FIRST YEAR PERFORMANCE OF PLANTED POHUTUKAWA, EASTERN BAY OF PLENTY COAST

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INTRODUCTION

Early performance of planted pohutukawa (*Metrosideros excelsa*) along the eastern Bay of Plenty coast has been variable with poor survival in many of the planting programmes located on sandy or shingle bays within the Opotiki district. ***Forest Research*** and the Opotiki District Council in collaboration with local communities and iwi established trials on three sites testing a range of treatments to improve the performance of planted pohutukawa along the Eastern Bay of Plenty coast. This project is jointly funded by Project Crimson, Opotiki District Council and Environment BOP.

OBJECTIVES

The objectives of the research were:

- To briefly survey the performance of nursery-raised seedlings of pohutukawa planted on key sites throughout the Opotiki district over the last five years.
- To determine the major factors likely to be affecting the survival and growth of planted pohutukawa seedlings.
- To design and implement joint ***Forest Research***, Opotiki District Council and local community planting trials on three sites evaluating a range of planting treatments based on results of the survey.
- To maintain trials and monitor the performance of planted pohutukawa during the establishment phase.
- To produce practical guidelines for managing agencies and local community-based interest groups on establishment of pohutukawa on coastal sites.

METHODS

Survey of existing plantings

All major plantings of pohutukawa in the Opotiki district undertaken within the last five years were inspected. Records were used to determine the location, planting density, date of planting and subsequent maintenance. Most planted areas were categorised into one of three site types - sandy beaches, shingle beaches, or volcanic derived subsoil. The subsoil sites were either material taken from road cuttings or unmodified weathered ash. Overall survival and growth of planted pohutukawa, establishment history and major edaphic factors were compared between sites.

Trial sites

Three trials were established on representative areas of each of the main site types identified in the survey (Fig. 1). The sites were:

1. ***Ohiwa*** - subsoil site derived from volcanic material; slope covered in kikuyu grass (*Pennisetum clandestinum*); adjacent to a camping ground on south side of the Ohiwa Harbour.
2. ***Snells Beach*** - sand dune site; relatively sheltered backdune site dominated by kikuyu, pohuehue (*Muehlenbechia complexa*) and boxthorn (*Lycium ferocissinum*); within the Opotiki sewage scheme disposal site.
3. ***Torere*** - shingle beach site; exposed flat beach immediately landward of the foredune in rank exotic grass and patches of pohuehue; western end of Torere Beach.

All sites were either fenced off from grazing animals or were located in areas that were unlikely to be grazed. Planting was in mid spring: Snells Beach planted 17-21 September, Torere planted 21-22 September, and Ohiwa planted 1-2 October 1998.

Planting treatments

Treatments were selected on the basis of the results of the survey and early results of ***Forest Research*** trials with pohutukawa in other regions. Treatments were:

- ***Fertiliser*** - a slow-release NPK fertiliser was applied to selected plants at time of planting at all sites. This involved placing a Growtab pellet beside the root ball approximately half way down the planting pit. There were unfertilised plants as controls.
- ***Added material*** - three types of material (subsoil, compost, mulch) was added as separate treatments to selected seedlings at time of planting at the sandy and shingle sites. This involved removal of the sand or shingle from an enlarged planting pit and placing at least two shovel-fulls of subsoil or compost into the pit to surround the root ball. The mulch treatment involved placing hay around the base of planted seedlings after planting.
- ***Irrigation*** - at the sandy and shingle sites, selected seedlings were watered once weekly during a 2 month dry period which occurred approximately 3 months after planting.

Treatment combinations for each site are given in Appendix 1 for Ohiwa, Appendix 2 for Snells Beach and Appendix 3 for Torere.

Trial design and layout

The trials ware a Randomised Complete Block design with four replicates of 10 plots each at both the sand dune and shingle sites. There were 5 replicates of 2 plots each at the subsoil site. Each replicate was located on a relatively uniform with 6 tree plots assigned a single treatment combination. All plots were identified by numbered wooden pegs to enable assessment of all seedlings on an individual basis.

MONITORING AND DATA ANALYSIS

Plant height, cover (width x breadth of the live crown of each plant) and vigour (subjective assessment of plant health and vigour with scores ranging from 1 = poor to 5 = good) were measured for all seedlings soon after planting (October 1999). Sites were inspected regularly during the first year.

