

# The Farmers Researching the Wonders of Woodchip

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# Woodchip – opportunities for animal health and soil health

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## Woodchip – an investigation into the financial, logistical, environmental and soil health benefits of using wood chip as animal bedding

- Funded by Scottish Government through the Knowledge Transfer Innovation Fund
- Project team:
  - SAOS (Fergus Younger, lead)
  - Argyll Small Woods Cooperative (Neil Donaldson)
  - Earthcare Technical (Audrey Litterick)



## Four farmers, four different farming systems

- ***Rab Smith, Coille Farm***, Bruichladdich, Isle of Islay
    - sheep farm
  - ***Duncan Macalister, Glenbarr Farm***, Kintyre
    - sheep, beef and arable farm
  - ***John Filshay, Lyleston Farm***, Cardross, Dunbartonshire
    - sheep and beef farm
  - ***Fergus Younger, Old Leckie Farm***, Gargunnock, Stirlingshire
    - sheep, beef, pigs and poultry farm
-



Considerable enthusiasm for woodchip as bedding amongst farmers in our project



## Woodchip for bedding

1. How does it compare financially with straw (and other bedding materials) for West coast farmers?
  2. Can West coast farmers obtain woodchip bedding in sufficient quantities at the right time(s) of year?
  3. If not, can they grow it on their farms or locally?
  4. (As we MUST start considering the carbon footprint of everything we do...) how does woodchip bedding compare environmentally with straw?
  5. What are the benefits in terms of animal health?
  6. What are the benefits (if any) of applying woodchip-based dung to soils?
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## Financial considerations

- Wood chip bedding is cheaper for some farmers in our project, but not all four. Depends on:
    - £cost (to farmer) of the wood chip, whether the chip is a waste or is being produced specially;
    - £cost in relation to alternatives (straw, paper waste etc.)
    - £Cost of haulage;
    - £Cost (if any) and suitability of storage for bedding pre-use.
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## Logistical considerations - is there enough when the farmer needs it?

- **Woodchip product (hardwood or softwood)**
    - use own wood or develop partnerships with local woodlands now?
    - For some, it will only work in the future – i.e. once local woods are planted and sufficiently mature to allow sustainable regular harvesting.
    - To be sustainable, wood must be harvested no faster than it can be replaced.
  - **Waste wood fines and chip:**
    - Only virgin timber (Grade A waste wood fines) should be used. Grade B, C and D waste wood fines contain contaminants (e.g. preservatives, paints, metal, plastic and glass particles) - should never be used for animal bedding which is later to be applied to land.
    - Some waste woods are currently transported very long distances in order to be re-used, recycled or burnt in biomass plants. Currently no legislation to prevent this – we should work to develop local markets.
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## Carbon implications

- Accurate carbon footprinting is going to become ever more important as we move towards carbon zero economies.
  - Must be sure to be honest about the carbon footprint of each activity, each sale and each purchase.
    - C accounting on many activities and imports is currently failing to account for all the carbon costs involved - include ALL C costs from entire activity.
    - Climate change mitigation should now come before **ALL** other considerations where possible...
-

## Carbon implications

- By using woodchip bedding, farmers have the **opportunity** to:
    - Cut the transport costs for bedding
    - Purchase from carbon-neutral local woodland
    - In some cases it may be possible to use locally-produced waste wood
    - Sequester carbon in soils by applying carbon-rich, nutrient-rich woodchip-based dung to soils (addition of both fertiliser nutrients and long-lasting organic matter).
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## Animal health implications

- **All three farmers** on our project who have used wood chip bedding for at least one season feel that it brings clear benefits in terms of animal health:
    - All three feel that there are fewer foot problems and less lameness.
    - **Duncan Macalister (Kintyre)** also says that he has less naval problems after birth in cattle.
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## Other benefits

- **Rab Smith (Islay)** **says** he spends less time topping up bedding during the season and finds wood chip easier to handle than straw.



## Other benefits



- **Duncan Macalister (Kintyre) says** his animals stay cleaner than when bedded on straw and he has fewer naval problems after birth with cattle.
  - **John Filshay (Dunbartonshire) says** he and his vet is impressed with the cleanliness and good health of sheep and cattle bedded on wood chip.
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## Soil health implications of using woodchip



- Clear evidence that soil health is declining in some cultivated UK soils.
  - Low soil organic matter contents are a common factor.
  - Can woodchip bedding help?
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## Why is soil health important?

