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THE IMPACT OF EVERY FOUR YEARS PK FERTILIZER APPLICATION ON THE CROP ROTATION PRODUCTIVITY AND ECONOMY

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Abstract

Long-term field trials were carried out at the Lithuanian Institute of Agriculture in Dotnuva (Central Lithuania) during 1971-2004 on an *Endocalcari – Endohypogleic Cambisol* (CMg-n-w-can) neutral light loam. The effect of P fertilizer application every four years and K biennially and every four years versus annual PK application was evaluated. Annual P_{45-90} K_{60-90} rates, and respectively more if applied every few years were distributed. The PK fertilizer rate intended for four years was applied for potato. Biennial K rate was applied for potato and red clover. The results of the investigated crop sequence of Norfolk crop rotation: potato, spring barley, red clover and winter wheat obtained over 1997-2000 and 2001-2004 periods are discussed. The experimental evidence suggests that agrochemical characteristics of the soil over experimental period were not subjected to significant changes and demonstrated moderate content of potassium and phosphorus. Biennial or every four years application of potassium on the background of phosphorus application every four years and nitrogen annual application did not have any significant negative effect on crop yield and soil properties. The superiority of every four year PK application was revealed while estimating crop growing costs.

Key words: Norfolk crop rotation, soil, yield, total energy.

Introduction

The basic logic of PK fertilizer application every few years from the agronomical point of view is to increase fertilizer inputs to crops of high productivity and decrease inputs to crops which give less response to PK poverty. Environmentally, such system of application helps to prevent over-application of fertilizer where response is unlikely. Trials of P and K application every few years were started in several countries in the 1960's /Gorlach et al., 1975; Säga, 1978/. On medium to high testing soils PK fertilization every 2-3 years was as effective to crops as annual. In the fertilizer recommendation schemes for K distribution the biennial application was involved /Bujnovsky, Fotyma, 2001/. K application every few years does not fit on light soils or on the soils with high potassium sorption capacity /Säga, 1978; Hrtanek, 1986/. The best overall method of fertilizing may be the biennial application of PK to maize and letting the soybeans be fertilized by the residual nutritious substances /Ebelhar et al., 2002/. Diomin /2003/ recommends distributing of K_{316} for every few year application in a four-course crop rotation.

Long-term trials designed to evaluate the effects of biennial and every four years application of PK fertilizer versus annual were initiated at the Lithuanian Institute of Agriculture in 1965. In the experiments carried out over the 1965-1971 period the optimal annual fertilizer rate of $P_{60}K_{60}$ was identified. Potato was revealed as the most responsive crop to PK application. In 1971 an experiment was started at LIA aimed at monitoring of long-term aspects of biennial and every four year potassium application versus annual in a four-course crop rotation. The Norfolk crop rotation was investigated. This rotation was recommended for intensive farming /Vasinauskas, Klimavičiūtė, 1967/. In the experiments conducted over the 1971-1994 period it was revealed that the annual fertilizer rate K_{60}, increased twice or four-times and applied to potato resulted in a higher tuber yield. An annual potassium application to spring barely and red clover, which were the second and the third crops in the rotation was generally equal to that when residual potassium was employed. The last crop of the sequence winter wheat was short of residual potassium and gave a better response to K_{60} applied annually /Mašauskas, Mašauskienė, 2005/. However, crop growing costs assessments identified the priority of every four year PK application /Mašauskas, Mašauskienė, 1996/.

The aim of this paper was to evaluate the effect of biennial and every four year PK fertilizer application in a four-course crop rotation when modern cultivars were fertilized more intensively compared with the 1971-1994 period: annual N and K rates were increased to $N_{90}K_{90}$.

