

**Title: Development of a Northeast region Bugwood node to collect and catalog images for use as reference tools by diagnosticians and identifiers.**

**Primary Investigator:** Karen L. Snover-Clift, Plant Pathology and Plant-Microbe Biology, Cornell University, Ithaca, NY

**Major Cooperators:** Bruce Watt, Plant Diagnostician, Pest Management Office, University of Maine and NEPDN, Orono, ME; and Charles Barger, Center for Invasive Species and Ecosystem Health (Bugwood Network), University of Georgia **Senior Personnel:** Rachel McCarthy, Plant Pathology and Plant-Microbe Biology, Cornell University, Ithaca, NY; and Joseph LaForest, Center for Invasive Species and Ecosystem Health (Bugwood Network), University of Georgia

### **I. Summary Statement**

This is an Extension project.

Having created a Bugwood-Cornell node with NEIPM funding in January of 2012, our objectives for next year are to increase the activity of the image submission through the Cornell node. The Cornell facilitator will train new parties interested in submitting images, will edit images for accuracy of content and quality of images, and will provide support to the University of Maine diagnostician as needed. Several collections at various universities in the Northeastern region need a repository for their images and personnel from these sites are actively pursuing information to develop content in the image library known as the Bugwood system. Our newly established node can provide support for submissions that may include the Maryland consumer horticulture collection, the Vermont animal science collection, and the herbarium and international agriculture collections at Cornell. Expansion of the Cornell node will provide much needed resources for diagnosticians and extension educators for use in educating clients and creating presentations. The facilitator will pursue images that include diagnostic features of endemic diseases, diseases of high significance, and foreign and select agent pathogens when possible, as well as quality views of culture plates, spores, and mycelia. The key to getting the images needed is the facilitator and his/her pursuit of valuable content. The IPM priorities covered by this grant include focusing on pests and crops found in multiple states, filling a niche not filled, involving multiple states and regions of the US, and is interdisciplinary.

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### **I. Problem, Background and Justification**

**This is an Extension proposal for a total of \$18,294.00 over one year.**

**Problem:** Plant disease and pest diagnosticians need tools to accurately diagnose plant problems. The proper diagnosis of pathogens and pests affecting agricultural and natural ecosystem plants allows growers and plant managers to select the appropriate IPM management tactics. Plant disease and entomology diagnosticians have limited resources for the identification of pathogen, insects, and mites. Diagnosticians that are part of the National Plant Diagnostic Network (NPDN) work with all commodity groups including field crops, vegetables, fruit, turfgrass, and ornamental plants and are expected to diagnose a wide variety of pathogens and pests. To provide accurate diagnoses, plant diagnosticians require rapid access to detailed diagnostic images to learn about the organisms and plant problems present in samples submitted to their laboratories. Currently, diagnosticians the Bugwood image library that contains disease, pest, and specific organism images but it has limits and does not contain a wealth of Northeast specific, diagnostic images. Many university faculty and extension educators have acquired image collections of a wide variety of diseases, pest problems, pathogens, insects, mites and weeds throughout their careers. As faculty and diagnosticians retire from the system, a wealth of information often goes with them, which creates a great loss of resource material. Not having this resource material readily available increases the length of time it takes to make an accurate diagnosis, impedes the training of new diagnosticians, and may impact trade and commodity sales.

**Background:** The goal of diagnostic facilities is rapid, accurate diagnoses. As a network, the NPDN strives to provide tools for our diagnosticians and for diagnosticians in industry, departments of agriculture, regulatory agencies, as well as, extension educators, crop consultants and IPM practitioners. Diagnosticians currently use literature resources including printed compendia and textbooks, on-line resources and university factsheets. Although very useful, often these resources do not provide extensive images of a wide variety of plant diseases, pests, and organisms at various stages of development. The lack of these types of resources slows prolongs sample processing time and hinders the diagnostician's accuracy rate.

Images showing documented symptoms of specific diseases and insect damage are vital tools for diagnosticians and their clients. Availability of these images with descriptions of the pathogens and pests is also very important. Annotated image sets allow diagnosticians to search for various morphological characteristics for comparison and help confirm the presence of a suspected pathogen or pest. They would also be useful for creating other resources such as factsheets, PowerPoint presentations, First Detector resources, IPM Pest Alerts, and diagnostic standard operating procedures for educators and their audiences such as growers, crop consultants, new diagnosticians, and future IPM practitioners.

