Proposal number/Title/PI: 12A, Targeting SWD pupae using mycoinsecticides as part of an IPM program for control of spotted wing drosophila in caneberries, Tanigoshi

The following criteria were established to assist the reviewers in selecting biopesticide projects for funding that: (1) are either in a more advanced stage of development (as opposed to exploratory or early stage of development) or involve expansion of the label; (2) have a high probability of being registered/marketed in a reasonable period of time; and (3) will be useful in meeting pest control needs involving minor crops (uses), including minor uses on major crops.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Adequacy of investigators and facilities</td>
<td>of 10</td>
</tr>
<tr>
<td>2. Experimental design, work plan and preliminary research</td>
<td>of 10</td>
</tr>
<tr>
<td>3. Does experimental design allow to determine performance relative to conventional control practices and how the biopesticide might fit into IPM programs.</td>
<td>of 10</td>
</tr>
<tr>
<td>4. Evaluation of Budget</td>
<td>of 10</td>
</tr>
<tr>
<td>5. Relevance of the proposal toward the development of data for registration or label expansion of the biopesticide.</td>
<td>of 10</td>
</tr>
<tr>
<td>6. Evidence of Efficacy. Positive supporting data provided.</td>
<td>of 20</td>
</tr>
<tr>
<td>7. Probability of biopesticide being used by growers (factors such as effectiveness and economics of use rates should be considered).</td>
<td>of 10</td>
</tr>
<tr>
<td>8. Other control measures currently available to control target pest.</td>
<td>of 10</td>
</tr>
<tr>
<td>9. Probability of biopesticide being registered, time to registration, and if label expansion, time to market.</td>
<td>of 10</td>
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<tr>
<td>TOTAL*</td>
<td>of 100</td>
</tr>
</tbody>
</table>

Funding Recommendation
(Chooke appropriate line)

YES
NO
MAYBE

Note: Attach a comment page, should you have specific comments related to the proposal not covered in the above criteria.

* There is a possibility of 10 points per criteria (except efficacy=20) for a total of 100 points. A rating of 0 means that the proposal does not meet the criteria at all, while a rating of 10 means it is ideal.
IR-4 BIOPESTICIDE GRANTS COVER PAGE

2014

<table>
<thead>
<tr>
<th>Proposal Number (For IR-4 Use):</th>
<th>Principal Investigator: Lynell K. Tanigoshi</th>
</tr>
</thead>
</table>

Proposal Title: Targeting SWD pupae using mycoinsecticides as part of an IPM program for control of spotted wing drosophila in caneberries

Institution: Washington State University

Total dollars Requested (Year 1 only) $24,298

Enter each biopesticide/crop/pest combination

<table>
<thead>
<tr>
<th>No.</th>
<th>Biopesticide and/or Conventional Product TRADE Name</th>
<th>Active Ingredient</th>
<th>Crop</th>
<th>Pest (Weeds, Diseases, Insects)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mycotrol O</td>
<td><em>Beauveria bassiana</em> Strain GHA</td>
<td>Red Raspberry</td>
<td>Spotted wing drosophila, <em>Drosophila suzukii</em> (Matsumura)</td>
</tr>
<tr>
<td>2</td>
<td>BotaniGard 22 WP</td>
<td><em>Beauveria bassiana</em> Strain GHA</td>
<td>Red Raspberry</td>
<td>Spotted wing drosophila, <em>Drosophila suzukii</em> (Matsumura)</td>
</tr>
<tr>
<td>3</td>
<td>Met52</td>
<td><em>Metarhizium anisopliae</em></td>
<td>Red Raspberry</td>
<td>Spotted wing drosophila, <em>Drosophila suzukii</em> (Matsumura)</td>
</tr>
<tr>
<td>4</td>
<td>BotaniGard ES</td>
<td><em>Beauveria bassiana</em> Strain GHA</td>
<td>Red Raspberry</td>
<td>Spotted wing drosophila, <em>Drosophila suzukii</em> (Matsumura)</td>
</tr>
</tbody>
</table>
## Proposal Title:
Targeting SWD pupae using mycoinsecticides as part of an IPM program for control of spotted wing drosophila in caneberries

<table>
<thead>
<tr>
<th>Name</th>
<th>Street</th>
<th>City/State</th>
<th>Zip+4</th>
<th>Phone Number &amp; Fax Number</th>
<th>E-mail Address</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project Director (Principal Investigator): Lynell K. Tanigoshi</strong></td>
<td>16650 State Route 536</td>
<td>Mount Vernon/WA</td>
<td>98273-4768</td>
<td>P 360-848-6152, F 360-848-6159</td>
<td><a href="mailto:tanigosh@wsu.edu">tanigosh@wsu.edu</a></td>
</tr>
<tr>
<td><strong>Administrative Contact: Jeanne Burritt</strong></td>
<td>16650 State Route 536</td>
<td>Mount Vernon/WA</td>
<td>98273-4768</td>
<td>P 360-848-6123, F 360-848-6127</td>
<td><a href="mailto:jburritt@wsu.edu">jburritt@wsu.edu</a></td>
</tr>
<tr>
<td><strong>Financial Grant Officer: Jeanne Burritt</strong></td>
<td>16650 State Route 536</td>
<td>Mount Vernon/WA</td>
<td>98273-4768</td>
<td>P 360-848-6123, F 360-848-6127</td>
<td><a href="mailto:jburritt@wsu.edu">jburritt@wsu.edu</a></td>
</tr>
<tr>
<td><strong>Authorized Grant Official: Daniel Nordquist</strong></td>
<td>Neill 423, PO BOX 643140</td>
<td>Pullman, WA</td>
<td>99164-3140</td>
<td>P 509-335-7717, F 509-335-1676</td>
<td><a href="mailto:nordquist@wsu.edu">nordquist@wsu.edu</a></td>
</tr>
<tr>
<td><strong>Individual Responsible for Invoicing: Sponsored Programs Services</strong></td>
<td>240 French Admin. Bldg., PO Box 641025</td>
<td>Pullman, WA</td>
<td>99164-1025</td>
<td>P 509-335-2058, F 509-335-2071</td>
<td><a href="mailto:sps@wsu.edu">sps@wsu.edu</a></td>
</tr>
</tbody>
</table>

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**NOTE:** THIS IS FOR INFORMATIONAL PURPOSES ONLY. THIS IS NOT MEANT TO BE SIGNED. DO NOT DELAY SUBMITTING YOUR PROPOSAL BY ATTEMPTING TO GET THIS SIGNED. THIS IS NOT MEANT AS A REPLACEMENT FOR ANY INSTITUTIONAL APPROVAL PAGES.
I. Grant Stage

What is the grant Stage to which you are applying? Early or Advanced
(Check appropriate line)

___ Early – Biopesticide not yet registered and has not completed the
Tier I toxicology data requirements.

X Advanced – the biopesticide is registered or at least has completed
the Tier I toxicology data requirements.

