Biosecurity for New Zealand's forage production systems

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Abstract

At a time of increasing and changing trade and tourism, biosecurity is becoming a major issue. New Zealand's pastoral ecosystems are uniquely vulnerable to invading pests and weeds and, in many regions, pastures are being used more intensively than ever. This in turn is making pest impacts more severe. Other factors causing increasing concern about biosecurity include climate change and public concern about existing pest management strategies. Weed problems are increasing in some marginal areas where there has been destocking. This contribution further discusses the need for contingency planning for biosecurity threats, particularly with reference to keeping weed and pest organisms out of this country at the border. In relation to this, funding issues for research are discussed and with this, the need for the government and sectors to clearly delineate areas of responsibility. This raises issues about the shortcomings of simplistic user-pays models and the ongoing conundrum of whether and how the perpetrators and/or the 'beneficiaries' of pest management research should pay after biosecurity failure.

Keywords: biosecurity, border control, eradication, funding, pests, pest management

Trade and tourism-based biosecurity pressure

New Zealand's forage production systems are based on exotic plant species that have, in the main, been introduced without their natural range of pests and diseases. This partial transfer of ecosystems makes New Zealand agriculture particularly vulnerable to invasions by weeds and pests, that can either arrive naturally by air and ocean currents, or more commonly, through unintentional introduction by ship, plane and post (now including the internet mail-order systems). The potential for accidental introduction is very substantial. Currently MAF records show New Zealand lands c.400,000 containers a year of which c. 39% are contaminated. Fourteen per cent of cargo is singled out and checked because of risk factors such as the point of origin and another 10% is randomly inspected. Thus, there is no doubt that contaminated containers are entering New Zealand even if interception rates are perfect. A further study of the external surfaces of shipping containers also showed considerable potential for entry by unwanted organisms (Gadgill *et al.* 2000). In addition, there are about 3.8 million passenger arrivals per year. All-in-all, MAF intercepts 86,000 at risk goods at the border each year which have been found to carry >4,600 unwanted organisms. From this it has been estimated that about 50 unwanted species enter this country every year although not all are able to establish. This already major biosecurity threat will increase with burgeoning tourism and trade which is being further compounded by the acquisition of increasingly diverse 'non-traditional' trading partners.

New Zealand's vulnerability to invasive species

When exotic species reach New Zealand, they often encounter a year-round abundance of favoured host plants, a relative absence of their own natural enemies and unexploited ecological niches. Thus, in all ecosystems invaders frequently go through explosive population increases and cause widespread damage. Indeed, such organisms often have a much higher pest status in New Zealand than in their country of origin. In contrast, only a few native insects, such as grass grub and porina, and no uniquely endemic plant parasitic nematodes, have switched from New Zealand native to introduced agricultural plants to become pests.

Past international pest arrivals have included Argentine stem weevil, black beetle, Sitona weevil, soldier fly, Tasmanian grass grub, whitefringed weevil and molluscs. Of the nematodes, root knot, cyst and lesion nematodes have attained serious pest status in pasture. Most recently, New Zealand forage production has been further undermined by the establishment and spread of the *Varroa* mite and clover root weevil; these species affect pollination and vigour in white clover respectively. The costs of these pests to New Zealand's pastoral industry and New Zealand *per se* are very high. For example, unmanaged, Argentine stem weevil has been estimated to incur costs to the pastoral industry of between NZ$78-251M per year (Prestidge *et al.* 1991). Caradus *et al.* (1995) have calculated that clover fixes c.1.57 million tonnes of atmospheric nitrogen per year which is worth over NZ$1.49 billion; the pest potential of clover root weevil and *Varroa* mite is obvious.

Pest outlook

Coinciding with this ongoing and mounting threat of invasion by foreign pest species, a number of other developments make it more imperative than ever that New Zealand's biosecurity system is excellent. Such considerations include:

(i) The intensification of farming systems, for example, dairy conversions, is making them ever more vulnerable to pest damage. As production systems move towards their technical limits they become much more easily disrupted and what may once have been regarded as minor outbreaks now may cause disproportionate damage.

(ii) Climate change will probably increase the diversity and distribution of pests that can establish in this country. For example, tropical grass webworm has been recorded as entering New Zealand on numerous occasions during the last century, but has only consistently caused major problems in Northland since 1999 (Hardwick & Davis 2000). Black beetle is slowly spreading south along coastal margins into Hawkes Bay and the Manawatu, while Tasmanian grass grub has continued to occupy new areas on free draining soils in the northern North Island (e.g. Hawkes Bay, Waikato, Bay of Plenty, South Auckland) in the last decade.

(iii) The possibility of the east coast areas becoming more drought-prone. This too, is likely to accentuate the effects of pest damage through reduced vigour of forage species.

(iv) Existing pest management strategies cannot be used in perpetuity. Social and political demands mean that once satisfactory solutions (e.g. those based on the use of pesticides or repeated cultivation) may no longer be acceptable.

