THE DESIGN OF MECHANIZATION TECHNOLOGY FOR ALFALFA CULTURE IN THE GOTHATEA HUNEDOARA AREA

G. VĂCĂRESCU, F. MLADIN, Anișoara DUMA COPCEA, Casiana MIHUȚ
University of Life Sciences "King Mihai I " from Timisoara, 300645, 119 Calea Aradului, Romania, Phone: +40256277001, Fax:+40256200296
Corresponding author: anisoaradumacopcea@usvt.ro, casiana_mihut@usvt.ro

Abstract. *The mechanization of fodder production is of major importance for agricultural production in general and for the field of animal husbandry in particular. Among the mechanized works for the production of fodder, harvesting works occupy a special place, both due to the role that fodder plays in animal nutrition, as well as due to the particularities related to quality. Harvesting must be done at the optimal time and in the shortest possible time, in order to maintain the quality of the fodder and keep the losses at a low level. Obtaining high-quality harvests, at the lowest possible costs, can only be achieved through the application of specific, perfected technologies, which allow a superior utilization of both natural resources and inputs. The main objective in harvesting, preparing and preserving alfalfa in the form of hay is to create a final product with a food value as close as possible to the initial green fodder. The quantity and quality of hay obtained from alfalfa depends to a large extent on a number of factors, namely: - the production and initial floristic composition of the fodder (when mowing); - harvest season (harvest phenophase); - duration of the hay harvesting and preparation period; - the method of harvesting, preparing and preserving hay; - the quality and degree of mechanized execution of the harvesting and preparation of fodder in the form of hay.*

Keywords*: mechanization, production, alfalfa*

INTRODUCTION

Natural resources play a very important role in agriculture. Farmers depend on these resources (land, water, energy, etc.) to grow plants and provide them to families and communities. Man's need to consume varied food, rich and close in protein structure to his own needs, have made animal production a continuous concern for him, who is forced to provide his animals with the necessary feed. In order to provide these fodder, in addition to the extensive areas with meadows, large areas of land in the category of arable land are needed, where concentrated fodder and large amounts of hay are obtained. Lucerne is cultivated in Romania on an area of over 400,000 hectares, in hilly and plain areas, due to the high production of green mass and the superior quality of the hay. [LĂCĂTUȘU MATILDA, și colab., 1981]. The contribution of alfalfa to the production of fodder necessary for the development of animal husbandry is of particular importance, because a fodder with a good floristic composition, with a complete nutritional value, having a balanced composition in protein, vitamins, salts and other substances constitutes the basic food of ruminants. [PETCU ELENA, și colab., 2009]. Solving the future problems of agriculture involves the use of high-yield tractors, as well as complex aggregates capable of solving the large volume of mechanized works on time and with increased efficiency. Alfalfa is highly valued due to its multiple uses as a fodder plant. Having a large production capacity and good longevity. It is also resistant to frost and drought but responds very well to irrigation. It has a high yielding capacity, under exceptional growing conditions it can be harvested 5-6 times a year. Alfalfa can be used as green fodder, semi-hay, silage (mixed with grasses), hay meal, granules or briquettes as well as in the preparation of combined fodder. [MARTENS, D., 2007]. Alfalfa is also a basic component of temporary meadows used by mowing. In the biological culture system, alfalfa hay occupies an essential role in the cattle feeding system. Lucerne is one of the plants improving the soil through the large amounts of organic matter rich in nitrogen that it leaves, by improving its

physical condition. The importance of alfalfa as fodder is due to its chemical composition, a different composition depending on the harvest phase. Alfalfa protein is of superior quality, with a high content of valuable amino acids (with the exception of methionine and cystine, amino acids whose composition includes sulfur). There are big differences in the chemical composition of alfalfa and different alfalfa preparations, in the sense that large amounts of nutrients are lost through improper preparation. Thus, through improper drying in the preparation of hay, the leaves are shaken, thus losing huge amounts of proteins, the leaves being richer in such substances than the stems. Alfalfa has good digestibility, which makes it highly efficient in animal nutrition. [MANOLACHE C., și colab., 1969].

