The IR-4 Project

Pest management solutions for specialty crops and specialty uses

2020 Annual Report

Major funding provided by special research grants and Hatch Act funds from USDA - NIFA, in cooperation with the State Agriculture Experiment Stations, USDA-ARS, and USDA-FAS

ANNUAL REPORT OF THE IR-4 PROJECT[1]
January 1, 2020 - December 31, 2020

On behalf of the IR-4 Project, the IR-4 Project Management Committee, and the dedicated scientists and staff working on the IR-4 mission, we submit this report of the IR-4 Project 2020 activities, research and accomplishments. The IR-4 Project continues to support the registration of safe and effective chemical and bio-based pesticides on fruits, vegetables, nuts, herbs, trees, shrubs, flowers and other specialty crops and minor uses on major crops (corn, cotton, soybeans, wheat, etc.). IR-4 remains relevant because the registrants of crop protection products (chemical and bio-based pesticides) often focus their product development efforts and resources on large acreage, major crops where potential sales are significant. Specialty crop markets are considered minor, with the cost of data development often exceeding potential return on investment from product sales. The IR-4 Project fills such voids by developing the data required by the U.S. Environmental Protection Agency (EPA) to register uses in these "minor" market areas.

Calendar year 2020 was one of the most difficult years in the history of IR-4. Multiple factors influenced the difficulties including the COVID-19 global pandemic, the relocation of IR-4 Project Headquarters, and the uncertainty about operating funds. Starting in mid-March 2020, almost everything changed. Staff at HQ and Regional Centers were no longer allowed unrestricted access to their offices and laboratories. Field research was vulnerable. Travel was restricted. IR-4 had to rapidly pivot and establish new procedures to maintain operations while following mandated restrictions. The resiliency of IR-4 was incredible. IR-4 lost only two field studies; both due to a cooperating company not being able to deliver test products on time.

This does not mean that IR-4 is fully operational. Access to some of the laboratories and offices is limited in some locations. Social distancing requirements limit how many people can work at one time. However, IR-4 has been able to triage operations and focus on the most important studies/projects. Significant work is now performed at home offices and meetings are held via Zoom and Webex.

Another major challenge testing IR-4 is the transition of IR-4 Project Headquarters from Rutgers University to North Carolina State University and the Northeastern Region from Rutgers University to University of Maryland Eastern Shore. These moves, combined with COVID-19 have placed an additional stress on team members at all IR-4 locations. The IR-4 Headquarters team lost nearly 150 years of service to IR-4 due to retirements in 2020. The remaining group at Rutgers remains committed to the IR-4 mission. The new team at NC State and University of Maryland Eastern Shore are highly motivated and eager to take on their new responsibilities.

The transition of IR-4 Headquarters to NC State was approx. 40% complete at the end of 2020 with transferring and/or hiring of scientific and support staff, securing new office space and movement of files/data and electronic systems. The transition will end September 2021 with all operations moved to NC State.

The other major challenge involved USDA's modifying IR-4's grant process. Starting with the fiscal year 2021 grant, USDA will now allow host institutions to charge limited indirect cost (10%) to recover some of their contributions. This change is something that IR-4 Project Management Committee has requested and is pleased that this change has been made.

[1] IR-4 Project, or Inter-Regional Research Project Number Four, is authorized by the Directors of the State Agricultural Experiment Station Directors as National Research Support Program Number Four (NRSP-4)

Unfortunately, this grant modification allowing indirect costs was approved in late 2020, well after IR-4 plans for 2021 were in place. Recognizing the impact of effectively reducing IR-4's funding by 10%, the five major host institutions of IR-4 (North Carolina State University, University of Maryland Eastern Shore, University of Florida, Michigan State University and University of California-Davis) all agreed to provide IR-4 a one-time waiver of the indirect cost collection. This will allow IR-4 to maintain operations in 2021.

The culture of IR-4 involves many partnerships with government and private sector partners. IR-4 continues to cooperate with many government/non-government organizations to accomplish its mission and leverage its resources. See Attachment 1 for the listing of Participants in the Process. Associated groups include:

- Specialty crop growers and their commodity organizations as represented by the IR-4 Commodity Liaison Committee (CLC),
- Land Grant Universities/State Agricultural Experiment Stations (SAES) including many 1862 institutions, and with University of Maryland Eastern Shore (an 1890 institution) joining in IR-4 management,
- Crop protection industry, including large and small companies that register chemical pesticides and biopesticides,
- Multiple units of the USDA including:
    - Agriculture Research Service (ARS),
    - Foreign Agriculture Service (FAS),
    - National Institute of Food and Agriculture (NIFA),
- US Environmental Protection Agency (EPA),
- California's Department of Pesticide Regulation (CA-DPR),
- Agriculture and Agri-Food Canada's Pest Management Centre (CN-PMC).

This document will focus on IR-4's research and regulatory activities along with the successes in 2020. The IR-4 Project has two main program areas: the Food Use Program and the Environmental (Ornamental) Horticulture Program for non-food crops. The IR-4 Project has delivered 21,925 registrations of chemical pesticides and biopesticides on specialty food crops since 1963. Over the last 25 years, IR-4 has emphasized research on products that are compatible with Integrated Pest Management Systems (IPM). This "IPM-friendly" technology includes "Reduced-Risk" pesticides, biopesticides, and certain products that can be used in organic farming. The Environmental Horticulture Program's deliverables are equally as impressive with data supporting close to 57,000 uses on trees, shrubs, flowers and other environmental horticulture crops.

Additional details about IR-4 can be found on the IR-4 Project's website: http://www.ir4project.org.

Food Use Program

Within the Food Use Program, IR-4 has six sub-objectives:

1. **Magnitude of the Residue Studies**: Following EPA guidelines, these studies provide data to set regulatory standards (pesticide tolerances or Maximum Residue Levels-MRLs) for the amount of chemical pesticide and /or its metabolites remaining on a crop at harvest or in a processed commodity (e.g., juice).
2. **Product Performance Testing**: Development of crop safety and/or efficacy data that provides assurances that the use of a pesticide (chemical or bio-based) is safe and effective.
3. **Crop Extrapolation Models**: Development of new proposals to expand and enhance the formal codified EPA Crop Groups/Sub-Groups, IR-4 crop grouping efforts propose models that allow collection of residue data on a small number of representative crops. That data then supports

pesticide tolerances for a much larger number of similar crops in the crop group or subgroup. Crop grouping extrapolation allows IR-4, the regulated community and EPA to use resources in a smart and efficient manner.

4. **Integrated Solutions**: Research utilizing all available crop protection tools in order to develop specific solutions for hard to manage pests, prevent or better manage pest resistance (to pesticides) and mitigate pesticide residues in the final food product. Integrated Solutions research also addresses management of pests in organic crop production systems.
5. **Biopesticides**: The continued goal of the IR-4 Biopesticide and Organic Support Program is facilitation of registration of crop protection products classified by EPA as Biopesticides. The program provides registration assistance to university and USDA researchers as well as to small biopesticide companies, with regulatory advice and petition preparation assistance.
6. **International Program:** Through various means IR-4 has developed, IR-4 assists domestic specialty crop growers' ability to export fruits, vegetables and other specialty crops to international markets by harmonizing pesticide residue standards. Partnerships developed by IR-4 enable harmonization of pesticide residue standards (Maximum Residue Levels) and avoiding non-tariff trade barriers.

Research Activities – Food Residue/Product Performance/Integrated Solutions

Since 1963, IR-4 stakeholders have submitted 13,193 requests for assistance to the IR-4 Food Use Program. Of these, 348 are currently considered "researchable projects" that remain as outstanding documented needs of specialty crop growers. The other requests have been addressed through previous research and regulatory submissions or cannot be registered at this time. The total number of new requests added to the IR-4 tracking system during 2020 was 261, including 61 requests to track new crop group updates, international requests or other miscellaneous factors.

IR-4's research priorities for 2020 were determined by stakeholders during the September 2019 IR-4 Food Use Workshop, in Hunt Valley, MD. Based on the outcome of that workshop and other priority-setting mechanisms,[2] IR-4 scheduled 72 residue studies in 2020, including 60 new studies and 12 carryover studies.

In support of the **residue studies** in the 2020, there were a total of 416 field trials. This total included 327 IR-4 "State" field trials conducted by land-grant university scientists, 64 field trials conducted by ARS researchers and 25 field trials managed by IR-4's partners in the Canadian Pest Management Centre (CN-PMC). This number includes sixteen carryover trials from trials lost in 2019 due to weather or other issues. The specific studies for 2020, including test chemical and crop, are shown in Attachment 2.

Most residue samples developed in the field trials are assigned to the IR-4 Analytical Laboratories. When necessary, other cooperating facilities or contractors may be utilized to ensure projects are completed in a timely manner.

IR-4 also addressed the **efficacy and/or crop safety data** needs for 42 projects by establishing 88 field trials. All were conducted with University cooperators - no performance trials were conducted by ARS or Canadian scientists. See Attachment 3 "2020 Food Use Product Performance Research Program" for full details. In addition, IR-4 continues to work closely with registrants and researchers to understand the quantity and scope of data requirements, and to ascertain the status of research results.

[2] IR-4 reserves a handful of priorities to address written proposals to "upgrade" projects and other projects to answer regional needs,

The 2020 **Integrated Solutions** research focused on 14 main project areas shown below. Seven projects were carry-overs from the previous year, and seven were new projects prioritized by stakeholders from new requests received in 2019.

Integrated Solutions #	Title
Carry-over projects:	
IS00027	Wireworms / Potato
IS00113	Verticillium wilt / Eggplant
IS00308	Damping-off / Hemp
IS00327	Cucumber beetle / Watermelon
IS00328	Weeds / Brassica leafy vegetables
IS00330	Orobanche parasitic weeds / Processing tomato
IS00348	Bacterial diseases / Post harvest organic sweet potato
New projects:	
IS00357	Lepidoptera / Hemp
IS00367	Vine Mealybug (*Planococcus ficus*) / Wine grapes
IS00368	Fire Blight (*Erwinia amylovora*)/ Apple, Pear
IS00372	Corn earworm larvae/Sweet corn
IS00374	Fusarium crown rot of tomato
IS00380	Bitter Rot (*Colletotrichum* spp.)/Apple
IS00381	Cabbage maggot/Root crops

For protocols and reports please see: http://ir4app.rutgers.edu/ir4FoodPub/IS_trial.aspx.

Submissions and Successes - Food Use Residue

IR-4 submitted data to EPA or to cooperating registrants for 26 chemicals, addressing 122 specific IR-4 requests (PR#s) for assistance. See Attachment 4 for a comprehensive listing of data submitted in 2020.

Based on IR-4 data and/or submissions, EPA reviewed 22 chemistries in 2020 and established 107 tolerances which can support 573 new uses. The 573 new uses in 2020 bring the IR-4 57-year total of clearances to 21,932. There was also one emergency/time-limited tolerance set based on IR-4 preliminary data. A complete list of these new uses, along with the new crop groups, is in Attachment 5.

Compliance with EPA Good Laboratory Practice Regulations

The Annual IR-4 QA Planning Meeting was held Feb. 27-28, 2020 in San Diego, CA. At this meeting, the audit plan for IR-4 QA officers for the 2020 field trial season was created. For calendar year 2020, regular inspections included 10 facilities, 156 in-life audits of field trials, 68 in-life audits of residue analytical laboratory activities, 38 analytical summary report/data audits and 405 field data book audits. During the 2020 calendar year, 49 final reports and amended reports were audited.

IR-4 facilities continue to work hard to meet the high standards demanded under GLP requirements. IR-4 has participated in a total of 183 EPA GLP IR-4 facility inspections since April 27, 1997, with only periodic minor findings to-date. In 2020, the EPA performed one inspection for GLP compliance/data integrity at an IR-4 research site.

IR-4 continues to use the eQA (electronic) reporting system to improve efficiencies and enhance communications across the program. Over 874 inspection and audit reports were processed using the web-based system in 2020. The electronic system was expanded in 2017 to include a document management system (eDOCs). This document management system is used to post protocols/changes, analytical methods and certificates of analysis for GLP test materials. To-date some 3721 sortable documents are now on the eDOCs system and are readily available to IR-4 study participants. In 2020, the document management system was further expanded to include HQ SOPs. Training of HQ SOPs has been enabled with the eDOCs system.

Crop Grouping Initiative

The IR-4 Food Crops Program continuously strives to work smarter and more efficiently to deliver new crop protection products for specialty crop growers. The 26 submissions in 2020 will support hundreds of new uses based on established crop group extrapolations. Over half of the projects tracked in the 2020 submissions were for crop group tolerances (65 PR# of the 122 submitted). Often times IR-4 realizes as many as 10 or more new uses for each residue study submitted.

The Final Rule to modify Crop Group 19, Herb and Spice Group was published in the Federal Register on November 6, 2020 (Vol. 85, No. 216). Crops in the current Crop Group 19 were separated into two new crop groups, Crop Group 25: "Herb Group" and Crop Group 26: "Spice Group". The rule also established two crop subgroups, Subgroup 25A for fresh herbs and Subgroup 25B for dried herbs. While Crop Group 19 included a total of 68 crops, the final rule established 418 commodities directly and 25 indirectly (crop definitions for basil, edible flowers, marjoram and mint) in the new Herb Crop Group 25 and 205 commodities in the new Spice Crop Group 26.

International Activities

In North America, IR-4's cooperation with Canada's Pest Management Centre continues to be mutually beneficial when priorities align. Canada contributed 25 field trials to the joint residue program in 2020. There also continues to be a good exchange of personnel, with Canadian PMC staff participating in various IR-4 meetings and vice versa.