Materials and methods

The experiment was carried out over the period 1971-2004 on an *Endocalcari-Endohypogleyic Cambisol* light loam. Fertilizer rates are demonstrated in Table 1. Potassium was applied in the form of potassium muriate, phosphorus in the form of monoammonium phosphate (amophos). In 1995 and 1996 a two-year break was taken during which vetch-oats mixture and spring wheat were cultivated and no fertilizers were used. In 1997 the experimental methodology was adjusted. Fertilizer rates were changed and with the aim of increasing soil fertility winter wheat straw was ploughed down and red clover harvested twice. The particular description of the materials and methods is given in the previous publication /Mašauskas, Mašauskienė, 2005/. In this paper the data of assessments of the 6^{th} (1991-1994), 7^{th} (1997-2000) and 8^{th} (2001-2004) rotations are discussed.

The data were processed and LSD_{05} was calculated by a statistical programme ANOVA /Tarakanovas, Raudonius, 2003/. F-test criterion was used. For energy balance[1] and profitability[2] evaluation the conventional factors were used. The equivalents in MJ kg^{-1} of yield dry matter for total energy evaluation were as follows: potato tubers 18.29, spring barley grain 19.13, red clover hay 18.19, winter wheat grain 19.13, straw of barley and wheat 17.54. Equivalents for energy input calculation in MJ per 1 kg of fertilizers were as follows: 86.8 for N, 12.6 for P_2O_5, 8.3 for K_2O and 51.5 for complex

[1] A. Aleksynas. Agroenergetika ir derlius. Vilnius, 1990. - 42 p.

[2] Mechanizuotų žemės ūkio paslaugų įkainiai. Lietuvos agrarinės ekonomikos institutas. I, II, III dalys. Vilnius, 2005, 90 p.

fertilizer (amophos). For agricultural profitability calculation the following price list was used (in Litas for 1 t products): 350 for potato, 302 for barley, 321 for second class wheat and 216 for dry matter of clover. The price in Litas for 1 t of fertilizer: 640 for ammonium nitrate, 940 for amophos, 650 for potassium muriate.

Table 1. Distribution of mineral fertilizers* in the rotations in the long-term experiment
1 lentelė. *Mineralinių trąšų* paskirstymas sėjomainos rotacijose ilgalaikiame bandyme*
Dotnuva, 1971-2004

