1963-2023

60 YEARS IR-4

2023 ANNUAL REPORT

Pest management solutions for specialty crops and specialty uses

ANNUAL REPORT OF THE IR-4 PROJECT
January 1, 2023 - December 31, 2023

1. Introduction

The IR-4 Project's mission is to support the registration of safe and effective chemical and bio-based pesticides (and emerging pest management technologies) on fruits, vegetables, nuts, herbs, trees, shrubs, flowers and other specialty crops, as well as minor uses on major crops (corn, cotton, soybeans, wheat, etc.). IR-4 exists because specialty crops and minor uses often lack the economic return on investment needed for the private sector to justify spending research and development resources on these registrations. The IR-4 Project fills such voids by developing the necessary data and cooperating with many government and non-government organizations to accomplish its mission and leverage its resources (see Attachment 1: Participants in the Process). IR-4's research projects/activities include:

- Conducting U.S. Environmental Protection Agency (EPA) guideline "Magnitude of the Residue Studies." This gives EPA a realistic exposure estimate that they use to perform dietary risk assessments associated with potential product registrations.
- Product performance testing (efficacy/crop safety projects) on food and non-food specialty crops. This provides assurances that the use of a crop protection product is safe and effective.
- Submission of proposals to EPA and other regulatory authorities to expand crop groups/subgroups that allow data from a few crops to cover many crops.
- Performing Integrated Solutions research projects, which utilize all available crop protection tools (chemical pesticides, biopesticides and emerging technologies) in order to identify 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 projects also address management of pests in organic crop production systems.
- Assisting with the registration of biopesticide and other emerging technologies discovered/developed by public sector scientists and small businesses.
- Facilitating harmonization of global pesticide regulations to assist domestic specialty crop growers' ability to export fruits, vegetables and other specialty crops to international markets.

2. Successes in 2023 (plus a correction for the 2021 Annual Report)

Food Program: EPA publication of actions that established **211** new tolerances for **18** active ingredients. These tolerances support **1613** potential new uses on food crops (Attachment 2). This is the highest number of new uses achieved in a calendar year.

NOTE: In May 2023 an error in the monthly report from December 2021 was discovered—tolerance actions for Bifenthrin and Cyflumetofen were inadvertently omitted. This correction adds 104 new uses and 13 new tolerances to the annual totals for 2021; thus, in 2021 EPA published 16 actions that established 128 new tolerances for 15 active ingredients, supporting 744 potential new uses on food crops.

Environmental Horticulture Program: BotryStop was registered in California, contributing to **500** new crop uses.

3. Registration Support Actions in 2023

Food Program

- IR-4 submitted to EPA **12** tolerance petitions and **2** Final Reports to the registrant for Label Expansion or Conditional Registration - these covered **92** unique requests (PR #s) for assistance and crop group tolerance updates (Attachment 3)
- **23** data packages were completed but not submitted
- **15** draft final reports were submitted to IR-4's Quality Assurance Unit for Good Laboratory Practice compliance auditing and were not finalized in 2023
- **134** Product Performance Reports and **47** Integrated Solutions Reports were posted and provided to cooperating companies
- Biopesticide registration actions and activities included:
    - **2** registrations involving **4** new active ingredients including AF36 Prime (an organic formulation of *Aspergillus flavus* AF36) and FourSure (combination of 4 atoxigenic *Aspergillus flavus* strains)
    - Responses to EPA regulatory reviews - American Chestnut distribution plans
    - Alum - resubmission of Biochemical Classification
    - **4** pre-submission meetings were held with EPA in conjunction with T3 Biosciences (*Pseudomonas soli*), Sporekill (Potassium salts of Fatty Acids) Silvec (CTV-SoD) and Lepidext (*Helicoverpa zea* nudivirus 2, HzNV2)
    - Submitted avian oral waiver for the Nudivirus of *Helicoverpa zea*
    - Participated in meeting, provided oral and written comments to support the beekeeping industry's position to maintain the jurisdiction of varroacides in EPA versus a potential shift to FDA jurisdiction
- International activities:
    - Provided technical leadership in International Priority Setting Workshops, project planning and implementation for the Minor Use Foundation
    - Conducted capacity building on biopesticide regulations and Good Laboratory Practices
    - Developed workflow plans and assisted in the structure of a new international database
    - Provided technical advice in the development of an import MRL program for mutual acceptance of tolerances to promote export of US commodities to Southeast Asia
    - Organized and hosted four Borlaug Fellows for training at North Carolina State University, UC Davis and the Global MRL Harmonization Workshop in San Diego, CA
    - Provided technical advice for study directors in GLP, protocol development and review, the decision process involving deviations in the field and Laboratory, and interpretation of results.

Environmental Horticulture Program: 22 research summaries were written to support new or update existing registrations, provided to registrants, and posted on the IR-4 website (see summaries in Attachment 6); **4,887** field and greenhouse trials contributed to these summaries; trials came from the following IR-4 Units:

- North Central Region 718 trials
- Northeast Region 601 trials
- Southern Region 1,579 trials
- Western Region 922 trials
- ARS Cooperative sites 1,071 trials

4. Research in 2023

Food Program - Summary of Research Study / Projects

- **52** new Magnitude of the Residue Studies (Attachment 4); **384** total field trials (354 New/30 Carryover)
- **65** Product Performance projects (Attachment 5) involving **143** efficacy/crop safety trials
- **72** field trials that contributed to **35** Integrated Solutions projects
- IR-4 Quality Assurance Unit performed activities to help ensure that IR-4 remained compliant with EPA's Good Laboratory Practice Regulations; activities include:
    - 2 Protocol audits
    - 17 Facility audits
    - 151 In-life Inspections of field sites
    - 74 In-life Inspections of analytical laboratories
    - 286 Field Databook audits
    - 45 Analytical Summary Report audits
    - 32 Final Report audits
    - 6 Amended Report audit
- IR-4 also successfully completed 3 inspections by EPA, and QA audited 24 contributing scientist reports

Environmental Horticulture Program-Summary of Research Study / Projects

- **657** field and greenhouse trials (275 efficacy, 379 crop safety) that contributed to **57** projects (see research trial details in Attachment 7)

Comprehensive Summary 2023 Research Trial Distribution

Cooperating Region	Food Use Residue Trials	Food Use Product Performance Trials	Integrated Solutions Trials	Environ. Hort. Product Performance Trials
No. Central Region	81	17	7	76
Northeast Region	34	17	8	60
Southern Region	73	50	25	218
Western Region	129	59	32	165
ARS Sites	56	0	0	138
Canadian Sites	11	0	0	0
TOTAL	**384**	**143**	**72**	**657**

Analytical Laboratory Status

	Awaiting Analysis	Analysis in Progress	Analysis Complete-Preparing Report
Southern Region Lab	17	10	9
Western Region Lab	17	7	12
ARS Tifton Lab	9	5	1
ARS Wapato Lab	7	3	7
Other Labs	18	10	5
TOTAL	**68**	**35**	**29**

