

**STATE MARKETING BOARDS  
GRANT AGREEMENT  
SIGNATURE PAGE**

AGREEMENT NUMBER

LAV-23

1. This Agreement is entered into between the Grantor and the Recipient named below:

GRANTOR

CALIFORNIA CITRUS NURSERY RESEARCH AND EDUCATION BOARD

RECIPIENT'S NAME

**The Regents of the University of California on Behalf of** UC Riverside **(campus name or ANR)**

2. The term of this Agreement is: One Year

The project term as identified in Attachment 1, Scope of Work and Budget is: 1/1/23 to 12/31/23

To extend the project term, the Recipient **must** obtain written approval from the GRANTOR in accordance with the terms of this Agreement.

3. The maximum amount of this Agreement is \$ 19,307

4. The parties agree to comply with the terms and conditions of the following exhibits which are by this reference made a part of the Agreement:

Exhibit A - Contacts/Notifications 1 Page

Exhibit B - Budget & Payment Provisions 2 Pages

Exhibit C – General Terms and Conditions 6 Pages

Attachment 1 – Scope of Work and Budget


Name of Project: Application of Transmissible Small Nuclear RNAs (TsnRNAs) for Nursery Production of Dwarfed Citrus Trees

**IN WITNESS WHEREOF, this Agreement has been executed by the parties hereto.**

**RECIPIENT**

RECIPIENT'S NAME (Organization's Name) **The Regents of the University of California**

BY (Authorized Signature)

  
Karen Garcia (May 11, 2023 16:34 PDT)

DATE SIGNED (Do not type)


PRINTED NAME AND TITLE OF PERSON SIGNING Karen Garcia, Senior Contract and Grant Officer

ADDRESS Sponsored Research Administration, 245 University Office Building, Riverside CA 92521-0217

**STATE OF CALIFORNIA**

STATE ENTITY'S NAME **California Citrus Nursery Research and Education Board**  
**(GRANTOR)**

BY (Authorized Signature)

  
Don Dillon (May 11, 2023 15:47 PDT)

DATE SIGNED (Do not type)

PRINTED NAME AND TITLE OF PERSON SIGNING  
Don Dillon, Board Chairman

ADDRESS

531-D North Alta Avenue, Dinuba CA 93618

**EXHIBIT A****RECIPIENT AND PROJECT INFORMATION**

1. The Grant Manager/Principal Investigator for this Agreement are:

<b>FOR GRANTOR:</b>	<b>FOR RECIPIENT:</b>
Name: John Gilstrap , Manager	Name: Irene Lavagi-Craddock
Section/Unit: Grants Management Office	Department/Program: Microbiology & Plant Path
Address: 531-D North Alta Avenue	Address: University of California
City/Zip: Dinuba CA 93618	City/Zip: Riverside CA 92521
Phone: 559-591-9005	Phone: 951-827-4932
Email Address: john@tabcomp.com	Email Address: irenela@ucr.edu

The ***Grant Specialist/Administrative Contact*** for this Agreement are:

<b>FOR GRANTOR:</b>	<b>FOR RECIPIENT:</b>
Name: Kim Sakamoto , Grant Administrator	Name: Karen Garcia, Senior Contract and Grant Officer
Board Name: California Citrus Nursery Research Board	Office: 245 University Office Building
Address: 531-D North Alta Avenue	Address: 245 University Office Building
City/Zip: Dinuba CA 93618	City/Zip: Riverside CA 92521-0217
Phone: 559-591-9005	Phone: 951-827-3692
Fax: 559-591-5744	
Email Address: kim@tabcomp.com	Email Address: karen.garcia@ucr.edu

**FISCAL CONTACT (If different from above):**

Name:	Bobbie McCracken, Manager
Office	Extramural Funding
Address:	900 University Blvd
City/Zip:	Riverside CA 92521-9800
Phone:	951-827-3303
Email Address:	EMF@ucr.edu

2. For a detailed Scope of Work and Budget, see Attachment 1.

## EXHIBIT B

### PAYMENT PROVISIONS AND BUDGET

#### 1. Invoicing and Payment

- A. The Recipient may not invoice for work performed prior to the commencement date or completed after the Project term date of this Agreement, unless prior approval from GRANTOR (Grant Manager) is obtained, and the Project term date is amended.
- B. For activities satisfactorily rendered and performed according to the attached Scope of Work and Budget (Attachment 1), and upon receipt and approval of the invoices, the GRANTOR agrees to reimburse the Recipient for actual allowable expenditures incurred in accordance with this Agreement and stated herein, which is attached hereto and made a part of this Agreement. Approval of invoices shall not be withheld based on scientific differences between Recipient and GRANTOR in the interpretation of the research data and final conclusions.
- C. Invoices shall be submitted to the Grant Manager within sixty (60) days after the end of each quarter or month in which work under this Agreement was performed. Should GRANTOR require additional documentation supporting an item of expense on RECIPIENT's invoice, Recipient shall provide the documentation within 15 days of receipt of GRANTOR's request.
- D. A final invoice shall be submitted for payment no more than 60 calendar days following the expiration date of this Agreement, or 60 calendar days after the project is complete, whichever comes first. Recipient's invoice should be clearly marked "Final Invoice," indicating that all payment obligations of the GRANTOR under this Agreement have ceased and no further payments are due or outstanding.
- E. At least ten percent of the total amount awarded in this Agreement will be withheld until receipt, review and acceptance of the Final Performance Report for one-year projects, and the Annual Progress Report for multi-year projects.

#### 2. Suspension of Payments

This Agreement may be subject to suspension of payments or termination, or both, and Recipient may be subject to debarment if the GRANTOR determines that:

- A. Recipient or Subgrantees, as defined in Exhibit C, Article 11(F), have made a false certification, or
- B. Recipient or Subgrantees violates the certification by failing to carry out the requirements noted in this Agreement.

#### 3. Budget Contingency Clause

If funding for any fiscal year is reduced or deleted for purposes of this program, the GRANTOR will have the option to either terminate this Agreement in accordance with the Right to Terminate (Paragraph 16) or offer to amend the Agreement to reflect the reduced amount.

