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## USDA-AGRICULTURAL RESEARCH SERVICE: A PUBLIC PARTNER FOR SUGARCANE RESEARCH AND DEVELOPMENT

By

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### Abstract

RESEARCH is the cornerstone for maintaining healthy and sustainable agricultural industries. Systems for obtaining funding and managing and dispersing resources are as diverse as are there systems for culturing sugarcane. This paper presents a model of managing agricultural research programs at the Federal agency level. The Agricultural Research Service (ARS) is USDA's principal in-house agricultural research agency and, as a Federal agency, it is tasked with conducting publicly-funded research for the benefit of the United States. ARS aims to generate relevant, significant, and timely scientific information for use by the Agency's many stakeholders: agricultural producers, food processing industries, natural resource managers, universities, and non-profit research institutions. To ensure that these objectives can be achieved, ARS implemented the National Program cycle, a cycle of phases embodying a series of recurring activities. Customers and stakeholders are actively engaged in each phase of the process and their contributions are integral to the direction of research and its success. Input, Planning, Implementation, and Assessment — are the four sequential phases through which ARS research progresses, ensuring that it remains of the highest quality. The cycle ties these activities together in a recurring 5-year sequence to ensure an effective and efficient program and project management within ARS. These efforts are aimed at maintaining a sustainable sugarcane industry that is responsive to changing economics, production problems, and opportunities, and will require continued Federal, but also State, private, and international cooperation to be successful. The beneficiaries of a sustainable sugarcane industry will be the citizens of the U.S. who will enjoy abundant and affordable sugar and sugar-based products.

### Introduction

The Agricultural Research Service (ARS) is USDA's principal in-house agricultural research agency and, as a Federal agency of the United States, it is tasked with conducting publicly-funded research for the benefit of the United States. To meet this mission, ARS has developed a system for developing and managing the Agency's research priorities that actively engage the private and public sectors in research planning and implementation.

ARS aims to generate relevant, significant, and timely scientific information for use by the Agency's many stakeholders: agricultural producers, food processing industries, natural resource managers, universities, and non-profit research institutions. The larger body of USDA beneficiaries, customers, and stakeholders includes U.S. consumers, other Federal agencies such as the Food and Drug Administration, regulatory agencies such as USDA-Animal Plant Health Inspection Service (APHIS) and the Environmental Protection Agency (EPA), and international markets.

Management of the ARS national research programs is headquartered in Beltsville, Maryland—also home to the largest ARS research facility—which is in close proximity to USDA

administrative headquarters in Washington, D.C. There are over 100 ARS research locations that serve crops, animals, natural resources, and food safety and quality throughout the United States, Puerto Rico, and the U.S. Virgin Islands, and four laboratories overseas.

Individual laboratories are led by research leaders, who oversee a number of related research projects, and who are responsible for ensuring the quality and performance of each project. Laboratories are grouped into eight geographical areas, each of which is under the direction of an area director. Sugarcane research is located at these primary sites: Canal Point and Miami, Florida; Houma and New Orleans, Louisiana; and Beltsville, Maryland.

The number of facilities in each area varies, as does the research focus, but all ARS scientists are tasked with addressing agricultural issues of regional and national significance. These issues are identified and selected through a national priority-setting process involving scientists, customers, stakeholders, and program officials.

National scientific direction is provided by the Office of National Programs, located in Beltsville. National Program Leaders (NPLs) are assigned to specific programs for leadership, based on their expertise and the research area of need.

Sugar crops, including sugarcane and sugarbeet, are assigned to one NPL as part of their national portfolio of crop responsibilities, and that person works with a team of NPLs to address the diversity of issues facing the national research program.

The annual fiscal budget for ARS is set by the U.S. Congress and is nominally similar each year. In 2009, the total ARS budget was US\$1.14 billion. Every spring, the NPLs, area directors, budget staff, and the agency administrator decide on the budget requests to be made for the following fiscal year, including what research should be continued, what new research should be initiated, and what, if any, should be terminated. These decisions are based on administrative priorities, progress obtained from individual annual reports submitted for each project, and research needs identified through ongoing contacts with stakeholders and customers associated with each national program.

