

Chapter 1. CROP AND SOIL MANAGMENT

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THE INFLUENCE OF REDUCED SPRING TILLAGE ON SOIL PROPERTIES, CROP YIELD AND PROFITABILITY IN A ROTATION

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Abstract

The goal of this research was to evaluate different reduced spring tillage methods on yielding capacity of spring sown crops, soil physical and chemical properties and to evaluate the profitability of reduced tillage methods investigated.

The field experiment was set up at the Lithuanian Institute of Agriculture in 2003-2005. Spring barley, spring oil-seed rape and spring wheat were grown. Five soil tillage systems were investigated in the field trial: 1. Shallow spring-time ploughing (15-17 cm depth) with a mouldboard reversible plough in combination with a compactor. Shallow cultivation for seed bed preparation. Sowing with a seed shank drill. Rolling after sowing with a heavy ring roller. 2. Shallow spring-time ploughing (15-17 cm depth) with a mouldboard reversible plough in combination with a compactor. Shallow cultivation for seed bed preparation. Sowing with seed drill with disc coulters in combination with a heavy spiked roller. 3. Shallow spring-time cultivation (5-7 cm depth) with a stubble cultivator consisting of sweep and disc coulters and spiked roller. Shallow cultivation for seed bed preparation. Sowing with a shank seed drill. Rolling after sowing with a heavy ring roller. 4. Shallow spring-time cultivation (5-7 cm depth) with a stubble cultivator consisting of sweep and disc coulters and spiked roller. Shallow cultivation for seed bed preparation. Sowing with a seed drill with disc coulters in combination with a heavy spiked roller. 5. Direct drilling with a drill with disc coulters in combination with a heavy spiked roller.

The highest penetration resistance, greatest bulk density and the least air-permeability were under direct drilling in a whole 0-20 cm soil depth. Penetration resistance under direct drilling in 2003 was higher by 20-23 %, in 2004 by 66-93 % and in 2005 by 54-169 % as compared to shallow ploughed and shallow spring-time cultivated soil. Air-permeability in direct drilled plots in 2004 was lower by 9-11 and in 2005 by 33-41 % as compared to shallow ploughed and shallow spring-time cultivated soil. The amount of phosphorus in 0-10 and 10-20 cm soil depth either in a deep ploughed or in a shallow cultivated soil was not influenced noticeably during the experimental years. By managing direct drilling in three successive years, the amount of phosphorus in soil had increased by 11 % in 0-10 cm soil depth, while in 10-20 cm soil depth the amount of phosphorus reduced by 10 %. In 10-20 cm soil depth the amount of K₂O increased by 13 % in shallow ploughed soil only.

In 2003 the highest yield of spring barley was obtained in the treatment where direct drilling was used. In 2004 a statistically significant yield increase was recorded in direct drilling

and shallow stubble cultivation + sowing treatment. The use of a seed drill with disc coulters in combination with a heavy spiked roller gave the best crop yield results. In 2005 direct drilling resulted in a lower grain yield by 1.95 t ha⁻¹ or 33 % compared to the yields in the ploughed and cultivated plots. The best results for economical effectiveness of crop production were obtained when shallow ploughing and/or shallow stubble cultivation in combination with a disc seed drill had been used.

Key words: spring-time tillage, soil properties, barley, oil-seed rape, wheat, yield, profitability.

Introduction

The research on different reduced tillage systems has been carried out all over the world for many decades. The real interest in reduced tillage in Lithuania appeared during the last 10-12 years. The reason for that was that a great number of different techniques suitable for reduced tillage were made available on Lithuania's market by famous foreign companies soon after restoration of independence /Kouwenhoven et al., 2002; Feiza et al., 2004; 2005a; 2005b/.

Deep ploughing might also be replaced by shallow or by rotary tillage. This did not deteriorate soil physical properties /Šimanskaitė, 1996; Ekeberg and Riley, 1997; Chen et al., 2005/. Numerous investigations suggest that reduced tillage application improves soil physical properties: soil structure, water infiltration, aggregate stability /Bronick, Lal, 2005/. Unfortunately, ploughless tillage causes some negative effects – an increase in bulk density and penetration resistance /Lampurlanes, Cantero-Martinez, 2003/. Some authors state that bulk density is one of the most important indices of soil physical properties /Campbell, O'Sullivan, 1991/. As time passes, the bulk density, similarly to penetration resistance, has a feature to return to its original state in spite of a tillage method used /Ferrerias et al., 2000/.

To reduce cereal production costs is very important for practical farming. Research on direct drilling carried out at the Lithuanian Institute of Agriculture revealed that the yield of winter wheat did not decrease after the first year of its application /Šimanskaitė, 2002/.

The goal of this experiment was to investigate the influence of different reduced tillage methods on soil physical properties and yield of crops grown with an intention to replace the traditional (plough tillage) system.

Materials and methods

Site and soil description. The study site is located at the Lithuanian Institute of Agriculture in Dotnuva. The field experiment was set up in 2003. The soil is an *Endocalcari - Epihypogleyic Cambisol*. Table 1 presents soil characteristics of the site.

Experimental design. The field experiment consisted of four replicates. Five soil tillage systems were investigated in the field trial set up in the spring of 2003 on an uncultivated field. Table 2 shows the tillage treatments.

Table 1. Soil characteristics of the trial at establishment
1 lentelė. Dirvožemio charakteristika įrengiant bandymą

Plough layer <i>Armens</i> <i>sluoksnis</i> cm	Bulk density <i>Tankis</i> Mg m ⁻³	Clay content <i>Dumblo</i> kiekis %	Available <i>Judrusis</i> P ₂ O ₅ mg kg ⁻¹	Available <i>Judrusis</i> K ₂ O mg kg ⁻¹	Total <i>Bendrasis</i> N %	Humus <i>Humusas</i> %	pH _{KCl}
30	1.26	25	131	252	0.132	2.24	7.2

