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New Hampshire
Department of Agriculture,
Markets & Food

Shawn N. Jasper, Commissioner

June 25, 2024

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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 & Food, Division of Pesticide Control to grant funds and enter into a Cooperative Project Agreement, in the amount of \$52,549, with the University of New Hampshire, Office of Sponsored Research, (VC #315187 B083), for the advancement of agricultural research and to assist in the promotion of Integrated Pest Management practices in New Hampshire, effective upon Governor and Council approval through October 31, 2026. **100% Other Funds.**

Funds to support this request are available in the following account in Fiscal Year 2025 and are anticipated to be available in Fiscal Years 2026 and 2027 upon the availability and continued appropriation of funds in the future operating budget with the authority to adjust encumbrances between fiscal years within the price limitation through the Budget Office, if needed and justified.

02-18-18-183010-21820000, Integrated Pest Management

<u>OBJECT CLASS</u>	<u>ACCOUNT</u>	<u>FY 2025</u>	<u>FY 2026</u>	<u>FY 2027</u>	<u>TOTAL</u>
075-500590	Grants and Subsidies	\$26,274.50	\$13,137.25	\$13,137.25	\$52,549

EXPLANATION

The New Hampshire Department of Agriculture, Markets and Food (NHDAMF), Division of Pesticide Control in fulfilling its responsibilities under the Integrated Pest Management (IPM) Program, RSA 430:50; to promote the principles of IPM and assist New Hampshire citizens to advance the practice of such principles, has reviewed the project, "Evaluating synthetic and organic fungicides for the management of blueberry leaf rust in New Hampshire", and finds it exemplifies good practices associated with Integrated Pest Management. The research and educational aspects associated with this project and the efforts of the University of New Hampshire Cooperative Extension identify and establish the presence and treatment methods for blueberry leaf rust, an emerging disease in the nation. Experience and results of this project serve the benefit of all citizens of New Hampshire. The attachment includes a summary of the project and the dollar amount associated with each component.

Respectfully submitted,



Shawn N. Jasper
Commissioner

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 10/31/26. 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: Evaluating synthetic and organic fungicides for the management of blueberry leaf rust in New Hampshire

- 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

Name: Rebecca L. Tgibedes
Address: State House Annex
1 Granite Place South, Suite 211
P.O. Box 2042
Concord, NH 03301
Phone: 603 271-7788

Campus Project Administrator

Name: Gretchen Swain
Address: University of New Hampshire
Sponsored Programs Administration
51 College Road
Durham, NH 03824
Phone: 603-862-1924

- 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

Name: David J. Rousseau
Address: State House Annex
1 Granite Place South, Suite 211
P.O. Box 2042
Concord, NH 03301
Phone: 603 271-3640

Campus Project Director

Name: Bo Liu
Address: UNH Cooperative Extension
Kendall Hall
129 Main Street
Durham, NH 03824
Phone: 603 862-0051

F. Total State funds in the amount of \$52,549 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. _____ from _____ under CFDA# _____. 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: Dianne Hall
Title: Manager Pre-Award Compliance,
Sponsored Programs Administration
Signature and Date: Dianne Hall Digitally signed by Dianne Hall
Date: 2024.06.21 15:31:59
+0400

**By An Authorized Official of:
Department of Agriculture, Markets &
Food**

Name: Shawn N. Jasper
Title: Commissioner
Signature and Date: Shawn N. Jasper 6/25/24

**By An Authorized Official of: the New
Hampshire Office of the Attorney General**
Name: Sheri L. Phillips
Title: Assistant Attorney General

Signature and Date: Sheri Phillips 6/25/2024

**By An Authorized Official of: the New
Hampshire Governor & Executive Council**
Name:
Title:

Signature and Date:

EXHIBIT A

- A. Project Title:** Evaluating synthetic and organic fungicides for the management of blueberry leaf rust in New Hampshire
- B. Project Period:** Upon Governor and Council Approval through October 31, 2026
- C. Objectives:** The objectives of the University of New Hampshire are to assist the Department of Agriculture, Markets & Food in the promotion and advancement of Integrated Pest Management in New Hampshire
- D. Scope of Work:** A detailed scope of work is on file with the Department of Agriculture, Markets & Food and described in Attachment A of this agreement.
- E. Deliverables Schedule:** A detailed description with schedule for each project is on file with the Department of Agriculture, Markets & Food and described in Attachment A of this agreement.

Major Project Components:

Both conventional and organic blueberry growers will have direct and effective approaches for management of blueberry leaf rust if the weather condition is favorable for disease spread.