To plan, implement, coordinate, and account for its research, ARS uses a matrix management approach. The matrix is composed of vertical ('line'/local) management organised by geographic Areas, and horizontal ('programmatic'/national) management organised by research programs (Office of National Programs), functions (budgeting, information technology, technology transfer, security), and business processes (administrative and financial management). The administrator and the executive team of ARS provide leadership to the matrix management system in accordance with the ARS strategic vision and mission, national program action plans, and established operating policies.

### **Background: National program organisation**

Senior leaders in ARS moved toward the present concept of national programs in 1993. ARS leaders realised that, to remain on the leading edge of agricultural research, the agency approach to interdisciplinary, nationally collaborative research had to be updated. With better national coordination of ARS's considerable resources, the agency could more effectively focus on significant problems of high national priorities.

In 1998, Congress decided that ARS establish procedures to enhance its accountability, and mandated that all new proposed research projects be subjected to scientific peer reviews. The ARS Office of Scientific Quality Review (OSQR) was organised as a result of this act, and is described below under Phase II: Planning.

Over the next few years, ARS revamped the way it managed its research portfolio; the 1000-plus research projects were aligned into 21 national programs that encompass all research in the agency. These national programs are grouped into four program areas: (1) Nutrition, Food Safety, and Quality; (2) Animal Production and Protection; (3) Natural Resources and Sustainable

Agricultural Systems; and (4) Crop Production and Protection (where most of the sugarcane research is conducted) (Table 1). Each of the four program areas is managed by a Deputy Administrator.

Each National Program is led by a team of NPLs, selected based on their area of expertise to provide research direction on a national level. Currently, 25 NPLs are responsible for planning and developing research strategies to address critical issues affecting American agriculture.

**Table 1**—ARS national programs.

<b>Nutrition, Food Safety/Quality</b>
• Human Nutrition
• Food Safety (animal and plant products)
• Quality and Utilisation of Agricultural Products: <b><i>(Projects for sugarcane include sugar chemistry and physiology for optimising field and factory utilisation)</i></b>
<b>Animal Production and Protection</b>
• Food Animal Production
• Animal Health
• Veterinary, Medical, and Urban Entomology
• Aquaculture
<b>Natural Resources and Sustainable Agricultural Systems</b>
• Water Resource Management
• Soil Resource Management
• Air Quality
• Global Change
• Rangeland, Pasture, and Forages
• Manure and By-product Utilisation
• Integrated Agricultural Systems
• Bioenergy and Energy Alternatives
<b>Crop Production and Protection <i>(All programs listed below, except Methyl Bromide Alternatives, have research projects assigned to sugarcane)</i></b>
• Plant Genetic Resources, Genomics, and Genetic Improvement (NP301)
• Plant Biological and Molecular Processes (NP 302)
• Plant Diseases (NP303)
• Crop Protection and Quarantine (NP 304)
• Crop Production (NP 305)
• Methyl Bromide Alternatives (NP 308)

### Implementation of the 5-Year National Program Cycle

The overarching objectives of the National Programs are *relevance*, *quality*, and *impact*, all important elements of accountability for ARS research.

Research must be *relevant* to the highest priority problems; the goals and outcomes of the research should significantly *impact* the problems; and the science must meet the highest standards of *quality*. To ensure that these objectives can be achieved, ARS implemented the National Program cycle; a cycle of phases embodying a series of recurring activities (Figure 1).

Customers and stakeholders are actively engaged in each phase of the process described below, and their contributions are integral to the direction of research and its success.

