Ramial woodchip for soil health and fertility

A common challenge farmers face is maintaining and improving soil health and soil fertility. Repeated applications of compost give long term improvements in Soil Organic Matter (SOM), soil water retention and soil nutrient status. But this material either needs to be sourced externally, which can be costly and unsustainable, or composted on farm, which requires space and time for the composting process to take place. Could fresh ramial woodchip from the management of trees and hedges on the farm offer an alternative? Senior Agroforestry Researcher ***Sally Westaway*** *investigates.*

What is ramial woodchip?

Ramial Chipped Wood (RCW) is fresh un-composted woodchip made from smaller diameter material. Young branches are nutritionally the richest part of a tree and can contain as much as 75% of the minerals, amino acids, proteins, and enzymes found in the whole tree. There is some evidence to suggest that the application of RCW to cultivated soils has benefits for soil health. A long-term study in the US showed positive results in terms of soil biological activity and SOM compared with grass cover crops or resting the soil with harvested alfalfa sod hay crops[1]. Research at Laval University[2] in Canada confirmed these findings. However, few studies followed up on these findings in European arable and horticultural systems.

The requirement for smaller diameter material makes hedges and short rotation coppice agroforestry systems ideal for RCW production. Offering 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

Replicated field trials were established on three farms in Southern England in winter 2017/18 (T1), trials were repeated in winter 2018/19 (T2) to give two trials on each site. At Tolhurst Organics an additional RCW trial was established in winter 2016/17 (T0) as part of the EU-funded SustainFARM project. All three farms are livestock free with no animal inputs, and fertility comes from fertility building crops, compost and/or mineral nitrogen.

Table 1. Farms participating in the trials and treatments used

Farm	Treatments (3 replicates)	Application rate and timing
Tolhurst Organics: Organic vegetable production	1. RCW from mixed hedge 2. Composted woodchip 3. Control of nothing	T0: 70 m^3/ha applied to 1st yr of 2 yr legume ley T1 & T2: 40 m^3/ha applied to 1st yr of 2 yr legume ley
Wakelyns Agroforestry: Agroforestry alley cropping with organic arable rotation	RCW from: 1. Poplar Short Rotation Coppice (SRC) agroforestry 2. Willow SRC agroforestry 3. Hazel SRC agroforestry 4. Mixed hedgerow 5. Control of nothing	T1: 40 m^3/ha applied to 1st yr of 2 yr legume ley T2: 80 m^3/ha applied to 2nd yr of 2 yr legume ley (rate doubled and reapplied)
Down Farm: Conventional arable cropping	1. RCW from mixed hedge 2. Green waste compost 3. Control of nothing	T1 & T2: 150 m^3/ha applied before sowing of spring crop (barley/ oilseed rape)

WOOdchip for Fertile Soils (WOOFS)

The WOOdchip for Fertile Soils (WOOFS) project EIP Operational Group is a partnership of researchers, farmers and foresters from the UK led by the Organic Research Centre. We have set up field trials on three farms researching the addition of RCW sourced from on-farm woody resources as a soil improver. By linking management of farm hedges and trees with the improvement of soils for agricultural production the project aims to increase the sustainability of farm systems. Specific objectives are to:

1. Determine whether applying woodchip (composted and ramial) is beneficial to soil health and structure.
2. Identify an efficient methodology to produce and apply woodchip on farm.
3. Produce guidelines for farmers on optimum application rates, time of application, stage in a rotation, species of tree, size of chip etc.

EIP-AGRI funds the WOOdchip for Fertile Soils Operational Group

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Baseline soil and compost/woodchip samples were collected at trial establishment, then in late summer 2018 and 2019 soil parameters were measured, crop/biomass samples taken, and worms counted. Trial T0 was cropped with potatoes in 2019 and crop yields and pest and disease incidence were measured.

Soils

The results from the first two years have shown no significant differences between the RCW treatments, the compost (green waste or woodchip) and the control plots for most of the soil parameters measured (P, K, Mg, SOM, pH and CO_2 burst). Some small differences between treatments in soil biological activity were observed. For example, in 2019 total bacteria was significantly higher in the woodchip plots compared to the green waste at Down Farm and the compost at Tolhurst Organics. It was also significantly higher in the willow woodchip plots at Wakelyns when compared to the other treatments, a pattern not seen in 2018. The total biomass of bacteria provides an indicator of abundance of food for predators, nutrient capacity and general diversity of the bacterial population and the health of the soil, suggesting some positive effects of the woodchip over the compost or control treatments. However, mycorrhizal root colonisation, fungi counts and fungi to bacteria ratios were also measured with no clear patterns seen between treatments at this stage.

