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Urban Tree Mortality: The Purposes and Methods for (Secretly) Killing Trees Suggested in Online How-To Videos and Their Diagnoses

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Abstract. Background: While urban trees offer numerous environmental benefits, some people view them as nuisances due to ecosystem disservices like smelly flowers, messy fruit, leaf litter, and damage to infrastructure. Because some trees are protected under ordinances or are owned by someone else, some people resort to covert methods to eliminate them. To assist arborists in identifying these clandestine practices, we investigated YouTube videos that suggest methods for secretly killing trees. Methods: Using established methodologies for YouTube reviews, we used search strings such as "poison neighbor's tree," reviewing the top 100 YouTube videos per search string based on relevance. After filtering, 79 videos were analyzed through deductive and inductive coding to classify tree-killing methods, the purpose of the method (e.g., wildlife habitat creation), and potential diagnostic signs and symptoms for arborists. Results: Herbicides were the most frequently suggested method, with glyphosate commonly referenced, followed by girdling and salt. Some videos emphasized secrecy in framing, yet none discussed potential legal ramifications. The methods often left physical signs, such as trunk damage from girdling or residue from salt application, which may aid arborists in detection. Conclusions: Our findings underscore the need for diagnostic tools that help identify subtle symptoms of poisoning or mechanical harm in urban trees. This study serves as a foundation for further research on tree-killing techniques, supporting forensic arboriculture and the remediation of intentionally damaged trees.

Keywords. Abiotic Disorders; Forensic Arboriculture; Tree Health Decline; Tree Vandalism; Unauthorized Tree Removal.

INTRODUCTION

It is commonly asserted that everyone loves trees (Braverman 2008). However, despite their many benefits, including reducing urban heat (Ziter et al. 2019), stormwater runoff (Berland et al. 2017), and air pollution (Nowak et al. 2006), trees also provide ecosystem disservices. Ecosystem disservices are the problematic environmental features and processes that run counter to human values and preferences (Lyytimäki and Sipilä 2009). In urban forestry, disservices can include smelly flowers, messy fruit, leaf litter, vegetation that interrupts sightlines, and infrastructure damage caused by growing roots and branches and failing trees and limbs (Klein et al. 2019; Roman et al. 2021). Several disservices arise from sudden, one-time events such as hurricanes or ice storms (Conway and Jalali 2017), including tree failure, which can damage infrastructure or result in injury or death (Klein et al. 2019). Other disservices occur seasonally or over the course of years. The latter often involves predictable, natural functions of trees (Roman et al. 2021). For example, the production of seeds and fruit can cause litter accumulation, autumn leaf fall can be a disservice as leaves require raking, and tall-growing trees can block views (Martin and Doucet 2022). Because of these natural processes and resulting disservices, some develop negative perceptions towards urban trees (Schroeder et al. 2006; Camacho-Cervantes et al. 2014; Fernandes et al. 2019).

On private properties, ecosystem disservices are a driver in tree removals (Conway 2016; Guo et al. 2019). In communities without private tree protection bylaws or ordinances, people can remove their trees at their own discretion. To prevent rampant tree loss, many communities have adopted regulatory mechanisms that prevent people from removing trees on their property (Ordóñez-Barona et al. 2021). However, there are often caveats in these regulations that treat dead, dying, or hazardous trees differently, reducing the permitting process or not requiring a tree be replanted (Conway and Lue 2018). A homeowner can therefore secretly kill their own tree to reduce time and cost associated with tree removal.

