

Native oak provenance experiment;

Quercus petraea (Syn. *Q. Sessiliflora*)

Quercus robur (Syn. *Q. pedunculata*)

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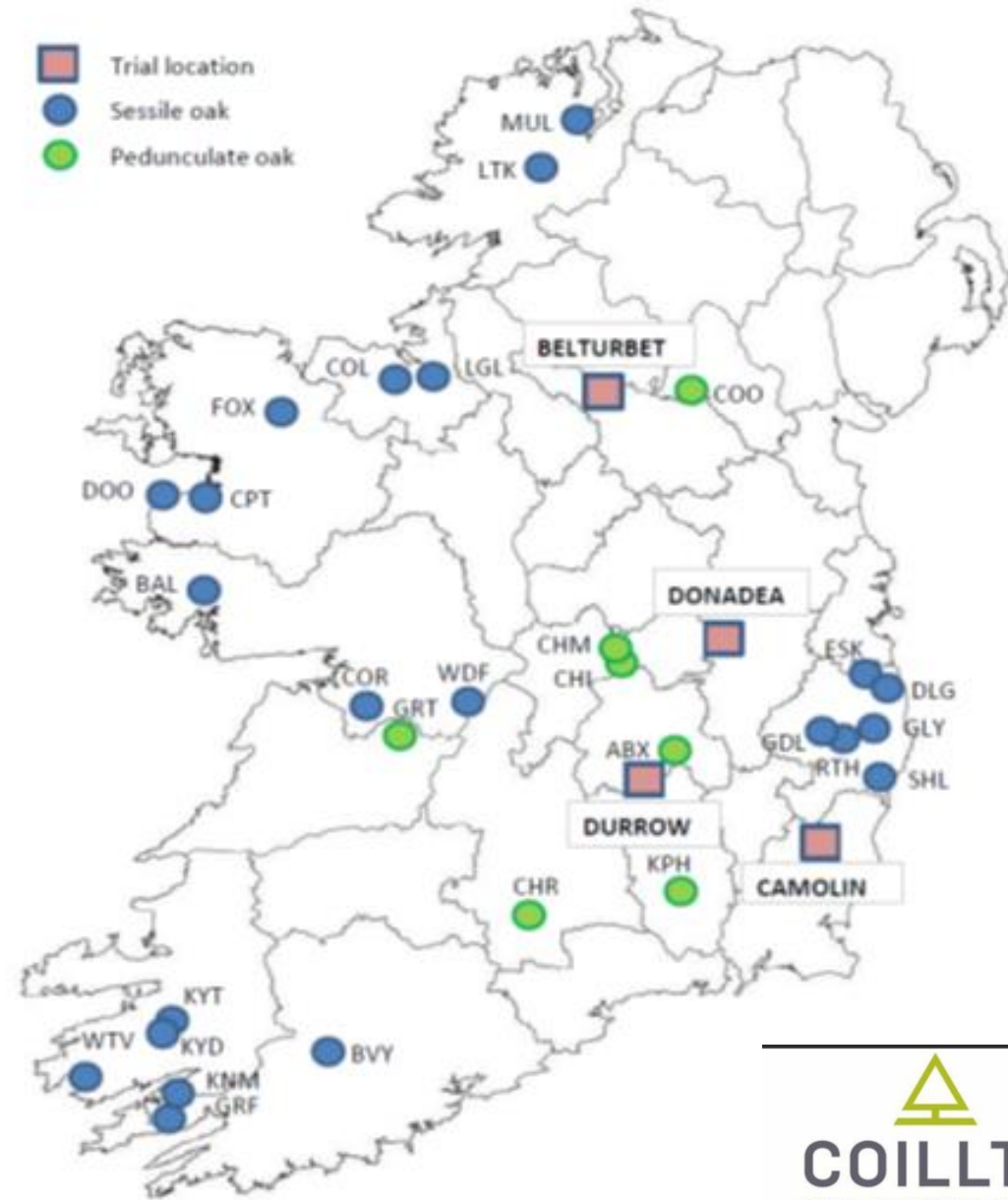


Native Oak experiment objectives

- To identify the best seed source for native Oak for Commercial purposes
- To research the impact of climatic factors on Oak tree growth
- To create a gene pool of native Oak as a safeguard for a threatened species

Native oak provenance experiment :

- ❖ 1984 – a mast year- acorns collected
- ❖ from 27 locations (Provenances)
- ❖ Nursery grown 3 years
- ❖ Planted in 1988 at four sites across Ireland



Details of planting sites

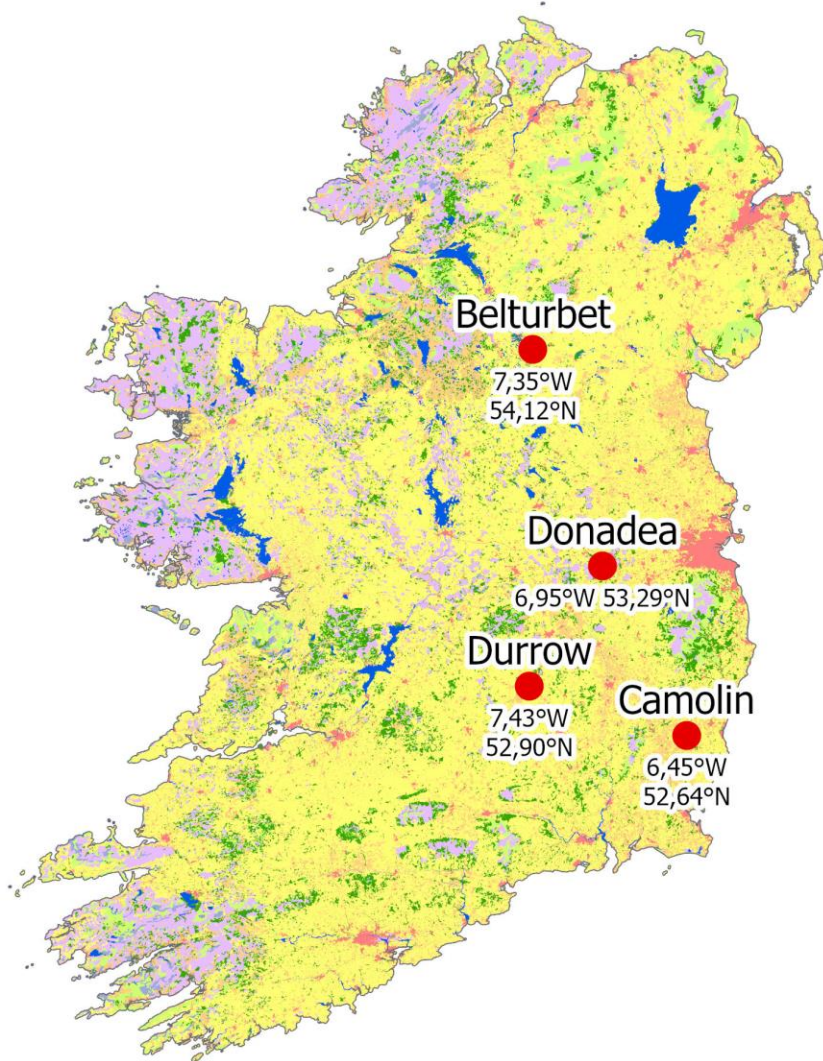
Location	Belturbet	Camolin	Donadea	Durrow
Map co-ords	54.117886, -7.355704	52.634913, -6.450884	53.288681, -6.946586	52.838702, -7.426398
Elevation (m)	52	72	0	105
Cultivation	None	Windrow/burn	None	Windrow/lop-top
Fertiliser	None	None	P 305 kg/ha K 305 kg/ha	
Herbicide	Glyphosate	Glyphosate	None	Glyphosate
Planting	Pit	Pit	Pit	Pit
Aspect	NW - SE	NW	E - W	N - S
Exposure	Moderate sheltered	Flat sheltered	Moderate	Sheltered
Soil	Agricultural Gy-Br podsollic	Acid brown earth	Cut-over peat	Grey - brown podsollic
Previous crop	NS/SS	NS	-	SS
Vegetation	Briars/grasses	Briars/grasses	-	Briars/grasses

Planting densities;

1.3 x 1.3 m spacing

~ 5,900 trees per ha

- ❖ Randomised block design
- ❖ 3 replications per site
 - ☐ Belturbet 225 trees per plot
 - ☐ Camolin 225 trees per plot
 - ☐ Durrow 221 trees per plot
- ❖ Donadea 4 reps
 - ☐ 144 trees per plot



