Scientific Challenges and Cost-Effective Management of Risks Associated with Implementation of Produce Safety Regulations

Key Takeaways
"Adjacent Land Use: Done Talking About It? Ready To Do Something?"

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Abstract

The risks associated with adjacent land use are complex and challenging to assess because at each fresh produce operation, the available water source(s) and its inherent quality, landscape, and environmental dynamics are different. The management of known hazards to the farm (including aerosols, domesticated animal adjacency and intrusion, flood and runoff potential, human activities, hydrogeology, vector behavior and attractants, adjacent crop dynamics and non-crop vegetation, and wildlife, among others) may be difficult to predictively assess given these and other potentially unique considerations. Without sufficient research to establish recommendations and support for generally long-term research, progress on practical surveillance or monitoring, actionable thresholds, prevention, and mitigation of food safety risks associated with adjacent land will continue to be challenging. Fresh produce growers need cost-effective tools to manage their presumptive or existing risks. Partnerships between industry, government, and academia (embracing the continuum from fundamental to cooperative extension) need to be formed and research prioritized and performed from model systems to 'real-world' to better understand how potential hazards from adjacent land use impact risk to the fresh produce supply chain.

Problem Statement

The fresh produce industry needs effective, science-backed guidance and recommendations on effective on-farm risk assessment and practices that substantially minimize the likelihood of a widespread contamination event while also optimizing effort allocation within the food safety system (e.g., size of operation). These existing best management practices (BMPs) have many positives attributed to them but are too often lacking a foreseeable management strategy. This is in large part because adjacent land activities or uses, posing potential risk, may not be under the sole control of the grower. Barriers to cooperative or collaborative hazard management or risk mitigation take many forms, including limited or absent willingness of neighbors to engage in solutions-directed dialogue. As mentioned above, the applicability of much of the BMP documents and checklists suffer from an absence of long-term situation-specific research on-farm (capturing the diversity of farm operations). Without the ability to perform research with a combination of common sense, confidentiality, and investment in a long-term targeted approach, it will not be possible to develop BMPs, and their associated verifiable metrics, to minimize risks associated with adjacent land use to the fresh produce industry.

Background

Adjacent land use, or the use of land adjacent to or nearby land used for fresh produce production, has been a controversial topic in food safety for quite some time for two main reasons: (1) adjacent land use activities may not be under control of the fresh produce grower or subject to regulatory protections and (2) differences in regulatory, academic, and stakeholder investments in this issue are seemingly contradictory, highlighting substantial knowledge gaps to developing BMPs. For these reasons, the situation-specific risks associated with adjacent land use are inadequately understood to inform business risk management and not sufficiently quantified in most cases. This fact has limited the ability of all stakeholders to address the adjacent land use issue effectively. However, hazards that are commonly associated with adjacent land use (and actively recognized as hazards in food safety systems) have been the subject of research and debate for years (Center for Food Safety and Nutrition (CFSAN) 1998; D'Lima and Suslow 2009; Suslow 2011; Giclas and Hadad 2012; Produce Marketing Association 2014; Gil et al. 2015). These factors include aerosols, domesticated animals, flood and runoff, human activities, hydrogeology, insect vectors, vegetation, and wildlife, among others.

Common Questions and Gaps

Questions regarding adjacent land use were separated into four types: (1) establishing specific adjacent land use hazards and the associated risks, (2) managing adjacent land use risks, (3) leveraging existing knowledge and gaps to conduct solutions-directed research focused on priority problems regarding adjacent land use, and (4) regulatory compliance; and each are discussed below.

(1) Establishing specific adjacent land use issues as risks. While adjacent land use is an umbrella term covering many types of surrounding lands, operations, and activities, establishing a specific adjacent land use as risky or not for potential product contamination may have unifying traits but ultimately must be addressed on a case-by-case assessment. An assessment of the adjacent lands should be evaluated as an integrated systems view for each location over different cropping systems, seasons, and environmental pressures, among other factors.

(2) Managing adjacent land use risks. Management of animal manure-based compost as well as green and food waste composting sites, domesticated animal feeding facilities and husbandry, internalization of pathogens (Koike et al. 2009), dust (Uesugi et al. 2007), and lessons learned from previous outbreak investigations (The California Food Emergency Response Team (CalFERT) and Food and Drug Administration (FDA) 2008) may all be considered in assessing management options in each operation. Variable outcomes of interactions between microorganisms on produce surfaces appears to matter most when establishing when a specific contamination event may become a food safety issue (Poza-Carrion et al. 2013). Approaches to manage these risks will differ by operation, but the effective management of antimicrobial products in agricultural water and use of buffer zones are integral. While there are specific, quantitative recommendations for developing and maintaining buffer distances between operations and surrounding lands/operations/activities, these have been essentially best efforts to extrapolate a safe harbor approach with incomplete data. The development of rapid, cost-effective tools for broad-based mapping (for example, quantum dots or microfluidic biosensor devices) and methods for monitoring operation-specific indicators to establish the risk exposure will be important for developing these specific setback distance recommendations.

