Vole Issues and Management around Homes, Orchards, and Row Crops

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Voles are a small rodent found in the family *Cricetidae*. Voles are most commonly known for burrowing systems they create. In Kentucky, there are four different species of voles: The Meadow vole (*Microtus pennsylvanicus*), Prairie vole (*Microtus ochrogaster*), Woodland vole (*Microtus pinetorum*), and the Southern Red-Backed vole (*Myodes gapperi*). Though each species is unique, they share common characteristics. All voles have a thick cylindrical shaped body and unlike mice, they have miniature ears often hidden underneath their dense fur. Voles have a naturally shorter tail that is significantly less than the total length of the body, whereas mice generally have a tail that is as long as or longer than their body.

The Meadow vole is one of the larger of the four species, having a maximum weight of 2.3 oz and the body length ranging from 3.7 – 7.0 in. Meadow voles will have thick coarse fur that appears dark brown on their backside and a creamy white belly. The ears will be mostly concealed by fur and not easily visible. Out of the four species, they have the longest tail that is normally over 1.6 in. A key distinguishing characteristic they possess is on the soles of their feet they will have 6 pads while the Prairie vole will only have 5. The Meadow vole can be found occupying meadows, roadsides, and areas with dense grass vegetation.

The Prairie vole (Figure 2) is slightly smaller than the Meadow vole, weighing a maximum 2.1 oz and the body length rangers from 3.9-6.5 in. Their fur is a grizzled gray-brown color and an orange-yellow belly. Unlike meadow voles, their ears are slightly more visible and not as concealed beneath the fur. The tail is short and is bi-colored with a tufted tip. As previously stated they have 5 pads on the soles of their feet. Both the Meadow and Prairie vole are often found in grassy like habitat. Their habitat preference is why they are often the culprits who cause agricultural damage to farm fields.

Woodland voles are also commonly called pine voles. A woodland max weight is around 1.6 oz and a total body length around 3.2- 5.1 in. Their fur color ranges from brown to a reddish-brown color and they have been noted to have short velvety fur. Their tail is the shortest out of the four voles and has a naked bi-color appearance. The Woodland vole prefers deciduous or pine forest habitats with a thick leaf layer covering.

Lastly, the most unique species of voles in Kentucky is the Southern Red-Backed vole. They are the smallest of the four species. Reaching a maximum weight of 1.3 oz and a length ranging from 3.2-4.4 in. As the name suggests, the back and top of head are a reddish color. The sides of the body will be gray yellow color that drastically contrasts with the back. Contradictorily to the other vole species, this vole does not establish an underground burrow system.

Figure 1. Comparison of size and appearance for Prairie vole and the commonly found *Peryomuscus spp.* (commonly Deer or White-footed mice species depending on location).

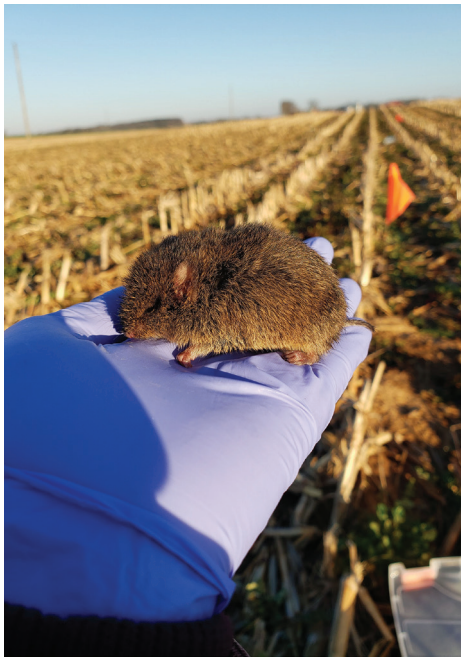

Figure 2. Prairie vole.

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Figure 3. Vole tunnel hidden by vegetation, no distinct runways visible.

Figure 4. Vole tunnel and faint runways.

Figure 5. Vole tunnel and defined runways.

