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RESEARCH CONCERNING THE INFLUENCE OF ANGLE OF FILING FROM THE KNIFE BLADES VINDROVERS ON THE MECHANICAL WORK ON CUTTING

BY

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Abstract. This paper presents the experimental results on cutting force and mechanical work consumed for cutting plant stems with knives equipped type forage harvester vindrover, for three sizes of sharpening angle and two position of the strains during cutting, for four cultures in different stages of vegetation.

Key words: vindrovers, strain, cutting force, sharpening angle.

1. Introduction

The harvest of forage and hay is made through reapers or vindrovers, which are equipped with cutting units based on knife-finger type reciprocating. In the cutting process, the blade's relatively large size compared with that of strain makes local crushing to appear in the cutting area, stretching and bending applications and ultimately produce fiber breakage (Neculăiasa & Dănilă, 1996).

Cutting blade geometry has a great importance on how to produce cutting the stems, causing them sharpening angle largely mechanical work consumed for cutting (Gasch, 2004). Calculation of cutting force is difficult to perform and therefore calls on laboratory stands where it is determined based on measurements.

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2. Material and Working Method

To determine the cutting force in vindrover blades using a laboratory stand whose schematic diagram is shown in Fig. 1. Knife blade 5 with smooth edge (Fig. 2) or serrated edge (Fig. 3), is mounted on a support bar 4 with rectilinear and is driven by the crank 11, a screw and ball joint 2. On both sides of the bar are mounted force transducer 3 and displacement transducer 7. Plant stem is caught between the blade 5 and 6 finger being arranged in two ways: vertical and inclined at 45º to the cutting plane. Signals from the two transducers are taken converters 8 and 9 and forward data acquisition board 10 connected to a computer.

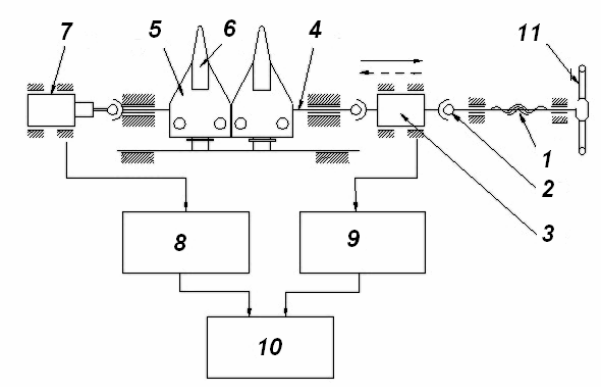

Fig. 1 − The schema of principle laboratory stand.

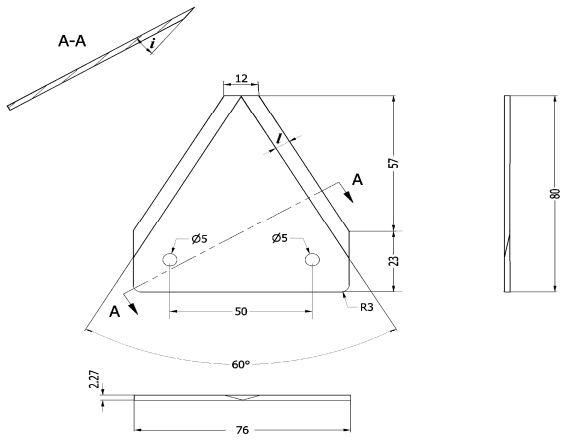

Fig. 2 − Smooth edge cutting blade geometry.

Slides used for experimental trials of three values and sharpening angle *i*: standard 20º, 15º and 10º.

As materials undergo cutting operation were used ghizdei strains before and after flowering, red clover before and after flowering, lucerne before flowering and grass Sudan, samples were taken from the field at harvest.

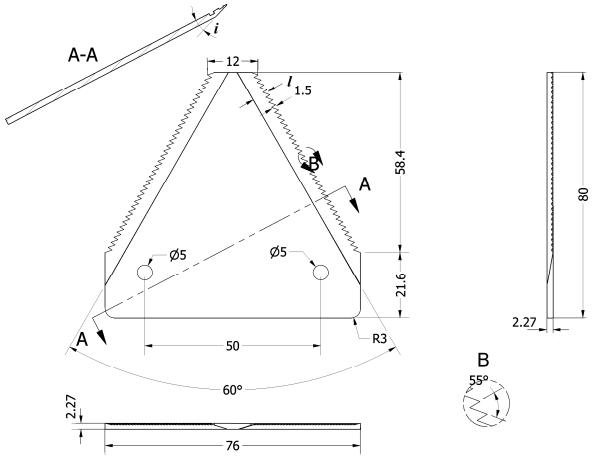

Fig. 3 − Serrated cutting edge blade geometry.