5. Impacts of IR-4 Activities

The IR-4 Project continues to provide tangible deliverables to growers of food and non-food specialty crops through the facilitation of registrations of safe and effective crop protection products. IR-4 is the only publicly funded program that develops data required for registrations. IR-4 has many positive impacts, including:

- Based on EPA actions, IR-4 data supported **1613** potential new registrations on food crops in 2023 and positively influenced **500** uses on non-food crops. These new registrations help producers grow high-quality food and ornamental crops while respecting the environment. This also has significant economic benefit[1] while helping farmers remain profitable and boost 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 and 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 environment and contribute to our well-being. IR-4's actions also prevent food waste throughout the supply chain, from the farm to the consumer.
- The IR-4 Project has been a major contributor to the advancement of Integrated Pest Management (IPM) tactics through approval of crop protection tools that give producers suitable options to manage destructive pests that disrupt advanced IPM systems.
- IR-4's Integrated Solutions initiative couples bio-based products with conventional products in a system whose objectives are to reduce chemical residues in food, provide a means to break up pest resistance to pesticides, and develop lower-risk solutions for the most difficult-to-manage pests.

[1] Michigan State University's Center of Economic Analysis reported the economic impact of IR-4 Project's activities supports over 111 thousand domestic jobs with a total annual payroll of $5.34 billion in 2021 dollars. The IR-4 Project is estimated to contribute $8.97 billion to annual gross domestic product. Economic contributions include direct expenditures of the IR-4 Project, anticipated crop losses mitigated under each of the two IR-4 Programs, through Biopesticide Regulatory Support and through gaining EPA exemptions for pesticide use when few or no other options for pest management exists. https://www.canr.msu.edu/resources/economic-impact-of-the-ir-4-project-and-programs-2022 for details.

- IR-4 continues to work with the EPA and the Codex Committee on Pesticide Residues (CCPR) to expand and enhance the Crop Groups/Sub-Groups. Crop groups allow the collection of residue data on a small number of representative crops and extend the use of the exposure values to a much larger number of similar crops in the crop group or subgroup. There are huge cost savings, as crop-grouping extrapolation allows IR-4 and others in the regulatory community to use resources smartly and efficiently. In 2023 no new Final Rules for US crop grouping updates were approved. Internationally, the 46th session of the Codex Alimentarius Commission adopted Class B - Primary commodities of animal origin and Class E - Processed commodities of animal origin (and corresponding Table 9 and 10 of representative commodities). Also adopted were consequential amendments to Groups 006, 023, and 12C.
- The Environmental Horticulture Program continues to support an industry valued at nearly $19.2 billion in annual sales (Horticulture Census, 2019, NASS). This industry is quite complex because growers cover 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.

6. Congressional Appropriations and other funding

Summary of IR-4 funding ($19,000,000)

Source	Amount	Administration	Activities covered
USDA-Minor Crop Pest Management (IR4) grant	$15.0 million	Competitive four-year grant to NC State	All core IR-4 research program and activities
USDA-ARS	$3.2 million	Contribute to and supports IR-4 research priorities	Funding of USDA-ARS scientists and activities[2]
National Research Support Program (NRSP-4)	$0.5 million	Competitive five-year grant awarded to NC State	Salaries and research coordination activities of IR-4 Headquarters
Various industry contributions	$1.2 million	Unrestricted donations to IR-4 Project	All IR-4 Project activities and expenses
USDA-Foreign Ag Service & Minor Use Foundation	$0.2 million	Funds to NC State	Used to support IR-4 activities of global harmonization of pesticide regulations and training

[2] USDA-ARS allocates a small amount of its Congressional Appropriation funds to support the salary and other expenses for their personnel involved with high priority research within IR-4's Food Use and Environmental Horticulture programs. Participating ARS scientists are given 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 University of Maryland Eastern Shore and travel support for IR-4 Quality Assurance Unit personnel to perform required on-site critical phase audits at ARS Field Research Centers.

In-kind contributions estimates ($22,689,800)

Estimate	Source
$2,774,800	SAES/land grant universities by hosting IR-4 field research centers, analytical laboratories and management offices throughout the United States[3]
$4,415,000	EPA Pesticide Registration Improvement Act fee waivers
$15,000,000	Crop protection industry[4]
$500,000	The government of Canada[5]

Expenditures supported by USDA-Minor Crop Pest Management (IR4) funds

Amount	Use
$5,249,627	Distributed to the four IR-4 Regional offices and Headquarters for non-laboratory personnel, supplies, equipment and other core expenses
$2,664,160	Distributed to the analytical laboratories for personnel, supplies, equipment and other expenses associated with laboratory analysis.
$2,581,785	Allocated to field trials for residue studies
$789,263	Allocated to field trials for product performance research
$484,294	Allocated for field trials that develop data in IR-4 Integrated Solutions research
$579,088	Allocated for field trials that develop product performance data in non-food crops
$1,125,600	Kept by NIFA to help fund their operations
$1,526,184	Provided to host institutions as indirect costs

Additional Expenditures supported by Industry Contributions

Amount	Use
$273,556	Salary and Fringe
$146,944	Travel

[3] Based on typical indirect costs allowance minus allowable indirect costs provided

[4] Based on 1:1 match of NIFA funds provided

[5] Contributions in joint research projects

$109,684	Meetings[6]
$319,019	Additional Research[7]
$86,240	Gift fee collected by NC State

7. New requests for assistance / Plans for the future

Food Program	Environmental Horticulture Program
▪ **203** new requests were entered into the IR-4 food use database, of which 141 were new stakeholder requests or for international needs and 61 were created by HQ for crop group tolerance revisions, referencing old PR#s, etc. The comprehensive total at the end of 2023 was **13,797**. ▪ The IS program received **27** new requests. ▪ IR-4 stakeholders prioritized "researchable" Requests for Assistance at the 2023 Food Use Workshop and identified **42** Magnitude of the Residue Studies, **11** product performance projects and **18** Integrated Solution projects as the highest priority for research in 2024. ▪ In the 2024 Food Crop Program, IR-4 will be focusing on the new research priorities, as well as some carryover projects (**365** Magnitude of the Residue trials, **134** Product Performance trials, **61** Integrated Solutions trials). The regional breakdown of the trials is presented in the table below. ▪ New active ingredients approved by the PMC as Biopesticide regulatory support projects included the RNAi of red palm weevil and the attenuated strain of cucumber green mottle mosaic virus	▪ Priorities for the Environmental Horticulture Program were established in the 2023 biennial workshop held in Little Rock, AR. ▪ **Ten** new requests were received for EHC research projects between 2022 and 2023. Two were the European Corn Borer to be able to ship plants into California. This was added as a regional project for 2023 based on regional support but was not selected by researchers. The other request was for Vascular Streak Disease; this was added as a regional project and selected for research for 2023. Flutriafol was requested for foliar diseases. Expansion of products typically used in pest control was requested to manage *Atta texana* in young *Pinus taeda* plantings. Broadening of mesotrione into additional species for in ground production was requested as was replacement pre-emergent herbicides for Surflan in field grown peonies and gladiolus. ▪ During the Biennial Workshop, **2** high priority efficacy research projects were selected for both entomology and pathology (Phytophthora & Pythium Efficacy, Pathology – Boxwood Foliar Disease Efficacy, Thrips Efficacy, Scale Efficacy) and **2** high priority crop safety projects were selected for weed science (Pre Emergent Herbicide Crop Safety and Post Emergent Herbicide Crop Safety). Both pathology and entomology have standing crop safety screening projects for new active ingredients. ▪ In addition, 6 regional projects were established. o Botrytis Efficacy (NCR, WSR)

