

National Plant Diagnostic Network: 2016 Review

Report of the Review Committee

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2016 NPDN Review Committee

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NPDN 2016 Review Executive Summary

The USDA National Institute of Food and Agriculture (NIFA) convened a Review Committee who met from March 8-10, 2016 to conduct a critical review of all facets of the National Plant Diagnostic Network (NPDN). The committee met in conjunction with the Fourth National NPDN meeting in Arlington, Virginia on March 8-12, 2016 coordinated by the University of Florida. The Review Committee was provided background materials on the mission and history of the NPDN, administrative structure, and accomplishments since its inception.

The Review Committee, consisting of professional representatives from major stakeholders, U.S. government agencies, and university partners of the NPDN, developed this report after a thorough review of the five regional network summaries, the NPDN committee activity summaries, and after meeting in Arlington with the NPDN Executive Committee and regional directors. Although much of the core of this review came from content and output from the 2016 national meeting, the basis of this report comes from the NPDN committees that implement the plans of work and coordinate the activities within and across regions. Relevant recommendations of the 2007 review report were also considered.

This report is divided into six sections following the framework established in 2007, which is reflective of the mission, scope, and structure of the NPDN. In each section, the summary is followed by a list of action items with specific recommendations for future improvement of the NPDN. The Review Committee did not feel it is necessary to reflect on the history and inception of the NPDN since this has been adequately addressed in previous documents. Instead, the Review Committee focused on an analysis of the current state of the NPDN and suggestions for the future, including areas for improvement.

Key Findings:

The NPDN and its laboratories are considered essential for minimizing destructive pathogens and pests of U.S. agriculture. Considering its funding challenges, especially since 2007, the NPDN has functioned extremely well, based on a review of its accomplishments including reports, service to multiple public and private entities and resulting refereed publications.

Long term funding and sustainability of the NPDN remain a concern by the Review Committee. Although the Review Committee does not offer specific funding solutions, the report identifies mission areas where funds are needed to support the program and ensure its sustained success.

Succession planning at levels of the executive committee, regional directors and USDA NIFA remains a concern. Many of the current regional directors have been with the NPDN from the beginning. A succession plan is essential to ensure that these mission-critical positions are a part of the ongoing and future operation of the NPDN. The continued stability and functioning of the NPDN with its partner institutions should be seamless and follow a well-developed transition plan.

The NPDN Advisory Council has not been effective and should be replaced by broad-based focused listening groups. These focused listening groups should be composed of representatives from the private sector, state/county governments and commodity representation to ensure all partners and benefactors of the NPDN are represented.

Rapid detection, evaluation and use of new methodology, diagnostics, and early communication of disease outbreaks are essential components of the NPDN and should remain a core mission. Training and education of first responders should be incorporated into training workshops. Diagnostic resources should be prioritized among NPDN labs, state and regional labs.

Effective linkages among NPDN labs should include enhanced surge capacity during disease outbreaks including an effective mechanism for referral and overload samples when a lab reaches capacity.

The NPDN Executive Committee and NIFA National Program Staff should continue to manage the NPDN as a cooperative agreement. A competitive funding model for the NPDN and its regions/labs would be highly disruptive to the continuity and vitality of the program.

I. Governance & Funding

The NPDN was established by the USDA, Cooperative State Research Education and Extension Service (USDA CSREES) from federal funds in 2002 to provide increased diagnostic capability to the nation's agricultural system.

The NPDN is administered by an Executive Committee and Operations Committee under a cooperative agreement with USDA NIFA, which replaced CSREES. Initially, the NPDN administration was divided among the five regions, each with a separate responsibility. Governance was assigned to the Great Plains Diagnostic Network (GPDN), the North Central Plant Diagnostic Network (NCPDN) provided oversight for public relations aspects, the Northeast Plant Diagnostic Network (NEPDN) coordinated diagnostics, the Southern Plant Diagnostic Network (SPDN) managed training and education and the Western Plant Diagnostic Network (WPDN) managed exercises. Information technology and data management was led by the National Repository. Following the budget reductions in 2011, the Executive Committee decided to focus on four areas. Each of the four areas: Diagnostics, IT Systems, STAR-D Accreditation, and Communication were to be a shared responsibility of the regions together. Committees were established to address governance, training and education because there was not sufficient funding for focused efforts in training and educational materials. Following the enactment of the Budget Control Act, a new strategic direction was established to focus on detection, diagnostics and reporting (communication). The strategic planning process is still ongoing.

The NPDN is composed of five regional hubs with each having unique challenges and regional characteristics. They are composed of institutional partners who vary in their level of participation in the region and greater Network. Partners in each region value the current structure and indicate they appreciate the communications, coordination of funding and reporting, and opportunities to network and attend training sessions that each regional hub provides. The diagnosticians in each of the labs look forward to regional meetings as an opportunity to exchange information, learn new techniques (as some regional meetings also have some hands-on diagnostic activities) and to network. Several regions have provided additional training for their partners, and the current structure allows new diagnosticians the ability to be mentored by established diagnosticians. Several partner labs with specific expertise have opened their doors to diagnosticians who seek training on a specific topic. Each partner also looks to their regional hub for leadership and guidance with STAR-D, and they appreciate the fact that the hub labs have achieved full accreditation or have been through a gap audit. State laboratory partners in each region have become embedded within each regional structure, and this has led to a sense of community that strengthens the diagnostic efforts within the regions and serves as a point of entry into those issues and activities that involve the entire NPDN.

The NPDN mission statement was recently revised and is currently being vetted pending ratification of the NPDN Governance Charter. It states:

The National Plant Diagnostic Network is a premier diagnostic system with the ability to quickly detect and accurately identify plant pests and pathogens and to communicate timely and accurate information.

The mission of the NPDN is based upon national agricultural security. It is charged with rapid detection, diagnosis, and early communication of outbreaks of plant pathogens. The Network coordinates and communicates with county and state extension agents, state departments of agriculture and the USDA, Animal and Plant Health Inspection Service, Plant Protection and Quarantine (USDA APHIS PPQ) during outbreaks in implementing its mission. Training of first responders and diagnosticians is an essential component of the NPDN, ensuring that the Network is prepared for the scope of its mission in the event of an outbreak. The NPDN is a critical component of our nation's biosecurity infrastructure and should serve as a model for other nations to emulate.

