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WORK PLAN NO.: [ ] **EXPERIMENT NO.:**

TITLE: SPINIFEX ESTABLISHMENT TRIAL, WHIRITOA - PERFORMANCE OF FIRST SEASONS GROWTH

AUTHOR(S): D. O. BERGIN & J. W. HERBERT

DATE: MARCH 1994

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KEYWORDS: *SPINIFEX SERICEUS*, SAND DUNES, SEEDLINGS, CUTTINGS, SEED,

ABSTRACT*

A small spinifex (*Spinifex sericeus*) trial was established on a Coromandel beach, to investigate whether revegetation techniques, largely developed in Australia using the same species, can be used to rehabilitate New Zealand dunelands. Of the range of establishment methods trialed, the planting of nursery-raised seedlings with the addition of a slow release fertiliser, was superior to transplanting of cutting onto dunes or direct seeding of dunes. However, seedlings are costly and difficult to raise in large numbers. Better performance is expected from cuttings transplanted in autumn and from direct seeding where better quality seed is used. Nitram, a fast release fertiliser, incorporated into the sand at planting, killed all seedlings and cuttings and prevented germination of seed.

SPINIFEX ESTABLISHMENT TRIAL, WHIRITOA
PERFORMANCE OF FIRST SEASONS GROWTH

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March 1994

ABSTRACT

A small spinifex (*Spinifex sericeus*) trial was established on a Coromandel beach, to investigate whether revegetation techniques, largely developed in Australia using the same species, can be used to rehabilitate New Zealand dunelands. Of the range of establishment methods trialed, the planting of nursery-raised seedlings with the addition of a slow release fertiliser, was superior to transplanting of cuttings onto dunes or direct seeding of dunes. However, seedlings are costly and difficult to raise in large numbers. Better performance is expected from cuttings transplanted in autumn and from seed where better quality seed is used. Nitram, a fast release fertiliser, incorporated into the sand at planting, killed all seedlings and cuttings and prevented germination of seed.

INTRODUCTION

Spinifex is one of the major indigenous sand binding species considered essential for stabilising coastal sand dunes throughout New Zealand. Active management is underway in many parts of the country to rehabilitate dunelands that have been modified by a range of factors including grazing, disturbance from high recreational use, sand mining and other commercial development. Previous attempts at propagating and establishing spinifex in New Zealand have been limited to a small range of treatments and sites with generally limited success.

An NZ FRI scientist visited research stations and duneland revegetation projects in New South Wales and Queensland where spinifex, which is also native to Australia, and a range of other species have been widely used for rehabilitation programmes. A report details propagation and establishment methods used in Australia and the implications for spinifex research in New Zealand (Bergin 1993).

A small spinifex trial was established at Whiritoa Beach, Coromandel, as a first step in determining whether successful methods used in Australia can be used on New Zealand beaches. The more promising treatments will be tested on a larger scale at the same location where reshaping of the foredune along part of the beach is planned by Environment Waikato and the Whiritoa Dune Care group in mid-1994.

PREVIOUS WORK

A considerable amount of work has been done on propagation and establishment of spinifex in Australia and has been reviewed by Bergin & Shaw (1991). Most of this work, both experimental and large scale management rehabilitation, has been carried out along the coasts of Queensland and New South Wales. The preferred method for establishing spinifex onto fresh dune surfaces is by direct seeding (Bergin 1993). Spikes, or seedheads are collected in large quantities in summer. Depending on the sowing method, spikes are either separated into spikelets and sown by tractor driven seed sowers (Queensland method), or kept whole and sown in holes dug by spade (NSW method). Mulching sown areas with brush matting or sowing an annual cereal crop on exposed sites assists establishment of spinifex. Topdressing sand dunes is also widely practiced with significant increases in growth of young plants.

A further method used in Australia for establishing spinifex onto bare dunes is transplanting of cuttings. There are two methods: stolon (runner) tips are taken from existing plants and placed in deep trenches, or divisions (sprigs) are taken from mature plants on the backdune and planted into deep holes.

Although more expensive to produce and applied on a smaller scale compared to direct sowing of seed and transplanting of cuttings, seedlings raised in the nursery from either seed or cuttings have resulted in successful establishment of spinifex on some Australian sites.

OBJECTIVES

The main objective of this trial was to test techniques, largely developed in Australia, for establishing spinifex on bare sand dune surfaces. Specific aims include:

- To evaluate two seed sowing methods - seed and spikes.

- To compare performance of 2 vegetative propagation methods - stolon tips and divisions.

- To evaluate performance of nursery-raised seedlings.

- To determine effectiveness of fertilisers applied at establishment.

