

Table S1. Oak species, collection sites and nursery sites.

Species	Greece	Italy	Germany
<i>Q. pubescens</i>	40°35'45"N, 23°45'22"E, 30 m asl	43°25'02"N, 10°52'25"E, 325 m asl	N/A
<i>Q. frainetto</i>	40°29'30"N, 23°37'51"E, 530 m asl	41°18'02"N, 13°02'54"E, 25 m asl	N/A
<i>Q. ilex</i>	40°35'10"N, 23°47'44"E, 5 m asl	41°18'02"N, 13°02'54"E, 25 m asl	N/A
<i>Q. robur</i>	N/A	N/A	„Oberrheingraben“
Nursery	40°35'60"N, 23°45'13"E, 25 m asl	43°20'18"N, 12°33'35"E, 450 m asl	49°50'06"N, 08°34'23"E, 95 m asl

Table S2. Average minimum and maximum monthly temperatures and total monthly precipitation recorded in the common gardens in the course of 2017, 2018 and 2019. Data in RIE, SWA were recorded on site, data in SAN at the climate station in Casteldilago, and data for OLY and STR close to the sites at the climate stations of Hellas Gold.

	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Germany - RIE										
2017	T min (°C)	-3.8	1.6	4.0	3.6	9.5	13.1	14.6	13.7	9.4
	T max (°C)	2.3	9.1	15.2	16.0	22.5	27.2	27.0	26.5	20.8
	Precip. (mm)	37.2	31.2	72.0	17.2	111.4	69.4	119.8	125.4	97.2
2018	T min (°C)	3.4	-3.3	0.5	7.6	10.8	14.3	15.6	14.9	9.7
	T max (°C)	8.4	3.4	9.6	20.7	23.9	25.2	29.5	28.3	23.3
	Precip. (mm)	110.6	21.4	51.4	63.8	50.2	109.6	21.2	28.6	44.4
2019	T min (°C)	-0.7	-0.3	3.0	5.8	7.4	13.6	14.8	14.6	10.0
	T max (°C)	4.2	10.5	13.2	17.1	18.2	28.2	27.6	27.5	21.0
	Precip. (mm)	56.2	31.2	70.0	36.8	59.0	37.2	21.0	50.0	70.6
Germany - SWA										
2017	T min (°C)	-5.1	0.5	2.8	1.7	8.0	11.4	13.3	12.5	8.2
	T max (°C)	1.5	8.9	15.1	17.2	24.0	29.5	28.6	27.9	21.4
	Precip. (mm)	26.2	22.4	52.2	1.0	105.8	19.2	97.4	85.4	32.8
2018	T min (°C)	2.7	-4.6	-0.7	5.7	9.6	13.3	13.4	13.3	8.0
	T max (°C)	7.9	2.9	9.9	23.3	27.2	29.2	33.5	31.9	25.5
	Precip. (mm)	80.0	13.8	30.4	55.2	24.0	45.0	12.8	15.6	30.4
2019	T min (°C)	-2.6	-1.8	2.7	4.2	5.7	12.3	12.5	12.7	7.7
	T max (°C)	2.8	9.9	13.3	18.6	20.1	30.5	30.1	29.7	21.9
	Precip. (mm)	11.8	20.2	48.8	36.0	60.2	57.0	28.8	52.0	54.6
Italy - SAN										
2017	T min (°C)	-0.2	4.6	4.8	6.2	11.1	16.5	17.0	18.4	12.6
	T max (°C)	10.2	16.0	19.8	22.3	27.3	33.9	35.5	36.9	26.0
	Precip. (mm)	58.0	78.4	38.8	35.8	39.8	33.2	40.4	34.6	97.4
2018	T min (°C)	3.1	1.0	4.5	9.3	12.6	14.8	17.4	17.0	14.9
	T max (°C)	13.9	10.9	14.9	24.2	25.0	29.2	33.7	32.9	29.8
	Precip. (mm)	50.6	69.2	223.2	55.4	152.2	110.6	36.8	114.2	55.8
2019	T min (°C)	-0.3	1.6	4.5	6.9	9.3	16.1	18.0	18.2	14.0
	T max (°C)	10.1	15.6	19.6	21.3	20.4	33.6	35.0	35.7	29.0
	Precip. (mm)	69.6	93.6	11.3	106.4	253.6	9.4	69.0	40.0	135.0

