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New Hampshire
Department of Agriculture, Markets & Food

Shawn N. Jasper, Commissioner

January 15, 2020

His Excellency, Governor Christopher T. Sununu
and the Honorable Council
State House
Concord, New Hampshire 03301

REQUESTED ACTION

Authorize the New Hampshire Department of Agriculture, Markets and Food, Division of Agricultural Development (DAMF) to enter into a Grant Agreement with the University of New Hampshire, vendor number #177867, for the period of Governor and Council approval to September 29, 2022 in the amount of $32,082.00 to conduct research and field trials to develop best practices for the use of natural products to manage apple fruit rots.100% Federal Funds – Specialty Crop Block Grant.

Funding is available in account, Spec Crop State Grant I, as follows with the authority to adjust encumbrances in each of the State fiscal years through the Budget Office if needed and justified as approved in the FY 20 & 21 budget and pending approval of the FY 22 & 23 budget.

Funding is available as follows: **02-18-18-185010-28200000 Specialty Crop Block Grant**

ACCOUNT	FY 2020	FY2021	FY2022	TOTAL
072-500573 Grants to Schools – Federal	$8,000	$21,000	$3,082	$32,082

EXPLANATION

The New Hampshire Department of Agriculture, Markets & Food (DAMF) received Specialty Crop Block Grant (SCBG) money from the United States Department of Agriculture to fund eight specific projects. The projects were solicited through the RFP process and submitted for review by USDA, Agricultural Marketing Service as part of our state application. The proposal submitted by the University of New Hampshire was one of the projects accepted by USDA for funding.

In the event that these Federal funds become no longer available, General Funds will not be requested to support this program.

Respectfully submitted,

Shawn N. Jasper
Commissioner

Office of Commissioner 25 Capitol Street PO Box 2042 Concord, NH 03302-2042
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TDD Access: Relay NH 1-800-735-2964

COOPERATIVE PROJECT AGREEMENT
between the
STATE OF NEW HAMPSHIRE, **Department of Agriculture, Markets & Food**
and the
University of New Hampshire of the UNIVERSITY SYSTEM OF NEW HAMPSHIRE

A. This Cooperative Project Agreement (hereinafter "Project Agreement") is entered into by the State of New Hampshire, **Department of Agriculture, Markets & Food**, (hereinafter "State"), and the University System of New Hampshire, acting through **University of New Hampshire**, (hereinafter "Campus"), for the purpose of undertaking a project of mutual interest. This Cooperative Project shall be carried out under the terms and conditions of the Master Agreement for Cooperative Projects between the State of New Hampshire and the University System of New Hampshire dated November 13, 2002, except as may be modified herein.

B. This Project Agreement and all obligations of the parties hereunder shall become effective on the date the Governor and Executive Council of the State of New Hampshire approve this Project Agreement ("Effective date") and shall end on **9/29/22**. If the provision of services by Campus precedes the Effective date, all services performed by Campus shall be performed at the sole risk of Campus and in the event that this Project Agreement does not become effective, State shall be under no obligation to pay Campus for costs incurred or services performed; however, if this Project Agreement becomes effective, all costs incurred prior to the Effective date that would otherwise be allowable shall be paid under the terms of this Project Agreement.

C. The work to be performed under the terms of this Project Agreement is described in the proposal identified below and attached to this document as Exhibit A, the content of which is incorporated herein as a part of this Project Agreement.

Project Title: **Integration of natural products to enhance efficacy of fungicides for control of summer fruit rots and postharvest decay of apple**

D. The Following Individuals are designated as Project Administrators. These Project Administrators shall be responsible for the business aspects of this Project Agreement and all invoices, payments, project amendments and related correspondence shall be directed to the individuals so designated.

State Project Administrator	**Campus Project Administrator**
Name: Gail McWilliam Jellie	Name: Noreen Norman
Address: NH Dept Agriculture, Markets & Food PO Box 2042 Concord NH 03302-2042	Address: University of New Hampshire Sponsored Programs Administration 51 College Road Durham, NH 03824
Phone: 603-271-3788	Phone: 603 862 2037

E. The Following Individuals are designated as Project Directors. These Project Directors shall be responsible for the technical leadership and conduct of the project. All progress reports, completion reports and related correspondence shall be directed to the individuals so designated.