Final Report: October 31, 2026

- F. Budget and Invoicing Instructions:** Campus will submit an invoice on regular Campus invoice form for \$52,549 at the time of Governor and Council approval. State will pay Campus within 30 days of receipt of the invoice. Any unused funds must be returned to the State after the project end date.

Budget Items	State Funding	Cost Sharing (if required)	Total
1. Salaries & Wages	\$5,000	0	\$5,000
2. Employee Fringe Benefits	1,875	0	1,875
3. Travel	2,300	0	2,300
4. Supplies and Services	32,530	0	32,530
5. Facilities & Admin. Costs	10,844	0	10,844
Subtotals		0	\$52,549
In Kind Contribution		0	0
Total Project Costs			\$52,549

- G. Other**

A representative of the Department of Agriculture, Markets & Foods reserves the right to attend seminars and audit any work performed by the grant recipient.

Attachment A: Project Proposal - "Evaluating synthetic and organic fungicides for the management of blueberry leaf rust in New Hampshire"

I. Itemized Budget:

Funding can only be used for items detailed in your budget. Requests for the purchase of non-consumable equipment that may serve a broader purpose than the IPM project will be rejected. Itemized budget must be specific.

Expense Account	TOTAL
Purchasing commercial fungicides	\$8,680.00
Three-year-old blueberry bushes: \$50/bush, 168 bushes x 2 years repeat = \$16800.00	\$16,800.00
Potting supplies such as pots, potting mix, and fertilizer	\$2,000.00
Pencils, notebooks, plastic bags, markers, labels, and signage for grower use and identification, flagging, and gloves	\$500.00
PI-salary	\$5,000.00
Fringe Benefits	\$1875.00
Analysis of Results/Statistical Consultation	\$750.00
Publication of Results in Plant Disease	\$800.00
Travel to and among study locations, Merrimack County, NH	\$2,300.00
Lab analysis for other leaf spot diseases on blueberry with regular and molecular techniques	\$3,000.00
Subtotal:	\$41,705
Indirect Costs at 26%	\$10,844
Total	\$52,549

II. Project Goal (Three sentences or less):

Evaluating synthetic and organic fungicides for control of blueberry leaf rust in greenhouses and fields.

III. Project Objectives (Be sure to include how this project serves the concepts of IPM):

1. Evaluating synthetic and organic fungicides for control of blueberry leaf rust in greenhouses.
2. Evaluating synthetic and organic fungicides for control of blueberry leaf rust in farms.

IV. Economic and Environmental Impact

Blueberries are an economically important fruit crop in New Hampshire (NH). Blueberry leaf rust, caused by the fungus *Thekopsora minima* (synonyms: *Pucciniastrum vaccinii*), is an emerging disease in the US, especially this disease is prevailing in the southeastern US in recent years. Until 2023, the disease had been reported in Maine, Vermont, Massachusetts, and Connecticut, but not in other New England States. In the summer and fall of 2023, blueberry leaf rust was found widely distributed in NH, including Merrimack, Hillsborough, and Strafford Counties. The disease can cause severe premature defoliation of affected bushes, which could affect winter hardiness of the canes, and have a direct impact on yield and reduction in flower bud development for the following year (<https://extension.unh.edu/resource/blueberry-leaf-rust>). This fungus has a wide host range including blueberry, cranberry, huckleberry, hemlock, spruce, azalea, and rhododendron. The wide distribution of the alternative hosts increases the difficulty in disease management.

Leaf rust pathogen is a heteroecious fungus requiring both primary and alternate host plants to complete its life cycle. In the northern US, the disease cycle begins in early summer when the windblown aeciospores spread from hemlocks, an alternate host, to infect young blueberry leaves. Leaf rust pathogen can tolerate a wide range of climates, but the disease is most severe in humid environments. The widespread outbreak in 2023 in NH might be due to the constant rain and prolonged period of humidity.

Removing hemlock trees, the alternative host of the leaf rust pathogen, around the blueberry fields is one of the management strategies. However, it is not practical in NH, since hemlock trees are a widespread native species that provide important ecosystem services. Even if you remove hemlock trees from your properties, the trees from your neighbors could still provide enough inoculum for spreading disease to your blueberry bushes. Also, leaf rust spores can travel great distances on wind currents making local removal of hemlocks a short-sighted and inefficient response.

Blueberry producers in NH primarily market their berries through pick-your-own operations and retail markets such as farm stands and farmers markets. Producing a reliable crop each year is vital to the long-term sustainability of their businesses. If blueberry leaf rust becomes a regular disease issue requiring management each year due to suitable climate conditions, growers, extension educators and researchers will need to have an effective approach to manage this disease. If left unmanaged and reoccurring for multiple years in a row, severe plant decline could occur, jeopardizing the long-term sustainability of these businesses in NH.

