Results of investigations of sewage sludge composting process-
1st and 2nd stage

EUROPEAN UNION
Interreg South Baltic

Results of investigations of sewage sludge composting process- 1st and 2nd stage

The main goal of the research was to find out how much supplementation can be reduced during the composting of sewage sludge

- **1) evaluation of the C/N ratio during composting**
- **2) influence of the C/N ratio on the compost maturation process**
- **3) influence of the C/N ratio on the transformation of chemical forms of heavy metals**

Methodology of field research

stage I

- components	dewatered sewage sludge	straw	wood chips	inocula (matured compost)	
series no. 1 (parts, wet mass)	4	1	0,5	0,5	(4-1-1)
series no. 2 (parts, wet mass)	8	1	1	1	(8-1-2)

stage II

	dewatered sewage sludge	straw	wood chips	
windrow no. 1 (parts, wet mass)	1	0	1	(1-0-1)
windrow no. 2 (parts, wet mass)	2	1	1	(2-1-1)

sludge

straw

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type of research	parameter	methodology	the number of analyzes			
			substrate samples		compost samples	
			stage I, 4 series	stage II, 2 series	stage I, 4 series	stage II, 2 series
			sludge/straw/chips	sludge/straw		
Physical and chemical properties	dry mass	PN-R-04006	4/4/4	2/1	40	18
	org. matter	PN-Z-15011-3	4/4/4	2/1	40	18
	C org.	PN-Z-15011-1,3	4/4/4	2/1	40	18
	N tot.	PN-R-04006	4/4/4	2/1	40	18
	P tot.	PN-Z-15011-3	4/4/4	2/1	40	18
heavy metals	Cr	(AAS)	4	-	40	-
	Cd		4	-	40	-
	Pb		4	-	40	-
	Hg		4	-	40	-
	As (inorganic)		-	2	-	2
speciation analysis	Zn- fr.I	according to the Tesiers method	4	2	40	18
	Zn- fr.II		4	2	40	18
	Zn- fr.III		4	2	40	18
	Zn- fr.IV		4	2	40	18
	Zn- fr.V		4	2	40	18
	Cu- fr.I		4	2	40	18
	Cu- fr.II		4	2	40	18
	Cu- fr.III		4	2	40	18
	Cu- fr.IV		4	2	40	18
	Cu- fr.V		4	2	40	18
	Ni- fr.I		4	2	40	18
	Ni- fr.II		4	2	40	18
	Ni- fr.III		4	2	40	18
	Ni- fr.IV		4	2	40	18
	Ni- fr.V		4	2	40	18
humic substance	FA	according to the IHSS Standard	4	2	40	18
	HA		4	2	40	18
total			**184**	**51**	**1040**	**398**
all			**1673**			

