June 2021

National Clean Plant Network

NCPN Network News

BIG NEWS! NEW WEBSITE! The NCPN Education & Outreach Committee has been very busy creating new products for delivering timely information about the Network. In June, an all-new NCPN website went live and we are very excited about the new design. Each crop has their own page, and simple, logical navigation takes you to in-depth information on clean plant resources. Check it out at **nationalcleanplantnetwork.org.**

Simultaneous to the new website going live, we are launching an **NCPN Social Media Campaign**. Join us on Facebook and Instagram **@nationalcleanplantnetwork** and on Twitter **@plant_clean** for timely updates on our mission to *"Start clean, stay clean!"*

NCPN Working Group Publishes Review of Economic Studies

The NCPN Economic Studies Working Group recently published a comprehensive paper that describes economic studies that are essential to the mission of NCPN. In the paper, Fuchs et al. review research of the economic impacts of diseases of vegetatively propagated specialty crops and describe how economic studies have identified profit-maximizing disease management solutions for some diseases. The paper covers collaborative research between agriculture economists, plant pathologists, extension educators, specialty crop growers, and regulators to develop and disseminate integrated recommendations on disease management strategies that resonate with growers. Studies on returns to investment in NCPN clean plant centers that produce, maintain, and distribute pathogen-tested propagative material are also highlighted. Finally, the authors discuss how additional economic studies could further incentivize the use of clean planting material and strengthen efforts to safeguard specialty crops in the United States.

Read the full paper: Fuchs, M., et al. 2021. *Economic studies reinforce efforts to safeguard specialty crops in the United States.* Plant Disease 105: 14-26.

GLRaV-3 Virus Screening in California: $90 Million Annual Value

Viruses and other graft-transmissible pathogens have no cure and are costly to nurseries and specialty crop producers. These pathogens spread through infected planting stock and plant propagation material. However, virus spread is minimized if clean, virus-tested stock is planted. In 2019, a paper by Fuller et al. documented the costs and benefits of a virus screening program for grapevine leafroll associated virus-3 (GLRaV-3) in the North Coast region of California. The economic benefits from the grapevine virus testing, therapy, and distribution program at Foundation Plant Services (FPS) at the University of California, Davis was in excess of $20 million/yr. A new study, published in 2020 by Cheon et al., expanded on this original study and estimated the value of the program for the rest of the main grape growing regions in California at $70 million. Combined, the value of GLRaV-3 screening in California is estimated at $90 million per year or approximately 1.6% of the estimated $5.5 billion value of the grape industry in California.

Virus-tested grapevine stock from Foundation Plant Services in Davis, CA

Read the full study: Cheon, J., et al. 2020. *Heterogeneous benefits of virus screening for grapevines in California.* American Journal of Enology and Viticulture 71:231-241.

Standardizing Testing Protocols Aims to Improve Flow of Clean Fruit Tree Material in U.S.

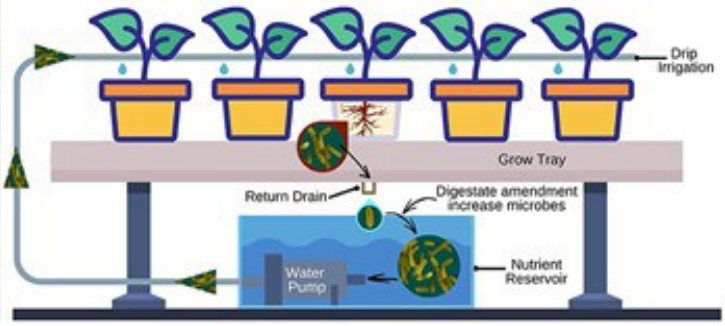
The National Clean Plant Network-Fruit Trees directors from the Clemson Clean Plant, Foundation Plant Services, and Clean Plant Center Northwest have been meeting over the past several months to update and harmonize the pathogens tested for in the production of clean G1 plant material. Simultaneously, they have been developing a list of pathogens that G1 plants in foundations will be tested for, including the damaging and highly transmissible Prunus-infecting Phytoplasmas, Little cherry viruses, and Plum pox virus. This national effort should improve the flow of plant material across the United States and create a unified national standard for NCPN-Fruit Trees Centers.

The foundation collections of virus-tested plants represent decades of work and the basis for certification programs around the country. The three centers are proactively testing for these and other harmful pathogens to ensure grower confidence.

