



An Updated Web-based Distance Diagnostic and Identification System for Extension ¹

J. Xin, T. Momol, L. Buss, P. Vergot III, L. Halsey, A. J. Palmateer ²

Introduction

The agricultural industry constantly faces threats of plant disease, insects, weed problems, invasive species, and even potential agro-terrorism. Studies show that, in Florida, annual costs are hundreds of million dollars for the state and producers to cope with pests, plant diseases, and invasive species. Given the vulnerabilities and impact to our agricultural industry, there is a critical need for rapid and accurate diagnoses of economically important insect pests and plant pathogens. The latest information technologies make it feasible to design alternative approaches to assist with the identification of potential plant pests and delivery of appropriate management strategies.

Pest management involves the correct and timely identification and control of weeds, insects, and diseases. Pests above threshold levels may ultimately lead to decline in the general health of agricultural crops, may cause structural damage, and most importantly, can threaten human health and safety. If pest problems are left untreated for too long, they

may lead to substantial economic loss to producers and even human health issues. Although pest management information is available on the Internet and from other sources, accurate identification of the pest is needed prior to proper pest control. Pest identification and diagnosis are in many cases difficult and often require consultation with a specialist. A common approach is to collect samples and deliver them by U.S. mail to a specialist for identification. The delivery process using regular U.S. mail can take days, leading to delays in pest control recommendations. Sometimes, mailed samples are not in a condition suitable for diagnosis due to deterioration in the mail. Accurate and rapid diagnosis can assist producers in avoiding costly mistakes through quick determination of appropriate pest identification and appropriate pest management practices benefiting human health and agricultural production.

Extension county agents, state specialists, and faculty of UF IFAS Office of Information Technology developed the Web-based Distance Diagnostic and Identification System (DDIS) for

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2. J. Xin, Associate In, Office of Information technology; T. Momol, Associate Professor, Office of District Directors; L. Buss, Senior Biological Scientist, Entomology and Nematology; P. Vergot III, Associate Professor, Office of District Directors; L. A. Halsey, County Extension Director, Jefferson County; A. Palmateer, Assistant Professor, Tropical REC, Homestead; Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611. (The use of trade name in the paper is solely for illustration purposes only. This is *not an endorsement* by the authors nor the University of Florida.)

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University of Florida IFAS Extension. The DDIS system allows users to submit digital images obtained in the field or after delivery to a local extension office for rapid diagnosis and identification of pest insects, weeds, diseases, and animals. DDIS creates a digital image library with an associated location, crop, and pest or disorder data that can be used in future educational programs. DDIS provides an effective method for agricultural extension county agents, state specialists, clinic and lab diagnosticians, and external experts to make rapid diagnoses and subsequent management recommendations. More importantly, DDIS provides a new venue for county extension agents to interact with their clientele and assist them on pest identification and diagnosis. DDIS is a part of:

- the Florida Plant Diagnostic Network (FPDN) (<http://fpdn.ifas.ufl.edu>)
- the Southern Plant Diagnostic Network (SPDN) (<http://spdn.ifas.ufl.edu>)
- the International Plant Diagnostic Network (IPDN) (<http://www.intpdn.org>),
- the National Plant Diagnostic Network (NPDN) (<http://www.npdn.org>) databases,

where samples can be shared at the national level.

Typical DDIS Hardware and Software

The Meiji trinocular zoom stereo microscope (EMZ5TR) and compound microscope (ML2100) are favored by many DDIS specialist in the lab, although others may be used depending on a diagnostician's requirements. A number of different digital cameras were selected and utilized for this project. These digital cameras were chosen for their features of image quality, ease of use, and microscope mounting capability, which allows DDIS clientele to use the same camera in the field and laboratory to capture “samples.” Figure 1 shows some examples of DDIS equipment. Since DDIS supports multimedia files such as audio or video clips, a digital video camera may be used to capture a video clip. DDIS hardware requirements change

when new technology is available. For the latest DDIS hardware configuration, please visit the DDIS website at <http://ddis.ifas.ufl.edu>.



Figure 1. Sample DDIS equipment. Credits: Canon S3IS-MM99-58 (upper left corner image) © Martin Microscope

DDIS is a web-based application. There are no special software requirements for users besides a Web browser and Internet connection.

DDIS User Roles

The DDIS system provides for different user roles which allow various users to perform distinct tasks assigned to them. Figure 2 shows interaction among DDIS users. Sample submitters could be:

- county extension agents or first detectors with full submission rights,
- extension clientele with right to submit samples to county extension agents in their county, or
- laboratory or clinic approved users with right to submit samples to that lab or clinic.

On the specialist side, there are four types of users:

- state specialists at UF IFAS departments,
- laboratory and clinic diagnosticians,
- registered non-UF IFAS DDIS specialists, and

- external experts referred by DDIS specialists.

As a part of the SPDN network, certified UF IFAS diagnostic labs may submit samples to SPDN (regional) and NPDN (national) databases.

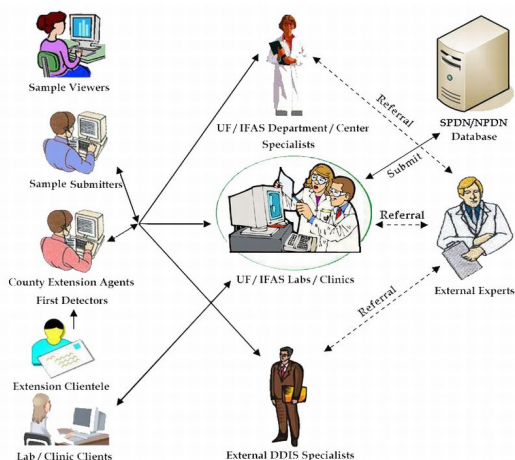


Figure 2. Collaboration among DDIS users and specialists.

