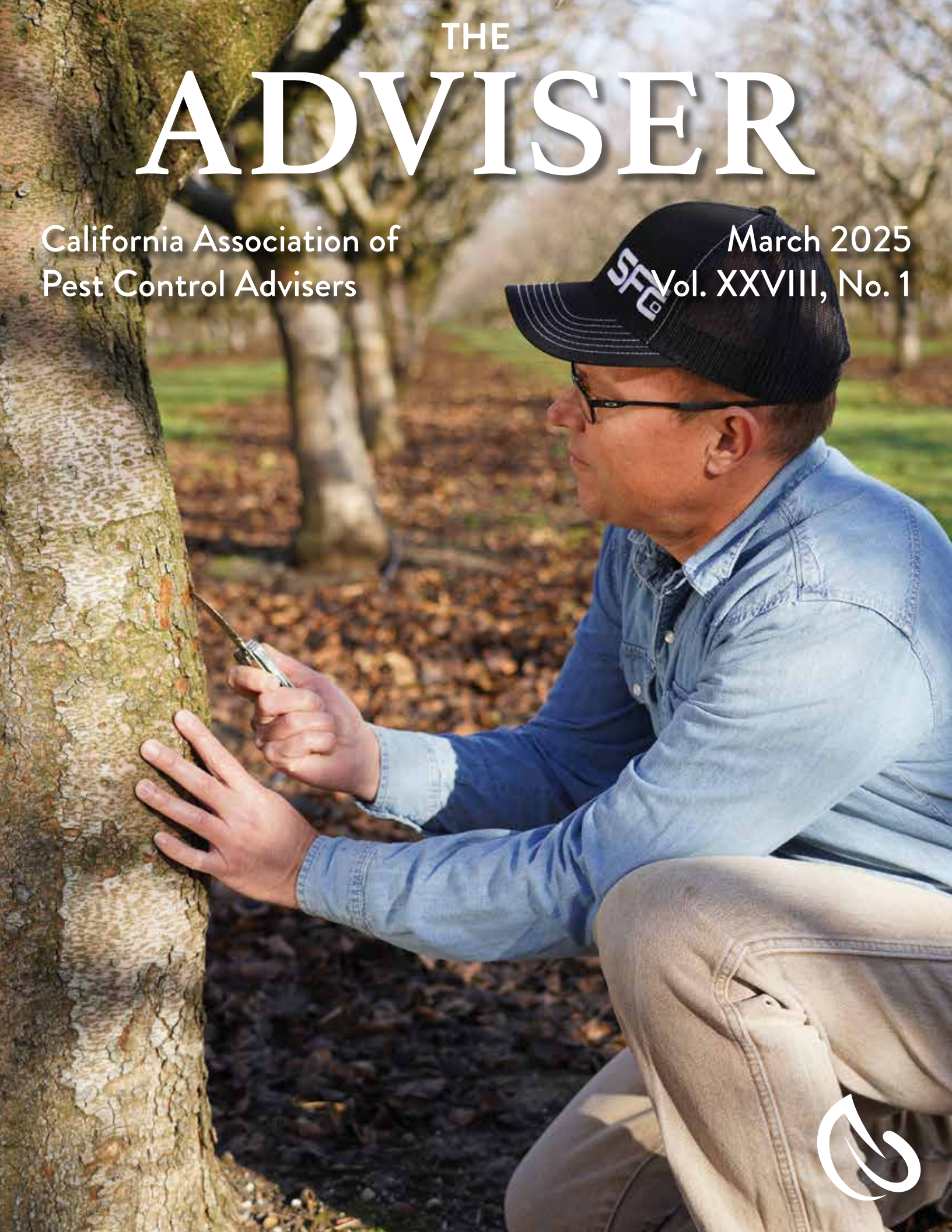

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Featured Article

Emergency Response to Rat Management in California's Nut and Fruit Orchards

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California's nut and fruit orchards are a cornerstone of the state's agricultural economy, but they face an ongoing threat from invasive roof rats (*Rattus rattus*). These pests can devastate crops, damage irrigation infrastructure, and pose food safety risks, making effective management critical. Recent research has highlighted integrated pest management (IPM) strategies that combine monitoring, baiting, and trapping to manage roof rat populations effectively and sustainably.

