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On Farm Biosecurity

The importance of the farm gate

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Executive Summary

For the 8th consecutive year World Class Biosecurity ranked the number 1 priority for industry leaders in KPMG's annual Agribusiness Agenda for 2018. It is interesting to note that while industry leaders recognise this as such a critical focus, at grass roots level there seems to be a disconnect or unwillingness to engage in practical on-farm biosecurity practices. In New Zealand we do have one of the best international biosecurity borders in the world, but as we continually see, this border protection cannot stop everything.

The only way to achieve complete border protection would be total isolation by eliminating international trade and travel. This is obviously not an option and with ever increasing international trade and travel, the risk of another incursion also increases. Given that we can't eliminate the risk of a future incursion, then the next step is preventing or slowing the spread of that incursion within New Zealand before it is detected. The only way to achieve this is through active farm gate biosecurity protection.

Some pests we have very good early detection systems for like the trapping systems for fruit-fly. Other pests and disease can exist without any obvious symptoms for several years making early detection very difficult and giving substantial time for spread before it is detected and any controls are put in place as part of a response.

Basic farm biosecurity practices do have a cost in terms of setup and ongoing maintenance and inconvenience, and for the most part there is little or no recognizable benefit from these practices. It's a lot like insurance where you are paying out for a service that hopefully you will never need, but if you do then it is vital. One of the other issues with biosecurity practices is that it is a lot like immunisation where you need basically everyone to get on board to make a difference. Unfortunately, those who do nothing can also be protected in the same way herd immunity works.

The key to creating lasting biosecurity practices is to make it part of our culture to the point where it just becomes business as usual. Therein lies the difficulty, making a cultural change within farming in New Zealand and making on-farm biosecurity the norm.

The key finding of this report are that biosecurity doesn't stop at the border and that we all have a role to play. Talk and education alone will not drive this change, we need to find the levers that will shift people from knowing they should be doing something about it – to doing something about. Those levers will not come from farmers, they must come from industry organisations pushing the need for biosecurity and working with commercial players in their industry to make biosecurity a mandatory part of their contracts. We have seen the push in this area for worker welfare and safety, and a strong social push to clean up the environment. We need that same push to also implement biosecurity practices to protect the environment and our livelihood.

Contents

Introduction

New Zealand has a natural advantage in terms of being able to control its borders. Our remoteness, whilst a huge disadvantage in terms of getting products to markets is also our greatest saviour in terms of protecting our environment from invasive pests and diseases. It also means that our natural fauna and flora developed without many of the threats we find around the world, making them highly susceptible. We can see the damage done to native bird populations who were not prepared for invasions of rats and stoats etc. It has only been recently we have truly understood the care needed when introducing new species to New Zealand

My interest in biosecurity started with the harsh lessons of the PSA incursion into kiwifruit in New Zealand. My small orchard was only 500m away from ground zero and like all growers, I got a crash course in the importance of basic biosecurity and hygiene practices. Prior to the Psa-v incursion being formally identified, the kiwifruit industry didn't have a culture of engaging in biosecurity, so these practices came too late as the disease was already spreading before we knew it was here. 7 years later I see some of the same mistakes being made again through the dairy industry with Mycoplasma bovis, where a lack of on farm biosecurity and a failure to properly implement NAIT (National Animal Identification and Tracing system) had allowed a far greater spread of the disease, making the response much larger and costlier than it needed to be.

I began my Nuffield travels hoping to look at examples of on farm biosecurity practices around the world in the hope of being able to bring some of those practices and experiences back home. Because New Zealand has strong border security, that can encourage complacency amongst farmers that any potential threats will be stopped at the border. I was interested to look at countries without the border protection we have, to see if the lack of external controls increased their reliance on their own farm gate biosecurity for protection. It was disappointing to see a total lack of preparedness worldwide, and the only farmers engaging in biosecurity had done so after an incursion had already established, and it was effectively too late. A prime example of this was, after visiting farms in Qatar which is known to have foot and mouth, we could fly directly to France and head straight from the airport onto a dairy farm with no questions asked.

Its little wonder that worldwide we are seeing an increase in exotic pest incursions taking their toll on agricultural production. I happened to spend some time looking at the citrus industry in Florida in the aftermath of Citrus Greening disease. This industry has been cut in half and lost around 6.5 billion $NZ in production over 4 years. To put that in context, New Zealand's total horticultural production employs over 60,000 people and is only around 5.5 billion.

As travel and international trade increase, the risk of biosecurity incursions will also increase. We now have around 10 million international passengers passing through Auckland Airport every year. The port of Tauranga alone has 1 million 20ft equivalent containers pass through it every year and these numbers are only increasing. Last year the Ministry for Primary Industries reported in their May Border Space report that they had found and stopped over 300 separate incursions of stink bug at the border, totalling around 2500 individual insects.

Even with world class biosecurity protecting our border, we cannot stop everything. Once we accept that, then it becomes critical what happens inside the border and how we as individuals protect our own border – the farm gate.

New Zealand's flagship policy of Biosecurity 2025 and the associated Ko Tatou, This Is Us campaign is focused on trying to make everyone in New Zealand aware of Biosecurity and the part they can play. For most New Zealanders this is just being aware and looking out for potential threats. Growers/farmers can also play a far greater role by actively controlling or preventing the spread of these pests. Many of these pests will have a detrimental economic impact on farming so it is only right that farmers play a greater role in the Biosecurity of New Zealand.

What is a Biosecurity Incursion?