State Project Director	**Campus Project Director**
Name: Gail McWilliam Jellie	Name: Anissa Poleatewich
Address: NH Dept Agriculture,Markets& Food PO Box 2042 Concord, NH 03302-2042	Address: University of New Hampshire 191 Rudman Hall 46 College Rd., Durham, NH 03824
Phone: 603-271-3788	Phone: 603-862-2128

Campus Authorized Official
Date 12/4/19

F. Total State funds in the amount of **$32,082.00** have been allotted and are available for payment of allowable costs incurred under this Project Agreement. State will not reimburse Campus for costs exceeding the amount specified in this paragraph.

Check if applicable

☐ Campus will cost-share % of total costs during the term of this Project Agreement.

☒ Federal funds paid to Campus under this Project Agreement are from Grant/Contract/Cooperative Agreement No. **AM190100XXXXG012** from **AMS/USDA** under CFDA# **10.170**. Federal regulations required to be passed through to Campus as part of this Project Agreement, and in accordance with the Master Agreement for Cooperative Projects between the State of New Hampshire and the University System of New Hampshire dated November 13, 2002, are attached to this document as Exhibit B, the content of which is incorporated herein as a part of this Project Agreement.

G. Check if applicable

☐ Article(s) of the Master Agreement for Cooperative Projects between the State of New Hampshire and the University System of New Hampshire dated November 13, 2002 is/are hereby amended to read:

H. ☒ State has chosen **not to take** possession of equipment purchased under this Project Agreement.
☐ State has chosen **to take** possession of equipment purchased under this Project Agreement and will issue instructions for the disposition of such equipment within 90 days of the Project Agreement's end-date. Any expenses incurred by Campus in carrying out State's requested disposition will be fully reimbursed by State.

This Project Agreement and the Master Agreement constitute the entire agreement between State and Campus regarding this Cooperative Project, and supersede and replace any previously existing arrangements, oral or written; all changes herein must be made by written amendment and executed for the parties by their authorized officials.

IN WITNESS WHEREOF, the University System of New Hampshire, acting through the **University of New Hampshire** and the State of New Hampshire, **Department of Agriculture, Markets & Food** have executed this Project Agreement.

By An Authorized Official of:
University of New Hampshire
Name: Karen Jensen
Title: Director, Pre-award, Sponsored Programs
Signature and Date: 12/4/19

By An Authorized Official of:
NH Dept.of Agriculture, Markets & Food
Name: Shawn N. Jasper
Title: Commissioner
Signature and Date: 1/14/2020

By An Authorized Official of: the New Hampshire Office of the Attorney General
Name: Eric Bp
Title: Asst. Attorney General
Signature and Date:

By An Authorized Official of: the New Hampshire Governor & Executive Council
Name:
Title:
Signature and Date:

Campus Authorized Official KJ
Date 12/4/19

EXHIBIT A

A. Project Title: Integration of natural products to enhance efficacy of fungicides for control of summer fruit rots and postharvest decay of apple

B. Project Period: March 1, 2020-September 29, 2022

C. Objectives: Attached

D. Scope of Work: Attached

E. Deliverables Schedule: 6 month and annual reports on project activity due in June and December of 2020, 2021 and 2022. Final printed and digital report due by December 10, 2022

F. Budget and Invoicing Instructions: Campus will submit invoices to State on regular Campus invoice forms no more frequently than monthly and no less frequently than quarterly. Invoices will be based on actual project expenses incurred during the invoicing period, and shall show current and cumulative expenses by major cost categories as shown below. State will pay Campus within 30 days of receipt of each invoice. Campus will submit its final invoice not later than 60 days after the Project Period end date.

