Onion Research and Development Program
2022-2023 Proposal

Project Title:

Exploring novel management tactics for onion maggot, onion thrips and IYSV

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New Research ☒
Amount Requested: $25,984

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Is this a duplicate submission to another entity Yes ☐ No ☒

- If funding is also being sought from other sources to support the proposed project is it
- Full Funding ☐ Partial Funding ☒
- Indicate the following:
  Source: **Federal Capacity Funds (FCF)(Cornell Hatch Project) ($180,000 over 3 years)**
  Amount: FCF funds will partially support a graduate student who will study onion maggot ecology and management (research not outlined here) as well as funding for CCE educators, Hoepting and Grundberg, who will conduct onion seed treatment trials (research described herein). This ORDP proposal seeks funds for Alan Taylor's program to treat onion seeds with insecticides because no funding was allocated for seed treating in the FCF project.

Project Summary:
Onion maggot and onion thrips are the most important pests of bulb onions in New York. Iris yellow spot virus (IYSV), which is transmitted by onion thrips, is causing severe Iris yellow spot (IYS) disease epidemics in the Elba muck. This year, management of IYSV was added as a high priority for the ORDP. Insecticide use is the most effective tactic for managing maggots and thrips and reducing the incidence and severity of IYS disease; however, there are some onion fields where onion maggot, onion thrips and IYS disease have not been effectively managed using the very best insecticides available. The goal of this proposal is to evaluate new products and approaches for managing onion maggot, onion thrips and IYS disease.

Onion maggot. The FarMore FI500 seed treatment package (Regard SC + Cruiser 5FS + fungicides) has been the industry standard for the past decade. However, beginning later next year, Syngenta will no longer offer FarMore FI500 that contains Regard SC. Rather, Trigard OMC will replace Regard SC in the FarMore FI500 package (=Trigard OMC + Cruiser 5FS + fungicide seed treatments). Currently, it is uncertain whether or not Corteva, the manufacturer of spinosad (= active ingredient in Regard SC), will offer spinosad as an onion seed treatment in the future. The potential loss of Regard SC seed treatment and the recent loss of chlorpyrifos in New York creates the need for identifying new active ingredients for onion maggot control as soon as possible. We propose to evaluate new and existing insecticides from BASF and other companies as seed treatments in 2022. All studies will be conducted in commercial onion fields in Orange, Orleans, Oswego and Wayne Counties on farms where onion maggot has been a problem. This project will be conducted by Nault, Taylor, Hoepting, Grundberg, a research technician, a temporary research technician, and onion growers who permit us to do the research in their fields.

Onion thrips. Thrips are generally controlled effectively following a season-long sequence of insecticides that are applied based on action thresholds, but outbreaks continue to occur and IYS disease epidemics are getting worse. Adult thrips infected with IYSV are now likely overwintering within and adjacent to onion fields. In the spring, adults emerge and are likely colonizing and spreading IYSV during the first half of the season. Movento/Senstar are applied first in the insecticide sequence for thrips control and their long residual activity typically permits a gap of two weeks before the next insecticide is needed in mid- to late July. Because Movento/Senstar are not very effective against thrips adults, the stage that transmits IYSV, the onion crop may be particularly vulnerable to IYSV through mid- to late July. An approach that focuses on early-season adult control should be evaluated to determine if this will reduce overall levels of IYS disease in the field. For onion thrips and IYS disease control, new and existing insecticides will be evaluated as foliar sprays to control thrips adults. This research will be conducted in both small-plot studies and in large field trials in the Elba Muck on farms where onion thrips and IYS disease have been a problem. This project will be conducted by Nault, Hoepting a research technician, a temporary research technician, and an onion grower who is willing to host this trial.

In addition to using insecticides to manage thrips and IYS disease, research is needed to evaluate commercially available onion cultivars that may be less vulnerable to both thrips and IYS disease. In 2021, Hoepting conducted a field trial designed to evaluate the sensitivity of various onion cultivars to bacterial bub rot. She also took data on thrips damage. Preliminary results indicated that thrips feeding damage generally increased as days to maturity of the cultivars decreased. However, there was a cultivar in each maturity class that stood out has having more thrips feeding damage than the others. For example, Trailblazer, Braddock and Red Wing had more thrips damage in the early, main and late maturity classes, respectively, than the other entrees. Crockett (118 days) had the least thrips feeding damage in the trial. There is a need to repeat this onion cultivar trial in 2022 to identify cultivars that may be less vulnerable to thrips damage and IYSV.