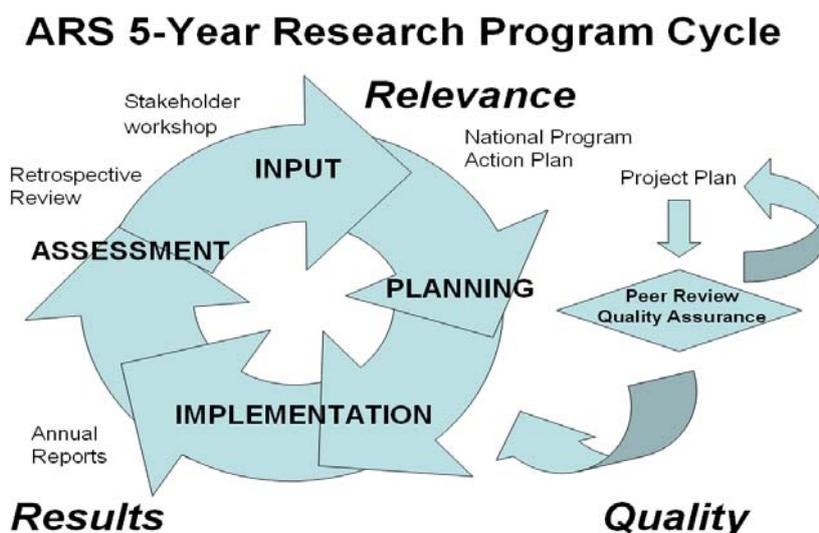


Fig. 1—ARS national program cycle.

The descriptors on the inside of Figure 1, input, planning, implementation, and assessment, are the four sequential phases through which ARS research progresses, ensuring that it remains of the highest quality. The cycle ties these activities together in a recurring 5-year sequence to ensure effective and efficient program and project management within ARS.

### Phase I: Input

Research in ARS derives its strength from its responsive nature to the needs of the U.S. public. At the National Program level, senior program leaders meet with customers, stakeholders, and partners; participate in Federal and USDA working groups and initiatives; and interact with Congress to build a strong understanding of national issues in agriculture and science. At the local level, senior managers also meet with customers, stakeholders, and partners, and participate in working groups to build a strong understanding of issues facing producers and industry. Each type of input is coordinated to produce a responsive program and project. This holds true for sugarcane research as well, as state and national stakeholders and scientists team up with the NPL to develop a regional and national program that addresses the most critical needs in breeding, genomics, germplasm preservation and distribution, pathology and entomology, agronomy, weed science, horticulture, remote sensing and monitoring, physiology, and sugar processing technologies.

Although input from these constituencies is ongoing, formally and informally, throughout the program cycle, the beginning of the cycle marks the consolidation of all input into a National Program Action Plan. The largest formal face-to-face input mechanism, the National Program Customer/Stakeholder workshop, immediately precedes the writing of that Action Plan. These meetings are designed to define specific researchable problems aimed at meeting high-priority needs within the agricultural community.

The workshops also provide an opportunity for ARS research scientists and program managers to interact and develop rapport with customers, stakeholders, partners, non-ARS scientists, and representatives from other agencies. For example, in the Crop Production and Protection Area, leaders from most, if not all, commodities work with our scientists and NPLs to determine the most critical needs of industry. In addition, input is obtained at numerous meetings and workshops during the year that is either commodity- or discipline-based.

Commodity representatives contribute greatly to the success of ARS research by providing in-kind support to relevant programs. For the ARS sugarcane programs in particular, Florida and Louisiana locations both have close collaborations with their respective industry and university researchers, growers, and producers. In 2007, as a response to requests from industry, a national

ARS Sugarcane Workshop was held for the first time in almost 25 years. Results from that 2-day event were captured in an Executive Summary with a vision and mission statement and primary research needs that can be viewed on the ARS Web site:

<http://www.ars.usda.gov/SP2UserFiles/Place/66250000/ARSSugarcaneWorkshopexecsumpacketfinal.pdf>.

## **Phase II: Planning**

Planning of ARS research is organised at two levels: National Program and individual project planning. National program planning begins at Headquarters with the development of the Action Plan. This plan is based on the vision and mission of ARS that encompass the broad goals of the Agency and on feedback from the Customer/Stakeholder workshop to define (1) problems to be addressed, (2) actions ARS will take to achieve the mission and goals of the National Program, (3) expected targets or outcomes of the research, and (4) locations that will be responsible for carrying out the work. As such, Action Plans provide guidance for project development, but also for facilitating project review and assessment of the National Programs. Scientists who contribute to the National Program are engaged in the process and often assist in the writing and formulation of the Action Plan.