Treatment *Variantas*	Potato (*Solanum tuberosum* L.) *Bulvės*	Spring barley (*Hordeum vulgare* L.) *Vasariniai miežiai*	Red clover (*Trifolium pratense* L.) *Raudonieji dobilai*	Winter wheat (*Triticum aestivum* L.) *Žieminiai kviečiai*
	1971, 1975, 1979, 1983, 1987, 1991	1972, 1976, 1980, 1984, 1988, 1992	1973,1977, 1981, 1985, 1989, 1993	1974, 1978, 1982, 1986, 1990, 1994
Control *Kontr. var.*	-	-	-	-
NP	$(N_{15}P_{60})N_{45}$	$(N_{15}P_{60})$ N_{20}	$(N_{15}P_{60})$	$(N_{15}P_{60})N_{30}$
NK	$N_{60}K_{60}$	$N_{35}K_{60}$	$N_{15}K_{60}$	$N_{45}K_{60}$
NPK	$(N_{15}P_{60})K_{60}$ N_{45}	$(N_{15}P_{60})K_{60}N_{20}$	$(N_{15}P_{60})K_{60}$	$(N_{15}P_{60})K_{60}N_{30}$
NP4	$(N_{60}P_{240})$	N_{35}	N_{15}	N_{45}
NP4K	$(N_{60}P_{240})K_{60}$	$N_{35}K_{60}$	$N_{15}K_{60}$	$N_{45}K_{60}$
NP4K2	$(N_{60}P_{240})K_{120}$	N_{35}	$N_{15}K_{120}$	N_{45}
NP4K4	$(N_{60}P_{240})K_{240}$	N_{35}	N_{15}	N_{45}
	1997	1998	1999	2000
Control *Kontr. var*	-	-	-	-
NP	$(N_{15}P_{60})N_{75}$	$(N_{15}P_{60})N_{30}$	$(N_{15}P_{60})$	$(N_{15}P_{60})N_{45}$
NK	$N_{90}K_{90}$	$N_{45}K_{90}$	$N_{15}K_{90}$	$N_{60}K_{90}$
NPK	$(N_{15}P_{60})K_{90}N_{75}$	$(N_{15}P_{60})K_{90}N_{30}$	$(N_{15}P_{60})K_{90}$	$(N_{15}P_{60})K_{90}N_{45}$
NP4	$(N_{60}P_{240})$ N_{30}	N_{45}	N_{15}	N_{60}
NP4K	$(N_{60}P_{240})K_{90}$ N_{30}	$N_{45}K_{60}$	$N_{15}K_{90}$	$N_{60}K_{90}$
NP4K2	$(N_{60}P_{240})K_{180}$ N_{30}	N_{45}	$N_{15}K_{180}$	N_{60}
NP4K4	$(N_{60}P_{240})K_{360}$ N_{30}	N_{45}	N_{15}	N_{60}
	2001	2002	2003	2004
Control *Kontr. var*	-	-	-	-
NP	$(N_{10}P_{45})$ N_{80}	$(N_{10}P_{45})$ N_{35}	$(N_{10}P_{45})$	$(N_{10}P_{45})$ $N_{50}+N_{30}$
NK	$N_{90}K_{90}$	$N_{45}K_{90}$	$N_{10}K_{90}$	$N_{60}K_{90}+N_{30}$
NPK	$(N_{10}P_{45})K_{90}N_{80}$	$(N_{10}P_{45})K_{90}N_{35}$	$(N_{10}P_{45})K_{90}$	$(N_{10}P_{45})K_{90}N_{50}+N_{30}$
NP4	$(N_{40}P_{180})$ N_{50}	N_{45}	N_{10}	$N_{60}+N_{30}$
NP4K	$(N_{40}P_{180})K_{90}$ N_{50}	$N_{45}K_{90}$	$N_{10}K_{90}$	$N_{60}K_{90}+N_{30}$
NP4K2	$(N_{40}P_{180})K_{180}$ N_{50}	N_{45}	$N_{10}K_{180}$	$N_{60}+N_{30}$
NP4K4	$(N_{40}P_{180})K_{360}$ N_{50}	N_{45}	N_{10}	$N_{60}+N_{30}$

* N nitrogen, P phosphorus (P_2O_5), K potassium (K_2O), in brackets nutritious elements in amophos
N azotas, P fosforas (P_2O_5), K kalis (K_2O), skliaustuose – mitybos medžiagos iš amofoso

Results and discussion

Chemical properties of the soil. In 1999 after the long-term phosphorus fertilizer application the active phosphorus content in soil was above medium (Table 2). The decreased content of phosphorus in the soil in 2004 was the result of decreased rate of phosphorus fertilizer over the 2001-2004 period. The content of humus, potassium and phosphorus in the soil when PK fertilizers had been applied annually was equal to that when fertilizers were applied every four years. The active forms of P and K in the soil were not subjected to significant changes. Our data are in agreement with Lipenite and Stikans /2003/ experiment where over a 17-year period the decrease in soil available potassium content by Egner-Riehm (DL) method was not identified despite the negative potassium balance.

Table 2. Humus, active phosphorus and potassium content* in the arable layer of the soil
2 lentelė. *Humuso, aktyviojo fosforo ir kalio kiekis* armenyje*
Dotnuva, 1999, 2001, 2004

