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ODJELJENJE PRIRODNIH I MATEMATIČKIH NAUKA

Knjiga 5.

SIMPOZIJUM O PROBLEMIMA ISTRAŽIVANJA ŠUMSKIH ZEMLJIŠTA

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INFLUENCE OF LIME AND PHOSPHORUS FERTILIZERS UPON ACCUMULATION OF MINERAL NITROGEN IN INCUBATION EXPERIMENT OF FOREST SOIL**

INTRODUCTION

Nitrogen in its available form for plants (NH_4 and NO_3 — N) is of central importance for forest trees. The increasing use of fertilizers in forestry presents, along with other problems, the problem of influence of fertilizers upon the mineralization of the native soil nitrogen. Since accumulation of mineral nitrogen in soil is a result of two processes — mineralization and immobilization — primarily only the net changes are registered.

The soil pH is considered to be a highly important factor in nitrogen mineralization (Harmsen van Schreven, 1955, Zöttl, 1960. and others). The optimum level of pH for nitrogen mineralization is in general on the alkaline side of the neutral point i. e. slihtly above 7.0 pH (Nömmik, 1968).

Application of lime is the most widely spread means for reduction of soil acidity. But, the results obtained in experiments with lime vary considerably concerning the total mineralization of nitrogen. While some authors mention positive effects with raw humus (Zöttl, 1960) or in the B horizon (Tamm & Petterson, 1969), others speak of slight depressive effects (Kaila & Soini, 1957, Kivikäs & Kivinen, 1959, Viro, 1963, Zöttl, 1963, Nömmik, 1968). The positive effect of lime upon the total mineralization of nitrogen in humus does not usually last very long, 7—8 weeks (Zottl, 1960), and after that initial phase, there occurs a period of depression in nitrogen mineralization.

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Contrary to that, addition of lime is of decisive significance in initiating and intensifying of nitrification in forest soils, (H e s s e l m a n. 1937) in his early experiments found nitrification in raw humus after addition of lime, with and without inoculation with nitrificants. Several authors have found nitrification on samples of raw humus and peat which were treated with $CaCO_3$ (K i v e k ä s & K i v i n e n, 1959, Z o t t l, 1960, 1963).

Phosphorus has seldom been investigated in connection with nitrogen mineralization, but some results point out a depressive effect (Z o t t l, 1963). According to V i r o (1963) phosphorus reduced nitrification considerably.

This paper contains short and long-term incubation experiments of humus and mineral soil treated with $CaCO_3$ and KH_2PO_4. Furthermore, experiments with incubation of humus and mineral soil from plots belonging to fertilizer experiments in field are described.

MATERIAL AND METHODS

For the incubation the soil material was used from both the humus and the layer directly below humus, 5 cm in depth. They originated from plots treated with CaNPK in Southern Sweden (Frodeparken) in a Norway spruce stand with a considerably high increment (age 65 years, annual increment 13—17 m^3/ha) and one experiments limed with 10^3 kg $CaCO_3$/ha 120 km north of Stockholm, in a Norway spruce stand with medium growth (age 90 years, mean annual increment of 6.5 m^3/ha). The soil of the surface layer can be described as forest brown soil with a thin layer of semi-raw humus (moder) on plots without lime (on limed plots moder almost completely turned into mull) and iron — humus podzol with a fairly thick layer of raw humus.

The data on soil properties given in Table 1 show that the soil is highly acidic (unfertilized plots). The difference in the contents of the total nitrogen in the soil organic matter, i. e. C/N ratio is clearly expressed. Concerning the contents o P, K and Ca the differrences vary, so that brown soil (Frodeparken) is much better supplied with P, but it is, contrary to that, poorer in K, and much poorer in Ca, in comparision with podzol.

Table 2. gives data on the properties of the soil form fertilized and unfertilized plots for 12 years after the treatment at the Frodeparken experiment and for two years after the treatment at the Lundbyskogen experiment. The changes caused by addition of $CaCO_3$ are clearly evident.

For the incubation experiment, the samples were taken by auger of diametar 7 cm, the total of 15—18 single samples per plot. After sifting in its natural humid form 40 gr of soil was taken for incubation, put it into an E-flask with a special plastic protection, and the moisture content was adjusted to 60% WHC (T a m m & P e t e r s o n, 1969. P o p o v i ć, 1971). The incubation period was 6—9 weeks with the short term experiment, and up to 2 years with the long term experiment. Constant temperature was kept at 20 °C, and air humidity in the chamber at 70—80 per cent. In the incubation experiment treated previously with $CaCO_3$ i. e.

Tabela 1.

DATA FOR SOME CHEMICAL PROPERTIES OF THE HUMUS AND MINERAL SOIL SAMPLES FROM CONTROL PLOTS APPLIED IN THE INCUBATION EXPERIMENT WITH LIME AND PHOSPHORUS FERTILIZERS SUPPLY IN THE LABORATORY

HEMIJSKA SVOJSTVA UZORAKA HUMUSA I MINERALNOG TLA SA KONTROLNIH PARCELA UPOTRIJEBLJENIH ZA INKUBACIONI EKSPERIMENT SA DODAVANJEM FOSFORNOG I KREČNOG ĐUBRIVA U LABORATORIJI

Locality / Lokalitet / Layer / Sloj	pH	Loss on ignition / gubitak žarenja % d. w.	Kjeldahl N % d. w.	C/N	P mg 100 g AL—	HCl—	Tot	K mg/100 g AL—	HCL—	Tot	Ca mg/100 g AL—	HCl—	Tot
Lundbyskogen													
”													
Frodeparken													
”													
A_0-hor	3,6	78,5	1,46	31	6	26	64	36	39	62	148	390	43'
A_1etc 0—5 cm	3,7	10,0	0,18	32	1	9	18	5	19	65	25	73	115
A_0-hor	4,0	47,8	0,99	28	6	31	87	23	40	58	57	—	—
A_1etc 0—5 cm	4,3	8,6	0,23	22	4	29	58	5	20	47	9	—	—

Tabela 2

DATA ON SOME CHEMICAL PROPERTIES OF HUMUS AND MINERAL SOIL FROM FERTILIZERS TRIALS, APPLIED IN THE INCUBATION EXPERIMENT

HEMIJSKA SVOJSTVA UZORAKA HUMUSA I MINERALNOG TLA SA OGLEDNIH ĐUBRENIH PARCELA UPOTRIJEBLJENIH ZA INKUBACIONI EKSPERIMENT