LIFECYCLE AND BEHAVIOR

Voles are a semi-fossorial species meaning they occupy both above and below ground habitat. With the exception of the southern red-backed vole, they establish a network of underground tunnels and burrows along with a systematic scheme of runways on the surface to go about their daily activities. Burrows systems will be used for nests, food storage, and protection. Runways are paths and trails made by the voles to different burrow entrances or to food sources. The Prairie vole have burrow chambers that can be anywhere from 0.1-1.9 in deep. Meadow voles will establish nests 3.9 in underground or under dense surface vegetation. Voles will typically be active day and night foraging for food.

Depending on the species of vole, gestation can last up to 21 days. Female voles can mature in 35-40 days depending on the quality of the food and habitat. For each species of voles, the number of liters per year and the amount of young birthed are slightly different. The Meadow vole can have anywhere from 5-10 litters each year, ranging from 3-5 pups per liter. The Woodland vole can have 1-6 litters per year with 2-4 pups per liter. The Prairie vole can have anywhere from 3-10 liters with 2-4 pups per liter. However, the highest recorded amount liters per year was in captivity with 17 litters by the Prairie vole.

HABITAT AND FOOD

The most common voles found in agricultural settings are the Meadow and Prairie vole. These two species will reside in pastures, orchards, roadsides, alfalfa fields, or habitats that contain a thick, dense vegetation. However, out of the two, Prairie voles prefer a dryer habitat while the Meadow vole will prefer a slightly moister habitat. There has been a spike in vole populations in agricultural fields due to the high quality of habitat it provides voles. Both cover crops and actual row crops provide a thick lush protective cover from predator species while supplying a continuous food source giving voles the chance to thrive.

Voles are forage feeders that have a wide variety of diet. Unlike some small mammals, voles are active feeders year-round and have been known to store food in their burrows for winter. A vole's diet consists of grasses, forbs, legumes, seeds, tuber roots, bulbs, insects, and bark. Due to the nature of the vole's diet, they can be immensely destructive on agricultural plants such as corn or soybeans.

VOLE DAMAGE/SCOUTING

Voles can cause a wide variety of damage to many different landscape settings such as lawns, orchards, and agricultural fields. In landscaping, voles are considered a nuisance species. In lawns, voles can kill newly planted shrubs or trees by gnawing the bark. Flower bulbs, garden plants, and vegetables are often sought out food items, this then damages or kills them. They can occasionally make it difficult to establish annuals. Also, look for surface ground runways that voles will create. The runways will appear as a worn down path in thick vegetation often about two inches thick. Differences in appearances of vole tunnel entrances and runways exist. Some are more defined than others and may make observing those less defined harder in fields, especially since they are often found where remnant vegetation or cover exists. (Figures 3, 4, 5).

Orchards, Nurseries, and Fruit Production Systems

In orchards or blueberry production systems, if voles are present this will be shown by girdling or gnaw marks on trees/bushes. Plants that have damage by voles will have irregular spaced gnaw marks at the base of the tree. However, this is not to be mistaken with rabbit damage which will have regularly spaced gnaw marks. If rabbits are causing the damage, lower branches will also be cleanly clipped off. Also, keep

an eye out for runways leading up to the trees. For more information on identification or control please refer to the University of Kentucky Horticulture Extension video on vole control in blueberry production here (https://www.youtube.com/watch?v=WvFJobCKo8M).

Lawns

Voles can cause unsightly issues in yards for homeowners. Usually these manifest themselves through the appearance of multiple golf ball sized holes spaced closely together. Runways for the animals, feces, and potentially loss of grass from consumption may also be visible. Due to the nature and size of lawns it is possible to control them with snap traps over a period of 1-2 weeks. The sooner you find the colonies the shorter the time to rid yourself of them. Regular mouse sized traps baited with peanut butter and oats will work. Place traps at ¼- 1/3 of the total number of burrow openings and cover them with a piece of cardboard to prevent birds from accessing them. Check them daily and continue trapping until no animals are caught for three consecutive days

Row Crop Agricultural Damage

Damage can be very apparent in agricultural fields when vole populations are at high levels. Damage will often be found next to or near field edges and close to waterways. These areas tend to provide the most habitat year round and act as a potential source population when crops are planted. Voles will consume planted seeds or clip off the tops of growing plants in fields. This will cause gaps in crop vegetation, leaving a crop circle appearance. The gaps in crops allow for unwanted weed species to grow and will be an obvious indicator of vole presence especially in soybean fields. In the fields, voles will establish surface runways. The runways will consist of closely clipped vegetation and have a width of about two inches.

