Fumigants & Pheromones

Digital Newsletter Delivered by Insects Limited, Inc. *Issue 181*

The Grey Silverfish: An existing pest in the North America and a spreading problem in Europe

Patrick Kelley, BCE
President of Insects Limited

The grey silverfish, *Ctenolepisma longicaudatum*, AKA "longtail silverfish" seems to be getting a lot more attention these days around the globe.

Although it has been present in the United States for some time, we have seen this species aggressively spread across all parts of Europe, leaving lots of damage to a wide range of materials in its wake.

These insects are synanthropic and rely on man to supply them with food and a living environment (synanthropic = ecologically associated with humans).

Grey silverfish can be differentiated from the common silverfish, *Lepisma saccharinum* by their extra-long bristletails.

Two hair-like cerci and a central filament called an epiproct make up the three long bristles coming off the tail end of this pest.

These bristles are nearly as long as the body of the adult silverfish. Grey silverfish also have barbed hairs (setae) around the outside of their bodies.

Larger than the common silverfish, grey silverfish can get up to 25 mm (nearly 1-inch) in length.

Insects Limited Video of Grey Silverfish: https://youtu.be/yA5TSJETaKI

[Image of a grey silverfish head and setae by Christian Dressen, via museumpests.net]

Another important factor that sets grey silverfish apart is its ability to survive where other related species in the family Zygentoma (formerly Thysanthura) cannot.

Grey silverfish are more resilient to lower humidities and can survive at 55% whereas 70% is needed for common silverfish making it more difficult to control compared to common silverfish and firebrats Thermobia domestica who can be controlled by simple moisture or temperature adjustments.

The main reason that silverfish are pests is because they can feed on and destroy books, paper and other belongings. Only a handful insects (termites, wood beetles) have the ability to break down the cellulose in books and paper, but silverfish have enzymes in their digestive system that allow them to receive nourishment from these items.

Grey silverfish seem to have spread like wildfire across most parts of Europe over the past decade. The species likely originated in South Africa, and it is argued that later introduction to North America is more likely than having origins there. Recorded first time in UK and in Norway in 2014, they are now in every country in Europe as well as Eastern European countries. In Germany, it has reported that 99% of silverfish problems stem from grey silverfish. They have been reported across the U.S. but mainly in the southernmost states and from the Midwest to California. They are voracious feeds and can do lots of damage in a relatively short time frame.

Grey silverfish can live from 5 – 7 years and females will lay approximately 50-60 eggs per year. They continue to molt even after they reach the adult stage.

[Grey silverfish image by Christian Dressen via museumpests.net]

This elongated molting ability makes killing them with residual chemicals a bit harder as they can shed the pesticide exposed exoskeleton. Sexual maturity is reached sometime after 16 months.

Monitoring silverfish with baited sticky traps such as the Trapper Museum Monitor is currently the best means of locating problem areas.

Removing possible food sources and sealing floor crack and other harborage areas can be means of reducing populations.

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The Rewards and Risks of Using Clothes Dryers to Combat Clothes Moths on Wool

Samantha Kiever, BCE
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If you own a wool sweater, then you've likely heard the advice to never, under any circumstances, put it in the dryer or it will never fit you again.

While this is generally good advice in protecting the longevity of your beloved garments, sometimes there are greater threats posed by sneaky insect invaders such as the dreaded clothes moth, and the pros of a tumble through the dryer may just outweigh the cons.

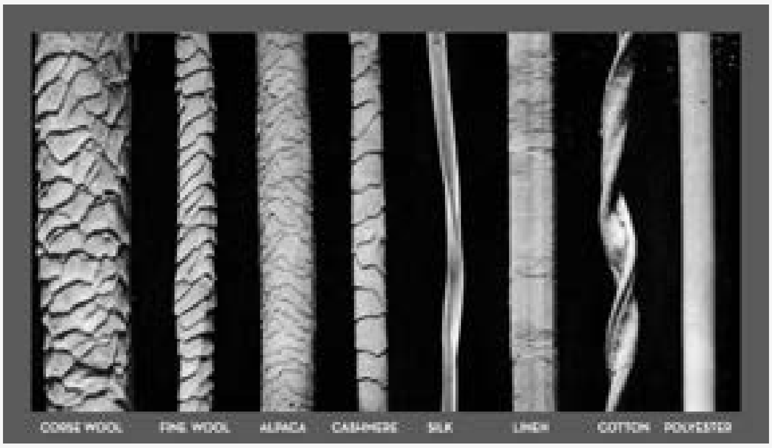
So what makes the dryer a concern for wool, anyways?

