# REVIEW OF SILVICULTURAL TRIALS

G.G. WEST

REPORT NO. 3 MAY 1994

FOREST & FARM PLANTATION MANAGEMENT COOPERATIVE

# EXECUTIVE SUMMARY

## REVIEW OF SILVICULTURAL TRIALS

G.G. WEST

REPORT NO. 3 MAY 1994

A review of research trials with silvicultural treatments has resulted in the collation of a database describing trials. Results from analysing this database indicate the following:

- Forest sites are much better covered by trials than farm sites.

- The current silvicultural trials are strong on diversity of treatments but generally lack depth in testing treatments on a range of sites.

- The silviculture\breeds trials are a well planned and designed series that may have too many trials.

- A better balance of the number of trials by issue or treatment is needed.

- The following issues are inadequately covered by a trial series:

  on forest sites
  1) pruning of new breeds
  2) the effect of followers
  3) Divergence/Convergence

  on farm sites
  1)pruning of new breeds
  2)timing of thinning (this is partially covered in the follower trials but these contain only one final crop stocking.)
  3) Divergence/Convergence

- The need for the F&FPM Cooperative to set goals for the future and develop a strategic plan for new silvicultural trials is emphasised by this study. There is also a clear need for greater collaboration with the Stand Growth Modelling Cooperative when planning future trials.

# Review Of Silvicultural Trials

by
G.G. West

## Introduction

Over the last twenty years a number of research groups at FRI have established and measured a large number of silvicultural trials. Silvicultural trials include a wide variety of tending treatments such as initial stocking, thinning, pruning, and final stocking. They also examine the interacting effects of silvicultural treatments with site and breed.

In the past forests have been established on a wide variety of sites that were generally unsuited to agriculture. A recent trend is the planting of fertile pasture sites which have been farmed for a number of decades. With the current strong investment interest in forestry the planting of farm sites is expected to increase rapidly.
Trees produced from the NZ FRI genetic improvement programme are expected to grow faster and have straighter stems with a number of breeds and levels of improvement currently available. To optimise the management of the improved tree breeds a knowledge of their response to silvicultural treatments is needed

As part of the current review of direction and strategy within the Forest and Farm Plantation Management (F&FPM) Cooperative, it has been identified that a review is needed to examine what silvicultural trials currently exist and what their purpose is. Also to assist with the planning of further trials, the current gaps and deficiencies in the existing trials need to be identified.

Currently the Stand Growth Modelling Cooperative is developing a PSP strategy (Hayward *et al,* 1991) to efficiently supply data for growth and yield modelling. This review is not part of that process but will assist in providing information on designed experiments that could augment growth monitoring plots for validating and building growth models.

## Methods

An initial step in this analysis was to define the scope of the review within the amount of time allocated to it. The following decisions were made to define which trials should be included :

- Only NZ FRI trials would be included. These would be largely trials controlled by the Plantation Management Group (PMG) and Mensuration Group, but trials controlled by other groups (eg PEG, Soils, and Pathology) that include a silvicultural treatment would also be examined. Although identified as NZ FRI trials many trials in this study are collaborative trials established jointly with forest growers.

- To include abandoned trials (ie trials no longer measured because they have been damaged or have matured and have been clear felled)

- To include growth monitoring plots

- Not to include shelter belt plots

## Results

Using the PSP database and the personal knowledge of key individuals in each research group, a database describing each trial was collated and entered into EXCEL. This database (appendix 1) was then interrogated to provide the following detail.

Table 1 gives the total number of current and abandoned plots found by site category . Site has been loosely defined into two categories:

1) Farm site = sites with a history of intensive pastoral farming of 10 years or more.
2) Forest site = unimproved sites receiving standard site amelioration practices where needed.

Of the total 3056 plots found in this review only 800 are located on farm sites. Abandoned plots (493) have been included because many provide useful data to examine current issues. Although they are no longer measured, these plots remain on the PSP system.

**Table 1: Total number of current and abandoned plots by site category**

| | Current Plots | Abandoned Plots | Total |
|---|---|---|---|
| Forest | 1797 | 459 | 2256 |
| Farm | 766 | 34 | 800 |
| | | | |
| **Total** | 2563 | 493 | 3056 |

## Plot types

Not all plots identified in this analysis are from silvicultural trials, some of the plots have been established for the purpose of growth monitoring. These plots simply monitor stand growth under current forest practice (for growth modelling purposes) and do not contain a range of treatments in a structured experiment. However it is useful to include in this analysis growth monitoring plots controlled by NZ FRI ( many forest companies have their own growth monitoring plots) to emphasise the distinction between these plots and true silvicultural trials. Silvicultural trials must be located on a uniform site, usually with a compact layout that tests a range of silvicultural treatments in a statistically valid design.

Plots from silvicultural trials have been identified in table 2 as "experimental" or "breed" plots. Breeds plots are from the New Breeds trial series that have been established and maintained largely by the Stand Growth Modelling (SGM) Cooperative . Some of the New Breed trials included here do not have silvicultural treatment comparisons and provide information only on genetic gain. A more detailed analysis of these trials is given later in this report.

**Table 2: The number of plots by controller and type.**

| Site | Controller | Type | Current | Abandoned |
|---|---|---|---|---|
| Forest | PMG | Experimental | 436 | 65 |
| | | Monitoring | 0 | 0 |
| | Mensuration | Experimental | 185 | 190 |
| | | Monitoring | 515 | 204 |
| | | Breeds | 592 | 0 |
| | Pathology | Experimental | 69 | 0 |
| Farm | PMG | Experimental | 254 | 32 |
| | | Monitoring | 158 | 2 |
| | | Breeds | 32 | 0 |
| | Mensuration | Breeds | 188 | 0 |
| | PEG | Experimental | 134 | 0 |
| Total | | | 2563 | 493 |

**Silvicultural treatments**

To further examine the designed silvicultural experiments, the trials have been sorted by the major treatment that occurs in the trial. Trials on forest sites are given in table 3 and on farm sites in table 4. Some of the New Breed trials detailed later have been included here.

