Fertiliser recommendations and Fertigation

Introduction

Wim Voogt

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Fertilisation

- Basic feeding the crop
- Improve productivity
- Restore soil chemical properties
- Correct nutrient imbalances
- Feeding micro organisms

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Fertiliser recommendation system

- Rules for application of fertilisers (nutrients) to crops (soil / substrate / irrigation water).
  Based on: Cropping plan, Soil (substrate) properties, Soil (substrate) analysis, e.g.
- Taking into account: Application method, Crop stage, Weather, Water quality e.g.
- 1) Nutrient sufficiency
- 2) Build / maintain / feed soil (substrate) system
- Optimum yields Optimum quality
- How much, When, What, How,....

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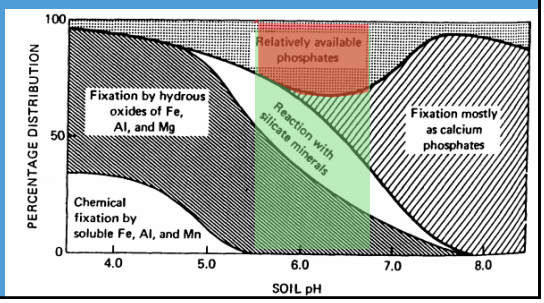
Soil issues

- What is the goal
  - Nutrient quantity
  - Nutrient concentration
    - Nutrient availability/ solubility
  - Specific: salinity, pH, physical

Capacity <-> Intensity



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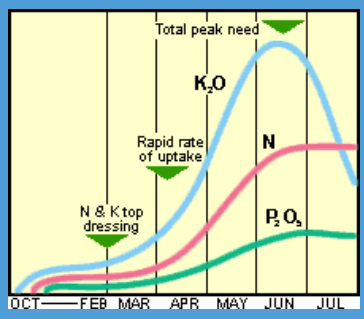
How and when to apply ?

- Base dressing
  - All nutriënts
  - Total crop requirement
  - Only P and/or K
- Base + side dressings
- Side dressings
- Fertigation
- Foliar application



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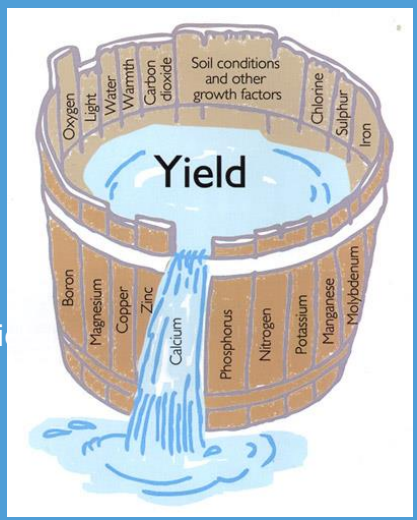
Crop requirement

- Genetically determined
- Cultivar differences

- Total
- Distribution over growing peri



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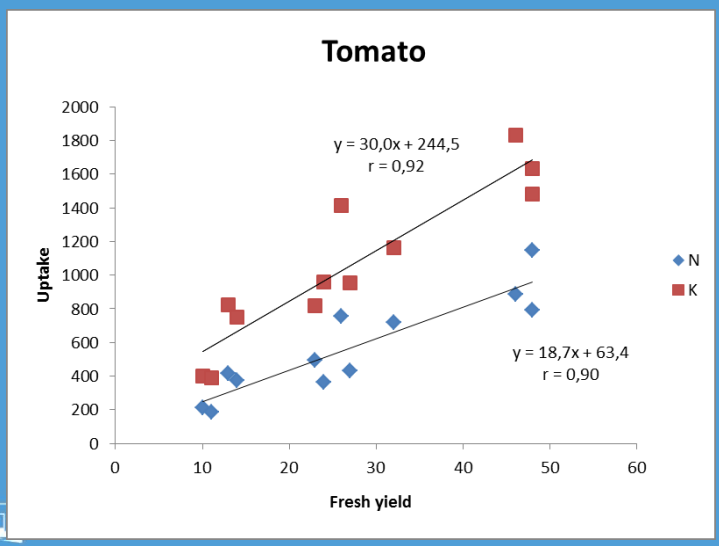
How much ?