Performance was assessed 9 months after planting (June 1999) including survival, plant height, plant spread or cover, and any comments affecting plant condition (e.g. browsing,

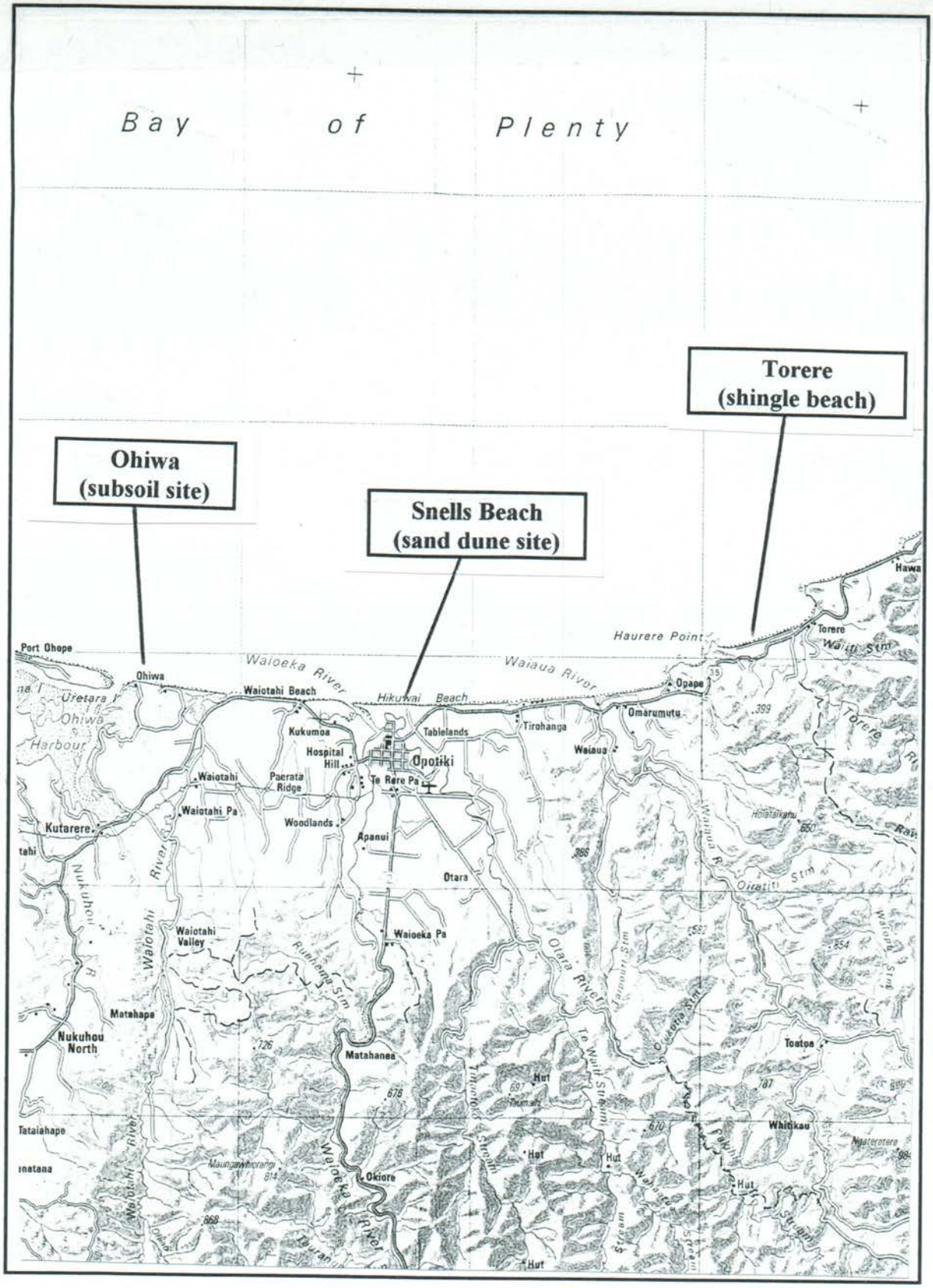

Figure 1 - Location of the three pohutukawa planting trials, Eastern Bay of Plenty.

disturbance by beach users). At the second assessment, the state of seedlings that had died were classified into one of four categories: 0 = no seedling remains found (died soon after planting); 2 = main stem found with no leaves and branches; 3 = stem found with few leaves (recently died). For the analysis of plant spread, the square root of width x breadth was calculated.

INTERIM RESULTS

Overall performance

Of all the performance parameters used to assess growth, survival and plant spread increment were the only parameters that gave significant results with some of the site and planting treatment comparisons.

Survival of planted pohutukawa within the first year of planting (Fig. 1) was the best on the subsoil site at Ohiwa (over 80%) and significantly less at the Snells Beach sand dune site (under 40%) and at the shingle beach site at Torere (20%).

With plant spread increment, there was a similar trend in performance between the sites. Pohutukawa planted on the subsoil at Ohiwa had clearly increased in plant spread since planting whereas growth at both the sand dune and shingle sites was poor or did not occur (Fig. 2).