#### 4. Prompt Payment Clause

Payment will be made in accordance with, and within the time specified in, California Government Code Title 1, Division 3.6, Part 3, Chapter 4.5, commencing with Section 927 – The California Prompt Payment Act.

#### 5. Allowable Expenses/Fiscal Documentation

- A. The GRANTOR will reimburse Recipient only for allowable expenses in accordance with the Scope of Work and Budget and applicable State and Federal laws.
- B. GRANTOR shall have no obligation to reimburse Recipient under this Agreement until Recipient has satisfied the following condition (if applicable):
  - 1. For the term of this Agreement, Recipient shall submit timely Progress Reports as specified in Attachment 1 – Scope of Work and Budget. If Progress Reports are not received per Attachment 1, the GRANTOR may invoke the Disputes Clause, Exhibit C, Paragraph 7. When Progress Report is received, payment will not be withheld. If Disputes Clause is not invoked by GRANTOR, timely payment will be made to Recipient.

- C. The Recipient must maintain adequate documentation for expenditures of this Agreement to permit the determination of the allowability of costs under this Agreement. If the GRANTOR cannot determine expenditures are allowable under the terms of this Agreement because records are nonexistent or inadequate, the GRANTOR may disallow the expenditures. These records shall be kept for three (3) years after project completion, or final invoice, or resolution of a dispute or litigation, whichever comes last.

**6. Budget**

For a detailed Budget for all work to be performed under the Scope of Work, see Budget (Attachment 1).

**7. Budget Flexibility**

Budget revisions between identified budget categories in cost reimbursement agreements that are within the total contract amount are allowed as described below:

Up to 10% of each annual budget amount or \$10,000, whichever is less, is allowed with approval of the Grant Manager.

Exceeding 10% or \$10,000, whichever is less, of the last approved budget will require: the Grant Manager's prior approval; and a formal amendment to this Agreement. The Recipient shall submit a revised budget to the GRANTOR for approval.

Budget transfers that would cause any portion of the funds to be used for purposes other than those consistent with the original intent of this Agreement are not allowed. Notwithstanding the above provision, the GRANTOR may proceed with a formal amendment to this Agreement for budget revisions.

## EXHIBIT C

### GENERAL TERMS AND CONDITIONS

#### 1. Approval

This Agreement has no force or effect until signed by both parties.

#### 2. Governing Law

This Agreement is governed by and will be interpreted in accordance with all applicable California laws.

#### 3. Recipient Commitments

Recipient accepts and agrees to comply with all terms, provisions, conditions and commitments of the Agreement, including all incorporated documents, and to fulfill all assurances, declarations, representations, and statements made by the Recipient in the application, documents, and amendments that were provided and authorized by the Administrative Contact in support of its request for funding.

#### 4. Performances and Assurances

Recipient agrees to faithfully and expeditiously perform or cause to be performed all project work as described in Attachment 1 – Scope of Work and Budget, and to apply grant funds received only to allowable project costs.

#### 5. Assignment

This Agreement is not assignable by the Recipient, either in whole or in part, without the written consent of the GRANTOR.

#### 6. Liability/Indemnification

A. The Recipient agrees to indemnify, defend and save harmless the GRANTOR, its officers, agents and employees from any and all liability, loss, expense, attorneys' fees or claims for injury or damages in the performance of this Agreement, but only in proportion to and to the extent such liability, loss, expense, attorneys' fees, or claims for injury or damages are caused by or result from the negligent or intentional acts or omissions of the Recipient, its officers, agents, or employees.

The GRANTOR agrees to indemnify, defend and save harmless the Recipient, its officers, agents and employees from any and all liability, loss, expense, attorneys' fees or claims for injury or damages in the performance of this Agreement, but only in proportion to and to the extent such liability, loss, expense, attorneys' fees, or claims for injury or damages are caused by or result from the negligent or intentional acts or omissions of the GRANTOR, its officers, agents, or employees,

#### 7. Disputes/Default

##### A. Dispute

The Recipient shall continue with the responsibilities under this Agreement during any dispute, except in the event of a substantial breach. In the event of a dispute, a "Notice of Dispute" is filed with the [GRANTOR/Recipient] within 30 calendar days of discovery of the problem. The Notice of Dispute must contain the Agreement number. Within 30 calendar days of receipt of the Notice of Dispute, GRANTOR and Recipient will meet for the purpose of resolving the dispute. In the event of a dispute, the language contained within this Agreement prevails.

##### B. Default Provisions

Subject to Article 10. Force Majeure, Recipient will be in default under this Agreement if any of the following occur:

1. Substantial breaches of this Agreement or any supplement or amendment to it.
2. Knowingly making any false representation, or statement with respect to this Agreement or the application filed to obtain this Agreement.
3. Failure to operate or maintain project in accordance with this Agreement.
4. Failure to make any remittance required by this Agreement.

Should an event of default occur, GRANTOR shall provide in writing a Notice of Default to the Recipient within 30 calendar days. Recipient shall have at least 30 calendar days to cure the default from the date the written notice is sent to the Recipient. If the Recipient fails to cure the default within the time prescribed by this Agreement, GRANTOR may terminate the Agreement according to the Right to Terminate (Paragraph 16).

#### C. Failure to Mutually Resolve Dispute

If both Parties cannot agree upon a resolution after following the processes described in this Agreement for Disputes or Default, both Parties retain the right to bring a lawsuit or seek any other legal or equitable remedy either Party may have.

### 8. Accounting and Deposit of Grant Funding

- A. **Separate Accounting of Funding Disbursements:** Recipient shall account for the money disbursed pursuant to this Agreement separately from all other Recipient funds. Recipient shall maintain audit and accounting procedures that are in accordance with generally accepted accounting principles and practices, consistently applied. Recipient shall keep complete and accurate records of all receipts and disbursements. Recipient shall require its Subgrantees to maintain books, records, and other documents pertinent to their work in accordance with generally accepted accounting principles and practices. Records are subject to inspection by GRANTOR during regular business hours.
- B. **Fiscal Management Systems and Accounting Standards:** The Recipient agrees that, at a minimum, its fiscal control and accounting procedures will be sufficient to permit tracing of grant funds to a level of expenditure adequate to establish that such funds have not been used in violation of State or Federal law or this Agreement.
- C. **Disposition of Money Disbursed:** All money disbursed pursuant to this Agreement shall be deposited, administered, and accounted for pursuant to the provisions of applicable law.