Budget Items	State Funding	Cost Sharing (if required)	Total
1. Salaries & Wages	18,338.00	0	18,338.00
2. Employee Fringe Benefits	1,467.00	0	1,467.00
3. Travel	2,798.00	0	2,798.00
4. Supplies and Services	9,479.00	0	9,479.00
5. Equipment	0	0	0
6. Facilities & Admin Costs	0	0	0
Subtotals	$32,082.00	0	$32,082.00
	Total Project Costs:	$32,082.00	

Campus Authorized Official KJ
Date 12/4/19

EXHIBIT B

This Project Agreement is funded under a Grant/Contract/Cooperative Agreement to State from the Federal sponsor specified in Project Agreement article F. All applicable requirements, regulations, provisions, terms and conditions of this Federal Grant/Contract/Cooperative Agreement are hereby adopted in full force and effect to the relationship between State and Campus, except that wherever such requirements, regulations, provisions and terms and conditions differ for INSTITUTIONS OF HIGHER EDUCATION, the appropriate requirements should be substituted (e.g., OMB Circulars A-21 and A-110, rather than OMB Circulars A-87 and A-102). References to Contractor or Recipient in the Federal language will be taken to mean Campus; references to the Government or Federal Awarding Agency will be taken to mean Government/Federal Awarding Agency or State or both, as appropriate.

Special Federal provisions are listed here: ☐ None or **Uniform Guidance issued by the Office of Management and Budget (OMB) in lieu of Circulars listed in paragraph above.**.

Campus Authorized Official KS
Date 12/4/19

Exhibit A
Section C & D

Project title: Integration of Natural Products to Enhance Efficacy of Fungicides for Control of Summer Fruit Rots and Postharvest Decay of Apple
Duration of Project: March 1, 2020-September 29, 2022

Project Partner and Summary. Management of tree fruit diseases is especially challenging in the Northeastern United States due to ideal climatic conditions for plant pathogens. To manage diseases successfully and sustainably, an integrated approach is necessary. The University of New Hampshire will conduct a series of research and commercial orchard trials to develop best practices for the use of natural products to manage apple fruit rots. The specific objective of this project is to evaluate integration of the natural biostimulant, chitosan, into apple IPM spray programs for management of fruits rots that develop during the growing season and postharvest. Experiments will test chitosan application timing and rate in combination with standard and reduced risk fungicide spay programs typical of NH apple orchards. The outcomes of this project include identification of chitosan spray schedules that reduce fungicide inputs, reduce losses to disease, improve fruit quality, reduce risk of fungicide resistance, and contribute to conservation of natural resources. This research is an important step in grower adoption of effective and sustainable practices for disease management. Results will be disseminated to stakeholders through grower meetings, twilight meetings, and UNH Extension publications.

Project Purpose. Management of tree fruit diseases is especially challenging in the northeastern region of the U.S. due to ideal climatic conditions for pathogen spread and infection. Compared to the arid climate of western U.S. fruit producing regions, the northeast has a wet climate with significant variability in precipitation and temperature. The weather in New Hampshire (NH) plays an important role in apple production. This is because disease is related to temperature, rain, and humidity. For example, infections of apple fruit by pathogenic fungi are favored by warm, moist conditions and lead to devastating fruit losses during the season and in storage. New Hampshire growers rely heavily on fungicides to protect fruit from infection. Regular fungicide use however, increases the risk of pathogen resistance to fungicides. The New Hampshire tree fruit industry has made tremendous progress toward more economically and environmentally sustainable practices. Pioneering work by Dr. McHardy at UNH and researchers at Cornell in the 1980's led to the development of weather-based disease forecasting models to help growers use fungicides only when an outbreak is predicted (Gadoury et al., 1989). McHardy was also instrumental in development of integrated pest management (IPM) strategies that combine cultural, biological, and chemical strategies to limit crop loss, reduce pesticide use, and mitigate fungicide resistance risk. Even with these advances, NH growers continue to battle fruit diseases.

The NH tree fruit industry includes 228 farms growing 1701 acres of tree fruit, valued at $9,293,000 (2017 NASS Ag Census). NH growers primarily market retail sales of fresh fruit by farm stand, pick-your-own, and direct sales to grocery stores. Fruit quality is critical as

KJ
12/4/19

consumers have a low threshold for imperfections caused by disease. As a result, fruit rot diseases are a significant concern for New Hampshire apple growers. Affected fruit either fall from the tree prematurely, are culled at harvest, or lost during storage. Several summer fruit rot and postharvest diseases occur in the northeast including bitter rot (*Colletotrichum* spp.), black rot (*Botryosphaeria obtuse*), white rot (*Botrysphaeria obtuse*), blue mold (*Penicillium* spp.), and gray mold (*Botrytis cinerea*). In 2015 Dr. Kirk Broders at UNH and colleagues reported increasing prevalence of some fruit rots, particularly bitter rot, in NH apple orchards. This same trend has been reported in other northeastern states including NY and PA (Rosenberger, 2017).