When you start talking about biosecurity the first thing to cover is what a biosecurity incursion is, how it can happen and why they can be so damaging. The problem here is the diverse range of potential threats and the pathways that they can take entering the country. If you look at some of the recent incursions, Myrtle rust an airborne fungus that appears to have been blown across the Tasman, Psa-v in kiwifruit is believed to have come from imports of flower stamen for pollen milling, Mycoplasma bovis is suspected to have entered with imported semen and fruit-fly can enter the country in fresh fruit either shipped in containers or carried by passengers on planes or cruise ships. There is also the constant threat of Brown Marmorated Stink Bug from imported cars and machinery or even coming in hiding in passenger's baggage. The potential threats are as numerous as are the potential pathways for them to enter. MPI face an almost impossible task in trying to protect New Zealand from these incursions and this is also why it is critical for farmers/growers to also play their part by having biosecurity practices in place to help stop or slow the spread of any incursions that do get past the border.

The New Zealand biosecurity system has several layers starting off shore at the pre-border level. This includes import health standards and trade agreements that require importers to ensure any products coming into the country are pest free. Examples of pre-border controls include heat treatment of vehicles offshore to control BMSB or cold treatment of fruit to control fruit-fly.

The second level is the most visible to most new Zealanders with biosecurity officers often using dogs inspecting passengers as they arrive. A similar process is also implemented for any cargo. Given the volume of cargo and the number of people entering the country it is impossible to inspect everyone or everything, so a key overlap from the pre-border is the intelligence on where to target the inspections to catch the most likely threats.

The final third phase is post border with inspection and trapping networks designed to pick up anything missed at the border. The recent fruit-fly finds are a timely reminder of this level with around 7,500 fruit-fly traps monitored on a regular basis around New Zealand. These traps are considered the last layer in our defence and are there to get an early detection of an incursion allowing MPI to manage and eliminate the incursion before it establishes widely. The traps are also necessary to give confidence to our trading partners that New Zealand is fruit-fly free.

The third phase only works for well-known pests that are easily recognisable or have traps that attract the pests to them, unfortunately most pests don't have effective traps and there are few systems for finding any invasive plants or pathogens. This is where it is so important the farmer's/grower's step in and provide a fourth level of control that is not widely acknowledged, the farm gate. This last step can be the difference between a small incursion and a large one.

Why an Incursion can be so devastating

Nature has a way of finding a balance, if you look at the case of Brown Marmorated Stink Bug (BMSB) then in its native China whilst it is a pest that does cause some damage, it is nowhere on the scale of the problems that it caused when it arrived in the US. Within a few years of establishing, numbers had swelled to the point where homeowners were being invaded by tens of thousands of these insects looking for a place to hibernate. The reason these numbers were able to grow uncontrolled was a lack of any natural predation. In China alongside BMSB there is a natural biocontrol. A small parasitic wasp Trissolcus japonicus or the samurai wasp, had developed that laid its eggs in BMSB eggs with the wasp larvae then killing its BMSB host. The two live in a natural symbiosis keeping eachothers levels in check. When BMSB was suddenly transported to the US there was no natural biocontrol to keeps its numbers in check, allowing them to expand to plague proportions.

When I visited the State of Pensylvania there had been a significant reduction in overall BMSB population numbers and local growers I talked to were once again coping. Losses from BMSB damage were back down to a manageable level. Why had BMSB numbers dropped? The Samurai wasp had been discovered and efforts were underway to breed and release large numbers of the wasp as a biocontrol. The local researchers were still unsure of the part the wasp was playing, or whether other predators or climate factors were leading to the decline. In an incursion there is often a natural boom and then bust cycle as once again nature develops its own balance.

If we look at the case of Panama Disease Tr4 in Bananas, The disease is thought to be native to Asia in particular the Philippines where the local bananas have adapted and developed a tolerance or immunity to the disease. Unfortunatly all the local bananas are seeded and are not suitable for commercial consumption. The Cavendish variety that is grown worldwide had never been exposed to Tr4 until Cavendish was planted in the Philippines were native bananas had previously grown. Because Cavendish had not previously been exposed to Tr4 it had not had an opportunity to develop immunity so was immediately overwhelmed. Due to poor biosecurity practices the disease has slowly been spread around the world decimating banana production in those areas.

We saw the same happen in New Zealand to Zespris Hort16A gold variety. Hort16A had no tolerance to Psa-v and within the space of a few years the majority of growers had been forced to remove all traces of the variety. The kiwifruit industry in New Zealand was extremely fortunate that one of the new varieties it had been working on happened to have sufficient tolerance to Psa-v to survive and grow well. Without this alternative tolerant variety the kiwifruit industry would be a shadow of what it currently is.

The Dangers of Apathy

One of the reoccurring themes from all the previous incursions I looked at was a lack of action before a pest or disease arrived. In many cases the threat was well know and should have been anticipated, and yet there was a reluctance to accept and prepare for this eventuality. Nowhere was this more evident than in Queensland amongst the banana growers. The first strain of Banana Panama TR1 wiped out commercially grown bananas worldwide in the 1950's. After replacing that cultivar with a new, more tolerant, one the industry was once again under threat from TR4 a new strain that has begun to decimate banana plantations worldwide. Even with the knowledge that their industry had been wiped out once by disease, a new strain was threatening the industry and had already wiped out production in Darwin, the banana growers in Queensland still refused to accept they were in danger and needed to act. It wasn't until the first detection was confirmed in Queensland, that the local growers suddenly confronted the risk and began implementing strict biosecurity practices on their properties. In Chile I saw a similar response, despite an incursion in Santiago of Brown Marmorated Stink Bug BMSB, one of the most devastating horticultural pests, growers a few hours away were completely unprepared and unconcerned about its arrival.