Greece - OLY										
2017	T min (°C)	0.2	6.0	8.3	9.1	14.1	18.7	20.3	20.7	17.1
	T max (°C)	6.2	12.6	17.2	18.6	24.8	36.0	36.2	39.4	31.2
	Precip. (mm)	25.0	49.9	24.2	84.5	35.7	75.0	4.1	99.7	10.0
2018	T min (°C)	3.3	5.3	7.0	11.1	15.6	18.4	20.1	20.1	17.0
	T max (°C)	10.7	11.2	15.1	22.2	26.0	28.5	30.4	32.1	27.8
	Precip. (mm)	25.0	49.9	24.2	84.5	35.7	46.0	108.2	95.6	8.0
2019	T min (°C)	2.2	4.0	6.2	9.1	12.9	18.8	19.5	20.9	17.3
	T max (°C)	8.5	11.7	15.5	17.9	23.9	30.1	30.8	33.2	28.3
	Precip. (mm)	227.9	24.1	30.2	57.1	47.8	48.7	45.2	0	35.3
Greece - STR										
2017	T min (°C)	-1.7	2.8	5.0	4.3	10.1	17.4	19.3	20.0	16.6
	T max (°C)	2.9	7.9	11.7	13.7	20.6	35.8	35.2	41.4	30.6
	Precip. (mm)	145.1	52.2	64.3	16.2	53.9	40.3	103.0	2.6	33.8
2018	T min (°C)	2.4	3.4	5.5	10.6	14.1	17.1	18.3	20.3	15.1
	T max (°C)	8.8	7.4	12.2	21.1	23.5	25.7	27.9	28.1	24.6
	Precip. (mm)	24.0	207.0	116.5	3.8	36.3	189.6	41.0	2.5	29.8
2019	T min (°C)	1.3	2.7	5.9	8.1	12.2	17.9	18.7	20.6	16.5
	T max (°C)	5.5	9.1	14.8	15.3	20.5	27.2	28.3	30.1	25.1
	Precip. (mm)	227.6	10.0	32.6	40.9	44.0	18.1	49.7	0.7	49.6

Table S3. Statistical analysis of height (in cm) in the common gardens, measured in summer 2019. Values followed by different letters within a row are significantly different at $P < 5\%$, as calculated by Kruskal-Wallis one-way-ANOVA tests with Dunn's post-hoc test. Means of *Q. robur* were analyzed by t-test at $P < 5\%$.

Species and provenance	Plantation site				
	RIE	SWA	SAN	OLY	STR
<i>Q. ilex</i> GR	50.21 ± 1.41 a	32.96 ± 1.07 b	46.13 ± 1.49 a	8.75 ± 0.92 c	15.33 ± 3.02 bc
<i>Q. ilex</i> IT	60.18 ± 2.20 a	49.01 ± 1.51 b	59.47 ± 1.40 a	15.50 ± 2.53 c	13.17 ± 2.46 c
<i>Q. frainetto</i> GR	23.24 ± 0.78 a	23.52 ± 0.95 a	23.43 ± 1.13 a	8.50 ± 1.02 b	11.53 ± 0.66 b
<i>Q. frainetto</i> IT	29.33 ± 0.93 a	33.63 ± 1.39 a	25.69 ± 1.38 b	11.94 ± 2.05 c	15.42 ± 1.36 c
<i>Q. pubescens</i> GR	39.74 ± 1.82 b	29.67 ± 1.13 c	46.25 ± 1.72 a	12.87 ± 0.80 e	21.39 ± 1.28 d
<i>Q. pubescens</i> IT	62.50 ± 2.31 a	36.32 ± 1.28 b	71.27 ± 2.42 a	13.81 ± 1.11 c	20.71 ± 1.32 c
<i>Q. robur</i> DE	50.41 ± 1.49 a	39.39 ± 1.22 b			

Table S4. Statistical analysis of root collar diameter (mm) in the common gardens, measured in summer 2016, to examine the parameters potential as indicator of second-year survival after outplanting. Values followed by different letters within a row are significantly different at $P < 5\%$, as calculated by t-tests.

