National Agricultural Research, Extension, Education, and Economics (NAREEE) Advisory Board

MINUTES OF THE CITRUS DISEASE SUBCOMMITTEE (CDS) MEETING

October 30, November 2 and 13, 2020
CDS Meetings #1, #2, #3
Virtual Meeting Via Zoom

CONTENTS

Respectfully submitted,

Justin D. Brown
Chair

Katherine Lewis
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Kate Lewis
Executive Director

APPROVAL BY ADVISORY BOARD: _____
Date

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Chair Executive Director

EXCUTIVE SUMMARY

The Citrus Disease Subcommittee (CDS), a statutory subcommittee of the National Agricultural Research, Extension, Education, and Economics (NAREEE) Advisory Board, held three brief public virtual meeting via the Zoom platform on October 30 (Meeting #1, 2:00-3:15 pm ET), November 2 (Meeting #2, 3:00-4:15 pm ET), and November 13, 2020 (Meetings #3, 12:00-1:30 pm ET). The meetings were held on an accelerated schedule because National Institute of Food and Agriculture's (NIFA) move from Washington, DC, to Kansas City had delayed meetings to obtain essential CDS member feedback on the citrus industry's priorities. CDS priorities guide NIFA's process for soliciting research proposals and awarding funds to projects supporting those priorities.

The main goal of Meeting #1 was for NIFA to provide the CDS members an update on the status of projects that were awarded funds in FY2020 (FY20) under NIFA's Emergency Citrus Disease Research and Extension Program (ECDRE) as a first step in preparing the CDS members to provide feedback on FY2021 (FY21) priorities that will guide NIFA's process for soliciting and awarding funds to projects. The main goal of Meeting #2 was for CDS members to hear presentations on seven Standard Projects that had received ECDRE FY2020 funding, and the main goal of Meeting #3 was for members to hear presentations on five Coordinated Agricultural Projects that received FY2020 awards.

Following the three brief meetings, the CDS members requested an additional meeting during the week of November 16-20 to review the ECDRE-funded projects for which they had heard presentations and to receive NIFA input on the kind of feedback the agency is seeking from CDS.

FRIDAY, OCTOBER 30, 2020 (Meeting #1)

PART I: Welcome and Introductions

The new NAREEE Board Executive Director/Designated Federal Officer (DFO) Kate Lewis opened the meeting and introduced herself and NAREEE Advisory Board Support Coordinator Ms. Shirley Morgan-Jordan before asking NIFA representatives, external guests, and CDS members to introduce themselves.

Guests introduced themselves. Present from NIFA were Michael Fitzner, the Acting Deputy Director of NIFA's Institute of Food Production and Sustainability NIFA; Ann Lichens-Park, the Acting Director of NIFA's Plant Protection Division; Erica Kistner-Thomas, the National Program Leader for ECDRE; Logan Appenfeller, a Program Specialist in NIFA's Plant Protection Division; Tim Widmer, the National Program Leader for Plant Diseases in the Agricultural Research Service (ARS), who noted that others from ARS could not attend and might not have received an invitation, but DFO Lewis noted that they will be informed about future meeting.

The CDS members present were Greg Galloway; Julia Inestroza; Gee Roe; Matt McLean; Mani Skaria; Harold Browning; Justin Golding; and John Gless, and CDS Chair Justin D. Brown. Richard De Los Santos, the NAREEE Board Representative, also joined.

External stakeholder guests present were Rick Dantzler, Citrus Research and Development Foundation (CRDF); Mike Sparks, Florida Citrus Mutual; Jim Syvertsen, CRDF; and Melinda Klein, Citrus Research Board (CRB), California.

PART II: NIFA Presentations

Opening Remarks

Dr. Parag Chitnis, the current Acting Director of NIFA, who regularly serves as the Associate Director of NIFA, introduced himself.

Dr. Michael Fitzner, Acting Deputy Director, Institute of Food Production and Sustainability, NIFA, gave a brief update on NIFA using PowerPoint slides, explaining that the consultation with the CDS subcommittee members was a key step in managing the ECDRE funds. He described the successful NIFA relocation to Kansas City, and said NIFA is reviewing more than 900 comments on how to improve the program, including some from CDS members. Dr. Fitzner stated that NIFA wants CDS members' input on priorities for ECDRE research funding in FY21. He gave a brief overview of the NIFA investments, starting with Specialty Crops Research Initiative (SCRI) that supported citrus greening projects prior to and after the 2014 Farm Bill, which included specific funding for Citrus Disease Research and Extension, which in the 2018 Farm Bill became ECDRE, adding "Emergency" to the program name. The $25 million a year investment since 2014 total more than $160 million invested in citrus disease research.

Summarizing the ECDRE process, with its Relevancy Review (RR) by industry and its Scientific Review (SR), Dr. Fitzner said the process results in a list of awards to successful project applications being submitted to the CDS, with project team presentations. He reminded members that $45 million in awards were made during the FY20 cycle to catch up on delayed project funding. He described the three types of projects: Standard Projects (SP) that are funded for up to two years at a total of $1.5 million, noting that they are narrower in scope than a Coordinated Agricultural Project (CAP) that are funded for over five years at a total of up to $15 million. Coordination Network (CN) projects can receive up to $1 million for a total of five years.

