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Earthworm Activity in West Texas Lawns

What those dark, lumpy soil piles are, whether they harm the grass, and what homeowners can do

A cited research summary for San Angelo, Sterling City, and the Concho Valley
Research compiled November 20, 2026

About this report

This public summary is written first for homeowners in the San Angelo and Sterling City area. A short section for lawn care professionals appears near the end. It is based on Texas A&M AgriLife Extension, other land-grant university extension services, EPA pesticide labels and pesticide law, and official USDA and NOAA records. It is a research summary, not a product label and not a recommendation to apply any pesticide.

Texas A&M AgriLife has useful local notes on earthworms and on how to tell lawn mounds apart, but it does not publish a detailed home-lawn earthworm fact sheet for West Texas. Where Texas-specific guidance is thin, this report says so and turns to other university turf programs. No field study of earthworms in Concho Valley lawns was found. Ask at the BES-TEX counter, or call 325.653.1300, for cultural tools and for what the store carries. Bring a photo of the piles if you are not sure what you are looking at.

Bottom line

- Dark, lumpy soil piles about the size of a fist or smaller, usually with no obvious open hole, are typical of earthworm castings (worm waste). Fresh piles are often darker and slightly shiny; they harden into bumps as they dry.
- Piles show up after rain or irrigation, and they are usually most noticeable in spring and fall, when the soil is cool to mild and stays moist. In West Texas they are common on irrigated lawns even though the climate is semi-arid.
- Earthworms do not feed on grass leaves or roots. The usual complaint is a messy or uneven surface, mud on shoes, and mower blades dulled or smeared when casts are cut while wet — not dead turf. University sources treat earthworms as beneficial soil animals.
- Killing the worms is usually not necessary or advisable. Their tunneling loosens soil, improves water and air movement, and helps break down thatch.
- No pesticide currently registered by the EPA was found that is labeled for earthworm control on home lawns. Using a lawn insecticide — or any pesticide — just to kill earthworms is an off-label use and is against federal law. The label is the law. Texas rules say the same thing.

- The practical approach is cultural: let the piles dry, then rake, brush, or mow them down; water deeply and less often so the surface can dry; mow at the high end of the recommended height for your grass; and core-aerate thin or bumpy lawns when the grass is growing well.

1. What the piles look like

Earthworm castings are the soil and digested organic matter that worms leave at the surface. Homeowners in this area often describe them as dark, lumpy piles about the size of a fist or smaller, with no visible hole. That description matches university accounts of surface casts.

Typical features, drawn from university extension sources, are:

- Shape and texture. Castings are irregular, crumbly, or conical piles of soil. The particles are clumped into small pellets — one North Carolina Extension article compares them to Nerds candy, but the color of soil — not loose, dusty grains like many ant mounds.
- Color. Fresh casts are often darker than the surrounding soil and may look slightly shiny or moist. As they dry they fade and harden into firm bumps.
- Size. Many casts are small: often about an inch high, and a few inches across. A Texas A&M AgriLife horticulturist in Bexar County identified mounds about 3 inches across and 2 inches high as earthworm castings. Piles can reach fist size, or a little larger, when activity is heavy or when casts build up in one spot. An AgriLife turf-pest chart also lists much smaller dirt “pellets” (about 1/8 inch) scattered in thatch; those are the same kind of waste, just in a finer form.
- The hole. Many casts have no obvious open hole. That is a useful clue. Some nightcrawler piles (sometimes called middens) sit at a burrow entrance, and a small shaft may be visible in the center. A Bexar County homeowner described just such a central shaft; AgriLife still identified the mounds as earthworm castings. A small opening does not rule worms out, but a clear, lasting hole the size of a pencil eraser is more typical of bees, wasps, or crayfish chimneys.
- Where they sit. Piles are scattered at random on the lawn surface, not arranged in a long raised tunnel.

When they appear

Earthworms come to the surface after rain or irrigation, and they are most active when the soil is moist. Kansas State University notes that activity is greatest when soil moisture is at or above field capacity, in darker soils rich in organic matter, and after rainy periods, when worms come up to feed and mate. They remain able to move whenever the soil is not frozen.