0 25 50 75 100 km

Legend

● Oak sites

Land cover classes

- Artificial areas
- Forest and seminatural areas
- Open spaces with little or no vegetation
- Other agricultural areas
- Pastures
- Shrub and/or herbaceous vegetation associations
- Water bodies
- Wetlands



Coordinate System
ETRS 1989 UTM Zone 29N

Source: LUISA Base Map 2018
(Batista, F. & Pigaiani, C., 2021)



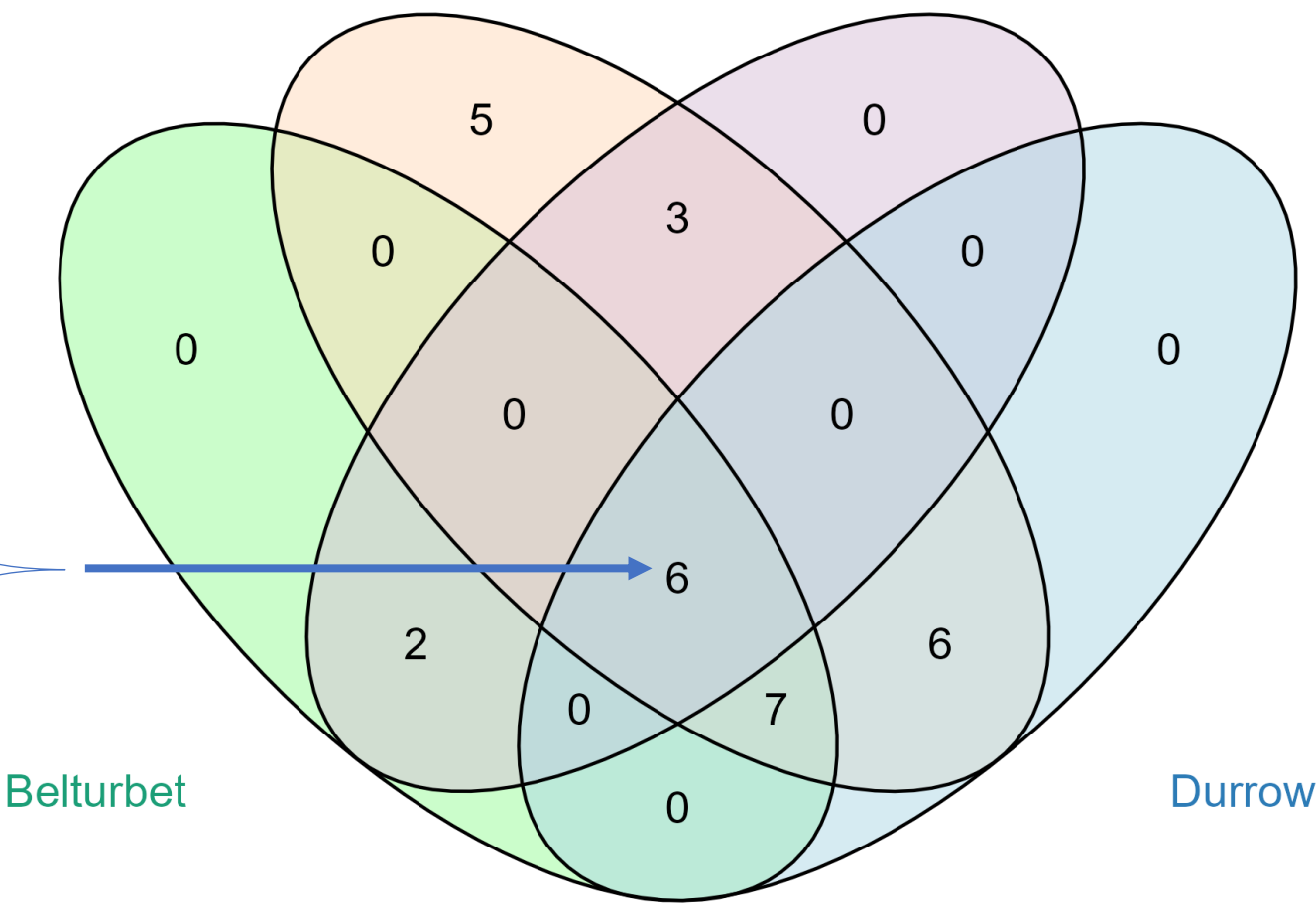
Distribution of Provenances across sites

Number of provenances common across sites

Irish Oak Forest Experiment commenced in 1989

Camolin

Donadea



Belturbet

Durrow

Provenances grown at all 4 sites

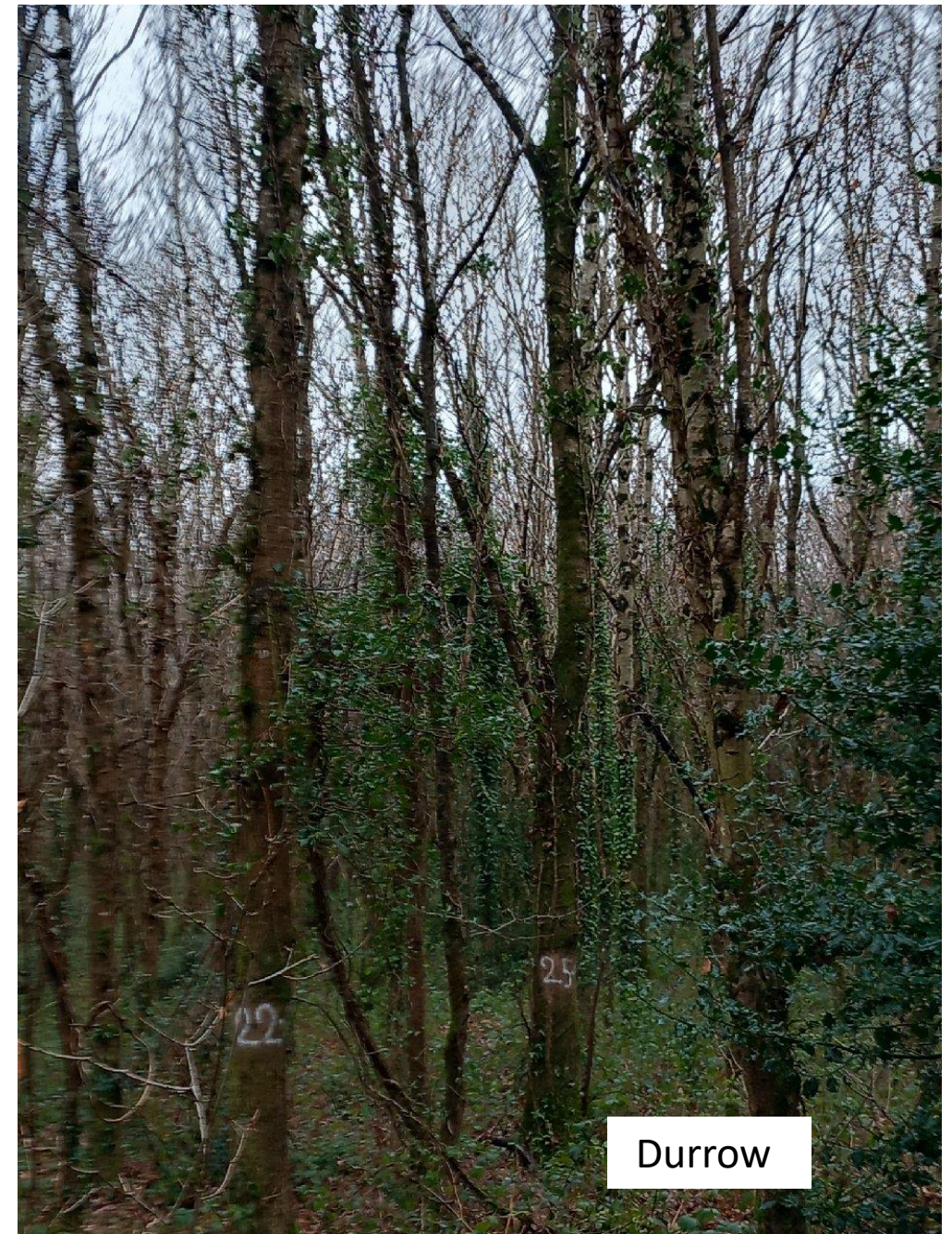
Species	Provenance
Pendunculate	Charleville Is.
Pendunculate	Gort
Sessile	Ballyvourney
Sessile	Foxford
Sessile	Kermare
Sessile	Letterkenny