Dr. Ann Lichens-Park then gave a report on 2020 awards, explaining that out of 57 preapplications submitted, 27 were invited to submit full applications, and 12 ECDRE projects were funded totaling $45 million, including seven SPs and five CAPs but no CNs because there were no applications. The projects address six of the nine FY20 ECDRE research priorities. She reviewed each of the ECDRE priorities and the projects addressing the priorities, noting that the NIFA website has full details for each of the awards whose details were presented during the follow-on meetings with project representatives on Nov. 2 and Nov. 13 (*see below*). Some projects support more than one priority area. Of the FY20 priorities, only the first six (1-6) were supported with awards and priorities 7-9 were not addressed. The priorities and associated projects were as follows:

1. *A delivery system for therapeutics, nutrition and other Huanglongbing (HLB) solutions especially those targeting the phloem*, supported by three projects, two CAPs, Manker, CRDF ($10,071,000) and Shatters, USDA/ARS ($9,380,000) and one SP, Mou, University of Florida (UF) ($1,473, 890).
2. *A better understanding of the HLB/vector/citrus pathosystem*, supported by one SP, Levy, UF ($1,496, 707).
3. *Consolidation of screening efforts for intervention targets and reduction of candidate lists to include only those most worthy of advanced testing and commercialization*, supported by three CAPs (Manker and Shatters, see priority 1) and Gupta, New Mexico Consortium ($4, 759, 531), with a slightly reduced duration at three years for both Manker and Gupta.
4. *A cure for HLB-infected trees and strategies for maintaining their productivity*, supported by a CAP, Roper, UC Riverside ($6,500,000)
5. *Regional management or eradication of ACP on commercial citrus groves and residential plantings; management strategies should incorporate appropriate resistance management measures*, supported by two SPs, Kuo, UC Davis ($1,411, 605) and Bonning, UF ($1,480,456).
6. *Progress in the development of commercial citrus varieties (rootstocks and scions) with genetic resistance to HLB using traditional breeding techniques and/or gene editing*, supported by one CAP, Ramadugu, UC Riverside, using traditional breeding ($4,670,000), and three SPs using gene editing: Culver, University of Maryland (UMD) ($942, 906), Irish, Yale ($1,497, 644), and Simon, UMD ($1,500,000)
7. *A reliable technique for culturing CLas bacteria*.
8. *Optimized detection and surveillance programs for ACP and/or HLB.*
9. *Greater understanding of the ecology and interactions of the citrus production system and the citrus greening disease complex (HLB and ACP).*

For the priorities not addressed, NIFA could not identify well-revised study proposals. Dr. Lichens-Park presented the ECDRE FY21 timeline, which called for grant awardees to make presentations the week of Nov. 9, 2020 (with actual dates being Nov. 2 and 13); CDS feedback on ECDRE FY21 priorities following the awardee presentations by Nov. 13, 2020: the release of NIFA's Request for Pre-applications (RFPA) Dec. 15, 2020; and the Request for Proposals (RFP) sent March 2021 to Project Directors (PDs) being invited to submit full applications based on the March 2021 RR results.

She explained that NIFA provides projects an increment of funding for the first year, and based on satisfactory progress, provides increments for future years. Somewhat less funding is available to make new awards. Funds available are for FY21, about $25 million, for FY22 about $20 million, and for FY23 about $16.9 million. She noted that if there were a matching requirement for CAPs and SPs, it would become more difficult for NIFA to get CAP awards because applying institutions would have to come up with a substantial match.

Finally, she noted that NIFA was asking for the CDS to provide advice on the ECDRE FY21 research priorities that should receive the $25 million available. She also said NIFA needs help from CDS in identifying subcommittee members to serve as liaisons on the advisory boards for

each CAP and in recommending an ECDRE RR panel manager and reviewers. She noted that CRB's Melinda Klein had done an outstanding job as the panel manager for the RR panels in FY2020. Another manger is needed for FY21.

Dr. Chitnis thanked Drs. Fitzner and Lichens-Park for their presentation and the CDS members for their advice from December 2019 which led to awards directed at the priorities. He said NIFA had responded to CDS members' comments and hoped the members feel NIFA addressed their recommendations. A comment that NIFA heard was on the need to involve researchers who were not citrus researchers, and several PDs, such as evolutionary biologist Vivian Irish of Yale, gave keynote presentations at the he 6th International Research Conference on Huanglongbing (IRCHLB) held March 10-15, 2019, in Riverside, California. Now these researchers are excited about the HLB problem and were funded. He asked CDS members to consider whether priorities not funded in FY20 should be highlighted in FY21. The draft RFPA will be prepared and once CDS provides final recommendations NIFA will enter them into the draft.

Dr. Fitzner noted that the CDS had been concerned about the relevancy of funded projects. In response, NIFA got CDS members involved in both the relevancy and scientific panels, but more work on that issue may be needed and NIFA welcomed CDS input on whether the process needs to be modified. He also noted that all projects funded were in the top of the relevancy rankings, so there was a good match correlation between the relevancy and scientific reviews in FY20.

CDS Questions and Feedback

DFO Lewis invited CDS Chair Justin Brown to make any comments on behalf of the subcommittee. He asked for clarification about whether the RR panel manager changes every year. Dr. Lichens-Park noted that Melinda Klein had been panel manager twice, but NIFA tries to avoid using the same person for more than two years. Chair Brown asked if it would make sense to alternate the states from which managers were selected, noting that CDS member Harold Browning had done the job by himself in Florida. He wondered if it made sense to seek another manager from Florida. Dr. Lichens-Park responded that managers from different states would be welcome but that was not a mandatory requirement. Dr. Chitnis added that if no one else is found NIFA would be pleased to have Melinda Klein take on the role again, and if CDS recommended inviting her NIFA would do so. Dr. Fitzner emphasized the significant demands placed upon the panel manager; normally, NIFA likes to rotate the manager to obtain different voices and resources.

Dr. Brown asked Dr. Browning if he had any ideas for a Florida-based manager. Dr. Browning responded that the job requires soliciting volunteers to serve and persuading them to follow through once the process starts. It needs someone who knows the industry, and he said he would give it some thought and offer ideas at the next CDS meeting.