Implementing biosecurity practices after a pest has already been detected, whilst it will help reduce future spread, means that for some time between arrival of the pest and its identification it was able to spread without any control. A key factor in this is then how long it can take between arrival and someone noticing it and alerting authorities. In the case of Fruit fly, which as I write this report, we are currently in the midst of 3 separate detections, there are thousands of pheromone traps nationwide as part of a surveillance network ensuring that any incursion is quickly identified and can be dealt with before it becomes established. When you look at Psa-v in Kiwifruit or Mycoplasma bovis, the pathogen can exist for years with plants or animals showing no sign of infection. During this time plant material or stock contact and movement can spread a disease widely before symptoms are first identified and controls put in place.

This is where farm gate biosecurity becomes the critical final cog in New Zealand's Biosecurity framework and why as grower's/farmer's it is critical that we play our part.

Changing Culture

The importance of farmers/growers implementing biosecurity practices on their farms is clear, the next step is how do we convince them to be proactive and actively partake in implementing biosecurity practices. It was clear from the Worksafe case study that simply educating about the risks was not enough to drive behavioural change. No amount of education about the risks of a biosecurity incursion will result in a change in behaviour, because whilst accepting that the risk exists, they will never accept that the risk will happen to them.

Education is only the first step, you then must identify the levers that will cause an individual to accept the need for action. The problem is that every individual is different and will require different levers to be pulled in order to obtain a shift. When we look at engaging with farmers/growers and encouraging them to be proactive around biosecurity we need to target as many different levers as possible in order to get action from the majority. For some people those levers will be regulation, and without enforcement there will be no action. For others it may be peer pressure or seeing others they respect act. In some of their promotions Worksafe have even targeted farmers wives knowing that pressure from them can also force a change.

Possibly the most critical step in any campaign is then identifying what the true drivers are for their industry and designing a package that targets as many of them as possible.

Within an industry the drive doesn't need to rely on government regulation, individual industries can implement required practices that force adherence to set practices. Most farmers will only ever do the minimum required to meet these standards, but any action is better than no action. The onus here then is on peak industry bodies to accept the role that they must play in establishing standards for their industry and then working with key players in the industry to ensure those standards become a requirement.

Basic farmgate Biosecurity

In this report I refer to wanting farmers to engage in basic farm gate biosecurity. In this section I will cover off what I mean by this phrase and give an outline of how to go about implementing this.

Biosecurity at the farmgate is about knowing and controlling what comes on and off your farm. You need to think of your property boundary as a control point and manage everything that comes on or off that property. Whether its staff, contractors or stock you need to assess and control any potential biosecurity threats. The main vectors you are trying to restrict the movement of are animals, plant material and soil. All three have the potential to transmit bacterial or fungal pathogens and all three can to some extent be controlled.

A simple first step is to get a map of your property which could be a GPS map or aerial photo or even use google maps. Draw a border around the property boundary and then look at any points where access can be obtained to the property. Things to consider are, is the property fenced, how many gateways there are, what is the risk of contact from neighbouring properties.

You then need to make a list of all possible movements across that boundary and assess what you can do to mitigate or minimise the transfer of pathogens across your boundary. Simple measures can be closing and securing gates to minimise entry points making it easier to manage one point rather than many. Restricting vehicle access or requiring workers to keep to metalled areas is another.

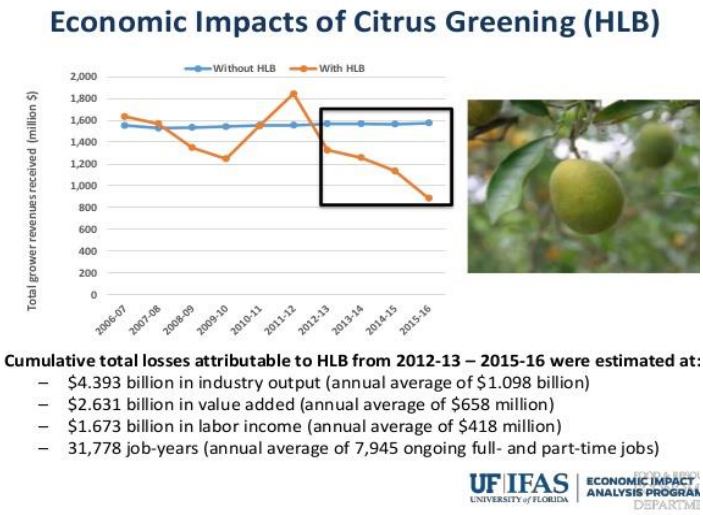
Another area to look at is fencing when livestock are involved. Mycoplasma bovis has highlighted the risk of transfer of pathogens between stock and it is important to eliminate the possibility of transfer between herds on boundary fencing. This does not necessarily mean that double fencing is necessary, but there needs to be some management plan to eliminate this risk. You could either run a hotwire inside the boundary effectively creating a second fence or alternatively work with the neighbour to ensure when you are grazing that paddock that he doesn't have stock in the neighbouring paddock. The most important thing is to recognise that this is a potential vector for transfer and then do something to eliminate it.