### 9. Equipment

Any equipment purchases must be included in the Scope of Work and Budget, and must contain:

- A description of the equipment
- How the equipment will be used
- A justification in support of the equipment's necessity
- The disposition of the equipment at the end of the project

Equipment is defined as:

- Non-expendable (having a normal life expectancy of one year or more);
- Tangible (can be appraised for value);
- Free standing (complete in itself, does not lose its identity when affixed to or installed in other property); and
- Having an acquisition cost of \$5000 or more.

### 10. Force Majeure

Neither party shall be liable to perform as required by this agreement to the extent such failure to perform is caused by any of the following: labor disturbances or disputes of any kind, accidents, failures of any required governmental approval, civil disorders, acts of aggression, acts of God, energy or other conservation measures, failure of utilities, mechanical breakdowns, material shortages, disease, or similar occurrences.

### 11. Subgrantees

- A. Recipient agrees to comply with all applicable Federal, State, and local laws and regulations during the term of this Grant Agreement. All Subgrantees must have the proper licenses/certificates required in their respective disciplines.
- B. Recipient must follow its documented procurement procedures when contracting with a Subgrantee. The procedures must reflect applicable Federal, State, and local laws and regulations.

- C. Recipient shall comply with all applicable laws and regulations regarding securing competitive bids and undertaking competitive negotiations in Recipient's contracts with other entities for acquisition of goods and services, with grant funds under this Agreement.
- D. A subgrant under this Agreement must be a written agreement between the Recipient and the Subgrantee, and must state the activities to be performed, the time schedule, the policies and requirements that apply to the Subgrantee, the amount of the subgrant, and a justification determining allowable costs.
- E. The subgrant must not affect the Recipient's overall responsibility for the management of the project, and the Recipient must reserve sufficient rights and control to enable it to fulfill its responsibilities under this Agreement.
- F. If the Recipient provides funds to any third party ("Subgrantee"), excluding any agency or department of the United States, to accomplish any of the work of this Agreement, the Recipient shall first enter into a written agreement with each Subgrantee by which the Subgrantee agrees to indemnify and hold harmless the GRANTOR and the State of California, and its officers, agents, and employees from any and all liabilities, losses, claims, demands, damages, or costs, including without limitation litigation costs and attorney's fees, resulting from or arising out of the Subgrantee's performance under its agreement with the Recipient, but only in proportion to and to the extent such liability, loss, expense, attorneys' fees, or claims for injury or damages are caused by or result from the negligent or intentional acts or omissions of the Subgrantee, its respective officers, agents or employees. The foregoing does not limit any breach of contract action that the GRANTOR may have against the Recipient. Nothing contained in this Agreement or otherwise creates any contractual relation between the GRANTOR and any Subgrantee, and no contract relieves the Recipient of its responsibilities and obligations hereunder. The Recipient's obligation to pay its Subgrantee is an independent obligation from the GRANTOR's obligation to make payments to the Recipient. As a result, the GRANTOR has no obligation to pay or to enforce the payment of any moneys to any Subgrantee.
- G. Recipient will perform their standard due diligence review of all Subgrantees before executing subgrants.

## **12. Audits**

GRANTOR reserves the right to conduct an audit at any time between the execution of this Agreement and the completion of the project, with the costs of such audit borne by GRANTOR. After completion of the project, GRANTOR may require Recipient to conduct a final audit to GRANTOR's specifications, at GRANTOR's expense, such audit to be conducted by and a report prepared by an independent Certified Public Accountant. Failure or refusal by Recipient to comply with this provision shall be considered a breach of this Agreement, and GRANTOR may elect to pursue any remedies provided in the "Default Provisions" section of this Agreement,

Pursuant to Government Code Section 8546.7, the Recipient shall be subject to the examination and audit by the GRANTOR for a period of three years after final payment under this Agreement with respect to all matters connected with this Agreement, including but not limited to, the cost of administering this Agreement. All records of Recipient or its Subgrantee shall be preserved for this purpose for at least 3 years after project completion or final billing, whichever comes later.

## **13. Non-Discrimination Clause**

With respect to this section, "contract" means this Agreement; "contractor" means University; and "subcontract" means Subaward.

During the performance of this contract, contractor and its subcontractors shall not unlawfully discriminate against any employee or applicant for employment because of race, religious creed, color, national origin, ancestry, physical disability, mental disability, medical condition, genetic information, marital status, sex, gender, gender identity, gender expression, age, sexual orientation, or military and veteran status. Contractors and subcontractors shall insure that the evaluation and treatment of their employees and applicants for employment are free of such discrimination. Contractors and subcontractors shall comply with the provisions of the Fair Employment and Housing Act (Gov. Code, § 12900 et seq.) and the applicable regulations promulgated thereunder (Cal. Code Regs., tit. 2, § 11000 et seq.). The applicable regulations of the Fair Employment and Housing Council implementing Government Code section 12990, set forth in Subchapter 5 of Division 4.1 of Title 2 of the California Code of Regulations are incorporated into this contract by reference and made a part hereof as if set forth in full. Contractor and its subcontractors shall give written notice of their obligations under this clause to labor organizations with which they have a collective bargaining or other agreement.

Contractor shall include the nondiscrimination and compliance provisions of this clause in all subcontracts to perform work under the contract.



**14. Unenforceable Provision**

In the event that any provision of this Agreement is unenforceable or held to be unenforceable, then the parties agree that all other provisions of this Agreement have force and effect and will not be affected thereby.

**15. Excise Tax**

The State of California is exempt from Federal excise taxes and no payment will be made for any taxes levied on employees' wages. The State will pay for any applicable State of California or local sales or use taxes on the services rendered or equipment or parts supplied pursuant to this Agreement. California may pay any applicable sales and use tax imposed by another State.