If you are applying for any Advanced Stage Proposal, and the product is not currently
registered with EPA, provide a list of the toxicology work that has been completed. Ask
registrant or have company provide information to IR-4.
II. Introduction

Objective: Test the efficacy of *Metarhizium brunneum (anisopliae)* Isolate F52 and *Beauveria bassiana* Strain GHA as a supplemental IPM management strategy against a novel preimaginal life stage of spotted wing drosophila, *Drosophila suzukii* (Matsumura).

Spotted wing drosophila, SWD, is one of the few direct pests of caneberries in the United States and the most devastating. It first appeared in California in 2008 and quickly spread north to Washington State in 2009. Unlike most drosophila, *D. suzukii*, SWD, directly damages ripening fruit by oviposition. This accelerates softening and decay in an already fragile fruit impacts machine harvest and fresh market production. In addition, late season raspberry and blackberry harvest coincides with the yearly population peak for SWD. Caneberry damage by SWD ranged from 20-50% in both California and Washington in 2009. The Washington State Red Raspberry Commission has named SWD the number one destructive insect of soft fruits and it is on the IR-4 list of priorities.

Control of *D. suzukii* is difficult because of their cryptic larval stage inside the fruit leaving only the adult stage of this mobile fly as the susceptible target. Currently effective control strategies depend entirely on protective cover sprays which hamper picking schedules and risk exceeding maximum residue levels set by export markets. Pyrethroids have performed well as SWD adulticides but rotational partners for an effective insect resistance management program are lacking and drosophila are notorious for resistance development. Organic caneberry production is struggling with even fewer options.

The biology of SWD opens an avenue for management using a fungal pathogen applied to the soil. Three of the four SWD life stages, larvae, pupae and adults, come in contact with the soil, making it the habitat with the most untapped potential for managing this pest. From the time the larval stage exits the berry and falls to the soil to pupate, until the time of adult eclosion, represents the longest continual period of contact and susceptibility (4-15 days) to fungal infectivity in the fly’s life cycle. Mycoinsecticides have not been widely embraced because of slow mortality rates but this method which targets the slow developing pupal stage, provides the best opportunity thus far for their efficacy. Biological control using entomopathogenic fungi is especially appealing since its mode of action is contact, an excellent choice for non-feeding preimaginal SWD and unlike viruses and bacteria do not require ingestion. Three opportunities exist for infectivity: late 3rd instar exiting the fruit and dropping to the soil for pupation, pupation within the puparium and adult eclosion from the puparium. Spores produced by fungal pathogens contact the larval drosophila cuticle, germinate then penetrate the cuticle followed by internal hyphal development killing the fly and resulting in production of a subsequent generation of spores. This multiplication of spores creates a field reservoir with potential for longterm efficacy as suggested by the long application interval reported on the mycoinsecticide labels. Soil-applied *M. anisopliae*, have resulted in 80% larval mortality in a similarly behaved fly, the western cherry fruit fly, *Rhagoletis indifferentes*. Fungal pathogens provide a supportive role by suppressing the population through the addition of a reduced risk biopesticide to an overall IPM program. Application of environmentally safe mycoinsecticides, require only minimal personal protection, enhancing worker safety and allowing quick re-entry in this multiple picked crop.

Blackberries and late season red raspberries are increasingly being grown under protected high tunnels in Washington State. Protected structures provide UV protection and optimal conditions to encourage sporulation of fungal pathogens. Mycoinsecticides are exempt from MRL tolerances and an organic formulation can provide organic growers with an additional tool for managing SWD.
III. **Experimental Plan**

1. Met52 EC, Novozymes Biologicals, *Metarhizium brunneum (anisopliae)* Isolate F52, 11% w/w a.i., 5.5x10⁹ CFU/ml, applied at 15 fl oz/acre (4.9x10¹² CFU/acre), in 50-80 gallons water/acre.

2. Mycotrol O, Laverlam International Corp., *Beauveria bassiana* Strain GHA, 10.9% a.i., 2x10¹³ spores/quart, applied at a rate of 1 quart/acre, in 50-80 gallons water/acre.

3. BotaniGard 22WP, Laverlam International Corp., *Beauveria bassiana* Strain GHA, 22.0% w/w a.i., 2x10¹³ spores/pound, applied at a rate of 1 lb/acre, in 50-80 gallons water/acre.

4. BotaniGard ES, Laverlam International Corp., *Beauveria bassiana* Strain GHA, 11.3% a.i., 2x10¹³ spores/quart, applied at a rate of 1 quart/acre, in 50-80 gallons of water/acre.

5. Untreated Check

All treatments will be applied twice, pre-season when berries begin to ripen and mid-season in order to optimize exposure to late 3rd instar larvae, pupae and adults eclosing from puparia.

The field trials will take place on the Washington State University Mount Vernon Northwestern Washington Research & Extension Center late season red raspberry mixed cultivar field and an on-farm stakeholder late season ‘Cowles’ blackberry field. Both sites are approximately 0.07 hectare in size with similar row configuration. The WSU NWREC site consists of 3 rows on 10' centers, 180 feet in length (55 m), of mixed red/yellow raspberry. Individual plots will extend 30' from post-to-post, separated by a buffer of at least 1 post length and staggered from row-to-row to maximize informative results. Each treatment will consist of 3 replicates in a randomized complete block design for a total of 15 replicates/application.

All treatments will be applied as a 2' (≈61 cm) soil band beneath the canes using the standard equipment for cane-burning, an ATV-pulled, cane-burning system, consisting of a single flat-fan nozzle (TeeJet OC-06) at 40psi. Two applications will be made, pre-season when berries just begin to show color and mid-season. For the late season red raspberry plots, first application will occur at beginning color, approximately mid-August and second application made approximately 1 month later in mid-September. For the late season blackberry plots, the first application is anticipated near 1 August with the mid-season treatment approximately the first week in September since ‘Cowles’ harvest typically runs until the end of October or first part of November. The application schedule will be adjusted as needed to best-fit berry ripening in the individual fields. After each application, three locations will be selected/treatment replicate for a total of 15 SWD larval/puparia traps for each caneberry crop/application (30 larval/puparia traps/crop/trial). Total SWD larvae can be concentrated by selecting canes that are heavy with ripe berry clusters and by tying multiple canes together. Immediately following application, bucket rims will be pressed into place beneath the funnels and soil inside the rims hand-tilled, assisting in percolation of the spores into the upper 5mm strata.