Wool is known for being prone to considerable shrinkage through a process called felting, especially when placed into a dryer. These effects can be minimized by controlling the three main factors responsible for shrinkage through felting:

1. **Movement**
2. **Moisture**
3. **Heat**

To understand the process of felting in wool, a basic understanding of the properties of wool is in order. The surface of wool is composed of overlapping scales. They can easily slide past each other in one direction, but the shingle-like scales on the fibers get caught up in each other when going the other way.

The overlapping scales behave much like two phone books with interwoven pages (Mythbusters demonstrated this phenomenon here), and the friction is hard to overcome when trying to pull the fibers apart again. Because of this, the fibers get more tightly and closely interlocked, which leads to the shrinking of the textile they make up.



Wool fibers are composed of overlapping scales that grab onto each other when agitated in a washing machine or clothes dryer.
Image from https://www.feltingart.com/what-is-felting-art

Moisture plays an important role in shrinkage because of the absorbent properties of wool.

As the fibers of the wool absorb water, the core of the fiber swells and the scales pop open like the scales of a pinecone.

The increased diameter of the *swollen fibers means that there is more contact and greater friction between the fibers*, and the scales being opened up also allows them to become interlocked more easily.

This is also true with heat. Heat can cause those scales on the fibers to pop up, and then very much the same process ensues that leads to increased friction and subsequent shrinkage. Movement speeds along this process by moving the fibers physically against one another, which provides more opportunities for the scales to grab hold of one another.

In the case of clothes moths, heat is a lethal force when used at the correct intensity and duration. Some may choose to put their garments into the oven on low heat in order to kill all life stages of clothes moth; however, this can lead to scorching of the garments and can pose a fire hazard. The dryer is designed specifically for clothing to go into, and they can run for a long time.

That still begs the question: *how hot does your average dryer get?*

To test this, three of our entomologists surrendered their dryers to science. We placed a load of woolen garments into our dryers along with a temperature logger, and in the end we were able to determine the heat inside of a mass of dry woolen garments in the dryer, which may differ from the actual air temperature in the dryer. We were also able to track how stable high temperatures were, and in the very end after many trips through the dryers, we were also able to inspect the woolen garments, which consisted of shrink resistant wool, pure wool, and wool blends, for signs of shrinkage and degradation.

Here is what we found:

Our dryers all varied in age, make, and model. However, all of the dryers took around ten minutes to reach a stable temperature regardless of whether they were set to low, medium or high. The temperatures in all of our dryers for each heat setting were also consistent with one another.

- On the lowest heat-delivering setting of our dryers, the temperature inside the mass of clothes reached between 111 and 113 degrees Fahrenheit (44°- 45° C).
- On medium, all three dryers maintained a temperature around 140-144 degrees Fahrenheit (60°-62° C).
- On high, all of our dryers held temperatures above 160 degrees Fahrenheit (71° C). This last point is particularly exciting, as this is what can allow us to utilize heat most effectively to deal with clothes moth problems.

Realistically, 120 degrees Fahrenheit (49° C) is all you need to kill clothes moths in just a matter of a few hours (and even this figure is generous in order to make sure that there are no stragglers), but by cranking up the heat, the duration needed decreases. The fact that your average clothes dryer can get much hotter (160 degrees/ 71° C) than that means that you can kill moths in less time. That means less tumbling, and therefore less friction. This can help to reduce the friction factor concerning wool shrinkage. I also placed some bioassays containing webbing clothes, moth eggs, larvae, pupae, and adults into my dryer on the highest setting with the woolen garments. After a one-hour long cycle, none of the eggs or pupae hatched, and the adults and larvae had all perished.

