Žemės dirbimas ir jo įtaka dirvožemiui, aplinkai ir ekonomikai

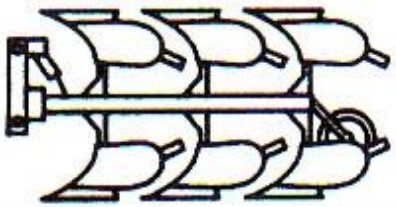
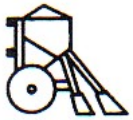
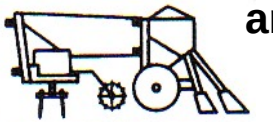
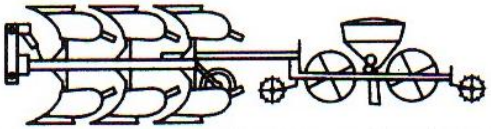
Prof. Kęstutis Romaneckas
2021 08 26

Žemės dirbimo uždaviniai

1. **Mechaniškai supurenti dirvos paviršių, negadinant jo struktūros; ?????**
2. **Įterpti augalų liekanas ir trąšas, sudarant augalams geriausias mitybos sąlygas ????????;**
3. **Sunaikinti augančias piktžoles, augalų kenkėjus ir ligų pradus ??????;**
4. **Reguliuoti dirvoje oro, vandens ir šilumos režimą;**
5. **Išlyginti dirvos paviršių;**
6. **Apsaugoti dirvą nuo erozijos. ????????**

Iki 1860 m. buvo sukurti beveik visi ž. ū. padargai ir susiformavo atskiri ž. ū. darbai !

Ražienų skutimas paplito apie 1860 – 1875 m !

Žemės dirbimo ir sėjos technologija	Gilusis žemės dirbimas	Seklusis žemės dirbimas	Sėja
Tradicinė intensyvi		 arba	
		 arba  arba	
			
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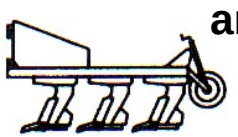
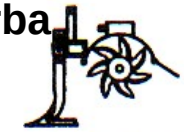
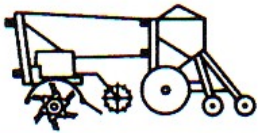
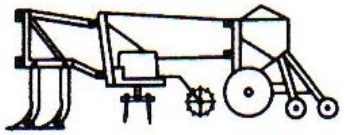
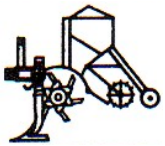
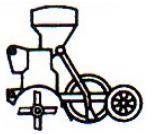
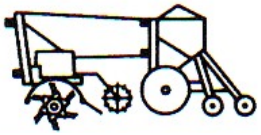
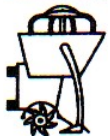
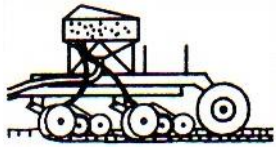
	 arba 	 arba	
	 arba		
	—	 arba  arba	
Tiesioginė sėja	—	—	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UN400
UST400


WL430


FINLAND


Kverneland
48
SCOTLAND
Andrew B.
Mitchell


ARIMAS?

Gražumėėėėlis .... Deginamos ražienos

Arimo trūkumai

- **Didelis pasipriešinimas traukai, reikalauja daugiau energijos, degalų**
- **Dėl galingų traktorių naudojimo, didelis dirvos suspaudimas**
- **Susidaro armens “padas”**
- **Suardomos dirvos poros, gadinama dirvos struktūra**
- **Labai staiga pakeičiamos sąlygos dirvos florai ir faunai**
- **Organinės trąšos ir augalų liekanos įterpiamos sluoksniais (nesumaišomos su dirva)**
- **Ilgai trunkanti operacija**
- **Ilgesni dirvos susigulėjimo terminai**

KOKIOS BESIKEIČIANČIO KLIMATO IR INTENSYVAUS ŽEMĖS DIRBIMO PASEKMĖS !?

Aktyvių temperatūrų sumos augimas

Table 1. Average air temperature of 24 hours and sum of active temperatures during maize vegetative period (April-September) in 2008–2015, Kaunas Meteorological Station

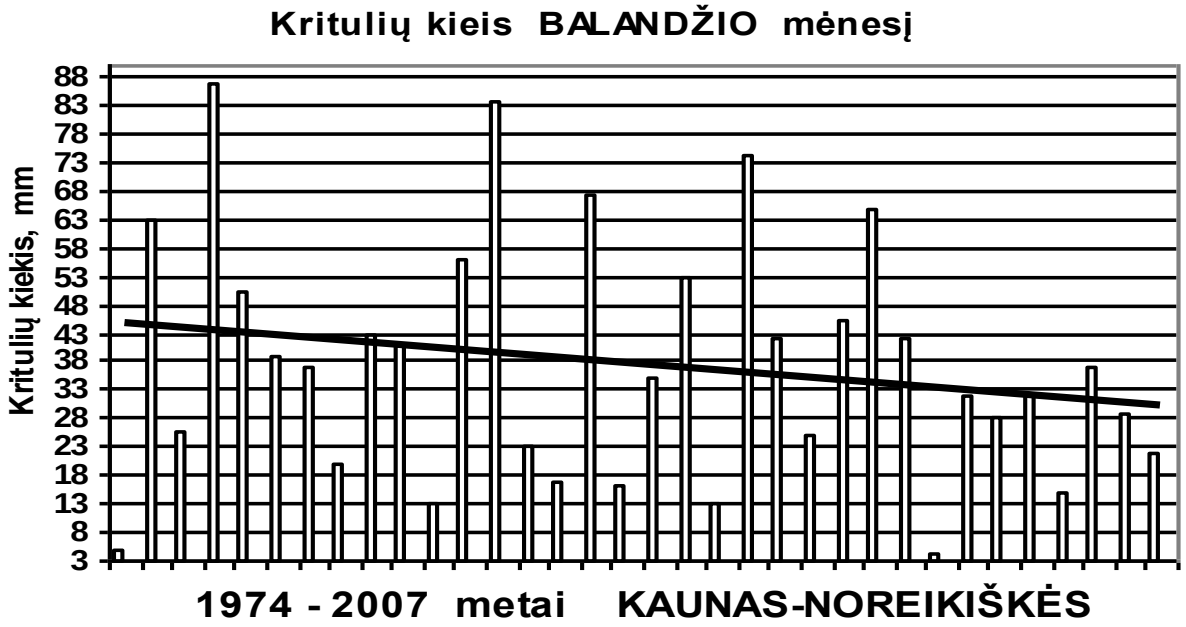
Year / Month	April	May	June	July	August	September	SAT
2008	8.8	12.1	16.0	18.1	17.9	12.2	2321
2009	8.9	12.7	14.8	18.4	16.9	13.8	2381
2010	7.4	13.7	16.5	21.9	19.7	12.0	2564
2011	8.9	13.1	18.1	19.6	18.1	13.6	2607
2012	7.7	13.7	15.3	19.4	17.1	13.3	2452
2013	5.5	16.1	18.5	18.1	12.1	12.3	2634
2014	9.1	13.2	14.6	20.5	17.8	13.5	2526
2015	7.1	11.4	15.4	17.4	20.3	14.3	2458
Average 1974-2013	6.9	13.2	16.1	18.7	17.3	12.6	-

Note: SAT – sum of active temperatures (≥ 10 °C), °C.

Kritulių kiekio augalų vegetacijos metu varijavimas

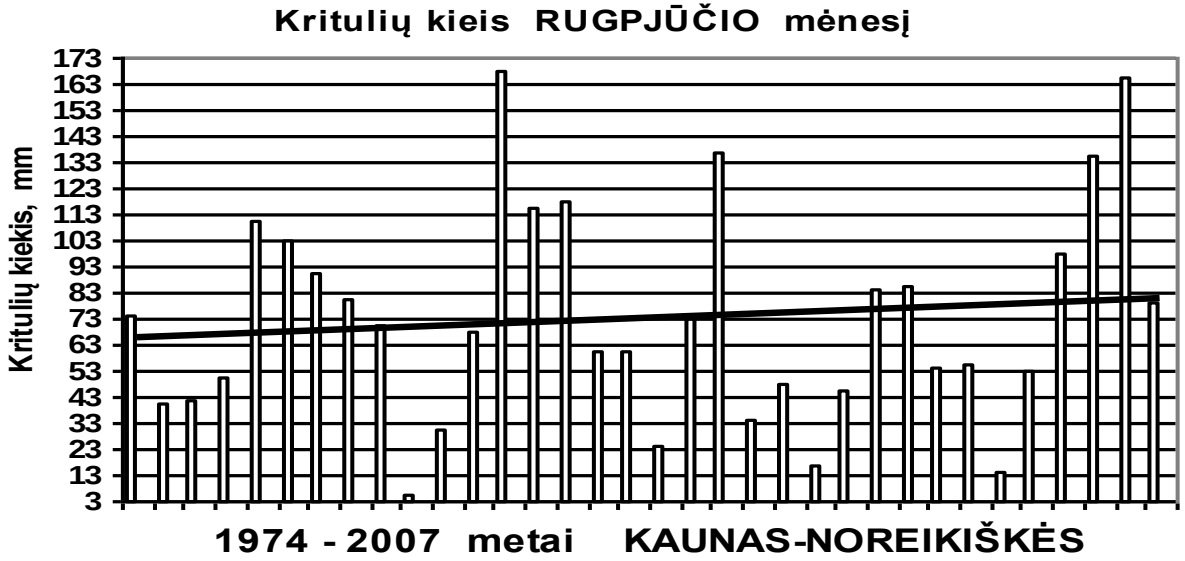
Table 2. Rainfall (mm) during maize vegetative period (April-September) in 2008–2015, Kaunas Meteorological Station

Year / Month	April	May	June	July	August	September	Sum
2008	32.1	35.5	83.2	43.0	99.3	27.0	320.1
2009	8.6	42.0	107.4	83.8	87.5	28.3	357.6
2010	58.5	84.8	127.0	101.0	112.0	63.3	546.6
2011	25.2	46.9	82.7	144.0	152.4	73.9	525.1
2012	72.3	50.3	93.4	112.8	69.2	67.2	465.2
2013	56.5	63.8	45.9	118.5	47.2	104.3	436.2
2014	21.3	84.2	49.4	52.5	111.3	20.7	339.4
2015	46.0	43.8	16.4	72.4	6.9	56.6	242.1
Average 1974-2013	41.3	61.7	76.9	96.6	88.9	60.0	425.4



Vid. = 37,3
Mo = 36,7
V%= 56,4

!!!

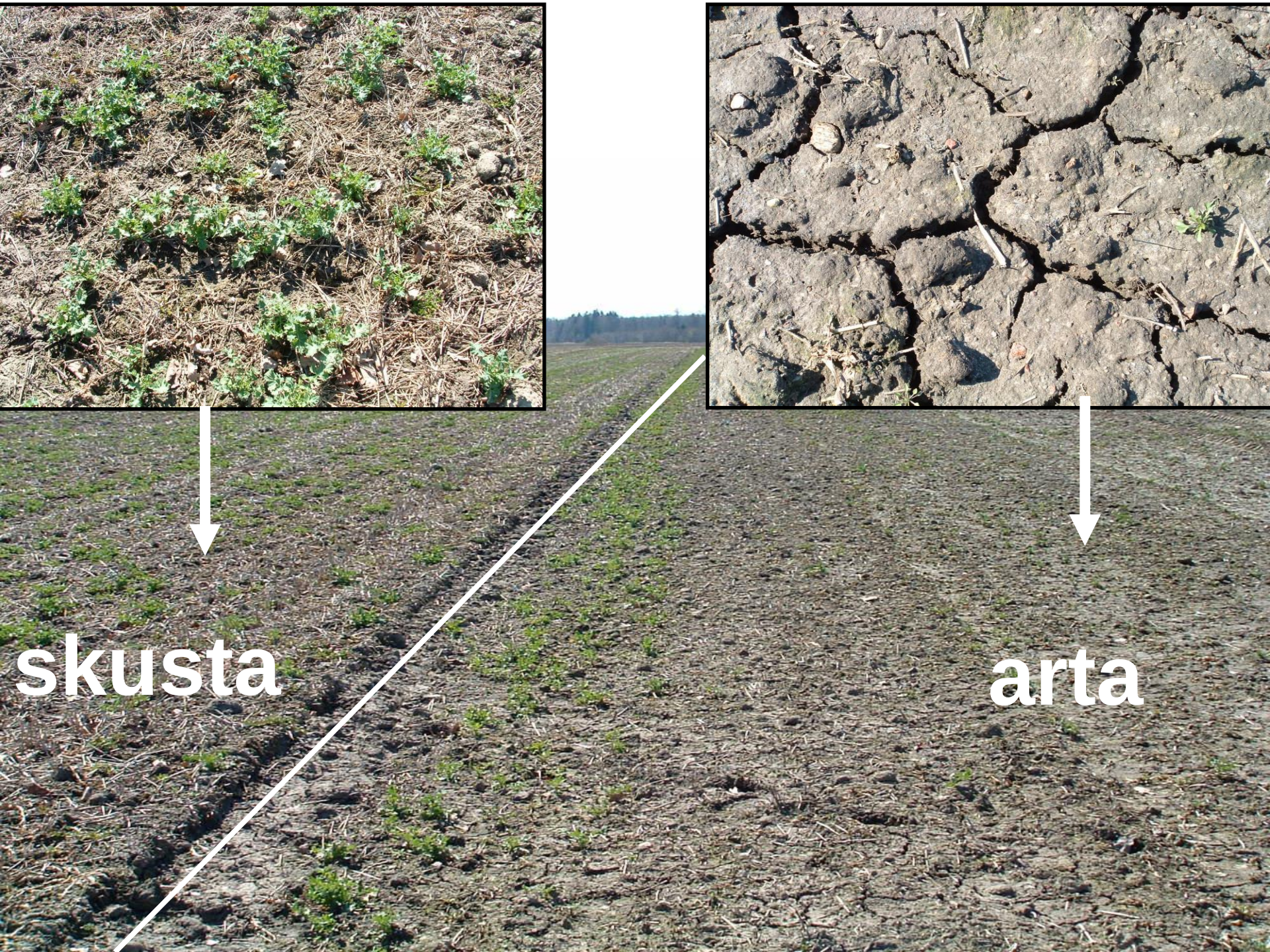


Vid. = 72,0
Mo = 56,3
V%= 53,7

Kruša

Sausra

Iššalimas / neperžiemojimas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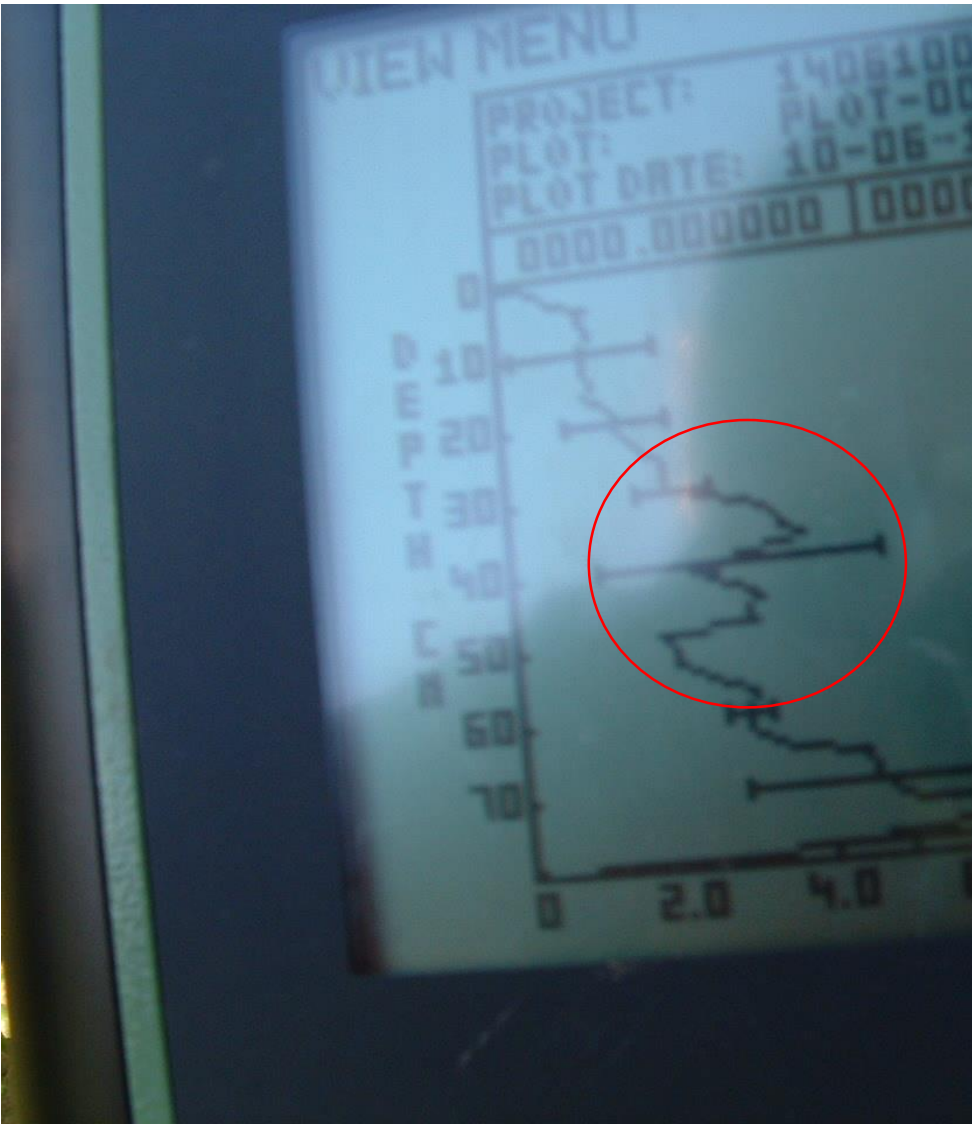
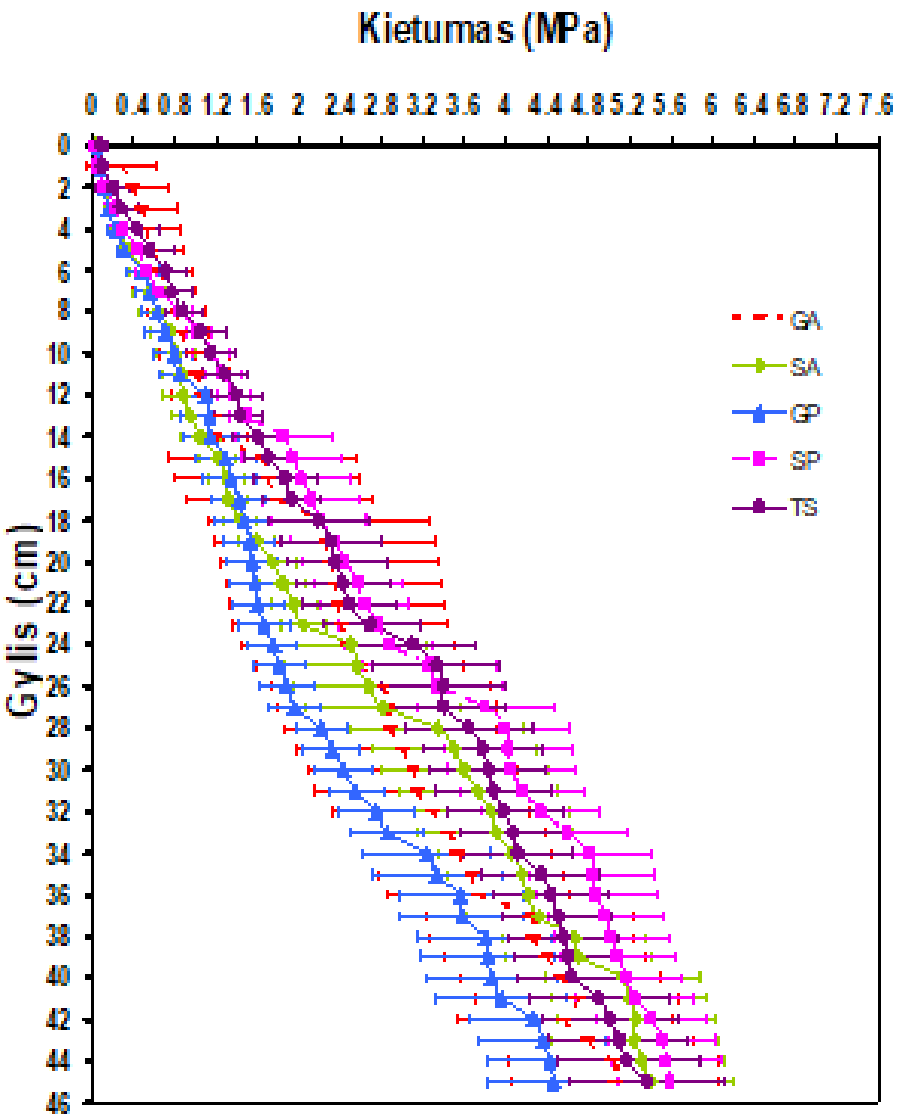
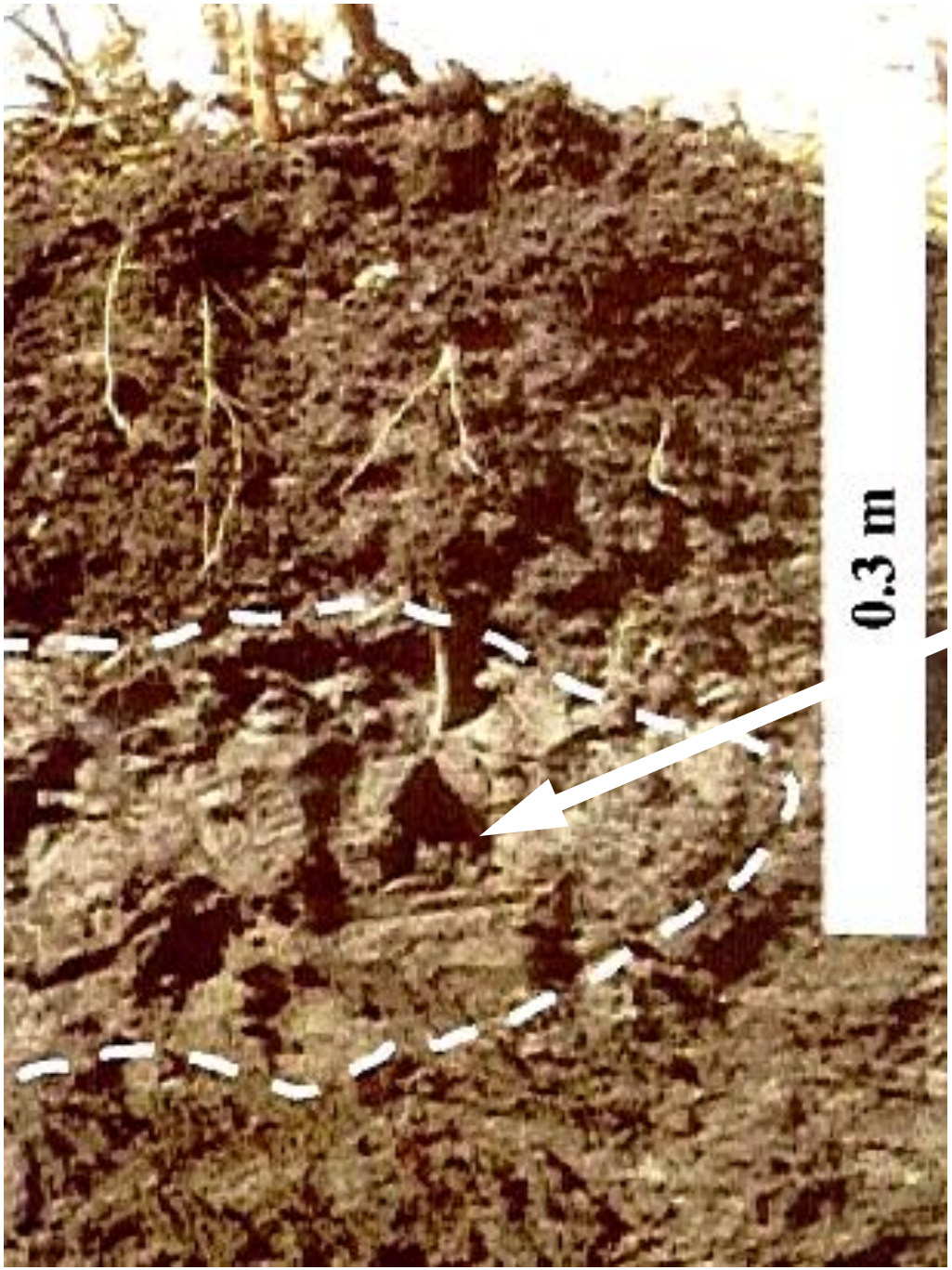
Dirvožemio suspaudimas