Locality / Lokalitet	Treat-ment / Tretman	pH	Loss on ignition / gubitak žarenja % d. w.	Kjeldahl — N % d. w.	Kjeldahl — N % o. m.	C/N	P mg/100 g AL—	P mg/100 g HCl—	P mg/100 g Tot	K mg/100 g AL—	K mg/100 g HCl—	K mg/100 g Tot	Ca mg/100 g AL—	Ca mg/100 g HCl—	Ca mg/100 g Tot
				A_0 — sloj, layer											
Frodeparken	O	3,9	49,0	1,16	2,37	24	6	31	67	23	40	58	57	—	—
„	PK	3,8	33,3	0,76	2,28	25	8	38	96	21	36	63	66	—	—
„	NPK	4,0	33,4	0,94	2,81	21	7	36	101	18	42	60	85	—	—
„	N	4,0	30,1	0,86	2,86	20	5	31	108	20	36	78	63	—	—
„	CaN	6,3	15,3	0,40	2,61	22	5	35	69	5	22	45	501	—	—
„	Ca	5,7	12,3	0,34	2,76	21	3	34	62	5	23	47	486	—	—
Lundbyskogen	O	3,8	82,6	1,56	1,89	31	7	26	—	44	40	—	198	660	—
„	Ca	4,5	69,3	1,30	1,88	31	6	21	—	39	43	—	382	1005	—
				A, etc 0—5 cm, sloj — layer											
Frodeparken	O	4,3	9,2	0,24	2,61	22	4	29	58	5	22	47	9	—	—
„	PK	4,0	9,2	0,25	2,72	21	8	40	82	4	22	47	12	—	—
„	NPK	4,0	9,4	0,25	2,66	22	8	42	74	5	26	43	18	—	—
„	N	4,2	9,5	0,25	2,63	22	2	25	52	4	20	41	13	—	—
„	CaN	6,3	9,6	0,23	2,40	24	3	32	65	2	20	43	243	—	—
„	Ca	5,7	8,5	0,23	2,71	21	2	31	60	2	18	43	240	—	—
Lundbyskogen	O	3,9	13,3	0,31	2,33	25	2	4	—	5	25	—	48	160	—
„	Ca	4,0	10,2	0,20	1,96	30	1	9	—	5	35	—	53	100	—

Tabela 3.

INORGANIC NITROGEN IN THE SOIL SAMPLES AFTER INCUBATION WITH ADDITION OF LIME AND PHOSPHORUS AT START. VALUES PPM/D. W.

NEORGANSKI AZOT U UZORCIMA TLA NAKON INKUBACIJE SA DODAVANJEM KREČA I FOSFORA PRI STARTU. VRIJEDNOSTI U PPM/S. M.

Treatment Tretman	Lundbyskogen Start	6	9 weeks — nedelja	Frodeparken Start	6	9 weeks — nedelja
A_0 — horizont						
Control	15 (1)	50 (2)	109 (1)	46 (3)	126 (3)	225 (2)
Phosphor.		97 (2)	174 (1)		153 (3)	234 (3)
Lime + phosphor.		136 (2)	171 (2)		665 (468)	457 (444)
Lime		157 (3)	172 (2)		575 (390)	441 (419)
A_1 etc, 0—5 cm						
Control	6 (1)	12 (1)	20 (1)	12 (2)	63 (2)	48 (1)
Phosphor.		17 (1)	21 (1)		60 (2)	55 (2)
Lime + phosphor.		81 (1)	79 (1)		132 (8)	87 (10)
Lime		77 (1)	82 (2)		139 (8)	108 (24)

( ) = nitrate nitrogen — nitratni azot

KH_2PO_4, the quantities were 300 ppm P i. e. 200 ppm P (for mineral soil), while $CaCO_3$ was added in quantity necessary for pH 6.5.

Extract of 4% solution of KA1 $(SO_4)_2$ was prepared for the analysis of organic nitrogen, by shaking it for 1/2 hour. Before shaking the reaction of the suspension was built to ca 6.0 — 6.5. Ammonium nitrogen was distilled in a micro-nitrogen apparatus with addition of natrium-borate pH 8.8). Colouring of the distillate was done with Nessler reagent, and NH_4 — N was determined in the photocolometric way with a Beckman photometer Model B. Nitrate nitrogen was determined with phenol — disulphonic acid, photocolorimetrically.

Total nitrogen was determined after Kjeldahl with addition of salicylic acid in order to include NO_3 — N, reaction pH electrometrically in water. Phosphorus, potassium and calcium were determined in AL — and HCl extract, as well as the total boiling in a mixture of nitric and perchloric acid.

RESULTS AND DISCUSSION

Changes in accumulation of inorganic nitrogen after the soil incubation which lasted for 6 — 9 weeks and after the treatment with phosphorus and lime are given in Table 3. Basic difference in reaction of the two investigated soils is clear on samples treated with $CaCO_3$. While the podzol (Lundbyskogen) showed certain increase of mineralization in the form

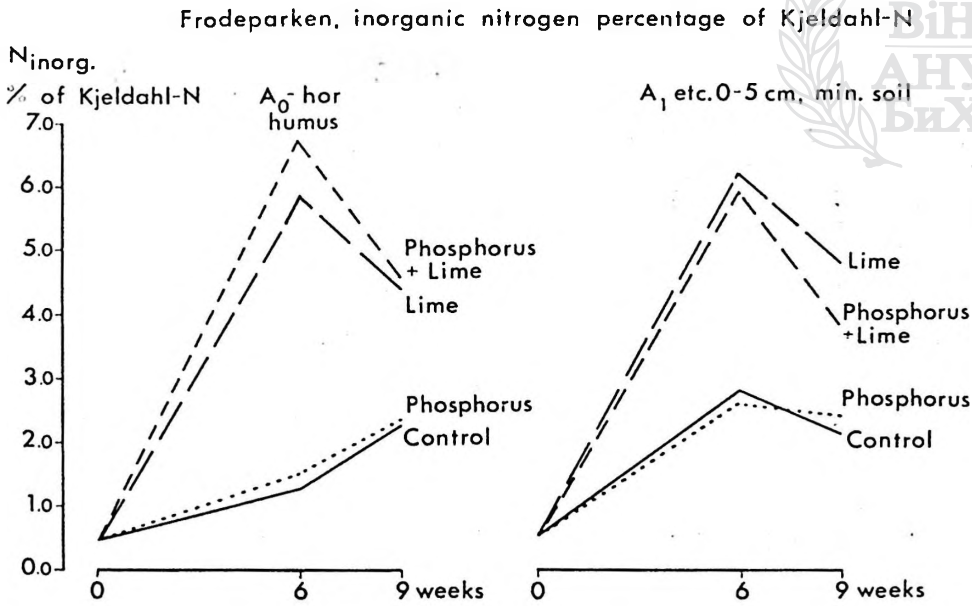

Fig. 1.