University turf programs in several states say surface casts are usually worst in spring and fall, when temperatures are moderate and soils stay wet longer. The University of Minnesota, writing about nightcrawlers, says cone-shaped mounds are most common in early to mid-spring; as the weather warms, the worms move deeper and are seen less often at the surface. Worms may also come onto sidewalks and driveways after a heavy rain or when a lawn is overwatered.

Those patterns fit the Concho Valley even though most of the detailed turf guides were written for wetter regions. Official National Weather Service normals for San Angelo (1991–2020) show a semi-arid climate with 20.93 inches of precipitation a year. Rain is concentrated in spring and fall: May is the wettest month at 3.05 inches, and September and October each average about 2.4 to 2.5 inches. July averages only 1.10 inches. Summer afternoons are hot (normal July high 97.4°F; normal July low 72.3°F). Winters are relatively mild

(normal January high 61.1°F; normal January low 33.7°F), so a long, frozen shutdown of worm activity is less certain here than in northern states. On unirrigated ground, worms would be limited by drought. On watered home lawns, the soil can stay moist enough for surface casting whenever irrigation is frequent — especially in spring and fall, and after a soaking rain.

2. How to tell castings from other piles

Several animals leave soil on a lawn. The table below uses Texas A&M AgriLife and other university or agency sources, and it notes how likely each one is around San Angelo and Sterling City. If you are unsure, bring a close-up photo to BES-TEX (325.653.1300).

What you see	Likely cause	How it differs from worm castings	In this area?
Dark, lumpy or pellet-like piles, marble- to fist-size; little or no open hole; often after rain or irrigation.	**Earthworm castings (including nightcrawler middens).**	Particles are clumped, often darker when fresh.	Yes, especially on irrigated lawns.
Fine, loose soil or sand, often with an entrance; ants appear if the mound is disturbed.	**Ants, including red imported fire ants.**	Grains are loose, not moist pellets. Fire ant mounds can be large (up to about 18 inches) with no obvious entrance until they are disturbed, when ants pour out.	Yes. Fire ants are a major West Texas pest.
Raised, snaking ridges or a soft, churned surface; narrow tunnels just under the grass.	**Mole crickets.**	This is tunneling and root injury, not scattered surface piles of pellets.	Uncommon. AgriLife maps southern mole crickets east of a Corpus Christi–San Antonio–Fort Worth line and south of I-20.
Mud “chimneys” with a clear center hole about ½ inch wide, in wet ground.	**Crayfish (crawfish).**	A standing open chimney hole in wet soil.	Only in chronically wet low spots, not on typical well-drained West Texas lawns.
Large fan- or crescent-shaped mounds of dug-out soil; the hole is usually plugged.	**Pocket gophers.**	Much larger than worm casts, and made of coarse excavated soil, not fecal pellets.	Yes. Botta’s pocket gopher is documented in Tom Green County. Yellow-faced pocket gopher is reported from nearby Sterling and Irion counties.
Long raised ridges just under the turf, or volcano-like mounds from a burrowing mammal.	**Moles.**	Raised tunnels, not small pellet piles. Moles hunt earthworms and soil insects in regions where they occur.	Not typical. A Texas Tech survey of Tom Green County mammals did not list moles.
A ½- to 1-inch open hole with spoil piled to one side; large wasps in summer.	**Cicada killer wasps.**	A distinct open burrow, often with a visible wasp. These wasps prey on cicadas and are not aggressive toward people unless handled.	Possible, especially in bare or sandy spots.
Small piles of loose dirt tied to an exit hole; large grubs that crawl on their backs.	**Green June beetle larvae.**	Tied to a hole. The on-the-back crawl is distinctive. Tunneling can injure turf when numbers are high.	Possible, more often in soils rich in decaying organic matter.
Small mounds the color of the soil (or lighter) with a pencil-eraser hole.	**Ground-nesting bees.**	A clear entrance hole. Fresh worm casts are often darker and lack that open hole. These bees are valuable pollinators and are not aggressive in the way yellowjackets can be.	Possible in spring. Do not treat them as a pest.

Table 1. *A field comparison of earthworm castings and look-alikes relevant to the Concho Valley. See the source list for the university and agency citations behind each row.*

3. Do earthworms damage the lawn?

University sources agree on the main point: earthworms are not turf pests in the usual sense. They do not feed on the grass. The University of California IPM program states that earthworms “are not pests of turfgrass and

do not feed on turf." The University of Minnesota says the mounds do not harm the turf, though the lumpiness can be a nuisance. North Carolina Extension writes that earthworms and their castings almost never cause damage to the lawn and there is no need to try to get rid of them.

