The cause of the decrease in the winter wheat yield after deep soil tillage to the depth of 50 cm was the decrease in the soil humidity in the higher areas of mezzo-relief.
Soil humidity (in % of soil capacity) and soil penetration resistance are mutually co-linear factorial traits.

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AUGSNES DZIĻIRDINĀŠANAS EFEKTIVITĀTES VĒRTĒJUMS ZIEMAS KVIEŠIEM IZMANTOJOT PRECĪZĀS LAUKKOPĪBAS TEHNOLOĢIJAS

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Darba mērķis - noteikt augsnes dziļirdināšanas efektivitāti ziemas kviešiem ražošanas platībās neizlīdzināta lauka makroreljefa apstākļos, izmantojot saimniecības lokālās ĢIS un augšņu izpētes datus. Izmēģinājumi iekārtoti SIA LLU MPS „Vecauce”. No 2005.- 2007. gadam stacionāros ar GPS noteiktos punktos, veikti augsnes penetrometriskās pretestības un mitruma mērījumi augsnes slāņos līdz 0.50 m dziļumam, noteikts augsnes granulometriskais sastāvs aramkārtā. Raža noteikta izmantojot kombaina CLASS LEXION 420 GPS iespējas. Konstatēts, ka augsnes dziļirdināšana izpildāma, ja augsnes penetrometriskā pretestība pārsniedz 600 kPa cm^{-2}.

THE EFFECT OF NITROGEN NUTRITION ON THE PRODUCTIVITY OF WINTER TRITICALE IN THE SOILS OF CENTRAL LITHUANIA

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Abstract

During the period 2000–2004 field trials with winter triticale were conducted at the LIA in Dotnuva on a light loam *Endocalcari - Epihypogleyic Cambisol.* The goal of the field trials was to determine the optimal conditions for winter triticale nitrogen nutrition and to estimate nitrogen fertilizer efficacy taking into account mineral nitrogen content in the soil.
Our experimental evidence suggests that nitrogen fertilizers were net effective every year, the regularities of grain yield variation resulting from fertilizer application also differed. A grain yield increase of 19.5–24.0 % was obtained through nitrogen fertilizer application. A rate of N_{90} was found to be optimal for triticale in our trials. Fertilizer efficacy is presented in kilos – averaged data suggest that when winter triticale had received N_{60}, N_{90} and N_{120}, 1 kg of fertilizer nitrogen produced 19.9±7.46 kg, 16.5±6.00 kg and 12.7±5.02 kg of grain, respectively. Additional fertilization of triticale was effective only in the normally wet years.
Having fertilized triticale with N_{90} and N_{120}, in the years conducive to the spread of diseases (2000–2001), a significant yield increase was obtained through fungicide application.

Key words: winter triticale, yield, efficacy of nitrogen fertilizers.

Introduction

Exhibiting a high yield potential, winter triticale is a promising crop. The area currently sown with triticale in Lithuania is steadily increasing and this increase has been determined by the availability of high-yielding, winterhardy, thick-stemmed, rather satisfactorily drought and disease resistant varieties. In terms of yield, winter triticale compares well with many winter wheat varieties. The grain chemical composition of triticale determines its rather wide application possibilities: the grain is used in the food industry, flour in confectionery, for beer, spirits, and starch production (Seguchi *et al*., 2000). In grain protein, the ratio of amino acids content is suitable for livestock feeding (Kuzeev *et al*., 1997; Alaru *et al*., 2003, Mikulionienė *et al*., 2002). Triticale is an excellent raw material for the expanding bioethanol industry to be used for environment-friendly fuel production.

Winter triticale is well suited for growing on various-textured soils and its cultivation is rational not only from the viewpoint of productivity but also from the viewpoint of the optimal maintenance of soil physical and chemical properties (Petraitis *et al*., 2002; Malecka *et al*., 2004).