Belturbet

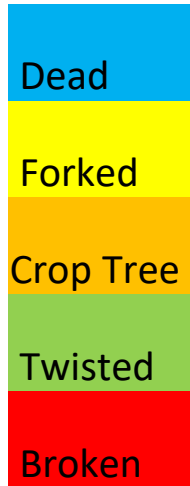


Camolin

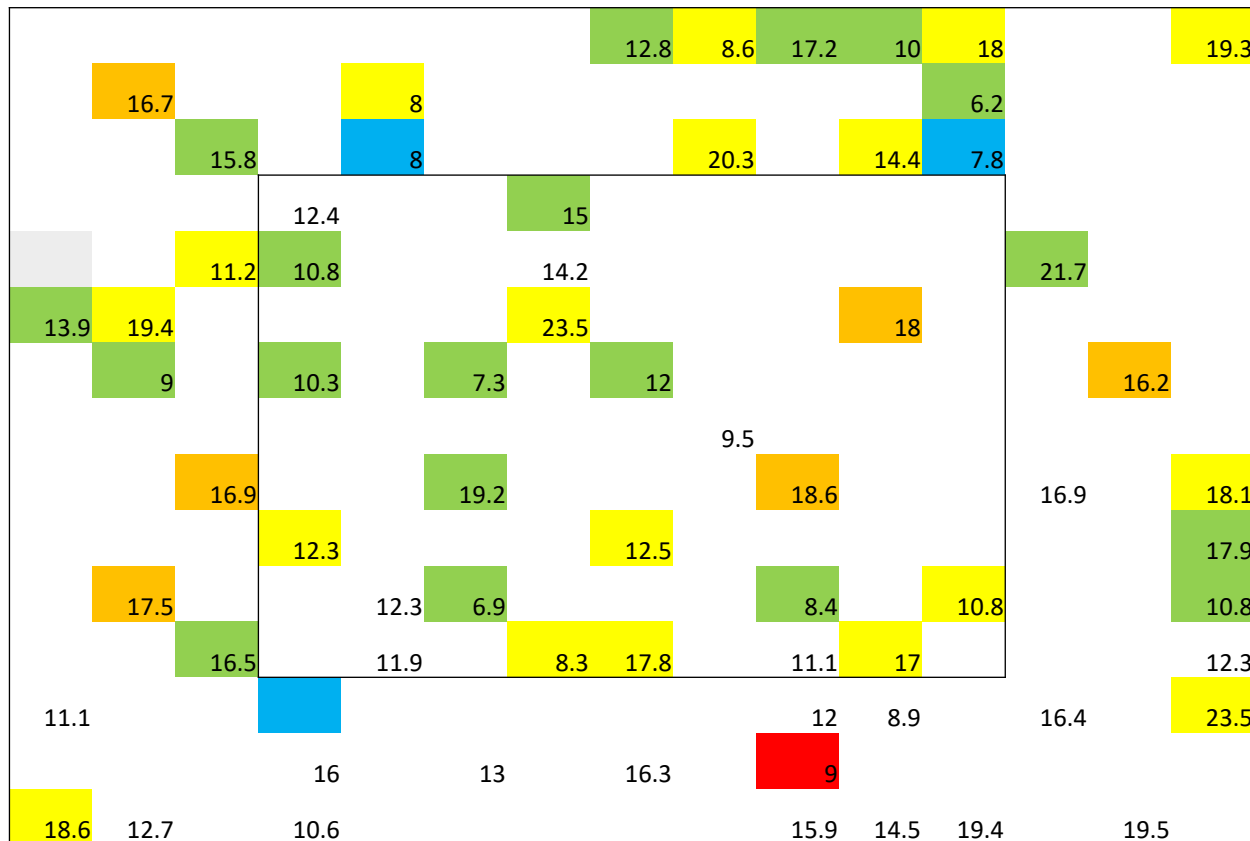


DBH, Height and Form recording

Legend



No value = Missing



Belturbet Plot

➤ DBH (cm)

- Central 9 x 9 trees

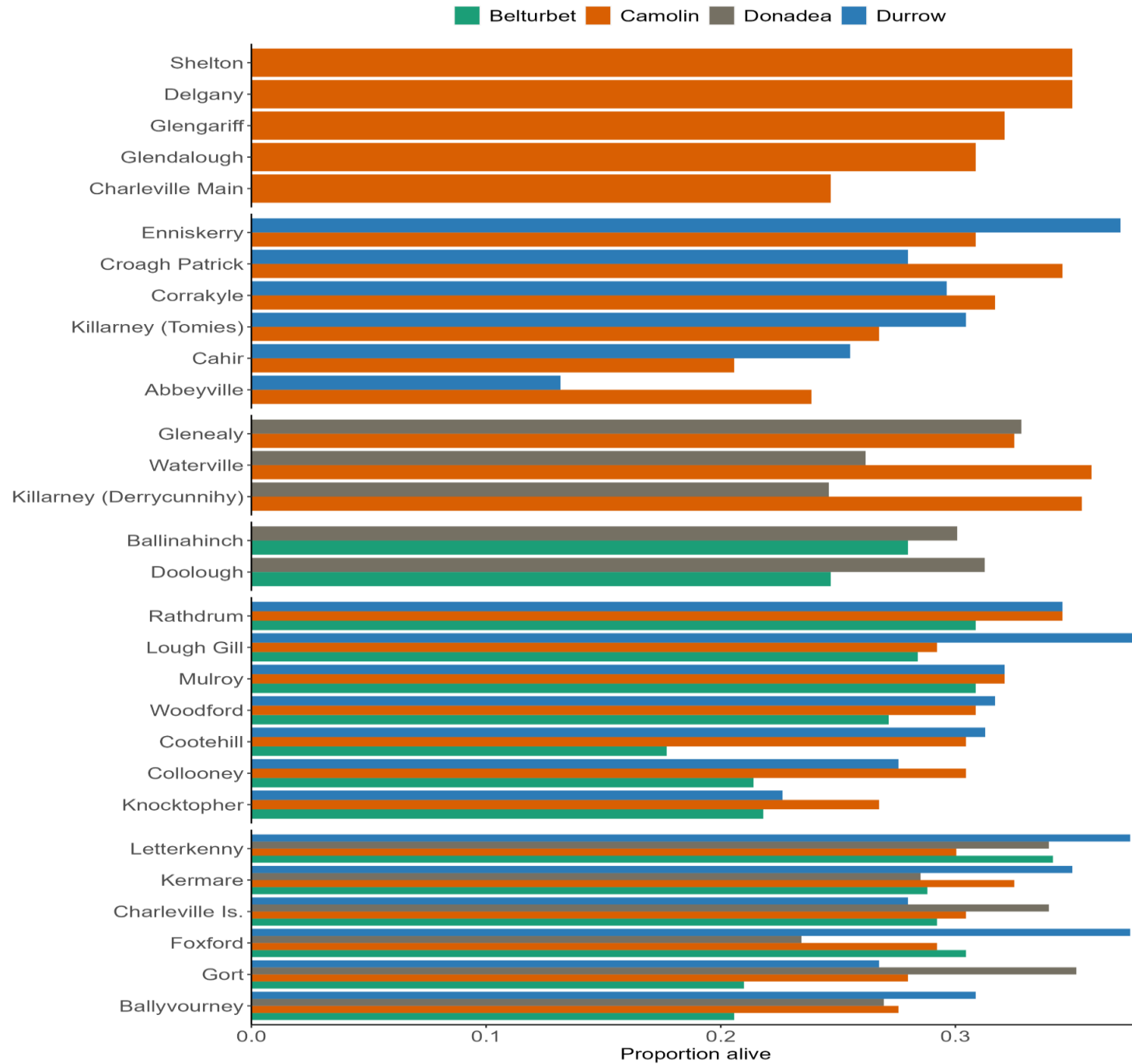
➤ Height (m)

- Five best trees per plot
- DBH (cm)
- Forking height (m)
- Crown height (m)
- Form – scored;