The problems people notice are almost all about the surface, not about dying grass:

- A bumpy, uneven lawn that is harder to walk on and easier to scalp with the mower.
- Casts that smear when they are wet, leaving mud on shoes, sidewalks, and mower decks, and dulling blades.
- In thin turf, dried piles can sit on the grass long enough to look messy or, if they are very thick, to smother a small patch. That is uncommon on a dense lawn.
- Earthworms are a preferred food for moles in regions where moles occur. University sources say there is no evidence that killing earthworms will solve a mole problem. Nine-banded armadillos are documented in Tom Green County, especially along the Concho River and its tributaries, and they dig in soil for insects and other invertebrates. Whether a high worm population is what draws an armadillo into a particular lawn was not established in the sources reviewed.

One AgriLife column, written about the upper Texas coast, notes that earthworms can occasionally become so numerous that turf feels sponge-like. That comment was not written about West Texas, and no similar local study was found.

What makes the piles more noticeable

- Frequent, shallow irrigation. Several universities say this keeps worms near the surface. Letting the top of the soil dry between deeper waterings drives them down. In a semi-arid climate, overwatering is often the reason a lawn stays wet enough for heavy casting.
- Fine or clayey soils that hold moisture at the surface. High worm numbers are more common in moist, heavier soils.
- Organic matter and thatch. Worms feed on partially decomposed organic matter. Lawns with clippings, compost, or a thatch layer can support more activity. (Worms also help break thatch down, which is one of their benefits.)
- Cool, wet periods in spring and fall, and the days after a soaking rain.
- Short, thin turf. Casts are easier to see when the grass is cut low or the stand is thin. A dense lawn at the proper height hides many of them.

Benefits worth keeping

The same sources that describe the mess also stress the benefits. Worm tunnels improve aeration and water infiltration and help relieve compaction. Feeding and casting recycle nutrients and organic matter. Thatch buildup has been linked to reduced earthworm numbers. Kansas State University puts it plainly: the presence and activity of earthworms is a sign of a healthy soil. Utah State University calls a worm population a good indicator of a healthy turf system. Those benefits matter on Concho Valley clay loams, which can seal and compact under foot traffic and irrigation.

4. Control: what is allowed, and what actually helps

Is any product labeled for earthworm control?

No. University turf programs state this in plain language, and a check of EPA's Pesticide Product and Label System for this report did not find a currently registered product labeled to control earthworms on home lawns.

Kansas State University (page updated March 27, 2026) writes: "No pesticides are labeled for earthworm control. Applying a pesticide for the control of earthworms that is not labeled to control earthworms is called off label and is against the law." The University of Wisconsin says there are no pesticides registered for earthworm control, chemical control is not recommended, and applications made for that purpose are off-label and against the law. Iowa State, Purdue, North Dakota State, Utah State, California IPM, and Minnesota Extension say the same thing in their own words: do not apply a pesticide to control earthworms.

For this review, EPA's product-name and pest-name search tools were queried for "earthworm" and "earthworms." The pest search returned no products. The only name match was "Earthworm 'Red Mite' Control" (EPA Reg. No. 47056-3), a product that has been inactive since May 20, 1987, and was aimed at mites on earthworms, not at earthworms in turf. That is not a lawn option.

Federal law is straightforward. Every EPA-registered pesticide label carries this statement: "It is a violation of Federal law to use this product in a manner inconsistent with its labeling." EPA's own introduction to pesticide labels says, "the label is the law." Texas has a matching rule: 4 Texas Administrative Code §7.71 defines use inconsistent with label directions and makes that use a violation. A pesticide may be used only for the sites and pests on the label in hand, at the rates and with the methods the label allows.

