



Disease Prevention Through Vector Control, Part 1

Innovations in Rodent Management

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It is the spring of 2020 and the majority of society is being asked to socially distance themselves from one another. There is a novel strain of virus known as COVID-19 causing a pandemic that, at the time of this writing, has killed 60,057 Americans [Center for Disease Control (CDC) website]. We are being told by our government not to go out in public unless you are an essential worker or unless it is absolutely necessary, to shelter in place, and to work from home. The CDC has postulated that COVID-19 might be spread by contact with contaminated surfaces or objects. Due to that possibility, they recommend that surfaces be cleaned frequently and that everyone washes or otherwise sanitizes their hands frequently and avoids touching their mouth, nose, and possibly eyes. That is because inanimate objects can act as fomite vectors of pathogens.

Similarly, rodents and insects (e.g. litter beetles, cockroaches and flies) are considered mechanical vectors of disease in poultry houses. They carry bacteria, fungi, protozoa, viruses, and parasitic worms on the interior and exterior of their bodies and transfer these pathogens between hosts when they are consumed or when they contaminate food and water sources. As with any disease, the best way to prevent

illness is to avoid getting infected. One way that we can mitigate the exposure of poultry to disease is to remove vectors from the equation. This topic could fill up an entire text book, so we will be tackling this issue in two parts. In this article we will be addressing the newest innovations and methodologies for rodent control. Part two of this article will cover insect vectors.

In addition to being physically destructive to infrastructure such as foundations, walls, electrical wiring, and insulation, and causing considerable feed losses, rodents are considered a vector of disease in animal production. They have been implicated as vectors of over 35 pathogens including *Salmonella* sp., *Campylobacter* sp., Cholera, Leptospirosis, Bordetellosis, Hanta virus, LCMV (Lymphocytic choriomeningitis virus) (Loncke & Dewulf, 2019) and possibly even avian influenza (Velkers, et al., 2017). It is difficult to exclude rodents from poultry houses, especially when they are juxtaposed to wooded areas and attracted to certain crops. Animal production barns provide rodents with shelter, an abundance of food, and a perfect climate for reproduction and development.

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Rodent control pillars

The basic tenets of a comprehensive rodent control program are to 1) set up bait stations around the perimeter of the interior and exterior of poultry houses, 2) keep them replenished with fresh bait, 3) monitor for activity using live traps, snap traps, sticky traps, or new sensing technology, 4) rotate between active ingredients, modes of action, and bait matrices, 5) utilize liquid bait stations, 6) bait attics, and 7) bait any active rodent burrows.

In an attempt to prevent rodents from migrating from nearby vegetation and buildings, tamper-proof bait stations should be placed against exterior walls of barns. For rats, it is recommended that stations be placed every 30–50 feet, whereas stations targeting mice should be placed every 10–15 feet, based on the average maximum foraging distances for each species. For new construction, these exterior bait stations may suffice until rodents are detected on the interior of barns. At that point, rodent bait stations need to be added to the perimeter of interior walls using the same spacing as described for each species. Tamper-proof bait stations can even be deployed around debris piles, fence lines, and the edges of woods as an added line of defense further from houses. Advances in bait station technology include the additions of weights (Tomcat® Titan and Aegis-RP Anchor) to keep stations from being moved away from their intended location (i.e. up against walls where rodents like to travel). Also, some stations are designed to be mounted vertically (Tomcat® Vertical and Aegis® Bait Stations) to keep them in place and out of the way of mowers and workers.

The number one reason rodenticide programs fail is that bait boxes are not cleaned and replenished often enough. When I am invited out to a farm to evaluate ways in which they can improve the effectiveness of their rodent program, nine times out of 10 the issue is empty bait boxes, or moldy, stale bait. Bait boxes should at least be checked once per month. Old bait should be replaced with fewer placements and totally consumed bait should be replenished with more

placements. The frequency of bait box maintenance should increase with increased rodent pressure.

Monitoring for activity

Monitoring for rodent activity will help discover where rodents are nesting and foraging and their population density. Look for anything larger than dime-sized holes in walls. Seal up as many as you can using sturdy materials such as concrete, steel, or galvanized sheet metal. Look for rub marks along walls and pillars where oil and dirt from rodent bodies have left behind a dark, shiny trail. Use these holes and rub marks as indicators of where to focus your baiting strategies. Place sticky traps, snap traps, or live traps along walls in places where rodents are suspected to travel. The number of rodents caught in these traps should serve as data points that can be used to measure changes over time in population densities as new strategies are added to your rodent program or new baits are being evaluated. Dispose of, reset, and/or replace these traps as needed when they are full. If no rodents are detected within a week, move the traps to another location.

