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Australian plant biosecurity surveillance systems

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ABSTRACT

Australia is an island nation and a primary producer of agricultural and horticultural products. There is a large diversity of plant biosecurity threats which could adversely impact on Australia's production and exports. Surveillance has traditionally been used to monitor pests and optimise production. Increasingly surveillance is being used for early detection of exotic incursions, demonstration of eradication of incursions and pest freedom from exotic or endemic pests. These newer uses of surveillance utilise general and specific surveillance: surveillance data is maintained in electronic databases. Specific surveillance is a targeted surveillance search used by industry or state regulators for a specific pest to support pest freedom or other trade standards. The plant biosecurity surveillance cycle shows the flow of surveillance operations. In this paper, this cycle is demonstrated by case studies including pre border and the northern Australian at-border surveillance for the Australian-Asian interface. Within Australia, the multiple plant pest surveillance program was established in most capital cities where there are high flows of population and produce. As an industry example, the cotton industry surveillance program, particularly for cotton leaf curl, demonstrates how plant biosecurity surveillance operates within an industry. Asiatic citrus canker is another example of industry pertinent surveillance. Finally, surveillance for the purpose of declaring pest freedom areas is reviewed using fruit flies and currant lettuce aphid as examples.

Contents

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1. Introduction - a diversity of threats

Invasive species cost an estimated US$314 billion annually, with over 120,000 plant, animal and pest species believed to have invaded Australia, Brazil, India, South Africa, the United States of America and the United Kingdom alone (Pimentel et al., 2001). Recognising the need for international standards to facilitate trade of plants and plant produce around the world, while minimising the movement of plant pests, the International Plant Protection Convention (IPPC) develops International Standards for Phytosanitary Measures (ISPMs). These standards include surveillance, defined as 'an official process that collects and records data on pest occurrence or absence by survey, monitoring or other procedures' (IPPC, 2010). As such, plant biosecurity surveillance provides a scientific basis for the assessment and management of risks posed to plant production and the environment by plant pests.

The term 'pest' refers to "… any species, strain or biotype of plant, animal or pathogenic agent, injurious to plants or plant products" (IPPC, 2010). The modern age of globalisation means that the threat from unwanted pests is greater than ever before (Hulme, 2009; Stanaway et al., 2001). Global pathways of entry through tourism, immigration and trade are open and largely unregulated in many areas (Hulme, 2009). Data published on the IPPC website indicates that Australia has reported on the status of 49 new plant pests comprised of 17 fungi, 12 invertebrates, eight viruses and virus like organisms, five bacteria and seven weeds (Table 1 covers the period from 13 November 2006 to 21 January 2014). These likely conservative numbers demonstrate the diversity of biosecurity threats confronting managers, scientists and persons designing and implementing surveillance systems. Of these pests, five have been eradicated, and a further 10 are under eradication or official control. The remaining detections were considered not feasible or cost-beneficial to eradicate, reflecting the fact that they were of minor concern or, more significantly, that detection did not occur until post-border establishment and spread. Moreover, many of these plant pests are cryptic, being vectored within or on other organisms and having symptoms that are hard to distinguish from endemic and established pests or abiotic constraints. Because of this they are difficult to detect through traditional surveillance activities.

2. Why do we do surveillance?

Plant biosecurity is a suite of risk management activities deployed across a continuum of jurisdictions, from pre-border, at border, to post-border activities that minimise the impact of plant pests on natural and managed ecosystems (Magarey et al., 2009; Nairn et al., 1996). Surveillance is a fundamental component of any plant biosecurity system, as knowledge of pest status is the basis for managing risk. Plant biosecurity surveillance systems are designed and implemented to assess pest status for many different reasons (McMaugh, 2005). These fall broadly into three categories:

1. surveillance to facilitate trade (e.g. area freedom, areas of low pest prevalence, pest free places of production);
2. surveillance to support pest management and control (e.g. commodity specific pest surveillance and monitoring of endemic pests); and
3. surveillance to facilitate early detection, and support and validate responses to pest incursions.

Surveillance systems often serve more than one of these purposes, which are intrinsically linked. For example in south eastern Australia, routine surveillance in the Fruit Fly Exclusion Zone (FFEZ) (Anon, 1996) was carried out systematically to validate area freedom (Category 1), and support pest management and control (Category 2) by ensuring early detection (Category 3) so that measures could be rapidly implemented to prevent establishment of Queensland fruit fly (QFly) (*Bactrocera tryoni* (Froggatt)) and provide early detection of Mediterranean fruit fly (Medfly) (*Ceratitis capitata* (Weidemann)) (Dominiak and Daniels, 2012). Such measures thereby facilitated market access for fruit grown within the FFEZ on the basis of area freedom.

3. Pest records to support pest status

Surveillance is a tool used to generate pest records, which in turn support determinations of pest status, through sufficient evidence in the form of accurate and reliable pest records (IPPC, 1998; van Halteren, 2000). The accuracy and reliability of a pest record is directly impacted by the design and implementation of the surveillance system through which it was generated. A pest record 'provides information concerning the presence or absence of a pest, the time and location of the observations, host(s) where appropriate, the damage observed, as well as references or other relevant information pertaining to a single observation' (IPPC, 1998). Substantial effort is directed towards ensuring individual reliability of pest records. The reliability of pest records 'is based on consideration of the data in regard to the collector/identifier, the means of technical identification, the location and date of the record, and the recording/publication of the record' (IPPC, 1998). Further, the reliability of pest records will be improved where nationwide or international database and metadata standards are in place to provide consistency and coherency in pest record management. Hill (2013) noted the importance of verifying old records with contemporary surveillance to ensure the validity of historic records in databases. The incorporation of fully documented voucher pest specimens in institutional repositories is imperative to support surveillance activities.

Pests may impact several categories including economic, social and environmental categories. Economic pests impact on individual producers, groups of producers and regional/international market access. This category of pest usually drives a funded response or eradication. Australia conducts surveillance for fruit flies to demonstrate freedom from particular species or to detect incursions (Dominiak and Daniels, 2012; Dominiak and Worsley, 2016). Pests such as Asian gypsy moths (*Lymantria* spp.) cause