The SWD late instar larvae/puparia traps consist of two parts: large plastic funnels and 5-gallon buckets (Fig. 1).

Three holes were drilled into each funnel so they could be suspended using twine, beneath clusters of ripe raspberry approximately 2-3 feet (~61 cm – 1 m) above the soil. Bucket rim traps were constructed by cutting 4” (10 cm) off the top of the rim of a 5-gallon bucket. The
open-ended funnel directs late instar SWD larvae into the 615 cm², rimmed area, creating the circular arena. This method confines the late instar SWD larvae, assisting in their recovery for analysis. A stick inserted into the open end of the funnel and pushed into the soil in the center of the rimmed area, eliminates potentially lost larvae due to misalignment from wind and interference by animals.

Temperature and relative humidity measurements will be recorded within the traps as well as in the crops as a whole, using a Hobo® temperature/relative humidity data logger (Onset). A thermocouple will be inserted 1 cm into the soil in one of the bucket traps. Maximum/minimum temperatures and RH will be recorded for the duration of the trial; trap placement – trap collection. Five days following placement of the rim traps, berry clusters above the rim traps will be visually checked to verify infestation and depending on levels of infestation, an insect-proof net cover with an elastic band will be stretched over each of the bucket rims. If necessary netting will be delayed depending on level of infestation by the berry clusters. Adults from each trap will be collected at three-day intervals for a period of 2 weeks, using an aspirator inserted into an overlapping slit in the netting. Captured adults will be counted and cohorts of flies representing each collection event will be placed in labeled, drosophila culture-vials, each filled with 2 cm of standard drosophila cornmeal diet. Differences in adult emergence from the field traps representing the 5 treatments/caneberry crop, particularly that of females, will be noted as delayed emergence may signify infection. Oviposition by collected females, will be closely monitored by allowing emergence of offspring from the 3-day collection vials, in order to determine effects of the infection on oviposition. “Fresh dead” flies will be collected and incubated in square Petri dishes with a ¼” layer of water agar, for a period of 3-5 days, to observe resultant sporulation characteristic of the two fungi and thus estimate prevalence of mycoses in the adult flies.

Weekly counts of adults in each treatment will be performed using a D-Vac vacuum insect net model # 122. Following the 2-week collection period for each application, approximately 2 cm depth of soil will be removed from inside the rim traps using a golf course cup cutter and sieved for remaining larval cadavers and puparia. Death by mycosis will be verified by incubation of surface sterilized cadavers/puparia at 98-100% RH. Percentage of infected adult and pupae/treatment, will be analyzed by ANOVA, SAS and means separated with Fisher’s Protected LSD, P<0.05. Adult D-Vac counts will be compared between treatments. In addition, replicate 1-gram soil samples will be removed from the surface 1 cm of soil. These samples will be subjected to serial soil dilution and plating on Beauveria and Metarhizium selective media to determine the colony forming units (viable spores) /gram of soil. These data will allow determination of the conidia concentrations in parallel with observed efficacy.

2. What crops or sites will this study be conducted on?
Caneberries (Red Raspberry and Blackberry).

3. What experimental design will be utilized?
Combined plots for both caneberries are approximately 1/3 hectare. Treatments will be applied to the soil. Each treatment will consist of 3 replicates for a total of 15 replicates/caneberry crop. A complete randomized block design will be used to test efficacy of the biopesticides. Percentage of infected adult and pupae/treatment, will be analyzed by ANOVA, SAS and means separated with Fisher’s Protected LSD, P<0.05. Soil-applied mycoinsecticide treatments are intended to be a supplemental approach combined with conventional foliar applied adulticides but in these trials no other conventional insecticides will be applied to the canopy plots in order to test if targeting preimaginal SWD using these biopesticides is efficacious. Under the treatment lists and design of biopesticide studies, this methodology fits into residue reduction – or short preharvest interval design because of the tight picking schedules (1-3 days) and multiple harvests required by caneberries.
4. How many locations (field or greenhouse)? How many replications?
Two field sites located at Washington State University Mount Vernon Northwestern Washington Research & Extension Center, Mount Vernon, WA 98273 and a local stakeholder on-farm site in near WSU NWREC in Skagit County, WA. Five treatments with 3 replicates each for each of the two different caneberry crops, 15 replicates x 2 for a total of 30 replicates for each of the two applications.

5. Describe how this proposal is designed to provide information on how it fits into an integrated pest management program.
Spotted wing drosophila is proving to be a difficult pest to control. IPM has for the most part been replaced with calendar sprays focusing primarily on pyrethroids and organophosphates. Control most likely will depend on more complex methodology than current industry methods and will include multiple approaches and modes of attack. Soil applied mycoinsecticides can be used simultaneously with current conventional and organic SWD programs in canebberries. Supplementing current SWD conventional and organic methods, which focus only on foliar adulticides with soil-applied mycoinsecticides, separates the caneberry habitat into two distinct niches, targeting 3 of the 4 life stages rather than only the adults and maximizing every opportunity to control the insect. Adding a long residual mycoinsecticide product with 0 PHI and brief REI is highly compatible with the multiple pick caneberry crops and will reintroduce IPM methods, providing protection from resistance development.

The trap design introduced in this experiment and developed by WSU NWREC researchers allows larvae to drop naturally into the soil, utilizing the insects’ natural field behavior to generate the most realistic data on potential of field infectivity. Screening adults emerging from the rim traps as well as recovery of larval cadavers and puparia will determine efficacy of the 4 different formulations of mycoinsecticides to SWD as well as potential for auto-dissemination of the spores to the foliage and to other flies increasing the potential of natural epizootics following field applications. Incorporating the spores into the upper 5mm strata provides natural UV protection and positive results may allow applications to unprotected caneberry fields. Holding adults, larvae and puparia for sporulation will provide a true field snapshot of % infectivity, timing and greater knowledge of the field ecology of mycoinsecticides.

6. Data collection – (Describe what data will be collected such as crop yields, crop quality, etc. If visual efficacy evaluations will be collected, describe the rating scale used and the evaluation timings).
Infectivity data will be gathered from adult flies emerging from the bucket rim traps and larval and pupal cadavers sieved from soil within the rim traps, will provide information which will separate infectivity by *M. brunneum* and *B. bassiana* from other causes of mortality. Our collaborator, Stefan Jaronski, USDA ARS will verify infectivity by the specific entomopathogenic fungi. Adult SWD will be counted in the weekly D-Vac vacuum samples, to detect differences in adult populations between treatments.