There has beenvery little research done so far under Lithuania's conditions on triticale fertilization, which is one of the links in cultivation technology, with a view to maximally exploiting varietal genetic productivity potential. There were also no tests done designed to estimate the role of soil mineral nitrogen in winter triticale nutrition and to ascertain the yield, yield increase and fertilizer efficacy as influenced by mineral nitrogen (N_{min}). The objective of the study was to identify optimal nitrogen nutrition conditions for winter triticale grown on Central Lithuania's soils and to estimate nitrogen fertilizer efficacy in relation to the mineral nitrogen content in the soil.

Materials and Methods

Experimental site. Field experiments were conducted during the period 1999-2004 at the Lithuanian Institute of Agriculture in Dotnuva on a light loam *Endocalcari - Epihypogleyic Cambisol* by a conventional field experiment method.

According to the values of agrochemical parameters, the soil pH_{KCl} was 6.0-7.0 (measured potentiometrically), plant available phosphorus and potassium contents - 129-206 mg kg^{-1} (P_2O_5) and 140-201 mg kg^{-1} K_2O, respectively (A-L methods), humus content 1.8-2.1 % (Tyurin) and total nitrogen content 0.12-0.14 % (Kjeldahl).

The soil at the 0-40 cm depth was relatively low in plant available mineral nitrogen ($N\text{-}NO_3$+$N\text{-}NH_4$, measured: $N\text{-}NO_3$ – ionometrically, $N\text{-}NH_4$ spectrophotometrically) ranging from 38.0±0.73 to 55.2±0.93. On average, in spring at the beginning of the triticale growing season, N_{min} content at the 0-40 cm soil layer from which plants utilize nutrients most intensively at the beginning of the growing season varied within the 38.0-55.2 kg ha^{-1} range, at low or moderate variation (V = 87-17.3 %). Having added up N_{min} present at 0-40 and 40-60 cm soil layers, it was noted that in different years it varied within the 55-70 kg ha^{-1} range, (V = 7.3-10.9 %). The distribution of N_{min} content in the soil profile was as follows: at the 0-40 cm depth on average 68-78 %, at the 40-60 cm depth 22-32 % of the total N_{min} content in the 0-60 cm depth.

The distribution of nitrate nitrogen ($N\text{-}NO_3$) in the soil profile was similar to that of N_{min}: at the 0-40 cm soil layer - 67-82 % of readily plant-available $N\text{-}NO_3$ content, the other 18-33 % was distributed within the deeper 40-60 cm layer. Ammonia nitrogen ($N\text{-}NH_4$) in separate experimental years accounted for 33 - 46 % of the mineral nitrogen content present at the 0-40 cm depth.

Experimental design: 1. Not fertilized (N_0 P_0 K_0),/ 2. $P_{60}K_{60}$ (background F)/ 3. N_{60} in spring (BBCH 25-29)/ 4. F+N_{30} in autumn +N_{60} in spring (BBCH 25-29)/ 5. F+ N_{60} in spring (BBCH 25-29)/ 6. F+ N_{90} in spring (BBCH 25-29)/ 7. F+ N_{60} in spring (BBCH 25-29) + N_{30} at the beginning of booting (BBCH 30-32)/ 8. F+ N_{120} in spring (BBCH 25-29)/ 9. F+ N_{90} in spring (BBCH 25-29) + N_{30} at the beginning of booting (BBCH 30-32)/ 10. F+ N_{90} in spring (BBCH 25-29) +Tilt (BBCH 47-59)/ 11. F+ N_{120} in spring (BBCH 25-29) +Tilt (BBCH 47-59). BBCH - scale describes the phonological development of cereals.

Treatments 2 and 4-11 received the same phosphorus and potassium fertilization level - $P_{60}K_{60}$.

According to the experimental design, triticale grown in the plots of two treatments (10 and 11) was sprayed with the fungicide Tilt (0.5 l ha^{-1}) at BBCH 47-59. Winter triticale was preceded by perennial grasses of the second year of use. At the end of tillering in the spring the triticale crop was sprayed with a mixture of herbicides and growth regulators, insecticides were used according to the need.

