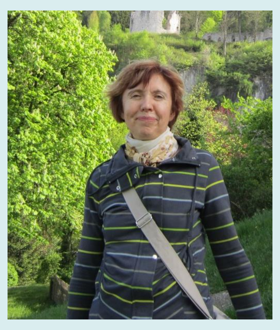
NUTRIENT STATUS OF ORGANIC GARLIC AFFECTED BY DIFFERENT GROWING TECHNOLOGIES: A PILOT STUDY



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Introduction

Garlic (*Allium sativum* L.) is considered to be one of the most important bulb vegetable crops used worldwide as a food seasoning and as a component of traditional and modern medicine, due to antimicrobial and antifungal properties as well as high content of phenolic compounds. In 2017, the area harvested reached over 500 ha and garlic cultivation becomes a promising agricultural sector in Latvia. One of the factors significantly affecting the production of garlic in Latvia is its sensitivity to weather conditions and soil composition.

As a part of the project on modernization of winter garlic cultivation to ensure guaranteed yield in organic production system (supported by the European Rural Development Fund) a **research was started to find out nutrient status of winter garlic grown in traditional growing technology (planted in late autumn) and innovative technology (ensuring optimal wintering conditions in a controlled environment, planted in spring as container plants).**

Materials and methods

Field trial was established at the organic farm, located at the Koknese's district, Latvia, on sandy loam during the season of 2018/2019.

In addition to cover crop/green manure incorporation, before garlic planting the soil was supplemented with a fertilizer approved for organic production: Physio Natur PKS 41, as a P, K, S, Ca, Mg source.

To test the innovative technology, garlic cloves were planted in cassettes filled with substrate prepared from sphagnum peat and manure. Nutrient concentrations before planting in soil and substrate, as vell as soil standards are given in Table 1.

Table 1. Soil and peat substrate nutrient concentrations in 1 M HCl extraction

Nutrient	Soil before planting November 2018	Peat/manure substrate February 2019	Soil standards in 1 M HCl extraction [1]
N	108	118	120-160
P	417	300	200-300
K	261	375	250-400
Ca	3979	5400	3000-8000
Mg	774	1000	600-1200
S	60	58	30-80
Fe	1125	455	800-2000
Mn	78	15	60-150
Zn	2,57	12.0	4,0-12,0
Cu	2,31	0.85	2,5-5,0
Mo	0,04	0.03	0,04-0,20
B	0,18	0.40	0,6-1,5
pH_{KCl}	6,57	5.82	6,5-7,5
$EC_{mS/cm}$	1,00	2.83	2,0-3,0
Org. mat., %	6.46	63.2	>3,0

Low level (highlighted: Zn 2,57; Cu 2,31, 0.85; B 0,18, 0.40)

Hardneck garlic cultivar 'Lubasha' (Ukrainian origin) and two local clones were used for the study.

Using traditional technology, garlic planting was done at the beginning of November 2018. For innovative technology, garlic cloves were planted in February 2019 in cassettes exposed to low-temperatures for 40 days and planted on field as garlic container seedlings during 1st week of May 2019.

To diagnose crop nutrient status, leaf samples were taken for nutrient (**N, P, K, Ca, Mg, S, Fe, Mn, Zn, Cu, Mo, B**) analysis three times during the growing season of 2019. The levels of Ca, Mg, Fe, Cu, Zn, and Mn were estimated by AAS, those of N, P, Mo, B by colorimetry, S by turbidimetry, and K by flame photometer [2]. Evaluation of mineral nutrition status of garlic was done on basis leaf standards developed by Nollendorfs and Rosen *et al*.[1], [3].

Results

- There were no significant differences ($p<0.05$) found in leaf nutrient concentrations for **K, Mg, S, Zn, Cu, Mo** and **B** between both garlic cultivation technologies and cultivar/clones. These results are presented as mean values over the field at the given sampling time (Table 2).
- Low concentrations of **K, Ca, Mg**, in garlic leaves were found for early season (pre-bulbing) (Table 2, Fig. 1). Significantly improvement in the leaf macronutrient, except for **K**, status was stated from midseason to late sampling time (before bulb maturity).
- Deficiency of micronutrients **Mn, Zn, Cu** and **B** in garlic leaves was found throughout the season.
- In most cases, the content of **Ca** in leaves were higher for traditionally grown garlic, while **N, P, Fe** and **Mn** – in the leaves of garlic planted in spring as container plants.

Table 2. Mean values of leaf nutrient concentrations in experimental field during the garlic crop cycle, 2018-2019.