Relation yield and total nutrient demand



Substrate

- Restricted Root Volume
  - 10 - 15 l m^{-2}
- Restricted quantity water and nutrients
  - 2 - 5 % of total demand

Adequate water and nutrient supply !

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Nutrient solutions

- Macro elements
  - N *(NO_3 and NH_4)*
  - K, Ca, Mg
  - S *(SO_4)*, P *(H_2PO_4)*
- Micro elements
  - Fe, Mn, Zn
  - B
  - Cu , Mo
- Other
  - Si, Cl

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Fertigation = nutrient solution example TOMATO

	Free drainage		Closed system		Targets root envi-
EC dS m^{-1}	2.6		1.6		3.7 ronment
pH	5.5		5.5		5.5
	mmol/l	mg/l	mmol/l	mg/l	mmol/l mg/l
NH_4	1	14	0.8	11	0
K	9.5	371	6.5	254	8 313
Na	0	0	0	0	< 8 < 180
Ca	5.4	217	2.75	110	10 40[illegible]
Mg	2.4	58	1.0	24	4.5 109
NO_3	16.0	224	10.75	224	23 322
Cl	2.5	89	1.0	36	< 12 426
SO_4	4.4	136	1.5	47	6.8 218
H_2PO_4	1.5	48	1.25	40	1 32

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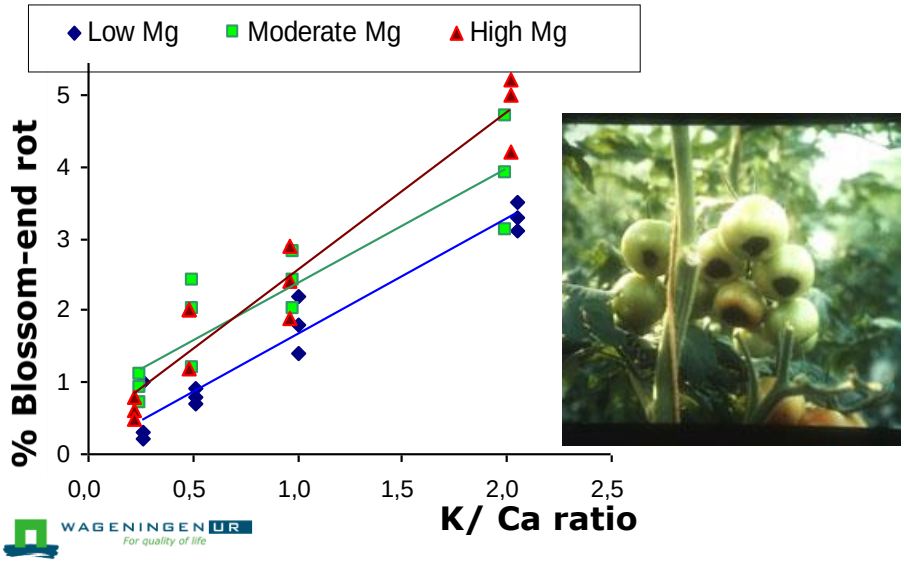
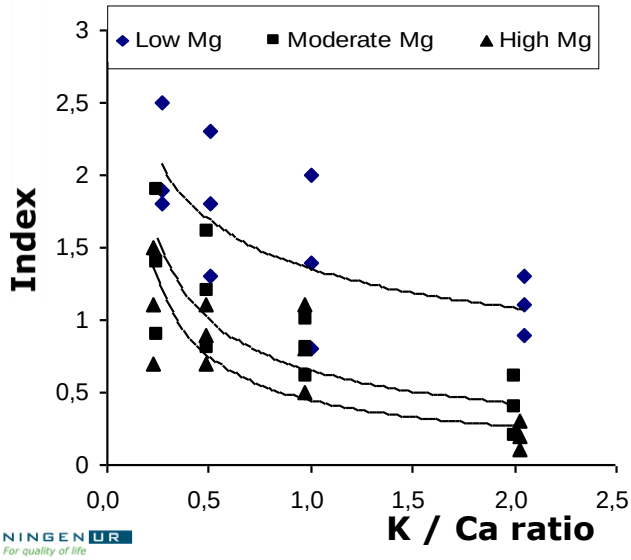
Based on exerimental results