The winter triticale cv. *Tewo* was sown for 2000 and 2001-year harvest. After it had been removed from the National List of Plant varieties, the cv. *Tornado* was sown for the 2002-2004 harvest.

Winter triticale was thrashed at complete maturity and grain yield data were adjusted to 15 % moisture.

Meteorological conditions, recorded *at the* Dotnuva Weather Station differed between the experimental years. Of the five experimental years, two were extremely dry and warmer than usual, three years were normally wet. The year 2000 was distinguished by a warm and dry spring – in April the mean monthly temperature was by +5.7 °C higher than the long-term mean, and the amount of precipitation was as low as 19 % of the mean long-term mean – 7.6 mm. During the period of intensive growth and development – in May and June humidity was close to normal, and in July the amount of rainfall was twice as high (185 %) as the long-term mean. The weather conditions during the 2000-2001 winter period were similar to long-term means. In 2001 the amount of rainfall that fell during the entire growing season corresponded to long-term mean, however its distribution was very uneven – 45 % of the total amount of rainfall that fell during the growing season occurred in July. Moreover, the mean air temperature of July was by 3.5 °C higher than the long-term mean. During the first months of the year 2002 the amount of rainfall was from 22 to 53, and exceeded the long-term mean by 91 %. Such heavy precipitation might have resulted in lower mineral nitrogen content in the soil in the spring of 2002. During the growing season of 2002 the weather was warm with several heat waves and exceeded the mean air temperature of individual months by 2.3 °C – 3.2 °C. In April the plants were exposed to stress resulting from dramatic temperature variations (from -5.5°C to +19.2°C) and shortage of moisture, since only about half (56 %) of the mean long-term rate fell. In June and July in some days the air temperature reached a striking maximum to 34-35 °C. The amount of rainfall during the summer growing season made up 57 % of that period's mean long-term rate. In the autumn of 2002 having sown winter triticale, the amount of rainfall that fell in October was record-breaking – 2.5 times as high as the long-term mean. The winter period was characterised by a slightly lower amount of precipitation than usual. The year 2003 was somewhat drier than the norm, the amount of precipitation that fell during the growing season was 80 % of the long-term mean. Of the summer growing season, July was noted for hot weather, with the daily mean temperature by 3°C higher than the long-term mean. In 2004 almost all the growing season was dry – the amount of precipitation that fell in April, May and June was accordingly 29, 53 and 70 % of the long-term mean. The sum total of precipitation that fell during the growing season was 72 % of the long-term rate.

Statistical grain yield data processing was done using analysis of variance. Correlations between grain yield, yield increase in different expressions and nitrogen fertilizer rates and mineral nitrogen were determined and regression equations were calculated following the directions in special literature (Littl *et al*., 1981, Tarakanovas *et al*., 2003). Symbols used in the paper: * and ** statistically significant at 95 % and 99 % probability level; LSD_{05} – the least significant difference at 95 % probability level; V % - variation coefficient.

Results and Discussion

Nitrogen fertilization is one of the major and most efficient means to increase yield, control yield formation processes and improve yield quality. The findings on nutrition of triticale, which is a relatively undemanding crop in terms of cultivation conditions, are scarce in literature. Different nitrogen rates are often indicated for winter triticale. On the background of $P_{100}K_{100}$ an optimal nitrogen rate is indicated to be 80 kg ha^{-1} (Paponov *et al*., 1999), more recent research suggests that the highest winter triticale yield was achieved through a nitrogen rate not lower than 120 kg ha^{-1} (Malecka *et al*., 2004), other researchers have reported optimal nitrogen rates to be from 60 to 120 kg ha^{-1} (Bulavina, 1993), 160 kg ha^{-1} or even 180 kg ha^{-1} (Cimrin *et al*., 2004; Mut *et al*., 2005).