GA - gilusis arimas 22-25 cm gyliu (kontrolinis palyginamasis variantas); SA - seklusis arimas 12-15 cm gyliu; GP - gilusis purenimas 23-25 cm gyliu; SP - seklusis purenimas 12-15 cm gyliu; TS – neįdirbta žemė (tiesioginė sėja). , 2016 m.



Formed compacted layer

Dirvožemio hidrologinių savybių blogėjimas

Žala dirvožemio struktūrai - vandens erozija

Dirvožemio plutos formavimasis

Vėjo erozija

Intensyviai įdirbta žemė ir pasekmės

Kritulių kiekio, iškritusio per parą, įtaka vandens susigėrimui (infiltracijai) į dirvožemį (Agrometeorologo žinynas, 1987)

Krituliai mm	Infiltracijos koeficientas	Susigėręs vanduo mm
1	1,0	1,0
5	0,92	4,8
10	0,82	9,1
15	0,72	12,9
20	0,62	16,2
25	0,52	19,0
30	0,42	21,3
35	0,32	23,1
40	0,22	24,4
45	0,12	25,2
50	0,02	25,5

Podirvio purenimas


COMBILINK
mag/eq


BRIX
BRIX


Halzenbühler
ler
NIK


HELIRIPPER


PEGAZ 3m


Cultus 300
VÄDERSTAD
Argentina
Info

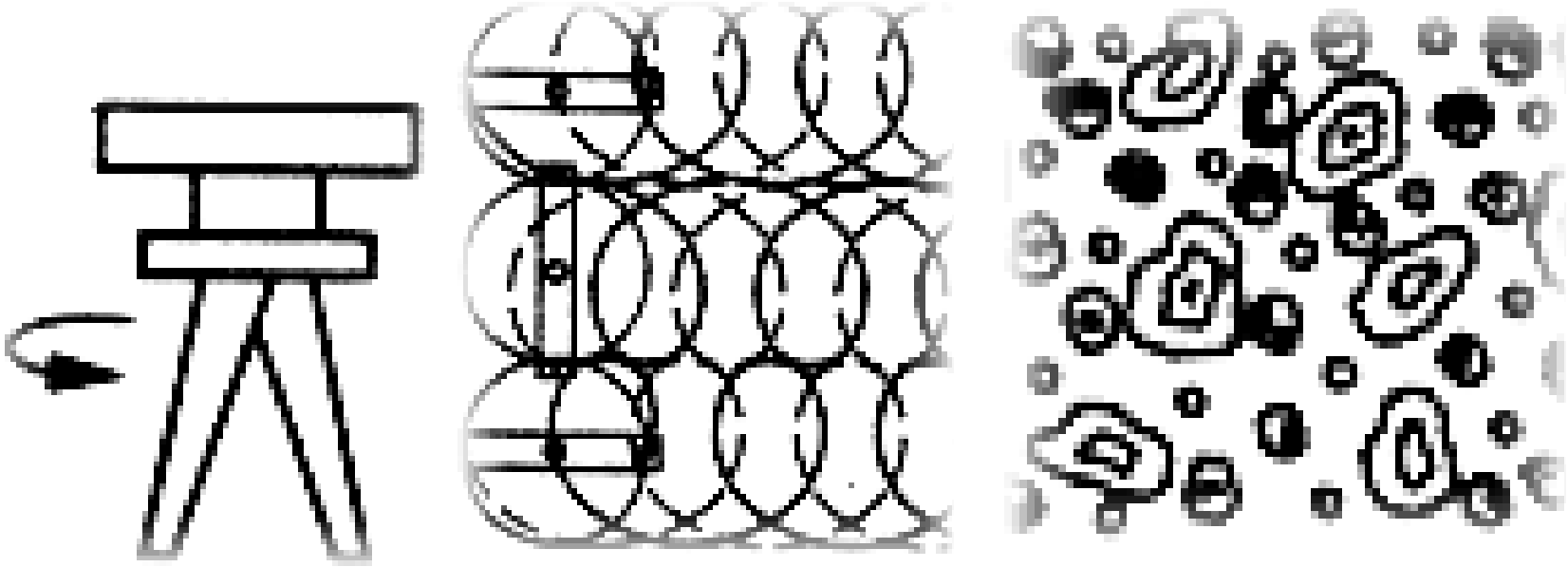

PRODUCT RANGE 2014
Farmet
Farmet
Farmet

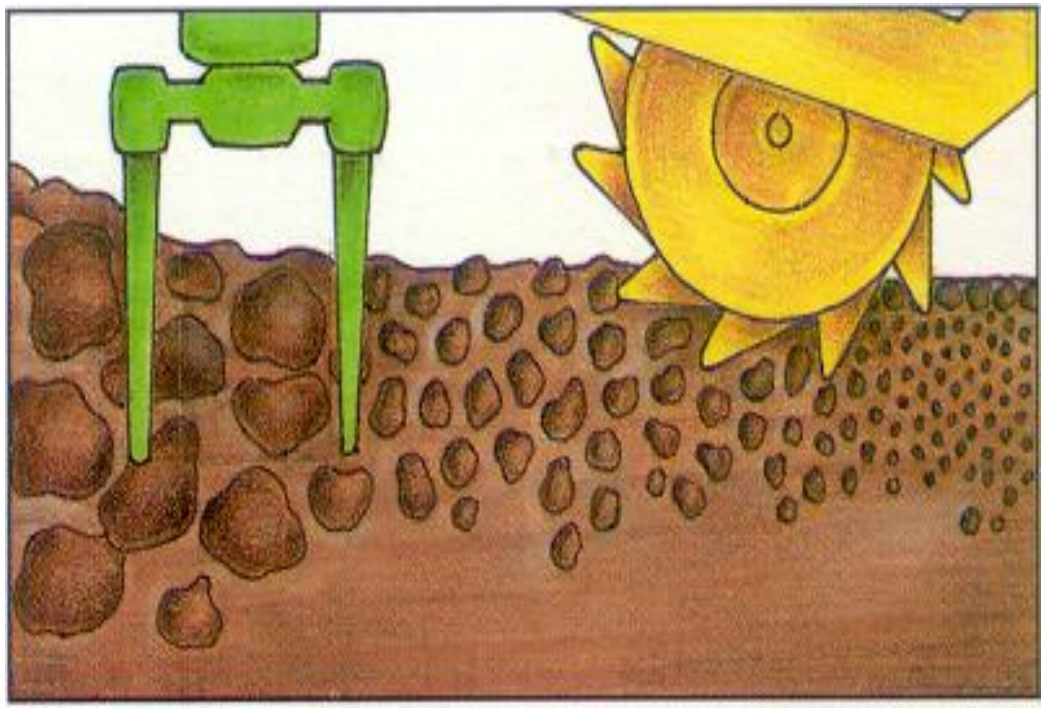

Cultiplow 52
AGRISEM

Agrisem armens purentuvas

Eksperimentas ūkyje, Raseiniai

Vertikalių rotorių kultivatoriai






AMAZONE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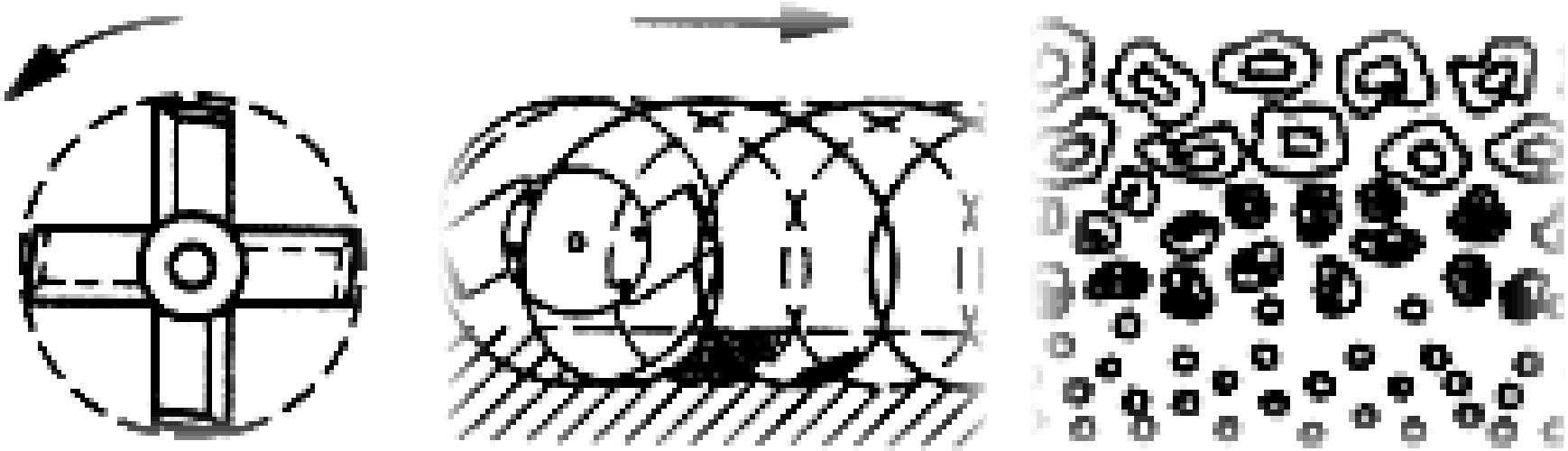
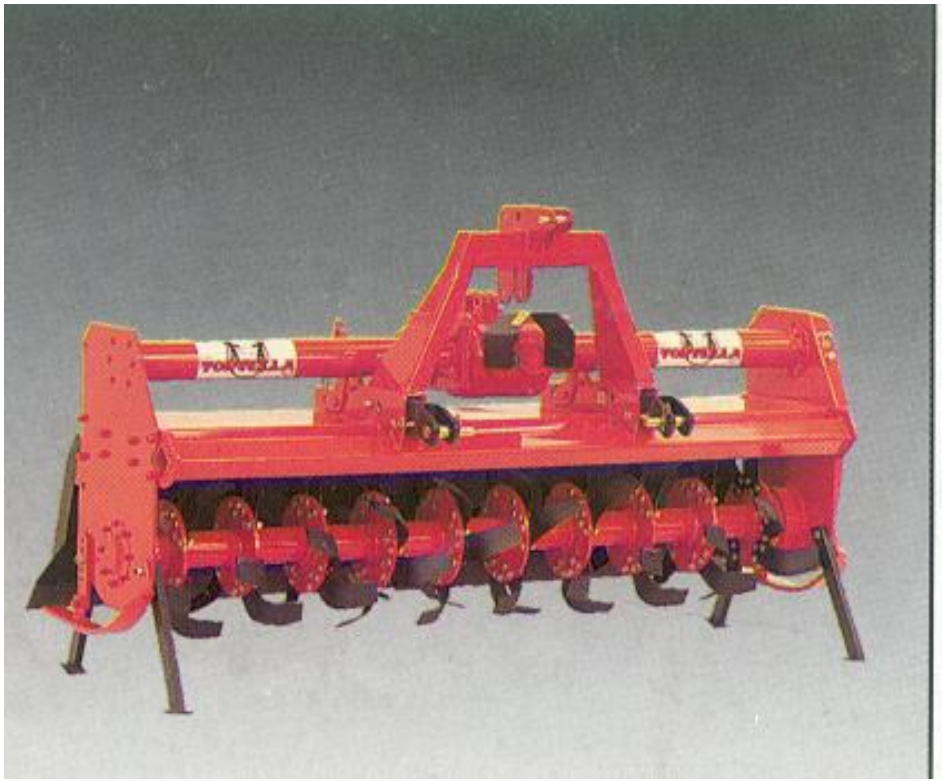
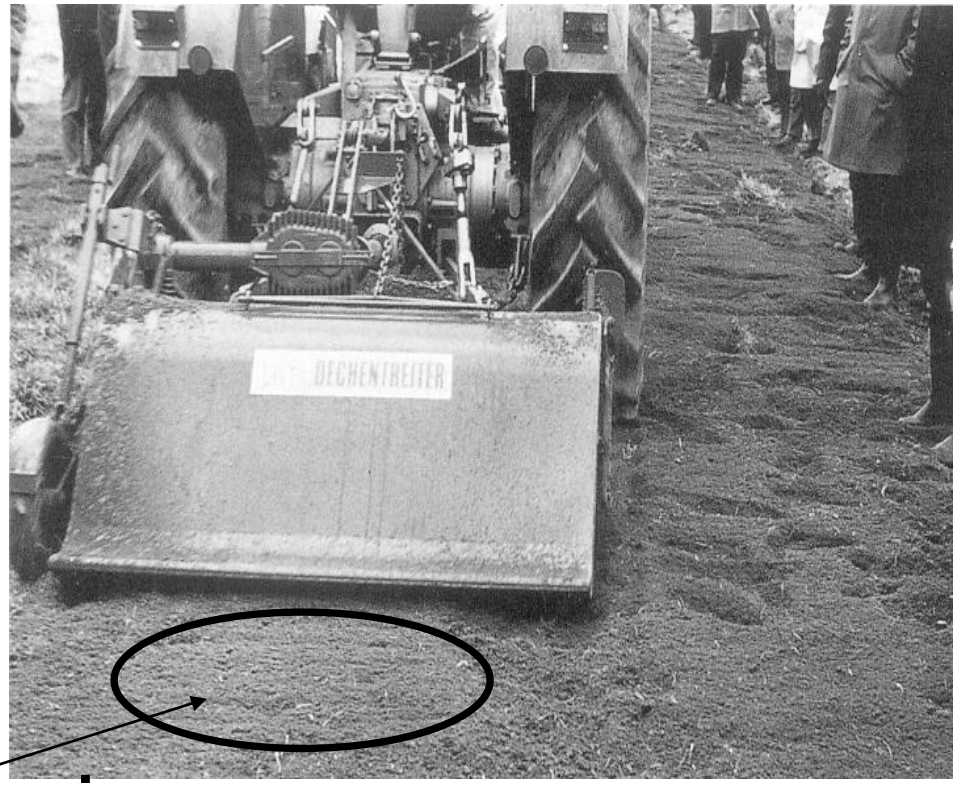
„Rotoriuota“ dirva

Freziniai kultivatoriai



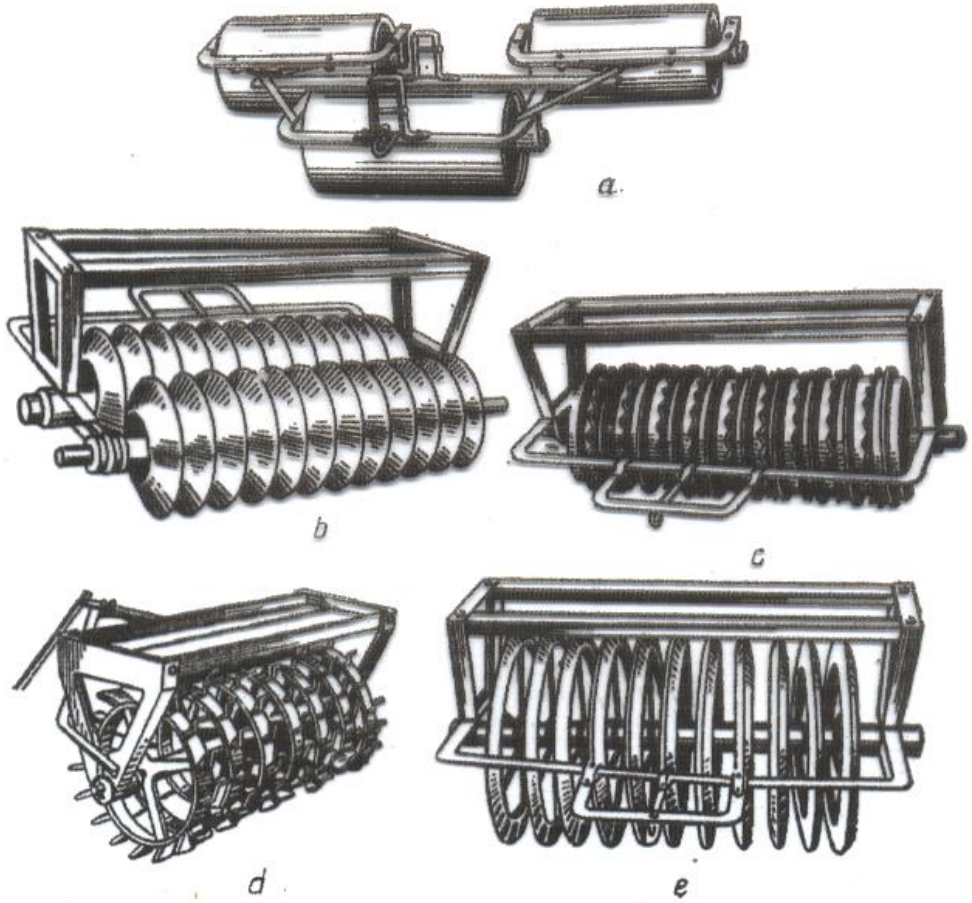




Labai susmulkina dirvožemį

„Rotoriuotos ražienos“

Volai



Volai:
a — cilindriniai; *b* — žiediniai; *c* — kombinuotieji; *d* — pentininiai; *e* — giliam dirvos sluoksniui suspausti

Kombinuotasis Laumetrio volas

Ruožinis – juostinis žemės dirbimas

agronomy MDPI

Article

Soil Properties after Eight Years of the Use of Strip-Till One-Pass Technology

Iwona Jaskulska [1,*], Kestutis Romaneckas [2], Dariusz Jaskulski [1], Lech Gałęzewski [1], Barbara Breza-Boruta [3], Bożena Dębska [4] and Joanna Lemanowicz [4]

Figure 1. Site of research at Śmielin, Kuyavian-Pomeranian province, Poland [36].