However, this new mission statement does not mention training and education. This is a reflection of the reduced funding over the past few years that forced the NPDN to more stringently prioritize its objectives. The NPDN Executive Committee is still committed to that program element which will be prioritized with diagnostics and communications.

The vision for the NPDN should undergo a strategic planning process and clarify a new statement based upon current realities. That new vision statement should reflect high expectations for NPDN, including;

- Increased recognition for NPDN's accomplishments both domestically and internationally
- Greater accountability for competent and reliable diagnostics from labs with active quality management systems in place (STAR-D laboratory accreditation, NPPLAP certifications, etc.)
- Increased global impact through cooperation and outreach programs (funded externally).

The NPDN has an Advisory Council that was active for a few years after the NPDN was established. They focused on strategic prioritization of efforts and resources. Its guidance was helpful, however in recent years, the Advisory Council has not been effective in the original intent due to limitations on participation by industry and commodity stakeholders. The Advisory Council has not been directly and consistently engaged with the NPDN leadership. Funding to support meetings was drastically reduced resulting in few opportunities for face-to-face interactions of the Advisory Council. The NPDN could have benefited from input through regular conference calls of the Advisory Council.

Additionally, the Advisory Council does not have all of the representation needed to provide broader advice to the NPDN because of FACA restrictions, which do not allow non-federal representation. A possible name change and a new charge as a listening or focus group could provide the needed input to the NPDN without violating FACA compliance. Despite initial attempts to more broadly engage private industry, their participation didn't come to fruition. One approach to greater stakeholder engagement with the NPDN could be regional activities such as summits, commodity focus groups or other open meetings. Another approach would be to use some survey tool to gauge the knowledge of, interest in, and utility of the NPDN to its diverse stakeholders and clients.

Extension and Experiment Station directors at Land Grant Universities play an important role in funding and support of diagnostic labs and personnel at their institution. It is appropriate to develop a mechanism to inform and engage Extension and Experiment Station Directors as well as leadership at state departments of agriculture and provide updates on the NPDN to increase opportunities for their direct engagement.

Succession planning at NPDN remains a concern from the executive director through the regional hub director, and through diagnostician levels. A succession process is needed for these critical positions and should be part of the ongoing evolution of the NPDN. It is critical for the stability and continued functioning of the NPDN and its partner institutions to have a succession plan. Transitions should be seamless and new diagnosticians should be welcomed by the regional network of current experienced diagnosticians and be provided access to expertise and assistance. New Regional Directors should be embedded into a collegial and functional Executive Committee.

Succession planning at the National Program Leader level at NIFA is also a concern. Development of the NPDN has greatly benefited from interaction and programmatic participation by its current NIFA National Program Leader (NPL). The NPDN requires administrative oversight by the granting agency under the guidance of a knowledgeable and engaged NPL representative to ensure a smooth transition during leadership changes. The Review Committee strongly encourages NIFA to promptly designate an NPL to provide administrative oversight with upcoming personnel changes on the National Program Staff. Specifically, it is recommended that an NPL be identified with strong program leadership, as well as technical and programmatic skills.

The review committee is pleased to note that an effective governance structure has been in place since its inception and that the Network is still capable of identifying and responding to plant pathogens in the food and agricultural production system in the face of severe reductions in funding. The NPDN has maintained support for diagnostic clinics/laboratories in all 50 states plus Puerto Rico, Guam, and American Samoa, while instituting new training and accreditation and certification programs for procedures and personnel. This has been partially accomplished by leveraging of state and federal dollars. It is also evident that the Regional Directors comprising the Executive Committee maintain a true spirit of teamwork both within and across all regions and have established effective working relationships with member Land Grant Universities, State Departments of Agriculture and USDA- APHIS.

Managing and pre-planning for diagnostic sample surge capacity is still a challenge across and within all regions. It was noted that no consistent performance matrix has been established that would assist regional coordinators to benchmark respective diagnostic clinics and allow them to prioritize selective equipment upgrades. Limited means exist to capture and communicate NPDN performance in order to document effectiveness and prove its value to all commodities and significant stakeholders.

Funds to support the NPDN are allocated from the Food and Ag Defense Initiative (FADI) through NIFA beginning in 2004. Funding peaked in 2010 and then began a steady decline in 2011. These cuts in federal funding led the Executive Committee and laboratories to redefine and narrow the scope and mission of the NPDN. Despite this challenge, NPDN has been able to modify their approach and deliver a program that assures support for a diagnostic presence in every state, although further cuts could have drastic consequences to our national agricultural system.

The need to increase base funding for all regions was recognized as a major challenge with decreasing federal budgets. There is a need to insure that efficiencies in funding (especially supplemental funding) flow are operating in all regions so that individual labs are not left with unreimbursed diagnostic costs or funding shortfalls. It has been suggested that not all states are treated equitably relative to funding perhaps as a result of the number of states in a given region or differences in operations between “hub” institutions.

It was recognized that there are significant opportunities to expand linkages with state departments of agriculture, state agriculture and environmental regulatory officials, county extension educators/agents and certified crop and nursery consultants. Efficient leveraging of resources with appropriate state agencies, non-government organizations (NGOs) and national/state commodity organizations should continue to be a high priority for all regional networks. The regional IPM Centers should become a formal part of the communication linkage and also search for leveraging grants and special pathogen appropriations. Laboratories should seek applicable certifications and accreditations as a means to document and improve staff capabilities, promote efficient utilization of equipment and facilities, and prove they continue to meet producer and customer needs.

Recommendations

a. Action Items

- The current NPDN Advisory Council has not been effective because of FACA compliance requirements, which prevents non-federal representation on advisory boards. The Review Team strongly recommends the establishment of a broad-based NPDN focus or listening group at both the national and regional level, to include representatives from the private sector, state/county extension, experiment station/research faculty, CCAs, state/federal regulatory agencies and National Plant Board (NPB) affiliates. It is especially important to include "industry" and NAHLN representation on the Advisory Board for

exchange of ideas on business practices and governance strategies. A possible name change and new charge to a non-advisory role as a listening group or focus group could provide the needed input to the NPDN without violating FACA compliance.

