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IMPROVEMENT OF CLAY LOAM *CAMBISOL* PROPERTIES BY COVER CROPS

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Abstract

During the period 2001-2004 field experiments were carried out at the Lithuanian Institute of Agriculture's Joniškėlis Research Station on *Endocalcari – Endohypogleyic Cambisol.* The experiments were designed to elucidate the effects of cover crops on organic matter accumulation in the soil and its impact on soil physical properties.

Experimental evidence suggests that having incorporated the biomass of various crops (with C:N ratio = 17.0-25.7) - oil radish, white mustard and red clover at flowering stage and that of cocksfoot and Italian ryegrass at heading stage, the content of soil organic carbon in the soil increased (4.0-5.6 %). When spring barley was grown under the effect of cover crops, soil bulk density was lower than in the control treatment. The most marked reduction in the soil bulk density (3.4 %) occurred under the effect of red clover biomass incorporation as green manure. The data averaged over two experiments suggest that significantly more water stable aggregates (by 2.1; 2.8 and 4.2 %, respectively) were identified after red clover, cocksfoot and Italian ryegrass compared with the soil without cover crops. Cover crops tended to deplete soil moisture reserves. The greatest reduction in soil moisture content (by 4.2 and 3.7 %) was recorded after undersown cover crops that accumulated the greatest mass –cocksfoot and red clover, compared with the soil without cover crops. Similar trends persisted in the years of effect, however, significantly lower productive moisture reserves (7.2 %) were identified only after red clover.

Key words: clay loam *Cambisol,* cover crops, chemical and physical soil properties.

Introduction

Numerous studies have been done and recommendations have been provided on the most suitable fertiliser forms and rates, application timing and methods. However, research on the effects of the technologies used after harvesting of main crops on soil properties, when the soil during the post-harvest period stays without any plant cover for a long time, is rather scanty. Cohesion and stickiness of heavy-textured *Cambisols* tend to decline, and hydrophysical and sorption properties tend to improve with increasing contents of organic matter in the soil /Vasinauskas, 1986; Gallardo-Carrera et al., 2006/. The data found in literature suggest that straw incorporation into the soil is a valuable biological means increasing organic matter content in the soil /Dexter et al., 2000; Franzluebbers et al., 2006/ Other researchers indicate that with the process of straw decomposition soil structure improves and the content of water stable soil aggregates increases, which is of special relevance for the soils with a high silt fraction /Stumpe et al., 2000/. Another means that helps improve soil physical state is incorporation of nitrogen-rich biomass of catch crops into the soil together with carbon –rich cereal straw /Macdonald et al., 2005; Rinnofner et al., 2005/. Experiments carried out in Germany show that proper use of straw and cover crops not only reduces mineral nitrogen excess in the soil but also restores soil humus, increases stable humic matter content, and improves aeration /Stumpe et al., 2000; Kavdir, Smucker, 2005/.

Our experiments were designed to ascertain the effects of cover crops and their biomass applied as green manure on the improvement of physical properties of heavy textured *Cambisols,* seeking to reduce their negative properties such as cohesion and cracking by increasing organic matter content in the soil.

Materials and methods

Site and soil characteristics. Experiments were conducted at the Joniškėlis Research Station of the Lithuanian Institute of Agriculture located in the northern part of Central Lithuania Lowland during the period 2001-2004. The soil of the experimental site is characterised as *Endocalcari-Endohypogleyic Cambisol (CMg-n-w-can)*, according to the texture – clay loam on silty clay, whose parental rock is lacustrine clay. The soil agrochemical properties in the 0-25 cm layer are presented in Table 1.

