The National Centre for Research and Development

FACCE SURPLUS
SUSTAINABLE AND RESILIENT AGRICULTURE FOR FOOD AND NON-FOOD SYSTEMS

BioFooDon MARS

The Polish Experiments 2022

Beata Rutkowska Wiesław Szulc

WP1 Biomass production. Potential crop yields on marginal soils under various regional conditions in Europe. Mapping and optimization of biomass productions

The Experimental Station in Skierniewice

Institute of Agriculture SGGW-WULS in Warsaw


Komenda Miejska
Policji w Skierniewicach
Szkolna
70
Barley/oat
experiment
Grasses
experiment
Jana III Sobieskiego 10,
96-100 Skierniewice
Prywatny Gabinet
Lekarski Neurolog dr n...

Experiments with oat

Meteorological conditions

	I	II	III	IV	V	VI	VII	VIII
mm								
2022	46.9	44.1	1.8	48.9	50.6	58.5	129.8	89.7
Mean 1921-2022	24.7	25.4	27.3	38.2	55.7	63.5	80.9	67.0
°C								
2022	1	3.3	2.7	7	14	19.3	19.3	20.8
Mean 1921-2022	-2.3	-1.6	2.2	7.9	13.6	16.8	18.6	17.8

Scheme of experiment

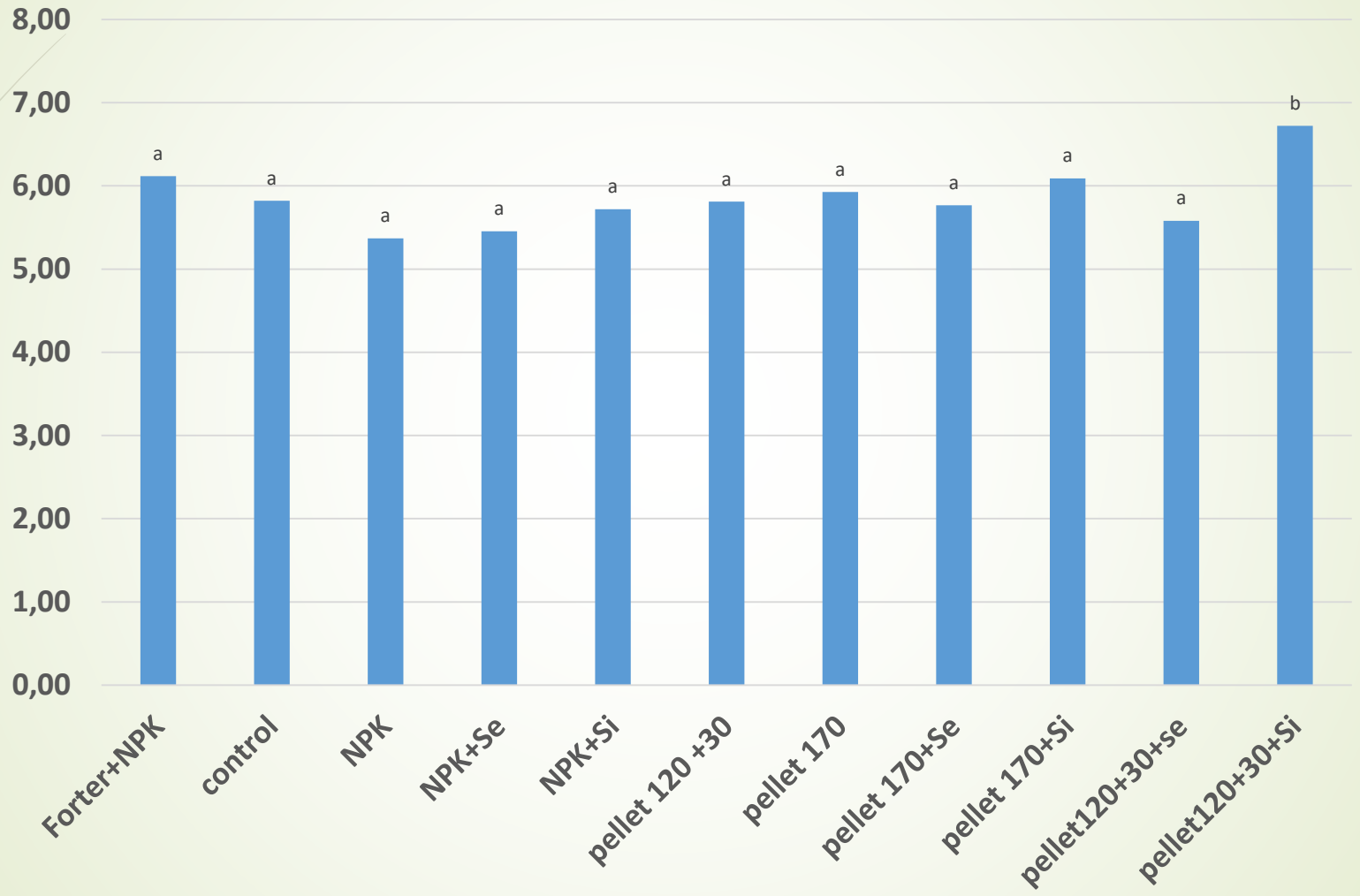
		10
		11
	10	11
	10	11
	1	7
	6	3
	2	5
8	9	4
4	8	9
5	1	2
7	3	6
4	9	8
1	2	5
3	6	7

1.5 m

11.5 m

1. Control - 0
2. N100P80K140
3. N100P80K140 +Se
4. N100P80K140 + Si
5. Compost pellets (N170)
6. Compost pellets (N 170) + Se
7. Compost pellets (N 170) + Si
8. Compost pellets (N120) +30 kg N mineral fertilizers
9. Compost pellets (N120) +30 kg N mineral fertilizers + Se
10. Compost pellets (N120) +30 kg N mineral fertilizers + Si
11. Forter + N100P80K140