METHOD

The trial was located on the south side of the Surf Club at Whiritoa Beach, Coromandel, between Tuna Place and Moray Place (Fig. 1). The trial comprised a total of 44 plots (i.e., 4 blocks of 11 plots each) placed along the foredune. Plots were located in bare sand above high water level with one of several establishment treatments assigned to each plot using a randomised complete block design. Plots consisted of a 3 m diameter circle in which treatments were applied. All plots were marked by a centrally located and numbered treated wooden 50 mm x 25 mm peg with 60 cm of peg left above ground. The trial was established on 8 September 1993.

The treatments were:

1. Sowing of seed - 2 methods
   - Separated seed - spikes (seedheads) separated into separate spikelets (seed) including seedhead debris sown in trenches to simulate the Queensland sowing technique. Two 1 m long trenches 100 - 150 mm deep were dug either side of the plot peg, a large quantity of seed material placed in each trench, and then seed covered with sand. A pre-sowing seed cutting test of a sample of seed indicated very low seed viability. A seed cutting test of a sample of spikes also indicated a very low seed viability.
   - Spikes - a handful of spikes (4 - 6 spikes) was placed into 150 mm deep holes dug by spade within appropriate plots and covered with sand to simulate the NSW sowing method. 20 holes approximately 50 cm apart were dug and spikes sown within each 3 m diameter plot.

2. Transplanting of cuttings - 2 methods
   - Stolons - stolon (runner) tips up to 1.2 m long were cut off nearby plants along the foredune and placed into 100 - 150 mm deep trenches with 75 mm of tip left exposed. Five stolons were placed in parallel trenches dug within

each plot. It was difficult obtaining a sufficient number of stolons from the beach at this time of the year (early September) with many stolons covered by sand during winter. Stolons were generally inflexible and brittle with no new growth.

- Divisions - divisions (sprigs) were obtained from plants on back dunes by spade and transplanted into 150 mm deep holes dug by spade within plots. Divisions were characterised by a short underground stem with several nodes at close spacing attached to a tuft of leaves. 20 divisions were placed within the 3 m diameter plots where appropriate. Finding divisions with 3 - 5 nodes (potential root growing points) was difficult with some wastage of material.

3. Nursery-raised seedlings - twenty 18 month old seedlings were planted in each appropriate plot. The 30 - 40 cm high seedlings (ex NZ FRI Nursery, Rotorua) were in polythene bags (PB 3/4) in a 1:1 peat:pumice potting mix. Roots systems adequately bound potting mix for ease of planting.

4. Fertilisers - all above treatments were tested with and without the application of a fast release, high N fertiliser Nitram (ammonium nitrate - 34% N) used widely in Queensland. A slow release NPK fertiliser, Magamp (medium granule) was tested with nursery-raised seedlings only. For spike sowing, division, and seedling treatments, approximately 40 g of fertiliser per hole was incorporated into the sand at planting. For seed and stolon treatments, 40 g of fertiliser was applied evenly along the trench as it was infilled with sand.

Treatment combinations for each plot are given in the Appendix with plot layout in Figure 1.

Performance of treatments were assessed for seed germination, and seedling survival, growth and health on 22 October 1993 (6 weeks after establishment) and 18 February 1994 (5 months after establishment).

RESULTS AND DISCUSSION

The survival of spinifex stolon, division and seedling establishment treatments is summarised in Table 1. The most effective treatment is planted nursery-raised seedlings. Application of Magamp at planting also enhanced survival 5 months after planting. The beneficial effect of applying Magamp was clearly evident in field

observations; fertilised seedlings were significantly larger with greater plant bulk and greener leaf colour compared to unfertilised plants. A similar response to application of Magamp at planting was also observed with pingao (*Desmoschoenus spiralis*) 8 months after planting on an East Coast beach (Herbert & Bergin 1991). However, unlike pingao, there remain some difficulties in propagation of large numbers of spinifex in the nursery. In addition to generally low viability of seed, newly germinated seedlings are difficult to prick into containers because of fragile root systems (pers. comm. Colin Faulds, NZ FRI Nursery). Consequently, there are large losses of seedlings during propagation.

Table 1: ***Percentage survival of spinifex stolon, division and seedling establishment treatments with and without fertiliser, Whiritoa Beach, Coromandel, 6 weeks after trial establishment. Percentage survival 5 months after establishment is given in parentheses.***

	Sample size	No fertiliser	Magamp	Nitram
Stolons	20	70 (40)	Not tested	5 (0)
Divisions	80	36 (31)	Not tested	0 (0)
Seedlings	80	94 (85)	94 (90)	0 (0)

Of the cutting treatments, stolons (40% survival) fared better than divisions (31%) 5 months after transplanting (Table 1). Surviving cuttings were not vigorous with little evidence of new growth. Dune conservationists in Queensland indicated that survival was usually around 50% with transplanting of cuttings (Bergin 1993). The lower survival in the Whiritoa trial is possibly related to the difficulty of finding suitable transplant material in early spring from nearby spinifex colonies. There is greater scope for collecting suitable vegetative material in autumn where stolons are young, green and actively growing compared to collecting stolons in spring. By early spring, stolons have hardened off during winter months with many becoming submerged in sand. Autumn transplanting for cuttings is also the preferred season in Queensland.