(3) Leveraging existing knowledge and gaps to conduct research around solving problems regarding adjacent land use. Existing research for solving some of these issues have evaluated animal vaccines against foodborne pathogens (Potter et al. 2004; Matthews et al. 2013; Smith et al. 2019; Garcia et al. 2020), but the use of prebiotic and probiotic applications to reduce pathogen shedding have also been reviewed (Callaway et al. 2004). There has been some advocacy on behalf of the produce industry with national-level livestock groups to find mutually beneficial approaches to reduce the risks associated with management of adjacent land, but these conversations are in the early phases of building engagement and trust and lack committed research support for priorities identified, at this time. Any research conducted should be designed to protect the viability of both fresh produce and livestock operations, such as through promoting privacy by de-identifying data to protect regions, commodities, and specific farm locations from becoming inappropriately associated with a food safety issue.

(4) Regulatory compliance. These findings should be supported by guidance documents that provide insight into how to effectively manage land used to grow fresh produce for human consumption, regardless of previous uses (for example, land previously used as pasture or affected by runoff or flood events), all with the emphasis of enhancing food safety and securing industry compliance with regulatory priorities. The hazards and risks associated with management of adjacent land often seem so obvious but setting “safe” buffer distances from an adjacent hazard, how to monitor, or when to react to wildlife intrusion or an unusual weather event remain complex and controversial issues.

Solution(s)

Three calls to action took shape during the webinar:

(1) Practice. Fresh produce growers should incorporate cost-effective tools (e.g., increasingly affordable, solar-powered, and cloud-based accessible digital still or video cameras to monitor wildlife movement, monitoring weather data before, during, and after key events to dictate or support food safety management practices) into their risk assessment procedures to gain a better understanding of what their risks are from their adjacent surroundings. Data-informed decision-making about fencing has been based on knowing what is there and when.

(2) Partner. Partnerships should be formed to cultivate “real world” field/farm trials to assess risks from adjacent lands and evaluate control strategies over time.

(3) Prioritize. Commodity groups and funding agencies should work to prioritize the funding of experiments to evaluate these risks while also maintaining appropriate protections (e.g., de-identified data) for cooperators who support the work (allowing in-field, on-farm research trials) to establish commodity-specific standards that reflect the growing and harvesting practices, regional considerations, and intended use of the crop.

Future Work/Conclusions

While regional risk factors may be acknowledged in the research and recognized by the industry, the management of these risks remains unresolved due to the lack of situation-specific research at the scale of industry. But industry groups are making efforts to better understand these issues to facilitate better recommendations and research studies (Horsfall 2020; Center for Produce Safety (CPS) 2021a, b). Future studies may focus on demonstrating dust particulate dispersal and gradient dilution during seasonal operations, such as those actively being conducted for romaine lettuce operations, and evaluating how those contamination events can impact harvest equipment. Understanding the local and regional movement of harvest equipment is helping with root cause analysis efforts, but these studies are still underway.

Additional Reading

Background:

Center for Food Safety and Nutrition (CFSAN) (1998) Guidance for Industry: Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables. In: US Food Drug Adm. https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-guide-minimize-microbial-food-safety-hazards-fresh-fruits-and-vegetables.

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Gil MI, Selma MV, Suslow T, et al (2015) Pre- and Postharvest Preventive Measures and Intervention Strategies to Control Microbial Food Safety Hazards of Fresh Leafy Vegetables. Crit Rev Food Sci Nutr 55:453–468. https://doi.org/10.1080/10408398.2012.657808

Common Questions and Gaps:

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The California Food Emergency Response Team (CalFERT), Food and Drug Administration (FDA) (2008) Investigation of the Taco John's Escherichia coli O157:H7 Outbreak Associated with Iceberg Lettuce. California Department of Public Health. https://www.marlerblog.com/files/2013/02/Attach-No-6A-2006-E.coli-O157-H7-Outbreak-Associated-with-Iceberg-Lettuce-at-Taco-Johns.pdf.

Poza-Carrion C, Suslow T, Lindow S (2013) Resident Bacteria on Leaves Enhance Survival of Immigrant Cells of Salmonella enterica. Phytopathology 103:341–351. https://doi.org/10.1094/PHYTO-09-12-0221-FI

Potter AA, Klashinsky S, Li Y, et al (2004) Decreased shedding of Escherichia coli O157:H7 by cattle following vaccination with type III secreted proteins. Vaccine 22:362–369. https://doi.org/10.1016/j.vaccine.2003.08.007

Matthews L, Reeve R, Gally DL, et al (2013) Predicting the public health benefit of vaccinating cattle against Escherichia coli O157. Proc Natl Acad Sci. https://doi.org/10.1073/pnas.1304978110

Smith DR, Gaunt PS, Plummer PJ, et al (2019) The AVMA's definitions of antimicrobial uses for prevention, control, and treatment of disease. J Am Vet Med Assoc 254:792–797. https://doi.org/10.2460/javma.254.7.792

Garcia SN, Osburn BI, Jay-Russell MT (2020) One Health for Food Safety, Food Security, and Sustainable Food Production. Front Sustain Food Syst 4:1. https://doi.org/10.3389/fsufs.2020.00001

Callaway TR, Anderson RC, Edrington TS, et al (2004) Recent pre-harvest supplementation strategies to reduce carriage and shedding of zoonotic enteric bacterial pathogens in food animals. Anim Health Res Rev 5:35–47. https://pubmed.ncbi.nlm.nih.gov/15460539/.

Future Work/Conclusions:

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