

REVIEW

Ability of governments to take actions to confront incursions of diseases – a case study: citrus canker in Florida

T. J. Centner* and S. Ferreira

The University of Georgia – Agricultural and Applied Economics, 313 Conner Hall, Athens, GA 30602, USA

When governments take actions under their police powers to prevent incursions of diseases, they may damage or destroy private property and a question arises of who should pay for property losses. A court in Florida concluded that the state needed to pay for property destroyed under a citrus canker eradication programme. Because this interpretation of the Florida Constitution's Just Compensation Clause makes it more difficult to administer a successful eradication programme, governments and scientists, working with industry, may want to develop a more comprehensive accounting of scientific data and procedures that justify an eradication programme's actions. This paper identifies three problems regarding Florida's efforts to eradicate citrus canker so that scientists, affected industries, and governments can employ an objective reassessment mechanism to support their actions without legal interference.

Keywords: assessment mechanism, citrus canker, eradication, governmental police power, liability

Introduction

With the widespread dissemination of plant and animal products, the control of diseases (including all types of pest) continues to be challenging. National and subnational governments have developed numerous institutions to deal with disease control because of the havoc caused by the introduction of diseases to producers, consumers, markets, food supplies and local biodiversity. Emergency quarantines, eradication programmes, and management strategies have been adopted to reduce the damages and costs associated with specific diseases. In many cases (foot and mouth disease being prominent) (Paton *et al.*, 2009), governments have been successful in thwarting the introduction of new diseases, with corresponding benefits to regional and national economies (Guillén & Sánchez, 2007; Haack *et al.*, 2010). In other situations, established diseases have been eradicated (Ragan, 2002; Bowman, 2006). Yet, not all eradication efforts are successful, meaning that producers have needed to adjust to managing the disease (Dee *et al.*, 2011).

*E-mail: tcentner@uga.edu

Published online 16 December 2011

Because governmental efforts to eradicate diseases cost money and may involve financial losses by producers and others, they are controversial. As eradication measures are usually beneficial to producers, many eradication programmes assign significant costs to this group (US Code, 2006). However, producers may not be a homogeneous group, especially in mixed landscapes where there are commercial and noncommercial producers. While commercial producers may be willing to pay for eradication efforts because of the long-term advantages of being free of a disease, noncommercial producers may not be as agreeable to paying for eradication efforts because of different knowledge and objectives (Gramig *et al.*, 2009). For example, noncommercial citrus producers in Florida, who are also referred to as homeowners, lamented the loss of citrus trees in their gardens because of the loss of fruit production (Salisbury, 2008). Yet, the evidence showed that citrus canker would drastically reduce homeowners' ability to successfully raise citrus (Schubert *et al.*, 2001).

Differences in who pays for eradication efforts also affect producers' measures to prevent disease incursions (Ranjan & Lubowski, 2005; Hennessy, 2007). If governments assume all the costs of disease control, producers may have little incentive to expend resources to reduce the risks involved with an incursion (Ceddia *et al.*, 2008). Thus, disease eradication and management programmes

have incorporated provisions that assign costs to encourage producers to take precautions to prevent disease incursions (Goodwin & Piggott, 2009; Van Opstal & Sunley, 2009).

In the USA, Congress has authorized the US Department of Agriculture (USDA) to take action to detect, control, eradicate, suppress, and prevent the spread of plant and animal diseases for the protection of agriculture and the American economy (US Code, 2006). Furthermore, individual American states have enacted legislation and administrative rules to address diseases. For situations in which the public would be harmed, a state government may declare a disease to be a public nuisance and take action to remove and destroy property to eradicate all sources of the disease. The Florida legislature authorized the state Department of Agriculture and Consumer Services to declare quarantines and plant pests as nuisances, and to develop a programme to prevent and limit the spread of citrus canker (Florida Statutes, 2010).

However, when governments destroy private property, a question may arise whether the property's owner should be compensated. In the USA, federal and state constitutional 'Just Compensation Clauses' require governments destroying property for public use to pay for property taken (Florida Constitution, 2010; *Stop the Beach Renourishment, Inc vs Florida Department of Environmental Protection*, 2010). Any permanent physical invasion by a government onto private property is an unconstitutional 'taking', and the government must pay for the property taken (*Pennsylvania Coal Company vs Mahon*, 1922).

Recent efforts by the state of Florida to eradicate the disease citrus canker raised the issue of whether a government can destroy trees exposed to the disease without full compensation to tree owners. The Florida legislature had declared citrus canker a public nuisance and the state had adopted a citrus canker eradication programme under which trees near a known infestation were destroyed (Florida Statutes, 2003). In a lawsuit, noncommercial owners of citrus trees removed and incinerated sued the state for the full value of trees destroyed (*Department of Agriculture & Consumer Services vs Bogorff*, 2010). Although the state argued that the destroyed trees were a nuisance and their destruction was a legitimate exercise of the state's police power, the court decided that the Florida Constitution required full payment for trees destroyed in the exposure zones.

