**Proposition number/Title/PI:** 1E, Efficacy of volatile sulfur compounds to stimulate sclerotial germination, Qian and Davis

The following criteria were established to assist the reviewers in selecting biopesticide projects for funding that: (1) in an exploratory or early stage of development (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 (0 to 10 or 20)</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. Evaluation of budget.</td>
<td>of 10</td>
</tr>
<tr>
<td>4. Time to completion and probability of attaining objectives in the proposed time frame.</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.</td>
<td>of 20</td>
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<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>
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<tr>
<td>8. Adverse environmental risks including crop safety, safety to beneficials, safety to ecosystems, and stability.</td>
<td>of 10</td>
</tr>
<tr>
<td>9. Other control measures currently available to control target pest.</td>
<td>of 10</td>
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<tr>
<td>10. Probability of biopesticide being registered, time to registration, and if label expansion, time to market.</td>
<td>of 10</td>
</tr>
<tr>
<td>11. Availability of a potential registrant. Likelihood of developing a formulated commercial product.</td>
<td>of 10</td>
</tr>
</tbody>
</table>

**TOTAL** of 120

**Funding Recommendation**
- 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 up to 120 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: Michael Qian/ R. Michael Davis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposal Title: Efficacy of volatile sulfur compounds to stimulate sclerotial germination</td>
<td>Institution: Oregon State University and University of California-Davis</td>
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<tr>
<td>Total dollars Requested</td>
<td>(Year 1 only) $26,085</td>
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### 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>
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<tr>
<td>1</td>
<td>Garlic powder, oil, onion</td>
<td>Volatile sulfur comp</td>
<td>Onion, Garlic</td>
<td>White rot</td>
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## Proposal Title:
Efficacy of Volatile Sulfur Compounds to Stimulate Sclerotial Germination of Sclerotium cepivorum for the Control White Rot of Onions and Garlic

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
</tr>
</thead>
</table>
| **Project Director (Principal Investigator):** Michael C. Qian/R. Michael Davis | Department of Food Science and Technology, Oregon State University, Corvallis, OR 97330 541-737-9114  
  Michael.qian@oregonstate.edu |
| **Co-Project Director (Principal Investigator):** R. Michael Davis          | Department of Plant Pathology, University of California, Davis, CA 96134 530-667-2719  
  rgwilson@ucdavis.edu |
| **Administrative Contact:** Patricia Hawk                                 | Office of Sponsored Program, Oregon State University, Corvallis, OR 97331 541-737-4933  
  sponsored.programs@oregonstate.edu |
| **Financial Grant Officer:** Kim Calvery                                  | Office of Post Award Administration, Oregon State University, Corvallis, OR 97331 541-737-2198  
  kim.calvery@oregonstate.edu |
| **Authorized Grant Official:** Patricia Hawk                             | Office of Sponsored Program, Oregon State University, Corvallis, OR 97331 541-737-4933  
  sponsored.programs@oregonstate.edu |
| **Individual Responsible for Invoicing:** Kim Calvery                     | Office of Post Award Administration, Oregon State University, Corvallis, OR 97331 541-737-2198  
  kim.calvary@oregonstate.edu |

**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.
Title:
Efficacy of Volatile Sulfur Compounds to Stimulate *Sclerotial* Germination of *Sclerotium cepivorum* for the Control White Rot of Onions and Garlic

Principal Investigator -
Michael C. Qian, Department of Food Science and Technology, Oregon State University, Corvallis, OR, 97330. Phone 541-737-9114, fax 541-737-1877, E-mail: Michael.qian@oregonstate.edu

R. Michael Davis, Cooperative Extension Specialist, Department of Plant Pathology, University of California, Davis, 95616 ph: (916)752-0303 fax (916)752-5674, E-mail: rmdavis@ucdavis.edu

Cooperator -
Rob Wilson, University of California Cooperative Extension, Modoc County, UC IREC, P.O. Box 850, Tulelake, CA 96134, ph (530) 667-2719 rgwilson@ucdavis.edu

Funding Request from IR-4 - $26,085

Name of Biopesticide - Garlic powder (*Allium sativa* L.), Garlic oil/juice, and onion residue compost