Dr. Chitnis asked for any additional CDS thoughts on the awards or process. One member said better preparation is needed for the CN projects because there are long-term benefits to coordination networks. The funding levels for NC projects is limited, but if the issue can be sorted out there could be citrus industry benefits for decades to come. Chair Brown asked if NIFA was seeking one person to serve as CDS membership liaison to the CAPs, and Dr.

Lichens-Park clarified that NIFA was asking for at least one liaison. Subcommittee members could reach out directly to PDs and volunteer for projects of most interest to them. Noting that several CDS members were absent, Chair Brown said outreach to all members would be important so everyone is aware of the request for liaisons. DFO Lewis reiterated her goal of ensuring that CDS members receive presentations from all funded projects.

A member noted that some scores in evaluating research proposals were very low, and asked if it made sense to eliminate the lowest one or two scores, as occurs in academia. Dr. Lichens-Park responded that on the scientific merit part of the reviews it is highly valuable when one reviewer sees problems other reviewers do not, sometimes identifying a "fatal flaw" in a proposal. So, for SRs, it would not make sense to discard the lowest score. But because the process is supposed to represent a consensus, a reviewer who identifies a "fatal flaw" must convince the other reviewers that the flaw is real. The member clarified that his suggested was specifically for the RR, not the SR.

Melinda Klein commented that in the process some reviewers were reliably low-scorers and others were reliably high-scorers, so for RRs reviewers considered removing both the lowest and highest scores to see how rankings were affected. It was noted that for SRs, the scores are not intended to be the final decision but to achieve consensus, and the same is true for RRs; for the CDS, if modifications are needed to the process, it would be important to keep the process consistent with other program procedures, The member said he would be reluctant to throw out scores because reviewers might ask why they would bother serving if their scores are discarded, a view another member agreed with.

Responding to a question, DFO Lewis explained her goals for scheduling two additional meetings to get project presentations for CDS members that they could use in providing FY21 feedback. Dr. Lichens-Park added that the project presentations are intended to give the CDS an opportunity to hear in more detail about the projects and to ask questions about them; they are also intended to familiarize the CDS with what EDCRE has already supported so that members are better positioned to offer advice on FY21 priorities. She reminded the CDS that NIFA was hoping for members' recommendations by Nov. 13 to enable the release of the pre-applications by Dec. 15. If that deadline cannot be met, the pre-applications and other steps will be delayed.

Chair Brown commented that he hopes to be prepared to offer recommendations by Nov. 13 after the project presentations but he did not feel prepared at present. The CDS will need to have a discussion, which at the CDS meeting in 2019 took a day and a half for presentations and follow-up CDS discussions. He sought CDS guidance to avoid short-changing the subcommittee's deliberations and members' thoughts on whether his concerns were overblown. Dr. Chitnis said the CDS should consider its 2019 recommendations with an eye to deciding if they want to add or remove anything, noting that the CDS will not be starting from scratch as it did in 2019 and thus could hold a more streamlined discussion. A member noted that in 2019 the CDS spent a lot of time but ended up with priorities similar to those of prior CDS subcommittees and there is a good chance the FY21 priorities will not be significantly different.

Dr. Fitzner apologized for the short timeline and reiterated that the goal is to get the ECRDE funds disbursed in a much timelier way to get the research started to help the citrus industry; this

year, the process will be very hurried, but a better timeline will be set in future years. NIFA must have CDS input before funds can be awarded; without that, "Plan B" would need to be invoked. A CDS member emphasized that after the presentations it will be imperative to schedule a meeting so the subcommittee members have an hour or two to deliberate on what priorities were set in prior years and to integrate the FY20 new priorities and assess continuing priorities. Dr. Chitnis said that if CDS members need information on projects funded in the past they should let NIFA know so it can be compiled and provided to the members. Dr. Erica Kistner-Thomas noted that all CDS members should have received an Excel spreadsheet summarizing all of the projects funded through competitive grants—though not Hatch Act funds—since the CDRE and ECDRE programs were enacted.

A member said it was unclear why three priorities received no awards, even though they seem to still be important for the broader HLB-management effort, and asked for clarification. Dr. Lichens-Park responded that for priority 7 (*A reliable technique for culturing CLas bacteria*), NIFA did not receive very many applications; she suggested that priority area might benefit if it was written more broadly in a way that would achieve the priority's end goal. The goal might take longer to achieve than the priority currently suggests. The CDS member noted that a steady stream of investments has been made in culturing since 2005 and many advanced teams state that they are nearing success; the member said Dr. Lichens-Park could perhaps help with the topic in a subsequent meeting. Dr. Lichens-Park responded that the review process is confidential and she cannot discuss the review of projects not funded. The CDS member suggested she could help broaden the priority statement with discussing details of non-funded projects.

On priority 8 (*Optimized detection and surveillance programs for ACP and/or HLB*), Dr. Lichens-Park said NIFA did not receive many applications, perhaps because other funding mechanisms are available for detection and surveillance research. And for priority 9 (*Greater understanding of the ecology and interactions of the citrus production system and the citrus greening disease complex [HLB and ACP]*), she said it is a basic science foundational area. A few applications were received but did not receive as high RR ratings as the projects NIFA supported.

A member noted that the $45 million EDCRE grants representing two years of funding might make for a more routine or "rubber stamp" FY21 response, a conclusion that would reinforce the need for a good evaluation of what EDCRE has done with two years' funding before launching another year of funding. CDS should be able to catch up next year.

Dr. Chitnis said CDS might have to consider what happens if Congress's appropriations language requires matching of funds by applicants. It deters applicants. A member asked if it was an issue determined by legislation. Dr. Chitnis said the Farm Bill reinstated a matching requirement in the SCRI, the basis for the funding authority. In the appropriations bill, the Secretary of the Department of Agriculture was authorized to waive the requirement for a year, which Secretary Sonny Perdue did, forcing FY20 awards to be gotten out by Sept. 30, 2021. If the same thing occurs again, NIFA will face another Sept. 30 deadline in 2021. After Oct. 1, matching might be required. Members commented that they did not want deadlines distorting their ability to make good decisions, with one member recollecting that CDS was pushed in

2015. Dr. Chitnis agreed with CDS giving its best advice as it is ready, and noted that NIFA's relationship with the CDS has greatly improved, a view a member concurred with.

