

NPRA NP303 Executive Summary

The USDA Agricultural Research Service, Office of National Programs (OPN), with facilitation from the Office of Scientific Quality Review (OSQR), convened an external retrospective review panel on April 23, 2020 to initiate a critical review of all facets of National Program 303 (NP303), Plant Diseases. The panel met virtually with National Program Leaders with facilitation by OSQR staff to develop a framework to assess the quality and accomplishments of ARS research within NP303 over the past five fiscal years. The retrospective review panel was provided NP303 annual reports from FY2015-FY2019, and selected supporting information provided in 8 appendices and documentation on the accomplishments of NP303 research during this five year period. The panel met again virtually with National Program Leaders on June 23, 2020 to discuss NP303's accomplishments and challenges and to clarify analyses of the information provided.

The retrospective review panel, consisting of academic and faculty representatives of four different land grant universities, developed this report after a thorough review of the NP303 annual reports and associated documentation. Although much of the core of this report came from content in the annual reports, attention was given to other aspects of the documented quality and accomplishments of NP303 research such as peer-reviewed publications, first disease reports, variety and germplasm releases, national sponsored initiatives, and selected accomplishments including external funding received, mentoring and editorships, international collaborations and technology transfers such as material transfer agreements and patents.

Taken together, this report reflects the panel's assessment of NP303's contribution and adherence to the NP303 Action Plan 2017-2021, and the USDA ARS Strategic Plan to conduct research to develop and transfer solutions to agricultural problems of high national priority and to provide information access and dissemination. This report addresses research conducted in each of the three component areas of NP303 and follows the Problem Statements outlined in the NP303 Action Plan. This report assesses the research conducted in NP303 based on its relevance, quality and impact of the researcher's contribution to U.S. agriculture.

Key Findings

It is the panel's consensus that, in its composite entirety, research conducted in NP303 over the past five years is fulfilling the stated goal to improve and expand knowledge of existing and emerging plant diseases and to develop effective disease management strategies that are safe and economically practical and sustainable. The number of projects in NP303 varied from a high of 59 in FY15 to a low of 50 in FY18 and FY19. Although the number of projects declined over this period, due to project consolidations, the number of scientists in the program remained consistent over the past four years ranging from 120 to 140. This reflects flexibility and continuity of projects while making necessary changes in research emphasis to respond to new and emerging problems with a fairly consistent number of scientists.

The ARS has a mandate to conduct research to meet national needs and NP303 conducts research in 17 states, mostly strategically located in commodity production areas of the country and many are co-located on U.S. land-grant university campuses and Agricultural Experiment Stations. Cooperative research between NP303 scientists and university scientists enhances the critical mass of efforts to implement and coordinate research on current and emerging agricultural priorities. This panel strongly encourages the NP303 National Program Leaders to support these collaborative ARS-university partnerships. As examples, the sponsored initiatives, such as the U.S. Wheat and Barley Scab Initiative, the National Sclerotinia Initiative, the ARS-State Potato Partnership Program and others, are highly regarded by the scientific community and by growers who benefit from the collaborative research. These initiatives ensure flexibility for NP303 scientists to respond to grower needs and fosters collaborative research and partnerships between ARS scientists and university researchers. It is the consensus of this panel to recommend continued support for these sponsored projects and to explore more collaborative opportunities as appropriate, particularly as novel emerging diseases develop on crop plants.

Peer-reviewed publications and peer-reviewed research grants and stakeholder funding are useful indicators of the quality and value of NP303 research. During this five-year review period, NP303 researchers published over 1,600 peer-reviewed articles mostly in high impact scientific journals. This represents a median of 320 publications per year and 2.3 to 2.9 publications per scientist annually. This is a productive indicator by academic standards. This contributes significantly to the stated goals of the ARS Strategic Plan and the NP303 Action Plan to deliver science-based information to meet producer and consumer demands while expanding our knowledge of existing and emerging diseases. The panel was impressed with the breadth and depth of NP303 research. Types of research ranged from developmental to basic and applied. All pathogen types were addressed; fungi, bacteria, oomycetes, nematodes, viruses/viroids and phytoplasmas. Similarly, management options were broad and included biologicals, chemicals, resistance mechanisms and other amendment options. In fulfilling the Action Plan goal to disseminate information, NP303 scientists reported on 42 new host associations in new geographical areas during the review period. NP303 scientists received 361 grants and awards that enhanced research to meet the objectives outlined in the NP303 Action Plan. The mixture of federally-funded grants, state government support, and industry supported grants enriches the funding base of the national program. Seeking funding from external sources to enhance the ARS base is encouraged by this panel, particularly multi-scientist grants in partnership with university researchers.

Although the ARS mission is to conduct agricultural research, scientists in NP303 engaged in mentoring and training of early career scientists. Developing new scientists is critical to maintaining a robust work force in ARS while bringing new skills and technologies to improve our knowledge of existing and emerging plant diseases. NP303 scientists trained and mentored over 929 postdoctoral fellows, graduate students and undergraduates over the 2015-2020 period. Two hundred and fifty (250) visiting scientists were hosted in ARS facilities during this five-year

period and 124 ARS scientists served as journal editors. These accomplishments taken together reflect the NP303 program's contribution to generate external funding while building on ARS's reputation as a collaborative institution focused on training, mentoring and contributing to professional societies in plant health.

