

Detection, quantification and management of the dispersal of *Nassella neesiana* (Chilean needle grass) seeds in hay bales

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Summary This paper outlines a project that intends to investigate the link between the occurrences of weeds in pasture hay crops and weed seeds in bales. Noxious weed in particular pose a threat to the livelihoods of primary producers in this manner. As an example of a noxious weed, this project will investigate *Nassella neesiana*, Chilean needle grass. This species is a restricted (noxious) weed that infests roadsides, native grasslands and pastures that may be baled for hay. In Victoria it has the potential to cause significant economic harm to agricultural areas and the trade in fodder and hay. This project aims to develop methods for the detection of weed seeds in hay bales and provide more information about the role of hay machinery in their spread. Later, we will investigate the extent of seed shedding from hay bales during transportation by road. This project will attempt to correlate the percentage cover of *N. neesiana* prior to harvest with the seed content of bales. Trial core samples from bales indicate that seeds of *N. neesiana* and other grass species were present. However, a correlation has not yet been established between weed biomass and the seed content of bales.

Keywords *Nassella neesiana*, Chilean needle grass, hay and fodder, seed dispersal.

INTRODUCTION

The project described in this paper investigates the relationship between the number of weed seeds in hay bales and the quantity of weeds in pasture hay crops prior to baling. It also intends to quantify the avenues of dispersal of the seeds during the manufacture and transportation of hay bales.

It has been historically assumed that seeds of pasture species are present in hay, because many species are summer flowering and seeding (Wells *et al.* 1986). However, no attempt has been made to develop predictive models for this process. It is important to understand this phenomenon, because of the risk that noxious weeds may be dispersed to the wider landscape, if these species are present in pasture hay crops.

The production of fodder and hay is vital to the grazing industry, allowing primary producers to feed livestock when forage in the paddock is unavailable.

The value of the fodder industry in Australia is \$1.6 billion (2006–07) and the cost of all weeds to agriculture in Australia is approximately \$A4 billion per annum (Sinden *et al.* 2005, Martin 2009). About 70% of hay is produced for use on farm. The remaining 30% is traded, with this becoming an increasing trend over recent years (Martin 2009).

Pasture weeds pose a serious threat to the hay industry by lowering yields, contaminating hay and increasing the cost of production. The trading of hay has the potential to contribute significantly to the spread of weed seeds via transportation of hay bales off-farm.

The research question that is to be addressed in this study is: what factors contribute to the shedding and dispersal of the seeds of Chilean needle grass during the manufacture and transportation of hay bales and how may these be addressed so as to reduce the spread of this weed?

Significance of this research Chilean needle grass *Nassella neesiana* will be used to model the dispersal of weed seeds during the manufacture and transportation of hay bales. The main reason for this is that *Nassella neesiana* is a Weed of National Significance and a restricted (noxious) weed in Victoria (Thorp and Lynch 2000). As for other noxious weeds, it is an offence under the Victorian *Catchment and Land Protection Act (CaLP) 1994* to trade or transport its seeds or other propagules (Department of Primary Industries 2009).

Nassella neesiana therefore has the potential to cause significant economic harm to primary producers if allowed to spread via the movement of fodder and hay from areas of current infestation.

The state of Victoria is the largest producer of pasture hay in Australia (57% of all production nationally) and the projected range for this weed coincides with the most productive regions for this commodity (Martin 2009, Department of Primary Industries 2009).

It is currently unknown if seeds of this species can be detected in bales harvested from areas of known infestation, and whether this can be correlated with the degree of paddock infestation (species percent cover). Seeds of this species may already be dispersed via hay

bales and may continue to do so in the future unless an economic and time efficient method for testing bales is developed.

In addition to the above, issues of animal welfare and environmental threats posed by this species are noteworthy.