DFO Lewis reiterated her responsibility to provide FY20 project information to CDS members within the coming two weeks, possibly using measures that would enable members to review materials on their own time followed by deliberation in a meeting. Chair Brown responded that her strategy was reasonable and said if CDS members had questions they should send them to NIFA right away, but on NIFA's part he suggested that the program should not wait for questions but send out information that is available and seems relevant since members might not know enough to ask the right questions.

Public Comment

DFO Lewis asked if there were any public comments; there were none. She noted that going forward, the standard operating procedures will allow for a more thoughtful and deliberative process. She adjourned the meeting.

MONDAY, NOVEMBER 2, 2020 (Meeting #2)

PART I: Welcome and Introductions

Introduction of Members and Other Attendees/Roll Call

DFO Kate Lewis opened the meeting and took roll call, affirming that there was a quorum of CDS members participating, then asked NIFA officials and guests to introduce themselves (see *List of Meeting Attendees*). CDS Chair Justin Brown welcomed and thanked participants.

PART II: NIFA ECDRE Standard Award Presentations

Opening Remarks

DFO Lewis described the procedure for each of the Grant Project Leaders representing the seven Standard Projects to report out on their research followed by a Q&A opportunity. The order of presentations was by the ECDRE FY2020 priorities reviewed in Meeting #1. The seven projects were:

Dr. Zhonglin Mou, University of Florida, presented on *A Novel Therapeutic Strategy for HLB-Infected Trees*, which addresses ECDRE Priority #1, explaining that all the work is based on the fact that the plant immune system is regulated by both positive and negative regulators; the approach is to modify the citrus immune system to create HLB resistance or tolerance by turning off the negative immune regulation, leading to HLB resistance or tolerance; he explained that the goal will be to identify the candidate gene editing targets. Over two years the project will meet six defined objectives: 1) Identify candidate targets based on information in well-studied plants; 2) Silence the candidate targets by CTV-RNAi in citrus; 3) Evaluate the protein levels of a citrus major defense regulator in the RNAi lines; 4) Define the efficacy of potential CTV-defensin-

RNAi vectors in commercial citrus; 5) Conduct field trials of promising CTV-defensin-RNAi vectors; 6) Engage stakeholders.

DFO Lewis asked if there were any questions and there were none.

Dr. Amit Levy, University of Florida, presented on the project *Unraveling Candidatus Liberibacter Asiaticus (*CLas*)-phloem interactions using isolated vasculature from seed coats*, which addresses ECDRE Priority #2, noting that it is hard to find the bacteria. HLB progression is tightly associated with phloem plugging in the stem, leading to the inhibition of sugar and nutrient transport into sink tissues, including the fruit. Eliminating these plugs will presumably result in renewed sugar transport and increased yields. However, there is a significant gap in our understanding of CLas-phloem interactions in citrus, which has been a major limiting factor for controlling the disease. He described the project's four objectives: 1) To understand phloem dynamics in CLas-infected fruit; 2) To identify novel CLas-phloem interactions in HLB progression; 3) To reduce phloem plugging to reestablish sugar transport; and 4) To engage stakeholders and disseminate the project's findings.

There were no clarifying questions.

Dr. Yen-Wen Kuo, University of California, Davis presented on *VIGS-Driven RNAI using insect specific viruses to manipulate psyllids and their endosymbionts as a strategy to control citrus greening/HLB*, which supports Priority #5. The project calls for investigating detailed interactions between CLas, geographically distinct *D. citri* (Asian citrus psyllid, or ACP) populations, and their viral and bacterial endosymbionts. The endosymbiont microbiome (viruses and bacteria) plays key roles in influencing insect biology, including vector competence. The project aims to engineer one or more psyllid-specific viruses previously identified by the project group to deliver novel RNAi effectors targeting *D. citri*, its endosymbionts, as well as HLB. She presented the two-year timeline to deliver a better understanding of the HLB, *D. citri*, and citrus pathosystem, specifically the interaction between CLas and its vector *D. citri*, and presented the project's objectives: 1) To engineer insect-specific viruses for use in *D. citri*; 2) To identify novel endosymbiont RNAi targets in geographically distinct *D. citri* populations; and 3) to use *D. citri* viruses to deliver specific small RNAs that interfere with *D. citri*, its endosymbiont microbiome, and/or CLas.

There were no clarifying questions.

Dr. Bryony Bonning, University of Florida, Gainesville, presented on *Optimal Bt toxins and gene silencing RNAs for management of Asian Citrus psyllid to mitigate the impact of citrus greening*, which supports Priority #5. The project goal, based on having identified Bt-derived pesticidal proteins active against ACP and promising candidate silencing RNAs, is to identify the very best combination of Bt pesticidal proteins and silencing RNAs that can be used in a final product for grower use. The final product will be transgenic ACP resistant citrus or "trap plants," which are highly attractive to ACP. They can be planted around citrus groves to attract and kill ACP before they reach the valuable citrus trees. The project objectives are: 1) To optimize ACP-active Bt pesticidal proteins that suppress psyllid populations; 2) to screen for the most effective ACP gene silencing RNAs; 3) to assess the impact of Bt pesticidal proteins and gene silencing in

combination, and 4) to identify the optimal promoter for delivery of Bt proteins, a critical component for transgenic plant delivery. She presented the timeline over two years and noted that there are two industry advisors to the project; although not required, she said such advisors are an excellent addition to the project.

