LOSSES IN ALFALFA MOWING PROCESS PERFORMED BY TRACTOR OSCILLATORY AND ROTARY MOWER

A.,VUKOVIĆ, S., BARAĆ, Bojana MILENKOVIĆ

University of Priština, Faculty of Agriculture Kosovska Mitrovica– Lešak, Serbia
E-mail: stojankav@open.telekom.rs

Abstract: The mowing is the first technical operation performed in the scope of quality cattle food preparation technology. It needs to be done within optimal agro-tehnical time framework in order to decrease potential negative impacts of external factors. This paper shows the losses created during alfalfa mowing process performed by oscillatory and rotary mower. The losses detected during research process have been divided into two groups: losses caused by increased incision height (over 6cm), and losses caused by crushing. The total losses made during mowing by the tested mower were calculated by adding the incusion height losses and crushing losses. The research results of oscillatory mower indicate that the minimal losses caused by the incision height are 0.57% of yields, at the aggregrate mowing speed of 3.82 km/h. Aggregate mowing speed increase tend to slightly increase the losses up to maximum values of 1.17% at the mowing speed of 8.17 km/h. The crunching losses ranged from minimal 0.31% at the maximum aggregate mowing speed, to maximum 0.43% at the minimal mowing speed. The average total losses of oscillatory mower were 1.18% of yields, at the averagge aggregate mowing speed of 5.76 km/h. The research results of rotary mower indicate that the minimal losses caused by the incision height are 0.96% of yields, at the mowing speed of 8.32 km/h.Agreggate mowing speed increase tend to slightly increase the losses up to maximum values of 1.34% at the mowing speed of 10.34 km/h. The crunching losses ranged from minimal 1.61% at the maximum aggregate mowing speed, to maximum 2.18% at the minimal mowing speed. The average total losses of rotary mower were 2.99% of yields, at the average aggregate mowing speed of 9.39 km/h.Comparing research results, it is evident that the oscillatory mower has achieved significantly lower losses in comparison to the rotary mower. The average oscillatory mower losses were 1.18% of yield, whereas the rotary mower losses were slightly higher and were 2.99% of yields. Having in mind the obtained results for tractor oscillatory and rotary mowers used for alfalfa mowing, it may be concluded thet these results range within optimal values, that there are no significant differences and they are in conformity with resultes obtained by other authors.

Kew words: oscillatory mower, rotary mower, moving, losses, incision height.

INTRODUCTION

The mowing is the first technical operation performed in the scope of quality cattle food preparation technology. It needs to be done within optimal agro-tehnical time framework in order to decrease potential negative impacts of external factors. During the alfalfa hay preparation process, the efforts are made to utilize as much biological green mass yield as possible in order to decrease potential losses. It is deemed that, for the sake of tiller preservation, the optimal alfalfa swath height rangers from 6 to 8 cm, i.e the alfalfa should not be cut under 6 cm. The losses may be caused either by needlessly high swath cut (over 6 cm for alfalfa), or by the cut grass crushing, since the crushed mass remains on the land parcel during the hay manipulation. The special attention needs to be paid to this kind of losses, having in mind that most of the crushed mass is composed of the leaf parts containing the greatest quantity of nutritious material.

According to (VUKOVIĆ et al., 2010), the drying process period of alfalfa (up to 20% of humidity), cut by oscillatory mower with classic cutting apparatus and rotary mower with

two drums, which was 47 hours for oscillatory and 55 hours for rotary cutting apparatus, had an impact on decreased fallen leaf losses. The researches made on oscillatory cutting apparatus (ZORANOVIĆ et al., 2009), show that the total losses very in scope between 0.90 up to 2.29% of yield, averagely 1.59% of yield. The swath height ranged from 5.35 up to 7.54 cm per probes, averagely 6.42 cm. The same authors indicate that the working swath of the tested oscillatory mowers decreases as the aggregate mowing speed increases, while the height of plant cut increases as the moving speed grows.