Disservices are also produced by publicly owned trees, resulting in some city residents expressing discontent about municipally owned trees (Delshammar et al. 2015). Similarly, disservices can arise from a tree on a neighbouring property, resulting in conflict between neighbours (Olivero-Lora et al. 2020). There have been several cases of tree poisoning or removals where people have trespassed to kill an unwanted tree (Dunster 2018; Stoffel et al. 2020). For example, in British Columbia, Canada, the defendants drilled holes in the claimants' tree and applied an unknown toxic substance, causing the tree to die (Bowbrick v. Jakob 2017). The tree had previously shaded the defendants' pool area. Also in British Columbia, a defendant admitted to poisoning 3 street trees to reclaim her partial ocean view (R v. Matheson 2006). In Texas, USA, the defendant killed a cypress tree by dropping a brown liquid into holes that were drilled into the roots (Withrow v. Armstrong 2006). In Oregon, USA, a sycamore was killed by a growth regulator herbicide applied to the root system (Brown v. Johnston 1971). In many such cases, the parties and the courts look to arborists as expert witnesses to identify the cause of death and, in the case of poisoning, the chemical agent used. Such investigations are important to the Courts, as intentionally poisoning trees or removing trees during willful or intentional trespass are subject to heavier liability and punitive damages (Dunster 2018).

People interested in killing nuisance trees are likely to use online resources to identify suitable methods. Online how-to videos are a common educational resource for procedural learning (Utz and Wolfers 2022). Of the online video-sharing services, YouTube is the largest and most visited (Snelson 2011), which provides a public forum that supports the sharing of unverified content (Osman et al. 2022). Unlike many websites, YouTube also records the date of publishing and the number of views.

Several research methodologies have been developed to utilize YouTube videos in review studies, predominantly for healthcare and medical studies (Sampson et al. 2013; Madathil et al. 2015; Osman et al. 2022) as well as research on environmental topics, including climate change (Shapiro and Park 2018; Duran-Becerra et al. 2020), climate engineering (Allgaier 2019), bird watching (Kikuchi et al. 2022), wildlife management (McLean et al. 2022), and wildlife conservation (Freund et al. 2021; Vins et al. 2022). By reviewing YouTube videos, we can address the use of social media and videos to discuss issues related to trees, a previously underexamined source in arboriculture and urban forestry (Martin and Doucet 2022). It is therefore an important area of preliminary examination for identifying tree-killing techniques that the public may discover.

To support practitioners in their diagnostics of these most nefarious abiotic disorders and disturbances, we conducted a review of online videos that explain how to (secretly) kill a tree. Our study examines 3 research questions: (1) What are the stated reasons the tree-killing methods could be used? (2) What are the most frequently recommended methods for killing a tree? (3) How can the proposed methods be detected? We explore these research questions through inductive coding of videos on YouTube (Alphabet Inc., Mountain View, CA, USA). This study is helpful for arborists trying to diagnose tree-killing techniques as part of forensic investigations. This study also provides the foundation for further studies on diagnostic methods for these tree-killing techniques.

METHODS

The video search was performed on 2023 December 15. Similar to literature reviews, video review methods use search strings. We conducted 5 searches with different strings of terms to identify videos associated with killing trees. The search terms were reviewed and approved by a team of 12 arborists and urban foresters. The 5 search strings were: 'secret kill tree'; 'secret poison tree'; 'kill neighbor's tree'; 'poison neighbor's tree'; and 'how to kill a tree'. YouTube shows the results that include the words in the search string, regardless of word ordering in the phrase (Granwehr 2021).

The first 100 results for each search were selected, resulting in a total list of 500 videos, representing the videos that YouTube's search engine deemed the most relevant to our search. Because YouTube sorts videos according to relevance as the default search optimization (Granwehr 2021), the selected videos represent the videos that a viewer would likely find when conducting the same search, although the ordering of results may differ between users based on their search history. Including the first 100 results helps ensure that the reviewed videos best reflect the tree-killing techniques viewed by YouTube users. Non-English and duplicate videos were removed.

The results of the search were saved to a spreadsheet (Microsoft Excel; Redmond, WA, USA) that included the video title, URL, account, posting date, views, likes, comments, and channel subscribers. The videos were then screened to ensure that they were related to methods for killing trees. Videos about how to remove stumps without a stump grinder were removed, but videos about how to kill living stumps, especially those that are sprouting, were retained.