VYTAUTO DIDŽIOJO UNIVERSITETO ŽEMĖS ŪKIO AKADEMIJA
ŽEMĖS ŪKIO INŽINERIJOS FAKULTETAS
ŽEMĖS ŪKIO INŽINERIJOS IR SAUGOS INSTITUTAS

Skirtingos konstrukcijos sėjamųjų įtaka rapsų sėklų guoliavietės parametrams

Autoriai: Dokt. Lina Salduikaitė, Prof. dr. Egidijus Šarauskis, Dr. Sidona Buragienė, Prof. dr. Kęstutis Romaneckas, Dr. Aida Adamavičienė, Dr. Žita Kriaučiūnienė, Dokt. Andrii Zabrodskyi, Dokt. Dainius Savickas.

Tarptautinė mokslinė konferencija „Žmogaus ir gamtos sauga", Akademija, Kauno r., 2020-05-07

. Mzuri Pro-Till juostinio žemės dirbimo ir sėjos mašina

Specifikacija	Mzuri Pro-til 4T
Darbinis plotis	4 m
Tarpucilių plotis	36,3 cm
Eilučių skaičius	11
Konstrukcija	Prikabinama
Noragėliai	Kaltiniai

Table 5. Earthworms, microorganisms, and activity of soil enzymes (in 2020, $n = 4$) as a result of different tillage systems; strip-till one-pass (ST-OP), reduced (RT), and conventional (CT).

Property	Unit	Strip-Till One-Pass (ST-OP)	Reduced (RT)	Conventional (CT)
Earthworms	no m^{-2}	86.3 a	48.5 b	20.3 c
Earthworms	g m^{-2}	111.9 a	52.3 b	23.2 c
Bacteria	10^6 cfu g^{-1}	44.6 a	36.7 b	31.3 c
Cellulolytic microorganisms	10^6 cfu g^{-1}	25.5 a	22.4 b	17.9 c
Actinobacteria	10^5 cfu g^{-1}	63.6 a	64.1 a	43,0 b
Filamentous fungi	10^4 cfu g^{-1}	62.8 a	55.7 b	38.4 c
Dehydrogenase	mg TPF kg^{-1} 24 h^{-1}	1.086 a	0.903 b	1.004 a
Alkaline phosphatase (AlP)	mM pNP kg^{-1} h^{-1}	1.106 a	0.985 b	0.899 c
Acid phosphatase (AcP)	mM pNP kg^{-1} h^{-1}	2.231 a	2.075 b	1.921 b
Catalase (CAT)	mg H_2O_2 kg^{-1} h^{-1}	0.467 a	0.411 b	0.452 a

a, b, c—letters in rows indicate significant differences at $p < 0.05$.

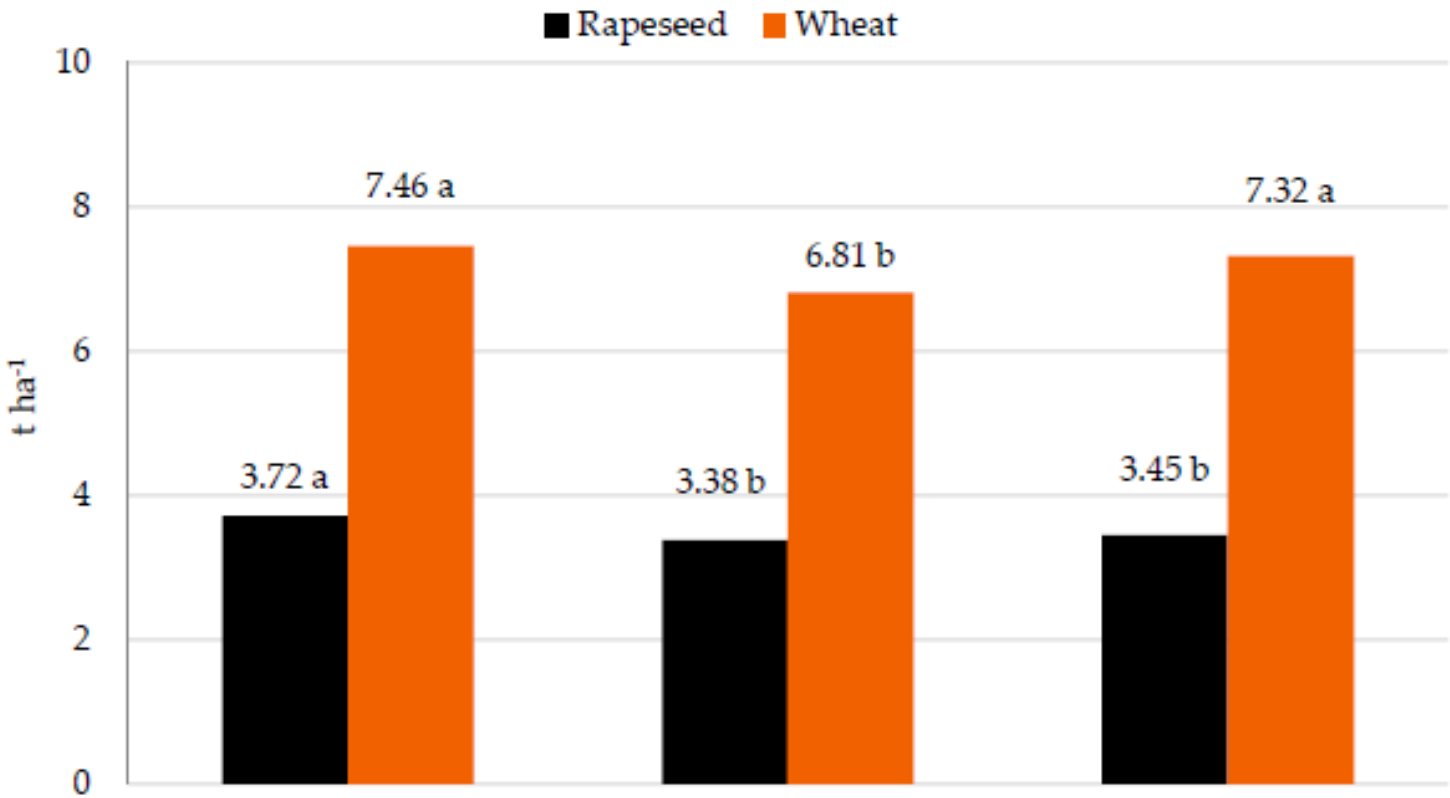


Figure 4. Winter wheat and winter rapeseed yields (average in 2012–2020) depending on the soil tillage treatments: strip-till one-pass (ST-OP), reduced (RT), and conventional (CT).

agronomy

MDPI

Article

A Strip-Till One-Pass System as a Component of Conservation Agriculture

Iwona Jaskulska [1,*], Kestutis Romaneckas [2], Dariusz Jaskulski [1] and Piotr Wojewódzki [3]

1. Conventional technology (CT) with mouldboard ploughing turning over plant residues (with wheat as the subsequent crop);
2. Strip-till one-pass method ST-OP 36 (with wheat as the subsequent crop),
3. Strip-till one-pass method ST-OP 72 (with maize as the subsequent crop).

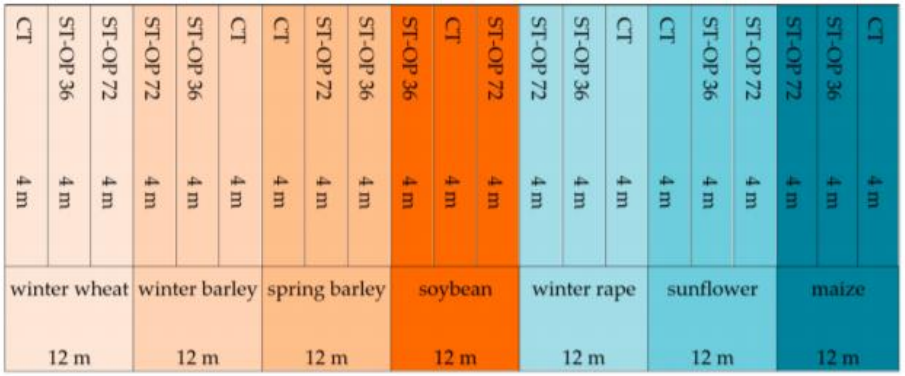


Figure 1. Scheme of arrangement of previous crops and succeeding one to estimate the impact of the tillage method on plant residues, one of three replications. CT, conventional; ST-OP 36, strip-till one-pass, 36 cm strip spacing; ST-OP 72, strip-till one-pass, 72 cm strip spacing.

Figure 3. The site of the surface runoff and soil loss experiment. (A) Field on a slope of 11% gradient; (B) Sedimentation container on a ploughed slope; (C) Sedimentation container on a mulched slope (strip-till one-pass, ST-OP); (D) Field surface after storm (erosion), conventional cultivation (CT); (E) Soil lost from CT field; (F) Soil lost from ST-OP.

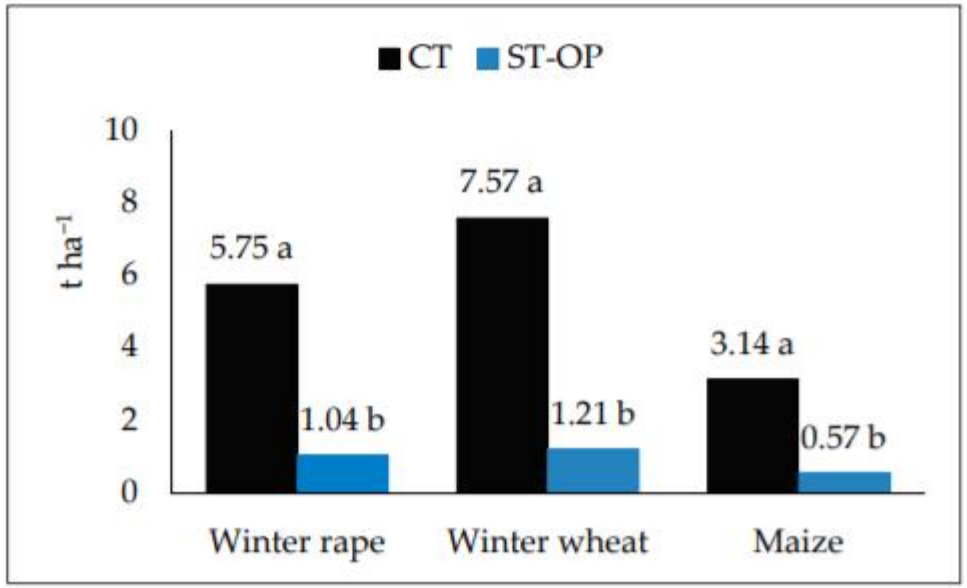


Figure 4. Soil loss during the growing season of winter rape (2015/2016), winter wheat (2016/2017), and maize (2018) depending on the method of soil tillage. Conventional (CT) and strip-till one-pass (ST-OP). The letters a and b indicate significant difference for tillage methods at $p < 0.05$.

Table 3. The aggregate size distribution (ASD), mean weight diameter (MWD), and soil aggregate stability index (SAS) values, as a result of different tillage systems. Conventional (CT), reduced (RT), and strip-till one-pass (ST-OP).

Soil Aggregates	Unit	Conventional (CT)	Reduced (RT)	Strip-Till One-Pass (ST-OP)
Aggregate size distribution (ASD)				
<0.25 mm	%	11.3	9.5	10.2
0.25–0.50 mm	%	11.1	11.2	10.8
0.50–1.0 mm	%	13.4	10.7	11.0
1.0–2.0 mm	%	12.0	12.7	11.8
2.0–3.0 mm	%	14.1	15.1	14.0
3.0–5.0 mm	%	16.6	17.2	16.5
5.0–7.0 mm	%	13.7	14.2	13.4
7.0–10.0 mm	%	7.8	9.4	12.3
CV	%	20.8	22.5	16.6
Mean weight diameter (MWD)	mm	2.84 b	3.04 a	3.17 a
Soil aggregate stability index (SAS)				
0.25–2.0 mm	%	52.4 b	63.5 a	65.1 a
2.0–10.0 mm	%	41.3 c	49.6 b	53.2 a

The letters a, b, and c indicate significant difference at $p < 0.05$.

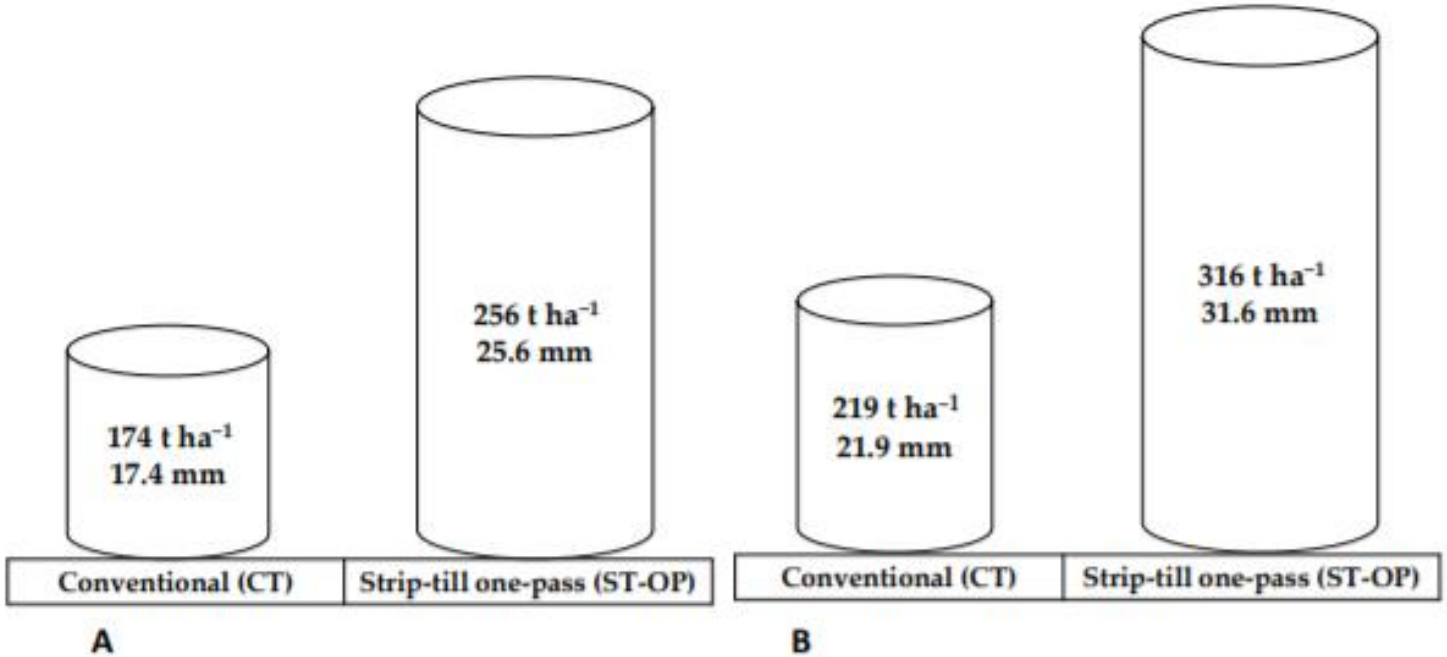


Figure 5. Soil water reserve in the 0–20 cm soil layer in the sowing period. (**A**) Winter barley (from 20 August to 20 September, 2016–2018); (**B**) Maize (from 20 April to 20 May, 2017–2019).

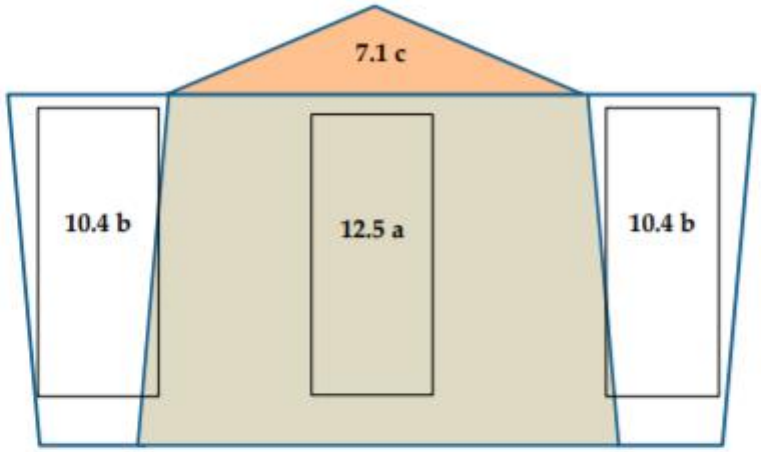


Figure 6. Spatial differentiation of soil moisture (% *v*/*v*) immediately after sowing winter barley. The letters a, b, and c indicate significant difference at $p < 0.05$.

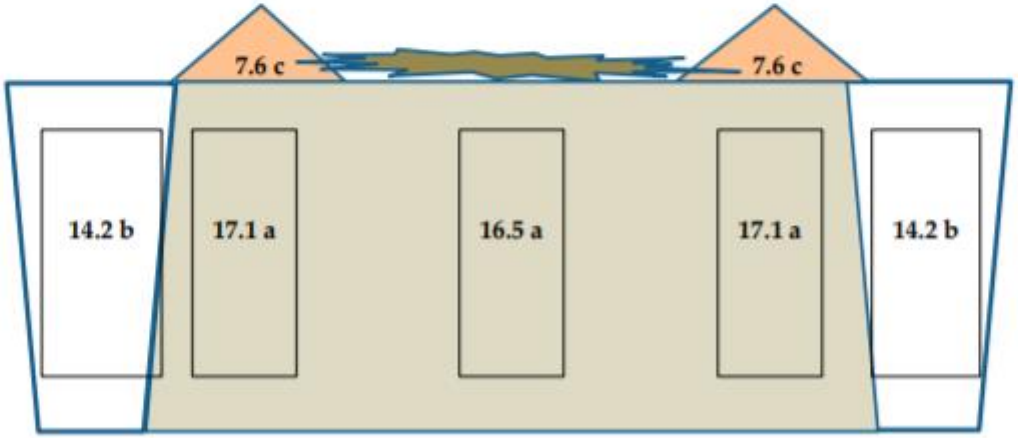


Figure 7. Spatial differentiation of soil moisture (% *v*/*v*) immediately after sowing maize. The letters a, b, and c indicate significant difference at $p < 0.05$.

Table 5. Inputs and CO_2 emissions as a result of different tillage systems. Conventional (CT), reduced (RT), and strip-till one-pass (ST-OP).