Alfalfa has a very good drought tolerance. This is highlighted by the fact that after long periods of drought, as soon as it rains, it forms a large number of shoots. Alfalfa has a high transpiration coefficient of 700-900. [HERMENEAN I., 2008]. Considering the average, i.e. 800 l consumption for the accumulation of one kg of dry matter, it can be calculated that for a production of 50 q/ha of hay, a quantity of water equivalent to 320 mm of precipitation is required. Hence the conclusion that high and constant alfalfa productions are obtained only where the precipitation exceeds 500 mm. [MOGA, I., și colab., 1996]. The rainfall regime is also of major importance. The winter-spring precipitation can ensure a good harvest for the first harvest, and those at the end of May help the sprouting for the second harvest. The following harvests are totally dependent on the pluviometric regime during the summer. It is very important that the harvest is done at the optimal time because it decisively influences the level of harvests in the following years. It is not allowed to repeatedly harvest alfalfa at short intervals (under 25-28 days) or too long (over 48 days). If harvesting is done too often, the production and longevity are affected, and if it is done too rarely, the quality suffers (digestibility and consumption decreases as the cellulose content increases). [MOGA, I., și colab., 2005]. In order to obtain good quality hay, it must be remembered that in alfalfa, the rate of water loss from the leaves is higher than that from the stem, which causes a moisture discrepancy between the two components, resulting in the leaves falling. This depreciates the quality of the known hay as the protein is found in higher proportions in the leaves. [CASIANA DOINA MIHUTși colab., 2023]. That is why the drying method directly on the ground is not recommended because leaves are lost and chlorophyll is degraded, drying lasting 3-5 days. In order to obtain quality hay, it is necessary to minimize the number of manipulations and the time required for drying. [SCHITEA MARIA, 2002, SCHITEA MARIA și colab., 2007, SCHITEA MARIA și colab., 2010]. That is why it is recommended that harvesting be done with machines equipped with crushers that crush the stem and make the stem dry quickly. When the humidity has dropped below 40%, it is baled. Next, the drying process is carried out by ventilation in the haystack. Lucerne cannot be ensiled alone (too little content in fermentable carbohydrates) but only in a mixture with grasses, the ensiling being done according to the technology of obtaining silage, semi-silage and semi-hay. [ANIȘOARA DUMA COPCEA și colab., 2023]

MATERIAL AND METHODS

The studies in this paper were carried out in the specific conditions of the Mureș Gorge. The territory under study belongs to Gothatea locality, Gurasada commune, Hunedoara county. The study concerns the culture of alfalfa. The area cultivated with alfalfa was 4 ha. The predecessor plant was wheat. The perennial alfalfa crop was harvested for a period of 5 years, from 2018 to 2022. Each year, 4 scythes were harvested from the respective area. The harvest was collected in the form of bales. The main mechanized works and materials used in alfalfa cultivation technology were the following:

Basic fertilization was carried out before sowing with complex fertilizers 16.16.16 in the amount of 200 kg/ha. In the vegetation, 150 kg/ha of ammonium nitrate were administered every year. The works were carried out with the universal tractor U-445 in aggregate with the machine for administering solid mineral fertilizers Amazone 300. The plowing work was carried out with the plowing unit consisting of the U-650 M universal tractor and the PP 4-30 mounted plow. Land preparation was carried out in two passes with the aggregate consisting of the U-650 tractor + GD-3,2 disk harrow.

Sowing was done with the SUP-29M seeder in aggregate with the U-650M tractor. The norm was 28 kg of alfalfa seed per hectare.

Alfalfa was harvested with the following aggregates:- mowing: Pottinger CAT 185 rotary mower + U-650 M tractor;- raked: Vicon Acrobat 510 mechanical rake + U-445 tractor;- baled: PPF baling press + U-650 M tractor;- bale transport: U-650 M tractor + tractor trailer. Two types of tractors were used to carry out the mechanized work on the alfalfa crop: the U-445 tractor and the U-650M tractor.Mowers are machines designed for cutting grassy fodder plants that remain on the stubble in the form of a continuous furrow, with a width smaller than the working width of the machine. The mowers differ from each other according to the type of cutting device, the working width and the way of coupling to the power source.