[6] Includes costs associated with 2023 National Education Conference, 60 Years of IR-4 Celebrations in Washington DC and NC State

[7] Includes additional field trials, food processing and laboratory analysis

	○ Equisetum Efficacy in Christmas Trees (NCR) ○ Lygus Efficacy (WSR) ○ Nematode Efficacy (NER) ○ Pollinator Plant Herbicide Crop Safety (SOR) ○ Root Aphid/Aphid Efficacy (NER) ○ Vascular Streak Dieback Efficacy (SOR) IR-4 will be focusing on the new research priorities, consisting of approx. 592 field trials

Summary of Planned 2024 Research Trial Distribution:

Cooperating Region	Food Use Residue Trials	Food Use Product Performance Trials	Integrated Solutions Trials	Environmental Horticulture Product Performance Trials
North Central Region	63	22	9	90
Northeast Region	26	19	10	58
Southern Region	74	46	22	228
Western Region	138	47	20	120
ARS Sites	52	0	0	96[8]
Canadian Sites	12	0	0	0
TOTAL	365	134	61	> 592

[8] *One location for USDA-ARS had not selected research options for 2024 at the time of compilation.*

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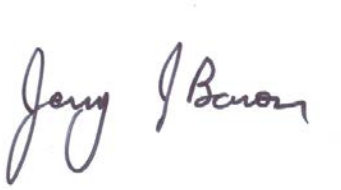
December 31, 2023

Approved by:



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ATTACHMENT 1 – Participants in the Process

A. <u>Commodity Liaison Committee (CLC)</u>—This advisory group provides input to the IR-4 Project Management Committee on overall operations and program direction. They are effective communicators to Congress on the importance of IR-4's deliverables to specialty crop agriculture in the United States. Members include:

Michael Aerts, Florida Fruit and Vegetable Association
Mark Arney, National Watermelon Promotion Board
Zack Bagley, California Tomato Research Institute
Michael Bledsoe, Village Farms, L.P.
John Walt Boatright, American Farm Bureau Federation
Jennifer Clarke, California Leafy Greens Research Program
James R. Cranney, California Citrus Quality Council
Alan DeYoung, Van Drunen Farms
Maggie Elliot, Hops Growers of America
William Frantz, Cranberry Institute
Michele Grainger, NC Sweet Potato Commission
Bob Jones, The Chef Garden
Bob Kaldunski, Ginseng Board of Wisconsin
Kevin Kudsk, National Onion Association
Michael Martin, Horticulture Research Institute
Armando Monterroso, Brooks Tropicals
Peter Nelson, Cherry Marketing Institute
Keith Pitts, Bioceres Crop Solutions
Amy Plato-Roberts, Lallemand Plant Care
Kan Quarles, National Potato Council
Rachel Roberts, American Mushroom Institute
Steven Salisbury, Mint Industry Research Council
Todd Scholz, USA Dry Pea & Lentil Council and CLC Chair
Jonathan Sarager, Western Growers
Alan Schreiber, Agriculture Development Group, Inc.
Berry Tanner, National Watermelon Association (alternate)
Amy Upton, Michigan Nursery & Landscape Association
Herman Waguespack, American Sugar Cane League
Lee Van Wychen, Weed Science Society of America
Ryan Wysocki, Michigan Blueberry

B. <u>Cooperating Government Departments and Agencies</u>

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

C. <u>Crop Protection Industry</u>–Companies with products involved in IR-4's research in 2023 include:

Company	Food Residue Study	Food Crop Product Performance	Integrated Solutions	Environmental Horticulture
Adama	X	X	X	
Agbiome			X	
Agrospheres			X	
Albaugh		X		
Andermatt			X	
Ascribe BioScience			X	X
AMVAC	X	X	X	
BASF Corporation	X	X	X	X
Bayer Crop Science	X	X	X	
Bayer Environmental Sciences (Envu)				X
Belchim Crop Protection	X			
Biosafe Systems			X	
Bioworks			X	X
BlackSmith BioScience INC			X	
Ceradis			X	
Certis USA			X	
CEV			X	
Clean-Ag			X	
Corteva Agrisciences	X	X	X	X
FMC Corporation	X	X	X	X
Gowan Company	X	X	X	X
Green Seal Company			X	
Helena Agri-Enterprises			X	
Helm Agro	X			
ICL Specialty Fertilizers				X

Company	Food Residue Study	Food Crop Product Performance	Integrated Solutions	Environmental Horticulture
IsaGro-USA				X
ISK Biosciences	X	X	X	X
Jet Harvest			X	
KI-Chemical	X	X		
Kemin Crop Technologies			X	X
Landis International	X		X	X
Marrone Bioinnovations (ProFarm)		X	X	X
Momentive			X	
Nichino America	X	X	X	
Nisso	X	X	X	X
NuFarm America	X	X		X
OAT Agrio			X	X
OroAgri			X	
Petro Canada			X	
PreZero			X	
PureCrop 1			X	
Rainbow Treecare Scientific				X
SePRO Corporation			X	X
Sipcam Agro			X	
Stepan				X
Summit Agro			X	
Syngenta Crop Protection	X	X	X	X
TDA				X
Terramera			X	
TKI Novasource	X	X	X	
TLC Products				X
Ultraquimia			X	

Company	Food Residue Study	Food Crop Product Performance	Integrated Solutions	Environmental Horticulture
UPL		X	X	
Valent USA, LLC	X	X	X	X
Vestaron			X	

D. Project Management Committee

Dr. Jerry Baron*, IR-4 Project Headquarters – IR-4 Project Executive Director
Dr. Douglas Buhler, Michigan State University – Administrative Advisor, North Central Region
Dr. John Davis, University of Florida - Administrative Advisor, Southern Region
Dr. Rubella Goswami, Acting USDA-NIFA-National Program Leader for IR-4
Dr. Liwei Gu*, University of Florida – Regional Director, Southern Region.
Dr. Matt Hengel*, University of California, Davis - Regional Director, Western Region and PMC Chair
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 –Advisor
Dr. Joseph Munyaneza, USDA-ARS - Administrative Advisor
Dr. Michele Samuel-Foo, USDA-NIFA-National Program Leader for IR-4 (away on detail)
Mr. Todd Scholz*, USA Dry Pea and Lentil-CLC Chair
Dr. Alvin Simmons*, USDA-ARS – Director Minor Use Program
Dr. John Wise*, Michigan State University – Regional Director, North Central Region
Dr. Simon Zebelo*, University of MD, Eastern Shore - Regional Director, Northeast Region
*Voting member