Table 2. Experimental design
2 lentelė. Tyrimų schema

Abbreviation <i>Sutrumpinimas</i>	Design of treatments / <i>Variantas</i>
I	Spring ploughing (15-17 cm depth) with a reversible plough in combination with a compactor. Shallow seed bed preparation. Sowing with a seed shank drill. Rolling with a heavy ring roller / <i>Arimas (15-17 cm) apverčiamuoju plūgu agregate su retažiedžiais armens tankinimo volais. Prieš sėją įdirbta kombinuotu agregatu. Sėta sėjama su inkariniais noragėliais. Po sėjos voluota sunkiu volu</i>
II	Spring ploughing (15-17 cm depth) with a reversible plough in combination with a compactor. Shallow seed bed preparation. Sowing with a seed drill with disc coulters in combination with a heavy spiked roller / <i>Arimas (15-17 cm) apverčiamuoju plūgu agregate su retažiedžiais armens tankinimo volais. Prieš sėją įdirbta kombinuotu agregatu. Sėta sėjama su diskiniiais noragėliais, agregate su spygliuotais tankinimo volais</i>
III	Spring cultivation (5-7 cm depth) with a stubble cultivator consisting of sweep and disc coulters and a spiked roller. Shallow seed bed preparation. Sowing with a shank seed drill. Rolling with a heavy ring roller / <i>Skutimas (5-7 cm) skutikliu, susidedančio iš lėkštinių diskų ir plokščiapjovių noragėlių agregate su peiliniais trupinimo-lyginimo volais. Prieš sėją įdirbta kombinuotu agregatu. Sėta sėjama su inkariniais noragėliais. Po sėjos voluota sunkiuoju volu</i>
IV	Spring cultivation (5-7 cm depth) with a stubble cultivator consisting of sweep and disc coulters and a spiked roller. Shallow seed bed preparation. Sowing with a seed drill with disc coulters in combination with a heavy spiked roller / <i>Skutimas (5-7 cm) skutikliu, susidedančio iš lėkštinių diskų ir plokščiapjovių noragėlių agregate su peiliniais trupinimo-lyginimo volais. Prieš sėją įdirbta kombinuotu agregatu. Sėta sėjama su diskiniiais noragėliais, agregate su spygliuotais tankinimo volais</i>
V	Direct drilling with a drill with disc coulters in combination with a heavy spiked roller / <i>Visiškas žemės dirbimo atsisakymas. Sėta tiesiogiai į ražieną sėjama su diskiniiais noragėliais, agregate su spygliuotais tankinimo volais</i>

Crop rotation: 1) spring barley (*Hordeum vulgare* L.) cv. 'Luokė', seeding rate 4.0 mln. ha⁻¹; 2) spring oil-seed rape (*Brasica napa* L.) cv. 'Maskot', seeding rate 6.0 kg ha⁻¹; 4) spring wheat (*Triticum aestivum* L.) cv 'Zebra', seeding rate 5.5 mln. ha⁻¹.

Fertilization. During the crop rotation there were incorporated: for spring barley N₇₇₊₃₀P₂₃K₃₄, for oil seed rape N₇₀₊₆₀P₂₀K₂₅, for spring wheat N₆₀₊₃₀P₆₀K₂₄.

Statistics and methods. Analysis of variance was performed using the computer programmes ANOVA and STAT_ENG. Soil physical and chemical analyses were performed according to standardized and commonly used procedures.

Results

Tillage influence on soil physical properties. Experimental data revealed that penetration resistance (Fig. 1, Table 3) under direct drilling in a whole 0-20 cm soil depth in 2003 was higher by 23 %, in 2004 by 93 % and in 2005 by 169 % as compared to shallow ploughed plots, and higher by 20 %, 66 % and 54 % compared to spring-time shallow cultivation, respectively.

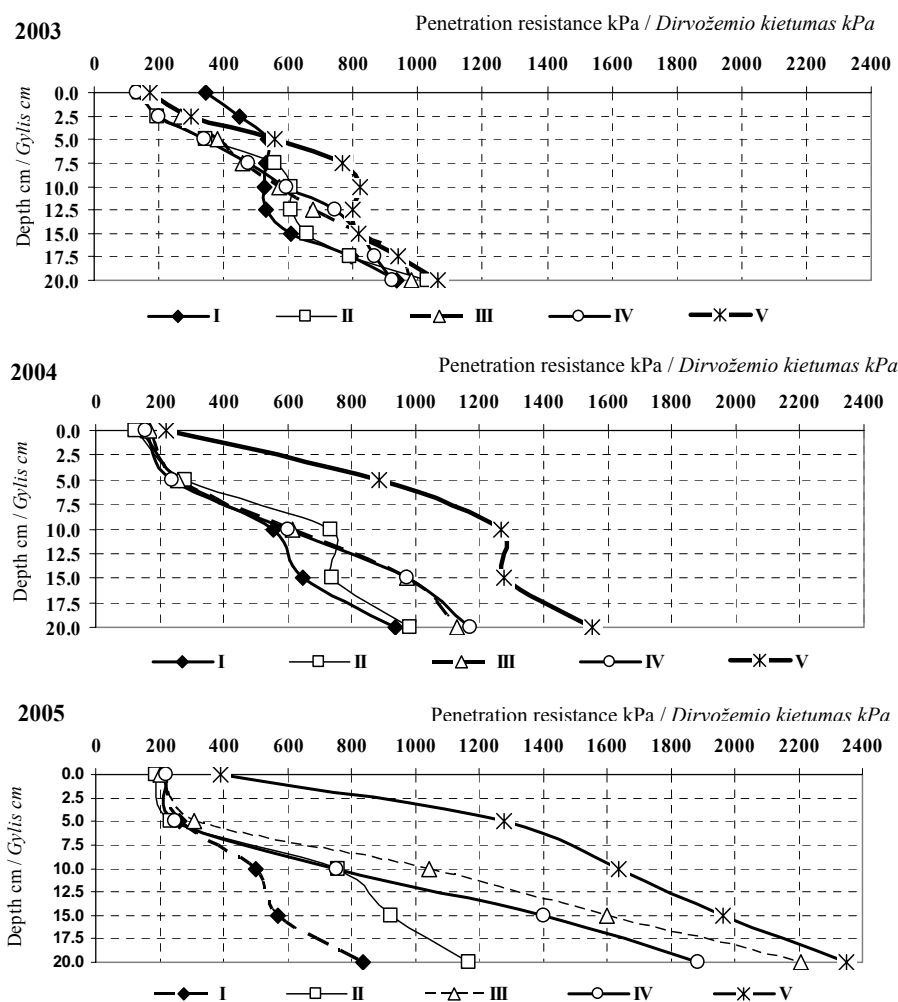


Figure 1. Soil penetration resistance after spring barley (2003), spring oil-seed rape (2004) and spring wheat (2005) sowing