Subsequently, scientists and line managers participate in planning individual research projects. Using research objectives identified in dialogue between researchers and the National Program team, a Project Plan is developed that addresses — either with basic, applied, or developmental science—the primary research objective(s). A robust Project Plan outlines research approaches, defines interactions among team members, enhances scientist productivity and impact, and creates opportunities for working with collaborators.

Once developed, the 5-year project plan is submitted for external peer review under direction of the ARS Office of Scientific Quality Review (OSQR), which develops a panel of highly regarded university and industry researchers in related fields. The ARS NPLs select the panel chair only, who in turn selects the panel members. The panel is asked to evaluate and rate the scientific quality, methodology, and outcomes in the proposed project plan based on the direction outlined in the Action Plan. As part of the review, the panel can suggest changes in the Project Plan to improve focus or identify other research considerations that also should be addressed. Plans that do not receive passing scores are asked to revise their plans based on the panel's comments and to resubmit for a second review by the panel. Once plans are passed by the panel, a new 5-year project is implemented.

## **Phase III: Implementation of the research plan**

This phase covers a wide range of processes, all of which are designed to optimise the research environment at all levels in the Agency. During this phase, line management may fill scientist vacancies and abolish positions, obligate and disperse funds, and develop agreements with outside organisations. As the cost of research continues to increase, there is a risk of losing resources to support important projects; thus, there is constant pressure to maximise efficiency, enhance collaborations, and accurately target the most important research.

Several mechanisms are in place to ensure that ARS research meets customer and stakeholder needs and is of high quality and impact. Included in these mechanisms are annual evaluations of individual scientist performance, annual reports of research progress, and yearly National Program reports that compile the best project accomplishments for a broader audience. If midcourse adjustments are necessary to avoid duplication of research and address gaps in research for new and emerging priorities, National Program Leaders have the authority to shift research objectives to meet these priorities, in consultation with project scientists and line management. For example, the finding in 2007 of orange rust (caused by *Puccinia kuehnii*) in Florida sugarcane, was the first report in the Western hemisphere, and prompted immediate attention to this new and serious disease.

#### **Phase IV: National program retrospective assessment: 5-Year programs**

Near the end of the project's 5-year life, the annual reports from each of the program's projects is summarised in a comprehensive Assessment Report, which looks at the past 5 years of accomplishments to compare against what was outlined in the Action Plan. This National Program assessment process (Retrospective Review) plays a key role in both retrospective evaluation and future priority setting in ARS. This report is used by an external panel of university and industry experts from relevant scientific disciplines to evaluate success of the National Program's performance in the prior 5- year cycle.

The panel assesses the National Program's impact and its delivery of information, knowledge, and technology that meet customer expectations, as determined by actual impact or progress toward anticipated benefits to end-users, scientific communities, and/or broader society as outlined in the Action Plan. After evaluating the compiled accomplishment summaries, the panel assesses the value of the research that has actually been conducted. The panel prepares a written report and makes recommendations for future research priorities. One outcome of the panel's Assessment Report is that the National Program team has tangible, independent judgment and commentary of the previous 5-year's research agenda, and a basis upon which to update the vision, direction, focus, and rationale of the research agenda (Action Plan) for the next 5 years.

ARS continually monitors the quality of its work to meet Federal requirements and ensure public accountability. These retrospective assessments reveal how well programmatic goals were met, whether any deviations from plans proved productive, and how future research can be focused on unmet needs.

The nature of high-risk, long-term research is that such endeavours may lead to applications only after many years, and many factors beyond the Agency's control can affect ultimate use by producers, processors, consumers, or policy makers. Thus, ARS strives to identify ways to assess performance, impact, or value beyond simple metrics of technical inputs and outputs. For example, programs like breeding for cold tolerance for sugarcane, adaptation to marginal soils, and application of genomics for enhancing the breeding program are long-term programs to which ARS is committed for the future sustainability of sugarcane in the United States.

The key building block for any performance assessment is the project annual reports, which describe the project's research progress and accomplishments each year. This information is used by management at all levels of the Agency, and it also informs the public about ARS progress and accomplishments.

