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ASSESSMENT OF SELF-PROPELLED E-301 FORAGE WINDROWER FUEL CONSUMES IN ROMANIAN PLAIN

CERCETĂRI PRIVIND CONSUMURILE DE COMBUSTIBIL LA LUCRAREA DE RECOLTARE A FURAJELOR CU AGREGATUL AUTOPROPULSAT DE COSIT E-301 ÎN ZONA CÂMPIEI ROMÂNE

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Abstract. Forage harvesting is one of the most important operations in grassland technology. Optimal timing and duration in performing such operation provide better forage quality. Specific fuel consume was assessed by reporting fuel quantity to the worked area and obtained working volume. Work capacity at shift time depends on the effective work moving speed, but is also influenced by some operation interruptions. In alfalfa harvesting and Sudanese grass harvesting, the specific fuel consume varied from 0.23 l/t in Sudanese grass to 0.25 l/t in alfalfa green fodder parcels. Forage harvesting fuel consume per area unit is bigger when using machineries with inappropriate technical characteristics. In operating regime, hourly work capacity is smaller than hourly work capacity in effective time due to operation interruptions.
Key words: mechanized harvesting, work capacity, fuel consume

Introduction

In the present, the complex mechanization has been applied in all agricultural sectors. The quantitative increasing of the working volume is not anymore required, the principal accent being the rational utilization of the agricultural machineries and technologies, which might reduce the energy and fuel consumes without affecting the crop production level.

Forage harvesting is one of the most important operations in grassland technology. Optimal timing and duration in performing such operation provide better forage quality. In mechanized forage harvesting, the energy consume per forage tonne depends on the average yield per hectare, as well as on the technology used to collect the harvested material. Energy consume decreases with the increasing of average yield per hectare due to the increasing of the hourly work capacity and the complete use of the engine power.

Characteristically for agricultural machineries and installations is the requirement to improve the work indices, in a rapid way, according to the continuous changes that occur in the crop production technologies and in the agricultural machineries manufacturing technologies.

Materials and Methods

Work capacity and fuel consumes were estimated at forage harvesting with E-301 windrower.

Specific Diesel fuel consume was established by reporting the fuel consume to worked area and to realized work volume.

Work capacity at shift time depended on the effective operating moving speed but is also influenced by some operation interruptions.

Defects and malfunctions that occur, conducted to a reduced work capacity of the harvesting machineries with a higher energy consume and inappropriate qualitative indices of the effectuated field operations. Consequently, these conditions may determine the forage harvesting machinery failure.

To determine the work capacity is required to have information on working time in minutes. Therefore, total working time T is composed from productive time T_l (effective work) and unproductive time T_n (because of off-field turns, refueling, technical servicing, discharging harvested material etc.).

Results and Discussions

In E-301 case, the moving operating speed varies because the transmission has a speed variation system that permits the continuous adjustment of the effective speed in function of terrain particularities and crop canopy status. Consequently, the average speed must be considered. The work capacity at effective time varies according to this average speed value, when the forage harvesting system operates without interruptions.

During a shift, a series of objective interruptions were recorded as follows:

- correction of the fenders position on the cutting platform – 7 min;
- verification of knives status – 8 min.;
- lunch break – 25 min.;
- physiological operator requirements – 10 min.

The total duration of the interruptions was 50 minutes. Compared to the shift duration of 480 minutes, resulted a work utilization coefficient ks = 0.9.

Table 1 presents the results for the work capacities and fuel consumes recorded at alfalfa harvesting with E-301 windrower.

Work capacity and fuel consume at forage harvesting operation with self-propelled E-301 forage windrower

Table 1

Probe	Work capacity			Fuel Consume	
at effective time ha/h	during shift ha/h	reported to cutterbar width ha/h.m.		l/ha	l/t
E-1	2,2	1.98	0.40	4.36	0.21
E-2	2,7	2.43	0.49	5.35	0.25
E-3	2,5	2.25	0.45	4.95	0.23
E-4	3,1	2.79	0.56	6.14	0.29
E-5	2,8	2.52	0.50	5.54	0.26
E-m	2,66	2.39	0.48	5.27	0.25

Results from Table 1 suggested that in operating conditions the hourly work capacity during shift is smaller with 12.1 % than the hourly work capacity at effective time due to operation interruptions. Consequently, in operating conditions, the fuel consume per hectare is bigger when the windrower engine is functioning during interruptions.

