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**EUCALYPTUS NITENS BREEDING
POPULATION CLONAL ARCHIVE**

L. Gea and R. McConnochie

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SUMMARY

The new breeding population of *Eucalyptus nitens* is composed of two clonal archives. An “elite” archive at Rangipo of the top-ranked clones with a breeding objective of **high density and growth**, and a larger clonal group of the remaining breeding population parents at Waiouru, selected for **high growth and average density**.

BACKGROUND

The open pollinated breeding population of *Eucalyptus nitens* was established in 1990 at three sites and contained 312 families. The progeny tests of these families were assessed at age 4.5 years, so an advanced breeding population for this species could then be progressed. During 1996 it was clear that the collection of open pollinated seed from the 1990 progeny tests would not be a feasible method of turning over the generation of *E. nitens*. Neither the single tree plot tests at Kinleith and Kaingaroa, nor the Forward Selection Block trial at Kinleith were producing seed. Alternative breeding strategies for the species were reviewed and the establishment of a clonal archive of breeding population parents at a good flowering site was considered the best option as a first step to developing the next generation.

ARCHIVE SITING

Grafting the best individuals in the top 200 families would be an expensive operation. The cost per successful graft ex **Forest Research** nursery was \$65, exclusive of scion collection. Therefore, the grafting of these selections was spread across three years both to spread costs and to work within the constraints of the grafting capacity at the **Forest Research** nursery. During 1996, 30 selections were grafted, another 22 the following year, and the remaining 123 selections were grafted in November 1998. The selections from the top ranked families were grafted first because scion material of the select trees could be collected at the same time both for the establishment of the breeding population clonal archive and for seed orchards by the members of the Eucalypt Breeding Cooperative.

A major concern for the breeding programme with *E. nitens* is that this species fails to produce seed unless environmental conditions are suitable. Waiouru has been identified as an outstanding area for the production of early and abundant seed production. Existing plantings of *E. nitens* in the army camp and around the Waiouru township at an altitude of 900 m showed that the combination of a cold winter and a dry summer promotes the production of large quantities of seed.

Early and heavy flowering of the genotypes in the breeding population is essential to advance the improvement programme.

Efforts were made therefore to secure an area of Defence Force land at Waiouru to establish the clonal archive, however these were unsuccessful in 1997 and the 30 selections initially grafted were re-potted into 10 litre buckets and retained in the *Forest Research* nursery. During 1998 a suitable site at Waiouru under the authority of The Royal New Zealand Navy was selected and access to the area was under consideration by the Defence Force NZ authorities. However, by September 1998 it became apparent that permission would not be obtained in time to establish the grafts produced in 1996 and 1997. Rather than regraft or attempt to hold the grafts in pots any longer, an alternative site was selected at the Rangipo Prison Farm near Turangi. This site was established in November 1998. The Waiouru site will be available for the establishment of the remaining 123 clones in 1999. Both the Rangipo and Waiouru sites have a well established windbreak on the west and south-west boundaries; shelter is very important for successful establishment and seed set. The terrain at both sites is flat for ease of access and maintenance. The sites have been previously grazed and required cultivation by ripping prior to planting. The control of weeds and protection from hares, rabbits and possums will be essential; initially there will be 100% weed control within one metre of each graft by either hand releasing or chemical application. The remaining area can be maintained by regular mowing and grazing stock must be excluded.

SELECTION INDICES AND SELECTED GROUPS

The results from first generation progeny trials at Kaingaroa and Kinleith were utilised for ranking the families and individuals of the breeding population. The output of the study provided a family and individual selection index score where growth and form were the most influential traits (Gea *et al.*, 1997). The study also provided the necessary information for initiating the first round of selection for the breeding population clonal archives and for clonal seed orchard purposes.

Information from Tasmania (Greaves, 1997) documented the importance of wood density for reducing the cost of pulp production. Until then, wood density was known to be a variable and heritable trait in *E. nitens*, but the cost of surveying the whole breeding population was a limiting factor for incorporating this trait into the assessment and eventually the selection index. At the end of 1997, a more precise pilodyn instrument for indirect measurement of basic density was purchased. The top 10 individuals per family at Kinleith, based on growth and form, in the best 250 families of the breeding population were identified. Two pilodyn measurements per tree were taken. Individual heritabilities for pilodyn were high (0.41). Wood density cores were taken from 3-5 individuals on a subset of 40 families with low pilodyn averages. The data also showed a moderately high phenotypic correlation ($r = 0.68$) between pilodyn measurements and wood density cores (Gea *et al.*, 1997). A new selection index was generated with growth, form and pilodyn information for the selection of individuals for the clonal archive and for clonal seed orchard grafting.

