THE CORONAVIRUS AND OTHER NASTY VIRIONS

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Dr. Roberts retired from Michigan State University in 2018 after committing four decades to advancing MSU's Land Grant Mission, originally signed into law by President Abraham Lincoln during the midst of the American Civil War. He has published hundreds of articles and has taught hundreds of lectures and workshops.

Dr. Roberts has researched many issues in Michigan's plant industry, including Oak Wilt, Dutch Elm Disease, Diplodia Tip Blight of Pines, along with a variety of cultural problems such as plant nutrition and herbicide toxicity. During his career, he has discovered a variety of new diseases and pests such as Phomopsis Canker of Spruce and the first bacterial wilt disease of turfgrasses in North America.

In the early 2000s, his research on Ash Decline in Southeast Michigan led to the discovery of the invasive Emerald Ash Borer in North America.

In his retirement, Dr. Roberts intends to remain active with the Arboriculture/Landscape/Nursery industries. Dr. Roberts is President, CEO and CBW (Chief Bottle Washer) of The Plant Doctor, LLC…aka The Tree Doctor.

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This is my PPE (Personal Protective Equipment) for my trips to the grocery store. I wear a "Handmade in USA" mask, nitrile gloves and glasses to protect my eyes from aerosols carrying the coronavirus, and I take sanitizing wipes or a sanitizing gel to sanitize my nitrile gloves. Can't be too careful.

P1

INTRODUCTION:

The Coronavirus, otherwise known as COVID-19 (Photo 1), which is the code for "the novel (new) Coronavirus Disease 2019", has changed our lives regardless of our profession. In Michigan's Plant Industry, we are challenged to continue with our business efforts whether they involve farmers growing food, growers of plants in nurseries and greenhouses, installation of hardscapes and landscapes, or maintenance such as plant healthcare. In trying to maintain social distancing to minimize the spread of the Coronavirus and to keep ourselves heathy, functioning and, in some cases, alive, we must think about how to fulfil our efforts while not being transmitters of the Coronavirus, which could jeopardize the health of each other and our clients. With this article, I hope to provide a little background about viruses, what they do and how to manage them.

What are Viruses?

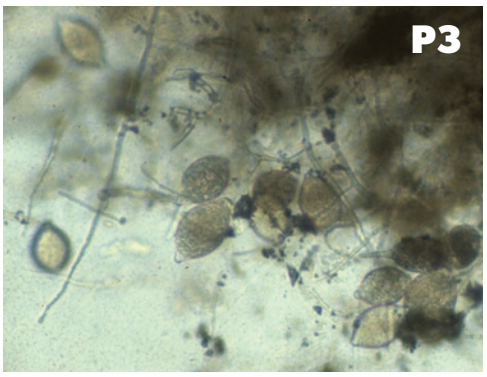
Viruses are some of the simplest entities on this planet. Viruses are comprised of two basic components: a nucleic acid (either **DNA**=Deoxyribonucleic Acid or **RNA**=Ribonucleic Acid) and a protein coat. The protein coat is designed to protect the nucleic acid from environmental harm. DNA is comprised of four building blocks (Nucleobases: A=adenine, C=Cytosine, G=guanine and T=Thymine) and it is the arrangement of these building blocks in a twisted ladder (double helix) arrangement that gives every living creature on this planet its uniqueness. The DNA is arranged into "long" structures we commonly call chromosomes, the double helix codes for the development, functioning, growth and reproduction of all known organisms and viruses on Planet Earth. At some time in our past, perhaps we might remember hearing about the discovery of the "double helix" DNA structure by English Scientists James Watson and Frances Crick in 1953.

Scientists have debated for decades whether viruses are "living" or "dead". After all, viruses contain no organs or cellular organelles or other structures that we commonly associate with other living creatures. They cannot see, hear, breathe, talk, walk, fly or perform any of the other basic functions we associate with other organisms in our environment. And like the scarecrow in the Wizard of Oz, viruses possess no brain. The primary purpose of viruses is to reproduce (replicate) themselves. Viruses by their very nature are "Obligate Parasites" (or pathogens), meaning they are obligated to live with a living host whether that be an animal or plant or other microbes; they cannot reproduce or multiply without a living host. Viruses may also attack other microbes; when they infect bacteria, they are known as bacteriophages. They reproduce by taking over their host's cellular machinery and forcing the host's cells to manufacture more virus particles. It's the DNA (or RNA) in the virus that provides the codes for its host to manufacture more virus particles. This forced replication of more virus particles disrupts the normal functioning of the host's cell and may eventually kill the cell. The killing of its host's cells is why animals (and humans) and plants develop symptoms of an infection. Another similar infectious entity is a Viroid, which is simply a virus (nucleic acid) without a protein coat. Viroids also attack plants and cause diseases similar to viruses.