After all videos were assessed, we retained 79 videos for coding and analysis and created transcripts of the videos so that we could code textual data. After the transcripts were verified, we then used a mix of deductive and inductive coding. Deductive coding is a content analysis method that uses predefined codes (Calvo and de la Cova 2023). By contrast, codes used in inductive coding are developed after repeat readings of the data (Corbin and Strauss 1990). We used deductive coding to identify themes based on our research questions. For each video, we identified text that addressed the 4 themes: (1) Purpose—the suggested reason for employing the method; (2) Secrecy—whether the purpose is intended to be secretive; (3) Legality—whether the video mentions or warns against illegal usage; and (4) Method—the type of method used to kill the tree.

Following the deductive coding, we read the transcripts several times to become familiar with the purposes and methods discussed, the first step in inductive coding per Thomas (2006) and Chandra and Shang (2019). After becoming familiarized with the transcripts, we developed potential codes to identify the many purposes and methods discussed in the videos. We then went through the transcripts and labeled the codes. For the Purpose theme, we identified both upper- and lower-level codes. Upper-level codes were the broad purposes, either to kill nuisance trees or ecological reasons. Videos about killing nuisance trees were ones that concerned how to kill a tree that is causing harm or inconvenience to people or property. Videos with an ecological purpose included removing trees to benefit or restore ecosystems, which may support either flora or fauna. We then assigned lower-level or subcodes to provide greater specificity about these 2 purposes. For the Method themes, the codes identify the methods that were used and, in the case of herbicide, the active ingredient that is recommended. We finished the inductive coding by removing any overlapping or redundant codes.

Lastly, we employed qualitative content analysis per Hsieh and Shannon (2005) to identify the number of occurrences and public engagement (e.g., likes, comments) associated with different purposes and methods. In the Discussion, we provide diagnostic details for each method to provide arborists with the tools to identify these disturbances in urban trees.

RESULTS

Overview

A total of 79 YouTube videos were found which discussed methods for killing trees, either by affecting the aboveground or belowground systems. The engagement with the videos varied greatly (Table 1), although the videos were evidently popular with a median viewership of 49,859 views. The most watched video had 5,667,741 views.

The videos were posted across 52 YouTube channels. The channel with the highest number of tree

Table 1. Engagement with YouTube videos about killing trees, either by affecting aboveground or belowground systems.

	Views	Likes	Comments	Subscribers
Median	49,859.00	259.00	40.50	11,850.00
Standard deviation	1,129,323.00	15,802.66	916.13	325,040.70
Maximum	5,667,741.00	113,000.00	6,400.00	2,230,000.00
Minimum	301.00	0.00	0.00	127.00

killing-related videos was Backyardables (*n* = 12; 17,200 subscribers)(www.youtube.com/@HowToKillATreeTV) and Green Shoots (*n* = 9; 4,690 subscribers)(www.youtube.com/c/GreenShoots).

Purpose: Why Kill a Tree?

The 79 videos could be sorted into 2 broad purposes: killing nuisance trees (*n* = 57; 72.15%)—videos that concern killing trees causing harm or inconvenience to people or property—and ecological reasons (*n* = 20; 25.32%)—videos that concern removing trees to benefit ecosystem health, including invasive species control and improving wildlife habitat. Even though there were more videos on killing nuisance trees, on average the ecological videos were watched 1.9 times more than videos about killing nuisance trees. The ecological videos also had 1.6 times as many comments as the killing nuisance trees videos. However, videos about killing nuisance trees had about the same number of likes as ecological videos. Two videos (3%) did not have a stated purpose.

Within the broader purpose of killing nuisance trees, the most common purpose was to kill entire trees (*n* = 39; 46%), followed by stumps or sprouts from tree stumps (*n* = 13; 16%) and tree roots (*n* = 5; 6%). The most common purpose of ecological videos was to remove invasive tree species such as tree of heaven (*Ailanthus altissima*)(*n* = 12; 15%). Four videos (5%) talked about using the methods to open the canopy and promote understory species, three videos (4%) talked about using the methods to establish wildlife habitat, and one video (1%) proposed the method to kill a tree while avoiding the use of pesticides.