Outreach. Results of this project will be presented virtually and/or in person (depending on COVID-19 restrictions) at onion grower meetings (e.g., Empire State Producers EXPO, Orange County Onion School, Oswego County Twilight Meeting and Elba Muck Twilight Meeting) and provided on Nault's website. Information also will be shared via CCE newsletter articles

Desired and realistic outcomes of this project will be significant advancements in both maggot, thrips and IYS disease management. This project will directly serve the 50+ onion growers throughout New York, but also serves the public who desires more sustainable pest management practices and that provide food security.

Objectives:

1. To evaluate novel insecticide seed treatments to manage onion maggot
2. To determine if foliar insecticide applications made during the first half of the season will reduce overall adult thrips densities and IYS disease levels later in the season
3. To evaluate the performance of commercially available onion cultivars for tolerance against onion thrips and IYS disease.

Organizational Capacity:

Brian Nault (PI) – Will organize and lead this project. Equipped with field-based and lab-based resources required to execute the research proposed herein. Connected with growers and their fields to conduct the research. Results will be presented at grower meetings and also will be posted on the website http://nault.entomology.cornell.edu/.

Alan Taylor (Co-PI) – Decades of experience studying seed science and technology, including onion seed treatments for insect and disease control. Will treat onion seeds with insecticides using equipment in his lab for the maggot studies.

Christy Hoepting (Collaborator) – Will assist Nault in coordinating and conducting most of the field experiments in the Elba Muck that are outlined in this proposal. She has over 20 years of experience working on onion insect pest management.

Ethan Grundberg (Collaborator) – Will assist Nault in coordinating and conducting the onion maggot control experiment in Orange County. He has many years of experience working on onion insect pest management.

Objective 1:
To evaluate insecticides delivered as seed treatments to manage onion maggot

Task 1.1
Now that chlorpyrifos is no longer an option for onion maggot control in New York and the potential loss of Regard SC seed treatment, efforts to identify new active ingredients for maggot control is more important than ever. In this experiment, efficacy of a new active ingredient from BASF and possible new ones from other companies delivered as seed treatments will be compared with currently available onion seed treatment packages (i.e., FarMore FI500 and FarMore FI500 that contains Trigard rather than Regard) to control onion maggot. Multiple rates of these new active ingredients will be examined to determine the lowest rate that provides the highest level of maggot control. Seeds will be treated by Alan Taylor in his lab at AgriTech.

This trial will be conducted on two farms in each of Orange, Orleans, Oswego and Wayne Counties with a known high infestation of onion maggot. The experiment will include the following treatments: No insecticide, FarMore FI500, FarMore FI500 with Trigard OMC, Regard SC, Trigard OMC, BASF's new active ingredient at multiple rates, and other active ingredients or formulations of spinosad to be identified later. All seeds, including those without insecticides, will be treated with EverGol Prime and fungicides in the FarMore 300 package to protect plants from onion smut and other seedling diseases. Trials will be planted in April and maintained by Nault, Hoepting and Grundberg. Plots will be 2.5ft wide x 25ft long and contain two rows of onions. Treatments will be arranged in a randomized complete block design and each treatment will be replicated 5 times. The number of plants wilting and dying from first-generation onion maggot feeding will be recorded at least one time per week from late-May until early July. Before the second-generation emerges, a final plant stand count will be taken in all plots. Percentage of plants killed by maggots will be determined by dividing the number of plants killed by maggots by the sum of plants killed by maggots plus the number of plants remaining during the final stand count and then multiplied by 100. Data will be analyzed using a mixed model ANOVA with treatment as a fixed effect and replication as a random effect. Treatment means will be compared using a Tukey-Kramer pairwise comparison test at $P<0.05$.

Performance Measure 1.1.1
We expect to identify the most effective insecticides and the best rates of these insecticides that will effectively protect the onion crop from onion maggot damage. Because onion maggot pressure is anticipated to be high at most locations, treatments with less than 10% maggot damage will be considered commercially acceptable.