NCPN-Fruit Trees Foundation collection at CPCNW in Prosser, Washington

Fermented Food Waste Can Improve Citrus Crop Growth

Global production of food waste is a far-reaching problem with sizable financial, ethical, social, and environmental costs. Over 66 million tons of food waste are produced annually in the United States alone. This waste can be converted into valuable digestate by-products that promote a circular economy within agri-food systems. A team from the University of California, Riverside (UCR), has found a way to keep food waste out of the landfills and put it to a more beneficial use. In their study, published in the journal *Frontier in Sustainable Food Systems*, the researchers found that fermented food waste can actually boost bacteria that — in addition to increasing crop growth — can make plants more resistant to pathogens as well as reduce carbon emissions from farming. Their study examined the by-products from two kinds of waste that are readily available in Southern California: beer mash, a by-product of beer production, and mixed food waste discarded by grocery stores. Beneficial microbes increased dramatically (two to three orders of magnitude) when fermented food waste by-products were added to the irrigation system watering citrus plants in the greenhouse. This trend continued each time the researchers added the treatments. When there are enough of these good bacteria, quorum sensing is reached and bacteria start producing antimicrobial compounds and metabolites that help plants grow better and faster. The treatment also improved the carbon to nitrogen ratio in the potting soil, which can be leveraged to optimize production systems and decrease synthetic chemical (fertilizer and pesticides) use by farmers.



In the photo on the far left, citrus seedlings in drip-irrigated hydroponic units in a temperature-controlled greenhouse.

In the adjacent illustration, simplified layout of a recirculating hydroponic system. FW and BM digestates, at 4 ml/L of nutrient solution, were amended to the reservoir at 7 days interval.

"California's citrus, in particular, is facing historical challenges such as Huanglongbing bacterial disease and limited water availability. There is a pressing need to develop novel agricultural practices." explains Georgios Vidalakis, UCR plant pathologist and study co-author.

The Sweetpotato Clean Plant Center at Louisiana State University Tests Alternatives for Increasing Production of Clean Plants

From mid-October through mid-May each year, there is a concerted effort to increase by 50-fold the number of greenhouse foundation plants produced at the Louisiana Sweetpotato Clean Plant Center. Traditionally, they have started with tissue culture, which eventually results in G1 'seed' storage roots, and also a limited number of vine cuttings that are sold direct to stakeholders. The Center is currently evaluating alternative means of starting plants, through semi-autotrophic hydroponics in a contained lab environment as an alternative or along with tissue culture increase. Efforts are being driven by an alternative business plan for the Sweet Potato Research Station, which in time, would shift the majority of sales to early-season plant sales vs. G1 seed sold each spring. There are inherent risks associated with growing a season-long crop before disseminating to stakeholders. Their goal is to diversify the business model, while continuing to meet the needs of industry and stakeholders. An underlying strategy is to improve efficiencies by incorporating new technologies along the way.

Quality Management is one of five key initiatives for NCPN, and COVID-19 shutdowns have provided an opportunity to make progress in refining and developing the documents needed to improve our quality management systems. Through NCPN support, the LSU Center has also added the capability of conducting multiplexed qPCR assays which has enabled them to improve quality control by including internal standards in the same test for Sweet potato leaf curl virus. Studies have been conducted validate that process.

Historically, various sweetpotato potyviruses have been prevalent in production fields, and as a result, breeding lines were quickly infected and automatically entered into therapy. However, progress in reducing re-infection in the field at the Sweet Potato Research Station has been very effective, resulting in the expedited release of many breeding lines by thoroughly testing them early on the breeding program, and by-passing meristem-tip culture for those that test negative.

The Clean Plant Center at LSU is currently evaluating alternative means of starting plants, through semi-autotrophic hydroponics.

New Testing Methods for Hop Pathogens Are More Sensitive and More Specific

Emerging new growth on hop plant in CPCNW screenhouse.

In February, the Clean Plant Center Northwest (CPCNW) published a paper on improved assays to detect the hop-infecting viruses: Hop mosaic virus, Hop latent virus, and American hop latent virus. These three aphid-transmitted viruses are common in U.S.-grown hops and cause losses to both hop yield and brewing quality. As these are often found at very low titer in infected hops, sensitive, accurate diagnostics are essential to producing and maintaining clean plants. Using these new assays, the CPCNW has screened both in-progress and foundation plants, identifying and removing infected plants for virus elimination. Such proactive measures are essential to protect the U.S. hop industry from harmful pathogens and maintain grower confidence in the clean plant concept.

The full paper, Development of RT-qPCR assays for the detection and quantification of three carlaviruses infecting hop, is published in *The Journal of Virological Methods.*

Private Nurseries and NCPN-Berries Work Collaboratively to Increase Clean Plant Availability

The U.S. berry industry relies on a network of nurseries that supply clean plants to fruit growers across the country. NCPN Clean Plant Centers are a vital link in this network, as are a number of privately owned nurseries that have in-house labs and clean plant capabilities.

