STUDIES AND RESEARCHES CONCERNING CORN SILAGE HARVESTERS

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ABSTRACT

Silage is one of the basic forms for preparing feed for ruminants, especially during the period for calves. Thus in the rations for dairy cows, it represents 40-50% of the total nutritional value. A particularly important role is played by mechanization technology for the preparation of the silage, using appropriate harvesting means. Combine harvesters for fodder plants are complex machines that can perform several technological operations such as: cutting plants, chopping and loading in the means of collection or lifting the material from the furrow. Harvesting fodder plants with the help of combines is the solution with the most significant advantages, because in this case high quality fodder is obtained, the complete mechanization of the harvesting process is ensured, the harvesting material requires a low consumption of live labor.

INTRODUCTION

The development of the particular zootechnical sector in the submontane areas of Oltenia and the intensification of the exploitation systems require the introduction of the most economical technologies, machines and installations for harvesting annual and perennial fodder crops, such as: alfalfa, clover, borceag, ryegrass, mixtures of grasses and legumes, as well as corn silage.

Silage is one of the basic forms of feed for ruminants during the period for calves, representing approximately 40-50% of the total nutritional value in the ration of dairy cows. Silage for green fodder is an effective method of preserving succulent fodder, as it has many advantages, namely:

- many fodder plants can be silage, as well as the secondary production of many agricultural crops (corn tulle, straw, beet packages, etc.);
- the silage of the fodder can be achieved in less favorable weather;
- quality silage is eaten with pleasure by cattle and sheep;
- silage works can be completely mechanized, requiring only sporadic manual work;
- storage spaces can be arranged with very low costs, storage volume being ten times lower than when storing hay;
- silage can be stored for up to three years and can be eaten by animals all year round.

Due to the mentioned advantages, silage feeds have an increasing share, sometimes even 90%, in the feeding of dairy cows, especially in the countries of Western Europe.

MATERIAL AND METHOD

The Jaguar 850 combine, made by the manufacturer Claas, is intended for harvesting silage corn and grass fodder. It is produced only in Germany and is powered by a 455 hp engine, Mercedes V8. The machine is intended for cutting and chopping directly from the chain, mainly corn for silage, in four rows, but can also be used for other fodder plants.

The shredder is loaded into the trailer coupled to the rear of the combine or to the trailer of the unit moving parallel to the combine.

Fig. 1.1.Combine CLAAS JAGUAR 850.

The front equipment is an ORBIS 450 type, which offers the possibility of harvesting even perpendicular to the rows of corn.

Fig.1.2. Combine Claas JAGUAR with ORBIS equipment.

The chopping of the feed in the case of the V24 chopping drum can be done between 4 and 17 mm, this being provided with 24 knives.

The chopping drum is a universal one, and in order to work on grasses, the second knife must be dismantled to help the material pass through the combine.

Fig.1.3. Chopping drum.

After the plants are subjected to the action of the chopping drum, the fragmented material is directed to the crushing rollers, represented by two counter-rotating rollers, which also have the role of accelerating the material, but also of breaking the corn grains to be more easily assimilated by animals. The grain breaker is followed by the thrower or fan, which sends the material at a speed of 60 m/s, loading it into the trailer.

In order to carry out laboratory-field experiments, the research methodology will be applied, which will be able to correctly establish the factors and their influence on the quality and economy of forage harvesting and preservation works, in different conditions of fodder crops, climate and soil slope.

RESULTS AND DISCUSSIONS

The laboratory-field tests were performed in 2018, and the exploitation ones in 2018 and 2019, within SCDA ȘIMNIC CRAIOVA, Dolj District, in two plots, one of 20 ha, in 2018 and another of 35 ha in 2019 (grown with corn silage), which had the following characteristics (Table 1).