Photo: Sally Westaway

Spreading ramial woodchip onto the trial plots at Tolhurst Organics, 2018.

Worms

Worm diversity and abundance also gives a good indicator of overall soil health. Both Tolhurst Organics and Wakelyns saw an increase in total numbers of worms between 2018 and 2019; however this was not seen at Down Farm and is likely to be a result of the reduced cultivation associated with the long term leys at the other two sites, and no significant differences in the total number of worms were seen between treatments. However some differences between the worm ecotypes were observed and at Tolhurst Organics 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 ($p = 0.020$). This was not seen at Down Farm or Wakelyns.

Crop yield and disease incidence

The soilborne plant disease Verticillium wilt results in substantial yield losses in many potato production areas. Symptom severity and disease incidence were assessed 100 days and 120 days after planting (DAP) potatoes at Tolhurst Organics and used to calculate a disease intensity index. Disease incidence was significantly higher in the RCW plots at 100 DAP ($p < 0.001$), but not at 120 DAP ($p = 0.61$) (Figure 1)

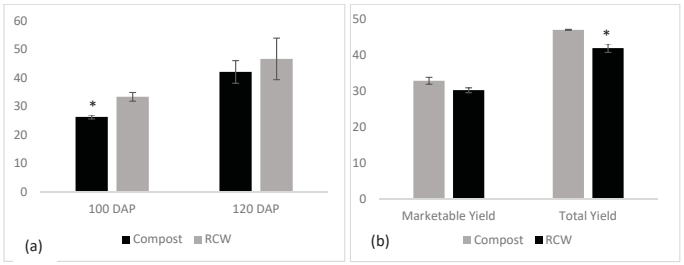

*Figure 1 (a): Potato Disease Intensity Index (%) at 100 and 120 DAP. (b) Total and marketable potato yields for Compost and RCW treatments. Mean +/- standard error * indicates significant results.*

Spring barley yields at Down Farm

There were no significant differences in yields seen in 2019, however in 2018 the spring barley yields were a lot lower reflecting the drought conditions that year and the control plots had a significantly lower average yield of 5.7 t/ha than either the woodchip (6.3 t/ha) or compost (6.4 t/ha) treatments ($p < 0.001$)

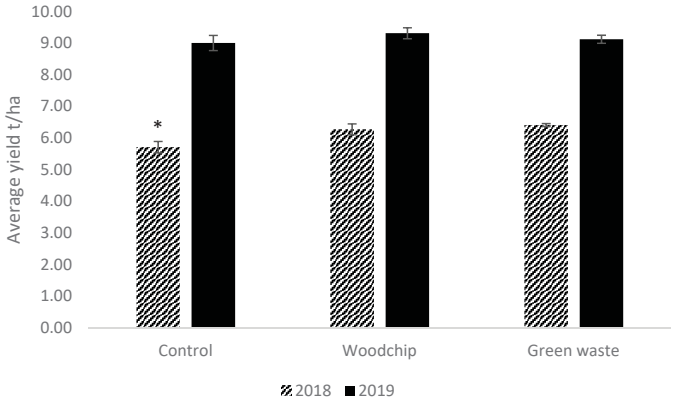

Figure 2: Average spring barley yields for the different treatments at Down Farm in 2018 and 2019. Mean +/- standard error (indicates significant results)*

Conclusions

No significant differences were observed between treatments for most of the soil parameters measured, suggesting 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[3] and ideally needs to be studied over a long period of time. Potato total yield was significantly higher in compost treated soil; however, this difference was not significant for the marketable yield partially due to increased pest damage in the compost plots. There was no difference in the spring barley yields in 2019, but in 2018 the yield was significantly lower in the control plot with no organic material added. This suggests that woodchip and compost may both act to increase the water holding capacity of the soil and increase the crop resilience to extreme weather events. The trials have one more year to run and we will continue to monitor crop and soil parameters to further investigate these results. In addition, next year the group will carry out a cost/benefit analysis of the logistics and economics of producing both RCW and compost on farm versus buying in fertility and organic matter and an output will be a best practice/how to guide for farmers and growers.

Some initial figures from the case study at Tolhurst Organics are outlined in the recent ORC publication Productive Hedges: https://zenodo.org/record/2641808#.XLWiPehKjIU

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