There were no clarifying questions.

The final three projects support ECDRE Priority #6.

Dr. James Culver, University of Maryland, presented on *Phloem targeted multiplexed gene editing for enhanced control of Huanglongbing in citrus*. The project targets the development of multiplexed gene editing systems for enhanced control of HLB in citrus, combining expertise in gene editing technologies, plant tissue culture, and phloem-responsive gene identification to develop a gene editing pipeline with capabilities to modify the expression of multiply phloem and defense-associated genes. The project objectives over the two-year timeline are: 1) The development of multiplexed gene editing and gene activation methods in citrus, establishing a citrus protoplast editing system and determining its specificity and efficacy against multiple target genes within the citrus genome; 2) The identification and validation of phloem and defense promoter specific sequence motifs for use in transcriptome reprogramming; 3) The validation of gene editing systems for the targeted transcriptional reprogramming of host defense responses. He described the end result as a toolbox of promoter targets.

There were no clarifying questions.

Dr. Vivian Irish, Yale University, presented on *Identification of HLB susceptibility genes in a citrus population generated using multiplexed CRISPR/Cas9 gene editing*. The two-year project's purpose is to create a library of about 1,200 gene-edited Valencia plants available for testing by the citrus research community; many groups have identified putative susceptibility genes, but the challenge is to identify which might be important to create tolerance in the citrus. The first step is to identify 1,200 potential HLB susceptibility genes; they also could be used for studying other diseases. The collection of citrus mutants will contribute to the development of HLB resistance in citrus, the study of how specific citrus genetic pathways contribute to HLB susceptibility, and the identification of candidate genes in citrus that could be intervention targets. The project also will study the economic and societal impact of using technologies like CRISPR/Cas9 to create new citrus cultivars, with a focus on assessing the acceptance of gene-edited crops by consumers and growers. The project will post the plant phenotyping information at https://CrisprCitrus.org

Dr. Irish was asked if the project will develop its plant constructs through mature or immature tissues. She replied that the project would use young seedlings, introducing the constructs into hypocotyl tissues, then maturing the constructs using those tissues.

Dr. Anne Simon, University of Maryland, presented on *Phloem-restricted, independently mobile RNA gene silencing system for mitigating citrus greening by targeting Liberibacter Asiaticus and citrus gene expressions*. She began by noting a mistake in the placement of her project, which has nothing to do with RNA editing but has to do with delivery systems, and treating and

possibly saving infected trees. RNA silencing is being used to affect plant and insect gene expression, but it can also be used for much more; it is a process by which small RNAs can target and eliminate viruses, fungi, and bacteria; the technique saved the Hawaiian papaya industry from a devastating virus. An appropriate delivery system for small RNAs has not been available to target HLB, but the project has discovered a natural RNA delivery system found in lemons and limes. She described the project's five objectives: 1) To generate a small RNA delivery vehicle for multiple insertion sites; 2) To identify small RNAs that specifically targets the bacteria that causes HLB; 3) To perfect small RNAs that are targeting *Citrus tristeza virus*, or CTV, allowing a return to sour orange rootstock; 4) To develop small RNAs to target all known isolates of CTV and prevent specific CTV infections; and 5) To reduce the flow of callose to the phloem and return the RNA from the laboratory host back into citrus and confirm that there is little or no effect on citrus health and fruit. It is doable within two years.

CDS Questions and Feedback

DFO Lewis opened the floor for questions.

One member noted that most of the projects use genetic alterations and asked if the term "organic" was applicable to any of the studies. Dr. Simon, noting that she likes genetically modified organisms, or GMOs, said her project is thinking about "organic" and has contacted a knowledgeable expert who said modifying virus vectors would not be GMO but probably would not be considered organic. However, the project will look into whether its wild-type, natural iRNA, is effective against the bacteria, and that would be an organic approach. Dr. Kuo added that her project's approach to manipulating the ACP will be environmentally sound because the viruses being worked on exist in populations already; slightly modifying the viruses should be safe because the viruses will not affect other insects.

Dr. Lichens-Park asked all the awardees whether they could achieve their objectives within the constraints placed on SPs, such as the $1.5 million, two-year limits, and how a matching requirement would have affected the ability of projects to submit applications. Dr. Bonning responded that a matching requirement would be a major hinderance that would reduce the submissions, and the two-year timeframe is very restrictive; it could be helpful to retain the maximum award amount but allow flexibility in the project duration. Some things take a long time, such as making transgenic plants. Dr. Culver agreed with both points and Dr. Simon commented that her project was more fortunate because it is not creating transgenic plants, and eight months ago had a vector able to control gene expression in plants or control a pathogen. Based on the fact that people are seriously working seven days a week because they understand the citrus industry's time constraints, the project expects a deliverable by the end of a year, but the question will be how much can be tested in greenhouses on young trees. Dr. Irish also agreed with others' statements but added that one of the most restrictive aspects will be the ability to test the materials projects are developing on HLB-infected plants; it will be very difficult given the paucity of resources to do testing. Dr. Simon added that her project had formed a company to accelerate getting through USDA, Environmental Protection Agency, and Food and Drug Administration regulatory processes.

DFO Lewis asked NIFA to clarify the purpose of the CDS hearing from ECDRE awardees for FY20. Dr. Lichens-Park responded that NIFA wanted awardees to present to the CDS so members can better understand what NIFA supported in FY20, ask questions, and provide feedback to NIFA for FY21. CDS would have a better idea of what NIFA has already supported. Dr. Fitzner added that NIFA's mission is "mission-linked research," and the NIFA-supported research must be linked to the needs of the growers represented on the subcommittee. Providing growers with a direct connection to the research community is an important step.