Performance at Snells Beach and Torere

The relatively poor survivals at both Snells Beach and Torere are no doubt contributing to the lack of significant differences between most planting treatments within each site for survival (Fig. 3 & Fig. 5) and for plant spread increment (Fig. 4 & Fig 6). One exception is the improved survival of irrigated plants at the Torere site (Fig. 5).

There was also a significant difference in growth between fertilised and non-fertilised plants at Torere where fertiliser appears to have depressed growth (Fig. 6). A similar trend of decreased growth of fertilised plants at the Snells Beach site may be apparent but is not statistically significant (Fig. 4).

At both Snells Beach and Torere, there may be a trend for better growth with planted pohutukawa on both sites where some material has been added to the planting pit, particularly compost or subsoil (Fig. 4 & Fig 6).

Other performance parameters

There was no significant differences between any of the other performance parameters used to assess planted pohutukawa in these trials. Most of the surviving seedlings had died back at the sand dune and shingle beach sites with recovery of some seedlings. There was some dieback of seedling tops on the subsoil site at Ohiwa but new growth had taken place and most seedlings. There were no trends in the assessment of vigour or in the classification of early versus late death of plants. There appeared to be no significant browsing of plants and no damage from any frosts at the 9 month assessment or when trials were inspected at regular intervals after planting.

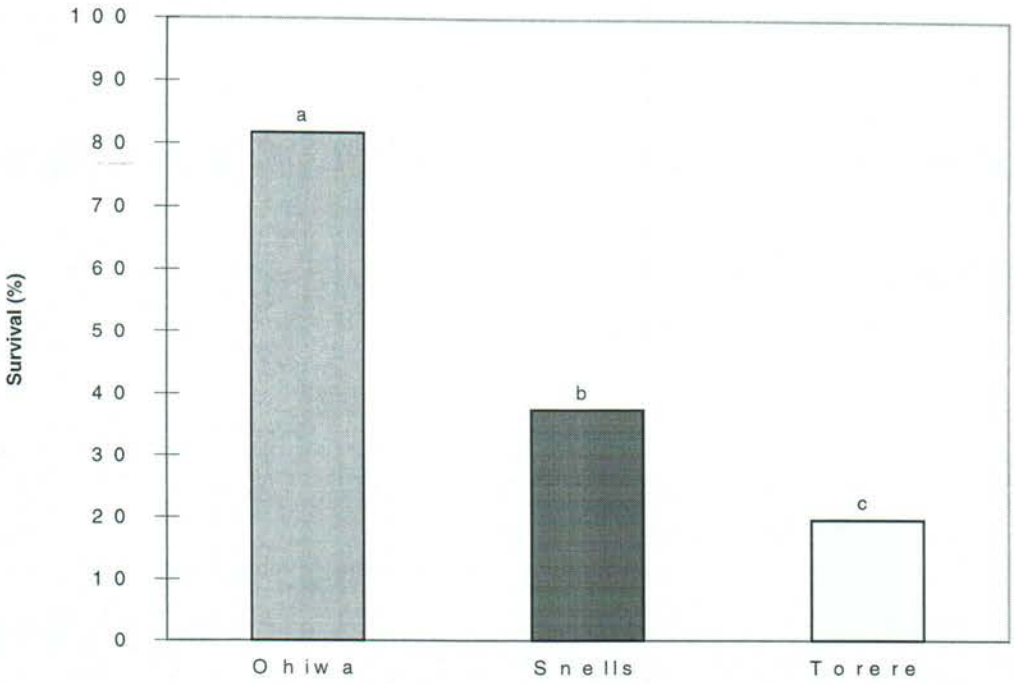

Figure 1: Survival of pohutukawa 9 months after planting averaged for all planting treatments within each of the three trial sites, Ohiwa (subsoil), Snells Beach (sand dune) and Torere (shingle beach). Sites with the same letter are not significantly different (p=0.05).