This correlation was relatively low (0.68), probably because of the sample selection, as only higher density trees (low pilodyn values) were sampled with a 5 mm pith to bark core and mainly from those individuals that were candidate selections for seed orchards.

For these reasons, the linear regression equation between Pilodyn penetration and corewood density was expected to be poorly estimated.

Corewood density = $502.06 - 10.55$ pilodyn penetration.

Genetic correlation between Pilodyn penetration and diameter was negative and low (-0.14) and even lower with corewood density (0.08). This showed that fast-growing trees with high wood density can be selected.

The New Zealand families (from Rotoaira) were clearly superior for wood density, though no selection for density had been applied. Families from AMCOR and NFP were of low to very low density (positive pilodyn penetration values).

Therefore, two distinct sets of clones were selected and grafted in 1996 and 1997, the first one selected using an index based on growth and form, and the second one with an index incorporating a double economic weight on diameter and pilodyn penetration (wood density).

The third round of grafting in 1998 included selections from the remaining 123 families to give a total of 200 clones for the breeding population clonal archive. The latter 123 selections will have little application for the establishment of clonal orchards.

GRAFTING

Healthy scion material from the best individual tree per family was collected by climbing. Some individuals from the top families which have provided scions on two consecutive years at present have a reduced crown but these are recovering. The percentage of successful grafts varied amongst clones and depended mainly on the health of the scion material.

Generally six ramets per clone were initially grafted to ensure that three grafts per clone would be available for planting in the archive. T. Faulds reported the grafting survival results for the 1997 grafting (Eucalypt Breeding Cooperative meeting March 1998). When rootstock and scion material diameter were matched at 2.00-3.00 mm, average survival was 78.5%. As at November 1998, the average grafting survival for all 123 clones was 91.6%.

TECHNICAL OPPORTUNITIES

The Rangipo site accommodates an elite group composed of 66 clones top ranked for indexes based on **growth and form, and on growth, form and high density**.

The position of the clones on the site was predetermined using the seed orchard computer programme COOL. Seed for the next breeding population generation can be produced by selectively crossing through control-pollination within this elite or collection of open-pollinated seed. The archive could also be utilised as a potential seed orchard and seed collections might be made selectively from the top parents represented there.

The Waiouru site layout will allow open pollination among the lower ranked 120 clones and it could be managed with a low cost open pollination strategy. Individual collections from the best parents may also be utilised for deployment if needed but the main objective will be to maintain the clones and serve as a clonal archive.

The Rangipo archive contains a high growth/high density “elite” breeding population with 16 clones from Rubicon, 35 clones from Toorongu, and 13 clones from McAlister. Details of the clone numbers, number of ramets, index values for growth, form, branching, Pilodyn penetration,

wood density and relatedness of each selection is listed in Table 1. Table 2 provides similar information for the clones that will be established at the Waieurua site.

New opportunities have evolved with the establishment of these two separate clonal archives for *E. nitens*. The new breeding population structure will require further planning; it can capitalise gains from the separate grafting events and offer new opportunities for developing a distinct “elite” breeding population which emphasises high wood density and a larger main population. This corresponds to the “Breeds” of the *Pinus radiata* breeding strategy.

REFERENCES

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Table 1 Grafts established in Breeding Archive at Rangipo Prison Farm, November 1998

