

SINGULARITIES OF WHITE CLOVER SEED HARVESTING IN LITHUANIA

BALTŲJŲ DOBILŲ SĖKLŲ DERLIAUS NUĖMIMO YPATUMAI LIETUVOJE

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This paper presents the results of white clover growing and seed harvesting in Lithuania. Institute of Agricultural Engineering of Aleksandras Stulginskis University carried out white clover seed harvesting experiments at an experimental field harvesting the white clover variety 'Bitūnai' seed yield using different technologies and machinery: direct combining of desiccated white clover, windrow harvesting and stripping-threshing. The following machinery has been used: mower KS-2.1, modular tractor MTZ-80, combine harvester SK-5, and combine harvester SR 500 with the stripper header and without it. Several biometrical indexes and technological characteristics of white clover were examined, also agricultural and energetic parameters, total energy of white clover yield and coefficient of the energetic efficiency were determined while harvesting the crop of white clover by all tested technologies.

After evaluating energy susceptibility of the machines, diesel and labour input as well as the energetic efficiency coefficient, it was established that windrow harvesting was the least effective technology for white clover seed harvesting. The total seed losses of white clover harvesting were the highest when using direct combining and windrow harvesting technologies and the lowest in the stripping-threshing technology. The most effective results of white clover harvesting were achieved by using the stripping-threshing technology with the output of combine harvester SR 500 being approximately 2 times higher compared to traditional technology.

White clover, harvesting, combine harvester, desiccation, humidity, seed losses, output, coefficient of energy efficiency.

Introduction

Perennial legumes and grasses occupy an important place among forage crops out of which the largest area is sown with clover. Cultivation of perennial legumes mixed with grasses enriches the soil with nitrogen, since legumes are able to acquire it from the atmosphere. Nitrogen fixing capacity of legumes depends on

soil reaction. In a field crop rotation, mixtures of perennial legumes and grasses are used under three management systems: cutting, grazing and combined [1].

Biological nitrogen accumulated by legumes is one of the main and cheapest sources for plant supply with nitrogen. On heavy soils, deep-rooted legumes have a positive effect on the porosity of topsoil and subsoil [2].

White clover (*Trifolium Repens* L.) is grown in mixtures with perennial grasses and in pastures. It is a low growing perennial herb. The plant grows from the tip by sending out runners that take root, and new runners are formed from each rooting point. The varieties of developed white clover and their growing range in Lithuania were studied by A. Grigas, L. Kadžiulis, A. Sprainaitis, I. Brazauskienė, N. Lemežienė, S. Virbickienė, J. Šlepetyš, E. Vilčinskas and other scientists. Some of white clover seed harvesting technologies and especially their direct combining were studied by J. Liaukonis, V. Audzevičius, K. Jurpalis et al. researchers. However, after the white clover harvesting using the method of direct combining, up to 83% of uncut heads of clover seeds remains in the soil [3]. Therefore it is necessary to investigate the white clover seed collection from the surface of soil, i.e. from stubble, applying different agricultural techniques, or even using other advanced agricultural seed harvest processing technologies. One of such technologies is the stripping-threshing technology of the perennial grass seed and other crop.

Objective of the study was to examine and evaluate the most rational white clover seed harvesting technology.

Object and methods

White clover (*Trifolium Repens* L.) is one of the most constituent green crops for pasture, hay and haylage. Soil and climatic conditions are a major factor determining crop productivity. The seeds of white clover are produced in a white fluffy head. For white clover to prosper, the soil should be well drained, kept moist and grown in full to moderate sun. Clover gives the best results in full sunlight.

In Lithuania white clover starts to flower towards the end of June and goes on flowering fairly vigorously until the mid-August. Newly seeded white clover generally flowers only after one full season, i.e. in the 2nd year and beyond. It takes about 4 weeks for clover seed to mature after pollination. Therefore, in order to get a good yield of white clover seed, the bees and, of course, non-rainy weather are needed for pollination of blooming clover heads.

In Lithuania the production of white clover varieties are as follows: Lithuanian - 'Bitūnai', 'Sūduviai', 'Dotnuviai', 'Nemuniai', 'Atoliai'; Danish - 'Nanouk', 'Millais', 'Rivendel'; Dutch - 'Riesling', 'Retor'; Swedish - 'Ramona', Norwegian - 'Holev' [4]. Field experiments with white clover varieties were conducted at the Lithuanian Institute of Agriculture during the period of 1998–2004 [5]. In terms of dry matter yield, the white clover variety 'Dotnuviai' was found to be the most productive (10.11 t ha⁻¹) of all the tested varieties, the standard variety 'Sūduviai' yielded 8.83 t ha⁻¹. White clover approved area in Lithuania in 2012 was 410 ha (total), including 300 ha of cultivar 'Nemuniai' and 110 ha of 'Sūduviai'.