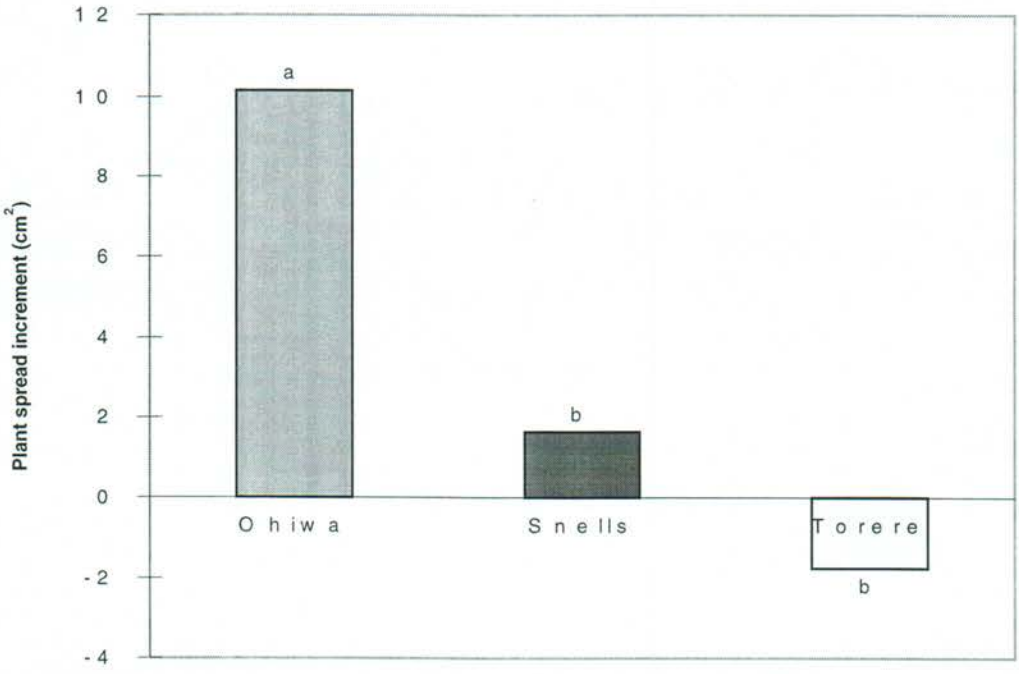

Figure 2: Plant spread increment of pohutukawa 9 months after planting averaged for all planting treatments within each of the three trial sites, Ohiwa (subsoil), Snells Beach (sand dune) and Torere (shingle beach). Sites with the same letter are not significantly different (p=0.05).

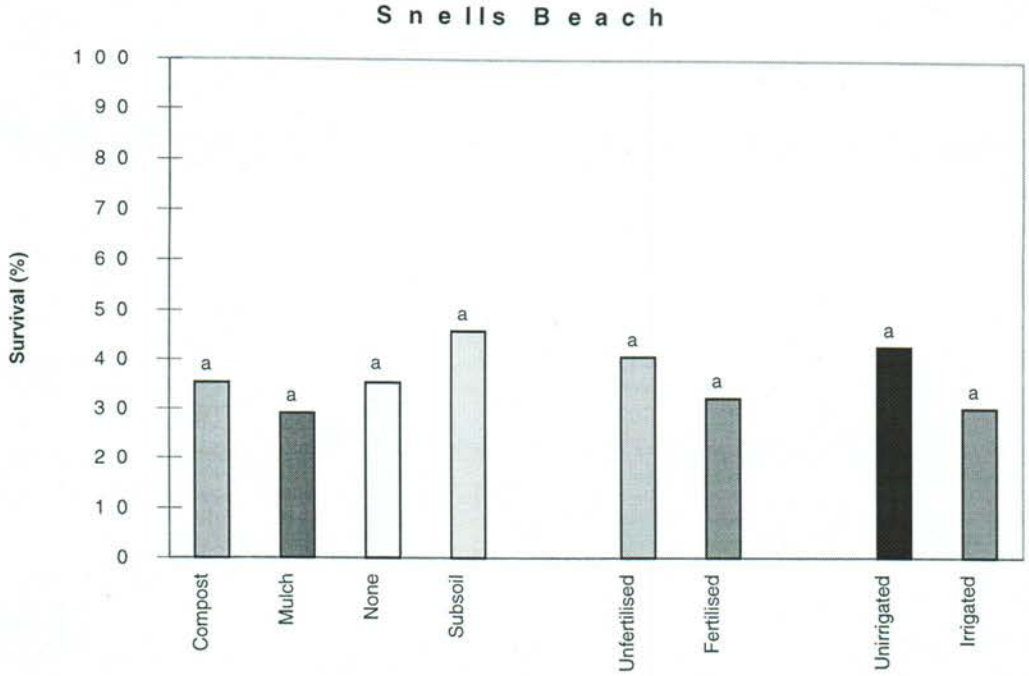

Figure 3: Survival of pohutukawa 9 months after planting for the added material (compost, mulch, none, subsoil), fertiliser and irrigation treatment groups, Snells Beach (sand dune site). Within groups, treatments with the same letter are not significantly different (p=0.05).