Another exciting observation is the state of the wool after its many trips through the dryer. We placed four garments into our dryers simultaneously, and they were tumbled through the dryers for nine hours total at temperatures ranging from 111°F/44° C to 160°F/71° C .

After all of this "mistreatment" per the usual wool-care guidelines, there appeared to be no appreciable shrinkage or pilling of the garments.

So should you include this method of clothes moth eradication in your pest management toolbox, and how do you do so safely?

Using a dryer should only be used on garments that do not have beadwork or other plastic or rubber elements that may melt or degrade under high heat.

Garments that are treated to avoid shrinkage are also prime candidates for this method, as are wool blends. Items that are pure wool are also free to join the party. We recommend drying only one article of clothing at a time and to neatly fold that item and place it into a mesh dryer bag to reduce friction and shrinkage. Be sure that the garments are as dry as possible before going into the dryer treatment, as well.

We only tested three dryers, so check with the manufacturer of your dryer for the maximum temperature that your dryer can reach before attempting, as you may need to adjust the duration of treatment if your dryer doesn't get quite as hot. Running the garments through the dryer for an hour should be enough to kill most, if not all, of the moth eggs, larvae, pupae, and adults that might be threatening your wardrobe. As always, use your best judgment when employing at-home DIY pest management techniques. Always ask yourself, "Is the risk to my item from this method better or worse than the risk that insects pose?"

"We recommend drying only one article of clothing at a time and to neatly fold that item and place it into a mesh dryer bag to reduce friction and shrinkage. Be sure that the garments are as dry as possible before going into the dryer treatment."

Pest management professionals can also recommend this treatment to residential clients as a means of continuing pest management efforts on their own between professional treatments. The lower an insect population is kept, the better. Recommending ways for customers to help manage the situation on their own can also boost appeal and trust between customers and professionals.

This, of course, is not the end of our story. Treatment for insect problems is never the end of the story. Integrating pest management is an ever-present task that we all must face in our personal lives, whether that be keeping spaces tidy to prevent insect infestation, or monitoring for signs of insect problems.

After treating your garments with heat, cleaning storage spaces and isolating clothing in bags such as our Greenway garment bags will ensure that residual populations don't spread back to your clothes and undo all of your hard work.

Continued pheromone monitoring can also alert you to potential outbreaks caused by residual populations, and the cycle can continue again until your moths have been thoroughly defeated.

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Cicadas are Coming!

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Research Entomologist and Product Support, Insects Limited

In 2024, two distinct cicada broods, Brood XIII and Brood XIX, will simultaneously emerge—an occurrence not witnessed since 1803. Brood XIII, on a 17-year cycle, and Brood XIX, on a 13-year cycle, represent rare instances of synchronized emergence, highlighting an unusual event in the life cycle of periodical cicadas.

These cicadas are systematically categorized into broods using Roman numerals, a system established by entomologist Charles Lester Marlatt in 1907. He identified 30 broods, with those on a 17-year cycle generally found further north compared to their 13-year counterparts.

Figure 1. Periodical cicadas. Photo by Gene Kritsky of Mount St. Joseph University

John Cooley, Ph.D., an associate professor at the University of Connecticut, notes that of the thousands of cicada species, fewer than ten species exhibit this periodic emergence. The overlap of these two specific broods occurs narrowly, centered significantly in Illinois, where Brood XIII emerges in the northern half, and Brood XIX in the southern.

Why 13 and 17 years?

The extended juvenile phase of these cicadas, spanning 13 or 17 years, serves as an evolutionary adaptation for predator evasion. The use of prime numbers in their life cycles—13 and 17 years—complicates synchronization for predators with shorter reproductive cycles, effectively disrupting predation patterns.