The movement of vehicles on or off a property is also a potential vector. Soil or plant material can easily be transferred between properties carrying pathogens or seeds from unwanted plant pests. New Zealand is currently dealing with Velvetleaf and Chilean needle grass incursions that can easily be spread between properties. To try and mitigate these risks any vehicle entering the property that will be working on the farm should go through some form of washdown to remove any soil or plant material before it enters the farm. This only applies to vehicles accessing paddocks or orchards, any other vehicle that is kept on sealed or metalled areas is much lower risk. This means the dairy tanker keeping to a metaled race does not require wash down, but a hay contractor heading out to work on your paddocks should be washed down to prevent any plant material from a previous farm entering yours.

Case Study 1 – Citrus Greening in Florida

Citrus Greening as it is commonly known originated in China where it is known as Huanglongbing HLB which translates to yellow dragon disease. The story of HLB in Florida actually starts prior to its arrival. Before HLB, Florida suffered an incursion of citrus canker. One of the initial responses to control canker was a cut out program that resulted in taking out a circle of 1900ft around any infected plant. Unfortunately, despite cutting out a large area of orchard, a hurricane swept through Florida that year spreading the wind and rain born disease everywhere. The complete failure of the cut-out program completely undermined the notion of ever using this technique to control future incursions.

The first sign of a coming problem with HLB was the arrival of the Asian citrus psyllid. The psyllid was a well-known vector for the transmission of the disease. For 4 years they battled the psyllid incursion without success keeping a close eye out for the first sign of HLB. The psyllid itself does very little damage, and after 4 years with no sign of HLB growers started to become complacent towards the management of the psyllid, which is very difficult to control.



This all changed with the first positive identification of HLB in an orchard in Florida. Interestingly talking with a grapefruit grower, this still did not concern them as they mistakenly believed it would not affect them. The industry instead has been devastated with total production dropping from 140m boxes to currently only 6m boxes. The number of post-harvest facilities has similarly dropped from in the 80's to now less than 10. This represents a catastrophic reduction in income and jobs within the local community. The overall citrus industry lost almost 4.5 billion USD between 2012 and 2015.

Since the incursion around $250m USD has been invested in research to try and overcome the incursion with little success. Whilst waiting for some solution growers find themselves very much in survival mode unsure of their future. Many growers have been forced to abandon orchards or cut them out and look at trying to grow some other crop instead of citrus. I saw a number of orchards

that once produced citrus now growing blueberries, watermelon, onions, basically trying anything they can think of to survive.

What does the future hold? The most likely solution to allow the industry to survive will be the breeding of new tolerant varieties, most likely created using some kind of genetic modification. Without the use of GM it is unlikely a new tolerant variety will be bred anytime soon. Natural selection breeding typically takes around 20 years to deliver new solutions – I'm not sure the industry can wait that long.

This does bring to mind the recent success in Hawkes Bay where farmers have been fighting to not allow any form of GM crop to be grown there. After 3 years of fighting this Federated Farmers have recently announced that are going to discontinue fighting for the availability of GM. Whilst I understand why the local farmers and growers have been fighting to be GM free with all the pressure being exerted in our major EU markets, I can't help thinking this decision may be short sighted and potentially expose them to greater risk at some time in the future.

When I look at what PSA did to the kiwifruit industry, the only reason we survived and were able to rebuild so quickly was the fact we had a naturally breed alternative variety, that had some inherent resistance to PSA. This resistance was however sheer luck as it was never a consideration in the breeding program. If G3 did not have any tolerance to PSA then I shudder to think what our industry would look like now. Would our industry have been able to survive long enough to breed a tolerant gold variety and how hard would the kiwifruit industry have looked at gene editing technology in order to save our industry.

Case Study 2 – Brown Marmorated Stink Bug Chile

Initial BMSB incursions into new countries are often initiated in urban areas – which coincides with the greatest movements of people and goods. The expectation is that if we at some stage do find an established BMSB population in New Zealand it will most likely be in an urban environment. What is happening in Santiago therefore provides us with a fantastic opportunity to learn how to try to control this pest with the difficulties an urban environment poses.

Earlier this year KVH helped bring Ilania Astorga to New Zealand to talk about the recent BMSB incursion into Santiago. Ilania works for the Agriculture and Livestock service, SAG, in Chile, basically the equivalent of the Ministry for Primary Industries here in New Zealand and is responsible for the BMSB response in Santiago. I was able to spend a day with Ilania talking about the history of BMSB in Chile and how they were dealing with the current incursion.

BMSB had been picked up at Chilean ports with increasing frequency since 2010 with the majority of finds coming in the far north in shipments from US. In 2011 it was declared a quarantine pest in Chile and fumigation protocols were put in place. This reduced but did not entirely eliminate BMSB border finds.

The first BMSB found inside the country away from the border was in 2011 in central Santiago. A thorough search of the surrounding area could not identify any more, so it was assumed to be a single interception.

In March 2015 a live insect was again found in central Santiago close to the location of the original 2011 find. Following a search of the area a second live insect was found. A local company then notified SAG they had found live BMSB in furnaces being imported from China. Once again, this notification was in close proximity. In all there were 6 different identifications within Santiago in 2015.

The following year SAG staff confirmed the presence of multiple life stages of BMSB indicating a breeding population. In March 2017 BMSB was declared under official control and a surveillance and trapping program was initiated with support from experts in New Zealand and the US. The trapping program involved placing sticky cards in trees that were laced with pheromones to attract BMSB. As well as inspecting the sticky cards they also used a stick to beat the surrounding foliage with a net underneath to catch any BMSB that were dislodged. The vast majority of BMSB captured have been through the beating of surrounding foliage indicating that the pheromone cards will attract BMSB into the vicinity but not onto the cards themselves.