Nitrogen fertilizer efficacy during 2001-2004 was sufficiently high and grain yield increases through its application were statistically significant (Table 1)

Table 1. The effect of fertilization and fungicides on grain yield t ha^{-1}

Treatment	*Year*					*Mean.*	
	2000	2001	2002	2003	2004	t ha^{-1}	*relative values*
Without fertilizers	8.34	3.86	7.30	4.01	5.78	5.86	100
$P_{60}K_{60}$ (background F)	8.59	4.46	7.32	3.94	4.73	5.81	99.1
N_{60} in spring	8.58	5.76	8.13	4.93	7.46	6.97	119.0
F+N_{30} in autumn +N_{60} in spring	8.53	5.85	7.64	5.84	7.53	7.08	1208
F+ N_{60} in spring	8.66	6.15	7.76	5.14	7.31	7.00	119.5
F+ N_{90} in spring	8.56	6.08	8.01	5.92	7.87	7.29	124.4
F+ N_{60} in spring + N_{30} at beginning of booting (BBCH 30-32)	8.20	5.95	8.04	5.79	8.20	7.24	123.5
F+ N_{120} in spring	7.89	6.,08	7.73	6.27	7.99	7.19	122.7
F+ N_{90} in spring + N_{30} at beginning of booting (BBCH 30-32)	7.81	6.28	7.99	5.78	8.46	7.26	124.0
F+ N_{90} in spring +Tilt (BBCH 47-59)	9.34	6.99	8.91	5.70	7.95	7.78	132.7
F+ N_{120} in spring +Tilt (BBCH 47-59)	9.21	7.12	7.72	6.13	8.58	7.75	132.3
LSD_{05}	0.676	0.447	0.839	0.669	0.962	0.727	

Only the year 2000 stood out when nitrogen fertilizers did not increase the yield but grain yield even in the check treatment amounted to 8.34 t ha^{-1}. It is likely that this was determined by the pre-crop – perennial grasses of the second year of use that contained a high content of clover, and the atmospheric nitrogen fixed by clover and accumulated in the soil might decline nitrogen fertilizer effect on triticale yield. Low nitrogen fertilizer efficacy could be also responsible for crop lodging in 2000. The data averaged over the five experimental years suggest that triticale grown without fertilizers produced a grain yield of 5.86 t ha^{-1}, and a yield increase of 19.5-24.0 % resulting from nitrogen fertilization was obtained, compared with the check treatment.

Yield increases on the background of PK, that resulted from single spring-applied nitrogen rates 60, 90 and 120 kg ha^{-1} were different during the experimental years and varied substantially – the variation in different fertilization levels was as high as 81-88 %. In 2001 and in 2002, which was especially warm it increased with a nitrogen rate up to 90 kg ha^{-1}. In 2003 and 2004 nitrogen fertilizers were the most effective – with increasing single rates to 120 kg ha^{-1}, the yield increased. Averaged data indicate that nitrogen rates of 60, 90 and 120 kg ha^{-1} gave grain yield increases of 1.20±0.447 t ha^{-1}, 1.49±0.540 t ha^{-1} and 1.52±0.602 t ha^{-1}, respectively.

Having estimated nitrogen fertilizer efficacy, expressed as kg grain per 1 kg of fertilizer nitrogen, it was found that with nitrogen rates of 60, 90 and 120 kg ha^{-1} applied to triticale, 1 kg of fertilizer nitrogen gave on average 19.9±7.46 kg, 16.5±6.00 kg and 12.7±5.02 kg grain, respectively.

Based on the experimental data, the correlation of triticale grain yield with mineral and nitrate nitrogen contents present at different soil layers (0-40 cm and 0-60 cm) was mathematically estimated. It was found that the contents of both nitrate and mineral nitrogen in the soil 0-40 cm and 0-60 cm layers correlated similarly with triticale grain yield data. The data of separate experimental years show that in ¾ of the cases tested (75 %) the correlation was weak and at 95 % the probability level statistically insignificant. The data averaged over the 5 experimental years indicate that yield correlation with N-NO_3 and mineral nitrogen amounts at the 0-60 cm soil layer were moderate and statistically significant. A slightly weaker, but close to moderate correlation was found between the grain yield and contents of plant available nitrogen forms at the 0-40 cm soil layer (Table 2).