DFO Lewis said she would seek guidance from NIFA on how the CDS can best provide feedback, such as a specific format, as NIFA forms its FY21 strategy and she will share that guidance with CDS Chair Brown. She said a similar meeting would follow on the five CAPs that received ECDRE funding. Lastly, she noted that the Zoom meeting had been recorded and said if any CDS members had an issue with that recording they should contact her. While most meetings will not be recorded, for information-sharing meetings that all CDS members cannot attend the recordings might be shared with absent members going forward.

Public Comment

DFO Lewis asked if there were any public comments. There were none so she adjourned the meeting.

FRIDAY, NOVEMBER 13, 2020 (Meeting #3)

PART I: Welcome and Introductions

DFO Kate Lewis opened the meeting, thanking CDS members and other participants, introduced herself as the new NAREEE Executive Director, and quickly reviewed the Meeting #2 structure that would be duplicated for Meeting #3. Ms. Shirley Morgan-Jordan introduced herself, followed by CDS members, NIFA, and other guests (see *List of Meeting Attendees*).

PART II: NIFA ECDRE Standard Award Presentations

Opening Remarks

CDS Chair Justin Brown welcomed everyone and expressed deep appreciation for CDS members participating, and for the presenters joining the meeting to update CDS. The five CAP awardees made presentations and responded to questions from CDS members.

Dr. Robert Shatters, USDA Agricultural Research Service, Horticultural Research Laboratory, presented on *Therapeutic molecule evaluation and field delivery pipeline for solutions to HLB*, addressing ECDRE FY20 Priorities 1 and 3. He noted that the project has an 11-member advisory board and total of 79 people involved with various expertise. The project is already delivering results. It employs six objectives to deliver near-term biological HLB solutions, a with a long-term goal of delivering economically feasible HLB solutions (defined as therapeutic molecule plus an effective delivery strategy), a means to vet new therapeutics, support for student and consumer education, and industry acceptance of the new technologies. He reviewed

the project's objectives and sub-objectives, including: 1) Molecule discovery and production; 2) A bench-to-field assay pipeline; 3) Therapeutic molecule delivery, with a goal of delivering greater than 90 percent of the therapeutic molecule into the citrus tree, multiple times a year, and without significant damage to the tree or excessive time spent on per tree applications; 4) Data collection to support regulatory approval, working with industry; 5) An economic assessment to evaluate the cost and commercial viability on lead therapeutic candidates in field trials know if it is cost-effective before going too far down the road.

A member asked Dr. Shatters to characterize the different delivery systems his project anticipates, describing whether they are *in vitro* or a topical application. Dr. Shatters said the issue is exploring topical applications to obtain plant infusion that will be cheaper for growers. The project also has a novel molecular approach that gets plants to produce what is necessary and another is a directly transgenic plant. The targets are psyllids, and some molecules target microbes, so both can be targeted.

Dr. Denise Manker, with the Citrus Research & Development Foundation (CRDF), Florida, presented on a *Collaborative approach between academics, growers and agrochemical industry to discover, develop and commercialize therapies for citrus Huanglongbing (HLB)*. She said the project is focused on attacking the disease directly, optimizing synthetic plant defense inducers through foliar application, and she emphasized her interest in seeing all of the CAP projects combining forces to address the HLB issues. The project's goal is to develop therapeutic leads identified in a previous three-year screening campaign into viable commercial product candidates that demonstrate efficacy in citrus fields against HLB for delaying or halting disease development to maintain productivity. The projects objectives, each with associated tasks, are: 1) Optimizing a lead class of synthetic plant defense inducers; 2) Developing promising microbial strains into viable product candidates; 3) Determining the relevance of hairy root plant tissue culture in predicting activity on HLB CLas-citrus hairy root cultures, which will be treated with therapies identified in Objectives 1 and 2, at multiple dosages; 4) Using greenhouse citrus assays to determine best conditions for field testing leads; 5) Field testing of leads to determine efficacy against HLB development; 6) Investigating metabolomics as an early detection method for HLB in field conditions; 7) Defining a registration pathway for moving leads towards commercialization; and 8) Developing an effective extension and outreach program. She reiterated that it will take a consolidated approach to deal with the disease.

A member asked Dr. Manker what the project's potential future funding needs would be as positive developments occur. She responded that the hope is that there will be enough value for Bayer Crop Science to take it on for commercialization, developing a biopesticide directly for the citrus market, but developing a synthetic chemical has high costs, so field trials are under way to see if the chemical could apply to other plants. The project does not want to fight for funds with soy or other major crops. If the chemical only applies to citrus, the project would turn it over to CRDF to find a commercial partner. The project will not seek funds beyond this three-year award. Dr. Rick Dantzler, who was with Dr. Manker, added that the project has made a made high-throughput system available to any other researchers worldwide if they want to test compounds.

Dr. Caroline Roper, UC Riverside, presented on *Combining cultural and genetic approaches for grove success to unravel and enhance resistance/tolerance to Huanglongbing*. She said that previous work demonstrates that as HLB severity increases, the root microbiome becomes enriched in soil-borne pathogens. The project will conduct experiments to empirically determine if these pathogens exacerbate the HLB-associated root and canopy decline, building on background data gathered over several years. The project's objectives call for: 1) Sampling mature trees in Florida commercial groves that fall into three different HLB severity levels for metagenomic microbiome analysis; 2) A field trial to be conducted in a recently replanted commercial citrus grove in Southwest Florida; 3) Testing the soil cultural practices evaluated on young orchards in Objective 2 on established mature orchards; 4) Identifying socioeconomic factors and risk perceptions that affect grower decisions to adopt new cultural practices that reduce the threat of HLB, with a survey of growers and pest control advisors and an analysis of the profitability of adopting root/tree health cultural practices. The project will draft manuscripts for peer-reviewed journals to share with the scientific community and extension resources, such as guidelines for growers, to share results with targeted end-users.