The most watched videos by total views were those with purposes related to killing stumps or sprouts from tree stumps followed by opening canopy for understory development (Table 2). These posts also had the highest cumulative engagement. On average, the per-video views and engagement were highest for videos about canopy opening, followed by killing stumps or sprouts from tree stumps. Killing entire trees had the third highest cumulative views, cumulative engagement, average views, and average engagement.

Only 3 videos (4%) had a stated purpose of secretly killing a tree, all of which had a broader purpose of killing nuisance trees. On average, these 3 videos had 11 times more views and likes than the other videos on killing nuisance trees. They also had 1.4 times more comments.

None of the 79 videos discussed the legal implications of killing the tree(s), even if owned by a neighbor or protected under legislation.

Methods for Tree Killing

There were 17 different methods proposed across the 79 videos (Figure 1). On average, the use of rubbing alcohol, copper nails or other metals, and flush cutting had the highest views. While most videos only suggested one method, 22 videos suggested multiple methods for killing a tree. The majority of videos used herbicide (*n* = 50), which was also the most viewed method based on total views (Figure 2). The second most commonly discussed method was applying salt around the tree (*n* = 12), yet it had fewer average views, likes, and comments than less commonly described methods. The most liked method (fewest number of views per like) was girdling, followed by copper nails or other metals. The most commented-on method (fewest number of views per comment) was copper nails or other metals, followed by girdling.

Herbicide was recommended in 50 of the videos, with 5 videos recommending multiple (alternative) herbicides. The most commonly recommended herbicide was glyphosate (*n* = 17) followed by triclopyr (*n* = 11) and picloram, sold as Tordon (*n* = 8) (Corteva Agriscience, Indianapolis, IN, USA). Also recommended, although to a lesser extent, were 2,4-Dichlorophenoxyacetic acid (*n* = 3), Imazapyr (*n* = 3), copper sulfate pentahydrate (*n* = 2), and copper sulfate (*n* = 1). Ten videos did not report the type of herbicide used. While 5 videos recommended multiple (alternative) herbicides, only one video recommended mixing herbicides, recommending 2,4-D and triclopyr in one tank.

DISCUSSION

Our review of tree-killing methods reveals that many of the available video results discuss broad purposes related to nuisance tree killing and ecosystem management, even when searching for secret killing or poisoning methods. Consequently, several of the methods are obvious and nondiscreet ways of killing trees. This also explains why no video warned of any legal ramifications from killing trees.

Nonetheless, the most popular method—herbicide—is a discreet option and one that has appeared in court cases (Dunster 2018; Stoffel et al. 2020). Herbicides such as glyphosate and triclopyr are commonly available and have proven efficacy. This contrasts with other methods including copper nails, boiling water, and rubbing alcohol that have little to no support in the literature. Of the various discreet methods, herbicide, salt, fertilizer, and fuel and oil are likely to be the most reasonable and most effective based on their known impacts to trees (Costello et al. 2003). There are, however, methods of detection for these 4 issues.

Salt as a tree-killing method involves applying

Table 2. Purpose of the tree-killing methods proposed in the YouTube videos and the engagement with each purpose.