Motomoco iQTM is a new remote sensing technology that records the number of rodent “hits” on a bait station. Special sensing trays can be placed in the bottom of Tomcat® Titan, Bullet, Live Catch, or Rat Traps. Each time a rodent enters a bait station, the sensor records that data point as an event. The station automatically sends this recorded data to an app downloaded on an individual’s cell phone or tablet whenever he or she gets within several feet of the station. The app software will then generate a report that shows which traps have been most frequented. This information helps make decisions on which traps need to be serviced and the location of the highest rodent activity. Over time, this data should prove invaluable for determining the effectiveness of rodent control programs and may provide an indication of the effectiveness of employees dedicated to rodent control.

Rodenticide classes

When it comes to rodenticide classes, there are only three: neurotoxins, anticoagulants, and hypercalcaemics. Neurotoxins affect the central nervous system, causing paralysis, and include the active ingredients bromethalin [Table 1] and zinc phosphide. Neurotoxins tend to achieve the fastest mortality of rodents of the three classes (usually

within hours to a couple of days depending on the formulation). Unfortunately, this can lead to bait shyness, or avoidance of bait. For that reason, neurotoxins can often only be used for a couple of weeks at a time.

Anticoagulants prevent the liver from producing vitamin K, which leads to internal bleeding. Anticoagulant active ingredients include brodifacoum, bromadiolone, difethialone, difenacoum, and diphacinone. You can expect anticoagulants to affect rodents that receive a lethal dose within 3–8 days.

Cholecalciferol is vitamin D₃ and is the only hypercalcaemic used in rodent control. An overdose of this vitamin delivered through rodent bait causes excessive calcium build up in the blood stream which leads to muscle weakness, and calcification of blood vessels, heart valves, liver, kidneys, and other soft tissues. This eventually leads to death (Rumbeiha, 2006). This active ingredient typically requires multiple feedings to achieve a lethal dose and causes death within 4–6 days.

The most important aspect to remember about rodenticide classes is that it is imperative to periodically rotate between them in order to avoid resistance. Rodenticide resistance in rodents to first- and second-generation anticoagulants has been found in several European countries (Meerburg et al., 2014). Rotate between active ingredients every 4–6 months and utilize at least two rodenticide classes each year.

Rodenticide formulations and methods

Rodenticide active ingredients are presented in many inactive ingredient formulations called 'matrices.' These include blocks or chunks, soft baits, meal baits, pellets, pitch packs, powders, and liquids. Each of these matrices has their own uses and advantages. Blocks or chunks are typically used in tamper-proof bait boxes. They have a hole drilled through the middle to skewer them on rods in bait boxes in order to keep them secure and in place. Soft baits can also be placed on skewers in bait boxes but are also often skewered on wire or nails and placed inside of barns where non-target organisms do not have access to them. The soft baits tend to be highly palatable.

When animals are removed from barns for cleanout, it provides an ideal opportunity for rodent control since there are no non-target animals present that would require all bait to be in bait stations. This is an ideal time for utilizing

neurotoxins. Meal bait and pellets are often used in trays, such as egg flats or paper plates, on the interior of barns when animals are removed during a cleanout. Place the flats of meal bait every 10–15 feet for mice and 30–50 feet for rats as described for bait boxes. No more than a cup of bait should be used in each tray, and replenish the bait as it is consumed. Overloading the trays with bait will lead to waste. Pick up all meal bait or pellet trays before animals are reintroduced into barns.

Meal baits or pellets should also be placed deep in rodent burrows. Burrows can be found in the soil near the exterior foundation and in manure piles in pits. Cover each burrow with your foot or shovel. Any new burrows that are uncovered within a few days should be baited. The simplest method of burrow baiting is to attach a funnel to a 4-foot long piece of ½-inch PVC pipe. Insert the end of the pipe 6 inches down into the burrow and apply 1 tablespoon of bait into each burrow. Re-cover each baited burrow with soil.

Pitch packs are intended for use in areas that are difficult to reach. They act as miniature bait stations in wall voids and attics. They are filled with anticoagulant bait as either meal bait or pellets. The newest invention in attic baiting is Neogen® Attic Attack Bait Stations. These 3-inch round bait stations can be inserted into pre-drilled holes in ceilings and allow you to bait hard to access attics from below. Once the traps are in place, you can remove the insert, place bait on a skewer, and replace the insert back into the station. Once the bait is consumed, a red indicator flag pops out to let you know which stations need to be serviced.