- The NPDN Executive Committee should complete development of a Strategic Plan for the next five years of the NPDN which establishes and identifies milestones for all aspects of the Network currently covered by NPDN subcommittees and prioritize them contingent on funding.
- As part of the strategic plan, a framework and process for annual self-evaluation should be developed that will help focus efforts on strengthening and measuring key activities. It should include common reporting topics and formats across all regions, and develop metrics for recording and reporting performance.
- Improve identification and coordination for recognizing labs with surge capacity in identification and sample processing of specific pathogens.
- Build a succession plan to efficiently transfer leadership responsibilities at the regional and national level.
- Develop a new vision statement that reflects the high expectations for NPDN's continued success.

b. Specific Recommendations

- Evaluate the basis for formula funding and practice transparency in annual funding allocations from national to regional to State Labs/Clinics. Improve accounting and timeliness in annual funding flow and reporting to/from each of these units as well.
- The current NPDN Advisory Council should be broadened by a newly formed focus group or interest group that complies with FACA requirements. This new body should be focused on strategic prioritization of efforts and resources. To ensure broader views and representation, the network directors should encourage this group to engage industry leaders and stakeholders in regional activities such as summits or other open meetings for face-to-face interactions and regular conference calls.
- The network directors should develop a mechanism to inform and engage Extension and Experiment Station Directors as well as state departments of agriculture to provide updates on the Network and to provide an opportunity to discuss the NPDN.
- The review committee recommends that a succession plan be developed for the Executive Director, Regional Directors and the NIFA NPL responsible for the NPDN. University extension and research administrators could play an important role in short term funding and support of labs at their institution if greater awareness of the scope and needs of NPDN labs was brought to their attention.
- NPDN Executive Committee and NIFA National Program Staff should continue to manage the NPDN as an ongoing cooperative agreement. A competitive funding model for the NPDN and its regions/labs would be highly disruptive to the continuity and vitality of the program.
- Regarding surge capacity, the review committee encourages NPDN diagnosticians to receive training offered by APHIS PPQ on high consequence pathogens and pests so that representative labs are prepared to assist during outbreaks of known agents. Since

potential pests may be undefined and broad ranging, complicating issues should be addressed beforehand such as maintaining sample integrity and chain of custody for shipping large numbers of samples long distances.

- Develop a survey tool to gauge the interest of diverse stakeholders and to determine long and short-term plans for labs and personnel at each diagnostic lab institution.
- New vision and mission statements should be more visible on the NPDN website.
- Consider adding a new committee to address “Surveillance” issues, including interaction of NPDN labs in partnerships with IPM-PIPE components and with USDA APHIS CAPS programs.
- Complete a five-year strategic plan focused on core components such as marketing, incorporating recommendations from the Public Relations and Outreach Review (below) and also focus on documenting and measuring effectiveness, prioritizing resources, and building the governance and internal communication infrastructure needed to support diagnostics and ensure the NPDN’s continued success.

II. Diagnostics

Since its inception in 2003, the Diagnostics Committee has focused on communications among diagnosticians, acquisition of USDA permits, creating standard operating procedures for diagnosis of regulated pathogens, coordinating select agent workshops and laboratory surge capacity, developing a workshop on basic techniques for diagnosticians, and establishing and implementing the STAR-D lab accreditation program. The Diagnostics Committee has initiated a conversation with the NPDN Database Committee to address concerns expressed at the 2015 Diagnosticians/IT meeting on the use of diagnostic confidence levels, which resulted in formation of an ad hoc sub-committee that was charged with surveying members on the use of diagnostic confidence levels. Results of that survey were presented at the 2016 NPDN national meeting. The Diagnostics Committee also collected data on surge capacity from every state to identify the resources available to handle a surge in sample volume that might occur in the event a select agent was found. The committee plans to update this survey, although it’s not stated when that will occur.

The National Plant Protection Laboratory Accreditation Program (NPPLAP) accredits laboratories across the U.S. with the goal of increasing national diagnostic capacity and ensuring lab capability in delivering accurate diagnostic determinations for USDA regulatory purposes. Several NPDN labs have achieved and are successfully maintaining NPPLAP accreditations. Likewise, STAR-D, a quality management system developed by NPDN is being practiced in an increasing number of NPDN labs. Scientists selected from NPDN labs are trained in audit procedures for STAR-D. This group continues to grow, ensuring the ability to support lab audits across the network. This effort, much like NPPLAP accreditation, is gaining traction with NPDN labs as more diagnosticians understand the value of not only accreditation, but the benefits of using a quality management system. There is value added to the STAR-D implementation through increased collaboration among Network labs, recognized standardization amongst peers, and strengthened quality assurance and control of network collected data. The International Organization of Standards

(ISO) 13484 is expected to be approved in the future and will offer an intermediary quality standard for NPDN labs that have an interest in achieving ISO or STAR-D accreditation. The ISO 13484 standard is the first standard put forward through ISO that specifically addresses plant pathogen testing using molecular biomarkers, and the process as initiated by the NPPLAP opens the door for the NPDN to additionally use the ISO process as a means for introducing technical protocols to be shared at an international level.

The APHIS National Identification Services (NIS) and NPDN labs have worked to preserve sensitive information and to communicate needed information regarding samples in a timely manner. When suspect positive samples are confirmed by the CPHST-Beltsville Lab, state government and local PPQ have teamed together with the support of NPDN to delimit the pathogen and rapidly respond to pathogen/disease establishment. Surge capacity has increased for regulatory samples with additional NPDN labs becoming NPPLAP accredited. Surge control efforts for non-regulatory samples are unknown, although in principle, high-throughput platforms in several NPDN labs will support processing of greater numbers of processed samples. Establishing and organizing surge potential in advance of an emergency is extremely beneficial and should be pursued.