- 1 = very poor

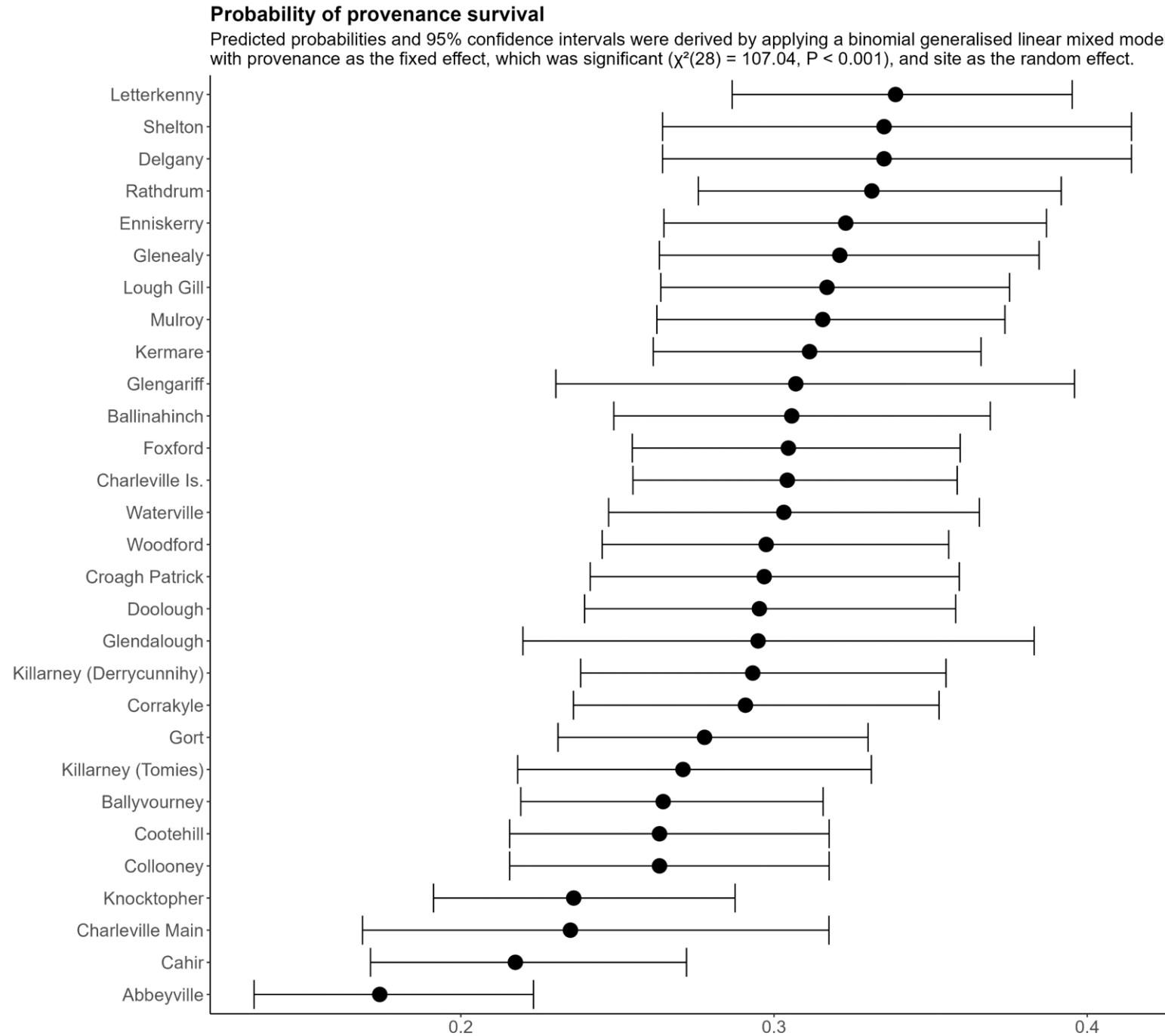
- 5 = excellent (straight stem > 8 m, apical leader, few side branches)

Comparing proportion of trees alive for each provenance and site

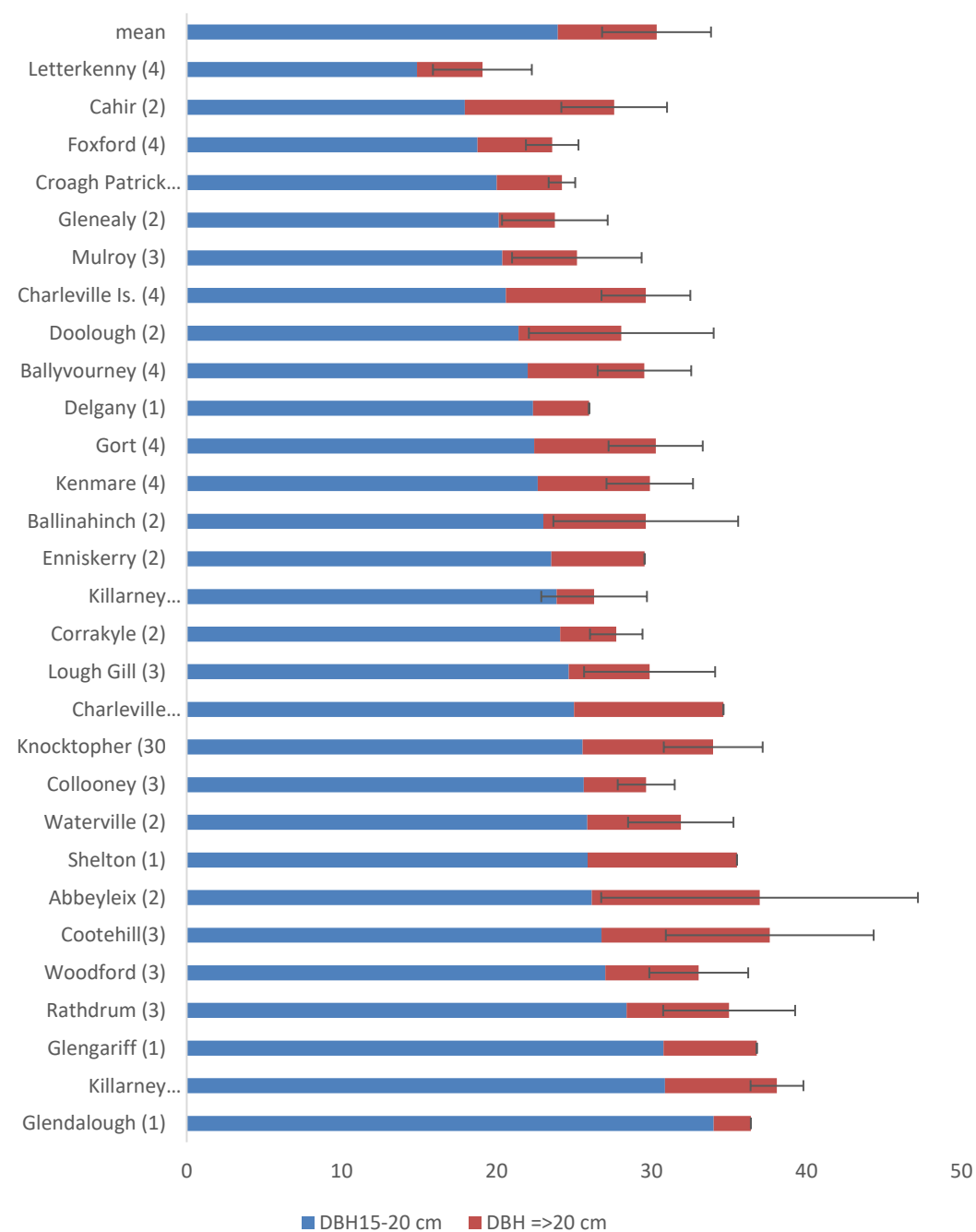


Source: Irish Oak Forest Experiment, Agri-Food & Biosciences Institute

REML analysis of
provenance
survival across all
sites in ranked
order



% Living trees DBH => 15 cm & 20 cm



Average Numbers of living trees in all plots across all sites – categorized by DBH (cm)

	Mean	Stdev	Sig
Living trees	70	13.87	*
<=10cm	28	11.46	NS
(10cm, 15cm]	21	6.79	*
(15cm, 20cm]	16	5.24	*
>20cm	5	3.10	*

- * = significant difference (P<0.05)
- ** = highly significant
- NS = not significant