Treatment *Variantas*	Humus % / *Humusas %*			P_2O_5 mg kg^{-1}			K_2O mg kg^{-1}		
	1999	2001	2004	1999	2001	2004	1999	2001	2004
Control *Kontr. var.*	2.1	2,34	2.19	152	151	141	118	135	128
NP	2.5	2.72	2.58	267	258	229	127	137	124
NK	2.2	2.55	2.41	166	153	134	120	146	145
NPK	2.3	2.28	2.32	172	236	182	122	152	136
NP4	2.1	2.64	2.46	227	223	196	109	122	124
NP4K	2.3	2.55	2.41	242	241	173	129	145	138
NP4K2	2.1	2.23	2.31	210	239	179	126	157	139
NP4K4	2.1	2.93	2.47	205	223	200	130	157	131
LSD_{05} / R_{05}	0.50	0.447	0.314	99.6	92.0	35.3	33.0	15.6	14.6

* Humus determined by Tyurin, active phosphorus and potassium by Egner-Riehm-Domingo (A-L) method
Humusas nustatytas Tiurino, aktyvieji fosforas ir kalis – Egnerio-Rimo-Domingo (A-L) metodais

Crop yield. The data suggest that in the 6th rotation the effect of $P_{240}K_{240}$ application for the potato yield which was the first crop in sequence was identical to that of $P_{60}K_{60}$ application (Table 3). After experimental methodology adjusting in the 7th and 8th rotations, the annual K_{60} rate was increased upon to K_{90}. Therefore potato which was treated with $P_{240}K_{360}$ in the 7th rotation and $P_{180}K_{360}$ in the 8th rotation produced a significantly higher yield compared with annual, respectively $P_{60}K_{90}$ or $P_{45}K_{90,}$ application. The extra yield of potato tubers of 2.9 t ha^{-1} was obtained in the 7th and 5.5 t ha^{-1} in 8th rotations. Potassium demand for potato is high. Potato uses up to 1.6 kg of phosphorus and 5.5 kg of potassium per ton of tuber yield.

No significant differences were obtained in grain yield of spring barley, the second crop in sequence, between the treatments treated with phosphorus and potassium annually and the treatments where residual PK of the four-fold rate was employed. The average yield of red clover, the third crop in the sequence, did not depend on the

Table 3. The effect of fertilization management in a four-course crop rotation on the crop yield