The application of Nitram has had a detrimental effect on all establishment treatments with 100% mortality of all planted seedlings and transplanted cuttings 5 months after the trial was established (Table 1). The devastating effect of Nitram on plant survival became apparent immediately after planting, killing all seedlings and divisions within 6 weeks. Clearly, this fast release fertiliser is not suited to incorporating in the sand when planting seedlings or transplanting cuttings. There is also indirect evidence that other fast release nitrogenous fertilisers incorporated into the planting hole may have a similar effect on survival of both pingao and spinifex. Nitram however, is widely used in Queensland for topdressing existing spinifex colonies where high rates consistently boost vigour and growth (Bergin 1993).

Six weeks after sowing, there was no germination of spinifex seed or spikes. However, newly germinated seedlings were first observed during a brief inspection within 4 months of sowing. Five months after sowing, and only in plots that were not fertilised with Nitram, seedlings had germinated in 3 out of the 4 plots sown with spikes and 2 out of the 4 plots sown with seed. Most seedlings ranged in height from 30 to 100 mm with the tallest seedling 200 mm high. Similar sowing techniques used in Australia has resulted in good germination with seedlings up to 250 mm high within 8 months of sowing. There was no germination in plots that had been fertilised with Nitram indicating fast release fertilisers should not be incorporated with seed at sowing.

In respect of the seed sowing treatments, it should be noted that the trial material was of inferior quality with very few developed seeds and low viability. Poor storage conditions for the seed probably contributed to low viability and successful methods of seed storage developed in Australia will be used for future seed collections here.

IMPLICATIONS FOR FURTHER WORK

Although some results are significant, this trial has only evaluated a limited range of treatments for establishing spinifex on new dune surfaces. Some implications for future trials and sand dune revegetation programmes are:

- Nursery-raised seedlings give the best results particularly where Magamp fertiliser is applied at planting.

- Further options for raising large numbers of spinifex seedlings in the nursery needs to be explored, such as direct seeding into containers.

- Transplanting of cuttings is likely to be more successful in early autumn. Transplanting in different seasons requires further investigation.

- Seeding of spinifex onto dunes is likely to be successful but requires further monitoring on a larger scale where good quality seed is sown.

- Sowing of spikes is a more practical option for small-scale revegetation programmes such as those envisaged in New Zealand compared to Australian beaches.

- Nitram or any other fast release fertiliser should not be incorporated into the planting hole when planting seedling or cuttings. In preference use Magamp for incorporating into the planting hole although more comprehensive fertiliser trials are urgently required.

ACKNOWLEDGMENTS

Jim Dahm and Harley Spence (Environment Waikato) assisted with site selection, integrated the trial with projects carried out by the Whiritoa Dune Care group, provided fertiliser, and along with local residents, helped install the trial. Seedlings were raised by Colin Faulds (NZ FRI Nursery). The trial was designed by Mark Kimberley (NZ FRI).

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APPENDIX — Spinifex establishment trial, Whiritoa Beach, Coromandel.

Plot No.	Block No.	Propagation Treatment*	Fertiliser Treatment**
1	1	Divisions	Nitram
2	1	Stolons	Nitram
3	1	Seed	Nil
4	1	Spikes	Nitram
5	1	Seedlings	Magamp
6	1	Seed	Nitram
7	1	Divisions	Nil
8	1	Seedlings	Nil
9	1	Stolons	Nil
10	1	Spikes	Nil
11	1	Seedlings	Nitram
12	2	Seed	Nitram
13	2	Divisions	Nil
14	2	Stolons	Nitram
15	2	Seed	Nil
16	2	Spikes	Nil
17	2	Seedlings	Nitram
18	2	Seedlings	Nil
19	2	Stolons	Nil
20	2	Seedlings	Magamp
21	2	Divisions	Nitram
22	2	Spikes	Nitram
23	3	Divisions	Nitram
24	3	Seedlings	Nitram
25	3	Divisions	Nil
26	3	Seed	Nil
27	3	Spikes	Nitram
28	3	Seed	Nitram
29	3	Seedlings	Nil
30	3	Stolons	Nil
31	3	Spikes	Nil
32	3	Seedlings	Magamp
33	3	Stolons	Nitram
34	4	Seedlings	Nil
35	4	Stolons	Nitram
36	4	Seedlings	Nitram
37	4	Divisions	Nil
38	4	Spikes	Nitram
39	4	Stolons	Nil
40	4	Seed	Nitram
41	4	Seed	Nil
42	4	Seedlings	Magamp
43	4	Divisions	Nitram
44	4	Spikes	Nil

* Propagation treatment : divisions (or sprigs) — divisions of spinifex from established plants on backdune; stolons (or runners) — transplanting of 1 m long stolen tips from established plants; seed — separated seed sown in trenches; spikes — whole seedheads sown in holes.

