



Minnesota Nursery & Landscape Association

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Nursery & Landscape Industry Best Management Practices (BMPs) to Reduce the Potential for Spreading Jumping Worms (*Amyntas* & *Metaphire* spp.)

There are no native earthworms in the glaciated regions of North America including Minnesota and the earthworms present in these areas are non-native species that have been introduced from Europe and Asia. Although the European earthworms that most people are familiar with have been in Minnesota for many years, jumping worms, which are native to southeastern Asia and are also known as Asian jumping worms, crazy worms, snake worms, crazy snake worms, Alabama jumpers, and, most recently, disco worms based on their wild and distinctive, snakelike movements when disturbed, have only recently been documented in Minnesota and are believed to pose a much greater threat to the environment than the European species. In part, this is because jumping worms grow much faster, spread more quickly on their own, and reproduce more quickly and efficiently than European earthworms (a single worm is all it takes) and populations can reach extremely high and damaging densities very quickly. They are also more voracious feeders than European earthworms and can consume up to 95% of the important litter (duff) layer in forest ecosystems where it is currently believed the potential for damage is the greatest.

Unlike European earthworms, Asian jumping worms are parthenogenic and reproduce via a process called parthenogenesis – a form of asexual reproduction wherein a mate is not required to reproduce, and unfertilized eggs develop into new individuals; once again, a single worm, and potentially a single cocoon, is all it takes to start a new infestation. Jumping worms live in the litter layer and the top few inches of the soil (the epi-endogeic functional group of earthworms; they do not create burrows and do not move deep into the soil like nightcrawlers) where they rapidly devour surface and soil organic matter and change soil structure and chemistry (including nutrient content and cycling), making soils more subject to erosion, inhibiting seedling establishment and the regeneration of native plants, damaging the relationships between soil fungi and plants, possibly reducing the soil's ability to absorb and hold water, and even damaging the roots of plants in nurseries, gardens, and native ecosystems. They can also displace soil fauna and other wildlife like salamanders and ground-nesting birds and thereby disrupt forest food chains. In combination, research suggests these effects could result in impacts on Minnesota ecosystems that are greater than the impact of any of these factors alone resulting in wide-ranging cascade effects with significant environmental and socio-economic consequences.

As is the case for all invasive species, prevention is key and the best approach is to avoid the introduction of jumping worms into non-infested areas including nursery production and retail facilities, designed landscapes, and natural areas; once present, they are difficult if not impossible to manage effectively with the tools that are currently available. And because the activities of people, including nursery and landscape practices, are primary pathways for the spread of jumping worms to new areas,

and because there are currently no effective controls for getting rid of them once they have become established, it is important to be proactive in taking precautions to avoid bringing jumping worms onto your property – including production, holding, shipping, and sales areas – and to avoid the introduction of jumping worms to the properties of others.

In response to the public's concerns about jumping worms and the negative impacts they can have on native ecosystems and managed landscapes, and the unfortunate reality that nursery and landscape practices are known to be an important pathway for the spread of jumping worms, it is important that green industry professionals are aware of and take the jumping worm threat seriously. Educate yourself about jumping worms and be proactive in taking steps to keep them out of production and retail facilities and otherwise prevent their spread so you will be prepared to answer any questions that your customers may have about jumping worms and your response to the challenges they pose. Unfortunately, jumping worms are in Minnesota and in the news; and from a public relations perspective, ignorance or indifference about the jumping worm threat is not advised.

The following best management practices are recommended to help prevent the introduction and spread of jumping worms to new areas:

- Be aware. Educate yourself, your employees, your customers, and others about jumping worms, including their impacts on natural environments and managed landscapes and their means of spread, and to identify jumping worms and recognize the telltale signs of their presence including granular soil that resembles used coffee grounds. The [University of Minnesota Jumping Worms Project](https://jwp.cfans.umn.edu/jumping-worms-project) (<https://jwp.cfans.umn.edu/jumping-worms-project>) website and the associated Worm Rangers Citizen Science Project provide a wealth of information on jumping worm identification and how to look for them and is a good place to start; updated regularly, the website includes self-guided jumping worm training and weekly Zoom-based training sessions. The *Invasive Species for Homeowners: Asian Jumping Worm* brochure [[FinalDraft JWORMfactsheet \(csetompkins.org\)](#), <http://csetompkins.org/resources/jumping-worm-fact-sheet>]. produced by the Jumping Worm Outreach, Research, & Management Working Group at Cornell University [[JWORM Working Group - New York Invasive Species Research Institute \(nyisri.org\)](#), <http://www.nyisri.org/research/jworm-2/>] is a good resource to share with customers.
- Be vigilant. Always be on the lookout for jumping worms and signs of their presence. Jumping worms have been found in compost, organic landscape mulches, container grown and balled and burlapped (B&B) nursery stock, yard waste, and landscape soils. Inspect all horticultural commodities and scout production facilities for jumping worms on a regular basis and be on the lookout for jumping worms when installing and managing designed landscapes, paying special attention to moist and shady areas. Jumping worms have an annual life cycle; adults die when exposed to freezing temperatures in the fall but leave behind eggs enclosed in protective cocoons that overwinter and typically begin to hatch in late April or May to start a new generation the following year. As a result, adult worms will not be found until late June or July and any large earthworms found in the spring will likely be European species. Although jumping worms are typically found at or near the soil surface in the litter layer or in organic landscape mulches in managed landscapes, they can be found several inches deep in the soil or within the root ball of container stock where they are less visible. In such cases, drenching the soil with a mustard solution prepared by mixing one-third cup of powdered yellow mustard with one gallon of water

and pouring the solution slowly into the soil can be an effective tool for finding jumping worms. One gallon of mustard solution is sufficient to treat an area that is about 14 inches square. If earthworms are present, they will be irritated, but not killed, by the mustard solution and they will come to the surface. The root balls of container stock can also be removed from the container and examined for the presence of jumping worms and can also be submerged in a bucket of mustard solution to saturate them and expel earthworms.

- Only buy horticultural commodities from reputable suppliers that are knowledgeable about the jumping worm threat and the potential pathways for their introduction and spread and have procedures in place to help ensure their products are not infested with jumping worms.
- Only use, sell, purchase, and trade landscape plants and landscape and garden materials that are believed to be free of jumping worms. In the case of jumping worms, appearances can be deceiving so err on the side of caution as newly hatched jumping worms (hatchlings) can be difficult to see in early spring and jumping worm cocoons are very small and difficult to detect.
- Only use, sell, purchase, and trade compost, woodchips, and woodchip mulch that has been exposed to a temperature of at least 40° Celsius (104° Fahrenheit) for a minimum of three days [based on initial research specific to jumping worms conducted at the University of Wisconsin-Madison; [Cocoon Heat Tolerance of Pheretimoid Earthworms *Amyntas tokioensis* and *Amyntas agrestis* \(bioone.org\), <https://bioone.org/journals/the-american-midland-naturalist/volume-181/issue-2/0003-0031-181.2.299/Cocoon-Heat-Tolerance-of-Pheretimoid-Earthworms-Amyntas-tokioensis-and-Amyntas-agrestis> \(bioone.org\), <https://bioone.org/journals/the-american-midland-naturalist/volume-181/issue-2/0003-0031-181.2.299/Cocoon-Heat-Tolerance-of-Pheretimoid-Earthworms-Amyntas-tokioensis-and-Amyntas-agrestis>\], or even better to at least 55° Celsius \(131° Fahrenheit\) for a minimum of three days following the recommended processes to further reduce pathogens \(PFRPs\) included in US Environmental Protection Agency regulations \(\[40 CFR Appendix B to Part 503 – Pathogen Treatment Processes\]\(https://www.ecfr.gov/current/title-40/chapter-I/subchapter-B/part-503/subpart-503.101/section-503.101-1\), \[https://irp-cdn.multiscreensite.com/da2ded30/files/uploaded/f1VYkAs7TxGx3aZT5jgf_625R92013chap7.pdf\]\(https://irp-cdn.multiscreensite.com/da2ded30/files/uploaded/f1VYkAs7TxGx3aZT5jgf_625R92013chap7.pdf\)\) to kill jumping worms and their eggs and other horticultural pests. Although the effective temperature and timing may vary somewhat based on soil moisture conditions and other factors, jumping worms and their eggs and developing embryos are killed when exposed to a temperature of 40° Celsius \(104° Fahrenheit\) for three days; immature and adult worms are killed at a lower temperature \(29° Celsius, 85° Fahrenheit\), but effective control requires that both jumping worms and their eggs be killed.](https://bioone.org/journals/the-american-midland-naturalist/volume-181/issue-2/0003-0031-181.2.299/Cocoon-Heat-Tolerance-of-Pheretimoid-Earthworms-Amyntas-tokioensis-and-Amyntas-agrestis)