Ortet No.	Tree Location (Rep.set.code)	Code	Related	DBH	STR	BRH	PIL	Density	Selection	Origin	Parent Code	Gen	Prov	Alt
886.811			1						BS	Heyfield	6	2	M	1000
888.874			4						BS	Conners Plain	81	2	M	1310
888.899			7						BS	Mississippi, Powellton	116	2	T	820
889.104									BS	Mt St Gwinear	111	2	T	1175
896.400	12306655	655	8	0.245	0.106	0.079	0.271		FS	Rubicon	S1612	2	R	
896.401	10301893	893	3	0.325	0.312	0.041	0.653		FS	Conners Plain	78	2	M	1310
896.402	10406925	925		0.252	0.394	0.167	0.021		FS	Snobs Creek	1398	2	R	937
896.403	10507835	835	4	0.124	0.529	0.377	0.014		FS	Conners Plain	81	2	M	1310
896.404	10508061	61		0.145	0.271	0.225	-0.463		FS	Mt St Gwinear	8	2	T	1175
896.405	10602698	698		0.137	0.529	0.189	-0.705		FS	Mt Erica	S2689	1	T	1000
896.406	10702694	694		0.231	0.351	0.408	0.304		FS	Mt Erica	S2677	1	T	1000
896.407	10705940	940		0.340	0.367	0.192	-0.482		FS	Toorong Plateau	1135	2	T	880
896.408	10708111	111	6	0.278	0.317	0.254	-0.781		FS	Mississippi Powelton	115	2	T	820
896.409	10806964	964	10	0.499	0.320	0.088	0.492		FS	Mt Torbeck	1414	2	R	729
896.410	11005874	874	4	0.225	0.523	0.292	-0.820		FS	Conners Plain	81	2	M	1310
896.411	11310057	57	2	0.281	0.199	0.018	-0.030		FS	Blue Range	75	2	R	1000
896.412	12202736	736	9	0.354	0.502	0.195	0.096		FS	Mt Erica	S2691	1	T	1000
896.413	10206655	655	8	0.445	0.210	0.061	-0.214		FS	Rubicon	S1612	2	R	
896.414	12502704	704	9	0.322	0.299	0.253	0.900		FS	Mt Erica	S2691	1	T	1000
896.415	12502736	736	9	0.366	0.274	0.103	-0.191		FS	Mt Erica	S2691	1	T	1000
896.416	12603632	632		0.184	0.223	-0.004	0.577		FS	Tweed Spur	S404	1	R	970
896.417	12608840	840		0.314	0.082	-0.052	-0.155		FS	Mt St Gwinear	89	2	T	1175
896.418	12701664	664		0.416	-0.044	-0.119	0.310		FS	Loch Valley	S59	1	T	900
896.419	12801606	606		0.310	0.217	-0.084	0.667		FS	St Gwinear	S377	1	T	900
896.420	12803728	728		0.084	0.261	0.159	-0.106		FS	Rubicon	S1710	1	R	
896.421	12806964	964	10	0.456	0.476	0.120	0.330		FS	Mt Torbeck	1414	2	R	729
896.422	12902068	68		0.263	0.279	0.207	-0.422		FS	Waiouru		1	T	900
896.423	13001611	611		-0.045	0.689	0.467	-0.354		FS	St Gwinear	S52	1	T	900
896.424	13003116	116		0.165	0.123	-0.070	-0.354		FS	Manapouri		1	NSW	
896.425	13003650	650		0.228	0.307	0.034	-0.292		FS	Snobs Creek	S407	1	R	937
896.426	13003732	732		0.344	0.299	0.136	0.204		FS	Rubicon	S1694	1	R	

Table 1 cont.