By agreeing with the homeowners of citrus trees, the court established an inimical precedent for disease control efforts. The court's ruling basically requires governments to insure persons against property losses from incursions of diseases without considering disease prevention measures that affect risk classification. There are no premiums based on insured-specific risk, taxpayers typically fund the compensation payments, and compensation may crowd out private risk mitigation (*Gramig et al.*, 2009). Under this policy, the guarantee of compensation for diseased property may lead producers to expend less effort to control disease incursions. Further-

more, governments concerned about paying compensation may be less anxious to engage in efforts to control diseases and this could have negative consequences in cases in which quick action is necessary. This review examines the citrus canker eradication programme and litigation to identify three aspects whereby the government, food production industries, and scientific community might be more proactive in documenting support for eradication efforts encompassing the destruction of property without compensation.

Eradicating citrus canker and the destruction of property

Agricultural production may be constrained by diseases. With the ability to import food products from other areas of the world, an incursion of a disease in an area can cause production to become uneconomical or impossible (*Sosnowski et al.*, 2009). To thwart outbreaks of diseases, emergency eradication programmes are adopted when the facts suggest that a disease may be precluded from establishing itself in an area (*Sosnowski et al.*, 2009). Citrus canker is a candidate for an eradication programme because it has fundamental features that make eradication feasible and desirable (*Graham et al.*, 2004).

Florida citrus canker eradication programme

On two occasions during the past 100 years, Florida was successful in preventing the introduction and dissemination of bacteria that cause citrus canker (*Schubert et al.*, 2001). Since the 1980s, the state has taken action to eradicate citrus canker, with the USDA declaring an extraordinary emergency in 1984 authorizing actions for the eradication of the disease (USDA, 1984). Subsequent actions by the USDA reassessed the efforts, performed a risk analysis, and provided additional funding (USDA, 1988, 1999a). Under the USDA's programme, trees infected or exposed to citrus canker in exposure zones of commercial producers were destroyed and the USDA paid commercial producers funds necessary to establish new plantings (USDA, 2000).

While there exists clear authority for a government to destroy infected trees, the destruction of trees in exposure zones without testing them for the presence of bacteria raises a question of whether the owners should receive compensation. Because the symptoms of citrus canker take time to manifest, the disease cannot be eradicated by simply destroying visibly infected trees (*Schubert et al.*, 2001). An analysis of the disease suggested that an exposure zone of 1900 feet (approx. 580 m) was required to preclude inocula from infecting additional trees (*Gottwald et al.*, 2000; *Schubert et al.*, 2001). With this evidence, the USDA found that trees in exposure zones needed to be destroyed and had no value (USDA, 2000). The Florida legislature adopted a law that defined 'exposed to infection' to include all citrus trees that 'do not yet exhibit visible symptoms of the disease but due to the proximity to infected trees will develop symptoms

over time' (Florida Laws, 2000). Using this definition, the legislature adopted a 1900-foot exposure zone in which all citrus trees were to be destroyed (Florida Laws, 2002).

Under Florida's citrus canker eradication programme, the state removed more than 1.56 million commercial trees and nearly 600 000 trees from noncommercial properties that were infected or within 1900-foot exposure zones (Gottwald *et al.*, 2002). State law established a payment schedule of \$55 per destroyed tree (noncommercial), an amount sufficient to purchase a replacement tree (Florida Statutes, 2010, sec. 581.1845). In 2005, regulators realized that the cost estimates of eradication were too low so the state's programme was repealed in January 2006 (USDA, 2006; Florida Department of Agriculture & Consumer Services, 2007). As a result of hurricanes and other events, disease inocula had spread to too many areas, so the costs for destroying trees exceeded anticipated benefits.

However, the repeal of the eradication programme did not placate the public furor of homeowners whose citrus trees had already been destroyed. Therefore, Ms Bogorff and more than 50 000 homeowners sued the state in Department of Agriculture & Consumer Services vs Bogorff (2010), claiming their trees were healthy and were worth more than the funds they received from the state. They sought damages, claiming that the state had unconstitutionally taken their private property for public use and they should be paid for the full value of the destroyed trees. The Bogorff plaintiffs' argument was based on the contention that the trees in exposure zones were not infected and the state had not definitively proven the trees posed a risk in spreading citrus canker.