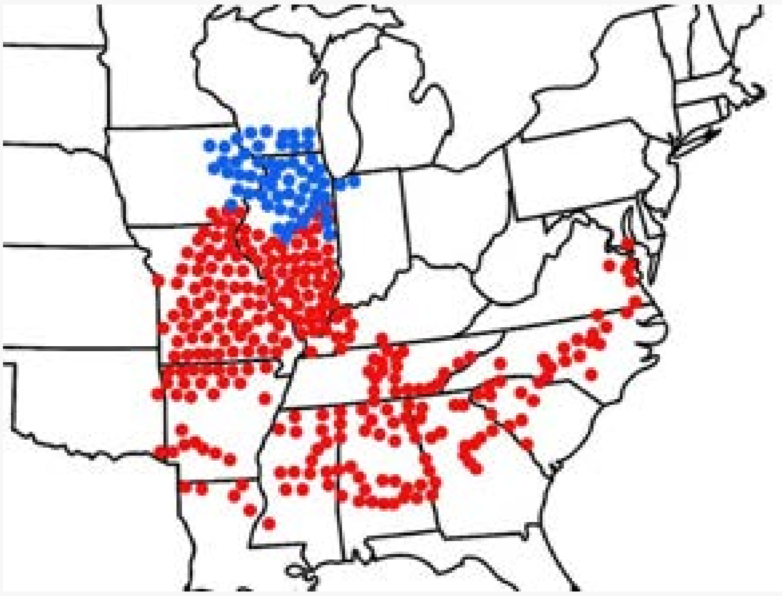

Figure 2. Periodical cicadas in Brood XIII, on a 17-year-cycle, and Brood XIX, on a 13-year-cycle, will emerge in 2024 in the same year for the first time since 1803. Their ranges are contiguous but do not overlap; collectively they're expected to appear in parts of up to 18 states, mostly in the Midwestern U.S. Illinois is at the epicenter of the dual emergence, with Brood XIX in the southern half of the state and Brood XIII in the north. (Image by Gene Kritsky of Mount St. Joseph University.)

Furthermore, by coordinating their emergence to occur simultaneously in massive numbers, the cicadas enhance their chances of survival, as the sheer volume of individuals can overwhelm and confuse predators.

Name	Nickname	Cycle (yrs)	Last emergence	Next emergence	Extent
Brood I	Blue Ridge brood	17	2012	2029	Western Virginia, West Virginia
Brood II	East Coast brood	17	2013	2030	Connecticut, Maryland, North Carolina, New Jersey, New York, Pennsylvania, Delaware, Virginia, District of Columbia
Brood III	Iowan brood	17	2014	2031	Iowa
Brood IV	Kansan brood	17	2015	2032	Eastern Nebraska, southwestern Iowa, eastern Kansas, western Missouri, Oklahoma, north Texas[32]
Brood V		17	2016	2033	Eastern Ohio, Western Maryland, Southwestern Pennsylvania, Northwestern Virginia, West Virginia, New York (Suffolk County)[33]
Brood VI		17	2017	2034	Northern Georgia, western North Carolina, northwestern South Carolina
Brood VII	Onondaga brood	17	2018	2035	Central New York (Onondaga, Cayuga, Seneca, Ontario, Yates counties)[Note 1]
Brood VIII		17	2019	2036	Eastern Ohio, western Pennsylvania, northern West Virginia
Brood IX		17	2020	2037	southwestern Virginia, southern West Virginia, western North Carolina
Brood X	Great eastern brood	17	2021	2038	New York, New Jersey, Pennsylvania, Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, Georgia, Tennessee, Kentucky, Ohio, Indiana, Illinois, Michigan[34][Note 2]
Brood XI		17	1954	Extinct	Connecticut, Massachusetts, Rhode Island. Last seen in 1954 in Ashford, Connecticut along the Fenton River
Brood XIII	Northern Illinois brood	17	2007	2024	Northern Illinois and in parts of Iowa, Wisconsin, and Indiana[Note 3]
Brood XIV		17	2008	2025	Southern Ohio, Kentucky, Tennessee, Massachusetts, Maryland, North Carolina, Pennsylvania, northern Georgia, Southwestern Virginia and West Virginia, and parts of New York and New Jersey
Brood XIX	Great Southern Brood	13	2011	2024	Alabama, Arkansas, Georgia, Indiana, Illinois, Kentucky, Louisiana, Maryland, Missouri, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, and Virginia[Note 4]
Brood XXI	Floridian Brood	13	1870	Extinct	Last recorded in 1870, historical range included the Florida panhandle[38]
Brood XXII	Baton Rouge Brood[39]	13	2014	2027	Louisiana, Mississippi[Note 5]
Brood XXIII	Mississippi Valley Brood[40]	13	2015	2028	Arkansas, Illinois, Indiana, Kentucky, Louisiana, Missouri, Mississippi, Tennessee

