Use of uncomposted woodchip as a soil improver in arable and horticultural soils

Sally Westaway[1], Anais Rousseau[2], Jo Smith[1]

[1]Organic Research Centre, RG20 0HR, Newbury, UK;
[2]Association Française d'Agroforesterie, 44 rue Victor Hugo, 32 000 AUCH, France

[1]E-mail: sally.w@organicresearchcentre.com

The challenge

One challenge farmers face is maintaining and improving soil health and soil organic matter in the heavily cultivated soils often found in arable and horticultural systems. Repeated applications of composted material have been well documented as leading to long term improvements in soil organic matter (SOM), soil water retention and improved soil nutrient status. But this material either needs to be sourced externally as a finished product which can be costly and unsustainable or composted on farm which requires space and time for the composting process to take place.

Ramial woodchip

The application of fresh uncomposted, or **ramial woodchip (RCW)** to cultivated soils also has significant potential benefits, with a long-term study in the US showing positive results in terms of soil biological activity and SOM (Free, 1971). Research by Caron et al (1998) confirmed these findings and recommends using smaller diameter material for chip production, chipped fresh when the leaves are off, as younger branches are more nutritionally dense. However, few studies have followed up on these findings in European annual cropped arable and horticultural farming systems.

RCW from hedges and agroforestry

The requirement for smaller diameter material make hedges and short rotation coppice agroforestry systems ideal for RCW production. RCW offers the potential for a sustainable source of fertility and organic matter that farmers can grow themselves whilst also providing an economic incentive for both the management of existing, as well as the establishment of new, on-farm woody resources.

On-farm trials

The WOOdchip for Fertile Soils (WOOFS) EIP Operational Group in the UK is researching the addition of uncomposted RCW sourced from on-farm woody resources as a soil improver. Trials have been established on three farms in Southern England in winter 2017/18. The trials aim to increase the sustainability of farm systems by linking agroforestry and hedgerow management with soil improvement. The farms are all livestock free with no animal inputs, and fertility comes from fertility building crops, compost and/or mineral nitrogen. Baseline soil and compost/woodchip samples were collected at trial establishment, then in late summer 2018 soil parameters were measured, crop/biomass samples taken and worms counted. At Tolhurst Organics an additional RCW trial established in winter as part of the EU funded SustainFARM project 2016/17 was also included.

Table 1. *Farms participating in the trials and treatments used in the trials*

Farm	Type	Treatments (3 replicates)	Application rate and timing
Tolhurst Organics	Organic vegetable production	1. RCW from mixed hedgerow 2. Composted woodchip 3. Control of nothing	70 m^3/ha applied to 1st year of 2 year legume ley
Wakelyns Agroforestry	Agroforestry alley cropping with organic arable rotation	RCW from: 1. Poplar SRC agroforestry 2. Willow SRC agroforestry 3. Hazel SRC agroforestry 4. Mixed hedgerow 5. Control of nothing	40 m^3/ha applied to 1st year of 2 year legume ley
Down Farm	Conventional arable cropping	1. RCW from mixed hedgerow 2. Green waste compost 3. Control of nothing	150 m^3/ha applied in winter before sowing of spring crop (barley)

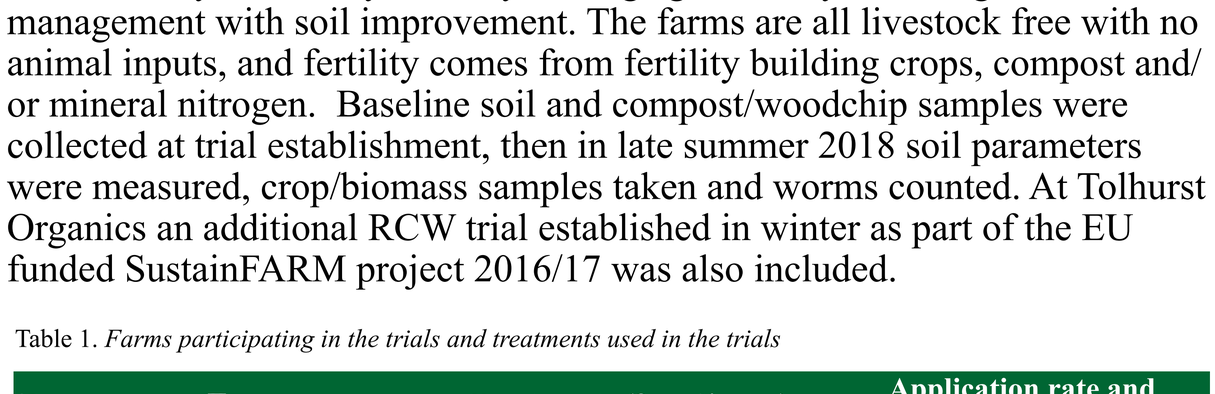

Figure 1 (a) Spreading RCW at Tolhurst Organics using a rear discharge muck spreader, 2018. (b) willow coppice for firewood and RCW production at Tolhurst Organics. (c) worm sampling at Tolhurst Organics (d) crop sampling at Down Farm

Initial results

First year results have shown no significant differences between the RCW and compost in terms of soil biology, soil chemistry or crop parameters (green manure biomass and spring barley yields). Where two years data are available (Tolhurst Organics), we see a slight increase in available P, K, Mg, SOM and biological activity in both the RCW and compost between the first and second year (Table 1).