Destroying property in exposure zones

The Bogorff plaintiffs' argument challenged the validity of the science used to delineate the 1900-foot exposure zone set in 1999. The state based the 1900-foot zone on a study by a USDA scientist who was an expert on citrus canker (Gottwald *et al.*, 2001). An epidemiology study showed the failure of an earlier, smaller exposure zone in controlling the spread of bacteria causing citrus canker. Drawing upon other data, the scientific study concluded a 1900-foot exposure zone was needed to successfully stop the bacteria from spreading. A task force of regulators, scientists and citrus industry representatives who dealt with citrus canker unanimously recommended the adoption of the 1900-foot exposure zone, and the state and federal agencies made the exposure zone part of the eradication programme.

In defending its eradication actions, Florida claimed that infected trees and trees in exposure zones were a public nuisance and the state had acted under its police power to prevent harm (Initial Brief of Florida Department of Agriculture, 2008). The state's argument was bolstered by other jurisprudence (Miller vs Schoene, 1928; Wallace vs Dohner, 1929; Malbrain vs Washington State Department of Agriculture, 2004) and examples of animal quarantine actions. State laws regulating animal diseases

often allow for the destruction of not only diseased animals but also animals 'exposed to any disease' (Kansas Statutes Annotated, 2011; Wisconsin Statutes, 2011). Two examples of lawsuits from other states concerning plant diseases highlight the court's refusal to follow established jurisprudence. These cases show that governmental programmes to eradicate plant pests do not require full compensation for destroyed property.

In Malbrain vs Washington State Department of Agriculture (2004), a court examined a factual situation analogous to Florida's citrus canker eradication programme. The Washington State Department of Agriculture developed an eradication plan and the governor proclaimed a state of emergency to prevent the citrus longhorned beetle from becoming established in Washington. Under the eradication plan, all potential host species within a radius of one-eighth of a mile (approx. 200 m) of the infestation site were removed despite no proof of infection. The state destroyed fruit, alder, willow, oak and some conifer trees owned by 51 landowners on approximately 13 ha. The state arranged to pay landowners for the purchase of replacement plants and supplied vouchers that could be used to purchase non-host species of vegetation.

Some landowners were unhappy with the loss of their plants and unsatisfied with the state's payment scheme. They sued and requested payment for the value of plants taken. The Malbrain appellate court concluded that the destruction of property to avert the dissemination of the beetle did not require compensation. The court noted that in destroying trees, the state had temporarily entered the plaintiffs' property in response to an emergency, but did not permanently occupy the properties, so did not effect a compensable taking. The state did not have to further compensate the plaintiffs for their losses.

Another example of an invasion of property to eradicate an insect pest was reported in Farmers Insurance Exchange vs California (1985). The state of California took action to control an invasion of the Mediterranean fruit fly, identifying premises within eradication areas as public nuisances. When the infestation proved more difficult to control than originally thought, the governor declared a state of emergency and invaded private property through an aerial spray programme that deposited chemicals on properties susceptible to an infestation. The spray programme resulted in incidental damages to automobile paint, leading insurance companies to sue the state for damages incurred by vehicle owners that the insurance companies were obliged to pay. The appellate court observed that emergencies justifying police action without compensation included the demolition of buildings to prevent the spread of a conflagration and the destruction of diseased animals, plants and fruit. A government's action will be upheld as part of a government's police power if it was reasonably necessary to protect order, health and general welfare. Because the state's action to eradicate a fruit fly infestation fell within this emergency exception, the plaintiffs' private interests were subservient to the right of the state; no compensation was owed for damages to vehicles.

Returning to the Florida citrus canker eradication efforts, the *Bogorff* trial court decided to question the merits of the USDA's scientific study and summarily decided that the task force had failed to determine whether the 'study was based on sound scientific principles' (Initial Brief of Florida Department of Agriculture, 2008, paragraph 24). The court wanted a parallel or duplicate study by scientists not connected with the state or federal governments. Yet, no information was advanced by the plaintiffs or the court indicating any deficiency in the study or the study's recommendation of a 1900-foot exposure zone. There was no evidence suggesting that the study did not accurately reflect the risk assessment for the spread of the disease nor any evidence alleging the state's pest risk analysis was faulty. Moreover, the scientific study by the USDA employed international standards for the framework for pest risk analysis (FAO, 2007), the establishment of pest-free areas (FAO, 1995) and pest risk analysis (FAO, 2004).

Developing scientific responses

If future courts follow the *Bogorff* ruling, producers will have fewer incentives to reduce risks and prevent incursions. The *Bogorff* decision suggests that scientists and the food production industry need to provide a comprehensible accounting of the salient features of an eradication programme as well as the harm inflicted by the disease. This accounting would be directed at establishing the eradication programme as a police power action that does not require compensation above the minimal amounts set forth for the particular programme.