It is critical for New Hampshire growers to have a diverse set of tools in their "tool box" to manage fruit diseases given changes in climate and weather patterns which may the increase occurrence and severity of disease outbreaks (Wright et al., 2017). The success of an IPM program is dependent on the availability of effective tools. NH Growers have begun integrating biologically-based tools with some success. More research is needed to identify the most promising tools and provide growers with best use practices. Natural bio-stimulant compounds show potential as disease management tools. Chitosan, a natural derivative of chitin, is one of the more promising bio-stimulants and is well documented for its anti-fungal activity (Allan and Hadwiger, 1979) and elicitation of plant defense (Jia et al., 2018). The efficacy of postharvest application of chitosan to prevent disease and extend shelf life of perishable fruits has been well documented. Less is known about the potential of pre-harvest application of chitosan to suppress fruit rots during the growing season and if chitosan acts synergistically with standard fungicide spray programs. *We propose to identify the utility of chitosan, as an anti-fungal control, to manage apple fruit rots during pre-harvest and post-harvest when used in combination with reduced risk and conventional fungicide programs*. Results of this study will provide direct benefit to NH tree fruit growers through adoption of new tools which will reduce losses, reduce pesticide use, and increase revenue.

Apple fruit rots are categorized based on when infections occur, and symptoms appear. The three main types include rots that develop during the growing season (summer rots), rots that remain dormant and appear in storage (quiescent) and rots that originate and develop in storage (postharvest). The goal of this project is to evaluate integration of chitosan into IPM programs for management of the three types of apple fruit rots. *Specific objectives are to evaluate application timing of chitosan products integrated into IPM spray programs for suppression of (1) summer rots, (2) quiescent bitter rot infections and (3) postharvest decay.*

Project Beneficiaries: This project will impact 228 NH apple growers. The project will also directly benefit socially disadvantaged farmers and beginning farmers as defined in the RFA.

Statement of Solely Enhancing Specialty Crops: I confirm that this project solely enhances the competitiveness of specialty crops in accordance with and defined by 7 U.S.C. 1621.

External Project Support. The New Hampshire Fruit Growers Association (NHFGA), which is an organization comprised of tree fruit growers in New Hampshire, is very supportive of this project. The NHFGA has supported the research of the project coordinator (PI Poleatewich)

KJ
12/4/19

through award of funding in 2018 ($1,500) for evaluation of the effect of cultivar on efficacy of biochemical inducers to suppress fire blight disease on apple. A letter of support from the NHFGA is attached to this proposal.

Expected Measurable Outcomes:
This project will address two of the listed Outcomes.
Outcome 4: Enhance the competitiveness of specialty crops though greater capacity of sustainable practices of specialty crop production resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources
Outcome 5: Enhance the competitiveness of specialty crops through more sustainable, diverse, and resilient specialty crop systems

Outcome Indicators
Outcome 4, Indicator 2.a: The specific indicators will include personnel working at the 228 NH apple farms that will gain knowledge of a new disease management tool and best practices for integrating the tool into their existing spray programs. This knowledge will promote adoption of best practices resulting in increased yields, increased efficiency, and conservation of resources. We anticipate at least 68 growers will adopt these recommended practices.

Outcome 4, Indicator 2.b: Of the 228 apple farms in NH (including beginning and socially disadvantaged farmers) reached by this research, 68 farms will report a reduction in pesticides used per acre.

Outcome 5, Indicator 3: As a result of fulfilling Outcome 4 indicator 2.a, 68 NH apple farmers will report an increase in revenue dollars due to reduced loss to fruit rots.

Outcome 5, Indicator 8: Of the 228 apple farms in NH reached by this research, 114 growers will gain knowledge about new disease management tools and best practices for implementation by attending educational meetings and receiving UNH Extension publications.

