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Using proximal sensor measurements for monitoring N status in lettuce

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The aim

- **applicability of proximal sensing in lettuce**

→ **SAP TEST and SPAD readings**
(Ulissi et al., 2011; Farneselli et al.,2006; 2010; 2014; Pena-Fleitas et al, 2015)

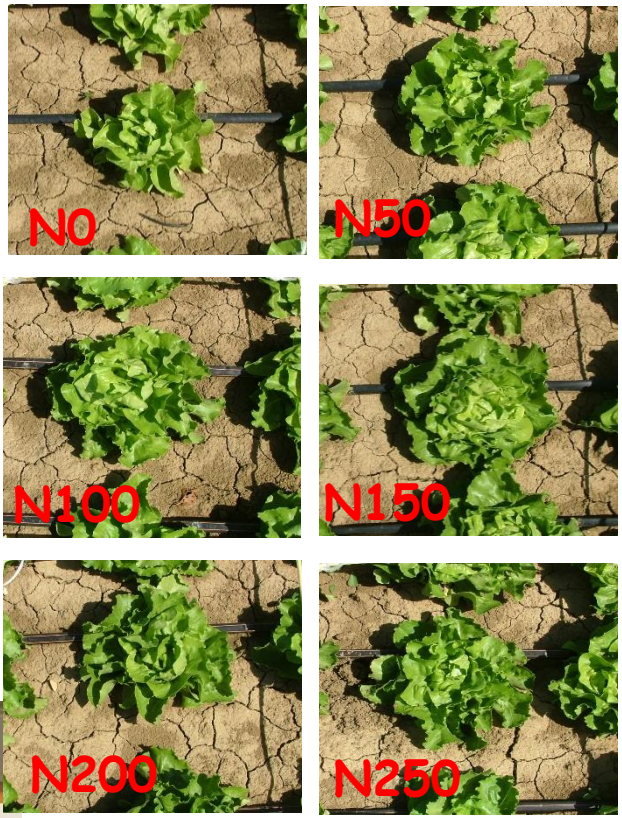
- Proximal sensed vegetation indices accurate for several herbaceous crops
- Little information in horticultural crops

WHY lettuce ?

In Italy

- **Most common vegetable**
- **Multile growing seasons during the year**
- **Some experiences on nitrogen fertilisation at UniPG (Tei et al., 1996;2000;2003)**

The EXPERIMENT



TREATMENTS

N0:	0 kg N ha^{-1}
N50:	50 kg N ha^{-1}
N100:	100 kg N ha^{-1}
N150:	150 kg N ha^{-1}
N200:	200 kg N ha^{-1}
N250:	250 kg N ha^{-1}

DETERMINATIONS (weekly)

- growth analysis

aerial biomass and N accumulation by lab analysis

- crop nutritional status evaluation by QUICK TESTS

1. **SPAD readings**

- Chlorophyll content
- midrib of wrapper leaf, close to head maturity
- Minolta SPAD-502 (Minolta Camera Co. Ltd., Japan)

2. **SAP TESTING**

- Petiole sap NO_3-N concentration
- Iono-specific electrode: Cardy Twin Nitrate Meter (Cardy Spectrum tecnologies, Inc. Plainfield,IL).
- midrib of wrapper leaf, close to head maturity

3. **Canopy reflectance by Hand-held radiometer RapiSCAN CS-45**

(Holland scientific Inc. Lincoln, NE, USA)

- Field of view: 45 degrees by 10 degrees
- Measurement channels: 670n, 730n, 780 nm
- Active light source
- NDVI, NDRE

SOME RESULTS

SPAD readings

Treatment	Chrophyll meter readings		
	20 DAT	26 DAT	33 DAT
N0	29,9 (0,58)	31,5 (0,84)	29,3 (1,39)
N50	32,7 (0,92)	31,5 (1,74)	31,0 (0,63)
N100	34,1 (0,67)	32,1 (1,15)	32,9 (1,05)
N150	35,3 (0,27)	36,0 (1,24)	33,0 (1.52)
N200	35,8 (0,73)	35,9 (1,53)	34,4 (0,41)
N250	35,6 (0,65)	36,4 (1,46)	36,8 (1,84)

SAP test

Treatment	NO_3-N (mg l^{-1})		
	20 DAT	26 DAT	33 DAT
N0	160 (15,8)	149 (22,9)	155 (23,9)
N50	133 (12,5)	185 (37,9)	183 (18,5)
N100	355 (30,7)	154 (36,1)	263 (18,9)
N150	380 (40,1)	220 (40,8)	281 (20,4)
N200	363 (37,7)	315 (31,8)	290 (20,4)
N250	403 (16,5)	385 (11,9)	350 (25,6)

SOME RESULTS
(at 33 DAT)

Treatments	DW ($g\ m^{-2}$)	N_{uptake} ($g\ m^{-2}$)	LAI_{max}	SPAD	SAP ($mg\ l^{-1}$)	NDVI	NDRE
N0	1429	2,5	3,0	29,3	155	0,426	0,143
N50	1895	3,6	3,7	31,0	183	0,446	0,159
N100	2295	4,2	4,3	32,9	263	0,619	0,220
N150	2927	5,4	5,1	33,0	281	0,604	0,215
N200	2575	5,2	5,3	34,4	290	0,643	0,223
N250	3157	6,6	5,4	36,8	350	0,638	0,224
F test	**	**	*	*	**	**	**
sed	316,9	0,76	0,72	1,94	28,3	0,05	0,013
R^2 (vs Ntot)				0,706	0,642	0,497	0,549

Further investigations

- NO_3-N (5-15% Ntot)
- critical N curve and NNI
- stage of development
- height of measurements
- other vegetation indices
- …

GRAZIE!

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