According to (POTKONJAK et al., 1991), the cutting height for the rotary mower ranges from the 6.9 to 7.33 cm, whereas the losses caused by the greater cutting height were 1.70% of yield. Certain authors, such as (GOTTFRIED, 2007, 2008; HUBERT, 2008), emphasize the need for mowers construction solutions with regards to simplicity, easy maintenance, functionality and reliability. These are very important parameters; however, the authors have not dealt seriously with the work quality in their studies.

When the alfalfa was mowed by the rotary mower with two drums (GAŠPARAC, 1988), the swath height ranged from 4.30 to 6.28 cm. The same author states that speeds of 8 to 12 km/h represent the average speed of these mowers and that the swath profile is satisfactory especially in case of work speed greater than 8 km/h. When the exploitation characteristic of oscillatory mower were tested (POTKONJAK et al., 2009), the same maximal speed of 8.82 km/h was registered, whereas the total average losses were 1.27% of yield. According to (WENNER et al., 1987), the oscillatory mower working speed of 5 to 8 km/h is recommended.

MATERIALS AND METHODS

The research covered oscillatory mower with classic cutting apparatus and rotary mower with two drums on the land parcel with average yield of 3.33 t/ha (without irrigation). It is noteworthy that the weather factors (drought) caused such a low yield, as well as the fact that the alfalfa was in blooming phase when mowed.

The green mass yield was determined based on alfalfa mass measurements taken from a length meter with swath width, calculated per hectare. The mower moving speed was determined by chronometer method. The cut height was determined on the spot of loss determination, measuring the cut height from all sides for each probe on appropriate surface. The average for each probe was based on the determined parameters.

The losses created during mowing process were measured on the surface of one length meter with mower swath width on the same place where the swath cut height was determined. The total losses are represented as sum of losses caused by the cut height and crushing process. The loss determination was done in three probes.

RESULTS AND DISCUSSION

The constructive working swath of oscillatory mower with classic cutting apparatus is 1.53 m. The coefficient of working swath utilization during tests on probes ranged from 0.89 to 0.95. The average value was 0.92 of constructive (table 1, figure 1). The tendency of decreasing coefficient of working swath utilization was noticed as the mower moving speed was increasing.

The constructive working swath of rotary mower with two drums is 1.65 m. The coefficient of working swath utilization during tests on probes ranged from 0.88 to 0.95. The average value was 0.91 of constructive (table 1, figure 1). The tendency of decreasing coefficient of working swath utilization was noticed as the mower moving speed was increasing.

Table 1

The achieved working swath,(m).

Type of mower	Working swath	Probe			Average
		1	2	3	
Oscillatory mower	Constructive	1,53			
	Achieved	1.45	1.41	1.36	1.41
	ß	0.95	0.92	0.89	0.92
Rotary mower	Constructive	1,65			
	Achieved	1.56	1.48	1.45	1.50
	ß	0.95	0.90	0.88	0.91

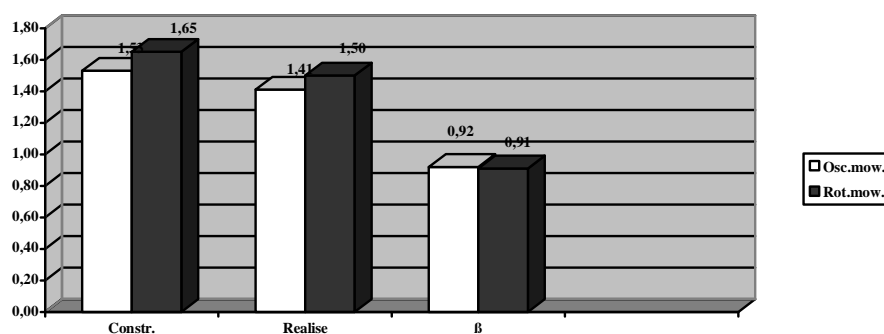ß- coefficient of achieved working swath

Figure 1. The achieved working swath,(m).

The average stem cutting height for the oscillatory mower was 6.08 cm at the average moving speed of 5.76 km/h, (table 2, figure 2). The lowest cutting height was 5.30 cm at the moving speed of 3.82 km/h. The highest stem cut was 7.11 cm at the speed of 8.17 km/h.