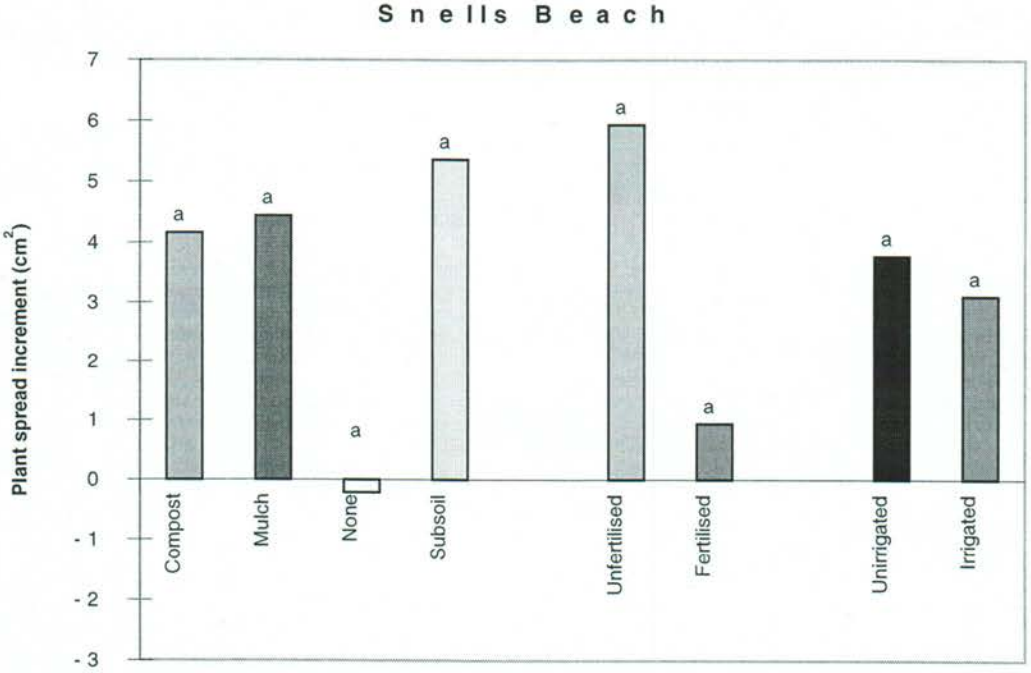

Figure 4: Plant spread increment of pohutukawa 9 months after planting for the added material (compost, mulch, none, subsoil), fertiliser and irrigation treatment groups, Snells Beach (sand dune site). Within groups, treatments with the same letter are not significantly different (p=0.05).

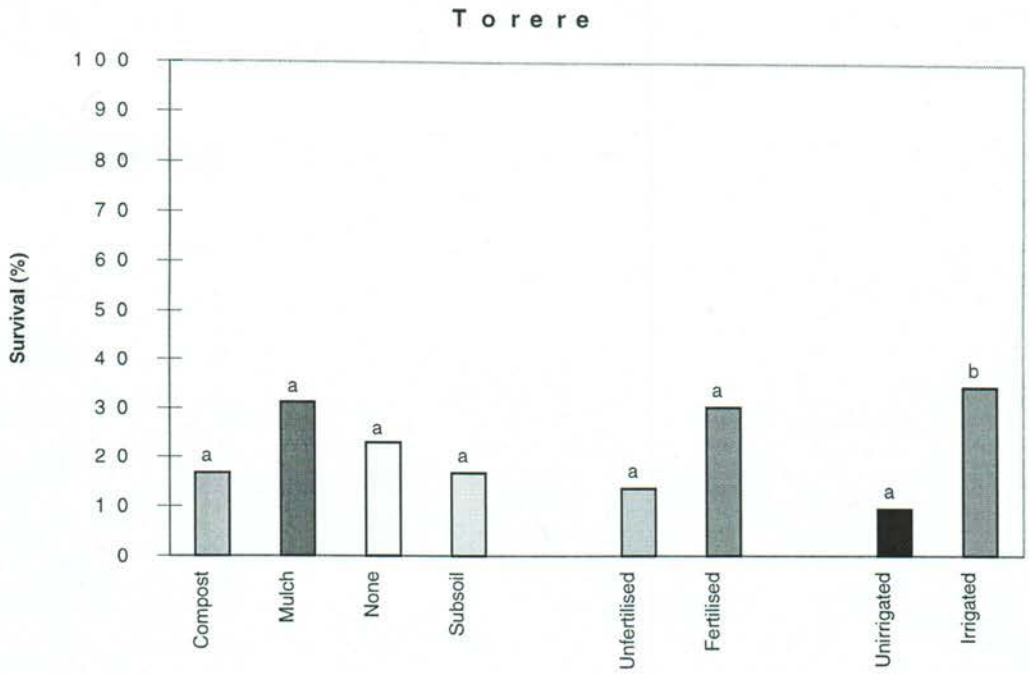

Figure 5: Survival of pohutukawa 9 months after planting for the added material (compost, mulch, none, subsoil), fertiliser and irrigation treatment groups, Torere (shingle beach site). Within groups, treatments with the same letter are not significantly different (p=0.05).