To plan for future challenges to eradication programmes, cooperative efforts between scientists and government officials can provide the foundation for justifying eradication efforts. The lessons from the citrus canker litigation suggest that once an eradication programme is in place, there needs to be a mechanism to consider new information and for reassessing the merits of the programme. Secondly, under an assumption that good science justified the eradication programme, scientists may be called to provide a convincing accounting of this science if a programme is challenged in court. Thirdly, scientists, with the help of the applicable food production industry, have knowledge that can provide the documentation required to show harm to support the uncompensated destruction of property serving as vectors for disease inocula.

The goal of each of these three responses is to justify the eradication programme as a governmental action under the police power that responds to a public nuisance by preventing harm (*Lucas vs South Carolina Coastal Council*, 1992; *Customer Company vs City of Sacramento*, 1995). With such a justification, the accompanying destruction of private property does not need to be compensated (Tomasovic, 2011). Conversely, if a government's action is not justified under the police power, the destruction of property requires compensation (*Stop the Beach Renourishment, Inc vs Florida Department of*

Environmental Protection, 2010). Even when the government's confiscation of property occurs under a legislative directive, if it cannot be justified under the police power, the government would need to compensate the owners of property taken.

Additional input and reassessment of a programme

The state of Florida worked with the scientific community in addressing the incursion of citrus canker and developing its eradication programme (Florida Laws, 2000; Schubert *et al.*, 2001; Gottwald *et al.*, 2002). However, the information that formed the basis for the government's decision in the mid-1990s became outdated as new outbreaks occurred, legal challenges interfered with the destruction of trees, and hurricanes caused a marked spread of inocula. By 2001 there was concern that the complete eradication of the disease under the state's eradication programme would be extremely difficult because of the widespread dispersal of inocula (Gottwald *et al.*, 2002). Other scientists recognized in 2002 that even a sound eradication programme could be doomed if it elicited strong negative public objections (Schubert *et al.*, 2001).

The negative public opinion was not successfully countered by the state. Because of legal challenges, there were two 18-month gaps between 2000 and 2004 during which the state was enjoined from fully implementing the removal of trees in eradication zones (Adams *et al.*, 2007). Despite these admonitions and programme setbacks, the state persevered in maintaining its eradication programme. This information raises the question of whether the state had a functional mechanism for reevaluating the merits of its eradication programme. The issue involves consideration of pertinent new information and an objective reassessment of the likelihood of success in eradicating the disease.

Looking at the guidelines for pest eradication programmes set forth under the International Plant Protection Convention (IPPC), an eradication programme should be subject to periodic review to analyse and assess information whenever an unforeseen circumstance is encountered that could affect the efficacy of the programme (FAO, 1998). In a compendium of activities under Florida's citrus canker eradication programme, the first listing for special public hearings and community liaisons occurred in 2000 (Gottwald *et al.*, 2002). This raises questions about the sufficiency of public information programmes or other means for sharing information with various audiences (see FAO, 1998). While Florida's eradication programme was accompanied by efforts to educate the public about its goals and objectives, the public failed to comprehend that the aetiology of citrus canker required the destruction of exposed plants prior to visible symptoms (Schubert *et al.*, 2001).

The most drastic change in circumstances occurred in 2004 when three major hurricanes traversed infected areas. Subsequent research showed that they dispersed canker inocula to new areas at significant distances from

pre-existing infections (Irey *et al.*, 2006). In November 2005, a panel of global experts concluded that eradication was not feasible (USDA, 2006). The decision to end the destruction of trees became effective in January 2006 (Florida Department of Agriculture & Consumer Services, 2007). With hindsight, it may be concluded that the state waited too long before ending its eradication programme. The inability to promptly destroy trees in exposure zones because of the legal challenges and knowledge that hurricanes had blown through infected areas presented substantial new information that cast serious doubts on the ability to eradicate citrus canker. By the end of 2004, this evidence supported a finding that eradication was unlikely as canker inocula had spread to too many areas. Yet, the state studied the results of inocula dispersal by the hurricanes for 14 months before relying on expert advice to discontinue the eradication programme in January 2006.

The lesson from reviewing these events is that, as captured by the IPPC guidelines, eradication programmes need a mechanism for considering new information and reassessing the merits of existing eradication efforts on a periodic basis, possibly every few months. The mechanism needs to encourage communications of new information and thoughts by the scientific community on an existing eradication programme to government regulators. Regulators need to be objective in promptly evaluating the information with respect to the continuation of eradication efforts. Moreover, an impartial evaluation depends on the absence of undue influence by any single special interest group. A timely reassessment of a programme needs to be able to accommodate the prompt cessation of eradication efforts when new information supports a conclusion that the disease cannot be eradicated.