Blueberry leaf rust is an emerging disease in NH. This disease is a major threat in blueberry production in the southern US, current management of leaf rust disease relies on fungicide applications to maintain plant health. However, most of the fungicides used in southern US have not been registered in NH. Therefore, we propose to conduct the three-year fungicide efficacy trials in greenhouse and fields, and the data generated from this research will help blueberry growers in NH to make informed decisions in the management of this important emerging disease.

V. How will your goals be accomplished? (i.e., experimental design)

1. The fungicide trials will be conducted at the Macfarlane Research Greenhouse at the University of New Hampshire in 2024 and 2025.

A three-year-old blueberry (cultivar Jersey) plant and four replicated pots will be used in these trials. A total of 38 fungicides and bio-fungicides with commercial application rates will be sprayed on plants using a CO₂-powered backpack sprayer, and water will be used as a negative control. Twenty-four hours after the spray, the inoculum of urediniospores of blueberry leaf rust will be sprayed homogenously with a portable air-pump sprayer onto fully expanded leaves, and non-inoculated plants will be sprayed with distilled water. The inoculated plants will be incubated in a moisture chamber with 100% humidity for two days, then will be moved to the greenhouse at 23/18 degrees Celsius for observing the disease development. The disease will be rated every five days after the symptoms appear.

For the inoculum in greenhouse trials, the urediniospores will be collected from three commercial blueberry farms with the history of leaf rust in 2023 in NH, the spores will be collected from pustules on the lower leaf surface of blueberry using a vacuum pump. The spores will be collected into a gelatin capsule, diluted in a light mineral oil to a concentration of 1×10^6 spore/mL, and the mixture spores will be used for inoculation. All inoculated plants and controls will be arranged in a completely randomized layout and plants will be watered as needed.

2. The field trials will be conducted at the two farms in 2025 and 2026, which include the Woodman Horticultural Research Farm at University of New Hampshire with 10-year-old bushes, and a commercial blueberry farm located at Loudon, New Hampshire with 8-year-old bushes. The blueberry leaf rust was severed in both farms in 2023 and lead to significant defoliation.

Four replications of each treatment and an untreated control will be a randomized complete block design with each plot consisting of four adjacent sprayed bushes in a row, with one or more unsprayed plants separating each plot. Spray treatments will be applied using a CO₂-powered backpack sprayer delivering the equivalent of 50 gallons per acre (gpa) with a cone nozzle at approximately 60 psi and all treatments will be applied until runoff. On each spray date, applications will be made in a single timed pass down one side of each plot. Treatments will be applied at pre-bloom, full bloom, flower drop and small green fruit.

Visual ratings of only the oldest (Spring) growth leave will be used throughout the trials. Disease ratings will include incidence (percentage of leaves spot), severity (maximum number of spots observed on a single leaf), and percent leaf defoliation. Evaluations will be recorded on August 15, August 31, September 15, September 30, and October 15. Meanwhile, Leaf spot diseases such as Septoria leaf spot and Pestalotiopsis leaf spot will also be monitored in this experiment.

Table 1. Fungicides will be evaluated for control of blueberry leaf rust (total price is \$8680.00).

Synthetic fungicides	FRAC codes(a)	Active ingredients	Price \$
Bravo WeatherStik	M5	Chlorothalonil	150.00
Dithane F-45	M3	Mancozeb	120.00
Cabrio	11	Pyraclostrobin	270.00
Abound	11	Azoxystrobin	200.00
Quadris	11	Azoxystrobin	150.00
Aprovia	7	Benzovindiflupyr	350.00
Captan	4	Phthalimide	350.00
Cevya	3	Mefentrifluconazole	450.00
Proline	3	Prothioconazole	200.00
Tilt	3	Propiconazole	150.00
Quash	3	Metconazole	500.00
Orbit	3	Propiconazole	200.00
Indar	3	Fenbuconazole	360.00
Quilt Xcel	3	Propiconazole	300.00
Bumper 41.8 EC	3	Propiconazole	150.00
Fontelis	7	Penthiopyrad	200.00
Merivon	7 + 11	Fluxapyroxad + Pyraclostrobin	450.00
Luna	7 + 11	Fluopyram + Trifloxystrobin	200.00
Top Guard EQ	3 + 11	Flutriafol + Azoxystrobin	350.00
Switch	12 + 9	Fludioxonil + Cyprodinil	150.00
Tanos	27 + 11	Cymoxanil + Famoxadone	320.00
Quadris	11	Azoxystrobin	250.00
Pristine	11 +	Pyraclostrobin + Boscalid	200.00
Revus	40	Mandipropamid	520.00
Trilogy	2 + 3 + 11	Iprodione + Triticonazole + Trifloxystrobin	160.00
Cueva (organic control)	M1	Copper octanoate	100.00