7. Describe the pests to be controlled, the degree to which they are a problem in your state or region and the frequency that they occur (season long problem, every year, every few years).
SWD first appeared in Washington State in 2009. Caneberry damage by SWD ranged from 20-50% in both California and Washington in 2009. SWD has established in Washington and their yearly appearance coincides with the red raspberry season. Peak SWD populations occur with the harvest of late season raspberry and blackberry varieties making them highly susceptible to damage. The Washington State Red Raspberry Commission has named SWD the number one destructive insect of soft fruits and it is on the IR-4 list of priorities.
8. Will the crop be inoculated with the target pest or otherwise be brought into the test system to ensure that it will be available for evaluation? If not, describe the frequency of occurrence. Every year since their first entry into Washington State, our late season red raspberries have been infested. We have chosen these fields along with a late season blackberry cultivar at a local on-farm location, which is also infested.

9. What is the proposed start date and completion date? Also describe this in chronological order in the context of the experimental plan. Two applications will be made, pre-season when berries just begin to show color and mid-season. For the late season red raspberry plots, first application will occur at beginning color, approximately mid-August and second application made approximately 1 month later in mid-September. For the late season blackberry plots, the first application is anticipated near 1 August with the mid-season treatment approximately the first week in September since ‘Cowles’ harvest typically runs until the end of October or first part of November. The application schedule will be adjusted as needed to best-fit berry ripening in the individual fields. These timeframes fit the 2-week schedule of data collection following each application and match commercial harvest.

10. Describe the test facilities where these studies will be conducted. Samples of adult flies and larval cadavers and pupae will be treated and held for observing sporulation (according to the detailed experimental methods) at the WSU NWREC Entomology Laboratory. The WSU facility is equipped with environmental chambers, which can be set to encourage sporulation. Verification of specific entomopathogenic fungi will be performed by Stefan Jaronski, USDA ARS NPARL facility in Sidney, Montana. The USDA ARS facility is fully equipped to analyze microbial specimens, Dr. Jaronsky’s specialty.

11. Budget: Provide an itemized budget, with categories such as labor, supplies, travel, etc. Provide a grand total. Note: Overhead costs are not permitted. Funding is only awarded on a per year basis, if this is a multiple year proposal, divide the budget for each year. Also include a list of support from the registrant and/or other sources. Provide information on other sources of monetary support and in-kind contributions from growers (land, plant material, etc). See Budget and budget details attached in appendix.

12. Describe why this product is needed and why growers are likely to use this product. (Also list alternative conventional and alternative biopesticide treatments)

Current methods for controlling SWD require weekly cover sprays. Entrust® (spinosad) is the only organic insecticide with any residual activity. If effective, this supplemental method of soil applied Mycotrol O, will provide organic growers with an additional tool with potential long residual, for managing SWD. Mycoinsecticides are costly but costs average $80/acre but its likelihood for longterm residual activity reduces applications and thus cost over an entire season. Pyganic® has no residual and neem products have not proven to be efficacious. Mycotrol O, like the other three products tested, is MRL exempt. Conventional growers have adopted a calendar spray approach using primarily pyrethroids and organophosphates. This approach risks exceeding tolerance levels for foreign target markets. Mycoinsecticides are exempt from MRL tolerances and there would be no risk in supplementing current conventional programs with this approach. Spinosad products have not performed well in caneberries and a genetic predisposition for resistance development in a closely related species of drosophila, Drosophila melanogaster, has been identified and suggests a possible similar scenario for SWD. In addition, the heavy insecticide application schedule interferes with the multiple development of beneficial insects and results in a reduction of the natural enemies of SWD.
picking schedules required by caneberries. Opportunity to add a component, which does not interfere with picking schedules, effectively targets a completely separate niche than current grower approaches, which has in another similarly behaved dipteran, western cherry fruit fly, resulted in 80% larval mortality, would suggest it would be embraced by organic and conventional growers alike.

Appendix 1

**PCR Forms.** Please fill out the attached Project Clearance Request Form for each biopesticide/crop combination involved in your proposal. (Not needed for Demonstration Stage Proposals).

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IR-4 Minor Use Biopesticide (*Required Fields) Project Clearance Request (PCR) Form

1. **Requestor:** Lynell K. Tanigoshi  
   *Affiliation:* Washington State University, Mount Vernon Northwestern Washington Research & Extension Center  
   *Address:* 16650 State Route 536  
   *City:* Mount Vernon  
   *State/Territory:* WA  
   *Zip:* 98273  
   *Telephone:* (360) 848-6152  
   *Fax:* (360) 848-6159  
   *E-mail address:* tanigosh@wsu.edu

2. **Pest Control Product (Active Ingredient {a.i.}):** *Metarhizium anisopliae Strain F52*  
   *Trade Name/Formulation:* Met52 EC (an EC formulation of the fungus)  
   *Registrant manufacturer:* Novozymes Biologicals, Salem VA  
   *Method of Production:* Fermentation

3. **Commodity (one crop or crop group per form):** Caneberries  
   *Use Site (e.g., field, greenhouse, post-harvest):* High tunnels  
   *Parts Consumed:* Berry  
   *Animal Feed By-Products:* Yes  
   *Planting Season:* Perennial  
   *Harvest Season:* late summer  
   *State/Territory Acreage:* 0.4  
   *% National:* NA  
   *Average Field Size:* <1 acre

4. **Insect/Disease/Weed:** Spotted wing drosophila  
   *Damage caused by pest:* ovipositional injury and larval feeding in maturing berries

5. **Why is this use needed?:** Spotted wing drosophila pupate in the soil. We need to evaluate the efficacy of Met52 EC sporulation on late instar larvae dropping to the soil to pupate. This selective treatment may provide long term residual with minimal impacts on natural enemies while providing an additional chemical tactic to reduce season long population increase by reducing adult emergence.

6. **Proposed Label Instructions**  
   *Rate per Application (lbs a.i. per acre or 1000 linear ft):* 15 fl oz/ac in 50-80 gal water/ac
Type of sprayers that may be used (e.g., fixed wing, ground boom sprayer, chemigation, air blast, ULV, granular spreader): ground boom sprayer

Range of Spray Volume (if applicable): Adequate water to move Met52 into the top 2 inches of soil

Maximum Acreage Treated per Day: No limit except practical

*Crop Stage during Application(s): Pink stage through harvest

*Maximum no. of applications: No regulatory limit; economic limits may exist

Minimum interval between applications: N/A

Maximum lbs active ingredient per acre per year/season: No limit

*PHI: N/A

7. *Availability of Supporting Data*: *Phytotoxicity(P) No phytotoxicity reported by registrant

*Efficacy(E) Undetermined

*Yield(Y) N/A

*Supporting data may be required before a residue study will be initiated.