Seed yield of white clover received in Lithuania amounts to 0.1- 0.2 t ha⁻¹. [6]. The average weight of 1000 seeds is 0.73 g; 1 kg contains 1.5 million seeds of white clover. About 10-25 % is non-germinating seeds. White clover is a very low plant, their stems are short (15-20 cm), mature white clover often are lodged. Therefore, not all clover heads are cut by combines' harvesters. This leads to the loss of as much as 30-50 % of total white clover seed yield [7].

Experimental tests. Institute of Agricultural Engineering of Aleksandras Stulginskis University carried out white clover seed harvesting experiments in 2007-2009 at an experimental field harvesting the white clover variety 'Bitūnai' seed yield using different technologies and machinery: direct combining of desiccated white clover, windrow harvesting and stripping-threshing. The following machinery has been used: mower KS-2.1, modular tractor MTZ-80, combine harvester SK-5, and combine harvester SR 500 with the stripper header and without it.

Study object. *Trifolium Repens* L., var. 'Bitūnai'.

White clover can be grown with the help of equipment, available in the most of the farms. It requires quite little attention during the growing season.

There are two methods of white clover harvesting. Direct combining allows the harvest to be completed in one operation. In general, Lithuanian farmers consider direct combining to be the best way of harvesting (after desiccating with diquat / reglone or glyphosate). In this case, the fields need to be flat and levelled, to ensure a stone free surface for the easier harvesting. However, the farmers from other countries usually give priority to the windrow harvesting of white clover and only very seldom use direct cutting except when the white clover stands tall and is sprayed with reglone or glyphosate. Swathing should be done in the early morning when the dew is present, or in damp weather to help keep the losses due to shattered seed down to a minimum. After swathing or windrowing, it is necessary to allow white clover to cure for a few days in the windrow (usually from 7 to 10 days). During this time, some dry matter will translocate into the nearly- mature seeds and they will ripen in the windrow. Windrowing also helps to reduce the shattering because the weather conditions are not dictating the harvesting time. It can be windrowed when grain is ripe and combined when the weather permits.

In order to reduce the cost of seed production, shorten their harvesting period and solve the combine – harvester shortage problem, it is necessary to accelerate the process of introduction of new, energy saving cereal and other crop harvesting technology in Lithuania. An example could be the stripping – threshing technology, using stripper – headers instead of cutters.

The Shelbourne Reynolds Engineering LTD (Great Britain) manufactures the strippers with 3-9.8 m operating width and sells them to different countries. The strippers operate with different type harvesters: New Holland, Claas, John Deere, Massey Ferguson and other. Stripping technology allows to increase the efficiency of a combine around 2 times as the combine with a stripper header reaches a working speed of 10-13 km h⁻¹ [8]. Using the crop stripping technology, only 10-20% of straw get into the harvester thus the harvester can work faster. Operation output increases and fuel consumption decreases.

At the Institute of Agricultural Engineering of Aleksandras Stulginskis University a stripping installation of 2.3 m working width has been developed for the combine SR 500 [9]. Research was carried out harvesting wheat, barley, linseed, red clover, pea and buckwheat.

White clover characteristics and technological features were determined according to the standard method. Harvester operation indices in all tested technologies were estimated taking into account the seed losses of cutting, picking, stripping, and threshing-separation of white clover. The stripper header technical characteristics and principle of operation were described [9]. Methods of establishing agritechnical energetic indicators, used equipment and devices and trial sample methods are described [10, 11]. All tested technologies of white clover harvesting were marked by letters:

A – swathing (windrow harvesting) technology using the mower KS – 2.1 for cutting the white clover into windrow, modular with tractor MTZ – 80;

B – direct combining of desiccated white clover using the combine – harvester SK-5;

C – direct combining of not desiccated white clover using the combine – harvester SR 500;

D – white clover has been harvested by the stripping-threshing technology using the combine SR 500 with an experimental stripper header.

Correct combine settings and operation are important to maintain seed quality. In addition, it is necessary to adjust the combine settings as weather and harvest conditions change. The main indicators of adjusting working parts of the combines SR 500 and SK-5 are presented in Table 1.