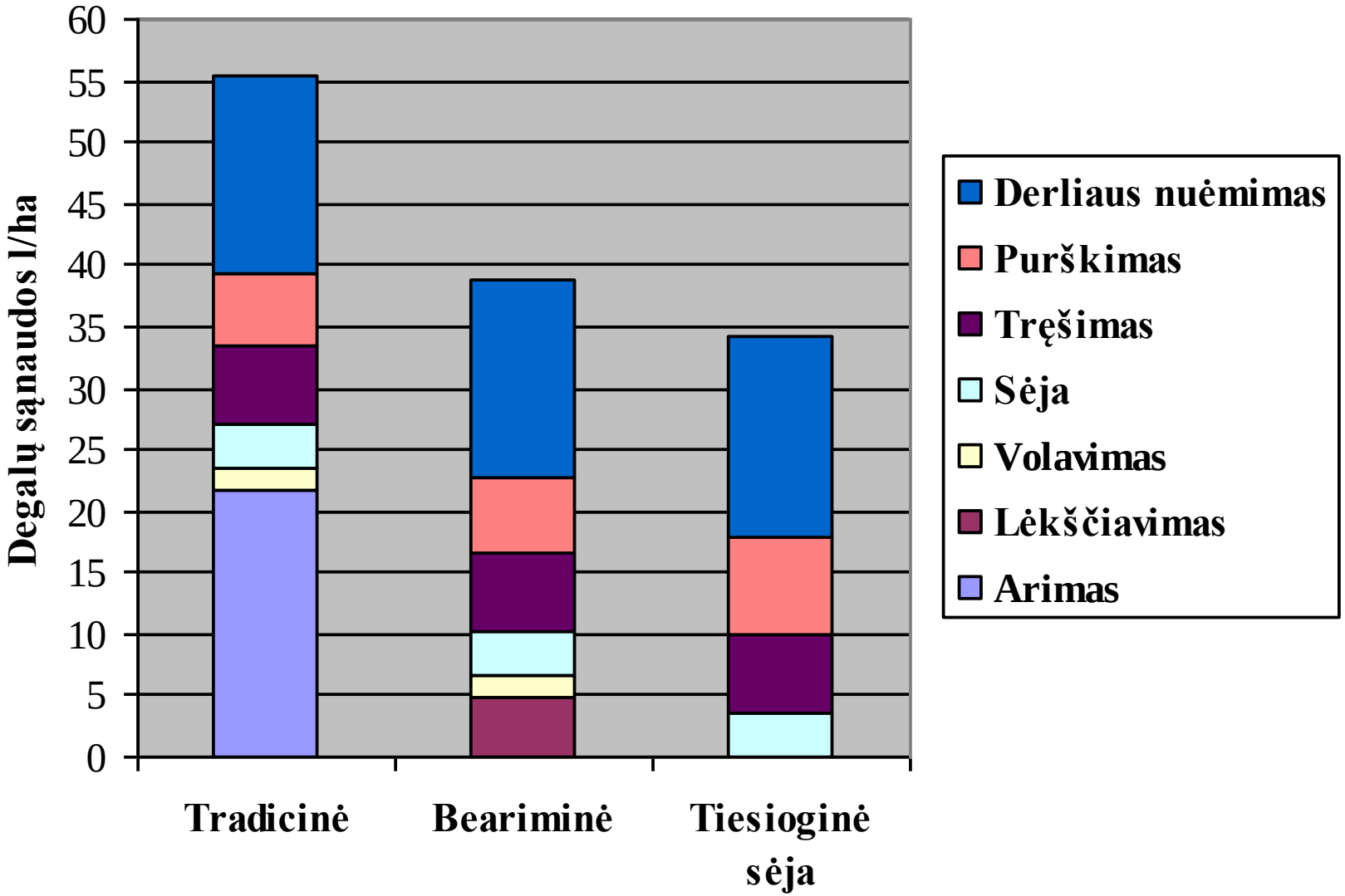
Crop	Unit	Conventional (CT)	Strip-Till One-Pass (ST-OP)
		labor input	
Winter barley	min ha^{-1}	142 a	28 b
Maize	min ha^{-1}	175 a	23 b
		fuel consumption	
Winter barley	L ha^{-1}	49.7 a	13.8 b
Maize	L ha^{-1}	58.0 a	12.2 b
		CO2 emissions	
Winter barley	kg ha^{-1}	136.7 a	38.0 b
Maize	kg ha^{-1}	159.5 a	33.6 b

The letters a and b indicate significant difference at $p < 0.05$.

Tausojančio žemės dirbimo pranašumai prieš arimą

- **Mažesnis vandens nubėgimas – iki 69 %;**
- **Mažesnis dirvožemio elementų išsiplovimas – iki 90 %;**
- **Mažesnis dirvožemio tankis – iki 20 %;**
- **Didesnis poringumas – iki 4 kartų;**
- **Geresnė vandens infiltracija – iki 75 %;**
- **Didesnė dirvožemio vandentalpa – iki 20 %;**
- **Didesnis dirvožemio agregatų stabilumas – iki 47 %;**
- **Didėja organinės medžiagos – iki 22 %;**
- **Mažesni fosforo nuostoliai – iki 65 %;**
- **Mažesni azoto nuostoliai – iki 85 %;**
- **Mažesnė CO2 dujų emisija – iki 77 %;**
- **Didesnis sliekų kiekis – iki 7 kartų;**
- **Didesnė sliekų biomasė – iki 5 kartų;**

Degalų sąnaudos



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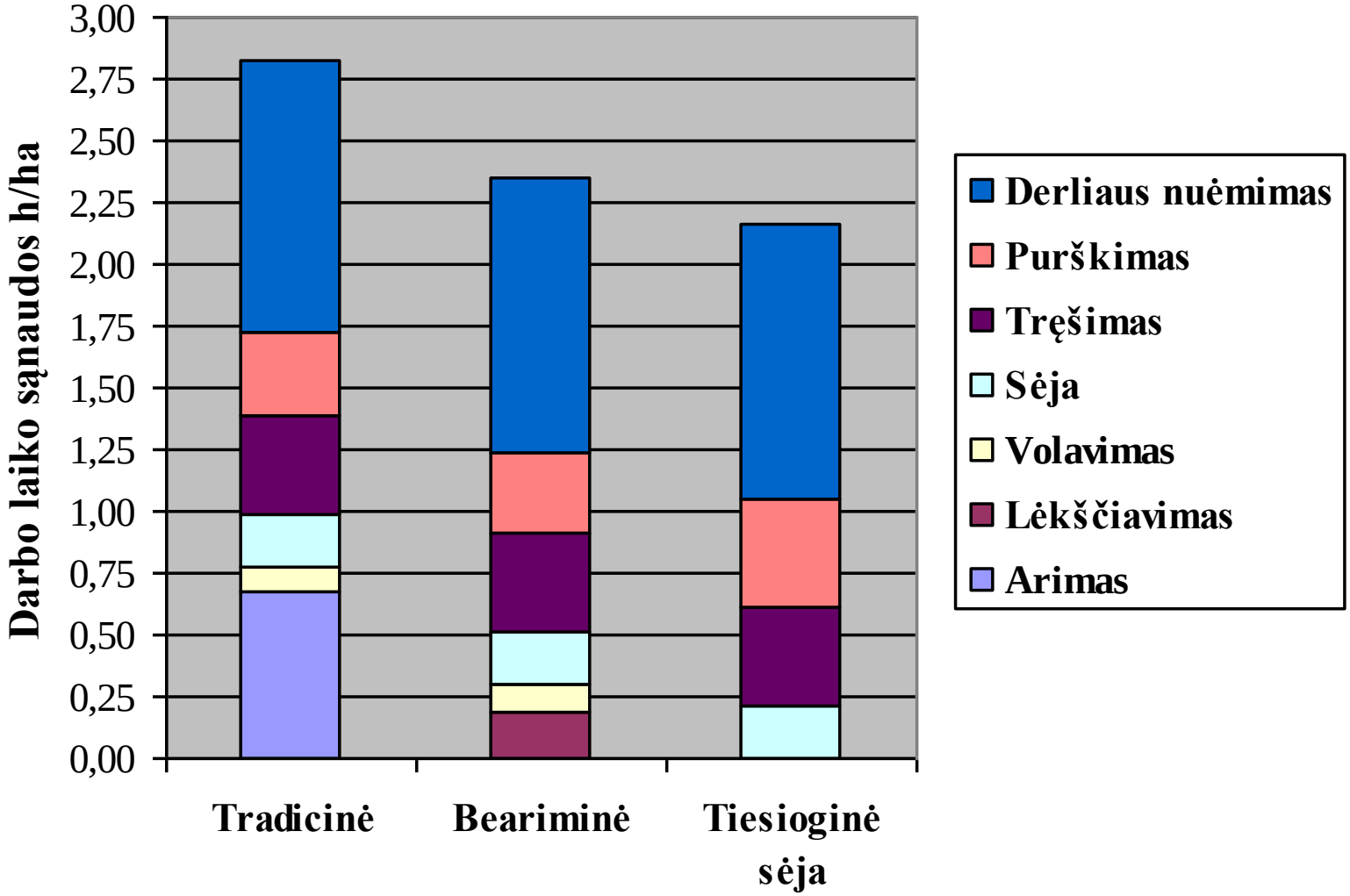

Journal of Cleaner Production 201 (2018) 428–438

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Energy use and carbon emission of conventional and organic sugar beet farming

Egidijus Šarauskis [a, *], Kęstutis Romaneckas [b], František Kumhála [c], Zita Kriaučiūnienė [b]

Table 4
Energy equivalent values of agricultural inputs and output.

Input/Output	Energy equivalent	Unit	Reference(s)
Human labour	1.96	MJ h^{-1}	(Tabar et al., 2010)
Diesel fuel	39.60	MJ L^{-1}	(Reineke et al., 2013; Tzilivakis et al., 2005)
Propane	50.80	MJ kg^{-1}	(Bos et al., 2014)
Agricultural machinery (including self-propelled machines)	357.2	MJ h^{-1}	(Tabatabaeefar et al., 2009)
Seed (sugar beet)	50.00	MJ kg^{-1}	(Erdal et al., 2007; Yousefi et al., 2014)
Seed (catch crop, i.e., mustard)	34.20	MJ kg^{-1}	(Reineke et al., 2013)
Manure	0.47	MJ kg^{-1} (FM)	(Soni et al., 2013)
Herbicide	295.0	MJ kg^{-1}	(Tabar et al., 2010)
Fungicide	115.0	MJ kg^{-1}	(Tabar et al., 2010)
Insecticide	58.00	MJ kg^{-1}	(Tabar et al., 2010)
Nitrogen	40.00	MJ kg^{-1}	(Reineke et al., 2013)
Phosphate	15.80	MJ kg^{-1}	(Reineke et al., 2013)
Potassium	9.30	MJ kg^{-1}	(Reineke et al., 2013)
Boron	5.00	MJ kg^{-1}	(Jacobs et al., 2016; Tzilivakis et al., 2005)
Output Sugar beet yield	17.28	MJ kg^{-1}	(Reineke et al., 2013)

FM – fresh matter.

Table 6
Technological and energy indicators of farming practices under different farm size (calculated by authors, according to (LIAE, 2017)).

Farming practice	Farm size (ha)	Machinery power (kW)	Working width (m)	Field capacity (ha h^{-1})	Working time (h ha^{-1})	Fuel consumption (L ha^{-1})
Deep ploughing (22–25 cm)	2	67	1.40	0.63	1.58	23.40
	10	67	1.40	0.70	1.43	22.90
	20	67	1.40	0.74	1.35	22.60
	40	102	1.75	0.94	1.06	23.60
	80	102	1.75	0.96	1.04	23.80
Shallow ploughing (16–18 cm)	2	67	1.40	0.65	1.53	17.40
	10	67	1.40	0.72	1.39	16.90
	20	67	1.40	0.76	1.32	16.60
	40	102	1.75	0.96	1.04	17.60
	80	102	1.75	0.98	1.02	17.80
Chiselling (25–30 cm)	2	67	2.50	1.06	0.94	15.80
	10	67	2.50	1.18	0.85	15.60
	20	67	2.50	1.21	0.83	15.10
	40	102	3.00	1.68	0.60	14.30
	80	102	3.00	1.71	0.58	14.40
Stubble cultivation (10–12 cm)	2	67	3.00	1.68	0.59	7.30
	10	67	3.00	1.97	0.51	7.02
	20	67	3.00	2.36	0.42	6.90
	40	102	4.00	3.32	0.30	7.00
	80	102	4.00	3.46	0.29	6.90
Discing (10–12 cm)	2	67	3.00	1.25	0.80	10.50
	10	67	3.00	1.38	0.72	10.00
	20	67	3.00	1.45	0.69	9.70
	40	102	4.50	2.36	0.42	9.50
	80	102	4.50	2.40	0.42	9.50
Pre-sowing cultivation (3–5 cm)	2	54	4.00	2.34	0.43	6.10
	10	54	4.00	2.49	0.40	5.80
	20	54	4.00	2.58	0.39	5.70
	40	83	6.00	4.00	0.25	5.70
	80	83	6.00	4.04	0.25	5.70
Conventional sowing	2	54	3.00	1.14	0.88	5.10
	10	54	3.00	1.28	0.78	4.80
	20	54	3.00	1.29	0.77	4.70
	40	54	6.00	2.51	0.40	3.20
	80	54	6.00	2.54	0.39	3.30
Direct sowing	2	67	3.00	1.12	0.89	7.30
	10	67	3.00	1.19	0.84	6.50
	20	67	3.00	1.20	0.83	6.30
	40	83	4.00	1.67	0.60	6.20
	80	83	4.00	1.69	0.59	6.20
Inter-row sowing	2	45	3.00	1.25	0.80	6.90
	10	45	3.00	1.43	0.70	6.60
	20	45	3.00	1.48	0.68	6.60
	40	45	3.00	1.51	0.66	6.60
	80	45	3.00	1.54	0.65	6.60
Spraying	2	67	24.00	8.78	0.11	1.39
	10	67	24.00	11.16	0.09	0.98
	20	67	24.00	11.77	0.08	0.90
	40	67	24.00	12.18	0.08	0.85
	80	67	24.00	12.39	0.08	0.84
Fertilisation	2	54	24.00	12.01	0.08	0.70
	10	54	24.00	14.17	0.07	0.60
	20	54	24.00	14.33	0.07	0.50
	40	67	24.00	14.99	0.07	0.60
	80	67	24.00	15.57	0.06	0.60
Manure distribution	2	138	12.00	2.25	0.44	7.90
	10	138	12.00	2.45	0.41	7.30
	20	138	12.00	2.51	0.40	7.10
	40	138	12.00	2.54	0.39	7.10
	80	138	12.00	2.56	0.39	7.20
Inter-row loosening	2	54	12.00	2.06	0.49	4.10

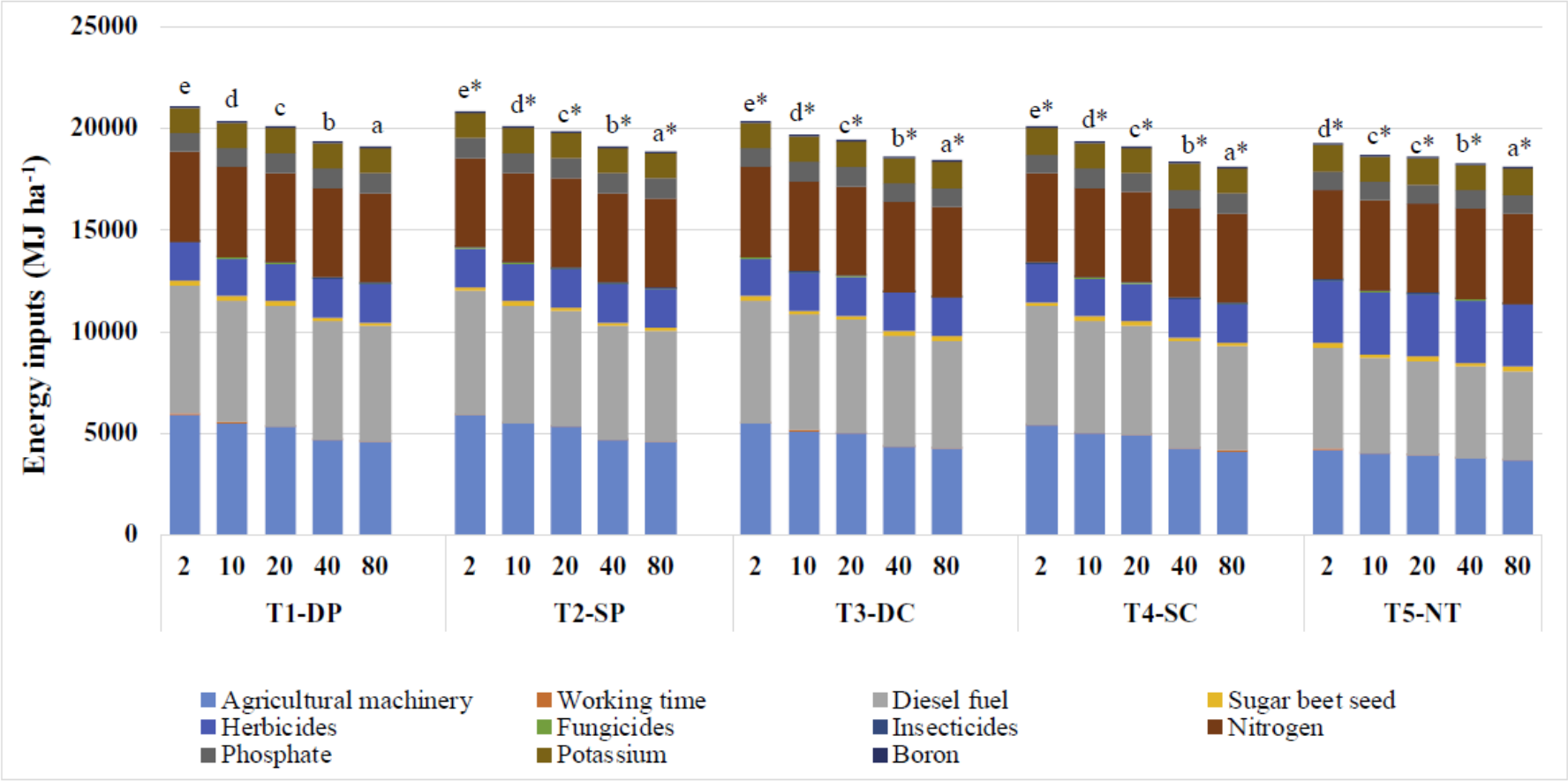

Fig. 1. Effect of tillage method on the energy inputs of sugar beet production on farms of various sizes (ha). T1-DP—deep ploughing (control), T2-SP – shallow ploughing, T3-DC – deep chiselling, T4-SC – discing as shallow cultivation, T5-NT – no tillage. The values within the same treatment (tillage method) followed by a different letter (a, b, …) statistically significantly differ at $P < 0.05$. Asterisk (*) shows statistically significant differences within the same farm size at $P < 0.05$, compared with T1-DP (control).

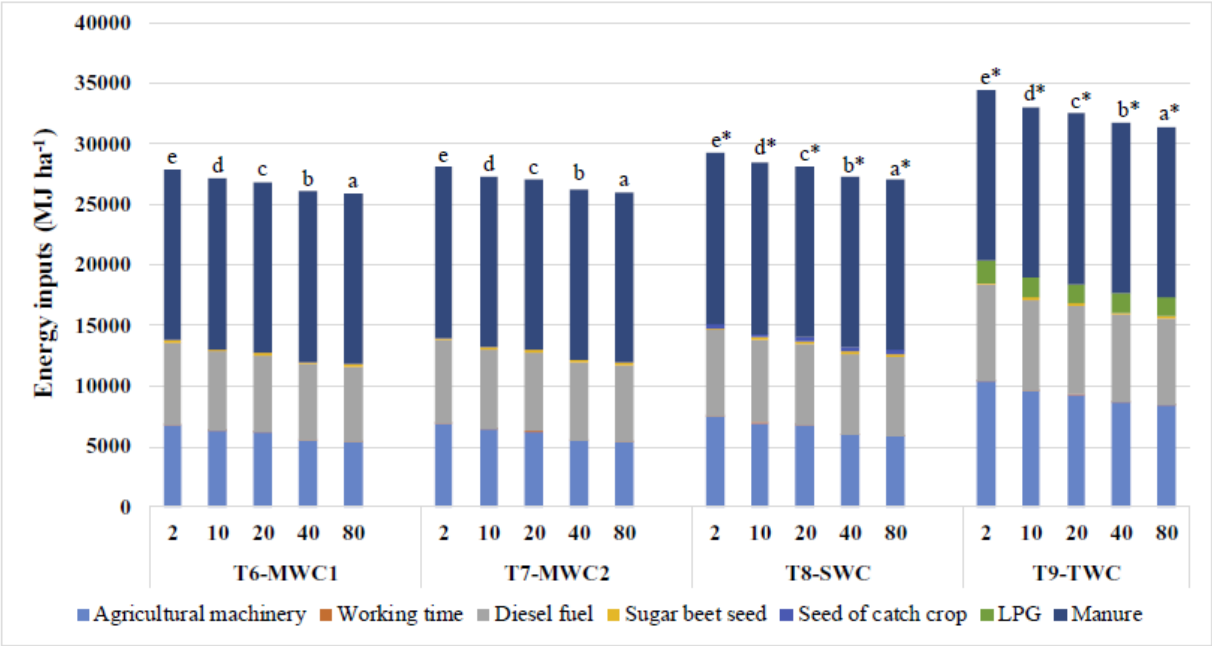

Fig. 2. Effect of weed control method on the energy inputs of sugar beet production on farms of various sizes. T6-MWC1 – mechanical weed control (inter-row loosening), T7-MWC2–mechanical weed control (inter-row cutting and mulching with weeds), T8-SWC – smothering weed control (inter-row cutting and mulching with catch crop), and T9-TWC – thermal weed control (steaming). The values within the same treatment (tillage method) followed by a different letter (a, b, …) statistically significantly differ at $P < 0.05$. Asterisk (*) shows statistically significant differences within the same farm size at $P < 0.05$, compared with T6-MWC1 (control).