8. *Submitted By (print name): Lynell K. Tanigoshi

*Signature: Lynell Tanigoshi

Date: 12/5/13

FOR OFFICE USE ONLY

Date: _____________

Cat: _____________ PR# _____________

IR-4 Minor Use Biopesticide (*Required Fields)

Project Clearance Request (PCR) Form


*Address: 16650 State Route 536

*City: Mount Vernon *State/Territory: WA *Zip: 98273

*Telephone: (360) 848-6152 FAX: (360) 848-6159

E-mail address: tanigosh@wsu.edu

2. *Pest Control Product (Active Ingredient [a.i.]): Beauveria bassiana Strain GHA

*Trade Name/Formulation: BotaniGard ES

Registrant (manufacturer): Laverlam International Corporation

Method of Production (Fermentation, in vivo, extraction from plants): Fermentation

3. *Commodity (one crop or crop group per form): Caneberries

*Use Site (e.g., field, greenhouse, post-harvest): High tunnels

Parts Consumed: Berry Animal Feed By-Products: Yes No X

Planting Season: Perennial Harvest Season: Late summer

State/Territory Acreage: 0.4 % National: N/A Average Field Size: <1 acre

4. *Insect/Disease/Weed: Spotted wing drosophila

Damage caused by pest: Ovipositional injury and larval feeding in maturing berries

5. *Why is this use needed?: Spotted wing drosophila pupate in the soil. We need to evaluate the efficacy of BotaniGard ES sporulation on late instar larvae dropping to the soil to pupate. This selective treatment may provide long term residual with minimal impacts on natural enemies while providing an additional chemical tactic to reduce season long population increase by reducing adult emergence.

6. *Proposed Label Instructions

*Rate per Application (lbs a.i. per acre or 1000 linear ft): 1 qt/ac in 50-80 gal water/ac

Type of sprayers that may be used (e.g., fixed wing, ground boom sprayer, chemigation, air blast, ULV, granular spreader): ground boom sprayer
Range of Spray Volume (if applicable): Enough water to ensure good coverage of treated area

Maximum Acreage Treated per Day: No limit except practical

*Crop Stage during Application(s): Pink stage through harvest

*Maximum no. of applications: No regulatory limit; economic limits may exist
Minimum interval between applications: 5-10 days

Maximum lbs active ingredient per acre per year/season: No limit

*PHI: 7

7. **Availability of Supporting Data**: *Phytotoxicity (P)*: No phytotoxicity reported by registrant

*Efficacy (E): Undetermined

*Yield (Y): N/A

Supporting data may be required before a residue study will be initiated.

8. **Submitted By (print name):** Lynell K. Tanigoshi

*Signature: ________________

Date: 12/5/13

FOR OFFICE USE ONLY

Date:
Cat: PR #:

---

IR-4 Minor Use Biopesticide (*Required Fields)
Project Clearance Request (PCR) Form

1. **Requestor:*** Lynell K. Tanigoshi, affiliation: Washington State University, Mount Vernon Northwestern Washington Research & Extension Center

*Address: 16560 State Route 536

*City: Mount Vernon

*State/Territory: WA

*Zip: 98273

*Telephone: (360) 848-6152

*FAX: (360) 848-6159

*E-mail address: tanigosh@wsu.edu

2. **Pest Control Product (Active Ingredient {a.i.}):** Beauveria bassiana Strain GHA

*Trade Name/Formulation: BotaniGard 22WP

Registrant (manufacturer): Laverlam International Corporation

Method of Production (Fermentation, in vivo, extraction from plants): Fermentation

3. **Commodity (one crop or crop group per form):** Caneberries

*Use Site (e.g., field, greenhouse, post-harvest): High tunnels

Parts Consumed: Berry

Animal Feed By-Products: Yes _ No X

Planting Season: Perennial

Harvest Season: Late summer

State/Territory Acreage: 0.4

% National: N/A

Average Field Size: <1 acre

4. **Insect/Disease/Weed:** Spotted wing drosophila

Damage caused by pest: Ovipositional injury and larval feeding in maturing berries

5. **Why is this use needed?:** Spotted wing drosophila pupate in the soil. We need to evaluate the efficacy of BotaniGard 22WP sporulation on late instar larvae dropping to the soil to pupate. This selective treatment may provide long term residual with minimal impacts on natural enemies while providing an additional chemical tactic to reduce season long population increase by reducing adult emergence.

6. **Proposed Label Instructions**

*Rate per Application (lbs a.i. per acre or 1000 linear ft): 1 lb/ac in 50-80 gal water/ac

Type of sprayers that may be used (e.g., fixed wing, ground boom sprayer, chemigation, air blast, ULV, granular spreader): ground boom sprayer

Range of Spray Volume (if applicable): Enough water to ensure good coverage of
treated area

Maximum Acreage Treated per Day: No limit except practical

*Crop Stage during Application(s): Pink stage through harvest

*Maximum no. of applications: No regulatory limit; economic limits may exist

Minimum interval between applications: 5-10 days

Maximum lbs active ingredient per acre per year/season: No limit

* PHI: 0

7. *Availability of Supporting Data*:

*Phytotoxicity (P): No phytotoxicity reported by registrant

*Efficacy (E): Undetermined

*Yield (Y): N/A

Supporting data may be required before a residue study will be initiated.

8. *Submitted By (print name):* Lynell K. Tanigoshi

*Signature: *Lynell K. Tanigoshi* *Date: 12/5/13

FOR OFFICE USE ONLY

Date: 

Cat: PR# 

IR-4 Minor Use Biopesticide (*Required Fields)  
Project Clearance Request (PCR) Form

1. *Requestor: __Lynell K. Tanigoshi__  
   Affiliation: Washington State University, Mount Vernon Northwestern Washington Research & Extension Center  
   *Address: 16650 State Route 536  
   *City: Mount Vernon  
   *State/Territory: WA  
   *Zip: 98273  
   *Telephone: (360) 848-6152  
   FAX: (360) 848-6159  
   *E-mail address: tanigosh@wsu.edu

2. *Pest Control Product (Active Ingredient {a.i.}): Beauveria bassiana Strain GHA  
   *Trade Name/Formulation: Mycotrol O  
   Registrant (manufacturer): Laverlam International Corporation  
   Method of Production (Fermentation, in vivo, extraction from plants): Fermentation

3. *Commodity (one crop or crop group per form): Caneberries  
   *Use Site (e.g., field, greenhouse, post-harvest): High tunnels  
   Parts Consumed: Berry  
   Animal Feed By-Products: Yes  
   Planting Season: Perennial  
   Harvest Season: Late summer  
   State/Territory Acreage: 0.4%  
   National: N/A  
   Average Field Size: <1 acre

4. Insect/Disease/Weed: Spotted wing drosophila  
   Damage caused by pest: Ovipositional injury and larval feeding in maturing berries

5. *Why is this use needed?: Spotted wing drosophila pupate in the soil. We need to evaluate the efficacy of Mycotrol O sporulation on late instar larvae dropping to the soil to pupate. This selective treatment may provide long term residual with minimal impacts on natural enemies while providing an additional chemical tactic to reduce season long population increase by reducing adult emergence.