**16. Right to Terminate**

- A. Both parties reserve the right to terminate this Agreement for Good Cause upon thirty (30) days written notice. Good Cause is defined as impossibility of performance or frustration of purpose. Good Cause does not include substantial breach (defined under the Disputes/Default clause above) or termination for convenience. Upon receipt of the GRANTOR's notice of termination or upon Recipient providing GRANTOR a notice of termination, the Recipient shall take reasonable efforts to limit or terminate all financial commitments and shall not incur new obligations under this Agreement. The GRANTOR shall reimburse the Recipient for costs incurred up to the effective date of termination and for costs incurred due to non-cancellable obligations, up to the undisbursed balance of funds authorized in this Agreement.
- B. In the case of early termination, the Recipient will submit, within ninety (90) days of the termination date, an invoice and a report covering services up to the termination date. Any deliverable as described in Attachment 1 to this Agreement that is fully or partially completed up to the termination date (work product), shall be provided to the GRANTOR.
- C. Upon receipt of the invoice, progress report, data, and work product, a final payment shall be made to the Recipient. This payment shall be for all costs incurred in accordance with this Agreement, and shall include labor and materials purchased or utilized (including all Non-cancellable Obligations) up to the termination date, and pro rata share of indirect costs as specified in the proposal budget.
- D. Pursuant to a Governor's Executive Order or equivalent directive, such as a court order or an order from a federal or state regulatory agency, the GRANTOR may issue a Suspension Notice. The Notice shall identify the specific Executive Order or directive and the Agreement number(s) subject to suspension. Work charged to the GRANTOR shall stop immediately upon receipt of the Notice. The Recipient retains the right to reimbursement of costs incurred to date, including non-cancellable obligations, and reserves the right to seek reimbursement through administrative or legal action.
- E. The Recipient shall include in any contract with any Subgrantee retained for work under this Agreement a provision that entitles the Recipient to suspend or terminate the agreement with the Subgrantee for any reason on written notice and on the same terms and conditions specified in this section.

**17. Amendments**

Changes to Scope of Work, Budget or the Project term, shall be requested in writing to the GRANTOR Grant Manager via letter, fax or email. GRANTOR Grant Manager shall respond in writing via letter, fax or email as to whether the proposed changes are accepted prior to implementing any change. Any accepted changes to the Scope of Work, Budget, or Project term must be subsequently approved by GRANTOR and an amendment signed by both Parties within 90 days of acceptance by the Grantor Grant Manager.

**18. Confidentiality and Public Records**

The Recipient and the GRANTOR understand that each party may come into possession of information and/or data which may be deemed confidential or proprietary and marked "Confidential" by the person or organization furnishing the information or data ("Confidential Information"). Such information or data may be subject to disclosure under the California Public Records Act, commencing with Government Code, Section 6250, or the Public Contract Code. The GRANTOR agrees not to disclose such information or data furnished by the Recipient and to maintain such information or data as confidential when so designated by the Recipient in writing at the time it is furnished to the GRANTOR, only to the extent that such information or data is exempt from disclosure under the California Public Records Act and the Public Contract Code.



## **19. Right to Publish**

- A. Subject to any restrictions on the publication, disclosure, dissemination and use of Confidential Information set forth in this Agreement or under any applicable law, the Recipient shall have the right to publish, disclose, disseminate and use, in whole and in part, any data and information received or developed under this Agreement.
- B. The Recipient will provide publications, presentations and other public releases directly resulting from work performed under this Agreement to the GRANTOR for review at least thirty (30) calendar days prior to publication and will identify the proposed recipient(s). During the first fifteen (15) calendar days of such review period, the GRANTOR may provide notice to the Recipient that it intends to rebut some or all aspects of the presentation, publication or other public releases. Upon Recipient's public disclosure of the presentation, publication or other public release, the GRANTOR may prepare and submit such rebuttal to the recipient(s) identified by the Recipient. Within the review period, the GRANTOR may provide feedback to the Recipient; the Recipient shall give good faith consideration to such feedback, but has no obligation to make any changes in said material, other than the removal of any material whose disclosure is prohibited or restricted by this Agreement or by any applicable law. Any of the above referenced time periods may be modified upon agreement of both Parties. Neither Party may unreasonably deny such requests.
- C. At the GRANTOR's sole discretion, the GRANTOR will require the Recipient to use one of the following disclaimers in any publication, presentation or other public release:
  - 1. "This project was funded by the <GRANTOR>. The contents may not necessarily reflect the official views or policies of the <Grantor> or the State of California."
  - 2. "This project was funded by the <GRANTOR>. The contents do not represent the official views or policies of the <GRANTOR>, or the State of California."

## **20. Copyrights**

- A. All rights in copyrightable works first created by the Recipient in the performance of the Scope of Work, Attachment 1, under this Agreement are the property of the Recipient. The Recipient shall grant the GRANTOR a royalty-free, nonexclusive, irrevocable license to use, reproduce, prepare derivative works, and distribute copies of the Deliverables identified in Attachment 1 to fulfill the GRANTOR's State purposes.
- B. Notwithstanding the above, if the purpose of the Scope of Work is specifically to create a copyrightable work for use by the State and that fact is indicated as a deliverable in Attachment 1, which may be amended upon mutual agreement of the Parties, then all rights in such copyrightable work will be the property of the State, subject to a reserved right for the University to use the copyrightable work for educational and research purposes and to allow other educational and nonprofit institutions to do so for educational and research purposes.
- C. Upon written request and subsequent amendment, the State may request delivery of computer software that is not identified as a deliverable on Attachment 1, but was first created in the performance of the Scope of Work. To the extent the University is legally able to do so, University shall grant a fully paid-up, royalty-free, nonexclusive, sublicensable, irrevocable license to use, reproduce, prepare derivative works, and distribute copies, to fulfill the State's government purposes, subject to restrictions, if any, identified on Attachment 1.