Figure 6. Vole colony located in the middle of a soybean field. No soybeans were able to grow within close range of the colony's tunnels as they were all consumed by the voles.

DAMAGE PREVENTION

To assess if there is potential for vole damage, it is best to scout fields prior to planting. In cover crops, look for darker colored patches of crops. These areas could be the location of a vole colony where there is a higher amount of scat and urine fertilizing the crops. Surface runways will also be moderately visible. The runways often have a worn-down path that stands out compared to the rest of the vegetation. A vole colony will consist of multiple entrances or burrows in a single location. The size of the burrow entrance will be the size of a golf ball or smaller. An active vole colony may have scat by the entrance of the burrow or freshly clipped vegetation around the burrow. The entrance will appear to be slick while an un-active colony will appear more dried out or not as well maintained.

Modify Habitat:

Depending on the level of infestation and the plot size you wish to manage, habitat modification may be a viable method to mitigate vole damage. Examples of habitat modification range from vegetation removal and low mowing to herbicide application. With that said, they all attempt to achieve the same goal of removing food and cover. Removing food and cover may cause vole populations to move to more suitable habitat, starve, or be more easily preyed upon by predators such as hawks, snakes, foxes and coyotes. Habitat modification may be effective on small scales but may become more expensive or time consuming when applied in larger agricultural systems such as row crop systems and should therefore be targeted towards areas of highest impact. Examples of implementation on larger row crop scales include keeping field edges mowed short to help reduce migration of voles from external habitat into row crop fields. This method is not perfect but can help lower the likelihoods of animals routinely moving in and out of row crop fields. Examples of other means of habitat modification for larger row crop systems include multiple types of tillage. Tilling a field will destroy runways, burrows, and eliminate cover and food available. However, producers should consider

Figure 7. Aerial photograph of severe vole damage caused by dozens of colonies located in a soybean field. Photo credit: Dr. Chad Lee, University of Kentucky

the impacts of tillage, as it increases the potential for soil erosion.

Similar methods can be implemented in backyard garden situations. Keeping grasses mowed immediately adjacent to gardens or other flower beds can help limit vole movement to those areas. Unfortunately many of the weed management tactics commonly used in those situations, mulching and black-plastic, will also provide voles cover habitat so individual situations will need to be evaluated to determine best management practices.

Exclusion:
Excluding voles may be an effective means of damage prevention depending on the size of the exclusion zone. Voles can be effectively excluded from damaging plants such as trees by circling the trunk with plastic cylinders or hardware cloth of ¼-inch or less. When doing this, significant space should be left between the protective material and the trunk to allow for future growth. The protective material should also be buried to keep voles from simply moving under the material. Similar methods may be used to exclude voles from a plot by fencing in the area with ¼-inch, or less, mesh and burying it 6 inches below ground to prevent voles from simply burrowing under. While this may be effective on a small scale, the labor and time associated with this method often eliminates it from being used in larger applications such as row crop systems.

Repellants:
Vole repellant options include products that are distasteful to the animal as well as products that increase the target animal's stress level. The first category of repellants is comprised of products containing thiram or capsaicin that aim to deter voles from consuming the plants they are applied on. The second category of repellants is comprised of products such as fox and coyote urine which may increase voles stress levels and depress reproduction rates. When using any repellent, always consult the label for application instructions and avoid application on any part of a plant that may be consumed by humans unless the label expressly states that this is unnecessary. While repellents may prove effective on a small scale or over short periods of time, the need for reapplication after precipitation events, as well as the time and labor associated with their use make them less feasible on larger scales and not recommended in row crop systems.