3 lentelė. *Trąšų paskirstymo keturių laukų sėjomainoje įtaka augalų derliui*

Dotnuva, 1991-2004

Treatment *Variantas*	6th rotation *6-oji rotacija*		7th rotation *7-oji rotacija*		8th rotation *8-oji rotacija*		7th and 8th rotation *7-oji ir 8-toji rotacijos*	
	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$
1. Potato tubers t ha^{-1} / *1. Bulvių gumbai t ha^{-1}*								
Control / *Kontr. var.*	15.9	0.61	14.6	0.44	16.6	0.91	15.6	0.44
NP	18.3	0.85	17.5	1.48	20.5	0.94	19.0	0.93
NK	22.0	1.70	20.5	0.64	24.2	0.77	22.4	0.71
NPK	24.0	0.63	19.2	0.51	26.8	0.86	23.0	0.61
NP4	19.0	1.08	15.4	0.36	19.5	1.21	17.5	0.59
NP4K	23.5	2.09	19.8	2.01	28.9	1.22	24.4	1.30
NP4K2	24.0	1.77	19.6	0.83	30.0	1.58	24.8	1.17
NP4K4	24.8	2.51	22.1	0.88	32.3	1.40	27.2	1.09
LSD_{05} / R_{05}	3.20		2.78		3.17		2.59	
2. Spring barley grain t ha^{-1} / 2. *Vasarinių miežių grūdai t ha^{-1}*								
Control / *Kontr. var.*	1.84	0.12	2.39	0.19	2.96	0.07	2.68	0.12
NP	2.85	0.20	4.33	0.15	3.65	0.24	3.99	0.93
NK	3.15	0.19	4.52	0.12	3.90	0.14	4.21	0.71
NPK	2.98	0.25	4.35	0.19	4.07	0.17	4.21	0.61
NP4	2.73	0.19	4.06	0.04	3.73	0.15	3.90	0.09
NP4K	3.08	0.17	4.55	0.11	4.05	0.02	4.30	0.06
NP4K2	2.63	0.07	3.93	0.16	3.81	0.18	3.87	0.12
NP4K4	3.06	0.25	4.25	0.25	3.92	0.13	4.08	0.19
LSD_{05} / R_{05}	0.436		0.375		0.449		0.358	
3. Red clover dry matter t ha^{-1} / *3. Raudonųjų dobilų saus. medž. t ha^{-1}*								
Control / *Kontr. var.*	2.27	0.05	5.14	0.07	3.87	0.14	4.50	0.08
NP	2.44	0.15	4.60	0.35	4.07	0.48	4.34	0.25
NK	2.62	0.18	4.58	0.27	4.20	0.25	4.39	0.25
NPK	2.72	0.12	4.69	0.30	4.91	0.25	4.80	0.14
NP4	2.68	0.12	4.71	0.14	3.70	0.10	4.20	0.11
NP4K	2.41	0.06	4.48	0.12	5.11	0.18	4.80	0.07
NP4K2	2.71	0.05	4.94	0.35	4.55	0.33	4.75	0.33
NP4K4	2.60	0.11	4.54	0.18	4.38	0.13	4.46	0.13
LSD_{05} / R_{05}	0.321		0.370		0.559		0.446	
4. Winter wheat grain t ha^{-1} / *4. Žieminių kviečių grūdai t ha^{-1}*								
Control / *Kontr. var.*	2.41	0.12	6.03	0.16	4.28	0.04	5.15	0.09
NP	3.92	0.16	7.18	0.48	6.59	0.38	6.89	0.40
NK	3.85	0.22	7.93	0.34	6.13	0.28	7.04	0.28
NPK	3.84	0.15	7.60	0.15	6.36	0.31	6.98	0.22
NP4	3.77	0.09	7.64	0.15	6.49	0.22	7.06	0.14
NP4K	4.00	0.14	7.72	0.11	6.46	0.19	7.10	0.15
NP4K2	3.56	0.17	7.59	0.19	6.26	0.11	6.93	0.15
NP4K4	3.79	0.20	7.79	0.21	6.53	0.16	7.16	0.15
LSD_{05} / R_{05}	0.466		0.715		0.679		0.260	

phosphorus and potassium distribution in the 6th, 7th and 8th crop rotations. Winter wheat was the fourth crop in the rotation which took the residual nutritious substances from the phosphorus and potassium fertilizers which had been applied for the pre-crop a year or three years before. The effect of annual potassium fertilizer application on wheat grain yield was identical to that when potassium was applied a few years before.

Summing up the long-term experimental results we came to the conclusion that in the combination with P_{240} as well as with P_{180} potassium fertilizer rates of K_{60} and K_{90}, increased twice or four times and applied directly to potato resulted in a higher tuber yield. This can be explained by the fact that dicots respond much better to K fertilizer than monocots, because of the differences in root morphology and extension. In the 7th and 8th rotation when nitrogen fertilizer rates were decreased, winter wheat straw was ploughed down and red clover cut twice, the yield of crops evidently increased. However the response of spring barley, red clover and winter wheat to the annual phosphorus and potassium fertilizer application was identical to that when four-times increased phosphorus rate and twice or four-time increased potassium rate were applied every two or four years.

Evaluation of total energy. Over 1997-2000 (7th rotation) and 2001-2004 (8th rotation) years the amount of total energy obtained from crop production in four-crop sequence tended to increase when PK application every four year versus annual PK application was treated (Table 4). The yield of potato exerted the most significant effect on the crop rotation total energy output. Therefore the measure which positively affected potato yield increased total energy output per rotation.