Commodities Protected - Onion, garlic, and other *Allium* species

Target Pest - The fungus *Sclerotium cepivorum* Berk, the cause of white rot

Formulation of Biopesticide - Finely ground powder from dehydrated garlic bulbs (an edible product), Garlic oil, extracted juice of garlic, and onion residue compost

Summary:
White rot of onion and garlic is a worldwide threat to *Allium* production. Traditional methods to control white rot are either economically prohibitive or ineffective. Tarped fumigation with methyl bromide was the most effective treatment, killing more than 95% of the sclerotia in the soil, but it has been phased out and was uneconomical in any case. Soil treatment with metam-sodium also reduces populations of sclerotia in the soil, but positive results have been erratic and retreatment is necessary. Metam-sodium also poses a degree of risk to the environment since it is a general biocide. Crop rotation is ineffective since the sclerotia are dormant in the absence of specific sulfides exuded from roots of *Allium* crops. It has been found that the fungus will only colonize on *Allium* plants and sclerotia germinate only in response to exudation by *Allium* roots. These exudates contain alkyl and alkenyl-L-cysteine sulfoxides, which are metabolized by the soil microflora to yield a range of volatile thiols and sulfides that activate the dormant sclerotia. This proposal is to apply volatile sulfur compounds from garlic oil or juice into soil in the absence of an *Allium* crops to trick the germination of the sclerotia in order to starve the fungus. The proposal will identify the composition of volatile sulfur compounds in the various garlic and onion products and wastes, and investigate their effectiveness to control white rot.
RI-4 proposal. Efficacy of Volatile Sulfur Compounds to Stimulate Sclerotial Germination of Sclerotium cepivorum for the Control White Rot of Onions and Garlic

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

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

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

II. **Introduction**

White rot of onion and garlic, caused by the soilborne fungus Sclerotium cepivorum Berk, is a worldwide threat to *Allium* production. The disease is extremely serious on these crops - an inoculum density of a single sclerotium in a liter of field soil can potentially result in crop failure and no economical control measures currently exist. Furthermore, once a field is infested, it will remain so for at least 40 years and probably longer since sclerotia of the fungus remains dormant indefinitely in the absence of *Allium* plants (Coley-Smith, 1959). Loss estimates to this disease are difficult to ascertain because once identified in a field, growers are forced to grow other, nonsusceptible (non-*Allium*) crops. Hence, infested fields are often forever abandoned from further onion or garlic production.

The white rot fungus produces no functional spores. Instead, it propagates only by the production of round, poppy seed-sized sclerotia produced on the roots of decayed host plants. Sclerotia spread in mass movement of soil, water, on animals (at least theoretically), and especially on infested plant parts. Once introduced into an area, *S. cepivorum* is gradually spread on contaminated equipment or planting materials, and slowly the production of garlic and onions in the entire region is threatened. Garlic culture is perhaps the principal mode of movement since it is propagated vegetatively, and garlic bulbs and cloves are sufficiently large that an infestation might go unnoticed. In any case, the disease is spreading throughout western North America.

White rot is a disease limited to *Allium* crops. The fungus successfully colonizes only *Allium* plants and sclerotia germinate only in response to exudation by *Allium* roots (Coley-Smith, 1959). These exudates contain alkyl and alkenyl-L-cysteine sulphoxides, which are metabolized by the soil microflora to yield a range of volatile thiols and sulfides that activate the dormant sclerotia (Coley-Smith, 1960). The specific reaction between sclerotia and sulphoxides or their breakdown products suggests a possible use of these sclerotial germination stimulants for controlling white rot disease. If these thiols can be applied to the ground in the absence of an *Allium* crop, the sclerotia may be “tricked” into germinating. In the absence of a host, the mycelium from germinating sclerotia persists for periods ranging from a few days to several weeks depending on the soil temperature, then die after exhausting nutrient reserves. The specific germination response to these stimulants can be as high as 100% (Coley-Smith, 1960 and Sommerville and Hall, 1987). Germinated sclerotia grow only 1-2 cm through the soil and die within two weeks if infection of roots or bulbs is not successful. When infested fields are planted with *Allium* crops, root exudates incite a germination response that includes all the receptive population of sclerotia in the soil around...
the sphere of influence of the Allium roots (Coley-Smith, 1986). Thus, the total population of sclerotia in a field is susceptible to control with this method (Crowe et al., 1980).