Ortel No.	Tree Location (Rep.set.code)	Code	Related	DBH	STR	BRH	PIL	Density	Selection	Origin	Parent Code	Gen	Prov	Alt	
896.427	13005874	874	4	0.176	0.210	0.221	-1.055	446	FS	Conners Plain	81	2	M	1310	
896.428	13007831	831	3	0.178	0.199	-0.030	-0.308		FS	Conners Plain	78	2	M	1310	
896.429	13008042	42	5	0.246	0.123	-0.009	-0.919		FS	Toorongo Plateau	110	2	T	880	
896.430	13008056	56	7	0.307	0.042	-0.006	-0.442		FS	Mississippi Powelton	116	2	T	820	
897.101	10105869	869	1	0.146	0.136	-0.175	-1.309		FS	Mt. Skene	117	2	M	1160	
897.105	10206917	917		0.290	0.120	-0.200	-0.570		FS	Snobs Creek	1259	2	R	945	
897.106	10301118	118		0.380	0.300	0.000	-0.530		FS	Rotoaira Mix (I. Nicholas)	-	2			
897.107	10301601	601		0.370	0.200	0.080	-0.510		FS	Mt Erica	S2681	1	T	1000	
897.109	10307106	106		0.290	0.002	-0.070	-0.781	429	FS	Heyfield	6	2	M	1000	
897.110	10310863	863		0.277	0.048	0.019	-0.785	440	FS	Blue Range	124	2	R	1000	
897.116	10705932	932		0.255	-0.083	0.003	-1.018	421	FS	Little Boys Ck	1302	2	T	1045	
897.124	11109879	879		0.074	0.287	0.297	-1.214	451	FS	Pennys Saddle	112	2	T	810	
897.129	11208054	54	7	0.276	0.010	-0.182	-0.070	426	FS	Mt St Gwinear	87	2	T	1175	
897.131	11309899	899		0.142	0.364	0.229	-0.536	FS	Mississippi, Powellton	116	2	T	820		
897.132	11407836	836		4	0.126	0.027	-0.081	-1.421	433	FS	Conners Plain	81	2	M	1310
897.134	11409853	853		0.500	-0.050	-0.400	-0.820	FS	Mt Erica	114	2	T	1067		
897.135	11410110	110		0.297	0.047	-0.134	-0.798	430	FS	Blue Range	71	2	R	1000	
897.139	11707933	933		0.185	0.206	0.193	-1.293	FS	Mt Skene	1351	2	M	1150		
897.140	11708049	49		0.160	0.220	0.270	-0.770	FS	Starling Hill, Powellton	16	2	T	729		
897.141	10608111	111		6	0.177	0.287	0.176	-0.886	458	FS	Mississippi Powelton	115	2	T	820
897.146	12002681	681	6	0.340	0.360	0.050	-0.350	FS	Mt Erica	S2686	1	T	1000		
897.147	12005923	923		0.400	0.370	0.260	-0.420	FS	Mt Toorongo Track	1347	2	T	1000		
897.150	12107922	922		0.314	-0.092	-0.229	-0.889	424	FS	Mt Shillinglaw	1375	2	M	915	
897.152	12202691	691		0.326	-0.169	-0.254	-0.972	411	FS	Mt Erica	S2688	1	T	1000	
897.153	12202701	701		0.234	0.130	0.184	-0.338	423	FS	Mt Erica	S2694	1	T	1000	
897.155	12209881	881		0.177	0.057	-0.059	-1.181	476	FS	Toorongo Plateau	20	2	T	880	
897.156	12307812	812		1	0.371	-0.002	0.019	-1.054	421	FS	Heyfield	6	2	M	1000
897.158	12408056	56		7	0.328	0.119	0.074	-0.629	429	FS	Mississippi Powelton	116	2	T	820
897.160	12409886	886	2	0.253	0.272	0.065	-0.481	429	FS	Mt Erica	113	2	T	1067	
897.161	12810063	63		0.197	0.224	0.026	-0.306		FS	Snobs Creek	104	2	R	945	
897.163	12704651	651		0.230	-0.035	-0.115	-0.908	431	FS	Macalister	S2715	1	M	600	
897.165	12710817	817		0.420	0.020	-0.170	-0.360	FS	Mt Victoria	17	2	R	1127		
897.166	12710829	829		0.304	0.042	0.022	-0.770	FS	Blue Range	75	2	R	1000		
897.168	12808042	42		5	0.300	0.078	-0.160	-0.867	421	FS	Toorongo Plateau	110	2	T	880
897.169	12809858	858		7	0.163	0.189	0.083	-0.654	454	FS	Mississippi, Powellton	116	2	T	820
897.174	13001605	605			0.047	0.013	0.028	-1.025	480	FS	Mt Erica	S375	1	T	1000

Table 2 *E.nitens* selections grafted 1998 for establishment in breeding population archive at Waiouru

