People planting native trees for climate stability and biodiversity

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The Miyawaki experiment – Trealla, Ballycleary, Kinvara, Co. Galway.

Introduction:

This experiment seeks to explore the application of the Miyawaki method of tree planting in an Irish context, specifically in the West of Ireland. The Miyawaki method claims to grow self-sustaining forests 10 times faster than conventional methods of tree-planting and to sustain between 30% and 100% more bio-diversity. We wished to see whether these claims are true. We also explored different aspects of the method, along with one adaptation of our own (See Section 3, Miyawaki Experiment Design, p.2 below).

Context:

The Kinvara Ballinderreen Tree Gang is a small community group in south Co. Galway. Our mission is to plant and care for native trees in the right places to mitigate the effects of the climate and bio-diversity crises. Given the tiny window of opportunity to avert climate catastrophe i.e before 2030, according to the IPCC, we thought it wise to try the Miyawaki Method of planting trees. Our reasoning was that, if we can grow self-sustaining forests even twice as quickly by this method, it would surely be worth doing, given the extreme urgency of the climate and biodiversity crises.

Rather than simply accept the claims made for this method, we felt it would be of greater value to design an experiment which compared it with conventional planting methods. Should this experiment yield positive results, our aim would be to encourage other organisations and groups nationally to adopt this method where appropriate.

It took over a year to find land on which to plant our Miyawaki forests. We began the experiment in 2020, once a landowner offered us the field in Trealla, with the first physical work happening in November 2020 (i.e. mulching M2).

The following describes the experiment under the headings of the various stages of the Miyawaki Method (as described by Afforestt*). It is drawn from a more detailed record of work done, which can also be made available to anyone who wishes to scientifically investigate any aspect of the experiment.

The Miyawaki experiment – Trealla, Ballycleary.

1. **Site choice (and soil):**

Although the soil in much of the Kinvara area is very thin and, hence, unsuitable for the Miyawaki method which, ideally, requires 1 metre of soil, this field was exceptional in so far as Joe had 2 mounds of spare soil (from a path he had made) and plentiful amounts of composted manure/straw available (a few miles from site). In addition, he had the machinery to transport the supplements and was willing to do so. We also had access to plentiful amounts of seaweed in the general area (Trácht strand and Tarrea Pier). It was only these exceptional circumstances which allowed us conduct the Miyawaki experiment in the Kinvara area.

Further aspects of the field which made it suitable were the fact that it is enclosed by walls and gated, which meant it was secure from farm animals etc. There was good access by road to an adjoining field and water on-site.

Jen Fisher, our Ecologist, did a survey of the field and found that, while fertilisers had not been applied, the soil had been highly modified by scrub clearance and tillage and been sown with Rye Grass and Agricultural Clover (See Appendix 1).

Hence, the establishment of a native woodland, surrounded by meadow (which we hoped to re-instate) would likely increase the bio-diversity of the area.

Soil Analysis:

The soil was mostly clay, compacted; heavy rain would puddle for a few days before draining. It was thin c 5 -7 inches in depth, which is typical of the area, so it was clear that a lot of supplementation would be necessary to attain the desired depth for Miyawaki planting.

We did two soil tests but the results, as explained by Southern Scientific Services, were hard to interpret. Soil test 1 (5.12.20): a 50:50 mix of soil from field and extra soil (Appendices 2A and 2B) used in M1. Soil test 2 (13.3.21): soil from field only (Appendix 2C).

2. **Tree Selection:**

We researched the native trees growing in Coole/Garrlylands, being the nearest woodland to Trealla. (See Appendix 3) in order to establish 'which native trees have grown here in the last 100 years and which might potentially grow in the next 100 years'.

Of these, we chose not to include Yew (as it can be poisonous to horses); Ash (die-back); Blackthorn (owner requested to leave it out as it can be invasive). Unfortunately, Wych Elm, Elder, Purging Buckthorn, Whitebeam, and Dog Rose had to be omitted as we were unable to source them. We only planted trees of native Irish provenance. They were sourced from Trees on the Land*, under their Sponsorship program. Goat-Willow cuttings were taken from the adjoining field.