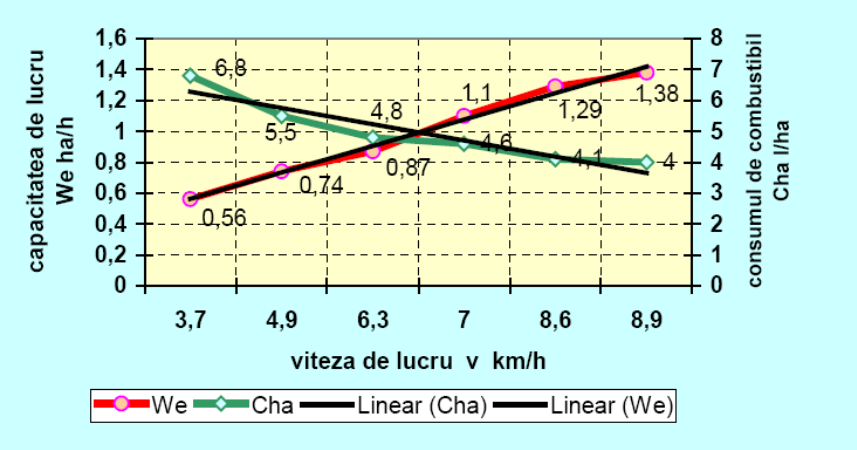

Fig. 1 Work capacity and fuel consume at forage harvesting using different work moving speeds

Figure 1 highlights the hourly work capacity at effective time and fuel consume at forage harvesting operation with E-301 forage windrower, using different moving operating speed.

Figure 1 suggests that the machinery work capacity increases and the fuel consume per area unit decreases when the moving speed increases.

Table 2 presents the experimental results from Sudanese grass harvesting with E-301 windrower.

Experimental results from Sudanese grass harvesting with self-propelled E-301 windrower

Table 2

Parameter	Measurement unit	Value
Parcel length *L*	m	360
Green fodder production *Qmv* Hay production *Qf*	t/ha t/ha	19.8 3.8
Hourly work capacity at shift time *Wh*	ha/h	1.6
Total fuel consume *Cp*	l/parcel	17.5
Worked Area *Ac*	ha	4.86
Number of rows *Nb*	-	27
Total time *Tt*	min	185
Average work speed *v*	km/h	3.37
Wheels slipping δ	%	6.75
Hourly fuel consume *Ch*	l/h	7.57
Fuel consume per area unit *cs*	l/ha	4.7
Specific fuel consume per forage unit *cm*	l/t	0.23

Table 3 presents the experimental results regarding the energy consume from Sudanese grass harvesting with E-301 windrower.

Energy Consume of the harvesting with self-propelled E-301 windrower

Table 3

Experiment	Average work speed v m/s	Hourly work capacity at shift time Wsc ha/h	Hourly fuel consume Ch l/h	Fuel consume Cha l/ha
ISE-1	3.37	1.60	7.44	4.65
ISE-2	3.58	1.63	7.66	4.70
ISE-3	4.02	1.68	7.79	4.64
ISE-4	3.74	1.64	7.67	4.68
ISE-5	3.15	1.52	7.31	4.81
ISE-m	3.57	1.61	7.57	4.70

Figure 2 presents the results regarding the hourly fuel consume and the fuel consume per area unit at Sudanese grass harvesting operation with E-301 forage windrower.

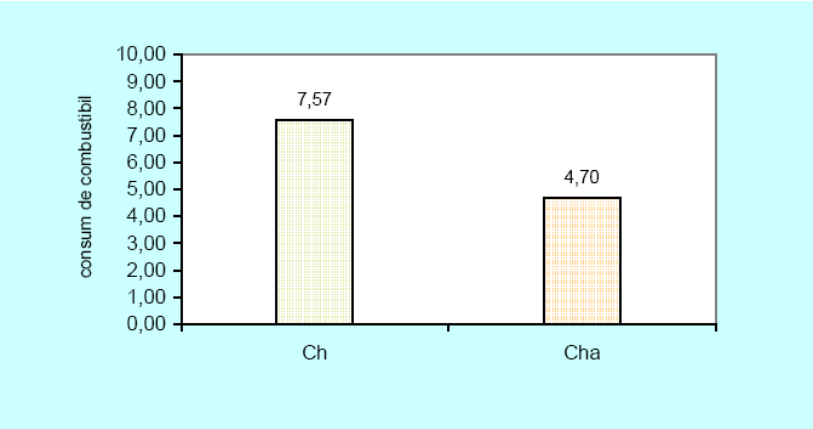

Fig. 2 Fuel consume from Sudanese grass harvesting with the self-propelled E-301 windrower

If the trailer is dragged by the self-propelled windrower, the windrower engine must allocate a part of power, which implies more energy consume for such operation. When using a trailer that is moving in parallel with windrower and that receives the grinded forage, the windrower engine is consuming less energy. However, the tractor that tows the trailer consumes both energy for traction and energy for moving.

Conclusions

In alfalfa harvesting and Sudanese grass harvesting, the specific fuel consume varied from 0.23 l/t in Sudanese grass to 0.25 l/t in alfalfa green fodder parcels.

Forage harvesting fuel consume per area unit is bigger when using machineries with inappropriate technical characteristics. In operating regime, hourly work capacity is smaller than hourly work capacity in effective time due to operation interruptions.

Fuel consume reported to forage production (liters/tonne of product) depends on the forage yield level, on the applied technology, and on the final form of the forage product.

A series of technical and management measures are required to reduce fuel consumes per harvested area unit that will conduct to the optimization of the correlation with agro-technical requirements concerning agricultural machineries utilization.

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