## **21. Patents**

### **Patent Rights – Recipient**

- A. Subject to the requirements of law, all rights to any patentable inventions or discoveries conceived and first actually reduced to practice in the performance of the Scope of Work, Attachment 1, conducted under this Agreement ("Patentable Inventions") shall belong to the Recipient. The State shall have a nonexclusive, sublicensable, irrevocable, paid-up license to practice or have practiced such Patentable Invention for government purposes.
- B. A State Confirmatory License (attached) will be executed by the Recipient to provide said license to any such Patentable Invention, within ninety (90) days after filing of patent application.
- C. Recipient shall file, prosecute and maintain a patent application claiming a Patentable Invention described in paragraph A above within two years of disclosure of a Patentable Invention to Recipient by inventors and will diligently pursue broad application of such Patentable Invention. If State notifies University of a need that is not being met by Recipient, Recipient will take steps to meet such need or will offer sufficient field-of-use rights to State to address such unmet need.

- D. If Recipient decides not to file a patent application within such two-year period or decides to abandon a patent or patent application claiming such Patentable Invention, and determines that it does not intend to pursue commercialization of such Patentable Invention, then Recipient will notify the State in sufficient time to preserve patent rights, and upon State agency request, Recipient agrees to assign title to State, subject to requirements of law, outstanding rights in third parties, and a reserved right to use the Patentable Invention for educational and research purposes and to allow other educational and nonprofit institutions to do so.
- E. Copyrightable works that may be patentable are also subject to the Patent Rights clause, which will take precedence in case of a conflict.

## **22. Travel**

Travel and reimbursement for Recipient employee travel costs shall be in accordance with the Recipient's travel policy in effect as of the date the cost is incurred. The Recipient's travel policy is found at: <http://policy.ucop.edu/doc/3420365/BFB-G-28> [UC].

## **23. Closeout**

The grant will be closed out after the completion of the project, receipt and payment of the final invoice and receipt and acceptance of the final report, resolution of any audit/desk review findings, and resolution of any performance or compliance issues.

### Attachment 1 Scope of Work and Budget

**Project Title:** Application of Transmissible Small Nuclear RNAs (TsnRNAs) for Nursery Production of Dwarfed Citrus Trees

**Project Summary:**

The development of commercial dwarfed trees, which are excellent candidates for high-density plantings and citrus production under protective structures (CUPS), to help meet challenges posed by Huanglongbing (HLB), water shortages, and labor costs.

**Deliverables:**

List all items that will be delivered by Recipient to GRANTOR under this Scope of Work:

Identify deliverable	Date due	Specify in this column if the deliverable is a copyrighted work subject to GRANTOR ownership as set forth in Exhibit C, Paragraph 20(B). If not checked, default is for Exhibit C, Paragraph 20(A) to control.
1. Annual Report	November 1, 2023	
2.		
3.		
4.		

**Third-Party data, materials or IP:**

Will any data, materials or intellectual property owned by a third party be knowingly utilized by Recipient in the performance of the project?

If Yes, list third party data, materials and/or intellectual property here.

Will GRANTOR be restricted from its use of any deliverables, as identified above, due to any third-party encumbrance? If yes, describe restriction.

**Detailed Project Description** – see attached additional pages.

**Budget** – see attached additional pages.

# California Citrus Nursery Board (CCNB) -Proposal of Research

**Project Title:** Application of Transmissible small nuclear RNAs (TsnRNAs) for nursery production of dwarfed citrus trees

**Fiscal Year:** 2023

**Project Duration:** Year 1

## Project Leaders:

Irene Lavagi-Craddock  
Dept. of Microbiology and Plant Path  
University of California,  
Riverside, CA 92521

Georgios Vidalakis  
Dept. of Microbiology and Plant Path  
University of California,  
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Fax No. :

Email: irenela@ucr.edu

Tel No.: 951-827-3763

Fax No.:

Email:georgios.vidalakis@ucr.edu

**Contractor's Name:** The Regents of the University of California, on behalf of its Riverside campus.

**Current and Pending sources for this project:** none

## Executive Summary

The development of commercial dwarfed trees, which are excellent candidates for high-density plantings and citrus production under protective structures (CUPS), will be critical to meet challenges posed by Huanglongbing (HLB), water shortages, and labor costs.

‘Transmissible small nuclear RNAs’ (TsnRNAs) are well-characterized viroid RNA species that modify tree performance without inducing disease. TsnRNA-IIIb reduces the canopy volume of navel orange trees on trifoliolate rootstock (approx. 50% in high-density planting), increases the yield per land surface unit, and concentrates fruit in the optimum canopy zone for harvest without affecting fruit quality. These findings indicate the potential value of such technology in HLB and general orchard management. The commercial use of TsnRNA for citrus dwarfing was permitted by the CDFA in 2001. However, citrus nurseries have indicated to us that to deploy this technology in a commercial setting, the optimal time and method of plant introduction of the dwarfing TsnRNA is an aspect that needs to be investigated. This is a critical aspect so that citrus nurseries will not jeopardize production (i.e., contamination with transmissible viroid RNAs) and can optimize their TsnRNA/Dwarfing workflow.

With the support of the CCNB Project “Optimizing the timing and inoculation method of Transmissible small nuclear RNAs (TsnRNAs) to produce dwarfed citrus trees”, we established a field trial with citrus trees treated with Transmissible small nuclear RNAs (TsnRNAs) at different time points representing different stages of nursery production. In this year’s new project, we are requesting funding to support the following objectives: 1. Maintain the already treated and planted field trees (Navels and Tango, time course experiment with liners) for future tree growth evaluation and dwarfing phenotype verification; 2. Complete the Tango time course experiment by filling the gaps (i.e. 18-month time point with liners and appropriate Navel controls); 3. Add a representative ready-to-be-sold non-liner nursery tree size treatment (i.e. approx. 1-1.5cm in diameter just below the bud union, 24 in tall); 4. Perform a cost-benefit analysis of TsnRNA-dwarfed trees.

