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Sap analysis to assess crop status of fertigated vegetable crops

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Petiole sap analysis

- Most published work done with NO_3^-; some with K; very little with other nutrients
- Many individual studies have demonstrated that petiole sap [NO_3^-] is strongly influenced by crop N management
- Published research has been fragmented
- Hochmuth prepared comprehensive recommendations for NO_3^- and K (next slide)
- Can be analysed on farm

LaquaTwin

Clean Grow sensor

Traditionally, reported sap NO_3^- concentration declined during crop

RECOMMENDED SUFFICIENCY RANGE VALUES, GENERALLY:

- Declined during crop
- Were defined for development phases

Crop	Crop Developmental Stage	Fresh Petiole Sap Concentration (ppm)	
		NO_3-N	K
Tomato (Field)	First buds	1000-1200	3500-4000
	First open flowers	600-800	3500-4000
	Fruits one-inch diameter	400-600	3000-3500
	Fruits two-inch diameter	400-600	3000-3500
	First harvest	300-400	2500-3000
	Second harvest	200-400	2000-2500

Source:

UF UNIVERSITY of FLORIDA IFAS Extension

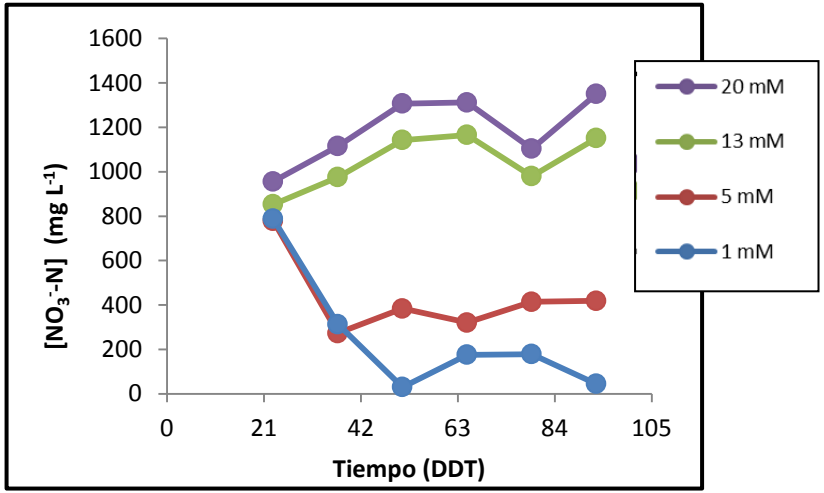
CIR1144

Plant Petiole Sap-Testing For Vegetable Crops[1]

George Hochmuth[2]

In recent work with fertigated crops, sap [NO_3^-] did not decline

Tomato (fresh, greenhouse)



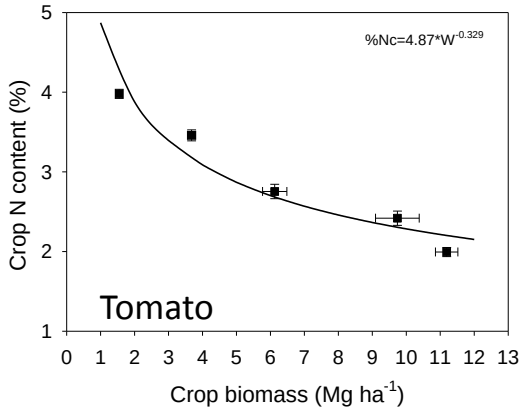
- Large differences with deficient treatments; values relatively constant
- We obtained similar results in melon and sweet pepper
- Michela Farneselli obtained similar results with outdoor processing tomato in Perugia, reference given in Peña-Fleitas et al 2015 paper

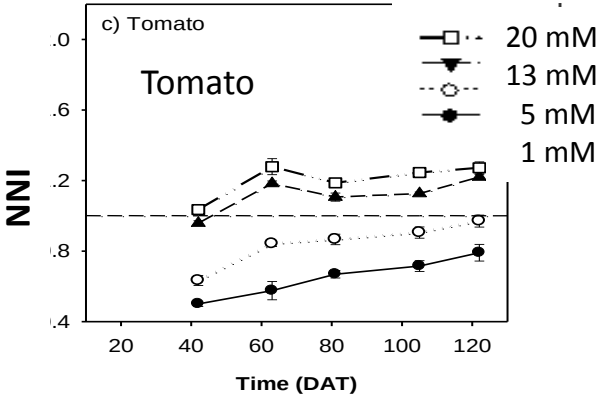
Source: Peña-Fleitas, et al. (2015). Assessing crop N status of fertigated vegetable crops using plant and soil monitoring techniques. *Annals of Applied Biology* 167, 387-405

Evaluating relation between sap [NO_3^-] and N status of crop

Nitrogen Nutrition Index (NNI)