The average stem cutting height for the rotary mower was 5.73 cm at the average moving speed of 9.39 km/h, (table 2, figure 2). The lowest cutting height was 5.25 cm at the moving speed of 8.32 km/h. The highest stem cut was 6.18 cm at the speed of 10.21 km/h.

The tendency of minor loss increase was noticed due to the cutting height (table 3, figure 3), as moving speed of the tested mowers increased. Averagely, the losses caused by the oscillatory mower cutting height were 0.81% of yield, ranging from 0.57% to 1.17% of yield at probes. With regards to the losses caused by the crushing, the tendency of loss decrease was noticed as the mower moving speed increased. Averagely, the losses caused by crushing were 0.37% of yield in probe intervals.

The total losses represent a sum of previous two types of losses. The average value of total losses was 1.18% of yield during the test of oscillatory mower with classic cutting apparatus. The total losses ranged in interval of minimum 1.00% to maximal 1.48% of yield.

Averagely, the losses caused by the rotary mower cutting height were 1.14%% of yield, ranging from 0.96% to 1.34% of yield at probes. With regards to the losses caused by the

crushing, the tendency of loss decrease was noticed as the mower moving speed increased. Averagely, the losses caused by crushing were 1.85% of yield, ranging from maximal 2.18% to minimal 1.61 % of yield in probe intervals. The average value of total losses was 2.99% of yield during the test of rotary mower with two drums. The total losses ranged in interval of minimal 2.88% to maximal 3.14% of yield.

Table 2

The stem cutting height, (cm).

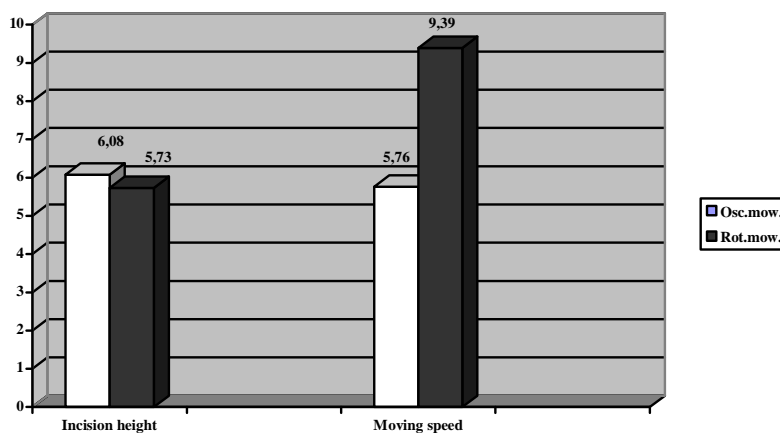| Type of mower	Parameter	Probe			Average
		1	2	3	
Oscillatory mower	Cutting height(cm)	5.30	5.83	7.11	6.08
	Aggregate moving speed (km/h)	3.82	5.29	8.17	5.76
Rotary mower	Cut height (cm)	5.25	5.75	6.18	5.73
	Aggregate moving speed (km/h)	8.32	9.65	10.21	9.39

Figure 2. The stem cutting height, (cm).

Table 3

Losses during mowing process, (% of yield)

Type of mower	Type of losses	Probe			Average
		1	2	3	
Oscillatory mower	Gvr	0.57	0.68	1.17	0.81
	Gus	0.43	0.38	0.31	0.37
	Gu	1.00	1.06	1.48	1.18
Rotary mower	Gvr	0.96	1.12	1.34	1.14
	Gus	2.18	1.76	1.61	1.85
	Gu	3.14	2.88	2.95	2.99