Weed outlook

Similarly, weeds present an ongoing biosecurity threat:

(i) Regional councils, responsible for weed control, are employing fewer biosecurity officers and there are now fewer people on farms so that early detection of new and spreading weeds is less likely.

(ii) In hill country areas there are now reduced stock numbers, especially of sheep. There has also been an increase in the prevalence of cattle and reduced use of herbicide. As hill country pastures have become less vigorous and laxly grazed, they have become more susceptible to weed invasion, especially by scrub weeds.

(iii) Smaller rabbit populations are likely to lead to increases in scrub weeds that will be largely irreversible.

(iv) Climate change is predicted to cause higher rainfall in the south and west. This will make control of pasture weeds by grazing more difficult, resulting in further increases in scrub weeds.

(v) Increasing temperatures will see the continued southward movement of sub-tropical grasses and other warm-zone species. Such conditions will also encourage warm-zone garden plants to become naturalised (called sleeper weeds) and result in new invasive weed species.

(vi) Many weeds, especially annuals or biennials like thistles, increase in area and numbers after dry summers; thus these are likely to increase as areas become more drought-prone.

New Zealand's response to newly-established ineradicable pests

As a generality, pest invasions of productive ecosystems cause economic impacts and disruption that are more than additive. Frequently, newly required management for an invasive species compounds with and disrupts existing control measures developed for the already-established pest complex. For example, the use of pesticides (synthetic or pathogen-based) can destroy established biocontrol systems based on parasitoids. Alternatively, the need to cultivate frequently (e.g. for weed control) can set back the build up of soil pathogens for the control of grassgrub. Indeed, quite unexpected effects can occur; for example, a negative interaction has been found between some endophytic grasses and the Argentine stem weevil parasitoid *Microctonus hyperodae* (Goldson *et al*. 2000). Whatever the impacts and interactions, any new pest outbreak requires expensive, in depth research that usually ends up with a pest management system more complex and disruptive than that which preceded it. In spite of this, production can still be reduced. Against this background, the current expectation is for Regional Councils to deal with new pests immediately after a species has been declared to be ineradicable (usually by MAF). This is ludicrous. Often many years of detailed research are required to establish a pest's damage potential, life history, population dynamics and biological control options. Even then, funding for such work is frequently not available, or is insufficient. As it stands, once a pest has established, the science community is expected to raise substantial funding for such research from an often very disaffected sector. This does nothing for science/stakeholder relations and retards the often long search for a practical solution. Similarly, the affected sector is rarely the perpetrator of the problem that it is saddled with. There has been talk of a contingency fund to allow the required work to proceed.

Contingency planning

These threatening circumstances mean the pastoral sector must be determined in its pursuit of a comprehensive and effective agricultural biosecurity programme. Such a programme should:

(i) Use the best available knowledge to identify and prioritise exotic threats to New Zealand's grassland farming system.
(ii) Identify the likely geographic origins of these species and determine their likely routes of entry.
(iii) Develop technologies for the early detection/ interception of these organisms.
(iv) Develop sector awareness of potential threats and provide identification systems to permit their early recognition.
(v) Develop strategies for the prompt containment and eradication of potential pest species that can be implemented immediately through prior arrangement with New Zealand's regulatory authorities. For example, pest control chemicals or biocontrol agents could be registered or approved in anticipation of need in responding to biosecurity breaches.
(vi) Identify the research approaches for ongoing management that would be available should a readily identifiable invader become established. For example, candidate classical biological control agents could be selected in advance and plans made for their rapid acquisition.
(vii) Assess whether the dispersal of some species could be considerably curtailed if internal biosecurity measures were to be adopted; agreement in principle could be drawn up by members of the pastoral sector for such a contingency.

Research funding, research capability and co-operation

Whatever the configuration, an effective New Zealand biosecurity system requires communication and collaboration between industry, research institutes, MAF Biosecurity and other government agencies. Such a system must also accommodate the contribution that science can make to upgrading this country's biosecurity capability. Such science-based advances can arise from a wide range of approaches including enhanced statistical techniques in surveillance/sampling of invasive species, DNA identification of a pest's point of origin (e.g. Lenney Williams *et al*. 1994), the development of highly specific microbial pesticides or new searching/detection technologies (e.g. Goldson *et al.* 2002; Suckling & Gibb 2002). However, in order to achieve this there must be appropriate understanding between industry and the Crown as to how such research may be funded. Indeed, nowhere needs biosecurity technology more than New Zealand and therefore it is most likely that it will have to be developed here. Having succeeded, there is every reason to expect that such technology would find markets off-shore. Indeed, this is precisely the sort of knowledge-intensive, smart niche technology that the New Zealand government is seeking and there is reason therefore to suppose that Crown assistance may be available.