The IR-4 Project, in conjunction with the Minor Use Foundation, organized requests for over 4,000 crop-pest combinations from 56 countries. Additional steps were coordinated including ranking of priorities, as well as development and organization of a new merit analysis system. This culminated in the Global Minor Use Priority Setting Workshop which was held in September, following the Food Use Workshop. Additional efforts are underway to determine the best solutions for the top priorities in greenhouse, temperate and tropical crops. The temperate priorities particularly benefit US interests and provide a new source of funding for domestic research. Global partners determined through earlier GLP training programs are now continuing on new residue projects to provide data to local authorities and Codex for product registration. All three of the regions participating in this project have received Standards Trade Development Facility (STDF) and USDA-FAS funding, which provides support for IR-4's contributions to the project as well. The Minor Use Foundation is now coordinating and supporting much of this work, alleviating much of the burden that IR-4 carried to initiate and successfully bring this work to where it is today. Primary international organizations include IICA in Latin America, and APAARI in Asia.

Pyriproxyfen on banana, with samples from Costa Rica and Guatemala, was submitted to JMPR. Codex MRLs for banana and mango are being reconsidered and may result in 2021 MRLs.

At the request of EPA, IR-4 personnel continue to be included as part of the US delegations to the Codex Committee on Pesticide Residues (CCPR); the Organization for Economic Co-operation and Development (*OECD*), Expert Group on Minor Uses and the Working Group on Pesticides and the Expert Group on Biopesticides; and the NAFTA Technical Working Group on Pesticides. IR-4 plays a

key role in these activities by supporting global standards and incentives that support minor uses. These include global recognition of crop grouping and extrapolation as well as promoting MRLs on specialty commodities. Unfortunately, the 52nd Session of the Codex Committee on Pesticide Residues (CCPR) scheduled for 30 March to 4 April 2020 in Guangzhou, China was cancelled due to COVID-19. However, the Electronic Working Group for Revision of the Classification of Food and Feed was re-initiated in November, 2020.

IR-4 helped develop new initiatives in Asia and Africa on residue mitigation and biopesticide regulatory harmonization, both of which were funded as full proposal grants by the Standards Development and Trade Facility (STDF). An additional planning grant has been awarded by STDF for residue mitigation studies in Latin America.

Plans for 2021

Food Use Residue Studies - The proposed 2021 Food Use Residue Program consists of 366 field trials. This trial plan includes 309 trials scheduled at IR-4 Field Research Centers/other University sites, 47 field trials at ARS sites and 10 field trials conducted by Canadian partners.

Food Use Product Performance Research - IR-4 is planning to conduct 97 food use field trials (all at state University sites) to develop product performance data for 41 different projects. Canadian partners at CN-PMC will also be contributing a number efficacy and crop safety trials in several projects.

Integrated Solutions - The high priority projects for the Integrated Solutions research in 2021 are shown in the table below, and include 7 previously supported projects from the 2020 program and 13 new projects for 2021 that were previously unfunded and established as new priorities by IR-4 stakeholders amounting to 38 field trials (3 supported by CA funds and 35 supported by NIFA $).

Integrated Solutions #	Title
Carry-over projects:	
IS00372	Corn earworm larvae / Sweet corn
IS00381	Cabbage maggot / Root crops
IS00357	Lepidoptera / Hemp
IS00330	Orobanche parasitic weeds / Processing tomato (2019 carry-over)
IS00348	Bacterial diseases / Post harvest organic sweet potato
IS00368	Fire Blight (*Erwinia amylovora*) / Apple, Pear
IS00380	Bitter Rot (*Colletotrichum* spp.) / Apple
New projects:	
IS00166	Cabbage maggot / Brassica crops
IS00382	Mite control / Hemp
IS00397	Thrips / Green onion
IS00376	Grape leafhopper / Grape
IS00002	Glyphosate resistant weeds
IS00383	Postemergence broadcast control of escaped broadleaf weeds / Sweet potato
IS00390	Weed control / Cold hardy small fruits
IS00389	Dormancy break – new/alternative products / Grape
IS00344	Powdery & downy mildew / Organic cucurbits
IS00384	Anthracnose (*Colletrotrichum* spp.) / Coffee

IS00391	Damping off / Organic hemp (GH)
IS00388	Nematode, sting (all species) / Strawberry
IS00399	Coffee rust

Environmental Horticulture Program

IR-4's role in the Environmental Horticulture Program involves the development of efficacy and plant safety data that indicates if crop protection products are safe and effective. This supports an industry valued at nearly $19.2 billion in annual sales (Horticulture Census, 2014, NASS). This industry is quite complex because growers cover many diverse markets including flowers, bulbs, houseplants, perennials, trees, shrubs and more. These plants are grown and maintained in greenhouses, nurseries, commercial/residential landscapes, interiorscapes, Christmas tree farms and sod farms. The Environmental Horticulture Program also coordinates some non-core research that aids the environmental horticulture industry. Currently, IR-4 is coordinating a multi-state research program that studies impact of systemic insecticides on pollinators and how the environmental horticulture industry can protect pollinators while at the same time produce high quality plants.

Research Activities

In 2020, IR-4 conducted 650 environmental horticulture research trials to support registrations in the greenhouse, nursery, landscape, Christmas tree and forestry industries. Of these, 251 were efficacy trials designed to compare different products to manage damaging insects, plant diseases and weeds; the remaining trials were conducted to determine the level of phytotoxicity to crops with these products. Please see Table 1 for a summary of research activities and Attachment 6 for a complete listing of 2020 field cooperators and Attachment 7 for research activities listed by project.

Table 1. Summary of IR-4's 2019 and Revised 2018 Environmental Horticulture Program Research Activities.

Category	2020			Revised 2019		
	Efficacy	Crop Safety	Total	Efficacy	Crop Safety	Total
Number of Studies (PR Numbers) with Planned Trials	157	267	424	236	287	523
Number of Trials	251	399	650	326	424	750

Submissions and Successes

During 2020, 24 data summaries were compiled based upon research reports submitted by researchers: Beetle, Borer, Weevil & White Grub Efficacy Summary - 2020, Bentazon Crop Safety - 2020, Bittercress Efficacy - 2020, Botrytis Efficacy Summary - 2020, Cyclaniliprole + Flonicamid Crop Safety - 2020, Dimethenamid-p Crop Safety - 2020, F6123 Crop Safety Summary - 2020, Fenamidone Efficacy/Crop Safety Summary - 2020, Fluopyram Crop Safety - 2020, Fusarium Efficacy Summary - 2020, Halosulfuron Crop Safety - 2020, Indaziflam Crop Safety - 2020, Iron HEDTA Crop Safety - 2020, Isoxaben Crop Safety - 2020, Mono and di potassium salts of phosphorus acid + Hydrogen peroxide Crop Safety - 2020, Oxalis Efficacy - 2020, Prodiamine Crop Safety - 2020, Pydiflumetofen Crop Safety Summary - 2020, Rhizoctonia Efficacy Summary - 2020, Scale and Mealybug Efficacy - 2020, Spurge Efficacy - 2020, Sulfentrazone Crop Safety - 2020, Thielaviopsis Efficacy Summary - 2020, Thrips Efficacy Summary – 2020. See Attachment 8 for Abstracts from the individual reports. Data from 5,232 trials contributed to the writing of these reports. Table 2 lists the number of trials by IR-4 Region that were used in the data summaries.

Table 2. 2020 Environmental Horticulture Program Research Summaries.

Region	Number of Trials
North Central	678
North East	906
Southern	1,908
Western	928
USDA-ARS	814
Total	5,232

During 2020, no new US EPA approvals occurred, but four labels were registered in California: Pedestal, Picatina Flora, Stargus, and Ventigra.

Table 3. Environmental Horticulture Program Registration Contributions, 2020.

Category	2020			
	Efficacy	Crop Safety	Both	Total
New US EPA Product Registrations [a]	0	0	0	0
US EPA Label Amendments [b]	0	0	0	0
State Registrations [c]	1	2	1	4
Not to be Registered	0	0	0	0
Number of Impacted Crops [d]	624	66	-	690

[a] New products for the environmental horticulture industry based on data collected through IR-4 and submitted to manufacturers in previous years.
[b] Label updates on existing products for the environmental horticulture industry based on data collected through IR-4 and submitted to manufacturers in previous years.
[c] State registrations and special local needs registrations on federally registered products for the environmental horticulture industry based on data collected through IR-4 and submitted to manufacturers in previous years.
[d] The number of impacted crops is an estimate of the total plant species grown commercially for environmental uses impacted by the IR-4 data.

Priority Setting

The last Environmental Horticulture Workshop was held as part of the "Week of Workshops" in Hunt Valley, MD in September 2019 to establish priorities for the 2020 and 2021 biennial research cycle.

Priorities from the 2019 Workshop include:

- Entomology Projects: Borers & Beetles (continued emphasis on Foliar Feeding Beetle Efficacy), Scale & Mealybug Efficacy, New Product Crop Safety
- Pathology Projects: Pythium Efficacy, Non-Oomycete Root Disease Efficacy, New Product Crop Safety
- Weed Science: Pre-Emergent Herbicide Crop Safety, Nostoc Efficacy
- Biopesticide Specific: Powdery Mildew Management with Biopesticides
- Regional Projects:
  - NCR – Ambrosia Beetle Efficacy, Root Knot Nematode Efficacy
  - NER – Improving Directions for Use with Fatty Acid Herbicides, Thrips Efficacy for Outdoor Uses
  - SOR – European Pepper Moth Efficacy, Bacterial Leaf Spots & Blight, SOR – Post Emergent Crop Safety & Efficacy for Glyphosate Resistant Weeds
  - WSR – Snail Efficacy, Liverwort Efficacy, Botrytis Efficacy on Peony

Invasive Species Research Activities

During 2020, the IR-4 Environmental Horticulture Program submitted two suggestions and participated in a third project to be funded under USDA-APHIS Farm Bill Section 7721. The first suggestion was to continue mitigation and diagnostic research into impatiens and cucurbit downy mildews, and the second project (submitted under two proposals) was to study mitigation options for box tree moth and survey for this new pest that was discovered in Canada during 2018.

Pollinator Protection Activities

Protecting pollinators has risen to a high level of public concern and is affecting decision making at many levels, from individual consumers to the federal government representatives. This SCRI research project ($6,509,975) has provided crucial, science-based information for EPA and grower decision making and has provided opportunities for the Environmental horticulture industry to contribute to improved pollinator health by growing plants under best production practices, thereby increasing pollinator forage quality and quantity in rural and urban landscapes.

This research project team is comprised of entomologists and agricultural economist from Clemson University, Connecticut Agriculture Experiment Station, Cornell University, Michigan State University, Penn State University, University of California, University of Florida and University of Kentucky.

During the fourth year of this project, we maintained test garden plots of annual and perennial cultivars and collected/counted the visiting pollinators. We continued studies on the amount of systemic insecticides found in pollen and nectar with plots of rhododendron, sunflower, annual and perennial salvia, knipofia, dahlia and snapdragon. We compiled the available efficacy and toxicology information for alternative treatment options, and we analyzed enterprise analysis budgeting provided by growers for costs with alternative tools. Our team wrote more than 5 scientific and 8 trade articles and gave more than 40 presentations to multiple audiences from K-12 students to scientific peers. Ultimately, these activities will improve pollinator health and conservation in urban and suburban areas and improve the sustainability and profitability of the environmental horticulture and beekeeping industries.

Biopesticide and Organic Support Program

Legacy Research Activities:

In 2020, priority research projects formerly conducted within the Biopesticide Research program were incorporated within the new IR-4 Integrated Solutions program, except for one ongoing stakeholder priority from the 2018 Biopesticide Workshop in St. Louis, MO (Project B00311, Virus and viroid/Tomato, Greenhouse grown, Kai-Shu Ling, USDA-ARS, Charleston, SC).

Regulatory Activities:

Interest in obtaining assistance from IR-4 in biopesticide registration continues to increase. A registration with an exemption from tolerance was obtained in 2020 for the bioherbicide *Pseudomonas fluorescens* ACK55 for the control of cheatgrass/downy brome, medusahead and jointed goatgrass in crops and rangeland. This registration was announced by EPA in a News Release on September 30, 2020: https://www.epa.gov/newsreleases/epa-approves-innovative-products-aid-wildfire-management. A registration with an exemption from tolerance was also obtained for sucrose octanoate esters, a biochemical insecticide/miticide for use in mushrooms, foliar applications in greenhouse, nursery and field crops and as a honeybee treatment for Varroa mites. A submission was made for oxalic acid dihydrate for an exemption from the requirement of a tolerance and label amendment for oxalic acid dihydrate to control Varroa mites.

In 2020 IR-4 submitted and successfully obtained EPA biochemical classification for pongamia oil and an insect behavior disruptor targeting Spotted wing Drosophila, and a pesticide determination for sterile male mosquitoes. Pre-submission meetings with EPA were held for noni fruit; American chestnut (plant-incorporated protectant); for an organic formulation of *Aspergillus flavus* AF36; and for bacteriophages for Varroa mite control on honeybees. An EUP final report was submitted for *Aspergillus flavus* TC16F, TC35C, TC38B and TC46G.

Through funding by USDA-FAS, IR-4 developed a new biopesticide regulatory framework for Pakistan and submitted a dossier for AflaPak which utilizes atoxigenic Aspergillus flavus technology. The project has now started to expand onto chili pepper.

The Biopesticide Program is also part of a consortium of university and USDA scientists that were awarded a NIFA CAP Grant to provide regulatory support for EPA registration of peptides active against citrus greening.

Impact of IR-4 Activities

Specialty crop growers/farmers benefit in having access to legally registered crop protection products to manage pests on their commodities. This helps them produce an abundance of high-quality food and ornamental crops needed and desired by consumers, helps growers remain profitable and contribute to our well-being and helps to bolster rural economies.

Food processors and food retailers benefit in having a consistent supply of high-quality produce and/or raw materials to meet consumer demand or keep their processing facilities open and operational. The public benefits through having an abundant choice of healthy vegetables, fruits, nuts and other foods available at reasonable prices, as well as having ornamental horticulture plants to enhance the landscape and environment. IR-4's actions also prevent food waste throughout the supply chain at the farm to the consumer.