Table 1. Chemical characteristics of the soil under experiments
1 lentelė. *Bandymų dirvožemio cheminė cherakteristika*

Experiment *Bandymas*	pH_{KCl}	Total nitrogen % *Bendrasis azotas %*	Organic carbon % *Organinė anglis %*	Mobile mg kg^{-1} *Judrieji mg kg^{-1}*	
				P_2O_5	K_2O
Experiment 1 *1 bandymas*	6.0	0.150	1.28	146	254
Experiment 2 *2 bandymas*	6.4	0.169	1.42	138	235

Experimental design. The trials involved the following design:

1. Without cover crop; 2. Oil radish (*Raphanus sativus* L.); 3. White mustard (*Sinapis alba* L.); 4. Red clover (*Trifolium pratense* L.); 5. Cocksfoot (*Dactylis glomerata* L.); 6. Italian ryegrass (*Lolium multiflorum* Lam.). Biomass of the cover crops was incorporated as green manure**.** Two analogous experiments were set up in 2001 (Experiment 1) and 2003 (Experiment 2) and lasted for two years (2001-2002 and 2003-2004) each.

Red clover and Italian ryegrass were undersown in spring barley shortly after sowing. Cover crops as post-crops: white mustard and oil radish was direct drilled by a stubble drill after cereal harvesting (on the same day), N_{30} was applied after cereal harvesting for optimal growth and development of oil radish, white mustard, cocks- foot and Italian ryegrass. The next year spring barley was grown after incorporation of cover crops biomass as green manure.

Measurements and assessments. Mass of plant residues was determined by Kachinski monolith (0.25 m x 0.25 m x 0.25 m) washing method. The mass of all plants' residues was recalculated to dry matter (DM). Nitrogen and organic carbon in the green material of cover crops, their plant residues were determined by the following methods: by Kjeldahl and by an analyser 'Heraeus', respectively. Soil samples for the determination of chemical and physical properties were taken from each plot of cover crops before application of their biomass and after cereal harvesting at a depth of 0-25 cm. Total nitrogen was determined by Kjeldahl method, organic carbon content, after picking out visible rootlets from the soil samples, by Tyurin method. Soil bulk density and porosity were determined after Kachinsky, structure by Savinov, stability of structural aggregates by Bakshejev methods. Soil moisture content was measured by drying the sample in the thermostat to a constant weight at a temperature of +105^{o}C.

The experimental data were processed by the methods of dispersion and correlation analysis, applying the programmes ANOVA and STATENG for statistical data treatment /Tarakanovas, Raudonius, 2003/.

Results and discussion

Cover crops. Emergence, establishment and development of cover crops depended on the amount of rainfall and its distribution over the growing season. The highest stand density of cover crops was recorded in the first experiment in 2001, when after cereal harvesting half of the monthly rate of rainfall fell during the first ten-day period of August. However, in the second experiment in 2003, when there was little rainfall in the first half of August, fewer postcrops emerged and the growth and development of all cover crops slowed down. As a result, in the second experiment the underground and overground biomass of all cover crops was by on average 37.8 % and 27.5 % lower compared with that in the first experiment (Table 2).

Table 2. Biomass of cover crops (t ha^{-1} DM)
2 lentelė. *Tarpinių pasėlių augalų biomasė (t ha^{-1} SM)*

Cover crops *Tarpiniai pasėliai*	Underground mass *Požeminė masė*			Overground mass *Antžeminė masė*		
	experiment / *bandymas*					
	I (2001)	II (2003)	average *vidurkis*	I (2001)	II (2003)	average *vidurkis*
Oil radish *Aliejiniai ridikai*	0.94	0.59	0.77	2.58	1.41	2.00
White mustard *Baltosios garstyčios*	0.74	0.66	0.70	3.86	1.80	2.83
Red clover *Raudonieji dobilai*	2.58	1.51	2.05	6.32	3.14	4.73
Cocksfoot *Paprastosios šunažolės*	2.05	1.57	1.81	3.39	2.62	3.01
Italian ryegrass *Gausiažiedės svidrės*	1.13	1.08	1.11	2.50	2.66	2.58
Average / *Vidurkis*	1.49	1.08	1.29	3.73	2.32	3.03
LSD_{05} / R_{05}	0.645	0.421	0.309	0.775	0.671	0.798

Comparison of various cover crops showed that undersown crops with a longer growing season produced a significantly higher underground biomass. The overground mass of all cover crops was by 1.7 (cocksfoot) to 4.0 (white mustard) times higher compared with underground mass. The highest overground biomass was produced by the undersown crops – red clover, cocksfoot and by postcrops –white mustard. This agrees with the data found in literature about the rapid initial growth and high competitive power of white mustard /Vos, et al., 1997/. Of all cover crops red clover was noted for the highest total dry matter content, which was by 1.6-2.4 times higher compared with the other cover crops.