Table 8
Carbon emission (CE) indicators of conventional sugar beet farms under different farm size.

Treat-ments	Farm size (ha)	Carbon input (kg ha^{-1})						Yield (t ha^{-1})	CE output (kg ha^{-1})	CE ratio
		Machinery	Diesel fuel	Seed	Chemical Fertilizers	Pesticides	Total			
T1-DP	2	422.0	441.1				1097.4d			15.83a
	10	392.2	418.6				1045.0c			16.62b
	20	380.3	411.6	14.20	175.3	44.80	1026.1b	43.43a	17372a	16.93c
	40	332.6	405.2				972.0a			17.87d
	80	324.1	396.9				955.3a			18.19e
T2-SP	2	419.5	424.6				1078.3e*			16.27a*
	10	390.2	402.0				1026.5d*			17.09b*
	20	378.8	395.0	14.20	175.3	44.80	1008.0c*	43.86a	17544a	17.40c*
	40	331.6	388.6				954.4b*			18.38d*
	80	323.1	380.4				937.7a*			18.71e*
T3-DC	2	390.2	420.2				1044.6e*			16.26a*
	10	363.4	398.5				996.0d*			17.06b*
	20	354.4	390.9	14.20	175.3	44.80	979.5c*	42.47a	16988a	17.34b*
	40	309.7	379.5				923.4b*			18.40c*
	80	301.2	371.0				906.4a*			18.74d*
T4-SC	2	383.6	405.5				1023.0e*			17.01a*
	10	356.9	383.0				974.1d*			17.87b*
	20	347.5	376.0	14.20	175.3	44.80	957.6c*	43.51a	17404a	18.17c*
	40	300.8	366.3				901.2b*			19.31d*
	80	293.3	357.5				885.0a*			19.67e*
T5-NT	2	298.7	349.5				907.6c*			17.970a*
	10	283.3	327.4				870.2b*			18.74b*
	20	279.9	321.3	14.20	175.3	70.00	860.6b*	40.77a	16308a	18.95b*
	40	266.4	315.6				841.5a*			19.38c*
	80	259.5	306.8				825.7a*			19.75c*

Note: T1-DP – deep ploughing (control), T2-SP – shallow ploughing, T3-DC – deep chiselling, T4-SC shallow cultivation (discing), and T5-NT – no tillage. For the yield and CE output the values followed by the same letter (a) do not statistically significantly differ, $P > 0.05$. For the total C input and CE ratio within the same treatment the values followed by a different letter (a, b, …) statistically significantly differ at $P < 0.05$. Asterisk (*) shows statistically significant differences within the same farming system and farm size at $P < 0.05$, compared with the first treatment.

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Improving energy efficiency and environmental mitigation through tillage management in faba bean production

Egidijus Šarauskis [a, *], Kęstutis Romaneckas [b], Algirdas Jasinskas [a], Rasa Kimbirauskienė [b], Vilma Naujokienė [a]

Table 7
The main technological and energy indicators of various faba bean technological operations (prepared based on LIAE [33] and calculated by the authors).

Technological operation	Machinery power (kW)	Working width (m)	Field capacity (ha h^{-1})	Working time (h ha^{-1})	Fuel consumption (L ha^{-1})
Stubble cultivation	102	3.00	2.19	0.46	8.4
Deep ploughing	67	1.05	0.53	1.88	24.8
Shallow ploughing	67	1.05	0.55	1.81	17.9
Deep cultivation	102	3.60	1.41	0.71	16.7
Shallow cultivation	102	3.00	2.00	0.50	8.8
Pre-sowing cultivation	67	3.60	2.29	0.44	6.7
Conventional seeding	67	3.00	2.36	0.42	3.5
Direct seeding	67	3.00	2.15	0.46	6.5
Spraying	67	12.00	11.16	0.09	1.0
Fertilization	54	12.00	14.17	0.07	0.6
Harvesting	90	3.00	0.84	1.19	23.7

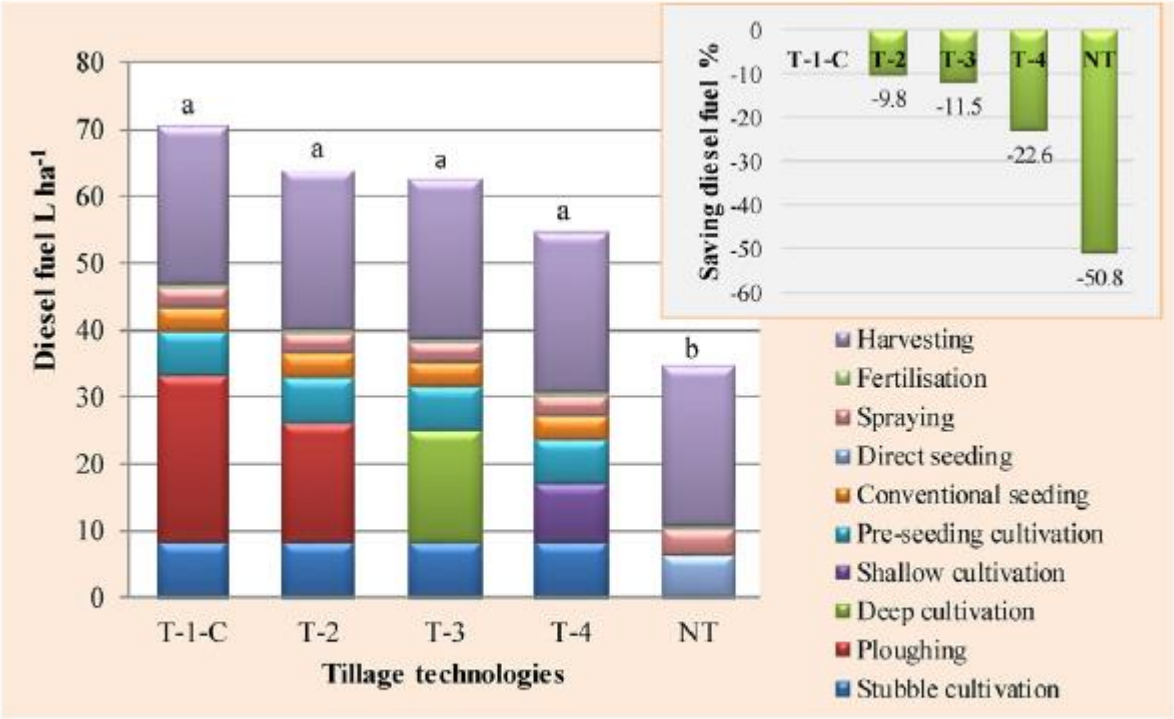

Fig. 1. Fuel consumption and savings for beans production using different tillage technologies.

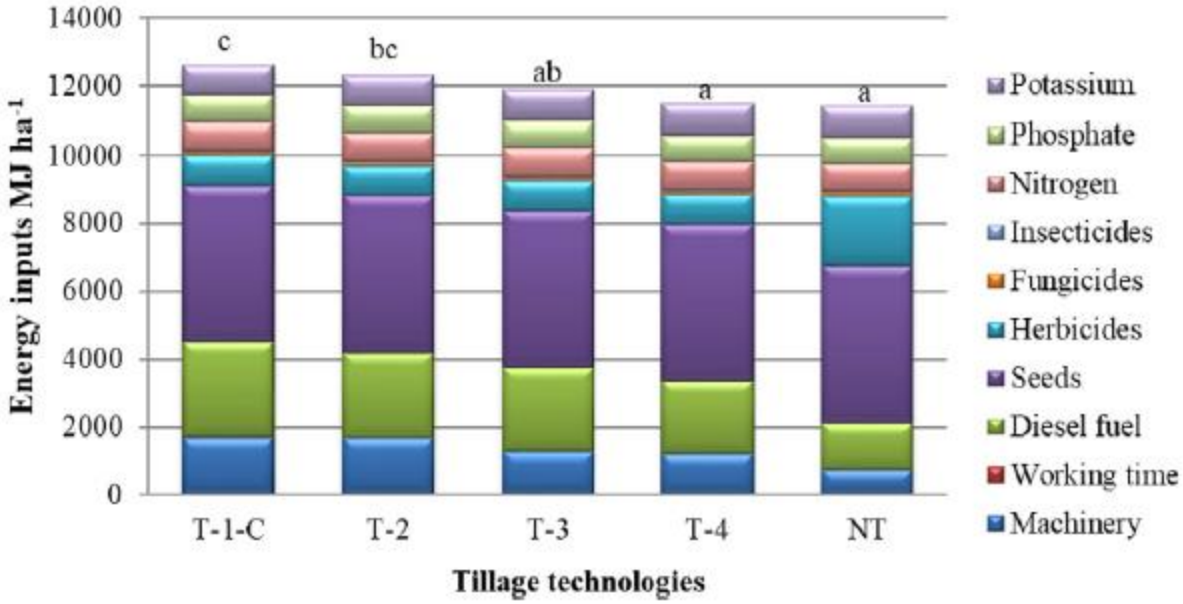

Fig. 2. Total energy inputs of faba bean production under different tillage systems*. *T-1-C, T-2, T-3, T-4, NT represent deep ploughing (control), shallow ploughing, deep chiselling, shallow cultivation, and no tillage, respectively.

Table 8
Effect of tillage technologies on yield and energy efficiency indicators in faba bean production.

Treatments	Energy input MJ ha−1	Yield of grain Mg ha-1	Energy output MJ ha−1	Energy efficiency ratio	Net energy MJ ha−1	Specific energy MJ kg−1	Energy productivity kg MJ−1
T-1-C	12613c	4.22a	84333a	6.69 ab	71720a	3.39 ab	0.33 ab
T-2	12315bc	3.86a	77200a	6.26 b	64885a	3.63 b	0.30 b
T-3	11872 ab	4.41a	88133a	7.42a	76261a	2.95a	0.37 ab
T-4	11484a	4.10a	82000a	7.14 ab	70516a	3.23 ab	0.36 ab
NT	11419a	4.24a	84800a	7.43a	73381a	2.74a	0.37a
$p \leq 0.05$	715.61	0.62	12,468	1.15	12,569	0.77	0.06

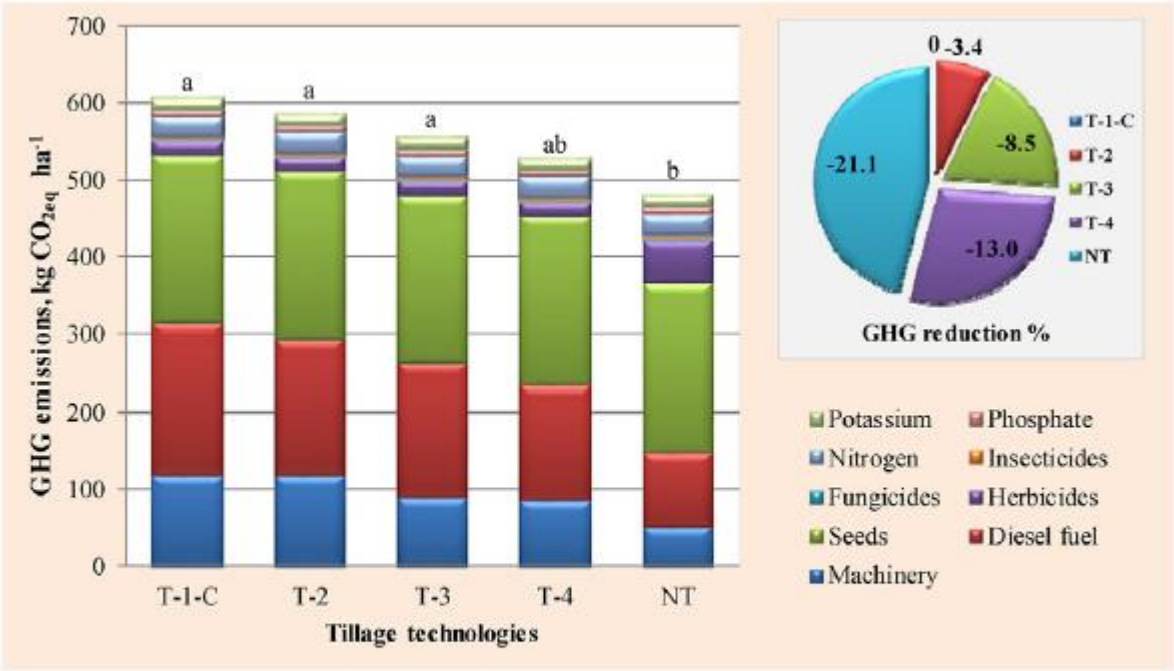

Fig. 3. Environmental mitigation of GHG emissions in faba bean production through different tillage methods*. *T-1-C, T-2, T-3, T-4, and NT represent deep ploughing (control), shallow ploughing, deep chiselling, shallow cultivation, and no tillage, respectively.

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Experimental analysis of CO_2 emissions from agricultural soils subjected to five different tillage systems in Lithuania

Sidona Buragienė [a], Egidijus Šarauskis [a,*], Kęstutis Romaneckas [b], Jurgita Sasnauskienė [c], Laura Masilionytė [d], Zita Kriaučiūnienė [e]

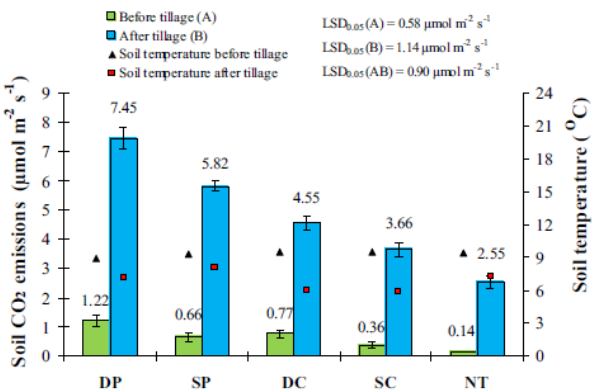

Fig. 2. Soil CO_2 emissions and soil temperatures before and after autumn tillage in 2009. (DP — deep ploughing, SP — shallow ploughing, DC — deep cultivation, SC — shallow cultivation, and NT — no tillage.)

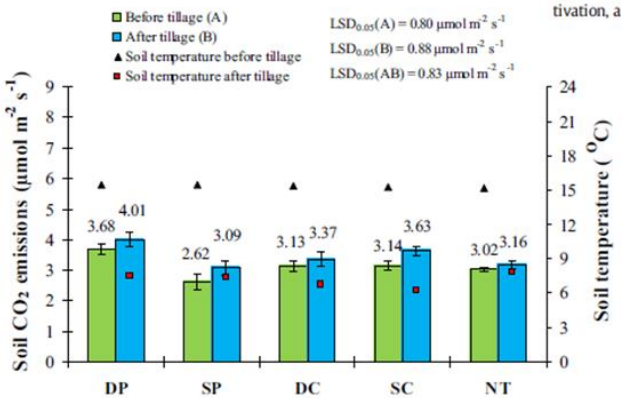

Fig. 3. Soil CO_2 emissions and soil temperatures before and after autumn tillage in 2010. (DP — deep ploughing, SP — shallow ploughing, DC — deep cultivation, SC — shallow cultivation, and NT — no tillage.)

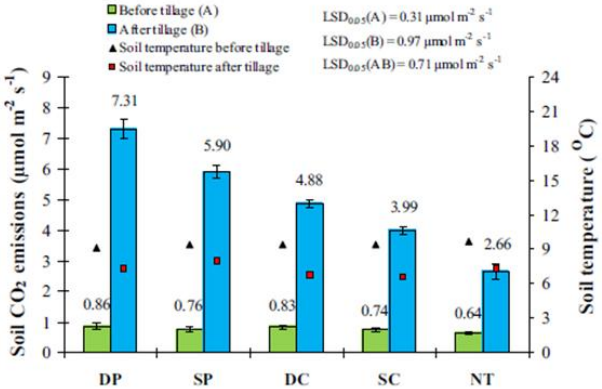

Fig. 4. Soil CO_2 emissions and soil temperatures before and after autumn tillage in 2011. (DP — deep ploughing, SP — shallow ploughing, DC — deep cultivation, SC — shallow cultivation, and NT — no tillage.)

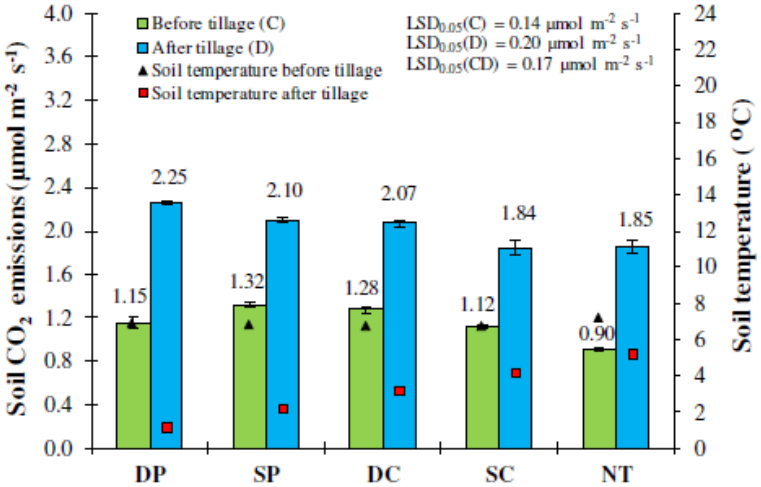

Fig. 5. Soil CO_2 emissions and soil temperatures before and after spring tillage in 2010. (DP — deep ploughing, SP — shallow ploughing, DC — deep cultivation, SC — shallow cultivation, and NT — no tillage.)

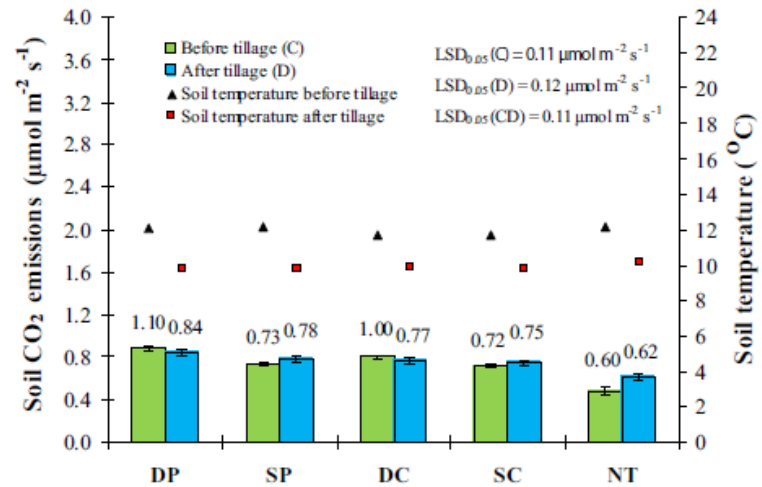

Fig. 6. Soil CO_2 emissions and soil temperatures before and after spring tillage in 2011. (DP — deep ploughing, SP — shallow ploughing, DC — deep cultivation, SC — shallow cultivation, and NT — no tillage.)