Ortet No.	Tree Location (Rep,ser,code)	Code	Related	DBH	STR	BRH	PIL	Grwth/Pil	Density	Selection	Origin	Parent Code	Generation	Provenance	Alt
898.001	10101015	15		0.153	-0.263	-0.469	0.000	-0.426	385	FS	*	-	1	Nimmitabel - Maire Road	
898.002	10101019	19		-0.063	0.126	-0.111	0.000	-0.111	381	FS	*	-	1	Nimmitabel - Maire Road	
898.003	10110103	103	11	0.201	0.211	-0.039	-0.683	1.259	443	FS	R	101	2	Toolangi	610
898.004	10203719	719		0.039	0.420	0.351	-0.133	0.982	410	FS	R	S1708	1	Rubicon	
898.005	10210848	848	12	0.130	0.405	0.204	0.104	0.764	368	FS	R	103	2	Royston Road	975
898.006	10207859	859		0.271	-0.012	0.010	-0.671	1.211	443	FS	M	117	2	Mt Skene	1160
898.007	10307825	825		0.088	0.246	0.209	-0.233	0.864	419	FS	M	33	2	Mt Useful	1295
898.008	10307811	811		0.064	0.044	0.005	-0.760	0.937	447	FS	M	6	2	Heyfield	1000
898.009	10405959	959		0.104	0.405	0.160	-0.223	0.996	414	FS	T	1424	2	Mt St Gwinear	1175
898.010	10308844	844	10	-0.070	0.506	0.414	-0.780	1.560	444	FS	T	92	2	Mt St Gwinear	1175
898.011	10402692	692		0.195	0.111	0.210	-0.607	1.318	398	FS	T	S2675	1	Mt Erica	1000
898.012	10406901	901	17	0.189	0.270	0.132	-0.118	0.899	478	FS	R	1269	2	Royston Dam	945
898.013	10406905	905		0.191	0.217	0.141	-0.340	1.081	416	FS	R	1250	2	Snobs Creek	937
898.014	10408041	41	9	-0.097	0.354	0.101	0.000	0.261	392	FS	T	85	2	Mt St Gwinear	1175
898.015	10509870	870	10	0.139	0.465	0.222	-0.569	1.536	425	FS	T	92	2	Mt St Gwinear	1175
898.016	10510865	865	5	0.051	0.400	0.312	0.037	0.778	413	FS	R	73	2	Blue Range	1000
898.017	10503723	723		0.144	0.070	-0.058	-0.720	1.019	458	FS	R	S1702	1	Rubicon	
898.018	10508818	818		0.187	-0.285	-0.234	-1.105	0.959	411	FS	T	20	2	Toorong Plateau	880
898.019	10506939	939		0.256	0.073	-0.166	-0.605	1.025	420	FS	R	1107	2	Tweed Spur	970
898.020	10601610	610		0.060	0.439	0.076	-1.117	1.751	443	FS	T	S44	1	St Gwinear	900
898.021	10601658	658		0.227	0.080	-0.147	-0.782	1.169	452	FS	T	S41	1	Mt St Gwinear	1175
898.022	10609867	867	13	0.248	0.413	0.090	-0.498	1.497	412	FS	T	111	2	Mt St Gwinear	1175
898.023	10610060	60		-0.035	0.033	0.144	-1.102	1.210	450	FS	R	100	2	Toolangi	610
898.024	10607953	953		0.214	0.184	-0.024	-0.403	0.991	418	FS	M	1149	2	Connors Plain	1260
898.025	10608820	820		0.164	0.317	0.199	-0.364	1.209	424	FS	T	25	2	Mt Horsfall	701
898.026	10902713	713		0.209	0.148	-0.013	-0.578	1.131	393	FS	T	S2683	1	Mt Erica	1000
898.027	11101609	609		0.079	0.055	0.082	-0.413	0.708	393	FS	T	S51	1	St Gwinear	900
898.028	11103720	720		0.169	0.280	0.084	-0.396	1.099	429	FS	R	S1699	1	Rubicon	
898.029	11103682	682		0.116	0.236	0.168	-0.762	1.399	424	FS	R	S1705	1	Rubicon	
898.030	11108045	45		0.345	-0.062	-0.200	-0.433	0.862	454	FS	T	15	2	Starling Hill, Powelltown	962