1. ^ Consists only of *M. septendecim*
2. ^ A premature emergence occurred in 2017.[35]
3. ^ Reputedly has the largest emergence of cicadas by size known anywhere. A premature emergence occurred in 2020.[36]
4. ^ Arguably the largest (by geographic extent) of all periodical cicada broods.[37]
5. ^ This 13-year brood does not include *M. neotredecim*.

Figure 3. Table of periodical cicadas. (Photo by https://en.wikipedia.org/wiki/Periodical_cicadas).

Life as a Cicada

Periodical cicadas spend the majority of their life underground as nymphs, within approximately two feet of the surface, feeding on plant root sap. They undergo five developmental stages in this environment. The nymphs dig deeper as they mature, eventually surfacing when soil temperatures signal the right conditions for their final molt into adulthood.

Upon emergence, typically between late April and early June, mature nymphs construct exit tunnels. Following their emergence, they undergo a final transformation on suitable vertical surfaces. After a brief period of maturation, they enter a short adult phase dedicated solely to reproduction. Males produce loud mating calls to attract females, forming dense groups that amplify their collective sound, facilitating mating.

Ecological Impact

Ecologically, cicadas are benign to humans and most wildlife, lacking defensive mechanisms like stings or bites. However, their life cycle significantly impacts local ecosystems. For example, tree growth can decline due to the nymphs' extensive root feeding prior to emergence. Predator species like moles and wild turkeys experience population fluctuations tied to the cicada life cycle, benefiting from the abundance of food during emergence years but facing food shortages afterward. After the cicadas die, their bodies decompose, enriching the soil with nutrients and impacting the broader forest ecosystem.