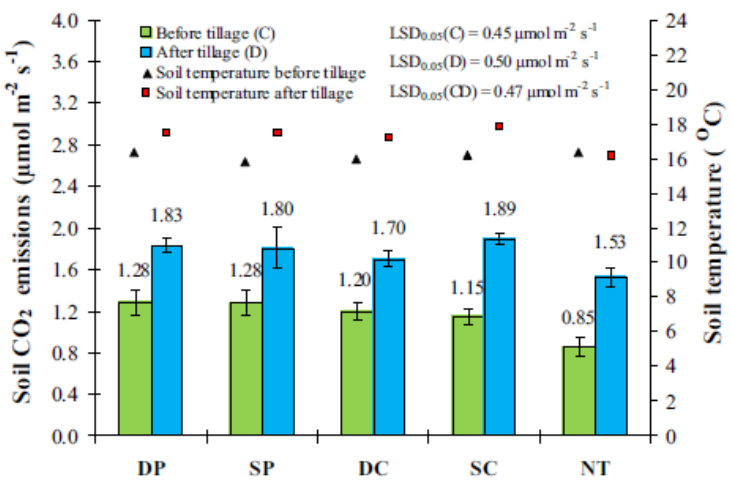

Fig. 7. Soil CO_2 emissions and soil temperatures before and after spring tillage in 2012. (DP — deep ploughing, SP — shallow ploughing, DC — deep cultivation, SC — shallow cultivation, and NT — no tillage.)

Pagrindinė išvada:

4. Because of the reduced working depth and the simplified technological processes, agricultural machinery consumes less diesel fuel in sustainable tillage systems than in the conventional DP system. This reduction in diesel fuel consumption has positive implications for environmental protection because environmental pollution and CO_2 emissions from agricultural machinery are reduced. The most environmentally friendly system was the NT system, which resulted in approximately 107 kg ha^{-1} of CO_2 emissions from agricultural machinery. In other tillage systems (DP, SP, DC, and SC), the CO_2 emissions from the machinery were 2 to 2.5 times higher.

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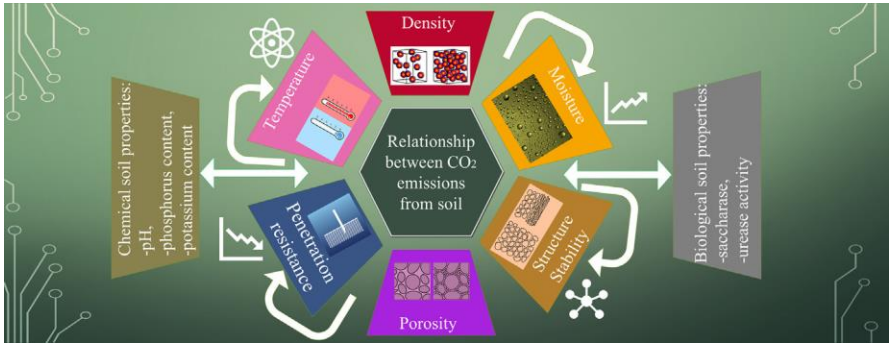
Relationship between CO_2 emissions and soil properties of differently tilled soils

Sidona Buragienė [a], Egidijus Šarauskis [a,*], Kęstutis Romaneckas [a], Aida Adamavičienė [a], Zita Kriaučiūnienė [a], Dovilė Avižienytė [b], Vitas Marozas [a], Vilma Naujokienė [a]



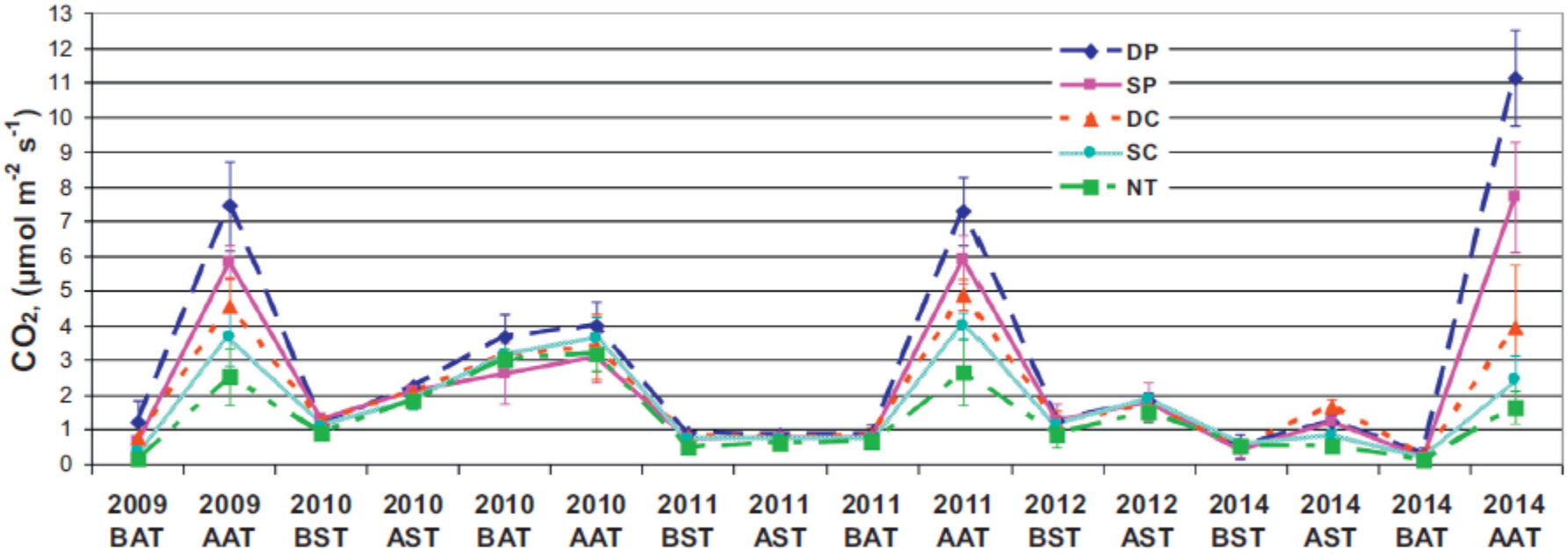


Fig. 3. CO_2 emissions from soil in 2009–2012 and 2014: BAT – before autumn tillage, AAT – after autumn tillage, BST – before spring tillage, and AST – after spring tillage.

Table 1
Correlations between soil properties and CO_2 emissions before autumn tillage.

Soil properties	Depth (cm)	CO_2 emissions ($\mu mol\ m^{-2}\ s^{-1}$)			
		2010	2011	2014	2010/2011/2014
Temperature (°C)	0–10	n	−0.918*	−0.329	−0.977**
Penetration resistance (MPa)	0–10	n	−0.734	−0.674	n
	10–20	−0.708	−0.799	−0.864	−0.523*
Density ($g\ cm^{-3}$)	0–10	n	n	0.407	n
	10–20	n	n	n	0.869**
Moisture (%)	0–10	n	−0.860	−0.644	0.418
	10–20	n	n	n	0.751**
Megastructure (%)	0–15	n	0.750	0.347	n
	15–25	0.471	0.780	0.415	−0.478
Macrostructure (%)	0–15	n	−0.749	−0.344	n
	15–25	−0.481	−0.712	−0.461	0.487
Microstructure (%)	0–15	n	−0.750	−0.376	−0.370
	15–25	n	−0.683	0.425	n
Water-stable structure (%)	0–15	n	n	−0.409	n
	15–25	n	0.562	−0.860	n
Total porosity (%)	0–10	n	n	n	−0.816**
	10–20	n	−0.389	−0.355	−0.836**
Aeration porosity (%)	0–10	0.386	0.476	n	−0.830**
	10–20	n	n	n	−0.878**

Note: n – not significant and very weak correlation.
* Differences significant at the 95% probability level.
** Differences significant at the 99% probability level.

Table 2
Correlations between soil properties and CO_2 emissions after autumn tillage.

Soil properties	Depth (cm)	CO_2 emissions ($\mu mol\ m^{-2}\ s^{-1}$)				
		2009	2010	2011	2014	2009/2010/2011/2014
Temperature (°C)	0–10	0.359	n	0.304	n	n
Penetration resistance (MPa)	0–10	−0.931*	n	−0.944*	−0.944*	−0.745**
	10–20	−0.908*	n	−0.819	−0.958*	−0.713**
Density (g cm^3)	0–10	−0.588	0.821	n	−0.826	n
	10–20	−0.776	0.608	n	−0.667	n
Moisture (%)	0–10	−0.823	−0.390	n	−0.868	−0.370
	10–20	−0.415	−0.344	n	0.819	n
Megastructure (%)	0–15	0.671	−0.403	n	−0.692	−0.318
	15–25	0.815	0.529	0.893*	0.361	n
Macrostructure (%)	0–15	−0.688	0.406	n	0.599	n
	15–25	−0.754	−0.556	−0.879*	−0.330	n
Microstructure (%)	0–15	0.656	n	0.673	0.820	0.328
	15–25	n	n	−0.896*	n	−0.336
Water-stable structure of (%)	0–15	−0.861	n	−0.714	−0.984**	n
	15–25	−0.470	−0.578	n	−0.628	n
Total porosity (%)	0–10	–	0.845	n	0.860	0.620*
	10–20	–	n	n	0.628	0.436
Aeration porosity (%)	0–10	–	0.900*	0.593	0.919*	0.727**
	10–20	–	n	−0.643	0.494	0.333
Soil pH	0–15	–	0.598	0.918*	n	n
	15–25	–	0.577	0.867	0.675	0.387
Plant available phosphorus content (mg kg^{-1})	0–15	–	−0.454	n	n	n
	15–25	–	n	0.455	0.932*	n
Plant available potassium content (mg kg^{-1})	0–15	–	−0.593	−0.428	−0.511	n
	15–25	–	n	n	0.919*	0.356
Saccharase activity (mg glucose 1 g soil per 24 h)	0–25	–	n	n	−0.655	n
Urease activity (mg NH_3 1 g soil per 24 h)	0–25	–	−0.756	−0.816	−0.678	−0.617*

Note: "–" – not analysed, n – not significant and very weak correlation.
* Differences significant at the 95% probability level.
** Differences significant at the 99% probability level.

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Article

Planosol CO_2 Respiration, Chemical and Physical Properties of Differently Tilled Faba Bean Cultivation

Rasa Kimbirauskienė [1], Kęstutis Romaneckas [1], Vilma Naujokienė [1,*], Aušra Sinkevičienė [1], Egidijus Šarauskis [1], Sidona Buragienė [1] and Stanisław Bielski [2]

Table 3. The effect of the tillage systems on the soil chemical composition (0–15 cm soil layer).

Tillage System	Timing	Soil Chemical Composition				
		pH_{HCl}, mol l^{-1}	P_2O_5, mg kg^{-1}	K_2O, mg kg^{-1}	Mg, mg kg^{-1}	N_{total}, %
2016						
Deep ploughing	BS	7.1	231	85	360	0.131
	AH	7.4	237	104	437	0.129
Shallow ploughing	BS	7.0	248	108*	347	0.143
	AH	7.4	257	122	434	0.139
Deep cultivation-chiselling	BS	7.4	250	120**	446	0.142
	AH	7.3	194	101	346	0.130
Shallow cultivation-disking	BS	7.1	284	149**	408	0.144
	AH	7.1	284	138*	324	0.144
No-tillage	BS	6.7	233	116**	274	0.168**
	AH	7.0	250	119	312	0.157*
2017						
Deep ploughing	BS	7.1	246	136	426	0.120
	AH	7.0	255	144	455	0.128
Shallow ploughing	BS	7.1	245	146	489	0.148**
	AH	7.0	233	158	463	0.141
Deep cultivation-chiselling	BS	7.4	242	148	481	0.131**
	AH	6.8	243	165	485	0.134
Shallow cultivation-disking	BS	7.2	270	168	634	0.149**
	AH	7.0	257	180	610	0.145
No-tillage	BS	7.1	276	166	608	0.143**
	AH	7.1	268	206	544	0.146
2018						
Deep ploughing	BS	7.3	309	123	282	0.116
	AH	7.3	322	132	298	0.115
Shallow ploughing	BS	6.9	347	150	358	0.144*
	AH	6.9	347	156	269	0.164*
Deep cultivation-chiselling	BS	6.6	318	132	242	0.136*
	AH	6.9	300	152	286	0.148*
Shallow cultivation-disking	BS	6.8	336	147	256	0.138*
	AH	6.7	376	188	268	0.161*
No-tillage	BS	6.4*	384	181*	208	0.158**
	AH	6.4*	355	201*	198	0.173**

Table 4. The effect of the tillage systems on the soil chemical composition (15–25 cm soil layer).

Tillage System	Timing	Soil Chemical Composition				
		pH_{HCl}, mol l^{-1}	P_2O_5, mg kg^{-1}	K_2O, mg kg^{-1}	Mg, mg kg^{-1}	N_{total}, %
		2016				
Deep ploughing	BS	7.4	266	104	419	0.135
	AH	7.5	246	98	415	0.137
Shallow ploughing	BS	7.4	251	107	428	0.140
	AH	7.5	232	97.0	455	0.141
Deep cultivation-chiselling	BS	7.5	154	67*	307	0.120
	AH	7.4	135	67*	305	0.110
Shallow cultivation-disking	BS	7.3	162	65*	306	0.013
	AH	7.4	160	66*	306	0.122
No-tillage	BS	7.4	166	60*	289	0.128
	AH	7.4	150	58*	291	0.135
		2017				
Deep ploughing	BS	7.4	228	144	489	0.132
	AH	7.0	198	120	424	0.142
Shallow ploughing	BS	7.4	231	131	477	0.164
	AH	7.0	190	114	427	0.150
Deep cultivation-chiselling	BS	7.4	129**	76**	501	0.123
	AH	7.2	156	114	391	0.134
Shallow cultivation-disking	BS	7.4	129**	71**	449	0.147
	AH	7.2	148	92	371	0.133
No-tillage	BS	7.5	171**	95**	609	0.156
	AH	7.2	164	104	547	0.132
		2018				
Deep ploughing	BS	7.3	310	130	296	0.115
	AH	7.3	301	130	256	0.137
Shallow ploughing	BS	6.9	338	132	290	0.152
	AH	7.1	325	138	368	0.144
Deep cultivation-chiselling	BS	6.6	204	78*	236	0.115
	AH	6.8	173	72*	214	0.112
Shallow cultivation-disking	BS	6.7	210	78*	218	0.116
	AH	7.1	217	80	214	0.126
No-tillage	BS	6.8	254	100	234	0.125
	AH	7.0	236	96	212	0.123

BS, before sowing; AH, after harvesting; * significantly different at $P \leq 0.05$ from the control (deep plowing, DP) within columns; ** at $P \leq 0.01$.

Table 6. The effect of the tillage systems on the CO_2 e-flux and the concentration above the ground.

Tillage System	CO_2 e-Flux Rate, µmol m^{-2} s^{-1}			CO_2 Concentration Above the Ground, ppm		
	Beginning of Vegetation	Middle of Vegetation	End of Vegetation	Beginning of Vegetation	Middle of Vegetation	End of Vegetation
			2016			
Deep ploughing	2.21	4.47	3.88	389.7	383.7	394.2
Shallow ploughing	2.90	3.81	3.27	387.2	409.5	392.4
Deep cultivation-chiselling	3.22	2.93	5.75	387.1	386.3	393.7
Shallow cultivation-disking	2.74	5.06	3.29	391.0	382.9	390.9
No-tillage	2.97	3.97	4.49	386.9	383.1	394.6
			2017			
Deep ploughing	3.19	3.43	2.00	387.8	391.8	389.8
Shallow ploughing	2.65	7.66**	2.93	389.0	406.1	388.7
Deep cultivation-chiselling	3.68	4.28	1.80	388.0	399.7	388.0
Shallow cultivation-disking	2.72	3.47	1.65	387.2	410.1*	387.5*
No-tillage	4.55	4.20	2.38	390.8**	393.7	387.4*
			2018			
Deep ploughing	3.57	5.02	2.32	390.5	395.2	376.6
Shallow ploughing	2.58	3.07	6.84**	387.4*	388.9	391.1
Deep cultivation-chiselling	2.82	3.12	9.75**	388.1	388.1	393.9
Shallow cultivation-disking	4.33	3.51	5.68*	389.5	388.9	381.4
No-tillage	2.46	3.15	5.54*	388.2	397.0	383.6

* Significantly different at $P \leq 0.05$ from the control (deep plowing, DP) within columns; ** at $P \leq 0.01$.

4. Conclusions

The highest concentration of potassium and total nitrogen in the soil was determined in nonreversibly tilled plots, especially in no-tilled soil, so faba bean crop enriched the soil with these elements through vegetation. The strongest influence was observed in 2018. The precrop residues on the topsoil prevented rapid evaporation of moisture. Consequently, higher moisture content was found in the topsoil layer of minimally or no-tilled plots compared with the deeply plowed soil. At the beginning of faba bean vegetation, more humid no-tilled plots warmed up slightly more slowly than the cultivated ones because the temperature of the topsoil was negatively related with the moisture content ($r = -0.912$; $P \leq 0.01$). The CO_2 e-flux and its aboveground concentration in the faba bean cultivation were generally not significantly affected by different tillage systems. These indicators were more dependent on meteorological conditions such as temperature and rainfall ($r = 0.792$ and 0.841; $P \leq 0.01$). In general, plowless tillage and no-tillage systems increased the amount of available nutrients (N, P, K, and M) in the soil. Faba bean crop largely increased the composition of potassium and total nitrogen and stabilized the soil CO_2 respiration during a single vegetative period.

Mūsų eksperimentai

LIETUVOS ŽEMĖS ŪKIO UNIVERSITETAS

Doc. dr. Kęstutis Romaneckas

ŽEMĖS DIRBIMO OPTIMIZAVIMAS CUKRINIAMS RUNKELIAMS

Habilitacijos procedūrai teikiamų mokslo darbų apžvalga

Biomedicinos mokslai (B 000)

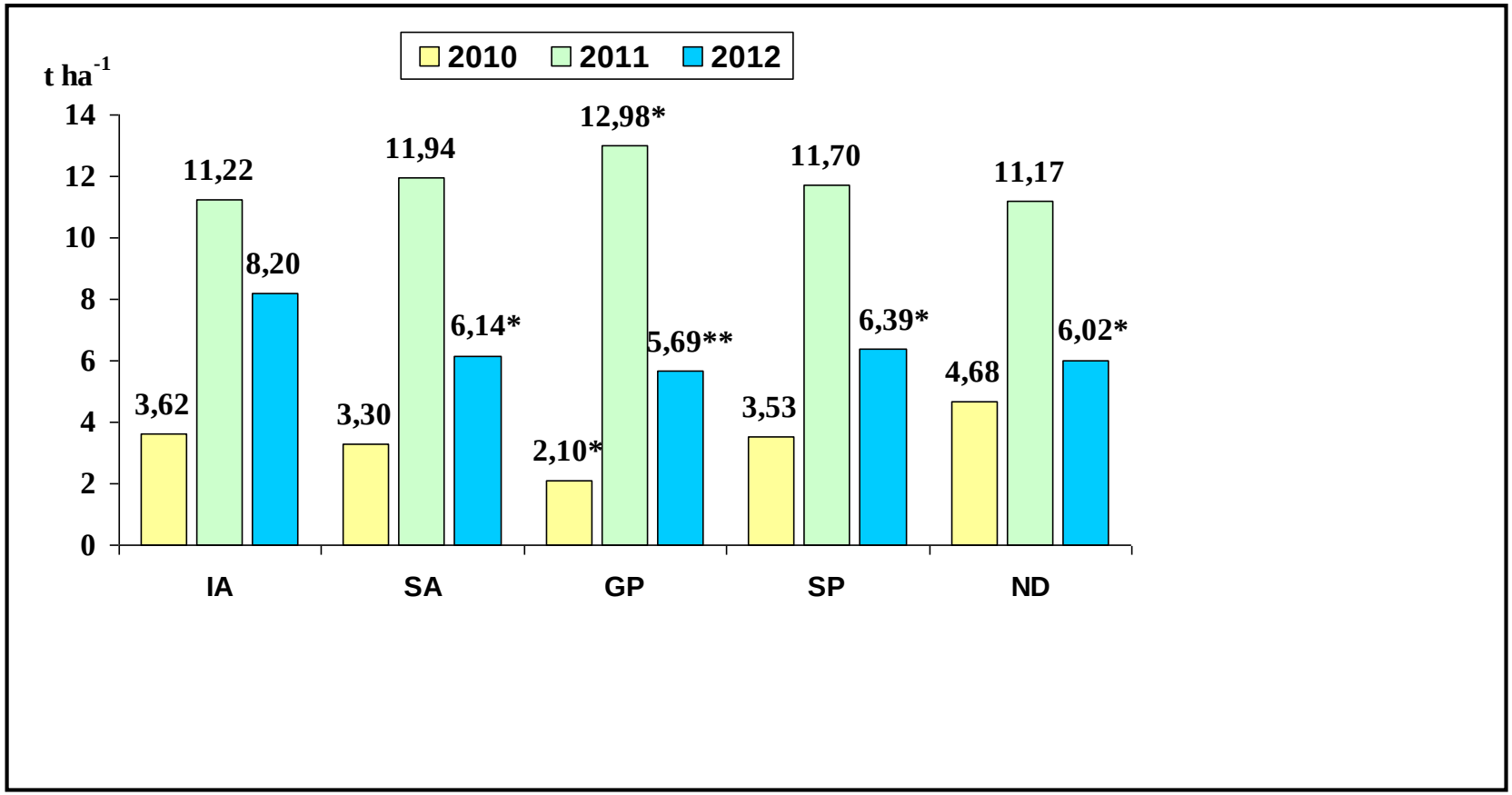
Agronomija (06B)