Nitrogen content in biomass has a decisive effect on the mineralization of biomass incorporated into the soil. In 2003, before incorporating into the soil the biomass of all cover crops had a much higher content of nitrogen compared with that in 2001 (Table 3).

Table 3. Nitrogen concentrations in the biomass of cover crops (%)
3 lentelė. *Azoto koncentracija tarpinių pasėlių augalų biomasėje (%)*

Cover crop *Tarpiniai pasėliai*	Underground mass *Požeminė masė*			Overground mass *Antžeminė masė*		
	experiment / *bandymas*					
	I (2001)	II (2003)	average *vidurkis*	I (2001)	II (2003)	average *vidurkis*
Oil radish *Aliejiniai ridikai*	1.58	2.61	2.02	2.30	4.58	3.44
White mustard *Baltosios garstyčios*	0.90	1.47	1.14	2.04	4.62	3.33
Red clover *Raudonieji dobilai*	2.40	2.78	2.56	2.80	3.79	3.30
Cocksfoot *Paprastosios šunažolės*	1.09	1.33	1.19	1.71	2.48	2.10
Italian ryegrass *Gausiažiedės svidrės*	1.49	1.39	1.44	1.79	2.27	2.03
Average / *Vidurkis*	1.49	1.92	1.67	2.13	3.55	2.84
LSD_{05} / R_{05}	0.215	0.470	0.313			0.89

This resulted from the fact that the plants were at a less advanced growth stage before incorporation, and the biomass of such plants have higher nitrogen concentrations compared with the more advanced growth stages /Wivstad, 1999/. Different soil nitrogen status also might have had some effect, in 2001 it amounted to 0.150 % and in 2003 to 0.169 %. Higher nitrogen concentrations and greater variations were identified in the overground plant mass compared with the underground plant mass. Measurements of nitrogen contents accumulated in the biomass of individual crops suggest that in 2001 the highest nitrogen concentration was in red clover underground and overground biomass, which was by 51.9 and 21.7 % higher compared with oil radish. Of the non-legume crops, the highest nitrogen concentration was found in oil radish roots and residues. The concentrations of nitrogen in white mustard and cocksfoot underground mass were significantly lower than those in oil radish underground mass. The lowest nitrogen concentrations in the overground mass were determined for non-legumes – cocksfoot and Italian rygrass, which were by 25.7 % and 22.2 % lower compared with oil radish. The ability of catch crops to absorb nitrogen from the soil profile is affected by rate and depth of colonization of the soil by roots /Vos et al., 1998/.

The data from the second experiment (2003) indicate that the nitrogen concentrations in plant underground mass was by 28.9 % higher compared with those of the first experiment. However, the concentration of nitrogen in cover crops overground mass was by 66.7 % higher (compared with that of the first experiment) and higher contents of nitrogen were accumulated by *Brassicaceae* Burnett: white mustard and oil radish – by 20.8 and 21.9 % more compared with red clover. The lowest nitrogen concentration in the plant overground mass was identified in undersown grasses.

The processes of soil-incorporated organic matter transformation are determined by the carbon to nitrogen ratio, which is narrower of the plant overground mass compared with underground mass /Maikštėnienė, Arlauskienė, 2004/. In the first experiment (2001) having incorporated plant biomass at a more advanced growth stage: of oil radish, white mustard and red clover at flowering stage, of cocksfoot and Italian ryegrass at heading stage, the carbon to nitrogen ratio in their biomass was close to the formation of soil humic compounds (Table 4). High nitrogen concentration determined that this ratio was the narrowest for oil radish and red clover, whereas in the second experiment (2003) the high concentration of nitrogen in the young biomass of *Brassicaceae* and legumes determined a narrow C to N ratio, determining soil-incorporated organic matter mineralization. Averaged data suggest that a significantly higher carbon to nitrogen ratio was in the overground mass of undersown grasses compared with that of a postcrop of oil radish.