I talked to Ilania about the support and feedback they were getting from the horticultural industry about the incursion. Given the limited budget SAG are operating under they can only afford to carry

out the trapping and inspection in Santiago at this stage. They hoped that they would be able to encourage industry to engage in trapping and monitoring in rural areas. So far SAG has been totally disappointed by the lack of support from the horticultural industries that BMSB poses a threat to. I was staggered to learn that despite presentations to growers about the obvious risk and impact that they were totally unwilling to engage with and support SAG. Ilania said the exact same pattern had emerged before PSA that the kiwifruit industry had no interest in supporting SAG until PSA was discovered in orchards. I fear it will be the same with BMSB, until orchards are being directly impacted and incurring losses – there will be a total lack of interest.

This caused me to reflect on the progress our industry has made since the PSA incursion. The fact that we now have an industry body KVH, that with the support of growers actively engages with MPI, prepares response plans and engages in incursion simulations places us far ahead of any industry I have seen worldwide. I have also in the past heard several growers ask whether they can buy or be supplied with fruit-fly traps to install and monitor on their own orchard, to try to improve our chances of early detection. This active engagement by industry drastically increases our chances of dealing with any potential future incursions.

For BMSB at this point in time the pheromone trap and physical capture are the only control methods being employed. They had only just started the trapping program when I visited but they were finding small numbers 3 weeks earlier than the previous year. It will be interesting to see if there is significant growth in the population this year or if the current trapping method is able to contain the population.

SAG have been closely watching the progress of the application to import the samurai wasp into New Zealand and given the positive outcome, will look to use our research as the basis to lodge an application of their own. Despite Chile being a competitor, it is absolutely in our best interests to assist with their application in any way because the potential to learn lessons on how to effectively release Samurai wasp would prove invaluable if or when it is required here. Reducing the populations in foreign countries will also have the added advantage of reducing the incursion risk in New Zealand

The other avenue for control being investigated is the potential use of drones to apply sprays to trees in the vicinity of the outbreak. A forestry company in Chile is currently working on using drones to spray trees and Ilania was hopeful they could use that knowledge to run a controlled spray application program in Santiago.

Scion in New Zealand are actively researching the potential for drones to be used here as an urban control method. The days of aerially spraying over Auckland like we did for painted apple moth in 2002 are well and truly past with the public relations nightmare that created effectively ending this as an option. However small direct applications by a drone to individual trees minimising any drift does potentially give us a publicly acceptable option that could well be used against BMSB, fruitfly or a range of other pests and diseases.

Carlos Cruzat the president of the Chilean Comite del Kiwi took me a few hours south of Santiago to one of the main kiwifruit growing areas near to the township of Curico. We went to an orchard where we met an orchard manager and respected agricultural advisor. I was disappointed with the blank look I got when I asked him about BMSB. It was clear that until BMSB was in the orchards and

having a direct economic impact that it would not concern them. It was staggering that despite one of the worst agricultural pests in the world in the early stages of establishing itself only a few hours away that local growers were barely even aware the risk existed and were totally unprepared to take any action.

Our last visit was to an estate which encompassed 680 hectares of the La Rosa vineyards mixed in with the production of several other horticultural crops including several blocks of kiwifruit. Unfortunately, the orchard manger did not speak English, so I had to rely on Carlos to translate making the conversation a little more difficult. The most pleasing thing I did see was the use of footbaths at the entrance to each block. This was the first sign of any form of biosecurity I had seen throughout my travels. The footbaths had initially been introduced in response to Psa-v, and it was pleasing to see them still in use.

Case Study 3 – Banana Panama

The final visit of my Nuffield was to tropical North Queensland. I had headed to Queensland to look at Tropical race 4 or TR4. TR4 is a devastating soil borne fungal disease affecting bananas and is often referred to as Banana Panama disease. Tropical race 1 the first variety of the disease was first described at the Brisbane botanical gardens back in the late 1800's

In the 1950's almost all bananas produced worldwide were of the Gros Michel variety. TR1 disease began to spread to all the banana producing areas of the world, slowly wiping out plantations worldwide. A desperate search for a solution led to the Cavendish variety which had tolerance to the TR1 strain. Cavendish plant material was quickly spread amongst all banana producing countries to replace the dying Gros Michel. Today almost all bananas grown worldwide for human consumption are of the Cavendish cultivar. In the Philippines another Tropical race, now designated as race 4 had developed alongside the native seeded banana cultivars. Because they had developed over time together, they had developed a natural symbiosis or tolerance and could happily live together. When Cavendish was planted in an area where native bananas had previously grown, Cavendish suddenly came into contact with the native TR4 for the first time, to which it had no natural tolerance. The result, Cavendish plants were overcome by the disease and started dying. Unfortunately overtime TR4 has since been spread by humans from its native location in the Philippines and is now devastating Cavendish plantations around the world.

It is not feasible to sterilise soil infected with TR4, which is thought to last in excess of 40 years in soil, without any host material. The upshot is once an area is infected it will be impossible to grow the current variety of Cavendish in that area for the foreseeable future.

TR4 was first detected in Australia in 1997 near Darwin. It then proceeded to effectively wipe out the production of Bananas in that area. The next area in Australia to have TR4 identified was Tully in Northern Queensland in March 2015, almost 20 years later. The Tully area is the largest banana growing area in Australia. Despite knowing the risk of TR4 and knowing an area in Australia had already been infected, the growers in Tully were totally unprepared for the arrival of TR4.