Some insecticides used for other lawn pests can harm earthworms as a side effect. In University of Kentucky field trials, a single labeled-rate application of carbaryl, and of several other older turf pesticides, reduced earthworm numbers by 60 to 99 percent, with effects lasting at least 20 weeks. That research describes a non-target effect. It does not make earthworm control a legal use. A current carbaryl turf granule label reviewed for this summary (10% Sevin Granules, EPA Reg. No. 34704-289, accepted April 9, 2025) lists insects such as armyworms and cutworms on turf. It does not list earthworms as a pest to be controlled, and its environmental-hazards statement addresses aquatic invertebrates, not earthworms. Toxicity in a research paper, or a general reputation for harming worms, is not a green light to use the product against earthworms.

Golf-turf research at the University of Kentucky also found that saponin-rich tea-seed meal can expel worms and reduce casts on research plots. Tea-seed products have been sold as fertilizers, not as pesticides labeled for earthworm control. Using a fertilizer or any unlabeled material to kill earthworms is not a legal or recommended option for home lawns. BES-TEX does not recommend it.

Is control of the worms advisable?

Usually, no. Iowa State University concludes that the destruction of earthworms is neither practical nor advisable. Wisconsin says the benefits greatly outweigh the nuisance, and that without worms, thatch and compaction may increase. Minnesota says to tolerate nightcrawlers whenever possible and never to use a pesticide on them. The practical goal on a home lawn is to smooth the surface and to change watering and mowing so piles are less obvious — not to wipe out the worms.

Non-chemical practices that help

These steps come from university extension guides. They are the recommended course for West Texas home lawns.

- Let the casts dry, then break them up. Rake, drag a mat or a piece of carpet, sweep with a broom, or mow after they have dried. Purdue notes that a pull-behind sweeper can work on a home lawn. California IPM suggests a dethatching rake set so the teeth drag through the mounds but do not dig into the grass crowns. Do not mow while the piles are wet; that smears mud and dulls the blade.
- Water deeply and less often. Allow the surface to dry between irrigations. This is also standard AgriLife advice for West Texas lawns, and it is the practice universities recommend to move worms deeper. Frequent, shallow watering does the opposite. As a general water-wise guide, AgriLife's xeriscape publication tells homeowners to mow bermudagrass at 1 inch and St. Augustinegrass and buffalograss at 3 inches, and to water efficiently rather than often.
- Mow at the high end of the recommended height for your grass. Taller leaf blades hide many casts and support a denser stand. Do not use cool-season heights (3 to 3.5 inches appears in some northern guides) on bermudagrass. Stay within the range for the species you grow; when in doubt, ask at the counter.
- Keep the lawn dense. Thin turf makes every bump obvious. Fertilize on a schedule suited to the grass and the season, and overseed or plug thin spots at the right time of year for that species.
- Core-aerate when the grass is growing well. Iowa State, Utah State, and North Dakota State all include core aeration as a way to gradually smooth a bumpy lawn and thicken the stand. Leave the cores on the lawn so they can help fill low spots. Repeat over more than one year; roughness builds up slowly and should be taken down slowly. Avoid power-raking or heavy verticutting during extreme heat. For warm-season lawns here, aerate during active growth, not while the grass is dormant or under severe heat stress.
- Skip the heavy roller. Iowa State University does not recommend a heavy roller. It may flatten some bumps, but it also compacts the soil and can thin the lawn. Utah State allows that a light roller may help, and still warns against a heavy one.
- Sand topdressing is sometimes used on golf turf to discourage surface casting; results are described as variable. It is not the first step for a home lawn. A lawn service can discuss a light, well-timed topdressing if casts are a chronic problem on a high-maintenance yard.
- Do not try to "fix" soil pH in order to kill worms. Some guides note that earthworms often do better in soils that are not strongly acidic. Concho Valley soils such as Angelo clay loam are already calcareous and moderately alkaline. Changing pH to suppress worms is not a recommended home-lawn practice in this region.

5. Local soils, climate, and what species live here

The official USDA-NRCS description of the Angelo series — a common soil of this region, with its type location in Tom Green County northeast of San Angelo — is a deep, well-drained, moderately slowly permeable clay loam formed in calcareous alluvium. The surface is typically a dark grayish-brown clay loam, violently effervescent and moderately alkaline. Associated soils on nearby positions include Cho and Mereta (shallower soils over a cemented lime layer) and Rioconcho and Tobosa on lower or heavier ground. Many San Angelo and Sterling City lawns sit on these or similar clayey, lime-rich soils. Water moves through them slowly, so frequent irrigation keeps the surface wet — exactly the condition universities link to surface casting. The official series

description even records “few wormcasts” in the subsoil of the typical Angelo pedon, which is a reminder that worms are a normal part of these soils. For a lot-specific map, use the USDA Web Soil Survey, or ask at the counter.