Table 4. Characteristics of the overground biomass of cover crops
4 lentelė. *Tarpinių pasėlių augalų antžeminės masės charakteristika*

Cover crop *Tarpiniai pasėliai*	C:N			Crude fibre % *Žalia ląsteliena %*		
	experiment / *bandymas*					
	I (2001)	II (2003)	average *vidurkis*	I (2001)	II (2003)	average *vidurkis*
Oil radish *Aliejiniai ridikai*	18.2	7.9	13.1	21.5	22.5	22.0
White mustard *Baltosios garstyčios*	21.6	8.5	15.1	35.4	20.3	27.9
Red clover *Raudonieji dobilai*	17.0	11.8	14.4	23.6	22.2	22.9
Cocksfoot *Paprastosios šunažolės*	24.8	17.7	21.3	30.6	23.3	27.0
Italian ryegrass *Gausiažiedės svidrės*	25.7	19.3	22.5	32.3	26.5	29.4
Average / *Vidurkis*	21.5	13.0	17.3	28.7	22.9	25.8
LSD_{05} / R_{05}			3.04			5.05

The degree and intensity of soil-incorporated organic matter decomposition is related to its chemical composition: the content of readily decomposable components and lignin in the biomass /Magid et al., 2004/. When the biomass of more mature plants was incorporated into the soil, (2001) the content of fibre in it was by 25.3 % higher compared with younger plants (2003). Significantly more fibre was accumulated by undersown grasses in the overground part. Averaged data of the experiments indicate that with increasing root and overground plant mass the C to N ratio widened (r = 0.66*, r = 0.68*, respectively) and fibre content increased (r = 0.59*, r = 0.692*).

Soil chemical properties. When barley was grown under the effect of cover crops growing and their biomass incorporation, the soil nitrogen status varied insignificantly. In the first experiment having incorporated the biomass of cover crops, the soil total nitrogen did not increase, whereas in the soil with a higher total nitrogen status (the second experiment) having incorporated plant biomass with a narrow C:N, an inappreciable nitrogen reduction trend was determined (Table 5).

Table 5. The effect of cover crops on the contents of total nitrogen and organic carbon and their ratio in the soil
5 lentelė. *Tarpinių pasėlių įtaka dirvožemio bendrojo azoto, organinės anglies kiekiui ir jų santykiui*

Treatment *Variantas*	Total N % *Bendrasis N %*			Organic C % *Organinė C %*			C:N		
	experiment / *bandymas*								
	I (2002)	II (2004)	average *vidurkis*	I (2002)	II (2004)	average *vidurkis*	I (2002)	II (2004)	average *vidurkis*
Without cover crop *Be tarpinių pasėlių*	0.149	0.164	0.156	1.26	1.43	1.34	8.5	8.7	8.6
Oil radish *Aliejiniai ridikai*	0.149	0.161	0.155	1.32	1.44	1.38	8.9	8.9	9.0
White mustard *Baltosios garstyčios*	0.150	0.161	0.155	1.33	1.43	1.38	8.9	8.9	8.9
Red clover *Raudonieji dobilai*	0.150	0.162	0.156	1.31	1.45	1.38	8.7	9.0	8.9
Cocksfoot / *Paprastosios šunažolės*	0.148	0.162	0.155	1.31	1.45	1.37	8.9	9.0	8.9
Italian ryegrass *Gausiažiedės svidrės*	0.153	0.161	0.157	1.33	1.43	1.38	8.7	8.9	8.8
Average / *Vidurkis*	0.150	0.162	0.156	1.31	1.44	1.37	8.7	8.9	8.8
LSD_{05} / R_{05}			0.084	0.069	0.054	0.027			0.36

This is also corroborated by the statistical analysis of this experiment, which suggests that with increasing nitrogen status in the incorporated plant biomass, the total soil nitrogen tended to decline (r = -0.826*). Organic carbon content has a marked effect on heavy textured soil physical properties, especially structure and its water stability. A more pronounced positive effect of cover crops on the variation of organic C was identified in the first experiment, where plant biomass with a more favourable C: N ratio was incorporated. The amount of organic C in the soil increased after all cover crops, and after white mustard and Italian ryegrass the increase in C content in the soil was significant (5.6 %), compared with the soil without cover crops. The data from the second experiment suggest that soil organic carbon varied inappreciably. Averaged data over the two experiments indicate that cover crops significantly increased soil organic carbon content (2.2-3.0 %), however, the ratio of C to N increased only minutely.