One of the initial problems faced by the first orchard in Tully to be diagnosed with TR4 was the immediate shutdown of its operations. Banana growers are able to stagger their production, so they harvest and sell bananas 52 weeks of the year. When TR4 hit Biosecurity Queensland or BQ immediately put movement controls on the property so no plant material or soil were able to be removed. Initially this also included the bananas themselves meaning the plantation was unable to

sell any of the bananas as the ripened and were forced to destroy and dispose of them instead. This meant an immediate halt to any income for the operation as well. BQ then worked through a process with the plantation owner to allow bananas to be moved off the property. Banana bunches do not carry the disease and it is only located in soil and lower down an infected trunk. The plantation owner suddenly had to put in place sufficient hygiene and biosecurity controls to satisfy BQ that the risk of moving TR4 was negligible. During this period, they were unable to move any bananas off the orchard so lost a significant amount of income, highlighting the importance of having industry incursion plans prepared and market access negotiated before a pest arrives.

The peak body in Australia for banana growers is the Australian Banana Growers Council (ABGC). The ABGC decided the best course of action was to try and stop the disease in Tully by buying the infected plantation, destroying any plants on it and trying to seal it off as best as possible. The idea was to try to eliminate the risk of any transfer of material off the property. The negotiation to buy the property was lengthy and difficult and required funds to be gathered from growers all around Australia, not just those close by, to complete the sale. Unfortunately, shortly after the orchard was removed a second site nearby had a positive test for TR4. A short time later a third neighbouring orchard also had a positive test. Both those plantations have killed off any plants in the blocks that had plants with positive tests but continue to farm other blocks following the implementation of strict hygiene practices approved by BQ.

The two main vectors for the transfer of TR4 are infected plant material or infected soil. In Australia as well as by people and machinery, soil can also be transferred by animals such as pigs and the movement of other plant material. Another significant risk facing Queensland growers is soil runoff following heavy rain, an all too frequent occurrence in a tropical region

All farms now have fences and traps to try and exclude wild pigs to mitigate this vector. There have also been attempts to reduce wild pig populations by shooting from helicopters in an effort to cull numbers.

The focus in Queensland now is on aggressive containment with on farm biosecurity at the forefront of the battle. Every plantation I visited had biosecurity signs up at the gate requiring any vehicles entering properties to go through some form of wash procedure. A number of these were 1000L IBC pods filled with a sanitiser solution and fitted with some sort of petrol or battery powered pump to enable vehicles entering to sterilise tyres before entering. The most extreme of these was a large-scale operation that a had fully automated drive through bath and spray system capable of handling trucks and buses.

Each plantation tended to have its own packing facility as movement of bananas in bunches can result in significant physical damage, once packed tightly into a box it is much safer to transport

them. The packing sheds I visited were all setup into hygiene zones, with different footwear for each zone. You would enter the packing facility from the road and remove your footwear. There would be a low brick wall which you could sit on then on the other side you would put on white gumboots for the clean packing facility. After putting on the white gumboots you still went through a foot bath before entering the shed. When you left the packing facility and entered the orchard you went through the same process transferring from the “clean area” white boots to the “dirty orchard area” and black gumboots. All packaging deliveries and loadouts to the shed are done through a dock so vehicles never leave the metal pad outside the packing facility. They had even setup a delivery system that allowed fertiliser to be dumped from a truck while it was still on the loading pad, with the fertiliser being dropped over a small boundary wall separating the farm from the road.

My very last visit of my Nuffield travels turned out to be my most rewarding. I met with a member of the family business who are the largest banana growers in Queensland. Being a very large, established grower, they run the business more like a commercial operation and have the ability to step back and think about the operation, as opposed to being on the ground fighting fires every day. The business was generational and their father who had been through the devastation TR1 had ingrained the importance of cleanliness and hygiene into the culture of the family business.

Before TR4 hit Queensland a member of the family had travelled to the Philippines to see first-hand the damage the disease was causing in that area. In the Philippines they observed the stark difference in outcome between two neighbouring plantations, one who had engaged and invested in biosecurity practices and the other who had done nothing. The grower engaging in biosecurity practices had managed to slow the progression of the disease, and whilst suffering loss, was still in business whilst his neighbour’s plantation was effectively a write off.

Despite witnessing the devastation to Bananas in the Philippines and being aware that the disease could impact their own plantation to the same level, the penny still didn’t drop that this could actually happen, and they should prepare for it.

When the TR4 did final appear in Queensland it was on a plantation almost neighbouring theirs. Whilst the visit to the Philippines hadn't been enough to implement biosecurity practices, the minute TR4 was identified they were able to immediately implement the practices they had seen and then led their industry in adopting on farm biosecurity practices. The disease has since been found in their plantation with all indications pointing to the spread occurring before those biosecurity practices were put in place. Their experience had taught them that biosecurity for TR4 was not about totally preventing the spread of disease, it was about controlling and slowing the spread. It was about buying time to prepare a long-term solution.

This triggered an interesting conversation about what happens next and what the long-term solution was for them. There is no cure for TR4 and it will survive for 40 plus years in the soil rendering it impossible to grow bananas in that area any time in the foreseeable future. One obvious solution is to abandon the current site and move to fresh land where there is no disease and start again. This has been the model in China where the disease has slowly wiped out the areas that can support banana production. The problem in China was when an area became infected and they needed to relocate, machinery was taken from the infected area to establish the new area. Obviously, this had the effect of spreading the disease to the new area. The result now is that almost all land suitable for Banana production in China is now infected.