E. IR-4 Project Headquarters (HQ)

Dr. Alice Axtell - Biology Team Lead and Principal Entomologist
Ms. Allison Ballantyne – Senior Operations Associate
Mr. Bill Barney – Biopesticide Regulatory Manager
Dr. Jerry Baron – Executive Director
Mr. Roger Batts - Principal Weed Scientist
Ms. Susan Bierbrunner* – Data Administrator
Ms. Donna Bouffard - Program Operations Coordinator
Dr. Michael Braverman* – Biopesticide & Organic Support Program Mgr./Int'l Capacity Building
Mr. James Byrtus – Lead Research Associate - Regulatory Sciences
Dr. Debbie Carpenter – Assoc. Director for Regulatory Sciences and National Laboratory Director
Dr. Krystal Chojnacki - National Chief of Staff
Ms. Christina Dineen – Chemist and Study Director
Ms. Jane Forder – Lead Quality Assurance Auditor - Northeast and North Central Region
Ms. Shiayi Huang - Data Applications Manager
Ms. Grace Lennon – Senior Regulatory Associate
Ms. Cristina Marconi - Registration Manager and Study Director

Dr. Johanna Mazlo - National Quality Assurance Unit Manager
Mr. Philip Moore - Study Director
Mr. Scott Muir - Lead Quality Assurance Auditor - Analytical Chemistry
Dr. Cristi Palmer* – Environmental Horticulture Program Manager
Dr. Jaimin Patel – Principal Plant Pathologist
Mr. Josh Peterson - Quality Assurance Auditor
Mr. Thomas Pike – Submission Manager and Senior Study Director
Ms. Hannah Ross – National Information and Communications Officer
Dr. Dan Rossi - Senior Management Associate
Mr. David Schnatter - Business Operations Associate
Dr. Van Starner – Senior Management Associate
Ms. Juliet Thompson – Research Specialist, Quality Assurance
Mr. Robert Welker - Study Director
*Rutgers University Employee

F. Regional/ARS Field Coordinators and Staff

Dr. Kari Arnold, Field Coordinator - Western Region
Ms. Megan James, Assistant Field Coordinator - Northeastern Region
Ms. Mika Pringle Tolson, Field Program Assistant - Western Region
Ms. Marylee Ross, Field Coordinator – Northeast Region
Ms. Kristen Searer-Jones, Assistant Field Coordinator - Southern Region
Dr. Alvin Simmons, Field Coordinator-USDA-ARS – ARS Office of Minor Use Pesticides
Ms. Nicole Soldan, Field Coordinator - North Central Region
Dr. Janine Spies, Field Coordinator – Southern Region

G. Laboratory Coordinators (Regional and ARS)

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

H. Quality Assurance Unit

Dr. Martin Beran, University of California, Davis
Ms. Jane Forder, North Carolina State University
Ms. Kathleen Knight, University of Florida
Dr. Johanna Mazlo, North Carolina State University
Mr. Scott Muir, North Carolina State University
Ms. Sherita Normington, University of California, Davis
Mr. Josh Peterson, North Carolina State University
Ms. Juliet Thompson, North Carolina State University
Dr. Yavuz Yagiz, University of Florida

I. IR-4 Researcher & State Liaison Representatives [9]

North Central Region

State	State Liaison	Research Area
IA	Vacant	D. Mueller (IS)
IL	Vacant	
IN	S. Meyers	J. Beckerman (IS) (EHC), S. Meyers (P)
KS	R. Cloyd	R. Cloyd (EHC)
MI	N. Soldan	S. Chaudhari (R), (P), M. Hausbeck (P) (IS) (EHC), T. Miles (P) (IS), M. Quintanilla (EHC), D. Saha (EHC), W. Shane (IS), N. Soldan (SLR) (R), C. Wheeler (R)
MN	Vacant	
MO	R. Smeda	
ND	B. Jenks	T. Guaderman (R), J. Quan Zai (R)
NE	A. Jhala	
OH	A. Leach	C. Herms (IS), L. Horne* (R), , H. Mathers (EHC), M. Reding* (EHC), A. Robinson (R) (P) (EHC),
SD	S. Clay	G. Reicks (R)
WI	D. Heider	S. Chapman (R), D. Heider (SLR) (R) (P)

Northeast Region

State	State Liaison	Research Area
CT	J. Aulakh	J. Aulakh (SLR), (EHC),
DE	B. Kunkel	D. Owens (P) (IS), M. VanGessel (P)
MA	S. Scheufele	
MD	M. Ross	D. Cochran (EHC), M. Hu (IS), M. Hickman (R), M. Ross, (R), K. Vollmer (P)
ME	L. Calderwood	
NH	A.Vinchesi-Vahl	A. Wallingford (P)
NJ	T. Besancon	T. Besancon (P), W. Bouchelle (R), L. Werner* (EHC), J. Fisher (R),

[9] R= Residue Field Trials/Food Program; P= Product Performance in Food Program; IS=Integrated Solutions, EHC=Environmental Horticulture Program and *=USDA Agriculture Research Service Researcher

		C. Rodriguez-Saona (IS), A. Wyenandt (P), (IS)
NY	L. Sosnoskie	N. Catlin (EHC), D. Gilrein (P) (EHC), H. Keagan (R), T. Lessord (P), B. Nault (P), A. Senesac (EHC), L. Sosnoskie (P) (IS), A. Taylor (P)
PA	G. Krawczyk	C. Brunharo (P)
RI	H. Faubert	
VT	A. Hazelrigg	
WV	C. Quesada	

Southern Region

State	State Liaison	Research Area
AL	E. Vinson	D. Held (EHC),
AR	H. Smith	M. Bertucci (P), A. Cato (P),
FL	P. Dittmar	N. Boyd (P) (IS), D. Carrillo (P), J. Crane (R), A. Dale (EHC), D. Thomasl (R) , P. Devkota (P), P. Dittmar (P), N. Dufault (IS), M. Frost (R), R. Gazis (P) (IS), A. Hajihassani (P), O. Liburd (IS), M. Long (R), C. Marble (EHC), D. Norman (EHC), N. Peres (P), D. Seal (P), B. Sellers (P), L. Sriyanka (P), R. Tannenbaum (R)
GA	S. Culpepper	P. Brannen (IS), S. Culpepper (P), B. Fraelich* (R), (EHC), R. Gazis (P), D. Riley (P), A. Sial (IS), S. Villanassery (EHC), P. Yu (EHC)
KY	R. Bessin	N. Gauthier (IS), Raul (IS), J. Larson (EHC), S. Carter (IS)
LA	T. Watson	
MS	A. Henn	S. Broderick (IS),
NC	D. Monks	S. Frank (EHC), K. Jennings (P) (IS), I. Meadows (EHC), W. Mitchem (P), J. Neal (EHC), L. Quesada (IS), C. Smith (P) (R), S. Villani (IS), J. Walgenbach (IS)
OK	C. Luper	T. Bauhman (P), G. De La Fuente (P)
PR	W. Robles Vazquez	E. Martinez (P), D. Rivera (EHC), W. Robles Vazquez (R) (P)
SC	M. Cutulle	T. Bilbo (P), P. Wade* (R) (EHC), H. Wang (IS)
TN	M. Gireesh	F. Baysal-Gurel (EHC), K. Addesso (EHC), J. Gillilan (IS), A. Witcher (EHC)
TX	M. Matocha	K. Cochran (P) (R), A. Dotray (P), T. Jones (R), R. Khan (EHC), J. Grichar (P), K. Ong (EHC), G. De La Fuente (P)
VA	D. Frank	J. Derr (EHC), M. Flessner (IS), S. Rideout (IS)