Objective 2:
To determine if foliar insecticide applications made early in the season will reduce overall adult thrips densities and IYS disease levels later in the season

Task 2.1
Small-plot field experiment targeting adult control. Movento and Senstar (spirotetrmat) are systemic and highly effective against onion thrips larvae, but much less effective against adults. Movento and Senstar are usually the first insecticides applied during the season to manage thrips infestations and their use occurs no earlier than mid- to late June. Typically, after two weeks of Movento and Senstar applications (late June through mid-July), a different insecticide is used that likely has better control of adults. The

consequence of this strategy is that the onion crop may be vulnerable to attack by viruliferous adults from mid-June through mid-July. Therefore, insecticides that are highly effective against adult onion thrips must be identified. To date, most of the information collected on onion thrips control using insecticides has involved either larval counts only or a combination of adults and larval counts, not adults only.
This small-plot trial will be conducted in an onion field in the Elba Muck that will likely experience a high infestation of onion thrips adults. To ensure high thrips pressure, the trial will be located in a mid- to late maturing field adjacent to an early maturing transplanted field because adults in the early transplants will migrate from that crop as it matures into the adjacent later maturing field. This experiment will include the following treatments: No insecticide, lambda-cyhalothrin (Lamcap II), methomyl (Lannate LV), lambda-cyhalothrin (Lamcap II) + methomyl (Lannate LV), spinetoram (Radiant SC), cyantraniliprole (Exirel), abamectin (Agri-Mek), abamectin + cyantraniliprole (Minecto Pro), Syngenta's newest active ingredient isocycloseram (Plinazolin), and azadiractin + pyrethrin (Azera). The onion field will be established by the cooperating grower who will likely transplant the crop in April or early May. Plots will be 5ft wide x 15ft long and contain four rows of onions; plots will have a 5 ft buffer of onions within rows. Treatments will be arranged in a randomized complete block design and each treatment will be replicated 4 times. Treatments will be applied using a CO_2–pressurized backpack sprayer and boom equipped with four, flat-fan nozzles (XR11002) calibrated to deliver 30 gallons per acre at 40 psi. Three or four weekly insecticide applications will be made to ensure that we capture a high influx of adults from a nearby early-maturing transplanted field, like Highlander. One week after each application, the number of adult thrips (plus larvae counted separately) will be visually recorded from 15 plants per plot. Statistical analyses will be conducted as described in Objective 1.

Performance Measure 2.1.1
We expect to identify multiple insecticides that will have a high level of activity against onion thrips adults.

Task 2.2
Large field experiment targeting control of thrips adults and IYS disease. The purpose of this experiment is nearly identical to the one described in Task 2.1, but also includes testing onions for IYSV and IYS disease. This large field experiment will be conducted in multiple onion fields in the Elba Muck where high infestations of onion thrips and high levels of IYS disease have commonly occurred. This experiment will include two treatments: 1) insecticide applications based on the onion thrips management program (= weekly scouting, action thresholds and a prescribed season-long sequence of insecticides), and 2) insecticide applications based on the onion thrips management program supplemented with weekly insecticide applications targeting thrips adults early in the season (prior to and during the period Movento/Senstar are applied). The early-season insecticide applications will begin at first detection of thrips or in early June, whichever comes first, and then extend through mid-July (n= 4-5 sprays). Based on our best guess, a tank mix of Lamcap + Lannate LV at maximum labeled rates will be used during this time. All applications will be made by the cooperating grower. Four pairs of adjacent transplanted onion fields, which will be planted with the same variety and similar date, will be identified in the central region of the Elba Muck. One field within each pair will be randomly chosen to receive the additional treatments.
One week after each application, the number of adult thrips (plus larvae counted separately) will be visually recorded from 100 plants per field. Additionally, in each field in early July and prior to 50% lodging, 200 plants will be randomly sampled and then taken to the laboratory and evaluated for IYSV using DAS-ELISA. Additionally, severity of IYS disease from 200 plants will be visually assessed twice during the season, once mid season and the next around 10% lodging. Severity of symptoms on these plants will be made using a 0-12 scale. Percent leaf dieback per plant will be estimated as well. Crop stage including number of green leaves per plant, stage of bulbing, % tipburn or % leaf dieback, and % lodging will be

recorded. Onion bulbs from 200 plants will be harvested and sorted by size and for culls, and each category counted and weighed. The percentage of bulbs with bacterial rot will be recorded as well.
Data will be analyzed following the general procedure described in Task 1.1.

Performance Measure 2.2.1
We expect that onion fields receiving the additional insecticide applications targeting onion thrips adults during the first half of the season will have lower thrips densities.

Performance Measure 2.2.2
We expect that onion fields receiving the additional insecticides targeting onion thrips adults during the first half of the season will have much lower levels of IYSV and IYS disease.