Inorganic nitrogen as % of Kjeldahl-nitrogen after incubation of soil samples with pretreatment by phosphorus and lime. Frodeparken 1969.

Neorganski azot u procentu od ukupnog azota (Kjeldahl) nakon inkubacije tla, sa prethodnim tretmanom fosforom i krečom. Frodeparken 1969.

of greater contents of ammonium nitrogen, the brown soil showed a very intensive reaction characterized by very high nitrification in the humus layer (A_0 — horizon).

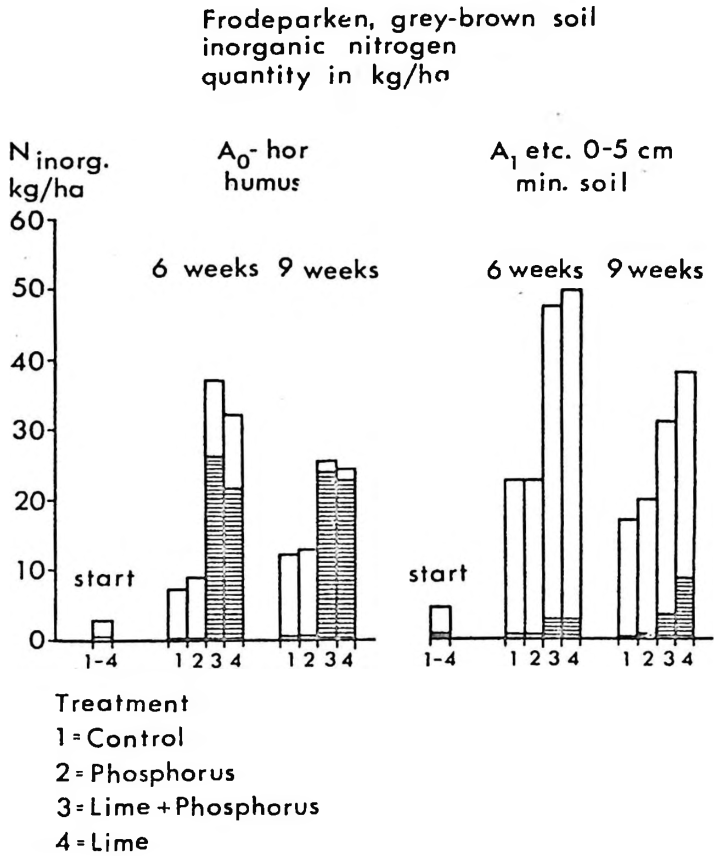

Fig. 2.

Amount of inorganic nitrogen after incubation of soil samples with pretreatment by phosphorus and lime. Frodeparken 1969.
Hatched part of column refer to nitrate nitrogen.

Količina neorg. azota (kg/ha) nakon inkubacije tla i prethodnog tretmana fosforom i krečom. Frodeparken 1969.
Šatirani dio kolone odnosi se na nitratni azot.

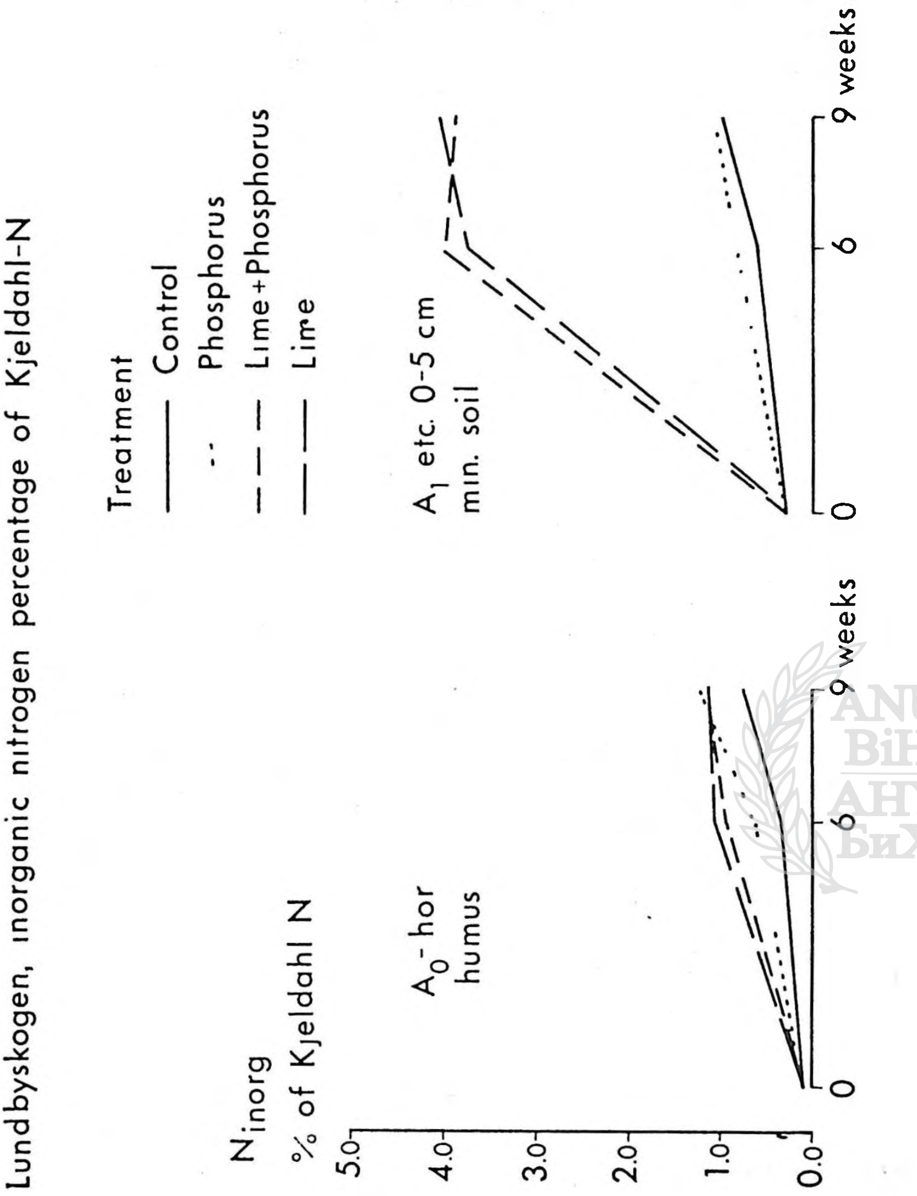

Fig. 3.