Table 4. Total energy calculated for crop yield in a rotation
4 lentelė. *Sėjomainos augalų derliaus bendroji energija*
Dotnuva, 1997-2004

Treatment *Variantas*	Total energy GJ ha^{-1}/ *Bendroji energija GJ ha^{-1}*							
	2001	2002	2003	2004	2001-2004		1997-2000	
	Potato tubers *Bulvių gumbai*	Barley grain and straw *Miežių grūdai ir šiaudai*	Clover two cuts *Dviejų pjūčių dobilai*	Wheat grain and straw *Kviečių grūdai ir šiaudai*	Total for four crops *Keturių narių suma*			
					GJ ha^{-1}	Relative values *Santykiniai skaičiai*	GJ ha^{-1}	Relative values *Santykiniai skaičiai*
Control *Kontr. var.*	140.4	141.5	100.5	166.2	548.6	68.9	555.4	75.8
NP	173.5	162.0	105.8	250.2	691.6	86.8	697.8	95.4
NK	204.8	175.2	109.1	238.3	727.4	91.3	760.1	103.9
NPK	226.5	186.5	127.5	256.2	796.7	100	731.5	100
NP4	164.9	168.0	96.0	252.0	680.9	85.4	688.6	94.1
NP4K	244.9	183.5	132.8	251.1	812.3	102.0	745.2	101.9
NP4K2	254.3	177.5	118.1	243.5	793.3	99.5	720.5	98.5
NP4K4	273.6	182.1	113.8	253.6	823.1	103.3	766.4	104.8
LSD_{05} / R_{05}	26.83	20.53	16.34	26.43	-	-	-	-

Higher fertilizer and energy costs cut margins for agricultural profitability. In the experiment an annual PK fertilizer application was related with higher fertilization costs compared with those when PK was applied every few years (Table 5).

Table 5. Energy costs for fertilizer and fertilization and total energy amount obtained in a four-crop rotation

5 lentelė. *Energijos sąnaudos trąšoms ir tręšimui, ir keturių laukų rotacijos derliaus bendroji energija*

Dotnuva, 1997-2000, 2001-2004

Treatment *Variantas*	1997-2000			2001-2004		
	Energy input for fertilizer and fertilization GJ ha^{-1} *Energijos sąnaudos trąšoms ir tręšimui GJ ha^{-1}*	Energy from crop rotation GJ ha^{-1} *Rotacijos augalų derliaus energija GJ ha^{-1}*	Difference in energy compared with annual NPK, GJ ha^{-1} *Energijos skirtumas, palyginus su kasmetiniu NPK GJ ha^{-1}*	Energy input for fertilizer and fertilization GJ ha^{-1} *Energijos sąnaudos trąšoms ir tręšimui GJ ha^{-1}*	Energy from crop GJ ha^{-1} *Rotacijos augalų derliaus energija GJ ha^{-1}*	Difference in energy compared with annual NPK, GJ ha^{-1} *Energijos skirtumas, palyginus su kasmetiniu NPK GJ ha^{-1}*
Control *Kontr. var.*	-	555.4	-176.1	-	548.6	-248.1
NP	21.93	697.8	-33.7	23.43	691.6	-105.1
NK	21.82	760.1	28.6	24.02	727.4	-69.3
NPK	25.28	731.5	-	26.78	796.7	-
NP4	21.74	688.6	-42.9	23.24	680.9	-115.8
NP4K	25.09	745.2	13.7	26.58	812.3	15.6
NP4K2	24.94	720.5	11.0	26.44	793.3	-3.4
NP4K4	24.87	766.4	34.9	26.37	823.1	26.4

Evaluation of profit. The profit was calculated when the data of treatments where fertilizers had been applied were compared with the control (without fertilizer) treatment (Table 6).

Although crop yield and prices fluctuate from year to year, the main tendencies of profitability limits should be identical to those which were calculated for the experimental data. We calculated the same costs for purchasing of fertilizers for every of four years. The fertilization costs for periodical PK application accounted for up to 62-67 % of the total costs for every-year fertilization. On the other hand, potato yield increase in P4K4 treatment led to increase of the profit. Summarizing up the calculations we conclude that one year profit mean for P4K4 treatment was by 1.06 Lt higher compared with annual PK application. At phosphorus every four years and potassium biennial application one Litas expenditure generated a profit of 0.62 Lt.