One natural sclerotial stimulant from Allium spp. is diallyl disulfide (DADS), which is also recoverable from the distillation of petroleum (Coley-Smith and Parfitt, 1986 and Entwistle et al., 1982). Diallyl disulfide distributed through the soil profile in the absence of an Allium crop in an infested field forced 90-99% of the sclerotia to germinate (Davis et al, 2009). This degree of control is similar to that achieved with methyl bromide fumigation. Unfortunately, DADS is no longer commercially available and the industry needs a natural product to substitute for its loss. We know natural products will work (Davis et al, 2009), but we don’t know anything about the concentration of the sulfide compounds in natural stimulatory products like garlic powder, garlic oil, or onion compost.

The objective of this project is to identify and quantify the sulfur composition in garlic oil, garlic powder, and onion residue compost, and study the dose-response effect of volatile sulfur for white rot control, and to develop a sustainable approach using garlic/onion oil or waste products as biostimulants to manage onion and garlic white rot. A method of quantifying the active ingredients in these compounds is needed because each batch is expected to have varying amounts of sulfur compounds. Once these compounds are quantified, specific formulations and rates can be recommended to growers.

III. Experimental Plan

Part I. Identification and quantification of volatile sulfur composition in garlic and onion products using GC-MS and GC-pulsed flame photometric detection

Samples of garlic and onion powder, oil, juice, and compost samples will be obtained from each of three different sources; waste products from allium processing plants in California will also be obtained if available.

The volatile compounds in the garlic/onion samples will be identified using solid-phase microextraction (SPME)-GC-MS and SPME-GC-pulsed flame photometric detection in sulfur mode. Each selected sample (2 g) will be placed in a 20 ml sample vial. The samples will be equilibrated at 50°C for 30 min and the extracted with a SPME fiber (2 cm, DVB/PDMS/Carboxen fiber or 1 cm Carboxen/PDMS fiber) for 30 min. After extraction, the volatiles on the SPME fiber will be desorbed onto GC-MS. A ZB-FFAP capillary GC column (30m, 0.32mm ID, 0.25μm file thickness, Phenomenex, Torrance, CA) will be employed to separate the compounds. The oven temperature will be programmed initially at 40°C (for 2 min), then increased at 6°C/min to 180°C, further increased at 4°C/min to 240°C, and held at this temperature for 20 min. Compounds will be identified by comparing with NIST mass spectra library and retention index on the two columns. The sulfur compounds will be further verified using SPME-GC-pulsed flame photometric detection in sulfur mode. The same SPME extraction and GC operation parameters will be used. Only sulfur containing compounds will be detected by sulfur-PFPD.

The concentration of volatile sulfur compounds in the samples will be quantitated using HS-SPME-GC-PFPD. 2 g of sample will be diluted with 8ml saturated NaCl solution in a 20 ml vial deactivated with dichlorosilane (Sylon CTTM, 5% in toluene. Sigma-Aldrich Co., St Louis, MO, U.S.A.). An aliquot (100 μl) of internal standard solution (500 μg/L EMS and 2 μg/L isopropyl disulfide in methanol will be added. An 85 μm Carboxen-PDMS StableFlex SPME fiber
SUPELCO (Bellefonte, PA, USA) will be used for the extraction of sulfur compounds. Samples will be pre-incubated for 5 minutes at 30 ºC with 500 rpm agitation, and then extracted for 20 minutes with 250 rpm agitation at the same temperature. The volatile compounds extracted by the SPME fiber will be thermally desorbed from 150-300 ºC in the GC injector in splitless mode. Separation of the analytes will be achieved using a DB-FFAP fused silica capillary column (30 m × 0.32 mm, 1.0 μm film thickness, Agilent, Palo Alto, CA) with a constant nitrogen flow of 2.0 ml/min. The oven temperature program will be as follows: 35 ºC held for 5 min, heated to 150 ºC at a rate of 10 ºC/minute, held for 1 minute, then heated to 220 ºC at a rate of 20 ºC min⁻¹ with a final hold time of 5 minute. The PFPD will be held at 300 ºC and 500 V with the hydrogen flow rate at 14 mL/min, air 1 flow rate at 17 mL/min, and air 2 flow rate at 10 ml/min. Chromatographic identification of target sulfur compounds will be performed by comparing retention times to those of authentic standards. Standard calibration curves will be obtained by adding increasing amount of the target compounds mixture to the wine. Concentrations will be calculated based on the square root of the peak area ratio of the compound to the internal standard. Duplicate analyses will be performed for each sample.