Inorganic nitrogen as % of Kjeldahl-nitrogen after incubation of soil samples with pretreatment by phosphorus and lime. Lundbyskogen 1969.

Neorg. azot u procentu od ukupnog azota (Kjeldahl) nakon inkubacije i pred-tretmana fosforom i krečom. Lundbyskogen 1969.

This highly positive reaction against $CaCO_3$ in brown soil seems to have obtained its maximum after 6 weeks of incubation, because in the course of the following three weeks we observed a considerable decrease of the total inorganic nitrogen, while at the same time soil treated with

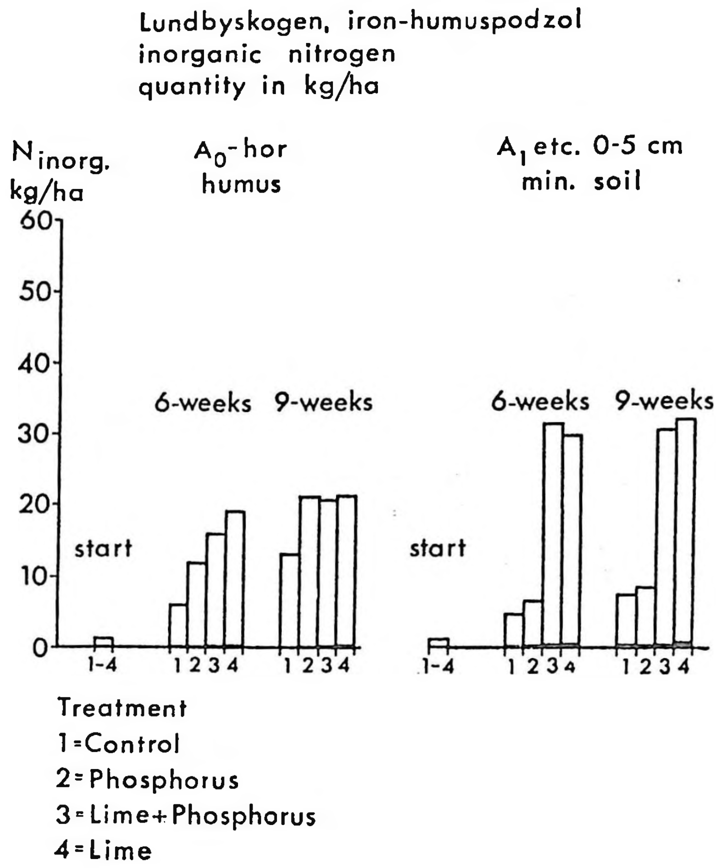

Fig. 4.

Amount of inorganic nitrogen after incubation of soil samples with pretreatment by phosphorus and lime. Lundbyskogen, 1969.
Black part os column refer to nitrate nitrogen.

Količina neorg. azota (kg/ha) nakon inkubacije uzoraka tla i prethodnog tretmana fosforom i krečom. Lundbyskogen 1969.
Šatirani dio kolone odnosi se na nitratni azot.

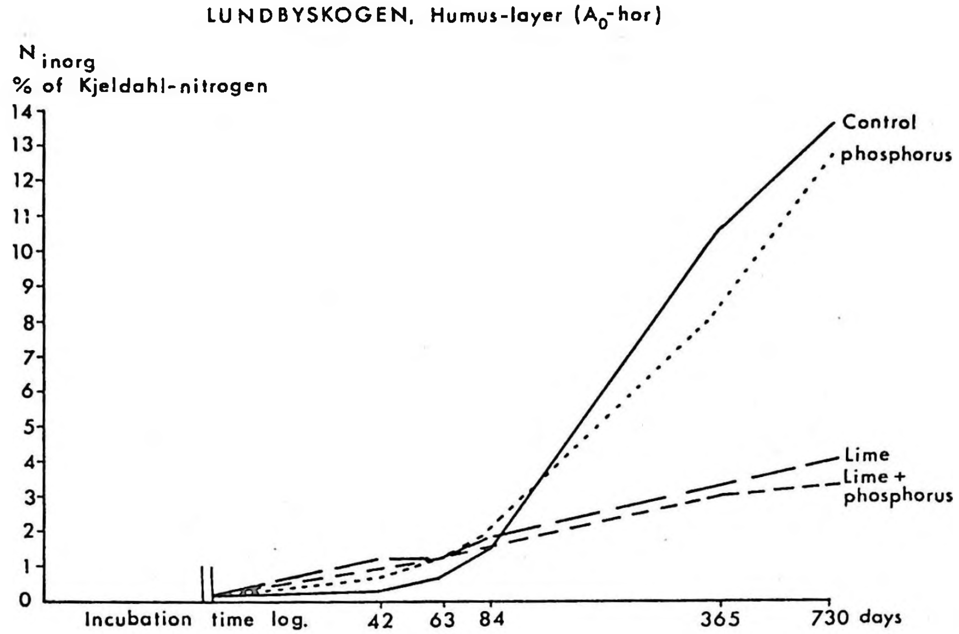

Fig. 5.