Audiences of the annual reports, which are posted on the ARS Web site, include Congress; the White House Office of Management and Budget; stakeholders, customers, and other scientific agencies and scientists; and the general public.

#### **Conclusions: ARS vision for the future of sugarcane research**

##### **ARS sugarcane research at a glance**

ARS has a long history of international sugarcane research cooperation, aimed at improving productivity in the United States and abroad, and developing new markets for the various products that can be produced from sugarcane and other agricultural crops grown in the United States. As pressures mount on global agriculture to solve the world's need for food and fuel in a sustainable fashion, interest in sugarcane has increased.

The success of these programs is due to their specific resources, diverse talents, and to the rich local, national, and international collaborations that are characteristic of these programs.

Primary ARS research programs for breeding, pathology, entomology, agronomy, physiology, and production at Houma and Canal Point have a long and productive history of collaborations with their respective university and industry partners. Although they are both located in a subtropical climate, their growing conditions are so different that surprisingly, in the history of

the breeding programs, only two cultivars (CP 65-357 and CP 89-2143) have been grown successfully in both states. Cultivars have traditionally been released for high sugar yield and adaptability to the local environment, but recently cultivars more suited for use as biofuels have been released. The ARS location in Miami, Florida houses the world sugarcane collection that conserves, protects, and distributes sugarcane and related germplasm to ensure genetic diversity for breeding programs worldwide.

Both Canal Point, FL and Houma, LA breeding programs have contributed significantly to international sugarcane programs through the direct use of commercial cultivars and through use of parental clones for breeding. For example, in Central America, where the climate is more similar to that of Florida, approximately 50% of the acreage in commercial production is with cultivars developed by the CP (Canal Point) USDA-ARS Sugarcane Field Station. There has also been extensive international collaboration, training of scientists and technology transfer with ARS research programs. Likewise, the Commodity Utilisation Laboratory in New Orleans, LA has made important contributions to improved industrial processing of sugarcane, and improved measurement and reduction of sugarcane deterioration.

Current ARS research priorities are listed below:

- Development of high yielding, widely adapted breeding lines and cultivars for sugar and bioenergy that yield well on varied environments to include marginal lands;
- Evaluation of complementary crops that can be grown as feedstocks with sugarcane for the year-round processing of biofuels;
- Association genetics and molecular marker development to advance conventional breeding programs;
- Precision agriculture and remote sensing;
- Mechanical harvesting and use of chemical ripeners
- Resistance to a constantly changing array of disease, insect, and weed pests
- Sugar chemistry, physiology, chemical engineering and impact on harvesting, and storage processing;
- Pathology to support the breeding program for disease resistance, detection, and monitoring; and
- Strategies for integrated and sustainable weed and insect management.

Currently, the two most serious threats to the U.S. sugarcane industry are brown and orange rust diseases, caused by the fungal pathogens *Puccinia melanocephala* and *P. kuehnii*, respectively.

Orange rust in the United States is restricted to Florida at this time and, when found in 2007, was the first report in the Western Hemisphere.

There is a concerted effort by the research communities to identify useful fungicides as a short-term control measure, and sources of genetic resistance to support and advance the sugarcane breeding program. Fungicide use is not sustainable, however.

Thus, molecular and other efforts to support and advance the breeding programs are critical. A full interdisciplinary approach to this disease is vital to provide a profitable crop for the sugar industry and the new biofuel crops.

Efforts are aimed at maintaining a sustainable sugarcane industry that is responsive to the changing economics, production problems, and opportunities, and will require continued Federal, State, private, and international cooperation to be successful.

**LE SERVICE DE LA RECHERCHE AGRICOLE DE L'USDA:  
UN PARTENAIRE PUBLIC DE LA RECHERCHE ET DU  
DEVELOPPEMENT POUR LA CANNE A SUCRE**

Par

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**MOTS-CLÉS: Programmes Nationaux,  
Acteurs, Gestion Matricielle.**