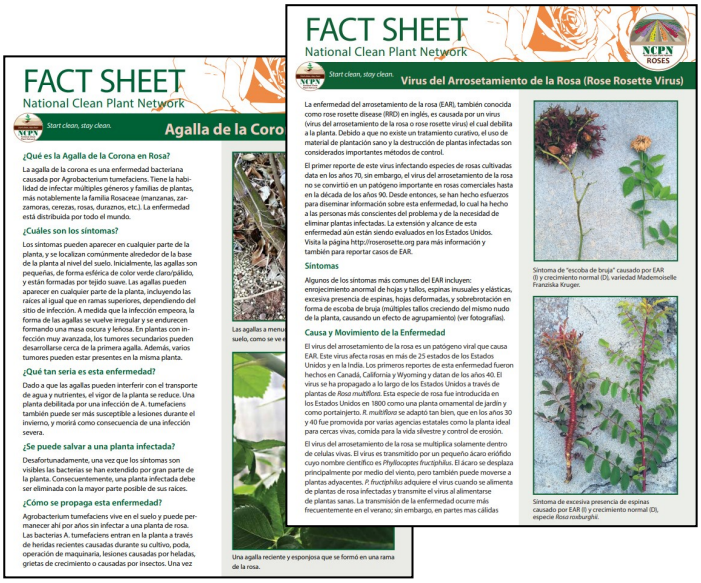
Most nurseries benefit from state-level certification programs that protect against the introduction of viruses and harmful diseases, ensuring quality plants for nursery stock. This has contributed to growth of the U.S. berry industry over the past few decades. Several nurseries have taken their production to the next level with in-house capacity to produce pathogen-tested growing material. These nurseries have established tissue culture labs, where virus-tested plantlets are propagated under sterile conditions. Screenhouses allow nurseries to maintain foundation plants and multiply their clean stock. Additionally, some nurseries have acquired a Controlled Import Permit from the USDA, allowing them to introduce new berry genetics from outside the U.S. and quarantine the material in a dedicated screenhouse for diagnostics and observation.

As with NCPN-funded facilities, private labs use molecular techniques for virus indexing and DNA finger printing. Testing methods include PCR, ELISA, as well as grafting to indicator plants. Heat treatment chambers are also employed on site for virus therapy and elimination.

Nurseries and Clean Plant Centers maintain good working relationships: the NCPN Centers develop--and make publicly available--virus detection protocols, especially the virus-specific primers for molecular detection methods. The NCPN Centers also verify clean plant processes and outputs by private nurseries through confirmation testing. This collaboration of NCPN-funded Centers and private nurseries increases the availability of clean planting material for growers. In North America, clean stock has a higher perceived value and is critical to the long-term health of the berry industry. A continued working relationship between NCPN and private nurseries is key to the success of the U.S. berry industry.

Strawberry plants in protective screen house

Rose Disease Factsheets Available in English and Spanish Versions


FACT SHEET
National Clean Plant Network
Start clean, stay clean.
Agalla de la Corona

¿Qué es la Agalla de la Corona en Rosa?

La agalla de la corona es una enfermedad bacteriana causada por Agrobacterium tumefaciens. Tiene la habilidad de infectar múltiples géneros y familias de plantas, más notablemente la familia Rosaceae (manzanas, zarzamoras, cerezas, rosas, duraznos, etc.). La enfermedad está distribuida por todo el mundo.

¿Cuáles son los síntomas?

Los síntomas pueden aparecer en cualquier parte de la planta, y se localizan comúnmente alrededor de la base de la planta al nivel del suelo. Inicialmente, las agallas son pequeñas, de forma esférica de color verde claro/pálido, y están formadas por tejido suave. Las agallas pueden aparecer en cualquier parte de la planta, incluyendo las raíces al igual que en ramas superiores, dependiendo del sitio de infección. A medida que la infección empeora, la forma de las agallas se vuelve irregular y se endurecen formando una masa oscura y leñosa. En plantas con infección muy avanzada, los tumores secundarios pueden desarrollarse cerca de la primera agalla. Además, varios tumores pueden estar presentes en la misma planta.

¿Qué tan seria es esta enfermedad?

Dado a que las agallas pueden interferir con el transporte de agua y nutrientes, el vigor de la planta se reduce. Una planta debilitada por una infección de A. tumefaciens también puede ser más susceptible a lesiones durante el invierno, y morirá como consecuencia de una infección severa.