- Without it, soils will fail to deliver optimal crop yields
  - As soil health declines, we will see increasing practical and environmental problems:
    - Decline in soil structure and reduction in percolation rates in wet weather.
      - Increasing susceptibility of soils to wind/water erosion;
      - Reduced resilience of soil to traffic and other stresses (especially when soils are wet);
      - Increased requirement for fuel and tractor power when cultivating;
    - Increased susceptibility of crops to pest and disease attack;
    - Reduction in potential yield, with the worst yields happening in poorer weather.
-

## Soil health crisis – what are we seeing?

- Low organic matter content in cultivated soils
    - Soils with poor resilience to a range of stresses
      - Wind and water erosion
      - Compaction (due to traffic, livestock in wet weather)
    - Increased susceptibility of crops to pest and disease attack
    - “Plateauing” and poor crop yields
    - Inconsistency in crop performance, with poorest performance in very wet or very dry years
    - Low levels of biological activity
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## Soil health crisis!

Problems worst in stockless, East coast arable and vegetable soils, especially in England, but in many Scottish soils too.



But this project concerns *West of Scotland livestock farms*, most of which do not have a problem with declining soil health.

- Potential soil benefits from woodchip dung to soils on these farms are likely to relate more to its nutrient content rather than its organic matter content.
  - There may also be challenges with making and applying woodchip dung to soils due to its potentially high carbon content (**high C:N = N lock-up**) and low speed of breakdown. It may need to be stacked for longer and/or turned more often.
  - Tests will be conducted on the finished dung and on soils to which the dung has been added in order to learn more.
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## Potential to trade dung and woodchip between farms

- Could buy and sell woodchip and dung between farms within local areas (similar to straw for muck deals).
    - e.g. arable farm provides wood chip from coppiced woodland or felled forestry to local beef or sheep farmer;
    - Above arable farmer collects/buys woodchip dung from local beef or sheep farmer because he has more need of the nutrients and organic matter.
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## Planned key outputs

- Website (<https://www.argyllsmallwoods.coop/wood-chip-bedding-study/>)
  - Short film of the participating farmers and their enterprises
  - Farmer case studies/guidance documents (one per farm)
  - Farmer seminar on one of the participating farms, with speakers (including farmers) talking about project outputs.
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Thankyou



# THE INFLUENCE OF A WILLOW MULCH ON APPLE AND PEAR SCAB

Dr G Percival: Bartlett Tree  
Research Laboratory  
A Bartkowski: G Thompsons,  
Great Oakley



# Scab diseases of apple and pear







Picture: <http://explorepahistory.com/displayimage.php?imgId=1-2-7E>



Picture: <https://www.npr.org/sections/health-shots/2011/06/18/137149149/for-pesticides-apples-are-worst-onions-the-best?t=1575462490661>

- ▶ Conventional control relies heavily on repeat fungicide spray applications.
- ▶ Increased tolerance to commercial fungicides.
- ▶ Failure of many fungicides to adequately control diseases once a tree is infected and
- ▶ Increased legislative restrictions regarding the use and application of fungicides means new techniques of disease control are now of environmental and economic importance.
- ▶ From a grower's perspective, the restrictions placed on the use of some fungicides, in particular Dodine which is widely used in conventional, are causing concern and the need to find alternative approaches is becoming increasingly urgent.

# A Different Approach:





# Tree Removal







# Thankfully there is a different approach



# Can we use vaccination principles for trees?

The answer is yes. Vaccinating plants against pests and diseases is not a new concept; the idea of inducing resistance in response to plant diseases was recognised in the early 20<sup>th</sup> century when heat or cold treated *Botrytis cinerea* (grey mould) when exposed to *Begonia* plants instead of causing infection as expected, resulted in the plants developing resistance.





▶ Several studies have found that “vaccinating” trees to be effective in controlling:

▶ Fire blight (*Erwinia carotovora*)

▶ *Phytophthora* root rot.

▶ Powdery mildew (*Sphaerotheca pannosa* var. *rosa*, *Phyllactinia* sp and *Uncinula necator*)

▶ Wilt disease of spruce (*Ceratocystis polonica*)

▶ Importantly, the level of disease control achieved was comparable with currently used agrochemicals and a “one-off” vaccination has been shown to provide growing season protection.