Recommendations

a. Action items

- Develop a comprehensive accreditation and certification process for NPDN that identifies minimum standards for accreditation. The quality management system should meet NPPLAP accreditation criteria. It may be necessary to identify specific levels of accreditation in a quality assurance/quality management system. It is also necessary to clarify how to obtain and distribute the resources needed to attain and retain the levels of quality assurance required for accreditation.
- Establish data and practices for monitoring of laboratory workload against lab capacity and develop a referral process for samples to effectively utilize the capacity of the Network in the event of a surge.
- Work with APHIS to establish a policy of rapid relay of confirmatory data and address issues of confidentiality of those data. The review committee recognizes that sample status is released by the CPHST-Beltsville Lab to NIS which then passes the information to the affected State Plant Regulatory Official (SPRO) and State Plant Health Director (SPHD) and others. As for the SOP itself, it covers everything from the first discovery of a pathogen or pest, to the time the final report is relayed to the SPHD and SPRO of the state involved, and everything in between. This includes the referral process for samples, alterations of protocol for surges, and rapid relay of confirmatory data, all done in a way to preserve confidentiality. The current revision of the SOP is a continuation of close coordination between NIS and NPDN.

b. Specific Recommendations

- Plan effective linkages among the NPDN labs for enhanced surge capacity in a large disease outbreak or bioterror event. This must include an effective mechanism for referral of overload samples when a lab reaches capacity. NIFA and APHIS PPQ are

- involved in the Integrated Consortium of Laboratory Networks (ICLN), a federal effort charged to create a cohesive system of labs capable of integrated and coordinated responses to support major incidents requiring lab support. However, since 2007, biosecurity has been de-emphasized, limiting the efforts of this recommendation.
- Continue the close coordination with APHIS PPQ identification services to refine Standard Operating Procedures and to improve Quality Assurance Systems. NPPLAP has supported, and benefits from the implementation of STAR-D by NPDN. A more formal agreement between NPDN and PPQ regarding the Planned Deviation system would benefit all.
 - Increase coordination with laboratories run by state departments of agriculture. This is vitally important to a well-functioning national system of plant diagnostic labs.
 - Better integrate the work of entomologists and weed biologists into the NPDN operation.
 - Implement strategies for every laboratory to meet a high standard of chain-of-custody for samples and data, sufficient to support APHIS, state departments of agriculture, DHS, and law enforcement agencies for forensic investigations of intentional plant pest or pathogen introductions. The STAR-D standard is based on the international standard ISO/IEC 17025:2005. This standard provides guidelines for maintaining chain-of-custody, document and record traceability, and requirements for confidentiality. The accredited lab is audited by third party peers, and uses systems expressed by the standard that have been adapted and foster continual improvement through customer interaction and periodic self-assessments. As more NPDN labs become STAR-D accredited, this recommendation should be addressed more widely.
 - Develop plans to work effectively among NPDN labs and with regional and state laboratories to prioritize diagnostic resources and specific disease assays. This should include state and APHIS CAPS surveys, as well as other monitoring and enforcement activities. Communication with PPQ and CAP programs is not clear. Each state however, is made aware of PPQ's priority pest list each year and could be doing something at the state level that PPQ is not aware. S&T has been working to offer specific disease assays to the NPDN and State laboratories. The CPHST Beltsville lab has been working collaboratively to identify CAPS pathogen priorities for molecular validation. Several of these are in progress but a few have been rolled out to state and NPDN labs. There are currently eight phytoplasmas on the CAPS priority pest lists. Phytoplasma screening by qPCR assays have been developed by CPHST Beltsville and are offered to NPDN and state diagnostic laboratories. A training session was held at CPHST Beltsville in March 2015 in which many NPDN labs participated.
 - Develop better communication and cooperation with NAHLN and with FERN via ICLN and establish a committee to identify and prioritize diagnostic assays suitable for inclusion in the ICLN surge reagents program, and communicate surge capacity and deficiencies to the ICLN. Identify sampling and sample handling issues for consideration by the ICLN Working Group on environmental sampling and sampling method validation. The committee could also work in parallel to the ICLN efforts with reagent suppliers on methods, efficacy and supply availability in surge events.

- Since STAR-D is operational and gaining momentum, it needs to expand its base to achieve sustainability. Targeted organizations could include, but are not limited to, the National Plant Board, National Clean Plant Network, as well as international groups.
- NPDN will benefit a great deal to have more NPDN labs that are STAR-D accredited.
- NPDN should consider a National Quality Manager position to further support STAR-D and support QM efforts across the system.
- Labs could expand their quality management activities to include direct comparisons of test results, standardization of instruments and platforms, ring tests, and development of non-regulatory proficiency tests.
- NPDN leaders and members should be more proactive when advocating for federal Farm Bill funds. Organization representation from stakeholders in Washington DC will raise awareness and support of the need for this lab system and its mission to protect American agriculture from losses resulting from pests and disease.
- Next generation sequencing is being used domestically and internationally to screen for pathogens. This is an important tool that has promise for NPDN labs. The review committee supports acquiring appropriate equipment and data sharing across labs.
- Planned Deviations are used by NPPLAP accredited labs when they have platforms or methods that are not described in established, validated Work Instructions. As more NPDN labs look to replace their Cepheid thermocyclers, labs need to engage NPPLAP for guidance when considering new platforms. Not all real-time PCR instruments are created equal, and the timing involved in the shift between platforms is important. It is likely that a Planned Deviation will be needed before the equipment can be used for regulatory samples. However, the deviation can satisfy all future use by different labs for the specific equipment studied.

c. Future Issues for Consideration

- In conjunction with APHIS, determine the feasibility of cooperating with the border countries of Canada and Mexico on methodology and data sharing of pests and pathogens of mutual concern. The committee recognizes that information sharing could have unintended trade impacts regarding pests and diseases of regulatory concern. The NPDN should work closely with PPQ prior to engaging in bi- or tri-lateral discussions.

III. Partnerships

The NPDN has been a model for effective partnerships among local, state and federal agencies and organizations. The NPDN's record of accomplishment in response to the enormous economic threats posed by exotic plant pathogens and pests is remarkable due largely to effective partnerships with Land Grant University diagnostic laboratories and USDA APHIS expert laboratories. These partnerships have resulted in many publications in refereed journals and in the validation of newly developed diagnostic protocols. The NPDN labs have also reinvigorated state plant diagnostic labs with improved infrastructure.

