Summary  A review of research conducted in New Zealand on the ecology of nassella tussock (*Nassella trichotoma* Nees) published in a brochure for Regional Councils and affected farmers reveals: (1) some seeds are viable when the panicle first emerges from the sheath, (2) soil-borne seed populations beneath pasture decay rapidly, (3) seedlings recruit throughout the year, but with an autumnal flush, and are derived mainly from seed formed in the previous year, (4) the species has occupied less than 50% of its climatically optimal range in New Zealand, and (5) the density of the nassella tussock population infesting some 800 farms in the Hurunui District of North Canterbury has reached an equilibrium (of about 17 plants ha⁻¹) between plants killed by grubbing and recruitment of plants from seed.

Keywords  Serrated tussock, seed survival, seedlings, potential distribution, population monitoring.

INTRODUCTION
Nassella tussock was a serious weed of grazed pastures during the early 1900s in the drought prone eastern hills of the South Island of New Zealand (Kriticos et al. 2004). Through a central government funded programme, populations on infested properties have been reduced to densities that no longer impact on pasture production (Bourdôt et al. 1992). However, many landholders are concerned that, without a regional control programme, populations could return to the economically damaging densities that prevailed in the past. This concern has provided the justification for affected regional authorities to include the species in their Regional Pest Management Strategies (RPMS) (under the Biosecurity Act 1993). To help answer common questions and to provide a robust basis for these RPMSs, recently published scientific studies were reviewed and summarised in a brochure that was distributed to affected farmers. The key components of this brochure are outlined in this poster paper.

MATERIALS AND METHODS
Biosecurity officers and managers from Environment Canterbury and the Marlborough District Council, the two local authorities most affected by nassella tussock, were consulted during the development of the brochure. Five questions of direct relevance to regional-scale decision-making for nassella tussock in New Zealand were developed and addressed by reviewing current and published research under three topic areas (Ecology, Distribution, Population Trend).

ECOLOGY
1. When do the seeds become viable?  Viable seeds are present from early November (late spring), peaking in number in late December to early January. Contrary to popular belief, some seeds are viable when the panicles first emerge from the sheath (Figure 1) but seeds do not continue to ripen once a plant is grubbed (Lamoureaux and Bourdôt 2002a).

2. How long do seeds survive in the soil?  In a recent study (1999–2004) nassella tussock seeds buried in soil beneath pasture decayed at a rate of 76% per year in the first year and at a rate of 23% per year.
thereafter (Lamoureaux, unpublished data). According to these decay rates, 24, 8 and 1% of seeds will have survived after 1, 5 and 13 years respectively in the soil (Figure 2).

3. When do seedlings establish? Recruitment of seedlings occurs in all months of the year but with a main ‘flush’ in autumn (Lamoureaux and Bourdôt 2002b). Seedlings arising in any one year appear to come from seeds produced in the last flowering period rather than from a seed bank. This hypothesis is supported by an experiment in which seedlings arose in an infested pasture only in plots to which fresh seeds were added (Lamoureaux and Bourdôt 2002b). This implies that population growth will depend more on year-to-year seeding than on the survival of seeds in the soil from past flowering events.

The management implications that follow from these results are:

(1) A nassella tussock plant must be grubbed prior to flower panicle emergence to prevent production of viable seeds.

(2) Prevention of seeding will stop population growth in nassella tussock, and eventually result in population decline.

DISTRIBUTION

4. What are the current and potential distributions of nassella tussock in New Zealand? A ‘Climex’ model (Kriticos et al. 2004), has revealed that nassella tussock occupies less than 50% of its climatically suitable range in New Zealand (Figure 3). Surveillance (and early detection) in the Regions and Districts predicted suitable but not yet occupied by nassella will help prevent its further spread in New Zealand.

POPULATION TREND

5. Is nassella tussock declining under the annual grubbing regime imposed by the Regional Pest Management Strategy in the North Canterbury Region? Historical records of nassella tussock plants grubbed on North Canterbury farms from 1966-1988 indicate a decline in population density occurred during this period (Bourdôt et al. 1992) (Figure 4). These data also show that fewer plants were grubbed per ha on farms with ‘improved’ pasture than on farms with ‘undeveloped’ pasture indicating that pasture improvement has reduced nassella tussock density.

In a more recent study, nassella tussock density has been monitored by Environment Canterbury on infested farms in the Hurunui District of North Canterbury each autumn, after the annual grubbing has been completed. The results reveal that population density in this District is stable (at 17 plants ha⁻¹) (Bourdôt and Saville 2005) under the current annual-grubbing programme and that about 25% of the plants present in autumn have seeded (Figure 5).
Annual grubbing to kill all plants before they seed is the aim of the nassella tussock control programme in the North Canterbury Region of New Zealand under the current Regional Pest Management Strategy (Smith and Lamoureaux 2006). In order to realise this ‘no-seeding’ policy, grubbing must be conducted prior to panicle emergence (Figure 1). Preventing seeding would be expected to result in a progressive decline in the re-infestation potential of infested pastures since soil-borne seeds decay continuously with time (Figure 2). Whilst such a decline is the objective of the current RPMS (Smith and Lamoureaux 2006) it is apparently not being realised (Figures 4 and 5). Rather, the population density in North Canterbury seems to be stable at an average across all infested properties of 17 plants ha⁻¹ (Figure 5). It is probable that this stability represents an equilibrium between plants lost from the population due to the annual grubbing, and recruitment of new plants from seed shed each year from the plants that escape detection at grubbing time and survive to produce seed (Figure 5), or are grubbed late in spring after the seeds in the panicles begin to be viable. Reducing this equilibrium density is likely to require a greater level of annual mortality of plants before they produce viable seed than is currently being achieved.

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REFERENCES