1 paveikslas. Dirvožemio kietumas po vasarinių miežių (2003), vasarinių rapsų (2004) ir vasarinių kviečių (2005) sėjos

Table 3. Analysis of variance of soil penetration resistance results
3 lentelė. Dirvožemio kietumo duomenų dispersija

	2003			2004			2005		
	MS	F _{act.} F _{fakt.}	LSD ₀₅ R ₀₅	MS	F _{act.} F _{fakt.}	LSD ₀₅ R ₀₅	MS	F _{act.} F _{fakt.}	LSD ₀₅ R ₀₅
Treatments Variantai	278856	45.64**		570296	47.76**		1710803	490.25**	
Tillage (A) Žemės dirbimas (A)	116089	19.00**	23.1	1030266	86.29**	48.9	3312738	949.3**	26.9
Soil layer (B) Dirv. sluoksnis (B)	1354774	221.71**	32.6	2097136	175.64**	42.4	6589638	1888.32**	20.8
Interaction (AxB) Sąveika (AxB)	30222	4.95**	76.4	35262	2.95**	106.6	201058	57.61**	57.7
Error / Paklaida	6111			11940			3490		

Note. 2, 3, 4, 5, 6 and 7 tables: MS – mean square, F_{act.} – actual variance ratio (F-test), LSD₀₅ (least significant difference), * P ≤ 0.05 and ** P ≤ 0.01

Pastaba. 2, 3, 4, 5, 6 ir 7 lentelėse: MS – kvadratų vidurkis, F_{fakt.} – faktinis (apskaičiuotas) Fišerio kriterijus, R₀₅ – mažiausia esminio skirtumo riba, esant 0,95 tikimybei, * P ≤ 0,05 ir ** P ≤ 0,01.

Soil bulk density (Fig. 2, Table 4) in direct drilled plots remained the highest (by 4-7 %) during the crop growing period.

Table 4. Analysis of variance of soil bulk density results
4 lentelė. Dirvožemio tankio duomenų dispersija

	2003			2004			2005		
	MS	F _{act.} F _{fakt.}	LSD ₀₅ R ₀₅	MS	F _{act.} F _{fakt.}	LSD ₀₅ R ₀₅	MS	F _{act.} F _{fakt.}	LSD ₀₅ R ₀₅
Treatments Variantai	0.05	5.58**		0.03	2.93**		0.04	3.7**	
Tillage (A) Žemės dirbimas (A)	0.03	3.52*	0.041	0.04	3.5*	0.048	0.03	2.56*	0.050
Soil layer (B) Dirv. sluoksnis (B)	0.19	23.02**	0.036	0.13	11.41**	0.042	0.21	17.78**	0.039
Interaction (AxB) Sąveika (AxB)	0.02	1.91	0.089	0.01	0.62	0.152	0.02	1.26	0.107
Error / Paklaida	0.01			0.01			0.01		

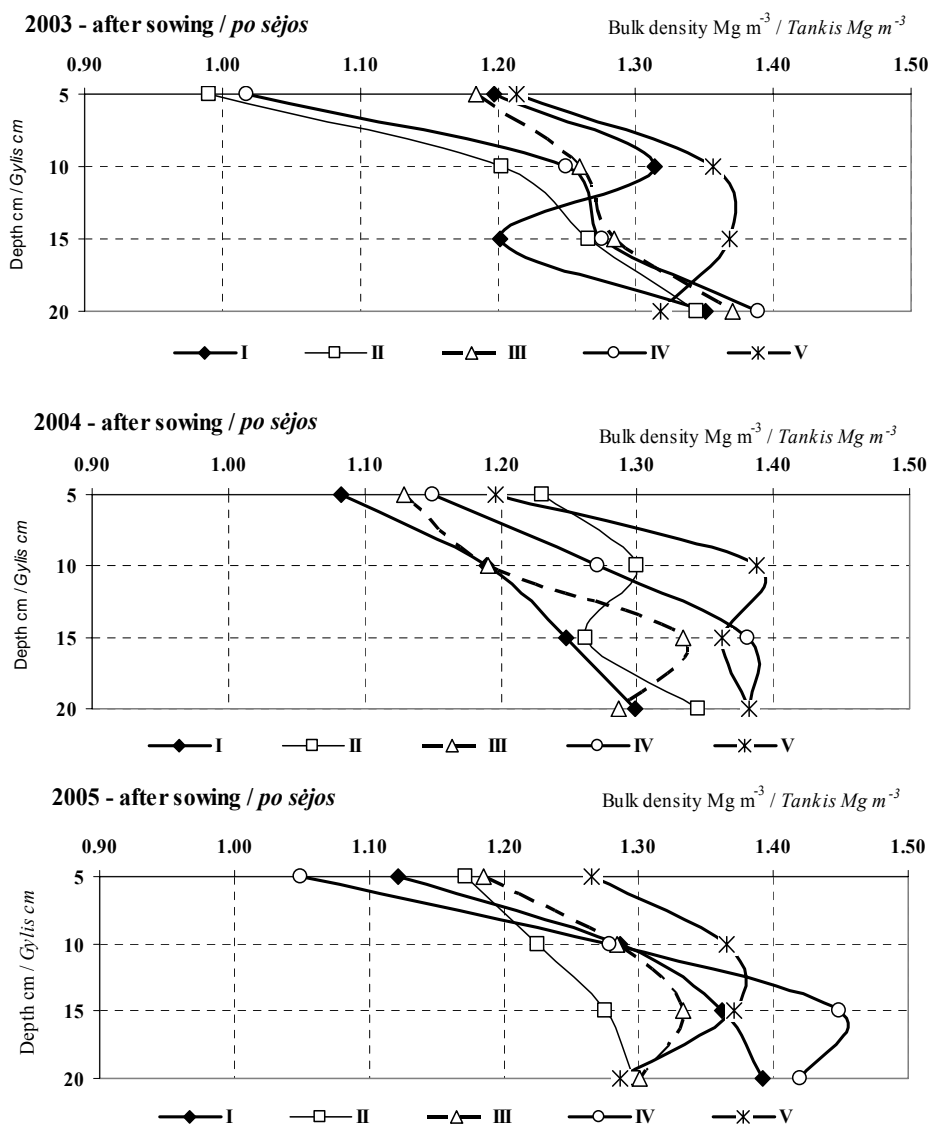


Figure 2. Soil bulk density after spring barley (2003), spring oil-seed rape (2004) and spring wheat (2005) sowing

2 paveikslas. Dirvožemio tankis po vasarinių miežių (2003), vasarinių rapsų (2004) bei vasarinių kviečių (2005) sėjós

Air-permeability (Fig. 3, Table 5) in direct drilled plots at 0-10 cm soil depth in 2004 was lower by 11 % and in 2005 by 41 % as compared to shallow ploughed plots and lower by 9 % and 33 % as compared to spring-time shallow cultivation, respectively. In shallow stubble cultivated plots penetration resistance was lower than in

the direct drilled plots, but higher than in the shallow ploughed ones. Shallow stubble cultivation reduced air-permeability in 5-10 and 10-15 cm soil depth as compared to shallow ploughing.