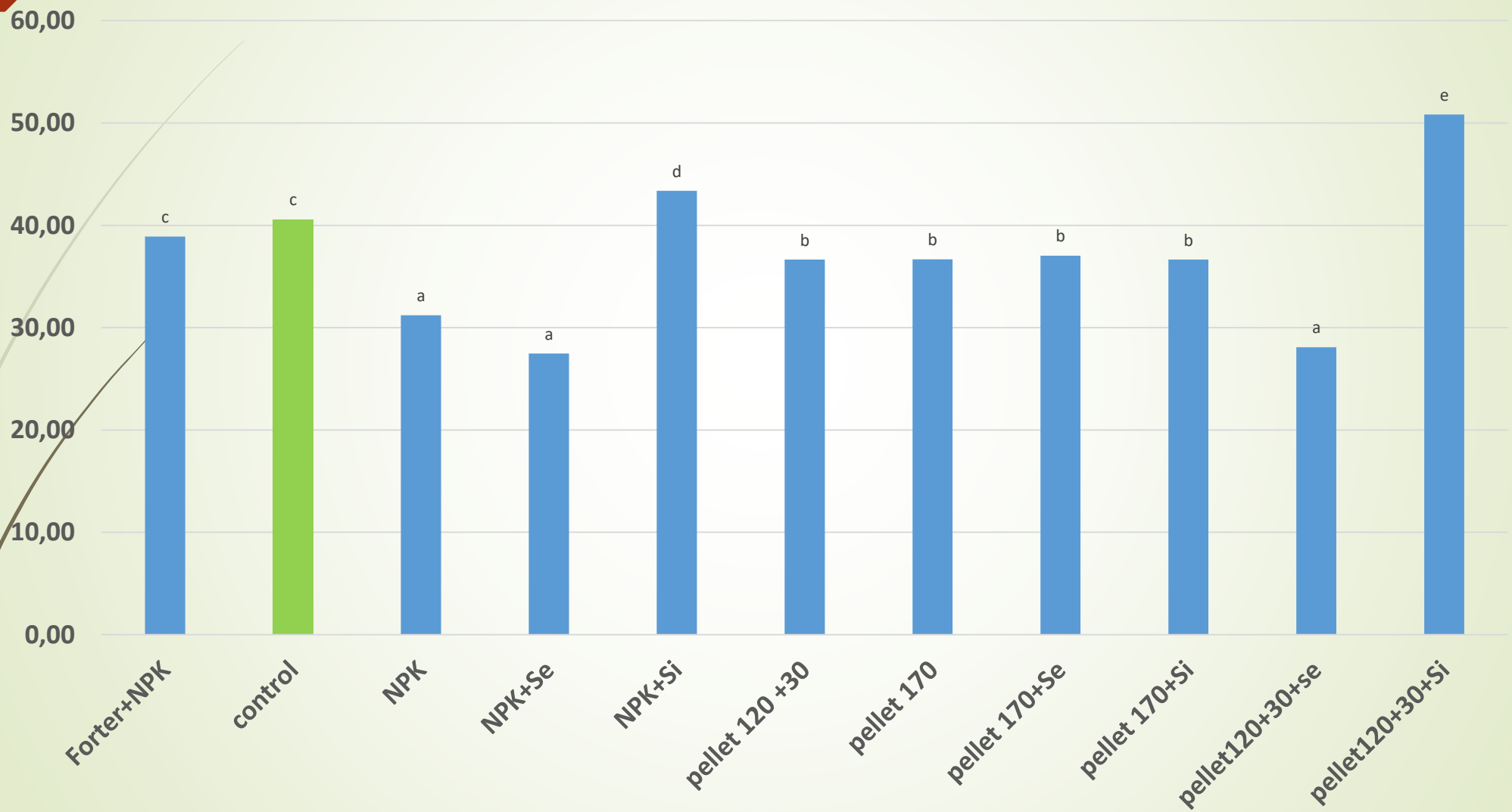
Changes of pH in soil



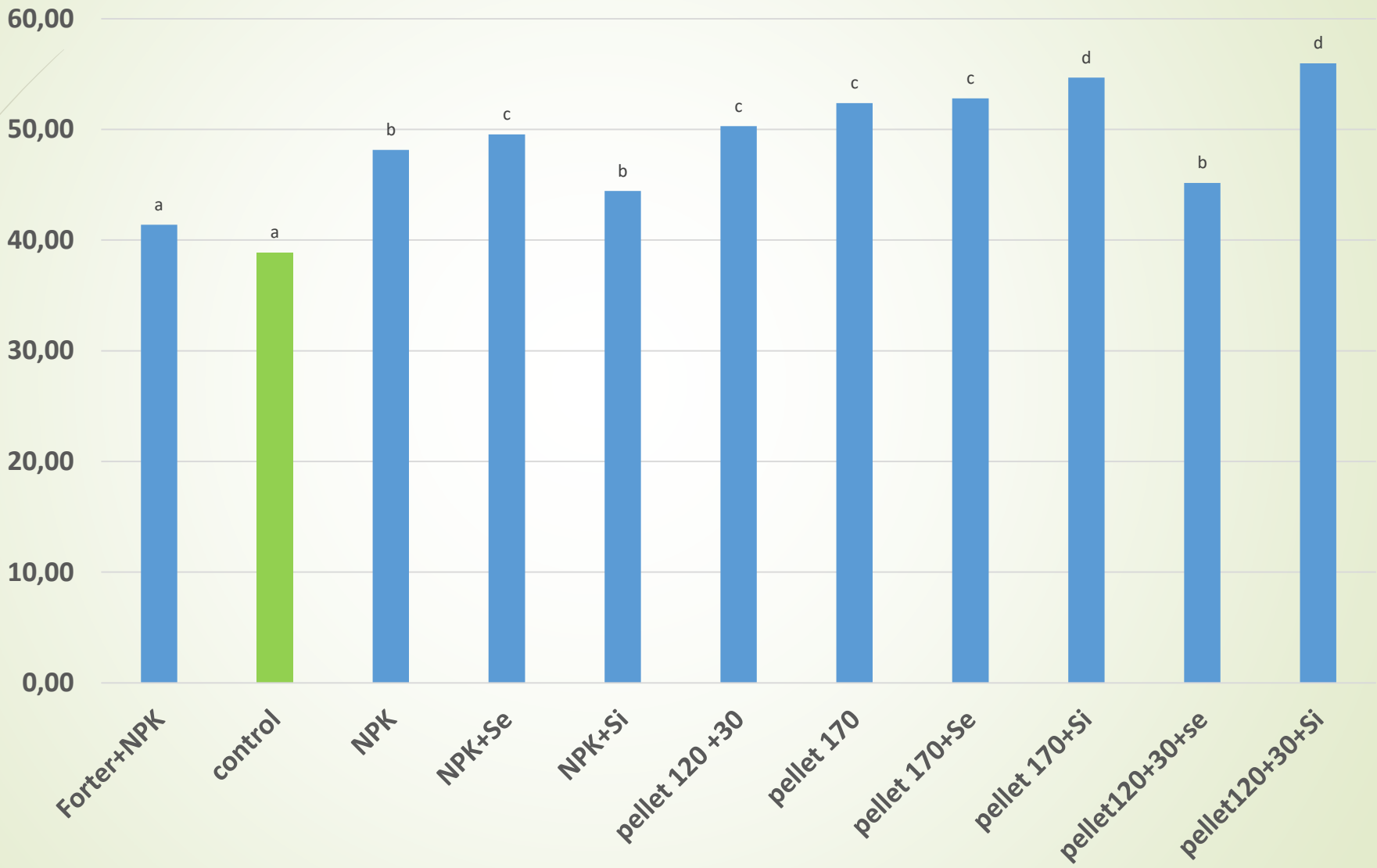
Content of C, N and S in soil (g/kg)

	C	N	S	C/N	C/S
Forter+NPK	9,86ab	1,07	0,16ab	9,2a	62,7b
control	8,10a	0,93	0,15a	8,7a	54,0a
NPK	**8,23a**	**0,94**	**0,14**	**8,7a**	**57,0ab**
NPK+Se	**8,56a**	**0,98**	**0,18b**	**8,7a**	**47,3a**
NPK+Si	8,65a	0,96	0,12a	9,0a	73,2c
pellet 120 +30	9,01a	1,00	0,14a	9,0a	62,9b
pellet 170	8,82a	1,00	0,14a	8,8a	62,5b
pellet 170+Se	8,99a	1,00	0,18b	9,0a	50,8b
pellet 170+Si	8,82a	1,00	0,16ab	8,8a	53,9a
pellet120+30+se	8,95a	1,00	0,14a	9,0a	62,7b
pellet120+30+Si	**10,50b**	**1,03**	**0,17b**	**10,2b**	**63,5b**

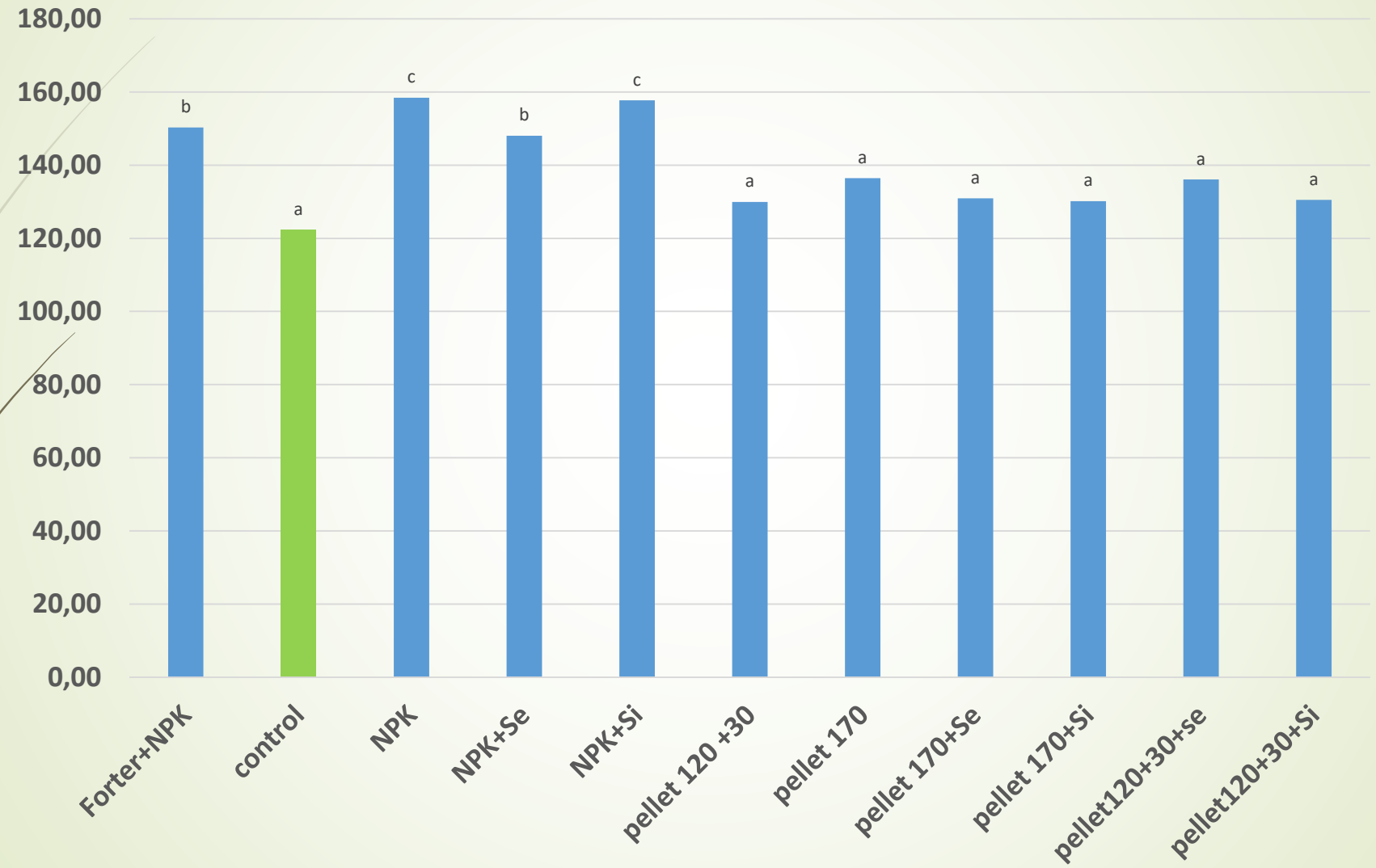
Content of Mg in soil (mg/kg)



