Resource-efficient vegetable production in Finland

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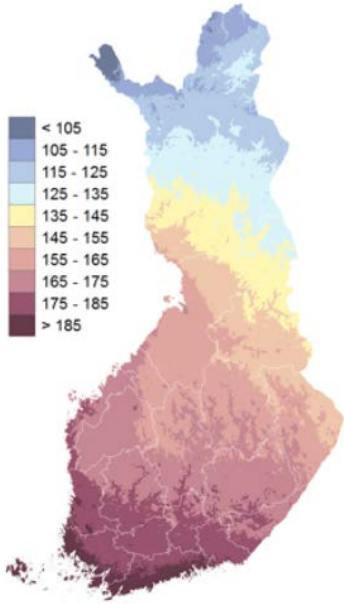
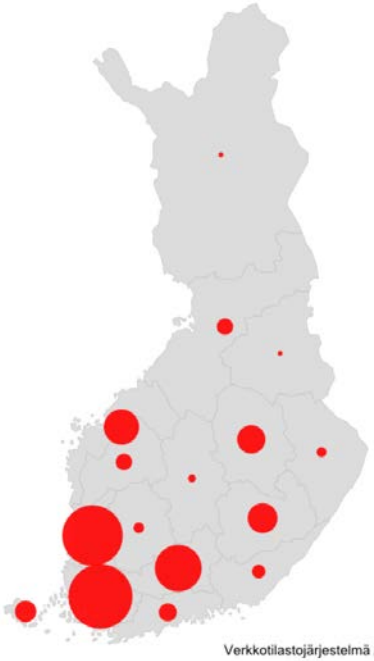
Features of vegetable production in Finland

- Short growing season (105-185 days)
- Climate change
  - ➢ Longer growing season
  - ➢ Higher temperature sum
  - ➢ Shorter period of snow cover and ground freezing



https://en.ilmatieteenlaitos.fi/

- Half of the total field vegetable production is located in south-western Finland
  - – near to the Baltic Sea or rivers running to the Baltic Sea



Effects of climate change, e.g.:
+ Higher yields
- Higher risk for nutrient losses and drought (+ more pests)

-> more understanding needed to balance the nutrient supply

https://stat.luke.fi/en/horticultural-statistics

Guidelines proposed for sustainable field vegetable production in Finland

- Based on the research and expertise work in the project ”Resource-efficient vegetable production” in 2016-2019
  - Co-operation between research, advisory service, education and practical farming
  - Field and farm experiments on three themes
    - *Efficient utilization of plant nutrients*
    - *Improving soil quality in vegetable production*
    - *Minimizing losses by storage diseases in onion and carrot production*

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Tools for future vegetable production

- Emphasis on soil quality
- Soil analysis – basis for nutrient balance
- Moderate use of phosphorus fertilizers
- Nitrogen from green manure
- Crop rotation to better use
- Catch crops after early and summer vegetables
- Alternatives for chemical plant protection
- Collaboration – key to success

4-page info sheet published in 2019

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Emphasis on soil quality

- Vegetables to be produced only in the best fields
  - suitable soil type, good soil quality
- Good **water** holding and infiltration capacity in soil are essential
- **Crop rotation** as the basic tool for improving the soil quality
  - Deep-rooting plants
  - Perennial plants (grasses) or autumn-sown cereals in rotation
  - Cover crops in cereals
- Increasing **soil organic matter** content by using manure / green manure / soil amendments

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Onion and Melilotus albus (2nd year). Photo Pirjo Kivijärvi, Luke

Benefits from green manure

- Unused potential for biological N fixation in vegetable rotations
- Other benefits: soil quality, weed control, increased biodiversity

Examples of N content in green manure

Annual	Dry matter yield kg/ha	N content kg/ha	N %
Vetch (*Vicia sativa/Vicia villosa*)	4 095	142	3.5
Pea-Faba bean (*Pisum sativum*/*Vicia faba*)	7 762	170	2.2
Pea (*Pisum sativum*)	5 453	127	2.3
White lupin (*Lupinus albus*)	5 667	149	2.6
Crimson clover (*Trifolium incarnatum*)	4 327	87	2.0
Perennial			
White melilot (*Melilotus alba*)	24 131	607	2.5
Hay- clover mixture (*Phleum pratense/Festuca arundinaceae/Trifolium pratense/Trifolium fybridum*)	14 513	340	2.3
Medick-hay mixture (M*edicago var./Phleum pratense/Festuca arundinaceae*)	12 616	341	2.7

Optimal timing of incorporation of green manure is essential!