Ortet No.	Tree Location (Rep,ser,code)	Code	Related	DBH	STR	BRH	PIL	Grwth/Pil	Density	Selection	Origin	Parent Code	Generation	Provenance	Alt
898.031	11105684	684	13	0.109	0.059	0.165	-0.518	0.960	389	FS	T#	S2648	2	Gwinear	900
898.032	11207048	48		-0.122	0.203	0.281	-0.932	1.172	469	FS	M	80	2	Conners Plain	1310
898.033	11205693	693		0.038	0.177	0.146	-0.959	1.359	396	FS	T#	S1637	2	Gwinear	900
898.034	11008104	104		0.055	0.238	0.137	-0.679	1.164	413	FS	T	111	2	Mt St Gwinear	1175
898.035	11205950	950		0.240	0.048	-0.183	-0.374	0.719	451	FS	SN	1168	2	Nimmitabel	1220
898.036	11205931	931		0.257	-0.007	-0.024	-0.370	0.853	450	FS	T	1301	2	Little Boys Ck	1045
898.037	11006697	697		0.376	-0.003	-0.331	-0.587	1.005	409	FS	R#	S1648	2	Toolangi	610
898.038	11410813	813		0.362	0.275	0.087	0.049	1.038	408	FS	R	12	2	Cathedral Range	1036
898.039	11407948	948		0.191	0.255	0.099	-0.157	0.892	392	FS	M	1197	2	Spring Hill	1240
898.040	11308053	53		0.073	-0.051	-0.059	-0.765	0.801	377	FS	T	90	2	Mt St Gwinear	1000
898.041	11202671	671		0.150	-0.066	-0.208	-1.051	1.078	461	FS	T	S379	1	Little Boys Ck	1045
898.042	11209883	883	3	0.093	0.368	0.225	-0.240	1.019	400	FS	T	30	2	Mt Erica	1067
898.043	11506928	928	5	0.385	0.029	-0.242	-0.660	1.218	431	FS	R	1333	2	Snobs Creek	920
898.044	11510827	827		-0.019	0.079	0.038	-1.303	1.381	489	FS	R	73	2	Blue Range	1000
898.045	11604117	117	15	0.035	0.397	0.463	-0.515	1.445	434	FS	NSW	4	2	Manapouri (see G. Milligan)	
898.046	11407043	43		-0.009	0.265	0.206	-0.294	0.747	419	FS	M	122	2	Conners Plain	1310
898.047	11609876	876		0.172	0.339	0.207	0.122	0.767	419	FS	T	26	2	Mt Horsfall	701
898.048	11609885	885		0.215	0.001	0.020	-0.268	0.720	415	FS	T	86	2	Mt St Gwinear	1175
898.049	11603688	688		0.094	0.076	0.167	-0.185	0.615	412	FS	R	S1701	1	Rubicon	
898.050	11610826	826	4	-0.138	0.394	0.341	-0.196	0.655	441	FS	R	70	2	Federation Range	1100
898.051	11302677	677	7	0.149	0.497	0.155	-0.245	1.194	499	FS	T	S31	1	Link Rd	900
898.052	11707833	833		0.068	0.230	0.117	-0.422	0.904	423	FS	M	79	2	Conners Plain	1310
898.053	11606902	902	17	0.205	0.004	-0.009	-0.634	1.040	413	FS	R	1272	2	Royston Dam	945
898.054	11703722	722	15	0.032	0.302	0.269	-0.971	1.606	481	FS	R	S1701	1	Rubicon	
898.055	11709856	856	3	0.059	0.023	0.147	-0.325	0.613	446	FS	T	116	2	Mississippi, Powellton	820
898.056	11509884	884		0.270	0.264	0.121	-0.257	1.184	444	FS	T	30	2	Mt Erica	1067
898.057	11801619	619		0.059	-0.254	-0.053	-1.173	0.982	422	FS	T	S2676	1	Mt Erica	1000
898.058	11802735	735		0.197	0.324	0.131	-0.158	1.008	438	FS	T	S2686	1	Mt Erica	1000
898.059	11806912	912		0.198	0.236	0.284	-0.231	1.147	426	FS	R	1284	2	Quartz Link Tra	1094
898.060	11904628	628		0.360	0.020	-0.128	0.217	0.395	383	FS	M	S2719	1	Macalister	600

Table 2 cont.