Part II. Efficacy of Volatile Sulfur Compounds to Stimulate Sclerotial Germination of Sclerotium cepivorum for the Control White Rot of Onions and Garlic

1. Provide a numerical list of all treatments including the products (Trade names and active ingredients, rate (units), application timing, etc.

   a. Treatments

   1. None
   2. Garlic powder 50 lbs/acre
   3. Garlic powder 100 lbs/acre
   4. Garlic powder 200 lbs/acre
   5. Garlic oil 2.5 mls/m2
   6. Garlic oil 5.0 mls/m2
   7. Garlic oil 10.0 mls/m2
   8. Onion compost 50 lbs/acre
   9. Onion compost 100 lbs/acre
   10. Onion compost 200 lbs/acre
   11. Diallyl disulfide 5 mls/m2

   b. Dates of applications - Garlic powder and diallyl disulfide will be applied as early in the spring as possible or in the fall after soil temperatures fall below 70 F at 2-4 inches depth. The optimum conditions for germination of sclerotia are 59-64 F (15-18 ºC) (falling to zero at soil temperatures below 50 F (10 ºC) or above 72 F (22 ºC)) and -0.03 MPa soil moisture (falling to zero near saturation and between -0.3 and -1 Mpa). Applications will be made when conditions are optimal.

   c. Application methods - Stimulants will be distributed as well as possible throughout the plow layer (upper 10 in. of soil profile) where sclerotia are distributed. Soil will be at good tilth. There will be no Allium production in the test site for at least one year prior to applying the treatments.

   Garlic powder and oil will be applied in a liquid suspension by a pressurized back pack
sprayer to dry soil and incorporated 10 in. deep with a power roto-tiller followed by sprinkler irrigation. Onion compost will be applied to the soil surface followed by tillage with a rotary tiller to a depth of 25 cm.

Diallyl disulfide and a non-ionic wetting agent will be sprayed on the soil surface at 5.34 gal/acre (50 liters/ha), immediately followed by tillage with a rotary tiller to a depth of 25 cm, then irrigated to move the stimulant down the soil profile and seal the soil.

2. What crops or sites will this study be conducted on?
   Garlic and Onion field

3. What experimental design will be utilized?
   Randomized complete block design
   Experimental unit - 20X50 ft. Data will be collected from the center 10X30 ft. Plots will be separated by a minimum of 25 ft. to prevent cross contamination of the volatile compounds.

4. How many locations (field or greenhouse)? How many replications?
   Two naturally infested fields, one in Modoc County and one in Fresno County, California.
   Four replications per treatment

5. Describe how this proposal is designed to provide information on how it fits into an integrated pest management program
   Traditional methods to control white rot are either economically prohibitive or ineffective. Tarped fumigation with methyl bromide was the most effective treatment, killing more than 95% of the sclerotia in the field, but it has been phased out and was uneconomical in any case. Soil treatment with metam-sodium also reduces populations of sclerotia in the soil and may allow the production of a single Allium crop after treatment, but positive results have been erratic and retreatment is necessary (Adams and Johnston, 1983). Metam-sodium also poses a degree of risk to the environment since it is a general biocide. Crop rotation is ineffective since the sclerotia are dormant in the absence of specific sulfides exuded from roots of Allium crops (Coley-Smith, 1960).

6. Data collection
   Soil Sampling - Soil populations of sclerotia will be determined at the time of soil treatment and at 4 month intervals thereafter. On each sampling date, two composited 20 1 cm-diameter core subsamples per plot will be collected from the soil surface to 10 inches deep. From each sample, 500 cc of soil will be directly assayed (or air-dried at room temperature prior to assay) by wet soil sieving (and if needed, suspending fractions in sucrose to separate sclerotia from heavier fractions). After sieving, soil residue will be frozen until observation and viability testing. Sclerotia are identified and plated on water agar amended with 25 ppm streptomycin to observe the proportion from which the fungus grows following disinfestation with mild bleach (0.05% NaOCl) to rid the surface of sclerotia of superficial contaminants. Following the bleach treatment, rarely do other organisms grow instead of or in conjunction with S. cepivorum. This viability test is a reasonable estimate of the
proportion of sclerotia capable of causing disease.