Many diagnostic labs are already capturing images in their database system for their own records but these are not widely shared as they are tied to sample information. Taking the time to separate them out is a great goal but due to time and IT resource restraints, it is often not done. In addition to the diagnostic laboratory collections, extension educators and key area experts often have great images of diseases, pests, and the organisms that cause problems. Since diagnostic laboratories are often associated with a land grant university, they also have connections to multi-disciplinary extension educators and faculty, teaching resources and other experts. These resources are often used by diagnosticians for help in identifying organisms and they can be utilized to provide additional descriptions for diseases and pest problems and the organisms that cause them. There is a need for an organized approach to collecting digital image collections and slide sets from universities across the nation and cataloging these resources in an accessible database system before they are lost through retirements and personnel movements.

The NPDN is a large network that would benefit from this work being done in the Northeast region. The NPDN was established in 2002 to provide a network of diagnostic laboratories to help enhance agricultural security through protection of the health and productivity of plants in agricultural and natural ecosystems in the United States. Since its establishment, NPDN members have uploaded over 672,500 individual plant diagnoses to the National Repository located at Purdue University. The large number and diversity of these sample diagnoses illustrates the potential for image collection and submission to the Bugwood Image Database.

The Bugwood Image Database has become the go-to on-line resource for images related to agriculture. It is a free on-line resource unlike other on-line resources, such as CAB Direct (<http://cabdirect.org/>), which includes image descriptions of fungi and bacteria, but can be cost prohibitive for diagnostic laboratories on limited budgets and often plant pathogens are not the main focus of these directories. The Center for Invasive Species and Ecosystem Health at the University of Georgia operates the Bugwood Image Database which powers several different image sites including [www.IPMImages.org](http://www.IPMImages.org). Although this system has the capacity to host the diagnostic image series and deliver it in an efficient manner to a wide range of audiences, it is dependent on the availability of content from its contributors. To date, few contributors have taken images with the purpose of creating a diagnostic series of plant pathology images.

**Justification:** Diagnosticians are uniquely positioned to acquire these images as they receive samples from all over their state and often from throughout their region and across the United States. Their location frequently puts them in close contact with land grant expertise, which can supply the identification of the organisms acquired from sample submissions.

University of Georgia has the IT structure in place to make the images widely available through the BugwoodImages database. It provides images to a wide variety of online resources and directly powers five image archives including [www.IPMImages.org](http://www.IPMImages.org). It also has an existing framework to allow organizations to setup 'data entry nodes' for adding images to BugwoodImages, entering information, and managing the availability of those images. The 5 image archives received 178 million hits in Federal FY 2010 with IPMImages.org receiving more than 18.5 million hits per year and with over 1.5 million unique visitors.

This project will solicit, retrieve, assemble, enhance, upload and publish diagnostic images utilizing the expertise of two diagnostic laboratories (NY, ME) using the recently created

image/data entry center (Bugwood-Cornell Node) and a central database (BugwoodImages). The new electronic materials will be delivered via the Bugwood Image Database as accessed through [www.IPMImages.org](http://www.IPMImages.org).

## **II. Objectives and Anticipated Impacts**

**Objectives:** This project has one objective: **To solicit, retrieve, assemble, enhance, upload and publish diagnostic images as an educational resource for diagnosticians, plant pathologists, entomologists and other IPM practitioners.**

This will be accomplished through 3 key outputs:

1. **Promoting use of the Bugwood-Cornell Node:** The first key output provides the ability to submit images through a Bugwood node located at Cornell University. The node was created in 2011-2012 and provides an avenue for the publication of images to the IPMImages.org site. This node can be utilized by anyone in the Northeast region and the staff at Cornell will review, edit, and facilitate the submission to Bugwood. During the period of this grant, Cornell personnel will provide assistance to those wanting to upload their images to the database. Specifically Cornell personnel will work with Bruce Watt from the University of Maine, other members of the Northeast Plant Diagnostic Network (NEPDN), and Cornell faculty and staff to introduce them to the node and to provide them with the services in Outputs 2 & 3.

*Anticipated Impact:* The use of the Bugwood-Cornell node will allow for additional input to the Bugwood system and will facilitate continued contribution to the project beyond the end of the project.