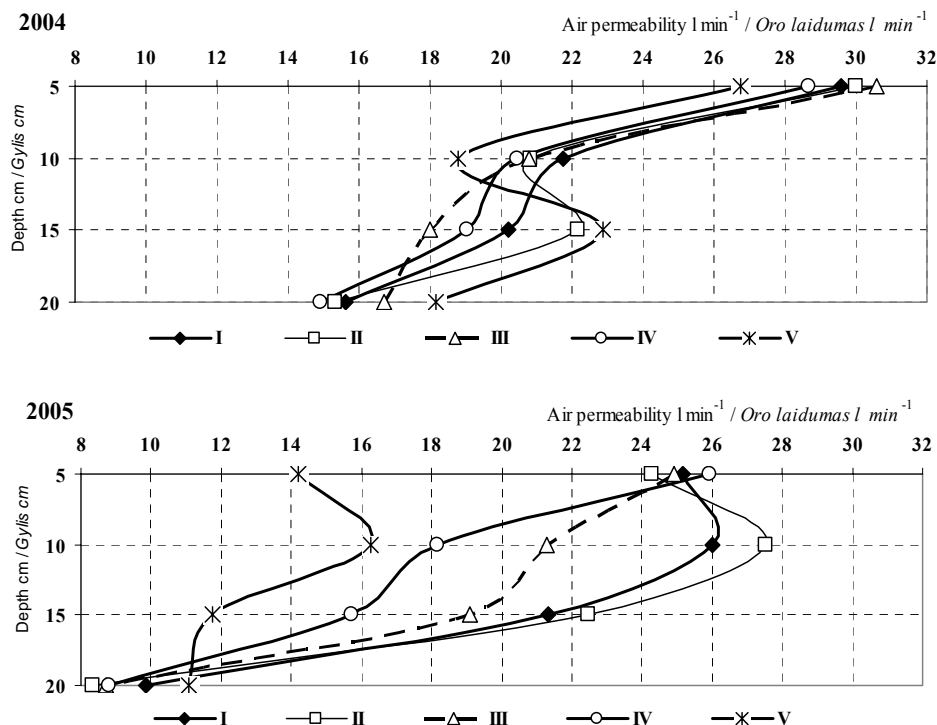


Figure 3. Soil air-permeability after spring oil-seed rape (2004) and spring wheat (2005) sowing

3 paveikslas. Dirvožemio oro laidumas po vasarinių rapsų (2004) bei vasarinių kviečių (2005) sėjos

Table 5. Analysis of variance of soil air-permeability results

5 lentelė. Dirvožemio oro laidumo duomenų dispersija

	2004			2005		
	MS	F _{act.} F _{fakt.}	LSD ₀₅ R ₀₅	MS	F _{act.} F _{fakt.}	LSD ₀₅ R ₀₅
Treatments / Variantai	101.2	2.43**		169.5	10.38**	
Tillage (A) / Žemės dirbimas (A)	2.5	0.06	2.887	138.5	8.48**	1.840
Soil layer (B) / Dirv. sluoksnis (B)	585.9	14.09**	2.501	900.5	55.16**	1.425
Interaction (AxB) / Sąveika (AxB)	12.9	0.31	6.293	33.7	2.06*	3.945
Error / Paklaida	41.6			16.3		

Disc seed drill combined with a heavy spiked roller was responsible for a greater penetration resistance and a higher bulk density in 0-5 cm soil depth in shallow ploughed or cultivated plots as compared to the action on soil properties of the shank seed drill and

followed by rolling with a heavy ring roller. The use of the disc drill was successful both on shallow ploughed (to 15-17 cm depth) and on shallow stubble cultivated (to 5-7 cm depth) land.

Tillage influence on soil chemical properties. The amount of phosphorus in 0-10 and 10-20 cm soil depth either in deep ploughed or in shallow cultivated soil was not influenced noticeably (Fig 4, Table 6). By managing direct drilling in three successive years the amount of phosphorus in soil increased by 11 % in 0-10 cm soil depth, while in 10-20 cm soil depth the amount of phosphorus reduced by 10 %.

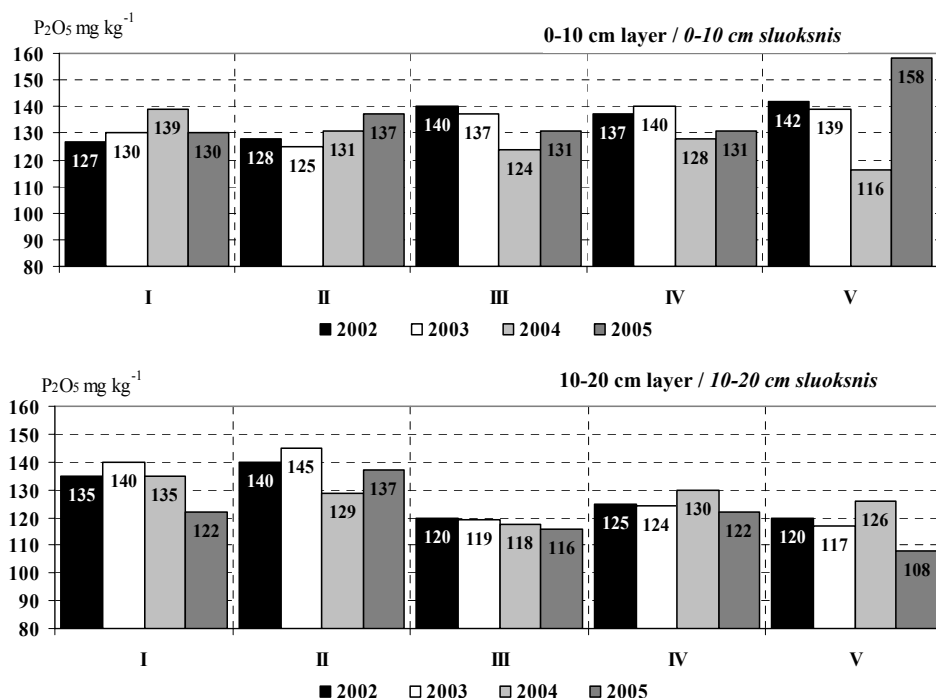


Figure 4. Soil phosphorus content in the different layers, 2002-2005
4 paveikslas. Fosforingumas skirtinguose dirvožemio sluoksniuose 2002-2005 m.

