

Shiitakes in the mist!

Farm Fungi project - growing exotic mushrooms and truffles in Ireland

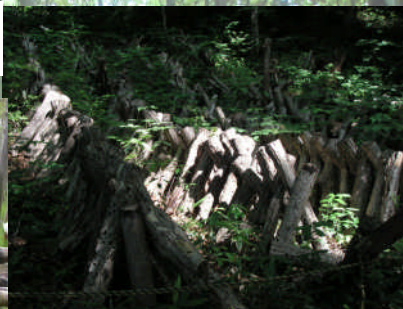
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FARM FUNGI - AIMS

- To assess the viability of producing edible saprophytic fungi

Pleurotus ostreatus (Oyster) and
Lentinula edodes (Shiitake) on logs and tree stumps derived as a result of the thinning process in plantation forests

- To generate our own native inoculum and commercialisable plugs from wild Irish material
- To document competing competitor fungal species on logs

EXPERIMENT LAYOUT

• 2008

3 sites in Co. Limerick
2250 logs of 1m length
307 Stumps inoculated
Dowels purchased from UK
Tree types – Alder, Ash, Beech, Oak, Sycamore
Moisture content readings on bimonthly basis
Fruiting monitored
Dowel density 50 dowels

• 2009

2 sites in Co. Limerick
900 logs of 1m length
Stumps inoculated
Dowels from UK plus our wild Irish strain
Tree types – Scot's Pine, Alder, Sycamore, Larch
Moisture content readings on bimonthly basis
Fruiting monitored
Dowel density experiment - 25, 35 and 50 dowels



INOCULATION

- 1m logs are measured (diameter) and labelled
- Holes are drilled in 1m logs in a trellis pattern
- Dowels are hammered into each 8mm hole
- All cuts are coated with molten cheese wax
- Logs are piled into stacks according to timber type
- Stumps are cut at 1m from ground level
- After labelling, they are inoculated into the cut top
- Again dowels are hammered into holes drilled into the top
- Cheese wax is applied to seal in dowels

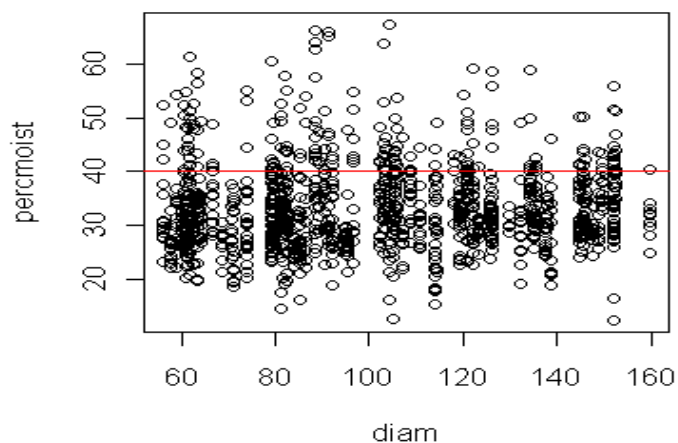
Inoculation in the woods



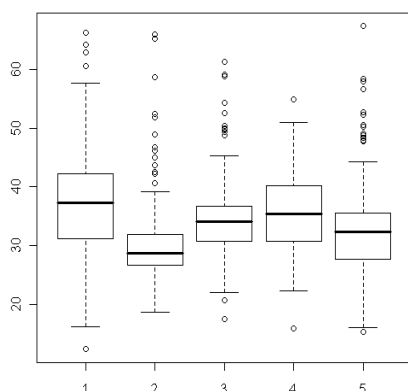
Wood moisture content measurements



MOISTURE READINGS



Moisture retention of different timber types



Boxplot of ANOVA for log type vs. percentage moisture across all 3 sites

X-axis 1=Alder, 2=Ash, 3=Beech, 4=Oak, 5=Sycamore

Y-axis Moisture content (%)

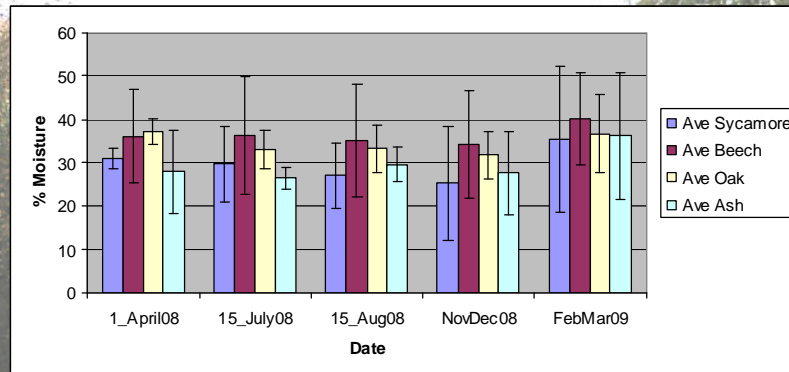
50 log readings for each of the 5 wood types were selected at random using a random number generator in Excel