Justification for destroying trees in eradication zones

The *Bogorff* homeowners sought payment for trees in exposure zones that had not conclusively been shown to be infected. They argued that with the absence of visible infection, the trees were healthy so they should receive compensation (Initial Brief of Florida Department of Agriculture, 2008). In defending its actions in the *Bogorff* lawsuit, the state of Florida failed to convince the trial court that trees in exposure zones could be infected without visible signs. An analysis of this issue suggests that a more detailed accounting of scientific data and procedures for the eradication programme's requirement of destruction of property in exposure zones is critical to justify an eradication programme.

The court decided to give credence to a witness who 'testified that trees not exhibiting visible symptoms of canker are presumed healthy' and homeowners who claimed their trees were healthy (Initial Brief of Florida Department of Agriculture, 2008). Yet, scientific evidence suggests that visibly healthy trees may be infected. The earliest symptoms of citrus canker appear around 7 days after inoculation (Gottwald *et al.*, 2002)

and symptoms visible to most people may take 60 days to appear (Schubert & Sun, 2003). Moreover, infections in the upper canopy of large trees may not be detectable through a visual survey from the ground (Initial Brief of Florida Department of Agriculture, 2008). Because of the difficulty in visibly ascertaining whether a tree is infected with citrus canker inoculum, trees are removed in exposure zones to eliminate windborne bacterial infections. The epidemiology of citrus canker suggests that the homeowners' observations and the testimony of the one witness could not conclusively document that trees in exposure zones were healthy. Perhaps if the state had offered more evidence countering the plaintiffs' evidence, the court would have acknowledged scientific findings that visual inspections cannot conclusively establish that trees are not infected with citrus canker.

Moreover, other courts have found that evidence of exposure to a disease is sufficient to justify its destruction under an eradication programme (*Miller vs Schoene*, 1928; *Malbrain vs Washington State Department of Agriculture*, 2004). For example, in preventing the establishment of a transmissible spongiform encephalopathy, the USDA was able to destroy the entire flock when two sheep tested positive (*Ag-Innovations Inc vs US Department of Agriculture*, 2006). To prevent the establishment of a citrus longhorned beetle, an eradication programme destroying all potential host plant species within a radius of one-eighth of a mile of an infestation site did not require full compensation for plants destroyed (*Malbrain vs Washington State Department of Agriculture*, 2004). When the epidemiology of a disease requires the destruction of plants or animals in exposure zones, the destroyed items are a nuisance and owners do not need to be compensated. For future challenges to eradication efforts, it is vital to help the trier of fact understand the mechanics of eradication, including the need to destroy property in exposure zones. When acting under their police power, governments should not incur liability for the destruction of items under rational programmes designed to eradicate an invasive disease.

Documenting harm

Turning to the requirement of harm, in evaluating Florida's action under the state's citrus canker eradication programme, there was evidence that the government was acting to prevent harm and was responding to a nuisance (USDA, 1999b; Florida Laws, 2000). These facts support a finding that the state acted under its police power and did not need to compensate owners for destroyed trees. However, there was also evidence that the state's actions provided benefits to the state's citrus industry, suggesting that the government should pay private property owners for destroyed trees. To justify the destruction of trees without compensation as a legitimate exercise of its police power, the state needed to posit credible evidence that the citrus canker eradication programme principally addressed harm.

The state legislature had declared citrus canker to be a nuisance (Florida Laws, 2000). Scientists had shown that the disease led to blemished fruit that could not be sold as fresh fruit (Schubert *et al.*, 2001), thus creating fewer marketing opportunities, and would require a management programme to maintain reasonable fruit yields (Dewdney & Graham, 2010). The USDA had said that the eradication programme was 'necessary to prevent damage to commercial and home-grown citrus and further spread of the bacterial disease agent' (USDA, 1999b). The USDA also noted that citrus canker 'could adversely affect homeowners who depend on backyard plantings to supplement their food supplies' (USDA, 1999b). Yet, a majority of this evidence was not cited by the *Bogorff* court. Moreover, the citrus canker eradication programme did not offer any funds or direct benefits to citrus producers other than nominal payment for destroyed trees, which was also paid to homeowners. Instead, the state's actions were directed at preventing citrus canker from spreading and harming others.