While Dr. Miyawaki advocates collecting the seeds of local native trees and growing them in pots, to be planted out with the rootball, this process was beyond our resources in all respects, time, volunteers, suitable nearby native forests. We used bare-root saplings from native seed, apart from willow, where we used cuttings from nearby trees. Saplings varied in size and age according to availability.

Our final list of trees:

Layer	Species	Miya 1	Miya 2	Miya 3	control 1	Total
Canopy	Pedunculate Oak	64	64	64	10	207
	Scots Pine	64	64	64	15	207
tree layer	Birch	69	69	69	16	223
	Alder	69	69	69	16	223
	Goat Willow	69	69	69	16	223
	Wild Cherry	69	69	69	16	223
sub layer	Hawthorn	77	77	77	15	246
	Rowan	58	58	58	11	185
	Crab apple	35	35	35	9	114
	Holly	31	31	31	7	100
	Spindle	24	24	24	9	81
	Hazel	12	12	12	6	42
Shrub Layer	Guelder Rose	16	16	16	4	52
	Total	**657**	**657**	**657**	**150**	**2126**

3. Miyawaki Experiment Design:

(See Appendix 4, Miyawaki Tree Planting Grid)

The initial intention was to compare the growth rates of a plot which followed all aspects of the Miyawaki method to a plot planted in the conventional way. (M1 and C2). However, being aware of the potential advantages of leaving the earth undisturbed (in terms of soil structure/preservation of microrhizomes), we added a plot (M2) which used all aspects of the

Miyawaki method apart from digging and mixing - instead laying the supplements above the soil and allowing them mulch down over the period of a year. We also created a plot which had no soil supplements, but which was densely planted (M3).

A final elaboration of the design was to divide this plot and the Control plot in two, with one half being mulched lightly, weeds trampled and the other half left untended (M3/M4, C1/C2). This was prompted by Imogen's (Trees on the Land) interest in testing a theory that the presence of weeds can actually aid the growth of trees.

Density

The Miyawaki plots were planted at a density of 3 trees per m2, the Controls at 1 tree per 1.5 m. The same proportion of each tree species was planted in each plot. To ensure a good spread of each layer in the Miyawaki plots, we ensured that each m2 contained no more than 1 canopy species, by placing it is a sack with either a tree, sub-tree or shrub layer for volunteers to plant out. Otherwise, the trees were planted randomly, apart from a few spaces left around the edges of each plot for some trees which came after the main planting day.

Plot layout

4 plots measuring 18 x 12 m. (with 2 of the plots further divided in 2, becoming M3/M4 and C1/C2).

Fence erected around plots, 2.5 m from the plots (apart from M2, on the right, due to lack of space). There is 4m between M1, M3 and C1, to allow for mowing by tractor. 3 m between C2 and M2.

The fence is to prevent hares (and also farm animals, should they break into the field). A lip of 1 foot at ground level for rabbits (not thought to be a problem).

While we had favoured planting along the left side of the wall, Imogen, of Trees on the Land, argued that we have a set-back from the walls of between 2 to 5 m.

4. Site readiness

Soil preparation (supplements):

We began to mulch M2 in November '20, in the hope of planting in Spring '21, but because of Covid restrictions, we decided to delay planting for a year. We continued to lay the layers of mulch throughout '21.