ISSN 1648-116X LŽŪU MOKSLO DARBAI. 2002. Nr. 56 (9)
BIOMEDICINOS MOKSLAI

Priešsėjinio dirvos dirbimo įtaka cukrinių runkelių morfometriniams rodikliams

Kęstutis Romaneckas

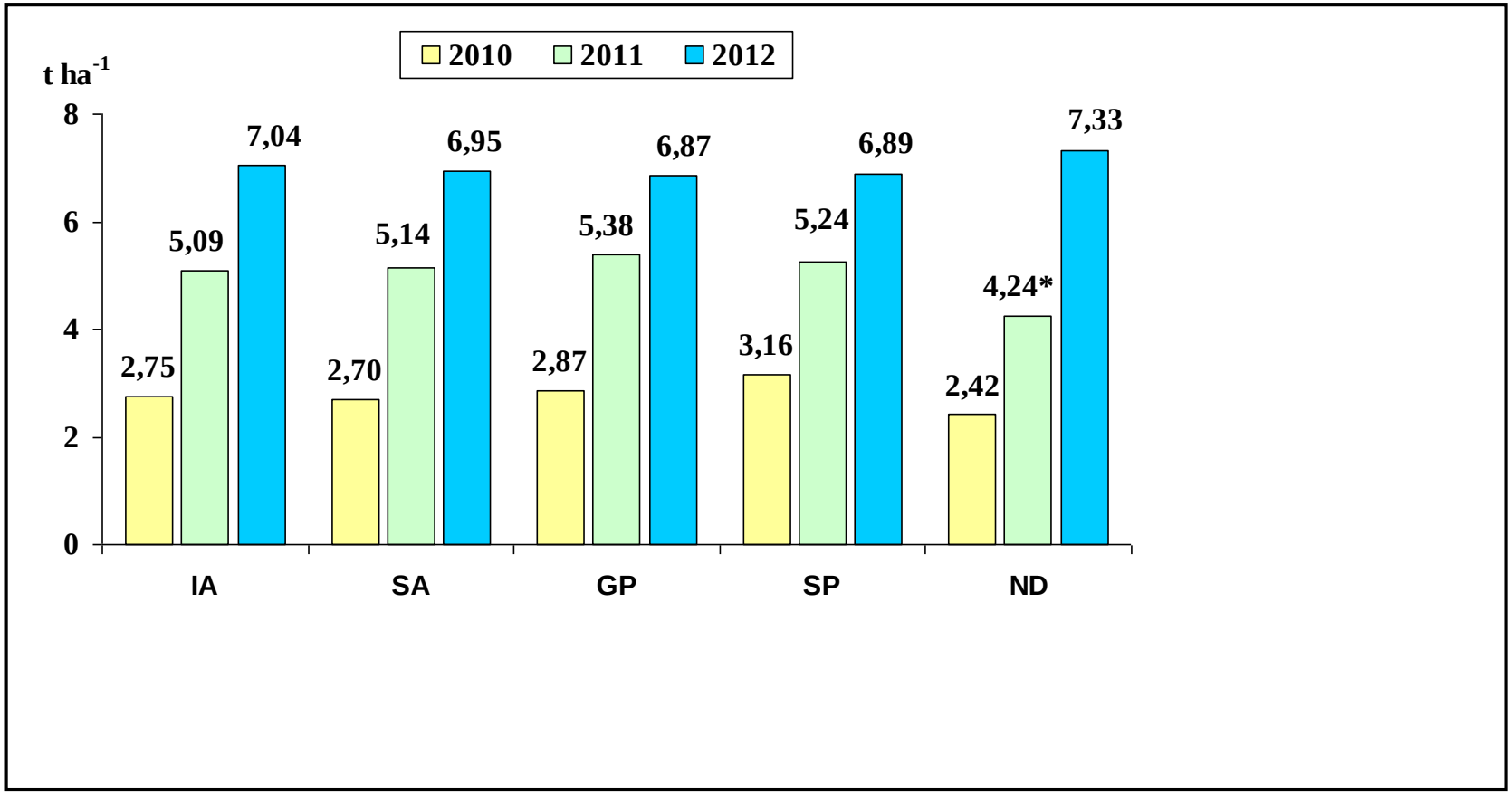
KUKURŪZAI



Pastaba: IA – įprastinis arimas, SA – seklusis arimas, GP – gilusis purenimas, SP – seklusis purenimas, ND – neįdirbta žemė; * - esminiai skirtumai 95 % tikimybės lygiui, ** - esminiai skirtumai 99 % tikimybės lygiui

7 pav. **Skirtingo rudeninio žemės dirbimo poveikis kukurūzų grūdų derlingumui**

VASARINIAI MIEŽIAI



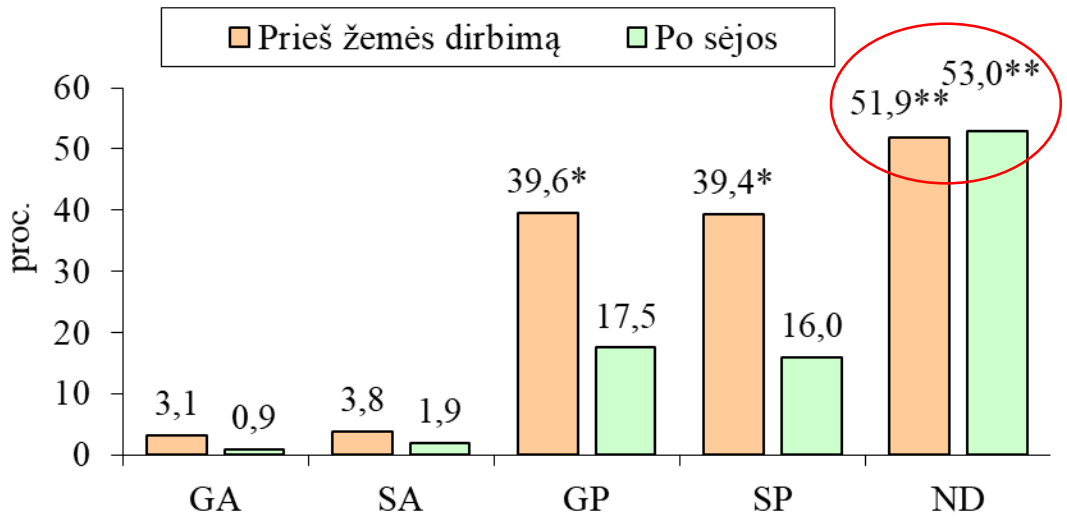
Pastaba: IA – įprastinis arimas, SA – seklusis arimas, GP – gilusis purenimas, SP – seklusis purenimas, ND – neįdirbta žemė; * - esminiai skirtumai 95 % tikimybės lygiui

10 pav. **Skirtingo rudeninio žemės dirbimo poveikis vasarinių miežių grūdų derlingumui**

IŠVADOS

Skirtingas rudenis žemės dirbimas neturėjo esminės įtakos vasarinių rapsų, žieminių kviečių ir dažniausiai vasarinių miežių produktyvumui. Panašios tendencijos stebėtos ištyrus ir 1000 sėklų masę. Kukurūzų produktyvumui didesnės įtakos turėjo tyrimų metų meteorologinės sąlygos. Perteklinės drėgmės sąlygomis produktyvesni buvo kukurūzai, augę giliai artoje dirvoje.

Žemės dirbimo supaprastinimas pupoms, 2016-2018 m.



Pastaba: * - esminis skirtumas nuo kontrolinio varianto (GA) esant 95 proc. tikimybės lygiui, ** - esant 99 proc. tikimybės lygiui.

GA - gilusis arimas 23-25 cm gyliu (kontrolinis palyginamasis variantas); SA - seklusis arimas 12-15 cm gyliu; GP - gilusis purenimas 25-30 cm gyliu; SP - seklusis purenimas 12-15 cm gyliu; ND – neįdirbta žemė (tiesioginė sėja).

8 pav. Augalinių liekanų (žieminių kviečių priešsėlio) kiekis dirvos paviršiuje prieš žemės dirbimą pavasarį ir po pupų sėjos

ŽEMĖS ŪKIO, MAISTO IR ŽUVININKYSTĖS MTTV PROJEKTO
Nr. MT-16-8

„Tvaraus ūkininkavimo ir trumpos rotacijos su pupomis poveikis aplinkai, pasėlių produktyvumui ir bioekonominiam potencialui realizuojant ES Žalinimo programą“

2016-2018 m. GALUTINĖ ATASKAITA

Tyrimo vadovas
Kęstutis Romaneckas

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Article

Planosol CO_2 Respiration, Chemical and Physical Properties of Differently Tilled Faba Bean Cultivation

Rasa Kimbirauskienė [1], Kęstutis Romaneckas [1], Vilma Naujokienė [1,*], Aušra Sinkevičienė [1], Egidijus Šarauskis [1], Sidona Buragienė [1] and Stanisław Bielski [2]

agronomy MDPI
Article

Weed diversity, abundance and seedbank in differently tilled faba bean (*Vicia faba* L.) cultivations

Kęstutis Romaneckas[1,*], Rasa Kimbirauskienė[1], Auira Sinkevičienė[1], Iwona Jaskulska[2], Sidona Buragienė[1], Aida Adamavičienė[1], Egidijus Šarauskis[1]

Augalinės liekanos

Augalinės liekanos x dirvožemio cheminė sudėtis

Nustatyta koreliacija tarp augalinių liekanų kiekio dirvožemio paviršiuje ir:

- kalio bei azoto kiekių 0–15 cm sluoksnyje (r = 0,702 ir 0,535, kai $P \geq 0,05$);
- CO2 koncentracijos ties dirvožemio paviršiumi antroje pupų vegetacijos pusėje (r = –0,876, kai $P \geq 0,05$);
- dirvožemio agregatų stabilumui (–0,906, kai $P \leq 0.05$)

Augalinės liekanos x sliekai

Nustatyta koreliacija tarp augalinių liekanų kiekio dirvožemio

- sliekų skaičiaus (r = 0,980, kai $P \geq 0,01$);
- biomasės (r = 0,989, kai $P \geq 0,01$);

Augalinės liekanos x sacharazė (r = 0,519, kai $P \geq 0,05$

Sliekai x sacharazė (r = 0,508, kai $P \leq 0.05$

Augalinės liekanos x trum. piktžolių skaičius ir biomasė

(r = –0,784; r = –0,748, kai $P \leq 0.05$). ?

Sliekai x pupų sėklų baltymingumas (r = 0,654, kai $P \leq 0.05$)

Sliekai x simbiotinių gumbelių skaičius ant pupų šaknų (r = 0,611, kai $P \leq 0.05$)

Dirv. struktūra x simbiotinių gumbelių skaič. (r = 0,815, kai $P \leq 0.05$)

Dirvožemio struktūra

Taip pat nustatyta koreliacija tarp sliekų skaičiaus ir biomasės bei dirvožemio struktūros stabilumo (r = 0,910 ir 0,902, kai $P \leq 0.05$).

Soil biological conditions

Table. Effect of different tillage systems on soil enzymatic activity in faba bean cultivation

Tillage system	Saccharase			Urease		
	mg glucoses 1 g of soil per 48 h			mg NH_3 1 g of soil per 24 h		
	2016	2017	2018	2016	2017	2018
DP	23.2	27.7	27.4	0.08	0.16	0.17
SP	19.7	27.2	29.9	0.11	0.16	0.23
DC	27.4	37.6	36.1	0.15	0.28	0.30
SC	26.5	33.8	40.4	0.19*	0.39*	0.55 **
NT	38.6*	49.2**	50.0 **	0.25**	0.61**	0.45 **

Note: DP – deep ploughing, SP – shallow ploughing, DC – deep cultivation, SC – shallow cultivation, NT – no-tillage (direct drilling). * – significant differences from the control treatment (DP) at $p \leq 0.05$, ** – at $p \leq 0.01$.

Table . Effect of different tillage practise on number (m^{-2}) and fresh biomass ($g\ m^{-2}$) of earthworms

Tillage system	2016		2017		2018	
	number	biomass	number	biomass	number	biomass
Deep ploughing	133.3	39.5	81.5	23.5	90.2	27.1
Shallow ploughing	154.0	60.0	80.3	42.9	113.2	33.7
Deep cultivation	109.3	72.0*	82.5	49.9	158.5	63.1*
Shallow cultivation	81.0	75.5**	69.8	96.0**	161.2	57.0*
No-tillage	196.3*	129.2**	119.5	134.7**	156.5	58.6*

Note: * – significant differences from the control treatment (DP) at $p \leq 0.05$, ** – at $p \leq 0.01$.

AGRICULTURAL AND FOOD SCIENCE

K. Romaneckas et al. (2019) 28: 101–111

Impact of sustainable tillage on biophysical properties of Planosol and on faba bean yield

Kęstutis Romaneckas, Rasa Kimbirauskienė, Aida Adamavičienė, Sidona Buragienė, Aušra Sinkevičienė, Egidijus Šarauskis, Algirdas Jasinskas and Aleksandra Minajeva

Impact on environment

Effect of tillage systems on CO2 e-flux and concentration above the ground

Tillage system	CO_2 e-flux rate µmol m^{-2} s^{-1}			CO_2 concentration above the ground ppm		
	beginning of vegetation	middle of vegetation	end of vegetation	beginning of vegetation	middle of vegetation	end of vegetation
2016						
Deep ploughing	2.21	4.47	3.88	389.7	383.7	394.2
Shallow ploughing	2.90	3.81	3.27	387.2	409.5	392.4
Deep cultivation-chiselling	3.22	2.93	5.75	387.1	386.3	393.7
Shallow cultivation-disking	2.74	5.06	3.29	391.0	382.9	390.9
No-tillage	2.97	3.97	4.49	386.9	383.1	394.6
2017						
Deep ploughing	3.19	3.43	2.00	387.8	391.8	389.8
Shallow ploughing	2.65	7.66**	2.93	389.0	406.1	388.7
Deep cultivation-chiselling	3.68	4.28	1.80	388.0	399.7	388.0
Shallow cultivation-disking	2.72					
No-tillage	4.55					
2018						
Deep ploughing	3.57					
Shallow ploughing	2.58					
Deep cultivation-chiselling	2.82	3.12	9.75**	388.1	388.1	393.9
Shallow cultivation-disking	4.33	3.51	5.68*	389.5	388.9	381.4
No-tillage	2.46	3.15	5.54*	388.2	397.0	383.6

CO2 e-flux and concentration above the ground in faba bean cultivation were generally not significantly affected by different tillage systems. These indicators were more dependent on the meteorological conditions, such as temperature and rainfall (r = 0.792 and 0.841).

*, significantly different at *P≤0.05* from the control (deep ploughing, DP) within columns; **, at *P≤0.01*.

Harmful emissions from the burning of faba bean waste pellets, 2018.

Tillage systems	CO_2 %	O_2 %	CO ppm	NO_x ppm	C_xH_y ppm	SO_2, ppm
DP	4,1	15,2	1072	151	56	2,0
SP	3,6	16,3	3293	129	243	4,9
DC	4,7	14,4	1314	187	70	0,0
SC	3,2	16,6	1443	91	100	0,0
NT	4,2	15,2	2879	202	250	1,3

Note: DP – deep ploughing, SP – shallow ploughing, DC – deep cultivation, SC – shallow cultivation, NT – no-tillage (direct drilling). * – significant differences from the control treatment (DP) at $p \leq 0.05$, ** – at $p \leq 0.01$.

“Grūduva” 2004 m.
Žieminiai rapsai

Žieminio rapso pasėlis atsinaujinus vegetacijai 2004 05 05 d. (tradicinė technologija)

Žieminio rapso pasėlis atsinaujinus vegetacijai 2004 05 05 d. (beplūgė technologija)

Beplūgė **Tradicinė**

Žieminiai kviečiai

a) b) c)

Žieminių kviečių pasėlis 2004 m. pavasarį, atsinaujinus vegetacijai: a) tradicinės technologijos; b) beplūgės technologijos; c) tiesioginės sėjos technologijos.

a)

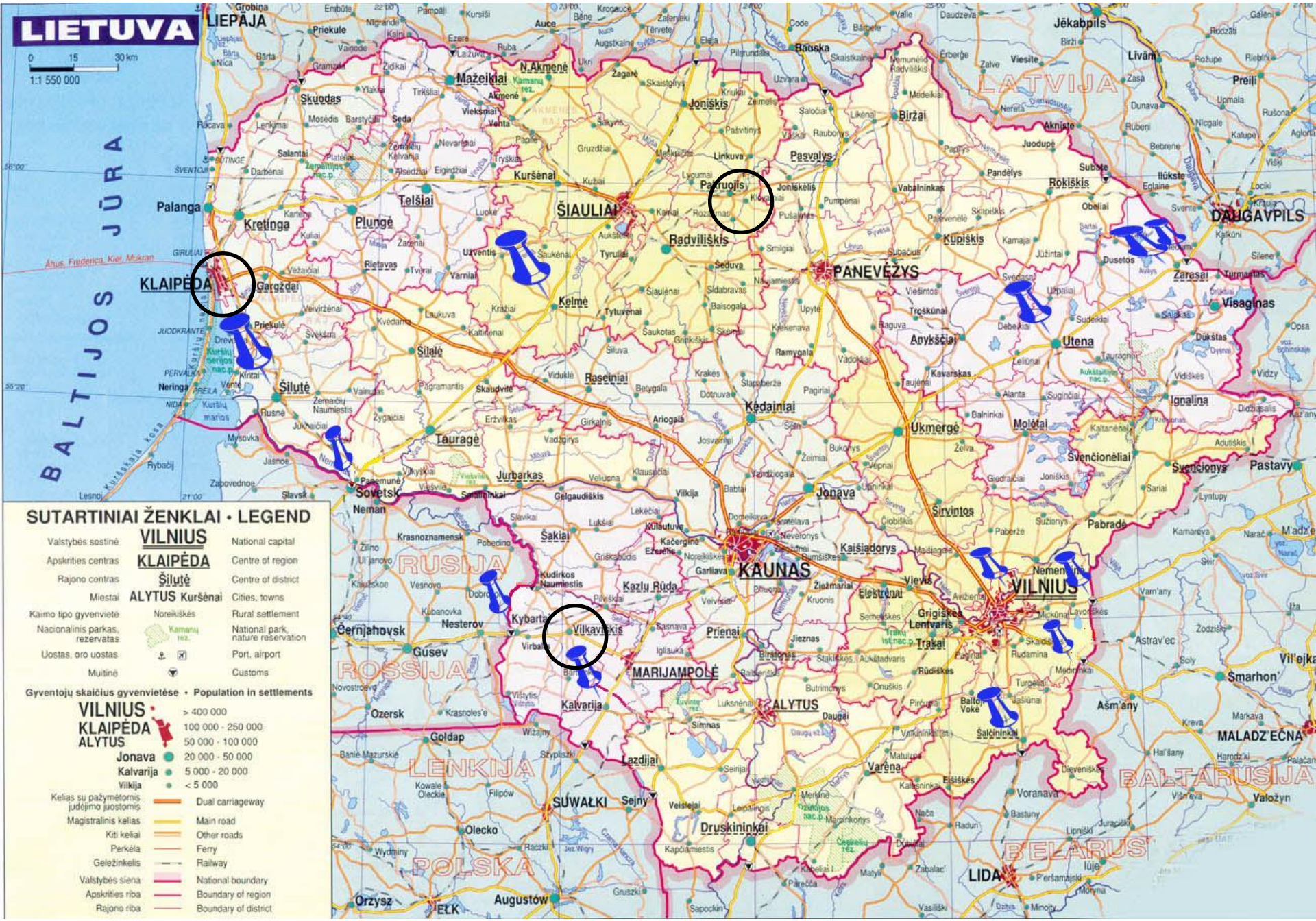
b)

c)

Žieminių kviečių pasėliai skirtingų žemės dirbimo technologijų taikymo sąlygomis: a) tradicinės; b) beplūgės; c) tiesioginės sėjos.