REML analysis results comparing growth across all provenances in all sites

	DBH (cm)			Height (m)			Form	
	Mean	Stdev	Sig (P=<0.05)	Mean	Stdev	Sig (P=<0.05)	Mean	Stdev
Belturbet	19.63	3.45	*	16.66	1.38	**	4.30	0.66
Durrow	16.66	1.63	*	14.59	0.78	*	3.90	1.40
Camolin	18.12	3.38	NS	14.09	1.26	*	4.20	0.81
Donadea	17.34	4.30	NS	11.88	1.40	NS	3.44	1.11
mean	17.94	3.19		14.30	1.20		3.96	1.00
stdev	1.275			1.963			0.39	
Sig (P=<0.05)	NS			**				

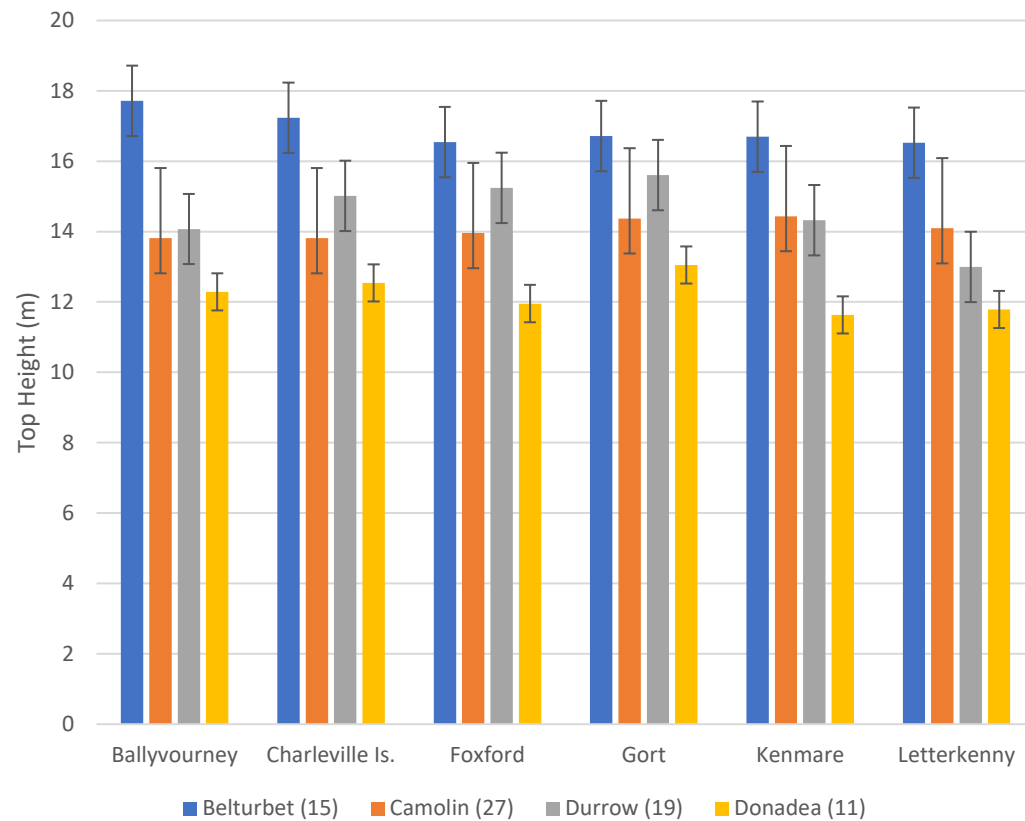
- * = significant difference (P<0.05)
- ** = highly significant
- NS = not significant (variables with the same letter notation)

Heights in ranked
order of
provenances
across sites

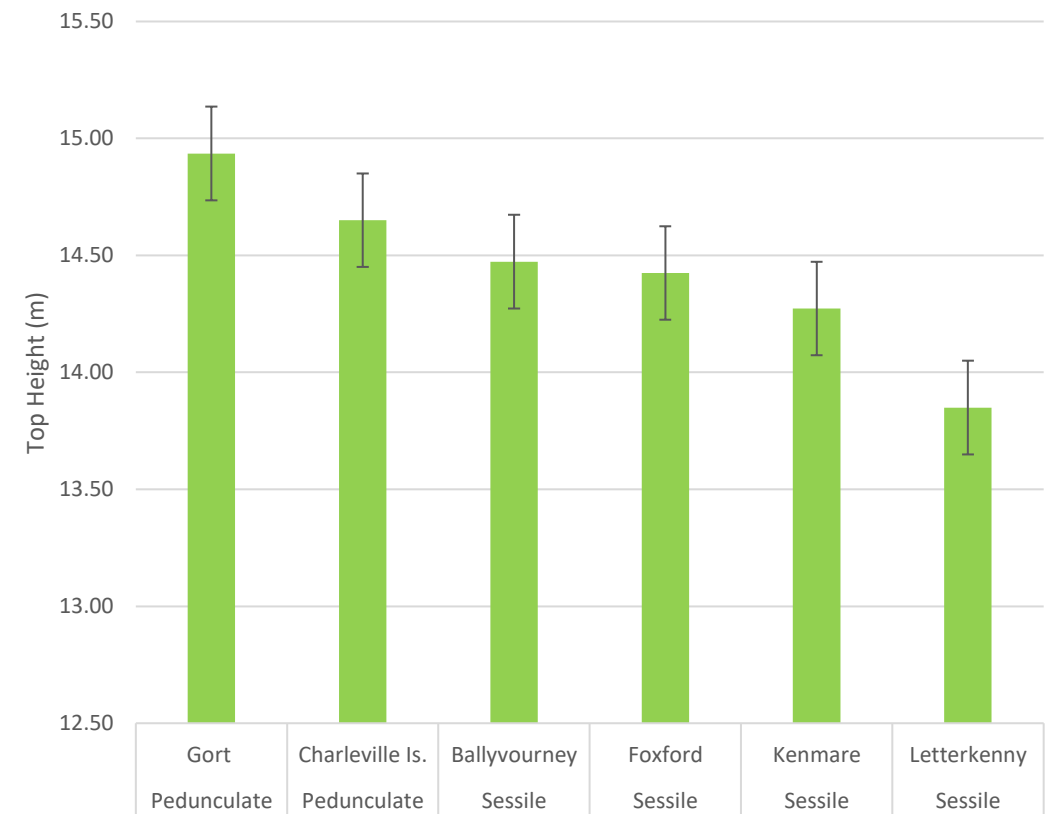
	Camolin		Durrow		Belturbet		Donadea	
Species	Prov_name	Height (m)	Prov_name	Height (m)	Prov_name	Height (m)	Prov_name	Height (m)
Sessile	Lough Gill	15.2	Woodford	16.0	Ballyvourney	17.7	Gort	13.1
Sessile	Rathdrum	15.1	Gort	15.6	Rathdrum	17.6	Charleville Is.	12.5
Sessile	Corrakyle	14.8	Rathdrum	15.5	Woodford	17.3	Ballyvourney	12.3
Sessile	Enniskerry	14.7	Collooney	15.4	Charleville Is.	17.2	Waterville	12.0
Sessile	Glenealy	14.6	Foxford	15.2	Cootehill	17.2	Foxford	12.0
Sessile	Kenmare	14.4	Cootehill	15.1	Lough Gill	16.9	Killarney (Derr)	11.9
Pedunculate	Gort	14.4	Charleville Is.	15.0	Gort	16.7	Letterkenny	11.8
Pedunculate	Cootehill	14.3	Cahir	14.8	Kenmare	16.7	Kenmare	11.6
Pedunculate	Abbeyleix	14.3	Enniskerry	14.7	Foxford	16.5	Glenealy	11.4
Sessile	Mulroy	14.2	Lough Gill	14.6	Letterkenny	16.5	Doolough	11.2
Sessile	Shelton	14.2	Kenmare	14.3	Doolough	16.4	Ballinahinch	10.9
Sessile	Glendalough	14.2	Abbeyleix	14.3	Collooney	16.4		
Sessile	Letterkenny	14.1	Croagh Patrick	14.3	Mulroy	16.2		
Pedunculate	Cahir	14.0	Ballyvourney	14.1	Knocktopher	16.1		
Sessile	Foxford	14.0	Knocktopher	14.1	Ballinahinch	15.0		
Pedunculate	Charleville Ma	13.9	Corrakyle	14.0				
Sessile	Woodford	13.9	Killarney (Tom)	13.9				
Pedunculate	Knocktopher	13.9	Mulroy	13.4				
Sessile	Killarney (Ton)	13.9	Letterkenny	13.0				
Sessile	Killarney (Der)	13.9						
Pedunculate	Charleville Is.	13.8						
Sessile	Ballyvourney	13.8						
Sessile	Waterville	13.6						
Sessile	Glengariff	13.4						
Sessile	Collooney	13.3						
Sessile	Croagh Patric	13.3						
Sessile	Delgany	13.2						