A Very Brief History of Viruses:

While viruses have probably been associated with life on Planet Earth since life began, their existence was not known or understood until relatively recently. In our history, the discovery of various organisms, including microorganisms, is almost always correlated with their commonality and size. Obviously, trees have been known since the dawn of humankind. Fungi, because of their reproductive structures we call mushrooms, were known since ancient times (Photo 2). Nevertheless, many fungi are microscopic and do not produce conspicuously sized fructifications such as a mushroom. A prime example is *Phytophthora infestans,* whose microscopic body (thallus) and spores (Photo 3) were largely invisible when the fungus began destroying Ireland's potato crops in the mid-1800s. Due to the lack of understanding of microbes and scientific capabilities, people became superstitious about the potato crop blight, blaming the new-fangled steam locomotives or believing they were being punished by God for all of their sins; they probably were sinning but with the development of Science, we know that a microscopic fungus was also involved. The Irish Potato Famine resulted in one million human deaths due to starvation out of the total eight million population. Another one million people emigrated from Ireland during this period to try to find a better life. The impact of the Irish Potato Famine rivals some nasty viral influenzas of humans. Bacteria were first discovered and believed to be the cause of plant disease in the late 1800s. The invention of the light microscope enabled scientists to see bacteria for the first time, although they appeared as tiny specks

P2



P3

P1 The Coronavirus has abruptly changed the way Americans and other people around the world interact and exist, at least temporarily. This photo of the Coronavirus was taken with an electron microscope. The virus measures approximately 125 nanometers (nm) or about 1/254,000th of an inch. (Photo Credit: U.S. Center for Disease Control)

P2 The cause of human and plant diseases was not well understood for many millennia. So, religion and superstition guided people's beliefs until the advancement of science. "Macroscopic" microorganisms such as these *Armillaria* 'shrooms' (fungus) were clearly visible to humans since the dawn of humankind and their ancestors. Many other fungal pathogens are microscopic and invisible to the naked human eye.

P3 *Phytophthora* (fungus) caused the potato crop in Ireland to fail in the mid-1800s and resulted in one million deaths due to starvation out of the total eight million population. Approximately one million people emigrated from Ireland, many to the United States. The mystery of the crop failure was solved later with the discovery of the microscopic *Phytophthora* spores (lemon-shaped "sporangia").

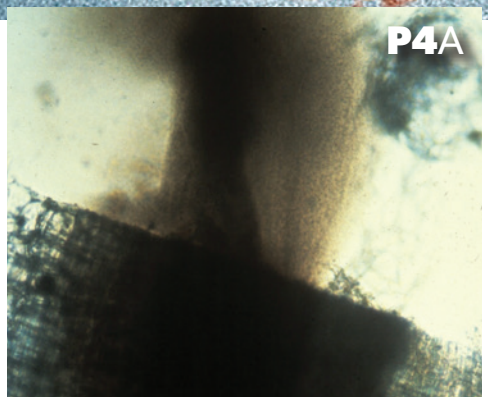
P4 A&B In the mid to late 1800s, bacteria were proven to cause plant diseases. Using a light microscope, we can see millions of microscopic bacteria spewing forth from this infected plant (4A). The advent of the electron microscope enabled us to see bacteria in much greater detail (Photo 4B). This bacterium measures approximately one micron (one millionth of a meter) or 1/25,400th of an inch or 0.00003937 inches.

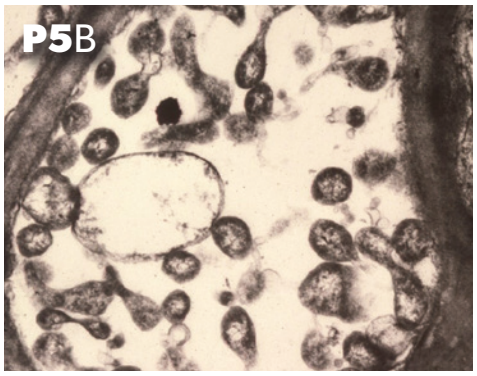
P5 A&B Phytoplasmas are similar in size to bacteria but lack the cell wall that give bacteria their rigid shape. Phytoplasmas induce symptoms in plants like those caused by viruses. In Photo 5A, note the mottled, mosaic sickly leaves of this ash tree, which was dying back from "ash yellows" in 2002 when the author was performing research that led to the discovery of the Emerald Ash Borer in North America. Photo 5B is an electron micrograph showing one plant cell (rounded photo border) infected by many phytoplasmas (dark objects).