One example of an effective partnership that had been successful early during the establishment of the NPDN but has since been less active is the NPDN's Exercise Program it conducted with USDA APHIS and the National Plant Board (NPB). Under this program, the NPDN conducted 71 exercises prior to 2011, but only four (4) since 2011 due to budget cuts. Following 2011, the Exercise Committee was merged into a subcommittee of the Training and Education Committee and currently meets only intermittently. The ETKnet, developed by the University of Florida SPDN Hub, provided some support in 2015 for the Exercise Committee to meet more regularly and assure an update of the exercise protocol, but its long term sustainability is still in doubt.

Implementing the Incident Command System (ICS) structure is another state/federal partnership that has been achieved with the NPDN. In conjunction with APHIS and the NPB, all NPDN labs have conducted full scale and functional exercises, but not all NPDN diagnosticians, State Plant Health Directors and State Plant Regulatory officials have exercised with the ICS structure again due to budget limitations.

Although progress has been made in engaging state and federal regulatory agencies, much potential exists in forming additional productive partnerships with stakeholder groups and the private sector. Several state and federal partners are also responsible for excluding and eradicating regulated plant pests and in most states significant progress has been made in improving the level of trust between regulatory agencies and extension and diagnostic personnel. However, a greater level of ongoing engagement and communication with commodity groups is also necessary to tighten the safeguarding safety net and assure that responses are rapid and accurate. The diagnostic/education/regulatory partnership must recognize the importance and value of business confidentiality, diagnostic challenges, and the need to minimize potential threats through quarantines and other restrictions.

One example of a successful commodity/stakeholder partnership is the Sentinel Plant Network Program conducted with the American Public Gardens Association. Through it, not only have greater resources been obtained for both the NPDN and the Association, but also a vastly expanded recognition of the NPDN can be made possible by leveraging professionals at botanic gardens themselves, who can promote NPDN to over 100 million visitors to public gardens per year, in addition to serving as botanical and surveying/monitoring resources. Greater awareness and use of this partnership can be made by any diagnostic lab.

The NPDN has profited from a commitment to forging strong partnerships between regional and state diagnosticians. All five NPDN regions have made great strides in developing strong partnerships and providing training for Certified Crop Advisors (CCAs), Pest Control Advisors (PCAs), county extension staff, and other first responders. Most prominently, a solid foundation for operating NPDN partnerships exists with the Integrated Pest Management (IPM) Center Network, in which the NPDN has formed formal partnerships in several regions. The successes of the Soybean Rust Information System, developed in partnerships with the USDA agencies, state departments of agriculture, industry partners and the Land Grant Universities, has been expanded in the development of the Integrated Pest Management Pest Information Platform for

Extension and Education (IPM-PIPE), a sentinel system and data management decision tool that will serve as a model for partnership between the NPDN and most, if not all, interested federal, state and private interests.

Past detections of plant pathogens with regulatory significance have provided an opportunity for extension personnel, CCAs, state regulators and diagnostic clinicians to exercise Incident Command System (ICS) structure and maneuvers. Additionally, these incidents have identified needed resources and prompted development of sampling and diagnostic mechanisms. The need to develop surge capacity has encouraged critical working relationships between scientists and administration with the diagnostic labs, State Plant Health Directors (SPHDs), State Plant Regulatory Officials (SPROs), APHIS-PPQ Center for Plant Health Science and Technology (CPHST), and APHIS-PPQ Plant Pest Diagnostics Service units. These are initial steps toward a fully integrated plant security system that point to the potential partnerships and their ability to harness the necessary capacity and imagination to safeguard U.S. agriculture. New potential and expected threats or any unexpected organisms may further challenge existing communication and diagnostic systems.

Partnerships could be more effective by including an industry component. Primarily due to concerns about confidentiality or lack of communication, these partnerships have not been extensively pursued and developed. Although resources directed for outreach may be viewed as limiting, this does not realize the potential rate of return from awareness. The CCAs, PCAs, representatives of seed, fertilizer, and pesticide manufacturers, scouts/field representatives for commodity groups and processors and professionals engaged within the horticulture industry all work together, giving them unique environmental and pest pressure information. These partnerships will not only ultimately lead to earlier detection of pests, but allow unique communication and response opportunities based on existing levels of trust.

The NPDN's unique function and focus on plants necessitates different approaches than those of the National Animal Health Laboratory Network (NAHLN). The broad number of potential pathogen and pest threats, as well as numerous ports of entry, necessitates more diverse approaches and greater field resources for the diagnostic labs of the NPDN. As a result, the NPDN and the NAHLN are structured differently and their approach to biosecurity are contrasting. The NAHLN is very focused on detection and diagnosis of a limited number of high consequence threat agents, while the NPDN's scope is to protect all plant systems from any threat. NAHLN labs are certified and NAHLN diagnosticians are proficiency tested to execute approved protocols for a limited number of pathogens/threat agents, analogous to the NPDN STAR-D and APHIS/PPQ NPPLAP programs. The NAHLN is operational in select labs in several states, while NPDN is operational in every U.S. state and its territories. The NAHLN is guided primarily by APHIS Veterinary Services while the NPDN is funded by agreements with USDA-NIFA with APHIS Farm Bill grants supplementing the USDA-NIFA agreements. Even considering these structural dissimilarities, there should be opportunities to interact and communicate with the NAHLN in laboratory accreditation, proficiency testing, and technology strategies. More on this relationship will be discussed in later sections.