6. *Proposed Label Instructions  
   *Rate per Application (lbs a.i. per acre or 1000 linear ft): 1 qt/ac in 50-80 gal water/ac  
   Type of sprayers that may be used (e.g., fixed wing, ground boom sprayer, chemigation, air blast, ULV, granular spreader): ground boom sprayer  
   Range of Spray Volume (if applicable): Enough water to ensure good coverage of treated area  
   Maximum Acreage Treated per Day: No limit except practical  
   *Crop Stage during Application(s): Pink stage through harvest  
   *Maximum no. of applications: No regulatory limit; economic limits may exist  
   Minimum interval between applications: 5-10 days  
   Maximum lbs active ingredient per acre per year/season: no limit  
   *PHI: 0

7. *Availability of Supporting Data*: *Phytotoxicity(P) No phytotoxicity reported by registrant  
   *Efficacy(E) Undetermined  
   *Yield(Y) N/A  
   Supporting data may be required before a residue study will be initiated.

8. *Submitted By (print name): Lynell K. Tanigoshi*  
   *Signature: [Signature]*  
   Date 12/5/13:

Appendix 2  
Labels – Supply the label or the proposed label of the biopesticide(s) to be evaluated.  
(Note: Labels of conventional products are not needed.). All of the biopesticides to be evaluated are conventional EPA registered products.
Appendix 3

Supporting preliminary data
While no preliminary supporting pathology research has been conducted, the bucket collection method has been tested and recovery of pupae was verified. This preliminary study supports the potential success of our proposal.

SWD Puparia Recovery 6 November 2013 WSU NWREC Red Raspberry Field
On 6 November 2013, one rim-trap (Fig 4) was sampled for SWD puparia. The rim was removed and a cup cutter was used to extract the soil inside the circled area defined by the rim. Approximately 2.5 gallons of soil was removed to a depth of 4 inches. Soil was placed into a pair of sieves, No. 16 (1.18 mm) and No. 8 (2.36 mm) mesh and rinsed with a garden hose, to remove the dirt. The remaining material was brought to the lab and sorted to find puparia. Many pieces of puparia were recovered along with 6 intact puparia and a severely damaged puparium as a result of the recovery process. The backlit photograph (Fig. 1) made under the dissecting microscope shows the 6 intact puparia in various states of development. Numbering from left to right in the photograph, #1 appears to show a darkened abnormal form inside the puparia as if the larva had atrophied. Number 2 shows a fly inside with advanced development, including red eyes and thoracic setae visible through the puparia but the wings are not as dark as they are in #3 and #6. Numbers 3 and 6 appear to have developed the furthest, however red eyes typical of late stage development, are not visible. Numbers 4 and 5 exhibit earlier stage of development and the puparium color of #5 is lighter than the remaining viable puparia suggesting hardening was also halted at an early stage. By 12 November a male SWD had eclosed and a female eclosed the next day, 13 November, numbers 2 and 5 (Fig. 1). By 15 November, four puparia remain intact from the original 6 recovered. Freezing nighttime temperatures occurred twice (Oct 29 and Oct 30, 31°F and 32°F respectively) prior to collection but soil temperatures have not gone below 47°F by the time of pupal recovery on 6 November. Average soil depth of the puparia remains unknown because soil plug samples did not stay intact. Careful scraping of the soil, layer by layer to uncover puparia in situ will be necessary to determine average soil puparium depth however it is believed to be shallow. As of 6 November, puparia are still able to develop when brought into a warm environment.

Appendix 4
Lynell K. Tanigoshi, Professor
Department of Entomology
WSU Mount Vernon Northwestern Washington Research and Extension Center
16650 State Route 536
Mount Vernon, WA 98273-9788
Phone: (360) 848-6152, Fax: (360) 848-6103-6159

E-mail: tanigosh@wsu.edu

Education:  
BS California State University, Long Beach 1963  
MS California State University, Long Beach 1968  
Ph.D. University of California, Riverside 1973

Experience:  
1972-77 Research Associate, WSU, Wenatchee, WA  
1977-83 Research Entomologist, USDA/ARS, Riverside, CA  
1983-88 Assistant Professor, Associate Entomologist, Washington State University  
1988-95 Associate Professor, Associate Entomologist, Specialist E-3, Washington State University  
1990 USAID Consultant, Biological Control, Thailand  
1990-1991 Fulbright Scholar, IITA, Republic of Benin  
1991 University of Amsterdam Fellowship  
1993 USAID/Peace Corps Consultant, IPM, Morocco  
1995-2003 Associate Entomologist, Specialist E-3  
2003 Professor, Entomologist, Washington State University

Professional Organizations:  
Entomological Society of America  
Acarological Society of America

Research Emphasis: Current research interests include insect and spider mite pest management in small fruits, nurseries, greenhouses, potato and the management of the invasive spotted wing drosophila. Emphasis will be placed on integrated pest management and applied biological control research technologies to economically control arthropod pests of blueberries, caneberries and strawberry through selective pesticides, augmentative releases and conservation of predatory mites and parasitic wasps when deemed appropriate.

Selected Publications:

Entomological Science (in press).


Recent major grant support:

USAID-IPM CRSP SE Asia. Strawberry IPM utilizing native predatory mites for biological control of spider mites in La Trinidad, Province of Benquet. $33,932.

WSDA/USDA Specialty Crop Block Grant Program. 2010-2012. Cut flowers: Developing sustainable insect management techniques and marketing strategies, including the underserved minority Hmong farmers. $245,033.

Appendix 5

If you were funded last year, submit a progress or final report. This must be submitted regardless of whether or not the current proposal is related to the previous one.
Not applicable.

Appendix 6

Registrant support. Please submit your proposal to the registrant and request the registrant or potential registrant fill out the registrant questionnaire form and submit this to IR-4. Letters of support from the registrant as well as grower or commodity groups are encouraged.