The state of Florida failed to communicate the harm caused by citrus canker, allowing the court to conclude that its eradication programme required compensation for destroyed property. However, ingrained in the trial and appellate courts' decisions is the conclusion that the programme was proindustry (Initial Brief of Florida Department of Agriculture, 2008; Dee *et al.*, 2011). This conclusion seems to be related to the slowness of the state to recognize that citrus canker could not be eradicated. If an eradication programme cannot successfully eliminate a disease, then the destruction of property under the programme is not to prevent harm: the disease will spread despite the removal of some infected property. Because the state of Florida lacked a functional objective mechanism for reassessing the likelihood of success of its eradication programme and trees were destroyed after credible evidence that eradication was improbable, the state was unable to convince the trial court that the destruction of trees was to prevent harm.

Discussion and conclusions

By failing to understand the disease and declining to find harm, the *Bogorff* court decided the state had unconstitutionally destroyed private property and needed to pay for it. The court's decision diminishes a government's ability to employ its police powers to address problems. It also expands owners' rights in their properties as the decision failed to recognize duties of owners to refrain from activities that harm others. While augmenting property rights may have considerable appeal to citizens, legislatures and courts, a weightier question is whether governments should be burdened with compensating property owners for proscribing harmful and noxious property uses (Centner & Ferreira, 2012). Governmental actions that damage or destroy property to control a pest or stop a nuisance are intended to further overall social well-being. Under established federal jurisprudence, in the absence of a permanent physical invasion or the total elimination of

the economic uses of homeowners' properties, governments can take actions without paying for the diminished values of private property. A government's exercise of its police power to prevent harmful uses of property does not need to be accompanied by compensation (Lucas vs South Carolina Coastal Council, 1992).

The US Supreme Court recognized that the control of diseases is an accepted governmental action under the police power (Miller vs Schoene, 1928). Property that facilitates incursions of diseases to new areas is considered to be communally harmful and historically could be destroyed without compensation (Claeys, 2003). Under this approach, persons have the responsibility to take action to preclude an incursion of a disease, otherwise their property can be destroyed in furtherance of the public good. The ability of a government to destroy diseased property means that owners have incentives to take actions to avoid exposure and prevent infestations.

From an efficiency viewpoint, disease control efforts should place responsibilities on persons best able to take actions to avoid exposure and eliminate a disease (Ceddia *et al.*, 2009). For many diseases, this involves persons or property owners who would suffer losses if their properties become infected. When a government employs nuisance law to confront a disease without compensating persons experiencing property losses, people have an incentive to take preventive actions to minimize losses. Individuals recognize that they lose if a disease becomes established, so use care to prevent it (Kuchler & Hamm, 2000).

However, if property owners are paid for the diminished value of properties adversely affected by a disease, as was ordered by the *Bogorff* court, the incentive to take preventive action is removed (Beach *et al.*, 2007). This introduces a moral hazard problem: property owners lack appropriate incentives to take prophylactic measures to prevent an incursion of a disease (Goodwin & Piggott, 2009). Required payment for property damaged in controlling diseases establishes an implicit insurance policy for producers without any risk classification or incentive to invest in disease control (Gramig *et al.*, 2009). The expected result is less success in preventing an incursion of a disease, greater probability that the disease will spread, initiation of disease control programmes introducing pesticides into the environment (Behlau *et al.*, 2010), and higher costs of disease control. It could be argued that compensation might provide an incentive for reporting outbreaks of citrus canker. However, given the difficulties in identifying infected trees and the fact that homeowners may place a greater value on preserving infected trees than on eradicating the disease (Ceddia *et al.*, 2009), this is unlikely.

Scientists need to be more convincing in explaining why eradication programmes are needed, how they need to be structured to remove all sources of a disease, and that the prevention of harm is a worthy governmental action. Simultaneously, in developing programmes to eradicate a disease, governments, scientists and affected industries need to recognize that the continued input of

pertinent new information and the reassessment of eradication efforts are necessary. In the absence of full information and an objective reassessment under which an eradication programme lacking merit can be immediately terminated, governments may destroy property without stopping the harm caused by the disease. An objective reassessment may not be possible if the decision to continue a programme is overly influenced by any particular stakeholder. Whenever credible evidence shows that an eradication programme will not eradicate the disease, courts may find that governments need to pay for destroyed property.

Acknowledgements

The research presented here is based on work supported by the Cooperative State Research Education and Extension Service (CSREES), US Department of Agriculture Project No. GEO00684.