Table 1. The main indicators of working parts' adjustment of the combine harvesters SR 500 and SK-5

1 lentelė. Kombainų SR 500 ir SK-5 darbinių dalių reguliavimai

Indicators and measure units	Measurement	
	SR 500	SK-5
Revolution rate of threshing drum, min ⁻¹	1250	1200
Gaps between drum and concave (front/end), mm	6/2	18/2
Revolution rate of fan's impeller, min ⁻¹	2500	530
Gaps between upper sieve chaffer, mm	14	20
Gaps between bottom sieve chaffer, mm	-	16
Gaps between upper sieve extension plates, mm	12	14
Diameter of bottom sieve holes, mm	5	-
Fan rod of damper, position	3	-
Fan air stream direction rod of shield, position	7	-

During the tests the experiment field length, trial duration, working widths of the stripper and combine header and fuel consumption were measured. The length of experiment field was 30 m.

The energy consumption and energetic efficiency of white clover harvesting technologies were estimated according to the methodological recommendations [12, 13, 14, 15,16, 17] and test results of the experiment.

Experimental data was processed using the statistical method, recommended by the international standard ISO 7256/1.2. The average values of the data and their validity intervals were presented according to the following formula $[\bar{X} \pm (t_{05} \times S_x)]$ [18].

Results and discussions

Agrobiological and technological features of white clover.

Distribution of mature and semi-mature heads of white clover was measured in every 5 centimetre section through the height of the crop, beginning from the soil surface. The research was carried out in the experimental field (Bernatoniai, Kaunas district) of IAgEng ASU Institute, harvesting the white clover variety ‘Bitūnai’ in 2007–2009. The results are presented in Fig. 1.

As it is seen in Figure 1, distribution of mature and semi-mature heads of white clover is about 22 % below 5 centimetres of the total crop’s height and 43 % below 10 centimetres of the height.

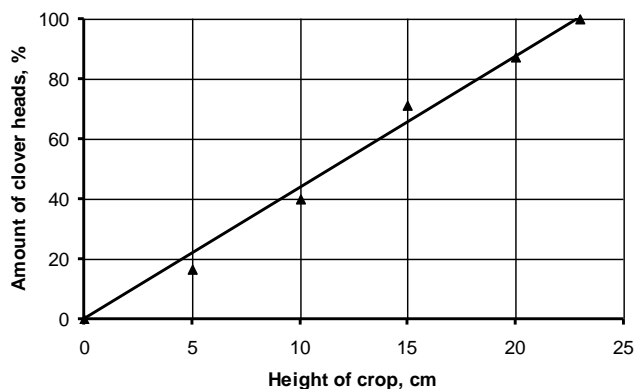


Fig.1. The integral graph of the average distribution of white clover heads, 2007–2009
1 pav. Baltųjų dobilų galvučių su sėklomis išsidėstymo grafikas

$$y = 4.377x;$$

$$R^2 = 0.9908$$

The amount of seed losses of white clover cutting depends on the smoothness of the field, working width of the harvesters and the ability of the header to copy field topography in the transverse direction (the same as with other types of clover). As it is seen in the Fig. 1, even if the field is perfectly flat and the average cutting height of white clover is 5 cm, around 20% of white clover heads, containing seeds, remains in the stubble. If the average cutting height is 10 cm – about 40% of white clover heads remains on the soil surface.

The moisture of the white clover crop is very important indicator, affecting the size of the seed losses during the process of harvesting. When a crop of white

clover contains a lot of green (wet) mass and the harvesting technology used is direct combining, the desiccation of crop is applied before harvesting. Fig. 2 shows the moisture variation of desiccated (rate of reglone was 1 and 2 l ha⁻¹) and not desiccated crop of white clover and Fig. 3 – the moisture variation of white clover heads (only) with seeds.

As it is seen from Fig. 2 and 3, the rate of reglone (1 or 2 l ha⁻¹) does not have much influence on moisture of white clover. This fact should be taken into consideration when estimating the norm of reglone for crop desiccation. However, weed infestation and degree of head maturation depend on the norm of reglone used for white clover desiccation.

Other technological features of white clover harvesting are presented in Table 2.