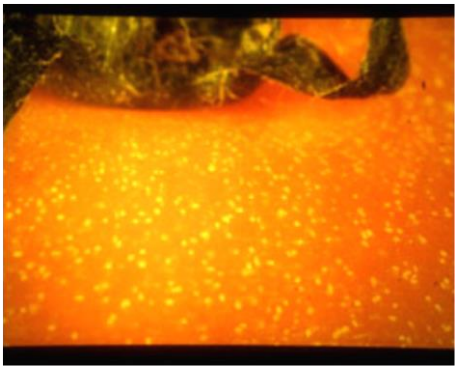
Effect of K:Ca ratio on quality: Blossom-end rot

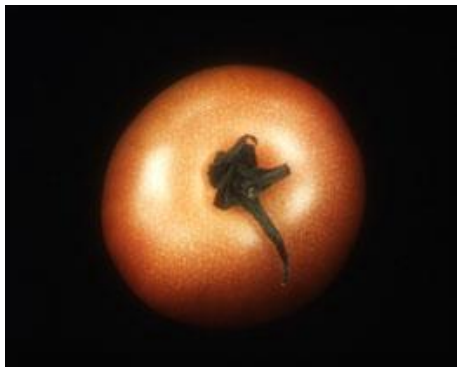


Effect of K:Ca ratio on quality: Gold specks (flecks, spots)



Effect of K:Ca ratio on quality:
Gold specks (flecks, spots)
Calcium oxalate crystal





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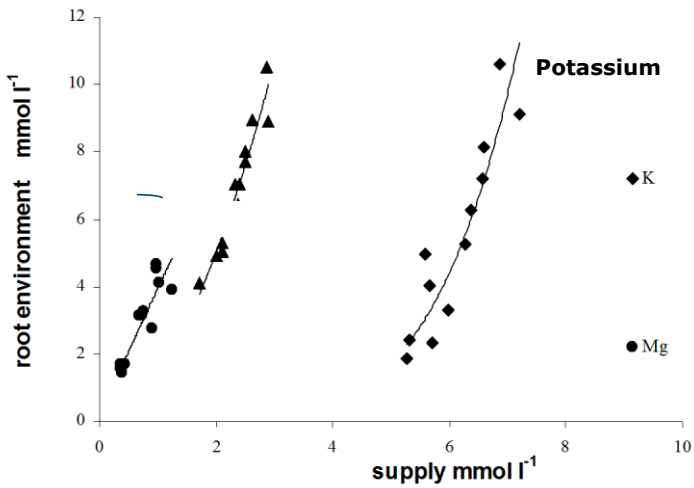
Relation between concentration in the supply and in root environment

Experiment with tomato at EC 2.8, recirculation



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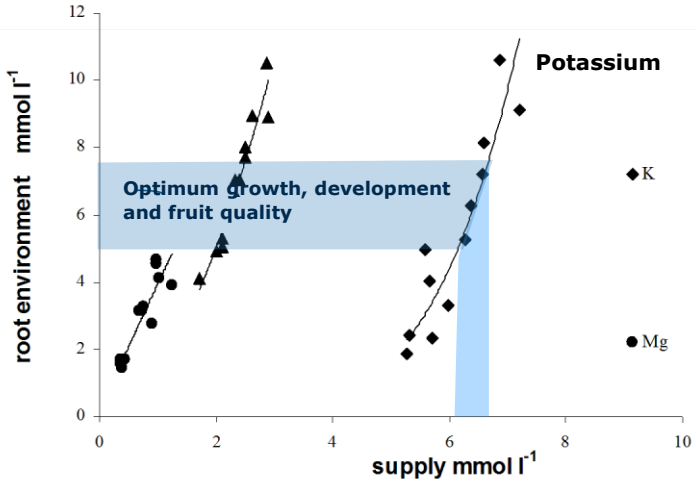

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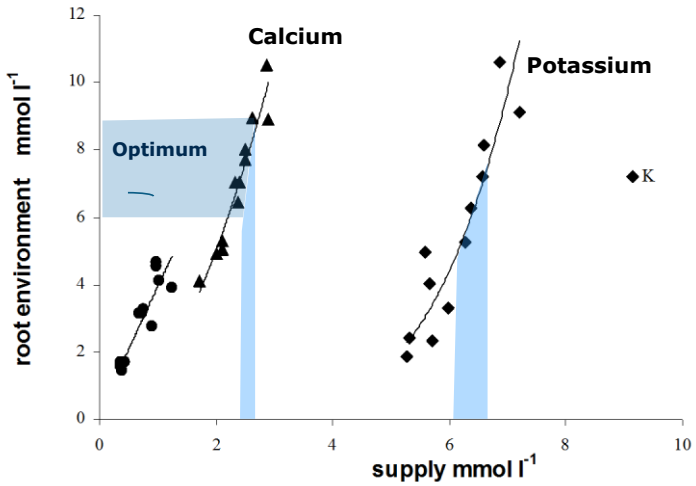

