Biosecurity in a changing climate, critical for our future

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The purpose of this paper is twofold. The first section highlights Biosecurity issues for the Australian Cotton industry while the second section examines the potential impact climate change will have on Biosecurity and our ability to manage endemic and exotic pests and diseases under changing climatic conditions.

Why have Cotton biosecurity

Australia's geographic isolation and lack of shared land borders have provided a degree of natural protection from exotic threats. Australia's national quarantine system also helps to prevent the introduction of harmful exotic threats to plant industry. Rapid increases in overseas tourism, imports and exports, mail and changing transport as well as the potential for pests to enter via natural routes, mean that relying on border quarantine measures is not enough. Biosecurity planning provides a mechanism for the cotton industry, government and other relevant stakeholders to actively scan the international literature for pests of significance to the cotton industry but not yet present in Australia. Once you have a biosecurity plan then the next step is implementation of the risk mitigation measures identified through the planning process. This may include undertaking active surveillance so that a new pest is detected early thus providing greater opportunity for eradication. Alternatively it may be recognising that a more virulent pest strain, of an existing pest, would be very difficult to detect until it was already well established. In this situation pre-emptive breeding or registration of known effective chemical to manage the pest if it arrives may be the preferred and most cost effective solution. A number of significant pests of the cotton industry (identified below) will most likely become established in metropolitan areas prior to migrating to cotton farming areas. In these situations ensuring biosecurity measures are in place on individual farms which delay or ideally stop the new pest moving onto farming operations are vitally important. This takes on even more significance if new production areas are established as there will be a short window of opportunity to establish the industry without many of the endemic pests found elsewhere. An example of where this is occurring now is in the Emerald area of Queensland. The citrus growers in Emerald are using the citrus canker incident to their advantage to only bring in to the area virus and pathogen free planting material. The intention is that by adopting this approach they can become a production area free of many of the endemic pests that affect other citrus production areas across Australia. While the trees are only around 12 months old there is evidence this approach is paying dividends already with reduced chemical used. The "Come clean go clean" initiative of the cotton industry is well suited to the concept of risk mitigation for high risk exotic plant pests.

Background to the Australian Cotton Industry

Cotton is grown in Australia in most of the major inland river valleys of eastern Australia, in a belt stretching from central Queensland in the north to the Menindee Lakes in southwest New South Wales. Cotton is generally grown as an irrigated crop in fertile alluvial floodplain soils, and is the major crop in a number of regions. Major town centres associated with the cotton industry include Emerald, Dalby, Goondiwindi and St George in Queensland, and Moree, Narrabri, Gunnedah, Bourke and Warren in New South Wales. Cotton has been grown in Australia since the 1800's, but not until the construction of large irrigation dams in New South Wales and Queensland in the 1960's that provided a reliable source of water was it able to become an established crop. Rapid expansion occurred in the 1980's and early 1990's, when production increased from around 1 million bales per annum to over 3 million bales per annum (1 bale equals 227 kilograms of lint cotton). While production reached a peak of 3.5 million bales in 2001, subsequent drought conditions have seen production fluctuate over recent years: 1.3 M bales in 2003/04, 2.9M bales in 2004/05 and 2.594M in 2005/06 (Australian Cotton Industry Council). Only 2 commercial cotton spinning mills remain in Australia, and the vast majority — over 95 % — of the Australian cotton crop is exported, primarily to spinning mills in south-east Asia. Primary destinations for Australian cotton include Indonesia, China, Thailand, Korea and Japan. Australian cotton commands a premium on world markets due to its high quality, low levels of contamination and close proximity to customers.

High Priority Emergency (Exotic) Pests for the Australian Cotton Industry

Insects

Cotton crops in Australia are attacked by a wide range of pests, including the cotton boll worm (*Helicoverpa armigera)*, native budworm (*H. punctigera*), green mirids (*Creontiades dilutis*), cotton aphids (*Aphis gossypii*), two-spotted spider mites (*Tetranychus urticae*) and the silverleaf whitefly (*Bemisia tabaci*). The introduction of transgenic cotton, which has aninsecticidal protein (from *Bacillus thuringiensis*, *Bt*) inserted has dramatically reduced the need to control the major insect pest, Helicoverpa spp. Nevertheless, many of the major insect pests of cotton and that are not controlled by Bt are still absent in Australia.

The high priority emergency plant pests of cotton, listed below, are not present in Australia. These pests represent the consensus views of industry and government as those pests which have the potential to cause major economic disruption to the industry should they become established in Australia.

The pests are;

- White fly *Bemisia tabaci* B type plus other emergingstrains (including Qtype)
- Boll weevil *Anthonomus grandis*
- Melon aphid *Aphis gossypii* (exotic strains)

- Tetranychus mites *Tetranychus spp. T.lombardini, T.turkestani, T.pacificus, T.desertorum*
- Green Jassid *Amrasca devastans; Amrasca biguttula biguttula*
- Tarnished plant bug *Lygus lineolaris*

Pathogens

Cotton production is also subjected to a number of pathogens in Australia, most noticeably verticillium wilt (*Verticillium dahliae*) and Fusarium wilt (*Fusarium oxysporum f. sp. vasinfectum*). To counter these and other pests and diseases, the industry has developed a range of best management practices and is a leader in farm hygiene, promoting the message 'Come clean, go clean'.

As for the insects the following emergency plant pathogens represent the consensus view of the most significant pathogens worldwide, but not yet present in Australia, that would affect cotton production.