# Interestingly tree defence responses are superior to that of humans!

- ▶ An injection against typhoid would only confer immunity against typhoid. Further separate injections would be required if immunity against diphtheria or measles was required.

## In trees, however, a single vaccination causes:

- ▶ Accumulation of antimicrobial proteins, fungi-toxic enzymes, phenolics and terpenoids within leaves, stems and roots.
- ▶ Leaves become thicker and more lignified.
- ▶ Enhanced resin production, production of phenolics and initiation of a wound periderm occurs.
- ▶ Importantly, because multiple defence mechanisms are switched on it is highly unlikely that pests and diseases can develop resistance to this measure.
- ▶ In addition, a single vaccination has been shown to provide resistance against biologically different pathogens (fungal, bacterial, virus) over a growing season

# Products that switch on tree defence systems:

Messenger (a.i. Harpin protein) in the US.

Bion (BTH) in Europe.

Agri-Fos (a.i. Potassium phosphite) in Australia and the US .

Rigel (a.i. **Salicylic acid** analog) in the UK

Oryzemat (a.i. Probenazole) Japan.



## ▶ A small but significant step.

- ▶ Trees can be vaccinated by applying products as a root drench!  
(Percival G.C and Banks J M (2015). *Arboricultural Journal*: 37(1): 7-20
- ▶ Applying products via the roots opens up opportunities to manage tree pest and diseases without the need to spray.





# ▶ Mulch





# Willow mulch





**Control**



**Penconazole**



**Mulch**





# Willow species



# Aims

To assess the efficacy of willow species woodchip mulches, applied to the base of the tree, against apple or pear scab. Specifically, it will:

- ▶ Determine the salicylic acid content of commonly used willow species
- ▶ Assess the efficacy of applying single species willow wood chip as a mulch for the control of apple/pear scab in apple and pear orchards
- ▶ Assess the efficacy of willow wood chip as plant growth and development stimulant in apple and pear trees by quantifying i) foliar nutrient content and ii) fruit sugar content (brix analysis).

**Table 1. Salicylic Acid content of the 10 most common UK willow species**

<b>Scientific name</b>	<b>Common Name(s)</b>	<b>Salicylic Acid (mg/g FW)</b>
<i>S. daphnoides</i>	European violet willow	3.21
<i>S. matsudana tortuosa</i>	Chinese Willow, Corkscrew Willow	2.33
<i>S. caprea</i>	Pussy Willow, Goat Willow, Great Sallow	1.95
<i>S. fragilis</i>	Crack willow, Brittle willow	1.65
<i>S. alba 'Chermesina'</i>		1.62
<i>S. pentandra</i>	Bay Willow	0.81
<i>S. triandra</i>	Almond willow; Almond leaf willow	0.60
<i>S. erythroflexuosa</i>		0.38
<i>S. viminalis</i>	Basket willow/ common osier	0.21
<i>S. alba</i>	White Willow	0.20



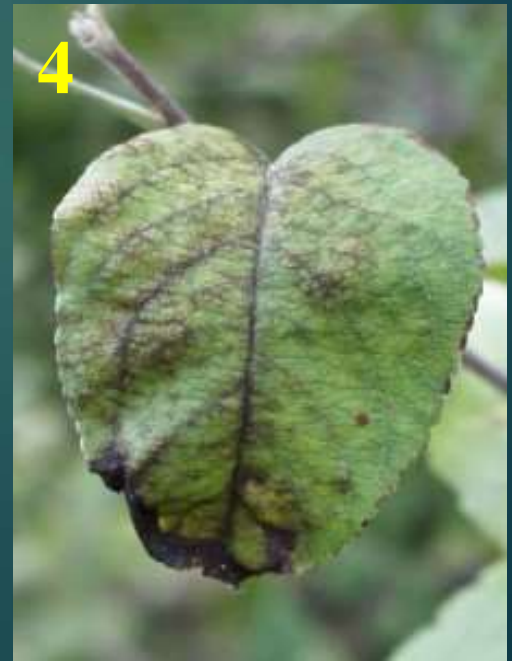
## ► Locations and Varieties

<b>SITE</b>	<b>Variety</b>
Buckinghamshire	Cox, Black Dabinett
Thatchers (Somerset)	Cox
Aston Manor (Hereford)	Prince William
G Thompson (Harwich)	Braeburn
Heinken (Hereford)	Mitchell
Pencoed	Fiesta, Spartan, Rubinette
Kempley Barn (Ross on Wye)	Helens early
Tom The Apple Man (Owestry)	Hereford, Ashmead, Blenheim
Sheppy's (Somerset)	Katy