**Table 3: Silviculture trials by treatment on forest sites.**

| Treatment | Current | | Abandoned | |
|---|---|---|---|---|
| | plots | trials | plots | trials |
| Initial stocking | 22 | 4 | 27 | 2 |
| Pruning | 89 | 4 | 32 | 1 |
| Thinning | 149 | 6 | 120 | 13 |
| Followers | 18 | 1 | 0 | 0 |
| Final Crop Stocking (FCS) | 168 | 19 | 3 | 1 |
| Poles | 44 | 2 | 0 | 0 |
| Cuttings/Seedlings | 8 | 1 | 0 | 0 |
| Poison Thinning | 17 | 1 | 13 | 2 |
| Prune/Thin/ N Fert | 40 | 2 | 60 | 1 |
| Configuration | 30 | 1 | 0 | 0 |
| Stand Reorganisation | 44 | 2 | 0 | 0 |
| Oversowing/Grazing x FCS | 28 | 1 | 4 | 1 |
| Disease x thin | 69 | 4 | 0 | 0 |
| Breeds x pruning | 0 | 0 | 0 | 0 |
| Breeds x FCS | 288 | 6 | 0 | 0 |
| Total | 1014 | 54 | 259 | 21 |

**Table 4: Silviculture trials by treatment on farm sites**

| Treatment | Current | | Abandoned | |
|---|---|---|---|---|
| | plots | trials | plots | trials |
| Initial stocking | 0 | 0 | 0 | 0 |
| Pruning | 8 | 1 | 0 | 0 |
| Thinning | 0 | 0 | 32 | 1 |
| Followers | 76 | 5 | 0 | 0 |
| Final Crop Stocking | 121 | 4 | 0 | 0 |
| Poles | 0 | 0 | 0 | 0 |
| Cuttings/Seedlings | 49 | 2 | 0 | 0 |
| Poison Thinning | 0 | 0 | 0 | 0 |
| Prune/Thin/ N Fert | 0 | 0 | 0 | 0 |
| Configuration | 0 | 0 | 0 | 0 |
| Stand Reorganisation | 0 | 0 | 0 | 0 |
| Oversowing/Grazing x FCS | 0 | 0 | 0 | 0 |
| Breeds x pruning | 32 | 1 | 0 | 0 |
| Breeds x FCS | 194 | 5 | 0 | 0 |
| Total | 480 | 18 | 32 | 1 |

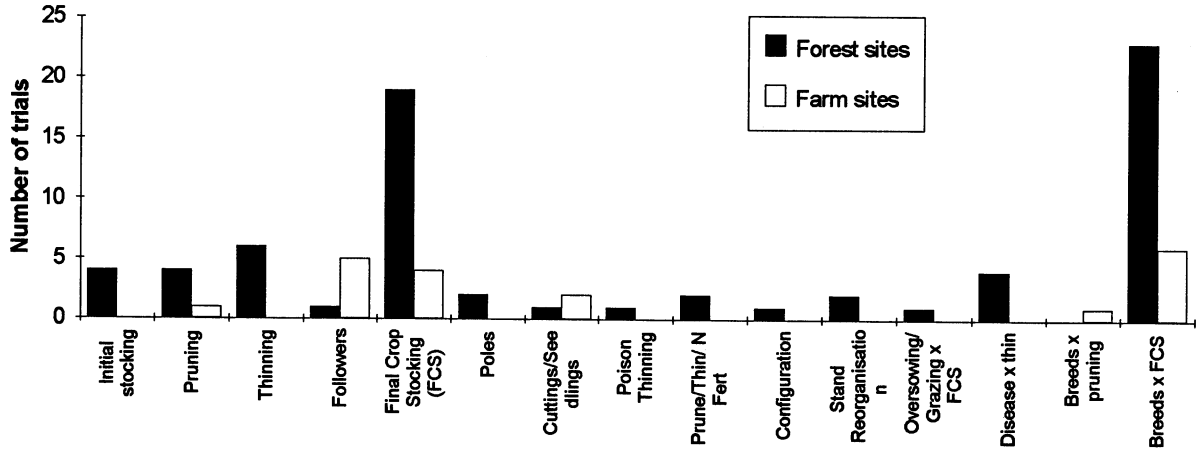
Clearly there are a very diverse range of silvicultural issues being addressed in these trials. Some issues are examined with more than one trial, indicating the trials are probably repeated on more than one site. However, many issues involve less than three trials indicating a lack of site coverage. An example of a large well planned series that covers most of the forest sites in New Zealand is a series of (old breed) trials examining final crop stocking. Details of this group are given in table 5.

**Table 5: Final Crop Stocking Trial Series on Forest Sites**

| Forest | Current age | No. Plots | No. of measurements |
|---|---|---|---|
| Aupouri | 16 | 10 | 5 |
| Aupouri | 17 | 10 | 5 |
| Ngapipito | 17 | 4 | 5 |
| Tairua | 13 | 8 | 5 |
| Rotoehu | 14 | 10 | 5 |
| Kaingaroa | 26 | 7 | 18 |
| Kaingaroa | 27 | 16 | 19 |
| Kaingaroa | 25 | 7 | 19 |
| Awahahonu | 16 | 6 | 5 |
| Golden Downs | 14 | 10 | 4 |
| Golden Downs | 13 | 10 | 4 |
| Golden Downs | 10 | 10 | 4 |
| Rai Valley | 13 | 10 | 5 |
| Hanmer | 13 | 8 | 4 |
| Ashley | 17 | 8 | 5 |
| Balmoral | 18 | 8 | 5 |
| Waimate | 15 | 10 | 5 |
| Black Mount | 16 | 8 | 5 |

Figure 1 illustrates the distribution of trials by treatment and site type. (The number of New Breed x FCS trials includes those currently established but without PSPs)

**Figure 1: Number of Silvicultural trials by treatment and site type**




## New Breeds trials

Except for the "Breeds" trials, all the above trials have been measuring "old" breeds ie GF 1 to GF14. The series of New Breeds trials have been designed to quantify the growth and yield gains from genetically improved radiata pine and to examine interactions of breed, site, and silviculture. The trial series involves a diverse range of trial designs and treatments - these are well detailed in Carson *et al*, 1991, Skinner and Carson, 1994. A notable omission from the silvicultural treatments of this series is pruning severity.

