**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!”

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**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.


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**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.

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.

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.

“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.

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

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.

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 fact-sheets 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.