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# Rodents, Rodent Control, and Food Safety

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**ABSTRACT:** The safety of the food supply is a primary consideration of farmers, wholesale and retail establishments, and ultimately consumers. In 2006, a major outbreak of food-borne illness in the U.S. caused by *Escherichia coli* O157:H7-contaminated bagged spinach resulted in 3 deaths and over 200 illnesses. Studies have shown that cattle and some commensal wildlife are known sources of *E. coli* O157:H7, but limited investigations on small mammals and deer have shown minimal prevalence of this bacteria. In 2007, with oversight from the California Department of Food and Agriculture, produce industry representatives developed the *Commodity Specific Food Safety Guidelines for the Lettuce and Leafy Greens Supply Chain*, known as the Metrics. These have led to significant uses of rodent control techniques including baits, traps, buffer strips and vegetation clearing in areas around leafy green production. One of the major issues regarding these strategies is that the target rodent species is generally unknown. Growers are faced with complying with buyers' interpretations of the Metrics or losing the sale of their crop. Until we provide better information on the occurrence and type of rodents in and around leafy green crops and food safety, we will have limited ability to help growers use cost-effective and environmentally acceptable methods to protect crops from potential rodent contamination. Rodent control experts need to provide specific strategies to help growers with the important issue of rodents and their association with crops and food safety.

**KEY WORDS:** *E. coli* O157:H7, food-borne illness, leafy green crops, monitoring, research needs, rodent control

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## INTRODUCTION

The safety of the food supply is a primary consideration of farmers, wholesale and retail establishments, and ultimately consumers. While past food safety efforts related to rodents and rodent control have primarily focused at the food processing level, recent food safety outbreaks have attracted more attention to farm production activities. Since 1995, there have been 20 outbreaks of food-borne illness in the U.S. from *Escherichia coli* O157:H7 on leafy greens such as spinach (RCDFMC 2007). While the sources of contamination of these outbreaks have not been determined, much speculation has focused on domestic and wild animals. In response to these outbreaks, industry, research, and government entities have been working to develop guidelines and standards to minimize risk of bacterial contamination of leafy green crops.

In 2006, a major outbreak of food-borne illness caused by *E. coli* O157:H7-contaminated bagged spinach resulted in 3 deaths and over 200 illnesses (Beretti and Stuart 2008). The contaminated product was traced to bagged leafy green spinach from Central California, although the illnesses occurred in 26 states. The source of the contamination was never determined, although wild pigs were strongly implicated. Government regulators and the industry responded to this latest threat to the food supply by developing standards and guidelines for growers and shippers to follow, in order to minimize food-borne contamination of leafy green products.

## Are Rodents Involved in Food-Borne Contamination?

Studies have shown that cattle and some commensal wildlife are known sources of *E. coli* O157:H7, but limited investigations on small mammals and deer showed minimal prevalence of this bacterium (Beretti and

Stuart 2008). Studies also indicate a very low probability that wild birds in natural environments will carry pathogens that will contaminate crops (Brittingham et al. 1988). Researchers are investigating rodents and other small animals to establish their relationship to *E. coli* O157:H7 contamination of crops (E. R. Atwill, pers. commun.). Until the actual link, or lack thereof, is identified, growers, shippers/buyers, and others will continue to treat rodents as suspects in the food-borne illness complex.