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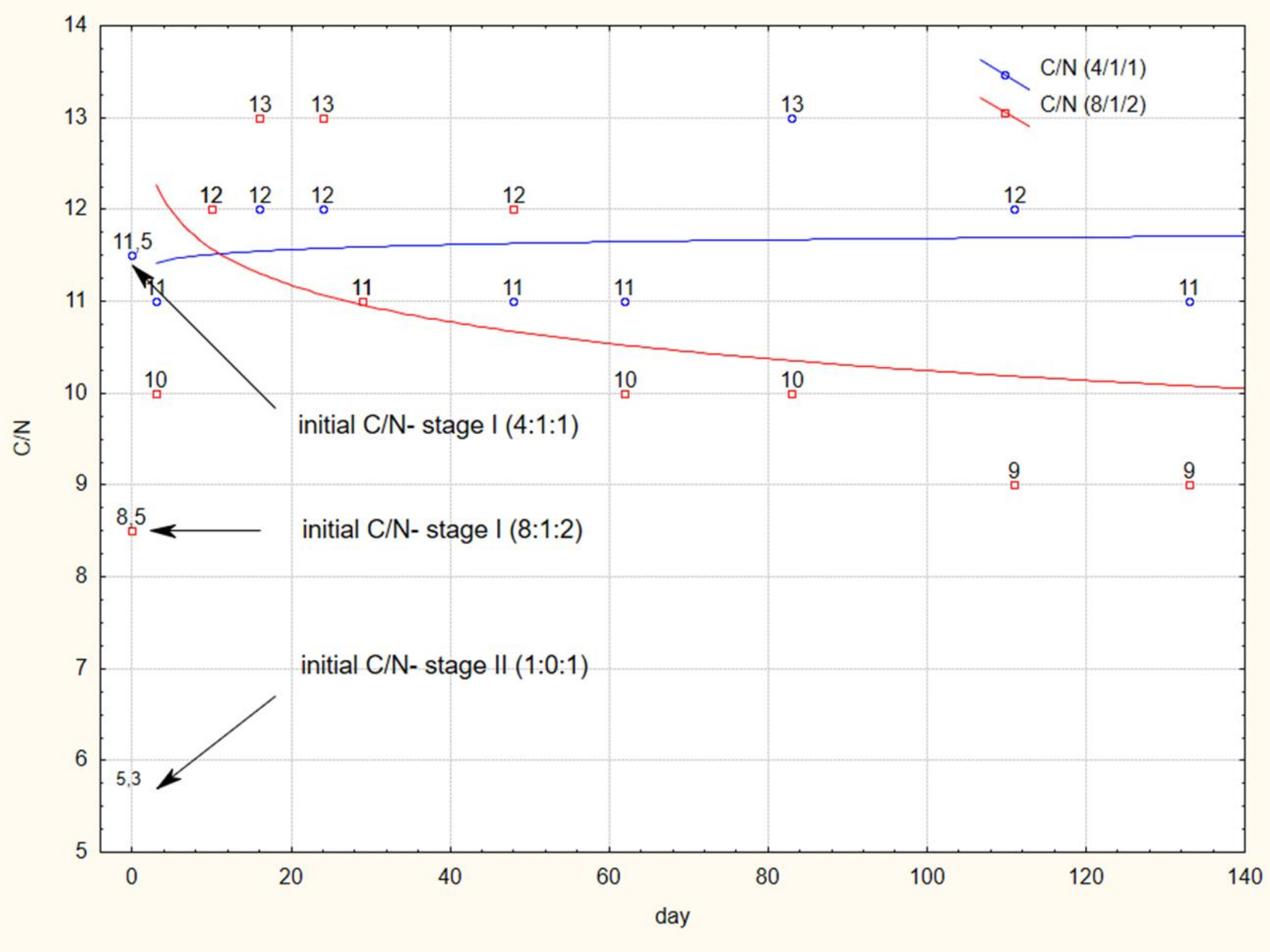
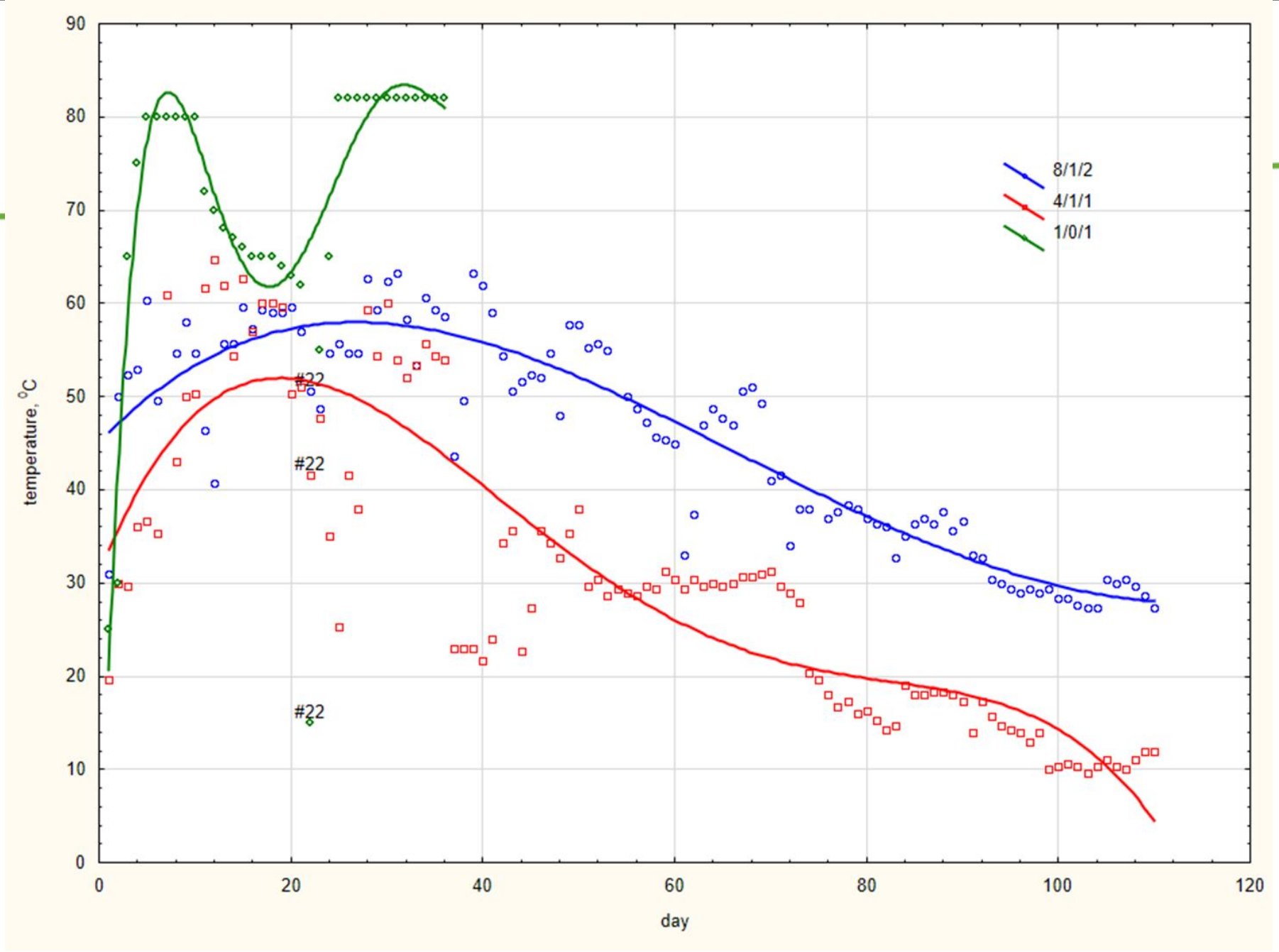