It shows how the influence of blade sharpening angle on cutting force and work needed for smooth and serrated edge blades, arranged vertically or inclined stem.

3. Experimental Results

The data from experimental measurements are presented in Figs. 4-7 and Table 1.

Following the experimental measurements has establish the cutting force depends on the stage of forage vegetation, being much higher after the flowering stage, when they begin to strain lignifize

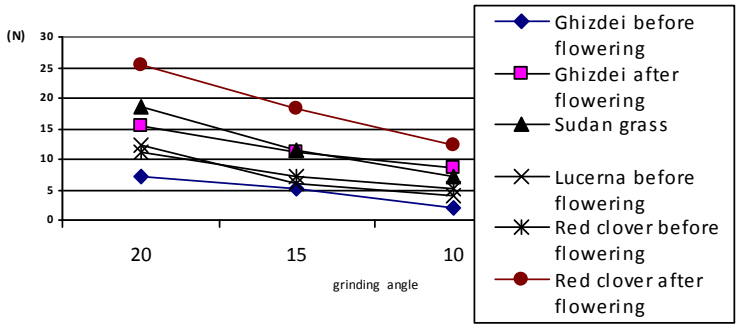

Fig. 4 − Cutting force variation depending on the angle of sharpening for vertical strain and smooth blade edge.

It was also found that cutting force decreases with decreasing angle of sharpening, the lowest values were recorded for 10º angle.

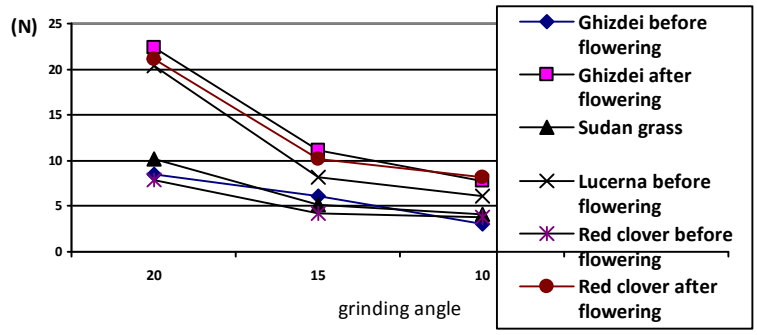

Fig. 5 − Cutting force variation in depending on the angle of sharpening for inclined strain and smooth blade edge.

Cutting force is higher when the strain is vertical, when cutting is performed by shearing, while it decreases at the inclined stems, when prevailing inclined cutting.

It could not be established a link between force and state of the cutting blade edge: smooth or serrated. In some cases it was higher in serrated blades, where the strain is retained by the teeth during cutting, while at smooth blades the cutting force was lower, the explanation being that by sliding of the strain, on blade is produced a stem cutting slip, in which the work of cutting is the lowest.

The work needed for cutting plant strains (Tables 1 and 2) has the same variation as for the cutting force, blade during the cutting stroke is less than the vertical strains and higher than inclined strains, but not large enough to compensate for the downward trend of cutting force.

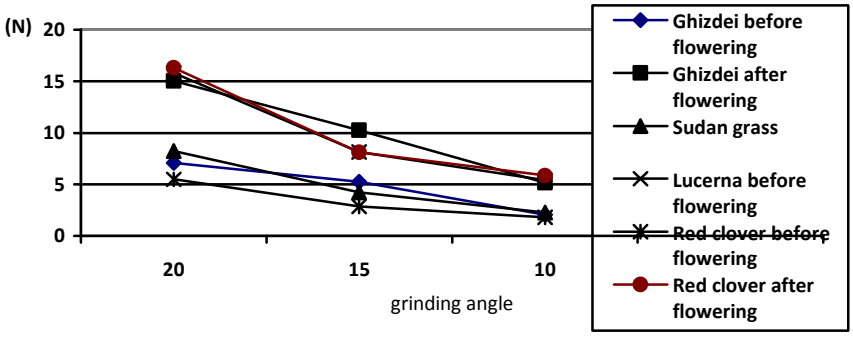

Fig. 6 − Cutting force variation in depending on the angle of sharpening for vertical strain and serrated blades.