Individual growers and commodity associations continue to articulate testimonies on how IR-4 has helped to feed Americans and beautify the environment. To better ascertain the impact of IR-4's research and regulatory activities, Michigan State University's Center of Economic Analysis reported the economic impact of IR-4 Project's activities in the Food, Ornamental Horticulture and Biopesticide and Organic Support programs. According to the report, ***"the estimated total effects of the IR-4 Project includes supporting an estimated 95,261 jobs with total labor income of $5.6 billion and annual contributions to gross domestic product totaling about $9.4 billion. These impacts represent best estimates of ongoing contributions to the U.S. economy, largely through crop agricultural productivity and damage mitigation via pest management."*** See http://ir4.rutgers.edu/Other/IR4%202017%20Impact%20Final.pdf for a full report of the IR-4 economic impact study.

IR-4 focuses its research on modern lower/reduced risk chemical pesticides and biopesticides. The strategic decision to focus on these newer products has helped ensure that growers can produce their commodities with the best available technology to manage pests while ensuring the highest degree of safety for humans and the environment. Many of the registrations are essential components of Integrated Pest Management systems.

IR-4's research and regulatory activities are proactively solving many other pest management issues facing specialty crop growers, including pest resistance to pesticides and pesticides being a barrier to trade and food waste. Though IR-4 is not solely responsible for solving these and other critical agriculture/societal issues, IR-4 efforts reduce the negative impact.

Congressional Appropriations and other funding

Various units within USDA, SAES, and the private sector help fund IR-4. Total funding received in calendar year 2020 was approximately $16.5 million. The main source of funding ($11.916 million) was through Congressional Appropriation via Special Research Grants administered by USDA-NIFA. These funds are used for research and regulatory operations by all units in all research areas. In 2020, the IR-4 Project Management Committee allocated these funds as follows:

- $7.391 million distributed to the four IR-4 Regional offices and Headquarters for personnel, supplies, equipment; laboratory analysis and other core expenses;
- $2.531 million allocated for field trials that produce the necessary residue samples and product performance data;
- $543,0000 supported Environmental Horticulture research;
- $371,000 provided for the Integrated Solutions projects and a few legacy Biopesticide projects;
- $234,000 to cover lease costs for analytical instruments in the IR-4 laboratories; and
- $842,500 was kept by NIFA to help fund their operations.

IR-4 Headquarters received $481,182 of Multistate Research funds from the SAES through a NRSP-4 award. These funds were used to fund salaries of its Program and Research Managers who provide overall leadership and coordination of the IR-4 Project's on-going research efforts.

USDA-ARS allocates $3,170,000 of its Congressional Appropriation funds to support the salary and other expenses for USDA-ARS personnel involved with high priority IR-4 research projects within IR-4's Food Use and Environmental Horticulture programs. Participating ARS scientists are given specific research assignments that complement the on-going research of the scientists at the SAES. From these funds, USDA-ARS contributes about $105,000 to IR-4 Headquarters that funds Environmental Horticulture research at Rutgers Tree Fruit & Ornamental Research and Education Center, as well as cost of travel for IR-4 Quality Assurance Unit personnel to perform required on-site critical phase audits at ARS Field Research Centers.

Crop Protection companies and commodity associations provided $1.15 million of unrestricted funds that are used to supplement other IR-4 funds. This includes performing additional field trials, analytical analyses, funding purchase supplies for research (e.g., GLP level sample bags), supplementing the cost of operations for IR-4 HQ, including additional expenses associated with the move to North Carolina State University, conducting the priority-setting workshops/other meetings and miscellaneous matters.

In addition to the above, IR-4 also receives significant in-kind contributions from multiple sources including:

- SAES/land grant universities by hosting IR-4 field research centers, analytical laboratories and management offices throughout the United States (estimated at nearly $6.0 million annually);
- EPA Pesticide Registration Improvement Act fee waivers (average approx. $6.0 million/annually);
- Crop protection industry (their in-kind contributions are about $12 million or a 1:1 match of NIFA funds);
- The government of Canada also makes significant in-kind contributions (>$500,000).

IR-4 funding from government and non-government sources has remained relatively flat over the past ten-years while research expenses and employee compensation continues to increase. To offset the decade of flat funding, the IR-4 Project continues to explore opportunities to cut expenses and/or increase efficiencies. Unfortunately, IR-4 has had to scale back its research efforts and research infrastructure to

manage the fiscal shortfalls. It was not that long ago that IR-4 established nearly 100 new residue studies annually. In 2020, this number dropped to 60. There is a similar pattern in the Environmental Horticulture Program.

Future Directions

The cornerstone of IR-4 research and regulatory efforts is an open and transparent stakeholder-driven research prioritization process that provides direction to IR-4 to perform studies that address the most important pest management voids in specialty crop agriculture. The majority of priorities for 2021 research in the Food Use Program (including magnitude of the residue studies, product performance projects, Integrated Solutions projects and a few legacy Biopesticide research studies) were established during a virtual online workshop, in which nearly 275 people participated.

Priorities for IR-4's 2021 Environmental Horticulture research were established in 2019 at the IR-4 Week of Workshops. The national priorities for 2021 are the same as the 2020 priorities (see above). The regional priorities shifted slightly with the addition of an efficacy screening project for the newly introduced Mediterranean oak borer.

Flat budgets and limited fiscal resources continue to be the most critical challenge for IR-4. The IR-4 Commodity Liaison Committee and the Minor Crop Farmers Alliance continue to advocate for IR-4 to the U.S. Congress and others in government about the importance of IR-4 and the need to provide adequate resources. Actions included a Congressional Lunch and Learn, visits with Congressional Members and/or their staff, a meeting with the Branch Chief of the Agriculture Division of the Office of Management and Budget, multiple visits with USDA/SAES leadership, etc. Senator Menendez of New Jersey developed a "Dear Colleagues" letter to the Senate Appropriation Committee recommending an increase to $20 million annually. In spite of all of these efforts, IR-4 funding levels have remained unchanged.

IR-4 continues to operate according to the principals outlined in its current strategic plan, ***IR-4 Project - VISION 2020***, recognizing that there was clear consensus of the future need for IR-4 in many specialty crop protection areas. As preferred technology evolves, there is a role for IR-4 to ensure that growers, including growers following organic production practices, have access to effective tools to manage pests. There was a clear recognition that existing and future resource constraints will limit IR-4's ability to meet the ever increasing and evolving demand for crop protection products for specialty crops and minor uses. The group also discussed other ways IR-4 can help, including support for regulatory actions by public sector scientists and small business, further expansion of crop extrapolation models, further integration of pest management technologies into a systems approach and training of global trading partners to cooperate in data development activities.

PUBLICATIONS

Bika, R., Alexander, L., **Palmer, C.**, and Baysal-Gurel, F. 2020. Efficacy of fungicides and biorational product of *Botrytis cinerea* on cut flowerheads of *Hydrangea macrophylla*. ASHS Poster

Bika, R., **Palmer, C.**, Alexander, L., and Baysal-Gurel, F. 2020. Comparative performance of reduced-risk fungicides and biorational products in management of post-harvest *Botrytis cinerea* on hydrangea cut flowers. HortTechnology. https://doi.org/10.21273/HORTTECH04656-20

Fulya Baysal-Gurel, Ravi Bika, Christina Jennings, **Cristi Palmer**, and Terri Simmons. 2020. Comparative Performance of Chemical and Biological-based Products in Management of Algal Leaf Spot on Magnolia. HortTechnology. https://doi.org/10.21273/HORTTECH04692-20

Homa, K., **W.P. Barney**, W.P. Davis, D. Guerrero, M.J. Berger. 2020. Cold Plasma Treatment Strategies for the Control of *Fusarium oxysporum* f. sp. *basilici* in Sweet Basil. HortScience, 56(1):42-51.

Kunkel, D. and M. Alvarez. 2020. AAFC PMC / USDA IR-4 Project Harmonization. Presentation to the NAFTA Technical Working Group. Oct. 2020

Kunkel, D., **R. B. Batts**, **J. Baron**, and **M. J. Braverman**. 2020. IR-4 Project Update and Program Changes. Proc. Weed Sci. Soc. America, Abstract #100

Palmer C. L., Smitley, D., Chong, J-H, Bethke, J, Corkidi L, Thayaril, N, Leonard E. 2020. Systemic insecticide residues in greenhouse annuals and implications for pest management. Virtual ESA Annual Meeting. Dec 2020

Palmer, C. L., **E. Vea**. 2020. Update on 2019 Weed Science Research in the IR-4 Environmental Horticulture Program and 2020/2021 Priorities. Northeastern Plant, Pest, and Soils Conference. January 2020

Vea, E., C.L. Palmer. 2020. Crop Vignette: Coleus. https://www.ir4project.org/ehc/crop-vignette-coleus/

Vea, E., C.L. Palmer. 2020. Crop Vignette: Gerbera. https://www.ir4project.org/ehc/crop-vignette-gerbera/

Vea, E., C.L. Palmer. 2020. Crop Vignette: Salvia. https://www.ir4project.org/ehc/crop-vignette-salvia/

Vea, E., C.L. Palmer. 2020. Crop Vignette: Hydrangea. https://www.ir4project.org/ehc/crop-vignette-hydrangea/

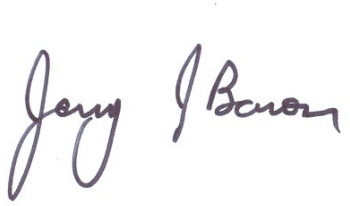
Vea, E., C.L. Palmer. 2020. Crop Vignette: Hosta. https://www.ir4project.org/ehc/crop-vignette-hosta/

Vea, E., C.L. Palmer. 2020. Crop Vignette: Ferns. https://www.ir4project.org/ehc/crop-vignette-ferns/

Welker, R.M., and **R. B. Batts**. 2020. Evaluation of Herbicide Programs in Dormant Stevia (*Stevia rebaudiana*) in North Carolina. Proc. Weed Sci. Soc. America, Abstract #97

December 31, 2020

Approved by:



J.J. Baron, Executive Director
IR-4 Project,
North Carolina Agriculture Research Service
North Carolina State University

John Wise, Chair,
IR-4 Project Management Committee
Michigan State University

Douglas Buhler, Chair,
IR-4 Administrative Advisers
Michigan State University

ATTACHMENT 1 – Participants in the Process

Commodity Liaison Committee (CLC)

These are the primary customers for IR-4 Project services. A concerted effort is always made to seek input from growers/commodity group representatives for establishing research priority setting policies. The IR-4 Commodity Liaison Committee (CLC) provides input to the IR-4 Project Management Committee on overall operations and program direction. They are often effective communicators to Congress on the importance of the IR-4 Project and its deliverables to specialty crop agriculture in the United States. Members include:

Michael Aerts, Florida Fruit and Vegetable Association
Mark Arney, National Watermelon Promotion Board
Michael Bledsoe, Village Farms, L.P. and CLC Chair
Jill Calabro, AmericanHort
Jennifer Clarke, California Leafy Greens Research Program
James R. Cranney, California Citrus Quality Council
Allison Crittenden, American Farm Bureau Federation
Mr. Alan DeYoung, Van Drunen Farms
William Frantz, Cranberry Institute
Amy Gandhi, Kemin Industries
Ms. Ann E. George, Washington Hop Commission
Zack Gihorski, National Association of State Departments of Agriculture
Jennifer Gray, Horticulture Research Institute
Bob Jones, The Chef Garden
Bob Kaldunski, Ginseng Board of Wisconsin
Armando Monterroso, Brooks Tropicals
Dennis Nuxoll, Western Growers Association
Keith Pitts, Marrone Bio Innovations
Kan Quarles, National Potato Council
Rachel Roberts, American Mushroom Institute
Steven Salisbury, Mint Industry Research Council
Todd Scholz, USA Dry Pea & Lentil Council
Alan Schreiber, Agriculture Development Group, Inc.
Mark Seetin, US Apple Association
Bob Simerly, National Onion Association
Berry Tanner, National Watermelon Association (alternative)
Dave Trinka, MBG Marketing
Amy Upton, Michigan Nursery & Landscape Association
Herman Waguespack, American Sugar Cane League

Cooperating Government Departments and Agencies

Agriculture and Agri Food Canada-Pest Management Centre (CN-PMC)
Health Canada-Pest Management Regulatory Authority (PMRA)
State Agricultural Experiment Stations/Land Grant Universities (SAES)
State of California Department of Pesticide Regulation (DPR)
U.S. Department of Agriculture, National Institute of Food and Agriculture (NIFA)
U.S. Department of Agriculture, Agricultural Research Service (ARS)
U.S. Department of Agriculture, Foreign Agriculture Service (FAS)
U.S. Department of Agriculture, Animal and Plant Health Inspection Service (APHIS)

Crop Protection Industry

ADAMA Ag Solutions Ltd.
AgBio Development Inc.
Agrimar
AgroSource Inc.
Albaugh, Inc.
Amvac Chemical Corporation
Arkion Life Sciences
BASF Corporation
Bayer CropScience USA
Bayer Environmental Science
Belchim Crop Protection
BetaTec
BioBest
Bio HumaNetics
BioProdex
BioSafe Systems
Bioworks
CAI Limited
Certis USA
Corteva Agriscience
Delta Analytical Corporation
Everris
Fine Americas
FMC Corporation
Gowan Company
Greenlight Biosciences
Hacco, Inc.
Helena Agri-Enterprises
Isagro, USA
ISK Biosciences
Janssen Pharmaceutica
K-I Chemical USA Inc.
Kemin Crop Technologies
Landis International
Loveland Products
Luxembourg-Pamol, Inc.
Marrone BioInnovations, Inc.
MGK
Natural Industries
Neudorff
Nichino America, Inc.
Nisso America, Inc.
Novozymes, Inc.
Nufarm Americas, Inc.
Oat Agrio
OHP
Pace 49, Inc.
Rainbow Treecare Scientific
Scotts Corporation
SePro Corporation
Sipcam Advan
Snowden Enterprises, Inc.
Summerdale, Inc.
Syngenta Crop Protection, Inc.
TDA
TKI Novasource
UPL NA Inc.
Valent Biosciences
Valent USA, LLC
Westbridge Agricultural Products