Western Region

State	State Liaison	Research Area
AK	P. Kaspari	
AZ	A. Hu	J. Palumbo (IS), M. Pena (P)
CA	K. Arnold	J. Adaskaveg (P) (IS), B. Aegerter (P),, W. Brim-DeForest (IS), S. Benson* (R), M. Bolda (P), N. Clark (P), K. Daane (P), J. Del Castillo Múnera (P), O. Daugovish (IS), A. Eskalen (EHC), D. Ennes (R), S. Fennimore (P) (IS), M. Gebiola (IS), C. Gispert (IS), B. Hanson (R)(P), D. Haviland (IS),, C. Jiang (EHC), C. Kron (IS), N. Leach (R), M. Lloyd (IS), P. Mauk (IS), T. Michilaides (P), E. Middleton (EHC), C. Nansen (EHC), K. Pearson (IS), J. Sidhu (P)(IS), K. Skiles (R), B. Tonnessen (IS), F. Trouillas (IS), B. Turner (R), B. Uber (EHC), H. Wang (P), C. Wang (P), S. Watkins (R), H. Wilson (IS), R. Wilson (P), Wang (P)
CO	B. Tonnessen	O. Clark (R), J. Klett (EHC),
GU	R. Miller	
HI	J. Coughlin	Z. Cheng (EHC), J. Coughlin (R) (P), J. Kam (R), O. Neher (IS), Z. Zhang (R)
ID	R. Hirnyck	P. Hutchinson (IS), W. Meeks (R) (P), J. Woodhall (IS), O. Neher (IS)
MT	Z. Miller	Z. Miller (P)
NM	C. Robbins	C. Robbins (EHC) (R)
NV	Vacant	
OR	D. Lightle	N. Achala (IS), P. Berry (P), K. Buckland (P), K. Galimba (IS), D. Lightle (R) (IS), M. Mattsson (R), M. Moretti (P) (EHC), C. Ocamb (P), E. Peachey (P), S. Reitz (IS), L. Santamaria (EHC), G. Shrestha (IS), V. Walton (IS), J. Weiland (EHC)
UT	C. Ransom	
WA	D. Walsh	G. Chastagner (EHC), D. Larson* (R) (EHC), W. Peng (R), L. Rui (P), D. Walsh (P), T. Waters (IS) (P)
WY	C. Beiermann	

ATTACHMENT 2 – 2023 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
Bifenthrin**	ADAMA, AMVAC, FMC	I	12/01/2021	Avocado		10578	1	1
				Berry, low growing, subgroup 13-07G	2	11888	8	1
				Cranberry		11000	0	0
				Brassica, leafy greens, subgroup 4-16B		8490	20	1
				Caneberry subgroup 13-07A		11837	1	1
				Fruit, citrus, group 10-10		11836	14	1
				Fruit, pome, group 11-10, except mayhaw		11016	10	1
				Fruit, small, vine climbing, except fuzzy kiwifruit, subgroup 13-07F	2	11887	5	1
				Nut, tree, group 14-12		11838	26	1
				Peach subgroup 12-12B		11017	2	1
				Pepper/eggplant subgroup 8-10B	2	11860	6	1
				Pomegranate		11249	1	1
				Tomato subgroup 8-10A	2	11835	9	1
Cyflumetofen**	BASF	I	12/06/2021	Hop, dried cones		12334	1	1
Rimsulfuron	CORTEVA	H	01/25/2023	Pomegranate		10606	1	1
				Tropical and subtropical, small fruit, edible peel, subgroup 23A		10184	56	1
Fluopyram	BAYER	N	02/01/2023	Brassica, leafy greens, subgroup 4-16B		13250	13	1
				Celtuce	4	13254	0	1
				Coffee, green bean		12758	1	1
				Fennel, Florence, fresh leaves and stalk	4	13255	0	1
				Kohlrabi	4	13249	0	1

				Leafy greens subgroup 4-16A		13252	18	1
				Leaf petiole vegetable subgroup 22B		13253	3	1
				Papaya		10765	1	1
				Peppermint, dried leaves		11971	1	1
				Peppermint, fresh leaves		11971	0	1
				Spearmint, dried leaves		11971	1	1
				Spearmint, fresh leaves		11971	0	1
				Spice group 26	2	13251	204	1
				Vegetable, brassica, head and stem, group 5-16		13248	0	1
				Edible podded bean subgroup 6-22A		13243	17	1
				Edible podded pea subgroup 6-22B		13244	3	1
				Succulent shelled bean subgroup 6-22C		13245	17	1
				Succulent shelled pea subgroup 6-22D		13246	2	1
				Pulses, dried shelled bean, except soybean, subgroup 6-22E		13247	25	1
Pydiflumetofen	SYNGEN	F	02/15/2023	Caneberry subgroup 13-07A		11794	5	1
				Greenhouse Pepper		11879	2	1
				Greenhouse Lettuce		11880	2	0
Penthiopyrad	CORTEVA	F	02/17/2023	Banana		11307	2	1
				Greenhouse lettuce		11444	1	0
Mandestrobin	VALENT	F	03/09/2023	Vegetable, tuberous and corm, except potato, subgroup 1D		12522	16	1
Trinexapac-ethyl	SYNGEN	P	03/29/2023	Clover, forage		11526	1	1
				Clover, hay		11526	0	1
Ethalfluralin	GOWAN, LOVLND	H	04/10/2023	Hemp, seed		12910	1	1
				Stevia, dried leaves		09871	1	1

				Vegetable, tuberous and corm, subgroup 1C	2	13174	16	1
				Individual crops of Proposed Crop Subgroup 6-22E	2	13175	25	25
				Individual crops of Proposed Crop Subgroup 6-22F	2	13176	6	6
Fluazifop-p-butyl	SYNGEN	H	04/27/2023	Berry, low growing, subgroup 13-07G	2	13198	8	1
				Brassica, leafy greens, subgroup 4-16B		02076	20	1
				Chive, dried leaves		02087	0	1
				Fruit, citrus, group 10-10		11363	14	1
				Fruit, stone, group 12-12		11364	11	1
				Leaf petiole vegetable subgroup 22B		02336	6	1
				Onion, green, subgroup 3-07B	2	02087	14	1
				Papaya		11265	1	1
				Vegetable, brassica, head and stem, group 5-16		11861, 11862	5	1
				Arugula		03399	0	0
				Broccoli, Chinese		03246	0	0
				Cabbage, Chinese (bok choy)		03027	0	0
				Cabbage, Chinese (napa)		02338	0	0
				Cauliflower		02327	0	0
				Collard		02334	0	0
				Kale		02332	0	0
				Mustard, Chinese		03245	0	0
Fomesafen	SYNGEN	H	05/09/2023	Vegetable, bulb, group 3-07		11620	26	1
				Vegetable, cucurbit, group 9	2	13300	8	1
				Vegetable, foliage of legume, except soybean, subgroup 7A		12467	2	1
				Vegetable, fruiting, group	2	13299	18	1