December 4, 2013

Lynell K. Tanigoshi
WSU NW WA Research and Extension Center
16650 State Route 536
Mount Vernon, WA 98273-4768
Dear Dr. Tanigoshi:

The WA Red Raspberry Commission (WRRC) is pleased to support the proposal being developed by Drs. Tanigoshi and Stefan Jaronski to investigate the potential of soil applied mycoinsecticides, Metarhizium brunneum (anisopliae) isolate F52 and Beauveria bassiana Strain GHA, for control of spotted wing drosophila, Drosophila suzukii (Matsumura) as part of an overall IPM program for managing SWD in caneberries. SWD control remains one of the WRRC’s top concerns and research priorities.
This practice would be a non-chemical, 0 PHI approach as an additional IPM strategy. The objective is to test the efficacy of a soil applied mycoinsecticides against the novel target, preimaginal stages of SWD, previously ignored. This project involves scientific and stakeholder participation through on-farm field trials to investigate efficacy of a non-chemical rotational partner to reduce risk of insecticide resistance, provide economic benefits to growers by reducing chemical insecticides through use of an MRL tolerance-exempt biopesticide, while minimizing negative human and environmental impacts.
Key personnel include entomologists with expertise in spotted wing drosophila management in caneberries and an entomopathogenic fungi expert with a specialty in Metarhizium based biopesticides.
The proposed research may play an important part in new strategies needed for additional control with 0 tolerance issues for berry exporters in Washington and the entire Western IPM region which produces nearly 100% of the caneberry crop (2010, NASS). The WRRC will work with the research team to distribute the results of this study to our growers. We strongly encourage the IR-4 team to support this work.

Sincerely,

Henry Bierlink
Executive Director
### BIIPESTICIDE PROJECT BUDGET

**Project Period:** From: 08/01/2014  To: 07/31/2015

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<th>A. Senior/Key Person</th>
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<td>2. Publication Costs</td>
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<td>6. Equipment or Facility Rental/User Fees</td>
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<tr>
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<td>$14,886.00</td>
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<tr>
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<td>$5,343.00</td>
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**Each budget item requires documentation**

**IMPORTANT**

On a separate sheet provide the following information: Project title, PI name and one paragraph statement of work
Identify each budget item individually - provide cost and a written description and/or purpose for the cost.
For rentals and fees: identify type of rental or fee and provide rental rate & purpose for the cost Any contractual work will require a separate budget and statement of work including rate and purpose

The Other category **MAY NOT** include construction or indirect overhead. These costs are not permitted, under any circumstances, under this grant.

1 Indicate in a footnote if the matching funds are monetary or in kind and their source
Please enter all values to the nearest hundred dollars.
Project title: Targeting SWD pupae using mycoinsecticides as part of an IPM program for control of spotted wing drosophila in caneberries

PI: Lynell K. Tanigoshi

Statement of Work:
Washington State University and USDA ARS will conduct a field evaluation of two mycoinsecticides: Novozymes Biologicals Met52 (Metarhizium brunneum (anisopliae)), and Laverlam International Corporation’s Beauveria bassiana Strain GHA products, Mycotrol O, BotaniGard 22WP, BotaniGard ES for efficacy against spotted wing drosophila, Drosophila suzukii (Matsumura). Mycoinsecticides suppress the population and will provide the addition of a reduced risk biopesticide to an overall IPM program. Four treatments including an untreated check, will be applied in three replicates twice/season as a 2’ band beneath the canes at berry ripening and mid-season using an ATV-pulled, cane-burning system, consisting of a single flat-fan nozzle. Bucket rim traps consisting of a 4” rims cut from standard 5 gallon buckets will be pressed into the soil beneath clusters of berries. A large plastic funnel hung beneath the berry clusters concentrates the dropping SWD larvae into the rimmed area. Immediately following the applications, soil within the rims will be fluffed to incorporate the spores into the top layer of soil and 5 days later insect-proof nets will be stretched over each of the bucket rims to collect any emerging adult SWD. After 5 days, adults from each trap will be collected at 3-day intervals for a period of 2 weeks. Captured adults will be counted and placed in labeled, culture-vials to observe oviposition effects from infectivity. Dead flies will be incubated to promote sporulation. At 14 DAT the soil will be removed in the bucket rim traps to a depth of 3 inches and sieved to recover pupae. Pupae will be held in culture vials for emergence or evidence of sporulation.

Budget details:

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<th>Cost</th>
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<td>Salaries</td>
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<td>Research Associate salary (3.25 mos @ $4,580/mo)</td>
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<td>Benefits</td>
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<td>Research Associate @ 35.89% benefits</td>
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<td>Mileage Sidney MT to Mount Vernon, WA 2,286 roundtrip $1,292 @ $0.565/mi $546 (motel 6 nights) and 6 days per diem $366 @ $61/day to conduct field trials and observe post treatment effects</td>
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<tr>
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<td>Flight to Sidney, MT $665, motel $420 (4 nights) and per diem $280 (5 days @ $56/day) Training in insect pathology laboratory techniques.</td>
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<tr>
<td>Materials &amp; Supplies</td>
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<td>Hobo data loggers, petrol for ATV, Petri dishes and agar for drosophila diet.</td>
</tr>
<tr>
<td>Total</td>
<td>$24,298</td>
<td></td>
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</tbody>
</table>

Matching funds Explanation:
Salary, benefits and unrecovered overhead - WSU Entomology Professor: $27,156
December 9, 2013

Rutgers University
Attn Dr. Michael Braverman Program Manager
Biopesticide and Organic Support IR-4 Project
500 College Road East, Suite 201W
Princeton, New Jersey 08540

Email: braverman@aesop.rutgers.edu

Dear Sir/Madam:

Washington State University is transmitting the enclosed proposal prepared by Dr. Lynell Tanigoshi, Agricultural Research Center.

Washington State University would be pleased to undertake and conduct collaborative research on “Using mycoinsecticides for control of SWD in caneberrries” for an approved budget of $24,298, with $27,156 of WSU match.

The University reserves the right to negotiate all terms and conditions associated from an award under this proposal. Negotiations concerning fiscal aspects of this project or any other official correspondence, including award documents, should be addressed to the Office of Grant and Research Development, Washington State University, 423 Neill Hall, Pullman, WA 99164-3140.

The University administrative contact for the enclosed proposal submission is:

☐ Sara Kinser
Grant and Contract Coordinator Lead
OGRD Telephone: 509-335-9661
Email: ogrd@wsu.edu

☐ Danielle Anthony
Grant and Contract Coordinator
OGRD Telephone: 509-335-9661
Email: ogrd@wsu.edu

☐ Tom Busch
Grant and Contract Coordinator
OGRD Telephone: 509-335-9661
Email: ogrd@wsu.edu

The signatory below is acknowledging review and approval of these materials; and is the institutionally authorized individual to bind the university in this matter.

