PAMPAS — A NEW FOREST WEED PROBLEM

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SUMMARY

Introduced pampas grasses (*Cortaderia selloana* and *C. jubata*) have been recognised as the cause of an important weed problem in northern exotic forests in New Zealand. Both species are cultivated throughout the country, but at present *C. selloana* is predominant as a weed, having spread from plantings for cattle fodder and erosion control. Native *Cortaderia* species (toetoe) are not a serious problem. Pampas suppresses young trees, increases silvicultural costs and creates a fire hazard. Although scrubcutters and herbicides are used, most emphasis is currently placed on grazing and oversowing regimes for control. Further evaluations of these and other control measures are in progress.

INTRODUCTION

Pampas grass belongs to the genus *Cortaderia* which is represented in New Zealand by four native and two introduced species. The name 'pampas' will be used for the introduced *C. selloana* and *C. jubata*, and 'toetoe' for the indigenous species. *C. selloana* has silvery-white, pink, or purple-tinted flower heads (panicles) and flowers from mid-March to late April, while *C. jubata* has consistently purple-tinted, uniform panicles, and flowers from late January to mid-March. Toetoe plants have cream-gold coloured heads, and flower from spring to late summer. Unlike pampas, they have waxy leaf bases and secondary veins in the leaves.

Cortaderia selloana (as *Gynerium argenteum*) was present in New Zealand in 1876 (Curl 1876). It has been used as stock fodder since the early 1930's (Grimmett 1935). The presence of *C. jubata* (as *C. atacamensis*) was reported by Connor in 1965. *C. selloana* is a native of Argentina and Brazil. *C. jubata* originates in the Andes of Bolivia, Peru, and Ecuador (Costas Lippmann 1977). Unlike *C. selloana*, which exists as either female or hermaphrodite plants, *C. jubata* reproduces without pollination, all plants being female.

COMMERICAL USE OF PAMPAS IN NEW ZEALAND

Selected strains of *C. selloana* were produced in large numbers for agricultural use between 1930 and 1950. A survey by Lynch and Osborn (1948) showed that most agricultural plantations were in the North Island in areas other than the East Cape and mountain regions. South Island plantations were fewer in number, but widely scattered throughout farmed areas. The use of pampas as a shelter plant and as supplementary stock fodder with a high roughage content persisted after 1950 but to a much smaller extent. Present commercial production is estimated at less than 1 000 000 plants *per annum*; three-quarters of these are produced by two or three main suppliers, the rest by numerous small nurserymen. Plants of both species are currently distributed to all parts of the country. At times, large numbers are supplied to organisations such as the Ministry of Works and Development for use in land protection and erosion control.

DISTRIBUTION OF PAMPAS IN FORESTS

No information is available on the occurrence of pampas in forested areas before 1970. Since then it has been recorded in most exotic forests in New Zealand. Since the mid 1970's its spread in forests north of Hamilton has been both dramatic and damaging. A 1978 survey in the State forests of Auckland Conservancy showed that approximately 16 000 ha in seven forests were heavily infested with pampas. In 1983 the pampas problem in this Conservancy was considered to be severe over about 19 000 ha

Proc. 37th N.Z. Weed and Pest Control Conf.

(29% of the total productive area). Both species are often present, but their relative proportions are very variable. *C. selloana* occurs more frequently, but *C. jubata* is sometimes dominant, e.g. in Maramarua Forest which has a relatively long record of pampas infestation. This is of considerable interest, since it has been stated that *C. jubata* became the dominant species in California at the expense of *C. selloana* (Costas Lippmann 1977). *C. jubata* may prove to be more aggressive than *C. selloana*.

It is possible that the pampas weed problem is being accentuated by the trend towards more open forest stands with fewer trees per hectare and more emphasis on pruning and thinning. However, untended forests also become infested, especially during the period between clearfelling and the development of a closed canopy by the subsequent tree crop. Soil disturbance during logging, land-clearing, and road construction favours colonisation. Soil fertility does not appear to be a limiting factor.

IMPLICATIONS FOR FORESTRY

Good forest establishment is sometimes impossible due to suppression of young trees by pampas plants. Pampas tussock formation can be well advanced within 2 years, individual plants eventually growing to over 2m in height (seed heads 3-4 m) and over 1m in diameter at the base.

Annual green matter production can be up to 125 tonnes/ha (Grimmett 1935); an annual dry matter yield of 15 tonnes/ha was reported for planted pampas by Dunlop and Coup (1951). No reliable data on pampas productivity in tree stands exist, but the grass clearly has considerable potential for competing with trees for moisture and nutrients. Pampas leaves from Waiuku Forest contained 0.7-1.3% nitrogen (N); 0.1-0.3% phosphorus (P); 2.0-3.4% potassium; 0.1-0.3% calcium, and 0.1-0.2% magnesium. Tree growth is known to be limited by N availability in sand dune forests, and by P and N availability in Northland clay forests. Immobilisation of N or P on clay soils or of N at the sand forest sites would be expected to have an adverse effect on tree productivity. In sand dune forests the N required for tree growth, normally supplied through biological fixation by perennial tree lupin (*Lupinus arboreus*), is likely to be reduced when pampas is present. Examples of suppression of young trees by pampas are common, and general retardation of growth in older trees is suspected although no quantitative data exist. Two trials in progress at Waiuku Forest should provide this information within the next few years.