The Scope of the Problem

Roof rats cause substantial damage through direct consumption of fruits and nuts, girdling of tree branches, and gnawing on irrigation lines. Their nocturnal and arboreal habits make them particularly challenging to manage in orchard settings. Monitoring data indicates that roof rat populations are expanding across California, with their home ranges averaging 5.8 acres, emphasizing the need for a coordinated, landscape-level approach. However, success at the individual level has also provided promising results. This is of particular importance if your neighbor happens to be an abandoned orchard where no management is likely to happen

Integrated Pest Management Strategies

Recent studies, including those funded by the Vertebrate Pest Control Research Advisory Committee of the

California Department of Food and Agriculture, the Citrus Research Board, and the University of California's Division of Agriculture and Natural Resources, have tested various management tools in orchards. These findings provide a roadmap for implementing an effective Integrated Pest Management (IPM) program tailored to roof rat behavior in orchard ecosystems.

1. Comprehensive Monitoring for Early Detection. The first step in any IPM strategy is understanding the scope of the problem through effective monitoring. Tracking tunnels equipped with ink cards, placed approximately 230 feet apart, are a proven tool for detecting roof rat activity. These tunnels capture ink footprints as rats traverse them, allowing growers to pinpoint activity hotspots. Game cameras strategically placed in orchards can provide additional insights into rat movement and behavior. Regular monitoring is critical to identify when and where management interventions are needed. Tunnels can be purchased from a number of sources (Black Trakka, Gotcha Traps, or Traps.co.nz, pestcontrolsolutions.co.nz).

2. Targeted Baiting Programs. Baiting is often the most effective method for an initial population knockdown. Elevated bait stations containing 0.005% diphacinone-treated oats should be deployed at 160-foot intervals. If you are planning to control mice too, the spacing needs to be closer (approx. 98 ft). The elevated placement prevents access by non-target species and aligns with the roof rats' natural climbing behavior. Consistent replenishment and monitoring of bait consumption are vital to ensure a continuous supply until activity subsides. Typically this can be achieved in about 4 weeks, although high-density rat populations may take longer.

Item	Known Supplier	Website
PVC Pipe	Industrial Plastic Supply, Inc.	iplasticsupply.com
Metal Endcap	AZ MFG, Inc.	azmfginc.com

3. Bait stations consist of three parts: a 13 inch length of 4-inch PVC pipe and two metal end caps.

- These bait stations are designed to maximize efficacy of rat management and minimize nontarget issues. Without the properly designed end caps, issues such as grain spillage, non-target entry and bait efficacy can be compromised. If you wish to make you own bait stations, you can drill holes ~ 1.75 inches in diameter toward the top

of 4-inch end caps. Homemade designs are likely only suitable for branches that come straight out (180° from trunk) as a bait station with this end cap design that is placed at an angle will make bait spillage very likely.

- The number of bait stations needed across the length (NLength.aa; the reference to ".aa" represents the decimal places resulting from the calculation) and width (NWidth.bb) of each orchard can be determined using the following formulas:

$$\frac{\textit{Length of orchard}}{\textit{Spacing}} = \textit{NLength.aa}$$

$$\frac{\textit{Width of orchard}}{\textit{Spacing}} = \textit{NWidth.bb}$$

Since *NLength.aa* and *NWidth.bb* and will not likely be whole numbers, growers should round these numbers down to whole numbers before multiplying to determine the number of bait stations (NBS) needed for the entire orchard (note that in a square orchard, *NLength = NWidth*).

$$\textit{NBS} = \textit{NLength} \times \textit{NWidth}$$

- Initially, add one cup of bait (approximately 0.25 pounds or 113 grams) to each bait station. Regularly inspect the bait stations to ensure a consistent supply of bait, adjusting the quantity based on consumption. If needed, up to 1 pound (454 grams) of bait can be added to a single bait station at a time. It's crucial to note that diphacinone, a first-generation anticoagulant, requires multiple feedings