According to the type of cutting device, mechanical mowers are divided into:- mowers with cutting devices with alternating rectilinear movement of the knives, where the cutting of fodder plants is done by shearing; the cutting devices of these mechanical mowers can be: with fingers and knife or with two knives; - mowers with rotary cutting devices ;

According to the way of attachment to the tractor, mechanical mowers can be: towed, carried or self-propelled (motor mowers).

Mechanical mowers consist of a frame on which the cutting device is mounted, the drive mechanism of the cutting device and the adjustment and lifting mechanisms. In mowers with a cutting device with rectilinear movement of the knives, the cutting device is mounted hinged to the frame of the machine, being supported during work on skids. With these mowers, the machine frame is mounted directly on the tractor chassis. In rotary mowers, the blade rotors are mounted to a housing, which is actually the frame of the machine, and in which is the transmission for driving them. With these mowers, the frame of the machine is attached to the suspension mechanism of the tractor. Mounted mowers can be mounted in front of the tractor, laterally between the front and rear wheels or laterally behind the tractor. When mounted in front of the tractor, mounted mowers must have a cutting width greater than the tractor's gauge. When carried behind the tractor, the mowers are supported by the suspension mechanism of the tractor which makes the transition from the working position to the transport position and vice versa. When they are carried in front or laterally, the mowers have a mechanism with a hydraulic cylinder that controls their transition from the transport position to the working position and vice versa. The cutting of fodder plants can be done in two ways: cutting by shearing (by supporting the plants) and cutting by inertia (without supporting the plants). Shear cutting is found in mowers with a cutting device with rectilinear reciprocating movement of the knives. The cutting of plants is done between the cutting blades of the knife and the counter-cutting blades of the fingers or between the cutting blades of the upper knife and the counter-cutting blades of the lower knife. The cutting blades of the knife are fixed with rivets on the blade-carrying bar of the knife and have two active (cutting) edges, inclined to the direction of advance. Active edges can be: jagged or smooth. Inertia cutting is performed by rotary cutting devices with a single active element - the knife - which applies a cutting force to the plant stem at a relatively high speed. The cutter with fingers and knife is built in two versions: cutter with fingers and press plates and cutter with fingers and guide plates. The finger cutter is made up of three groups of elements: the fixed part, the movable part (knife) and the drive mechanism. The fixed part

includes: the finger bar, the fingers, the fixing screws, the pressing plates and the guide plates. The fingers have the role of dividing the plants to be cut into longitudinal strips and supporting them during cutting. The fingers are mounted, by fixing screws, to the finger bar. Counter-cutting blades are fixed on the fingers by riveting. The press plates serve to adjust and maintain the clearance between the cutting blades of the knife and the counter-cutting blades of the fingers. The knife bar guide plates provide support for the knife at the rear. The mobile part of the cutting device (the knife) includes: the blade holder bar, the cutting blades and the knife head. The drive mechanism of the cutting device has the role of transforming the rotational movement of the drive shaft into rectilinear-reciprocating translational movement of the knife. The following mechanisms are used for cutting devices with rectilinear rectilinear movement of the knives: connecting rod-crank mechanism, connecting rod-crank-rocker mechanism, oscillating washer mechanism, oscillating fork mechanism, hydrostatic mechanism, etc. The cutting device with two knives with reciprocating rectilinear movement consists of a support bar supported on two skates and two knives, respectively the upper knife and the lower knife, between which blades the plants are cut by shearing. The two knives are supported and guided by articulated arms, being operated from a crankshaft by means of connecting rod-crank mechanisms, the elbows of the cranks (knobs) being shifted to 180^0 .