This series of trials have been developed in two ways:

1) by establishing PSPs into existing genetic gain trials
2) by planting a new series of trials since 1987.

These trials are detailed in Table 6 and can be categorised into three main types :

1) Genetic gain trials with no variation in silvicultural treatment
2) Final crop stocking (FCS) trials with no variation in breed
3) Silviculture/breed trials with variation in silvicultural treatment and breed

Most of the trials in the third category test a range of seedlots (with various levels of improvement within breed) on a range of sites, with a range of silvicultural treatments. Silvicultural treatments mainly involve a range of final crop stockings (with a constant selection ratio) augmented by timing of thinning treatments. It may be clearer if these trials were referred to as the "Breeds x FCS" trials.

## Table 6: New Breeds trials

| Expt No. | Forest | Pl. Yr. | Trial Name | Owner | Site | PSP Estab | No. Plots |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| RO 972 | ROEU | 70 | EFM Initial Stocking | FCOR | High SI | 1975 | 16 |
| AK 538 | WHAP | 73 | EFM Initial Stocking | ERNS | Med SI | 1978 | 4 |
| | | | | | | | |
| AK 1056 | WOOD | 75 | FCS 850 Polycross | CHHF | Med SI | 1986 | 24 |
| RO 2098 | KANG | 75 | FCS 850 Polycross | FCOR | Med SI | 1986 | 24 |
| NN 529/1 | GDNW | 75 | FCS 850 Polycross | TASM | Low SI | 1986 | 24 |
| CY 597 | EYWL | 75 | FCS 850 Polycross | CHHF | Low SI | 1986 | 24 |
| | | | | | | | |
| AK 1058 | AUPO | 78 | GTI Genetic Gain | JUKN | Low SI | 1986+91 | 18 |
| RO 2103/1 | KANG | 78 | GTI Genetic Gain | FCOR | High SI | 1986+91+93 | 24 |
| RO 2103/2 | KANG | 78 | GTI Genetic Gain | FCOR | High SI | 1986+91 | 18 |
| WN 377 | MOHA | 78 | GTI Genetic Gain | CHHF | High BA | 1986+91 | 18 |
| NN 530/2 | GDNE | 78 | GTI Genetic Gain | TASM | Med SI | 1986+91+92 | 18 |
| CY 421 | WMTE | 78 | GTI Genetic Gain | TLDS | Med SI | 1991 | 12 |
| SD 564/1 | LONG | 78 | GTI Genetic Gain | ITTR | High BA | 1991 | 12 |
| SD 564/2 | LONG | 78 | GTI Genetic Gain | ITTR | High BA | 1991 | 12 |
| NN 530/1 | GDNW | 79 | GTI Genetic Gain | TASM | Med SI | 1986 | 24 |
| RO 2103/3 | KANG | 79 | GTI Genetic Gain | FCOR | High SI | 1986 | 20 |
| SD 682 | DEAN | 80 | GTI Genetic Gain | ITTR | Med SI | 1986 | 19 |
| | | | | | | | |
| FR 58 | RVHD | 82 | Thin - G Will Best practices | CHHF | High SI | 1988 | 6 |
| FR 59 | MOER | 81 | FCS 880 Progeny | CHHF | Low&Med SI | 1988 | 6 |
| FR 60 | WEIT | 82 | FCS Pair Cross | CHHF | High BA | 1988 | 12 |
| RO 1897 | KANG | 84 | GTI Genetic Gain | FCOR | Med SI | 1990 | 66 |
| | | | | | | | |
| FR 7 | WOOD | 87 | Silviculture/Breed | CHHF | Med SI | 1992 | 54 |
| FR 8 | TAHO | 87 | Silviculture/Breed | TASM | Med SI | 1992 | 54 |
| FR 9 | KANG | 87 | Silviculture/Breed | FCOR | Low SI | 1993 | 48 |
| FR 10 | GLNG | 87 | Silviculture/Breed | CHHF | High BA | 1992 | 54 |
| FR 11 | DTLG | 87 | Silviculture/Breed | TASM | Low SI | 1993 | 48 |
| FR 12 | OTCO | 87 | Silviculture/Breed | WENT | High BA | 1994 | 48 |
| | | | | | | | |
| FR 54 | MMRN | 88 | Silviculture/Breed | CHHF | High BA | 1992 | 44 |
| FR 55 | EYWL | 88 | Silviculture/Breed | CHHF | Low SI | 1995 | 22 |
| FR 56 | DALE | 88 | Silviculture/Breed | SELW | Med SI | 1995 | 44 |
| FR 57 | TIKO | 88 | Silviculture/Breed | CHHF | High SI | 1993 | 42 |
| | | | | | | | |
| FR 77 | TIKO | 89 | Silviculture/Breed | CHHF | High SI | 1995 | 30 |
| FR 78 | GWAV | 89 | Silviculture/Breed | CHHF | Med SI | 1995 | 30 |
| FR 84 | KAWE | 89 | Silviculture/Breed | CAXT | High BA | 1993 | 36 |
| FR 85 | KANG | 89 | Silviculture/Breed | FCOR | Med SI | 1993 | 42 |
| FR 86 | GDNS | 89 | Silviculture/Breed | TASM | Med SI | 1995 | 16 |
| | | | | | | | |
| FR 121/1 | TUNG | 90 | Silviculture/Breed | CHHF | Med SI | 1996 | 25 |
| FR 121/2 | ATIA | 90 | Silviculture/Breed | CHHF | Med SI | 1996 | 32 |
| FR 121/3 | GWAV | 90 | Silviculture/Breed | CHHF | Low SI | 1996 | 22 |
| FR 121/4 | TIRU | 90 | Silviculture/Breed | CHHF | High SI | 1996 | 18 |
| FR 121/5 | HOKO | 90 | Silviculture/Breed | ITTR | High SI | 1996 | 27 |
| FR 121/6 | P.TA | 90 | Silviculture/Breed | TASM | High SI | 1996 | 25 |
| FR 121/7 | HNUI | 90 | Silviculture/Breed | TASM | High BA | 1996 | 18 |
| | | | | | | | |
| FR 121/8 | MANT | 91 | Silviculture/Breed | ITTR | Med SI | 1997 | 25 |
| FR 121/9 | SANT | 91 | Silviculture/Breed | ERNS | Low SI | 1997 | 25 |
| FR 121/10 | BLUE | 91 | Silviculture/Breed | ERNS | Low SI | 1997 | 25 |
| FR 121/11 | SHEL | 91 | Silviculture/Breed | SELW | Low SI | 1997 | 25 |
| FR 121/12 | ASHY | 91 | Silviculture/Breed | CHHF | High SI | 1997 | 25 |
| FR 121/13 | GDNE | 91 | Silviculture/Breed | TASM | HIgh SI | 1997 | 25 |
| | | | | | | | |
| | | | | | | Total | 1329 |
| | | | | | | Number of trials | 49 |