It is not surprising that rodents are suspected transmitters of *E. coli* O157:H7. *E. coli* and other infectious bacteria are known to occur in rodents (Clark 1994), and the theoretical link is easily made between these animals and crop contamination. Wild rodents are common in areas where leafy greens are grown. The agricultural practices of clearing land, developing irrigation sources, water runoff containment, and sometimes the crop itself provide good habitat for many small rodents including mice, rats, and squirrels. Leafy greens often are grown near riparian areas where small rodents naturally occur. Some fields adjoin rangelands and other wild areas where natural populations of rodents reside. All of these situations provide ample opportunity for rodents to be close to the leafy green cropping areas. People rightly assume that rodents will travel to areas where food and harborage is available. Often, this means the crop. Once rodents are in the crop, even if only briefly, most would agree that there is a high probability that the rodent will urinate or defecate in the area. If you assume the rodents are potential carriers of *E. coli* O157:H7, this contamination is unacceptable from a food safety perspective. It is not hard to see why regulators, buyers and others are so concerned with rodents associated with leafy green production. Until research rules out rodents as potential

contamination sources, we will need to help growers and others understand the relationship between rodents, their crops, and cropping operations. But first, we need to understand these ourselves.

### WHAT IS CURRENTLY BEING DONE?

In 2007, with oversight from the California Department of Food and Agriculture, produce industry representatives developed the California Leafy Green Products Handler Marketing Agreement (see [www.caleafygreens.ca.gov](http://www.caleafygreens.ca.gov)). As part of this agreement, industry representatives developed the *Commodity Specific Food Safety Guidelines for the Lettuce and Leafy Greens Supply Chain*, known as the Metrics (Beretti and Stuart 2008). The guidelines focus on the entire production operation from farm to packaging and distribution with the goal of minimizing microbial contamination. For example, under “Issue: Encroachment by Animals and Urban Settings”, there were several “things to consider” related to wildlife (although rodents were not listed as wildlife of concern) that are known to be potential carriers of human pathogens. Growers were encouraged to consider ... “If unusually heavy wildlife pest activity or evidence of wildlife pest activity occurs (e.g., presence of wildlife feces), consider whether or not to harvest affected portions of the field”. In general, the Metrics specify practices and procedures to follow to minimize food-borne contamination of crops. In addition, shippers and buyers can and do impose additional requirements on growers as a condition of buying their crop (Beretti and Stuart 2008). These have led to significant uses of rodent control techniques including baits, traps, buffer strips, and vegetation clearing in areas around leafy green production.

### What Does “The Metrics” Say About Rodents?

The Metrics is a 54-page document that is continually evaluated and updated (see [www.caleafygreens.ca.gov](http://www.caleafygreens.ca.gov)). While it is the guiding document for leafy green production related to food safety, it does not specifically address rodents as potential species of concern. The specific wildlife species that have been shown to pose the greatest risk and are the focus of the Metrics are deer, pigs (wild and domestic), cattle, goats, and sheep. However, the Metrics’ best management practices that might apply to rodents include:

- Document any observed encroachment by animals of significant risk during production periods.
- Locate production to minimize potential access by animals of significant risk and maximize distances to possible sources of microbial contamination.
- If there are animals of significant risk present, make particular efforts to reduce their access to lettuce and leafy green produce.
- Do not harvest areas of fields where unusually heavy activity by animals of significant risk occurs. Consider fencing, barriers, noisemakers, and other practices that may reduce intrusions. Specifically, do not harvest any crop found within a minimum 5-foot radius buffer distance from the spot of the contamination unless remedial action can adequately control the risk. Re-

move fecal material from the field.

- If contamination is discovered in harvest containers such as bins/totes, discard the product, and clean and sanitize the container before reuse.
- Train harvest employees to recognize and report evidence (e.g., feces) of animal of significant risk activity.

These are examples of what growers are faced with regarding wildlife in and around their crops. The Metrics are guidelines and are subject to interpretation by buyers and handlers, which means growers must often follow several different interpretations to protect their ability to sell the crop (Beretti and Stuart 2008).