Project Management Committee (PMC)

Dr. Jerry Baron*, IR-4 Project Headquarters – IR-4 Project Executive Director
Dr. Tom Bewick, USDA-NIFA - National Program Leader
Dr. Michael Bledsoe*, Village Farms, Inc. - CLC Chair
Dr. Douglas Buhler, Michigan State University – Administrative Advisor, North Central Region
Dr. John Davis, North Carolina State University - Administrative Advisor, Southern Region
Dr. Liwei Gu, University of Florida – Regional Director, Southern Region.
Dr. Matt Hengel*, University of California, Davis - Regional Director, Western Region
Dr. Marcel Holyoak, University of California, Davis – Administrative Advisor, Western Region
Dr. Moses Kairo, University of MD Eastern Shore - Administrative Adviser, Northeast Region
Dr. Steven Lommel, North Carolina State University – Administrative Advisor
Dr. Joseph Munyaneza, USDA-ARS - Administrative Advisor
Dr. Alvin Simmons*, USDA-ARS – Interim Director Minor Use Program
Dr. John Wise*, Michigan State University – Regional Director, North Central Region, and PMC Chair
Dr. Simon Zebelo*, University of MD, Eastern Shore - Regional Director, Northeast Region
*Voting Member

IR-4 Project Headquarters (HQ)

IR-4 Headquarters is co-located at 500 College Road East, Suite 201W, Princeton, NJ 08540 and 840 Main Campus Drive, Suite 1200, Raleigh, NC 27606

Ms. Tammy Barkalow – Assistant Director, Quality Assurance (Rutgers - Retired 3QR 2020)
Mr. Bill Barney – Manager, Crop Grouping/Study Director (Rutgers)
Dr. Jerry Baron – Executive Director (North Carolina State University)
Mr. Roger Batts - Principal Weed Scientist (North Carolina State University-Hired 1QR 2020)
Ms. Susan Bierbrunner – Data Manager and Administrative Support (Rutgers)
Dr. Michael Braverman – Manager, Biopesticides and Organic Support Program (Rutgers)
Ms. Uta Burke – Administrative Support (Rutgers)
Mr. James Byrtus –Data Manager and Administrative Support (North Carolina State University-Hired 2nd QR 2020)
Dr. Debbie Carpenter – Acting National Director (Rutgers)
Ms. Jackie Cavaliere – Program Assistant: Environmental Horticulture (Rutgers)
Dr. Krystal Chojnacki - National Chief of Staff (North Carolina State University-Hired 2nd QR 2020)
Ms. Cheryl Ferrazoli – Administrative Support (Rutgers - Retired 4th QR 2020)
Ms. Jane Forder – Quality Assurance (Rutgers)
Mr. Matt Havers - Program Coordinator: Environmental Horticulture (Rutgers)
Ms. Jennifer Heiss – Communications Officer* (North Carolina State University-Hired 4th QR 2020)
Ms. Kathryn Homa – Manager, Plant Pathology Activities/ Study Director (Rutgers)
Ms. Shiayi Huang - Database Developer (Rutgers)
Ms. Carolyn Jolly – Study Director/Research Coordinator (Rutgers)
Dr. Daniel Kunkel – Senior Associate Director (Rutgers - Retired 4th QR 2020)
Ms. Grace Lennon – Study Director/Research Coordinator (Rutgers)
Dr. Johanna Mazlo - Manager, Quality Assurance (North Carolina State University-Hired 3QR 2020)
Mr. Philip Moore - Study Director (North Carolina State University-Hired 2nd QR 2020)
Ms. Sherri Nagahiro – Business Manager (Rutgers)
Dr. Cristi Palmer – Manager, Environmental Horticulture Program (Rutgers)
Dr. Venkat Pedibhotla – Assist. Director, Research Planning/Product Performance (NC State-Hired 2nd QR 2020)
Mr. Thomas Pike – Study Director/Acting Entomology Manager (Rutgers)

Mr. Kenneth Samoil – Study Director/Research Coordinator (Rutgers)
Ms. Karen Sims – Administrative Support (Rutgers)
Dr. Van Starner – Assistant Director, Research Planning & Outreach (Rutgers - Retired 4th QR 2020)
Ms. Juliet Thompson – Administrative Support (Rutgers)
Dr. Ely Vea – Assistant, Environmental Horticulture Program (Rutgers)

Field Coordinators (Regional and ARS)

Dr. Michael Horak, University of California, Davis – Western Region
Ms. Marylee Ross, University of Maryland – Northeast Region
Dr. Alvin Simmons, USDA-ARS – ARS Office of Minor Use Pesticides
Dr. Janine Spies, University of Florida – Southern Region
Dr. Anthony Van Woerkom, Michigan State University – North Central Region

Laboratory Coordinators (Regional and ARS)

Dr. Sue Erhardt, Michigan State University – North Central Region
Mr. Thomas Hendricks*, USDA-ARS – Tifton, GA
Dr. Matt Hengel, University of California, Davis – Western Region
Dr. Gail Mahnken, University of Florida – Southern Region
Ms. Tamara Snipes*, USDA-ARS – Tifton, GA
Mr. T. Todd Wixson, USDA-ARS – Wapato, WA

Quality Assurance Unit

Ms. Tammy Barkalow*, Rutgers University - Headquarters
Dr. Martin Beran, University of California, Davis – Western Region
Dr. Zhongxiao (Michael) Chen, Michigan State University – North Central Region
Ms. Jane Forder, Rutgers University – Northeast Region
Ms. Kathleen Knight, University of Florida – Southern Region
Ms. Lisa Latham, Michigan State University – North Central Region
Dr. Johanna Mazlo*, North Carolina State University - Headquarters
Ms. Sherita Normington, University of California, Davis - Western Region
Ms. Juliet Thompson, Rutgers University – Northeast Region
Dr. Yavuz Yagiz, University of Florida - Southern Region

Additional Technical Staff

Mr. Stephen Flanagan – Assistant Regional Field Coordinator, Western Region
Ms. Megan James – Field Coordinator Assistant, Northeastern Region
Ms. Nicole Soldan – Field Program Assistant, North Central Region
Ms. Mika Pringle Tolson – Field Program Assistant, Western Region

*Partial Year

IR-4 State Liaisons Representatives

Northcentral Region

IA	Robert Hartzler
IL	Vacant
IN	Vacant
KS	Ray Cloyd (EH)
MI	Anthony VanWoerkom
MO	R. Smeda
ND	Andrew Robinson
NE	Amit Jhala

OH	Doug Doohan
SD	Sharon Clay
WI	Dan Heider (Food) & Russel Groves (EH)

Northeast Region

CT	Jatinder Aulakh
DE	Brian Kunkel
NH	Cheryl Smith
NJ	Thierry Besancon
NY	Brian Nault
MA	Robert Wick
ME	Lily Calderwood
MD	Marylee Ross
PA	Greg Krawczyk
RI	Heather Faubert
VT	Vacant
WV	Carlos Quesada

Southern Region

AR	Nilda Burgos
FL	Peter Dittmar
GA	Stanley Culpepper
KY	Ric Bessin
LA	Melanie Lewis Ivey & Raj Singh
NC	David Monks
OK	Charles Luper
PR	Wilfredo Robles-Vazquez
SC	Matt Cutulle
TN	Zack Hansen
TX	Mark Matocha
VA	Tim McCoy

Western Region

AL	Phillip Kaspari & Edgar Vinson
AZ	John Palumbo (Food) & Alex Hu (EH)
CA	Michael Horak
CO	Jane Stewart
GU	Ross Miller
HI	Julie Coughlin
ID	Rhoda Hirnyck
MT	Zachary Miller
NM	Vacant
NV	Maninder Kaur Walia
OR	Dani Lightle
UT	Corey Ransom
WA	Doug Walsh
WY	Bill Stump

Regional Field Research Scientists –Food Program

North Central Region				
Residue			Performance	
MI	S. Chaudhari, M. Hausbeck, A. Van Woerkom, B. Zandstra		MI	S. Chaudhari, M. Hausbeck, B. Zandstra
NE	J. Spotanski		ND	B. Jenks
OH	D. Doohan, L. Horst*		OH	D. Doohan
SD	G. Reicks		SD	G. Reicks
WI	S. Chapman, D. Heider		WI	S. Chapman, D. Heider

Northeast Region				
Residue			Performance	
MD	M. Ross		DE	M. VanGessel
NJ	J. Fisher, T. Freiberger		MA	H. Sandler
NY	G. Jordon		MD	M. Hu
			NJ	T. Benancon
			NY	C. Hoepting, B. Nault, S. Palmer

Southern Region				
Residue			Performance	
FL	M. Frost, M. Long, Tannenbaum, D. Thomas		FL	N. Boyd, J. Crane, P. Devkota, P. Dittmar, R. Gazis, O. Liburd, A. Monterroso, D. Odero, R. Raid, G. Vallad
GA	B. Fraelich*		GA	A Sial, A. Hajihassani
LA	D. Wright		KY	S. Carter
MS	T. Horn		LA	D. Wright
NC	R. Batts		MS	M. Shankle
PR	W. Robles Vazquez		NC	K. Jennings, R. Leon
SC	P. Wade*		OK	Z. Carpenter
TX	M. Arias, C. Marconi, T. Jones		PR	W. Robles Varquez, R. Feliciano
			TX	Z. Carpenter, H. Davis, P. Dotray, C. Marconi

Western Region				
Residue			Performance	
CO	C. Oman		AZ	B. Poudel
CA	S. Benzen*, D. Ennes, G. Kyser, N. Leach, M. Mitchell, K. Skiles, B. Turner, S. Watkins		CA	J. Adaskaveg, N. Clark, B. Hanson, C. Kron, P. Mauk, R. Smith, S. Stoddard, T. Verrinder, Z. Wang, R. Wilson
HI	J. Coughlin, J. Kam		HI	J. Coughlin,
NM	C. Hamilton		OR	D. Gent, M. Moretti, E. Peachy
OR	D. Lightle		WA	Ian Burke, D. Walsh, T. Waters
WA	D. Larson*			

Canada				
Residue			Performance	
BC	M. Clodius, D. Nield			
NS	D. Hanscomb, J. Jotcham			
ON	M. Hendricks, G. Riddle, R. Wismer			
QC	D. Cloutier, J. Smaers			

ATTACHMENT 2 – 2020 Food Use Research Projects - Residue Studies

Chemical	Crop	PR #
2,4-D	Ginseng	12605
2,4-D (amine)	Coffee	09498
Abamectin	Sugar beet	12757
Abamectin	Miracle fruit	12564
Azoxystrobin	Pomegranate	10827
Acifluorfen	Basil	12791
Bentazon + Acifluorfen	Pea (dry)	12841
Chlorantraniliprole	Rice	12790
Clofentezine	Lychee	09324
Clopyralid	Hazelnut (Filbert)	12720
Cyazofamid	Bean (dried shelled)	09533
Cyproconazole	Orange (postharvest)	12994
Cyproconazole	Lemon (postharvest)	12993
Cyproconazole	Grapefruit (postharvest)	12995
Emamectin benzoate	Bean, lima (succulent)	12675
Ethephon	Orange	12754
Flonicamid	Onion	08550
Fluazinam	Grape	12715
Fluazaindolizine	Mint	12752
Flumioxazin	Stevia	12542
Flupyradifurone	Beet greens (garden)	12666
Flutianil	Hemp	12834
Flutolanil	Garden beet	09520
Flutolanil	Carrot	12902
Flutolanil	Radish	12903
Flutolanil	Tomato	12904
Flutolanil	Pepper (bell & nonbell)	11195
Glufosinate	Sweet potato	10558
Indoxacarb	Avocado	08609
Kasugamycin	Plum	12698
Linuron	Onion (green)	12815
Linuron	Bean (edible-podded & succulent shelled	11772
Linuron	Stevia	12811
Oxytetracycline	Plum	12809
Permethrin	Dragon fruit (Pitaya)	10630
Potassium phosphite	Peanut	12705
Propiconazole	Dragon fruit (Pitaya)	12556
Pyrifluquinazon	Blueberry	12831

Pyrifluquinazon	Safflower	12750
Quizalofop	Dill	08690
S-Metolachlor/Metolachlor	Chia	12908
S-Metolachlor/Metolachlor	Greens (mustard)	12817
S-Metolachlor/Metolachlor	Gold-of-Pleasure (Camelina)	12867
Sulfoxaflor	Mango	11460
Sulfosulfuron	Tomato (processing)	12634
Uniconazole-P	Cucurbit vegetables (GH transplants)	10697
XDE-659	Garden beet	12805
XDE-659	Carrot	12845
XDE-659	Radish	12906
XDE-659	Onion	12804
XDE-659	Lettuce (GH)	12797
XDE-659	Greens (mustard)	12909
XDE-659	Broccoli	12806
XDE-659	Tomato (GH)	12792
XDE-659	Pepper (GH)	12794
XDE-659	Cucumber (GH)	12793
XDE-659	Blueberry	12807
XDE-659	Strawberry (GH)	12796
XDE-659	Herbs (GH)	12865
XDE-659	Hops	12839