Table 6. Analysis of variance of soil phosphorus content results
6 lentelė. Dirvožemio fosforingumo duomenų dispersija

	2003			2004			2005		
	MS	F _{act.} F _{fakt.}	LSD ₀₅ R ₀₅	MS	F _{act.} F _{fakt.}	LSD ₀₅ R ₀₅	MS	F _{act.} F _{fakt.}	LSD ₀₅ R ₀₅
Treatments Variantai	869	2.74*		272	3.89**		455	9.77**	
Tillage (A) Žemės dirbimas (A)	201	0.63	18.3	508	7.25**	10.1	134	2.88*	7.0
Soil layer (B) Dirv. sluoksnis (B)	20	0.06	11.6	5	0.07	6.4	1778	38.14**	4.4
Interaction (AxB) Sąveika (AxB)	1749	5.51**	25.8	104	1.48	14.3	445	9.56**	9.9
Error / Paklaida	317			70			47		

The amount of potassium in the shallow ploughed plots increased by 18 % in 0-10 cm soil depth (Fig. 5, Table 7). For shallow cultivation and direct drilling this index was 10 and 12 %, respectively. In 10-20 cm soil depth the amount K₂O increased by 13 % only in shallow ploughed soil. In shallow cultivated soil it remained unchanged, while in direct drilling plots it reduced by 17 %.

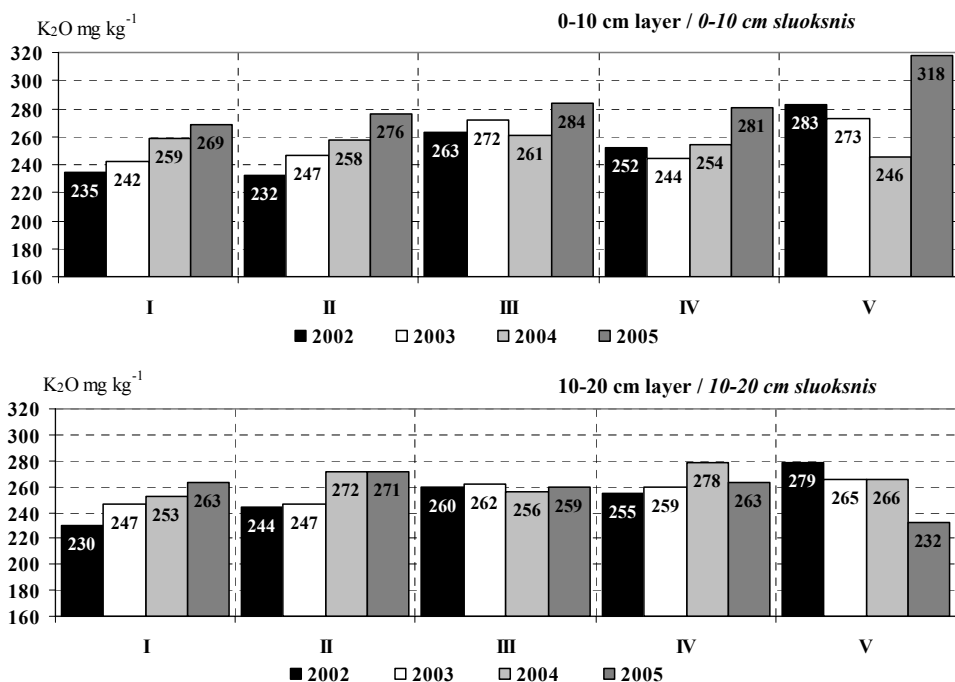


Figure 5. Soil potassium content in the different layers, 2002-2005
5 paveikslas. Kalio kiekis skirtinguose dirvožemio sluoksniuose 2002-2005 m.

Table 7. Analysis of variance of soil potassium content results
7 lentelė. Dirvožemio kalingumo duomenų dispersija

	2003			2004			2005		
	MS	F _{act.} F _{fakt.}	LSD ₀₅ R ₀₅	MS	F _{act.} F _{fakt.}	LSD ₀₅ R ₀₅	MS	F _{act.} F _{fakt.}	LSD ₀₅ R ₀₅
Treatments Variantai	1972	5.04**		1187	0.80		2751	2.65*	
Tillage (A) Žemės dirbimas (A)	3616	9.25**	20.3	1098	0.74	46.7	1228	1.18	39.1
Soil layer (B) Dirv. sluoksnis (B)	1040	2.66	12.8	235	0.16	29.5	13739	13.24**	24.7
Interaction (AxB) Sąveika (AxB)	561	1.43	28.6	1513	1.02	66.1	1528	1.47	55.2
Error / Paklaida	391			1483			1037		

Direct drilling application in three successive years without adding of organic matter had a tendency to reduce the amount of organic carbon in 0-20 cm soil depth (Fig.6, Table 8). The amount of organic C reduced in shallow ploughed plots on average by 20 %, in shallow cultivated and in direct drilled plots by 16 and 4 %, respectively.