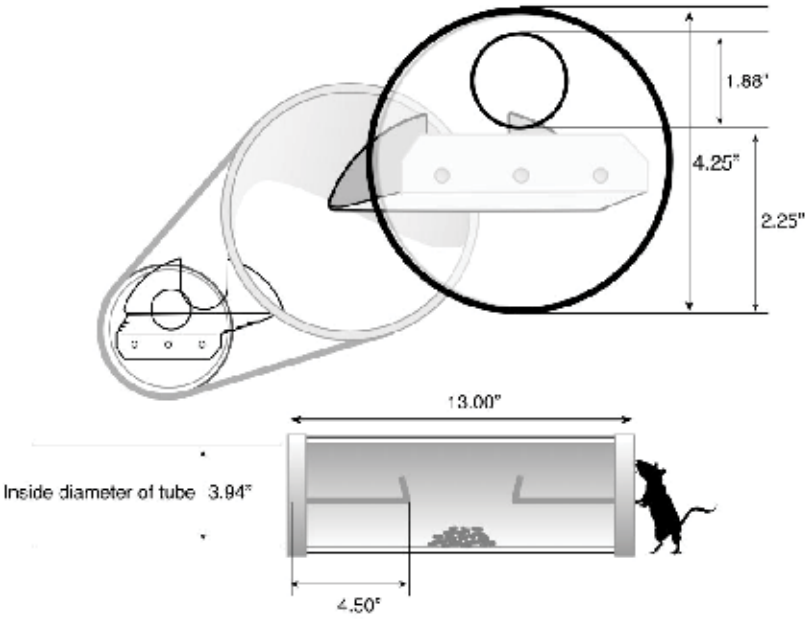
Here is an example of the calculations for a square, 80-acre orchard (1,867 ft × 1,867 ft):

$$\frac{\textit{Length of orchard}}{\textit{Spacing}} = \textit{NLength.aa} \quad \frac{1{,}867\ \text{ft}}{164} = 11.38\ \text{ft}$$

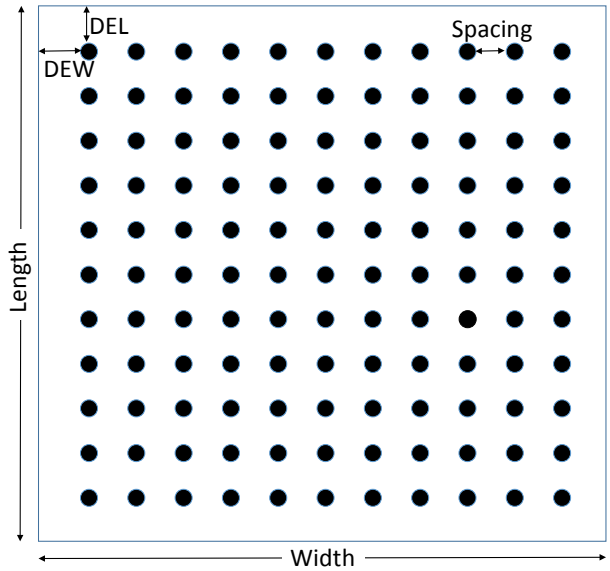
$$\frac{\textit{Width of orchard}}{\textit{Spacing}} = \textit{NWidth.bb} \quad \frac{1{,}867\ \text{ft}}{164} = 11.38\ \text{ft}$$

$$\textit{NLength} \times \textit{NWidth} = \textit{NBS} \qquad 11 \times 11 = 121\ \text{bait stations}$$

$$\frac{.aa \times \textit{spacing}}{2} = \textit{DE} \quad \frac{0.38 \times 164\ \text{ft}}{2} = 31\ \text{ft}$$



Design of bait stations used to control roof rats and deer mice. © 2014 The Regents of the University of California Division of Agriculture and Natural Resources