2. **Solicit, Retrieve, Assemble, and Enhance Images from Image Collections:** Reviewing and enhancing images from many collections will allow us to pick out only those images we feel will contribute significantly to the BugwoodImages database. This will likely be the most time consuming portion of the project as determining what images are of value will be decided by reviewing NPDN significant pathogen lists, the USDA select agent listing, the Widely Prevalent listings, as well as consulting with researchers and extension educators and faculty about regional significant organisms, and searching through society documentation to determine if significant listings from the American Phytopathological Society (APS) and the Entomological Society of America (ESA), and others societies exist. Using Photoshop and other computer software, images will be enhanced to clean up any imperfections and manipulated to improve clarity and color quality. Our goal is to review 1,500 images from Cornell University faculty and staff and support the review of 1,000 images from the University of Maine. Other collections from other Northeastern region universities brought to our attention will be supported as time permits.

*Anticipated Impact:* The review and manipulation of images from various collections will enable us to define what images are of value and significance therefore, narrowing down the field of many images to those that we consider highly valuable and enhancing those of value to their finest condition.

3. **Upload and Publication of Images from Image Collections:** The third key output of this project is to add the reviewed and enhanced images to the IPMImages.org site. After the review process, images from the various collections will be added to the site. Of the images reviewed,

we expect to add 750 images from Cornell University faculty and staff and 500 images from the University of Maine. Since these images are the most significant and are of high quality, we expect NPDN diagnosticians will have access to these images and permission to use them for creation of disease and pest factsheets, Powerpoint presentations, and NPDN SOPs and picture clues. Every image uploaded will be saved at multiple resolutions for use in different types of applications.

*Anticipated Impact:* The upload and publication of images from various Northeastern and beyond collections will provide diagnosticians, extension personnel, consultants, IPM practitioners and all green industry members an expanded resource of quality images of diseases, pests, and harmful organisms. The addition of these “cream of the crop” images will allow for quicker, more accurate identifications by diagnosticians and provide an expanded resource of images for use in publications.

### **III. Approach and Procedures**

#### **1. Continued use of a Bugwood-Cornell Node:**

- University of Georgia personnel will remotely provide service to promote continued use of the Northeast node. The proposal does not include any funding for the University of Georgia personnel. Their services are included voluntarily.
- No additional hardware or software is needed to continue this project as they were purchased in the first year of funding.
- Personnel from the University of Georgia, Cornell University and the University of Maine will dedicate time to the continuation of the Northeast node. The proposal provides salary support for personnel at Cornell University and the University of Maine so personnel can dedicate specific time to this task.

#### **2. Solicit, Retrieve, Assemble, and Enhance Images from Image Collections:**

- Cornell University personnel will review the current IPMImages.org website to determine improvements specific to the Northeast region. This will ensure that while reviewing the collections, critically needed images will receive higher priority for inclusion into the system.
- Cornell University personnel will collect images from faculty and staff and review the collections for desirable content, image quality, and determine what enhancements are needed to prepare the images for inclusion in BugwoodImages.
- Cornell University personnel will work closely with University of Maine personnel to process their images through the newly established Bugwood-Cornell node.
- Once images are selected for inclusion into the database, personnel will annotate the images with critical information such as description, photographer identification, place image taken, host type, etc. Additionally, enhancements will be made to improve the quality of the image and various resolutions of the image will be prepared.
- Ongoing work beyond the scope of this project may include a call for needed images to other Northeast diagnosticians and members of the NEPDN for inclusion into the BugwoodImages database system.

#### **3. Upload and Publication of Images from Various Image Collections:**

- Personnel will prepare images for inclusion in BugwoodImages, upload the images once enhancements are complete.

- Supervisory personnel at Cornell University will review the images and descriptive content for accuracy.
- Once approved by supervisory personnel, the images will be uploaded with descriptive content.
- Cornell University personnel will provide resources and support for the University of Maine and other laboratories within the Northeast region to facilitate posting to the IPMImages.org site.
- Cornell University personnel will inform NPDN members, via the 5 region's listservs and emailing lists, of the availability of images as they are added to the site.