Agricultural company „KRETUVOS AGROSERVISAS“

2009-2010


LIETUVA
0 15 30 km
1:1 550 000
BALTIJOS JŪRA
LIEPĀJA
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PANEVĖŽYS
KAUNAS
VILNIUS
ALYTUS
MARIJAMPOLĖ
DAUGAVPILS
LATVIJA
RUSIJA
ROSSIJA
LENKIJA
POLSKA
BELARUS
BALTARUSIJA
SUTARTINIAI ŽENKLAI • LEGEND
Valstybės sostinė VILNIUS National capital
Apskrities centras KLAIPĖDA Centre of region
Rajono centras Šilutė Centre of district
Miestai ALYTUS Kuršėnai Cities, towns
Kaimo tipo gyvenvietė Noreikiškės Rural settlement
Nacionalinis parkas, rezervatas Kamanų rez. National park, nature reservation
Uostas, oro uostas Port, airport
Muitinė Customs
Gyventojų skaičius gyvenvietėse • Population in settlements
VILNIUS > 400 000
KLAIPĖDA 100 000 - 250 000
ALYTUS 50 000 - 100 000
Jonava 20 000 - 50 000
Kalvarija 5 000 - 20 000
Vilkija < 5 000
Kelias su pažymėtomis judėjimo juostomis Dual carriageway
Magistralinis kelias Main road
Kiti keliai Other roads
Perkėla Ferry
Geležinkelis Railway
Valstybės siena National boundary
Apskrities riba Boundary of region
Rajono riba Boundary of district

Disc loosener:

Subsoiler:

„AGRISEM“ drill:

- scattered sowing method;
- higher speed of process;


FORD


AGRISEM
Combiplow 47
Disc-O-Mulch n°1 mondial
AGRISEM
INTERNATIONAL


KURT
SEED
AGRISEM
INTERNATIONAL
Maximulch


KURT
SEED
AGRISEM
INTERNATIONAL
Maximulch


KURT
KURT
20 x 2500
AGRISEM
INTERNATIONAL
Maximulch

WINTER OILSEED RAPE

Vilkaviškis reg.

Pakruojis reg.

Klaipėda reg.

WINTER WHEAT

Vilkaviškis reg.

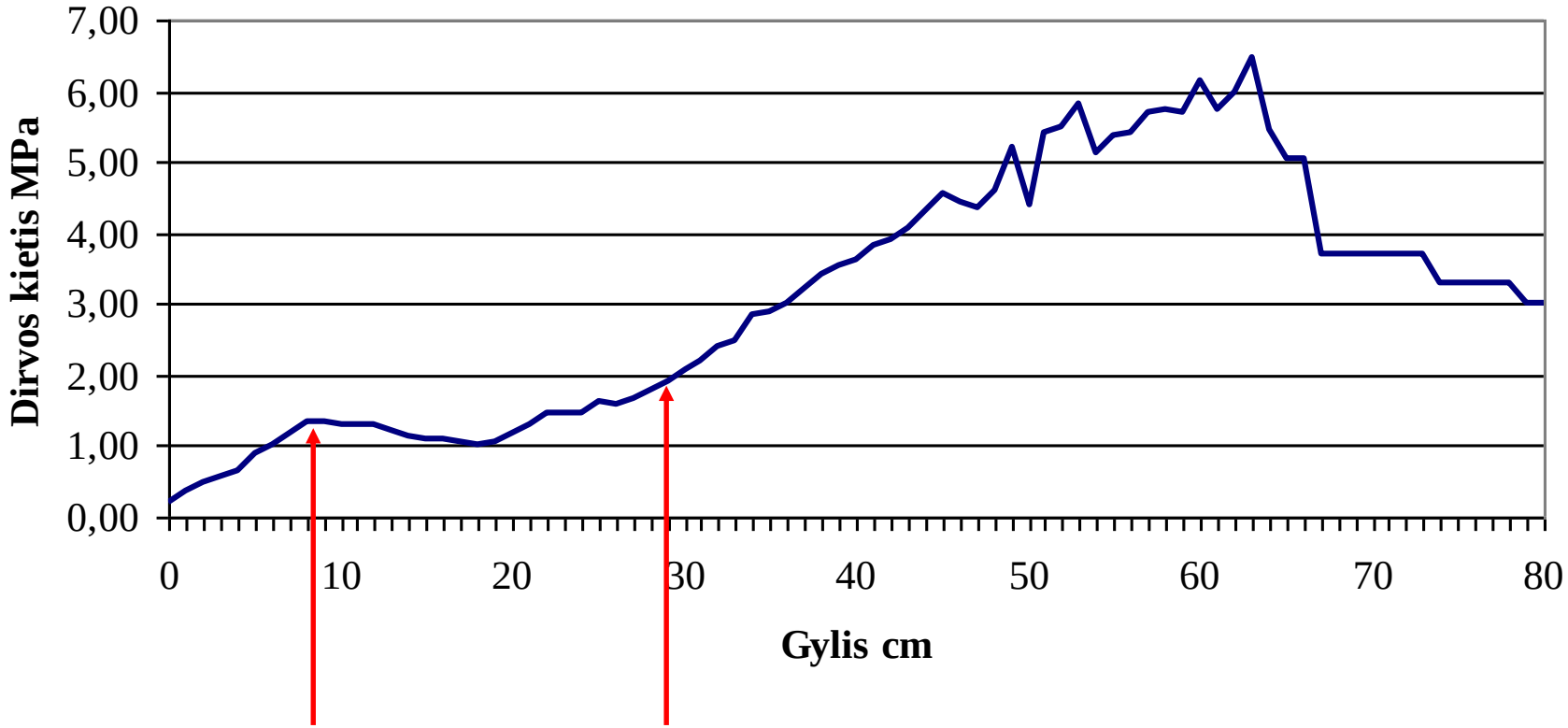
Pakruojis reg.

Klaipėda reg.

ALBINO NAVICKO ŪKIS, PAKRUOJO RAJ. 2009-2010

Žieminių rapsų sėja

“Agrisem” gilaus purenimo ir sėjos agregatas (Pakruojo r. 2009 m.)

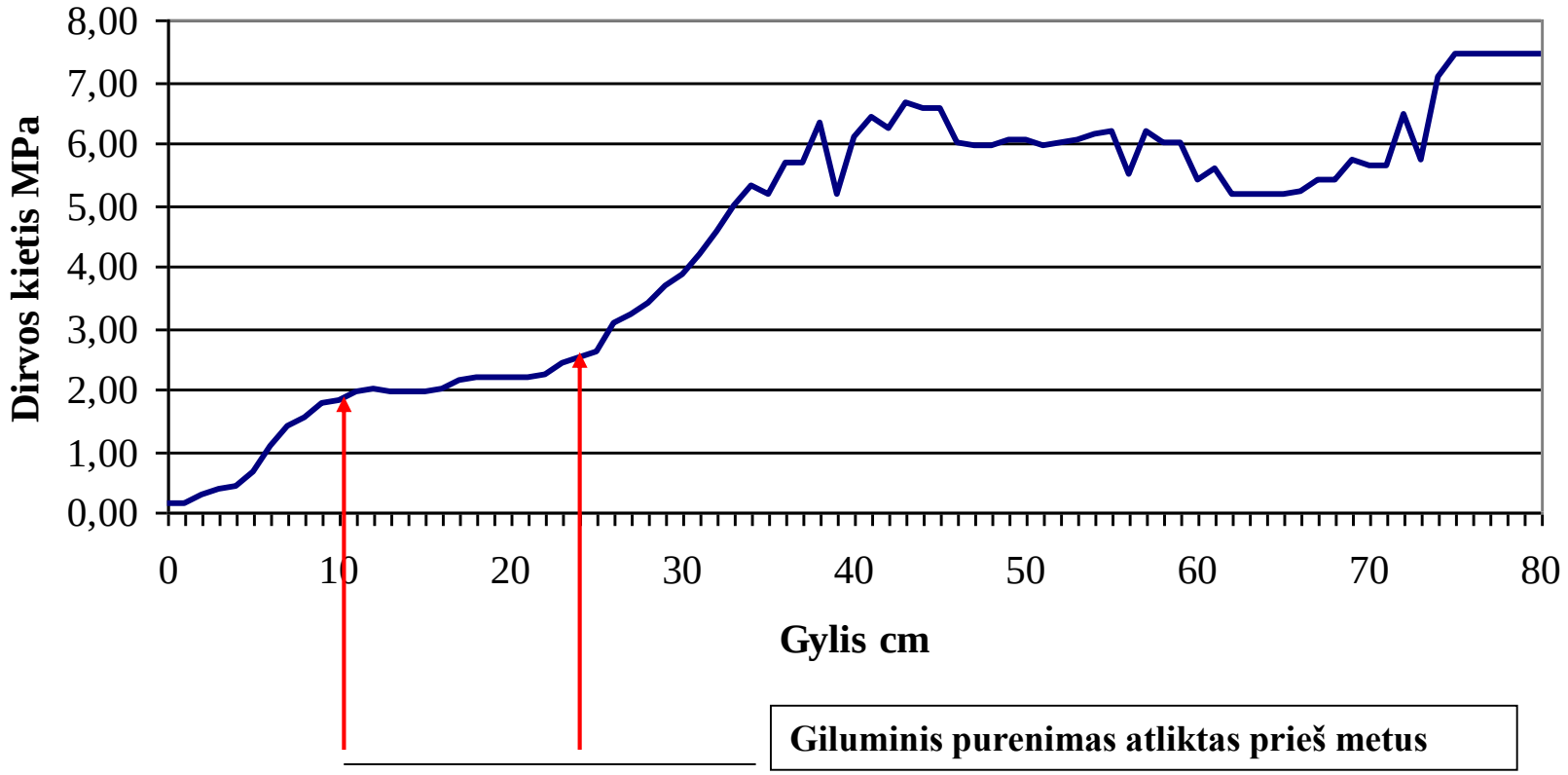


Dirvos kietis skirtingame dirvos gylyje po žieminių rapsų sėjos

Žieminių rapsų produktyvumo parametrai

Augalų skaičius kv. m	Ankštarėlių skaičius kv. m	1000 sėklų masė g	Biologinis sėklų derlius t/ha
76,8	6129	6,0	5,19

Žieminių kviečių sėja (prieš tai skusta lėkštiniu skutikl



Dirvos kietis skirtingame dirvos gylyje po žieminių kviečių sėjos

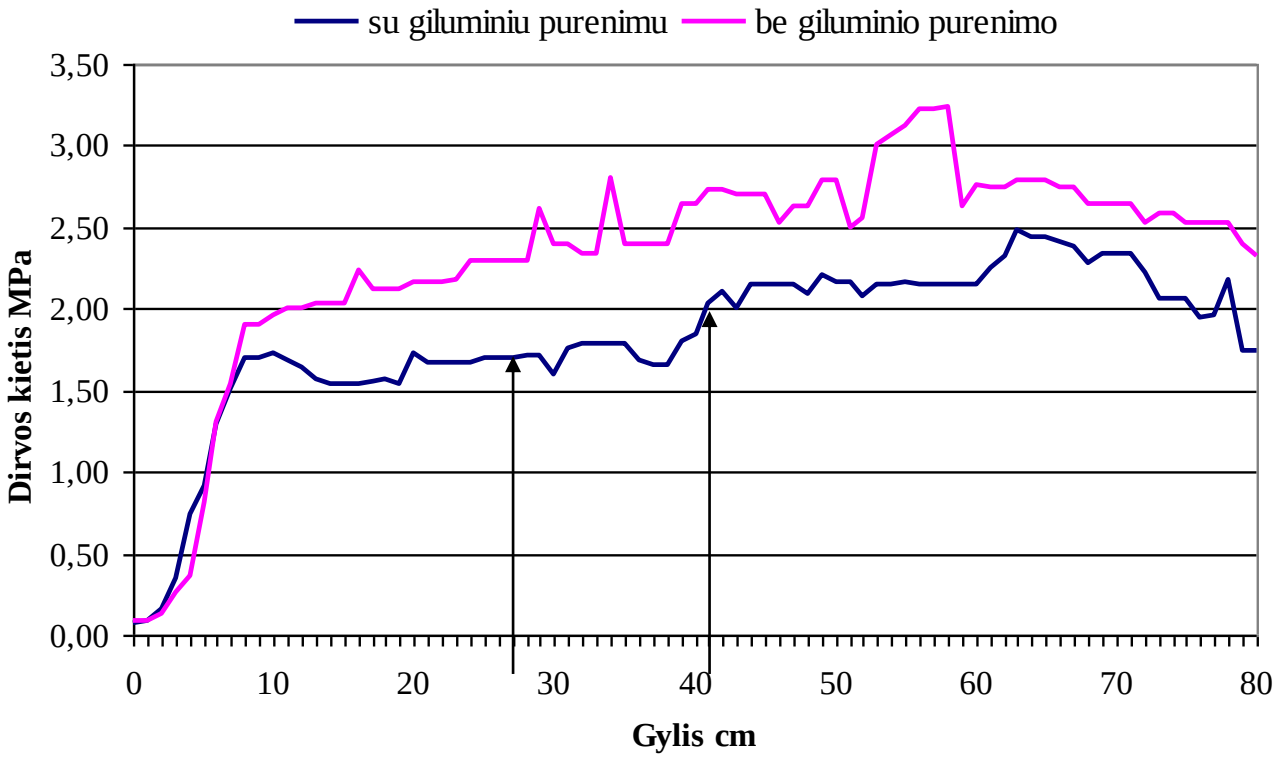
Žieminių kviečių produktyvumo parametrai

Augalų skaičius kv. m	Produktyvių stiebų skaičius kv. m	1000 sėklų masė g	Biologinis sėklų derlius t/ha
284	531	33,4	6,10

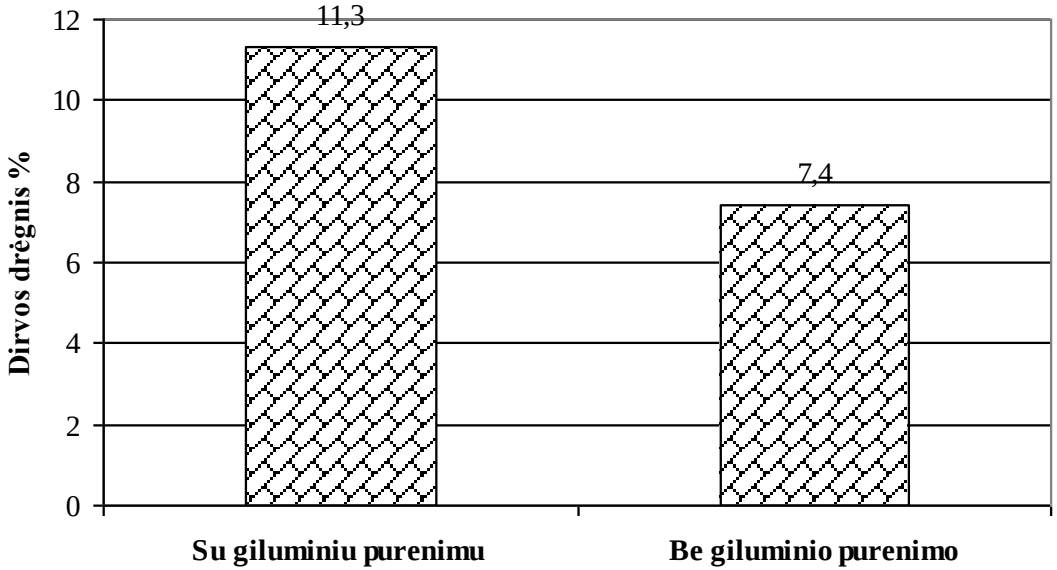
I. BITINO ŪKIS, KLAIPĖDOS RAJ., PLIKIAI , 2009-2010

Žieminio rapso sėja

„Agrisem“ sėjamoji (Klaipėdos r., 2009 m)



Giluminio dirvos purenimo įtaka dirvos kiečiui

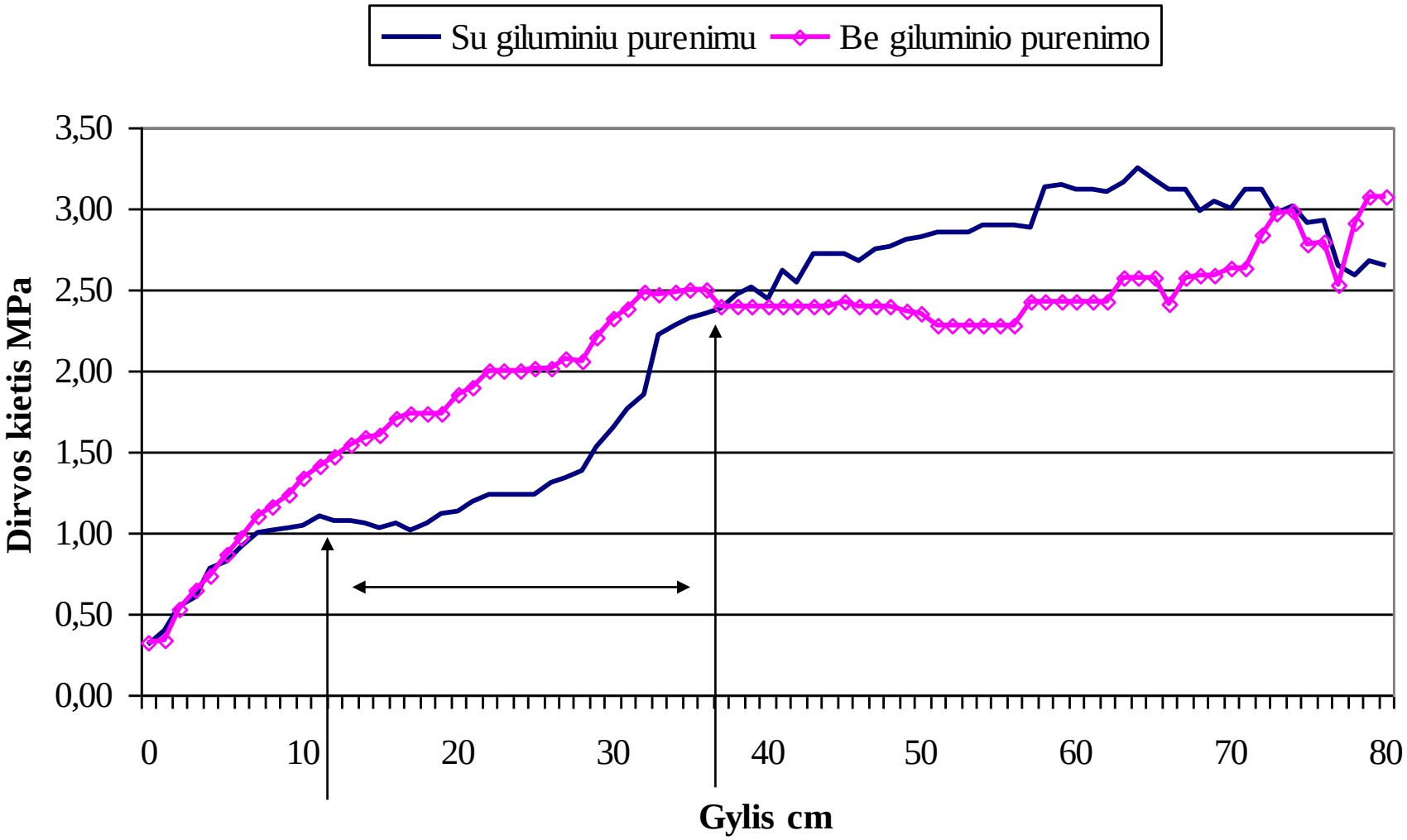


Giluminio dirvos purenimo įtaka dirvos drėgniui 0-5 cm gylyje

Žieminių rapsų produktyvumo parametrai

Augalų skaičius kv. m	Ankštarėlių skaičius kv. m	1000 sėklų masė g	Biologinis sėklų derlius t/ha
143	3921	5,2	5,14

Žieminių kviečių sėja



Dirvos kietis po žieminių kviečių sėjos (Klaipėjos raj., 2009)

Žieminių kviečių produktyvumo parametrai

Augalų skaičius kv. m	Produktyvių stiebų skaičius kv. m	1000 sėklų masė g	Biologinis sėklų derlius t/ha
381	511	44,0	7,09

2010 metų žieminių rapsų sėja

Skusta + giliai purenta + pakrikai sėta

Giliai purenta + pakrikai sėta


2011 m. pavasaris
Vilkaviškio raj.


skusta
arta


Ačiū už dėmesį