	Supplements	**Preparation**
Total Supplements to M2 =	**Seaweed** - 2 trailer-loads (12x6x2.5 ft. Trailer)	Manure/seaweed etc Deposited in heaps by

	Horse-manure - 3 trailer-loads (composted with straw for over 3 years) **Straw/haylage** – 3 1/4 large bales of straw; 5 bales haylage **Cardboard**	tractor and mostly spread by volunteers raking
Date 5.12.20	2 trailer loads seaweed	Spread by hand
Jan.21	1/2 load composted manure	
10.1.21	3 Bales straw	
April 21	½ Composted manure	
April & May 21	Cardboard	
24 July 21	1 load manure; Cardboard; haylage	Spread by tractor/volunteers
8 August 21	1 load manure; cardboard; haylage	volunteers
16.12.21	Weeded; spread manure	
3.3.22/26.3.22 (after trees planted)	Finished spreading manure	volunteers

M1

The Miyawaki method requires digging the soil, removing it, weeding it and mixing it back with the supplements. The soil was too heavy to do that and would have required a much larger digger, which would have compacted the soil greatly. Instead, we layered it, as follows:

Joe removed the grass layer from M1 (1 or 2 in. deep).

He crumbled the remaining soil with his disk crumbler (depth c 7 inches - clay). 10.11.21

We then weeded the soil and removed any stones.

19.11.21 We covered it with **seaweed** (Joe left it in piles throughout with tractor) – 2 trailer loads. We spread the composted manure on the plot, using wheelbarrows and rakes, spades. Joe had deposited piles along the perimeter to avoid soil compaction). Joe brought 12 trailer

loads of soil from other field and tipped it from trailer as he drove.

We picked out stones and roots from soil and spread it more evenly.

Note: We had intended to mix in quite a lot of straw to aid perforation, but found that we could not cut it up. For fear of it creating a barrier to roots or water, we just mixed in a small amount (c ½ large bale) with the extra soil.

11.12. 21. We spread 1 final layer of compost.

The soil mixture varied in depth from 11 to 15 inches, which, while not ideal, is close to the .5 metre which an Afforest advisor on the Miyawaki method suggested would be sufficient, given that it was agricultural or woodland soil.

We had intended to add more soil, but we did not have the time or the person-power to spread it and remove stones and weeds.

Supplements M1	**Horse-manure** 3 trailer-loads (12x6x2.5 ft. Trailer) **Seaweed** - 2 trailer-loads **Straw/haylage** – 3 1/4 large bales of straw; 5 bales haylage **Soil** – c. 12 trailer-loads	= Same as M2, apart from added soil & no cardboard
10.1.21	3 Bales straw	To prevent growth
July 21	Mowed	
10.11.21	Joe scraped grass (c. 2 inches); Crumbled soil	Digger and crumbler
13.11 21/15.11.21	Removed stones and weeds/roots	Volunteers
19.11.21	Seaweed, manure, straw	Spread
27.11.21/2.12.21/5.12/21	Soil spread; picked stones/weeds out	Tractor & volunteers

11.12.21/12.12/21	Final layer of compost spread	

We added nothing to plots M3/M4 or C1/C2 before planting.

Fence:

We erected a pole and wire fence to keep out hares. Total hours = 38 (excluding Joe, who hammered the poles in mechanically). We had 3 gates made, placed opposite paths between plots wide enough to be mowed by tractor and mower.

Planting:

Prior to planting, we marked plots M1, M2, M3 and M4 with a grid of square metres, using natural lime, as a guide for planting 3 trees per m2. (See photo below).We also sorted and divided the trees between the 4 plots to ensure the correct numbers of each species went to each plot. (See Final List of Trees, p.2 above)

5. Tree planting:

16.12.21 TY students from Seamount planted 28 trees (Spindle and willow whips) on C2. It was important for us to involve the local students, who could only participate during weekdays.

18.12.21

Our aim was to plant as many of the 2,126 trees as possible on one big planting day, largely as a means of attracting and engaging as many people in tree-planting as possible. There were also practical considerations, such as the uncertain weather conditions in December, the proximity to Christmas and also because of the level of organisation required to host it. We almost managed it.

We planted c 1800 trees, with c 40 adults and 20 children participating. In order to ensure that no more than 1 canopy tree was in each metre, we matched them with 2 trees from the tree or sub-tree layer in (recycled) plastic sacks. The volunteers then planted them randomly, apart from the edges of the plot, where we had placed canopy trees every few metres.