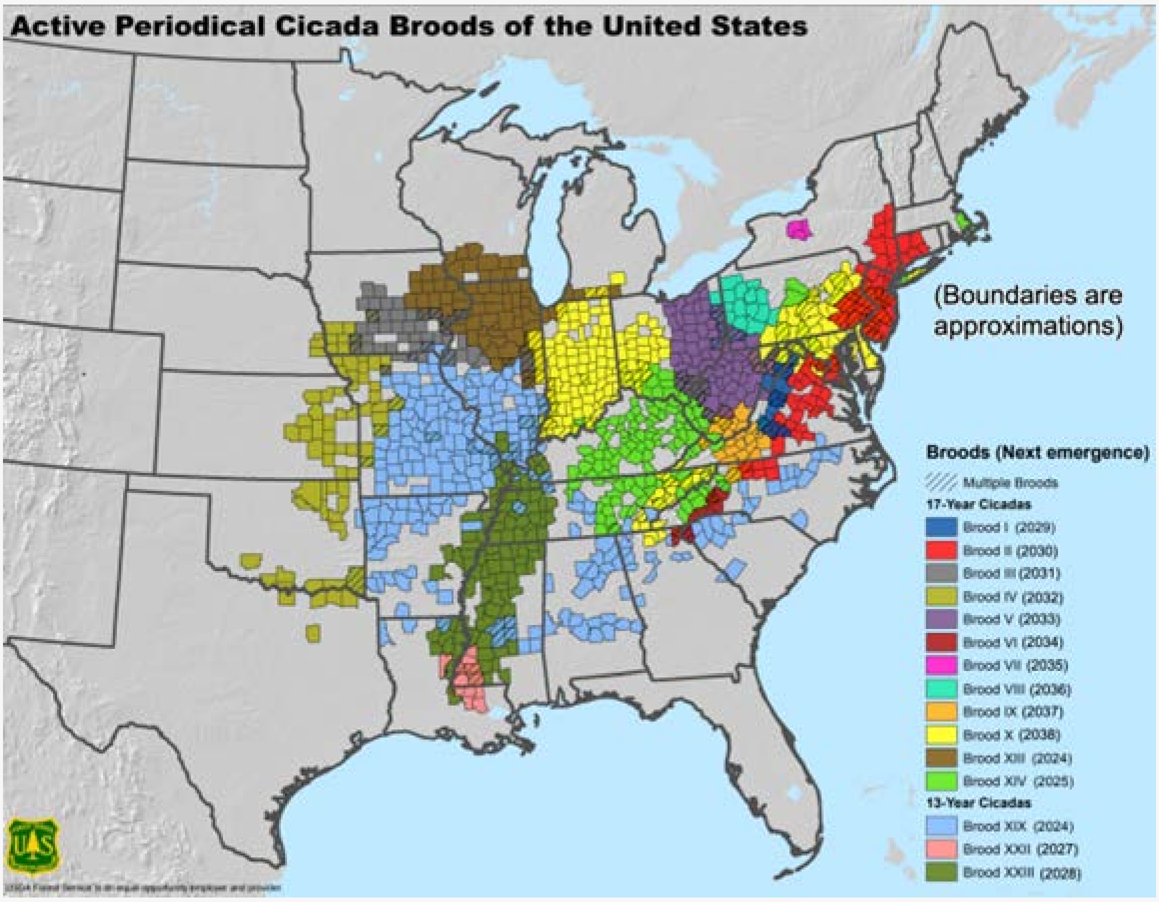

Figure 4. USDA Forest Service map of periodical cicada brood locations by county and timing of next emergence (as of 2024)

References

Bernhardt, C. (2024, April 25). *Periodical cicadas, 2024: Entomologists prepare for the six-week serenade.* Entomology Today. https://entomologytoday.org/2024/04/25/periodical-cicadas-2024-brood-xix-xii-entomologists-prepare-six-week-serenade/

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Smart PH3: Innovation in Remote Phosphine Measurement

INOQUA
AMBIENTES SALUDABLES

wiagro

Phosphine (PH3): A Vital Fumigant in Grain Protection

Phosphine (PH3) is a grain fumigant used to prevent stored grain infestations by insect or mite pests.

While these pests typically do not pose a direct threat to human health, they can transmit bacteria and viruses that contaminate stored products.

Phosphine fumigation exterminates insects and ensures the quality of grains (and other commodities) as long as an appropriate concentration is maintained during the correct exposure period in a well-sealed system.

Technological Collaboration: Inoqua and Wiagro Leading the Agroindustry

In collaboration with Wiagro, leaders in agro-industrial technology, Inoqua is proud to introduce the Smart PH3 Monitor, an innovative tool that enables remote measurement and control of phosphine fumigation through IoT devices and a web visualization platform accessible on both PCs and smartphones.

How does it work?

Ranges of Phosphine Measurement

The service provides the possibility to know, through the Low Range sensors, the phosphine values in the areas surrounding the treatment, avoiding the risk of exposing personnel in case of leaks. Additionally, the High Range sensors allow for remote and continuous control of fugation quality.

	LOW RANGE Smart PH3-5	HIGH RANGE Smart PH3-2000
Concentration	0-5ppm	0-2000ppm
Resolution	1ppm	1ppm
Error	+/-2%	+/-2%
	Outdoors	Indoors