## **Project's Benefit to Citrus Nursery Industry**

The introduction and potential spread of HLB and other exotic diseases in CA make it imperative to develop effective disease management plans to ensure that the CA citrus industry continues to thrive. For example, high-density groves have been reported to yield better despite being infected with HLB (Belasque et al., 2010). Dwarf trees are a prerequisite for high-density plantings (avoid overlapping trees resulting in competition, reduced yields, and high production costs) and CUPS, which could be one way to manage HLB and other vector-transmitted diseases.

TsnRNA dwarfed citrus trees were originally developed at the University of California, Riverside (Semancik et al., 1997). At the time, pathogen-tested Valencia orange scions were budded to trifoliate rootstock seedlings. At the time of budding, the rootstock seedlings were also graft-inoculated with citron sources of TsnRNA-IIIb isolates (syn. citrus dwarfing viroid, CVd-IIIb). Following one year in a glasshouse, trees were planted at the Lindcove Research and Extension Center (Exeter, CA). Measurements of tree height and canopy circumference showed a dramatic reduction in tree size in response to the presence of TsnRNA-IIIb.

In another experiment, pathogen-tested Parent Washington navel orange scions were budded on 12-month-old trifoliate Rich 16-6 rootstock seedlings grown from seed produced from disease tested mother plants. At the time of budding, the seedling rootstocks were also grafted with two blind buds from the source tree of the CDFA approved growth-modifying TsnRNA-IIIb (GenBank deposit AF18147) (Semancik et al., 1997;), an approach that resulted in dwarfed citrus trees in high-density plantings (Vidalakis et al., 2011; Lavagi-Craddock et al., 2020).

Employing the TsnRNA dwarfing technology at the commercial level to allow efficient citrus production in high-density planting or in CUPS will be key to meeting the challenges posed by diseases, water shortages, labor costs, and reducing the environmental impact of insecticides. The efficient, safe, and cost-effective production of such trees by nurseries is an absolute prerogative to allow TsnRNA dwarfed citrus trees deployment to a commercial level with the potential of doubling sales of nursery trees per acre.

Ideally, nurseries would want to be able to introduce (e.g. graft, slash) the dwarfing agent(s) one week before shipment so that if a client cancels an order, trees can be sold to someone else. Typically, 6–18-month-old trees are sold to growers, depending on whether they are liners or non-liners, but whether this is the optimum tree age for TsnRNA introduction for optimum dwarfing results and any nursery economic benefits remain to be verified.

This project addresses the following CCNB's Program Priorities:

1. Growing Citrus in screenhouses/greenhouses in containers.
  - New ways to control citrus pests & pre shipment treatments.

## **Objectives**

### Research:

The project aims to assess the dwarfing efficiency of TsnRNAs through the following objectives:

1. Maintain the already treated and planted field trees (Navels and Tango, time course experiment with liners) for future tree growth evaluation and dwarfing phenotype verification;
2. Complete the Tango time course experiment by filling the gaps (i.e. 18-month time point with liners);
3. Add a representative ready-to-be-sold non-liner nursery tree size treatment (i.e. approx. 1-1.5cm in diameter just below the bud union, 24 in tall);
4. Perform a cost-benefit analysis of TsnRNA-dwarfed trees;

### Educational:

Results will be shared with citrus nurseries, growers and other stakeholders (regulators, extension specialists and the general public) during CCPP, CCNB, and other public citrus events such as the CCPP Walkthrough, UC Riverside Citrus Day, and the LREC Fruit Display. Information will also be disseminated via [ccpp.ucr.edu](http://ccpp.ucr.edu) and

facebook.com/UCRCCPP/. Results will be published in scientific journals, and presented at professional conferences and grower seminars.

## Workplans and Methods

### Proposed for 2023

#### Objective 1. Maintain the already treated and planted field trees (Navels and Tango, time course experiment with liners) for future tree growth evaluation and dwarfing phenotype verification

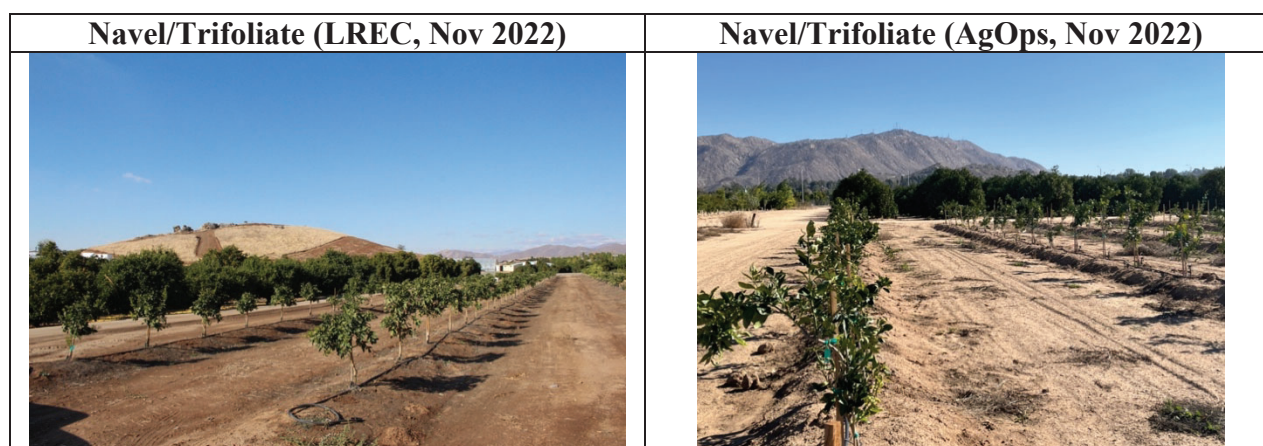
Disease-tested **Parent Washington navel orange** trees on *P. trifoliata* rootstock provided by Tree Source nursery were treated with TsnRNA-IIIb and planted **at high-density (6ft x 18ft; i.e. approx. 1.8 x 5.5m)** on raised beds at AgOps-Riverside and Lindcove Research and Extension Center-LREC, Exeter (Table 1).