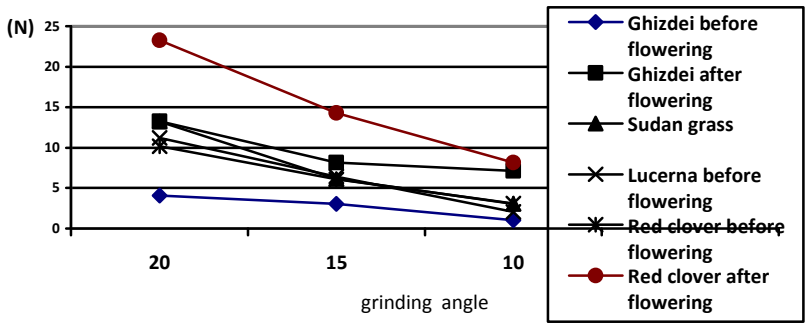

Fig. 7 − Cutting force variation in depending on the angle of sharpening for inclined strain and serrated blades.

Table 1

Variation of Mechanical Work to Cut Vertical Plant Stems

	smooth blade			serrated blade		
	20º	15º	10º	20º	15º	10º
Ghizdei before flowering	0.055	0.049	0.023	0.066	0.047	0.036
Ghizdei after flowering	0.193	0.117	0.085	0.160	0.133	0.102
Sudan grass	0.127	0.082	0.034	0.150	0.065	0.035
Lucerne before flowering	0.199	0.104	0.064	0.206	0.117	0.075
Red clover before flowering	0.172	0.091	0.062	0.109	0,062	0.038
Red clover after flowering	0.382	0.274	0.121	0.225	0.144	0.107

Table 2

Variation of Mechanical Work to Cut Inclined Plant Stems

	smooth blade			serrated blade		
	20º	15º	10º	20º	15º	10º
Ghizdei before flowering	0.050	0.029	0.012	0.035	0.021	0.010
Ghizdei after flowering	0.112	0.070	0.045	0.162	0.082	0.069
Sudan grass	0.153	0.082	0.046	0.114	0.084	0.069
Lucerne before flowering	0.161	0.092	0.032	0.183	0.099	0.064
Red clover before flowering	0.106	0.046	0.023	0.089	0.055	0.027
Red clover after flowering	0.348	0.262	0.86	0.162	0.103	0.069

4. Conclusions

Forage cut by cutting apparatus that equips vindrovers is influenced by factors related to culture, respectively factors related to construction knife.

Cutting plant resistance increases with the degree of maturation (after flowering stage), when the mass of vegetation reaches maximum.

Cutting force drops with decreasing plant blade sharpening angle, but decrease at the same time the cutting edge wear resistance. This disadvantage can be compensated by covering the active edge of the blade with titanium compounds.

Position of inclined stem leads to a decrease in cutting force, but this causes a higher stubble and therefore loss of plant mass at harvest.

These experimental data together with others that are found in the literature, can determine the choice of sharpening angle to reduce the required cutting force, but to ensure a good wear resistance.

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CERCETĂRI PRIVIND INFLUENȚA UNGHIULUI DE ASCUȚIRE A LAMELOR DE CUȚIT DE LA VINDROVERE ASUPRA LUCRULUI MECANIC LA TĂIERE

(Rezumat)

Lucrarea prezintă rezultatele experimentale obținute la tăierea tulpinilor unor plante furajere, cu ajutorul aparatului de tăiere de tip cuțit-deget de la vindrovere. Au fost efectuate încercări privind forța de tăiere şi lucrul mecanic consumat la tăierea ghizdeiului, a ierbii de sudan, lucernă şi trifoi roşu, în diferite stadii de vegetație, cu lame tăietoare cu muchie netedă şi zimțată, tulpinile fiind în poziție verticală sau înclinată la 45º.

Pentru măsurătorile experimentale s-a folosit un stand care permite determinarea forței de tăiere şi deplasarea cuțitului în procesul de tăiere a tulpinilor, pe care s-au montat cuțite a căror unghi de ascuțire a avut trei valori distincte: standard de 20º, micşorat de 15º, respectiv 10º. În aceste condiții s-a putut constata o descreştere a forței de tăiere a tulpinilor cu scăderea unghiului de ascuțire, aceeaşi tendință fiind caracteristică şi lucrului mecanic de tăiere, atât pentru tulpinile verticale, cât şi pentru cele înclinate.