Table 2. The agrobiological and technological features of white clover during the period of harvesting

2 lentelė. Baltųjų dobilų charakteristika ir technologinės savybės

Title of indices and measure units	White clover	
	desiccated	not desiccated
Weed infestation, %	13.45 ± 0.82	13.45 ± 0.82
1000-seed mass, g	0.682 ± 0.03	0.654 ± 0.03
Seed yield, t ha ⁻¹	0.203 ± 0.04	0.214 ± 0.05
Seed and straw proportion	1 : 63	1 : 89
Moisture, % :		
seed	18.75 ± 0.57	24.39 ± 0.81
straw	57.91 ± 0.72	77.13 ± 0.95
chaff	41.22 ± 0.35	45.79 ± 0.54

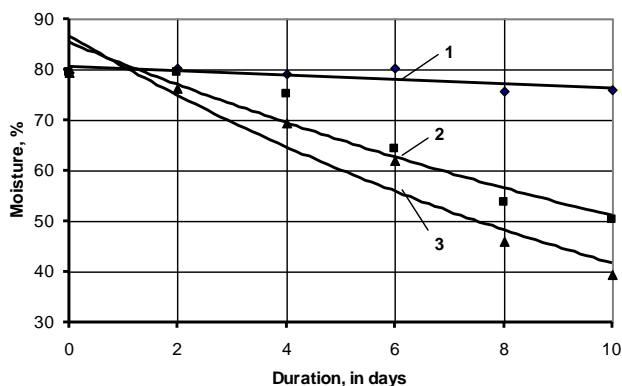


Fig. 2. Determination of moisture dynamics of white clover plants: 1 – not desiccated plants; 2 – desiccated plants: the rate of reglone is 1 l ha⁻¹; 3 – desiccated plants: the rate of reglone is 2 l ha⁻¹

2 pav. Baltųjų dobilų drėgnio dinamika: 1 – augalai nedesikuoti; 2 – desikuoti 1 l ha⁻¹ reglono; 3 – desikuoti 2 l ha⁻¹ reglono

$$y_1 = -0.4147x + 80.565; \quad R_1^2 = 0.5729$$

$$y_2 = 85.321e^{-0.0514x}; \quad R_2^2 = 0.9216$$

$$y_3 = 86.668e^{-0.0732x}; \quad R_3^2 = 0.9265$$

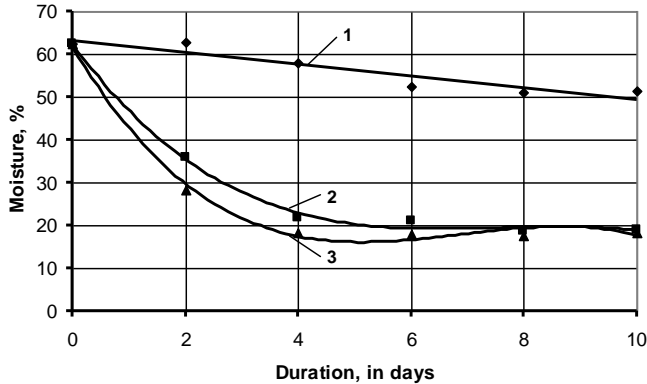


Fig. 3. Determination of moisture dynamics of white clover heads (only): 1 – not desiccated plants; 2 – desiccated plants: the rate of reglone is 1 l ha^{-1} ; 3 – desiccated plants: the rate of reglone is 21 l ha^{-1}

3 pav. Baltųjų dobilų galvučių drėgnio dinamika: 1 – augalai nedesikuoti; 2 – desikuoti 1 l ha^{-1} reglono; 3 – desikuoti 21 l ha^{-1} reglono

$$y_1 = -1.3704x + 63.157; \quad R_1^2 = 0.8814$$

$$y_2 = -0.1067x^3 + 2.4147x^2 - 17.83x + 62.358; \quad R_2^2 = 0.9962$$

$$y_3 = -0.1664x^3 + 3.4435x^2 - 22.199x + 61.75; \quad R_3^2 = 0.9937$$

Note. Desiccated white clover has been used with traditional technology when crop was harvested by direct combining using the harvester SK-5 (version B). Not desiccated white clover has been used with windrow harvesting (version A), with direct combining by the combine harvester SR 500 (version C) and with stripping-threshing technology (version D).

Agro-technical indicators of white clover harvesting were examined. The operating speed of the combine in stripping-threshing (D) technology of white clover has a great impact on seed stripping (combing) losses: the higher is the speed the lower are the seed losses (Fig. 4). However, operating speed is limited by the technical capabilities of the harvester itself. The maximum operating speed of the combine SR 500 reached in our experiments was only $7.1\text{-}7.5 \text{ km h}^{-1}$ and this corresponds to the maximum speed of the second gear (the third gear is used for transportation). This was the result of operation of the combine with stripper at maximum possible speed. On the opposite, the increase of combine speed resulted in higher losses of white clover heads when using threshing-separation (first curve of Fig. 4) together with overall seed losses of stripping-threshing technology (version

D). The rational speed of the combine SR 500 with stripper is the possible maximum speed, i.e. in our tests it was about 7 km h⁻¹. In that case the overall seed losses of the stripping-threshing technology were 15.8% of the total biological yield of white clover seed.