Mechanical rakes are used in the technology of harvesting and preserving fodder in the form of hay. They perform the turning or turning over of the mowed furrows and gathering the dry hay into the furrows. Depending on how they are attached to the tractor, mechanical rakes can be: mounted rakes, semi-mounted rakes or trailed rakes. According to the position of the working bodies in relation to the direction of advance, mechanical rakes can be: transverse rakes, oblique rakes, axial rakes. Oblique rakes with rotating discs have as active organs discs with elastic fingers arranged vertically and inclined to the direction of advance. Each disk is freely mounted on a support that is articulated to the machine frame. The discs can oscillate freely in the vertical plane, being equipped with springs. The angle of inclination of the discs with respect to the forward direction of the machine is 50-60 degrees for tight and turned, respectively 40-50 degrees for beaten and loose. During work by moving the machine, the discs, in contact with the ground, acquire a rotational movement. The hay is moved from one disc to another until the last one, resulting in a furrow parallel to the direction of advance. For the furrows, the mutual position of the discs changes.

Mechanical piston presses were used for baling alfalfa hay.

The technological composition of piston presses includes the following technological sub-assemblies: frame, lifter-gatherer, feeding devices, pressing mechanism, tying device, device for adjusting the degree of pressing, support of coils with the material to be tied (string or wire) and mechanical transmission for operating the working organs. The frame consists of a transverse beam at the ends of which two wheels with tires are mounted and a longitudinal beam that constitutes the pressing chamber (channel) and from which the traction bar is hingedly mounted, which has two fixing positions, transport and working position. The gathering lifter is of the type with elastic fingers and includes the support frame, the drum with elastic fingers, the grid for guiding the material, the copy wheel and the compensating spring. The feeding organs have the role of taking the material from the plant collector lifter and introducing it into the pressing chamber. They can be made in the form of a helical conveyor, rotating forks or chains with forks. The pressing mechanism consists of the pressing chamber, piston, piston actuation mechanism, knife, counter knife and flywheel.

The tying device has the role of tying parallelepiped bales with wire or string and consists of: needles, needle mechanism, wire or string retainer, wire twister or string knotter, mechanism for removing the knot, knives for cutting the wire or strings, control mechanism of the tying device. The working process of the piston press is as follows: by moving the press along the furrows, the

material is lifted from the stubble by the elastic fingers of the collector lifter and transmitted in a continuous layer to the intermediate feeder that divides the material into portions and transmits it power group. The forks of the feed group drive the material into the press chamber when the piston is not in the press chamber (in the idle stroke of the piston). In the active stroke (when the forks are not in the pressing chamber) the piston pushes the portion of material along the pressing chamber and performs the separation of the material in the pressing channel from that remaining in the chute of the feeding group by cutting with the help of the knife (mounted on the body piston) and the fixed counter knife (mounted on the frame of the pressing channel). The portions of material pressed with each stroke of the piston make up the bale which is gradually pushed through the pressing channel. With the advance of the bale in the press channel, the tying wires (wire or twine) are progressively pulled and the star wheel of the control mechanism of the tying device is turned. When the bale has reached the adjusted length, the coupling of the main shaft of the tying device is ordered. The needles of the tying device enter the pressing chamber, pass through the channels in the piston and deposit the tying threads in the retainers. During this time, the wire twister or string knotter executes the tying of the bale and the knives cut the wire or string. The needles retract and leave the ties for the next bale in the pressing channel. Bale tying takes place in a very short time, practically when the piston is outside the pressing chamber (during the idle stroke). With a new active stroke of the piston, the material introduced into the pressing channel pushes the formed bale into the channel and forcibly extracts the ends of the ties from the twisting or knotting device. With each portion added to the new bale being formed, the bound bale is gradually pushed into the baling chute and finally falls from the discharge chute onto the stubble. .

RESULTS AND DISCUSSIONS

Fertilization works for the alfalfa crop were:- Basic fertilization with complex NPK fertilizers (16:16:16) – 200 kg/ha;- Fertilization in vegetation with nitrolimestone – 100 kg/ha. A basic fertilization and 3 fertilizations in vegetation (in years II, III and IV) were carried out. The aggregate consisting of the U-445 tractor + the Amazone 300 fertilizing machine was used for the fertilization works. The machine is of the carried type and driven by cardan transmission from the tractor's power take-off. The capacity of the fertilizer hopper is 300 liters. Adjusting the fertilizer rate is done by adjusting the opening of the fertilizer dispenser slots and by changing the working speed. The working speed when fertilized was 8 km/h, the working width was 12 m, the diesel consumption was 3 liters/ha, the fertilized area was 2 ha/hour. The expenses related to the mechanized fertilization works, expressed in lei per hectare, are centralized in table 1.