				8-10		, 12785		
Trifloxystrobin	BAYER	F	06/20/2023	Brassica, leafy greens, subgroup 4-16B		13227	13	1
				Celtuce	4	13238	0	1
				Fennel, Florence, fresh leaves and stalks	4	13239	0	1
				Fruit, citrus, group 10-10		13229	14	1
				Fruit, pome, group 11-10		13230	5	1
				Fruit, stone, group 12-12		13231	11	1
				Kohlrabi	4	13240	0	1
				Leafy greens subgroup 4-16A		13233	18	1
				Leaf petiole vegetable subgroup 22B		13232	3	1
				Nut, tree, group 14-12		13234	26	1
				Onion, bulb, subgroup 3-07A		07049	11	1
				Onion, green, subgroup 3-07B		07049	15	1
				Spice group 26	2	13228	204	1
				Vegetable, Brassica, head and stem, group 5-16		13226	5	1
				Vegetable, fruiting, group 8-10		13237	12	1
				Individual crops of proposed subgroup 6-22A: Edible podded bean legume vegetable subgroup		09916	25	25
				Individual crops of proposed subgroup 6-22E: Dried shelled bean, except soybean, subgroup		13235	25	50
				Individual crops of proposed subgroup 6-22F: Dried shelled pea subgroup		13236	6	8
Glufosinate	BASF, UPL NA	H	06/20/2023	Tropical and subtropical, medium to large fruit,		10242	43	1

				edible peel, subgroup 23B				
				Tropical and subtropical, medium to large fruit, smooth, inedible peel, subgroup 24B		12050	40	1
				Tropical and subtropical, small fruit, inedible peel, subgroup 24A		10239	19	1
				Grass, forage		12109	1	1
				Grass, hay		12109	0	1
Acifluorfen	UPL NA	H	07/27/2023	Berry, low growing, subgroup 13-07G	2	13412	9	1
				Soybean, vegetable, edible podded		10958	1	1
				Soybean, vegetable, succulent shelled		10958	1	1
Fluxapyroxad	BASF	F	08/16/2023	Stevia, dried leaves		12535	1	1
				Stevia, fresh leaves		12535	0	1
				Coffee, green bean		13186	1	1
Pyraclostrobin	BASF	F	08/16/2023	Stevia, dried leaves		12535	1	1
				Stevia, fresh leaves		12535	0	1
				Coffee, green bean		13186	1	1
Spinosad	CORTEVA	I	08/28/2023	Stalk and Stem Vegetable Subgroup 22A		13265	12	1
				Spice Group 26		13266	175	1
				Greenhouse cucumber		11926	1	0
				Greenhouse lettuce		12292	1	0
				Greenhouse pepper		11944	1	0
				Greenhouse tomato		11919	1	0
Spinetoram	CORTEVA	I	09/5/2023	Stalk and stem vegetable subgroup 22A		11830	12	1
				Spice group 26	2	13257	175	1
				Greenhouse cucumber		11926	1	0
				Greenhouse lettuce		12292	1	0
				Greenhouse pepper		11944	1	0
				Greenhouse tomato		11919	1	0
Flonicamid	FMC, ISK	I	09/20/2023	Bushberry crop subgroup 13-07B		11969	19	1

				Caneberry crop subgroup 13-07A		08585	5	1
				Cherry subgroup 12-12A	2	08558	0	1
				Corn, sweet, kernel plus cob with husks removed		11970	1	1
				Corn, sweet, forage		11970	0	1
				Corn, sweet, stover		11970	0	1
				Peach crop subgroup 12-12B		08558	0	1
				Plum subgroup 12-12C	2	08558	0	1
				Pomegranate		12283	1	1
				Prickly pear, fruit		11966	1	1
				Prickly pear, pads		11966	0	1
				Edible podded bean subgroup 6-22A	2	13432	17	1
				Edible podded pea subgroup 6-22B	2	13433	3	1
				Succulent shelled bean subgroup 6-22C	2	13434	17	1
Flonicamid (continued)	FMC, ISK	I	09/20/2023	Pulses, dried shelled bean (except soybean) subgroup 6-22E	2	13436	25	1
				Pulses, dried shelled pea subgroup 6-22F	2	13437	6	1
Dodine	UPL NA	F	12/13/2023	Fruit, pome, group 11-10	2	13268	10	1
				Fruit, stone, group 12-12		13269	11	1
				Nut, tree, group 14-12		13270	27	1
				Olive, with pit		13126	1	1
						2023 Totals[10]	**1613**	**211**

*F=fungicide, H=herbicide, I=insecticide/acaricide, M=molluscicide, N=nematicide, P=plant growth regulator

[10] In May 2023 an error in the monthly report from December 2021 was discovered - tolerance actions for Bifenthrin and Cyflumetofen were inadvertently omitted; this correction adds 104 new uses and 13 new tolerances to the annual totals for 2021; thus, in 2021 EPA published 16 actions that established 128 new tolerances for 15 active ingredients, supporting 744 potential new uses on food crops (replacing the 14 actions establishing 115 new tolerances for 13 active ingredients supporting 640 new uses, as reported in the 2021 "Annual Report of the IR-4 Project"); these Bifenthrin and Cyflumetofen data are reported here, but the tolerances and uses are not added to the 2023 totals

** Note Code
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 to a crop group or subgroup tolerance ***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

ATTACHMENT 3 – 2023 Submissions to EPA, unless otherwise noted as submitted to Registrants, Codex or State Departments of Agriculture

Pest Control Agent	Registrant	Type*	Date	Commodity, Subgroup or Crop Group	PR#
Ethaboxam	VALENT	F	02/02/2023	Leaf petiole vegetable subgroup 22B	12075
Flutriafol	FMC	F	03/16/2023	Brassica, leafy greens, subgroup 4-16B Celtuce Cottonseed subgroup 20C Fennel, Florence, fresh leaves and stalk Fruit, pome, group 11-10 Fruit, stone, group 12-12 Kohlrabi Leafy greens subgroup 4-16A, except head lettuce and radicchio Leaf petiole vegetable subgroup 22B Tropical and subtropical, small fruit, edible peel, subgroup 23A Vegetable, Brassica, head and stem, group 5-16	13602 13606 13603 13607 13609 13610 13608 13604 13605 11935 13601
Cyazofamid	ISK	F	04/10/ 2023	Chickpea, edible podded Chickpea, succulent shelled Edible podded bean subgroup 6-22A Parsnip, root Pulses, dried shelled bean, except soybean, subgroup 6-22E Succulent shelled bean subgroup 6-22C	13616 13619 13617 13018 09533 13618
Pyridate	BELCHIM	H	07/05/2023	Vegetable, brassica, head and stem, group 5-16 Field corn subgroup 15-22C Kohlrabi Mint, dried leaves Mint, fresh leaves	13645 13646 13647 12477 12477
Picarbutrazox	NISSO	F	07/17/2023	GH lettuce	12291
Bifenthrin	ADAMA, AMVAC, FMC	I	07/26/2023	Celtuce Citrus, oil Coffee, green bean Cottonseed subgroup 20C 13651	13659 11166 11527 13651