Soil physical properties. Cultivation of cover crops and incorporation of their biomass into the soil, which resulted in positive organic carbon changes, exerted some effect on soil physical properties. The effect of cover crops on soil bulk density was inconsistent. The data of the first experiment show that the effect of cover crops on the variation of soil bulk density was inappreciable and insignificant (Table 6). In the second experiment the effect of cover crops on soil bulk density was more marked – oil radish, red clover and cocksfoot significantly increased soil bulk density, whereas white mustard declined it.

Table 6. The effect of cover crops on the variation of soil bulk density (Mgm^{-3})
6 lentelė. *Tarpinių pasėlių įtaka dirvožemio tankio kitimui (Mgm^{-3})*

Treatment / *Variantas*	Before cover crops incorporation into the soil / *Prieš tarpinių augalų įterpimą į dirvą*			In the following year* / *Kitais metais*		
	experiment / *bandymas*					
	I (2001)	II (2003)	average *vidurkis*	I (2002)	II (2004)	average *vidurkis*
Without cover crop *Be tarpinių pasėlių*	1.48	1.41	1.44	1.48	1.44	1.46
Oil radish *Aliejiniai ridikai*	1.46	1.43	1.45	1.46	1.45	1.46
White mustard *Baltosios garstyčios*	1.47	1.36	1.41	1.46	1.45	1.45
Red clover *Raudonieji dobilai*	1.49	1.47	1.48	1.43	1.42	1.43
Cocksfoot *Paprastosios šunažolės*	1.51	1.44	1.47	1.46	1.45	1.46
Italian ryegrass *Gausiažiedės svidrės*	1.48	1.41	1.45	1.45	1.44	1.45
Average / *Vidurkis*	1.46	1.42	1.45	1.46	1.44	1.45
LSD_{05} / R_{05}	0.038	0.019	0.045	0.036	0.027	0.026

* After barley growing / *Po miežių auginimo*

When in the following year after the incorporation of cover crops biomass spring barley was grown the effect of the practices used was more consistent. The data of the first experiment suggest that after cultivation of all cover crops the bulk density of the ploughlayer tended to decline, and after undersown red clover it declined significantly (3.4 %), compared with the treatment without cover crops. The data of statistical analysis indicate that with increasing soil organic carbon content, the soil bulk density tended to decline (r = -0.598*). The data of the second experiment show that where cover crops had poorly emerged and developed due to the drought, the ploughlayer's bulk density differed little between the treatments, however, after the undersown red clover it was slightly lower. The rapidly-mineralising nitrogen-rich biomass of cover crops had a greater direct effect on cereal productivity than on soil properties. As some authors indicate, this results from the fact that nitrogen-rich biomass of cover crops increases the content of mobile humic acids in the soil /Yang et al., 2004/.

The data of the first experiment show that all cover crops tended to increase moisture losses, since they utilised soil moisture for biomass formation, which resulted in the declining soil moisture (Table 7).

Table 7. The effect of cover crops on the variation of soil moisture
7 ***lentelė.*** *Tarpinių pasėlių įtaka dirvožemio drėgmės kitimui*

