



Sustainable Management of Soil Organic Matter

Edited by
R.M. Rees, B.C. Ball,
C.D. Campbell and
C.A. Watson



British
Society of
Soil Science



CABI Publishing

Contents

Contributors	xi
Preface	xix
Introduction	1
1 Organic Matter and Sustainability	9
<i>M.R. Carter</i>	
1.1 Critical Levels of Soil Organic Matter: the Evidence for England and Wales	23
<i>P.J. Loveland, J. Webb and P. Bellamy</i>	
1.2 FT-IR Studies on Soil Organic Matter from Long-term Field Experiments	34
<i>R.H. Ellerbrock, A. Höhn and H.H. Gerke</i>	
2 Modelling Soil Organic Matter Dynamics – Global Challenges	43
<i>K. Paustian</i>	
2.1 Soil Organic Matter Sustainability and Agricultural Management – Predictions at the Regional Level	54
<i>P.D. Falloon, P. Smith, J. Szabo, L. Pasztor, J.U. Smith, K. Coleman and S. Marshall</i>	
2.2 Modelling of Carbon Dynamics in a Rural Area of Central Germany	60
<i>U. Franko and S. Schenk</i>	

2.3	Modelling Variation in C and N Loss and Effects on N Mineralization After Grassland Ploughing Over a Catchment	67
	<i>G.M. Richter, G. Tuck and J.U. Smith</i>	
2.4	Modelling Decomposition of Sugarcane Surface Residues and the Impact on Simulated Yields	74
	<i>P.J. Thorburn, F.A. Robertson, S.N. Lisson and J.S. Biggs</i>	
2.5	Questionable Assumptions in Current Soil Organic Matter Transformation Models	83
	<i>J.R.M. Arah and J.L. Gaunt</i>	
2.6	A Procedure for Isolating Soil Organic Matter Fractions Suitable for Modelling	90
	<i>J.L. Gaunt, S.P. Sohi, H. Yang, N. Mahieu and J.R.M. Arah</i>	
3	Soil Organic Matter Management: The Roles of Residue Quality in C Sequestration and N Supply	97
	<i>G. Cadisch and K. Giller</i>	
3.1	Crop Residue Effects on Soil C and N Cycling under Sugarcane	112
	<i>F.A. Robertson and P.J. Thorburn</i>	
3.2	Effect of Residue Quality on N ₂ O Emissions from Tropical Soils	120
	<i>E.M. Baggs, N. Millar, J.K. Ndufa and G. Cadisch</i>	
3.3	Evaluation of the Soil Organic Matter Dynamics Model MOTOR, for Predicting N Immobilization/Mineralization Following Field Incorporation of Paper Mill Sludge in a Horticultural Soil	126
	<i>A.J.A. Vinten, P. Martin-Olmèdo, S. Sattar, P.J. Kuikman and A.P. Whitmore</i>	
3.4	Organic Matter Management in Practice – The Potential to Reduce Pollution	135
	<i>M. Shepherd, R. Harrison, R. Mitchell, A. Bhogal and J. King</i>	
3.5	Carbon and Nitrogen Losses after Ploughing out Grass and Grass-Clover Swards	142
	<i>M.F. O'Sullivan, A.J.A. Vinten and B.C. Ball</i>	
3.6	Fate and Behaviour of Organic Contaminants During Composting of Municipal Biowaste	150
	<i>N. Hartlieb and W. Klein</i>	
3.7	The Impact of Changing Farming Practices on Soil Organic Matter and Soil Structural Stability of Fen Silt Soils	157
	<i>D.L.J. Hatley, T.W.D. Garwood and P.A. Johnson</i>	

3.8	Crop Management Systems to Conserve Soil Fertility After Long-term Setaside in Southern Italy	163
	<i>M. Mazzoncini, L. Crocè, P. Bàrberi, S. Menini and E. Bonari</i>	
3.9	Modelling Traditional Manuring Practices in the North Atlantic Context: Soil Sustainability of a Shetland Island Community?	173
	<i>W.P. Adderley, I.A. Simpson, M.J. Lockheart, R.P. Evershed and D.A. Davidson</i>	
3.10	Organic Matter and Anthrosols in Amazonia: Interpreting the Amerindian Legacy	180
	<i>J.M. McCann, W.I. Woods and D.W. Meyer</i>	
3.11	Persistence of Soil Organic Matter in Archaeological Soils (Terra Preta) of the Brazilian Amazon Region	190
	<i>B. Glaser, G. Guggenberger, L. Haumaier and W. Zech</i>	
3.12	Organic Matter Dynamics in Soils of the Former Lake Texcoco, Mexico	195
	<i>M.L. Luna-Guido, I. Beltrán-Hernández, F. Mercado-García, C. Siebe, J.A. Catt and L. Dendooven</i>	
3.13	Low-input Ecological Rice Farming in Bangladesh	201
	<i>S.K. White, M.F. Hossain, N. Sultana, S.F. Elahi, M.H.J.K. Choudhury, S. Sarker, Q.K. Alam, J.A. Rother and J.L. Gaunt</i>	
3.14	The Influence of Cultivation on the Composition and Properties of Clay–Organic Matter Associations in Soils	207
	<i>C. Chenu, M. Arias and E. Besnard</i>	
3.15	The Influence of a Grass–Clover Mixture on Soil Organic Matter and Aggregation of a Podzolic Loamy Sand Soil	214
	<i>N.P. Buchkina and E.V. Balashov</i>	
4	The Role of Soil Organic Matter and Manures in Sustainable Nutrient Cycling	221
	<i>K.W.T. Goulding, D.V. Murphy, A. Macdonald, E.A. Stockdale, J.L. Gaunt, L. Blake, G. Ayaga and P. Brookes</i>	
4.1	Can Concepts of N Saturation Developed for Forest Systems be Applied in Arable Soils?	233
	<i>D.V. Murphy, N. Dise, K.W.T. Goulding, J. MacDonald, C. Peake, P. Redfern and E.A. Stockdale</i>	
4.2	Nitrogen Mineralization Under Bare Soils After the Destruction of Grazed Pastures	239
	<i>F. Vertès, F. Laurent, S. Recous, P. Leterme and B. Mary</i>	
4.3	Dissolved Organic Nitrogen in a Peaty Podzol: Influence of Temperature and Vegetation Cover	247
	<i>P.J. Chapman, B.L. Williams and A. Hawkins</i>	