#### **IV. Evaluation Plans**

##### **Evaluation Plans:**

##### **1. Promote the use of a Bugwood-Cornell Node:**

- Evaluation of this output can be performed by the users and peers of the system. The users will indicate whether they can submit images and their associate content to the IPMImages.org site through the Cornell node.
- Additionally, monthly searches of the system for images submitted through the Cornell node by Cornell personnel and by University of Maine personnel will be an indication the Cornell node is working properly and is being utilized. Successful utilization will be indicated by increasing image numbers added each month and increasing traffic to those images.

##### **2. Review and Enhance Images from Various Image Collections:**

- Supervisory personnel will review the progress of sorting through the image collections and preparing them for upload to ensure goals for the number of images submitted to the database are met.

##### **3. Upload and Publish Images from Various Image Collections:**

- Images submitted to this database will be evaluated using a peer reviewed system.
- Evaluation of this output will include a determination of the:
  - Number of images added by Cornell University personnel
  - Number of images added by Cornell personnel from University of Maine personnel
  - Number of hits to the images added from the Cornell-Bugwood Node
- User statistics will be collected quarterly and reviewed for image frequency of use, length of stay and login source.
- We will also solicit feedback using online survey tools and during face-to-face meetings of the NEPDN and NPDN members, during which time we will demonstrate how to access new images, review process, and the option to add their images to the collection.

##### **Progress Report:**

The original grant that created the Cornell node was a NEIPM grant began in September of 2012 and was titled, "Development of a Northeast region Bugwood node to collect and catalog images for use as reference tools by diagnosticians and identifiers". Training for the establishment of the node was given by Joe LaForest, IPM Coordinator, University of Georgia, Center for Invasives and Ecosystem Health, during the week of January 30-February 2, 2012. In just a few short weeks since the training, we have submitted 623 images

to the network. These images cover 115 subjects and include significant diseases such as chrysanthemum white rust, Japanese apple rust, thousand cankers disease and boxwood blight. Many of the images are microscopic views of plant pathogens that may aid diagnosticians in their identifications. The images have already been viewed 3,279 times. The current sources of the images are the Cornell Department of Plant Pathology and Plant-Microbe Biology and our collaborator, Bruce Watt of the University of Maine.

#### **V. Key Personnel:**

**PI Snover-Clift** has been the Director of the Plant Disease Diagnostic Clinic of the Department of Plant Pathology and Plant-Microbe Biology at Cornell University since July of 1998 and the Associate Director of the Northeast Plant Diagnostic Network since November of 2002. Snover-Clift received her Bachelor of Science degree from Cornell in Floriculture and Ornamental Horticulture and a Masters of Professional Studies degree in the department of Plant Pathology. Her Masters research focused on an evaluation of onion flower susceptibility to *Aspergillus niger*. As Director of the Clinic, Snover-Clift is responsible for diagnosing plant diseases on a wide range of host plants such as woody ornamentals, herbaceous plants, fruits, vegetables, turfgrass, and field crops. Additional duties include training Master Gardeners, Extension Educators, and other green industry members on the basics of plant disease and the pathogens that cause them, as well as introducing youth to the vast world of fungi. As Assistant Director of the NEPDN, Snover-Clift supports the overall mission of providing detection of a possible bioterrorist attack or accidental introduction of harmful pathogens on the nation's natural and agriculture systems and maintains a regional center capable of supporting the diagnostic needs of 12 northeastern states. As program area manager of the diagnostics subcommittee, Snover-Clift provides leadership in the creation of Standard Operating Procedures, coordination of highly sophisticated, identification procedure training events, and maintaining active communications of significant events.

**Cornell University** is well positioned to continue its contribution to this project. Extension staff and faculty have large collections of image materials that can be reviewed for those images needed in the database. We can request participation in this project from many plant related disciplines. The department of Plant Pathology and Plant-Microbe Biology has committed to submitting 1,500 images for review and contributing 750 images depending on image significance and quality. Additionally, we will solicit images from the other 14 NEPDN diagnostic laboratories in our region and work with Bruce Watt and the University of Maine to submit another 500 images. Cornell University personnel can aid other members of the Northeast region in submitting their image collections. The department employs a full time photographer that has 26 years of experience photographing diseases, pathogens and insects. His work has been used on numerous scientific magazine covers, in the production of numerous books and, of course, in countless scientific articles and journals. His expertise is an enormous resource for members of the department and will be as well for this project. A laboratory technician will dedicate 20% of her time to the project. Snover-Clift will also organize the peer review process and user feedback.

