, with specific fuel consumes between 9.9 and 13.3 l/ha, the results depends by green mass yield, the distance between plot and crop storage platform and road conditions.

Table 3

Energy and exploitation indexes for U-651M + LW –220T Pico

Velocity step	Velocity [km/h]	Fuel consume [l/h]	Effective productivity [ha/h]	Specific fuel consume [l/ha]	Obs.
1.	II R	5.85	0.965	11.34	Plot "Summer camp" Green mass 50.6 to/ha,
2.	II R	6.10	1.001	13.33	
1.	II R	6.42	1.04	9.92	Plot "Florești hill" Alfa – Alfa Green mass 36.4 to/ha,
2.	II R	6.66	1.52	10.0	

❖ **Tractor U-651M + silo-harvesting combine VICON MH – 90S Twin**

Vicon MH – 90 S Twin is a tractor mounted silo-harvesting combine for two maize rows, the drummer was working at 1600 rpm and was equipped with 10

knives. The harvested maize loaded in the **RM-2** trailer during the combine unit work was transported to the silo storage pull by the help of a second U-650 M tractor.

According to the unit power balance it was used the 1-st gear step, the 2-nd one lead to engine smoke limit. The ground speed (table 4) was between 3.02 and 3.07 km/h, with 32.87 to 35.77 l/ha. The effective productivity was between 0.178 to 0.189 ha/h, in these conditions the mean specific fuel consumption has the value of 0.8 l/tonne of maize silo.

Table 4

Energy and exploitation indexes for U-651M + VICON MH-90S Twin

Velocity step		Velocity [km/h]	Fuel consume [l/h]	Effective productivity [ha/h]	Specific fuel consume [l/ha]	Obs.
1.	I - slow	3.05	12.07	0.427	32.87	USAMV didactical farm, maize silo 35 t/ha
2.	I – slow	3.02	12.80	0.423	35.18	
3.	I - slow	3.07	13.23	0.430	35.77	
4.	I – slow	3.03	12.53	0.424	34.36	USAMV didactical farm, maize silo 52 t/ha,
5.	I - fast	Smoke limit				

Conclusions

After six years of testing of these agricultural machines there are important conclusions and recommendations such as:

1. The high quality results of these four agricultural machines for different fodder, climate and humidity of plants and soil, recommended the using in fodder plant harvesting technologies;
2. The effective productivity for rotary mower GMD-44 and rotary rake GRS-24 with U-445 tractor are bigger then Romanian agricultural machine used for fodder plant harvesting;
3. Self loading machine LW-220T Pico and Silo-harvesting combine VICON MH-90S Twin with U-651M tractor eliminate handling operations, a high quality of maize silo, which recommend them to be assimilate in our agricultural machines factories;
4. The specific fuel consumption is influenced by green mass yield, for silo-harvesting combine VICON MH-90S Twin is recommended to use a tractor with a higher power (up to 80 HP)

Bibliography

1. **Bărbieru, V., V. Sârb, I. Drocaș, V. Gherman, Al. Naghiu, O. Ranta** (2000) – *Încercări experimentale privind utilizarea rațională a agregatului U-*

650M + R.T. la adunatul furajelor , Simpozion Național Cluj-Napoca, volum XXVI, pag. 470-472.

2. **Bărbieru, V., V. Sârb, I. Drocaș, V. Gherman, Livia Naghiu, A. Molnar** (2001) – *Laboratory-field testing and in exploitation for rotary rake GRS-24*, Buletin USAMV Cluj-Napoca 55-56, pag, 157.

3. **Sârb, V., V. Bărbieru, I. Drocaș, O.Ranta** (2002) – *Research concerning rotary mower with discs GMD-44 to fodder plant harvesting*, Buletin USAMV Cluj-Napoca 57, pag. 200 – 204.

4. **Sârb, V., V. Gherman, Livia Naghiu, M. Morar, V. Bărbieru** (2004) – *Research upon the energy and working indexes of the Vicon MH-90S Twin silo Harvesting combine*, Buletin USAMV Cluj-Napoca 60, pag.157 – 161.