Sincerely,

Dan Nordquist
Director
DN/db
Lynell K. Tanigoshi, Ph.D.
Entomology Professor
WSU NWEC
16650 State Route 536
Mount Vernon, WA 98273-4768
360-848-6120
tanigosh@wsu.edu

Dear Drs. Tanigoshi, Gerdeman, and Jaronski

Your research on microbial biocontrol alternatives for spotted wing drosophila (SWD) is very valuable to red raspberry growers and other small fruit growers being impacted by SWD. This is now the most significant pest impacting berry growers across the US and alternatives are needed for sustainable IPM and IRM. The strategy for using soil applications to target the pupating stage of insects has been a successful one with other insect pests. The persistence of Metarhizium in the soil combined with the fact that only to top of the soil profile need be treated improve the technical chances of success. The fungi would have the opportunity to infect while late stage larvae are entering the soil for pupation, during pupation, or as adults emerge from the soil further increasing the chance of success. We hope that your research demonstrates that M. anisopliae strain F52 provides such an alternative and we fully support your efforts in the project.

Thank you for your efforts.

Sincerely,

Jarrod Leland, Ph.D.
Senior Research Scientist
Novozymes Biologicals
5400 Corporate Circle
Salem, VA 24153
540-302-1225
JRRL@novozymes.com
Appendix 1—Registrant Questionnaire

Please fill out the first page of this form for each crop/biopesticide combination and send to the registrant.

Registrant please return to IR-4 Project Headquarters, Michael Braverman, Biopesticide and Organic Support Program Manager, 500 College Road East; Suite 201 W; Princeton, NJ 08540-6635, Tel: (732) 932-9575 ext. 4610, Fax: (609) 514-2612, braverman@aesop.rutgers.edu

Principal Investigator: Lynell K. Tanigoshi

Address: WSU NWEC
16650 State Route 536
Mount Vernon, WA 98273-4768
360-848-6152
tanigosh@wsu.edu

Telephone: 406-433-9486

Proposal Title: Use of selected mycoinsecticides for control of pupae, a novel life stage target of spotted wing drosophila in caneberry production.

Registrant name and address: Novozymes Biologicals, Inc., 5400 Corporate Circle
Salem VA 24153

Product Name:
Active Ingredient: *Metarhizium anisopliae* Strain F52
Trade Name: NZBB2166

The following section is to be completed by the Biopesticide Registrant. The PCR form is to be completed by the researcher for Early and Advanced Stage Proposals (Due Nov. 12)

1) Is this product EPA registered through BPPD? Yes ___ X___ No ______
   
   Is this use covered by your current label? Yes ______ No ___ X___

If this product is not yet registered with EPA, describe where you are at in collecting the toxicology data or Stage of the registration process. If this project was previously funded, describe how the registration status has changed since last year.
Is label and toxicology work currently limiting product only to non-food uses?

No.

2) Assuming the efficacy data are favorable, what is the likelihood that this use will be added to your label?

Given the significance of the pest if we are able to demonstrate a useful level of control at an economic rate acceptable to growers we would be eager to add this target to our label.

3) Considering the use rate(s), what is considered to be the farm-level cost for the treatment in $/acre?

We will need to refine rates with this research and determine the best application practices to use our applications most efficiently. Our product is currently in similar markets and we are aware of the price sensitivities as we move from greenhouse applications to outdoor agriculture.

4) How would you rank the importance of the proposed use compared to other potential uses?
This crop group is a target focus for our planned label expansions and given the significance of the pest I would rank it high as a target.

5) If you are only considered a potential registrant (do not currently own rights to the product), rank your degree of interest in this product.
N/A

6) Were you involved or consulted in the development of the treatments or proposal?
I have been involved to date and I would expect to continue to be involved as further details are identified and preliminary lab bioassay results are generated. I have worked closely with Dr. Jaronski on a number of projects and we have always had open communication on these.

7) What financial support are you planning on providing, if any?
Novozymes will be providing in kind support in the form of product samples for the laboratory and field trials.

Name of Registrant representative  Date

Jarrod Leland  12/4/13
Appendix 1—Registrant Questionnaire

Please fill out the first page of this form for each crop/biocide combination and send to the registrant.

Registrant please return to IR-4 Project Headquarters, Michael Braverman, Biopesticide and Organic Support Program Manager, 500 College Road East; Suite 201 W; Princeton, NJ 08540-6635, Tel: (732) 932-9575 ext. 4610, Fax: (609) 514-2612, braverman@aesop.rutgers.edu

Principal Investigator: Lynell K. Tanigoshi

Address: WSU NWEC
16650 State Route 536
Mount Vernon, WA 98273-4768
tanigosh@wsu.edu

Telephone: 360-848-6152

Proposal Title: Use of selected mycoinsecticides for control of pupae, a novel life stage target of spotted wing drosophila in cranberry production.

Registrant name and address: Laverlam International, 117 South Parkmont, Butte, MT 59701

Product Name:
Active Ingredient: Beauveria bassiana Strain GHA
Trade Name: BotaniGard 22WP, Mycotrol O

The following section is to be completed by the Biopesticide Registrant. The PCR form is to be completed by the researcher for Early and Advanced Stage Proposals (Due Dec. 9)

1) Is this product EPA registered through BPPD? Yes X No

   Is this use covered by your current label? Yes ______ No X

If this product is not yet registered with EPA, describe where you are at in collecting the toxicology data or Stage of the registration process. If this project was previously funded, describe how the registration status has changed since last year.
Is label and toxicology work currently limiting product only to non-food uses?
No

2) Assuming the efficacy data are favorable, what is the likelihood that this use will be added to your label?
It will be added to label.

3) Considering the use rate(s), what is considered to be the farm-level cost for the treatment in $/acre?
We do not know the rate yet. If we assume 1 liter per acre, it will cost about $60.

4) How would you rank the importance of the proposed use compared to other potential uses?
Any limiting pest that can be controlled with the use of our biopesticide is important.

5) If you are only considered a potential registrant (do not currently own rights to the product), rank your degree of interest in this product.

6) Were you involved or consulted in the development of the treatments or proposal?
No, but a consultant in the project is an expert on the use of our product.

7) What financial support are you planning on providing, if any?
We are providing the product for the trials.

Luis A Mazariégos H. December 4th, 2013
Name of Registrant representative Date

President & CEO
Title
October 15, 2013.

Lynell Tanigoshi  
Washington State University  
16650 State Route 536  
Mount Vernon, WA 98273

Ref: Letter of Support for the use of Beauveria bassiana Strain GHA to control Spotted Winged Drosophila.

This letter confirms that Laverlam International Corp. supports the proposed IR-4 Biopesticide grant application request for use of Beauveria bassiana Strain GHA to control the preimaginal life stages of Spotted Winged Drosophila in red raspberry tunnels.

We would appreciate receiving a copy of your application for our records at the time of submission.

Sincerely,

[Signature]

Luís A. Mazariegos  
President & CEO