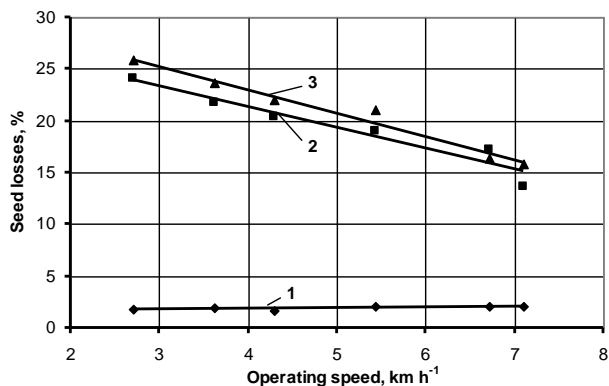


Fig. 4. The influence of working speed of the combine SR 500 on white clover seed losses in the stripping technology: 1 - threshing-separating; 2 - stripping; 3 - total

4 pav. Kombaino SR 500 darbinio greičio įtaka baltųjų dobilų nušukavimo technologijos sėklų nuostoliams: 1 – kūlimo-separavimo; 2 – šukavimo; 3 – visuminiai

$$y_1 = 0.0893x + 1.4839;$$

$$R_1^2 = 0.6531$$

$$y_2 = -2.0007x + 29.314;$$

$$R_2^2 = 0.9303$$

$$y_3 = -2.2535x + 32.0;$$

$$R_3^2 = 0.9723$$

During comparative research the dependences on combine operating speed of cutting, threshing-separating and overall seed losses using traditional technology (version C) and the combine SR 500 were established (Fig. 5).

Using traditional (cutting-threshing) technology, the combine operating speed in white clover field is limited not only by increase of threshing-separating seed losses (Fig. 5, curve 1), but also by combine's operation, as working at a higher speed than 3.5-4.5 km h⁻¹ (which is the rational operating speed in traditional technology of harvesting), the technological process of the harvester often breaks down, i.e. the auger of the reaper and the threshing apparatus gets chocked.

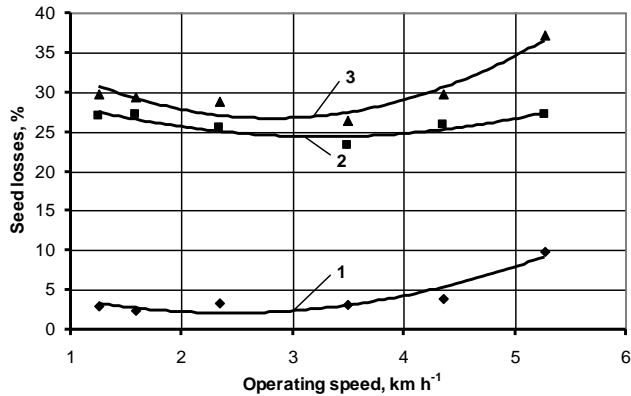


Fig. 5. The influence of working speed of combine SR 500 over white clover seed losses in the traditional technology: 1 - threshing-separating; 2 - cutting; 3 - total

5 pav. Kombaino SR 500 darbinio greičio įtaka baltųjų dobilų sėklų nuostoliams tradicinėje (pjovimo-kūlimo) technologijoje: 1 – kūlimo-separavimo; 2 – pjovimo; 3 – visuminiai

$$y_1 = 0.8904x^2 - 4.3412x + 7.3304; \quad R_1^2 = 0.8806$$

$$y_2 = 0.7633x^2 - 5.0055x + 32.542; \quad R_2^2 = 0.7748$$

$$y_3 = 1.6517x^2 - 9.3266x + 39.825; \quad R_3^2 = 0.9044$$

When summarising the data in Fig. 4 and Fig. 5, it could be stated that comparing the white clover stripping-threshing technology with traditional one, the combine's SR 500 achieved operating speed is nearly twice higher using the first technology (D) than using the second one (C), while the output increased as well.

Technological characteristics of white clover harvesting technologies.