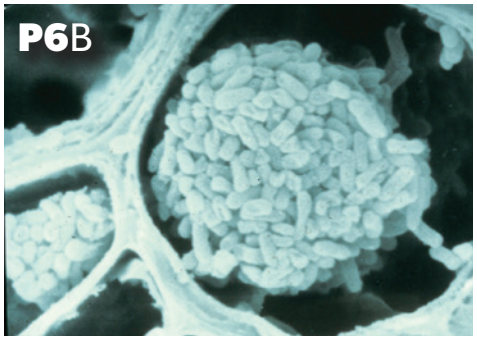
P6A The invention of the electron microscope in the 1930s and 1940s enabled scientists to see much smaller objects than we could normally see with the naked eye or the light microscope. This Philips 300 TEM (Transmission Electron Microscope) was state-of-the-art in 1980 when Dr. Karen Klomparens and the author used it to research the discovery of the first bacterial wilt disease of turfgrasses in North America. The large cable at the top of the microscope column emitted 100,000 volts of energy (electrons) to impact a sample at the base of the column to "illuminate" it. The photo on the wall, taken by this electron microscope, shows four xylem vessels of creeping bentgrass plugged with numerous bacterial cells.

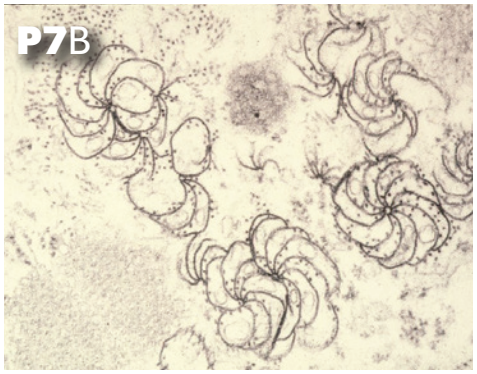
P6B A different type of electron microscope known as a scanning electron microscope (SEM) enabled a 3D appearance of the same bacterial wilt disease on bentgrass. Note that one xylem vessel is chock full of rod-shaped bacteria.

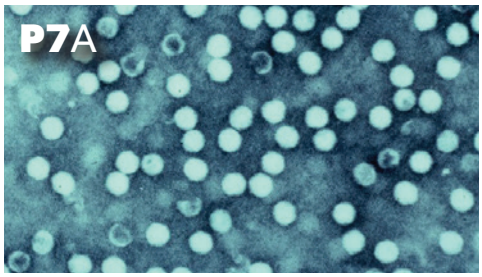
P7 A,B,C Like animal viruses, plant viruses appear in a variety of shapes: Spherical (Polyhedrons, 7A), Pinwheels (Potyvirus= "Potato Virus Y", 7B) and Rod-shaped (TMV=Tobacco Mosaic Virus, 7C). It was discovered that TMV could be spread to many species of plants just from cigarette smokers touching plants.









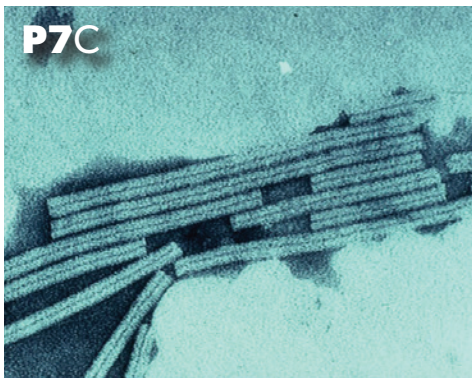


(Photo 4A) until the invention of the electron microscope (Photo 4B). Bacteria typically measure in the one-micron size, which is about 1/25,400th of an inch. Another microbe of similar size to bacteria is the Phytoplasma, which commonly causes plant diseases such as aster yellows and ash yellows (Photos 5A & 5B). With the invention of bacteria-proof filters in the late 1800s, scientists knew that some infectious agent way smaller than bacteria was capable of being transmitted in plant sap to infect healthy plants. It wasn't until the invention of the electron microscope in the 1940s that humans could actually see viruses for the first time (Photos 6A, 6B and 7A, 7B & 7C). With the electron microscope, we could see in better detail microscopic organisms such as bacteria and phytoplasmas, and we could actually see viruses that were previously invisible. Viruses are typically 10-100X smaller than bacteria.

The "Coronavirus" measures about 125 nanometers, which is about 1/254,000th of an inch. In other words, we could line up 254,000 Coronavirus particles side by side and they'd only take up about an inch of space, yet we still couldn't see them.

What is COVID-19?