Recommendations

a. Action Items

- The review committee recommends that NPDN leadership and individual diagnostic laboratories seek partnerships with national and state NGOs such as the Farm Bureau, commodity groups and processors, CCAs and agricultural product producers and suppliers that allow for greater stakeholder engagement. The Sentinel Plant Network Program partnership is a good beginning, but only by holding focus groups and directly seeking out the needs of these interest groups will greater resources and recognition be obtained.
- The review committee recommends that the NPDN directors develop a strategy to inform and engage Land Grant Extension and Experiment Station Directors as well as state departments of agriculture to gain support of network host institutions.
- Individual NPDN laboratories should establish and/or strengthen the partnerships with SPROs, SPHDs and natural resource agencies.
- The NPDN Exercise Program and the Incident Command System should be reinvigorated to facilitate the establishment and maintenance of relationships among NPDN, state and federal staff involved in plant health emergencies. USDA-NIFA should consider this a high priority for increased supplemental funding.

b. Specific Recommendations

- NPDN leadership should seek partnerships with those federal agencies whose missions involve land or resource management or plant pest regulations.
- NPDN leadership should establish a communication link with the NAHLN and consider opportunities to communicate and exchange information with the NAHLN in laboratory accreditation, proficiency testing, and technology strategies. One option is to have an NAHLN representative seat on the Advisory Board (or its replacement entity) for NPDN and vice versa for exchange of ideas or business practices.
- As available, individual state diagnostic laboratories should establish partnerships with non- traditional cooperators such as Historically Black Colleges and Universities, Tribal Nations, and private land managers.
- NPDN laboratories should identify roles, responsibilities, and measures of success with partners and establish mechanisms to share data, as well as investigational and analytical information. NPDN should further identify international standards which provide guidelines for these practices including those available by ISO, Codex, IPPC, AAVLD, and RPPOs. This can be facilitated by developing and implementing MOUs with key partners.
- NPDN laboratories should develop and implement additional ICS preparedness scenarios in cooperation with key partners to improve communication, enhance readiness and engage mutually available diagnostics. Varying the size of scenarios in regional, state, and local locations and cropping systems will challenge different resources and personnel.
- NPDN should strengthen partnerships with industry and professional associations such as the American Phytopathological Society (APS), the American Public Gardens Association, AmericanHort, the California Association of Pest Control Advisors, the

- American Farm Bureau and others to increase recognition and awareness of its crucial work. Consideration should be given to enhance the Sentinel Plant Network Program.
- NPDN should plan engagement activities with stakeholders such as focus groups, periodic summits, or other open meetings to gain and exchange information.
 - Representatives of stakeholder organizations should be considered for membership on the NPDN Advisory Board (or its replacement entity).
 - The NPDN should consider strengthening communications with the National Seed Health System to increase the Network's role in seed-related issues.

IV. Public Relations and Outreach

The NPDN has engaged in structured public relations efforts since its inception and has established a Public Relations Committee, which has been less active in recent years due to budget constraints. Efforts have included the development of a variety of promotional print and electronic materials, highlighting national and regional activities, laboratory capacity and disease-specific information. National and regional newsletters, brochures, and websites have been effectively deployed to distribute information. In a notable example of outreach activities, NPDN partnered very effectively with several commodity groups, and USDA agencies to develop effective materials on field crop pathogen identification and management as well as ornamental plant pathogens and diseases. The NPDN websites provide quality information on new disease issues and outbreaks in a user-friendly interface (<http://www.NPDN.org>, <http://www.NPDN.org>; <https://firstdetector.org/>; <http://www.protectingusnow.org/>, [sentinel plant network \(www.sentinelplantnetwork.org\)](http://www.sentinelplantnetwork.org), www.npdn-spn.org).

Despite years of continuous effort, some potential partners and stakeholders are still not knowledgeable about the NPDN mission and activities. Additionally, as previously stated, a top priority must be to further educate commodity groups, private industry and other plant industry stakeholders on the mission, scope and activities of the NPDN, and engage them as partners. There is a lack of brand awareness, both of the NPDN itself, and of its products. Although there is a brand logo and identity, it must be focused into a plan with communication goals. The NPDN should develop a formal public relations strategy, with strategic goals at the national, regional and state levels. It is imperative that state, regional and national NPDN members identify and engage new audiences, while sustaining the interest of existing partners and stakeholders. For example, not all University administrators currently view the NPDN as an entity that is contributing to their current strategic goals.

The NPDN has had a complicated relationship with state departments of agriculture (SDA). Extension and regulatory missions are not always the same and Extension needs for diagnostic methods and specificity of identification are often different. Some diagnosticians and administrators in SDAs perceive NPDN labs as a parallel effort, and some state diagnosticians do not grasp how they could interact with their NPDN cohorts.

Recommendations

a. Action Items

- Develop a formal public relations strategic plan with goals at the national, regional and state levels. Consider public relations more broadly in websites, newsletters, and interactions with groups. Identify target audiences for the strategy and for distribution, and prioritize audiences such as Land Grant University administrators, and State Plant Health Directors. This plan should contain measurable elements that define what successful execution looks like, as well as a programmatic brand review that identifies strong as well as repetitive brands that exist within NPDN.
- Diagnosticians in each laboratory should engage in regional meetings, focus groups, open houses and visits by stakeholders to diagnostic clinics on a rotating basis. These visits should be tracked by NPDN as evidence that outreach is taking place at an increased rate.
- Improve access, search capability and content on the website(s), especially publicly accessible information and training materials for stakeholders (including but not limited to producers, crop advisors, first detectors, and green industry/commodity professionals. Websites may need to be consolidated, re-organized, or co-branded to ensure that NPDN is best identified as the source of these valuable programs.
- The NPDN leadership and Public Relations Committee should develop a framework and process for annual self-evaluation that will help to focus strengthening activities, including reporting topics and formats, and metrics for recording and reporting performance.
- NPDN laboratories in states where there is no Land Grant University, should strengthen partnerships with SDAs as partner labs and interact with the SDAs in regional meetings and trainings.

b. Specific Recommendations

- Expand professional outreach by organizing annual town hall meetings and providing booths, displays, and information at venues such as at annual meetings of the American Phytopathological Society, the American Public Gardens Association, AmericanHort, the National Plant Board, National Association of state Departments of Agriculture, Partners in Community Forestry, and the North American Plant Protection Organization.
- Identify key agricultural legislators in each state and develop plans to educate them via the NPDN partners in that state on local, regional and national accomplishments and needs. Consider inviting State legislative and Congressional staff to diagnostic labs or meeting them at disease impact sites for awareness building.
- Develop and disseminate communications toolkits that diagnosticians can use to introduce/promote the NPDN in their outreach efforts.
- Consolidate website presence and make tools available to constituents in an organized and brand-identifiable fashion based on results of PR strategic plan
- Adopt a formal, structured annual reporting system for NPDN labs at the local/state and national levels. Ideally, it could include short statements of accomplishment that can be disseminated to various audiences. Develop “Points of Progress” for

- communication at the state and regional levels for Experiment Station Directors, SPROs, and USDA agencies.
- Publish more of the diagnostic laboratories output in scientific journals. Consider publishing pathogen diagnostic standard operating procedures and ring-test results in easily accessible journals such as those in the Plant Health Management Network.