ATTACHMENT 3 – 2020 Food Use Product Performance Research Program

Chemical	Crop	PR#	Comments	State university trial sites
Acetamiprid	Safflower	12032	need E/CS data to add safflower to label; supported by 2019 residue study on sunflower	CA, CA
Acetamiprid	Sunflower	12668	2019 residue study	SD, SD
Acifluorfen	Basil	12791	2020 residue study	CA, MI
Bentazon + Acifluorfen	Dry pea	12841	2020 residue study	ND, WA
Bifenazate	Blueberry	11995	2019 residue study	GA, FL
Clopyralid	Grape	12604	need E/CS data before residue	CA, CA, MI, WA, WA
Copper Hydroxide	GH basil transplants	12077	2020 H+ performance priority	MI, MI
Cyflumetofen	Melon	11787	2019 residue study	CA, AZ
Cyflumetofen	Cucumber	11786	2019 residue study	CA
Cyflumetofen	Squash	11788	2019 residue study	CA
Cyflumetofen	Pepper	11790	2019 residue study	CA, CA
Diquat	Grape	12220	2019 residue study	CA, NY, WA
Fluazinam	Grape	12715	2020 residue study	MD, MD
Fludioxonil + Pydiflumetofen; Thiophanate-methyl; Fluopicolide;Mefenoxam	Asparagus	12619 12622 12621 12618	need E/CS data only	MI, MI
Flupyradifurone	Olive	12563	2019 residue study	CA
Fluopyram	Carrot	12425	tolerance covered; need efficacy data to confirm use	CA
Glufosinate	Coffee	09493	2019 residue study	HI, HI
Glufosinate	Sesame	11148	2020 H+ performance priority	OK, TX, TX, TX, TX
Glufosinate	Sweet potato	12905	2020 H+ performance priority	CA, LA, MS, NC, NC
Linuron	Green onion	12815	2020 upgrade priority	FL, MI
Linuron	Succulent bean	11772	2020 upgrade priority	DE, FL
NMG787	Onions	12322	2018 residue study	GA
Paraquat	Sweet potato	12869	need E/CS data to add sweet potato to label; Subgroup 1C tolerance supports this crop	CA, MS, NC
Picarbutrazox	Ginseng	12606	need field data to confirm GH data	MI
Prometryn	Leek	12131	2018 residue study	CA
Propiconazole	Dragon fruit	12556	2020 residue study	FL, FL
Propiconazole	Passionfruit	12560	2019 residue study	FL, FL

Pyroxasulfone + Flumioxazin	Tomato & Pepper	12576 12577	2020 H+ performance priority	CA, DE, FL, NJ
Pyroxasulfone + Flumioxazin	Cassava	11939	2020 H+ performance priority	PR, PR
Quizalofop	*Brassica carinata*	12335	need E/CS data to add crop to label	FL, NC
Quizalofop	Dill	08690	2020 residue study	MI, NJ
S-metolachlor	Chia	12908	2020 upgrade priority	KY, OR
S-metolachlor	Gold-of-pleasure	12867	2020 upgrade priority	MT, OR, SD
Sulfentrazone	Cranberry	12296	need E/CS data to add crop to label	NJ
Sulfentrazone	Basil	12416	need E/CS data before residue	CA, NJ
Trifloxysulfuron	Strawberry	12500	2019 residue study	FL, NC
XDE-659	Onion	12804	2020 residue study	FL, MI
XDE-659	Broccoli	12806	2020 residue study	MI, NY
XDE-659	GH pepper	12794	2020 residue study	AZ
XDE-659	GH herbs	12865	2020 residue study	MI
XDE-659	Radish	12906	2020 residue study	MI
			Total	88

ATTACHMENT 4 – 2020 Submissions to EPA, Registrants, Codex, and State Departments of Agriculture

Pest Control Agent	Registrant	Type*	Date	Commodity or Crop Group	PR#
Florasulam+Fluroxypyr	DOWAGR	H	01/14/2020	Grass (seed crop)	11317
Fluxapyroxad	BASF	F	02/11/2020	Pomegranate	11754
				Vegetable, fruiting, group 8-10	12940
				Fruit, pome, group 11-10	12941
				Cottonseed subgroup 20C	12942
Pyraclostrobin	BASF	F	02/11/2020	Pomegranate	11754
Fluazinam	ISK, SYNGEN	F	02/18/2020	Individual pea commodities of proposed crop subgroups 6-18B, 6-18D and 6-18F	11231 12947 12949 12951
				Tomato subgroup 8-10A	10592
				Papaya	08274 12480
				Individual commodities of proposed crop subgroup 6-18A: edible podded beans	12946
				Individual commodities of proposed crop subgroup 6-18C: succulent shelled beans	12948
				Individual commodities of proposed crop subgroup 6-18E: dried shelled beans except soybeans	12950
				Vegetable, brassica, head and stem, group 5-16, except cabbage	12944
				Brassica, leafy greens, subgroup 4-16B	12943
				Kohlrabi	12945
Buprofezin	NAI	I	02/26/2020	Bushberry subgroup 13-07B, except lowbush blueberry, lingonberry, and gooseberry	11983
				Individual commodities of proposed crop subgroup 6-18A: edible podded beans	12952
				Vegetable, fruiting, group 8-10 (expansion of GH uses to all commodities in this crop group	09004
Propamocarb-HCl	BAYER	F	03/19/2020	Broccoli	11717
				Cabbage	11847
Methoxyfenozide	DOWAGR	I	03/30/2020	Rice	11979
				Vegetable, leafy, group 4-16	12917
				Vegetable, brassica, head and stem, group 5-16	12918
				Celtuce	12919
				Florence fennel	12920
				Kohlrabi	12921
				Leaf petiole vegetable subgroup 22B	12923
				Tropical and subtropical, palm fruit, edible peel, subgroup 23C	12924
				Tropical and subtropical, small fruit, inedible peel, subgroup 24A	12925
				Cottonseed subgroup 20C	12979
				Commodities in proposed subgroup 6-18A	12980
				Commodities in proposed subgroup 6-18B	12981

				Commodities in proposed subgroup 6-18C	12982
				Commodities in proposed subgroup 6-18D	12983
				Commodities in proposed subgroup 6-18E	12984
				Commodities in proposed subgroup 6-18F	12985
ISM-555	TBD	I	04/17/2020	Peanut	11985
				Onion	11986
Prometryn	ADAMA SYNGEN	H	04/17/2020	Pepper	12036
				Broccoli	12035
				Cabbage	12034
				Spinach	12029
Bicyclopyrone	SYNGEN	H	05/26/2020	Onion (green)	11829
Cyprodinil	SYNGEN	F	06/05/2020	Sugar apple	07119
				Vegetable, brassica, head and stem, group 5-16	12962
				Kohlrabi	12963
				Brassica, leafy greens, subgroup 4-16B, except watercress	12964
				Leaf petiole vegetable subgroup 22B	12965
				Celtuce	12966
				Florence fennel	12967
				Leafy greens subgroup 4-16A, except parsley, fresh leaves	12968
				Lemon/lime subgroup 10-10B	12969
				Tropical and subtropical, small fruit, inedible peel, subgroup 24A	12970
Fludioxonil	SYNGEN	F	06/05/2020	Sugar apple	07119
				Dragon fruit	12400
				Japanese persimmon	12900
				Cucumber (new drench use in GH)	12008
				Pepper (new drench use in GH)	12009
				Tomato (new drench use in GH)	12010
				Cottonseed subgroup 20C	12953
				Leafy greens subgroup 4-16A	12955
				Leaf petiole vegetable subgroup 22B	12954
				Celtuce	12956
				Florence fennel	12957
				Sunflower subgroup 20B	12958
				Mangosteen	12960
				Durian	12961
				Jackfruit	12974
				Tropical and subtropical, small fruit, inedible peel, subgroup 24A	12996
				Various tolerance clarifications	none
2,4-D	DOWAGR, LOVLND, NUFARM	H	06/05/2020	Sesame	12990

Quinclorac	ADAMA, ALBAGH	H	06/11/2020	Cranberry (data for EU markets)	12639
Glufosinate	BASF	H	07/14/2020	Tomato subgroup 8-10A	12021
				Pepper/eggplant subgroup 8-10B	12022
				Melon subgroup 9A	12018
				Squash/cucumber subgroup 9B	12019 12020
				Fig	11547
				Avocado	10240
				Hops	11525
				Bushberry subgroup 13-07B	13020
				Rapeseed subgroup 20A	13021
				Cottonseed subgroup 20C	13022
				Fruit, small, vine climbing, except fuzzy kiwifruit, subgroup 13-07F	13023
				Tropical and subtropical, small fruit, edible peel, subgroup 23A	13024
				Vegetable, tuberous and corm, subgroup 1C	13025
Acequinocyl	UPL NA	I	07/22/2020	Banana	10001 11267
Fluensulfone	ADAMA	N	07/22/2020	Sugar beet	10908
				Vegetable, brassica, head and stem, group 5-16	13037
				Brassica, leafy greens, subgroup 4-16B	13038
				Leafy greens subgroup 4-16A	13039
				Leaf petiole vegetable subgroup 22B	13040
				Celtuce	13042
				Florence fennel	13043
				Kohlrabi	13041
Cyflumetofen	BASF	I	07/29/2020	Hops	12334
MCPA	LOVLND, NUFARM	H	08/06/2020	Clover (revised tolerance)	11994
Oxathiapiprolin	SYNGEN	F	08/21/2020	Avocado (metabolite data)	12370
				Pomegranate (metabolite data)	12371
				Strawberry (metabolite data)	12372
Ethaboxam	VALENT	F	09/22/2020	Vegetable, brassica, head and stem, group 5-16	10680 11870
				Brassica, leafy greens, subgroup 4-16B	11877
Ethalfluralin	GOWAN, LOVLND	H	10/05/2020	Stevia	09871
				Hemp	12910
				Vegetable, tuberous and corm, subgroup 1C	13174
				Individual crops of proposed Dried shelled bean, except soybean, subgroup 6-19E	13175
				Individual crops of proposed Dried shelled pea, subgroup 6-19F	13176
Oxytetracycline	AGROSO, NUFARM	B, F	10/15/2020	Walnut	11876
				Olive	11737

Novaluron	ADAMA	I	10/21/2020	Individual crops of proposed Edible podded pea legume vegetable subgroup 6-19B and Succulent shelled pea subgroup 6-19D and Pea forage Individual crops of proposed Dried shelled pea subgroup 6-19F Individual crops of proposed Edible podded bean legume vegetable subgroup 6-19A Individual crops of proposed Dried shelled bean, except soybean, subgroup 6-19E Individual crops of proposed Succulent shelled bean subgroup 6-19C	09778 09777 13053 13055 13054
Mandestrobin	VALENT	F	11/03/2020	Lettuce (head and leaf)	11027
Sulfur Dioxide	DELTA, SNOWDEN, TEDMRK, TESSARA	F	12/23/2020	Blueberry (post-harvest) Fig (post-harvest; no tolerance proposed)	10614 12404

ATTACHMENT 5 – 2020 Tolerance Successes - Permanent Tolerances Published in the Federal Register

Pest Control Agent	Registrant	Type*	Date	Commodity or Crop Group	Note	PR#	# of Uses	# of Tolerances
Fenhexamid	ARYSTA	F	01/16/2020	Onion, bulb, subgroup 3-07A		07149	11	1
				Onion, green, subgroup 3-07B		08243	15	1
				Kiwifruit, fuzzy		09741	1	1
				Caneberry subgroup 13-07A	1	10506	1	1
				Bushberry subgroup 13-07B	1	10507	11	1
				Fruit, small, vine climbing, except fuzzy kiwifruit, subgroup 13-07F	2	10509	5	1
				Berry, low growing, subgroup 13-07G	2	10510	8	1
				Fruit, stone, group 12-12, except plum, prune	1	12504	0	1
				Leafy greens, subgroup 4-16A, except spinach	1	12505	17	1
				Vegetable, fruiting, group 8-10, except nonbell pepper	1	12506	11	1
				Arugula	4	12507	0	1
				Cress, garden	4	12508	0	1
				Cress, upland	4	12509	0	1
Acetamiprid	NISSO, UPL NA	I	02/14/2020	Tropical and subtropical, medium to large fruit, smooth, inedible peel, subgroup 24B		11326 11602 11724	42	1
				Leafy greens subgroup 4-16A	1	12485	18	1
				Leaf petiole vegetable subgroup 22B	1	12486	3	1
				Celtuce	4	12487	0	1
				Florence fennel	4	12488	0	1
				Brassica, leafy greens, subgroup 4-16B	1	12489	13	1
				Vegetable, brassica, head and stem, group 5-16	1	12490	0	1
				Kohlrabi	4	12491	0	1
				Fruit, stone, group 12-12	1	12493	11	1
				Nut, tree, group 14-12	1	12494	26	1
				Rapeseed subgroup 20A	2	12495	15	1
				Cottonseed subgroup 20C	2	12496	0	1
Chlorfenapyr	BASF	I	02/14/2020	Basil		10087	2	2
				Chive				