Broad purpose	Specific purpose	Count *n* (%)	Totals			Averages		
			Views	Likes	Comments	Views	Likes	Comments
Kill nuisance trees	Entire trees	39 (49%)	7,124,040	30,453	2,218	182,668	781.0	57
	Stumps or sprouts from tree stumps	13 (16%)	11,140,328	202,274	9,650	856,948	15,560.0	742
	Tree roots	5 (6%)	254,470	3,689	190	50,894	737.8	38
Ecological	Invasive species removal	12 (15%)	1,443,061	6,462	834	120,255	539.0	70
	Canopy opening for understory development	4 (5%)	10,719,481	65,371	5,550	2,679,870	16,343.0	1,388
	Wildlife habitat creation	3 (4%)	122,904	1,453	186	40,968	484.0	62
	Kill a tree without pesticides	1 (1%)	7,915	23	7	7,915	23.0	7
No stated purpose	No stated purpose	2 (3%)	37,900	261	27	18,950	131.0	14

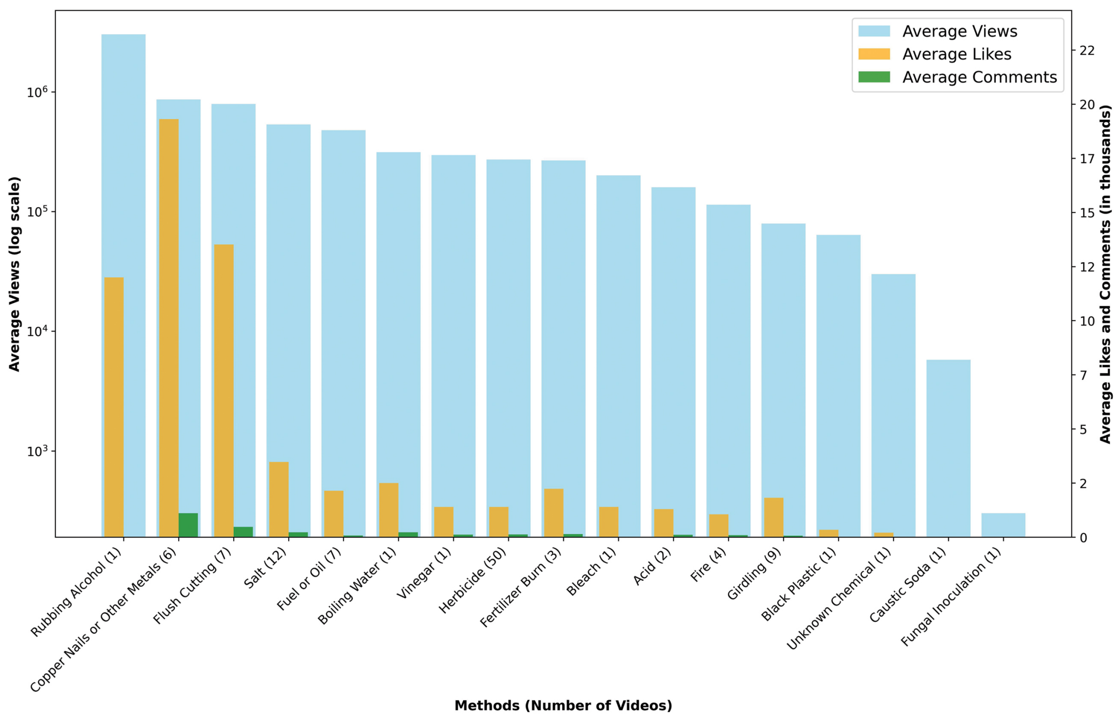

Figure 1. Average number of views, likes, and comments on reviewed YouTube videos about tree-killing methods. Note that the count of methods exceeds the number of videos because 22 videos suggested multiple methods.