References

- Adams DC, Keenan RM, Olexa MT, McGovern RJ, 2007. The legal basis for regulatory control of invasive citrus pests in Florida: a review of the citrus canker and spreading decline cases. *Drake Journal of Agricultural Law* **12**, 409–22.
- Ag-Innovations Inc vs US Department of Agriculture, 2006 US Dist LEXIS 9552 (Dist Ct, Vt).
- Beach RH, Poulos C, Pattanayak SK, 2007. Farm economics of bird flu. *Canadian Journal of Agricultural Economics* **55**, 471–83.
- Behlau F, Belasque Jr J, Graham JH, Leite Jr RP, 2010. Effect of frequency of copper applications on control of citrus canker and the yield of young bearing sweet orange trees. *Crop Protection* **29**, 300–5.
- Bowman DD, 2006. Successful and currently ongoing parasite eradication programs. *Veterinary Parasitology* **139**, 293–307.
- Ceddia MG, Heikkila J, Peltola J, 2008. Biosecurity in agriculture: an economic analysis of coexistence of professional and hobby production. *Australian Journal of Agricultural and Resource Economics* **52**, 453–70.
- Ceddia MG, Heikkila J, Peltola J, 2009. Managing invasive alien species with professional and hobby farmers: insights from ecological-economic modelling. *Ecological Economics* **68**, 1366–74.
- Centner TJ, Ferreira S, 2012. Controlling diseases and nuisances: time-based rights and agricultural production. *Land Use Policy*. doi.org/10.1016/j.landusepol.2011.09.006.
- Claeys ER, 2003. Takings, regulations, and natural property rights. *Cornell Law Review* **88**, 1549–671.
- Customer Company vs City of Sacramento, 1995. 895 P2d 900 (Cal Sup Ct).
- Dee S, Otake S, Deen J, 2011. An evaluation of ultraviolet light (UV₂₅₄) as a means to inactivate porcine reproductive and respiratory syndrome virus on common farm surfaces and materials. *Veterinary Microbiology* **150**, 96–9.
- Department of Agriculture & Consumer Services vs Bogorff, 2010. 35 So3d 84 (Fla Ct App).
- Dewdney MM, Graham JH, 2010. *Florida Citrus Pest Management Guide: Citrus Canker*. Gainesville, FL, USA: Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida.
- FAO, 1995. *Requirements for the Establishment of Pest Free Areas*. Rome, Italy: Food and Agriculture Organization of the United Nations, International Standards for Phytosanitary Measures (ISPM) No. 4.
- FAO, 1998. *Guidelines for Pest Eradication Programmes*. Rome, Italy: Food and Agriculture Organization of the United Nations, International Standards for Phytosanitary Measures (ISPM) No. 9.
- FAO, 2004. *Pest Risk Analysis for Quarantine Pests Including Analysis of Environmental Risks and Living Modified Organisms*. Rome, Italy: Food and Agriculture Organization of the United Nations, International Standards for Phytosanitary Measures (ISPM) No. 11.
- FAO, 2007. *Framework for Pest Risk Analysis*. Rome, Italy: Food and Agriculture Organization of the United Nations, International Standards for Phytosanitary Measures (ISPM) No. 2.
- Farmers Insurance Exchange vs California, 1985. 221 Cal Rptr 225 (Cal Ct App).
- Florida Constitution, 2010. Art X, section 6(a).
- Florida Department of Agriculture and Consumer Services, 2007. *Comprehensive Report on Citrus Canker in Florida*. Tallahassee, FL, USA: Division of Plant Industry.
- Florida Laws, 2000. Ch 308.
- Florida Laws, 2002. Ch 11.
- Florida Statutes, 2003. Section 581.184.
- Florida Statutes, 2010. Sections 581.031, 581.101, 581.184, 581.1845.
- Goodwin BK, Piggott NE, 2009. Spatiotemporal modelling of Asian citrus canker risks: implications for insurance and indemnification fund models. *American Journal of Agricultural Economics* **91**, 1038–55.
- Gottwald TR, Levy L, Dixon W, 2000. Research reports – what is known. In: *International Citrus Canker Research Workshop, Fort Pierce, FL, 20–22 June, vol. 1*. 1–203.
- Gottwald TR, Hughes G, Graham JH, Sun X, Riley T, 2001. The citrus canker epidemic in Florida: the scientific basis of regulatory eradication policy for an invasive species. *Phytopathology* **91**, 30–4.
- Gottwald TR, Graham JH, Schubert TS, 2002. Citrus canker: the pathogen and its impact. *Plant Health Progress*. doi: 10.1094/PHP-2002-0812-01-RV.
- Graham JH, Gottwald TR, Cubero J, Achor DS, 2004. *Xanthomonas axonopodis* pv. *citri*: factors affecting successful eradication of citrus canker. *Molecular Plant Pathology* **5**, 1–15.
- Gramig BM, Horan RD, Wolf CA, 2009. Livestock disease indemnity design when moral hazard is followed by adverse selection. *American Journal of Agricultural Economics* **91**, 627–41.
- Guillén D, Sánchez R, 2007. Expansion of the national fruit fly control programme in Argentina. In: Vreysen MJB, Robinson AS, Hendrichs J, eds. *Area-Wide Control of Insect Pests*. Dordrecht, Netherlands: Springer, 653–60.
- Haack RA, Hérard F, Sun J, Turgeon JJ, 2010. Managing invasive populations of Asian longhorned beetle and citrus longhorned beetle: a worldwide perspective. *Annual Review of Entomology* **55**, 521–46.
- Hennessy DA, 2007. Behavioural incentives, equilibrium endemic disease, and health management policy for farmed animals. *American Journal of Agricultural Economics* **89**, 698–711.