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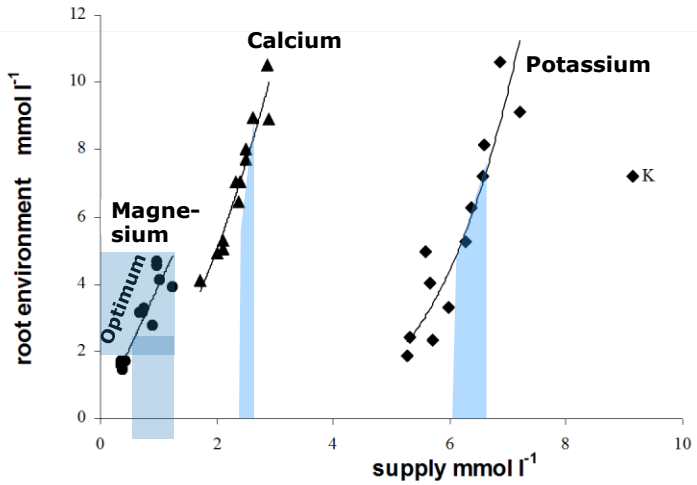

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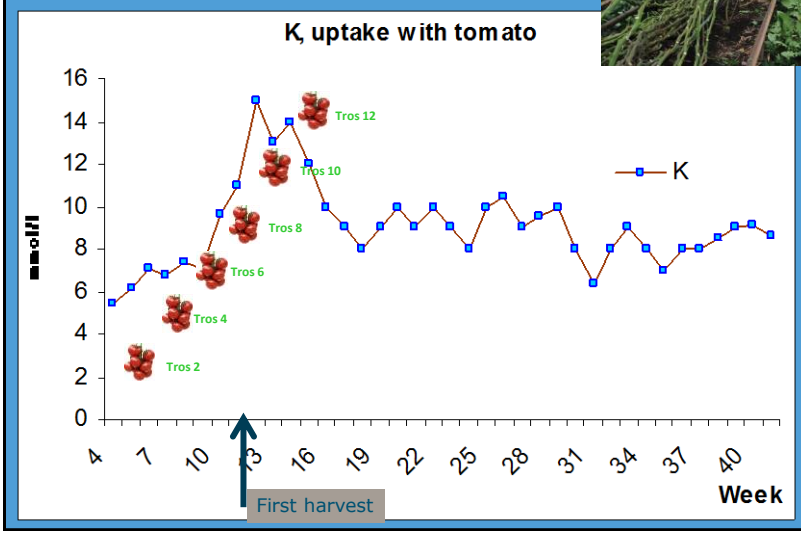
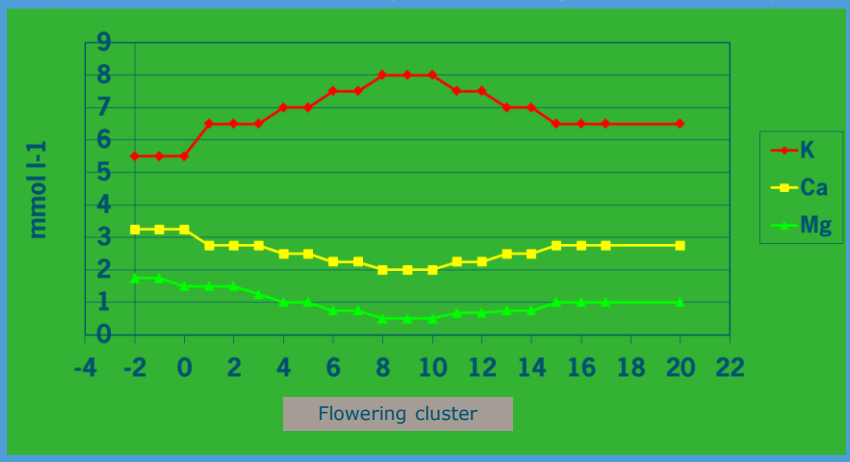
Example tomato