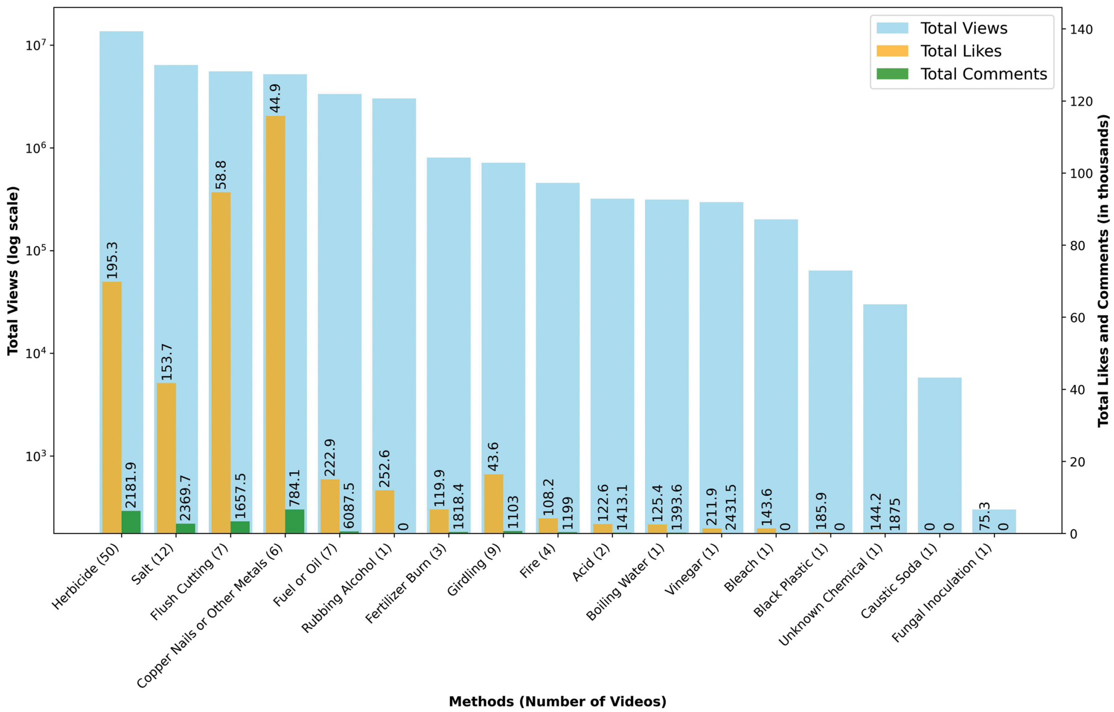

Figure 2. Total number of views, likes, and comments on reviewed YouTube videos about tree-killing methods. The numbers above the likes and comments indicate the number of views per like or comment. Note that the count of methods exceeds the number of videos because 22 videos suggested multiple methods.

large amounts of salt to the soil. This can be detected using soil electrical conductivity (EC). Following the application of salt, the saturated soil paste will have a high EC value, indicating a high salt concentration (Brady and Weil 2008). There are also visual symptoms. Root-based absorption of salt results in growth stunting and yellowing foliage, becoming necrotic before defoliation (Costello et al. 2003).

Fertilizer burn is also a common abiotic disorder of urban trees, although it is often presented as a consequence of misapplication of fertilizer rather than malapplication of fertilizer (Lilly et al. 2022). The application of fertilizer can be seen as patches of rich green or dead grass where there is high—even toxic—amounts of nutrients. The fertilizer can be detected using nutrient soil tests (Brady and Weil 2008).

Fuel and oil as tree-killing methods involves soil drenching with, commonly, gasoline or diesel. There are several test kits available to determine the presence of petroleum hydrocarbons (Environmental Protection Agency 2015). There is little published literature on fuel and oil, however. The expansion of pipelines renewed some interest in the effects of oil spills on trees, finding that most vegetation died with deciduous species experiencing more rapid injury than evergreen species (Jenkins et al. 1978). A study of a jet fuel spill found that mangrove vegetation experienced widespread and rapid damage, despite little residual contamination to the water and sediments (Ballou and Lewis 1989). Further research is needed, however, to provide remediation options for urban trees.

