

**Cryptic diploid lineage of *Betula ermanii* at its southern boundary populations in
Japan**

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21 Table S1 The location, tree height, girth, leaf area, ploidy and morphology tests for individuals from southern boundary populations of *Betula ermanii*.

Population	Lat	Long	Alt	Height (m)	GBH (cm)	SLA (cm ² /g)	Ploidy	Leaf morphology	Seed morphology
SHK	34.11	135.90	1758.53	6.5	122.5	132.63	2x	done	done
SHK	34.11	135.90	1773.38	7.5	97	145.30	-	done	-
SHK	34.11	135.90	1776.48	5	61	159.02	2x	done	done
SHK	34.11	135.90	1777.49	6	67.5	137.19	-	done	-
SHK	34.11	135.90	1778.12	8	70	132.39	-	done	done
SHK	34.11	135.90	1780.84	8	85	111.11	-	done	done
SHK	34.11	135.90	1781.75	8	59	164.01	2x	done	done
SHK	34.11	135.90	1781.63	7.5	55.5	151.42	-	done	done
SHK	34.11	135.90	1777.99	9	74	129.01	-	done	done
SHK	34.11	135.90	1776.72	8	80.5	153.03	-	done	-
SHK	34.11	135.90	1776.55	8	47	149.97	2x	done	-
SHK	34.11	135.90	1775.99	10	63.5	175.40	-	done	-
SHK	34.11	135.90	1773.37	12	86	142.42	-	done	-
SHK	34.11	135.90	1779.61	10	83	153.50	-	done	-
SHK	34.11	135.90	1778.55	11	70	141.40	-	done	-
SHK	34.11	135.90	1790.03	4	82.5	169.69	2x	done	-
SHK	34.11	135.90	1789.77	4.5	63.5	172.19	-	done	-
SHK	34.11	135.90	1786.37	3	41	147.51	2x	done	done
SHK	34.11	135.90	1796.31	3	39	156.72	2x	done	-
SHK	34.11	135.90	1796.53	3	35	163.47	2x	done	-

SHK	34.11	135.90	1795.60	2	41	155.06	-	done	done
SHK	34.11	135.90	1796.00	3	58	148.05	-	done	-
SHK	34.11	135.90	1796.01	3	22.5	114.72	-	done	-
SHK	34.11	135.90	1791.41	3.5	65	126.23	-	done	-
SHK	34.11	135.90	1797.97	4	59.5	179.03	2x	done	-
SHK	34.11	135.90	1797.97	5	61.5	150.32	2x	done	done
SHK	34.11	135.90	1797.95	3.5	50	129.80	-	done	done
SHK	34.11	135.90	1798.81	4	38.5	156.80	-	done	done
SHK	34.11	135.90	1805.07	4	44.5	142.82	-	done	done
SHK	34.11	135.90	1805.30	4	48	162.53	-	done	done
TRG	33.86	134.09	1562.56	9	64	146.00	4x	done	-
TRG	33.86	134.09	1573.10	9	67	186.12	4x	done	-
TRG	33.86	134.09	1609.53	9	42.5	179.81	-	done	-
TRG	33.86	134.09	1654.66	6.5	41.5	145.61	-	done	-
TRG	33.86	134.09	1673.08	7	54	161.59	-	done	-
TRG	33.86	134.09	1736.92	6.5	36.5	176.30	-	done	-
TRG	33.86	134.09	1766.29	8	18.5	124.26	-	done	-
TRG	33.86	134.09	1786.25	5	39.5	131.80	-	done	-
TRG	33.86	134.10	1851.56	5	46	157.71	2x	done	-
TRG	33.86	134.10	1861.34	5	37	168.75	2x	done	-
TRG	33.86	134.10	1872.91	4.5	31	132.37	-	done	-
TRG	33.86	134.10	1882.20	3.5	21	123.39	-	done	done

TRG	33.86	134.10	1892.71	7	39	135.69	-	done	-
TRG	33.86	134.10	1897.08	3	21.5	125.88	-	done	-
TRG	33.86	134.10	1916.52	5	21	126.77	2x	done	-
TRG	33.86	134.10	1912.87	2.5	23	111.67	-	done	done
TRG	33.86	134.10	1910.79	3	27.5	107.71	2x	done	done
TRG	33.86	134.10	1903.15	4	31	125.92	-	done	done
TRG	33.86	134.09	1897.91	3	30.5	109.01	-	done	done
TRG	33.86	134.09	1891.82	6	54.5	121.38	-	done	-
TRG	33.86	134.09	1883.90	7	33	108.48	-	done	-
TRG	33.86	134.09	1877.38	8	49.5	134.87	-	done	-
TRG	33.86	134.09	1876.47	7	48.5	135.98	2x	done	-
TRG	33.86	134.09	1872.89	10	79.5	156.84	-	done	-
TRG	33.86	134.09	1864.47	4.5	37	113.62	2x	done	done
TRG	33.86	134.09	1859.38	6.5	71	148.56	2x	done	-
TRG	33.86	134.09	1853.25	3	27.5	115.70	-	done	-
TRG	33.86	134.09	1827.89	3	27	138.22	-	done	-
TRG	33.86	134.09	1814.99	4	42.5	172.38	2x	done	-
TRG	33.86	134.09	1798.19	11.5	168	159.92	-	done	-
ISZ	33.76	133.14	1465.46	7	55	130.69	4x	done	done
ISZ	33.76	133.14	1463.33	6	72	138.26	4x	done	-
ISZ	33.76	133.15	1461.07	15	76	150.78	-	done	-
ISZ	33.76	133.14	1463.09	7.5	47.5	121.40	-	done	-