COVID-19 is a type of virus that is classified in the Coronavirus group. It is defined as a spherical virus with appendages emanating from its surface (Photo 1). Like other coronaviruses, it may have originated from other mammals or



birds (avian), which possibly can become infected or be carriers. Unlike many other viruses, many of which are DNA viruses, the Coronavirus is an RNA virus. There are several characteristics that make the Coronavirus particularly threatening to human health:

1) The Coronavirus is highly contagious, meaning it is easily spread and capable of infecting people.
2) The Coronavirus can survive (unnoticed) on various surfaces for several hours to several days.
3) The Coronavirus is reported to be 10X more deadly than most flu viruses.
4) The Coronavirus has a long incubation period of about 10 days. What this means is from the time of infection to symptom expression in humans, we don't even know we have the virus for about 10 days, during which time we can be symptomless carriers and transmitters of the virus. By comparison, the common cold virus has an incubation period of 2-3 days.

Other Nasty Human Viral Diseases and Pandemics:

Following are just a few of the nasty disease epidemics that have impacted humans over many centuries. Basically, most are spread in the same manner: through human contact (hand shaking, kissing, etc.), contact with contaminated surfaces (doorknobs, shopping carts, etc.), and aerosols from human coughs and sneezes, among other modes. Likewise, avoiding these diseases can occur though frequent handwashing, sanitizing surfaces, social distancing, and so forth.

Common Cold: The common cold is caused by many different types of viruses that induce sneezing, sore throat, stuffy nose, and coughing after attacking the nose and throat. There are about one billion cases per year in just the U.S. Infection occurs by touching contaminated surfaces and by inhalation of aerosols from coughs and sneezing. Symptoms usually develop 2-3 days after infection and clear up within a few days to two weeks.

Common Flu (aka Influenza): The Influenza Viruses attack the lungs, nose and throat, and in certain high-risk groups can be deadly. Those high-risk groups are children, the elderly and those with other health issues. Symptoms include a fever, runny nose, sore throat, muscle and joint pain, headache, coughing, and fatigue. There are many different types of Flu viruses, and scientists try to guess every year what vaccines may be most effective against the strain they expect. There are generally more than three million cases per year of severe illness from Influenza worldwide. Of those, the number of deaths average between 300,000 and 650,000 per year worldwide. Over the last three decades, the number of deaths in the U.S. ranged from 3,000-49,000 annually. Complications from Influenza include viral and bacterial pneumonia, either of which can be deadly.

The 1918 Influenza Pandemic: The 1918 Influenza Pandemic was originally called the Spanish Flu Pandemic – a misnomer, because the flu actually originated elsewhere, probably in the U.S. It was called the Spanish Flu because Spain was initially a neutral country during the beginning of World War I and, with their free media, covered the outbreak from the beginning. Hence, people assumed Spain was the origin whereas censorship of the news by other countries involved in the war covered up the flu pandemic to keep morale high. The disease was spread very quickly around the world by troop movement, especially U.S. troops engaged in World War I. It has been reported that more U.S. troops died of Influenza in WWI than were killed in battle. About a quarter to a third of the world's population, about 500 million people, became infected. Some sources suggest that between 50 million and 100 million people died from the disease. To emphasize the lethality of the 1918 Influenza, in Brevig Mission, a small village in Alaska, 72 of 80 adult Inuit natives died within a five-day period in November 1918. They were buried in a mass grave where the permafrost preserved their bodies for decades. In recent decades, scientists returned to this location and several others to try to resurrect the 1918 Influenza virus to study why it was so aggressive and lethal. In the late 1990s, scientists were eventually successful in reconstructing/recovering the virus.

Pneumonia: A lung infection, symptoms of pneumonia, which can be of viral or bacterial origin, may include coughing with phlegm, fever, chills, and difficulty breathing. Essentially, the infection causes the lungs to fill with fluids, making breathing difficult. More than three million cases are reported every year in the U.S. Anyone may be at risk if the infection is not dealt with in a timely manner. Treatments include antibiotics (for bacterial pneumonia) and vaccines.

The Plague: Also known as The Black Death or The Bubonic Plague, The Plague was the most devastating pandemic recorded in human history, killing between 75 million and 200 million people in Eurasia. The pandemic peaked in Europe from 1347 until 1351, perhaps killing between 30 and 60% of the population there. The Plague was caused by a bacterium (*Yersinia pestis* – not a virus) and was spread to humans by the Oriental Rat Flea. Because of little science at the time, superstition resulted in extensive religious upheaval and confusion about its cause. In one account, the Heavens were blamed in a conjunction of three planets during 1345. A Miasma Theory that blamed "bad air" was also proposed.