Disease challenges seem to be coming at us from all directions lately. COVID-19 has reduced our processing capacity and affected the normal demand from restaurants. Our government responded by asking us to shelter in place to alleviate the strain on our hospitals while detection methods, new treatments, and vaccines are developed and evaluated.

As diseases evolve, it necessitates rapid, innovative technology. Removing mechanical vectors of disease to protect our food supply is no different and our industry is responding with new weighted bait stations, attic baiting systems, remote sensing technology, and more palatable bait matrices. Implementing these new technologies can advance a facility's biosecurity.

References Cited

2020. Coronavirus Disease 2019 (COVID-19). Center for Disease Control and Prevention. <https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/cases-in-us.html>

Loncke, T. and Dewulf, J., 2019. Rodent Control in Animal Production. *Biosecurity in Animal Production and Veterinary Medicine*, p.283.

Meerburg, B.G., M.P. van Gent-Pelzer, B. Schoelitsz, and T.A. van der Lee. 2014. Distribution of anticoagulant rodenticide resistance in *Rattus norvegicus* in the Netherlands according to Vkorc1 mutations. *Pest Management Science* 70: 1761–1766.

Rumbeiha, W.K. 2006. Cholecalciferol. *Small Animal Toxicology*, 2nd ed.; Peterson, M.E.; Talcott, P.A., Eds.; Elsevier Saunders: St. Louis, MO; pp 629–642.

Velkers, F.C., S.J. Blokhuis, E.J.B. Veldhuis Kroeze, and S.A. Burt. 2017. The role of rodents in avian influenza outbreaks in poultry farms: a review. *Veterinary Quarterly* 37: 182–194.

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TABLE 1. RODENTICIDE COMPARISON CHART							
ACTIVE	PRODUCT	MFR	% OF ACTIVE	MODE OF ACTION	# OF FEEDINGS	KILL TIME	
BROMETHALIN	Rampage® Chunx	Motomco	0.01%	ATP Inhibitor Disrupts Energy Cycle, Non-Anti-Coagulant	Single Feed	12-24 hours	
	Rampage® Meal		0.01%				
	Rampage® Soft Bait		0.01%				
	CyKill™	Neogen	0.01%				
	Gunslinger®	Lipha-Tech	0.01%				
	Cannon™ Soft Bait		0.01%				
BRODIFACOUM	Jaguar® Chunx	Motomco	0.005%	2nd Generation Anti-Coagulant	Single Feed	4-6 days	
	Jaguar® Soft Bait		0.0025%				
	Havoc® (XT)	Neogen	0.005%				
	Havoc® Meal Bait		0.005%				
	Havoc® Attack		0.005%				
BROMADIOLONE	Hawk® Chunx	Motomco	0.005%	2nd Generation Anti-Coagulan	Single Feed	4-6 days	
	Hawk® Meal Bait		0.005%				
	Hawk® Soft Bait		0.005%				
	Decimax™ Soft Bait	Neogen	0.005%				
	Boothill®		Lipha-Tech				0.005%
	Revolver® Soft Bait						0.005%
CHOLECALCIFEROL (VITAMIN D ₃)	Aggrid ₃	Motomco	0.075%	Hypercalcemia	Mutiple Feed	4-6 days	
	Selontra®	BASF	0.075%				
DIFETHIALONE	Hombre®	Lipha-Tech	0.0025%	2nd Generation Anti-Coagulant	Single Feed	4-6 days	
	Renegade® Meal Bait		0.0025%				
	Fast Draw® Soft Bait		0.0025%				
DIPHACINONE	Tomcat® Chunx	Motomco	0.005%	2nd Generation Anti-Coagulant	Mutiple Feed	6-8 days	
	Tomcat® Liquid		0.106%				
	Ramik®	Neogen	0.005%				
ZINC PHOSPHIDE	Eraze™ Ag	Motomco	2.0%	Non-Anti-Coagulant Acute	Single Feed	2 hours	
	ZP® Tracking Powder		10.0%				
	Prozap® ZP Tacking Powder	Neogen	10.0%				

Prior to using any product mentioned in this article, carefully read and follow all available instructions, warnings and safety information made available by the product’s manufacturer.