Objective 3:
To evaluate the performance of commercially available onion cultivars for tolerance against onion thrips, IYS disease and bacterial rot

Task 3.1
Previous research by Christy Hoepting in 2020 revealed differences in the performance of commercially available onion cultivars against onion thrips feeding damage, IYS disease and bacterial rot. The purpose of this experiment is to repeat her study with measures of thrips densities. The trial will be located in the northern portion of the Elba muck in the same general location as previous variety trials.
This experiment will have two separate planting dates, one in early April and the other one month later. In each planting, there will be 16 entrees consisting of early, main and late-maturing cultivars. These cultivars have a range of plant characteristics that differ in plant architecture, leaf color and vigor. Plot size will be one bed (5 ft wide) x 30 ft long. Plots later will be bisected into sub-plots such that half will remain untreated (5 ft x 15 ft), while the other half will receive weekly applications of insecticides to create a “positive undamaged control” (5 ft x 15 ft). These “positive controls” will be treated initially with insecticides when there is approximately 1 thrips per leaf and then will continue weekly until 50% lodging. The sequence of products will loosely follow the onion thrips management program in which two weekly applications of Movento will be followed by two weekly applications of Minecto Pro, and then two weekly applications of Radiant (Exirel will be used after Radiant if needed). Applications will be made using a CO_2–pressurized backpack sprayer and boom equipped with four, flat-fan nozzles (XR11002) calibrated to deliver 30 gallons per acre at 40 psi. All other pesticide inputs (herbicides and fungicides) will be applied over the entire test site.
Densities of onion thrips adults and larvae will be recorded separately every other week from 10 randomly selected plants per plot (untreated half only) until 50% lodging. Prior to excessive feeding injury by thrips, around the 5-7 leaf stage, plant characteristics will be evaluated. These will include visually rating plant architecture from upright to floppy leaves (1-10 scale), leaf color from green to blue (1-13 scale) and plant vigor (1-5 scale). Onion thrips feeding damage also will be evaluated prior to lodging for each cultivar. Damage will be estimated using a (1-10 scale) that considers the percentage of white foliage across each sub-plot (treated and untreated evaluated separately). At the same time, general plant height per plot will be recorded.
Severity of IYS disease will be visually assessed twice during the season, once mid season and the next around 10% lodging. Severity of symptoms will be made using a 0-12 scale and each sub-plot will be evaluated separately. Percent leaf dieback per plant will be estimated per plot at this time as well.

Crop stage including number of green leaves per plant, stage of bulbing, % tipburn or % leaf dieback, and % lodging will be recorded per plot (treated and untreated separately) whenever data are collected per plot.
Prior to harvest, onion plants that have prematurely died will be visually estimated per plot (both treatments separately). Onion bulbs will be harvested from the middle 13 feet of the inner two rows per plot (~ 140-160 bulbs), sorted by size and for culls, and each category counted and weighed. The percentage of bulbs with bacterial rot will be recorded as well.
Data will be analyzed following the general procedure described in Task 1.1.

Performance Measure 3.1.1
We expect that all onion cultivars in the first planting will have more thrips damage and IYS disease incidence and severity than those in the second planting.

Performance Measure 3.1.2
We expect that onion cultivars in the insecticide-treated sub-plots will have minimal thrips densities, thrips damage and IYS disease compared with those in untreated sub-plots. Insecticide treatment will be more effective in cultivars that are more tolerant to thrips than susceptible ones.

Performance Measure 3.1.3
We expect that there will be differences in thrips feeding damage, thrips densities and efficacy of insecticides among cultivars. We expect to identify cultivars that are susceptible and those that are tolerant to thrips feeding. With this information, growers will know which cultivars to avoid planting in thrips “hot spots” and which cultivars can endure thrips “hot spots”.

Performance Measure 3.1.4
We expect that there will be differences in IYS disease severity among cultivars. We intend to identify cultivars that are susceptible and those that are tolerant. This trial will provide an opportunity to further explore the relationship between thrips and IYS disease. For example, we may find that thrips density and/or feeding damage is not related to IYS disease expression. Thus, a cultivar that can tolerate high thrips pressure may not succumb to IYSV, or vice versa.

Performance Measure 3.1.5
We expect there to be differences in incidence of bub rot among cultivars. This trial design will provide an excellent opportunity to explore the relationship between onion thrips and bulb rot (which currently is controversial).