Polio: This viral disease first hit the U.S. in 1894. It caused crippling, paralysis and death. In the 1940s to 1960s it was the most feared disease in the U.S. In 1952 alone, over 60,000 children were infected. Our 32nd President of the United States, Franklin Delano Roosevelt, contracted Polio 12 years before he became President in 1933; he was largely crippled but with cooperation from the press Roosevelt was able to hide the disease from the American public. Roosevelt founded The National Foundation for Infantile Paralysis, which spearheaded the March of Dimes. Many attempts were made at developing a vaccine; some people died from the research tests. Finally, Jonas Salk injected several millions of people with a vaccine that he developed, and it worked! I can remember as a grade schooler drinking a liquid form of the Polio vaccine from a small paper container (Dr. Sabin's formulation). When Salk was questioned about why he didn't patent his vaccine, he replied, "Could you patent the sun?"

Ebola: EVD (Ebola Viral Disease) was discovered in 1976 in the Democratic Republic of Congo (formerly Zaire) near a village along the Ebola River, for which the disease receives its name. The fatality rate ranged from 20-90%, averaging 50% for those infected by the virus. From 2014-2016, an outbreak in west Africa quickly spread and became a global epidemic. The spread was blamed on poor medical practices including the reuse of needles. If you recall, a few cases reached the U.S. At the time, our government reacted quickly by implementing strict quarantine measures and by playing a major leadership role by devoting unprecedented aid and by mobilizing thousands of Americans and supplies to Africa to help contain and minimize the spread of the disease there. The U.S. was the largest investor in funding and personnel to manage the Ebola epidemic around the world.

SARS: Severe Acute Respiratory Syndrome is caused by another Coronavirus called SARS-CoV. The disease first appeared in 2002 and quickly spread around the world within a few months. Luckily, it was quickly contained. The disease is remarkably close to COVID-19 regarding its structure/size and its impact on humans, but they are, nevertheless, different viruses. It was decided to call the current Coronavirus "COVID-19" with the purpose to avoid confusion of the two viral diseases even though they exhibit similar impacts on our respiratory system.

P8 A&B Plant viruses can infect many other species of plants than the plant on which they were originally discovered. Symptoms of INSV (Impatiens Necrotic Spot Virus) are visible here on the foliage (8A) and flower (8B) of Gloxinia.

P9 Virus infections of plants may resemble other problems such as Phytoplasma-induced "Yellows" disease (Photo 5A) or nutritional disorders or herbicide injury. The distortion of this Wisteria leaf was caused by herbicide injury. (Photo Credit: Denise Shroeder)

P10 Viruses in nurseries and greenhouses can spread very rapidly through large blocks of plants whether by human contact or by insects that can transmit the virus.

Antibodies and Antigens:

The immune system in animals (including humans) produces antibodies in response to foreign agents (called antigens) that try to invade our bodies. Usually our bodies do a pretty good job of protecting us or helping us recover from some diseases such as the flu and the common cold. Without an immune system, the viruses (and other microbes) would simply overwhelm our bodies and kill us. When we contract the common cold for example, we develop symptoms such as a sore throat and runny nose, which are the result of the viral infection. With time, however, our symptoms gradually disappear and that means the antibodies are catching up to the antigens and escorting them out of our bodies for a hopeful full recovery. The production of antibodies is why we do not contract the same cold virus again, at least in the succeeding few months or years; if we contract another cold, it would undoubtedly be from another strain of the cold virus that our antibodies cannot recognize. With a weakened immune system, our bodies may not be able to keep up sufficiently with the production of antibodies to offset the antigenic viral attack. Hence, our recovery may be much slower, or we may not recover at all. In many decades in the past, blood plasma was taken from people who recovered from such serious diseases and injected into infected people, thus stimulating the production of antibodies to help them recover. This older method has been considered for the Coronavirus.

Plant Viruses:

Viruses may also infect plants. In general, viruses that infect plants do not infect animals (or humans). Plant viruses are often named for the first plant on which they were discovered and for the symptoms they produce on that plant. As an example, INSV (Impatiens Necrotic Spot Virus) was first found on impatiens and causes a "necrotic spot". INSV attacks many other plants (Photos 8A & 8B). TSWV (Tomato Spotted Wilt Virus) was likely first found on tomato and caused a spot and a wilt. Both INSV and TSWV are spread by thrips. TMV (Tobacco Mosaic Virus) was likely first discovered on tobacco but possesses a very broad host range by being capable of attacking many species of plants. TMV can readily be spread by mechanical means such as touching by humans, even from the tobacco smoke of smokers.