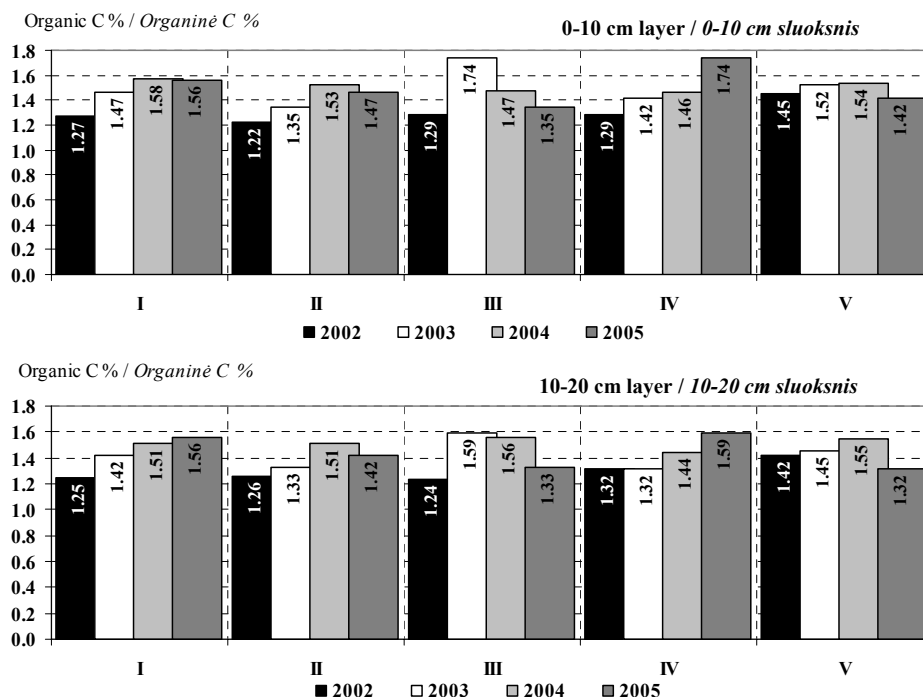


Figure 6. Soil organic carbon content in the different layers, 2002-2005
6 paveikslas. Organinė C skirtinguose dirvožemio sluoksniuose, 2002-2005 m.

Table 8. Analysis of variance of soil organic carbon results
8 lentelė. Dirvožemio organinės C duomenų dispersija

	2003			2004			2005		
	MS	F _{act.} F _{fakt.}	LSD ₀₅ R ₀₅	MS	F _{act.} F _{fakt.}	LSD ₀₅ R ₀₅	MS	F _{act.} F _{fakt.}	LSD ₀₅ R ₀₅
Treatments Variantai	0.066	1,91		0.006	0.52		0.074	3.20**	
Tillage (A) Žemės dirbimas (A)	0.130	3.74*	0.191	0.009	0.74	0.132	0.149	6.45**	0.156
Soil layer (B) Dirv. sluoksnis (B)	0.059	1.68	0.121	0.000	0.01	0.083	0.041	1.76	0.099
Interaction (AxB) Sąveika (AxB)	0.004	0.13	0.271	0.005	0.42	0.187	0.007	0.32	0.221
Error / Paklaida	0.035			0.012			0.023		

The influence of reduced spring tillage on crop yield. Spring barley (2003).
Average grain yield of barley in the trial was 3.14 t ha⁻¹ (Fig. 7). The lowest yield was registered in treatment II. The highest yield was harvested in treatment V, while grain yield in treatments I and IV was marginally lower compared to yield in treatment V.

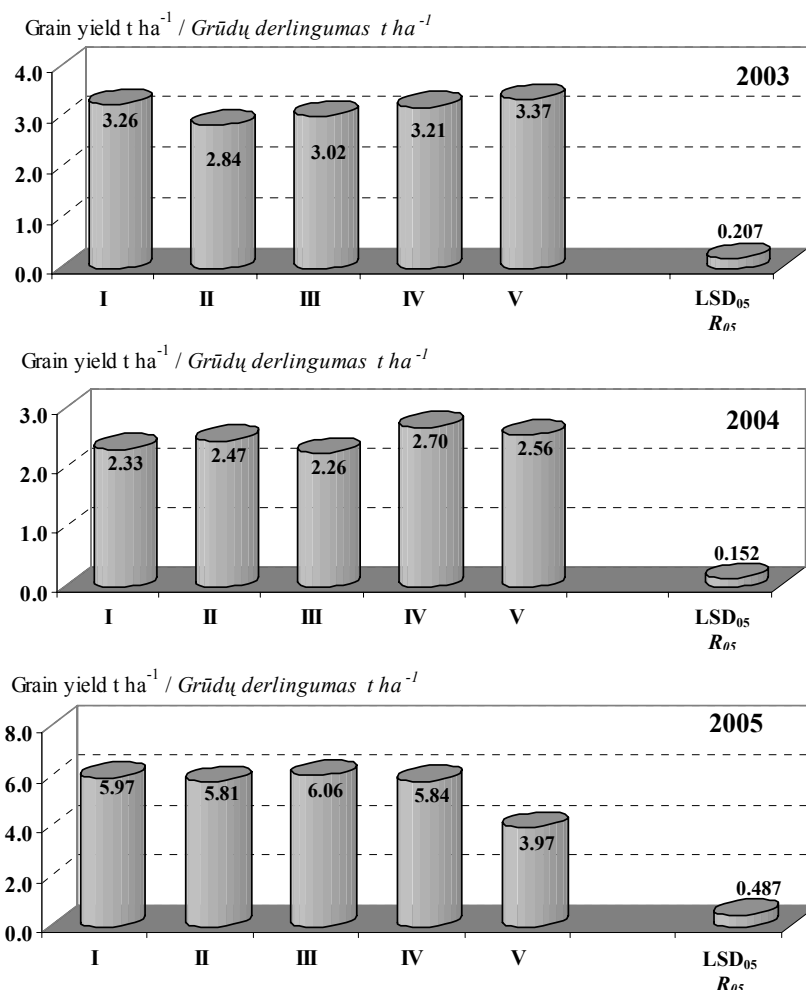


Figure 7. Spring barley grain (2003), spring oil-seed rape (2004) and spring wheat grain (2005) yield

7 paveikslas. Vasarinių miežių grūdų (2003 m.), vasarinių rapsų sėklų (2004 m.) ir vasarinių kviečių grūdų derlingumas (2005 m.)

Regression analyses revealed that an increase in soil bulk density (mean index per year) from 1.24 to 1.35 Mg m⁻³ led to an increase in grain yield from 2.84 to 3.37 t ha⁻¹ according to mathematical relationship $y = a + bx - cx^2$ ($R^2 = 0.67^{**}$). The influence of soil penetration resistance on grain yield was not statistically significant.

Spring oil-seed rape. Average yield of oil-seed rape in the trial was 2.46 t ha^{-1} (Fig. 7). The lowest seed yield was registered in treatment III. The highest yield was produced after application of tillage measures in treatment IV and also after application of direct drilling (V). The data showed that seed yield in treatment IV was by 15 % higher and in treatment V by 9 % higher compared to the yield in treatments I-III.