Climate, from the National Weather Service office in San Angelo (1991–2020 normals), is semi-arid and hot in summer, with rain concentrated in the spring and fall. That timing matches both the official Angelo soil description (“the majority of the yearly rainfall occurs during the fall and spring months”) and the seasons when homeowners most often notice casts. Sterling City has no separate long-term National Weather Service climate station in the materials reviewed; it shares the same West Texas climate region and is typically as dry or slightly drier. On unwatered ground, moisture is the limiting factor. On a sprinkler-fed lawn, irrigation timing matters more than the annual rainfall total.

A published list of earthworm species for San Angelo or Sterling City lawns was not found. Homeowners do not need a species name to identify castings. Across U.S. turf literature, the nightcrawler (Lumbricus terrestris) is the species most often tied to obvious surface mounds and middens; other European lumbricids such as Aporrectodea species are also common in North American soils. Texas research that names species is mostly from East Texas forests, reclaimed mine soils, and a Central Texas biosolids site, where native Diplocardia worms and some nonnative lumbricids have been recorded. Whether those same species dominate irrigated Concho Valley lawns has not been documented in the sources reviewed. Treat that as an open question, not as a local species list.

6. Notes for lawn care professionals

The legal limit is the same for commercial applicators as for homeowners: no product found in this review is labeled for earthworm control, and off-label use is a violation of FIFRA and of 4 TAC §7.71. Do not apply carbaryl, imidacloprid, or any other insecticide, fungicide, or fertilizer for the purpose of reducing worm populations or casts, even if older research shows a non-target effect.

A professional program can still improve the appearance of a lawn: confirm the diagnosis (castings vs. fire ants, gophers, or cicada killers); switch the client to deeper, less frequent irrigation; raise mowing height within the species range; drag or brush casts when dry, before mowing; core-aerate during active growth and return the cores; and, on high-maintenance sites, consider a carefully scheduled light sand topdressing, knowing that university reports of results are mixed. Power raking or verticutting can shave down accumulated bumps but should not be done in extreme heat and should not be so aggressive that it tears crowns. If a client hopes that “cleaning up the worms” will also stop armadillo digging or a mole problem, say plainly that university sources do not support that claim for moles, and that armadillo digging in this county has more than one possible food source.

Tea-seed (saponin) research remains a golf-turf finding, not a labeled home-lawn treatment. If a client has seen that work mentioned online, the accurate answer is that it is not a registered pesticide use for earthworms.

7. What to do: a short checklist

1. Look closely at the piles. Dark, lumpy or pellet-like soil, often after rain or watering, with little or no open hole, points to earthworm castings. Loose, grainy mounds with ants, large fan-shaped dumps of soil, open wasp burrows, or mud chimneys in standing-wet spots are something else.

2. If you are not sure, take a close-up photo and bring it to BES-TEX, 4512 Adobe Dr., San Angelo, or call 325.653.1300.
3. Leave the worms in place. They are helping the soil. Control of the animals themselves is usually unnecessary.
4. Do not apply a pesticide to kill earthworms. No product was found that is labeled for that use, and off-label use is illegal.
5. Stay off the mower while the piles are wet. Let them dry.
6. When they are dry, break them up with a rake, a broom, a drag, or a regular mowing.
7. Water deeply and less often. Let the surface dry between irrigations.
8. Mow at the high end of the recommended height for your grass (bermudagrass is mowed much shorter than St. Augustine or buffalograss).
9. Thicken thin turf with proper fertilization and, when the season is right, by plugging or overseeding. Core-aerate compacted or chronically bumpy lawns while the grass is growing well, and leave the cores.
10. Do not use a heavy roller to smash the bumps. Compaction makes the lawn thinner later.

Questions about a specific lawn, or about tools for aeration and raking, can be settled at the BES-TEX counter, Monday through Friday, 8 AM to 5 PM. The store does not sell a pesticide for earthworm control, because a legally labeled product for that use was not found.