Herbicides are the most complex issue. Herbicide symptoms vary by active ingredient and species and are influenced by precipitation (Costello et al. 2003). There are also several lookalike symptoms that prevent conclusive diagnostics. Symptoms can therefore be described as being consistent with herbicide damage, but laboratory testing is required to definitively confirm the presence of herbicide. However, some application methods result in long-term signs. The "hack and squirt" method of using a small hatchet to make an incision in the trunk and spraying herbicide into the incision will result in an obvious cut into the bark. Similarly, drilling holes into the tree to inject herbicide will result in holes in the tree. Even though the chemical agent may not be apparent, the method of application would be.

The detection of chemical herbicide agents is ubiquitous in its approach, using some form of chemical residue testing. There are many established methods for the common agents. Testing for glyphosate, which was the most commonly recommended herbicide, uses high-performance liquid chromatography (HPLC) to test for glyphosate parent ions and aminomethylphosphonic acid (AMPA) ions (Botten et al. 2021). Similarly, triclopyr is an auxin type systemic herbicide that regulates plant growth sold under the trade names Garlon, Remedy, and Turflon (all produced by Corteva Agriscience, Indianapolis, IN, USA). Tests for triclopyr use the acid form, although tests can also be run based on the specific product used. Tests for Garlon 3A® test for triclopyr amine, tests for Garlon 4® and Pathfinder II® (Corteva Agriscience, Indianapolis, IN, USA) test for triclopyr butoxyethyl ester (Durkin 2011). A version of the QuEChERS ("quick, easy, cheap, effective, rugged, and safe") solid phase extraction method can be used to detect triclopyr using HPLC-MS/MS (European Food Safety Authority et al. 2022), although further research is needed on detection for trees.

The remaining methods are more self-evident. Girdling, which is the removal of bark, phloem, and cambium from the trunk of the tree—either in whole or in part—is readily visible as a ring of missing bark. The detection of flush cutting, which is cutting the tree or shoot at or below grade, is self-evident. Similarly, the causal agent is obvious with copper nails hammered into the tree, fire set to the trunk, or black plastic covering the foliage or soil. Fungal inoculation also involved drilling a hole into the tree, which leaves a visible hole in the tree.

Limitations and Further Research

Current arboricultural textbooks discuss common abiotic disorders, including salt damage, flooding, droughts, and natural gas leaks (e.g., Costello et al. 2003; Lilly et al. 2022). Based on the results of our study, further research is needed to develop diagnostic practices for several tree-killing methods not discussed in these textbooks. In particular, research on fuel and oil and herbicide will provide additional diagnostic resources to practitioners. For all methods, it is also important to establish remediation protocols that can help support trees subject to sublethal doses or replanting on sites with residual salt, fuel, oil, or herbicides.

By only reviewing English-language videos, we have excluded potentially relevant videos from non- English sources. As a result, our findings are biased towards English-speaking countries. Purposes and methods may differ in other regions, and further research might seek to identify methods from outside of English-speaking countries like the United States and Canada. Arborists working in countries where English is not a common language should be aware that the dominant tree-killing methods may differ. Similarly, YouTube privacy settings preclude us from mapping the purposes and methods by country or state/province. Methods that are dominant in our review, such as herbicide or salt application, may not be the dominant method in an arborist's country or state, particularly if a chemical is banned from public sale.

Because we only examined YouTube videos, there are likely other methods that have not been captured by our review. While an expanded review could examine court cases, newspaper articles, and websites, these sources present different methodological challenges and do not offer engagement data. However, the improvement of diagnostic methods unique to urban areas can help bolster the information available to arborists. This review thusly serves as a preliminary examination of tree-killing methods and provides a baseline for further exploration into diagnostics and remediation techniques.

CONCLUSION

While trees provide many benefits in urban environments, they also provide disservices. There have been many cases of people trying to kill trees that are legislatively protected or privately owned. To assist arborists in detecting these methods, we used YouTube videos to examine what methods are suggested to the public. We highlight the most common, inconspicuous, and likely most effective options: herbicide, salt, fertilizer, and fuel and oil. Forensic arboriculture and expert witness testimony relies on objective fact, and this review provides a starting point for investigations into suspect tree mortalities.

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