C/N (4/1/1)
C/N (8/1/2)
initial C/N- stage I (4:1:1)
initial C/N- stage I (8:1:2)
initial C/N- stage II (1:0:1)
C/N
day
14
13
12
11
10
9
8
7
6
5
0
20
40
60
80
100
120
140
11,5
8,5
5,3



Goleniowskie Wodociągi i Kanalizacja

The main goal of the research was to find out how much supplementation can be reduced during the composting of sewage sludge.

The main scope of the investigation was:

1) evaluation of the C/N ratio during composting

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The conditions of sequential extraction according to the Tessier's method

stage	fraction	extractant	extraction's conditions	
			time	temperature
FI	exchangeable	10 cm^3 1M CH_3COONH_4 ; pH=7	1h	ca 20°C
FII	carbonates	20 cm^3 1M CH_3COONa with H_3COOH; pH=2	5h	ca 20°C
FIII	associated with Fe / Mn oxides	20 cm^3 0,4 M $NH_2OH \cdot HCl$ w 25% (v/v) CH_3COOH	5h	95°C
FIV	associated with humic substance	a) 5cm^3 0,02 M HNO_3 + 5cm^3 30% H_2O_2 , pH=2 b) 5cm^3 30% H_2O_2 , pH=2 c) 10 cm^3 3,2M CH_3COONH_4 in 20% (v/v) HNO_3	a) 2h b) 3h c) 0,5h	a) 85°C, b) 85°C, c) ca 20°C
FV	residual	determined as the difference of the total value of metals and the sum of fractions FI, FII, FIII, FIV		

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COUNCIL DIRECTIVE

of 12 June 1986

on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture

ROZPORZĄDZENIE
MINISTRA ŚRODOWISKA[1)]

z dnia 6 lutego 2015 r.

w sprawie komunalnych osadów ściekowych[2), 3)]

(ordinance : regarding on municipal sewage sludge)

material/ regulation	stage	heavy metals, mg/kg *dm*						
		Zn	**Cu**	**Cr**	**Cd**	**Pb**	**Ni**	**Hg**
sewage sludge	no. I	551,75	225,25	26,25	0,5	48,5	10,5	0,55
	no. II	531,5	216,75	-	-	-	13,75	-
86/278/2001/EU		2500÷4000	1000÷1700	-	20÷40	750÷1200	300÷400	16÷25
257/2015/PL		2500	1000	500	20	750	300	16

PL, EU- Polish and European Union regulations

COMMISSION DECISION

of 28 August 2001

establishing ecological criteria for the award of the Community eco-label to soil improvers and growing media

(notified under document number C(2001) 2597)

(Text with EEA relevance)

(2001/688/EC)

heavy metals, mg/kg *dm*	acording with		compost , days old		
			133		105
	PL	EU	4-1-1	8-1-2	1-0-1
Cr (VI)*	100	2*	48	58	-
Cd	5	2	1,3	0,5	-
Ni	60	50	17	22	**76,5**
Pb	140	120	32	41	-
Hg	2	1	0,37	0,55	-
Zn	-	800	453	555	294,5
Cu	-	300	201	253	122,5
As (inorganic)	-	40	-	-	.....

sample No.	data	time, weeks	Ni, mg/kg *dm*				
			I	II	III	IV	V
1/1	24.11.2020	0	0,310	0,125	0,375	2,250	33,1904
2/1	01.12.2020	1	0,300	0,375	0,375	3,125	50,575
3/1	08.12.2020	2	0,300	0,375	0,500	6,000	26,5750
4/1	15.12.2020	3	0,150	0,000	0,000	3,125	43,9750
5/1	22.12.2020	4	3,300	0,000	0,000	3,125	32,5750
6/1	29.12.2020	5	0,075	0,000	0,000	4,000	77,4250
7/1	05.01.2020	6	0,000	0,000	0,000	4,125	39,3750
8/1	12.01.2021	7	0,000	0,250	0,000	4,625	56,8750
9/1	26.01.2021	8	0,150	0,000	0,000	4,250	72,1000

Fr (I + II + III)= 0,15

Fr (IV + V)= 76,35

Conclusion: the amount of bioavailable Ni is 0,15 mg/kg d.m. and it's less than acceptable - 50 mg/kg d.m.