### HOW ARE GROWERS RESPONDING TO THESE REQUIREMENTS?

With the uncertainty of how the Metrics applied to rodents, growers have adopted many different approaches to comply. In 2007, the Resource Conservation District of Monterey County surveyed 600 irrigated row-crop growers through the Central Coast of California (RCDMC 2007). The questions focused on how growers were interpreting (or complying with) the Metrics. Many of the actions appeared to address potential rodent occurrence in and around leafy green crops. The commonly adopted measures to reduce wildlife contamination risks included buffers, fences, traps, and poison baits. Of these, buffers, traps, and baits were most likely targeting rodents (Figure 1). Fencing probably was used to exclude larger animals such as pigs, deer, and dogs, although the survey did not ask the specific animal targeted. These actions are quite significant in scope. The survey respondents managed more than 140,000 acres of row-crop land and had applied some activity to deter or eliminate wildlife on 133,000 of these acres (RCDMC 2007). The use of bait stations on 108,283 acres and bare ground buffers on 91,890 acres demonstrates the magnitude of these uses, even though rodents are not “officially” species of significant risk.

### CONCERNS ABOUT CURRENT RODENT CONTROL EFFORTS

Leaving aside the issue of whether rodents are species of significant risk for microbial contamination of leafy green crops, there are concerns about how the Metrics is being used relative to rodents and rodent

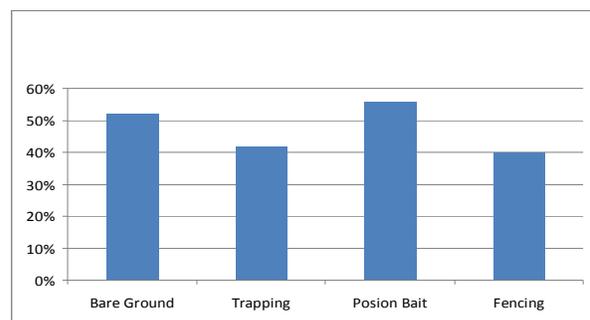


Figure 1. Percentage of respondents that adopted specific wildlife mitigation measures.

control. With the huge number of acres being treated with rodent control strategies (133,000 acres), particularly bare ground strips, traps, and poison baiting, there are significant efficacy and environmental risks. One of the major issues regarding these strategies is that the target rodent species is generally unknown (D. Huss, pers. commun.). Growers see ground squirrels adjacent to the crop and field mice (voles and mice) surrounding and sometimes in the crop. Generally, they do not identify the species or know the specific habits of the animals they are targeting. In many cases, growers are told by buyers to eliminate rodents without any proof that they are actually present.

### **Bare Ground Strips**

Bare ground strips (buffer strips) are used to separate the leafy green crop from the rodents. While this is a recommended strategy for damage prevention, little is known about the size of strip needed to provide enough separation (Clark 1995). In most cases, bare strips are maintained around leafy green crops without knowing the target species. Without knowing the target animal and the strip size needed to provide separation, this approach may be creating significant vegetation-free areas that are having little impact on potential crop contamination.

### **Traps**

Traps are used as a direct control technique and, in some cases, as an indicator of rodent presence in the area. As a control technique, it is hard to imagine trapping as an effective approach to keeping small rodents from entering (or living in) leafy green crops. Traps are better suited as monitoring devices to indicate the presence of rodents, and to identify the species involved. In many cases, traps are used as prophylactics to satisfy buyers and others that the farmer is doing everything possible to protect the crop.

### **Poison Baits**

Poison baits were the most commonly adopted wildlife mitigation measure (RCDMC 2007). While rodents are not listed as animals of significant risk, poison baits used must be targeted at them, since California allows use of poison bait for very few animals other than rodents. However, at a recent grower meeting, several indicated that baits were also being used to control birds, despite the fact that no bird poisons are registered for this use. In traveling through California's Central Coastal growing region, it is now (2008) common to see leafy green fields bordered lined with PVC bait stations. Presumably these bait stations contain first-generation anticoagulant materials, which are commonly used in agricultural settings. However, the target animals and overall bait usage is unknown. Indiscriminate and excessive use of anticoagulants can result in increased hazards to wildlife (Salmon 2007) and, while rare in field rodent situations, anticoagulant resistance (Salmon and Lawrence 2006a). The cost of baiting is also significant. One marketing director for a major lettuce buyer puts it this way: "Some processors are requiring trapping stations [bait stations] every 50 ft for rodents. I grow

7,500 acres of vegetables. This would equal approximately 16,000 stations. So, 16,000 stations  $\times$  \$30 = \$480,000. The stations need to be monitored 2 times per week". Clearly, the costs of this approach are enormous, while the benefit is largely unknown.