Table 2. Correlation coefficients between triticale grain yield (y, t ha^{-1}) and mineral and nitrate nitrogen contents (x) present at different soil layers

Year	Nitrate nitrogen ($N\text{-}NO_3$)		Mineral nitrogen (N min)	
	0-40 cm	0-60 cm	0-40 cm	0-60 cm
2000	0.31	0.50	0.31	0.37
2001	0.39	0.37	0.32	0.33
2002	0.20	-0.016	0.37	0.04
2003	-0.66	-0.59	-0.61	-0.56
2004	-0.72*	-0.61*	-0.40	-0.33
Avg. over 5 yrs.	-0.49**	-0.58**	-0.41**	-0.53**

The correlations between winter triticale yield and nitrogen fertilizer rates are presented in Table 3. The strength of correlation varied from weak and statistically insignificant at the 95 % probability level (η = 0.35, in 2002) to strong and significant at the highest 99 % probability level (η = 0.92, in 2001). In separate experimental years nitrogen fertilizers were responsible for 13 to 84 % yield data variation. However, the data averaged over the 5 experimental years show that only 11 % yield variation was related to the nitrogen fertilizer rate.

While calculating the dependence of nitrogen fertilizer efficacy on nitrogen content in the soil and the nitrogen fertilizer rate, we took nitrate and mineral nitrogen content present at the 0-60 cm depth, as the most appropriate indicator that defines nitrogen abundance in the soil, since at the beginning of the growing season, before the main spring fertilization, a large part of mineral nitrogen present in the soil (about 30 %) was found at the 40-60 cm depth. In the year 2000 there was no grain yield correlation with these parameters. The data from 2001-2004 period indicate that similar yield correlation in terms of strength and significance, was determined when adding up both nitrate and mineral nitrogen content with fertilizer nitrogen content (Table 3). The correlation was moderate or strong, in 60 % of the cases tested – statistically significant at the 99 % probability level. During the experimental period, the sum of $N\text{-}NO_3$ and N_{min} and nitrogen applied with fertilizers present at the 0-60 cm soil layer determined from 24 to 88 % and from 24 to 93 % of the yield, respectively. The data averaged over the 5 experimental years show that the correlation between the yield and total soil mineral nitrogen forms and fertilizer nitrogen content was weak but statistically significant (r=0.31*).

Table 3. Correlation coefficients between the yield (y, t ha^{-1}) and nitrogen fertilizer rate (x_1, kg ha^{-1}) and total contents of nitrogen present in the soil and applied with fertilizer (x_2 and x_3, kg ha^{-1})

Year	Correlation coefficients		
	H x_1 – nitrogen fertilizer rate	R x_2 – sum of $N\text{-}NO_3$ and fertilizer nitrogen at the 0-60 cm soil layer	r x_3 – sum of N min and fertilizer nitrogen at the 0-60 cm soil layer
2000	0.50*	0.05	0.04
2001	0.92**	0.88**	0.87**
2002	0.35	0.49	0.49
2003	0.73**	0.96**	0.97**
2004	0.75**	0.94**	0.93**
Avg. over 5 yrs.	0.32**	0.31*	0.31*