Given the importance of biosecurity as discussed above and the media attention of recent years (e.g. white spotted tussock moth, clover root weevil, disease-bearing mosquitoes, painted apple moth etc.) the government has quite reasonably commissioned the development of a Biosecurity Strategy for New Zealand. The draft is scheduled to appear soon. The background work for this has resulted in considerable discussion about the level of funding for underpinning research for New Zealand's biosecurity. However, the essence of such analysis can become obfuscated through varied understanding of what actually constitutes biosecurity research (an issue for the Strategy to resolve) and this has led to very diverse estimates. Indeed, a better way to examine the issue is to consider the direction in which such aggregates of funding may be tracking. In doing so, particular attention must be paid to securing this country's remaining biosecurity research capability, which in many areas has already become very seriously depleted. The loss of taxonomic expertise is one example of this.

It is important to recognise that when monies were transferred from the Department of Scientific and Industrial Research and MAF Technology to the Foundation for Research, Science and Technology (FRST), there was an understanding that funding for research into Crown agency (e.g. MAF, MoH, DoC etc.) operational requirements such as biosecurity would remain; the major difference was the introduction of a contestable system for its procurement. Since that time however, there has been ongoing and vigorous policy development in RS&T. Particularly, in the last five years there have been avid (and well-reasoned) efforts to develop New Zealand as a knowledge-based economy with a strong emphasis on growing private sector R&D and enterprise. Research funds have accordingly been diverted in a specific attempt to enable industry to achieve such a goal (e.g. the New Economy Research Fund). Such aims are clearly enunciated in the government's 'Growing an Innovative New Zealand' document.

While such an industry-enabling activity is laudable and the logic unassailable, science funding has remained static, leading to the erosion of support in areas that underpin New Zealand's biosecurity capability. Thus, capability has deteriorated at a time when biosecurity has become an increasingly important and economic issue for New Zealanders. Even more seriously, reference to the stated intent of the Foundation for Research, Science and Technology (FRST) makes it clear that further funding is likely to be diverted from areas such as biosecurity research with the expectation that 'industry' will compensate. Such an expectation to an extent is reasonable, but a simplistic user-pays argument does not work entirely because biosecurity affects all sectors of

New Zealand. Such circumstances point to the need for positive advocacy of, and responsibility for, scientific research into biosecurity. Amongst other things, such action would also ensure that future decisions about base-line funding will not be made on an arbitrary basis.

Given the circumstances discussed above, it would therefore seem appropriate that New Zealand's pastoral industries continue their dialogue with FRST and more generically, the government, to ensure that all parties are co-operating to the extent that biosecurity capability is maintained. Not to do so would be very unfortunate particularly in light of the pressures that are coming on to New Zealand's grassland (and other) ecosystems as discussed above. Such dialogue is not without basis. There is now also clear direction from the Minister of Research, Science and Technology to the science community that biosecurity research capability needs to be preserved and developed (*Draft Operating Framework for Crown Research Institutes, January 2002*).

From a grasslands ecosystem biosecurity perspective, it is critical that the decisions made in the near future are supportive of underpinning research. Hopefully, this will appear in the recommendations of the Biosecurity Strategy as well as ways to optimise the currently very *ad hoc* system for funding biosecurity research, science and technology.

REFERENCES

Caradus, J.R.; Woodfield, D.R.; Stewart, A.V. 1995. Overview and vision for white clover. *Agronomy Society of New Zealand special publication No. 11. Grassland Research and Practice Series No. 6*: 1-6.

Gadgill, P.D.; Bulman, L.S.; Crabtree, R.; Watson, R.N.; O'Neil, J.C.;Glassey, K.L. 2000. Significance to New Zealand forestry of contaminants on the external surfaces of shipping containers. *New Zealand Journal of Forestry Science 30*: 341-358.

Goldson, S.L.; Proffitt, J.R.; Fletcher, L.R.; Baird, D.B. 2000. Multitrophic interaction between the ryegrass host plant, *Lolium perenne*, its endophyte *Neotyphodium lolii*, the weevil pest *Listronotus bonariensis* and its parasitoid *Microctonus hyperodae* Loan. *New Zealand Journal of Agricultural Research 43*: 227-233.

Goldson, S.L.; Braggins, T.; Proffitt, J.R.; Simmons, N.; Hart, A.; Frampton, E.R. 2002. Sniffertech[R]; progress to date. *Proceedings of the New Zealand Plant Protection Symposium on Biosecurity* (accepted).

Hardwick, S.; Davis, L.T. 2000. Field control of *Herpetogramma licarcisalis* (Walker) in northern Northland pastures. *New Zealand Plant Protection 53*: 360-364.

Lenney Williams, C.; Goldson, S.L.; Baird, D.B.; Bullock, D.W. 1994. Geographical origin of an introduced insect pest, *Listronotus bonariensis* (Kuschel), determined by RAPD analysis. *Heredity 72*: 412-419.

Prestidge, R.A.; Barker, G.M.; Pottinger, R.P. 1991. The economic cost of Argentine stem weevil in pastures in New Zealand. *Proceedings of the New Zealand Weed and Pest Control Conference 44*: 165-170.

Suckling, D.M.; Gibb, A.R. 2002. Use of pheromones to combat insect incursions. *Proceedings of the New Zealand Plant Protection Society Symposium on Biosecurity* (accepted).