Dry weather conditions revealed the influence of tillage and seeding machinery on seed yield. In 2004 the use of disc drill caused a better and more qualitative incorporation of rape seed into the soil. Better seed yields in treatments II and IV demonstrate this fact. Use of disc drill for direct drilling led to similar seed yield compared to the yields in treatments II and IV, and to 10-13% higher yield compared to the yields in treatments I and III. The influence of soil physical properties on seed yield was not statistically significant.

Spring wheat. Average grain yield of wheat in the trial was 5.59 t ha^{-1} (Fig. 7). There were no significant differences among the yields in treatments I-IV, while direct drilling (V) led to lower grain yield by 1.95 t ha^{-1} or 33 % compared to the yields in treatments I-IV.

Tillage influenced soil physical properties. No tillage led to impairment of soil physical indices. Nevertheless, the influence of soil physical properties on grain yield was not statistically significant. However, impairment of soil physical properties (increase in bulk density and penetration resistance, and decrease in soil air-permeability) tended to decrease spring wheat grain yield. The lowest grain yield in treatment V (direct drilling) indicated this fact.

The influence of soil chemical properties on crop yields in different tillage treatments was not statistically significant.

Profitability. Grain yield of spring barley in the trial amounted to 3.4 t ha^{-1} and expenditures in different treatments totalled from 1097.78 to $1285.78 \text{ Lt ha}^{-1}$, the prime expenditures were not lower than 325.75 Lt t^{-1} , thus the profit was not reached (Fig. 8).

Seed yield of spring oil-seed rape varied from 1.56 to 2.00 t ha^{-1} . Prime expenditures were high 681.46 - $913.65 \text{ Lt ha}^{-1}$. In all treatments the profit was negative, while the least loss was registered in direct drilled treatment. In this treatment profitability was 5 %, while in the rest of the treatments it was 14-41 %. The profitability would be reached, if the yield of oil-seed rape amounted to 2.3 t ha^{-1} in shallow tilled treatments and 2.0 t ha^{-1} in direct drilled treatment.

In 2005 the highest grain yield of spring wheat was 6.06 t ha^{-1} . Expenditures in treatments were very similar and amounted to $1409.35 - 1428.35 \text{ Lt ha}^{-1}$.

Growing of spring wheat was profitable in I-IV treatments. Net profit varied from 461.63 to $540.37 \text{ Lt ha}^{-1}$, and one litas produced 0.32 - $0.38 \text{ Lt net return}$.

Effectiveness of production when applying shallow ploughing or shallow cultivation did not differ. One litas produced on average $0.35 \text{ Lt net return}$.

The best results for effectiveness of production were obtained when shallow ploughing and shallow cultivation in combination with a disc seed drill had been used.

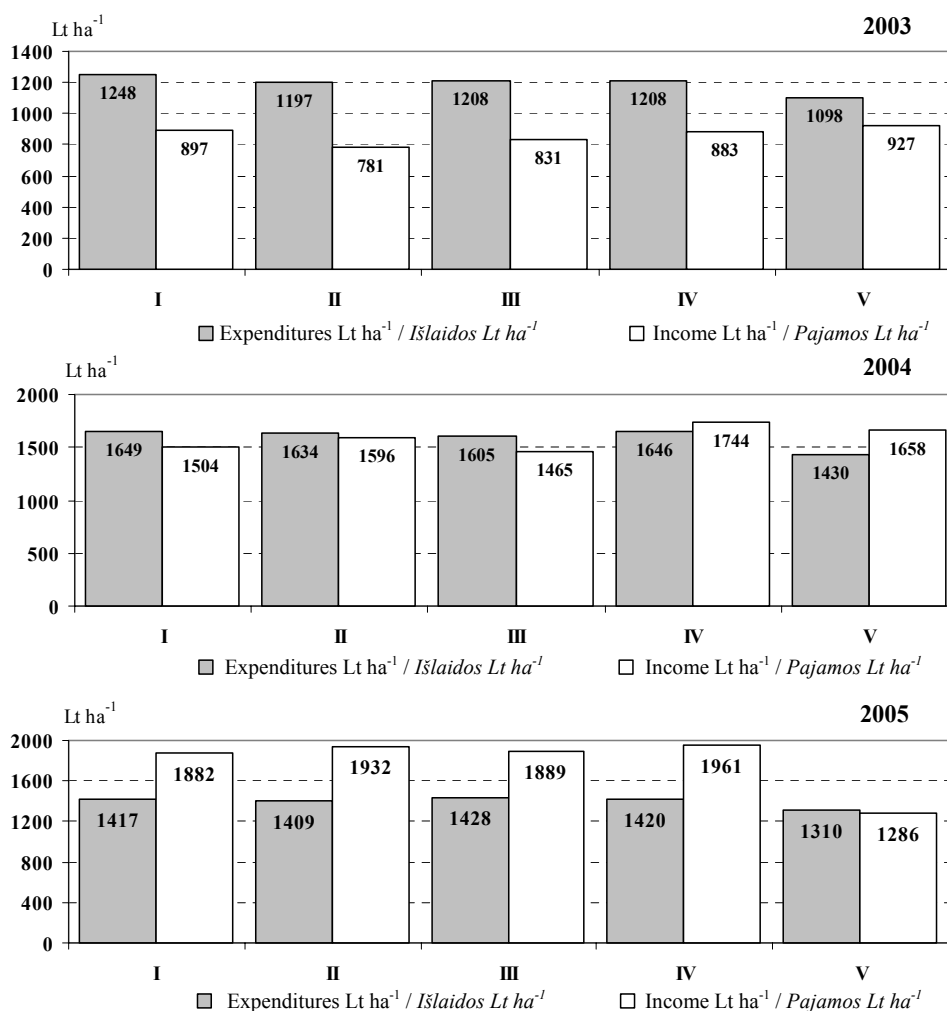


Figure 8. Profitability of different methods of spring-time ploughless tillage when growing spring barley (2003), spring oil seed rape (2004) and spring wheat (2005) **8 paveikslas.** Skirtingų pavasarinio žemės dirbimo būdų pelningumas, auginant vasarinius miežius (2003), vasarinius rapsus (2004) ir vasarinius kviečius (2005)

Conclusions

1. The highest penetration resistance, greatest bulk density and the least air-permeability were under direct drilling in a whole 0-20 cm soil depth. Penetration resistance under direct drilling in 2003 was higher by 20-23 %, in 2004 by 66-93 % and in 2005 by 54-169 % as compared to shallow ploughed and shallow spring-time cultivated plots. Air-permeability in direct drilled plots in 2004 was lower by 9-11 and in 2005 by 33-41 % as compared to shallow ploughed and shallow spring-time cultivated plots.