Treatment *Variantas*	Before cover crops incorporation into the soil *Prieš tarpinių augalų įterpimą į dirvą*			In the following year* *Kitais metais*			
	moisture % / *drėgmė %*						mean productive moisture mm *produktyviųjų drėgmės atsargų vidurkis mm*
	experiment / *bandymas*						
	I (2001)	II (2003)	average *vidurkis*	I (2002)	II (2004)	average *vidurkis*	
Without cover crop *Be tarpinių pasėlių*	19.3	18.7	19.0	15.1	18.4	16.8	61.2
Oil radish *Aliejiniai ridikai*	19.1	18.5	18.8	14.3	18.4	16.4	59.5
White mustard *Baltosios garstyčios*	19.0	18.6	18.8	14.5	18.3	16.4	59.5
Red clover *Raudonieji dobilai*	18.7	17.8	18.2	14.3	17.8	16.0	56.8
Cocksfoot *Paprastosios šunažolės*	18.1	18.5	18.3	15.0	17.9	16.5	60.0
Italian ryegrass *Gausiažiedės svidrės*	18.8	18.8	18.8	15.0	18.2	16.6	59.9
Average / *Vidurkis*	18.8	18.5	18.6	14.7	18.3	16.4	59.5
LSD_{05} / R_{05}	0.574	1.07	0.646	0.667	1.85	0.956	3.275

The greatest significant reduction in soil moisture occurred through the under-sown crops – cocksfoot and red clover, whose biomass was the largest. The lowest moisture losses occurred after the postcrops – white mustard and oil radish. In the second experiment the soil moisture also tended to decrease through cover crops growing, except for Italian ryegrass.

In the years of effect, as the data from the first experiment suggest, after incorporation of cover crops biomass there was noted a moisture reduction trend, and after oil radish and red clover soil moisture content was significantly lower. Similar but less distinct soil moisture variation trends were identified in the second experiment. Averaged data show that when spring barley was grown after red clover biomass incorporation the reserves of productive soil moisture were lower compared with the control treatment. Regression analysis suggests that there was a strong correlation between cover crops underground and overground mass and soil moisture. With increasing cover crops underground and overground mass (r = -0.693*, r = -0.769**, respectively) and nitrogen content in it (r = -0.863**, r = -0.600*, respectively), the reserves of productive moisture tended to decline. The soil incorporated nitrogen-rich plant biomass promoted the activity of soil micro-organisms that also utilised soil moisture reserves /Dilly, 2004/.

The stability of soil structural aggregates >1.0 mm is presented in Table 8.

Table 8. The effect of cover crops on the stability of soil structural aggregates (>1.0 mm)
8 lentelė. *Tarpinių pasėlių įtaka dirvožemio struktūrinių agregatų (>1,0 mm) stabilumui*

Treatment *Variantas*	Before cover crops incorporation into the soil / *Prieš tarpinių augalų įterpimą į dirvą*			In the following year* *Kitais metais*		
	experiment / *bandymas*					
	I (2001)	II (2003)	average *vidurkis*	I (2002)	II (2004)	average *vidurkis*
Without cover crop *Be tarpinių pasėlių*	79.8	75.5	77.7	88.4	75.1	81.7
Oil radish *Aliejiniai ridikai*	82.1	75.5	78.8	88.8	73.9	81.3
White mustard *Baltosios garstyčios*	81.2	76.8	79.0	90.6	75.1	82.9
Red clover *Raudonieji dobilai*	81.7	76.0	78.9	90.9	75.9	83.4
Cocksfoot *Paprastosios šunažolės*	81.6	77.6	79.6	91.3	76.7	84.0
Italian ryegrass *Gausiažiedės svidrės*	81.9	76.1	79.0	91.5	78.7	85.1
Average / *Vidurkis*	81.4	76.3	78.8	90.2	75.9	83.1
LSD_{05} / R_{05}	4.76	2.30	2.29	2.25	2.55	1.58

In the autumn, before incorporation of cover crops biomass into the soil a trend of increasing of structural aggregates stability (on average 1.8 % per both experiments) was determined in both experiments. In the following year after cover crops biomass incorporation, their effect on soil structural stability was more distinct. In the first experiment significantly more stable structural aggregates in the soil was identified under the effect of undersown crops: after red clover, cocksfoot or Italian ryegrass growing and incorporation of their biomass by 2.8, 3.3 and 3.5 %, respectively more compared with the treatment without cover crops. In the second experiment the same trends persisted in the variation of soil structural aggregates stability, however, a significant increase was recorded only after Italian ryegrass. The data averaged over the two experiments indicate that significantly more stable structural aggregates were identified after red clover, cocksfoot and Italian ryegrass (by 2.1, 2.8 and 4.2 %, respectively) compared with the control treatment.