As noted, plant viruses come in different shapes and sizes (Photos 7A, 7B & 7C). Most plant viruses infect their host plants and become systemic within their hosts. Symptoms of viral infections in plants are variable but may exhibit mosaic, mottling, leaf and flower distortions, spots, and death. Plants infected by viruses may be mistaken for other maladies such as Phytoplasma diseases (Photo 5A) and herbicide injury (Photo 9). Some viruses are picked up and spread by insects. Others are spread simply by physical contact, such as touching the plants with our hands while transporting or moving them. Obviously, because viruses tend to be systemic in plants, viruses can also be spread in cuttings. Hence, viruses can be disseminated through large blocks of plants in nurseries and greenhouses in short order (Photo 10). In our industry, viral diseases tend to be more common in herbaceous plants than in woody plants (shrubs and trees).

Because plants have no immune system per se, control of plant viruses generally involves destroying infected plants because they cannot recover from viral infections. Other control measures include managing insect vectors and

having employees utilize sanitary procedures such as hand washing. In some cases, heat treatment of seeds and plants may rid the plant of viral infections. Collecting meristematic cells for tissue culture may prevent the transmission of viruses because meristematic tissue is often virus free, at least initially.

Controlling Viruses:

Because of their microscopic size, viruses (and bacteria, etc.) can be very challenging to manage. We can't see them so they must not be there, right? Probably the best way to prohibit viral infections of any type is avoidance. As stated over and over again by public health officials, washing our hands with hot, soapy water is probably the most effective practice to prevent our infection and subsequent spread of the Coronavirus. But handwashing is not going to stop the spread of the Coronavirus or our infection by it if we don't follow sanitary procedures *smartly*. This also applies to many other viruses such as those that cause the common cold and flu. Viruses can also spread in small droplets (aerosols) when someone sneezes or coughs; so, placing our nose and mouth in our elbow when coughing should minimize aerosols. At the time of this writing, the Coronavirus is also believed to be carried in our breath when breathing or talking.

Don't Cha Toucha Your Face! It is my understanding that the Coronavirus, like many other viruses, cannot infect the skin on our hands; they can, however, infect recent cuts and possibly bruises on our hands. The major method of transfer of the virus from infected people to surfaces we touch to our hands is when we touch the delicate tissues around our eyes, nose and mouth. So, when going to the grocery store to pick up food and beverages, it's wise to be very conscious to not touch our face until after we've returned home and sanitized our hands... and groceries.

Groceries, Gas and Banking: During our days and perhaps weeks of self-quarantine and social distancing to weather this pandemic, our most likely exposure to the Coronavirus will likely occur during our necessary ventures-out for such necessities as food, gas and banking needs. Boxed, bottled and canned food and fresh produce can transmit the Coronavirus if they've been handled by an infected person. Remember, these products have probably been handled several times by people during transportation and stocking processes, as well as by other shoppers who picked up the items but decided not to take them. When I return home with my groceries, I fill up the sink with hot soapy water and immerse sealed containers to wash them (Photo 11). This practice even includes snack items such as potato chips and popcorn sealed in plastic bags. Sealed (bottled) beverages such as wine and fruit juices can be sanitized similarly. Fresh produce with a "skin" such as bananas, avocados and citrus can also be surface cleaned/sanitized in this manner. For boxed items, I wipe down the surfaces with sanitizing wipes. When getting fuel for our vehicles, it is prudent to sanitize our hands before and after pump operation. Clutching the pump handle with plastic or nitrile gloves or a paper towel can minimize our exposure (Photo 12). And, don't forget that credit card or money that is touched by others – the Coronavirus can easily be transmitted on these items. Washing your hands frequently is probably the most important step in helping to prevent our exposure to the Coronavirus. Once we become sensitized to all of the intricacies of Coronavirus dissemination, it's mostly a common-sense approach from then on.

Sanitizing Agents: With the hoarding of hand sanitizing wipes and gels it is sometimes difficult to get the products we think we need to protect ourselves from the Coronavirus and other nasty critters. Following is a list of some "chemicals" that may help us deal with the Coronavirus, and other nasty virions. In the nursery, landscape and arboriculture industries, the following sanitizing agents can be used to sterilize just about anything: pots, benches, chainsaws, pruners, shovels, etc. Please be cautious – sanitizing agents are essentially biocides, meaning they kill living entities such as bacteria and fungi. They "denature" non-living entities such as viruses and viroids. Used correctly, sanitizing agents are relatively safe. However, they can harm/kill humans and pets and plants if exposure is significant.

Hot Soapy Water: The protein coat of the

P11 To help minimize my potential infection by the Coronavirus, I sanitize all of my groceries as soon as I return home. I immerse sealed containers in my sink filled with hot, soapy water, similar to washing my hands. This photo shows three of the major food groups: wine, snacks and more wine.