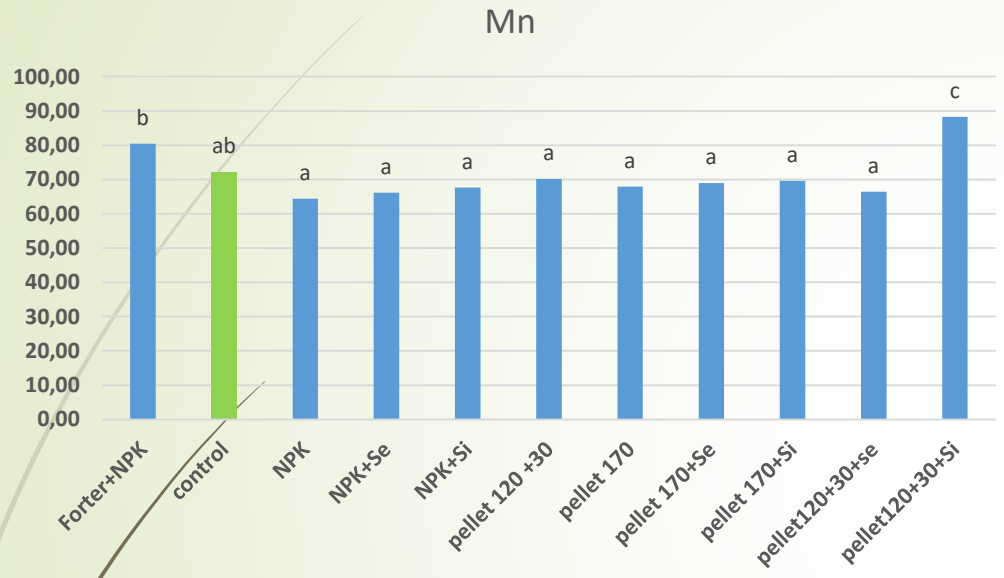
Content of P in soil (mg/kg)

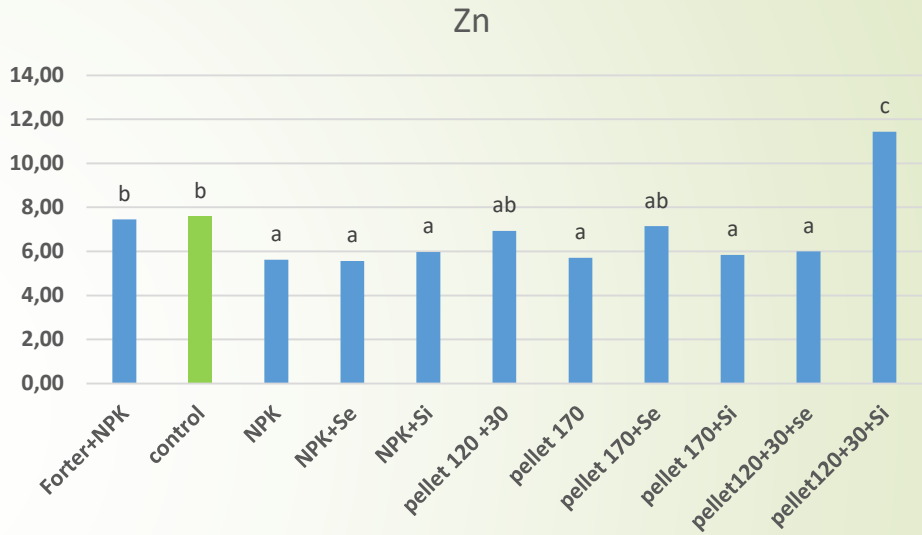


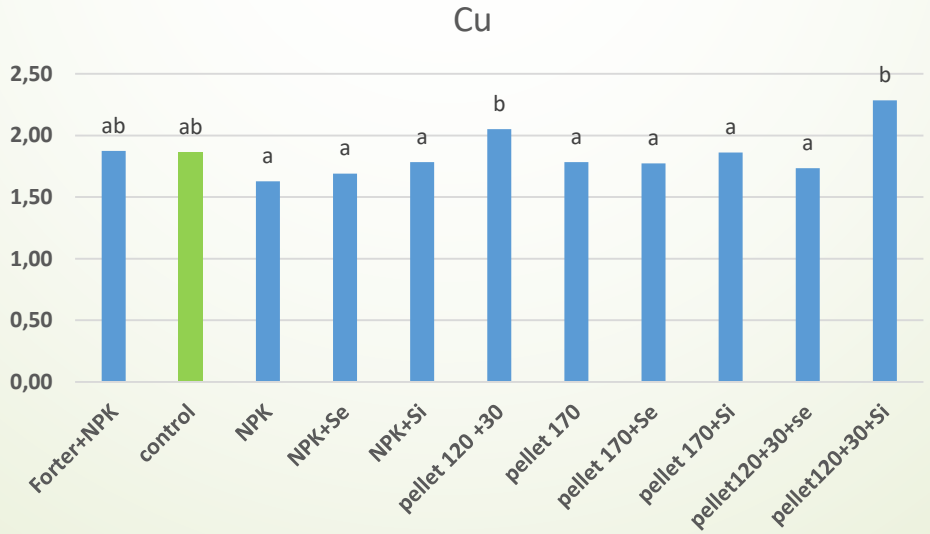
Content of K in soil (mg/kg)



Content of microelements in soil (mg/kg)

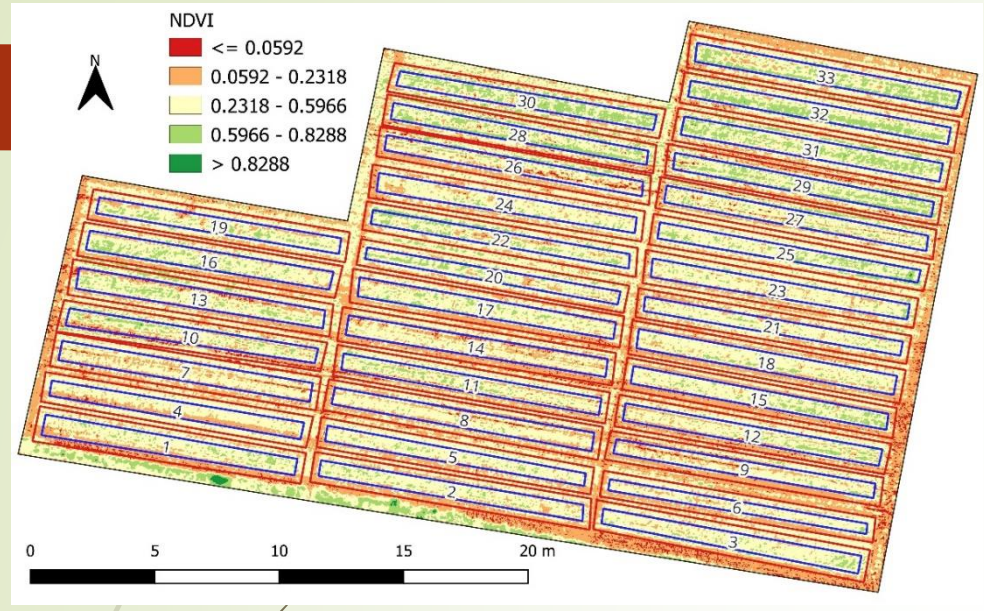




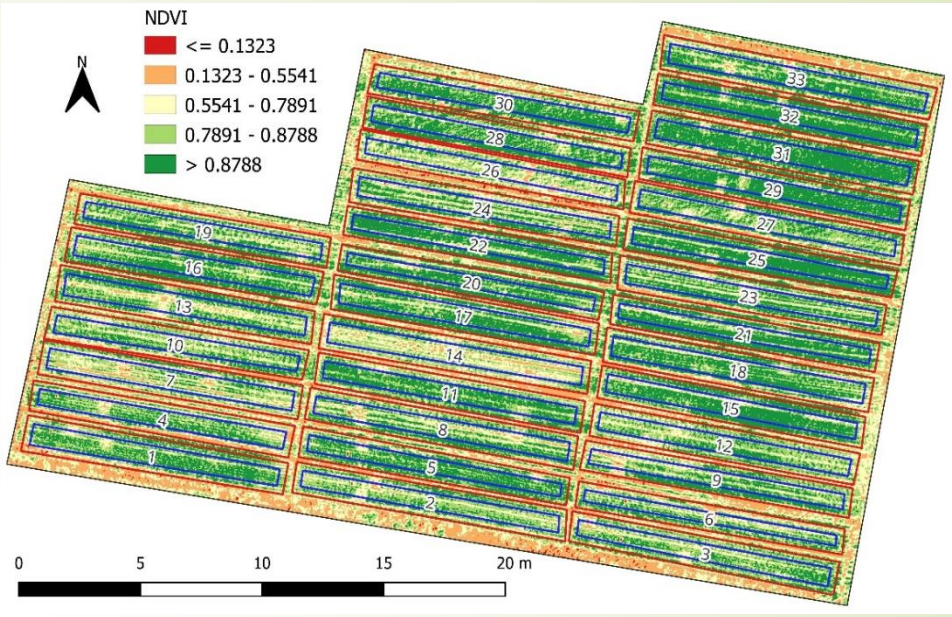


object	NDVI 2022/05/09	NDVI 2022/05/26	NDVI 2022/06/03	NDVI 2022/06/13	NDVI 2022/06/22
control	0.308a	0.679a	0.783a	0.692a	0.728a
pellets (N120)+30Nmin	0.388ab	0.784b	0.829ab	0.763bcd	0.768abc
pellets (N120)+30Nmin+Se	0.377ab	0.796b	0.845ab	0.783bcd	0.778abc
pellets (N120)+30Nmin+Si	0.516cd	0.831b	0.868ab	0.789bcd	0.793abc
pellets (N170)	0.372ab	0.773ab	0.821ab	0.747abc	0.755abc
pellets (N170)+Se	0.399abc	0.770ab	0.819ab	0.746ab	0.749ab
pellets (N170)+Si	0.394abc	0.780b	0.832ab	0.758bcd	0.761abc
Forter+NPK	0.526d	0.837b	0.899b	0.833d	0.837c
NPK	0.436bcd	0.819b	0.876b	0.829cd	0.826bc
NPK+Se	0.435bcd	0.806b	0.880b	0.804bcd	0.808abc
NPK+Si	0.382ab	0.749ab	0.826ab	0.787bcd	0.792abc

