Monitoring the N release from organic amendments using proximal sensing

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Introduction

- The uncertainty in predicting nitrogen (N) release from organic amendments can lead to insufficient supply of N and therefore to crop N deficiency, which will decrease crop yield. Reducing the uncertainty associated with the N supplied by organic amendments is therefore crucial in order to rationalize their use in horticulture and reduce the use of synthetic N in these cropping systems.
- The sustainable and economically viable use of organic amendments requires ongoing assessment of crop N status which can lead to an indirect estimation of soil plant available N
- Proximal sensed vegetation indices (VIs) provide valuable in-season diagnostic information to determine current plant N status.

Aim

- Compare the three main Vis currently in use (NDVI, NDRE and CCCI) to monitor the N content of a horticultural crop to asses the efficiency of an optimized organic amendments application strategy

Vegetation index and reflectance vs. crop N content				
	NDVI	NDRE	CCCI	RE
R^2	0.60	0.67	0.61	0.23
significance	***	***	***	***
RMSE	0.67	0.61	0.66	0.93
Model	Linear	Linear	Linear	Linear

*** P<0.001

Table 1. Regression analysis, and its significance between the three vegetation indices, RE reflectance and crop N content. RMSE is the root mean square error of VIs and RE from the regression model.

Results and Conclusion

- The NDRE was the index with the highest coefficient of determination for N content in lettuce (R^2 0.67, RMSE 0.61) followed by CCCI and NDVI with R^2 of 0.61 (RMSE 0.66) and 0.60 (RMSE 0.67), respectively (Table 1).
- The temporal trend of NDRE allowed to early detected crop N deficiency in the Ma treatment during the 2015 season while surplus of soil plant available N in the +CONV treatment in the 2014 season (Figure 2 and Table 2).
- NDRE during the mid/late stage of development of lettuce, with the inclusions of non-limiting N plot, has the capability to assess whether the crop is receiving sufficient N under an optimized organic amendments strategy.

Measurement	*Year*	*Treatments*			
	2014	*CONV*	*Ma+CONV*	*Ma+Opt*	*0N*
Yield [t/ha]		49 (1.7)	48 (7)	47 (4)	40 (7)
Crop N [%]		4 (0.2)a	4.1 (0.2)a	3.7 (0.12)a	2.6 (0.23)b
Soil min N [kg N/ha]	*Post-harves*	53.6 (21)b	106 (12)a	87 (13)ab	12 (5)c
	2015	*CONV*	*Ma*	*Ma+Opt*	*0N*
Yield [t/ha]		63 (9)	62(10)	68 (8)	66 (10)
Crop N [%]		2.8 (0.3)a	1.6 (0.09)c	2.2 (0.4)ab	1.4 (0.1)c
Soil min N [kg N/ha]	*Post-harvest*	38.5 (31)ab	21 (9)b	55 (26)a	15 (7)b

Table 2. Crop yield and crop N content (mean (SE)) and soil mineral N at post-harvest. Means denoted with different letter indicate significant differences between treatments (P<0.05)

Methodology

Two seasons of Lettuce (*Lactuca sativa*) planted on raised bed from June to September for the 2014 and 2015.

Treatments:

-(1st season) Raw feedlot manure (Ma) with 100% (+CONV) and reduced (CONV - $N_{(min\ org\ amend)}$, +Opt) mineral fertilizer based on standard farm practices.
-(2nd season) Ma alone and with reduced rate (+Opt)

Monitoring:

Weekly to fortnightly measurements of soil plant available N (PAN); plant reflectance at 670, 730, and 780 nm using hand-held radiometer RapidSCAN CS-45 (Holland scientific Inc., Lincoln, NE, USA); crop N content.

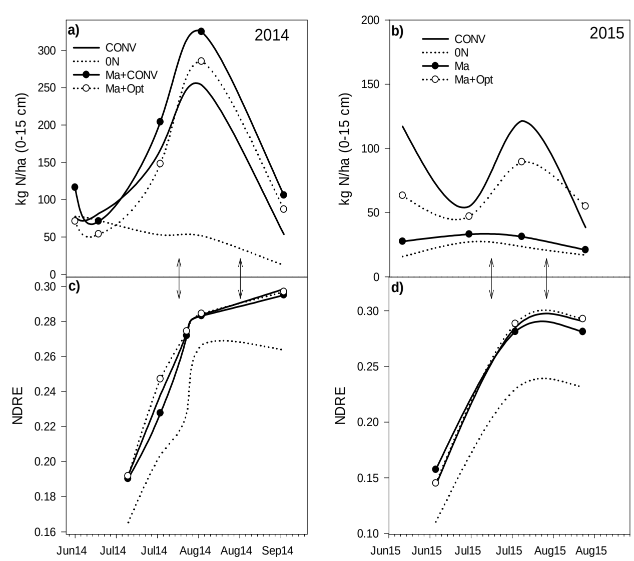

Figure 2. Soil mineral N levels (0-15 cm depth) for the 2014 (a) and 2015 (b) seasons, and NDRE temporal trend during the 2014 (c) and 2015(d) seasons. Arrows indicate the timing of N fertilizer application

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