The more recently planted trials are the silvicultural/breed trials that have been planned to cover a range of site types. Trials have been established in eight growth modelling regions and on at least one high, medium, and low site index site, as well as a high basal area site (ie ex-farm site) within most regions. Some trials are not yet tall enough to establish PSP plots. Table 7 gives details of the number of plots in the silvicultural/breeds trial series by site category and whether they are currently established with PSPs.

**Table: 7 Silviculture/Breed trial series**

| Site Category | PSPs established | | PSPs not established | | Totals | Totals |
|---|---|---|---|---|---|---|
| | Trials | Plots | Trials | Plots | Trials | Plots |
| High Basal Area | 5 | 194 | 1 | 18 | 6 | 212 |
| High Site Index | 1 | 42 | 6 | 150 | 7 | 192 |
| Med Site Index | 3 | 150 | 6 | 172 | 9 | 322 |
| Low Site Index | 2 | 96 | 5 | 119 | 7 | 215 |
| Totals | 11 | 482 | 18 | 459 | 29 | 941 |

High basal area sites are ex-pasture or farm sites.

**Discussion**

With more time and effort the database collated on these trials could be substantially improved to provide further levels of information, eg levels of treatment, age , and period of measurement. When the PSP plot history database is complete this will be easy to achieve. When reviewing permanent sample plots (PSPs) it is important to identify the type of data and knowledge that each plot will yield. Plots that are not within a structured experiment cannot be used to test ideas or hypothesis, however such plots can still be useful to give a measure of growth for that particular site and regime (growth monitoring) and are used to validate or build growth models for a particular site or region.

The primary aim of structured experiments is to provide data on the response of the tree crop to specific silvicultural treatments without the confounding effect of site variation. They can also be very useful in the building of growth models and provide data that will allow the model to respond correctly to silvicultural treatments. Such trials may be analysed alone or combined with others across sites to provide knowledge and answer questions. Silvicultural trials also provide essential information on log quality, particularly branch size, stem straightness, and taper.

A large series of cuttings versus seedlings trials established by the Propagation and Early growth group (PEG) have not been included in this analysis because they consist of row plots without a range of silvicultural treatments. However two of the large plot cutting/seedling trials with a range in final crop stockings are included.

Many of the issues examined by silvicultural trials are covered only in one or two trials (or sites) and are clearly not a planned series. The consequence of this will be that the interaction with site will be unknown and the results may be misleading if extrapolated to other sites. The exception to this is the final crop stocking series and the new breed series. Also some trials have been specifically designed to test this aspect, notably the site/pruning/ final crop stocking trial (WN364) in the Hawkes Bay.

A minimum of 5 trials is probably needed to model site effects with useful results, therefore many of the silvicultural issues addressed by these trials are not adequately covered by a trial series. However, the priority for research into these issues is not equal and hence resources will have to be directed into areas of greatest concern or uncertainty.

**Conclusions**

Currently forest sites are much better covered by trials than farm sites. If future forest expansion is going to be on farm sites, then a better understanding of the influence silvicultural practices have on these sites is needed.

A better balance of the number of trials by issue or treatment is needed.

The silvicultural trials examined in this analysis are strong on diversity of treatments but generally lack depth in testing treatments on a range of site types. Many issues that are examined with only one or two trials will not be adequately understood because of the lack of information from a range of sites.

Conversely the silviculture/breeds trials are a well planned and designed series that may have too many trials. Given that there is a limit to the resources that can be put into silvicultural trials, such a large series (29 trials when all are established with PSPs) will dissipate effort away from other issues and could create an opportunity cost. However the exact number required is difficult to determine. As these trials are likely to form the core data-set of future growth models it may be essential to maintain the current number. Any solution to this problem is likely to involve a trade-off between the desired precision of the results and the cost of achieving that precision. The silviculture/breeds trials (NB these are only a portion of the New Breeds trials) could be better named the *Breeds X final crop stocking (FCS) series* to avoid the confusion that they cover all types of silviculture.

