Organic carbon

Development of a UV absorbance test for monitoring soil humic substances

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The decline in the concentration of organic carbon in cropping soils on the Darling Downs over the last 50 years is associated with a decline in soil structure and in soil fertility. In North Queensland, organic carbon levels have also declined, but a consistent relationship between sugar cane yield decline and soil organic carbon has not been conclusively established. Soil organic carbon includes rapidly recycled green plant residues, along with tougher, more resilient plant residues which over time, become soil humus. Distinguishing between these different forms until now has been costly, requiring expensive laboratory instruments.

Experience with aquatic humic substances and compost extracts indicates microbially processed compounds that have undergone humification, strongly absorb ultraviolet (UV) light at a wavelength of 253.7 nm. We have adapted this method for soil extracts, to determine if this test can be used to indicate the health status of sugar cane soils. Results from air-dried soil samples provided by growers attending a workshop in Mackay indicate grassy headlands that have not been cultivated have the highest concentration of dissolved organic carbon (DOC), with the highest proportion of humified organic carbon (Table 1: UV absorbance and SUVA, calculated by dividing UV absorbance by DOC). The UV field method only detects UV absorbance (pink shaded column), but can be undertaken on freshly collected soil samples under field conditions. The equipment needed to undertake UV field testing is in photo 1.

Soil type	UV $_{253.7\ nm}$ abs. units	Dissolved Org C (mg/L)	SUVA (mg/L/m)	% oven-dry moisture
Baumann chicken manure paddock	1.31	5.5	24.2	2
Hunter organic bananas with compost	3.08	6.4	48.4	7
Hunter slashed headlands	**4.22**	**6.3**	**67.2**	**17**
River silt Burdekin	2.08	4.9	43.1	2
Ahern riverbank 50 yr cane, millmud 2011	2.48	6.3	38.6	4
Ahern org pumpkin millmud 2012	2.34	6.2	37.6	2
Attard Nth Eton 3151-2-1-3	1.51	7.6	20.0	1
Attard Eton 3151-2-1-2 **	2.10	7.3	28.8	3
Attard Nth grass 3079-7-2 **	**3.10**	**7.9**	**39.3**	**5**
Attard Nth Eton 3151-2-1-4	1.28	4.3	29.8	1

** Asterisks are soils treated for 5 years with fish, seaweed and molasses

Table 1: Summary table of UV lab method results for Mackay and Burdekin grower soil samples.

Field UV method data is restricted to the UV absorbance data (shaded in red).

Both the grassy headland soils that had not been cultivated had the highest air-dry moisture content, highest UV absorbance and the highest proportion of the total dissolved organic carbon (DOC) that was humified (Specific UV absorbance or SUVA, calculated by dividing UV absorbance by the DOC).

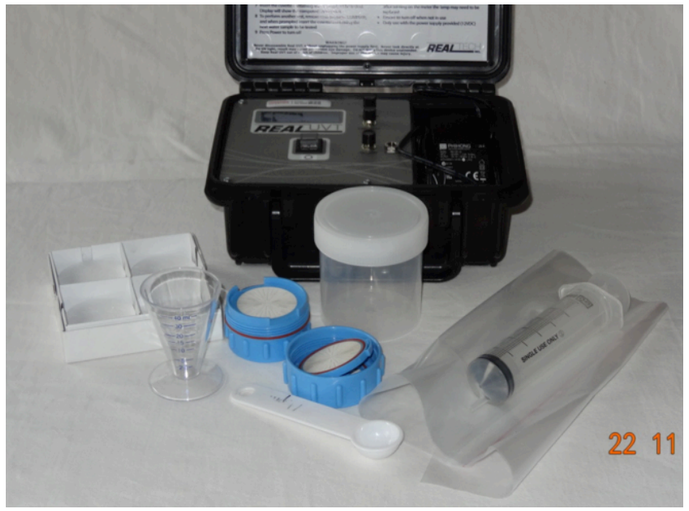

Figure 1: Components of the field UV method testing kit. From front left to right, 47 mm diameter, 45 µm glass fibre filter paper discs, 40 mL measuring cup, 47 mm filter disc holder, one teaspoon measure, one capped plastic container for shaking the solution, one 60 mL syringe for forcing the liquid through the filter, and a sealed plastic bag for pulverising the soil sample. Portable UV spectrophotometer is at the rear.

Biography

Dr Pamela PIttaway

Qulifications:
Ph. D. Botany/Agriculture, La Trobe University, Melbourne Victoria
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During her PhD candidature Pam investigated the influence of soil type and climate on eucalyptus dieback associated with the soilborne disease Phytophthora cinnamomi. Postdoctoral research at the Waite Institute Adelaide University on the susceptibility of wheat to root disease further stimulated her interest in plant, soil and microbial interactions. Lecturing in Introductory Entomology, Microbiology and Integrated Pest Management at Roseworthy (SA) and Gatton (Qld) Agricultural Colleges expanded Pam's interest in interdisciplinary scholarship and research. Since joining the NCEA in 1997, Pam has collaborated with engineers and primary producers on alternative strategies for managing agricultural organic waste, and with water resource managers on the impact of aquatic humic substances on artificial monolayers and water quality. Pam has extended her research on aquatic humic substances to develop a test for soil humic substances, as an index of soil health.

Key research areas include

- Soil health and thermophilic composting
- Biology of natural aquatic microlayers