Organic fungicides	FRAC codes(a)	Active ingredients	Price \$
Serenade	Biological	Bacillus subtilis	140.00
Double Nickel	Biological	Bacillus amyloliquifaciens	300.00
PurGrow 100%	/	Hypochlorous acid	/
PurGrow 10%	/	Hypochlorous acid	/
OSO 5% SC	/	Polyoxin D zinc salt	200.00
PureSprayGreen	/	Paraffinic oil	70.00
Howler	Biological	Pseudomonas chlororaphis	100.00
Theia	Biological	Bacillus subtilis	370.00
ThymeGuard	/	Essential oil	200.00
TimorexACT	/	Extract of the tea tree plant (Melaleuca alternifolia)	100.00
Cueva	M1	Copper octanoate	
Oxidate	/	Hydrogen Peroxide + Peroxyacetic acid	200.00
Sonata	Biological	Bacillus pumilus	200.00
Pristine (synthetic fungicide contr)	11 + 7	Pyraclostrobin + Boscalid	

(a) Fungicide Resistance Action Committee (FRAC) group. Products in the same FRAC group have the same or similar mode of action, with potential for pathogens to develop cross resistance to those products (except for products with the letter 'M' which have multiple modes of action with no record of fungicide resistance developing in pathogen populations).

VI. Sample Methods (if applicable)

VII. How will your data be evaluated?

All fungicide trials either in greenhouses or fields will be repeated once. The scoring of disease severity and percent leaf defoliation for each plant will be converted to a percentage value (midpoints, whereby 0 = 0%, 1 = 12.5%, 2 = 25%, 3 = 62.5%, and 4 = 87.5%). The percentage scores of the severity ratings will be used for statistical analysis. All analyses will be performed using Statistical Analysis Systems software (PC-SAS 8.0; SAS Institute, Cary, NC). Variances of the raw data for the repeat experiments of disease severity will be compared using Levene's test for homogeneity under the general linear model procedure (PROC GLM) of SAS version 9.3 (SAS Institute) to make sure two sets of data can be analyzed separately or in combination. In addition, data will be subjected to analyses of variance (ANOVA) and means comparisons using Tukey's multiple comparison test ($P = 0.05$) with PROC GLM of SAS with main effects of trials (experimental repeats), replications, and isolates or fungicides and the interaction of trials with isolates or fungicides. Isolates and fungicides will be considered fixed effects, whereas repeats of the trials, replications, and the interactions of trials with isolates or fungicides will be considered random effects. After the statistical analysis, the most effective fungicides will be selected based on both greenhouses and field experiments.

VIII. Explain how the results of your project will be shared/publicized. (papers, presentations, publications, advertisements, etc.) All published literature must contain a statement attributing funding to the New Hampshire Department of Agriculture, Markets and Food Integrated Pest Management Program. Publications must be submitted with the final report.

Our outreach plan will engage scientists, extension state specialists, field specialists and industrial representatives to disseminate the results to blueberry growers. Two levels of outreach and information dissemination will be accomplished. First, fungicides testing data will be published as extension newsletters or bulletins and will be reported at local and regional growers' meetings and field days. Second, the research results will be disseminated in high quality scientific journals such as Plant Disease

through the peer review process, and the information will be presented at scientific meetings such as American Phytopathological Society Conference (APS) and northeastern APS.

IX. Detail how other groups may adopt some of the information you learn or develop:

Both conventional and organic blueberry growers will have a direct and effective approach for management of blueberry leaf rust if the weather condition is favorable for disease spread. The recommendation regarding the use of fungicides will be incorporated into future editions of the Northeastern Small Fruit Management Guide and the New England Tree Fruit Management Guide (the current one does not have the management of blueberry leaf rust). The fungicide trials will be expected to help conventional and organic blueberry growers in NH make informed decisions regarding the use of synthetic and organic fungicides to control leaf rust, an emerging fungal disease in NH.

A complete list of all persons involved in the proposed project; include the names, addresses and phone numbers of the individuals

Bo Liu/State specialist in plant pathology and director of the UNH plant diagnostic lab
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Tyler Edwards/Plant pathology program manager of the UNH plant diagnostic lab
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