Gvr- cutting height losses; Gus- crushing losses; Gu- total losses;
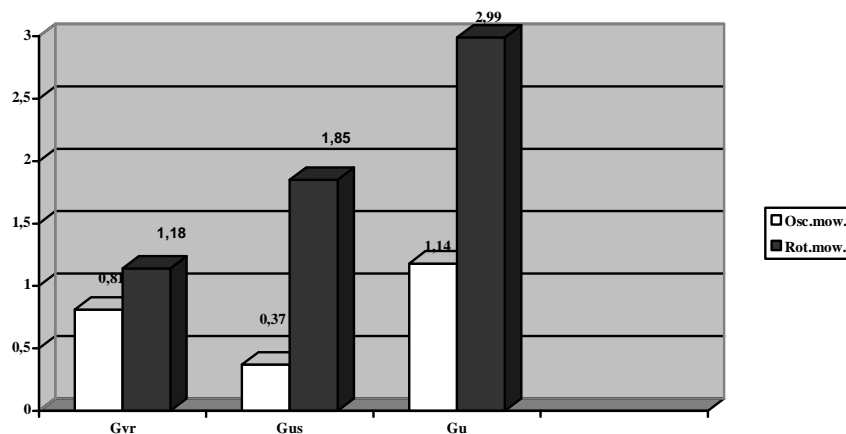
Figure 3. Losses during mowing process, (% of yield)

CONCLUSION

Bearing in mind that the acceptable maximal loss is 5% of yield, it is evident that the research results of oscillatory mower with classic cutting apparatus and rotary mower with two drums used for alfalfa mowing indicate that these mowers have achieved optimal and low levels of losses. Comparing research results, it is evident that the oscillatory mower has achieved significantly lower losses in comparison to the rotary mower. The average oscillatory mower losses were 1.18% of yield, whereas the rotary mower losses were slightly higher and were 2.99% of yield.

With regards to other tested parameters, it is noteworthy that the tested mowers have achieved slightly lower coefficient of achieved working swath than the constructive one (oscillatory 0.92, rotary 0.91). The lower cutting height was achieved, the oscillatory mower cut was on 6.08 cm; however it is in scope of optimal value ranging from 6 to 8 cm recommended for alfalfa mowing. The rotary mower average cutting height was 5.73 cm which deviates, but not significantly, from the optimal value.

Having in mind the obtained results for tractor oscillatory and rotary mowers used for alfalfa mowing, it may be concluded thet these results range within optimal values, that there are no significant differences and they are in conformity with resultes obtained by other authors.

BIBLIOGRAPHY

1. GAŠPARAC, J.: Rezultati uporednih ispitivanja rotacijskih kosilica.Savetovanje: Zadaci mehahanizacije poljoprivrede, Zbornik radova I-dio, Opatija, 1988.
2. GOTTFRIED, E.: Mit Power oder nur Easy. Profi, Magazin für professionalle Agrartechnik,1: 16-21, 2007.
3. GOTTFRIED,E.: Zum Fürchten. Profi, Magazin für professionalle Agrartechnik, 1: 30-33, 2008.
4. HUBERT,W.: Leicht geschnitten. Profi, Magazin für professionalle Agrartechnik,1: 26-28, 2008.
5. VUKOVIĆ, A., STANIMIROVIĆ, N., BARAĆ, S.: The influence of different type of mowers on alfalfa drying speed, XII International Symposium on Forage Crops of Republic of Serbia, Biotechnology in animal husbandry, book 2, vol. 26, 561-567, Belgrade, 2010.
6. POTKONJAK, V., ZORANOVIĆ, M.: Uporedna analiza tehničko- eksploatacionih parametara rotacione kosačice i kosačice sa dva noža. Studija naučno-istraživačkog karaktera, str.,

Poljoprivredni fakultet, Institut za poljoprivrednu tehniku, Novi Sad, 1991.
7. POTKONJAK, V., ZORANOVIĆ, M, ANĐELKOVIĆ, S.: Eksploatacione karakteristike različitih tipova kosačica pri košenju lucerke, Savremena poljoprivredna tehnika, vol. 35, br 1-2, 73-78, Novi Sad, 2009.
8. ZORANOVIĆ, M., POTKONJAK, V.: Eksploatacione karakteristike kosačica pri košenju lucerke, Savremena poljoprivredna tehnika, vol. 22, br 5, 266-272, Novi Sad, 1996.
9. WENNER, H.L., KOL, I.: Landtechnik Bauwesen, Teil B, Verfahrestechniken. BLV Verlagsgesellschaft, München, 1987.