Trapping:
Trapping voles is another method of damage control that may be effective depending on the scale it is applied. While placing traps may be time consuming it can prove very effective on smaller plots or lawns. When using traps to mitigate vole damage, traps should be placed in or along holes and runways. Traps set along runways should be placed with the trigger in the runway and the trap perpendicular to the runway. It is not necessary to bait traps; however, if you wish to do so a mix of peanut butter and oatmeal on the trigger will suffice. Deploying traps in holes or in an enclosure sized for a vole may mitigate trapping of non-target species and therefore bolster effectiveness. Traps should be checked regularly and moved if nothing is caught within 48 hours. With this in mind, trapping efforts as a whole may continue as long as the target species is being captured. While traps may be effective on small plots and populations, the time and labor required for their successful deployment must be taken into account when applied to larger plots. These considerations combined with the reproductive capabilities of rodents make trapping inadvisable for large row crop systems.

Toxicants:
Toxicants offer perhaps the most efficient results for vole damage control at a large scale. With this said, it is important to keep in mind that they also pose the highest risk of accidental poisoning of non-target species and humans. It is therefore important to consult your state and local regulations before purchasing or applying toxicants. Perhaps the most commonly used toxicant for vole population control is zinc phosphide. Zinc phosphide is a restricted use toxicant and can only be used in above ground applications by a registered applicator. Zinc phosphide often comes in a pellet bait form that should be applied by hand on holes or runs, or drilled to avoid

consumption by non-target species or humans. It may be used in a variety of non-food agricultural scenarios such as no-till corn and dormant orchards, but is limited to food applications such as grapes and sugarcane. Currently there are no labeled products for row crop production systems but field borders do have some options labeled for use at this time.

Other toxicants may include active ingredients bromethalin or cholecalciferol and are anticoagulants that may require multiple consumptions before becoming fatal to the target species. Depending on state and local regulations, some toxicants may be broadcast per their label instructions; however, this may increase the amount of toxicant needed to achieve the same impact on the vole population and raise the risk of impacting non-target species. **While toxicants may offer an efficient means of vole population control, regulations and label instructions must be followed to ensure minimized risk of human and non-target species contact.** For these reasons, application limitations restrict toxicants from being used in most row crop systems.

Alternative Feeding:

Alternative feeding is essentially the application of some other food source to remove the need for voles to consume crop plants. This may prove effective in mitigating crop damage, as voles are less likely to consume crops if they have a plentiful food supply. This can be applied in scenarios such as Roundup Ready® soybeans, where standard soybeans can be broadcast evenly prior to seeding and (if any seeds germinate) controlled later with Roundup®. Research suggests that one bushel of soybeans, evenly spread, may be sufficient. In this scenario, vole damage may be mitigated by the additional food provided early since voles generally feed on new leaves and not the whole plant once the plants are established. In this way, alternative feeding may mitigate crop damage during this critical seedling period and may be useful in row crop systems.

Raptor Perches:

Raptor perches are an effective way to encourage vole predators, such as hawks and owls, to frequent a given location. This may aid in deterring voles from colonizing an area or help to control small populations. With this said, while raptor perches are encouraged in large scale applications such as row crop systems they are likely most effective when combined with other measures such as habitat modification. Use of rodenticides is discouraged if you are placing raptor perches as rodents who consume the rodenticide will be eaten by the raptors and cause the raptor's health to be impacted indirectly by the rodenticide.

VOLE BENEFITS

Rodents such as voles may be beneficial, in certain numbers, due to their proclivity for consuming a variety of insects and agricultural weed seeds. When found in low densities, these possible benefits should be considered along with all other pertinent factors.

CONCLUSIONS/INTEGRATED METHODS

When attempting to confront issues of vole damage it is generally most effective to employ an integrated pest management approach. This entails assessing the problem and coming up with a targeted strategy for each instance. Often times, the most effective way to mitigate vole damage is to employ a combination of the damage prevention measures listed above. For instance, the use of toxicants may prove more effective over the long term when combined with habitat modification measures such as low-mowing or herbicide application. Given a certain scenario this two-pronged approach may be more effective at controlling the existing vole population while at the same time limiting their resources and encouraging persisting individuals to leave. In the end, preventing vole damage is a multifaceted undertaking that requires not only an understanding of voles and your particular situation, but also an integrated management plan over potentially several years.

References and Other Resources

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