- Initial Brief of Florida Department of Agriculture, 2008. *In re: Citrus Canker Litigation*, Case No. 00-18394 (08), Circuit Court, Seventeenth Judicial Circuit, Broward County, FL, 20 Apr.
- Irey M, Gottwald TR, Graham JH, Riley TD, Carlton G, 2006. Post-hurricane analysis of citrus canker spread and progress towards the development of a predictive model to estimate disease spread due to catastrophic weather events. *Plant Health Progress*. doi: 10.1094/PHP-2006-822-01-RS.
- Kansas Statutes Annotated, 2011. Section 47-124.
- Kuchler F, Hamm S, 2000. Animal disease incidence and indemnity eradication programs. *Agricultural Economics* **22**, 299–308.
- Lucas vs South Carolina Coastal Council, 1992. 505 US 1003 (Sup Ct).
- Malbrain vs Washington State Department of Agriculture, 2004. 86 P3d 322 (Wash Ct App).
- Miller vs Schoene, 1928. 276 US 272 (Sup Ct).
- Paton DJ, Sumption KJ, Charleston B, 2009. Options for control of foot-and-mouth disease: knowledge, capability and policy. *Philosophical Transactions of the Royal Society B* **364**, 2657–67.
- Pennsylvania Coal Company vs Mahon, 1922. 260 US 393 (Sup Ct).
- Ragan VE, 2002. The Animal and Plant Health Inspection Service (APHIS) brucellosis eradication program in the United States. *Veterinary Microbiology* **90**, 11–8.
- Ranjan R, Lubowski RN, 2005. A model of producer incentives for livestock disease management. *Stochastic Environmental Research and Risk Assessment* **19**, 315–25.
- Salisbury S, 2008. State loses another canker lawsuit. *Palm Beach Post*, 22 February, 1D.
- Schubert TS, Sun X, 2003. *Bacterial Citrus Canker*. Tallahassee, FL, USA: Florida Department of Agriculture and Conservation Services, Plant Pathology Circular no. 377 (5th revision).
- Schubert TS, Gottwald TR, Rizvi SA, Graham JH, Sun X, Dixon WN, 2001. Meeting the challenge of eradicating citrus canker in Florida – again. *Plant Disease* **85**, 340–56.
- Sosnowski MR, Fletcher JD, Daly AM, Rodoni BC, Viljanen-Rollinson SLH, 2009. Techniques for the treatment, removal and disposal of host material during programmes for plant pathogen eradication. *Plant Pathology* **58**, 621–35.
- Stop the Beach Renourishment, Inc vs Florida Department of Environmental Protection, 2010. 130 Sup Ct 2592 (Sup Ct).
- Tomasovic BS, 2011. High-voltage conflict on Blackacre: reorienting utility easement rights for electric reliability. *Columbia Journal of Environmental Law* **36**, 1–57.
- US Code, 2006. Title 7, sections 7701 and 8301.
- USDA, 1984. Citrus canker; declaration of extraordinary emergency because of citrus canker. *Federal Register* **49**, 41268.
- USDA, 1988. Movement of citrus fruit from Florida. *Federal Register* **53**, 3999.
- USDA, 1999a. Declaration of emergency because of citrus canker. *Federal Register* **64**, 13540.
- USDA, 1999b. Citrus canker eradication program. *Environmental Assessment*. http://www.aphis.usda.gov/plant_health/ea/downloads/ccea.pdf. Accessed 5 September 2011.
- USDA, 2000. Citrus canker payments for commercial citrus tree replacement. *Federal Register* **65**, 61077–80.
- USDA, 2006. Letter of Chuck Conner to Charles H. Bronson, Florida Commissioner of Agriculture. <http://www.doacs.state.fl.us/pdf/Canker%20-%20Bronson.pdf>. Accessed 5 September 2011.
- Van Opstal NA, Sunley R, 2009. EPP0 workshop on eradication, containment and contingency planning. *OEPP/EPPO Bulletin* **39**, 143–5.
- Wallace vs Dohner, 1929. 165 NE 552 (Ind Sup Ct).
- Wisconsin Statutes, 2011. Section 95.17.