Table 1: Soil health results (mean +/- SE) between treatment and year. * indicates significant results

	Treatment			Year		
	Compost	**RWC**	**p**	**2017**	**2018**	**p**
Available P	26.33 ± 2.73 mg/L	25.18 ± 2.75 mg/L	0.698	22.57 ± 1.46 mg/L	28.95 ± 4.04 mg/L	0.0226 *
Available K	92.58 ± 6.54 mg/L	90.94 ± 8.84 mg/L	0.909	61.48 ± 4.60 mg/L	122.04 ± 10.77 mg/L	9.02e-10 ***
Available Mg	80.76 ± 3.73 mg/L	80.89 ± 2.80 mg/L	0.981	70.16 ± 2.55 mg/L	91.50 ± 3.99 mg/L	2.56e-09 ***
Organic matter	4.34 ± 0.13 %	4.34 ± 0.07 %	1.00	3.93 ± 0.09 %	4.75 ± 0.12%	1.16e-09 ***
pH	6.42 ± 0.12	6.15 ± 0.20	0.041 *	6.28 ± 0.14	6.30 ± 0.17	0.903
CO_2	237.16 ± 6.96 mg/kg	230.75 ± 8.63 mg/kg	0.694	201.25 ± 9.78 mg/kg	266.67 ± 5.81 mg/kg	5.72e-08 ***

Worm diversity and abundance gives a good indicator of overall soil health. At the site where the treatments have been in place for two years no significant differences in the total number of worms were seen between treatments. However more endogeic (soil living) worms were counted in the compost plots and significantly more epigeic (worms that live in and feed on the leaf litter) in the RCW plots ($p = 0.020$) (Figure 2).

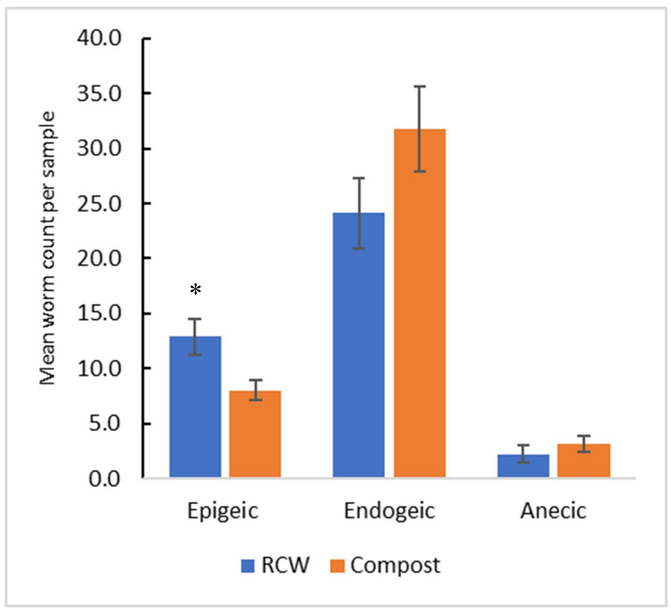

Figure 2. Worm counts from March 2019 by main ecotype, +/- SE. Treatments applied January 2017.

Conclusions

The absence of any significant differences between the treatments suggests that applying woodchip green, and so avoiding the need to compost, may be a viable alternative to other inputs. However the breakdown of woodchip, colonization by fungus and subsequent action on the soil is a long-term process (Lemieux and Germain, 2000) and needs to be studied over a longer period of time. Crop (potato) health and yield assessments are planned for late summer 2019, three years after the first RCW application, this will give more information on the potential of RCW for crop nutrition and health. If the results are positive RCW from agroforestry offers the opportunity to future proof farms and reduce reliance of external inputs.

Acknowledgements

SustainFARM is funded in the UK by Defra as part of the European FACCE SURPLUS ERA-NET. EIP-AGRI funds the Woodchip for fertile soils Operational Group (https://ec.europa.eu/eip/agriculture/en). Many thanks to Martin Wolfe, Robert Benford and Iain Tolhurst for participation and enthusiasm with these trials.

www.sustainfarm.eu

The European Agricultural Fund for Rural Development: Europe investing in rural areas

References

Caron C. Lemieux G. and Lachance L. (1998) Regenerating soils with ramial chipped wood. Publication no. 83, Dept of Wood and Forestry Science, Quebec

Free, G.R. (1971) Soil Management for Vegetable Production on Honeoye Soil with Special Reference to the Use of Hardwood. Plant Sciences Agronomy

Lemieux, G. and Germain, D. (2000) Ramial Chipped Wood: the Clue to a Sustainable Fertile Soil. Publication 128. Département des Sciences du Bois et de la Forêt, Québec, Canada