There are banana varieties that are tolerant to TR4, however they all are seeded and not suitable for retail consumption. You are left with the final option of trying to breed a version of Cavendish which is tolerant to TR4.

The family have decided to invest in developing a tolerant variety and are actively exploring 2 paths. The first is a natural breeding program based on propagating up individual plants that seem to show some tolerance and ability to survive in affected areas. They hope that this solution will provide them with a viable option, however they also understand that there are no guarantees. The second option they are pursuing is Genetic engineering using Crispa technology. This is definitely their least preferred option as it will result in uncomfortable discussions with markets that are philosophically opposed to genetic engineering. It is not unrealistic to think that they face a future of choosing between a genetically modified banana or no banana at all.

I saw distinct similarities between this situation and where we find New Zealand facing the threat of Kauri dieback. Both are soil borne diseases that will continue to be spread not only by humans but also by weather, pigs and other wild animals. We are fighting a battle to slow the spread of Kauri Dieback and buy time, but what are we doing with that time. I would like to think we are able to have a serious conversation about the possibility of using Crispa technology to save the Kauri tree in New Zealand. I know this will an uncomfortable conversation in parts of our society, but I also reflect back on the decision facing banana growers, is a GM Kauri better than no Kauri at all?

Case Study 4 – Changing Farmer Behaviour

When I look at the idea of trying to drive behavioural change within the primary industries to accept biosecurity as standard practice, I saw a strong correlation to Worksafe New Zealand's drive to change farmer behaviour around Health and Safety. I saw numerous parallels between the "She'll be right" or the "It will never happen to me" attitude that results in nothing being done.

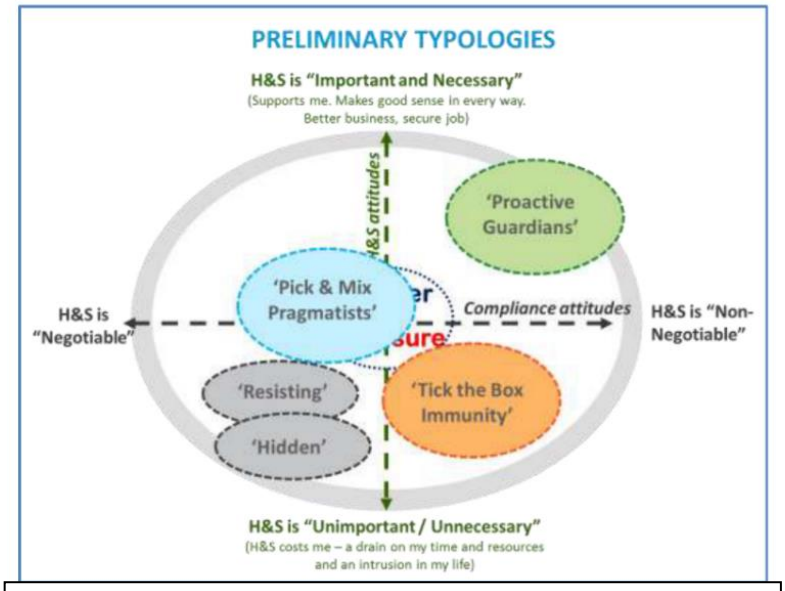
In the 1990's New Zealand's Health and Safety laws were reformed and farmers for the first time found themselves subjected to legislation requiring them to engage in H&S practices. At the time there was a fair amount of kick back from farmers who believed they were exempt from H&S regulations and that forcing them to comply would ruin the industry. Through persistent messaging and a mix of education and strict enforcement Worksafe have managed to create a behavioural shift among farmers to the point that for most of us H&S is just a part of everyday life, its treated as business as usual.

It is fair to say even today there is still some resistance towards H&S practices, and those of us engaging in it were dragged there kicking and screaming, but I believe Worksafe have been successful in making it accepted as part of the culture. This is the reason I was interested in looking at what Worksafe had been doing as I believe the same theory can be applied to making Biosecurity widely accepted as a core part of farming to the point it just becomes business as usual.

When Beef and Lamb looked at why people get into farming, they found that it wasn't about the rural lifestyle and working outdoors, but it was about the way of life, the ability to make your own choices and be your own boss. This led them to look at what are the most common drivers that lead to people choosing farming as a way of life, two stood out. Firstly, those who wanted to be in control and run things their way. Secondly, they found a significant number who entered the industry sought the isolation of working on a farm as they preferred being on their own and didn't want to work with others.

It's clear that neither of these groups like being told what to do, and any attempt to tell farmers how to run their farm will result in a backlash. What you need to do is look at what motivates individuals, what are the levers you can pull that will result in a shift. You must start with education and getting farmers to the point they understand there is a problem, the levers kick in getting past this point, what will push them over the edge from accepting there is an issue, to being prepared to do something about it.

Worksafe commissioned Nielsen to study attitudes and behaviours of workers in New Zealand towards health and safety. The study found bosses and workers could be classified using 5typologies What the report highlighted was the different levers or motivators required depending on where you sat on the chart. The proactive guardians were already motivated to implement change and saw the value in engaging in H&S. They did not need to be pushed, but rather need validation that they were making the right decision and could see that others would also be forced into following. At the opposite end of the scale those sitting in resisting rely on enforcement to finally push them into making changes. It was noted that peer pressure could play a role in finally motivating change within this group.



Nielsen, Health and Safety Attitudes and Behaviours in the New Zealand Workforce

The outcome for Worksafe is that when they look to engage with farmers, they realised that there are different levers that you must pull for different groups and that any campaign therefore has to operate on multiple levels targeting as many different levers as possible. You could describe this as a shot gun approach to motivation.