How Does the DDIS Process Work?

Figure 3 shows the process of DDIS sample submission and diagnosis. From a user's viewpoint, the system operates like a sophisticated e-mail system within a centralized database to save and capture data for future retrieval and processing.

First, a user observes a pest or symptom and captures an image through a digital camera with or without the use of a microscope. After capturing the “digital samples,” the user then signs on to the DDIS website to submit these with the pertinent field data to a database. The on-line submission forms mimic the hard copy paper forms also used by the UF/IFAS diagnostic laboratories. After the user submits a sample to the DDIS server, it automatically notifies the specialist(s) that an identification and diagnosis is needed. Specialists can then retrieve the submitted sample via the website, and determine an identification or diagnosis along with appropriate control recommendations. After identification and diagnosis are complete, specialists submit their findings and recommendations to the database. The DDIS system automatically notifies the sending user that the diagnosis and recommendations are available to view in the DDIS website. Users then retrieve a report of the diagnosis and recommendations.

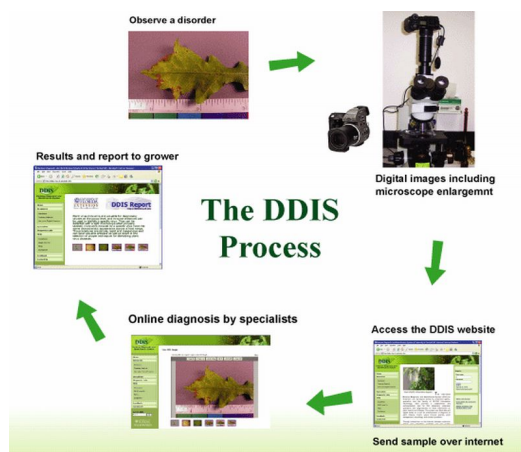


Figure 3. DDIS sample submission and diagnosis process.

Users also may send a sample simultaneously to several specialists for diagnosis. For example, a sample can be sent to a pathologist and a physiologist so that they may collaborate on an answer. Multiple responses by the different specialists are sent to the user. The entire process of diagnosing pest problems through DDIS can often be completed in a matter of a few hours, rather than many days as would be required using conventional or overnight mail.

New Updates for DDIS

The web-based DDIS includes many updated features to take advantage of current and emerging technologies. The system provides the following new interfaces and functions:

- New user interface and personalized sample management process
- Improved sample submission process separated into three distinct steps to avoid losing diagnosis form data in the event of image upload failure
- Addition of a role-based user system defining roles as a) viewer only, b) Extension agent clientele, c) lab/clinic clientele, and d) lab diagnosticians/department state specialists, and internal/external specialists
- Dynamic map-based distribution displays for sample numbers submitted by county and pest distribution by county including timely alerts of pest or pathogen outbreaks

- Simplified one-click SPDN/NPDN submission, accessing the internal homeland security system, as the DDIS development team was tasked
- Sample referral to an external expert or other DDIS specialists when requested
- Enhanced diagnosis form allowing for: a) multiple diagnoses, b) save and retrieve previous diagnosis, c) auto-complete pest and host name data entry, d) invasive species identification, and e) standard NPDN pest code (required by homeland security)
- Enhanced user sample management function to change a sample from Public to Private or vice versa
- Allow the sample submitter to grant sample viewing permission to other end users

Interaction with Extension Clientele through DDIS

USDA reports reveal that high-speed Internet access methods have become more available to Internet users in the farm sector since 2005. In 2007, a total of 55 percent of U.S. farms had Internet access (USDA, 2007). DDIS provides a new venue for county extension agents to assist their clientele of growers, crop consultants, homeowners, and master gardeners who want to submit digital plant and animal samples for identification of pest issues. After a county extension agent receives the sample, he/she may reply to the sample submitter or forward the sample to the appropriate clinics or specialists for diagnosis. This feature provides a direct on-line communication between county extension agent and their clientele.

How Do I Register as a DDIS User and Submit a Sample?

To become a DDIS user, visit the DDIS website (<http://ddis.ifas.ufl.edu>) and select "Sign Up" from the DDIS home page. Fill in all required data entries and follow the on-screen instructions. It is

recommended that new users go through the DDIS "Quick Start" and "How To" tutorials. Users may submit a DDIS sample in three easy steps: 1) sign up as a DDIS user, 2) prepare a digital sample, and 3) submit the sample to specialists or clinics.

Summary

DDIS was developed for use in rapid diagnosis of pest problems and identification of plants, insects, and diseases. Although DDIS provides a successful means for quick identification and diagnosis, the system may not replace traditional laboratory analysis for many difficult plant disease samples. DDIS creates an archive of images with associated location, host crop, and pest or disorder data statewide. These archived images become a digital reference library to aid in identification and understanding of plant insect and disease management, as well as for education of extension personnel and their clients. DDIS at UF/IFAS:

- Provides a Web-based diagnostic system with rapid early detection of pests, plant diseases, and invasive species
- Increases the collaboration environment among county extension agents, their clientele, and UF IFAS state specialists as well as other experts throughout the world
- Alerts respondents about high-consequence pests
- Archives results in an accessible and dynamic database for research and educational use
- Maintains real-time data network with SPDN and NPDN
- Collaborates internationally with IPDN
- Empowers users with the delivery of appropriate management strategies

Reference

USDA, 2007. Farm Computer Usage and Ownership. USDA, National Agricultural Statistics Service, *Sp Sy 9*. (07).