Comparison of the six common provenances

Top Height - 6 Common provenances
by forest

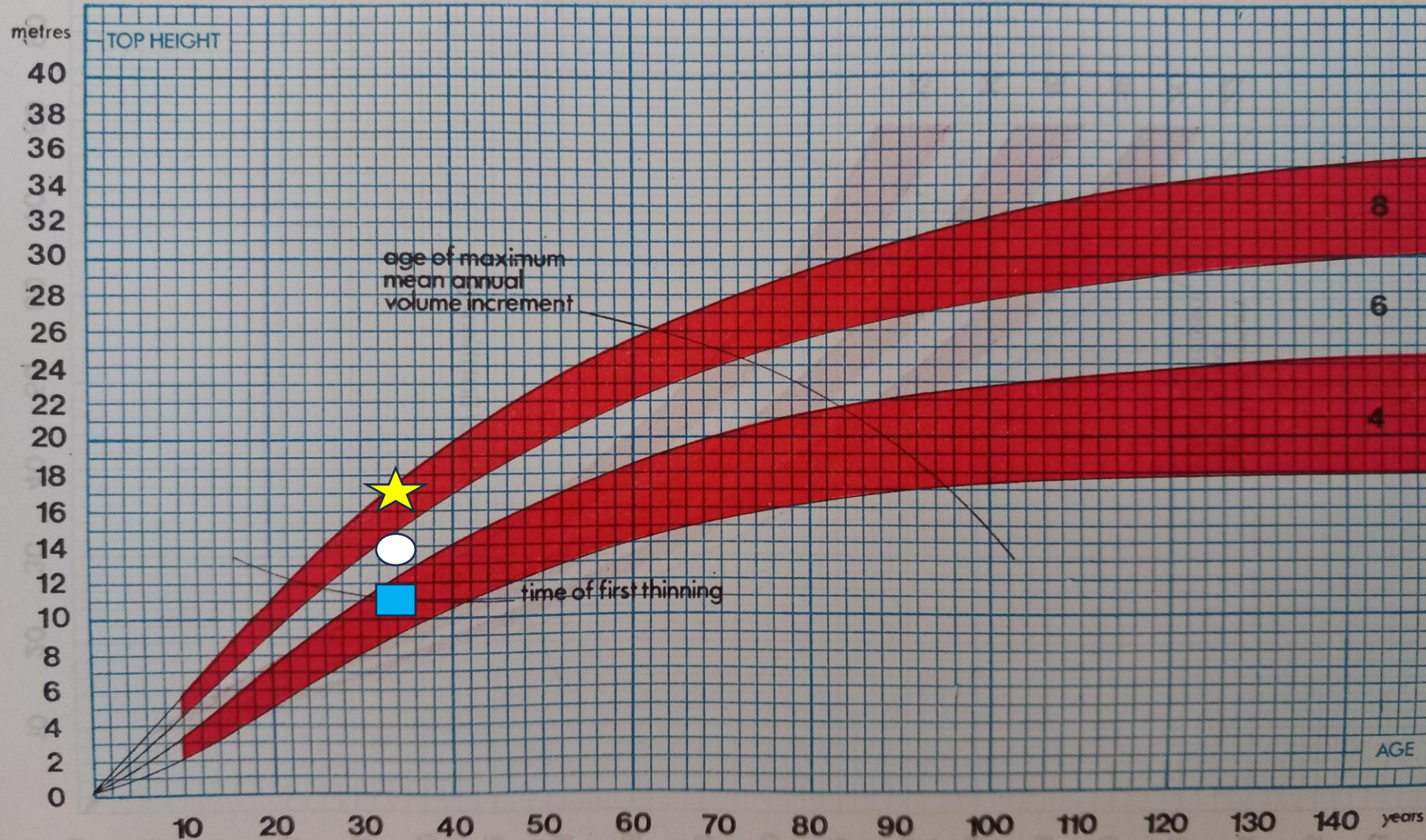


Average Top height across 4 forests



OAK

GENERAL YIELD CLASS CURVES



- Oak Forest Location

★ Belturbet

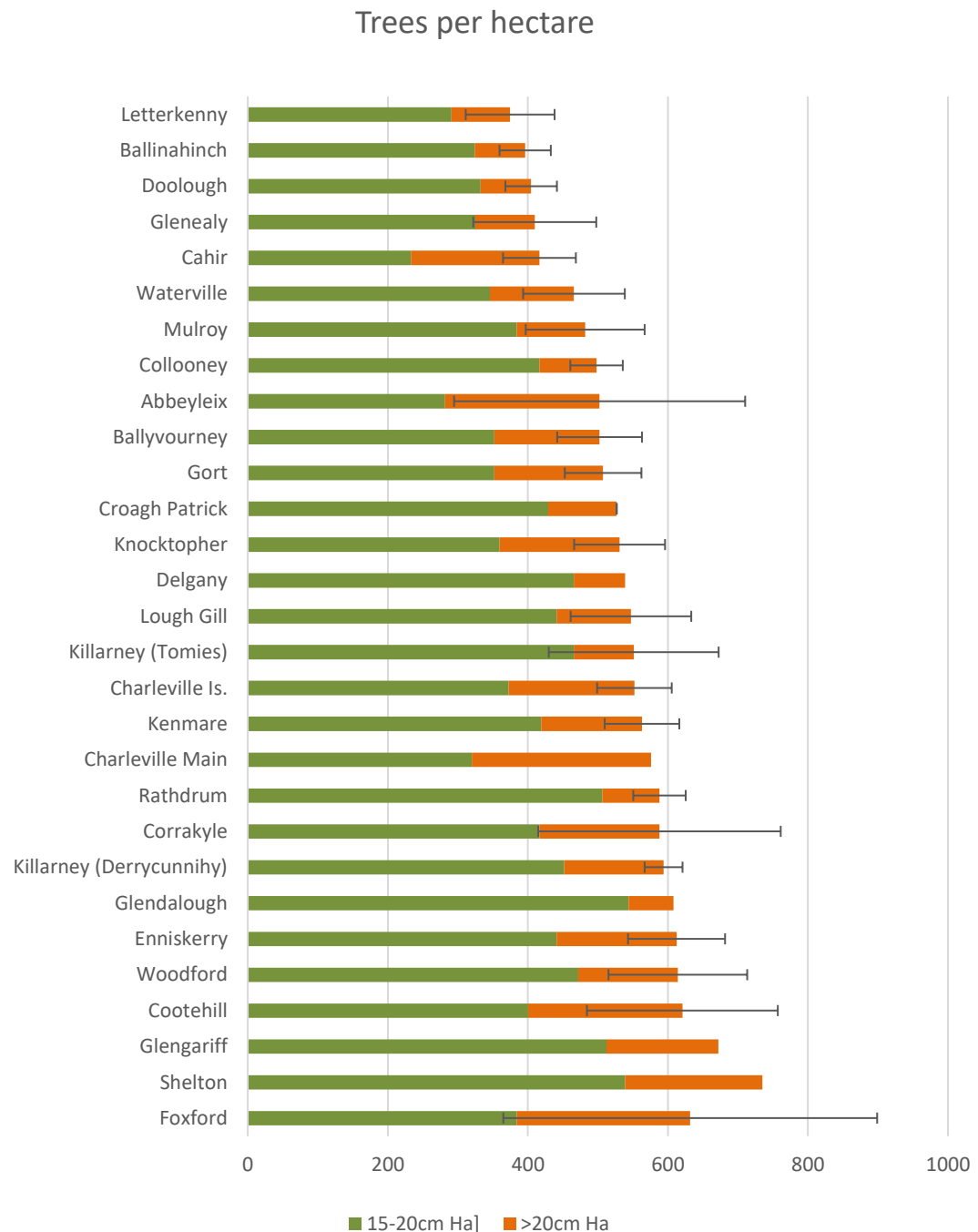
○ Camolin

○ Durrow

■ Donadea

(Graphic Reproduced from Forest Management Tables, Booklet 34, Forestry Commission, UK.)