Data Analysis- Treatment comparisons will be made by analysis of variance and class comparisons using the Statistical Analysis System (SAS Institute, Inc., Cary, NC release 6.11 ed.) or MSTATC (Michigan State University, East Lansing, MI version 1.42). The concentration of volatile sulfur compounds in garlic and onion products will be correlated with the population of sclerotia in soil samples

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).

The severity of white rot is directly related with the number of sclerotia in the soil at planting (Crowe et al., 1980). Surprisingly few sclerotia can result in great crop losses. For example, economic losses to white rot can occur at inoculum densities as low as 0.1 sclerotium/liter of soil yet in many infested fields populations may be as high as 200 or more sclerotia/liter of soil. Populations above 10 sclerotia/liter of soil may cause near total crop loss, and populations near 1 sclerotium/liter may cause crop losses between 30-60%. When a sclerotium germinates and infects an Allium root, mycelia grow upward toward the bulb, eventually destroying it (Crowe and Hall, 1980). The fungus also spreads plant to plant, increasing disease incidence within the same growing season.

An example of the potential losses this disease poses to all production areas is the Salinas Valley in California, which at one time was a major producer of Allium crops. As white rot spread, garlic and onion production became less and less profitable, and the industry largely moved to the Central Valley of California. Today, the number of infested fields in the Central Valley is growing every year, despite efforts to prevent further introduction into the area and predictions that the weather was too warm to support growth of the fungus. The disease is now a recognized threat to the largest garlic and onion production area in the world.

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.

Test Plants – An onion or garlic crop will planted the following fall after treatment to evaluate the benefits of disease control, if any, from the soil stimulants.

9. What is the proposed start date and completion date? Also describe this in chronological order in the context of the experimental plan.

Starting Date - June 1, 2014
Termination Date – May 30, 2015

10. Describe the test facilities where these studies will be conducted.

The flavor chemistry laboratory at Oregon State University is well equipped for volatile analysis. We have three GC-MS instruments including a multidimensional GC-MS. All GC-MS instruments are equipped with CTC (Gerstel) multi-purpose autosamplers including headspace, solid phase microextraction, and stir bar sorptive extraction. In addition, we have many GC units include one equipped with pulsed flame photometric detector for sulfur analysis, and another one with sulfur chemiluminescence detector. The PI has five research
publications and a book related to volatile sulfur analysis in various food products. All other field equipment needed for the completion of this experiment, including microscopes, sampling tools, and farming equipment, are available at the experimentation sites in CA.

11 Budget:

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<td>Total</td>
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</table>

Funding from other sources – We anticipate partial funding from the California Garlic & Onion Research Advisory Board

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

These natural products are readily available, environmentally friendly, and renewable. The use of natural *Allium* products in fields infested with the white rot pathogen may allow continued *Allium* production in fields and may help prevent the localized spread of white rot in an infested area, such as California’s Central Valley. The benefits of natural products as a disease management tool include worker safety, environmental compatibility, advantages as a renewable resource, and ease of application. Efficacy data developed in this project will aid in the registration of garlic powder and oil as a biopesticide. These deregulated products are readily available from garlic dehydrators. Onion compost is also readily available in California.

**Literature Cited**


**BIOPESTICIDE PROJECT BUDGET**

**To: 5/30/15**

**Project Period: 6/1/14**

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<th>Funds Requested</th>
<th>Matching Funds</th>
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A. Senior/Key Person  
B. Other Personnel  

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<th>Total Number, Other Personnel</th>
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</thead>
</table>

C. Fringe Benefits  

<table>
<thead>
<tr>
<th>Total Salary, Wages and Fringe Benefits</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>D. Equipment</th>
</tr>
</thead>
</table>

| NOT ALLOWED |

<table>
<thead>
<tr>
<th>E. Travel</th>
</tr>
</thead>
</table>

1. Domestic  
2. Foreign  

| $0 |

<table>
<thead>
<tr>
<th>F. Participant Support Costs</th>
</tr>
</thead>
</table>