Shift in K uptake due to fruit load



Adjustments to crop development stage



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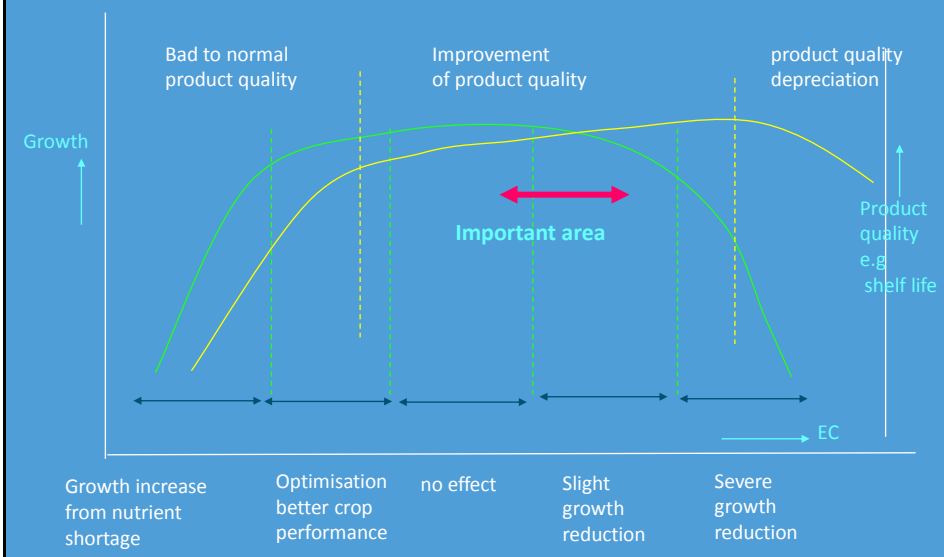
General graph about EC effect



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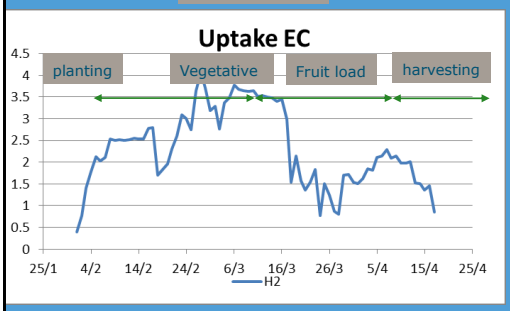
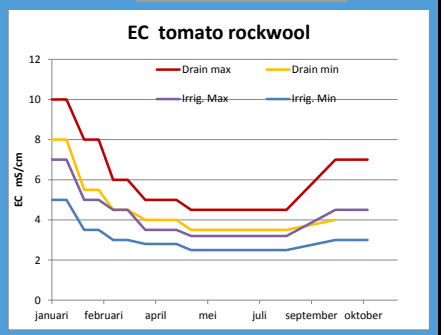
Seasonal effect

Sweet pepper



Calculated uptake concentration expressed in mS/cm of a sweet pepper crop

EC recommendation



Recommended irrigation EC for tomato during the growing cycle: Dutch climate conditions

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Fertiliser recommendation system

- Rules for application of fertilisers (nutrients) to crops (soil / substrate / irrigation water).
  Based on: Cropping plan, Crop stage , Soil (substrate) properties, Soil (substrate) analysis, e.g.
- Taking into account: Application method, Crop stage, Weather, e.g.
- To provide sufficient nutrients for the crop
- Optimum yields
- Optimum quality
- Sustainability issues ?
  - Leaching ?
  - P saturation

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Sustainability issues

- Prevent N (P) leaching:
  - Add water supply guide lines ?
- N /P levels: sufficient for crop + security margin
  - Can we recommend minimum levels instead of optimum levels