A member asked Dr. Roper if the project would evaluate different seed mixes, and different compost sources, and correlate that information with different regions' likely compost. She responded affirmatively, noting that the project has two different seed mixes being tested in Florida, one legume-based and another with a different mixture. The project is sourcing different compost mixtures because California and Florida have different mixtures, and is accounting for the fact that regions use different irrigation systems, such as drip irrigation, berms, and other types. Another member asked about the glyphosate part of the research and soil health. She said glyphosate has been associated with exacerbating fruit drop in HLB-infected trees, so some research is being done on that, and glyphosate might be needed for weed control. The project will quantify how glyphosate half-life in soil is affected by different cultural treatments as well as glyphosate impacts on fruit drop.

Dr. Chandrika Ramadugu, UC Riverside, presented on *Novel, non-transgenic, hybrid citrus varieties with resistance to Huanglongbing: evaluation and cultivar development*. The project is using the genetic resources of wild relatives to introduce resistance traits into cultivated citrus, building on studies that show Australian limes have HLB resistance traits that are superior to citrus. Building on this insight, hybrids that possess both good fruit quality and strong HLB resistance have been created as building blocks of new HLB solutions the project is exploiting to develop commercially acceptable, non-transgenic, HLB-resistant cultivars. The eight objectives are: 1): Establish multi-state field trials for four F1 hybrids (mandarin X Australian lime) already selected for HLB resistance and fruit quality; 2) Induce precocious fruiting in advanced hybrids; 3) Evaluate advanced hybrids for HLB resistance in controlled greenhouse conditions in California, Florida, and Texas; 4) Develop rapid methods for detection of multiple pathogens to facilitate rapid release of quarantined plants by budwood certification programs in those three states; 5) Transfer the budwood of selected hybrids to collaborating nurseries in all three states for propagation; 6) Work with regulatory agencies to obtain permits for the interstate movement of hybrids and for the release of five selected hybrids; 7) Propagate and release selected varieties for further field trials and plan for future commercialization; and 8) Pursue extension to familiarize the industry with novel hybrids, conduct taste panels, and obtain feedback.

A member asked Dr. Ramadugu if she expected to be able to test the fruit within the next year. She responded that several have been identified for fruit evaluation; it is unclear if they will fruit within three years and she might seek a one-year extension. The project will generate several different citrus varieties, some for juice, some for the fresh market. Another member asked if she could identify the genetics providing resistance, and she responded that the project can identify fragments of the chromosome but not the exact gene that is needed.

Dr. Goutam Gupta, of the New Mexico Consortium (NMC), presented on *Providing practical solutions for HLB treatment and prevention*. The project seeks to offer effective, safe, affordable HLB therapy by enhancing citrus' innate immunity for rapid CLas clearance using exogenous application studies on both greenhouse and field trees over three years on two citrus derived helix-turn-helix (HTH) peptides. The project will conduct metagenome analysis on the field and greenhouse samples to determine the effect of the HTH peptides. The project has initiated a pipeline for developing products for HLB treatment, HLB prevention, and ACP control and proposes to expand it, registering a product in three years and registering a transgenic product in seven years with the ultimate goal of examining whether HLB resistance is transferred to the untransformed scion grafted on the rootstock. Initial studies indicate that the chimeras expressed by the transgenic citrus can lower the CLas level in ACP. The project objectives are: 1) HLB treatment; 2) HLB prevention; 3) Blocking of ACP transmission; 4) Examining the effect of therapeutics on citrus innate immunity during infection; 5) Examining the effect of therapeutics on citrus and soil microbiome; 6) Collecting data for regulatory processes; 7) Creating an open access "Knowledge Base" describing the project concept and its application in therapy of HLB and other plant diseases; 8) Conducting education and outreach, holding onsite and online meetings and workshops to communicate to the growers and stakeholders the scope, deliverables, and impact of the project.

A member asked what makes the project novel and how it will surmount the regulatory process. Dr. Gupta responded that the peptide clearing the bacterium and augmenting the host immunity without bacterial resistance are the novel parts; also, the project has already drafted the first application for the regulatory process. Dr. Gupta asked if CDS members were aware of others using the same approach. A CDS member responded that two other projects use peptides but the NMC spectrum of peptides is novel.

Dr. Manker stated that her project was required to have a CDS member and asked who that was because the advisory group's first meeting is imminent. Dr. Lichens-Park responded that NIFA hoped based on the meeting presentations that the CDS members would identify projects interesting enough for them to serve on project advisory boards; NIFA hopes the members will contact projects, and if not, NIFA will find someone willing to serve on projects. CDS Chair Brown offered to serve and urged other CDS members to volunteer. Members leaving CDS can serve on project boards. Responding to Dr. Heck, CDS member Gregory Galloway volunteered to serve on her project and said he also wished to serve on Dr. Ramadugu's project. Dr. Gupta asked for contact information so volunteers could be added to the NMC advisory board and offered to share information about other members whom he would invite to the annual meeting; it was agreed he should receive the contact information from DFO Lewis.

CDS Questions and Feedback

DFO Lewis asked if there were any final questions before adjourning the meeting. CDS Chair Brown raised the matter of scheduling an additional meeting to give the subcommittee members time to discuss what they had heard from the 12 projects and the feedback they would be providing to NIFA. DFO Lewis asked NIFA for input on the ideal timeframe for receiving the CDS feedback. Dr. Fitzner responded that NIFA recognized that the CDS was being asked to respond on an accelerated timeframe and would accept the members' input whenever feasible, to which Dr. Lichens-Park added that NIFA's aim was to publish its next RFA by December 15, so meeting that deadline would be excellent. DFO Lewis agreed to explore if feedback could be developed offline or in an additional meeting. Chair Brown expressed his interest in having a meeting for members to engage in dialogue and to receive NIFA input on what it is looking for from CDS, even if that meant an accelerated schedule of meeting during the week of Nov. 16-20. He welcomed CDS members to comment on his preference. Dr. Browning suggested that CDS should plan to meet during the week suggested for two hours or so to review the presentations and look at the broader list of projects that Ms. Morgan-Jordan shared with CDS. He suggested a Doodle Poll for the week of November 16-20, Chair Brown agreed, and asked if there was any disagreement; there was none.