Alder is the most moisture retentive while Ash is the poorest

There is a notable error associated with the measurement method

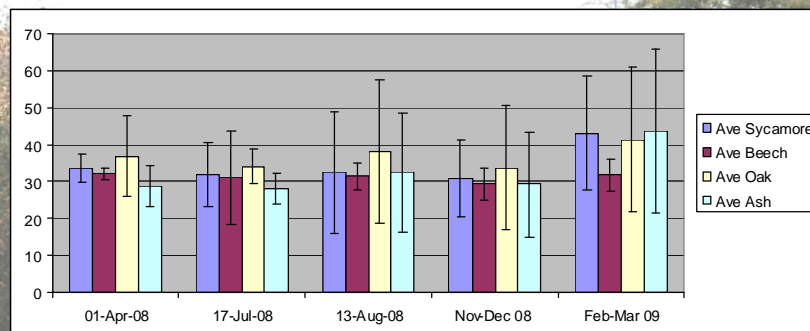
Outer xylem moisture content results

1. Blossomhill



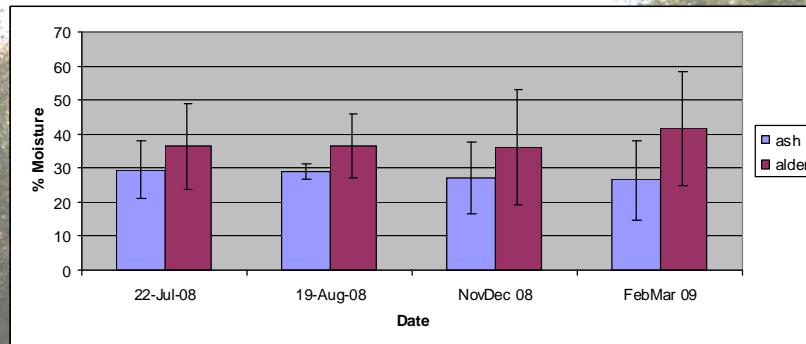
Outer xylem moisture content results

2. Springfield

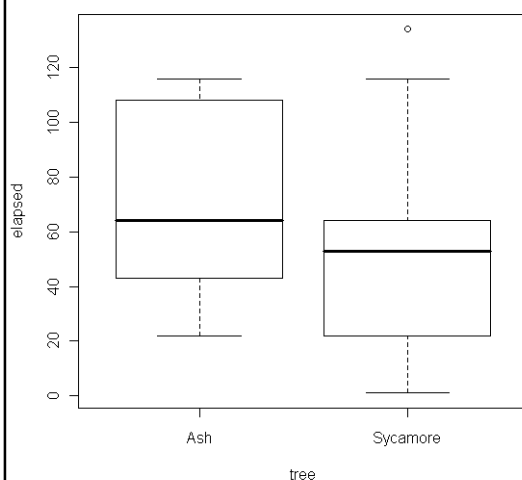


Outer xylem moisture content results

3. Askeaton



OYSTER TIMING VARIATION DEPENDENT ON STUMP TIMBER TYPE



This boxplot shows the significant relationship between time elapsed and host timber type of stumps

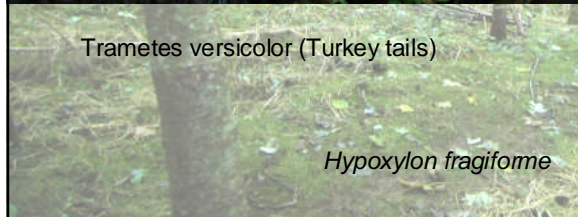
($p = 0.01691$, 95%)

Pleurotus ostreatus on Ash stumps fruit over a week later than *Pleurotus ostreatus* on Sycamore stumps

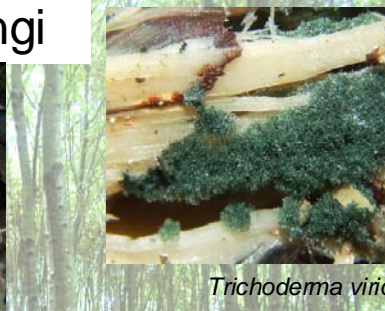
Weeds - Competitor fungi



Trametes versicolor (Turkey tails)



Hypoxylon fragiforme



Trichoderma viride



FARM FUNGI COMPETITOR FUNGI RESULTS

Undergraduate thesis by Lynne Kelly (2009)

Contaminant Species	Sycamore	Beech	Ash	Oak
Cryptosphaeria eunomia			X	
Diatrype bullata	X			
Diatrype stigma	X	X	X	
Diatrypella quercina	X			X
Diatrypella favacea		X		
Diaporthe pustulata	X			
Euepixylon udum				X
Eutypa scabrosa				X
Hypoxylon fragiforme	X			
Hypoxylon rubiginosum				X
Hysteroglyphium fraxini			X	
Melanamphora spinifera		X		
Melanomma pulvis-pyrius				X
Nectria cinnabarina	X	X		X
Tremella globispora	X			X
Trichoderma sp.	X			X