The issue of Divergent and Convergent trends in basal area growth, as caused by thinning and/or pruning treatments, is not adequately covered by current trials. Previous work on this topic (Maclaren *et al*, 1992) indicated that the long term trend in growth after pruning could be different from that after thinning. Current (later ) growth models do not reflect this.

Not all issues warrant further research, however the most obvious issues inadequately covered by the existing trial series are the following :

on forest sites
1) pruning of new breeds
2) the effect of followers
3) Divergence/Convergence

on farm sites
1) pruning of new breeds
2) timing of thinning (this is partially covered in the follower trials but these contain only one final crop stocking.)
3) Divergence/Convergence

The database collated in this analysis could be significantly improved when the PSP plot histories are computerised. Further analysis could then be warranted.

This analysis emphasises the need for the F&FPM Cooperative to set goals for the future and develop a strategic plan for new silvicultural trials. There is also a clear need for greater collaboration with the Stand Growth Modelling Cooperative when planning future trials.

**References**

Carson, S D, Carson, M J, Wilcox, P L , Kimberly M. 1991: Trials designed to quantify growth and yield gains from genetically improved radiata pine. Stand Growth Modelling Cooperative Report No. 24.

Hayward, W., Goulding, C., Rawley, B., West, G., 1991: PSP future strategy report. Stand Growth Modelling Cooperative Report No.22.

Maclaren, J.P., West, G.G., Kimberly, M.O. 1992: The divergence/convergence question. NZ FRI Project Record No. 3279, Stand Management Cooperative Report No. 32

Skinner, J.A., Carson, S D, 1994: Trials designed to quantify growth and yield gains from genetically improved radiata pine - an update. Stand Growth Modelling Cooperative Report No. 24a