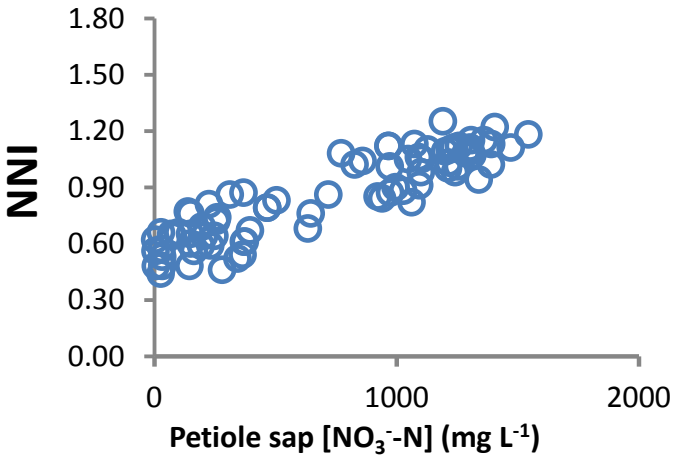
- Established indicator
- Based on critical N curva (%N critical)
- NNI = %N $_{actual}$ / %N $_{crítico}$
  - NNI = 1 No N limitation or N excess (**Optimal for growth)**
  - NNI < 1 N **deficiency**
  - NNI > 1 **Excess** N



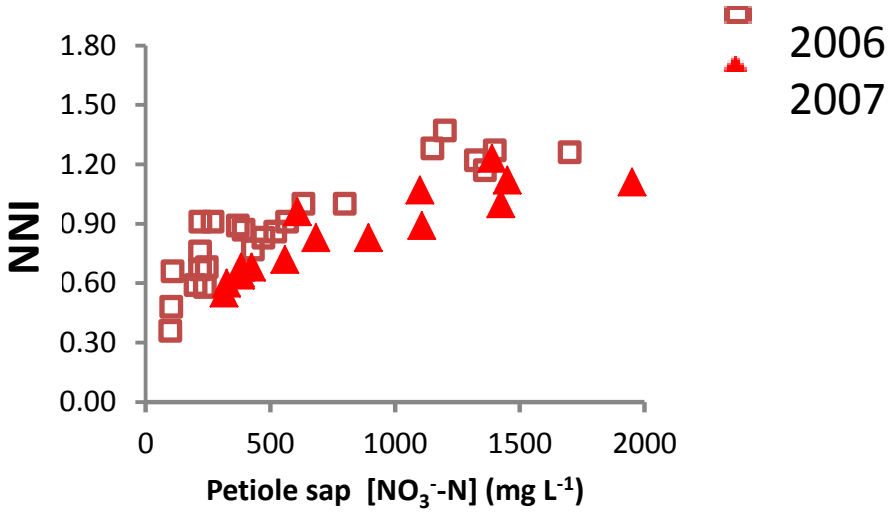


Relation between sap [NO_3^-] and crop N status (NNI)

Fresh tomato, greenhouse, Almeria



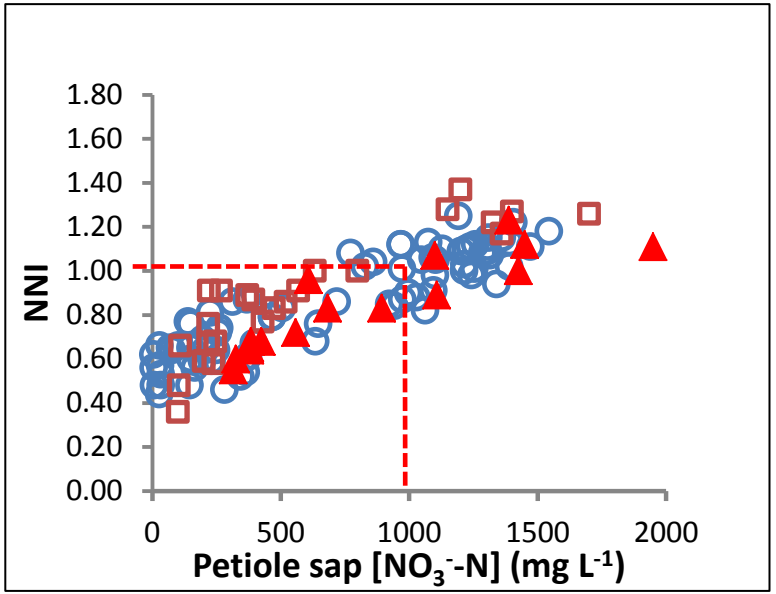
Processing tomato, open field, Perugia



- In these three crops, strong relation between sap [NO_3^-] and NNI for most of crop
- Processing tomato data from Michela Farneselli; reference given in Peña-Fleitas et al 2015 paper
- Similar relationships with pepper and melon in Almeria greenhouses

Source: Peña-Fleitas, et al. (2015). Assessing crop N status of fertigated vegetable crops using plant and soil monitoring techniques. *Annals of Applied Biology* 167, 387-405