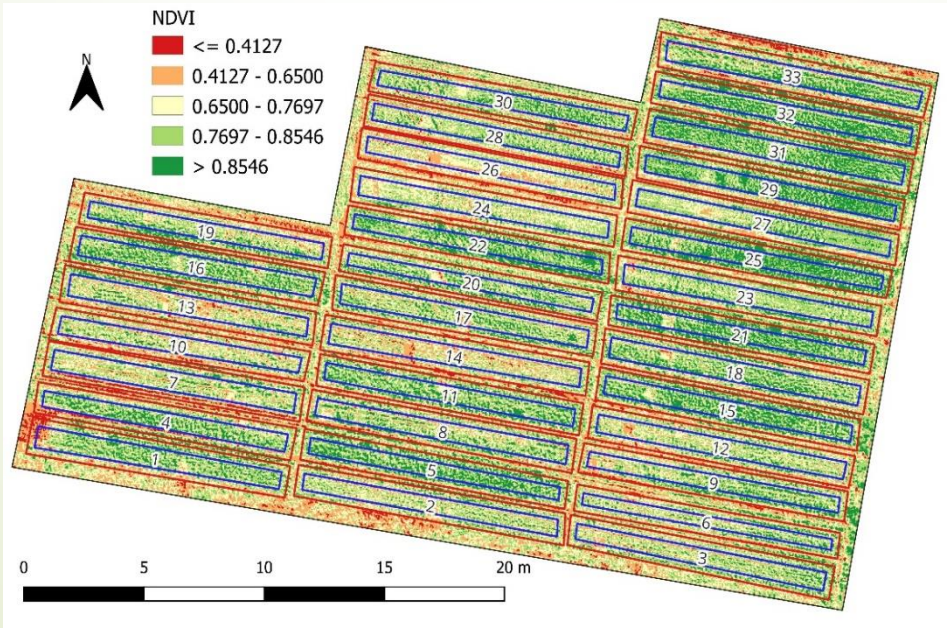
9.05.2022 **tillering**



22.06.2022 **stem elongation**



23.06.2022 **heading**



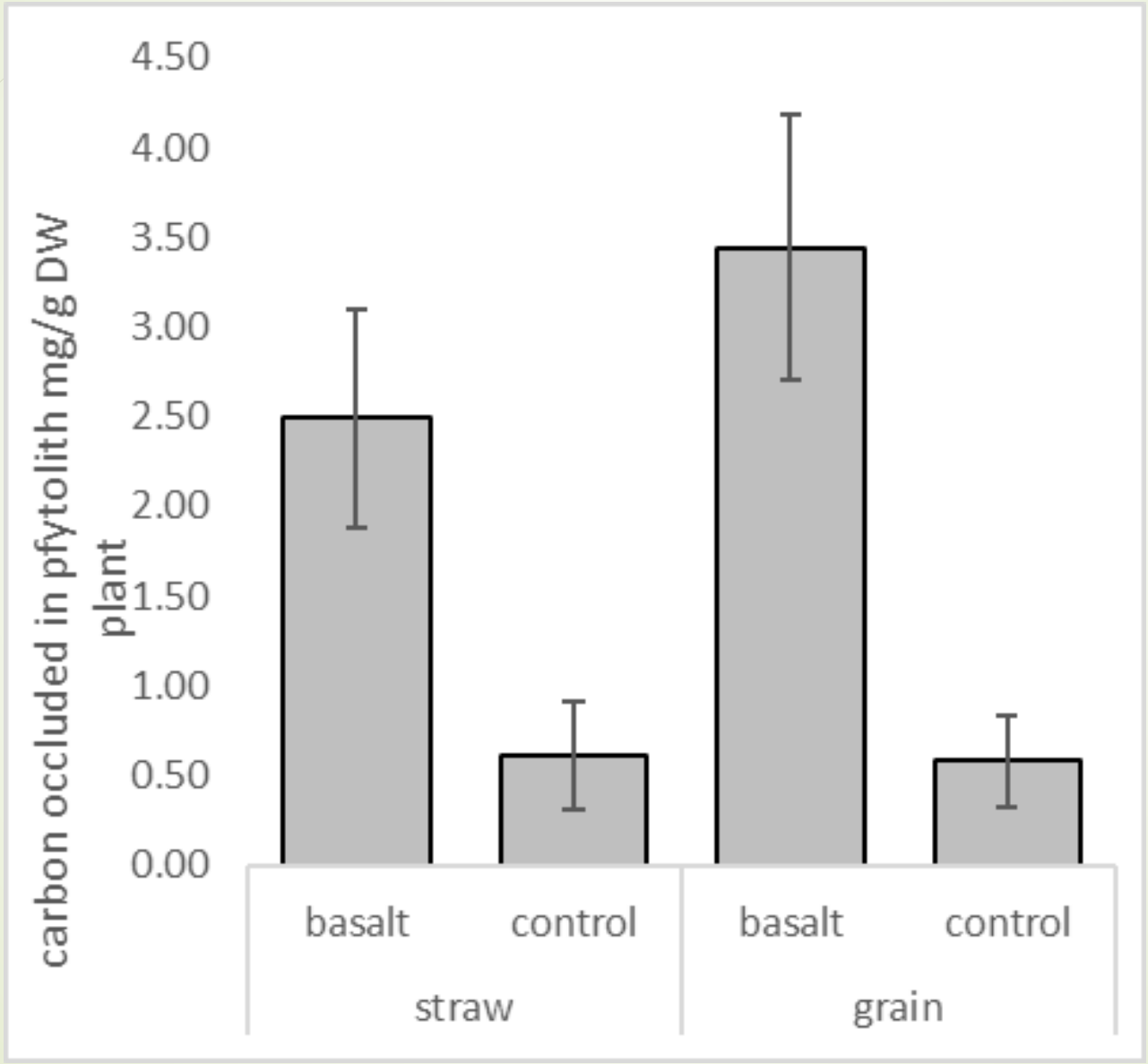
Phytolites

	grain					straw					
	phytoliths	C occluded on phytoliths			CO_2	phytoliths	C occluded on phytoliths			CO_2	CO_2 Grain+straw
	mg/g s.m	mg/g phytolith	mg/g D.M.	in yield kg	kg/ha	mg/g s.m	mg/g phytolith	mg/g D.M.	in yield kg	kg/ha	kg/ha
control	19.43a	8,13a	0,73d	2,10e	7,70g	27.89b	12,47a	4,66a	4,10a	15,04a	22,74a
NPK	19.24a	12,26	0,23b	0,93c	3,41e	31.23d	15,30b	5,13b	10,69f	24,76c	28,17b
NPK+Se	19.59a	9,52a	0,19a	0,70bc	2,58c	28.38c	14,69b	6,20d	8,69e	31,90e	34,48d
NPK+Si	20.13ab	13,66d	0,28	1,16d	4,27f	38.97f	18,91d	8,70f	9,09	50,90g	55,17f
pellet 120 +30	19.88a	11,24c	0,22b	0,80c	2,92d	31.07d	16,70c	6,97e	7,81d	28,67d	31,60c
pellet 170	19.28a	9,17a	0,18a	0,54a	1,98a	30.29cd	13,18b	5,59c	5,08b	18,64b	20,62a
pellet 170+Se	18.46a	10,56b	0,20a	0,66b	2,43b	31.47d	12,11a	4,26a	5,10b	18,73b	21,16a
pellet 170+Si	21.28b	8,69a	0,18a	0,63b	2,33b	34.20e	14,21b	6,89e	7,59c	27,85d	30,18c
pellet120+30+Se	18.63a	10,30b	0,19a	0,66b	2,43b	28.61b	17,47c	7,05e	8,24e	30,26e	32,69c
pellet120+30+Si	20.06ab	9,25a	0,18a	0,68b	2,48b	32.91d	14,58b	6,52d	8,32e	30,52e	33,01d
Forter+NPK	19.74a	7,88a	0,67c	2,82f	10,34h	24.42a	13,99b	7,48e	10,26f	37,65f	47,99e