Projected numbers of
trees per hectare with
DBH => 15 -20 cm and
> 20 cm for each
provenance (averaged
across all sites).



What affects tree survival and growth?

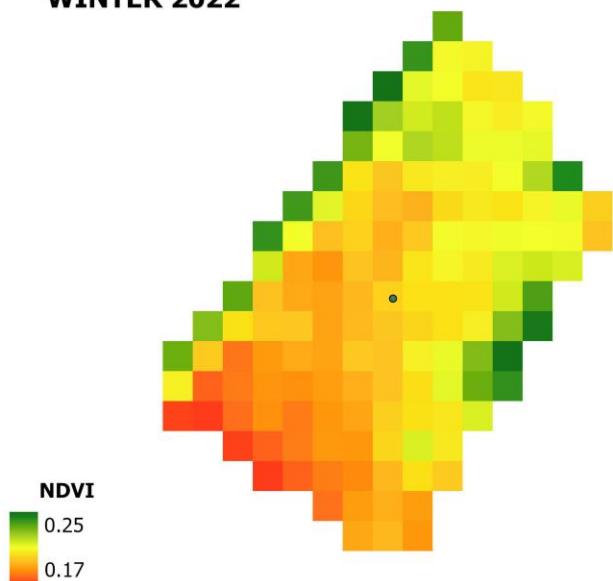
➤ Climatic factors

- Precipitation
- Drought periods
- Extreme high temperature events

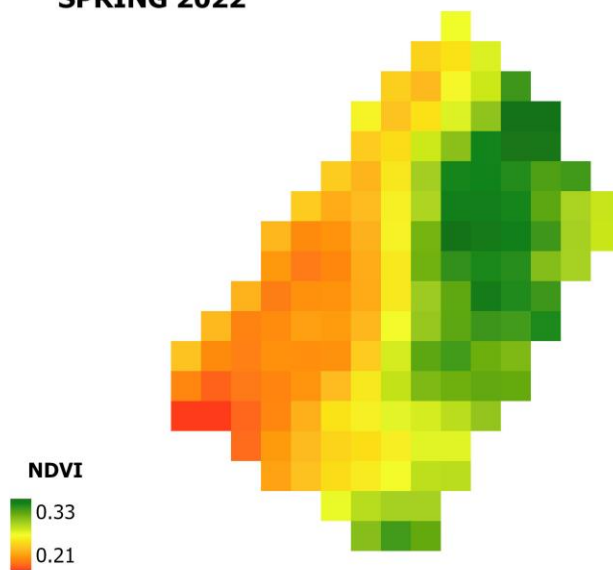
➤ Location

- Elevation
- Soil type
- Soil pH, EC
- C/N ratio

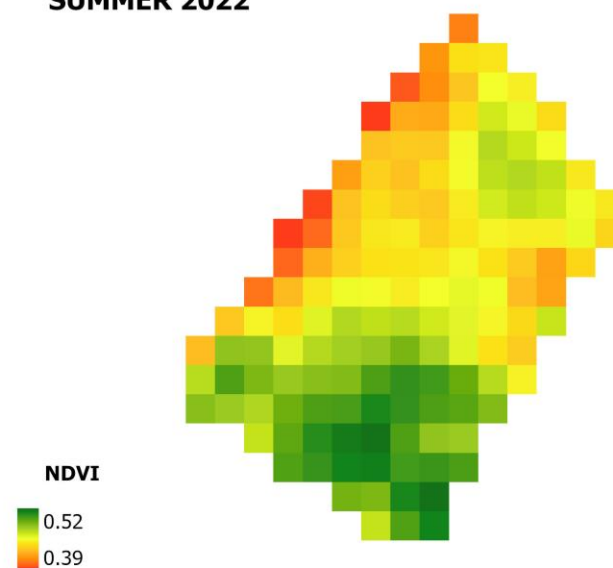
WINTER 2022



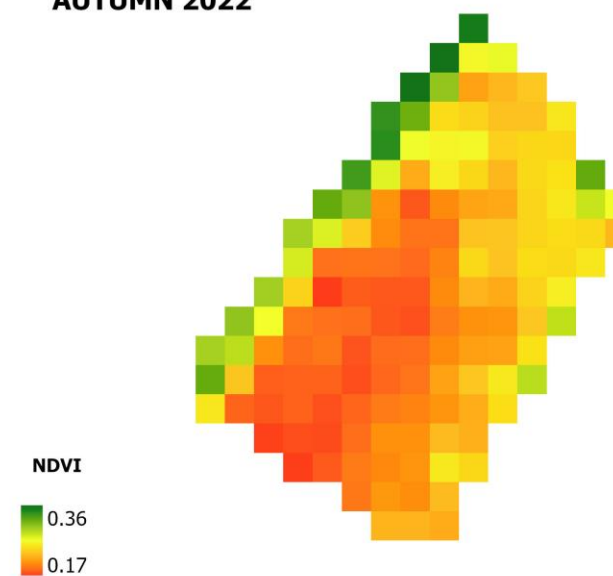
SPRING 2022



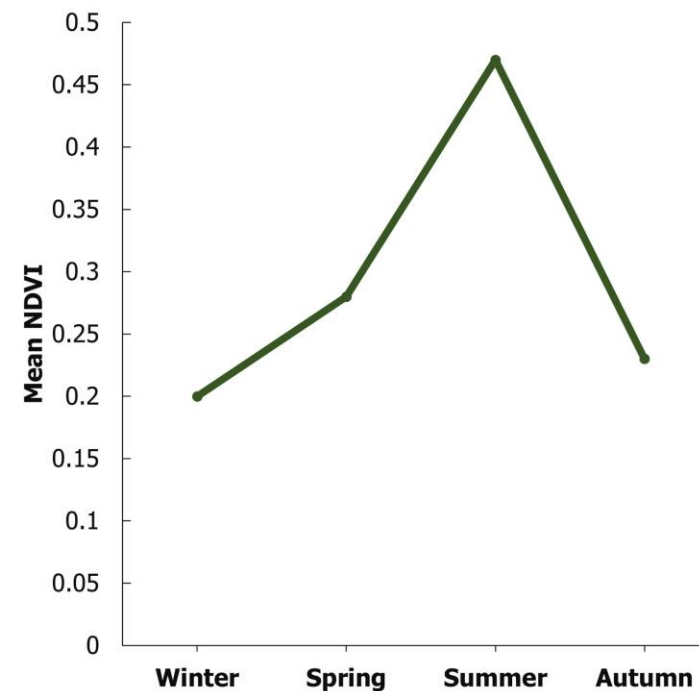
SUMMER 2022



AUTUMN 2022



Belturbet oak site
Normalized Difference Vegetation Index (NDVI)
Seasonal mean values



Other environmental features of the site



Annual mean rainfall: 963 mm



Soil subgroup according to the Irish Soil Information System:



Annual mean temperature: 9.2 °C

Typical Brown Earth



Coordinate System
ETRS 1989 UTM Zone 29 N

Soil data source:
(Teagasc & Cranfield University,
2014)