1. Travel  
2. Other  

| $0 |

<table>
<thead>
<tr>
<th>G. All Other Direct Costs</th>
</tr>
</thead>
</table>

1. Materials and Supplies  
2. Publication Costs  
3. Consultant Services  
4. Computer Services  
5. Subawards/Consortium/Contractual Costs  
6. Equipment or Facility Rental/User Fees  
7. Alterations and Renovations  
8. Other 1  
9. Other 2  
10. Other 3  

<table>
<thead>
<tr>
<th>Total Direct Costs</th>
</tr>
</thead>
</table>

| $26,085 |

**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. *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.
Resume of PIs:

Michael C. Qian
Professor, Flavor Chemistry
Department of Food Science & Technology, Oregon State University
Corvallis, OR 97331
Phone #: (541)-737-9114 (O)  Fax # (541)-737-1877
Email: Michael.qian@oregonstate.edu

Education:
PhD 2000  Food Science, University of Minnesota
MS  1989  Food Science, Univ. of Illinois at Urbana-Champaign
BS  1982  Chemistry, Wuhan University, China

Professional Membership:
Member of American Chemical Society
Member of Institute of Food Technology
Member of American Dairy Scientist Association
Member of American Society for Enology and Viticulture
Member of the honor society of Phi Kappa Phi

Professional Leadership:
2014: Program Chair of Agricultural and Food Chemistry Division, the 247th American Chemical Society national meeting, March, 2014 Dallas, TX
2013: Program Chair of Agricultural and Food Chemistry Division, the 246th American Chemical Society national meeting, September 8-12, 2013 Indianapolis, IN
2013-2014: Chair of Agricultural and Food Chemistry Division, American Chemical Society.
2012-2013: Chair-elect of Agricultural and Food Chemistry Division, American Chemical Society
2011-2012: Vice chair of Agricultural and Food Chemistry Division, American Chemical Society
2007-2008: Chair of Flavor Chemistry subdivision, American Chemical Society
2004-2006: Vice chair of Flavor Chemistry subdivision, American Chemical Society

Symposium Organizer for the Division of Agricultural and Food Chemistry, American Chemical Society:
Michael Qian and Tom Shellhammer, Flavor Chemistry of Alcoholic Beverage-ACS symposium, Aug.22-26, Boston, MA, 2010

Award:
The Honor Society of PHI KAPPA PHI Emerging Scholar Award, 2006

**Employment:**
- 2012-now Professor, Department of Food Sci & Tech, Oregon State University
- 2007-2012 Associate professor, Dept. Food Sci & Tech, Oregon State University
- 2001-2006 Assistant professor, Dept. of Food Sci & Tech, Oregon State University
- 1987-1990 Graduate Assistant, Univ. of Illinois at Urbana-Champaign
- 1982-1987 Teacher, Huazhong Agricultural University, China

**Publications**

**Books:**

**Book Chapters:**


4. Qian, Michael C.; Burbank, Helen. 2007 “Hard cheese-Parmesan cheese” in Improve the flavor of cheese. Bart Weimer Eds  pp 421-443

5. Qian, Michael C.; Burbank, Helen; Wang, Yuanyuan. 2006 “Pre-separation technique for flavor analysis” in Sensory Directed Flavor Analysis, Marsili Eds  pp 111-154

Peer Reviewed Journal Publications:


12. Xiaofen Du, Chad Finn, Michael C. Qian. Distribution of Volatile Composition in 'Marion' (Rubus Species Hyb) Blackberry Pedigree. J. Agric. Food Chem. 2010, 58 (3), 1860-1869


15. Daniela D. Voigt, François Chevalier, Michael C. Qian, Alan L. Kelly. Effect of high-pressure treatment on microbiology, proteolysis, lipolysis and levels of flavour compounds in mature blue-veined cheese. Innovative Food Science and Emerging Technologies. 2010, 11, 68–77