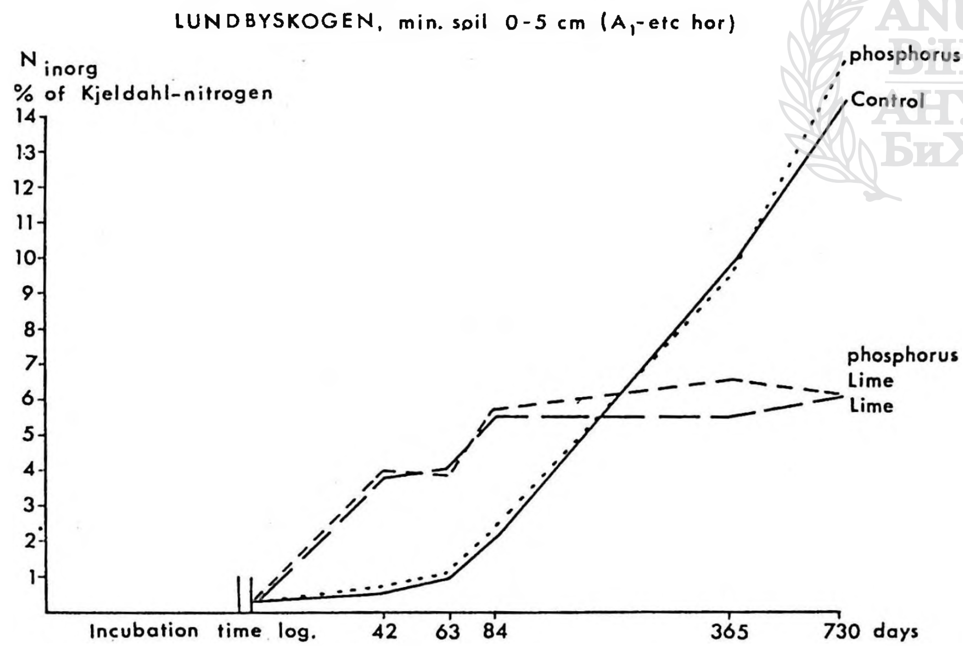

Fig. 6.

Inorganic nitrogen as % of Kjeldahl nitrogen after incubation of soil samples with pretreatment by phosphorus and lime. Lundbyskogen, 1969.

Neorg. azot u procentu od ukupnog azota (Kjeldahl) nakon dugoročne inkubacije tla prethodno tretiranog fosforom i krečom. Lundbyskogen, 1969.

P and untreated soil showed a constant increase of inorganic nitrogen contents (Table 3). This trend of decrease of inorganic nitrogen contents on podzol was not observed in the course of 9 weeks of incubation.

Mineral soil (A_1 etc, 0—5 cm) showed somewhat weaker but positive reaction to the treatment with $CaCO_3$ with both soil types.

The inorganic nitrogen calculated as percentage of the total nitrogen in soil (Kjeldahl — N) presented in Figs. 1 and 3 clearly show the differences in reaction against addition of phosphorus and $CaCO_3$, where the effect in mineral soil (A_1 etc, 0—5) is expressed much more clearly.

For practical purposes, calculation of inorganic nitrogen quantity in kg/ha fora certain layer of soil, which is possible in this case, in interesting, since the samples were taken of definite surface. The results of the calculation presented in Figs. 2 and 4 show that because of considerably greater total weight of the layer of mineral soil (A_1 etc, 0—5 cm), quantities of inorganic nitrogen in that layer are much larger than in the A_0 — horizon (humus). At the same time the difference among particular treatments remained the same.

It seems that the problem of effects of $CaCO_3$ upon mineralization of nitrogen in soil depends upon incubation time which, with different authors varied from one to even 12 months (Kaila & Soini, 1957, for instance), and that might explain the differences in results. The result of incubation experiment of two years, shown in Figs. 5 and 6. is very interesting. Positive effects of $CaCO_3$ treatment on nitrogen mineralization in soil vanish after 12 weeks of incubation in humus (A_0 — horizon) and a little later in mineral soil (A_1 etc.).

Addition of phosphorus only to the soil did not influence the course of nitrogen mineralization, probably because one can not talk about any lack of phosphorus for the needs of microbiological activity in soil.

Having studied the results of the laboratory experiments, which produced a fairly clear picture of the effect of phusphorus and $CaCO_3$ on nitrogen mineralization, we came across the question of what is the reaction to the same treatment in a field experiment (in the stand) after a certain period of time following the treatment. Therefore we conducted an experiment on soil incubation from differently fertilized plots on brown soil (Frodeparken), as well as an experiment with liming of podzol (Lundbyskogen). The results of this experiment presented in Table 4 and in Figs.

CONTENT OF INORGANIC NITROGEN IN SOIL SAMPLES FROM DIFFERENT TREATED FERTILIZER TRIALS, AFTER INCUBATION EXPERIMENT IN THE LABORATORY. VALEUS IN PPM/D. W.

SADRŽAJ NEORGANSKOG AZOTA U UZORCIMA TLA SA RAZLIČITIH ĐUBRENIH PARCELA NAKON INKUBACIJE U LABORATORIJI. VRIJEDNOSTI U PPM/S. M.

Locality Lokalitet	Treatment Tretman	Incubation period, weeks — Period inkubacije, nedjelja 0	 6	 9
Frodeparken		A_0 — horizont — A_0 horizon		
	Control	75,8 (1,5)	250,8 (36,0)	297,4 (115,6)
	PK	47,8 (2,2)	246,2 (35,4)	364,6) 94,2)
	NPK	45,2 (7,3)	345,6 (80,8)	402,8 (103,0)
	N	76,6 (2,0)	258,4 (36,1)	321,0 (104,4)
	CaN	5,8 (2,3)	37,6 (10,8)	44,2 (38,2)
	Ca	8,5 (3,6)	21,0 (17,3)	29,4 (17,2)
Lundbyskogen				
	Control	22,7 (1,9)	162,1 (2,8)	221,5 (2,5)
	Ca	20,5 (2,0)	65,1 (2,1)	107,6 (1,1)
Frodeparken		A_1 etc, 0—5 cm, mineral soil — mineralno tlo		
	Control	5,6 (0,5)	38,9 (0,8)	63,8 (17,7)
	PK	59,2 (0,5)	32,2 (4,1)	54,2 (19,9)
	NPK	9,9 (1,3)	54,2 (5,7)	74,1 (30,4)
	N	12,3 (0,3)	47,8 (12,4)	62,8 (24,0)
	CaN	2,9 (1,5)	32,8 (9,8)	37,3 (24,2)
	Ca	1,9 (1,2)	11,0 (8,4)	34,0 (27,2)
Lundbyskogen				
	Control	8,7 (0,4)	27,8 (0,8)	33,5 (0,8)
	Ca	13,5 (0,5)	27,5 (0,6)	34,1 (0,5)

( ) nitrate nitrogen — nitratni azot

7, 8, 9 and 10 show a definitely clearly expresed depressive effect of $CaCO_3$ fertilization upon nitrogen mineralization in soil, which is particularly clear in brown soil. This depressive effect is considerably smaller with mineral soil, it almost does not exist with podzol and judging from Fig. 9 it almost becomes positive. Such a difference in the reaction after the treatment with $CaCO_3$ between humus and mineral soil was noticed by T a m m and P e t t e r s o n, but only in laboratory experiments.