## Appendix 1

| | | Trials involving Silviculture | | | | as at Feb 1994 | | |
|---|---|---|---|---|---|---|---|---|
| PLOT ID | Breed | EXP Type | Controller | PSP Status | Site | Forest | Species | No of plots |
| RO 1080 | 850 | Cut/Seed | PMG | C | Farm | NGTI | P.RAD | 32 |
| RO 1012 | | GM | PMG | C | Farm | REFF | P.RAD | 6 |
| RO 1070 | | GM | PMG | C | Farm | WAFF | P.RAD | 12 |
| WN 255 | 850 | Cut/Seed | PMG | C | Farm | RTKR | P.RAD | 17 |
| AK 465 | | FCS | PMG | C | Farm | WHFF | P.RAD | 12 |
| RO 382 | 850 | FCS | PMG | C | Farm | TIKI | P.RAD | 80 |
| SD 474 | | FCS | PMG | C | Farm | OTCO | P.RAD | 17 |
| SD 489 | | FCS | PMG | C | Farm | INVE | P.RAD | 12 |
| HOROHORO | | Clonal | PMG | C | Farm | HRHR | P.RAD | 0 |
| RO 1982 | | GM | PMG | C | Farm | ORFF | P.RAD | 13 |
| AK 1026 | | GM | PMG | C | Farm | CUMB | P.RAD | 9 |
| WN 293 | | GM | PMG | C | Farm | RTKR | P.RAD | 8 |
| FR 91 1 | | GM | PMG | C | Farm | MEIN | P.RAD | 4 |
| FR 91 2 | | GM | PMG | C | Farm | WAKB | P.RAD | 3 |
| RO 2021 2 | | GM | PMG | C | Farm | MOUR | P.RAD | 4 |
| RO 2021 4 | | GM | PMG | C | Farm | NGTI | P.RAD | 7 |
| FR 95 7 | | GM | PMG | C | Farm | TURN | P.RAD | 6 |
| FR 95 8 | | GM | PMG | C | Farm | TUKI | P.RAD | 3 |
| FR 95 8 | | GM | PMG | C | Farm | RICT | P.RAD | 3 |
| FR 95 8 | | GM | PMG | C | Farm | SUMM | P.RAD | 2 |
| FR 95 9 | | GM | PMG | C | Farm | HARP | P.RAD | 6 |
| FR 101 | | GM | PMG | C | Farm | LOVE | P.RAD | 6 |
| FR 102 1 | | GM | PMG | C | Farm | WATT | P.RAD | 6 |
| FR 102 2 | | GM | PMG | C | Farm | WILO | P.RAD | 1 |
| FR 102 3 | | GM | PMG | C | Farm | Cooks | P.RAD | 3 |
| FR 102 4 | | GM | PMG | C | Farm | MacKen | P.RAD | 3 |
| FR 102 6 | | GM | PMG | C | Farm | FLIT | P.RAD | 2 |
| FR 96 | | GM | PMG | C | Farm | HOCK | P.RAD | 7 |
| FR 97 1 | | GM | PMG | C | Farm | MAKA | P.RAD | 5 |
| FR 97 2 | | GM | PMG | C | Farm | MCIN | P.RAD | 3 |
| FR 97 6 | | GM | PMG | C | Farm | STDM | P.RAD | 1 |
| FR 97 7 | | GM | PMG | C | Farm | ALEX | P.RAD | 1 |
| FR 98 1 | | GM | PMG | C | Farm | BUCH | P.RAD | 3 |
| FR 98 2 | | GM | PMG | C | Farm | OBAN | P.RAD | 3 |
| FR 98 3 | | GM | PMG | C | Farm | TNGL | P.RAD | 2 |
| FR 99 5 | | GM | PMG | C | Farm | POIN | P.RAD | 3 |
| WN 422 | | GM | PMG | C | Farm | MTST | P.RAD | 1 |
| FR 101 2 | | GM | PMG | C | Farm | FLET | P.RAD | 7 |
| FR 99 1 | | GM | PMG | C | Farm | DWKN | P.RAD | 3 |
| FR 99 2 | | GM | PMG | C | Farm | DILL | P.RAD | 2 |
| FR 99 3 | | GM | PMG | C | Farm | VAVA | P.RAD | 6 |
| FR 99 4 | | GM | PMG | C | Farm | RBRK | P.RAD | 4 |
| AK 864 | | POLES | PMG | C | Forest | POUT | P.RAD | 32 |
| FR 102 5 | | FOLLOW | PMG | C | Farm | STEV | P.RAD | 9 |
| FR 132 | | FOLLOW | PMG | C | Farm | RKAT | P.RAD | 16 |
| FR 133 | | FOLLOW | PMG | C | Farm | PAEN | P.RAD | 16 |
| FR 166 | | FOLLOW | PMG | C | Farm | GLNG | P.RAD | 19 |
| FR 186 | | Prune 2L | PMG | C | Farm | JACK | P.RAD | 8 |
| FR 195 | | FOLLOW | PMG | C | Farm | DIPT | P.RAD | 16 |
| FR 151 | | Prune & T | PMG | C | Forest | Okuku | P. RAD | 25 |
| RO 1080 | | Cut/Seed | PMG | C | Forest | KANG | P.RAD | 8 |
| RO 1083 1 | | Silv/fert | PMG | C | Forest | KANG | P.RAD | 20 |
| RO 1083 2 | | Silv/fert | PMG | C | Forest | KANG | P.RAD | 20 |
| RO 2030 | | BREEDS P | PMG | C | Farm | TUMM | P.RAD | 32 |
| RO 363 | | Prune C/D | PMG | C | Forest | KANG | P.RAD | 12 |
| WN 226 | | FOLLOW | PMG | C | Forest | GWAV | P.RAD | 18 |
| RO 1825 | | SReOrg | PMG | C | Forest | HAUT | P.RAD | 40 |
| FR71 | | SReOrg | PMG | C | Forest | WAIT | P.RAD | 4 |
| FR 194 | | Poles | PMG | C | Forest | MGHA | P.RAD | 12 |
| FR 199 | | Config | PMG | C | Forest | KINL | P.RAD | 30 |
| FR 201 | | Prune 2L | PMG | C | Forest | NGAU | P.RAD | 20 |
| PMG 500 | | Poison T | PMG | C | Forest | KROA | P.RAD | 17 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| AK 1017 | | SReOrg | PMG | C | Forest | woodhill | P.RAD | 0 |
| RO 1824 | | SReOrg | PMG | C | Forest | Hautu | P.RAD | 0 |
| RO 1826 | | SReOrg | PMG | C | Forest | Hautu | P.RAD | 0 |
| AK 1025 1 | | FCS | PMG | C | Forest | TIRU | P.RAD | 8 |
| AK 1025 2 | | FCS | PMG | C | Forest | AUPO | P.RAD | 10 |
| AK 1025 3 | | FCS | PMG | C | Forest | AUPO | P.RAD | 10 |
| AK 1025 4 | | FCS | PMG | C | Forest | NGAP | P.RAD | 4 |
| CY 588 1 | | FCS | PMG | C | Forest | WMTE | P.RAD | 10 |
| CY 588 2 | | FCS | PMG | C | Forest | BALM | P.RAD | 8 |
| CY 588 3 | | FCS | PMG | C | Forest | ASHY | P.RAD | 8 |
| CY 588 4 | | FCS | PMG | C | Forest | HANM | P.RAD | 8 |