We also left spaces along the edges of the plots for the trees which had been delayed in coming from the nurseries.

The atmosphere was electric, with many parents with young children enthusiastically planting. Only the dying of the light prevented us from planting them all.

19.12.21 We planted the remaining 200 trees.

12.3.22 We planted the 117 trees which arrived late around the edges of the 4 plots. **M1.:**

5. Maintenance and Monitoring:

Maintenance	M1, M2 plots		M3, C2	Meitheals	Other tasks
2022	Weeded and mulched x 4 (c. 1 1/4 large bale per plot)		mulches x 2, Trampled x 2 Cut briars x 2	31	Trampling bracken on paths; cutting briars
2023	Weeded and Mulched x 4	6.8.24 Branches in M2 closed in	Weeded grass around trees x 1; Trampled x 2 Cut briars x 1	13	; ; ;
2024	Mulched M1 x 1 Edges of M2 x 1	18.7.24 Branches in M1 closed in	Trampled x 1 Cut briars x 1	9	; ; ;
	No more mulching required				

6. Monitoring:

Year 1:

We photographed each plot in May and Sept. 2022. We also took a video by drone in Sept. 22 showing the differing rates of growth of the plots and measured the tallest trees in each plot.

Year 2:

We took a drone video and photographed the plots in Sept. 23. We didn't measure the trees as M2 trees were too high to reach.

Year 3:

We measured the 3 tallest trees in all plots, except M2, where we measured only at the perimitre as the trees was too dense to allow access to the interior of the plot. We also took a drone video 22.9.24.

Year 1 (Sept. 2022)

Highest trees in each plot		feet. inches	C.M.
M2	Cherry	6.3	193
	Cherry	6.1	188
	Rowan	5.8	178
M1	Hawthorn	5.2	158
	Willow	4.7	143
M3	Spindle	4.4	134
	Spindle	3.8	115
C1	Spindle	3.8	117
M4	Oak	3.5	118
	Oak	3.1	95
C2	Spindle	3.3	102
	Cherry	2.6	80

Year 3. Sept. '24

Highest trees in each plot	Species	feet. inches	C.M.
M2 Perimeter only	Alder Birch Other birch, alder Oak	13.29 13.12 Similar height 8.53	4.05m. 4.00m. Similar height 2.60m.
M1	Alder Alder Alder Birch Oak	12.99 12.70 12.34 10.50 8.69	3.96m. 3.87m. 3.76m. 3.20 2.65m.
M3	Alder Alder	8.04 7.05	2.45m 2.15m.

	Oak	7.05	2.15m.
M4	Birch Birch Birch Alder Oak	6.07 5.74 5.25 4.30 3.94	1.85m. 1.75m. 1.60m. 1.31m. 1.20m.
C1	Birch Birch Wild Cherry Oak	6.07 5.91 4.92 4.00	1.85 m. 1.80 m. 1.50 m. 1.22 m.
C2	Alder Alder Alder Oak Birch	7.87 5.91 5.25 4.27 3.67	2.40m. 1.80m. 1.60m. 1.30m. 1.12m

Observations after Year 1 (2022):

Although it is far too soon to reach any overall conclusions as to which method best promoted tree growth and health in our plots, the results after year 1 are interesting: As expected, the two Miyawaki plots which received soil supplements (M1, M2) have grown approximately twice as fast as the others. Interestingly, of these two, M2 greatly outstripped both M1 and all the other plots. M2 was the one in which we did not dig the soil, but allowed the supplements to mulch into the soil over a period of a year before planting. We speculate that this is due to the enhanced mycrorhizal connections in the undisturbed soil. If this differential in growth rate continues over time, it would suggest that providing the soil supplements as mulch pre-planting is preferential to Miyawaki's suggested method of digging it in.

Another finding is that adding straw or other mulch after planting definitely holds in the moisture, as those plots without mulch suffered more from the drought (browning leaves etc) than those which had been mulched. Mulching also feeds the earth, as demonstrated by greener plots and fewer wildflowers than in the unmulched plots.