Commercially processed compost, mulch, and manufactured growing media are typically exposed to temperatures and other processes that should kill jumping worms during production and should be free of jumping worms when they leave the manufacturer. To be safe, ask the manufacturer about jumping worms and how their products are processed relative to jumping worms and whether they might be subject to becoming infested with jumping worms during the curing/finishing stage of composting when temperatures have cooled down. Although it is understood that exposure to elevated temperatures can be difficult for larger volumes, similar precautions are also recommended for soil, growing media, and growing media components that might harbor jumping worms as feasible and appropriate. When feasible, exposure to higher temperatures up to 82° Celsius (180° Fahrenheit) for a shorter duration (at least 30 minutes is typical) may also be an option depending on the material being treated, the facilities available, and the pests of concern.

Whenever possible, horticultural commodities that are produced and managed with jumping worms in mind (exposure to sufficient heat to kill jumping worms and their eggs, proper storage, etc.) are the safer choice and nursery and landscape professionals should choose the best course of action relative to jumping worms based on their individual circumstances.

- Compost that is [United States Composting Council \(USCC\) certified](https://www.compostingcouncil.org/) (US Composting Council; <https://www.compostingcouncil.org/>) or state regulated has been exposed to temperatures that will kill jumping worms and their eggs (as well as most pathogens) and [commercially processed growing media and organic mulches](https://mulchandsoilcouncil.org/FAQs.php) (<https://mulchandsoilcouncil.org/FAQs.php>) are typically exposed to temperatures that exceed 104° F during production and should be much less likely to contain jumping worms so long as they are handled and stored properly to avoid subsequent infestation (Mulch and Soil Council; <https://mulchandsoilcouncil.org/>). Individual green industry firms can also independently certify the quality of their products relative to jumping worms based on the implementation of production practices designed to reduce the likelihood that they will be a source of jumping worms including exposure to temperatures that are lethal to jumping worms and their eggs during processing.
- Solarization (using the energy of the sun to heat materials covered with or enclosed in clear plastic to help control diseases and other pests) can be an effective means for exposing relatively small volumes or layers of soil, compost, mulch, and other materials (including bagged materials) to temperatures that are sufficient to kill jumping worms and their eggs (a least 104° Fahrenheit for a minimum of three days). The material being solarized should be moist to enhance the process.
- Steam is a tool that has long been used as a standard practice for managing diseases, insects, weeds, and other pests in greenhouse and nursery settings by using low pressure, aerated steam to pasteurize growing media, nursery pots and trays, and used growing media and plant wastes and can be used to produce temperatures that will kill jumping worms and their eggs. Depending on the pest or pests of concern temperatures of 140-180 for a minimum of 30 minutes are typically used.
- On behalf of your customers and for your own due diligence, ask your suppliers what they are doing to help prevent the spread of jumping worms when sourcing horticultural commodities and be prepared to answer questions from your customers about jumping worms.
- Jumping worms do not live in trees and woodchips that come directly from chipped trees and have not come in contact with the ground or other materials that may be infested with jumping worms, or been transported in contaminated equipment (trucks, trailers, etc.), should be safe to use as landscape mulch.
- Inspect shipments of horticultural commodities, including delivery trucks and containers, for jumping worms (and other pests) before and during unloading. Jumping worms have been found in trucks delivering nursery stock to Minnesota garden centers from out of state.
- Whenever possible, store bagged compost, bagged organic soil conditioners, bagged mulch, and landscape plants in a manner that avoids contact with the ground to help prevent infestation with jumping worms. Raised benches and elevated storage platforms for bagged horticultural commodities (compost, mulch, soil, etc.) and plants are a good idea.