Nutrient	Unit	Early season, pre-bulbing May 2019	Mid-season, bulbing June 2019	Pre-harvest July 2019	Sufficiency range
K	%	1.86±0.09a	2.25±0.09b	1.80±0.14a	2.50 – 4.50
Mg	%	0.18±0.01a	0.32±0.02b	0.71±0.06c	0.25 -0.40
S	%	0.41±0.03a	0.53±0.04b	0.48±0.03ab	0.30 – 0.90
Zn	mg kg^{-1}	14.66±0.98b	10.05±0.74a	10.37±0.70a	20 - 60
Cu	mg kg^{-1}	3.12±0.33a	3.48±0.18a	3.71±0.18a	5 - 10
Mo	mg kg^{-1}	0.62±0.01a	0.56±0.12a	0.90±0.05b	0.5 – 2.0
B	mg kg^{-1}	10.67±0.31a	14.50±0.68b	24.29±1.70c	25 - 50

Low level (highlighted: K all three; Mg May; Zn all three; Cu all three; B May and June)

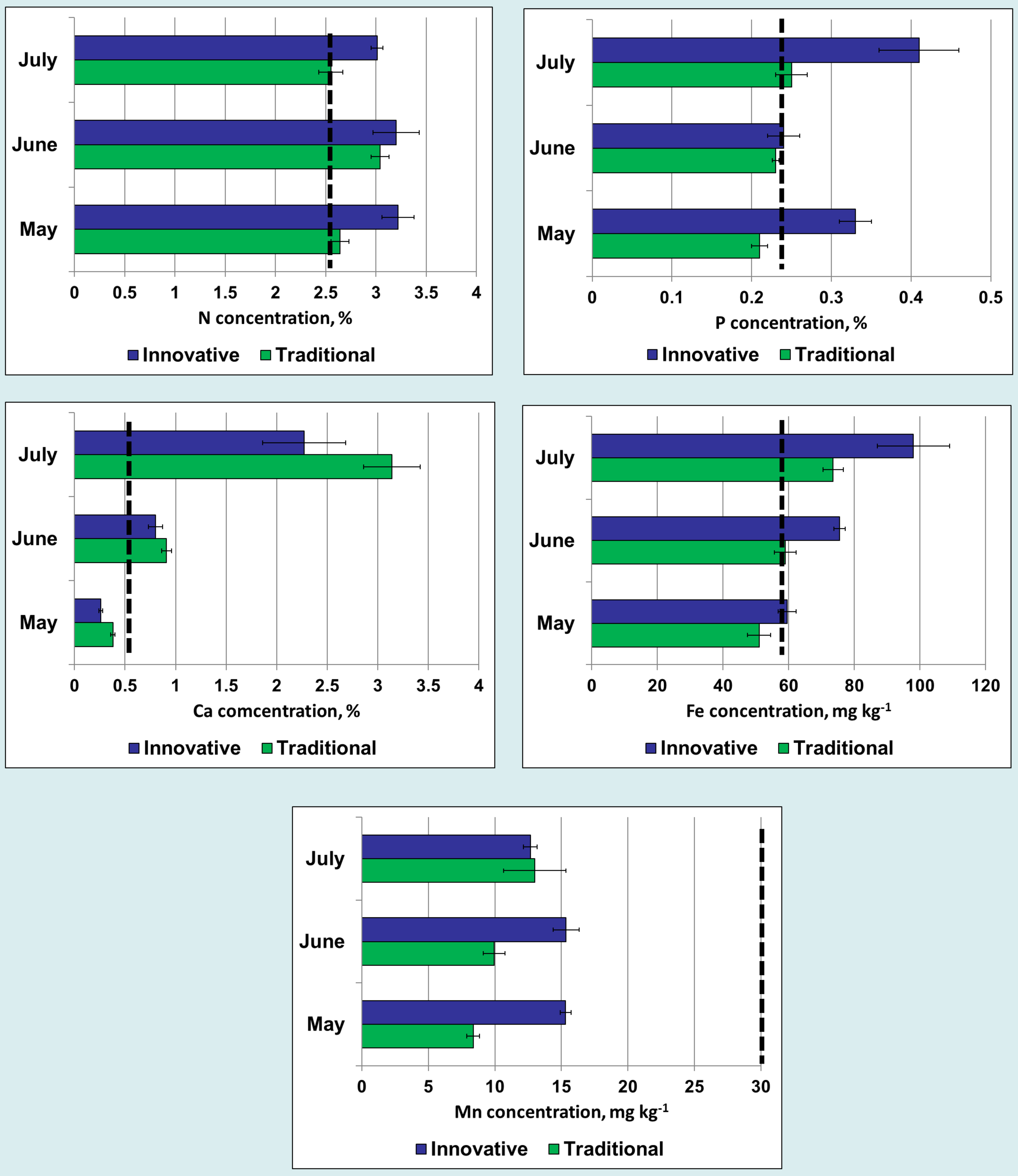

Figure 1. Impact of cultivation technologies on nutrient concentration in garlic leaves. Traditional technology: cloves planted in autumn, 2018; innovative technology: planted in cassettes in February 2019, overwintered in controlled conditions, planted in spring as garlic container seedlings, 2019. Minimum sufficiency level for a nutrient ----

Conclusions

- The results suggested that there was only slight difference found in nutrient status of garlic between the cultivation technologies and cultivar/clones.
- Several nutrient imbalances, regardless of the technology used, were identified: deficiency of **K, Mn, Zn, Cu** and **B** in garlic leaves was found throughout the season.
- Although further research is needed, innovative garlic growing technology for preventing overwintering damages tended to provide equal or even better (**N, P, Fe, Mn**) nutrient accumulation and, therefore, has all the facilities to ensure a high garlic yield.
- As nutrient imbalances adversely affect the yield and quality of garlic, measures should be taken to improve the fertilization regime for organic garlic, in particular as regards the supply of K and micronutrients.

References

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