In plant nutrition diagnostics tests nitrogen fertilizer efficacy is defined by yield increase or calculated figure – percentage yield. It is calculated by dividing the yield of each experimental plot by the highest yield obtained in the experiment. The correlation of winter triticale separate year's and percentage yield with soil nitrogen – nitrate and mineral present at the 0-40 and 0-60 cm depth was determined (Table 4). In most cases the correlation between the mentioned indicators was best described by a parabola of the second degree, however, the correlation was significant not in all the cases studied. The contents of both $N\text{-}NO_3$ and N_{min} at the 0-40 cm soil depth correlated very similarly with percentage yield, the correlation ranged from moderate to strong. At the 0-60 cm depth, the percentage yield correlated stronger with soil N_{min} than with $N\text{-}NO_3$, but it was statistically significant only in 40 % of cases. The data from 5 experimental years suggest that average percentage yield correlations with soil nitrogen were most often represented by a linear equation, indicating an inverse moderately strong correlation (r = -0.50-0.51) which was significant only in half of the cases.

Table 4. The relationship between percentage yield (y) and N min and $N\text{-}NO_3$ at the 0-40 and 0-60 cm soil layers

Year	Denomination of trait x	Equation	r/ η	dxy	F_{Fisher}
2000	$N\text{-}NO_3$ 0-40 cm	$y=-25.28+1.4134x-0.0191x^2$	0.63	0.40	3.3
2001		$y=-3.07+0.3016x-0.0056x^2$	0.70*	0.50	6.4
2002		$y=-3.86+0.4495x-0.0103x^2$	0.64	0.41	4.9
2003		$y=-1.68+0.2165x-0.0044x^2$	0.84*	0.71	7.4
2004		$y=2.18-0.0513x$	0.71*	0.50	9.4
Avg. Over 5 yrs.		$y=- 1.78-0.0523x+0.0007x^2$	0.54	0.29	2.8
2000	$N\text{-}NO_3$ 0-60 cm	$y=- 2.69+0.1888x-0.0024x^2$	0.61	0.37	1.5
2001		$y=- 3.40+0.1728x-0.0017x^2$	0.38	0.14	0.1
2002		$y=- 4.57+0.3499x-0.0054x^2$	0.65*	0.42	5.8
2003		$y=-3.43+0.2273x-0.0029 x^2$	0.79*	0.62	5.6
2004		$y=2.32-0.0415x$	0.61*	0.38	5.4
Avg. Over 5 yrs.		$y=1.28-0.0099x$	0.50**	0.23	15.9
2000	N min 0- 40 cm	$y=- 2.74+0.01640x-0.0018x^2$	0.70*	0.49	5.5
2001		$y=-42.00+1.5463x-0.0139 x^2$	0.55	0.30	2.3
2002		$y=- 7.41+0.4367x-0.0056x^2$	0.51	0.26	1v3
2003		$y=-13.57+0.6851x-0.0081x^2$	0.90**	0.81	17.7
2004		$y=10.35-0.3734x+0.036x^2$	0.47	0.22	0.6
Avg. Over 5 yrs.		$y=1.34-0.0096x$	0.50**	0.25	17.7
2000	N min 0-60 cm	$y=- 5.39+0.2004x-0.0016x^2$	0.69	0.47	5.0
2001		$y=- 50.49+1.4507x-0.0102x^2$	0.57	0.33	3.2
2002		$y=- 16.09+0.6058x-0.0053x^2$	0.72*	0.52	8.7
2003		$y=- 14.61+0.4950x-0.0039x^2$	0.84*	0.71	10.9
2004		$y= 9.96-0.2679x+0.0020x^2$	0.39	0.15	0.4
Avg. over 5 yrs.		$y=1.54-0.0101x$	0.51	0.26	18.6

Extra fertilization of winter triticale with N_{30} rate in the middle of booting stage, when at the beginning of the growing season 60 and 90 kg ha^{-1} rates of nitrogen had been applied, gave a low and insignificant yield increase in most cases. In 2003 and 2004 extra fertilization for N_{60} – applied triticale was slightly more effective – the grain yield was by 0.65 and 0.89 t ha^{-1} higher compared with the treatments fertilized once at N_{60} and the yield increase was significant at a slightly lower than 95 % probability level. An additionally applied N_{30} rate for triticale fertilized with N_{90} in spring was ineffective, since in the experimental years with considerable moisture deficit the grain tended to dry and maturity was accelerated, therefore additionally applied nitrogen remained unutilised.