- Arrive clean, leave clean; always clean soil and debris from vehicles, equipment, tools, and personal gear (footwear, gloves, clothing) before moving from one location or property to another and do not transport infested soil or landscape debris to new areas unless it has been sufficiently heat treated. The handling of soil from sites that may be infested with jumping worms is a concern, and the MNLA is working with the state agencies that are reviewing disposal options for such soils to help manage this potential pathway for the spread of jumping worms. These types of precautions should be standard practice for preventing the spread of jumping worms and other invasive species and pests.
- Do not sell, buy, or use jumping worms, or earthworms from sources that may be contaminated with jumping worms, for composting (vermiculture/vermicomposting), soil improvement, or fishing bait. And since it is difficult to know if earthworms purchased for vermicomposting (typically red wigglers) are contaminated with other types of earthworms including jumping worms, earthworms used for composting should not be released into the outdoor environment. The addition of earthworms to residential compost piles is not required for backyard compost piles to function properly.
- Report suspected jumping worm infestations using [EDDMapS Midwest](https://www.eddmaps.org/midwest/) (Early Detection and Distribution Mapping System Midwest; <https://www.eddmaps.org/midwest/>) or [Report a Pest](https://www.mda.state.mn.us/reportapest) (Minnesota Department of Agriculture; <https://www.mda.state.mn.us/reportapest>). [A map of the current distribution of jumping worms in the United States](#) (including Minnesota) is available on the EDDMapS website (<https://www.eddmaps.org/distribution/uscounty.cfm?sub=58695>). If there is concern about the presence of jumping worms being tied to a specific property, suspected infestations can also be reported such that the exact location is not public via the [University of Minnesota Jumping Worm Project](https://jwp.cfans.umn.edu/) (<https://jwp.cfans.umn.edu/>) or by contacting Laura Van Riper at the Minnesota Department of Natural Resources (DNR; laura.vanriper@state.mn.us) or Jim Calkins at the MNLA (jim@mnl.biz). Good quality pictures of the suspected jumping worms (be sure to rinse off soil and other debris) that provide a clear view of the clitellum (if present; the collar- or saddle-like band located toward the head end of adult earthworms that is part of the reproductive system and is only present on sexually mature, adult worms) in relation to the head end of the worm should be submitted along with reports of suspected jumping worm infestations and a short video showing the movements of suspected jumping worms can also be helpful. It is also a good idea to preserve specimens in alcohol and refrigerate in case an expert would like to see the sample.
- Remove and destroy any jumping worms that are found by placing them in a sealed polyethylene bag and placing them in the trash. Adult and immature jumping worms may also be killed by placing them in a container of rubbing alcohol or vinegar or solarizing or freezing them in a polyethylene bag before disposing of them in the trash.
- Whenever possible, retaining organic materials and landscape soils that are or are suspected of being infested with jumping worms (and other pests like noxious weeds) on the property where they originated, rather than moving them offsite, is generally considered the safest and, therefore, the preferred option for preventing the spread of these pests at this time. Unless the material can be isolated and heat treated on site, it is risky to allow yard waste and landscape soil that is infested with jumping worms to be deposited at a nursery and landscape business facility and

caution is advised. And while it is understood that client preferences and site conditions may make it difficult to leave infested materials at some residential and commercial properties from a landscape management perspective in more urbanized areas, it is important to have a plan for handling such materials.