*Table 1: Summary of Navel trees already treated with TsnRNA and planted in the field;*

Treatment date	Time Point	Treatment	Treated and planted trees *
May-17	0mo	Control	31
May-17	0mo	Graft	11
May-17	0mo	Slash	12
Nov-17	6mo	Graft	11
Nov-17	6mo	Slash	9
May-18	12mo	Graft	14
May-18	12mo	Slash	8
Nov-18	18mo	Graft	4

\* Sum of trees at AgOps and LREC

*Figure 1: Navel trees already treated with TsnRNA and planted in the field.*



These trees (Table 1) will be maintained and measured once per year. Maintenance includes repropagations and confirmatory qPCRs as needed. Yearly tree measurements of tree height and canopy size will be recorded. Differences are expected to become noticeable and statistically significant 4-5 years post-field planting (i.e. in 2026-2027).

Similarly, Tango scions budded on *P. trifoliata* rootstock provided by Tree Source nursery were treated with TsnRNA-IIIb and planted **at high-density (6ft x 18ft; i.e. approx. 1.8 x 5.5m)** on raised beds at AgOps-Riverside and Lindcove Research and Extension Center-LREC, Exeter (Table 2).

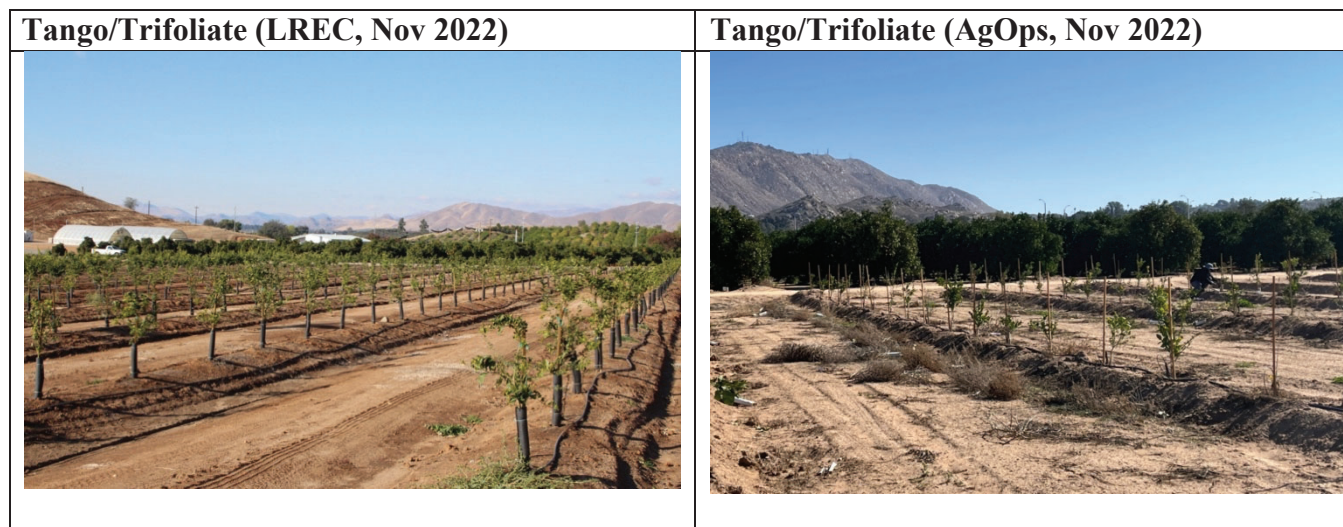
*Table 2: Summary of Tango trees already treated with TsnRNA and planted in the field. For each time period treatment, a minimum of 3 trees is required for statistical analysis regardless of the application of the treatment (i.e. pruning vs no pruning)*

Treatment date	Time Point	Treatment	Treated and planted trees *
Jan-20	0mo	Controls	24
Jan-20	0mo	Healthy w/Pruning	12
Jan-20	0mo	IIIb w/Pruning	5
Jan-20	0mo	IIIb no pruning	17
Jul-20	6	Controls	10
Jul-20	6	IIIb w/Pruning	16
Jul-20	6	IIIb no pruning	14
Jan-21	12	Controls	16
Jan-21	12	IIIb w/Pruning	6
Jan-21	12	IIIb no pruning	2
<i>Tango 18-month treatment missing; it will be completed in Objective 2</i>			
Jan-22	24	Controls	15
Jan-22	24	IIIb w/Pruning	3
Jan-22	24	IIIb no pruning	4
Jul-22	30mo	Controls	16 **
Jul-22	30mo	IIIb w/Pruning	16
Jul-22	30mo	IIIb no pruning	16
Jan-23	36mo	Controls	16
Jan-23	36mo	IIIb w/Pruning	16
Jan-23	36mo	IIIb no pruning	16

\* sum of trees at AgOps and LREC; \*\* For the 30 and 36-month treatments, the numbers of trees treated are reported, PCR test pending.



Figure 2: *Tango trees already treated with TsnRNA and planted in the field.*



These trees (Table 2) will be maintained and measured once per year. Maintenance includes repropagations and confirmatory qPCRs as needed. Yearly tree measurements of tree height and canopy size will be recorded. Differences are expected to become noticeable and statistically significant (4-5 years post-field planting, i.e. in 2027).

## 2. Complete the Tango time course experiment by filling the gaps (i.e. 18-month time point with liners)

The Tango time course experiment mostly coincided with the COVID-19 pandemic. As a result, some time points were affected (the 18-month time point and to a lesser extent the 12-month time point). These will now be added and the appropriate controls will be included. The controls include known dwarf-inducing TsnRNA treatments published in the scientific literature so we can have a reference point since Tango has not been used before in TsnRNA dwarf trials. Trees will be planted **at high-density (6ft x 18ft; i.e. approx. 1.8 x 5.5m)** on raised beds at AgOps-Riverside and Lindcove Research and Extension Center-LREC, Exeter. Trees will be maintained and measured once per year. Maintenance includes repropagations and confirmatory qPCRs as needed. Yearly tree measurements of tree height and canopy size will be recorded. Differences are expected to become noticeable and statistically significant (4-5 years post-field planting).