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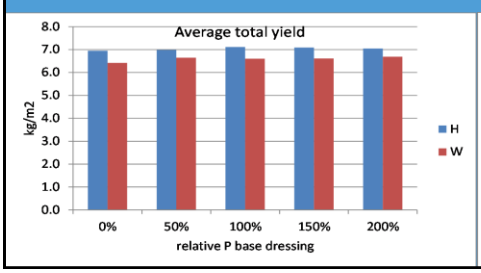
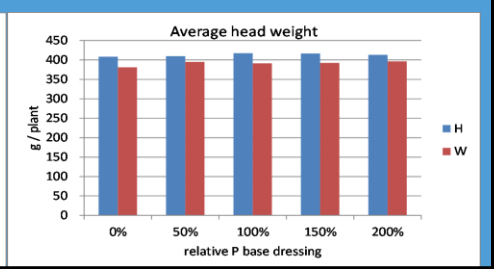
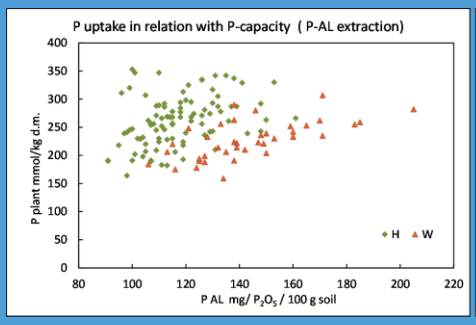
P- depletion trials

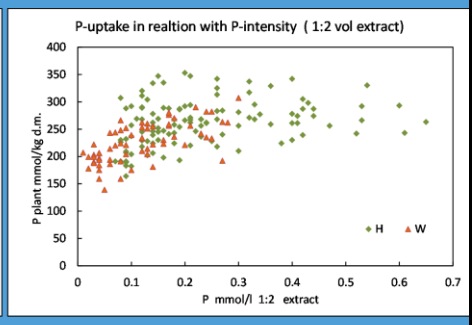
Treatments: 0, 50, 100, 150, 200 % P supply of the standard P application, 20 - 40kg P/ha/crop.
3 – 5 years trial, 23 lettuce crops





Revision of P recommendation system

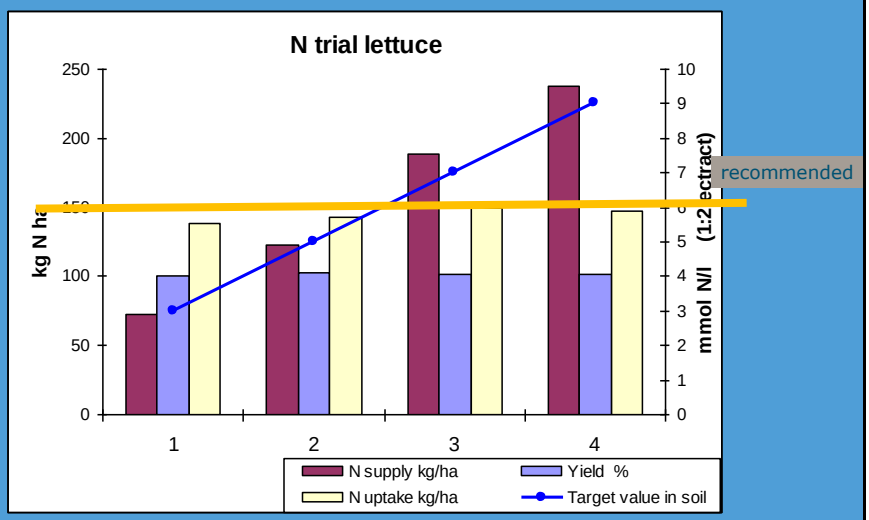




		P- capacity		P-Al* (mg P_2O_5 / 100 g soil)		
	P 1:2 ** mmol/l	0 - 20	21-40	41-80	81-120	>120
P intensity	< 0.05	4	3	2	1	0
	0.06-0.1	3	2	1	0.5	0
	0.11-0.2	***	1	0.5	0	0
	0.16-0.2	***	0.5	0	0	0
	>0.2	***	0	0	0	0

* P-ammoniumlactate method (capacity)
** P 1:2 volume water extraction
*** unlikely combination

Reduction of N



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Future fertiliser recommendation system

- Rules for application of fertilisers (nutrients) to crops (soil / substrate / irrigation water).
  Based on: Cropping plan, Crop stage , Soil (substrate) properties, Soil (substrate) analysis, e.g.
- Taking into account: Application method, Crop stage, Weather, e.g.
- To provide sufficient nutrients for the crop
- Optimum yields
- Optimum quality

- Aimed at minimizing
  - Leaching / nutrient losses
  - Sustainable soils (substrates?)

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