31. R.R. Jetti, E. Yang, A. Kurnianta, C. Finn, and M.C. Qian. Quantification of selected aroma-active compounds in strawberries by headspace solid-phase microextraction gas chromatography and correlation with sensory descriptive analysis. J. Food Sci. 2007, 72,S487-S495


36. Yu Fang and Michael. C. Qian. Quantification of selected aroma-active compounds in Pinot noir wines from different grape maturity. J. Agric. Food Chem. 2006, 54(22); 8567-8573


44. Yu Fang; Michael C. Qian. Sensitive quantification of sulfur compounds in wine by headspace solid-phase microextraction technique. J. of Chromatography A. 2005, 1180:177-185

45. Wang, Yuanyuan; Finn, Chad; Qian, Michael C. Impact of growing environment on Chickasaw blackberry (Rubus L.) aroma evaluated by gas chromatography olfactometry dilution Analysis. J. Agric. Food Chem. 2005, 53, 3563-3571


R. Michael Davis

Cooperative Extension Specialist and Professor
530-752-0303 Ph
Department of Plant Pathology 530-752-1199 Fax
University of California, Davis  rmdavis@ucdavis.edu
Davis, CA  95616
Graduate Group Memberships: Plant Pathology, Forensic Science

Education:
University of California  Sept. 1974 to Mar. 1979, Ph.D., Mar. 1979
Riverside, CA  92521  Major: Plant Pathology
Long Beach, CA 90804  Major: Biology
Ventura Junior College  June 1969 to June 1971, A.A., June 1971
Ventura, CA  93001  Major: Liberal Arts

Professional Experience:
University of California  Oct. 1986 to present
Cooperative Extension and Professor
Dept. of Plant Pathology
University of California, Davis

Research and Extension responsibilities on diseases of field and vegetable crops in California.

Texas A&I University  Mar. 1979 to Oct. 1986
Citrus Center  Associate Professor/Plant Pathologist
Weslaco, TX  78596
Teaching and research on citrus diseases.
Major Research Interests: Fungal, bacterial, and viral diseases of field and vegetable crops, especially tomatoes, potatoes, carrots, onions, garlic, cucurbits, cotton, and corn; mushroom production and diseases

Professional Societies:
American Phytopathological Society
American Phytopathological society, Pacific Division
California Native Plant Society
Mycological Society of America
North American Mycological Society

Course Responsibilities:
PLP 40, Edible Mushroom Cultivation; PLP 135, Field Identification of Mushrooms; PLP 185, Advanced Mushroom Taxonomy; PLP 205, Diseases of Vegetables and Field Crops; Freshman Seminar, Agriculture’s Role in the Conservation of Wildlife
SAS 2, Feeding the Planet
Recent Publications:


American Phytopathological Service:

Editor-in-Chief, Plant Disease, 2010-2012.
Senior Editor, Plant Disease, 2007-2009.
Associate Editor, Biological and Cultural Tests for Control of Plant Diseases, 2001-2003.
Associate Editor, Plant Disease, 1988-1990.
Bill,

Attached is a support letter for the grant Mike Davis and Mike Qian have submitted. We developed the biostimulant DADS (diallyl disulfide) for use on white rot, but the high cost and availability from a Chinese source made use uneconomical. We have done some preliminary work and believe we can use garlic oil/juice as a shanked in treatment and/or waste from processing and dehydration facilities as compost to achieve the same results as DADS without the cost.

Thanks to some help from IR-4, we do have several useful conventional fungicides that will help manage white rot. What we need is the biostimulant to reduce sclerotal populations initially in a field so that we can come back into infected fields a season or two later and use one of the conventional fungicides now available to again plant garlic and onions in previously infected field. What we need to know now is more about the concentration of diallyl disulfide in oil, juice and plant waste that is a natural component of the organo sulfur compound allicin in garlic and onions.

Thanks for your support.