**Resumé**

LA RECHERCHE est la pierre angulaire d'un maintien d'une industrie agricole viable et durable. Les systèmes pour obtenir des financements, gérer et distribuer les ressources sont aussi diversifiés que le sont les systèmes pour cultiver la canne à sucre. Cet article présente un modèle de gestion des programmes de recherche agricole au niveau d'une agence fédérale. Le service de la recherche agricole (Agricultural Research Service, ARS) est la principale agence fédérale créée et abritée par l'USDA, avec comme tâche principale de mettre en place et conduire les financements publics pour la recherche au bénéfice des Etats-Unis. L'ARS a pour objectifs de générer une information scientifique pertinente, significative et opportune pour une utilisation par les nombreux partenaires et acteurs de l'agence: producteurs agricoles, industries alimentaires, gestionnaires des ressources naturelles, universités et institutions de recherche sans profit. Pour garantir que ces objectifs seront bien finalisés, l'agence agricole ARS a mis en place le cycle de Programme National, un cycle d'étapes comprenant une série d'activités récurrentes. Les clients et partenaires sont activement engagés dans chaque étape/phase du processus et leurs contributions sont partie intégrante de l'orientation donnée à la recherche et son succès. L'apport d'idées, le planning, la mise en place et l'évaluation sont les 4 phases séquentielles à travers desquelles l'ARS progresse, tout en s'assurant que le processus reste de la plus haute qualité. Le cycle d'étapes relie ces activités entre-elles sur une séquence récurrente de 5 années pour garantir, au sein de l'ARS, un programme et un projet de gestion efficace et efficient. Ces efforts ont pour objectif de maintenir une industrie de canne à sucre durable et réactive au changement économique, aux problèmes de production, aux opportunités, et ceci va demander la mise en place, avec succès, d'une coopération fédérale, nationale, privée et internationale. Les bénéficiaires d'une industrie de canne à sucre durable sont les américains eux-mêmes, qui vont profiter d'un sucre et ses produits dérivés abondants et bon marché.

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**USDA—SERVICIO DE INVESTIGACIÓN PARA LA AGRICULTURA:  
UN SOCIO PUBLICO PARA LA INVESTIGACIÓN Y  
EL DESARROLLO DE LA CAÑA DE AZÚCAR**

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**PALABRAS CLAVES: los Programas Nacionales,  
las Partes Interesadas, la Administración de Matriz.**

**Resumen**

LA INVESTIGACIÓN es base para el mantenimiento de las industrias agrícolas sanas y sostenibles. Los sistemas para la obtención de financiación y para la administración y la dispersión de recursos son tan diversos como hay sistemas para cultivo de caña de azúcar. En este documento se presenta un modelo de gestión de programas de investigación agrícola al nivel de la Agencia Federal. El Servicio de Investigación Agrícola (ARS) es la Agencia principal de investigación agrícola del USDA y, como una Agencia Federal, se encarga de llevar a cabo investigaciones financiadas con recursos públicos para beneficio de los Estados Unidos. ARS pretende generar información científica pertinente, importante y oportuna para el uso de las partes interesadas de la Agencia: los productores agrícolas, las industrias de procesamiento de alimentos, los administradores de recursos naturales, las universidades y las instituciones de investigación sin fines de lucro. Para garantizar que se puedan conseguir estos objetivos, ARS ha implementado el ciclo del Programa Nacional, el cual es un ciclo de fases que incorpora una serie de actividades recurrentes. Los clientes y las partes interesadas participan activamente en cada fase del proceso y sus contribuciones son parte integrante en la dirección y el éxito de la investigación. Datos iniciales (de entrada), planificación, implementación y evaluación son las cuatro fases secuenciales a través de las cuales se desarrolla la investigación de la ARS, asegurando que siga siendo de la más alta calidad. El ciclo une estas actividades en una secuencia recurrente de 5 años para garantizar una gestión de programas y proyectos eficaz y eficiente dentro de la ARS. Estos esfuerzos están encaminados a mantener una industria de la caña de azúcar sostenible, que sea sensible a la evolución de la economía, y a las oportunidades y problemas en la producción, que requerirán apoyo federal continuo, así como también la cooperación internacional, estatal y privada para tener éxito. Los beneficiarios de una industria sostenible de la caña de azúcar serán los ciudadanos de los Estados Unidos que disfrutarán de azúcar y productos a base de azúcar abundantes y asequibles.