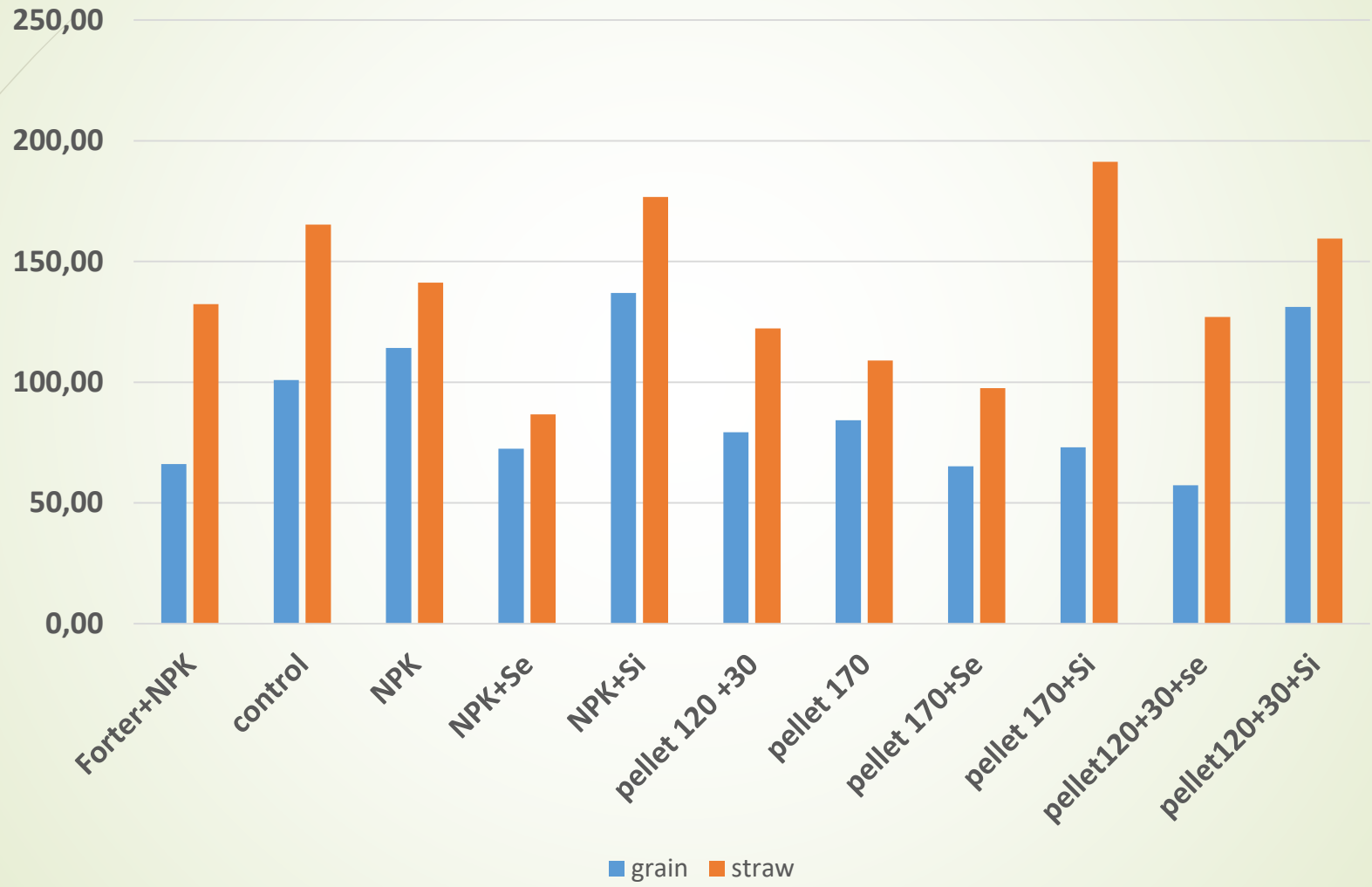
Phytolites Estonia Evelin

	grain			straw		
	phytoliths	C occluded on phytoliths		phytoliths	C occluded on phytoliths	
	mg/g s.m	mg/g phytolith	mg/g D.M.	mg/g s.m	mg/g phytolith	mg/g D.M.
Comp Cont	18,69	2,65	0,23	34,06	14,19	5,28
Comp Si+Se	19,18	2,44	0,25	38,56	20,71	8,06
Comp+Si	19,12	2,48	0,23	49,08	13,36	3,55
Cont	19,35	6,54	0,61	25,08	42,87	21,64
Fert Cont	17,24	3,29	0,30	36,55	35,23	13,83
Fert Si+Se	17,55	2,62	0,28	29,10	38,21	16,80
Fert+Si	17,39	4,84	0,45	22,06	40,90	13,90
Si	19,86	4,12	0,37	38,47	31,67	12,14
Si+Se	19,10	6,43	0,63	33,44	43,92	18,20

Phytolites Belgium Francois



Si content in oat (mg/kg)



Summary

The highest yields of oat were obtained on treatments of mineral fertilization with the addition of silicon and selenium

The NDVI index shows that the condition of plants is much better in the case of mineral fertilization with foliar application of silicon and selenium than in other fertilization treatments

The foliar application of silicon significantly increases the content of this element in the grain (NPK+Si, pellet120+30+Si) and straw (pellet170+Si) as compared to the control object.


Experiments with grasses

Tiomothy grass (*Phleum pratense*)
Tall Fescue (*Festuca arundinacea)*

	4m	4m	4m	4m
1. 5m	A	B	C	D
1. 5m	D	A	B	C
1. 5m	D	B	A	C
1. 5m	B	D	C	A

Tall Fescue
(Festuca arundinacea)

4m	4m	4m	4m
A	B	C	D
D	A	B	C
D	B	A	C
B	D	C	A

Tiomothy grass
(*Phleum pratense*)