				Edible podded bean subgroup 6-22A Edible podded pea subgroup 6-22B Fennel, Florence, fresh leaves and stalks Kiwifruit, fuzzy Kohlrabi Leaf petiole vegetable subgroup 22B Pulses, dried shelled bean, except soybean, subgroup 6-22E Pulses, dried shelled pea subgroup 6-22F Rapeseed subgroup 20A Safflower Succulent shelled bean subgroup 6-22C Succulent shelled pea subgroup 6-22D Swiss chard Tropical and subtropical, palm fruit, edible peel, subgroup 23C Vegetable, brassica, head and stem, group 5-16, except cabbage Clover, forage Clover, hay Citrus fruit group 10-10	13652 13654 13660 12627 13658 13649 13656 13657 13662 11068 13653 13655 13661 12649 13650 11297 11297 11164, 11165, 11166
Dimethenamid-p	BASF	H	07/31/2023	Bulb vegetable group 3-07 Field corn subgroup 15-22C Grain sorghum and millet subgroup 15-22E Pomegranate Sweet corn subgroup 15-22D	13669 13670 13671 13081 13672
Inpyrfluxam	VALENT	F	08/31/2023	Vegetable, cucurbit, group 9	13350, 13351, 13352
Azoxystrobin + Fludioxonil	SYNGEN	F	09/11/2023	Sweet potato (post harvest)	12118
Famoxadone	CORTEVA	F	09/29/2023	Arugula Brassica, leafy greens, subgroup 4-16B Celtuce	12234 08759 12237 12236

				Cress, garden Cress, upland Fennel, Florence Leaf petiole vegetable subgroup 22B Leafy greens subgroup 4-16A, except spinach Mango Pepper/eggplant subgroup 8-10B Tomato subgroup 8-10A Vegetable, root, except sugar beet, subgroup 1B Vegetable, tuberous and corm, subgroup 1C Succulent shelled bean subgroup 6-22C	12235 12238 12231 12230 10677 13782 13781 08875, 10812, 08757, 12415 12232 07262
Cymoxanil	CORTEVA	F	09/29/2023	Arugula Brassica, leafy greens, subgroup 4-16B Celtuce Cress, garden Cress, upland Fennel, Florence Leaf petiole vegetable subgroup 22B Leafy greens subgroup 4-16A, except spinach Mango Vegetable, fruiting, group 8-10 Vegetable, root, except sugar beet, subgroup 1B Vegetable, tuberous and corm, subgroup 1C Succulent shelled bean subgroup 6-22C	12234 08759 12237 12236 12235 12238 12231 12230 10677 12233 08875, 10812, 08757, 12415 12232 07262
Afidopyropen	BASF	I	12/15/2023	Greenhouse lettuce	11695
Permethrin	ADAMA, AMVAC, FMC, UPL NA	I	12/18/2023	Arugula Cress, garden Cress, upland Dragon fruit (pitaya) Field corn subgroup 15-22C Leafy greens subgroup 4-16A Sweet corn subgroup 15-22D	12305 12306 12307 10630 13796 12303 13797

Methoxyfenozide	CORTEVA	I	12/18/2023	Edible podded bean subgroup 6- 22A Edible podded pea subgroup 6- 22B Field corn subgroup 15-22C Grain sorghum and millet subgroup 15-22E Pulses, dried shelled bean, except soybean, subgroup 6-22E, except pea, blackeyed, bean/ pea, southern Pulses, dried shelled pea subgroup 6-22F Succulent shelled bean subgroup 6-22C Succulent shelled pea subgroup 6-22D Sweet corn subgroup 15-22D Tropical and subtropical, medium to large fruit, edible peel, subgroup 23B Rice subgroup 15-22F	13785 13786 13787 13788 13789 13790 13792 13793 13794 12898, 13795 13791

*F=fungicide, H=herbicide, I=insecticide/acaricide, M=molluscicide, N=nematicide, P=plant growth regulator

ATTACHMENT 4 – 2023 Food Use Research Projects, New Residue Studies[11]

Chemical	Crop	PR #
Acequinocyl	Hops	13539*
Afidopyropen	Sunflower	13537
Azoxystrobin	Mint (GH transplants)	13108
BCS-CW64991	Cucumber (GH)	13088*
BCS-CW64991	Tomato (GH)	13087*
Benzovindiflupyr + Difenoconazole	Coffee	13179
Bifenthrin	Onion (bulb and green)	13485
Clethodim	Avocado	13533
Clethodim	Olive	13451
Clethodim	Rice	13184
Cyclaniliprole	Hemp	13035
Cyflumetofen	Caneberry	11808
Ethaboxam	Cherry	13286
Ethephon	Hazelnut (Filbert)	13450
Fenpyroximate	Hemp	13033
Fenpyroximate	Lychee	13390
Fluazifop-P-Butyl	Pea (succulent shelled)	13541
Fluazifop-P-Butyl	Squash (summer)	13540
Fluazinam	Avocado	08284
Fludioxonil + Pydiflumetofen	Asparagus (fern)	13489
Fludioxonil + Pydiflumetofen	Basil	13078
Fludioxonil + Pydiflumetofen	Mint	13293

[11] PR # followed by "*" indicate that the study is no longer active

Chemical	Crop	PR #
Fluroxypyr	Mint	13142
Flutianil	Basil	13542
Flutolanil	Strawberry	09102
GF-4031	Cherry	13295
Glufosinate	Peanut	13463
Glufosinate	Strawberry	13455
Indaziflam	Asparagus	13026
Inpyrfluxam	Coffee	13449
Inpyrfluxam	Tomato	13511
Isocycloseram (ISM-555)	Pepper (GH)	13405
Isocycloseram (ISM-555)	Pomegranate	13504
Isocycloseram (ISM-555)	Strawberry (GH)	13407
Isocycloseram (ISM-555)	Sunflower	13538
Isocycloseram (ISM-555)	Tomato (GH)	13403
Mefentrifluconazole	Hops	13505
Novaluron	Caneberry	13502
Propiconazole	Guava	13045*
Pyridaben	Miracle fruit	12562
Pyridate	Sweet corn	07883
Pyriofenone	Lettuce (GH)	11473
Quizalofop	Hops	13495
Rimsulfuron	Avocado	13484
S-metolachlor/metolachlor	Perennial peanuts	13165
Tiafenacil	Blueberry	13487