- either very late in autumn or
- In the middle of growing season, followed by a catch crop after green manure

Note: risks related to plant diseases!

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Moderate phosphorus fertilization

- In vegetable production, often relatively high phosphorus (P) fertilization is used
  - ➢ High soil P content in vegetable fields
  - ➢ Increased risk for P leaching
- P fertilization experiments in Finland in 2014−2020 (onion, white cabbage, carrot, celeriac, lettuce, swede, pickling cucumber)
  - − In most experiments, no significant effect of P fertilization on yield
  - − If a significant effect was observed, moderate applications of 10-20 kg of P ha^{-1} were sufficient

- − So far, it can be recommended that sufficient annual P application corresponds to P uptake in yield, resulting in zero P balance

Soil and plant analyses – basis for balanced nutrition

- Fertilization should be based on up-to-date soil analysis data
  - Also micronutrients considered
- Improvement of soil nutrient status already before vegetable year in crop rotation
- Usage of plant analyses (in lab) to compare the nutrient status of crops growing in different fields

Data on nutrient analyses collected from field and farm experiments

Example: Plant analysis (Megalab interpretation provided by Eurofins laboratory and Yara) in onion; 80 samples, taken in 5-leaf-stage, macronutrients

Nutrient	**Megalab sufficiency limit**	<5%	<10%	<25%	Median	<75%
N g/kg dm	**20**	26.6	27.6	29.1	32.3	35.3
P g/kg dm	**2.50**	1.43	1.59	**1.92**	**2.66**	3.26
K g/kg dm	**25**	24.0	**24.4**	**26.4**	30.5	32.5
Mg g/kg dm	**2.5**	2.06	2.09	**2.26**	**2.6**	2.77
S g/kg dm	**2.0**	3.53	3.61	3.87	4.78	6.36

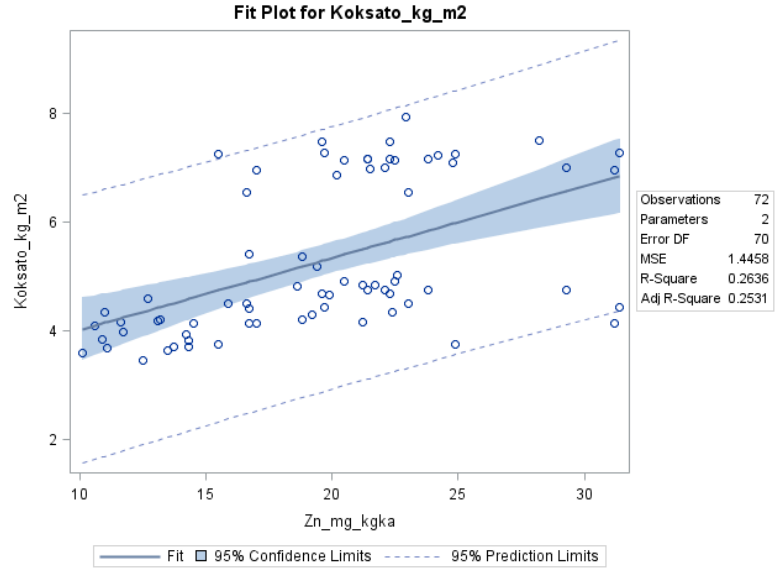
Example: Plant analysis (Megalab interpretation provided by Eurofins and Yara) in onion; micronutrients

Nutrient	**Megalab**	<5%	<10%	<25%	Median	<75%
Mn mg/kg dm	**40**	24.6	26.5	28.4	32.2	**39.1**
B mg/kg dm	**30**	14.2	15	16.3	18.6	**20.3**
Cu mg/kg dm	**7**	4.7	5	5.3	**6.4**	**7.5**
Zn mg/kg dm	**20**	10.9	11.6	14.3	**19.3**	**22.3**
Fe mg/kg dm	**30**	73	77	79	88	100

Mn, B and Cu concentrations often under the limit; Fe over

Plant analysis is a good tool to compare nutrient status in different fields etc. Direct use of results for giving fertilizer recommendations is challenging and low concentrations don't always limit the yield.

Relation between Zn and total yield



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Conclusions

- Plant nutrition should be regarded from a wider view, not just as an technical procedure with soil analyses and fertilization
- Soil quality is the combination of chemical, physical and biological processes, leading to either good or poor nutrient uptake and utilisation in plants
- On the other hand, we need more research data and understanding to adjust the nutrient availability according to plants' needs

Thank you!

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