Table 1

The main features of corn silage crop

No.	**Characteristic**	**Plot of 20 ha, year 2018**	**Plot of 35 ha, year 2019**
1.	The length of the plot	367 m	249 m
2.	Distance between rows	0,7 m	0,7 m
3.	Average plant height	1,97 m	2,13 m
4.	Insertion of cobs on the plant	0,62 m	0,67 m
5.	Average length of cobs	0,34 m	0,35 m
6.	The weight of plants with cobs	3,78 kg/m^2	4,34 kg/m^2
7.	Stem diameter at the cutting site	22,7 mm	23,6 mm
8.	Relative humidity	68-70 %	68-70 %
9.	Baking phase	Milk-wax	Milk-wax
10.	Average green mass production	37 t/ha	48 t/ha

The working width can be adjusted for 60, 70 and 75 cm between rows by lengthening or shortening the stem conveyor chain. This adjustment was made according to the distance between the rows at which the corn was sown. If

the maize is sown at other distances than those that can be adjusted at the machine, strain losses occur due to incorrect operation of the stem conveyor and feed drums.

If the combine to harvest corn silage is equipped as standard, with 24 knives on the chopping drum, and its speed is 1600 rpm, the following chopping lengths are obtained, in percent (figure 1).

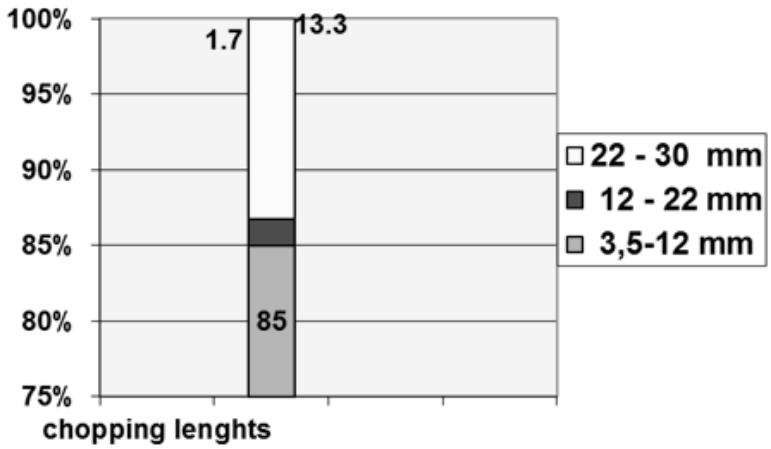

Figure 1. Chopping lengths.

The length of the chop is negatively affected by the wear of the knife edge, when it requires sharpening after a maximum of four hours of operation. Also, the distance between the knife and the counter-knife influences the chopping length, which is all the greater as the distance between the two elements increases. In the working conditions in which the tests were made, the feed losses were minimal, being below 2%.

If the orientation of the deflector in the longitudinal and transverse planes is not correct and the trailer is not provided with watertight upliftings, unjustified accidental feed losses occur.

In the event of blockages of the plant cutting device and the feeding drums, caused by various hard bodies (metal scraps, stones and others), the combine is not damaged due to the safety elements available and which interrupt the transmission of movement to the active organs of the machine. machine. Such events occurred during the tests.

Following the processing of the data on the exploitation tests, the data contained in Table 2 were obtained. The following assessments can be made:

- the actual working time is negatively influenced by the numerous turns of the unit at the ends of the plot, which have been hampered due to the more or less loaded trailer;
- the working volume of the combine depends on the speed of movement, which is influenced by the amount of green mass of silage corn per hectare; thus, the speed was between 6.82 km/h at a production of 37 t/ha and 6.65 km/h at a production of 48 t/ha.

These parameters also influenced the hourly fuel consumption, as well as the one per unit area (Table 3).