| NN 525 1 | | FCS | PMG | C | Forest | GDNW | P.RAD | 10 |
| NN 525 2 | | FCS | PMG | C | Forest | GDNW | P.RAD | 10 |
| NN 525 3 | | FCS | PMG | C | Forest | GDNW | P.RAD | 10 |
| NN 525 4 | | FCS | PMG | C | Forest | RAI | P.RAD | 10 |
| RO 2067 1 | | FCS | PMG | C | Forest | ROEU | P.RAD | 10 |
| RO 589 1 | | FCS | PMG | C | Forest | KANG | P.RAD | 7 |
| RO 589 2 | | FCS | PMG | C | Forest | KANG | P.RAD | 16 |
| RO 589 3 | | FCS | PMG | C | Forest | KANG | P.RAD | 7 |
| SD 680 | | FCS | PMG | C | Forest | BLAC | P.RAD | 8 |
| WN 368 | | FCS | PMG | C | Forest | AWNU | P.RAD | 6 |
| RO 1891 | 850 | O&FG | PMG | C | Forest | KANG | P.RAD | 28 |
| RO 590 | | PRUNE & FCS | PMG | A | Forest | KAING | P.RAD | 32 |
| RO 395 | | THIN | PMG | A | Forest | ROEU | P.RAD | 11 |
| RO 571 | | THIN | PMG | A | Forest | WAKA | P.RAD | 5 |
| RO 903 | | Poison T | PMG | A | Forest | KANG | P.RAD | 9 |
| WN 216 | | Poison T | PMG | A | Forest | GWAV | P.RAD | 4 |
| WN 227 | | THIN | PMG | A | Forest | NGAU | P.RAD | 4 |
| RO 1012 | | THIN | PMG | A | Farm | REFF | P.RAD | 32 |
| RO 1982 | | GM | PMG | A | Farm | ORFF | P.RAD | 2 |
| RO 972 | | INS | MENS | C | Forest | ROEU | P.RAD | 16 |
| AK 538 | | INS | MENS | C | Forest | WHAP | P.RAD | 4 |
| AK 1056 | | FCS 850 Polycross | MENS | C | Forest | WOOD | P.RAD | 24 |
| RO 2098 | | FCS 850 Polycross | MENS | C | Forest | KANG | P.RAD | 24 |
| NN 529/1 | | FCS 850 Polycross | MENS | C | Forest | GDNW | P.RAD | 24 |
| CY 597 | | FCS 850 Polycross | MENS | C | Forest | EYWL | P.RAD | 24 |
| AK 1058 | | GTI Genetic Gain | MENS | C | Forest | AUPO | P.RAD | 18 |
| RO 2103/1 | | GTI Genetic Gain | MENS | C | Forest | KANG | P.RAD | 18 |
| RO 2103/2 | | GTI Genetic Gain | MENS | C | Forest | KANG | P.RAD | 24 |
| WN 377 | | GTI Genetic Gain | MENS | C | Farm | MOHA | P.RAD | 18 |
| NN 530/2 | | GTI Genetic Gain | MENS | C | Forest | GDNE | P.RAD | 18 |
| CY 421 | | GTI Genetic Gain | MENS | C | Forest | WMTE | P.RAD | 12 |
| SD 564/1 | | GTI Genetic Gain | MENS | C | Farm | LONG | P.RAD | 12 |
| SD 564/2 | | GTI Genetic Gain | MENS | C | Farm | LONG | P.RAD | 11 |
| NN 530/1 | | GTI Genetic Gain | MENS | C | Forest | GDNW * | P.RAD | 24 |
| RO 2103/3 | | GTI Genetic Gain | MENS | C | Forest | KANG * | P.RAD | 20 |
| SD 682 | | GTI Genetic Gain | MENS | C | Forest | DEAN * | P.RAD | 19 |
| FR 58 | | Thin - GWBest practices | MENS | C | Forest | RVHD | P.RAD | 6 |
| FR 59 | | FCS 880 Progeny | MENS | C | Forest | MOER | P.RAD | 6 |
| FR 60 | | FCS Pair Cross | MENS | C | Farm | WEIT | P.RAD | 12 |
| RO 1897 | | GTI Genetic Gain | MENS | C | Forest | KANG | P.RAD | 66 |
| FR 7 | | Silviculture/Breed | MENS | C | Forest | WOOD | P.RAD | 54 |
| FR 8 | | Silviculture/Breed | MENS | C | Forest | TAHO | P.RAD | 54 |
| FR 9 | | Silviculture/Breed | MENS | C | Forest | KANG | P.RAD | 48 |
| FR 10 | | Silviculture/Breed | MENS | C | Farm | GLNG | P.RAD | 54 |
| FR 11 | | Silviculture/Breed | MENS | C | Forest | DTLG | P.RAD | 48 |
| FR 54 | | Silviculture/Breed | MENS | C | Farm | MMRN | P.RAD | 44 |
| FR 84 | | Silviculture/Breed | MENS | C | Farm | KAWE | P.RAD | 36 |
| FR 85 | | Silviculture/Breed | MENS | C | Forest | KANG | P.RAD | 42 |
| AK 729 | | GM | MENS | C | Forest | TIRU | P.RAD | 18 |
| AK 918 | | GM | MENS | C | Forest | AUPO | P.RAD | 41 |
| AK 963 | | GM | MENS | C | Forest | PURE | P.RAD | 13 |
| AK 964 | | GM | MENS | C | Forest | WUKU | P.RAD | 24 |
| AK 966 | | GM | MENS | C | Forest | MARM | P.RAD | 22 |
| AK 979 | | GM | MENS | C | Forest | WIPO | P.RAD | 5 |
| AK 980 | | GM | MENS | C | Forest | OMHU | P.RAD | 5 |
| AK 981 | | GM | MENS | C | Forest | OTGA | P.RAD | 4 |
| AK 982 | | GM | MENS | C | Forest | WAIN | P.RAD | 5 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| AK 1030 | | GM | MENS | C | Forest | WHAP | P.RAD | 13 |
| CY 560 | | GM | MENS | C | Forest | EYWL | P.RAD | 25 |
| FR 14 | | GM | MENS | C | Forest | HIRA | P.RAD | 4 |
| FR 15 | | GM | MENS | C | Forest | RAI | P.RAD | 3 |
| FR 16 | | GM | MENS | C | Forest | WIRU | P.RAD | 3 |
| NN 514 | | GM | MENS | C | Forest | MOTU | P.RAD | 17 |
| RO 230 | | GM | MENS | C | Forest | WAKA | P.RAD | 1 |
| RO 912 | | GM | MENS | C | Forest | KANG | P.RAD | 1 |
| RO 1085 | | GM | MENS | C | Forest | KANG | P.RAD | 3 |
| RO 1850 | | GM | MENS | C | Forest | Mangatu | P.RAD | 97 |
| RO 2050 | | GM | MENS | C | Forest | ROEU | P.RAD | 11 |
| RO 2080 | | GM | MENS | C | Forest | HORO | P.RAD | 4 |
| RO 2089 | | GM | MENS | C | Forest | LTAU | P.RAD | 2 |