FARM FUNGI COMPETITOR FUNGI RESULTS

- 16 contaminant species found on 4 log types in Jan-Feb 2009, only 10 in a follow-up study in Feb 2010
- Ash the poorest host (3 species)
- Sycamore and Oak most similar, 4 different fungal species common to both tree types
- Difference between fungal diversity on upper and lower surfaces of logs; 7 different species of fungi found exclusive to one or the other
- No significant correlation between log diameters and quantity or biodiversity of fruiting bodies present
- Oak wood taken to Blossomhill from a wood in Midlands held 9 of the 16 species recorded as contaminants. Of these, 5 were unique to Oak
- A repeat study at Springfield in 2010 by Niamh Jones found only 11 species between the same four timber types

Production on tree stumps



Oyster mushroom sporocarps began to appear as expected in November 2008, mainly on Sycamore stumps

Almost 50% of Sycamore stumps have produced on average, 2.3 fungi per stump, between Jan and Aug 2009

Ash stumps produced very few fruits

90% of stumps that produced between November 2008 and April 2009 are Sycamore with 10% Ash stumps

Oysters on Stumps at Blossomhill November 2008 – March 2010

Timber type	# Shows	Shows measured	Fresh wt. (g)	Average wt. (g)
Sycamore	431	374	4304	11.5
Beech	25	17	242	14.26
Ash	4	2	23	11.5

Production on thinnings



Logs did not produce as much as stumps initially but are catching up. Main production period for Oysters is approximately 6 months after inoculation, late Aug – Dec and up to 4 further flushes

Oyster sporocarps appeared sporadically on all timber types

Shiitake take over 16 months to fruit so their first fruiting began in November 2009 and is ongoing with watering

Oyster mushrooms on inoculated Beech and Sycamore logs Sep 2009 to May 2010 from 2008 trial at Blossomhill.

	Beech	Sycamore
Number of logs producing oyster fruits	60	27
% of total inoculated (180)	33	15
Total no. of fruits Sep 09-May '10	190	95
Total weight of fruits Sep 09-May '10 (g)	2910	1028
Mean no. of fruits per log (\pm SD)	3.2 (\pm 3.6)	2.6 (\pm 2.3)
Mean weight of fruits per log (g) (\pm SD)	49.3 (\pm 67.7)	24.7 (\pm 20.6)

Shiitake on logs results at Blossomhill
September 2009 – May 2010

Timber type	Fresh wt. (g)	Average wt. (g)
Beech	1296.61	21.24
Oak	192	24
Sycamore	180	18

FARM FUNGI SUMMARY

- Initial inoculation work is time consuming
- At low-tech level there is a poor return, ok for kitchen garden model
- All timber types show promise apart from Ash
- Watering necessary at least in Summer months
- Market development possible, import replacement

Truffière study



Tuber aestivum/uncinatum



AIMS

- A study of commercial trees introduced to Ireland to instigate truffle plantations (truffières)
- Success of French *Tuber uncinatum* (Burgundy Truffle) and French host trees in Irish green-field and forest planting conditions
- Whether undesired fungal species are being accidentally introduced to Ireland on roots of imports

SITE DESCRIPTION

- 300 Oak (*Q. robur*) and 50 Hazel pre-inoculated with *Tuber uncinatum* were planted in Feb 2006 at Blossomhill, Co. Limerick.
- 50 Oak and 50 Hazel were underplanted in an adjacent 15-year old Ash plantation
- Inoculated trees sourced from France
- Roots were checked in France by CTIFL for truffle mycorrhizae before export
- Monitoring of root mycorrhizae ongoing

MYCORRHIZAL MONITORING

Initial sampling in April 2008

9 core samples were taken from roots of

5 *Quercus robur*

4 *Corylus avellana* (2 from green-field planting, 2 from 15-year old woodland)

1 *Quercus robur* root displayed obvious mycorrhizae* of *Tuber uncinatum*

Sampling in April 2010

2 trees were dug up and all mycorrhizae examined

1 *Quercus robur*

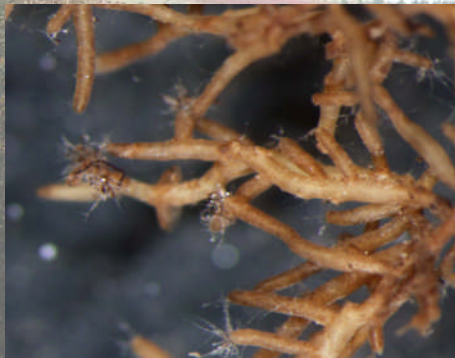
1 *Corylus avellana*

Both root systems displayed obvious mycorrhizae* of *Tuber uncinatum*

(*as described in Agerer (1987-1993))

Fruiting of truffles should begin year 5 for Hazel; year 7 for Oak, so perhaps in 2011??

The mycorrhization level is considered low to international experts but the right species is present



Tuber aestivum mycorrhizae on Hazel



T. aestivum mycorrhizae on Oak

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- Howard Fox (National Botanic Gardens)
- Jim Fraser
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- Wojciech Chmura for a wild Irish strain of *Pleurotus ostreatus*
- Dr. Sophia Millington Ward (Trinity College, Dublin)
- Prof. Koji Iwase and his group (Tottori University, Japan)

Irish truffles - fact, not fiction!



Thank you!