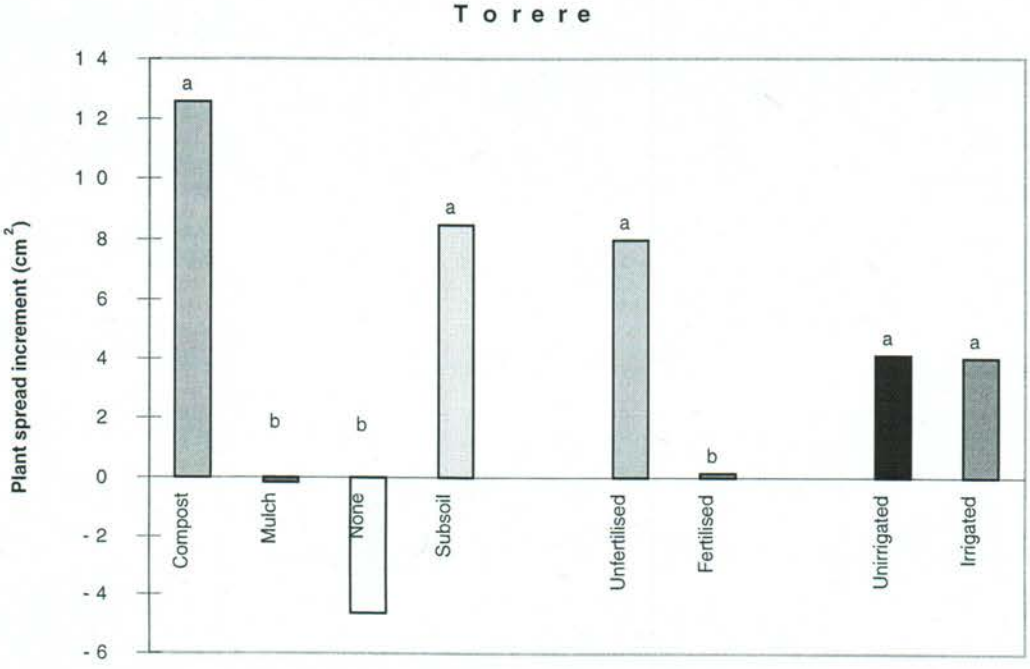

Figure 6: Figure 4: Plant spread increment of pohutukawa 9 months after planting for the added material (compost, mulch, none, subsoil), fertiliser and irrigation treatment groups, Torere (shingle beach site). Within groups, treatments with the same letter are not significantly different (p=0.05).

Competition

There was no major regrowth of weeds in the vicinity of planted pohutukawa on the shingle site at Torere. Pohuehue had become more dominant at the Snells Beach site and were clearly affecting growth of pohutukawa with many plants smothered by intertwining branches of this native ground cover. Vigorous kikuyu grass had to be cleared from around planted pohutukawa at the Ohiwa site but this was only done immediately prior to measurement 9 months after planting.

INTERIM CONCLUSIONS

These trials confirm that there is high mortality and poor growth of planted pohutukawa on both sand dune and shingle sites which had been identified in early planting programmes on similar sites in the Opotiki district (Plate 1). Although there may be a trend for improved growth of seedlings in these trials where compost or subsoil has been incorporated into the planting pit, the overall mortality is still very high on sandy and shingle beaches. Lack of shelter at the Torere site and competition from surrounding vegetation at the Snells Beach site may be factors affecting survival and growth of planted pohutukawa. An earlier planting time may have also improved results.

The initial survey of existing plantings of pohutukawa indicated that substrate type may be a major factor in performance. The current trials have shown that substrate type is important but that there are a range of other factors such as shelter, competition, and planting treatments that contribute to performance and these will vary from one site to the next. The Bay of Plenty trials have attempted to test a range of practical techniques for large-scale planting of pohutukawa on the coast. Techniques such as constructing elaborate shelter frames or using large quantities of compost could be evaluated but would not be practical for planting large numbers of plants.

The relatively low numbers of seedlings at both the sandy and shingle sites is likely to be affecting results in these Bay of Plenty trials. The apparent negative effect of fertiliser is in contrast to ***Forest Research*** trials on the Coromandel Peninsula that have clearly shown application of slow-release fertiliser at planting significantly boosts early performance of pohutukawa (Bergin & Herbert 1997). A difference in the type of fertiliser used could be contributing to this difference. In the Coromandel trials, 30 g of granulated Magamp was incorporated into the planting hole as each seedling was planted whereas a single slow-release pellet was placed on the side of the root ball at planting for each seedling in the Eastern Bay of Plenty trials.

Of interest is the establishment and development of numerous pohutukawa on rotting driftwood on sandy and shingle beaches along parts of the Eastern Bay of Plenty such as at Hawai (Plate 2) and also observed by Chris Stone at Maraenui. Pohutukawa are growing well on these sites where cattle or horses do not have access. Roots of these plants are clearly penetrating the rooting wood.