¿Se puede salvar a una planta infectada?

Desafortunadamente, una vez que los síntomas son visibles las bacterias se han extendido por gran parte de la planta. Consecuentemente, una planta infectada debe ser eliminada con la mayor parte posible de sus raíces.

¿Cómo se propaga esta enfermedad?

Agrobacterium tumefaciens vive en el suelo y puede permanecer ahí por años sin infectar a una planta de rosa. Las bacterias A. tumefaciens entran en la planta a través de heridas recientes causadas durante su cultivo, poda, operación de maquinaria, lesiones causadas por heladas, grietas de crecimiento o causadas por insectos. Una vez

Las agallas a menu
suelo, como se ve e

Una agalla reciente y esponjosa que se formó en una rama de la rosa.

FACT SHEET
National Clean Plant Network
NCPN ROSES
Start clean, stay clean.
Virus del Arrosetamiento de la Rosa (Rose Rosette Virus)

La enfermedad del arrosetamiento de la rosa (EAR), también conocida como rose rosette disease (RRD) en inglés, es causada por un virus (virus del arrosetamiento de la rosa o rose rosette virus) el cual debilita a la planta. Debido a que no existe un tratamiento curativo, el uso de material de plantación sano y la destrucción de plantas infectadas son considerados importantes métodos de control.

El primer reporte de este virus infectando especies de rosas cultivadas data en los años 70, sin embargo, el virus del arrosetamiento de la rosa no se convirtió en un patógeno importante en rosas comerciales hasta en la década de los años 90. Desde entonces, se han hecho esfuerzos para diseminar información sobre esta enfermedad, lo cual ha hecho a las personas más conscientes del problema y de la necesidad de eliminar plantas infectadas. La extensión y alcance de esta enfermedad aún están siendo evaluados en los Estados Unidos. Visita la paigna http://rosesrosette.org para más información y también para reportar casos de EAR.

Síntomas

Algunos de los síntomas más comunes del EAR incluyen: enrojecimiento anormal de hojas y tallos, espinas inusuales y elásticas, excesiva presencia de espinas, hojas deformadas, y sobrebrotación en forma de escoba de bruja (múltiples tallos creciendo del mismo nudo de la planta, causando un efecto de agrupamiento) (ver fotografías).

Causa y Movimiento de la Enfermedad

El virus del arrosetamiento de la rosa es un patógeno viral que causa EAR. Este virus afecta rosas en más de 25 estados de los Estados Unidos y en la India. Los primeros reportes de esta enfermedad fueron hechos en Canadá, California y Wyoming y datan de los años 40. El virus se ha propagado a lo largo de los Estados Unidos a través de plantas de *Rosa multiflora*. Esta especie de rosa fue introducida en los Estados Unidos en 1800 como una planta ornamental de jardín y como portainjerto. *R. multiflora* se adaptó tan bien, que en los años 30 y 40 fue promovida por varias agencias estatales como la planta ideal para cercas vivas, comida para la vida silvestre y control de erosión.

El virus del arrosetamiento de la rosa se multiplica solamente dentro de celulas vivas. El virus es transmitido por un pequeño ácaro eriófido cuyo nombre científico es *Phyllocoptes fructiphilus*. El ácaro se desplaza principalmente por medio del viento, pero también puede moverse a plantas adyacentes. *P. fructiphilus* adquiere el virus cuando se alimenta de plantas de rosa infectadas y transmite el virus al alimentarse de plantas sanas. La transmisión de la enfermedad ocurre más frecuentemente en el verano; sin embargo, en partes mas cálidas

Síntoma de "escoba de bruja" causado por EAR (I) y crecimiento normal (D), variedad Mademoiselle Franziska Kruger.

Síntoma de excesiva presencia de espinas causado por EAR (I) y crecimiento normal (D), especie *Rosa roxburghii*.

Rose viruses and other diseases commonly occur in garden and landscape roses and are easily transmitted through the propagation cycle. To help inform both commercial and hobby growers about reducing the risk of targeted pathogens, NCPN-Roses has published two factsheets and makes them readily available to the general public. The *Rose Rosette Disease Factsheet* and *Crown Gall Factsheet* are available in English or Spanish versions. They may be downloaded from the NCPN-Roses website at https://ucanr.edu/sites/ncpnrose/ or obtained directly from Natalie Anderson at n-anderson@tamu.edu, as either a PDF file or printed version. Gardening clubs, extension offices, nurseries, and all others interested in growing roses are encouraged to access this vital information and learn more about how to prevent the spread of harmful disease.