V. Training & Education

The mission of the NPDN Training & Education Committee (TEC) is to provide general leadership, guidelines and direction for the national First Detector training program. This mission is accomplished by developing materials in several formats to facilitate the work of First Detectors and First Detector educators. All NPDN materials are available online at www.firstdetector.org. The 2007 review indicates that from its origins, education and training were stated goals of the NPDN and an important infrastructure was built: “A vast network of first responders has been developed and is rapidly expanding down to the local level, fulfilling one of the primary visions of the network.” Training is a primary focus of the Network and is accomplished at the national, regional and state level with effectiveness, applying a “train-the-trainer” philosophy. Online scenario-based training has been implemented with online access, and Standard Operating Procedures are in place on the internet for open access.

Overall, the TEC has been very successful in addressing its core mission of training “First Detectors.” Since its inception in 2003, an estimated 16,000+ participants have received face-to-face training across a broad variety of commodities, and this likely under-represents the total number of participants since many sessions were not recorded in the database. An e-learning module program was implemented in 2009 and nearly 5,000 participants have viewed over 23,000 training modules including those registering through other partner sites including the NPDN training gateway, Protect US (a partnership with the Regional IPM Centers), and the Sentinel Plant Network (a partnership with the American Public Gardens Association). In addition, training has occurred in 22 countries worldwide.

The mission of the TEC is defined in the context of serving First Detectors and First Detector educators only, and does not explicitly address the needs of diagnosticians themselves. However, diagnosticians and other professionals involved with the NPDN do receive training in places such as at specialized workshops offered annually by USDA-PPQ CPHST-Beltsville on specific topics related to diagnosis and identification of plant pathogens of regulatory significance as well as other key topics. These are valuable training sessions outside the scope of that offered for First Detectors and not limited to compliance trainings such as that for STAR-D, but not mentioned in the TEC report specifically.

Extensive budget reductions occurred in 2010, and for the education focus to continue, extramural funding was obtained. Collaborations with Protect US and the Sentinel Plant Network provided additional funding through the Farm Bill (10201) and resulted in a suite of tools (e.g. e-learning modules, interpretation, and scouting guides, etc.) for identification of high

consequence pests and pathogens housed at www.firstdetector.org, and advanced taxonomic training videos, which are housed on the YouTube site, www.youtube.com/user/npdnchannel. Current partners listed on the www.firstdetector.org site include USDA-APHIS, Regional IPM Centers, the CAPS program, the National Plant Board and the State Departments of Agriculture, EDEN, the Center for Ecosystem Species and Health (Bugwood), the Community Invasive Species Network (Protect US), and the Sentinel Plant Network.

The training and education programs of the TEC were very successful in raising the initial visibility and awareness of the NPDN and the importance of plant biosecurity to the general public from 2003 until the 2010 budget reduction. Nearly 5,000 First Detectors have been trained since 2009 when the e-learning platform was implemented and although it has been successful, it is not a replacement for face-to-face training. Given new funds, First Detector training should be reemphasized by both face-to-face and electronic means. Branded training materials should also be updated as needed. Although efforts were made to raise the visibility of the First Detector network and NPDN on social media, the impact of this effort is unclear.

The learning gateway established at www.firstdetector.org serves to direct users to its many different resources. However, because it has lacked one consistent programmatic source of dedicated funding, decisions on the look and interactivity of the website will need attention. Many collaborators have been involved, and the First Detector program seems to be split between gaining resources by collaboration, and retaining its own brand presence.

The use of “First Detector” is a strong brand positioning statement for NPDN, and it should be retained, although having this wrapped in a strong communications / public relations plan would elucidate which social media streams (if any) should be retained. A communication specialist should be retained to make recommendations for improving TEC activities.

Recommendations

a. Action Items

- First detector training should be incorporated into Certified Crop Adviser training workshops with CCA continuing education credits being approved for the NPDN core e-learning modules. In 2009, NPDN created and launched e-learning modules which provided an opportunity for asynchronous learning.
- Establish new and continue to sustain partnerships that support and leverage NPDN and First Detector materials.
- Invest in a central information sharing hub and house regional and central training resources in one location under an NPDN or First Detector Umbrella. Unify education and training across all regions and platforms to better support the NPDN and the First Detector network.
- Survey audiences to determine utility and potential resource overlap with other programs and develop new content that seeks to serve a unique audience

b. Specific Recommendations

- Expand first detector training to encompass Master Gardeners, CCAs, crop consultants, and other agribusiness professionals. Substantial progress was made from 2007-2010 in expanding First Detector training primarily with the implementation of e-learning modules beginning in 2009. More recently, the NPDN YouTube channel was expanded and it hosts First Detector training materials and advanced taxonomic resources mostly used for internal NPDN training purposes. TEC activities expanded their presence in social media including Facebook and Twitter, and First Detector training and resources were promoted through the Sentinel Plant Network and First Detector newsletter. Some of these activities were curtailed in 2010 following a substantial budget reduction.
- Expand the current initiative on Incident Command System training to all regions.
- Continue to develop, expand and refine online training tools and update and expand the e-learning system through expanded collaborations.
- Establish Training and Education Committees in all regions.
- Develop and provide certifications and certification programs for various types of training. The committee recognizes that a certification for completing First Detector training has been developed and a receipt of credit in CCA-approved and other state pesticide education courses has been provided.
- Strengthen links between diagnosticians and First Detectors. Although many diagnosticians conducted First Detector training from 2003 to 2010, budget reductions in 2011 resulted in substantially less First Detector training. Although this mechanism for strengthening links between diagnosticians and First Detectors no longer exists, collaborations like the Sentinel Plant Network have served to route new first detector trainees to the www.firstdetector.org site. Some effort has been made to expand the TEC presence using social media, but it is not specific whether this benefits first detectors or NPDN diagnosticians. It does not replace face-to-face engagement. NPDN's e-newsletter, although successful, is mainly targeted at NPDN diagnosticians.
- Continue to partner with other agencies, NGOs, and Extension to channel first detectors to resources/ allied education programs (e.g. Don't Move Firewood, Sentinel Plant Network, Bugwood, etc.).
- Appoint an education and training leader vested with the authority to participate in education and training decisions at the executive level.
- Promote the First Detector program and its resources more broadly under the banner of NPDN.
- Seek to eliminate repetition in site content. Develop a plan to maintain and/or phase out educational resources. Clarify and/or reduce other microsites and other maintenance-intensive social media presences that aren't returning time investments.
- Determine exact audience to be served by existing and future resources. The focus of education and training can serve NPDN network personnel and expand to encompass professionals and allies, but the latter have many different programs already serving them.