Data collection to report on outcomes and indicators: Experiments will be conducted to evaluate chitosan application timing for suppression of summer rots (obj 1), quiescent infections (obj 2), and postharvest disease (obj 3) in a research orchard followed by on-farm trials at two New Hampshire commercial apple orchards. The research orchard trials will be located at the Penn State Fruit Research and Extension Center in Biglerville, PA during years 1 and 2 of the project. Currently, the University of New Hampshire does not have a research orchard which significantly limits the research that can be done and limits our ability to bring new tools to New Hampshire growers. Research orchard trials are critical to creating uniform disease conditions and rigorous evaluation of new tools. The conditions in Pennsylvania are similar to New Hampshire, and the results will be directly applicable to New Hampshire growers. Following a first season of research trials, on-farm trials located at two New Hampshire commercial orchards will begin in year 2 and continue in year 3. Concurrent research and on-farm trials will run in year 2. This strategy will allow us to collect two seasons of research orchard and on-farm data. Two seasons of data is the minimum for field research to

KJ
12/4/19

ensure consistency of results and capture climatic variation from year to year. All experiments will be conducted on apple cultivars Honeycrisp and Golden Delicious. These cultivars are popular in New Hampshire and are susceptible to summer rots, quiescent bitter rot infections, and postharvest rots.

Research orchard trials (2020-2021): The plant pathologist, Dr. Peter, from Penn State will oversee the research orchard trials in close collaboration with PI Poleatewich. We will use a Penn State apple research block that has a history of fruit rots and/or we will hang rotting fruit above the trees to initiate infection (e.g. fruit with bitter rot). Treatment programs will be based on different timing applications and chitosan rates. Chitosan treatments will be combined with a standard fungicide program and a program using reduced risk materials typical of northeast orchards. Treatments will be arranged in a randomized complete block design with at least four replications. For the evaluation of timing and product efficacy, we will monitor fruit throughout the season for disease.
To determine disease incidence at harvest, we will collect 25 fruit/treatment per replication, such that at least 100 fruit will be evaluated for disease.

For suppression of quiescent rot infections, we will collect immature fruit throughout the season, surface disinfest them, and freeze them for 24 hours. After 24 hours, the fruit will be left at room temperature for quiescent infections to emerge. Disease incidence will be recorded.
For postharvest fruit rot evaluations, clean fruit (not showing rot symptoms) will be collected at the end of the season (100 fruit/treatment) and stored in a 1°C cooler located at the Penn State Fruit Research and Extension Center. Fruit will be stored for 3 months and rated for fruit rot incidence monthly. Disease incidence will be recorded. A second batch of clean fruit (20 per treatment) will be used to evaluate disease suppression of wound inoculated fruit. Disease severity data will be collected by measuring lesion size 7 days post inoculation.

Appropriate statistical analyses will be performed for all evaluations. Data collected on fruit rot severity and incidence will used to select the most effective treatment for further study in NH orchards.

NH on-farm trials (2021-2022): Dr. Poleatewich and a UNH graduate student, Liza DeGenring, will oversee the on-farm trials in New Hampshire. Two commercial orchards will be selected with the help of UNH Extension Specialist George Hamilton (see attached letter of support). Treatments will be selected based on performance in the research trials at Penn State. Chitosan treatments will be overlaid on the growers existing spray program to ensure minimal disruption to the grower's normal operations. The experimental design will be similar to the research trial. One difference is that we will rely on natural inoculum present at the commercial farms. Chitosan treatments will be applied to trees by the UNH graduate student using a backpack sprayer. Treatments will be applied to a minimum of five replicates in a randomized design. Data will be collected on incidence and severity of fruit rots during the growing season (obj 1), quiescent infections (obj 2), and postharvest disease (obj 3) as described in the research orchard section above.

KJ
12/4/19

Grower outreach and knowledge transfer: Data from this study and resulting recommendations will be shared with growers at two twilight meetings organized by the NH Fruit Growers Association and UNH Extension in year 2 and 3. Results will also be presented at the Fruit Growers annual meeting. Growers will be surveyed at these meetings during the project period and follow-up meetings beyond the project period to collect data on grower adoption of best practices (Outcome 4, Indicators 2a and 2b) and impact of adoption on competitiveness of the industry (Outcome 5, indicators 3 and 8).

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12/4/19