Energy and other technological characteristics of all tested harvesting technologies, i.e. direct combining of white clover using the combine harvester SK-5 (method B), windrow harvesting (method A) when cutting to the windrows using the mower KS-2.1 modular with tractor MTZ-80 and windrow picking and threshing using combine SK-5 as well as the results of versions C and D are presented in Fig. 6 – 10. (Note: when white clover was harvested using different technologies – versions A, B, C and D – the chaff was not collected).

The average operating speed of white clover harvesting indicates the output of the combine harvester (Fig. 6).

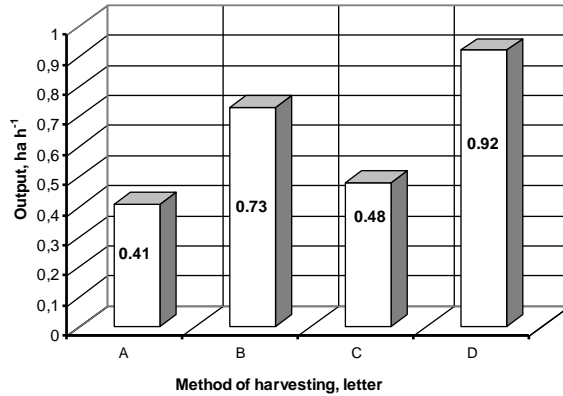


Fig. 6. The output of machines harvesting white clover by different technologies
6 pav. Mašinų našumas baltųjų dobilų sėklų derlių nuimant įvairiomis technologijomis

The lowest output of combine harvester has been achieved in the windrow harvesting and the highest output of combine has been achieved in the stripping-threshing technology of white clover harvesting. The total seed losses of white clover harvesting by all tested technologies are shown in Fig. 7.

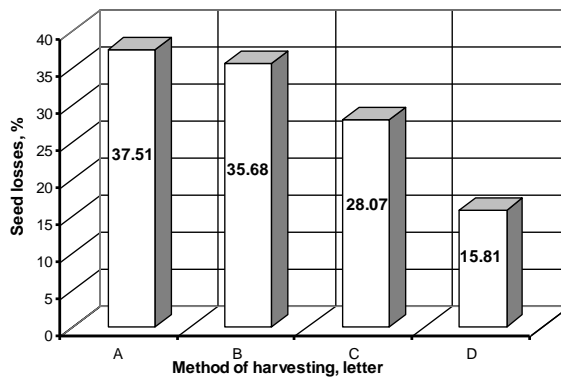


Fig.7. The total seed losses of white clover harvesting by different technologies
7 pav. Visuminiai baltųjų dobilų sėklų nuostoliai juos nuimant įvairiomis technologijomis

The efficiency of white clover harvesting is determined not only by extend of seed losses but also by energy costs, i.e., work efficiency of different machinery and number of working operations. The labour input of white clover harvesting using different machines is shown in Fig. 8.

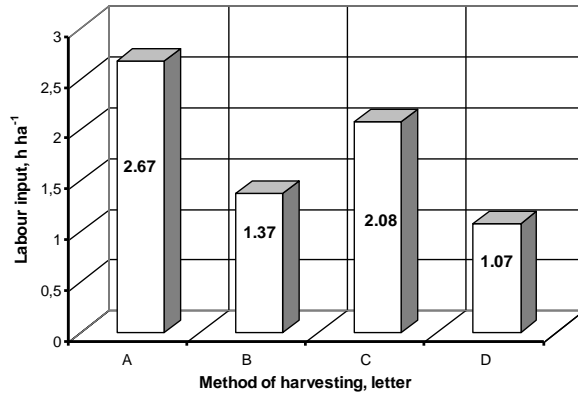


Fig. 8. The labour input of white clover harvesting using different technologies
8 pav. Darbo energijos sąnaudos baltųjų dobilų sėklų derlių nuimant įvairiomis technologijomis

The lowest labour input was obtained in the white clover stripping-threshing technology because the output of the combine was the largest.

Energy input and energy, accumulated in production were calculated per one hectare. For energetic assessment we have estimated the average seed and straw yield, seed losses, actual capacity of all tested technologies, fuel input and other data taken from our experimental results. Actual seed losses were deducted from biological seed yield of white clover.

The diesel consumption during white clover harvesting by different machinery is presented in Fig. 9.