Species	Species and provenance					
	<i>Q. ilex</i> GR	<i>Q. ilex</i> IT	<i>Q. frainetto</i> GR	<i>Q. frainetto</i> IT	<i>Q. pubescens</i> GR	<i>Q. pubescens</i> IT
Germany - RIE						
Survived	11.74 ± 0.19 a	12.03 ± 0.18	6.48 ± 0.19 a	9.09 ± 0.20 a	15.04 ± 0.33 a	17.54 ± 0.30 a
Perished	9.75 ± 1.49 a	-	3.80 ± 0.37 b	5.75 ± 0.25 b	13.20 ± 0.80 a	11.75 ± 1.11 b
Germany - SWA						
Survived	11.67 ± 0.21 a	12.48 ± 0.24 a	6.78 ± 0.22 a	9.21 ± 0.24 a	15.14 ± 0.39 a	17.33 ± 0.30 a
Perished	11.90 ± 0.53 a	12.50 ± 0.51 a	7.49 ± 0.29 a	8.64 ± 0.32 a	15.10 ± 0.74 a	17.61 ± 1.12 a
Greece - OLY						
Survived	10.75 ± 1.55 a	18.00 ± 1.73 a	6.65 ± 0.64 a	9.59 ± 1.03 a	20.17 ± 0.96 a	16.87 ± 0.59 a
Perished	11.09 ± 0.34 a	17.50 ± 0.35 a	6.69 ± 0.17 a	7.54 ± 0.31 b	19.15 ± 0.48 a	17.09 ± 0.41 a
Greece - STR						
Survived	9.67 ± 0.61 a	14.00 ± 1.22 a	6.24 ± 0.30 a	6.81 ± 0.37 a	19.33 ± 0.51 a	17.97 ± 0.56 a
Perished	9.88 ± 0.26 a	13.67 ± 0.28 a	6.72 ± 0.22 a	7.77 ± 0.32 a	20.81 ± 0.62 a	18.08 ± 0.40 a

Table S5. Mean values of fitness indicators (FI) of the plants in 2016, separated into those who established live in 2017 and those who perished in the first year after plantation (dead in 2017).

Species and provenance / country of plantation	live in 2017		dead in 2017		signif. diff.
	FI (mean)	SE	FI (mean)	SE	
<i>Q. ilex</i> GR / GE	0,5964	0,0035	0,5666	0,0141	no
<i>Q. ilex</i> IT / GE	0,5697	0,0031	0,5638	0,0129	no
<i>Q. frainetto</i> GR / GE	0,5684	0,0037	0,5521	0,0089	no
<i>Q. frainetto</i> IT / GE	0,5675	0,0034	0,5801	0,0087	no
<i>Q. pubescens</i> GR / GE	0,5688	0,0038	0,5763	0,0098	no
<i>Q. pubescens</i> IT / GE	0,5960	0,0028	0,5904	0,0106	no
<i>Q. ilex</i> GR / GR	0,3551	0,0185	0,3298	0,0038	no
<i>Q. ilex</i> IT / GR	0,3787	0,0229	0,3971	0,0036	no
<i>Q. frainetto</i> GR / GR	0,3541	0,0152	0,3425	0,0045	no
<i>Q. frainetto</i> IT / GR	0,3473	0,0131	0,3582	0,0061	no

<i>Q. pubescens</i> GR / GR	0,4374	0,0055	0,4348	0,0042	no
<i>Q. pubescens</i> IT / GR	0,4577	0,0063	0,4569	0,0039	no

Table S6. Spearman correlation analyses between Relative Population Fitness (RPF) ranking positions in 2019 vs. 2016 at the German sites. RPF were calculated as described in Materials and methods. Pearson's r value was also calculated for the height data in 2019 vs. 2016 at the German and Greek sites. Significance values for the correlations are given at P< 5% (*), 1% (**), 0,1% (***)

	RIE+SWA			OLY+STR	
	Spearman's r for RPF	Pearson r for height	n	Pearson r for height	n
IlxGR	0.051 ^{ns}	0.131 [*]	373	-0.188 ^{ns}	17
IlxIT	-0.023 ^{ns}	0.031 ^{ns}	370	-0.284 ^{ns}	18
FraGR	-0.203 ^{***}	-0.077 ^{ns}	357	-0.137 ^{ns}	46
FraIT	-0.204 ^{***}	-0.025 ^{ns}	357	-0.014 ^{ns}	39
PubGR	0.109 [*]	0.054 ^{ns}	368	-0.075 ^{ns}	145
PubIT	-0.168 ^{**}	-0.044 ^{ns}	386	0.173 ^{ns}	80