However, one unintended consequence of mulching may be to trample tiny saplings which are not easy to see in the straw. To avoid this, using cardboard as mulch may be preferable but would bring its own technical challenges – how to place it and hold it down around densely-planted trees. Or one could put a protective barrier around tiny saplings, such as Holly or Scots Pine.

Year 2 (2023):

The growth patterns observed in Year 1 continued into Year 2. By the end of Year 2, the trees in M2 had closed in to the degree that it became very hard to gain access without damaging either the trees or ourselves. This is the point where no further maintenance is required (apart from preventing briars/nettles invading from outside the plot).

Year 3 (2024)

The growth patterns continued as before, with M2 tallest and branches forming a canopy over the groundfloor, next in height (by visual assessment), M1, whose branches had closed in by July, followed by M3, m4, C2, C1.

Less maintenance of plots was needed due to M2 and M1 branches closing in. The Miyawaki method requires weeding and mulching until the undergrowth is shaded out by the branches of the trees. Hence, when an under growth of dandelions, wild garlic, some nettles and grass reappeared in Spring on M2, we weeded and mulched along the parts along the edges that we could reach in April. In retrospect we realise that, given that Irish forests are mosly deciduous (our only 2 evergreens being Holly and Scots Pine, both of which are still small), the undergrowth will never be shaded out in Springtime. Hence, it is unnecessary and inappropriate to weed/mulch in Spring, from this point on. In future we will allow the natural forest floor undergrowth in Spring, knowing that the trees will leaf up later in the year.

M1's branches had closed in by July, so we only weeded/mulched in March and April. Otherwise, we have just trampled C2 and M3 and where bracken incurred along edges of C1. As for M2 and M1, the only future maintenance may be preventing briars and nettles incurring from outside the plots, as a protection for the smaller trees in these plots.

These are just observations from the first 3 years. While there is no doubt that the Miyawaki plots which had the soil enhancements have grown remarkably quickly, it is possible that the Controls, while taking longer to establish, may in time equal or surpass the Miyawaki plots in growth. It also remains to be seen how the trees in the Miyawaki plots fare as they compete more for space and light over the coming years.

Bio-diversity:

Even before planting, the soil ecology of M2 was greatly enhanced by the mulching. The compacted, heavy clay soil which characterised the rest of the filed had transformed into a crumbly, light soil alive with earthworms and other signs of soil life. In 2023, a nice meadow patch appeared to the right of the fence, where the bracken had been crushed by tractor tires. In 2024, bees had created a hive in a sack storing our folding chairs; a resting place for badgers was observed, along with gall wasps, bumble bees, speckled wood butterfly, green shield bug, weevils, gall wasps and a profusion of wild garlic in M2.

General reflections:

The Miyawaki Method requires intensive work, both pre-planting and in the first 2 to 3 years of growth. After that, no further management is permitted. The idea is that this dense forest will be self-sustaining

into the future. It would seem to be best suited for sites which have immediate access to roads (for delivery of soil supplements and mulching materials, such as straw). It might be worth experimenting with using cardboard mulch mats after planting, rather than straw, as grass/weed suppressants. These considerations suggest that the ideal sites for creating Miyawaki forests might be along motorways and around newly built housing or industrial estates. Soil supplements might include whatever suitable organic material is available locally, such as chipped wood, as trialled by Stepping Stone Forests* in Dublin.

While we intend to continue to monitor the differential growth rates and increases in bio-diversity over the next 17 years we, as a voluntary community group, lack the resources to do the kind of precise evaluation that this experiment merits. Our hope is that we might attract scientists, whether professional or at student level, to conduct more advanced studies.

References:

www.afforesst.com – open-source info on Miyawaki method. Based in india.

www.ivn.nl - ebooklet on Miyawaki method. Based in the Netherlands.

www.treesontheland.com – a charity which distributes native trees to organizations and individuals.

www.steppingstoneforests.org – A Dublin-based community group using chipped wood as mulch pre-planting.