2. The amount of phosphorus in 0-10 and 10-20 cm soil depth both in deep ploughed or shallow cultivated soil was not influenced noticeably. When applying direct drilling in three successive years the amount of phosphorus in the soil increased by 11 % in 0-10 cm soil depth, while in 10-20 cm soil depth the amount of phosphorus reduced by 10 %. The amount of potassium in shallow ploughed plots increased by 18 % in 0-10 cm soil depth. For shallow cultivation and direct drilling this index was 10 and 12 %, respectively. In 10-20 cm soil depth the amount K_2O increased by 13 % only in shallow ploughed soil. In shallow cultivated soil it remained unchanged, while in direct drilling plots it reduced by 17 %.

3. In 2003 the best yield of spring barley was obtained in the treatment where direct drilling had been applied. In 2004 statistically significant yield increase of oil seed-rape was registered in direct drilling and shallow stubble cultivation + sowing treatments. The yield increase was 10 % and 15 %, respectively as compared to shallow spring ploughing. A seed drill with disc coulters in combination with a heavy spiked roller produced the best results. The same drill was also suitable for direct drilling of oil-seed rape. In 2005 direct drilling led to lower grain yield by 1.95 t ha⁻¹ or 33 % compared to the yields in the ploughed and cultivated plots.

4. The best results for economical effectiveness of production were obtained when shallow ploughing or shallow cultivation in combination with a seed drill with disc coulters in combination with heavy spiked roller had been used.

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SUPAPRASTINTO PAVASARINIO ŽEMĖS DIRBIMO ĮTAKA DIRVOŽEMIO SAVYBĖMS, AUGALŲ DERLINGUMUI IR RENTABILUMUI SĖJOMAINOJE

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Santrauka

Tyrimų tikslas – nustatyti skirtingų pavasarinio supaprastinto žemės dirbimo būdų įtaką sėjomainos augalų derlingumui, fizikinėms ir agrocheminėms dirvožemio savybėms bei išaugintos produkcijos rentabilumui.

Tyrimai daryti Lietuvos žemdirbystės institute 2003-2005 metais. Auginti vasariniai miežiai, vasariniai rapsai ir vasariniai kviečiai. Tirta: 1. Seklus (15-17 cm gyliu) dirvos arimas apverčiamuoju plūgu agreguojant su retažiedžiais (arimo tankinimo) volais. Prieš sėją įdirbta kombinuotu priešsėjiniu agregatu. Sėta sėjama su inkariniais noragėliais. Po sėjos voluota sunkiu volu. 2. Seklus (15-17 cm gyliu) dirvos arimas apverčiamuoju plūgu agreguojant su retažiedžiais (arimo tankinimo) volais. Prieš sėją įdirbta kombinuotu priešsėjiniu agregatu. Sėta sėjama su diskinais noragėliais, agreguojant su sunkiais spygliuotais tankinimo volais. 3. Seklus (5-7 cm gyliu) dirvos skutimas ražienų skutikliu, susidedančio iš lėkštinių diskų ir plokščiapjovių darbinių noragėlių agreguojant su peilinais trupinimo-lyginimo volais. Prieš sėją įdirbta kombinuotu priešsėjiniu agregatu. Sėta sėjama su inkariniais noragėliais. Po sėjos voluota sunkiu volu. 4. Seklus (5-7 cm gyliu) dirvos skutimas ražienų skutikliu, susidedančio iš lėkštinių diskų ir plokščiapjovių darbinių noragėlių agreguojant su peilinais trupinimo-lyginimo

volais. Prieš sėją įdirbta kombinuotu priešsėjiniu agregatu. Sėta sėjama su diskiniiais noragėliais, agreguojant su sunkiais spygliuotais tankinimo volais. 5. Visiškas žemės dirbimo atsisakymas. Sėta tiesiog į ražieną sėjama su diskiniiais noragėliais, aggregate su sunkiais spygliuotais tankinimo volais.

Didžiausias dirvožemio kietumas ir tankis bei mažiausias oro laidumas nustatyti 0-20 cm dirvožemio sluoksnyje sėjant augalus tiesiai į nepurentą dirvą. Dirvožemio kietumas, sėjant tiesiog į ražieną, 2003 m. buvo 20-23 %, 2004 m. 66-93 %, 2005 m. 54-169 % didesnis, o oro laidumas, sėjant tiesiog į ražieną, 2004 m. buvo 9-11 %, 2005 m. 33-41 % mažesnis, nei artuose ar skustuose laukuose.

Fosforo kiekio pokyčiai 0-10 ir 10-20 cm dirvožemio sluoksnyje ar giliai ariant, ar sekliai skutant dirvą, buvo nežymūs per tyrimų laikotarpį. Sėjant augalus tiesiai į nepurentą dirvą, fosforo kiekis dirvožemio 0-10 cm sluoksnyje padidėjo 11 %, o 10-20 cm dirvožemio sluoksnyje – sumažėjo 10 %. Kalio kiekis 10-20 cm dirvožemio sluoksnyje padidėjo 13 %, kai dirva buvo sekliai purenta.

2003 metais didžiausias miežių grūdų derlingumas užaugintas sėjant juos tiesiai į nepurentą dirvą. 2004 metais statistiškai patikimai didžiausias vasarinių rapsų sėklų derlingumas nustatytas sekliai skutant dirvą ir sėjant augalus sėjama su diskiniiais noragėliais, agreguojant su tankinimo volais. 2005 metais sėjant tiesiog į ražieną vasarinių kviečių derlingumas buvo 1,95 t ha⁻¹, arba 33 % mažesnis, nei artuose ar skustuose laukuose.

Ekonomiškiausia buvo dirvą sekliai pavasarį arti arba sekliai ją skusti bei sėti sėjama su diskiniiais noragėliais.

Reikšminiai žodžiai: pavasarinis žemės dirbimas, dirvožemio savybės, vasariniai miežiai, vasariniai rapsai, vasariniai kviečiai, rentabilumas.

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