				Cucumber		12356	1	1
				Vegetable, fruiting, group 8-10	6	11606 12642	0	1
Cyantraniliprole	FMC	I	02/14/2020	Strawberry		10328	1	1
Prohexadione calcium	BASF FINEAMA	P	02/14/2020	Alfalfa		12024	1	2
				Corn (tolerance to support regional registration for alfalfa inter-seeded in corn grown in Pennsylvania and Wisconsin)				
Penoxsulam	DOWAGR	H	03/09/2020	Artichoke (globe)		11282	1	1
Cyazofamid	ISK	F	03/18/2020	Ginseng		11636	1	1
				Vegetable, brassica, head and stem, group 5-16	1	12651	0	5
				Brassica, leafy greens, subgroup 4-16B	1	12652	12	1
				Leafy greens subgroup 4-16A	1	12653	18	1
				Kohlrabi	4	12654	0	1
Acequinocyl	ARYSTA	I	05/15/2020	Bushberry subgroup 13-07B		11867	19	1
Isoxaben	DOWAGR	H	05/15/2020	Caneberry subgroup 13-07A		10248	5	1
				Hop		11748	1	1
Flonicamid	ISK, FMC	I	05/28/2020	Leafy greens subgroup 4-16A, except spinach	6	11705	0	1
Fenpyroximate	NAI	I	06/18/2020	Peanut		11748	1	2
				Tropical and subtropical, medium to large fruit, smooth, inedible peel subgroup 24B, except banana	3	11699	35	1
Cyflumetofen	BASF	I	07/01/2020	Cherry subgroup 12-12A		11747	5	1
				Peach subgroup 12-12B		11761	2	1
				Plum subgroup 12-12C		11762	15	1
				Tomato subgroup 8-10A		11450	11	1
				Pepper/eggplant subgroup 8-10B		11451	10	1
				Cucumber		11452	1	1
				Strawberry (data to support greenhouse uses)	6	11890	0	1
Oxathiapiprolin	SYNGEN	F	07/06/2020	Berry, low growing, subgroup 13-07G, except cranberry		11719	8	1
				Tropical and subtropical, medium to large fruit, smooth, inedible peel, subgroup 24B		10915 11603 11795	42	1
				Hop		11759	1	1

				Individual commodities of proposed Edible podded pea legume vegetable subgroup 6-18B	2	12691	5	1
				Individual commodities of proposed Succulent shelled pea subgroup 6-18D	2	12692	2	1
S-metolachlor	SYNGEN	H	07/06/2020	Dill		11325	1	3
				Rosemary		10819	1	2
Permethrin	FMC	I	07/28/2020	Fruit, small, vine climbing, except fuzzy kiwifruit, subgroup 13-07F (regional registration east of the Rocky Mountains and imported and processed grapes)		12541 01953	6	1
				Tea		10840	1	1
				Vegetable, tuberous and corm, subgroup 1C	2	12301	16	1
				Leaf petiole vegetable subgroup 22B	1	12304	3	1
				Celtuce	4	12308	0	1
				Florence fennel	4	12309	0	1
				Cherry subgroup 12-12A	2	12313	3	1
				Peach subgroup 12-12B	2	12314	0	1
				Swiss chard	2		0	1
Novaluron	ADAMA	I	08/13/2020	Sunflower subgroup 20B		11344 11596	14	1
				Brassica, leafy greens, subgroup 4-16B	1	12661	12	1
				Vegetable, brassica, head and stem, group 5-16	1	12662	0	1
				Kohlrabi	4	12663	0	1
				Vegetable, fruiting, group 8-10	6	12323	0	1
				Cottonseed subgroup 20C	2	12664	0	1
				Tropical and subtropical, small fruit, inedible peel, subgroup 24A		10956	19	1
Flupyradifurone	BAYER	I	08/21/2020	Stalk and stem vegetable subgroup 22A, except prickly pear, pads, and prickly pear, Texas, pads		11318	10	1
				Sesame seed		11725	1	1
				Sunflower subgroup 20B		11673 11674	14	1
				Coffee		11712	1	1
				Tropical and subtropical, palm fruit, edible peel, subgroup 23C		11831	9	1
				Pineapple		11711	1	1

				Grass, forage, fodder and hay, group 17 (regionally restricted to Pacific Northwest)		11755	3	1
				Vegetable, Brassica, head and stem, group 5-16	1	12724	0	1
				Kohlrabi	1	12725	0	1
				Brassica, leafy greens, subgroup 4-16B	1	12726	12	1
				Leaf petiole vegetable subgroup 22B	1	12727	2	1
				Celtuce	1	12728	0	1
				Florence fennel	1	12729	0	1
				Leafy greens subgroup 4-16A	1	12730	17	1
				Tropical and subtropical, inedible peel, cactus, subgroup 24D	2	12731	7	1
Saflufenacil	BASF	H	09/25/2020	Caneberry subgroup 13-07A		11079	5	1
				Fig		11557	1	1
				Chia		11841 12241	1	2
Afidopyropen	BASF	I	10/08/2020	Strawberry		11680	1	1
				Vegetable, fruiting, group 8-10 (addition of greenhouse uses)	6	11676 11677	0	1
Clofentezine	ADAMA	I	10/22/2020	Hops		11735	1	1
Sethoxydim	BASF	H	12/03/2020	Basil		02063 04010	1	2
2,4-D	DOWAGR, LOVLND, NUFARM	H	12/21/2020	Wheatgrass		12375	1	4
				Sesame		11807 12990	1	1
						Totals	573	107
*F=fungicide, H=herbicide, I=insecticide/acaricide, M=molluscide, N=nematicide, P=plant growth regulator								

[1] Update of established tolerance on old crop group or subgroup

[2] Conversion of established tolerance(s) on representative commodities to a crop group or subgroup tolerance

[3] Conversion of established tolerance(s) on representative commodities *and* submission of new data to complete the requirements for a crop group or subgroup

[4] Individual commodity tolerance established in response to crop group revision

[5] Response to EPA request for Codex harmonization

[6] Revised tolerance

[7] Tolerance for indirect or inadvertent residues

Time-Limited Tolerances

Pest Control Agent	Registrant	Type*	Date	Commodity or Crop Group and Expiration Date	Note	PR#	No. of Uses	No. of Tolerances
Kasugamycin	ARYSTA	B	10/08/2020	Almond (expires 12/31/2023)		11461	1	1
						Totals	1	1
*regulator=bactericide								

ATTACHMENT 6 – 2020 ENVIRONMENTAL HORTICULTURE PROGRAM RESEARCHERS

IR-4 Region	Name
Northcentral	Dr. Janna Beckerman
	Dr. Chris Currey
	Dr. Douglas Doohan
	Dr. Francesca Hand
	Dr. Mary Hausbeck
	Dr. Hannah Mathers
	Dr. Marisol Quintanilla
Northeast	Dr. Jatinder Aulakh
	Dr. Nora Catlin
	Dr. Diana Cochran
	Dr. Dan Gilrein
	Dr. Brian Kunkel
	Dr. Andy Senesac
Southern	Dr. Karla Addesso
	Dr. Fulya Baysal-Gurel
	Dr. JC Chong
	Dr. Jeffrey Derr
	Dr. Steve Frank
	Dr. Mengmeng Gu
	Dr. David Held
	Dr. Chris Marble
	Dr. Xavier Martini
	Dr. Inga Meadows

IR-4 Region	Name
Southern (cont)	Dr. Joe Neal
	Dr. Dave Norman
	Dr. Daniel Potter
	Dr. Erfan Vafaie
	Dr. Anthony Witcher
USDA-ARS	Mr. Dave Bodine
	Mr. Ben Fraelich
	Dr. Nik Grunwald
	Mr. John Harvey
	Dr. Mike Reding
	Mr. Paul Wade
Western	Dr. Ann Chase
	Dr. Gary Chastagner
	Dr. Zhiqiang Cheng
	Dr. James Klett
	Dr. Marja Kiovunen
	Dr. Marcelo Moretti
	Dr. Christian Nansen
	Dr. Ed Peachey
	Dr. Luisa Santamaria
	Dr. Steven Seefeldt
	Dr. Buzz Uber
	Dr. William Walton

ATTACHMENT 7 – 2020 Environmental Horticulture Program Research Activities

Discipline	Project	Researchers	Crops	Products	Trials
Entomology	Afidopyropen (BAS 440I) Crop Safety *	4	12	1	14
Entomology	Borer & Beetle Efficacy *	6	4	15	48
Entomology	Cyclaniliprole + Flonicamid Crop Safety *	3	10	1	17
Entomology	Cyflumetofen Crop Safety *	1	1	1	1
Entomology	Mealybug Efficacy *	3	3	9	26
Entomology	Mollusc Efficacy	1	1	3	3
Entomology	Mosquito Larvicide Bromeliad Crop Safety	1	1	1	5
Entomology	Scale Efficacy *	3	2	9	27
Entomology	SP3014 Crop Safety *	2	6	1	6
Entomology	Thrips Efficacy *	2	1	8	16
Entomology	V-10433 Crop Safety *	1	3	1	3
Pathology	Botrytis Efficacy *	6	3	10	51
Pathology	Cyflufenamid Crop Safety *	1	1	1	1
Pathology	Cylindrocladium Efficacy *	1	1	10	10
Pathology	F6123 Crop Safety *	3	11	1	26
Pathology	Fluopyram (ESP 715) Crop Safety *	4	9	1	19
Pathology	Flutianil Crop Safety *	3	5	1	5
Pathology	Fluxapyroxad + Pyraclostrobin Crop Safety *	5	6	1	10
Pathology	Fusarium Efficacy *	1	2	9	9
Pathology	IKF-309 Crop Safety *	2	9	1	9
Pathology	Mandestrobin Crop Safety *	2	6	1	6
Pathology	Mefentrifluconazole (BAS 750) Crop Safety *	4	11	1	24
Pathology	Mono and di potassium salts of phosphorus acid + hydrogen peroxide Crop Safety	1	1	1	2
Pathology	Oxathiapiprolin Crop Safety *	3	7	1	9
Pathology	Picarbutrazox Crop Safety *	6	9	2	14
Pathology	Pseudomonas chlororaphis Crop Safety *	3	4	1	4
Pathology	Pydiflumetofen + Difenoconozole Crop Safety *	1	7	1	14
Pathology	Pydiflumetofen Crop Safety *	5	10	1	21
Pathology	Rhizoctonia Efficacy *	2	1	6	12
Pathology	SP2480 Crop Safety *	3	3	1	4
Pathology	SP2700 Crop Safety *	4	4	1	6
Pathology	TDA01 Crop Safety *	2	2	1	2
Pathology	Thielaviopsis Efficacy *	2	1	9	18
Weed Science	Bentazon Crop Safety *	8	19	1	30
Weed Science	Dimethenamid-p Crop Safety *	4	5	1	6
Weed Science	Dithiopyr Crop Safety *	2	6	1	6
Weed Science	Flumioxazin + Pyroxasulfone Crop Safety *	3	4	1	5
Weed Science	General Weed Efficacy *	2	1	4	24
Weed Science	Indaziflam Crop Safety *	6	8	1	13
Weed Science	Iron HEDTA Crop Safety *	10	33	1	46
Weed Science	Isoxaben + Dithiopyr Crop Safety *	8	13	1	27
Weed Science	Isoxaben Crop Safety *	1	1	1	1
Weed Science	Liverwort Efficacy	1	1	8	8
Weed Science	Oxadiazon Crop Safety *	2	3	1	4
Weed Science	Oxalis Efficacy *	1	1	4	4
Weed Science	Oxyfluorfen + Prodiamine Crop Safety *	4	7	1	7
Weed Science	Pendimethalin + Dimethenamid-p Crop Safety *	2	2	1	3

Weed Science	Pendimethalin Crop Safety *	4	9	1	13
Weed Science	Prodiamine + Isoxaben Crop Safety *	2	4	1	4
Weed Science	SP1770/SP1772 Crop Safety *	2	8	1	9
Weed Science	Spurge Efficacy *	1	1	4	4
Weed Science	Sulfentrazone Crop Safety *	2	3	1	3

* National Priority Projects

For a detailed list of research activities visit https://www.ir4project.org/ehc/ .

ATTACHMENT 8 – Environmental Horticulture Research Summaries for 2020

Borers, Beetles, and White Grub Efficacy
Collectively, managing coleopteran insects can be challenging because the adult and larval stages may both cause damage and sometimes occur on different hosts or on different plant parts. While organophosphates, pyrethroids, and neonicotinoids can provide good to excellent control of coleopteran insects, not all products work equally well in all situations. Treatments for borers are very different than treatments targeting white grubs. Developing newer classes of chemistry are important to reduce the environmental consequences and to minimize the development of resistance. Starting with the 2004 Annual Workshop, screening a number of products to manage coleopteran insects became one of the high priority projects for entomology. From 2005 through 2019, 78 products representing 53 different active ingredients were tested for management of adult and larval stages of coleopteran insects. In addition, 10 products representing 10 active ingredients were evaluated for lepidopteran clearwing borers in 2008 and 2009. These products represented both biological and chemical tools. Some products were already registered but more data were needed, or they were considered standards to measure the level of efficacy achieved with other materials. Other products were in development but have not yet been registered with the EPA. While a number of coleopteran and lepidopteran species were tested, only enough experiments were able to be completed on the coleopteran species black vine weevil, Japanese beetle, oriental beetle, Sri Lankan weevil, and viburnum leaf beetles to recommend actions to register or amend labels for these pests.

Bentazaon Crop Safety
Basagran T/O has been registered for several years as a directed application and as an over-the-top application on limited plant species. However, growers have expressed the need to have additional plants added for over-the-top applications. Data collected throughout the history of the IR-4 Environmental Horticulture Program are presented here to support specific Basagran T/O applications over the top of certain ornamental horticulture plants. The rates chosen for this research were 1.0, 2.0 and 4.0 pounds active ingredient per acre (lb ai per A) as the 1X, 2X and 4X rates. In addition, early studies compared single versus two consecutive applications of 1.0 lb ai per A or 2.0 lb ai per A followed with 1 lb ai per A. Throughout the years, 90 different crop species/genera were examined for over-the-top applications. Of these, 22 exhibited no or minimal transient injury after application at all three rates. Twenty-six crops require further research because of unclear results. Thirteen crops exhibited no phytotoxicity at 1.0 lb ai per acre but did have some injury at the higher rates or with repeat applications. Thirty species exhibited phytotoxicity at even the 1.0 lb ai per acre rate.