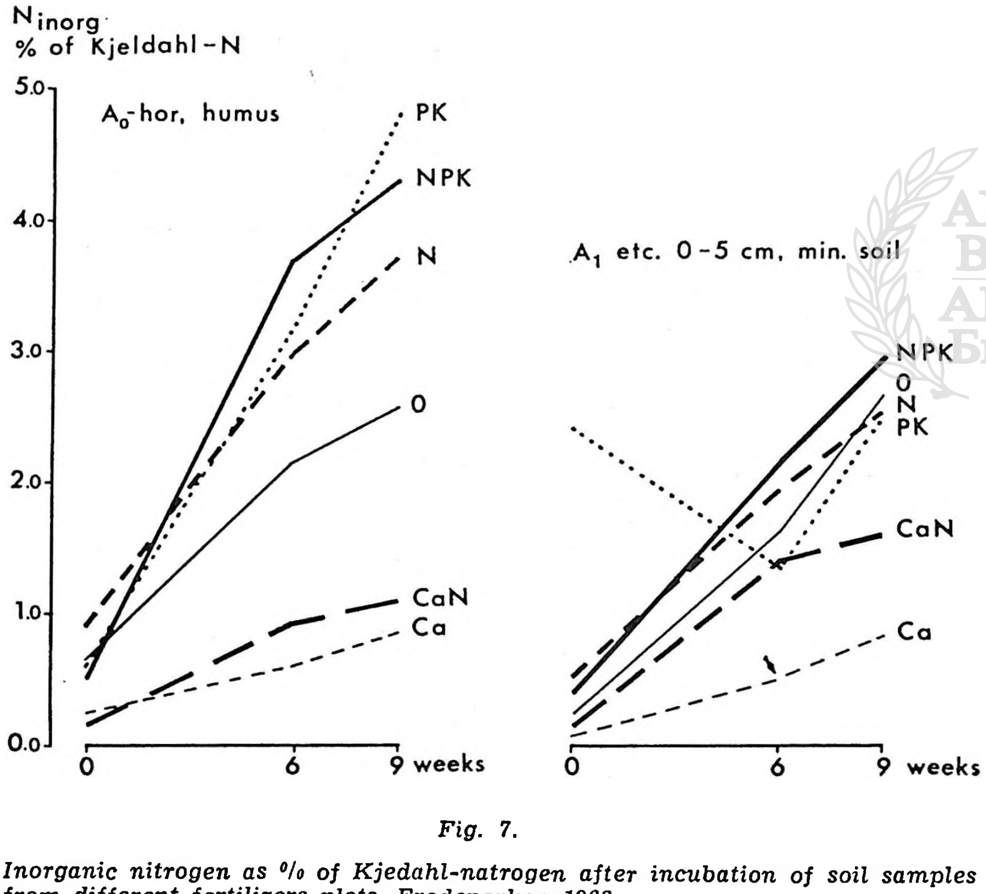

Fig. 7.

Inorganic nitrogen as % of Kjedahl-natrogen after incubation of soil samples from different fertilizers plots. Frodeparken 1966.

Neorganski azot u procentu od ukupnog azota (Kjeldahl) nakon inkubacije uzoraka tla sa različito đubrenih parcela. Frodeparken, 1966.

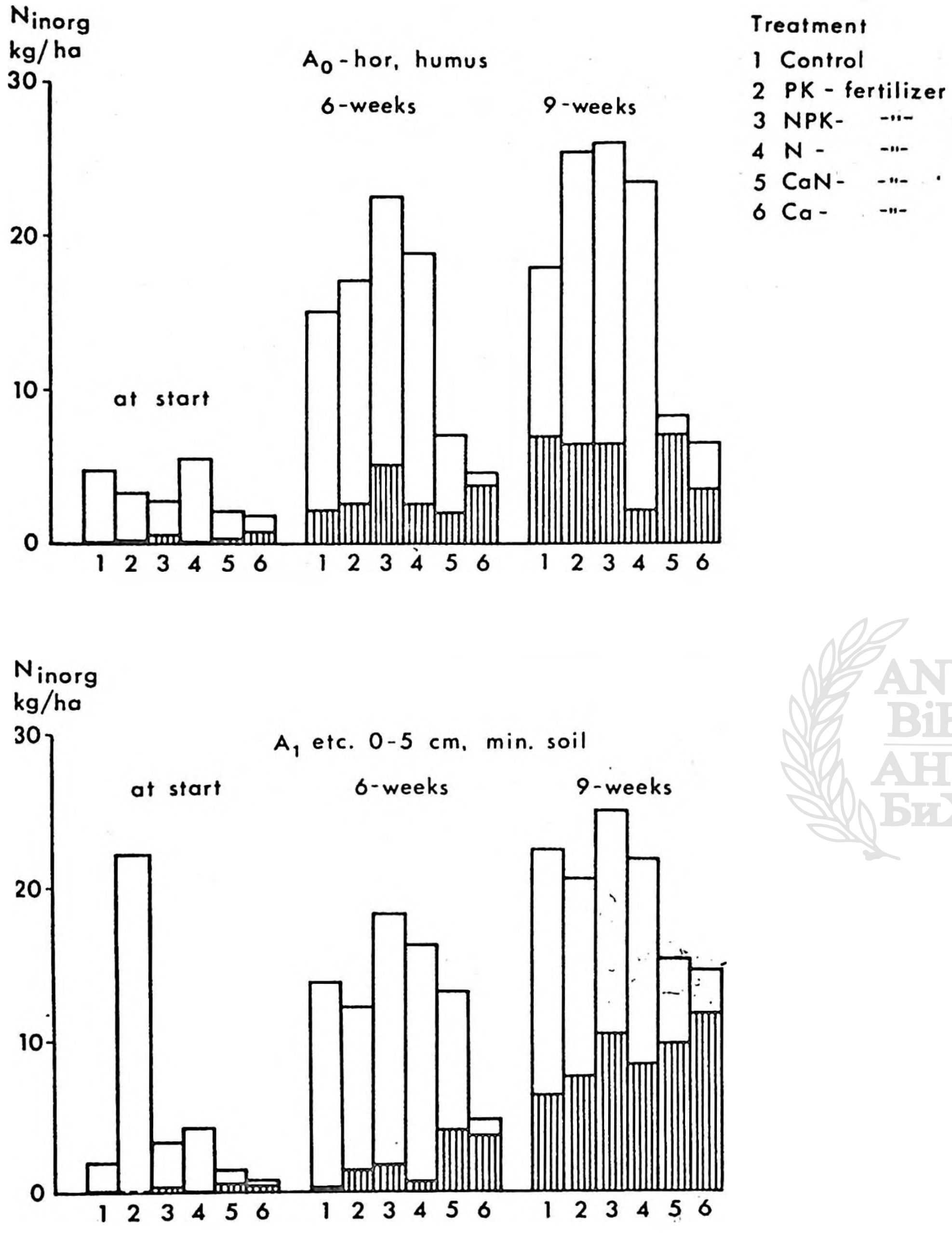

Fig. 8.