Plate 1: There has been high mortality of good quality nursery-raised pohutukawa seedlings across all treatments in planting trials including where compost or subsoil was incorporated into the planting hole on this shingle beach at Torere, eastern Bay of Plenty.

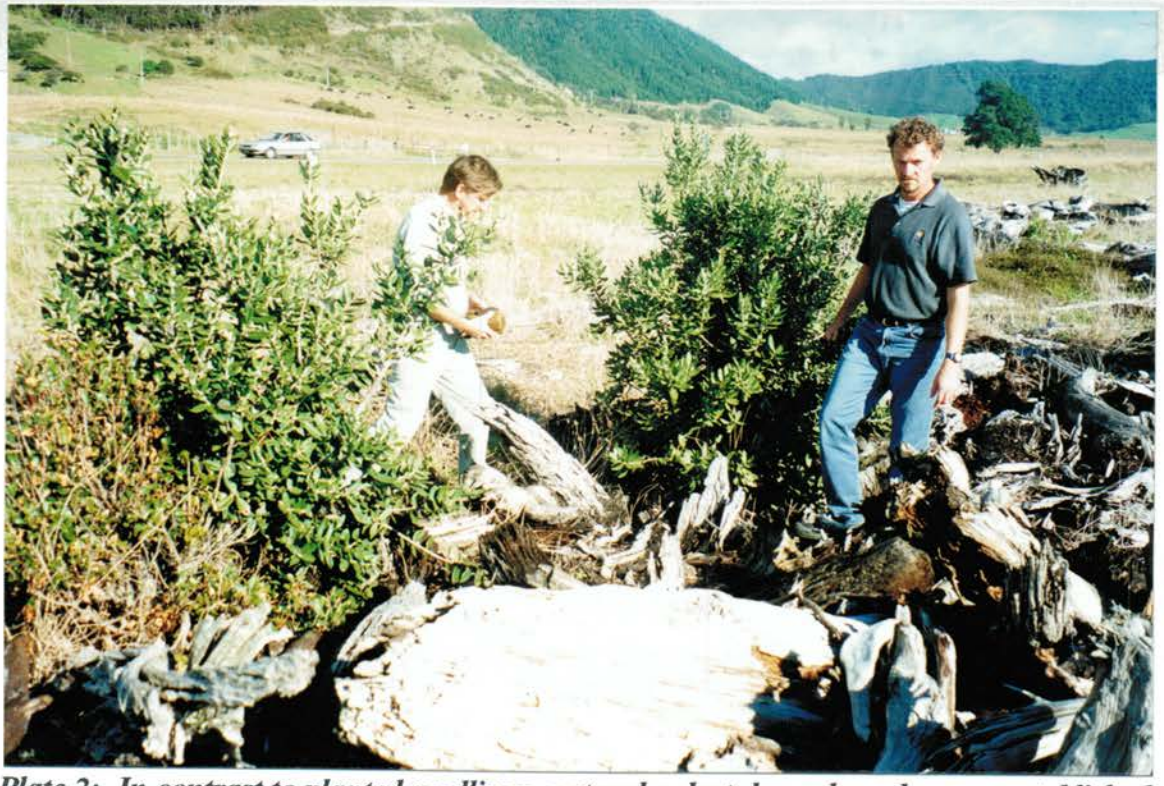

Plate 2: In contrast to planted seedlings, natural pohutukawa have become established on shingle beaches amongst rotting driftwood on several beaches along the eastern Bay of Plenty coast including here at Hawai, immediately east of Torere.

FUTURE DIRECTION

Further consultation is required to determine the future direction of this research project. Possible avenues for further investigation that could be discussed are:

- Providing a shelter of companion plants is suggested in guidelines for planting pohutukawa by Bret McKay in Bercusson & Torrance (1998). ***Forest Research*** trials on the Coromandel show that several species including flax (*Phormium tenax*), tauhinu (*Ozothamnus leptophyllus*), ngaio (*Myoporum laetum*) and karo (*Pittosporum crassifolium*) establish well on exposed coastal sand dune sites (Bergin & Herbert 1997). Note the relatively good growth of pohutukawa planted in the lee of a flax dominated mound at Hawai Beach. However, the mound which is probably subsoil could be contributing to better performance.
- Conduct a survey existing large pohutukawa in bays along east coast beyond Opotiki (e.g. Whanarua Bay) and determine site characteristics that may be influencing establishment and survival.
- Undertake detailed water holding capacities studies of the different substrate types to determine factors that may be influencing survival.
- Test the use of longer planter bags to enable deeper planting of pohutukawa seedlings ot ensure root systems are within moister horizons (pers comm. Greg Jenks).
- Use buckets with no bases to shelter newly planted seedlings as per establishment guidelines by Bret McKay (Bercusson & Torrance 1998).
- Use large quantities of compost or topsoil per planting hole as has been recommended by Andy Spence (Auckland Regional Council) who has reported good success with this method on east coast beaches north of Auckland.
- Investigate distinct morphological traits within the local populations of pohutukawa (e.g. aerial roots, red stem/glossy leaves) that may indicate greater tolerance of difficult sandy and shingle sites during the establishment phase.
- Investigate successful natural regeneration of pohutukawa in rotting driftwood on sandy and shingle beaches in the Opotiki district; trial any practical methods using driftwood for establishing nursery-raised pohutukawa seedlings on such sites.
- Evaluate a range of fertiliser treatments for planted pohutukawa including rates of application; types of slow-release fertilisers (e.g. pellets vs granulated); and methods of application.