### **RESEARCH NEEDS**

Clearly, food safety issues are driving concerns about rodents and their relationship to microbial contamination of leafy green crops in California. The Metrics provides suggested guidelines that are subject to interpretation by buyers and others. Growers are faced with complying with buyers' interpretations or losing the sale of their crop. Until we provide better information about rodents, their occurrence in and around leafy green crops, and food safety, we will have limited ability to help growers use cost-effective and environmentally acceptable methods to protect crops from potential rodent contamination. People will err on the side of food safety, so providing answers to the most challenging questions is essential.

### **Rodent Occurrence and Movement In and Around Crops**

Little is known about rodents in the areas of leafy green production. Without this information, effective detection, exclusion, and control strategies cannot be developed. Animals living in the crop likely present a different contamination risk than those in the surrounding area. Buffer strips are species-dependent and, with some, not considered effective at all. Trap and bait placement clearly depends on movements, feeding habits, and location of the target. For some rodents that are likely in the crop area, no baits are registered. Often, traps are also species-specific. Without knowing what species are of concern, designing strategies to manage them is impossible.

### **Monitoring**

Rodent monitoring programs around leafy green crops should be very effective in identifying the occurrence of rodents of concern. Non-toxic blocks, chew strips, traps, tracking patches and video surveillance are examples of monitoring methods that could be used. Monitoring strategies are an effective as part of an integrated pest control plan (see <http://www.pestcontrolresearch.com/monitoring.htm>). A major advantage of monitoring is that other control measures such as baiting would be used only when they are warranted. This would significantly reduce costs, environmental risks, and the potential for developing resistance to the bait. Monitoring could also help in demonstrating that growers are taking appropriate measures to reduce potential crop contamination by rodents.

### **Value (and Size) of Buffer Areas**

To many, buffer strips or areas would seem to be the ideal method to keep rodents out of crops. Experience and some research show that some, but not all, rodents are reluctant to cross open areas. This reluctance could translate into a virtual fence that the animals will not

cross. Once species of concern are identified, research can address the value of buffer strips, including the size and structure needed to be effective. This is likely a good approach to minimizing rodent contact with leafy green crops, but efforts are needed to understand their place in the overall rodent control strategy.

### **New Baits and Baiting Strategies**

Recent work has shown that changing existing rodent baiting strategies can increase effectiveness and reduce environmental risks (Salmon et al. 2007). New baits are another approach that can be effective in specific situations. One example of this was the development of a zinc phosphide fresh bait to control voles (*Microtus californicus*) in artichoke fields (Salmon and Lawrence 2006b). Application methods, bait selection, and timing of use can all be used to make poison baits more effective with less environmental risk (Ellis et al. 2006, Kowalski et al. 2006, Salmon 2007).

### **CONCLUSIONS**

Growers of leafy greens are faced with a serious challenge. They must adhere to the Metrics, which may be interpreted differently by individual buyers. This has led to drastic approaches to address perceived rodent contamination of crops, despite having little evidence that rodents were involved in the food-borne illnesses associated with these crops. Growers must act to protect their ability to sell their crop and to reduce their liability if an outbreak does occur. Research by food scientists and others is addressing the potential of rodents to transmit food-borne microbes, especially *E. coli* O157:H7. This will help in determining what rodent control measures are necessary to protect crops. Rodent control experts need to develop and tailor specific strategies, in order to help growers in the important issue of rodents and their association with crops and food safety.

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