Example of the layout of bait stations (black-filled circles) for an 80-acre, square-shaped orchard. The length and width of the orchard are both 1,867 ft. In this example, only roof rats are present, so we use 164-ft spacing between bait stations. Initial bait stations are 31 ft from the edge of all sides of the orchard (DEL and DEW). © 2014 The Regents of the University of California Division of Agriculture and Natural Resources

A bait station attached to a scaffold branch in an almond orchard. © 2014 The Regents of the University of California Division of Agriculture and Natural Resources

for the target species to ingest a lethal dose. Therefore, maintaining a continuous bait supply throughout the baiting process is essential.

In wet and humid conditions, the bait may absorb moisture. If this happens, replace it with fresh, dry bait to maintain its effectiveness. While bait stations are designed to minimize spillage during rodent feeding, it is still important to monitor for any spilled bait and promptly clean it up to ensure safe and effective use.

- Rules and regulations
  - While there have been many changes to the application of Diphacinone and licencing requirements with the new category M, none of these impact the application of 0.005% Diphacinone baits in orchards. It is important to follow the label:
  - When applied in orchards, the bait must be applied at a minimum of 5 feet off the ground
  - You must remove and properly dispose of fouled bait
  - Carcass collection: Collecting and disposing of dead rodents is a critical step in the responsible use of anticoagulant rodenticides, such as diphacinone. This practice minimizes risks to non-target wildlife, domestic animals, and humans while ensuring compliance with environmental safety standards.
    1. Regulatory Compliance: The label states "Collect dead rodents and dispose of them by deep burying, burning (if permitted in your County or community), or double plastic bagging or by wrapping in newspaper and discarding in the trash. Wear disposable plastic gloves or other suitable hand protection if you must pick up carcasses by hand."

    2. Prevent Secondary Poisoning: Anticoagulant rodenticides work by disrupting the clotting mechanism of rodents, causing internal bleeding. Rodents that die after consuming these baits may still contain residues of the toxin in their bodies. Scavengers such as birds of prey, foxes, raccoons, and domestic pets are at risk of secondary poisoning if they consume these carcasses.

  - Avoid Public Health Hazards:
    - Dead rodents can become a source of unpleasant odors, attract flies, and harbor bacteria or parasites that may pose a risk to human health.
    - Timely removal reduces these risks and maintains sanitary conditions in and around orchards or treated areas.

4. Trapping: A Cornerstone of Long-Term Success in Roof Rat Management: Trapping is a critical component of IPM for roof rats in California's orchards and the next step in managing rats once a successful knockdown from bait has been achieved. As roof rats are arboreal and nocturnal, effective trapping requires strategic planning, proper spacing, and regular maintenance to achieve long-term control and prevent reinfestation.

- Strategic Placement for Optimal Results
  Research has shown that snap traps housed in protective trapping tunnels are highly effective when deployed in orchards. These tunnels not only shield the traps from non-target animals and environmental factors but also guide the rats into the traps, increasing capture rates. For optimal results, place trapping tunnels approximately 245 feet apart, ensuring coverage across the rat's home range, which can extend up to 280 feet in radius.
- Combining Trapping with Monitoring
  Trapping should follow an initial knockdown phase with baiting to address residual rat populations. Monitoring tools, such as tracking tunnels equipped with ink cards, can identify activity hotspots. Target these areas with traps to maximize effectiveness. Regular monitoring also provides early warnings of reinfestation, enabling timely intervention.
- Maintenance and Labor Considerations
  Trapping requires consistent maintenance to ensure efficacy. Check traps periodically (e.g., every three weeks) to rebait and reset them as needed. Automated solutions like Goodnature® A24 traps, which feature long-lasting lures and CO2 cartridges, reduce labor demands. Although less effective and far more costly than other options, these traps could supplement a broader IPM strategy if labor shortages do not allow for regular trap checks.
- Economic Viability
  Snap traps in trapping tunnels offer a cost-

effective solution for long-term pest management. While the initial investment may exceed bait-only approaches, the reusability of trapping tunnels and the reduction in bait expenses make this strategy sustainable. For example, studies have shown that after the first year, the cost of IPM programs using snap trapping aligns closely with bait-only strategies, at approximately $16 per acre annually.