Conclusions

1. Of all the undersown cover crops the highest contents of overground and underground biomass were accumulated by red clover 6.78 t ha^{-1} DM, of the postcrops by white mustard 3.53 t ha^{-1} DM.

2. Averaged data suggest that the highest nitrogen concentration was in red clover and oil radish underground and overground mass (2.56, 2.02 % and 3.30, 3.44 %, respectively).

3. The processes of soil-incorporated plant biomass transformation were determined by the carbon to nitrogen ratio (C:N) in the biomass. The biomass of cover crops (C:N ratio = 17.0-25.7) - oil radish, white mustard and red clover incorporated into the soil at flowering stage and that of cocksfoot and Italian ryegrass incorporated at heading stage increased organic carbon content (4.0-5.6 %).

4. When spring barley was grown in the following year after incorporation of all cover crops biomass, soil bulk density (depth of 0-25 cm) tended to decline and the most marked reduction (3.4%) occurred after red clover. Under the effect of cover crops significantly more water stable structural aggregates formed (0-25 cm depth) after red clover, cocksfoot and Italian ryegrass – by 2.1, 2.8 and 4.2 %, respectively compared with the soil without cover crops.

5. Undersown cover crops tended to reduce soil moisture (0-25 cm depth). Cocksfoot and red clover declined soil moisture significantly by 6.2 and 3.1 %, respectively, compared with the soil without cover crops. In the year of effect significantly lower soil moisture content (5.3 %) was recorded having incorporated oil radish and red clover biomass.

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SUNKAUS PRIEMOLIO RUDŽEMIO SAVYBIŲ GERINIMAS TARPINIAIS AUGALAIS

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Santrauka

Siekiant nustatyti tarpinių augalų įtaką organinių medžiagų susikaupimui dirvožemyje ir jų poveikį fizikinėms savybėms tyrimai atlikti Lietuvos žemdirbystės instituto Joniškėlio bandymų stotyje giliau karbonatingame giliau glėjiškame rudžemyje (*Endocalcari – Endohypogleyic Cambisol)* 2001-2004 metais.

Nustatyta, kad įterpus įvairių tarpinių augalų – aliejinių ridikų, baltųjų garstyčių ir raudonųjų dobilų žydėjimo, paprastųjų šunažolių ir gausiažiedžių svidrių – plaukėjimo tarpsniais, biomasę, kurios C ir N santykis = 17,0-25,7, dirvožemyje organinės anglies kiekis didėjo (4,0-5,6 %). Tarpinių pasėlių poveikyje auginant vasarinius miežius, dirvožemio tankis buvo mažesnis negu kontroliniame variante. Labiausiai dirvožemio tankis sumažėjo raudonųjų dobilų biomasės įterpimo žaliajai trąšai poveikyje – 3,4 %. Vidutiniais dviejų bandymų duomenimis, iš esmės – atitinkamai 2,1; 2,8 ir 4,2 % daugiau vandenyje patvarių struktūrinių agregatų buvo po raudonųjų dobilų, paprastųjų šunažolių ir gausiažiedžių svidrių, negu dirvožemyje be tarpinių pasėlių. Tarpiniai augalai mažino dirvožemio drėgmės atsargas. Labiausiai dirvožemio drėgmė sumažėjo po įsėlinių didžiausią masę sukaupusių tarpinių augalų paprastųjų šunažolių ir raudonųjų dobilų, atitinkamai 4,2 ir 3,7 %, palyginus su buvusia dirvožemyje be tarpinių pasėlių. Poveikio metais panašios tendencijos išliko, tačiau iš esmės mažiau produktyviųjų drėgmės atsargų buvo tik po raudonųjų dobilų (7,2 %) .

Reikšminiai žodžiai: sunkaus priemolio rudžemis (*Cambisol*), tarpiniai augalai, cheminės ir fizikinės dirvožemio savybės.