** Fertiliser treatment : fertiliser was incorporated into the sand with planting and sowing treatments. Approximately 30 g of Nitram (fast release fertiliser) and Magamp (slow release) was applied to appropriate seedling/division treatments.

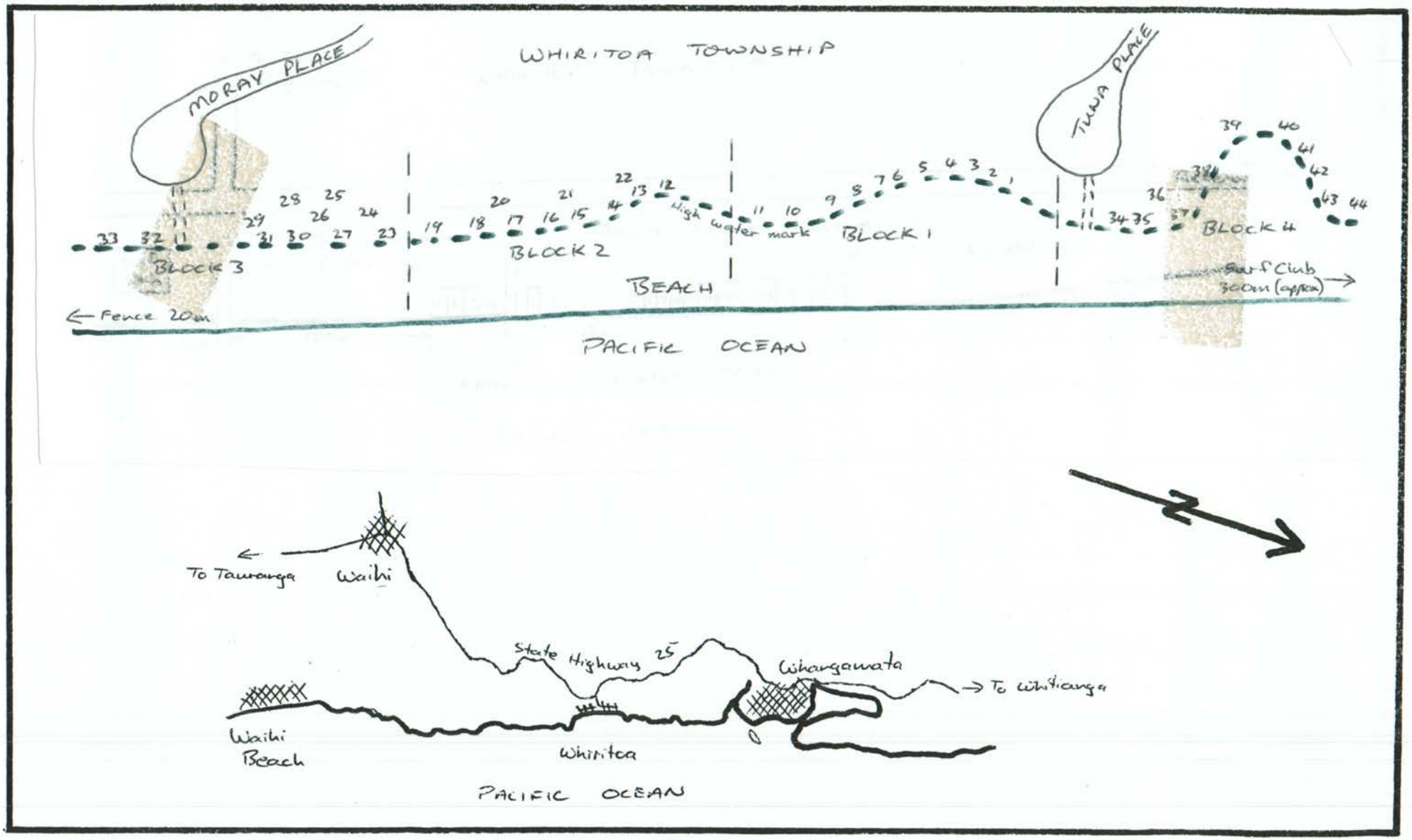

Figure 1: Location of the spinifex establishment trial, Whiritoa Beach, Coromandel.