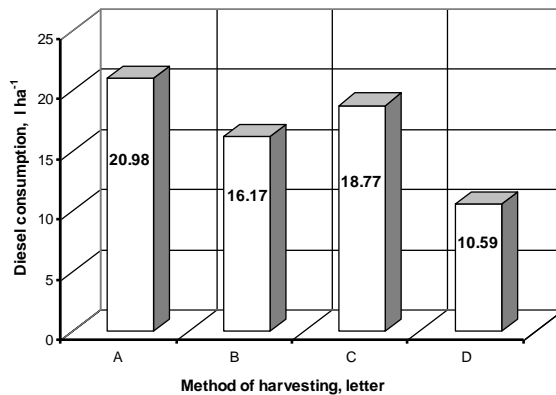


Fig. 9. The diesel consumption during white clover harvesting by different technologies
9 pav. Baltųjų dobilų sėklų derliaus doravimo technologijų degalų sąnaudos

The highest diesel consumption was reached in windrow harvesting technology, because the largest amount of machines was needed in this technology.

The energy parameters of all tested white clover harvesting technologies is best illustrated by the coefficient of energy efficiency K_e (Fig. 10), i.e. relationship

between energy input (for white clover growing and harvesting) and energy accumulated in the production. From the data of Fig. 10 we can see that the most effective method of white clover harvesting is stripping-threshing technology because its coefficient of energy efficiency is the highest and equals to 5.62, which means that 1 MJ of energy input generates over 5 MJ of energy.

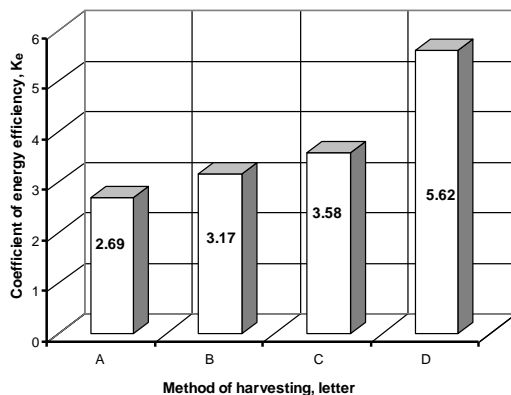


Fig. 10. The energetic efficiency of white clover harvesting by different technologies
10 pav. Baltųjų dobilų sėklų derliaus dorojimo technologijų energetinis efektyvumas

Conclusions

1. Lithuanian soil and climatic conditions are favourable for white clover growing. The average seed yield of white clover is about 0.2 t ha^{-1} , the average yield of dry matter – over 10 t ha^{-1} , the mass of 1000-seed – about 0.7g. The desiccation of white clover using reglone (or other desiccant) before the harvesting is an effective mean to reduce crop moisture. The rate of reglone $1\text{-}2 \text{ l ha}^{-1}$ is sufficient norm for white clover desiccation. The lower norm of desiccant would be sufficient if used under good (favourable) weather conditions.
2. During harvesting white clover is often characterized by high moisture (over 60%), sometimes – by considerable weed infestation and heads of the crop are located in low: about 40% of heads are located below 10 cm from the soil surface, around 20% – below 5 cm. Therefore, the seed losses of white clover cutting (during harvesting) often reach 25–30% of the total biological seed yield. In addition, the fields, where white clover grows, should be unruffled, without stones and the machinery cutting clover should be adjusted to the lowest possible cutting height.
3. Due to agro-biological properties of white clover as well as imperfections of some machines' construction, the seed losses of direct combining was 28–35%. Harvester's productivity reaching $0.5\text{--}0.7 \text{ ha h}^{-1}$ is relatively low. This is a result of lower working speed which was limited by threshing-separating seed losses and capabilities of the combine harvesters. After evaluation of criteria of machines' productivity, value of seed losses, diesel and labour input and the coefficient of energy efficiency, it was established that windrow harvesting meth-

od was the least effective technology (from tested ones) for white clover harvesting. Therefore, more productive technologies should be used for white clover harvesting. One of them is stripping- threshing technology.

4. Comparing the stripping-threshing technology of white clover harvesting with traditional (cutting-threshing) crop harvesting technology, the output of the combine SR 500 increases by 1.92 times, diesel input declines by 1.77 times, energy efficiency coefficient rises 1.56 times and is equal to 5.62 which means that 1 MJ of energy input generates over 5 MJ of energy.