4m	4m	4m	4m
A	B	C	D
D	A	B	C
D	B	A	C
B	D	C	A

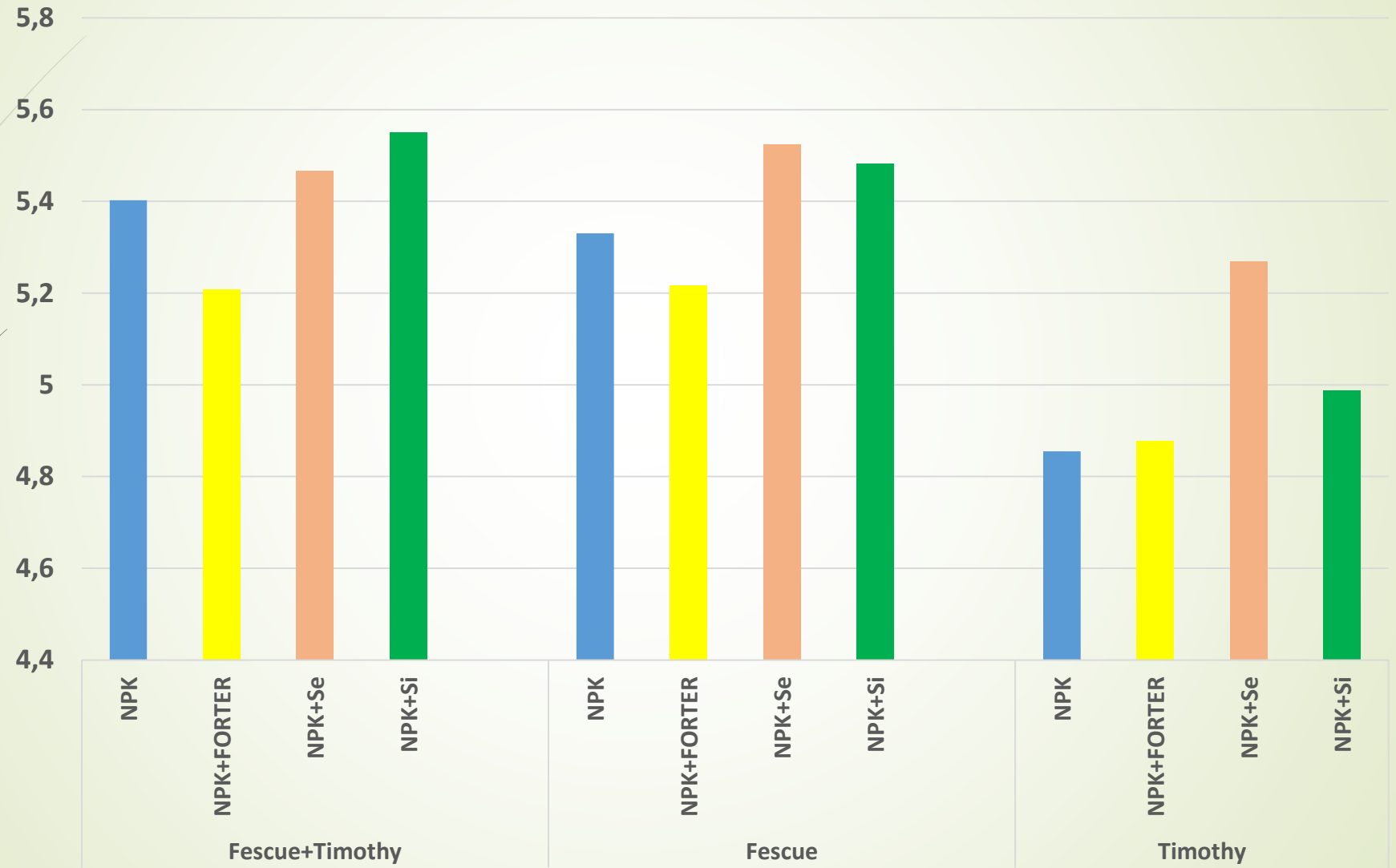
A. Control - NPK

B. NPK + Si –Optysil

C. NPK + Se (Na_2SeO_4)

D. NPK + Forter

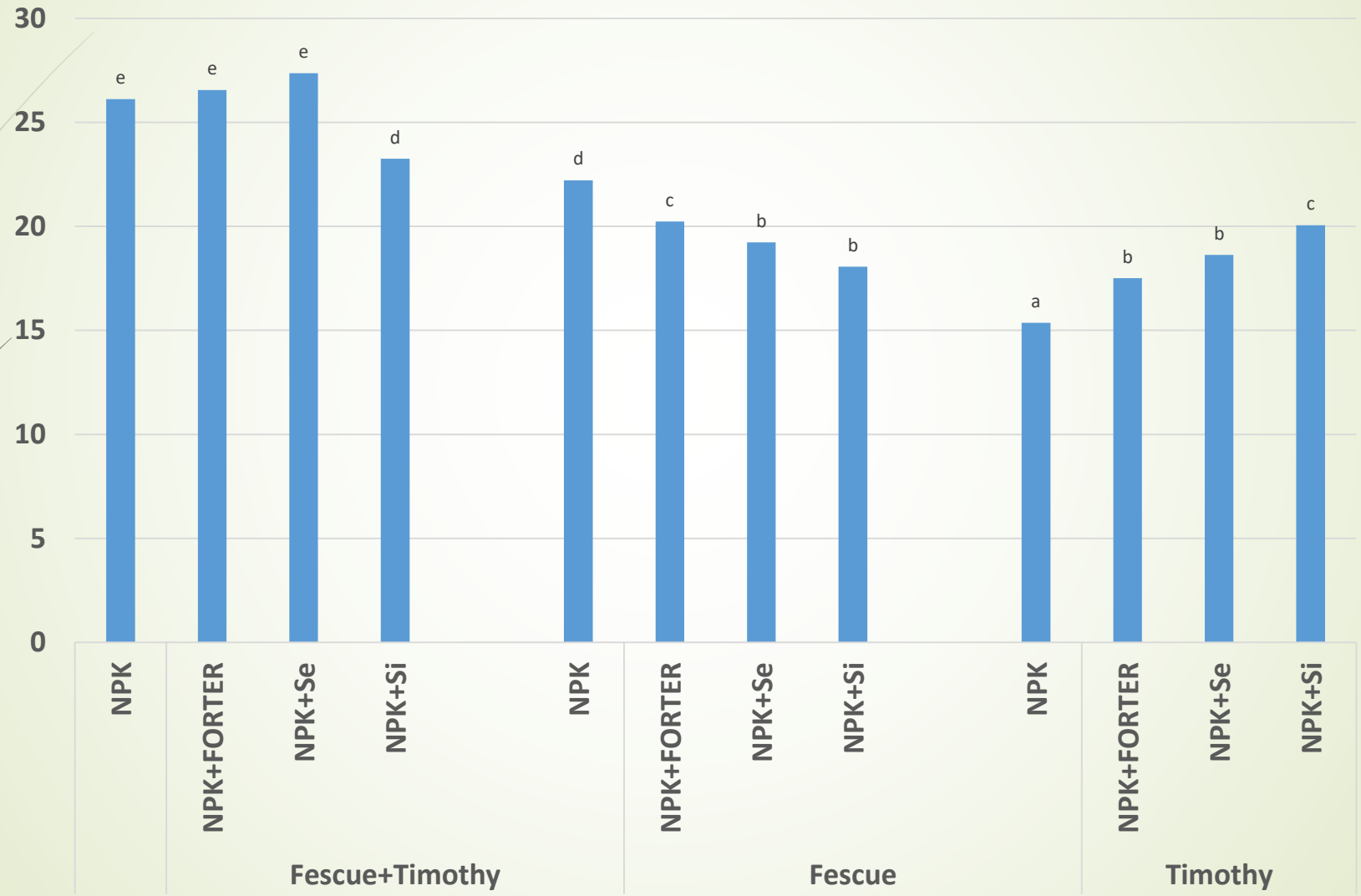
Changes of pH in soil



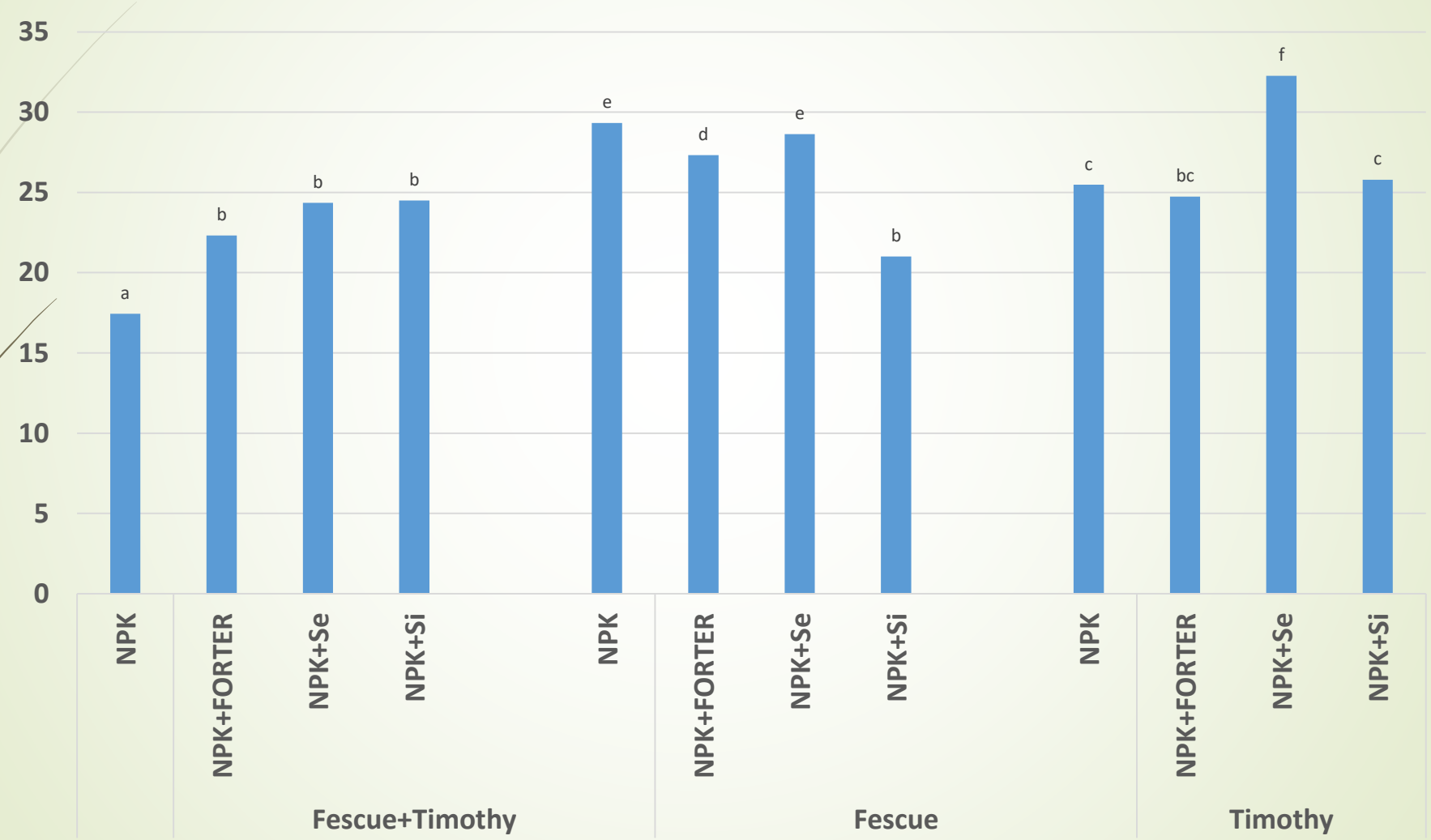
Content of C, N and S in soil (g/kg)

		C	N	S	C/N	C/S
Fescue+Timothy	NPK	10,04a	1,11	0,14	9,0	70,0
	NPK+FORTER	10,83b	1,09	0,16	9,9	68,6
	NPK+Se	9,36a	1,08	0,14	8,6	66,0
	NPK+Si	10,63b	1,18	0,15	9,0	71,8
Fescue	NPK	9,79a	1,11	0,15	8,8	64,9
	NPK+FORTER	10,22a	1,11	0,16	9,2	62,9
	NPK+Se	10,00a	1,08	0,16	9,3	63,0
	NPK+Si	9,32a	1,07	0,15	8,7	61,7
Timothy	NPK	9,22a	1,06	0,14	8,7	64,4
	NPK+FORTER	10,27b	1,07	0,16	9,6	63,4
	NPK+Se	8,80a	1,06	0,15	8,3	60,1
	NPK+Si	9,11a	1,08	0,14	8,4	62,9