## 3. Add a representative ready-to-be-sold non-liner nursery tree size treatment (i.e. approx. 1-1.5cm in diameter just below the bud union, 60cm (24 in) tall – This objective will start in 2024 as trees need to be produced by a nursery

Typical nurseries that sell ready-to plant trees (i.e. not liners), consider a tree ready for planting at 6-9-months of age, that is when the caliper just below the bud union measures approx. 1-1.5cm, and the tree is 60cm (24 in) tall. A treatment for a representative ready-to-be-sold non-liner nursery tree for Navel and Tango on Trifoliolate (Rich16-6) will be added with the appropriate controls (for example, TsnRNA Viroid Mix). Trees will be planted **at high-density (6ft x 18ft; i.e. approx. 1.8 x 5.5m)** on raised beds at AgOps-Riverside and Lindcove Research and Extension Center-LREC, Exeter. Trees will be maintained and measured once per year. Maintenance includes repropagations and confirmatory qPCRs as needed. Yearly tree measurements of tree height and canopy size will be recorded. Differences are expected to become noticeable and statistically significant (4-5 years post-field planting).

## 4. Perform a cost-benefit analysis of TsnRNA-dwarfed trees

To assess the potential economic benefit offered by TsnRNA-IIIb-dwarfed citrus trees, a cost-benefit analysis of TsnRNA-dwarfed trees will be performed in collaboration with an economist.

The cost of nursery production for dwarfed trees (e.g., additional grating step) using TsnRNAs, will be estimated based on the cost of tree production for different nursery systems. To obtain a more accurate cost-benefit analysis for the nursery production and sale of dwarfed trees, already available experimental data and information from complementary studies on yield and horticultural practices (e.g., skirting, harvesting, fertilization, irrigation, etc.) will also be used to estimate the likely economic benefit of citrus-dwarfed trees.

### **Budget Justification**

Funds (\$7,860) are requested to maintain the already planted and treated Navel and Tango trees and purchase additional trees to repeat the missing treatment (see objective 2); Costs include minimal laboratory supplies for PCR tests and travel to visit the trials and maintain the treatments as needed (land charges, repropagate as needed, collect samples, measure trees etc.).

Funds (\$11,447) are requested for the part-time support (0.15 FTE) of an economics Junior Specialist to perform a cost-benefit analysis of TsnRNA-dwarfed trees.

### **Project Management and Evaluation**

Irene Lavagi-Craddock, Georgios Vidalakis and Ashraf El-Kereamy will direct the experiments. Irene Lavagi-Craddock and LREC staff will monitor growth of the trees and analyze data. An annual report to the CCNB on the status of the project will be provided and presentations will be given as requested by the CCNB. Field visits for all interested parties will be encouraged at any time and at events such as the UC Riverside Citrus day and the CCPP Walkthrough at LREC.

### **Literature Review**

Belasque J. Jr, Bassanezi R., Yamamoto P., Ayres A., Tachibana A., Violante A., Tank A. Jr, Di Giorgi F., Tersì F., Menezes G. 2010. Lesson from huanglongbing management in São Paulo State, Brazil. *Journal of Plant Pathology*, 92, 285–302.

Lavagi-Craddock, I., Campo, R., Pagliaccia, D., Kapaun, T., Lovatt, C., Vidalakis, G. 2020. Citrus dwarfing viroid reduces canopy volume by inhibiting shoot apical growth of navel orange trees grown on trifoliolate orange rootstock. *Journal of Citrus Pathology*, Vol. 7 1-6

Semancik J., Rakowski A., Bash J., Gumpf D. 1997. Application of selected viroids for dwarfing and enhancement of production of ‘Valencia’ orange. *Journal of Horticultural Science*, 72: 563-570.

Vidalakis, G., Pagliaccia, D., Bash, J.A., Semancik, J.S. 2010. Effects of mixtures of citrus viroids as transmissible small nuclear RNA (TsnRNA) on tree dwarfing and commercial scion performance on carrizo citrange rootstock. *Annals of Applied Biology*, 157:415-423.

Vidalakis, G., Pagliaccia, D., Bash, J.A., Afunian, M., Semancik, J.S. 2011. Effects of Citrus Dwarfing viroid, a transmissible small nuclear RNA on tree size and scion performance specific to poncirus trifoliata rootstock with applications for high density planting. *Annals of Applied Biology*, 158: 204-217.

ATTACHMENT #1

**BUDGET PROPOSAL**

**Project Title/Description:** Application of Transmissible small nuclear RNAs (TsnRNAs) for nursery production of dwarfed citrus trees

**Project Leader:** Irene Lavagi-Craddock and Georgios Vidalakis

**Proposed Fiscal Year:** 01/01/2023 – 12/31/2023

A. PERSONNEL SERVICES:

UCR Staff Salary Junior Specialist 0.15 FTE	\$7,571.00
UCR Staff Benefits Junior Specialist 0.15 FTE	\$3,876.00

B. OPERATING EXPENSES:

Laboratory Supplies (qPCR assays)	\$1,400.00
Travel	\$1,000.00
Tree purchase	\$600.00
LREC Navel and Tango land charges 12mo	\$2,700.00
AgOps Navel and Tango land charges 12mo	\$2,160.00

C. TOTAL OPERATING EXPENSES \$19,307.00

D. TOTAL BUDGET REQUESTED \$19,307.00

**Note:**

A CRB project to further study TsnRNAs was awarded this fall. The CRB project aims to screen for different scion varieties that can be dwarfed and analyze existing TsnRNA-dwarfed trees to assess the potential to reduce cost production and the environmental impact offered by this technology. The optimization of TsnRNA's inoculation proposed here to the CCNB is a separate and well-delimited project that complements the CRB.

Signature of Requestor: \_\_\_\_\_

Date: 28<sup>th</sup> March 2023

Signature of Requestor: \_\_\_\_\_

Date: 28<sup>th</sup> March 2023

Department Chair: \_\_\_\_\_

Date: \_\_\_\_\_











# LAV-23

Final Audit Report

2023-05-11

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