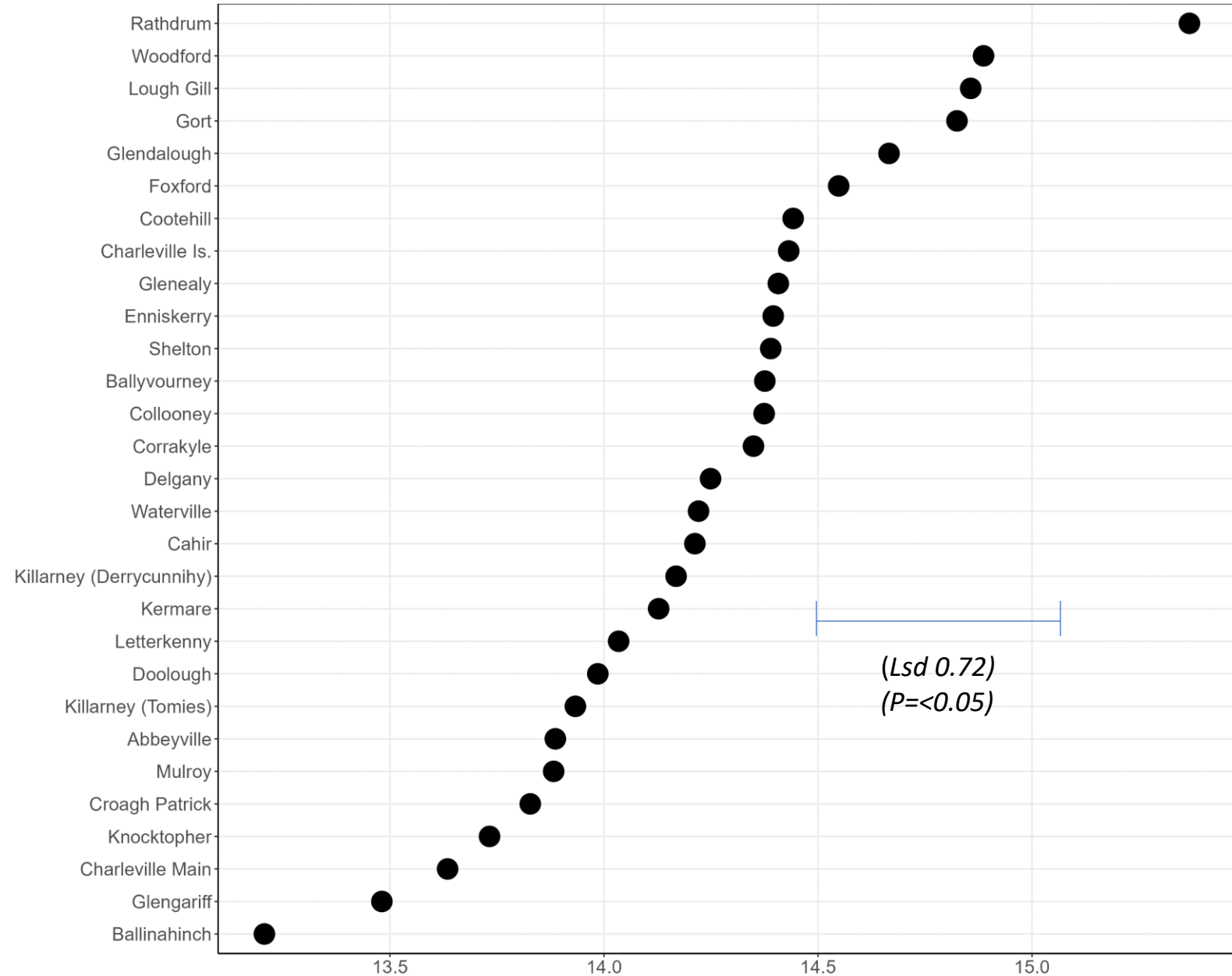
0 50 100 200 Meters

REML analysis of Top height growth assessing the significance of provenance and adjusted for;

- Location
- elevation
- pH
- Tree DBH (15 – 20 cm, >20 cm)
- Rainfall (Apr – Sep)

Assessing provenance growth differences: top height (m)

Residual Maximum Likelihood (REML) was applied to assess the significance of provenance, adjusted for pH, elevation, proportion of trees alive [15cm, 20cm] and > 20cm and mean Apr-Sep rainfall, while accounting for the random effect of site. Provenance was significant (REML: $F(28,1061)=3.65$, $P < 0.001$). The average least significant difference was 0.72. REML means displayed.

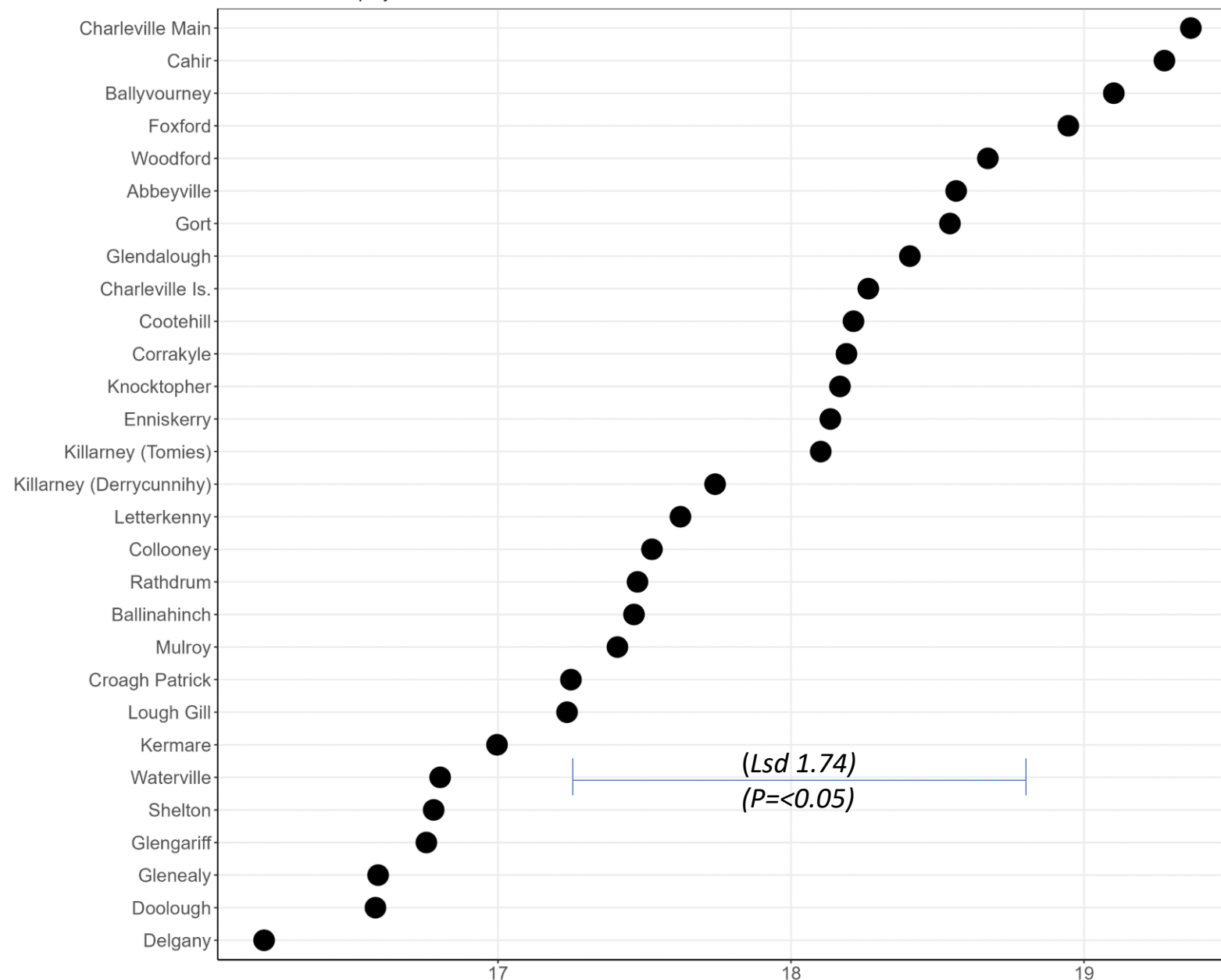


Source: Irish Oak Forest Experiment, Agri-Food & Biosciences Institute

REML analysis of DBH height growth assessing the significance of provenance and adjusted for;

- Location
- elevation
- pH
- Tree DBH (15 – 20 cm, >20 cm)
- Rainfall (Apr – Sep)

Assessing provenance growth differences: diameter at breast height (cm)
Residual Maximum Likelihood (REML) was applied to assess the significance of provenance, adjusted for pH, elevation, proportion of trees alive [15cm, 20cm] and > 20cm and mean Apr-Sep rainfall, while accounting for the random effect of site. Provenance was significant (REML: $F(28,1062)=1.93$, $P = 0.003$). The average least significant difference was 1.74. REML means displayed.



Source: Irish Oak Forest Experiment, Agri-Food & Biosciences Institute

Conclusions;

- There were significant differences found between provenances growth attainment
- Provenance growth changed significantly between locations
- Growth performance was not consistent across locations
- Location was found to have a significant effect on growth response
- Climatic factors were found to be significant
- Tree form is a major factor in assessing for future Crop tree selection

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Met Éireann- data sourced under a Creative Commons Attribution 4.0 International (CC BY 4.0). Data (not shown) has been modified for use in statistical formulations.

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