Performance Measure 3.1.6
We expect that cultivars that are tolerant to onion thrips and IYS disease will have significantly higher yields than those that are susceptible to onion thrips and IYS disease.

Outcome and Benefits Expected:
Below is a brief comment concerning the expected outcome for the various objectives.

Objective 1. New insecticide seed treatments will limit onion maggot damage to less than 10%, which would be considered commercially acceptable under high maggot pressure. Insecticide options for onion maggot are limited and identification of new products would be economically important to the industry.

Objective 2. Identifying the best thrips adulticides and then applying them during the first half of the season when viruliferous adults are likely colonizing onion fields should reduce thrips infestations and thereby reduce incidence and severity of IYS disease. While this approach increases the overall use of insecticides to manage this problem, we are hopeful that such an approach would only be needed where IYS has been a perennial problem. Increased bulb yields in fields where this approach is used will generate much greater profits, which will more than offset the cost of these additional insecticide applications.

Objective 3. Identifying specific onion cultivars that are less vulnerable to thrips feeding and damage, IYS disease and bacterial bulb rot will likely produce larger, higher-quality bulbs. This information will be invaluable for the onion industry as maximizing profits is important for farm viability.

Accomplishments/Benefits to Date:

See accompanying progress report by Nault for onion maggot management.

Research Experience Relevant to the Proposal:

Brian Nault (PI) - Experience studying onion maggot and onion thrips biology and management in onion in New York for 20 years.

Alan Taylor (Co-PI) – Decades of experience studying seed science and technology, including onion seed treatments for insect and disease control.

Christy Hoepting (Collaborator) – Experience studying onion maggot and onion thrips management in onion for 25 years, the last 20 years in New York.

Ethan Grundberg (Collaborator) – Experience studying onion maggot and onion thrips management in onion for the past 10 years in New York.

Budget:

SALARY				
POSITION TITLE (Exempt)	ANNUALIZED SALARY PER POSITION		PERCENT OF EFFORT FUNDED	TOTAL
POSITION TITLE (non-Exempt)	HOURLY PAY RATE PER POSITION	STANDARD WORK HOURS PER WEEK	NUMBER OF WEEKS FUNDED	TOTAL
Research Support Specialist III, Band G 10823 (Nault Program)	$21.00	20	26	$10,920.00
Temporary Technical Support, Unbanded 10986 (Nault Program)	$15.00	20	12	$3,600.00
Research Technician IV, Band D, 10955 (Taylor Program)	$32.05	39	4	$5,000.00
			Subtotal	$19,520.00
TOTAL SALARY				
			SALARY TOTAL	$19,520.00

OPERATING EXPENSES - TYPE/DESCRIPTION	TOTAL
Materials & Supplies - Field and lab supplies (Nault Program)	$500.00
Other Direct Expenses:	
Pesticides for large field trials (Nault Program)	$2,000.00
OPERATING EXPENSES - TOTAL	$2,500.00

OTHER EXPENSES - TYPE/DESCRIPTION	TOTAL
Indirect Costs - Direct Costs x 18%	$3,964.00
OTHER EXPENSES - TOTAL	$3,964.00
	$25,984.00

Objective 1: $5,000
Objective 2: $10,000
Objective 3: $10,000

Budget Justification:

Salaries and Wages:$19,520

Research Technician III (Nault Program):Will assist in conducting all field experiments involving onion maggot and onion thrips including planting onions, making pesticide applications, maintaining field plots, sampling plants for IYSV, collecting and analyzing field data.

Temporary Technical Support (Nault Program):Will assist in data collection. Nault will write the reports.

Research Technician IV (Taylor Program): Will treat all onion seeds with single and combinations of insecticides and fungicides.

Nault will be responsible for coordinating the research outlined above. Taylor will be involved in all seed treatment trials and will evaluate seed treatments for potential toxicity, germination issues and root growth inhibition. **NOTE**: Hoepting and Grundberg will conduct onion seed treatment trials in their respective locations and funding from the FCF grant will support their activities.

Operating Expenses:$2,500
Materials and Supplies:Plot stakes, flags, insecticide application items, PPE, etc. will be needed. Land used for these studies will be provided gratis by cooperating onion growers.

Other:Most pesticides used in this study will be donated by industry, but some will need to be purchased especially for the large field trials. Additionally, industry may provide some financial support for some of these insecticides, but their funds do not cover all costs incurred.

Other Expenses:$3,964
Indirect Costs 18%