| RO 2109 | | GM | MENS | C | Forest | WAIM | P.RAD | 4 |
| SD 188 | | GM | MENS | C | Forest | OTCO | P.RAD | 11 |
| SD 619 | | GM | MENS | C | Forest | BLAC | P.RAD | 9 |
| SD 681 | | GM | MENS | C | Forest | BERK | P.RAD | 13 |
| WD 417 | | GM | MENS | C | Forest | HOCH | P.RAD | 25 |
| WN 295 | | GM | MENS | C | Forest | GWAV | P.RAD | 19 |
| WN 296 | | GM | MENS | C | Forest | MOHA | P.RAD | 18 |
| WN 297 | | GM | MENS | C | Forest | LISM | P.RAD | 17 |
| WN 354 | | GM | MENS | C | Forest | KWKA | P.RAD | 18 |
| WN 363 | | GM | MENS | C | Forest | WAIR | P.RAD | 27 |
| WN 369 | | GM | MENS | C | Forest | NGAU | P.RAD | 13 |
| WN 375 | | GM | MENS | C | Forest | HAKE | P.RAD | 13 |
| WN 376 | | GM | MENS | C | Forest | TGMO | P.RAD | 6 |
| RO 1858 | | GM | MENS | C | Forest | P.TA | P.RAD | 1 |
| AK 401 | | THIN | MENS | C | Forest | WHAP | P.RAD | 13 |
| CY 453 | | THIN &P | MENS | C | Forest | GERD | P.RAD | 12 |
| NN 100 | | THIN | MENS | C | Forest | GDNE | P.RAD | 4 |
| RO 902 | | FCS | MENS | C | Forest | KANG | P.RAD | 8 |
| RO 905 | | THIN | MENS | C | Forest | KANG | P.RAD | 31 |
| RO 994 | | INS | MENS | C | Forest | WAIM | P.RAD | 1 |
| RO 1008 | | INS | MENS | C | Forest | KANG | P.RAD | 1 |
| WN 364 | | PRUNE &FCS | MENS | C | Forest | ESK | P.RAD | 32 |
| RO 955 | | THIN &INS | MENS | C | Forest | TARAWERA | P.RAD | 83 |
| AK 35 | | INS | MENS | A | Forest | WOOD | P.RAD | 13 |
| AK 54 | | THIN | MENS | A | Forest | MARM | P.RAD | 3 |
| AK 149 | | THIN | MENS | A | Forest | WUKU | P.RAD | 4 |
| AK 977 | | Silv/fert | MENS | A | Forest | AUPO | P.RAD | 60 |
| RO 67 | | THIN | MENS | A | Forest | WAKA | P.RAD | 2 |
| RO 70 | | THIN | MENS | A | Forest | KANG | P.RAD | 4 |
| RO 71 | | THIN | MENS | A | Forest | ROEU | P.RAD | 1 |
| RO 74 | | FCS | MENS | A | Forest | WAKA | P.RAD | 3 |
| RO 213 | | THIN | MENS | A | Forest | KANG | P.RAD | 9 |
| RO 215 | | THIN SELEC | MENS | A | Forest | KANG | P.RAD | 3 |
| RO 231 | | THIN | MENS | A | Forest | KANG | P.RAD | 46 |
| RO 586 | | THIN | MENS | A | Forest | HORO | P.RAD | 20 |
| RO 905 | | THIN | MENS | A | Forest | KANG | P.RAD | 8 |
| SD 54 | | INS | MENS | A | Forest | BERK | P.RAD | 14 |
| AK 729 | | GM | MENS | A | Forest | TIRU | P.RAD | 7 |
| AK 918 | | GM | MENS | A | Forest | AUPO | P.RAD | 6 |
| AK 963 | | GM | MENS | A | Forest | PURE | P.RAD | 5 |
| AK 964 | | GM | MENS | A | Forest | WUKU | P.RAD | 7 |
| AK 966 | | GM | MENS | A | Forest | MARM | P.RAD | 8 |
| AK 979 | | GM | MENS | A | Forest | WIPO | P.RAD | 4 |
| AK 980 | | GM | MENS | A | Forest | OMHU | P.RAD | 1 |
| AK 982 | | GM | MENS | A | Forest | WAIN | P.RAD | 3 |
| AK 1030 | | GM | MENS | A | Forest | WHAP | P.RAD | 1 |
| CY 560 | | GM | MENS | A | Forest | EYWL | P.RAD | 16 |
| FR 15 | | GM | MENS | A | Forest | RAI | P.RAD | 2 |
| FR 16 | | GM | MENS | A | Forest | WIRU | P.RAD | 2 |
| NN 514 | | GM | MENS | A | Forest | MOTU | P.RAD | 17 |
| RO 912 | | GM | MENS | A | Forest | KANG | P.RAD | 1 |
| RO 1850 | | GM | MENS | A | Forest | WAKA | P.RAD | 27 |
| RO 1877 | | GM | MENS | A | Forest | KANG | P.RAD | 1 |
| RO 1895 | | GM | MENS | A | Forest | WAKA | P.RAD | 4 |
| RO 2050 | | GM | MENS | A | Forest | ROEU | P.RAD | 5 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RO 2109 | | GM | MENS | A | Forest | WAIM | P.RAD | 4 |
| SD 188 | | GM | MENS | A | Forest | OTCO | P.RAD | 8 |
| SD 616 | | GM | MENS | A | Forest | SILP | P.RAD | 4 |
| SD 619 | | GM | MENS | A | Forest | BLAC | P.RAD | 12 |
| SD 681 | | GM | MENS | A | Forest | BERK | P.RAD | 8 |
| WD 417 | | GM | MENS | A | Forest | NEMO | P.RAD | 3 |
| WN 295 | | GM | MENS | A | Forest | GWAV | P.RAD | 5 |
| WN 296 | | GM | MENS | A | Forest | MOHA | P.RAD | 5 |
| WN 297 | | GM | MENS | A | Forest | LISM | P.RAD | 10 |
| WN 354 | | GM | MENS | A | Forest | KWKA | P.RAD | 8 |
| WN 363 | | GM | MENS | A | Forest | KROI | P.RAD | 7 |
| WN 369 | | GM | MENS | A | Forest | NGAU | P.RAD | 7 |
| WN 375 | | GM | MENS | A | Forest | SANT | P.RAD | 4 |
| WN 376 | | GM | MENS | A | Forest | TGMO | P.RAD | 2 |
| RO 2005/1 | 268 | Cut/Seed | PEG | C | FARM | Valley Rd | P.RAD | 70 |
| RO 1887/4 | 850 | Cut/Seed | PEG | C | FARM | Rerewhakaitu | P.RAD | 64 |
| RO2064/1 | | Disease x thin | PATH | C | Forest | Kaingaroa | P.RAD | 13 |
| RO2064/2 | | Disease x thin | PATH | C | Forest | Kaingaroa | P.RAD | 13 |
| FR18 | | Disease x thin | PATH | C | Forest | Mangatu | P.RAD | 24 |
| 20037 | | Disease x thin&P | PATH | C | Forest | Kinleith | P.RAD | 19 |
| | | | | | | | | |
| | | | | | | | TOTAL | 3056 |