REFERENCES

Bercusson, L.; Torrance, J. 1998: *Pohutukawa. Tree of Aotearoa.* Tandem Press. 87p.

Bergin, D. O.; Herbert, J. W. 1997: Revegetation of sand dunes in New Zealand using indigenous species. Proceeding of *Pacific Coasts and Ports '97 Conference*, 7-11 September 1997, Christchurch. Vol. 1: 425-30.

APPENDIX 1 - Treatment combinations for pohutukawa planting trial established in October 1998, Ohiwa Harbour, Eastern Bay of Plenty.

Block	Plot	Material	Fertiliser	Irrigation
1	1	None	Yes	No
1	2	None	No	No
2	3	None	Yes	No
2	4	None	No	No
3	5	None	Yes	No
3	6	None	No	No
4	7	None	Yes	No
4	8	None	No	No
5	9	None	Yes	No
5	10	None	No	No

APPENDIX 2 - Treatment combinations for pohutukawa planting trial established in October 1998, Snells Beach, Opotiki.

Block	Plot	Material	Fertiliser	Irrigation
1	1	None	Yes	No
1	2	Mulch	Yes	No
1	3	None	No	No
1	4	Subsoil	Yes	No
1	5	None	No	Yes
1	6	Compost	Yes	No
1	7	Mulch	Yes	No
1	8	None	Yes	Yes
1	9	Subsoil	Yes	No
1	10	Compost	Yes	No
2	11	None	No	No
2	12	None	No	Yes
2	13	Mulch	Yes	No
2	14	Subsoil	Yes	No
2	15	None	Yes	Yes
2	16	None	Yes	No
2	17	Compost	Yes	No
2	18	Mulch	Yes	No
2	19	Subsoil	Yes	No
2	20	Compost	Yes	No
3	21	Mulch	Yes	No
3	22	Compost	Yes	No
3	23	None	Yes	Yes
3	24	Subsoil	Yes	No
3	25	Compost	Yes	No
3	26	Subsoil	Yes	No
3	27	None	Yes	No
3	28	None	No	No
3	29	Mulch	Yes	No
3	30	None	No	Yes
4	31	None	No	Yes
4	32	Subsoil	Yes	No
4	33	Compost	Yes	No
4	34	None	No	No
4	35	Compost	Yes	No
4	36	None	Yes	Yes
4	37	Subsoil	Yes	No
4	38	Mulch	Yes	No
4	39	Mulch	Yes	No
4	40	None	Yes	No

APPENDIX 3 - Treatment combinations for pohutukawa planting trial established in October 1998, Torere Beach, Eastern Bay of Plenty.

Block	Plot	Material	Fertiliser	Irrigation
1	1	None	Yes	No
1	2	Mulch	Yes	No
1	3	None	No	No
1	4	Subsoil	Yes	No
1	5	None	No	Yes
1	6	Compost	Yes	No
1	7	Mulch	Yes	No
1	8	None	Yes	Yes
1	9	Subsoil	Yes	No
1	10	Compost	Yes	No
2	11	None	No	No
2	12	None	No	Yes
2	13	Mulch	Yes	No
2	14	Subsoil	Yes	No
2	15	None	Yes	Yes
2	16	None	Yes	No
2	17	Compost	Yes	No
2	18	Mulch	Yes	No
2	19	Subsoil	Yes	No
2	20	Compost	Yes	No
3	21	Mulch	Yes	No
3	22	Compost	Yes	No
3	23	None	Yes	Yes
3	24	Subsoil	Yes	No
3	25	Compost	Yes	No
3	26	Subsoil	Yes	No
3	27	None	Yes	No
3	28	None	No	No
3	29	Mulch	Yes	No
3	30	None	No	Yes
4	31	None	No	Yes
4	32	Subsoil	Yes	No
4	33	Compost	Yes	No
4	34	None	No	No
4	35	Compost	Yes	No
4	36	None	Yes	Yes
4	37	Subsoil	Yes	No
4	38	Mulch	Yes	No
4	39	Mulch	Yes	No
4	40	None	Yes	No