Sources

URLs were checked on November 20, 2026. A few official pages (the live USDA Official Series Description site and one AgriLife page) blocked or failed an automated check on that date; in those cases a working archived copy or a successful full-text retrieval from the same official URL is noted. Retailer pages, manufacturer marketing pages, and online forums were not used.

[1] Rodriguez, David. 2016. Expert response to “little mounds in lawn in the fall,” Bexar County, Texas. Ask Extension no. 376428. Texas A&M AgriLife Extension Service, Bexar County. https://ask.extension.org/kb/faq.php?id=376428

[2] Gulley, Chad. 2017. Earthworms are a benefit to the soil. Texas A&M AgriLife Extension Service column, March 3, 2017 (reprinted by the Tyler Morning Telegraph). Notes occasional very high populations on the upper Texas coast. https://tylerpaper.com/2017/03/03/earthworms-are-a-benefit-to-the-soil/

[3] Texas A&M AgriLife Extension, Texas Imported Fire Ant Research and Management Project. Damage symptoms of common turfgrass pest problems and possible causes (earthworm pellets, fire ants, crayfish chimneys, mole cricket ridges, green June beetle piles, digger wasp / cicada holes). https://fireant.tamu.edu/learn/damage-symptoms-of-common-turfgrass-pest-problems-and-possible-causes/

[4] Reynolds, Casey, Mike Merchant, and Diane Silcox Reynolds. 2015. Tawny and Southern Mole Crickets: Identification and Control. Texas A&M AgriLife Extension, publication SCSC-PU-159. Distribution: southern mole crickets east of a Corpus Christi–San Antonio–Fort Worth line and south of I-20 in most of east Texas. https://extensionentomology.tamu.edu/wp-content/uploads/2025/03/tawny-and-southern-mole-crickets-1.pdf

[5] Pontasch, Frances. 2018. Green June Beetle in Texas. Texas A&M AgriLife Extension, publication EHT-101. https://extensionentomology.tamu.edu/wp-content/uploads/2025/03/green-june-beetle-in-texas.pdf

[6] Texas Apiary Inspection Service, Texas A&M University. Cicada killers (identification and nesting). https://txbeeinspection.tamu.edu/cicada-killers/

[7] Texas A&M AgriLife Extension. Xeriscape: Landscape Water Conservation. Publication E-447. Mowing heights cited: bermudagrass 1 inch; St. Augustinegrass and buffalograss 3 inches. https://irrigation.tamu.edu/wp-content/uploads/sites/3/2021/03/E-447.pdf

[8] University of California Statewide IPM Program. Earthworm — Lumbricus terrestris. The UC Guide to Healthy Lawns. https://ipm.ucanr.edu/TOOLS/TURF/PESTS/inearthwm.html

[9] Williamson, R. Chris. 2010 (revised April 26, 2010). Earthworms in Lawn. University of Wisconsin–Madison Division of Extension. https://hort.extension.wisc.edu/articles/earthworms-lawn/

[10] Iowa State University Extension and Outreach. 2016. Earthworms in the Lawn. https://yardandgarden.extension.iastate.edu/encyclopedia/earthworms-lawn

[11] Reicher, Zac. 2007. Earthworms Activity in Lawns. Purdue University Turfgrass Science. March 6, 2007. https://turf.purdue.edu/earthworms-activity-in-lawns/

[12] Kansas State University Turf and Landscape. Earthworms (lawn problem solver). Updated March 27, 2026. https://www.k-state.edu/turf/resources/lawn-problem-solver/problem-solver/digging/earthworms/

[13] Utah State University Extension. Over Hill, Over Dale: Earthworms in the Lawn. https://extension.usu.edu/yardandgarden/research/over-hill-over-dale-earthworms-in-the-lawn

[14] McGinnis, Esther E. 2024. Dakota Gardener: Managing earthworm damage in lawns. NDSU Extension, May 8, 2024. https://www.ag.ndsu.edu/news/columns/dakota-gardener/dakota-gardener-managing-earthworm-damage-in-lawns

[15] Glen, Charlotte. 2022. What Is Causing Mounds and Tunnels in My Yard? N.C. Cooperative Extension, Pender County Center. January 18, 2022; updated August 10, 2022. https://pender.ces.ncsu.edu/news/what-is-causing-mounds-and-tunnels-in-my-yard/