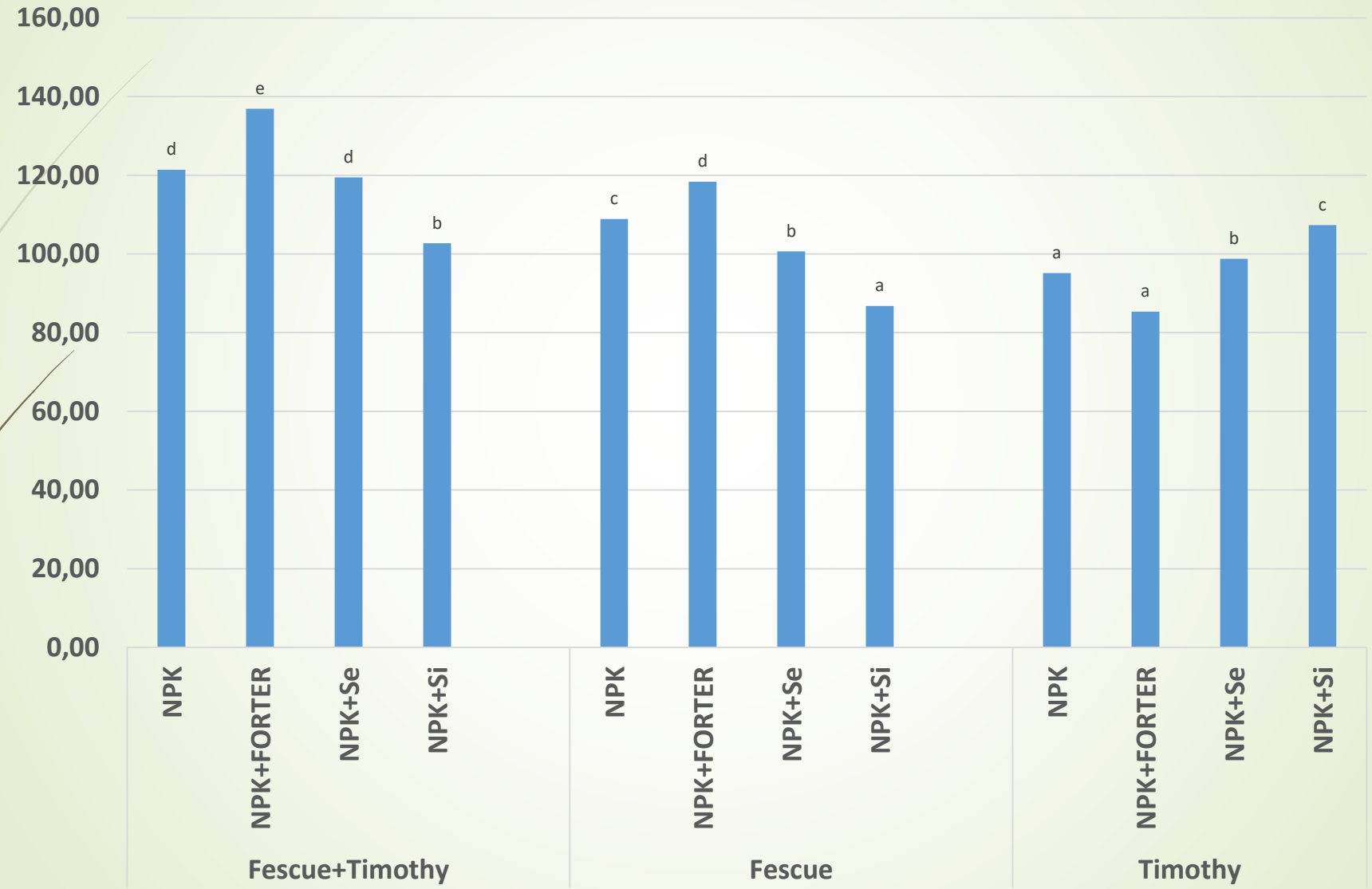
Content of Mg in soil (mg/kg)



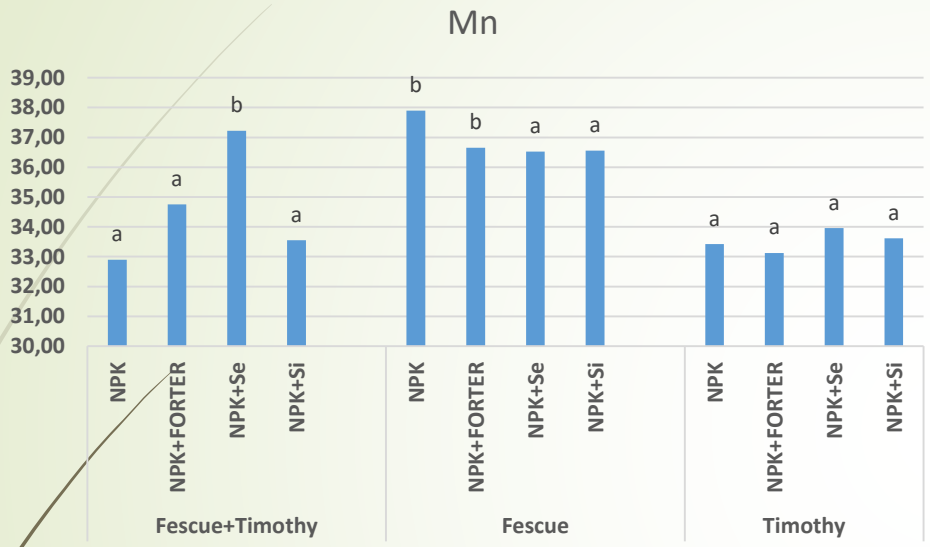
Content of P in soil (mg/kg)

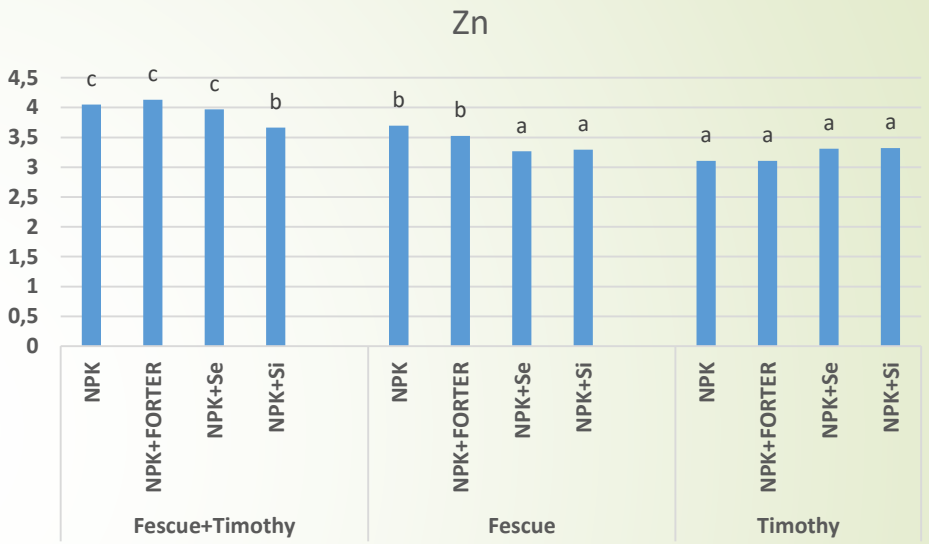


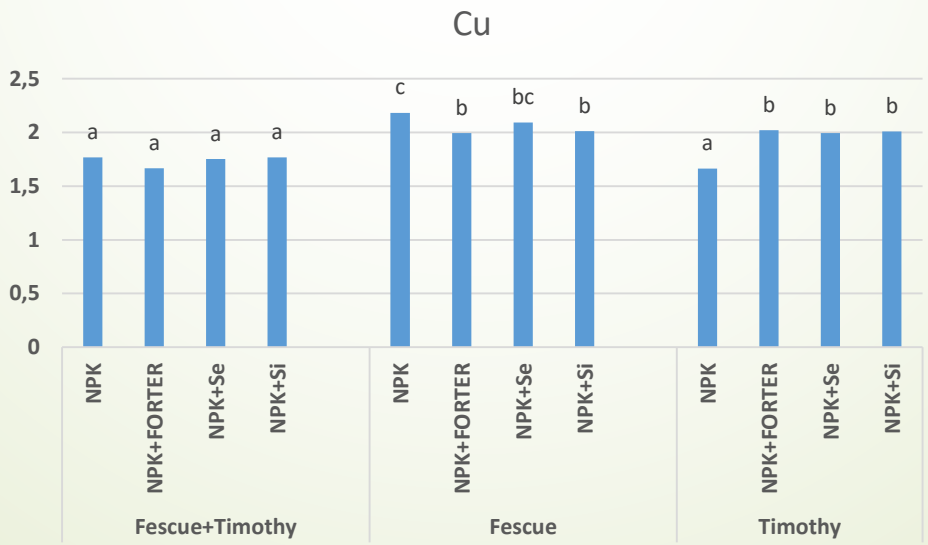
Content of K in soil (mg/kg)



Content of microelements in soil (mg/kg)







Yield t/ha

	Cut 1	Cut 2	Cut 3	**Sum**	
NPK	**3.46b**	**3.32b**	1.89a	**8.67b**	Timothy + Fescue
NPK+Si	3.28a	2.86a	1.88a	**8.02a**	
NPK+Se	2.85a	3.03a	1.97a	**7.85a**	
NPK+Forter	3.11a	2.76a	1.89a	**7.76a**	
NPK	1.35a	1.58a	1.51b	**4.45a**	Timothy
NPK+Si	1.35a	**1.82b**	1.42b	**4.59a**	
NPK+Se	1.23a	1.49a	**1.85c**	**4.57a**	
NPK+Forter	1.71b	1.52a	1.05a	**4.28a**	
NPK	2.59a	2.63a	1.77b	**6.99ab**	Fescue
NPK+Si	**2.78b**	2.70a	1.73b	**7.22b**	
NPK+Se	2.46a	2.33a	1.56a	**6.35a**	
NPK+Forter	2.43a	2.50a	1.87b	**6.80a**	

Timothy + Fescue

	NDVI 26.05		NDVI 09.07		NDVI 07.09	
NPK	0.827	a	0.847	a	0.744	a
NPK+Si	0.828	a	0.835	a	0.740	a
NPK+Se	0.803	a	0.850	a	0.757	a
NPK+Forter	0.836	a	0.845	a	0.742	a

Timothy

	NDVI 26.05		NDVI 09.07		NDVI 07.09	
NPK	0.800	a	0.786	a	0.837	a
NPK+Si	0.813	a	0.806	a	0.839	a
NPK+Se	0.790	a	0.767	a	0.842	a
NPK+Forter	0.815	a	0.788	a	0.831	a