- The Role of Collaboration
  Trapping is most effective when integrated into a coordinated, area-wide IPM program. Neighboring orchards can synchronize trapping efforts, reducing reinfestation risks and sharing resources for greater efficiency. However, even individual growers can achieve significant success by strategically deploying and maintaining traps.

By committing to a well-maintained trapping program and integrating it into a broader IPM strategy, growers can achieve long-term success in managing roof rat populations while minimizing economic and environmental costs.

5. Ongoing Monitoring and Adaptation: Regular use of tracking tunnels every three months can help gauge population levels and guide additional management actions. If rat activity resurges, supplementary baiting or trapping may be required.

Using Proper PPE When Handling Dead Rats

Handling dead rats during a snap trapping program, or while collecting carcasses post baiting, requires strict adherence to safety protocols to minimize the risk of exposure to zoonotic diseases, parasites, and allergens. Proper personal protective equipment (PPE) is essential for ensuring the health and safety of individuals managing traps. Here's what you need to know:

Recommended PPE for Handling Dead Rats

1. Gloves: Use disposable nitrile or latex gloves to prevent direct contact with the rat's body, blood, or parasites. Never handle dead rats with bare hands.
2. Respiratory Protection: Wear an N95 respirator or similar mask to avoid inhaling dust, dried urine particles, or other contaminants that may carry diseases like hantavirus.
3. Protective Clothing: Wear long-sleeved clothing or coveralls to minimize skin exposure. Ensure clothing is washed thoroughly after use or opt for disposable coveralls.
4. Boots: Sturdy, closed-toe footwear protects against accidental injuries when navigating orchard terrain.

Safe Handling and Disposal Practices

1. **Remove Rats Carefully:** Use gloved hands to remove dead rats from traps, avoiding direct contact.
2. **Bag and Seal:** Place the carcass in a sealable plastic bag, and then double-bag it to prevent leaks or contamination.
3. **Dispose Responsibly:** Follow local regulations for disposing of animal remains. Many areas allow disposal in secured trash containers but verify specific requirements.
4. **Wash Hands:** After removing PPE, wash hands thoroughly with soap and water for at least 20 seconds.

Why PPE Matters

Roof rats and other rodents can carry a variety of diseases which can be transmitted to humans through direct contact, inhalation, or contaminated surfaces. Using proper PPE and following safety protocols significantly reduces these risks, protecting the health of orchard workers and their families.

By prioritizing safety and using appropriate protective measures, growers can confidently and effectively manage baiting and snap trapping programs while maintaining a safe working environment.

Environmental Considerations

Environmental stewardship is also a key consideration. The use of elevated bait stations minimizes risks to non-target species, and adherence to updated regulations ensures compliance with state and federal guidelines. It is crucial for growers to stay informed about rodenticide use restrictions and to consult resources like the California Department of Pesticide Regulation's PRESCRIBE database to determine potential restrictions for the use of pesticides in a given area (https://www.cdpr.ca.gov/docs/endspec/prescint.htm).

A Call to Action for Pest Control Advisers

Pest Control Advisers (PCAs) play a vital role in supporting growers with roof rat management. By integrating monitoring, baiting, and trapping into a cohesive IPM strategy, PCAs can help growers protect their orchards from these destructive pests while minimizing environmental impacts. Collaboration among neighboring landowners can further enhance the efficacy of these programs, creating a united front against roof rat infestations.

Conclusion

An effective emergency response to rat management in California's nut and fruit orchards requires a proactive, integrated approach. Combining monitoring, baiting, and trapping within an IPM framework provides the best opportunity to mitigate damage and protect valuable crops. By adopting these strategies, growers and PCAs can ensure the long-term health and productivity of California's orchards. ■