[16] Krischik, Vera, and Mark Ascerno. 2021 (reviewed). Nightcrawlers. University of Minnesota Extension. https://extension.umn.edu/yard-and-garden-insects/nightcrawlers

[17] Potter, D. A., M. C. Buxton, C. T. Redmond, C. G. Patterson, and A. J. Powell. 1990. Toxicity of pesticides to earthworms (Oligochaeta: Lumbricidae) and effect on thatch degradation in Kentucky bluegrass turf. Journal of Economic Entomology 83(6): 2362–2369. https://scholars.uky.edu/en/publications/toxicity-of-pesticides-to-earthworms-oligochaeta-lumbricidae-and-/

[18] Potter, D. A., C. T. Redmond, K. M. Meepagala, and D. W. Williams. 2010. Managing earthworm casts (Oligochaeta: Lumbricidae) in turfgrass using a natural byproduct of tea oil (Camellia sp.) manufacture. Pest Management Science 66(4): 439–446. University of Kentucky record: https://scholars.uky.edu/en/publications/managing-earthworm-casts-oligochaeta-lumbricidae-in-turfgrass-usi/ PubMed: https://pubmed.ncbi.nlm.nih.gov/20024948/

[19] United States Department of Agriculture, Natural Resources Conservation Service. Official Series Description: Angelo Series (established, Tom Green County, Texas; revised November 2013). The live OSD site returned an error on November 20, 2026; the official text was confirmed from an archived copy of the same USDA page: https://web.archive.org/web/20240712142837/https://soilseries.sc.egov.usda.gov/OSD_Docs/A/ANGELO.html Current lot-level maps: USDA Web Soil Survey, https://websoilsurvey.nrcs.usda.gov/app/

[20] National Weather Service, San Angelo, TX. Climate records and 1991–2020 normals. Annual precipitation 20.93 inches. Monthly rainfall and temperature normals: https://www.weather.gov/sjt/climate-normalsplusrecords https://www.weather.gov/media/sjt/pdf/SJT%20avg%20rainfall.pdf https://www.weather.gov/media/sjt/pdf/SJT%20normal%20max%20temperature.pdf https://www.weather.gov/media/sjt/pdf/SJT%20normal%20min%20temperature.pdf

[21] U.S. Environmental Protection Agency. Introduction to pesticide labels (“the label is the law”). https://www.epa.gov/pesticide-labels/introduction-pesticide-labels

[22] U.S. Environmental Protection Agency. Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and federal facilities (prohibits use of a registered pesticide in a manner inconsistent with its labeling). https://www.epa.gov/enforcement/federal-insecticide-fungicide-and-rodenticide-act-fifra-and-federal-facilities

[23] 4 Texas Administrative Code §7.71, Use Inconsistent with Label Directions (Texas Department of Agriculture). https://www.law.cornell.edu/regulations/texas/4-Tex-Admin-Code-SS-7-71 Official Texas Secretary of State TAC: Title 4, Part 1, Chapter 7, §7.71.

[24] U.S. Environmental Protection Agency, Pesticide Product and Label System (PPLS). Name and pest searches for “earthworm” and “earthworms,” November 20, 2026; the only name match (EPA Reg. No. 47056-3) has been inactive since May 20, 1987. https://ordspub.epa.gov/ords/pesticides/f?p=PPLS:1

[25] Loveland Products, Inc. 10% Sevin Granules, EPA Reg. No. 34704-289. EPA-stamped label accepted April 9, 2025. Earthworms are not listed as a pest; environmental hazards address aquatic invertebrates. Reviewed as an example of a current carbaryl turf/landscape label, not as a recommended product. https://www3.epa.gov/pesticides/chem_search/ppls/034704-00289-20250409.pdf

[26] Bow, R. Ann, Robert C. Dowler, and Terry C. Maxwell. 1997. The Mammals of Tom Green County, Texas. Occasional Papers, Museum of Texas Tech University, No. 169 (September 1, 1997). Documents nine-banded armadillo and Botta’s pocket gopher in the county; discusses yellow-faced pocket gopher in nearby Sterling and Irion counties; does not list moles. https://www.depts.ttu.edu/nsrl/publications/downloads/OP169.pdf