4.4	Dissolved Organic Nutrients (N, P and S) in Shallow Forest Soils: Fluxes and Spectroscopic Characterization <i>K. Kaiser, G. Guggenberger and W. Zech</i>	256
4.5	Dissolved Organic Carbon Losses from Grazed Grasslands <i>K.B. McTiernan, S.C. Jarvis, D. Scholefield and M.H.B. Hayes</i>	264
4.6	Effects of Sterilization and Incubation Temperature on Formation and Quality of Dissolved Organic Matter in Soils <i>B. Marschner and A. Bredow</i>	274
4.7	Nitrogen Fluxes Through Sustainable Farming Systems in the Mid-hills of Nepal <i>C.J. Pilbeam, P.J. Gregory, B.P. Tripathi and R.C. Munankarmy</i>	280
4.8	N, P and K Budgets for Some UK Organic Farming Systems – Implications for Sustainability <i>S. Fortune, J.S. Conway, L. Philipps, J.S. Robinson, E.A. Stockdale and C.A. Watson</i>	286
4.9	The Effects of All-arable Organic Rotations on Soil Organic Matter Levels and the Phosphorus and Potassium Status Over the Period 1987–1998 <i>L. Philipps</i>	294
4.10	Manure Fertilization for Soil Organic Matter Maintenance and its Effects Upon Crops and the Environment, Evaluated in a Long-term Trial <i>J. Raupp</i>	301
4.11	Effect of Elevated CO ₂ and Temperature on Soil C and N Cycling <i>H.A. Torbert, S.A. Prior and H.H. Rogers</i>	309
4.12	Interactions Between Elevated CO ₂ and N in Soils: Influence on N ₂ O Fluxes and Rhizosphere Denitrifier Activity <i>P. Martin-Olmèdo, J. Grace and R.M. Rees</i>	316
4.13	Carbon Mitigation Options in Agriculture: Improving our Estimates for Kyoto <i>P. Smith, P.D. Falloon, D.S. Powlson and J.U. Smith</i>	324
4.14	Soils and Soil Organic Matter Along a Transect from Central Taiga to Forest Tundra, Siberia <i>G. Guggenberger, S. Bussemer, J.G. Karpov and E.L. Baranovskij</i>	330
4.15	Carbon Dynamics in Upland Soils after Serious Fires <i>S.F.I. Haslam, D.W. Hopkins and J.A. Chudek</i>	337

5 Implications of Soil Biodiversity for Sustainable Organic Matter Management	343
<i>K. Ritz and B.S. Griffiths</i>	
5.1 Microbial Catabolic Evenness: A Potential Integrative Indicator of Organic Matter Management?	357
<i>B.P. Degens</i>	
5.2 'DOK' Long-term Farming Systems Trial: Microbial Biomass, Activity and Diversity Affect the Decomposition of Plant Residues	363
<i>A. Fließbach, F. Eychorn, P. Mäder, D.I. Rentsch and R. Hany</i>	
5.3 Comparison of Phenotypic, Functional and Genetic Diversity of Bacterial Communities in Soils	370
<i>S. O'Flaherty, S. McGrath and P. Hirsch</i>	
5.4 Organic Matter in Restored Soils as Affected by Earthworms and Land Use	377
<i>J. Scullion and A. Malik</i>	
5.5 Rhizosphere Effects on Soil Microbial Biomass Size and Turnover in a Soil of High and Low Fertility	386
<i>A. de Neergaard and J. Magid</i>	
6 Soil Teeming with Life: New Frontiers for Soil Science	393
<i>J.M. Tiedje, J.C. Cho, A. Murray, D. Treves, B. Xia and J. Zhou</i>	
6.1 Sustaining Soil Organic Matter	413
<i>R.M. Rees, B.C. Ball, C.D. Campbell and C.A. Watson</i>	
Index	427