**PI Watt** has been the Plant Diagnostician at the University of Maine for over 20 years. He received his Doctorate in Forest Biology from the University of Maine and his Masters degree in Plant Pathology and Bachelor of Science in Natural Resources from the University of Rhode Island. In his present position as an Associate Scientist he is responsible for diagnosing any plant

problem for all the citizens of Maine. Apart from his role as a diagnostician he is responsible for training Master Gardener volunteers and other grower groups on the identification and management of plant diseases. As a member of the National Plant Diagnostic Network, he also trains First Detector volunteers to act as a first defense against the introduction of exotic pests. One of his main interests is in developing a photographic catalogue of the plant diseases and their pathogens that occur in Maine. Bruce Watt will collaborate by submitting approximately 500 images to the Bugwood images database through the node at Cornell University. The proposed budget represents salary for digital image manipulation, data uploads, and tracking of submitted images.

### **Timeline**

#### **September-December 2012**

- Collection of images to review from Cornell University
- Collection of images to review from University of Maine
- Review image quality and descriptive content for accuracy

#### **January-March 2013**

- Upload images from Cornell University
- Upload images from University of Maine
- Evaluate number of images being submitted and accessed
- Inform NPDN members, First Detector educators, extension educators, IPM practitioners and other collaborators of image availability
- Time permitting-invite other Northeastern members to use the node and provide assistance to them
- Begin addition of other images through the node interface to establish protocols as a long-term Bugwood-Cornell node
- Prepare final survey and evaluation forms to include information about number of images in the system, number of hits on those images, subject matter addressed, and how users use the images.

**Appendix:**

**Logic Model:**

<b>Inputs</b>	<b>Audience Activities</b>	<b>Short Term Impacts</b> (Knowledge Change)	<b>Intermediate Impacts</b> (Action Change)	<b>Long Term Impacts</b> (Condition Change)
<ul style="list-style-type: none"> <li>• Funding</li> <li>• Personnel time</li> <li>• Content</li> <li>• NPDN regional staff support</li> <li>• NPDN diagnostician support</li> <li>• IT support</li> <li>• Bugwood Network support volunteers</li> <li>• Use existing equipment and supplies: computer, image processing software, digital camera, microscope</li> </ul>	<p><u>Sample Audiences</u></p> <ul style="list-style-type: none"> <li>• Plant Disease and Pest Diagnosticians</li> <li>• Extension Agents and Educators</li> <li>• Extension Specialists</li> <li>• IPM Practitioners</li> <li>• NPDN First Detectors</li> <li>• Master Gardeners</li> <li>• Crop/Pest Management Consultants</li> <li>• Pesticide Applicators</li> <li>• General Public</li> </ul> <p><u>Sample Activities</u></p> <ul style="list-style-type: none"> <li>• Print and Electronic Materials</li> <li>• Presentation Materials</li> <li>• Web site training</li> </ul>	<p><u>Sample Indicators</u></p> <ul style="list-style-type: none"> <li>• Users enter images into BugwoodImages through Cornell node</li> <li>• Image collections are reviewed and some images are enhanced to be added to IPMImages</li> <li>• Increase audience awareness of harmful plant pathogens and pests</li> </ul> <p><u>Possible Measures</u></p> <ul style="list-style-type: none"> <li>• Peer review of new node</li> <li>• Supervisor review of progress</li> <li>• Web site training</li> </ul>	<p><u>Sample Indicators</u></p> <ul style="list-style-type: none"> <li>• Quality images are available on IPMImages</li> <li>• Images are preserved for future users</li> <li>• Users utilize the increased number of images for making identifications of harmful plant pathogens and pests</li> </ul> <p><u>Possible Measures</u></p> <ul style="list-style-type: none"> <li>• Increased number of printed and electronic materials are available</li> <li>• Increased number of presentations with new images</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Diagnosticians and other users create educational and diagnostic materials and procedures from newly available images</b></li> <li>• <b>IPMImages becomes known as a reliable resources for high quality diagnostic images</b></li> </ul> <p><u>Possible Measures</u></p> <ul style="list-style-type: none"> <li>• Document new images to IPMImages</li> <li>• Document online usage statistics at IPMImages</li> <li>• Survey users</li> </ul>