# Scab Severity Scale - Leaf



# Scab Severity Scale - FRUIT





# ► Sugar Analysis





► Foliar Nutrient Analysis (Nitrogen, Sulphur, Phosphorous, Potassium, Calcium, Magnesium, Manganese, Iron, Copper, Zinc, Boron)



SITE	Variety	LEAF SCAB		
		Control	Mulched	Spray
Bucks	Cox	2.5a	2.2a	NA
Bucks	Black Dabinett	2.7a	2.5a	NA
Thatchers	Cox?	0.9a	0.7a	0.5b
Aston Manor	Prince William	0.9a	0.6b	NA
Harwich	Braeburn	1.6a	1.4a	NA
Heinken	Mitchell	0.9a	0.6b	0.7a
Pencoed	Fiesta	0.8a	0.8a	NA
Pencoed	Spartan	0.9a	0.7a	NA
Pencoed	RubINETTE	0.8a	0.5b	NA
Kempley Barn	Helens early	3.0a	2.9a	NA
Tom The Apple Man	Hereford	1.1a	0.8a	NA
Tom The Apple Man	Ashmead	0.9a	0.7a	NA
Tom The Apple Man	Blenheim	1.1a	1.1a	NA
Sheppys	Katy?	1.6a	1.2b	1.3ab

**Table 2. The influence of willow mulch versus non-mulched and sprayed trees for apple scab management**

<b>Parameter</b>	<b>Control</b>	<b>Mulched</b>	<b>Spray</b>
<b>Leaf Scab Severity</b>	<b>1.4a</b>	<b>1.2a</b>	<b>0.6b</b>
<b>Fruit Scab Severity</b>	<b>0.9a</b>	<b>0.8a</b>	<b>0.7a</b>
<b>Brix</b>	<b>10.8a</b>	<b>11.0a</b>	<b>12.2a</b>
<b>Nitrogen</b>	<b>2.31a</b>	<b>2.49a</b>	<b>2.39a</b>

Results, based on pooled data from all trial sites, show that:

1. Apple scab severity of leaves and fruit was lower than that of non-mulched controls. However, these differences were, in most cases, not statistically significant.
2. Fruit sugar content was higher than that of non-mulched controls but not statistically significantly so in most cases.
3. Leaf nutrient content (Nitrogen, Sulphur, Phosphorous, Potassium, Calcium, Magnesium, Manganese, Iron, Copper, Zinc, Boron) was higher than that of non-mulched controls but not statistically significant
4. Only fungicide spray treatments significantly reduced leaf and fruit scab severity but had no significant effect on foliar nutrient and fruit sugar content.



# Future Recommendations



At some of the sites visited the amount of willow mulch applied was far lower than that recommended (5kg per tree) while the size of the tree was quite large (4-6 metres). This raises the possibility that the overall amount of SA provided to the tree was insufficient to induce any resistance response.

# Authors Trials





# Site Trials



# Future Recommendations

Treat with *S. daphnoides* or *S. matsudana tortuosa* as these species possess an inherently higher SA content which may result in even lower scab severity and higher leaf nutrient/fruit sugar content.

SA is primarily concentrated within willow bark. Consequently the use of a willow bark mulch (a by-product of basket weaving) would be superior to that of a mulch made from willow wood and offers possibilities for future research.

Some of the varieties tested were scab sensitive. A willow wood mulch may offer greater possibilities when used with intermediate and resilient species.

Use of SA sprays (Rigel-G) in combination with willow mulches, especially those with a low SA content





END?



# Mulch and other trials on farm.















# END?





# Woodchip @ Close Farm



# Close farm / Home Farm Highgrove

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- 3 tunnels
- 30 types vegetables , 100 varieties
- 1.2 labour
- Wholesale
- Honesty box
- Shops ,cafes ,pubs.
- PYO
- Foraging families.





























Courgette  
cocorolle  
1cm  
18/3  
14/20

















OCA







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Seed for sale



mulch







# Contact:

- Facebook:
- Frederik Bonestroo
- Close Farm Organic Vegetables
- Farmer Fred's Foraging Families
- Woodchip for soil health

Thank you

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