Ortet No.	Tree Location (Rep,ser,code)	Code	Related	DBH	STR	BRH	PIL	Grwth/Pil	Density	Selection	Origin	Parent Code	Generation	Provenance	Alt
898.061	11702699	699	6	0.136	0.141	0.195	-0.572	1.180	431	FS	T	S2690	1	Mt Erica	1000
898.062	11702712	712		-0.026	0.579	0.378	0.005	0.901	428	FS	T	S2682	1	Mt Erica	1000
898.063	11710830	830		0.063	0.229	0.157	-0.623	1.134	432	FS	R	77	2	Blue Range	1000
898.064	11908070	70		-0.147	0.333	0.244	-0.905	1.187	426	FS	-	-	1	Waiouru - ammenity planting	900
898.065	12110044	44		0.016	0.229	0.276	-0.970	1.507	417	FS	R	103	2	Royston Road	975
898.066	12107936	936		0.120	0.189	0.088	-0.640	1.157	476	FS	M	1360	2	White Star Mine	1200
898.067	12206903	903	12	0.117	0.226	0.072	-0.467	0.999	434	FS	R	1297	2	Tweed Spur	957
898.068	12201607	607		-0.057	0.574	0.305	-0.497	1.262	432	FS	T	S48	1	St Gwinear	900
898.069	12306952	952		0.184	0.271	0.082	-0.636	1.356	438	FS	R	1104	2	Tweed Spur	970
898.070	12307942	942		0.034	0.052	0.159	-0.559	0.837	421	FS	M	1153	2	Mt Skene	1150
898.071	12310894	894		0.254	0.101	-0.029	-0.544	1.125	426	FS	R	71	2	Blue Range	1000
898.072	12304716	716		0.115	0.043	0.187	-0.907	1.367	474	FS	M	S2723	1	Macalister	600
898.073	12302675	675	7	0.162	-0.053	-0.131	-1.005	1.146	439	FS	T	S381	1	Mississippi	820
898.074	12705873	873		-0.153	0.235	0.344	-0.364	0.637	408	FS	M	79	2	Conners plain	1310
898.075	12205069	69		-0.079	0.127	0.445	-0.464	0.877	425	FS	-	-	1	Waiouru - ammenity planting	900
898.076	12407920	920		0.063	0.394	0.268	-0.558	1.345	427	FS	M	1376	2	Mt Shillinglaw	915
898.077	12404648	648		0.056	0.125	0.133	-0.906	1.276	400	FS	M	S2713	1	Macalister	600
898.078	12406921	921		0.080	0.181	0.263	-0.507	1.110	429	FS	R	1388	2	Con Gap Rd/Snob	937
898.079	12002714	714	2	0.040	0.347	0.225	-0.663	1.315	407	FS	T	S2684	1	Mt Erica	1000
898.080	12410115	115		0.100	0.145	0.157	-0.081	0.584	443	FS	R	97	2	Toolangi	610
898.081	12409896	896		0.221	0.503	0.198	0.026	1.118	437	FS	T	24	2	Mt Horsfall	701
898.082	12409875	875		-0.100	0.202	0.193	-0.857	1.050	478	FS	T	84	2	Mt St Gwinear	1175
898.083	12505683	683		-0.038	0.192	0.181	-0.858	1.154	472	FS	T#	S1638	2	Noojee	960
898.084	12505960	960		0.158	0.341	0.178	0.000	0.834	414	FS	T	1429	2	Little Boys Creek	1030
898.085	12502700	700	8	-0.060	0.259	0.212	-0.888	1.240	410	FS	T	S2693	1	Mt Erica	1000
898.086	12606955	955		0.128	-0.022	0.074	-0.250	0.558	418	FS	R	1110	2	Tweed Spur	1020
898.087	12609897	897		0.208	-0.037	0.072	-0.868	1.320	454	FS	T	82	2	Mt Erica	1067
898.088	12510062	62		0.294	0.418	-0.108	-0.139	1.037	420	FS	R	70	2	Federation Range	1100
898.089	12510113	113		0.195	0.022	0.031	-0.314	0.758	413	FS	R	9	2	Mt Torbeck	729
898.090	12602715	715		0.055	0.101	-0.007	-0.902	1.107	434	FS	T	S2685	1	Mt Erica	1000

Table 2 cont.