Table 1

Expenditures for mechanized fertilization works (four works)

Nr. crt	Specification	Rating	Value lei/ha
1	Remuneration expenses	$\mathbf{C_R}$	32
2	Fuel expenses	$\mathbf{C_M}$	72
3	Depreciation expenses	$\mathbf{C_A}$	24
4	Technical service expenses	$\mathbf{C_{DT}}$	16
5	Ancillary expenses	$\mathbf{C_{AX}}$	28
TOTAL		$\mathbf{C_T}$	**172**

Plowing work must comply with certain technological requirements: constant plowing depth for each furrow, plowing without mistakes, overturning and shredding of plowed furrows, introduction of plant residues under the furrow. For the plowing work, the plow carried with 4 bodies PP4-30 in aggregate with the universal tractor U-650M was used. Preparing the plow for work was done in the field with the tractor's right-hand wheels in the

furrow. The working depth, the working width of the first body, the working width of the plow, the horizontality of the plow frame with the help of the tie rods from the tractor and the adjustment mechanisms of the plow were adjusted. The plot on which the plowing work was carried out was divided into 4 posts which were plowed in parts and at the tiller. The ends of the plot were plowed after turning the furrows towards the plowed land. The plowing depth was 22 cm, the working speed was 6 km/hour, the diesel consumption was 22 liters/ha and the surface shows in an hour 0.5 hectares.

In table 2. the expenses of the mechanized plowing work are centralized.

Table 2

Expenditures for mechanized plowing

Nr. crt	Specification	Rating	Value lei/ha
1	Remuneration expenses	$\mathbf{C_R}$	42
2	Fuel expenses	$\mathbf{C_M}$	132
3	Depreciation expenses	$\mathbf{C_A}$	8
4	Technical service expenses	$\mathbf{C_{DT}}$	12
5	Ancillary expenses	$\mathbf{C_{AX}}$	38
TOTAL		$\mathbf{C_T}$	**232**

The work of preparing the land for sowing has the role of shredding, leveling, loosening the soil and destroying weeds. It is important to keep water in the soil. The land must be very well shredded because alfalfa seeds are small. Land preparation was carried out by two passes with the aggregate consisting of the universal tractor U-650 M and the trailed disc harrow GD-3,2. The working depth was adjusted to 10 cm, the working speed was 8 km/h, the diesel consumption was 8 liters/ha and the working capacity was 8 hectares per day.

The expenses related to the two discussion papers, expressed in lei per hectare, are centralized in table 3. The disc harrow performs seed bed preparation work by discus, on plowed land. The working depth is 10 cm and the working width is 3.2 m. The disc harrow GD-3.2 M consists of: frame, traction triangle, batteries with discs in number of 4 asymmetrically mounted in X, the running gear and the hydraulic mechanism for adjusting the working depth. The working speed was 8 km/h, the working capacity was 1.6 ha/h and the fuel consumption was 8 litres/ha. The costs per discussed hectare are centralized in the technological sheet for the mechanization of land preparation works in table 3.

Table 3

Costs for mechanized works to be discussed (two works)

Nr. crt	Specification	Rating	Value lei/ha
1	Remuneration expenses	$\mathbf{C_R}$	42
2	Fuel expenses	$\mathbf{C_M}$	96
3	Depreciation expenses	$\mathbf{C_A}$	14
4	Technical service expenses	$\mathbf{C_{DT}}$	16
5	Ancillary expenses	$\mathbf{C_{AX}}$	34
TOTAL		$\mathbf{C_T}$	**202**

Alfalfa sowing was carried out with the SUP 29M mounted sowing machine in aggregate with the U 650 M universal tractor. The SUP-29M universal mounted sowing machine is intended for sowing in rows seeds of cereals, clover, alfalfa, peas, parsley, carrots , onions, radishes, etc. It works in aggregate with 60-80 HP tractors and sows on a number of 29 rows at a distance of 12.5 cm between the rows. The sowing work was carried out at a speed of

8 km/h, the diesel consumption was 6 liters per hectare and the daily rate was 8 hectares per day. The costs of the mechanized sowing work are shown in table 4.