Appendix 1 :Ecological Report by Jenny Fisher

The site is best classified as Improved Agricultural Grassland/ Neutral Meadow mosaic GA1/GS1 and was characterised by species such as Perennial Rye Grass, Creeping Thistle, Bracken and brambles which dominated the sward. The site has been highly modified by scrub clearance and tillage and been sowed with Rye Grass and Agricultural Clover. In addition, the field has been recently grazed by horses and areas of tight sward and some poached areas were evident, interspersed with areas of encroaching brambles, thistles and blackthorn. The site, however, has not been fertilised and enriched with nutrients which probable accounts for a large array of broadleaf herb species which were recorded on site. Species recorded at the site included, Dandelion, Daisy, Hawkbit, Prickly Sow Thistle, Ribwort Plantain, Creeping Buttercup, Ragwort, Red Clover, Tufted Vetch, Creeping Buttercup. In addition, plants which grow in Neutral or calcareous conditions were recorded occasionally such as Agrimony, Ox-eye Daisy, Common Cat's Ear, Selfheal and Red Bartsia. Annual Meadow Grass, Red Fescue, False Oat Grass, Common Couch Grass and Creeping Bent were all recorded in the sward occasionally. The soil on site appears to be shallow and clay rich (approximately 6 inches) sitting on calcareous rocky subsoil. None of the habitats recorded on site were considered to be consistent with or linked to Habitats listed on Annex I of the EU Habitats Directive.

Appendices 2A, 2B, 2C Soil Tests attached

Appendix 2A

Soil test 1 (mix of soil from field and extra soil):

21/12/20 Nitrogen result

Appendix 2 B:

18.1.21 Carbon result

Appendix 2C:

Soil test 2 7.5.21 (soil from field only):Soil 2B

Appendix 3: Native Species in Coole-Garryland Reserve:

Canopy

Ash *(Fraxinus excelsior)*

Pedunculate oak *(Quercus robur)*

Scots pine *(Pinus sylvestris)*

Yew *(Taxus baccata)*

Wild cherry *(Prunus padus)*

Shrub layer

Goat willow *(Salix caprea)*

Wych elm *(Ulmus glabra)*

Hawthorn *(Cretaegus monogyna)*

Birch downy, silver or common (hybrid)

Rowan *(Sorbus aucuparia)*

Hazel (*Corylus avellana*)

Holly *(Ilex aquifolium)*

Elder *(Sambucus nigra)*

Crab-apple *(Malus sylvestris)*

Dog-rose *(Rosa canina)*

Spindle *(Euonymus europaeus)*

Privet *(Ligustrum vulgare)*

Burnet Rose *(Rosa pimpinellifolia)*

Guelder Rose *(Viburnum opulus)*

Purging buckthorn *(Rhamnus catharticus)*

Hawthorn (*Cratagus monogyna*)

Blackthorn *(Prunus spinose)*

Honeysuckle *(Lonicera periclymenum)*

Ground flora

Ivy *(Ilex hedra helix)*

Male fern (*Dryopteris filix-mas*)

Harts tongue (*Asplenium scolopendrium*)

Bryophyte cover ie mosses

Woodland flowers appearing in spring

Lesser celandine *(Ficaria verna)*

Primrose *(Primula vulgaris)*

Wood Anemone *(Anemone nemorosa)*

Dog Violet *(Viola riviniana)*

Bluebell (*Scilla hyacynthioides*)

Wood sorrel *(Oxalis acetosella)*

Barren and wild strawberry occurs along paths

Whitebeam (Sorbus aria) is frequent in Castletaylor wood near Ardrahan but I have only seen two in Coole which were probably planted. Irish whitebeam (Sorbus Hibernica) is endemic to Ireland, occasional, mainly in central and SE Ireland.

NB The land owner has expressly asked that no hazel or blackthorn be planted as they are quite invasive.

Appendix 4 : Miyawaki Experiment Design (attached)

Appendix 5: Drone Videos (attached)