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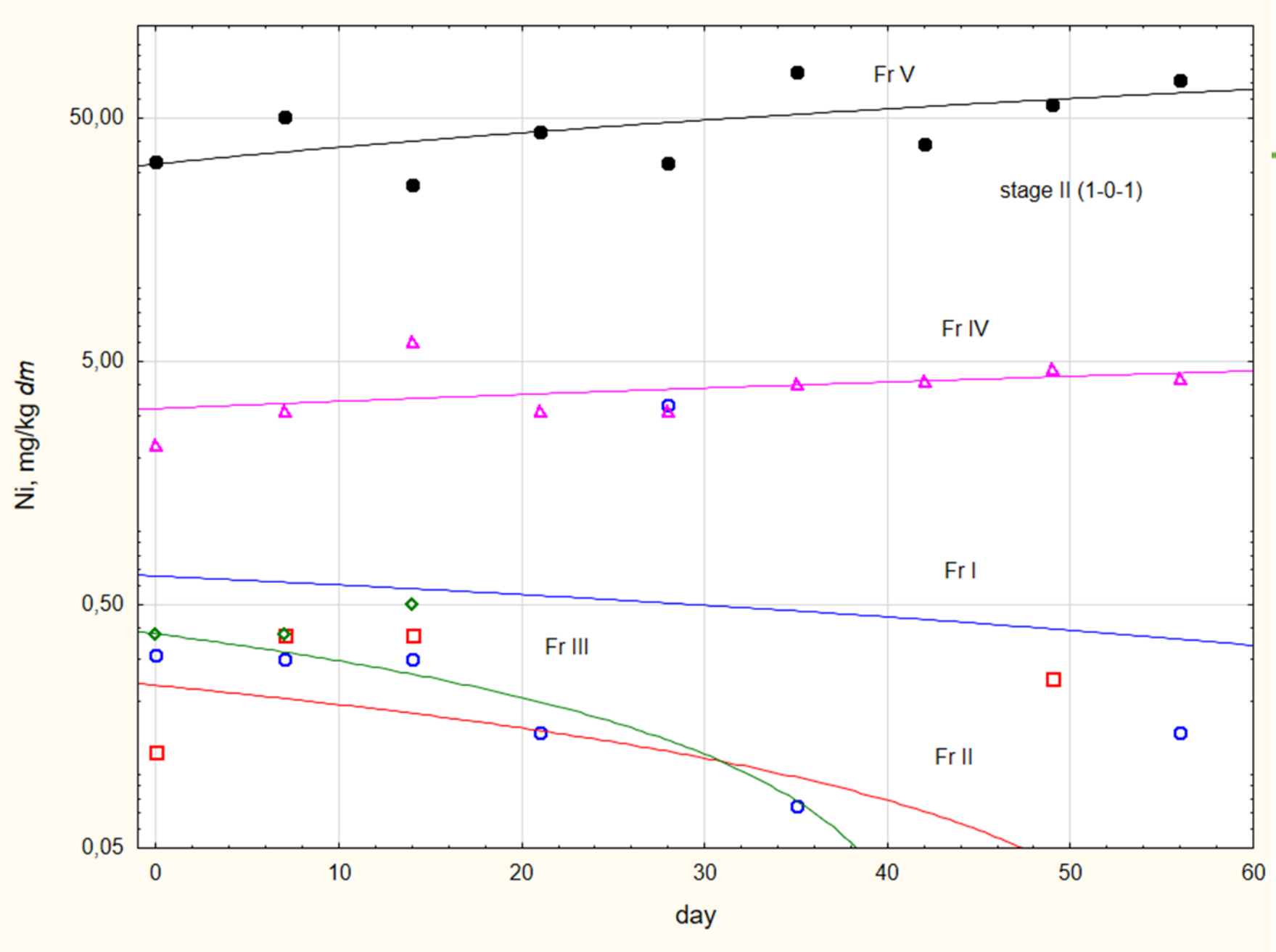
Fr V
stage II (1-0-1)
Fr IV
Fr I
Fr III
Fr II
50,00
5,00
0,50
0,05
Ni, mg/kg dm
0
10
20
30
40
50
60
day

Final Report , stage I:

https://www.step-interreg.eu/wp-content/uploads/2019/09/00-final_report_ang_complete-1.pdf

Final Report , stage II: soon

Thank you for attention

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