Table 4

Costs for mechanized sowing of alfalfa

Nr. crt	Specification	Rating	Value lei/ha
1	Remuneration expenses	**C_R**	42
2	Fuel expenses	**C_M**	96
3	Depreciation expenses	**C_A**	14
4	Technical service expenses	**C_{DT}**	16
5	Ancillary expenses	**C_{AX}**	34
TOTAL		**C_T**	**96**

Mowing works

Alfalfa is a perennial plant. The culture technology extended over 4 years. In each, 4 harvesting operations were carried out (mowing + raking + baling). The Pottinger CAT 185 rotary mower was used for the mowing work in combination with the 65 HP U-650M universal tractor. The mower is carried and driven from the tractor PTO shaft. It has a working width of 2.4 m. The actuation of the two rotating drums is done by transmission with trapezoidal belts. The width of the mowed furrow is 1.8 m. In table 5, the costs of mechanized alfalfa mowing work are centralized.

Table 5

Costs for mechanized alfalfa mowing operations

Nr. crt	Specification	Rating	Value lei/ha
1	Remuneration expenses	**C_R**	240
2	Fuel expenses	**C_M**	576
3	Depreciation expenses	**C_A**	96
4	Technical service expenses	**C_{DT}**	112
5	Ancillary expenses	**C_{AX}**	192
TOTAL		**C_T**	**1216**

For the mechanized raking works, the aggregate consisting of the U-445 tractor + Vicon Acrobat 510 mechanical rake was used.The mechanical raking works were carried out at a speed of 8 km/h, the diesel consumed was 3 liters per hectare. In table 6, the expenses of mechanized raking works are centralized.

Table 6

Costs for mechanized alfalfa raking work (16 papers)

Nr. crt	Specification	Rating	Value lei/ha
1	Remuneration expenses	**C_R**	64
2	Fuel expenses	**C_M**	288
3	Depreciation expenses	**C_A**	64
4	Technical service expenses	**C_{DT}**	64
5	Ancillary expenses	**C_{AX}**	96
TOTAL		**C_T**	**576**

The mowed, threshed and raked alfalfa was collected in the form of perellipepid bales with the PPF mechanical press. The press is of the piston type, being actuated by cardan transmission from the power take-off shaft of the U-650 M tractor. The working speed was 6 km/h and the diesel consumption was 8 liters per hectare. The costs for the 16 mechanical baling works are centralized in table 7.

Table 7

Costs for mechanized alfalfa baling operations (16 papers)

Nr. crt	Specification	Rating	Value lei/ha
1	Remuneration expenses	C_R	288
2	Fuel expenses	C_M	768
3	Depreciation expenses	C_A	128
4	Technical service expenses	C_{DT}	192
5	Ancillary expenses	C_{AX}	256
TOTAL		C_T	**1632**

CONCLUSIONS

From the analysis of studies carried out on lucerne culture, in the Gothatea area, Hunedoara county, carried out over a period of 4 years, the following conclusions can be drawn.

Lucenna, being a perennial crop, has proven to be a profitable crop with good profit per hectare.

The average production harvested from one hectare of alfalfa was 8 tons of alfalfa bales in one year, respectively 32 tons of hay per hectare in 4 years.

The total investment was 5890 lei/ha, of which: 4126 lei mechanized works and 1764 lei materials. It means that the production price was:

5890 lei/ 32 tons = 184 lei/ton.

Taking into account that a bale has a mass of around 25 kg, one ton of hay has 40 bales. So the production price for a bale of alfalfa hay was approximately:

184 lei/40 bales = 4.6 lei/bale.

Alfalfa hay is sold at prices between 8-12 lei per bale, i.e. between 320-480 lei/ton of hay. The profit obtained from one ton of hay is 136-296 lei/ton. Compared to the production price, the profit obtained varies between 74% - 161%.