Fescue

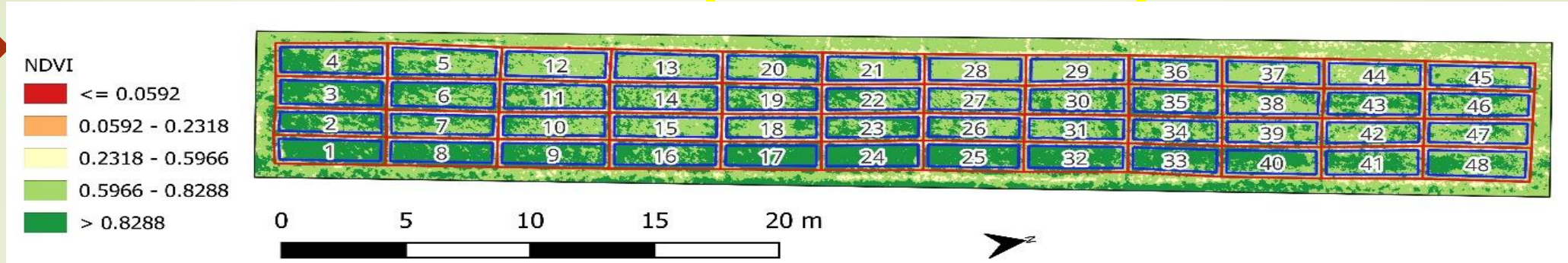
	NDVI 26.05		NDVI 09.07		NDVI 07.09	
NPK	0.827	a	0.848	a	0.741	a
NPK+Si	0.825	a	0.854	a	0.742	a
NPK+Se	0.814	a	0.846	a	0.732	a
NPK+Forter	0.816	a	0.845	a	0.763	a

Timothy + Fescue

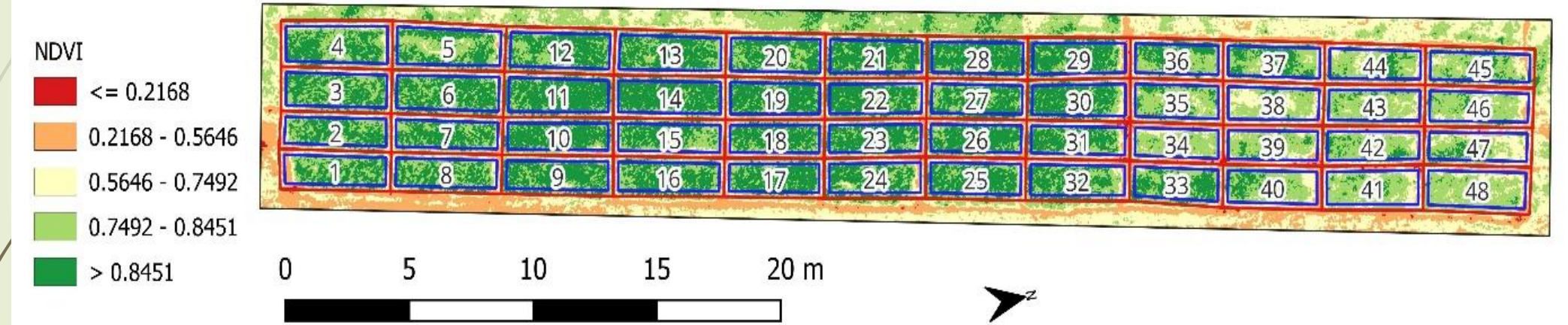
Fescue

Timothy

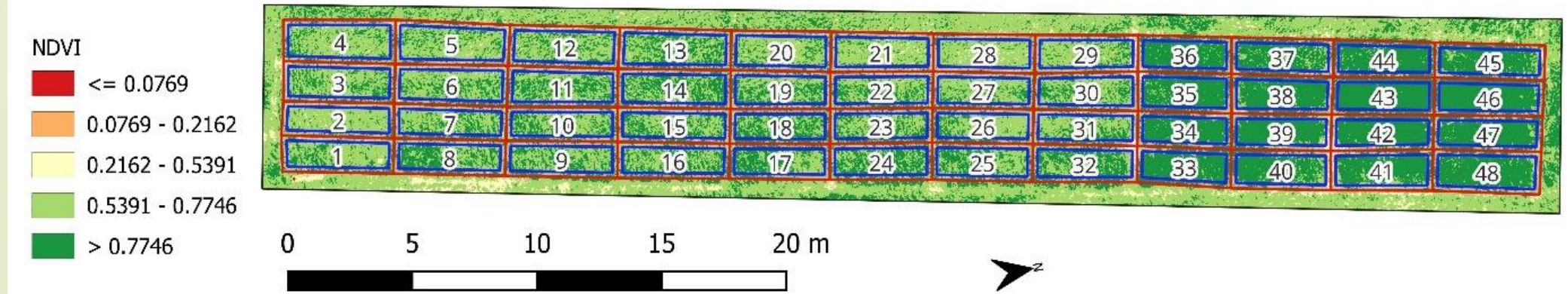
09.05.2022



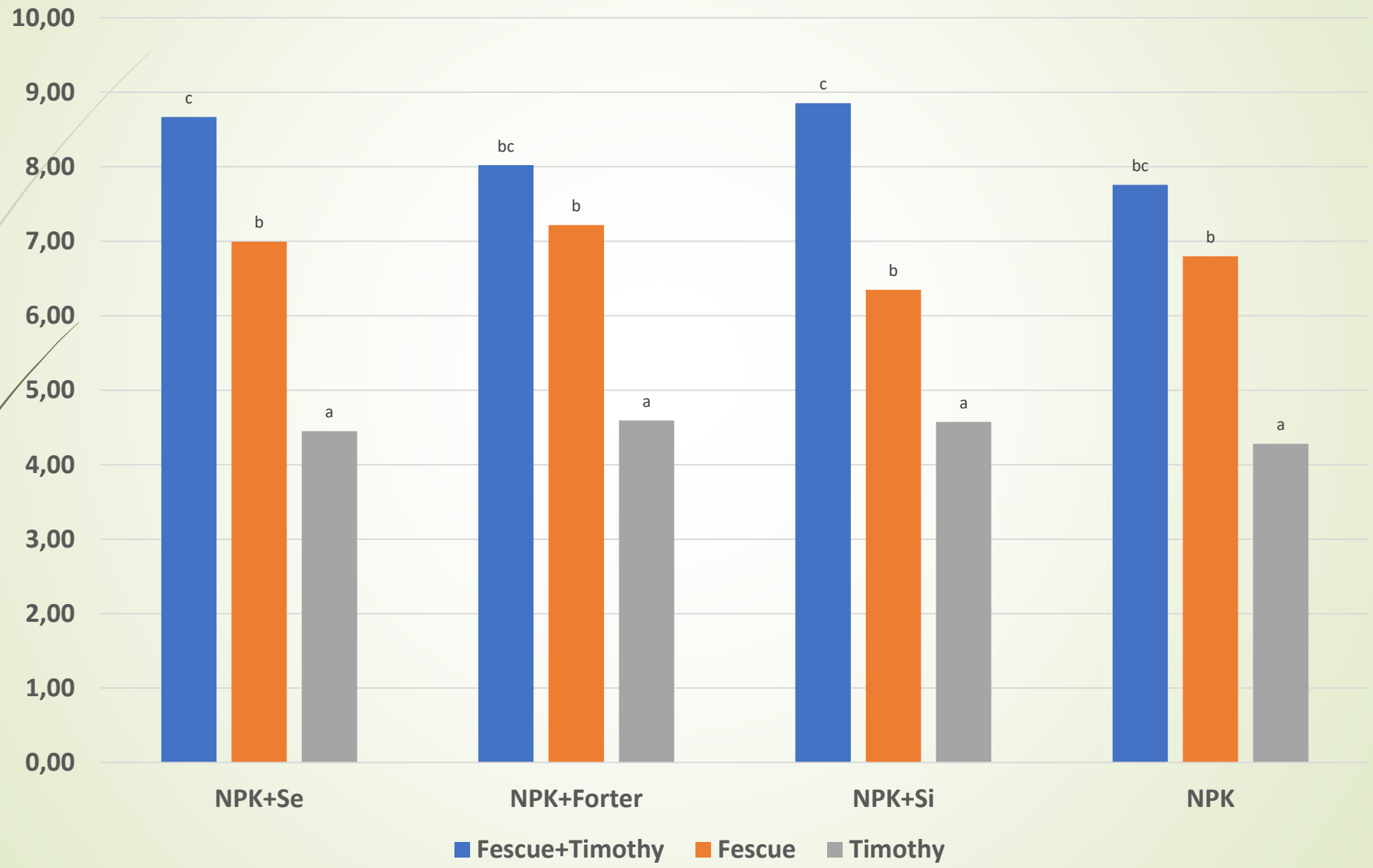
13.06.2022



07.09.2022



Si content (mg·kg^{-1} DM)



Summary

In the experiment with grasses the mixture (Timothy + Fescue) yielded the best. The highest yields were obtained with NPK + Se and NPK + Si fertilization. The lowest yields were always obtained with Timothy

In the case of Timothy grass. the condition of the plants was the best in the NPK + Si combination

Fertilization with silicon and selenium increased the content of these elements in grasses. The highest content of Si was found in the first cut

Milestones

M1.1 (month 36)
Title: Increasing yield of crops cultivated on marginal soils.
Description:
Beneficial effects of different organic amendments will be shown.

M1.2 (month 36)
Title: Cultivation of energy /industrial crops on contaminated soils
Description:
Beneficial effects of biochar and Si application on uptake of heavy metals by these crops will be assessed.

Thank you for your attention