Therefore the reduction of input costs gained from every few year fertilization practices is one of the main positive indices when periodical and annual fertilization practices are studied.

Table 6. The economic evaluation of PK application in a crop rotation
6 lentelė. *Tręšimo fosforu ir kaliu sėjomainoje ekonominis įvertinimas*
Dotnuva, 2001-2004 m.

Treatment *Variantas*	For four crops in the 8th rotation Lt ha^{-1} *Keturių augalų 8-tos rotacijos Lt ha^{-1}*					Average annual profit Lt ha^{-1} *Vidutinis metinis pelnas Lt ha^{-1}*	Net profit per 1 Litas expenditure Lt ha^{-1} *1 Lt išlaidų davė grynojo pelno Lt*
	Price for extra yield *Derliaus skirtumo vertė*	Total costs / *Išlaidos*			Profit *Pelnas*		
		Fertilizer *Trąšoms*	Fertilization *Tręšimui*	For extra yield handling *Derliaus priedo sudorojimui*			
Control *Kontr. var*	-	-	-	-	-	-	-
NP	2353.77	688.4	123	183.91	1358.46	399.62	1.36
NK	3602.53	814.3	123	241.2	2424.03	606.01	2.06
NPK	4773.78	1078.4	183	304.3	3208.08	802.02	2.05
NP4	1956.95	687.2	85	162.1	1022.65	255.66	1.09
NP4K	5573.72	1077.2	145	347.2	4004.32	1001.08	2.55
NP4K2	5711.88	1077.2	123	356.8	4154.88	1038.72	2.67
NP4K4	6606.53	1077.2	115	414.5	4999.83	1249.96	3.11

Conclusion

Phosphorus fertilizer application every four years for potato and potassium application biennially for potato and red clover, or every four years PK application for potato, when nitrogen was applied annually, did not have any significant negative effect on crop yield in Norfolk crop rotation and on soil agrochemical properties. The superiority of every four year PK application was reflected in crop growing costs.

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SĖJOMAINOS AUGALŲ PRODUKTYVUMO IR EKONOMINIO EFEKTYVUMO PRIKLAUSOMUMAS NUO TRĘŠIMO FOSFORO IR KALIO TRĄŠOMIS KAS KETVERI METAI

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Santrauka

Lietuvos žemdirbystės institute Dotnuvoje 1971-2004 m. vykdyti ilgalaikiai PK trąšų paskirstymo sėjomainos augalams bandymai. Bandyta giliau karbonatingame giliau glėjiškame neutraliame lengvo priemolio rudžemyje (RDg 4-k2). Tirtas kasmetinių P_{45-90} K_{60-90} ir atitinkamai padidintų, skirtų 2-4 metams trąšų normų paskirstymas Norfolko keturių laukų sėjomainos (bulvės, miežiai, raudonieji dobilai, žieminiai kviečiai) augalams. Straipsnyje aptarta 1997-2000 ir 2001-2004 metų sėjomainų rotacijų derlingumas, dirvožemio savybių kitimas. Įvertinti ekonominiai periodinio tręšimo aspektai. Tyrimų laikotarpiu bandymo dirvožemis buvo ir liko vidutiniškai turtingas fosforo ir kalio. Išbėrus fosforo ir kalio trąšų ketverių metų normą bulvėms bei dvejiems metams skirtas K trąšų normas bulvėms ir dobilams, sėjomainos augalų derlingumas nesumažėjo, palyginus su kasmetiniu PK tręšimu. Tręšimo kas keleri metai pranašumas, palyginus su kasmetiniu, išryškėjo įvertinus sėjomainos augalų auginimo kaštus.

Reikšminiai žodžiai: Norfolko sėjomaina, dirvožemis, derlius, energetinis įvertinimas.