ISZ	33.76	133.14	1485.96	5.5	20	157.17	2x	done	done
ISZ	33.76	133.14	1517.86	8	38	197.98	-	done	-
ISZ	33.76	133.14	1514.00	9	43	150.53	-	done	-
ISZ	33.76	133.14	1510.36	12	53.5	178.37	2x	done	-
ISZ	33.76	133.14	1522.14	6	44	189.51	-	done	done
ISZ	33.76	133.14	1528.01	7	35	139.64	-	done	-
ISZ	33.76	133.13	1560.12	7	42	177.38	2x	done	-
ISZ	33.76	133.13	1560.08	7	47.5	121.39	-	done	done
ISZ	33.76	133.13	1568.59	2.5	16	152.44	-	done	-
ISZ	33.76	133.13	1611.02	3	36.5	126.04	-	done	done
ISZ	33.77	133.13	1635.27	3	53	188.83	2x	done	done
ISZ	33.77	133.13	1651.77	2.5	43.5	104.18	-	done	done
ISZ	33.77	133.13	1652.89	8	35.5	168.39	-	done	-
ISZ	33.77	133.13	1647.98	4.5	52	133.92	-	done	done
ISZ	33.77	133.12	1648.64	11	42	134.77	-	done	-
ISZ	33.77	133.12	1656.95	5	32.5	140.66	2x	done	done
ISZ	33.77	133.12	1663.34	7	33	163.49	2x	done	-
ISZ	33.77	133.12	1663.85	16	108	141.29	-	done	done
ISZ	33.77	133.12	1674.95	9	35	141.70	-	done	-
ISZ	33.77	133.12	1681.77	11	105	115.55	-	done	done
ISZ	33.77	133.12	1680.13	12	67	126.82	2x	done	-
ISZ	33.77	133.12	1680.61	8	65	111.08	-	done	-

ISZ	33.77	133.12	1706.33	7	20.5	174.68	2x	done	-
ISZ	33.77	133.12	1753.00	7	32	222.87	-	done	-
ISZ	33.77	133.11	1776.29	5	27	137.02	-	done	-
ISZ	33.77	133.11	1800.23	5	39	171.21	-	done	-

Lat, latitude (°N); Long, longitude (°E); Alt, altitude (m); GBH, girth at breast height; SLA, specific leaf area (area to dry weight ratio) of early leaves. The 14 populations were: URU, Uryu; AKS, Akkeshi; HKD, Hakkoda; GYS, Goyo-san; CKS, Choukai-san; BDS, Bandai-san; MKT, Mikuni-touge; YGT, Yatsugatake; APW, Alps-west; NGH, Nougouhaku-san; APS, Alps-south; SHK, Shaka-gatake; TRG, Tsurugi-san; ISZ, Ishizuchi-san.

35 Table S2 The results of ANOVAs for leaf morphological traits and principal component axes.

		Ploidy	Population
Leaf area (cm ²)	df	1	6
	F	120.32	10.33
	<i>P</i>	< 0.01	< 0.01
Leaf length (mm)	df	1	6
	F	24.34	4.32
	<i>P</i>	< 0.01	< 0.01
Leaf width (mm)	df	1	6
	F	36.17	13.08
	<i>P</i>	< 0.01	< 0.01
Leaf length/width	df	1	6
	F	2.43	11.10
	<i>P</i>	0.12	< 0.01
Leaf perimeter (mm)	df	1	6
	F	0.35	8.99
	<i>P</i>	0.56	< 0.01
Leaf perimeter/leaf area	df	1	6
	F	282.82	8.72
	<i>P</i>	< 0.01	< 0.01
Leaf veins (<i>n</i>)	df	1	6
	F	8.56	7.21
	<i>P</i>	< 0.01	< 0.01
Leaf base length (mm)	df	1	6
	F	103.13	6.47
	<i>P</i>	< 0.01	< 0.01
Leaf base length/leaf length	df	1	6
	F	152.10	9.23
	<i>P</i>	< 0.01	< 0.01
PCA axis 1 score	df	1	6

	F	179.34	12.19
	<i>P</i>	< 0.01	< 0.01
PCA axis 2 score	df	1	6
	F	49.53	14.48
	<i>P</i>	< 0.01	< 0.01

Df, degrees of freedom; F, Fisher's F value for the variance component of each factor; PCA, principal components analysis.

56 Table S3 The results of ANOVAs for seed morphological traits and principal component axes.

		Ploidy	Population
Seed weight ($\times 100$) (mg)	df	1	5
	F	52.31	14.06
	P	< 0.01	< 0.01
Seed area ($\times 100$) (cm ²)	df	1	5
	F	0.27	1.83
	P	0.60	0.13
Seed length (mm)	df	1	5
	F	0.02	2.34
	P	0.89	0.06
Seed width (mm)	df	1	5
	F	7.68	9.46
	P	< 0.01	< 0.01
Seed length/width	df	1	5
	F	5.73	12.07
	P	0.021	< 0.01
Seed wing length (mm)	df	1	5
	F	17.04	3.23
	P	< 0.01	0.01
Seed wing length / Seed width	df	1	5
	F	27.79	6.67
	P	< 0.01	< 0.01
PCA axis 1 score	df	1	5
	F	45.88	13.96
	P	< 0.01	< 0.01
PCA axis 2 score	df	1	5
	F	0.03	2.01
	P	0.87	0.10

57 df, degrees of freedom; F, Fisher's F-value for the variance component of each factor; PCA, principal

58 component analysis.