Although composting is not the ideal solution, composting sites that meet the minimum temperature and other requirements specified by the Minnesota Pollution Control Agency (MPCA; 131° Fahrenheit for a minimum of 15 days and a process that helps ensure all of the material being composted is exposed to such temperatures) are currently the best option for the offsite disposal of organic wastes that are or may be infested with jumping worms (and noxious weeds) with the exception of retaining such materials on the site where they originated. Information about composting sites registered with the MPCA, including a compost site locator tool, is available on the MPCA website at [Compost facilities | Minnesota Pollution Control Agency \(state.mn.us\)](https://www.pca.state.mn.us/waste/compost-facilities) (<https://www.pca.state.mn.us/waste/compost-facilities>). Contact information for these facilities is also provided. Only the composting facilities that have the apple core icon (sites that take food waste) and not the tree icons are required to follow the minimum temperature (131 degrees F) and pile turning requirements under their MPCA permits. Other facilities that are not permitted for food waste by the MPCA may follow similar procedures but exposure to 131 degrees F and regular turning of the piles are not permit requirements so you should explain your concerns about jumping worms and ask them about their process. Remember, too, that 131 degrees F is a higher temperature than what is required to kill jumping worms and their eggs (104 degrees F for at least three days and attempting to ensure that the entire pile is exposed to such conditions over time) and the process followed by other facilities may meet this requirement. In all cases, it is recommended to call ahead to let the facility know you are bringing in yard waste material that is infested with jumping worms, or suspected of being infested with jumping worms, to make sure they will accept the material.

None of the MPCA composting sites are appropriate for the disposal of landscape soils which is a concern that does not have a good solution at this time and existing facilities that accept soil from landscapers and landscape managers (not a wise practice if the site is not already infested with jumping worms) and permitted landfills are currently the only offsite options for disposal at this time. Permitted landfills are believed to be the best option and especially if the landfill site is already infested. As for yard waste, if soil is known or believed to be infested with jumping worms, it is recommended to call ahead to let the facility know this to make sure they will accept the material. A list of MPCA permitted landfills that accept mixed municipal solid waste is available at [Minnesota Landfills Accepting Mixed Municipal Solid Waste \(state.mn.us\)](https://www.pca.state.mn.us/sites/default/files/w-sw6-04.pdf) (<https://www.pca.state.mn.us/sites/default/files/w-sw6-04.pdf>).

Once again, whenever feasible, retaining organic materials and landscape soils that that are known or suspected as being infested with jumping worms or other pests on the property where they originated, rather than moving them offsite, is the safest option for preventing the spread of these pests at this time. The MNLA and others continue to work with the MPCA with the goal of develop a plan for disposing of nursery and landscape materials that are infested with jumping worms. In situations where keeping infested materials on site is not possible, nursery and landscape professionals may contact the MPCA at 651-296-6300 to be directed to an MPCA representative who can work with you on a case-by-case basis to safely dispose of soil, container

stock, and other materials that are infested with jumping worms until a more detailed disposal strategy is developed.

As the available disposal options for materials that are contaminated with jumping worms indicates, the current waste management system has not been designed with the goal of preventing the spread of jumping worms and other invasive species as a primary focus. As a consequence, the disposal options that are currently available are not perfect and discussions about the best options for handling yard waste, nursery stock, and soil that is infested with jumping worms and other pests continue.

Although the Minnesota Nursery and Landscape Association (MNLA) understands that these BMPs are not perfect, they have been developed based on the most current information available on how to help prevent the spread of jumping worms at this time. Jumping worms are a serious concern and a threat the nursery and landscape industry cannot afford to ignore; instead, wisdom suggests the green industry should be an educated and proactive leader in helping to prevent the spread of jumping worms. To this end, and in lieu of formal regulation (which is being considered), nursery and landscape professionals are encouraged to determine how they will respond to the challenges posed by jumping worms and how to share this information with their customers and clients.

The MNLA is committed to supporting research on the management of jumping worms and these BMPs will be regularly updated based on the findings of jumping worm research. This includes the ongoing jumping worm research at the University of Minnesota that is being funded by the Minnesota Invasive Terrestrial Plants and Pests Center [MITPPC; [Jumping Worms in Minnesota | Minnesota Invasive Terrestrial Plants and Pests Center \(umn.edu\)](#), <https://mitppc.umn.edu/project/jumping-worms-minnesota>] and more recently the Horticultural Research Institute [HRI, the AmericanHort Foundation; [Horticultural Research Institute Announces 2022 Grant Awards \(hriresearch.org\)](#), <https://www.hriresearch.org/horticultural-research-institute-announces-2022-grant-awards>] and includes the development of improved jumping worm BMPs as an objective.



Adult jumping worms and the granular soil structure they produce.

Photo Credit: James Calkins