Animal welfare issues associated with *N. neesiana*

Unpalatable flowering stems are produced during spring and summer, reducing the amount of feed available to livestock and large infestations can reduce carrying capacity (McLaren *et al.* 1998, Gardener *et al.* 2003). The awn and hairs on the seeds readily adhere to the wool of sheep, and the seeds have a sharp callosity (point), allowing these to burrow into the skin of sheep (Fischer *et al.* 1996, Gardener *et al.* 2003). This causes distress to the animals and impacts on primary producers by devaluing the fleece, pelt and carcass (Bell 2006). The seeds may also pose an occupational health and safety issues to abattoir workers by causing hand injuries during the processing of carcasses (Ridley 1930).

Environmental threats of *N. neesiana*

Nassella neesiana is also a serious environmental weed threat. It is able to occupy and dominate areas that have been subjected to disturbance, as well as degraded areas of native grasslands that are in poor condition (McLaren *et al.* 1998, Faithfull *et al.* 2009).

Its seeds germinate in spring or after rainfall, competitively excluding native grasses such as *Themeda triandra* by taking up soil moisture before the seeds of the latter species can germinate (Faithfull *et al.* 2009). It also responds more quickly than other species to disturbances that result in the release of nutrients (Faithfull *et al.* 2009).

PROPOSED RESEARCH

Proposed methods Several tactics are proposed to determine whether or not it is possible to recover seeds from bales after baling, whether or not this can be correlated with percentage cover of *N. neesiana*, and if seeds are shed in significant numbers from bales during baling and transportation. These strategies are listed and described below.

Pasture composition and percentage cover Study sites that have existing infestations of *N. neesiana* have been identified in the Greenvale area (NW Melbourne). To establish the degree of infestation, a pasture survey will be conducted to determine the percentage cover of all pasture species, including *N. neesiana*, at each site.

Core sampling of bales To date, bales that were 'dosed' with *N. neesiana* seeds have been core sampled. This constituted a pilot study, during which bales of 'clean' hay were dosed with dyed seeds of *N. neesiana* at a known concentration (2.5 g of seed m⁻² of pasture). The bales were dosed by rolling out the clean hay, adding the seeds to the windrow and re-rolling the bales. Twenty cores were taken with the intention of performing analysis on ten of these initially and examining the remaining ten if a larger sample size is needed. Data to be collected include the number of cores that have seed, the amount of seed in each core and the total amount of seed in all ten (or twenty) core samples. Thus far, examination of some of the cored material has given positive results for the presence of the seeds of the hay species (ryegrass) and *N. neesiana*. This work is ongoing and no statistical analysis has yet been carried out.

Recovery of seed from core samples Seeds will be separated from the core samples using three methods: manually searching for seeds, sieving to separate seeds from trash and using flotation to separate seeds from trash. These methods will be trialled to determine the time efficiency and effectiveness of each.

Manual searching of hay core material has been trialled and it appears that, although this method is able to yield seeds of *N. neesiana* and other species of which the hay is composed, it is quite slow and inefficient.

Machinery hygiene studies After harvesting operations, each of the machines involved in hay bale production (mower, rake and baler) will be cleaned to ascertain whether the attached seed can be quantified for each machine type.

Dispersal of seed by transport Later in this study, transportation of hay bales by truck will be investigated to determine whether seeds of *N. neesiana* are shed from the bales. This will enable a quantification of the risk of the spread of the seeds of this species along the transport route, and the significance of transporting trucks as dispersal vectors.

INTENDED OUTCOMES

This study will take the following steps to achieve a successful outcome. Firstly, proof-of-concept will be demonstrated that the level of *N. neesiana* infestation corresponds with the amount of seed captured in hay bales, enabling a predictive model to be applied that detects the presence of previously unnoticed infestations of *N. neesiana*.

Secondly, information will be assembled about human-mediated dispersal of *N. neesiana* in the hay cycle, specifically with regard to the transportation of hay bales by truck, offering opportunities to recommend how this might be minimised.

As a result of the foregoing, we anticipate developing recommendations for standard operating procedures that will lead to suppression of *N. neesiana* seed dispersal on and off farm, with special reference to the manufacture and movement of hay bales. This will improve management of this weed, reducing damage to livestock, the environment and primary producers' livelihood.

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