P12 Minimizing our risk of Coronavirus infections involves social distancing and staying at home. With that in mind, grocery stores, gas stations and banks may become the primary social locations of viral transfer between humans. It is vital that we use common sense to minimize that risk such as frequent hand washing and other techniques discussed in this article. At gas pumps, I use gloves or paper towels to pick up the pump nozzle. Also, that keypad may contain millions or Coronavirus particles that you can't see. And don't forget to sanitize your credit card if someone else has touched it!

P13 Now that I have your attention, perhaps we need to be reminded of how diseases spread so easily among people. Our bathroom manners say it all. Whether it's laziness or lack of knowledge, we can do a much better job of using sanitary procedures to minimize the spread of diseases.

virus can be stripped away or denatured with hot, soapy water. Remember the mantra, "Wash your hands!" After I go grocery shopping, I fill the sink with hot, soapy water to wash all of the sealed containers in hopes of eliminating the Coronavirus and other nasty critters from their surfaces (Photo 11). Unsealed containers can be wiped down by disinfectants listed in this article. By the time you collect the items at the grocery store, several people probably handled them; some of those people may be carriers of the Coronavirus.

Household Bleach: Bleach or "Clorox" typically contains 5.28% sodium hypochlorite. A great sanitizing agent can be made from household bleach by mixing one-part bleach with nine parts water. The 10% bleach (0.528% sodium hypochlorite) can be used to sanitize surfaces such as counters, doorknobs, etc. Simply put the diluted solution in a spray bottle. The smell may be offensive but diluted bleach is an excellent disinfectant/sanitizer; the smell will dissipate over time.

Alcohol: Various alcohols such as ethanol, methanol (wood alcohol) and Isopropyl alcohol can serve as sanitizers. They are commonly found in hand sanitizing gels and wipes. Ethanol is "denatured" with other toxic chemicals to prohibit its consumption by humans. Because alcohol tends to desiccate the skin, you can make your own hand sanitizer by adding a little aloe vera gel or a moisturizer. Remember the old westerns where they sanitized the bullet hole wound with whiskey and then gave the patient the rest of the bottle as an anesthetic? Yeah, well, in a pinch, you can probably use whiskey, gin, vodka, or other spirits. These typically come as 80 proof, which means they are 40% alcohol. We'd like to keep the alcohol content for sanitizers above 50-60%, but these may still do the trick. Some people might consider the use of these adult beverages for sanitizing a waste, but it's better than getting the Coronavirus.

Hydrogen Peroxide: H_2O_2 is a great disinfectant. It can be used to sanitize surfaces.

Lysol: Benzalkonium chloride is the active ingredient in Lysol. When used according to label directions, the diluted product can make a great disinfectant. Other products marketed under the Lysol brand name may contain hydrogen peroxide.

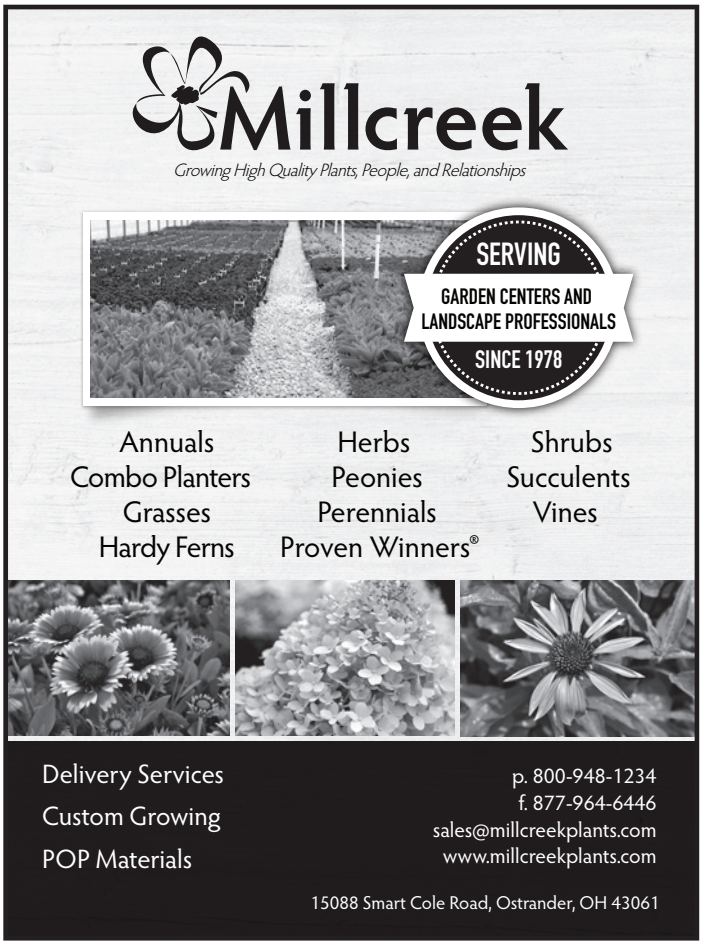
Ammonia: Ammonia is a highly toxic broad-spectrum disinfectant. Quaternary ammonium salts are marketed under numerous brand names.