International collaborations are another important measure of leadership within the scientific community. NP303 scientists engaged in over 1,000 international research collaborations from 2015-2020 with nations throughout the world. Existing and emerging pathogens do not recognize international borders so these collaborations are critical to timely disease detection and tracking spread of plant diseases. The NP303 National Program Leaders are encouraged by this panel to continue support of the ARS international laboratories and maintain a physical presence in countries strategically located to conduct research with foreign nationals and international collaborators. Expanded opportunities for developing country scientists to work in ARS research labs is also encouraged.

Technology transfer, involving patents and material transfer research agreements, are integral to the development of many new or enhanced technologies ranging from rapid methods for disease detection, formulations to control pathogens, and improved resistance as valuable management strategies. During the five year period of this review, NP 303 scientists filed 12 patent applications with the U.S. Patent and Trademark Office of which 10 patents were awarded and entered into 48 Material Transfer Agreements for joint research with both public and private sector partners. These agreements to transfer materials and engage in joint research effectively facilitates the dissemination of knowledge and meet the stated goals of the NP303 Action Plan. As new technologies are developed that might have commercial applications, ARS should encourage its scientists to file more patent applications and transfer technology to the public sector. The NP303 scientists have been integral to the development of new germplasm for disease and pest resistance. In the past five years, NP303 researchers issued 235 cultivar or germplasm release notices. Many of these releases were collaboratively released with university and private sector partners.

Microbial collections are increasingly being lost as retirements occur. ARS is encouraged to consider ways to preserve the diversity of microbial collections in central repositories, particularly significant type strains of plant pathogens and share resources for archiving collections with land grant university scientists. There has been a long history of preserving plant collections and mycological herbaria at ARS. Microbial collections also need to be archived for future use.

The panel appreciates the work of scientists in NP303 during this five year period. The research in NP303 provided new knowledge and tools to improve disease management options and comprehensive strategies for the control of emerging and existing diseases. The work in NP303 is innovative and paves the way for further research and applications. This panel appreciates the depth and breadth of the NP303 research and encourages the Office of National Programs to

seek out additional research collaborations with other public institutions such as university agricultural experiment stations and to integrate NP303 research further with state and private sector programs. The panel did not identify any major weaknesses in the research conducted but general recommendations for future research and areas for improvement are listed at the end of this report.

Panel Conclusions

The panel's consensus is that the scientists in NP303 are fulfilling the goals in the NP 303 Action Plan and are addressing the problem statements within. The research conducted in the program is innovative and pioneering in selected projects and provides new knowledge and tools to improve plant health. There is a solid balance of research types with almost half of the research being regarded as "basic" while developmental and applied research provides applications to specific problems.

The research in NP303 delivers high quality science-based information and technologies which will likely meet producer's needs and consumer demands and benefit the advancement of new knowledge. The high-quality research conducted in the program is evidenced by the high number of peer-reviewed publications, collaborations, patents and the many variety and germplasm releases which have resulted in a high impact for the agricultural base it serves.

General Recommendations for Future Research and Areas for Improvement

The panel has identified a few areas of improvement and suggestions for future research below. Research projects identified in the annual reports vary in how well they accomplish their objectives and recommendations do not apply to all.

- 1) Increase integration of NP303 research with other public institutions such as state departments of agriculture and land grant university agricultural experiment stations to leverage resources and expand research.
- 2) Expand and increase support for living microbial culture collections with well-maintained databases to support research activities. Systematics and bioinformatics of pathogens are critical for understanding disease spread, transmission and disease etiology. The microbial collections and their associated databases should be easily searchable and accessible for valid public research. To ensure the long-term preservation and management of microbial collections, each scientist in NP303 who maintains and curates pathogen collections should develop a transition plan in their project plan for the transfer of their collections after retirement or separation from the agency. ARS should consider expanding the collections to house and archive collaborative collections on important pathogen groups.

- 3) Seek out additional opportunities where appropriate and practical to expand international collaborations and extend outreach globally, particularly with foreign national agricultural research institutions, centers of the Consultative Group for International Agricultural Research (CGIAR) and through the ARS overseas laboratories. Consider more opportunities for international visiting scientists to work in ARS labs.
- 4) Further involve and engage research stakeholders and extension specialists in problem identification and outreach. Participatory trials and demonstration plots with growers, producers and extension specialists are excellent opportunities to ensure that ARS products, management strategies, and new technologies are adopted. These engagements leverage technologies and management tools to advance the ARS mission.
- 5) Increase efforts to develop accurate disease diagnosis tools, especially more specific biochemical, molecular and genomic tests. Definitive diagnostics are the key for characterizing emerging and re-emerging pathogen populations and ultimately for implementing effective disease management strategies.
- 6) Encourage the use of precision breeding and genome editing to facilitate crop improvement for disease resistance.
- 7) Encourage more technology transfer of innovative research by expanding assistance and opportunities for scientists to file patents from research.