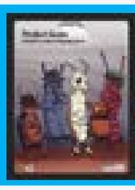
Customer Case: Corteva

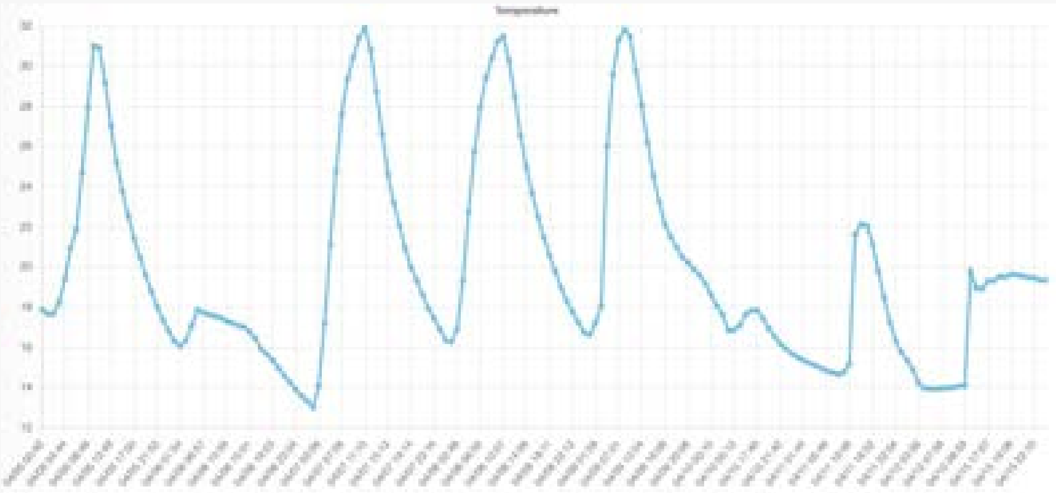
High PH3 Monitor - 2000

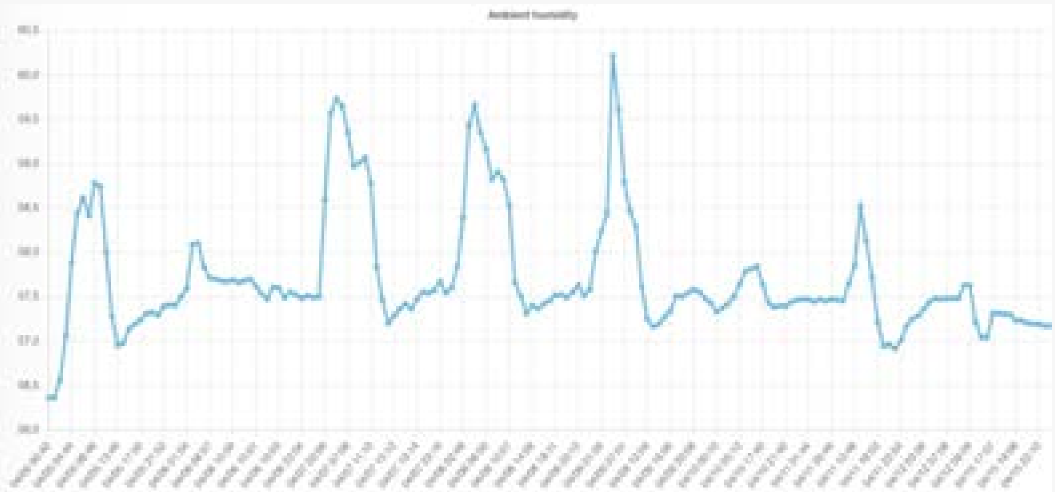
Fumigation Monitoring in a 40-foot Container

Treatment Date: From 4/5/24 to 4/15/24

In the following graphs, we can observe the levels of phosphine, temperature, and ambient humidity.







The Smart PH3 monitor, along with the web platform, not only allows for remote measurement and monitoring of fumigation but also plays a crucial role in detecting potential anomalies during the process. For instance, in situations where temperatures are low, reaching the target concentration may require a few additional days.

The system provides accurate data on environmental conditions, enabling operators to make informed decisions and adjust the fumigation process as needed.

Benefits:

- Remote Monitoring of Phosphine (PH3) Levels, Temperature, and Humidity
- Wireless Data Transmission
- Staff Independence for Control of "Safe" Levels
- Remote Leak Detection
- Blockchain Technology

For more information, please contact:

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