The importance of the fungicide on triticale productivity increased in wet years when conditions for disease occurrence were favourable. In 2000 and 2001 when during the growing season the amount of precipitation was close to the long-term mean (114.2 % and 98 %, respectively) and warm weather prevailed, conditions conducive for the spread of disease were created and the efficacy of the fungicides was high. Triticale fertilized with N_{90} and N_{120} and sprayed with Tilt produced a statistically significant yield increase – 0.78-0.91 and 1.32-1.04 t ha^{-1}, respectively, compared with triticale that received the same fertilization but was not applied with fungicides. At a higher nitrogen fertilization level the fungicide gave a higher yield increase.

Conclusions

Nitrogen fertilizers were effective for winter triticale and significantly increased grain yield by on average 19.5 – 24.0 %. Averaged data suggest that on PK background, N_{60}, N_{90} and N_{120} gave a grain yield increase of 1.20±0.447 t ha^{-1}, 1.49±0.540 t ha^{-1} and 1.52±0.602 t ha^{-1}. Additional winter triticale fertilization was effective in normally wet years; dry weather in separate experimental years was unfavourable for the uptake of additionally applied fertilizer nitrogen, therefore the yield increase obtained was insignificant.

Having estimated the dependence of winter triticale grain yield on nitrogen fertilizer rates, in most cases – five out of six were determined to be statistically significant, moderately strong or strong correlation (η=0.50*-0.92**), nitrogen fertilizers determined 13-84 % grain yield variation.

The relationship between the winter triticale yield and the total nitrogen fertilizer and nitrate ($N\text{-}NO_3$) and mineral nitrogen (N_{min}) content at the 0-60 cm soil depth was identified. In terms of strength and significance, the correlations differed little when comparing nitrate and mineral nitrogen and in 60 % of the cases studied were statistically significant at a 99 % probability level.

Having estimated fertilizer efficacy in percentage yield, a slightly higher correlation was determined with mineral nitrogen content at the 0-60 cm soil layer than with nitrate nitrogen content found at the same depth. With increasing mineral nitrogen content in the soil, the efficacy of nitrogen fertilizers tended to decline.

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SLĀPEKĻA MĒSLOJUMA IETEKME UZ ZIEMAS TRITIKĀLES RAŽĪBU LIETUVAS VIDIENES AUGSNĒS

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Laika periodā no 2000.-2004. gadam Dotnuvā Lietuvas Zemkopības institūtā viegla smilšmāla augsnēs *(Endocalcari – Epihypogleyic Cambisol)* ar mērķi noteikt optimālos apstākļus mēslošanai ar slāpekli un novērtēt slāpekļa mēslojuma iedarbību, ņemot vērā minerālā slāpekļa saturu augsnē, tika veikti lauka izmēģinājumi ar ziemas tritikāli.

Rezultāti liecina, ka mēslošana ar slāpekli ne katru gadu ir efektīva, graudu raža atšķirīgi variēja arī mēslojuma devas ietekmē. Lietojot slāpekļa mēslojumu, tika iegūts graudu ražas pieaugums 19.5–24.0 %. Izmēģinājumos kā optimālā slāpekļa norma tritikālei tika noteikta N_{90}. Dati liecina, ka ar katru mēslojuma kilogramu ziemas tritikālei pie devas N_{60}, N_{90} un N_{120}, ražas pieaugums ir attiecīgi 19.9±7.46 kg, 16.5±6.00 kg un 12.7±5.02 kg graudu. Tritikāles papildus mēslošana bija efektīva tikai normāli mitros gados.

Pie mēslojuma devas N_{90} un N_{120} slimību izplatībai labvēlīgos gados (2000–2001), nozīmīgs ražas pieaugums tika iegūts, izmantojot fungicīdus.