Relation between sap [NO_3^-] and NNI - fertigated tomato



- Tomato greenhouse
- Processing tomato 2016
- Processing tomato 2007

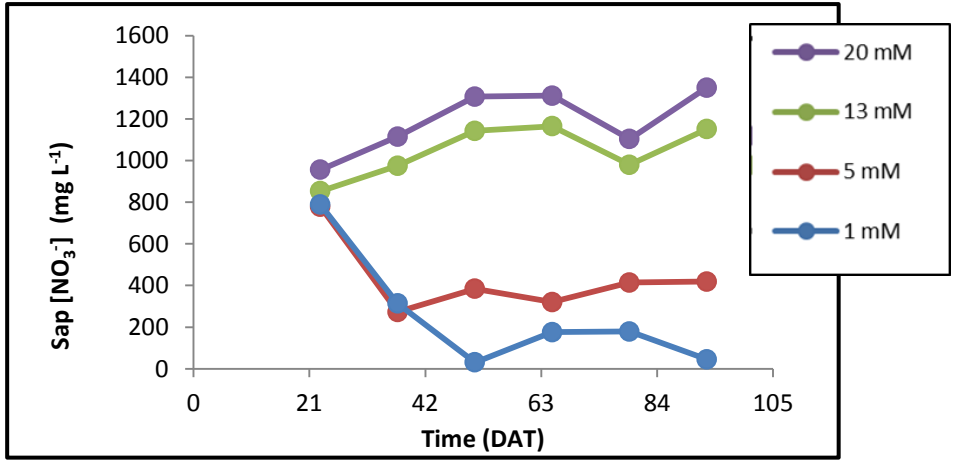
- Constant relation between sap [NO_3^-] and NNI
- Constant sufficiency value for tomato of 1000 mg L^{-1}
- In later work with pepper, we obtained higher R^2 values when determined for each of four development phases vs. one value for crop

Source: Peña-Fleitas, et al. (2015). Assessing crop N status of fertigated vegetable crops using plant and soil monitoring techniques. *Annals of Applied Biology* 167, 387-405

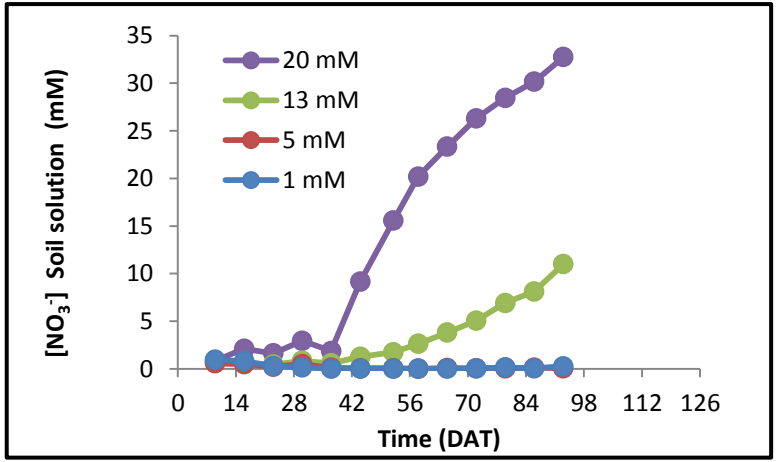
Use of sap [NO_3^-] for optimal N management

Suggestion to use in combination with a soil monitoring system e.g. soil solution [NO_3^-] which is more sensitive to excess N

Sap



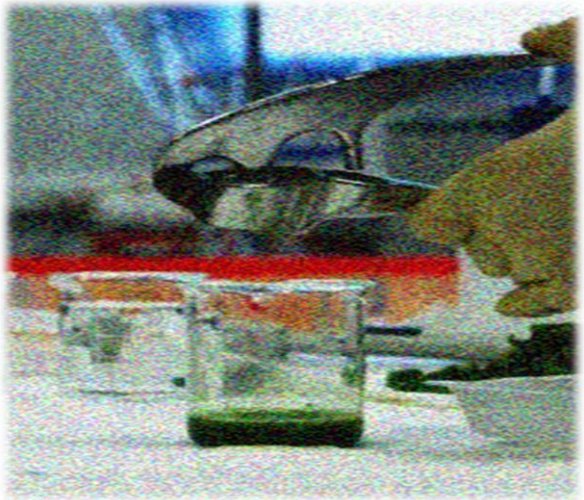
Soil solution



Both [NO_3^-] in sap and the soil solution can be analysed on-farm with rapid analysis systems

Source: Peña-Fleitas, et al. (2015). Assessing crop N status of fertigated vegetable crops using plant and soil monitoring techniques. *Annals of Applied Biology* 167, 387-405

Additional issues

- Other nutrients
- Some companies are analysing many nutrients and providing recommendations
  - NovaCropControl, The Netherlands
  - Hortus Technical Services, Australia
    - Formerly CropTech
    - Has 20+ years of experience
- Using leaf rather then petiole
  - Done by NovaCropControl, The Netherlands
  - More rapid handling
- Sampling both newer and older leaves
  - Done by NovaCropControl, The Netherlands
  - Generally only most recently expanded leaf used

Thanks for your attention