One of the keys was that education on its own was not enough, that there need to be a call to action that pushed a farmer from just being aware of the risk and possibly even thinking about how to resolve it, to acting.

Conclusions

No matter what industry you are in it is only a matter of when not if you will be hit by another biosecurity incursion. The level of on-farm biosecurity in your industry will determine how fast that incursion spreads and will also have a direct impact on how severe and damaging that incursion is.

Whilst implementing biosecurity practices on your own property can improve your own chances of reducing the impact of an incursion, having all your neighbours implementing the same practices and therefore working collectively will give you a far greater chance of having a positive outcome.

This communal based approach to biosecurity relies on everyone doing their bit. Peer pressure is a powerful weapon and will bring many on board, unfortunately, as previously discussed in this report it is very difficult to get everyone on board and despite the best advice and support, at some point you will need the stick approach to get the last few to do their bit.

Farmers left to their own devices will not act. It is therefore the responsibility of all primary industry bodies to educate and help drive change in their industry. They need to establish what drivers their farmers will respond to and use those drivers to engage with their farmers.

They also need to engage with other organisations to pressure them into making biosecurity a fundamental requirement across their industry. We need the likes of Fonterra to refuse to enter a property to collect milk unless the farmer can show evidence of a biosecurity plan. Freezing works should refuse to accept livestock unless there is full traceability and evidence of a biosecurity plan. These industry players are the ones who can provide a strong lever to drive this and force a change.

It is also in the best interest of these industry organisations to play their part in biosecurity because their business ultimately is tied to the stability and success of their supplying industries. A freezing works being shut down in the middle of a foot and mouth outbreak will suffer just as much as the farmers who supply them.

The most important point is the need to be proactive and to have practices in place before an incursion occurs and not simply react once it is already too late. This only works if everyone is onboard, however an individual farmer on their own implementing biosecurity practices will make little difference, a whole community implementing these practices will be much more protected. In this biosecurity works a lot like immunisation, even a small group who refuse to vaccinate can then get infected and increase the pressure and risk to others who are vaccinated. If everyone in a community is vaccinated, then it is very difficult for an infection to establish. According to the Immunisation Advisory Centre's Measles fact

sheet, countries which have consistently high levels of immunisation have been able to eliminate the disease from the population. Unfortunately, as we can see with the antivaxx movement in many countries including New Zealand, it is almost impossible to get consensus and to get everyone to work together. With vaccinations it will probably take regulation and enforcement to make sure everyone is vaccinated, and the same will be true with biosecurity. Until farmers are all forced to implement biosecurity practices, the few who are proactive and do implement biosecurity practices on their property will continue to be put at risk by neighbours who refuse to engage.

Recommendations

Based on the experience I gained looking at different incursions around the world, my recommendations are as follows.

1) That all farmers/growers in New Zealand adopt basic biosecurity practices as part of their everyday management.
2) That industry organisations encourage and support farmers/growers to create farm biosecurity plans and provide guidance on the necessary measures to manage known pathways within their industry. Incumbent on this is that industry bodies continue to play an active role themselves in understanding potential threats and developing contingency plans to deal with these threats should they arrive.
3) That food safety certifications such as GLOBALGAP or NZGAP include biosecurity plans as part of their assessment of good agricultural practice. Including biosecurity in these certification schemes will provide the stick to ensure farmers/growers resisting change are forced into. If all companies dealing with primary produce, make biosecurity a condition of purchasing any primary produce from farmers/growers then the incentive will certainly be there.
4) That industry encourages and engages in a serious, science-based discussion about Genetic Engineering and the potentially important role it could play in helping a primary industry overcome a future incursion.

These recommendations are already too late to prevent current incursions, but we must learn from past failings and be better in the future. I look at the damage done to the Dairy industry and think how much worse this incursion has been because of a lack of controls. I also have hope that the industry will learn from this and implement industry wide biosecurity controls. These same biosecurity controls put in place to help prevent the spread of Mycoplasma bovis, could potentially save this industry in the future from being devastated by another incursion such as foot and mouth.

"Those who cannot learn from history are doomed to repeat it."
George Santayana

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Sample Property Biosecurity Plan

Entry pathway	Entry Points	Steps to mitigate/minimise
Orchard Staff	Orchard Entrance	Park vehicles on roadside and not in orchard. Have footbath at entrance to ensure footwear clean before entering property.
Spraying contractor	Orchard Entrance	Require contractor to wash and sterilise machinery to ensure it is free of soil and plant material before entering orchard.
Harvest truck	Metalled loadout	Truck only to access metalled area therefore minimising risk of potential transfer to orchard
Harvest tractors and trailers	Orchard Entrance	Require contractor to wash and sterilise machinery to ensure it is free of soil and plant material before entering orchard.
Stock	Northern Boundry	Single fence onto neighbouring property which has livestock. Will run electric fence down border if stock next door to keep separate.
Stock	Purchase new stock	Utilise NAIT to track tgransfer of stock and record farm where they have come from incase of future quarantine issue. If stock are sold track location they have gone to.
Bees	Orchard Entrance	Require Beekeeper delivers all bees to sealed loadout area only. Will then deposit hives around orchard using own tractor.
Fertiliser Delivery	Metalled Loadout	Any fertiliser deliveries to be made to the metalled area only. Fertiliser then applied using own tractor
Shelter Trimmer/Mulcher	Orchard Entrance	Require contractor to wash and sterilise machinery to ensure it is free of soil and plant material before entering orchard.