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BALTŪJŲ DOBILŲ SĖKLŲ DERLIAUS NUĖMIMO YPATUMAI LIETUVOJE

Reziumė

Baltųjų dobilų agrobiologinės savybės, jų desikacija reglonu, biometriniai rodikliai bei sėklų derliaus nuėmimo technologijų tyrimai atlikti 2007–2009 metais Aleksandro Stulginskio universiteto Agroinžinerijos instituto bandymų lauke, įrengtame Kauno rajono Bernatonių kaime. Tyrėme reglonu desikuotų sėklinių baltųjų dobilų derliaus nuėmimą tiesiog kombainu SK-5, nedesikuotų baltųjų dobilų atskirtinę sėklų derliaus nuėmimo technologiją juos į pradalgės pjaunant žoliapjove KS – 2,1 agreguojama traktoriumi MTZ – 80; išdžiūvusios pradalgės rinktos ir kultos kombainu SK – 5 bei naują, našią, mūsų sukurtą dobilų galvučių (ir kitų žemės ūkio augalų grūdinės arba sėklinės dalies) nušukavimo-kūlimo technologiją kombainu SR 500 su eksperimentiniu nušukavimo įrenginiu (striperiu). Pastarosios technologijos tyrimų rezultatus lyginome su tradicine baltųjų dobilų pjovimo-kūlimo technologija serijinės gamybos tuo pačiu kombainu SR 500. Atlikti biometrinių rodiklių tyrimai parodė, kad apie 43 % baltųjų dobilų galvučių su sėklomis yra žemiau 10 cm ir apie 22 % – žemiau 5 cm nuo bendro pasėlio aukščio (matuojant nuo dirvos paviršiaus). Todėl vien pjovimo (javų kombainais ar kt. mašinomis) baltųjų dobilų sėklų nuostoliai siekia 25–30 % nuo viso biologinio sėklų derliaus. Jiems sumažinti baltųjų dobilų laukų paviršius turi būti išlygintas, nuo jų nurinkti akmenys, o mašinų pjaunamieji aparatai turi gerai kopijuoti lauko paviršių skersine kryptimi. Pasėlių priešpjūtinės desikacijos tyrimai parodė, kad baltiesiems dobilams desikuoti pakankama reglono norma yra 1–2 t ha⁻¹. Mažesnioji norma naudotina esant palankioms oro sąlygoms. Atskirtinė baltųjų dobilų sėklų derliaus nuėmimo technologija dėl didelių sėklų nuostolių, mažo našumo, didelių darbo ir dyzelino sąnaudų buvo mažiausiai efektyvi iš visų tirtų. Efektyviausia buvo baltųjų dobilų galvučių su sėklomis nušukavimo-kūlimo technologija, kuri kombaino SR 500 našumą, lyginant su tradicine technologija padidino 1,9 karto, dyzelino sąnaudas sumažino 1,8 karto, o energetinio efektyvumo koeficientas viršijo 5, t.y. investuotas 1 MJ sukūrė daugiau kaip 5 MJ energijos.

Baltieji dobilai, sėklų derliaus nuėmimas, javų kombainas, desikacija, drėgnis, sėklų nuostoliai, našumas, energinio efektyvumo koeficientas

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ОСОБЕННОСТИ УБОРКИ БЕЛОГО КЛЕВЕРА НА СЕМЕНА В ЛИТВЕ

Резюме

Исследования проведены на опытных делянках Института сельскохозяйственной инженерии Университета Александра Стульгинскиса при уборке клевера белого на семена (сорта 'Bitūnai') разными технологиями: прямым комбайнированием (белый клевер десичированн реглоном и недесичированн), отдельным способом уборки и методом очеса-обмолота. Опыты проведены в поселке Бернатоний Каунасского района. Для скашивания клевера белого в валки применили косилку KS – 2,1 и трактор MTZ – 80 . Для осуществления технологии прямого комбайнирования применили зерновые комбайны SK-5 и SR 500. Для очеса использовали зерновой комбайн SR 500 с экспериментальным стриппером и без него (базовая технология). Исследовали основные биометрические показатели, технологические свойства клевера белого, также агротехнические и энергетические показатели. Опыты показали, что для десикации клевера белого достаточной нормой реглона является $1-2 \text{ л га}^{-1}$, меньшая норма десиканта применяется при благоприятных погодных условиях. Установлен расход топлива и труда, энергосодержание урожая , определен коэффициент энергетической эффективности. Согласно энергетическим показателям наименьшей по эффективности технологией является отдельная уборка. Наилучшей по эффективности технологией является технология очеса-обмолота, так как , в сравнении с прямым комбайнированием, производительность комбайна увеличила в 1,9 раза, расход горючего снижала в 1,8 раза, а коэффициент энергетической эффективности превышал 5, т. е. вложен 1 МД энергии создал более 5 МД энергии .

Белый клевер, уборка, зерновой комбайн, десикация, влажность, производительность, потери семян, коэффициент энергетической эффективности.