Bittercress Efficacy
Nursery growers have had a longstanding battle to control weeds in environmental horticulture crops. Bittercress (*Cardamine spp.*) is one of the most difficult weeds to control in container grown ornamentals. It grows aggressively in containers and can outcompete ornamental crops for water, nutrients, and light. Several chemical tools are available for preemergent control. However, there remains a need for effective control of emerged weed seedlings. At the 2007 Environmental Horticulture Workshop, IR-4 initiated a study to determine whether preemergent herbicides could provide efficacy for bittercress, and other weeds, up to the 2-4 leaf stage. Research was conducted from 2008 through 2019. This report is a brief summary of available data from 18 experiments received through the IR-4 Environmental Horticulture Program. Early postemergence applications of Casoron, Certainty, Gallery, Marengo/Indaziflam, and V-10142 provided significant control of emerged bittercress. These findings benefit growers by identifying select preemergence herbicides which control specific weeds at early emergence stages in container grown ornamental horticulture crops.

Botrytis Efficacy
At the IR-4 Environmental Horticulture Program Workshop in 2011, Botrytis Efficacy was selected as a high priority project to expand the knowledge and list of fungicides available to growers for these diseases. In addition to research collected through the IR-4 Program, this summary includes a review of experiments conducted from 1998 to 2019 on environmental horticulture crops. During this time period, numerous products representing 54 active ingredients were tested as foliar applications against several *Botrytis* species causing blight and gray mold on multiple environmental horticulture crops. Most products are now registered and commercially used. Almost all trials were conducted on *Botrytis cinerea*; other species tested were *B. elliptica*, *B. paeoniae* and *B. tulipae.* Although there were insufficient IR-4 data for definitive conclusions, seven relatively new products that are included in this research project, Orkestra Intrinsic, Mural and Emblem (NUP 09092), Rhapsody/Serenade, Astun/IKF 5411, Picatina, and Picatina Flora looked effective, while Botector, BW165N, Proud 3, SP2480, SP2770 and SP2773 looked ineffective. Data on other relatively new products (Broadform, EcoSwing, F9110, MBI-110, Oxiphos, PreStop, Prophytex, Regalia, S2200, Torque, Tourney, Trinity) were limited to provide some conclusions. Of the established registered products, Compass, Daconil, Decree, Heritage, Insignia, Pageant and Palladium generally provided excellent efficacy; Chipco 26019 and Veranda O provided good efficacy and Disarm provided mediocre efficacy. ZeroTol, and the copper products (Badge X2, Camelot, Phyton 27, STBX-304) generally performed poorly under the conditions of these experiments.

Cyclaniliprole + Flonicamid Crop Safety
Pradia (cyclaniliprole + flonicamid) is a new insecticide combination recently registered for environmental horticultural crops for the control of a wide variety of insects including aphids, leafminers, scales and mealybugs, foliage feeding beetles and caterpillars, thrips, and whiteflies. In 2019, the IR-4 Project completed 16 crop safety trials on 9 ornamental plant genera or species. In these trials, 2 exhibited minimal or no injury after foliar applications. For the remaining 7 crops, sufficient information has not yet been generated. However, all tested crops are not sensitive to foliar applications up to 4X the proposed high label rate.

Dimethenamid-p Crop Safety
From 2007 to 2019, IR-4 completed 549 trials on Tower EC (dimethenamid-p). The data contained in this report was generated to register uses of dimethenamid-p on and around environmental horticulture plants with over-the-top applications. The dimethenamid-p rates in the testing program were 0.97, 1.94 and 3.88 pounds active ingredient per acre (lb ai per A) as the 1X, 2X and 4X rates. Tower EC had been applied to 154 plant genera or species. Of these, 65 plant species exhibited no or minimal transient injury after application at all three rates. Twenty-four (24) crops exhibited no phytotoxicity at 0.97 lb ai per acre but did have some injury at 1.94 and 3.88 lb ai per acre. Ten crops – *Aquilegia sp., Catharanthus roseus, Cladrastis sp.*, *Echeveria sp.*, *Echinacea sp.*, *Epilobium canum, Muhlenbergia dubia, Rudbeckia hirta, Teucrium chamaedrys* and *Viburnum opulus* – exhibited significant phytotoxicity at even the lowest rate.

F6123 Crop Safety
F6123 is a new fungicide being developed by FMC for the control of powdery mildew, rusts, scab, black spot (*Diplocarpon rosae*), and other foliar diseases. The IR-4 Project completed 25 crop safety trials on 13 environmental horticulture plant species or genera during 2019 to 2020. At this time, sufficient information has not yet been generated for reliable conclusions on F6123 crop safety. In these limited number of trials, F6123 applied foliar caused minimal or no injury in 12 species or genera; however, drench application caused significant injury in 8 species or genera.

Fenamidone Efficacy/Crop Safety
From 2004 to 2012, fenamidone (FenStop, FenStar) was screened through the IR-4 Program as drench or foliar applications for effacay against nine *Phytophthora* species causing root rots and stem/leaf blights (*P. cactorum*, *P. cinnamomi*, *P. citricola*, *P. cryptogea*, *P. drechsleri*, *P. nicotianae*/*parasitica, P.*

ramorum, *P. syringae,* and *P. tropicalis*), five Pythium species (*P. aphanadermatum*, *P. dissotocum*, *P. irregulare*, *P. ultimum*, and *P. vipa*), and two downy mildews (coleus, snapdragon). Efficacy ranged from highly effect to similar to nontreated inoculated controls depending on pathogen, host, and level of disease pressure. Based on findings it is recommended the following specific diseases be added to fenamidone labels: Coleus downy mildew, *Phytophthora cryptogea, Phytophthora nicotianae, Phytophthora ramorum, Phytophthora cinnamomi, Pythium aphanadermatum, Pythium mamillatum, Pythium ultimum,* and Snapdragon downy mildew. Currently, the FenStop/FenStar label is limited to greenhouse use. It is recommended this be expanded to include outdoor use patterns.

Fluopyram Crop Safety
Indemnify (fluopyram) is a new fungicide being developed by Bayer for the control of nematodes; the current product is only registered for turf uses. The IR-4 Project has completed 37 crop safety trials on 18 environmental horticulture plant species or genera. Two crops (begonia, petunia) exhibited differential responses between foliar and drench applications with no to slight injury observed with foliar sprays, but moderate to severe injury with soil drenches. Four additional crops also did not exhibit injury after foliar or soil applications. Additional data are needed for 12 other crops (including foliar application on petunia) are needed for a definitive conclusion on crop safety.

Fusarium Efficacy
From 2001 to 2019, numerous products representing 40 active ingredients were evaluated in greenhouse and field trials as soil drench, soil incorporation, foliar,in-furrow, drip irrigation or tuber soak applications against several *Fusarium* species causing rots (crown, stem and tuber rots) and wilt on ornamentals, and wilt and root rot on vegetables. *Fusarium* species tested included: *F. avenaceum, F. commune, F. oxysporum, F. solani* and *F*. sp. Most trials were conducted on *F. oxysporum* on larkspur, liriope, lisianthus and watermelon. Although there were insufficient data for definitive conclusions, several relatively new products showed promising, though inconsistent, efficacy comparable to the standards. These include Picatina/Adepidyn/Miravis (pydiflumetofen), Heritage (azoxystrobin), Compass (trifloxystrobin), Hurricane (fludioxonil+mefenoxam), Insignia (pyraclostrobin), Insimmo (acibenzolar), Postiva/Miravis Duo (pydiflumetofen + difenoconazole), SP2169, Tourney (metconazole) and Trinity (triticonazole). Astun, Broadform, BW240/RootShield Plus (*Trichoderma harzianum & T. virens*), CG100 (caprylic acid), Mural, Orkestra, Pageant (boscalid+pyraclostrobin), Palladium (cyprodinil+fludioxonil) and SP2550 provided no to mediocre efficacy. Proline (prothioconazole) provided consistently good control of *F. oxysporum* in watermelon trials. The established standards 3336, Medallion and Terraguard generally provided inconsistent efficacy.

Halosulfuron Crop Safety
Since 1995, IR-4 has completed 391 trials with products containing halosulfuron (Sedgehammer, Manage) on 137 crops. The data contained in this report were generated to expand the current SedgeHammer label to include both directed and over the top applications on certain plant species along with adding nursery production sites. The halosulfuron rates in the 2006 and 2007 testing program were 0.045, 0.09 and 0.18 pounds active ingredient per acre (lb ai per A) as the 1X, 2X and 4X rates. In 2008, 2009, 2010 and 2011, halosulfuron rates were 0.031, 0.063, and 0.125 lb ai per acre; the lowest registered rate is 0.031 lb ai per acre.

Of the 137 in-ground or container grown plant genera or species examined, 36 crops exhibited no or minimal transient injury after application at all three rates. Eleven crops exhibited no phytotoxicity at 0.045 lb ai per acre but did have some injury at the higher rates. Twenty-four crops exhibited phytotoxicity at even the lowest rate.

Indaziflam Crop Safety
From 2011 through 2019, IR-4 has completed 141 trials evaluating two granular and one liquid formulations of indaziflam for crop safety. The data contained in this report was generated to register the use of indaziflam on and around environmental horticulture plants with over-the-top applications. The rates tested were 0.045, 0.089 and 0.178 pounds active ingredient per acre (lb ai per A) as the 1X, 2X and 4X rates. The indaziflam 0.03%G formulation was applied to 17 plant genera or species, the Marengo G formulation applied to 34 crops, and the Marengo 74SC liquid formulation applied to 17 genera or species. Of these crops, 8 exhibited no or minimal transient injury after application at all three rates including *Aucuba japonica, Berberis sp.*, *Liriope sp.*, *Ophiopogon japonicus*, *Rhododendron sp., Rosa sp*., *Taxus media* and certain *Viburnum* species. The remaining crops evaluated have only been screened in 1 or two trials or exhibited minimal to significant injury. Further testing is required on many species before a conclusion can be made confirming crop safety.

Iron HEDTA Crop Safety
Fiesta (Iron HEDTA) is a new herbicide currently labeled for post emergence broadleaf weed control on lawns (use on rights of way or non-crop areas), turf, golf courses, parks, playgrounds, cemeteries and athletic fields. Neudorff is interested in adding environmental horticulture crops to the Fiesta label. The IR-4 Project completed 146 crop safety trials on 83 environmental horticulture plant species / genera during 2016 to 2019. In these trials, 7 plant species / genera (*Buxus* sp*., Calamagrostis acutiflora, Carex cherokeensis, Festuca glauca*, *Juniperus* spp., *Muhlenbergia capillaris* and *Taxus x media*) exhibited no or minimal transient injury after application to either dormant or actively growing plants at all 3 rates in at least 3 trials. Six species / genera (*Cotoneaster apiculatus, Heuchera* spp*., Hibiscus* sp., *Lagerstroemia indica, Ophiopogon* sp. and *Teucrium chamaedrys*), where Fiesta was applied to actively growing plants, exhibited no phytotoxicity at 1X but did have some injury at 2X and 4X rates. Twenty species / genera exhibited significant phytotoxicity at even the lowest rate; in ten of these crops, Fiesta was applied to dormant plants.

Isoxaben Crop Safety
Gallery 75DF (isoxaben) was initially registered in 1992 for ornamental horticulture uses. This initial label contained an extensive list of ornamental horticulture crops where Gallery could be used without causing phytotoxicity. It also included a short list of crops where Gallery applications were not recommended. Between 1992 and 2013, IR-4 examined 98 crop species / genera to expand this label to other crops, including several different fern species grown in field containers. Of these, 24 crop species exhibited no or minimal transient injury with 20 already placed on the Gallery label. Eight crops exhibited injury in this research: *Astilbe sp.*, *Athyrium filix-femina, Buddleia davidii, Dendranthema x morifolium*, *Digitalis purpurea*, *Echinacea purpurea, Stachys byzantine*, and *Thymus sp*. A new formulation, Gallery SC, was tested between 2014 and 2019 to determine crop safety on 35 species / genera in 74 trials. Of these, two species, *Chasmanthium latifolium, Juncus effusus, Leymus arenarius, Sorghastrum nutans, Sporobolus heterolepis,* and *Stipa sp.* exhibited no or minimal transient injury; *C. latifolium* is already in the Gallery SC label.

Mono and di potassium salts of phosphorous acid + Hydrogen peroxice Crop Safety
OxiPhos (Mono and di potassium salts of phosphorus acid + hydrogen peroxide) is labeled for managing oomycetes (downy mildew, Phytophthora and Pythium pathogens) and diseases caused by certain bacterial pathogens. While the label does list specific crops, additional screenings were needed to broaden this list. The IR-4 Project completed 23 crop safety trials on 11 environmental horticulture plant species or genera during 2016 to 2019. No injury was observed on azalea and rose; these two crops can be added to the list of crops previously tested for crop safety. For the remaining nine crops, more information is needed either because only 1 or 2 trials were conducted or because consistent results were not achieved across research sites.

Oxalis Efficacy
Nursery growers have had a longstanding battle to control weeds in environmental horticulture crops. Oxalis (*Oxalis* spp.) is one of the most difficult weeds to control in container grown ornamentals. It grows aggressively in containers and can outcompete ornamental crops for water, nutrients, and light. Several chemical tools are available for preemergent control. However, there remains a need for effective control of emerged weed seedlings. At the 2007 Environmental Horticulture Workshop, IR-4 initiated a study to determine whether preemergent herbicides could provide efficacy for oxalis, and other weeds, up to the 2-4 leaf stage. Research was conducted from 2008 through 2019. This report is a brief summary of available data from 27 experiments received through the IR-4 Environmental Horticulture Program. Early postemergence applications of Casoron, Certainty, Dismiss, Gallery, Marengo/Indaziflam, SureGuard, Tower and V-10142 provided significant impact on emerged oxalis (*Oxalis* spp.). These findings benefit growers by identifying select preemergence herbicides which control specific weeds at early emergence stages in container grown ornamental horticulture crops.