Table 2

Data recorded during operating tests

Working speed (Km/h)	Workload		Fuel consumption (l)	T_{07} (min)	T_{01} (min)
	(Ha)	(t)			
6,82	4,96	183,52	127,30	152	88
6,76	9,75	360,75	268,13	290	164
6,65	11,46	550,08	340,47	342	216

Table 3

Productivity and fuel consumption indices

Working speed (Km/h)	W_{07} (ha/h)	$K_{07} = T_{01} / T_{07}$	W_s (ha/day)	Q (l/ha)	Q_h (l/h)	Q_t (l/t)
6,82	1,10	0,579	11.08	25,66	28,23	0,693
6,76	1,06	0,565	10,60	27,50	29,15	0,743
6,65	1,17	0,631	11,70	29,71	34,76	0,618

The following can be seen:
- the K07 working time utilization coefficient was between 0.579 and 0.631;
- the fuel consumption per unit area and per ton of silage obtained (figure 2) is correlated with the speed of movement and decreases with the increase of silage production per hectare; the reduced skating of the tractor (below 7%) it was due to the rather dry and less loose soil in 2015 and a bit higher (11-13%) in the experimental year 2016, on a looser and slightly wetter soil;
- the average effective working capacity of 1.11 ha/h and a specific consumption of 27.62 l/ha of fuel are influenced by the production per hectare of corn silage.

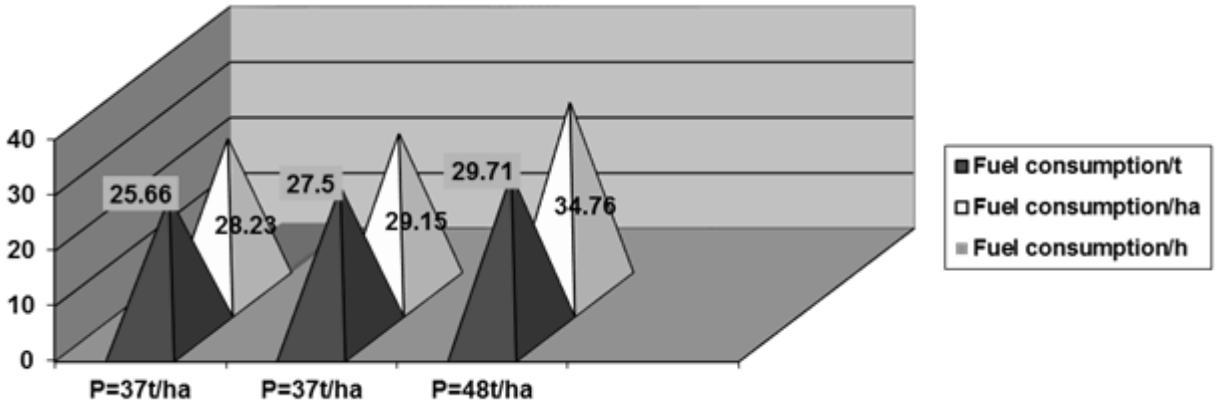

Figure 2. Variation of the fuel consumption.

The graph and the table show that at a production of 37 t/ha, the specific fuel consumption is 0.693...0.743 l/t, and at a production of 48 t/ha it is 0.618 l/t. The hourly consumption of fuel reaches up to 34.76 l/ha at a production of 48 t/ha.

CONCLUSIONS

During the experimental tests the following were found:
- CLAAS JAGUAR combine works well in weed-free cornfield;
- the cutting height of the corn stalks is limited to the proximity of the soil depending on its humidity and the degree of loosening;
- major failures did not occur due to the safety systems of the combine, which interrupt the movement to the active organs when blockages with stones or other hard bodies appear;
- the experienced combine ensures a working capacity close to the one specified in the technical note, being useful and necessary for large zootechnical units, managing to achieve

around 11.7 ha/day, respectively 550 t/day;

- fuel consumption decreases with increasing silage corn production per hectare; under conditions of 48-50 t/ha of corn silage, the consumption per ton of chopped corn for silage reached 0.618l / t;

- the working capacity of the Claas JAGUAR 850 combine is 550 t/day, which recommends it for large livestock farms.

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