 Regards,
Bob Ehn
CEO/Technical Manager

CA Garlic and Onion Research Board
CEO/Technical Manager
(559) 297-9322 Work
(559) 281-3231 Mobile
(559) 298-3481 Home
robertehn@sbcglobal.net

CA GORAB

Information from ESET NOD32 Antivirus, version of virus signature database 8967 (20131025)

The message was checked by ESET NOD32 Antivirus.

http://www.eset.com
October 25, 2013

Mr. Bill Barney
IR-4 Project, Rutgers University
500 College Road East, Suite 201W
Princeton, New Jersey 08540-6635

Dear Mr. Barney:

SUBJECT: LETTER OF SUPPORT FOR DR. MICHAEL DAVIS (UC DAVIS) AND DR. MICHAEL QIAN (OREGON STATE UNIVERSITY) APPLICATION FOR BIOPESTICIDE & ORGANIC SUPPORT PROGRAM GRANT IN AID

On behalf of the California Garlic and Onion Research Advisory Board, we acknowledge our support for funding Dr’s. Davis and Qian’s grant proposal to investigate the use of biopesticides in managing the white rot pathogen in California garlic and onions. California is the largest producing state in the U.S. of garlic and onions. California produces 80 - 90% of the commercial garlic in the U.S., with adjoining states Nevada and Oregon the major seed garlic producing states. California is the largest producer of processing onions in the U.S. Our total acreage of both processed and fresh garlic and onions is annually ~ 20,000 acres of processed onions and 16-18,000 acres of garlic. Although garlic and onions are truly a specialty crop they each contribute $150 million farm gate value annually.

The research efforts through our Marketing Order have been to focus resources on management of Sclerotium cepivorum, the white rot disease that affects garlic and processed onions by establishing a coordinated research program to minimize the effects of this fungal disease on Allium species in the U.S. Management of the white rot organism includes both short term research to evaluate chemical, cultural and biological control of the organism. I just finished compiling the number of fields and acres affected with white rot in California. With the addition of 18 new fields with white rot infections in 2012 and 3 additional fields this year, I now have 130 fields totaling 19,301 acres of prime west side San Joaquin Valley farm ground that we can never go back in and plant an Allium crop. White rot also affects our ability to grow garlic for seed as historical production areas in eastern Washington, eastern Oregon and the counties in northern California now have areas with white rot which makes it difficult to find any field with a history of no onion or garlic field production.
A major part of our work is geared toward finding a sustainable method for managing white rot using biopesticides either in combination with or in rotation with conventional pesticides. We have developed some conventional tools to manage white rot, but lack a total system approach to allow us back in previously infected fields. While we know that garlic juice/oil and onion and garlic waste contain the natural biostimulant diallyl disulfide, we need to know the concentration in each of the elements as well as the effective dose needed to stimulate sclerotia.

We are at a point where we can achieve early adaptation of a sustainable approach to managing white rot in both conventional and organic garlic and in processed onions. Our next step is to show that such a program works on a commercial basis and then demonstrate that to our grower/producer audience.

We have just completed review and approval of our 2014 crop season research proposals. It is our intent to fund the work proposed by Dr. Mike Davis (UC Davis) and Dr. Michael Qian (Food Science and Technology Oregon State University) this coming season. Of our annual grant in aid budget (~$100K annually), we have been spending 60+% of that on white rot as that is the most significant factor affecting our ability to continue to produce high quality garlic for U.S. consumption.

We are pleased to write this letter of support for the Davis and Qian proposal to demonstrate use of “Volatile Sulfur Compounds to Stimulate Sclerotial Germination of Sclerotium septivorum for the Control of White Rot of Garlic and Onions”. The CA Garlic and Onion Research Advisory Board will also support EPA registration of a biostimulant should an exception to registration under Section 25(b) of FIFRA not be feasible.

Sincerely,

Robert C. Ehn
CEO/Technical Manager CAGORAB
cc: Kevin Lehar, Chairman, CA Garlic and Onion Research Advisory Board
Dr. L. Michael Davis, UC Davis Extension Plant Pathologist, UC Davis, CA
Dr. Michael Qian, Department of Food Science and Technology, Oregon State University, Corvallis, OR
October 25, 2013

Mr. Bill Barney
IR-4 Project, Rutgers University
500 College Road East, Suite 201W
Princeton, New Jersey 08540-6635

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Robert C. Ehn
CEO/Technical Manager CAGORAB
cc: Kevin Lehar, Chairman, CA Garlic and Onion Research Advisory Board
Dr. L. Michael Davis, UC Davis Extension Plant Pathologist, UC Davis, CA
Dr. Michael Qian, Department of Food Science and Technology, Oregon State University, Corvallis, OR