- Consider providing a moderated online technical forum for conversation and information sharing, using open source forum software.

VI. Integration with Research

The role of NPDN is not to conduct research. The NPDN relies on research results and practices to evaluate its own responses to plant health managers. In some cases, NPDN personnel have been directly or indirectly involved in some research areas dealing with the appearance, diagnosis and management of diseases new or rare in their areas by providing methods development of tests created through outside research activities (one or more of the five in their jurisdiction). Since its inception in 2003, the NPDN has been responsible for numerous peer reviewed publications and since 2007 alone, 33 peer reviewed publications involving research have been written, averaging two to three per year (range: 1 to 5 per year) with collaborators. These findings and others have been communicated directly or indirectly to over 9 million people since 2007.

The emphasis of NPDN is to remain a premier and diagnostic system for detection, identification of plant pests and pathogens and communication. Based on its initial inception, NPDN was to be aligned with the veterinary counterpart NAHLN. This has been partially achieved through quality management training, sharing information regarding program operations practices, and use of the NAHLN webportal, but additional alignment is needed. Opportunities for increasing capacity across the two fields should be created. Sharing of materials and information/ideas can open doors for producing other sources of income, and collaborative cross-development studies will strengthen the knowledge base of both networks. Fostering communication between the networks remains a challenge for multiple reasons. There are some cross - kingdom pathogens of plants that cause devastating diseases for animals. For example, the bacterium *Rathayibacter toxicus*, a select agent, causes Rathayibacter poisoning of animals. Its first appearance in the U.S. may be observed by the occurrence of dead ungulates, especially cattle. The source of consumption may not be readily apparent without consultation with NPDN personnel. Therefore, some means of secure communication should be discussed with the administrators of NIFA and NAHLN, so that at least the record of desired interaction is clear. An added box of interaction ideally should be on the flow charts sent to USDA. The introduction of *R. toxicus* was the source of an ICLN exercise in 2012. One outcome from the exercise was recognition that lab capacity was increased through joint efforts between the NPDN and the NAHLN. Other sapronoses examples include *Claviceps purpurea* (ergotism) and *Aspergillus* species, and there is increasing evidence that plant pathogens play a role in reducing the effectiveness of human health and increase the effectiveness of sapronoses (Emerging Infectious Diseases, volume 9, number 3— March 2003, letter: *Emerging Human Infectious Diseases: Anthroponoses, Zoonoses, and Sapronoses*).

Recommendations

a. Action items

- NPDN diagnosticians should help test new APHIS regulatory diagnostic test methods and protocols for robustness and reproducibility before they become implemented into programs.
- NPDN diagnosticians should work collaboratively with CPHST and/or state regulators to develop or update new regulatory diagnostic methods that enable their lab to adjust to new technology trends or create a better fit for their specific lab scope while maintaining the APHIS mission.
- NPDN should provide assistance and resources for industry, especially beta testing prior to commercial product release.
- NPDN should review plant diagnostic test needs that occur throughout the Network for opportunities on developing standardized and high throughput testing protocols with appropriate validation and assessments of key test performance measurements. NPDN can research information from NAHLN, the industry, and other diagnostic test arenas on how to accomplish this objective and then apply these concepts to current plant pathological knowledge.

b. Specific recommendations:

- Develop an effective linkage with NAHLN for communication and cooperation, including consideration of a joint exercise involving animals and plants that is complementary to the ICLN.
- Develop a plan with USDA for the collection, maintenance and dissemination of reference strains, including obligate parasites. Develop a mechanism for the production and validation of standardized reference materials from these strains for network distribution. Because this is critical for verification purposes, the plan should include comparative studies and tracing of both spread and eradication of organisms, and include how strains are identified, maintained, and quality controlled. Language can be drawn from the International Organization of Standards documents ISO 17043 and ISO Guide 34 to help ensure common quality assurance practices are used. Diagnostic test developers, including industry, need representative strains of pathogens/ pests for evaluating countermeasures. However, industry will often maintain proprietary materials. Opportunities must be sought out to encourage sharing of proprietary materials to increase the Network's state of readiness for an emergency based on the NPDN's identified threats to their stakeholders.
- Evaluate the need for surveillance and methodology applicable to aquatic economic and invasive plants. These are likely to become of greater economic impact in the future with water composition changes, higher water levels and decreased soil availability due to erosion, quality deterioration and human population expansion. Resources for some required elements of the evaluation may be available through the inclusion of experts from other fields responsible for similar evaluations such as the EPA, USDA-FS, and US Fish and Wildlife Services.

c. Future issues:

- Consider interactions with engineering, other diagnostic test arenas, or industry for evaluating new methods of 'surveillance'. For example, the use of unmanned aerial vehicles with telescopic capability for disease and pest introduction and spread, especially in the enlarged farm acreages and difficult wild terrains in an era of climate challenges makes early detection potentially easier, faster and of greater economic importance.
- Further advances in research and materials development requires adequate funding. The review committee endorses rebuilding of the financial base for the NPDN, which has helped minimize or even essentially eliminate some plant disease invasions and their deleterious effects. Although support for agriculture in some states is reasonable, there are states that should be expected to provide adequate support without federal assistance. Competitive funds may also play a role in advancing the science and dissemination of information of plant disease threats.