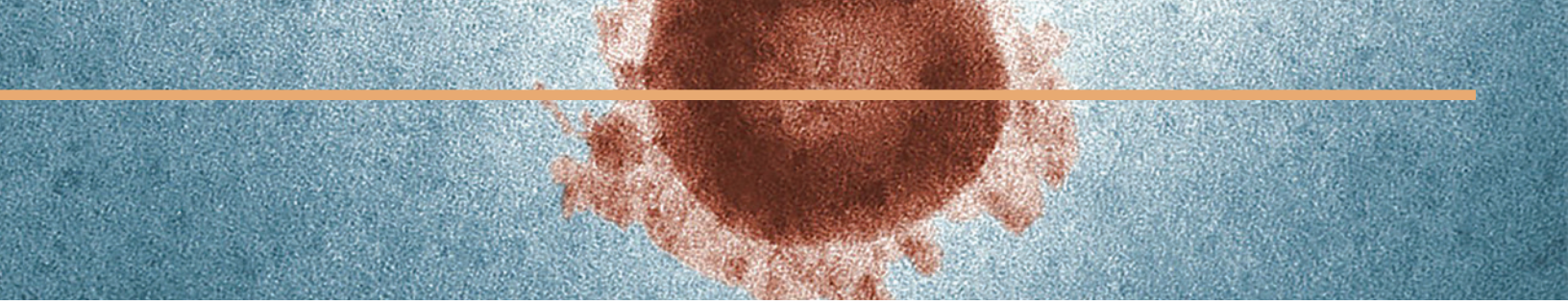
Heat: All life succumbs to heat if temperatures get hot enough. Even non-living viruses become denatured or inactive with heat. Very hot water is generally sufficient to "cook" the protein coat and nucleic acid molecules that comprise the virus. Microwaving can kill viruses on some surfaces such as plastic, paper, food, etc. On the other hand, cold temperatures including freezing doesn't kill viruses.

Bathroom Manners:

Today, even though we humans possess a great deal of scientific knowledge and understanding of the natural world, we're still somewhat ignorant about "germs". Perhaps our bathroom manner represents the best example to help us understand how the Coronavirus and other diseases can spread so easily among people. Consider the following scenarios:

Scenario #1: Depending on the data source, approximately 60% of men and 40% of women do not wash their hands after using the bathroom. So, the Coronavirus, the common cold virus, other flu viruses, and (sorry) fecal material are found on the door handles of bathrooms. In fact, fecal material has been found on all sorts of surfaces including shopping carts. Gross! After leaving the bathroom, that macho man who refused to wash his hands may put his finger





in his mouth to try to dislodge a food particle from between his teeth. Double Gross!!!

Scenario #2: Of the men (and women) who wash their hands, they may wash their hands by grabbing the dirty sink knobs before and after washing. Then, after drying their hands with a paper towel, they toss the towel in the trash can before grabbing the handle to exit the bathroom. This protocol nullifies any sanitary measures to prevent the spread of diseases! Obviously, we want to use the paper towel to shut off the sink faucet after washing our hands and to grab the door handle before tossing that paper towel into the trash.

Scenario #3: I think we've all seen those signs in the bathroom, "Employees Must Wash Their Hands Before Returning to Work." The primary challenge is that many restaurants and other businesses have replaced their paper towel dispensers with hand blow dryers. In other words, none of us, including restaurant food handlers, can exit the restroom without grabbling that dirty, contaminated door handle!

As a Plant Pathologist I have often thought that "we're about due for another pandemic" because of habitat destruction, the explosion of the human population on Plant Earth and because of our rapid transportation all over the world in a matter of hours – a prime ingredient in the rapid development of a Pandemic caused by a noxious, deadly virus. Perhaps COVID-19 represents a stark reminder of pandemics yet to come. Mother Nature has her way of "thinning the herd' when we humans believe we've become the Masters of the Universe. Nevertheless, we all must take these matters seriously and do our part to minimize the dissemination of COVID-19 and other consequential diseases.

To my friends and colleagues, be smart, be safe and be healthy!

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