Ortet No.	Tree Location (Rep,ser,code)	Code	Related	DBH	STR	BRH	PIL	Grwth/Pil	Density	Selection	Origin	Parent Code	Generation	Provenance	Alt
898.091	10903604	604	7	0.186	0.193	-0.026	-0.964	1.503	484	FS	R	S89	1	MMBW Rd	1000
898.092	10901880	880		0.015	0.301	0.469	-1.038	1.839	499	FS	M	79	2	Conners Plain	1310
898.093	10709891	891		0.223	-0.028	0.019	-0.482	0.920	451	FS	T	113	2	Mt Erica	1067
898.094	10801608	608		0.075	0.379	0.256	-1.201	1.986	496	FS	T	S49	1	St Gwinear	900
898.095	11703718	718	1	0.152	0.278	0.263	0.028		420	FS	R	S1706	1	Rubicon	
898.096	12210055	55		0.046	0.240	-0.053	-1.186	1.465	459	FS	R	9	2	Mt Torbreck	729
898.097	12609854	854		0.076	0.201	0.067	-0.627	1.047	464	FS	T	114	2	Mt Erica	1067
898.098	12609847	847		0.137	0.265	0.114	-0.402	1.056	423	FS	T	101	2	Toolangi	610
898.099	12603727	727	11	0.062	0.343	0.093	-0.532	1.093	457	FS	R	S1711	1	Rubicon	
898.100	12603678	678		0.233	0.075	-0.099	-0.749	1.191	427	FS	R	S1709	1	Rubicon	
898.101	12706913	913		0.170	0.215	0.148	-0.363	1.065	436	FS	R	1252	2	Snobs Creek	937
898.102	12709851	851		0.160	0.182	0.056	-0.673	1.231	443	FS	T	111	2	Mt St Gwinear	1175
898.103	12709866	866	9	0.138	0.274	0.021	-0.618	1.189	485	FS	T	85	2	Mt St Gwinear	1175
898.104	12808816	816		0.094	-0.033	0.040	-0.624	0.818	420	FS	T	16	2	Starling Hill, Powelltown	762
898.105	12810861	861		0.110	0.061	-0.031	-0.695	0.946	439	FS	M	121	2	Conners Plain	1310
898.106	12804717	717		0.114	0.289	0.153	-0.578	1.247	449	FS	M	S2724	1	Macalister	600
898.107	12810888	888		0.065	0.164	0.073	-0.709	1.075	412	FS	R	14	2	Cathedral Range	1036
898.108	12903067	67		-0.035	0.290	0.372	0.415	0.176	421	FS	-	-	1	Waiouru - amenity planting	900
898.109	12905708	708		0.035	0.271	0.221	-0.215	0.776	447	FS	T#	S2649	2	Gwinear	900
898.110	12906943	943		0.040	-0.179	-0.004	-0.522	0.419	454	FS	R	1124	2	Barnawall Plain	1180
898.111	12908050	50	6	0.283	0.167	0.112	0.165	0.679	400	FS	T	27	2	Mt Horsfall	701
898.112	13010046	46		-0.028	0.260	0.086	0.134	0.156	402	FS	R	77	2	Blue Range	1000
898.113	12202737	737		0.192	0.061	-0.148	-0.256	0.553	414	FS	T	S2689	1	Mt Erica	1000
898.114	12403724	724		0.094	0.285	0.309	0.059	0.723	416	FS	R	S1703	1	Rubicon	
898.115	12003729	729	8	0.033	0.441	0.469	-0.024	1.000	375	FS	R	S1697	1	Rubicon	
898.116	11408823	823		0.182	-0.024	-0.131	-0.136	0.344	413	FS	T	29	2	Mt Erica	1067
898.117	11609892	892		0.208	0.225	0.078	0.015	0.703	394	FS	T	82	2	Mt Erica	1067
898.118	10904730	730		0.341	0.250	0.184	0.056	1.059	377	FS	R	S1696	1	Rubicon	
898.119	10701612	612		0.078	-0.138	-0.182	-0.723	0.559	424	FS	T	S53	1	St Gwinear	900
898.120	10705961	961		0.188	0.135	0.242	-0.308	1.062	418	FS	T	1421	2	Newlands Rd	1070
898.121	11102710	710		-0.195	0.081	0.039	-1.465	1.196	443	FS	T	S2679	1	Mt Erica	1000
898.122	10706957	957		0.277	0.256	0.196	-0.259	1.264	387	FS	R	1412	2	Mt Torbreck	1158
898.123	10909889	889	2	0.090	0.361	0.192	-0.286	1.018	412	FS	T	24	2	Mt Horsfall	701