Amount of inorganic nitrogen after incubation of soil samples from different fertilizers plots. Frodeparken, 1966.

Količina neorganskog azota (kg/ha) nakon inkubacije uzoraka tla sa različito đubrenih parcela. Frodeparken, 1966.

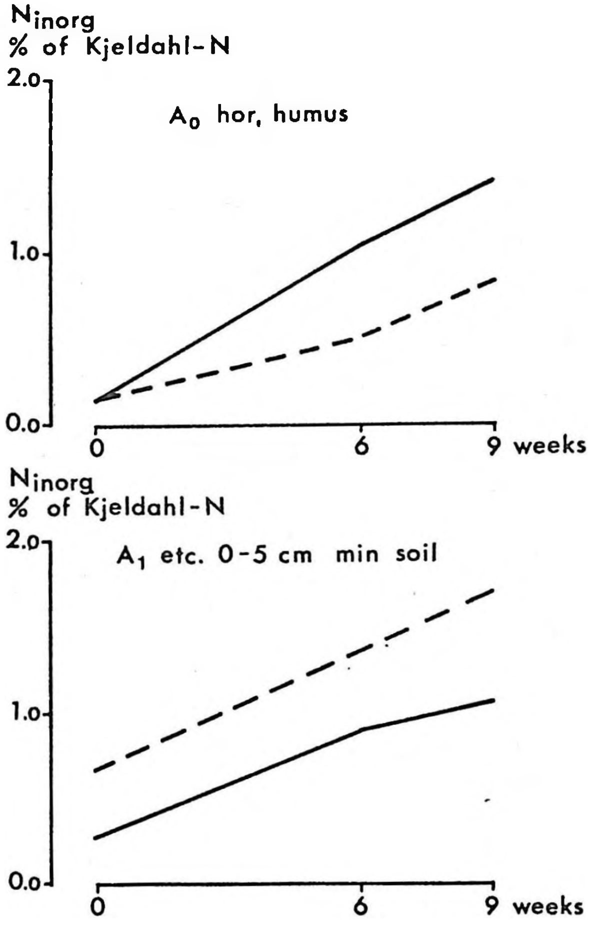

Fig. 9.

Inorganic nitrogen as % of Kjeldahl nitrogen after incubation of soil samples from limed and unlimed plots. Lundbyskogen, 1971.

Neorganski azot u procentu od ukupnog azota (Kjeldahl) nakon inkubacije uzoraka tla sa kalcificiranih i kontrolnih parcela. Lundbyskogen, 1971.

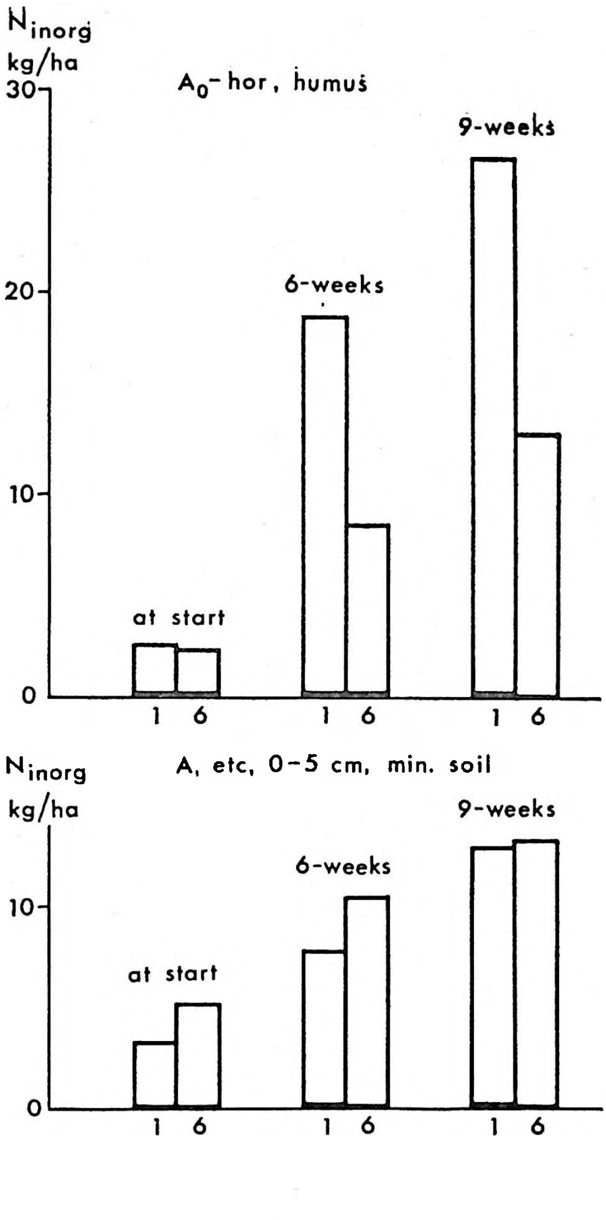

Fig. 10.

Amount of inorganic nitrogen after incubation of soil samples from limed and unlimed plots. Lundbyskogen, 1971.

Količina neorganskog azota nakon inkubacije uzoraka tla sa kalcificirannih i kontrolih parcela. Lundbyskogen, 1971.

Comparing soil reaction to $CaCO_3$ treatment in a laboratory experiment and a field experiment, one can conclude that short term incubation experiments with samples of soil from differently fertilized plots taken some years after fertilization confirm the results of long term incubation experiment with pretreatment in laboratory (Lundbyskogen, Figs. 5 and 6.)

On the other hand qualitative changes in the mineralization process with brown soil (appearance of intensive nitrification) are of lasting character, judging from the results of soil incubation from differently fertilized plots (Table 4 and Fig. 8).