The pests are;

- Cotton Leaf Curl Virus
- Gemini virus
- Fusarium wilt (exotic races) *Fusarium oxysporum Schlecht..f.sp.vasinfec tum Atk.* Sny. & Hans.
- Texas root rot or Phymatotric root rot *Phymatotrichopsis omnivora* (Duggar) Hennebet = *Phymatotrichum omnivorum* (Shear) Duggar
- Verticillium wilt (defoliating strains) *Verticillium dahlia* Kleb.
- Bacterial blight (hypervirule nt races) *Xanthomonas axonopodis pv mavacearum Xanthomonas campestris pv mavacearum*
- Blue disease Luteovirus (suspected)

Biosecurity in changing climate

In this section of the paper I will describe the possible biosecurity implications of climate change on the Australian cotton industry. Climate change represents both a threat and an opportunity for the cotton industry. One of the opportunities that arise is the likely shift back to natural fibres such as cotton, wool and hemp etc. This shift should occur as oil supplies are depleted, the price of oil increases and the cost of carbon credits takes effect. Agriculture, depending on how an emissions trading scheme which includes agriculture is structured, may be a beneficiary of carbon trading thus making natural fibres even more competitive.

However for the purposes of this paper only climate change issues and their potential impacts on biosecurity for the Australian cotton industry will be covered. Australia's rural industries are recognised for their ability to improve productivity in line with international best practice, a willingness to adopt new innovations, and for their resilience in one of the most challenging climates in the world. These challenges are taking on new meaning with scientific evidence mounting that climate change is now impacting on the Australian climate. The climate experts tell us that the northern parts of the country will get wetter while the southern parts will get drier over time. The Cotton industry will need to adapt to these changing conditions and look for new production areas in which to grow cotton. One area that immediately springs to mind is the Ord region in Western Australia. I will use this area as my example region to demonstrate the possible impacts of climate change on biosecurity as it has a number of the key attributes I am describing. As a précis to this I will for the purposes of this paper assume the ban on GM cotton in WA has been relaxed. The Ord is a good example region in that it is in the area where rainfall is likely to increase, it is a suitable area for growing cotton, it has plenty of capacity for irrigation and there is ample land available given the sugar industry is no longer the major user of water and land.

So what does developing a cotton industry in the Ord in times of climate change potentially mean? There is evidence that climate change will lead to increased risks and severity of impact of plant pests (pests in this context includes insects and pathogens). Increased temperatures and changing weather patterns will also change the traditional geographic distributions of pests and diseases – all this will put further emphasis on the importance of sound on farm biosecurity. It is well established that many insect pests thrive under higher temperatures so if climate change results in increasing temperatures the number of generations of insects per season will increase. Decreasing generation times will result in pesticide resistance developing in shorter and shorter times. In addition pests which were previously "managed" in the cooler areas, as they entered a resting phase or died out will now be able to continue developing year round. Examples of pests that will benefit from warmer conditions include cotton boll worm, silverleaf whitefly and two-spotted spider mites. These are endemic pests which will need to be managed under existing climate change conditions now but if one re examines the high priority pest list you will see similar exotic species are also listed making the task of managing the range of insect pests complex. The same principles apply to the pathogens. There are a number of pathogens in the list of endemic and high emergency pests that would be favoured by increased temperatures and rainfall.

Another challenge, not readily recognised, is that not only will known pests and diseases change their behaviour as the climate changes, but moving agriculture to new areas brings its own unique challenges. For the cotton industry moving to the wetter northern areas may result in challenges not yet considered. Using my Ord example it is known that there are native *Gossypium spp*. growing in that region of Australia. What is not know, at this time, is what pests attack these native "cotton" plants and what they would do if a large population of suitable host plants were planted nearby. I do not have a cotton example to illustrate the potential impact of this situation however there is a horticulture example that shows what can happen when a host crop is moved into new area where native pests are present.

In Australia we have one of the world's most economically significant fruit flies – Queensland fruit fly. This fruit fly is an Australian native and caused little damage in the Australian rainforest until horticulture spread from Cairns to Tasmania, creating a "land bridge" of food. With a range of new food available this pest has now emerged as the most economically important plant pest in Australia. In fact a recent study has shown that Australian Governments and Industry have spent a minimum of $128 million managing this pest over the last 5 years. The point to note is we do not know what other native pest/s may emerge when we take new crops into new areas.

Moving Australian agriculture north also moves it closer to our Asian neighbours. Many of the serious plant pests identified through the industry biosecurity planning processes have identified serious pests that are established in our near northern neighbours. With the crops moving closer to the northern parts of Australia, in search of reliable water, the opportunity for pests to 'jump" across to Australia using natural means of dispersal increases. Sound surveillance systems will be required to monitor crops being grown in the north to ensure rapid detection of new pests should they become established.

One of the biosecurity initiatives that has been implemented by the Australian Government, State and Territory Governments and plant industries has been the development and endorsement of the Emergency Plant Pest Response Deed (EPPRD). This arrangement is a world first for plant industries and it clearly outlines roles and responsibilities of all signatories should an exotic pest of economic significance is detected. This arrangement would facilitate a national cost sharing arrangement aimed at the eradication of a newly detected emergency (exotic) plant pest. These arrangements allow for grower owner reimbursement costs to be met, if the crop is destroyed, and enables industry to participate as full members on the national decision making committees. Industry in gaining these advantages also shares the cost of the eradication program on a pre agreed proportional split basis. Details of these new arrangements can be found on the Plant Health Australia web site http://www.planthealthaustralia.com.au/site/index.asp

In summary while the cotton industry is well prepared for biosecurity threats from offshore, with the development of the Cotton Industry Biosecurity Plan, more needs to be done to implement the plan at a regional level. This regional application of surveillance, awareness and training will take on more significance if the industry moves production to new areas to take advantage of water availability as a consequence of climate change.

Reference

Plant Health Australia (2006) "Cotton Industry Biosecurity Plan - Version 1". Published PHA web site.