Dr. Gupta said his project hoped to share progress every quarter and asked if it was possible to add project results to the NIFA website. Dr. Lichens-Park responded that there is only a mechanism for an annual update on NIFA's website. Dr. Manker asked if there was any mechanism for researchers to get together because there is a lot of synergy among projects. Dr. Lichens-Park said that NIFA requested proposals for Coordination Network awards but received few. Dr. Fitzner added that NIFA traditionally holds a Project Director meeting to discuss their work and possible synergies; he said NIFA will try to restart such meetings. But in any case, NIFA is interested in the projects and will reach out before the annual progress reports are due. NIFA's ECDRE funds are significant and NIFA wants maximum impact; if growers are happy, NIFA is happy with the results.

A CDS member sked when members' terms are up. DFO Lewis responded that all terms have been extended through the end of December. Dr. Heck asked if project participants can interact with the CDS and DFO Lewis said yes, it is in the CDS's interest to stay engaged in formal and informal ways, with quarterly or semi-annual updates, as CDS requested in its previous meeting when members said they wanted to be more engaged. DFO Lewis said she would follow up with Chair Brown about a further meeting.

Public Comments

DFO Lewis asked for any public comments and there were none.

She adjourned the meeting at 1:46 pm, slightly beyond the official agenda time.

ACTION ITEMS

- CDS members will provide NIFA with input on ECDRE priorities for FY21, including considering whether priorities not funded in FY20 should be highlighted in FY21.
- CDS members were asked to help NIFA identify subcommittee members to serve as liaisons on the advisory boards for each CAP.
- CDS members were asked to recommend an ECDRE Relevancy Review panel manager and reviewers for FY21.
- CDS members were asked to inform NIFA if any further modifications are needed to the ECDRE Relevancy and Scientific review processes to ensure stakeholder needs are being met.
- Dr. Harold Browning will consider potential recommendations for a Relevancy Review panel manager and present his suggestions at the next CDS meeting.
- All CDS members will be made aware of NIFA's request for subcommittee liaisons to the CAPs.
- Dr. Lichens-Park was asked in a subsequent meeting to help CDS with revising how EDCRE's FY20 priority 7 is worded.
- If CDS members have information requests they should ask NIFA right away, and if NIFA has relevant information the program should send it to members without waiting for questions.
- NIFA will provide DFO Lewis any guidance on the preferred format, if any, for CDS members to provide feedback on projects and priorities.
- CDS members should contact CAP project leaders to volunteer as advisory board members for projects of specific interest.
- Dr. Gupta with the NMC will receive contact information from DFO Lewis so CDS volunteers can be added to the NMC advisory board and will share information about other members whom he would invite to the annual meeting.
- CDS members requested a Doodle Poll to schedule a follow-up meeting for the week of Nov. 16-20 so members can discuss the project presentations and feedback to NIFA.
- DFO Lewis will contact CDS Chair Brown about a follow up meeting.

APPENDIX A: LIST OF MEETING ATTENDEES

MEETING #1, October 30, 2020

CDS Members Present: Justin D. Brown, Harold Browning, Gregory Galloway, John C. Gless, Justin Golding, Julia Inestroza, Matt McLean, William "Gee" Roe III, Mani Skaria (Richard De Los Santos, liaison)
CDS Members Absent: David F. Howard, James Snively
NAREEE Advisory Board Staff: Kate Lewis, Shirley Morgan-Jordan
NIFA Staff: Logan Appenfeller, Dr. Parag Chitnis, Dr. Michael Fitzner, Erica Kistner-Thomas, Ann Lichens-Park
Other USDA Staff: Tim Widmer
Other Guests: Rick Dantzler, Melinda Klein, Mike Sparks, Jim Syvertsen

MEETING #2, November 2, 2020
CDS Members Present: Justin D. Brown, Harold Browning, Gregory Galloway, Justin Golding, Julia Inestroza, Matt McLean, James Snively
CDS Members Absent: John C. Gless, David F. Howard, William "Gee" Roe III, Mani Skaria,
NAREEE Advisory Board Staff: Kate Lewis, Shirley Morgan-Jordan
NIFA Staff: Logan Appenfeller, Dr. Michael Fitzner, Erica Kistner-Thomas, Ann Lichens-Park
Other USDA Staff: Tim Widmer
Other Guests: Rick Dantzler, Marcy Martin, Mike Sparks
Presenters: Bryony Bonning, James Culver, Vivian Irish, Yen-Wen Kuo, Amit Levy, Zhonglin Mou, Anne Simon

MEETING #3, November 13, 2020
CDS Members Present: Justin D. Brown, Harold Browning, Gregory Galloway, John C. Gless, Justin Golding, David F. Howard, Julia Inestroza, Matt McLean, William "Gee" Roe III (Richard DeLos Santos, liaison)
CDS Members Absent: Mani Skaria, James Snively
NAREEE Advisory Board Staff: Kate Lewis, Shirley Morgan-Jordan
NIFA Staff: Logan Appenfeller, Dr. Michael Fitzner, Erica Kistner-Thomas, Ann Lichens-Park,
Other USDA Staff: Tim Rinehart, Tim Widmer
Other Guests: Rick Dantzler (with Denise Manker), Michelle Heck (with Robert Shatters),
Presenters: Goutam Gupta, Denise Manker, Chandrika Ramadugu, Caroline Roper, Robert Shatters