SUMMARY

For a short — time incubation experiment, using soil materials from A_0 and A_1 horizons of an iron-humus podzol and forest brown soil from spruce stand, respectively, it was found that the liming (pH adusted to 6.5) increased initially the accumulation of inorganic nitrogen in the soil. This positive effect of liming was of short duration, however, attaining the maximum after 6 do 9 weeks of incubation (forest brown soil A_0-hor.) investigated.

On proceeding incubation of samples from podzol soil it was shown that the mineralization decreased after 3 months incubation so that after one and two years incubation the $CaCO_3$ — treated samples showed much lower contents of inorganic nitrogen than the control. The different reaction on the $CaCO_3$ treatment of the two soil types studied should be stressed. In raw humus of the podzol soil the N mineralization was enhanced by $CaCO_3$ addition, but only ammonia was accumulated. In samples of forest brown soil the $CaCO_3$ addition induced an intensive nitrification which did not occur in the control and P — treated samples.

The addition of phosphorus did not affect significantly the nitrogen mineralization.

The fertilizer experiment was carried out on the same site a long time ago. (1956, Frodeparken and 1969 Lundbyskogen). Soil samples taken from a field trial, fertilized 10 years ago, showed an incubation that the $CaCO_3$ addition had a clear negative effect on the inorganic nitrogen accumulation after 6 — and 9 — weeks incubation. Exceptionaly could be observed a poorly positive effect by $CaCO_3$ — treatment for the mineral soil from podzol (two yearsafter liming in the field).

Liming showed a long-term effect on the nitrification in brown soil, opposite to negative balance of total inorganic nitrogen. In the podzol soil was not possible to determine notably nitrification after liming in the field. As an important factor for the phenomenon of nitrification could be mentioned C/N ratio, which varied from ca 20 in brown soil, and to 31 in the podzol.

Both sorts of experiments showed clearly that the liming involves a short-term positive effect on the accumulation of inorganic nitrogen by increasing of the microbiological activity, but this not longer than 8—10 weeks.

Otherwise this phenomenon of nitrification in the brown soils is of great interest, and it seems to be of longer duration.

POPOVIĆ B.

DJELOVANJE KREČNOG I FOSFORNOG ĐUBRIVA NA AKUMULACIJU MINERALNOG AZOTA U OGLEDU INKUBACIJE ŠUMSKOG TLA

KRATAK SADRŽAJ

U cilju ispitivanja efekta fosfornog i krečnog đubrenja na mineralizaciju azota u šumskom tlu vršena je inkubacija uzoraka humusa i mineralnog tla iz sloja 0—5 cm neposredno ispod humusnog u mračnoj komori pri temperaturi od 20 °C i vlažnosti zraka 70—80%. U ogled su bila uzeta dva tipa tla: kiselo-smeđe i željezno-humusni podzol, oba pod smrčevom šumom.

Uzorci tla su stavljeni u inkubaciju u svježem stanju (nisu sušeni) i vlažnost je prethodno dotjerana na 60% od maksimalnog kapaciteta za vodu (WK).

Određivanje amonijačnog i nitratnog azota je vršeno u ekstraktu 4% $K A_l (SO_4)_2$ rastvora pri startu, te nakon 6 i 9 nedjelja inkubacije.

Kratkoročni inkubacioni eksperiment (do 9 nedjelja) sa željezno-humusnim podzolom i kiselim smeđim tlom iz smrčevih šuma, te prethodnim tretmanom sa $CaCO_3$ do postizanja pH — reakcija 6,5 i sa fosforom u količini od 320—420 ppm P (odnosno 200 ppm P za mineralno tlo) pokazalo je da kalcifikacija povećava akumulaciju ukupnog neorganskog azota u tlu. Taj pozitivan efekt kalcifikacije izgleda da je kratkotrajan, jer nakon 9 nedjelja inkubacije moguće je konstatovati smanjenje sadržaja ukupnog neorganskog azota kod jednog dijela istraživanih uzoraka tla (kiselo-smeđe tlo, A_0 — hor).

Različita reakcija u odnosu na $CaCO_3$ — tretman za dva tipa tla u ovom ogledu može se utvrditi. Na mineralizaciju azota u sirovom humusu podzola pozitivno je djelovao $CaCO_3$ — tretman, ali je povećanje ograničeno samo na amonifikaciju (nitrifikacija nije registrovana). U uzorcima smeđeg tla tretiranim sa $CaCO_3$ konstantovana je pojava intenzivne nitrifikacije, koja kod kontrolnih i samo sa P-tretiranih uzoraka tla nije opažena.

Dugoročni inkubacioni ogled sa podzolom u trajanju od 2 godine sa istim predtretmanom ($CaCO_3$ i KH_2PO_4) pokazao je jasno da je pozitivna reakcija na $CaCO_3$ — tretman kratkotrajnog karaktera. Mineralizacija azota je počela da opada nakon 3 mjeseca inkubacije kod tretiranih uzoraka, da bi u ukupnom bilansu nakon 1 i 2 godine inkubacije bio utvrđen znatno manji sadržaj neorganskog azota u tlu.

Tretman samo sa fosforom nije pokazao izraženi efekat; ni u kombinaciji sa $CaCO_3$ nije imao većeg uticaja na akumulaciju neorganskog azota.

Isto stanište je bilo iskorišteno za ogled sa đubrenjem prije više godina. Uzorci tla sa različito đubrenih parcela podvrgnuti su kratkoročnom ogledu inkubacije (do 9 nedjelja) i pokazali su jasno negativan uticaj kalcifikacije na akumulaciju neorganskog azota. Izuzetak čini jedino sloj mineralnog tla (A_1 etc. 0—5 cm) kod podzola, gdje se može opaziti slabiji pozitivan efekt $CaCO_3$-tretmana.

Kalcifikacija je pokazala ipak dugotrajan efekt u odnosu na pojavu nitrifikacije kod smeđeg tla, uprkos negativnom bilansu ukupnog neorganskog azota. Nasuprot tome, kod podzola nije opažena pojava iste. Kao jedan važan faktor za pojavu nitrifikacije u ovom ogledu se smatra C/N odnos, koji varira 20—24 za smeđe tlo i 25—31 za podzol.

Obje vrste sprovedenog eksperimenta su pokazale da kalcifikacija može imati jedan kratkotrajni pozitivni efekt na akumulaciju neorganskog azota kao rezultat povećanja mikrobiološke aktivnosti u tlu, ali ne duže od 8—10 nedjelja. Pri tom je od posebnog interesa pojava nitrifikacije, koja može biti znatno dugotrajnija.

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