Prodiamine Crop Safety
Prodiamine has been registered in the United States for many years for uses in and around ornamental plants in production nurseries and in landscapes. There have been several label amendments expanding the list of ornamental plants where prodiamine formulations can be used. Since 1977, the IR-4 Project has conducted over 568 trials using granular, wettable powder, wettable dry granular and emulsifiable concentrate formulations. The marketplace contains multiple brands of prodiamine with similar formulations. This report is written to support amending any prodiamine label, so prodiamine will be used throughout instead of trade names with the exception of the specific products and formulations tested as referred to in Tables 4 and 5. One hundred thirty-two plant species or genera exhibited no or minimal, transitory phytotoxicity to applications of WDG, WP and EC formulations. Of these, 64 species or genera are not currently on prodiamine WDG labels. It is recommended that 36 of these be placed on these labels along with moving 12 species from the portion of the label excluding use in CA to the portion of the label including use in CA. With additional data demonstrating no or minimal transient phytotoxicity, it is recommended the remaining 25 species also be added. Twenty-three species or genera exhibited no phytotoxicity at a 1X rate of the WDG, WP or EC formulations, but at higher rates there was some damage. Since some of the data was generated with EC and wettable powder formulations along with wettable dry granular formulations, it is recommended additional research be conducted on these species. Only 8 species (*Ajuga sp., Carex pennsilvanica, Ilex x meserveae, Limonium sp., Petunia x hybrida, Sedum spurium, Viola tricolor,* and *Zinnia sp.*) demonstrated significant phytotoxicity even at a low label rate. Sixty plant species or genera exhibited no or minimal transitory phytotoxicity to applications of prodiamine G formulations. Of these 11 are not currently listed on prodiamine G labels. It is recommended that these be placed on the labels. Only 2 crops (*Cortaderia* and *Leucanthemum maximum*) exhibited significant damage after prodiamine G applications.

Pydiflumetofen Crop Safety
Pydiflumetofen is a new fungicide being developed by Syngenta for the control of leaf spots (*Septoria, Cercospora, Alternaria, Venturia*), powdery mildew, *Fusarium, Botrytis, Sclerotinia, Corynespora,* and other foliar diseases. The IR-4 Project completed 61 crop safety trials on 22 ornamental horticulture plant species or genera during 2015 to 2019. In these trials, all 22 species or genera exhibited minimal or no injury. Ten genera exhibited minimal or no injury in 3 trials and 12 species or genera exhibited minimal or no injury in the limited number of trials (one or two) for each crop. Syngenta may consider adding these to the label.

Picarbutrazox Crop Safety
Picarbutrazox is a novel fungicide with a new mode of action being developed by Nisso America for the control of oomycete diseases such as *Bremia, Peronospora, Pseudoperonospora, Phytophthora* and *Pythium.* The IR-4 Project completed 27 crop safety trials on 12 environmental horticulture plant species

or genera during 2018. In these trials, all 12 species or genera exhibited no or minimal injury. Three species or genera (*Impatiens hawkeri, Impatiens walleriana* and *Rosa* sp.) exhibited no injury in 3 trials, and 9 species or genera exhibited no or minimal injury in the limited number of trials (one or two) for each crop. Nisso America may consider including these to a future label.

Rhizoctonia Efficacy

From 1999 to 2019, numerous products representing 48 active ingredients were evaluated in several greenhouse experiments as soil drench, soil incorporation, foliar or soak application, and in 2 field trials as soil drench, against *Rhizoctonia solani*. Trials were conducted on begonia, chrysanthemum, garden impatiens, petunia, poinsettia, snapdragon, viburnum and zinnia. The relatively new registered products Affirm/Endorse/Veranda O (polyoxin D), Empress Intrinsic (pyraclostrobin), Heritage (azoxystrobin), Medallion (fludioxonil), Mural (azoxystrobin + benzovindiflupyr) and Pageant Intrinsic (p*yraclostrobin + boscalid)* showed excellent efficacy. Although there were insufficient data for definitive conclusions, BAS 703/Orkestra, BAS 750, Broadform, Compass, Disarm, Hurricane, Picatina, Promax, Prostar, Tourney and Trinity generally provided good to excellent efficacy, while Astun, SP2700, and ZeroTol generally provided poor to mediocre efficacy. The biological products Actinovate, Howler, IT-5103, MBI-110/Stargus, MBI-601, Pvent, RootShield PLUS and SoilGard also provided mediocre to excellent efficacy in limited number of tests. Of the established standards, Terraclor generally provided good efficacy, while 3336 generally provided inconsistent efficacy.

Scale & Mealybug Efficacy

Managing scale and mealybug insects presents unique challenges. Products with contact modes of action must be applied at specific timings in order to reach the most susceptible crawler stages. Products with systemic modes of action may work well for certain species and not others based on application timing and whether the insect feeds within phloem or xylem. In 2003, IR-4 initiated a high priority project to determine efficacy of several insecticides on several scale and mealybug species so data can be obtained to add appropriate species to existing registrations. This research was conducted between 2004 and 2020.This report is a brief summary of available data from 94 experiments received through the IR-4 Environmental Horticulture Program.

Several neonicotinoids (Aloft SC/Celero 16WSG, Flagship 0.22G/25WP, Safari 2G/20SG/Transtect 70WSP, and TriStar 30SG/70WSP), insect growth regulators (Distance and Talus 40SC/70DF), and other products were tested against scales and mealybugs. All products tested generally provided excellent control of elongate hemlock scale, cryptomeria scale, gloomy scale, citrus mealybug and Mexican mealybug, generally mediocre to excellent control of false oleander scale, Fletcher scale, Florida wax scale, magnolia scale, and poor control of armored scale. For other species, efficacy levels varied with the active ingredient and method/timing of application. In single trials, Altus, Talus and Ventigra provided good efficacy on cycad scale, while Altus, Pradia, Sarisa and Talus provided good efficacy on lobate lac scale.

All products tested on citrus mealybug and Mexican mealybug, including Aria, Flagship, Safari, Talus, and TriStar, generally provided good to excellent control of these species. An experiment on Madeira mealybug showed excellent control when TriStar was mixed with Capsil surfactant, and poor control without Capsil. Rycar, Safari and Talus provided good to excellent control of this species, while A16901B provided mediocre control when applied as drench but good when applied as foliar treatment. Pradia and Ventigra also provided excellent control of Madeira mealybug. Phormium mealybug control was good to excellent with all neonicotinoids tested – Flagship, Safari and TriStar. Good to excellent control of Rhizoecus root mealybug was obtained with A16901B, Aria, Kontos, MBI-203, MBI-205 and Safari in single experiments. ISM555 provided good control of crapemyrtle bark scale and Madeira mealybug, while SP3014 provided good control of Madeira mealybug, in single trials.

Seven recently registered products (Altus, Mainspring, Pradia, Rycar, Sarisa, Ventigra and XXpire) looked promising on several species based on their efficacy relative to standards. Further research is needed to obtain additional efficacy data to recommend actions to register or amend labels for these pests.

Spurge Efficacy

Nursery growers have had a longstanding battle to control weeds in environmental horticulture crops. Spurge (*Chamaesyce maculata*), is one of the most difficult weeds to control in container grown ornamentals. It grows aggressively in containers and can outcompete ornamental crops for water, nutrients, and light. Several chemical tools are available for preemergent control. However, there remains a need for effective control of emerged weed seedlings. At the 2007 Environmental Horticulture Workshop, IR-4 initiated a study to determine whether preemergent herbicides could provide efficacy for spurge, and other weeds, up to the 2-4 leaf stage. Research was conducted from 2008 through 2019. This report is a brief summary of available data from 18 experiments received through the IR-4 Environmental Horticulture Program. Early postemergence applications of Casoron, Certainty, Gallery, Marengo/Indaziflam, Pendulum, SP 1770, Tower and V-10142 provided significant control of emerged spurge. These findings benefit growers by identifying select preemergence herbicides which control specific weeds at early emergence stages in container grown ornamental horticulture crops.

Sulfentrazone Crop Safety

Since 1996 IR-4 has completed 259 trials with products containing sulfentrazone (Sulfentrazone 0.2G and Dismiss 4F) on 111 crops. The data contained in this report was generated to register uses of sulfentrazone on and around environmental horticulture plants with over-the-top applications. The sulfentrazone rates in the testing programs were 0.125, 0.25 and 0.5 pounds active ingredient per acre (lb ai per A) as the 1X, 2X and 4X rates. Sulfentrazone 0.2G had been applied to 54 plant genera or species. Of these, 12 exhibited no or minimal transient injury after application at all three rates. One crop exhibited no phytotoxicity at 0.125 and 0.25 lb ai per acre but did have some injury at 0.5 lb ai per acre. Only 3 crops (*Canna sp.*, *Echinacea purpurea*, and *Hosta sp.*) exhibited phytotoxicity at even the lowest rate. Dismiss 4F has been applied to 65 crops since 1996. Of these only 6 (*Buxus sp., Ilex vomitoria 'nana', Juniperus horizontalis, Rosa sp., Taxus sp.*, and *Thuja sp.*) exhibited no damage with over-the-top applications at all tested rates. Seven crops had minimal, transitory damage at the lower rates but some phytotoxicity at the 4X rate and 15 crops exhibited damage at all tested rates.

Thielaviopsis Efficacy

From 2003 to 2018, numerous products representing 31 active ingredients were evaluated in greenhouse trials as soil drench against *Thielaviopsis basicola* causing black root rot on ornamentals. Although there were insufficient data for definitive conclusions, two new experimentals (BAS 750 - mefentrifluconazole) and A20808C showed promising efficacy comparable to the standards. Several products that are not yet labeled for *Thielaviopsis basicola* also showed promising efficacy in single trials. These include Empress Intrinsic (pyraclostrobin), Endorse/Veranda O (polyoxin D), *Mural (a*zoxystrobin + benzovindiflupyr), Picatina Flora (Pydiflumetofen + fludioxonil*),* Stargus (*Bacillus amyloliquefaciens* strain F727*).* Tourney (metconazole) and Vital (potassium phosphite). The established standards 3336 and Terraguard generally provided excellent efficacy.

Thrips Efficacy

For the last 14 years, the IR-4 Environmental Horticulture Workshop has ranked developing efficacy data on new products to manage thrips as a High Priority Project either nationally or regionally. Thrips remain an important threat for several reasons: 1) the damage thrips cause to environmental horticulture plants, decreasing the value of the infested crops; 2) the tospoviruses (tomato spotted wilt, impatiens necrotic ringspot) they can vector; 3) the newly arrived invasive species which impact at least 250 different environmental horticulture species; and 4) growers lack the ability to rotate among 3 to 4 different modes of actions to effectively manage resistance development in the thrips populations they must control to

maintain economic viability. From 2005 through 2019, 89 products representing 59 different active ingredients were tested for thrips management. These products represented both biological and chemical tools. Some products were already registered, but more data were needed particularly with the newly invasive thrips species or they were considered standards to measure the level of efficacy achieved with other materials. Other products were in development but have not yet been registered with the EPA. The five thrips species tested in the IR-4 program were Chilli Thrips (*Scirtothrips dorsalis*), Gladiolus Thrips (*Thrips simplex*), Privet Thrips (*Dendothrips ornatus*), Weeping Fig Thrips (*Gynaikothrips uzeli*), and Western Flower Thrips (*Frankliniella occidentalis*).

Contact the IR-4 Project

IR-4 Project Headquarters Locations:

NC State University
1730 Varsity Drive, Venture IV
Suite 210
Raleigh, NC 27606

Rutgers University
500 College Road East
Suite 201 W
Princeton, NJ 08540

IR-4 Project Leadership

Executive Director
Dr. Jerry Baron
(908) 627-4213
jjbaron@ncsu.edu

Acting National Director
Dr. Debbie Carpenter
(732) 932-9575 ext. 4637
dcarpent@njaes.rutgers.edu

Assistant Director for Research Planning and Product Performance
Dr. Venkat Pedibhotla
vkpedibh@ncsu.edu

Manager, National Quality Assurance Unit
Dr. Johanna Mazlo
jmazlo@ncsu.edu

Manager, Biopesticide and Organic Support Program
Dr. Michael Braverman
(732) 932-9575 ext. 4610
mbrave@njaes.rutgers.edu

Manager, Environmental Horticulture Program
Dr. Cristi Palmer
(732) 932-9575 ext. 4629
clpalmer@njaes.rutgers.edu

IR-4 Regional Contacts

North Central Region
Dr. Anthony VanWoerkom
Regional Field Coordinator
Michigan State University
3815 Technology Boulevard
Lansing, MI 48910-8396
(517) 336-4611 (MSU)
(269) 561-5040 (Trevor)
(517) 432-2098 (Fax)
vanwoer3@anr.msu.edu

Northeast Region
Marylee Ross
Regional Field Coordinator
University of Maryland Eastern Shore
27664 Nanticoke Road
Salisbury, MD 21801
(410) 742-8788 ext. 310
(410) 742-1922 (Fax)
mross@umd.edu

Southern Region
Dr. Janine Spies
Regional Field Coordinator
University of Florida
P.O. Box 110720
1642 SW 23rd Dr. Bldg 685
Gainesville, FL 32611-0720
(352) 294-3991
jrazze@ufl.edu

Regional Contacts continued

Western Region
Dr. Michael Horak
Regional Field Coordinator
University of California Davis
One Shields Avenue
Meyer Hall Room 4218
Davis, CA 95616
(530) 752-7634
mjhorak@ucdavis.edu

USDA-ARS
Dr. Alvin Simmons
Regional Field Coordinator
U.S. Vegetable Laboratory
2700 Savannah Highway
Charleston, SC 29414
Phone: (843) 402-5307
alvin.simmons@ars.usda.gov

Connect with us:

www.ir4project.org

ir-4_project@ncsu.edu

This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2020-34383-32455 with substantial cooperation and support from the State Agricultural Experiment Stations, USDA-ARS, USDA-APHIS, and USDA-FAS. In accordance with Federal Law and U.S. Department of Agriculture policy, this institution is prohibited from discriminating on the basis of race, color, national origin, sex, age or disability.