From the analysis of expenses for mechanized works, it can be seen that the largest share is due to expenses with diesel fuel, with a weight of 48% (1964/4126 = 0.48). Some of these expenses can be reduced if, instead of used tractors, tractors with supercharged engines that have lower fuel consumption are used.

The alfalfa harvest season is a decisive technological factor, influencing the level and quality of harvests, on the one hand, and on the other, the longevity of the crop. As such, a large, constant and long production can only be obtained by respecting the biological requirements of the plant.

Obtaining high productions per hectare and with low expenses requires strict compliance with culture technologies by using agricultural aggregates as complex as possible and with the highest possible yield.

BIBLIOGRAPHY

DUMA COPCEA ANIȘOARA, CASIANA MIHUȚ, NICOLETA MATEOC-SÎRB, LUCIAN NIȚĂ, ADALBERT OKROS, IAROSLAV LAȚO, TEODOR MATEOC, DANIEL POPA, 2023, Studies on minimum wheat tilling, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development Vol. 23, Issue 2, 2023 PRINT ISSN 2284-7995, E-ISSN 2285-3952

HERMENEAN I., 2008, Tehnologii, mașini și instalații pentru recoltarea și conservarea sub formă de fân a furajelor de pe pajiști, Ed. Universității Transilvania, Brașov.

LĂCĂTUȘU MATILDA, TUDOR CONSTANȚA, TEODORESCU IRINA, NĂDEJI M., 1981 – Structura faunistică din culturi de lucernă. Stud Cerc. Biol., Anim., 33, 2: 179 – 182.

MANOLACHE C., BOGULEANU GH., PAŞOL P., NICA FELICIA, NICOLAESCU NINETA, 1969 – Contribuţii la studiul dinamicii sezoniere şi diurne a faunei lucernierelor. Com. Zoo., Prima consfătuire de entomologie, Bucureşti, 83 – 98.

MARTENS, D., 2007 – Management of drought stress in alfalfa. available at http:/www. Co. Stearns. Mn. Usldocum – ents/ E×T 07 242007 WC. Pdf.

MIHUT;CASIANA DOINA ANIȘOARA CLAUDIA DUMA - COPCEA; ADALBERT OKROS; CARMEN CLAUDIA DURAU; ANTOANELA LENA COZMA, 2022. Conservative tillage soil systems in context of the climate changes. Proceedings of 22nd International Multidisciplinary Scientific GeoConference SGEM Vienna 2022. DOI: 10.5593/sgem2022V/4.2/s19.28. Issue 10.5593/sgem2022V/4.2 ISSN 1314-2704; ISBN 978-619-7603-50-7 Volume 22 Issue 4.2

MOGA, I., SCHITEA, MARIA, 2005 – Tehnologii moderne de producere a seminţelor la plantele furajere. Edit. Ceres, Bucureşti, 288 pag.

MOGA, I., SCHITEA, MARIA, MATEIAŞ, M.C., 1996 – Plante furajere. Edit. Ceres, Bucureşti, 355 pag.

PETCU, ELENA, SCHITEA, MARIA, EPURE CÎRSTEA, VALENTIN, 2009 – The effect of water stress on cuticular transpiration and its association with alfalfa yield. Romanian Agricultural Research, 26: 25-28.

SCHITEA, MARIA, 2002 – Priorităţii în ameliorarea plantelor furajere. In: Priorităţi ale cercetării ştiinţifice în domeniul culturilor de cãmp. Edit. Ceres, Bucureşti: 79-88 I.S.B.N. 973-8115-02-7.

SCHITEA, MARIA, 2010 – Rezultate în ameliorarea lucernei la INCDA Fundulea în perioada 2000-2009. An.INCDA Fundulea, LXXVIII, 2: 63-78.

SCHITEA, MARIA, VARGA, P., 2007 – Realizări în ameliorarea plantelor furajere la Fundulea. An. INCDA Fundulea, LXXV: 203-228.

*** https://agrointel.ro/

*** https://ien.vicon.eu/

*** https://www.autovit.ro/utilaje-agricole/tractoare-agricole/deutz-fahr/

***https://www.pestre.ro/blog/cultura-lucernei-proces-tehnologic-si-rentabilitate/