Fire danger, a most important consideration in forestry, is increased in pampas-infested stands. This is partly because of reduced accessibility, but also because large quantities of dead foliage build up in and around the tussocks of large plants.

High forest establishment costs are incurred where trees require releasing from pampas. Release treatments, which barely ensured tree survival, were estimated to cost \$350/ha in 1983. The costs of later tending operations (pruning, thinning) are also higher in stands where pampas is present and tree growth is uneven. Work is hindered by the physical barrier formed by the tussocks, and complete body covering is essential to avoid cuts from the abrasive edges of the leaves. One evaluation has indicated that the presence of dense pampas can increase total tending costs by 144%.

CURRENT MANAGEMENT OPTIONS FOR CONTROL OF PAMPAS IN FORESTS

Eradication of pampas has not been considered as a practical objective in heavily infested forests. This is partly due to the scale of the problem, but also to the fact that sources of infestation outside the forest boundary are beyond the control of the forest manager. Control measures therefore aim at reducing pampas growth to the point where tree survival and productivity are acceptable and tending costs are not unduly increased. Current practice includes various combinations of the four following options, some of which depend on forest location and soil type.

(i) Cutting

This labour-intensive method produces variable results and gives only temporary control. It is used when there is no alternative. In 1983 one cutting was estimated to cost \$150/ha.

(ii) Chemical control

Herbicides can be used before or after tree planting. In the past, pampas has not been acknowledged as a problem until tussocks have formed. Only mature plants were treated, usually by aerial spraying. Hexazinone (Velpar) at 6 kg ai/ha has been most frequently used. However, on sandy soils hexazinone causes damage to the tree crop and eliminates the lupin regrowth required for adequate tree nutrition. In sand-dune forests weed wiping and knapsack spot treatments with glyphosate (Roundup), using 12% and 0.72% solutions respectively, have been reasonably effective. Other herbicides, including 2,4-D plus paraquat, dalapon/amtrole and dalapon alone have been used for spot application with variable success. Chemical methods of control may cost up to \$400/ha and are considered to be too expensive for routine use. There is an obvious need for a cheaper, selective herbicide.

(iii) Grazing

The agroforestry concept has been used for pampas control in several forests. Where the terrain is suitable, local farmers have been encouraged to graze cattle in pampas-infested blocks. Unfortunately, this system is dependent on the availability of suitable stock (beef cattle) and the forest manager may not have ultimate control over timing or intensity of grazing. Fencing, water supply and some supplementary (high-protein) fodder are also required. A satisfactory degree of pampas control can be achieved if all conditions are met. Grazing can be started 2-3 years after tree planting.

(iv) Oversowing with pasture species

The introduction of pasture plants (especially nitrogen-fixing species) is seen as a useful means of providing the high-protein supplement required to maintain body weight in cattle grazing on pampas. At present *Lotus pedunculatus* "Grasslands Maku" appears to have good potential for growth in forest stands. It is a nitrogen-fixing forage plant with a relatively low requirement for phosphate and lime. Seed is sown in mature tree stands designated for grazing and in recently cleared areas where it is hoped that the establishment of ground cover will inhibit pampas development before grazing commences.

Of the options listed above, cutting and chemical control are very expensive, while oversowing and grazing, although showing promise, can be difficult to manage. Some forest sites are not suitable for weed control by grazing.

TOETOE CONTROL

Although of widespread occurrence, the native *Cortaderia* species have not been propagated and planted on the large scale observed for pampas, and are not considered to be a major problem. Control has been necessary on some indigenous forest cutover sites in the central North Island, particularly where replanting has been delayed, but programmes combining aerial use of herbicides with crushing, burning, and grazing can eliminate the need for releasing trees from subsequent invasion. Hexazinone has some potential as a release treatment (Bowers and Porter 1977).

CURRENT RESEARCH ON PAMPAS CONTROL IN FORESTS

Effective control of existing pampas will probably only be achieved by the integration of several methods, and there is a need for further development and evaluation of the options already described. Prevention of reinfestation requires more knowledge about the biology of the individual species involved. Current studies include:

1. Identification of *C. selloana* and *C. jubata* from vegetative characteristics.
2. A survey of all forests to determine the distribution of each species.
3. Definition of seed longevity and the conditions which limit seed germination.
4. Determination of growth characteristics and requirements for nutrients and moisture.
5. Examination of potential growth restraints other than grazing, e.g. shading, competition from other plant species, pathogenic organisms.
6. Evaluation of oversowing and grazing in a management scale pilot trial set up as a joint venture between the Department of Lands and Survey and the New Zealand Forest Service.

7. Screening of herbicides for use on scattered plants, and on large areas before and after tree planting.
8. The influence of pampas on tree productivity.

ACKNOWLEDGEMENTS

Information included in this presentation has been gathered from many sources, most of them as yet unpublished. Special thanks for information and assistance are due to Mr D. Kershaw, the Forest Health Officers, Miss A. Gillman, Mr C. Ecroyd, Mrs B. Knowles, and Dr D. Preest (all of the Forest Research Institute); Mr D. Black and the staff of the New Zealand Forest Service, Auckland Conservancy; and Mr N. Percival of the Ministry of Agriculture and Fisheries, Rotorua.

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