Chemical	Crop	PR #
Tiafenacil	Cucumber	13498
Tiafenacil	Mint	13274
Tiafenacil	Pepper (bell and nonbell)	13501
Tiafenacil	Tomato	13500
Uniconazole-P	Basil (GH transplants)	12028
Uniconazole-P	Mint (GH transplants)	13530

ATTACHMENT 5 – 2023 Food Use Product Performance Research Program[12]

Chemical	Crop	PR#	Research Trial location
2,4-D Choline	Caneberry	13332	AR, CA, NC, OR
2,4-D Choline	Strawberry	13304	CA, CA, NC
Acetamiprid	Dragon fruit	13057	FL, PR
Afidopyropen	Safflower	13459	CA
Azoxystrobin	Cabbage (GH transplants)	13112	MI
Azoxystrobin	Mint (GH transplants)	13108	NJ
Bifenthrin	Onion (bulb and green)	13485	NY, WA
Cyantraniliprole	Dragon fruit	13306	FL
Cyantraniliprole	Strawberry (GH)	11679	FL, SC
Cyazofamid	Hemp	13058	KY, OR
Cyazofamid	Parsnip	13018	MI, OR
Cyazofamid	Turnip (roots)	13015	OR
Cyflumetofen	Caneberry	11808	AR, CA
Cymoxanil	Strawberry	13256	CA, FL
Dimethomorph + Ametoctradin	Basil	13242	CA, CA
Fenpyroximate	Lychee	13390	FL
Flazasulfuron	Peach	13323	CA, CA, MI, NC, NC, WA
Florpyrauxifen-benzyl	Coffee	13262	HI, HI, PR, PR
Florpyrauxifen-benzyl	Hazelnut	13486	OR, OR
Florpyrauxifen-benzyl	Papaya	13263	HI, HI, PR, PR
Fluazaindolizine	Onion (dry bulb)	12770	FL
Fluazinam	Avocado	08284	FL
Fludioxonil + Pydiflumetofen	Basil	13078	TX
Fludioxonil + Pydiflumetofen	GH cucumber	12673	CA
Fludioxonil + Pydiflumetofen	Mint	13293	ID
Flumiclorac	Sesame	13503	OK, TX, TX, TX
Flutolanil	Strawberry	09102	MI, WV
Fluxapyroxad + Pyraclostrobin	Asparagus (fern)	13493	MI, MI

[12] PR # followed by "*" indicate that the study is no longer active

Chemical	Crop	PR#	Research Trial location
GF-4031	Strawberry	13355	MI
Glufosinate	Asparagus	13499	IN, NJ, WA, WI
Glufosinate	Caneberry	12051	AR, NC, OR, OR
Glufosinate	Dragon fruit	13330	FL, PR
Glufosinate	Mango	13296	N/A
Glufosinate	Passionfruit	10241	FL, PR, PR
Glufosinate	Sesame	11148	OK, TX
Glufosinate	Spinach	13453	AZ, CA, FL, GA, OH
Glufosinate	Strawberry	13455	FL, WA
Indaziflam	Asparagus	13026	CA, MI, NJ, OR
Inpyrfluxam	Tomato	13511	CA
Isocycloseram (ISM-555)	Pepper (GH)	13405	FL, GA
Isocycloseram (ISM-555)	Pomegranate	13504	CA, CA
Isocycloseram (ISM-555)	Tomato (GH)	13403	NH
Isofetamid	Hemp	13007	VT
MBI-015	Hops	13512	NY, OR
Mefenoxam	Lettuce (head and leaf)	13194	CA
Mefenoxam	Passionfruit	13046*	FL
Mefentrifluconazole	Hops	13505	OR
Metribuzin	Snap bean	13362	DE, GA, MD
NAA	Hazelnut	13065	OR, OR
Penthiopyrad	Avocado	13075	CA
Penthiopyrad	Pomegranate	13514	CA, CA
Pyraziflumid	Lettuce (GH)	12975	MI
Pyroxasulfone	Asparagus	12935	CA, ID, MI, MI, NJ, OR
Pyroxasulfone	Sesame	11951	OK, TX
Quinclorac	Peach	12572	CA, CA, MI, NC, NC, PA
Quinclorac	Strawberry	11611	NY
Quizalofop	Hops	13495	MI, NY, OR
S-metolachlor	Perennial peanuts	13165	FL, FL

Chemical	Crop	PR#	Research Trial location
S-metolachlor	Camelina	12867	MT
Spinosad	Pea (succulent shelled)	13103	DE, NY
Sulfur Dioxide	Sweet potato	12521*	NC
Tiafenacil	Blueberry	13487	NJ, OR
Tiafenacil	Hops	13282	ID, MI, NY, OR, WA
Tiafenacil	Mint	13274	CA, OR, WI
Tiafenacil	Tomato	13500	CA, FL
		Total	**143**

ATTACHMENT 6 - 2023 Environmental Horticulture Program Research Summaries

Abamectin Crop Safety

Abamectin has been registered since 1987 for environmental horticulture crops, initially for leafminers and spider mites on annuals and herbaceous perennials. Then in 2000, woody ornamentals plus aphids, thrips, whiteflies and other mite groups were added to the Avid 1.5 EC label. Since 1984, IR-4 has included Avid 0.15EC in 113 crop safety trials and 48 efficacy experiments, with it being viewed as a standard commercially available tool in the more recent research activities.

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 from 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 2022, 91 products representing 58 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, red headed flea beetle, Sri Lankan weevil, and viburnum leaf beetles to recommend actions to register or amend labels for these pests.

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 2022 on environmental horticulture crops. During this time period, numerous products representing 56 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*; however, other species tested were *B. elliptica*, and *B. tulipae.* For *B. cinerea*, across all crops and rates screened, Affirm, Picatina Flora, Astun, Spirato/Medallion, Mural, Tourney, Pageant Intrinsic, Decree, and Postiva provided good to excellent efficacy routinely as did two not-yet-registered tools for Botrytis management: XDE-659 and Trinity. Orkestra Intrinsic, PreStop, S2200, Broadform, and Regalia generally provided good reduction in disease; however, some variability was seen among experiments. S2200 also was variable in performance but could be registered and be part of an overall management program. For *Botrytis elliptica*, fewer experiments have been conducted. The best performing tools with at least 3 trials are Orchestra Intrinsic, Mural, and S2200. ZeroTol, and the copper products (Badge X2, Camelot, Phyton 27, STBX-304) generally performed poorly under the conditions of these experiments.

Dimethenamid-p Crop Safety

From 2007 to 2023, IR-4 completed 594 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, 74 plant species exhibited no or minimal transient injury after application at all three rates. Thirty (30) 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. Fifteen crops – *Aquilegia* sp, *Catharanthus roseus, Cladrastis* sp., *Crassula ovata, Crassula* sp., *Echeveria* sp., *Echinacea purpurea, Echinacea* sp, *Epilobium canum, Helianthus annuus, Muhlenbergia dubia, Rudbeckia fulgida, Rudbeckia hirta, Teucrium chamaedrys,* and *Viburnum opulus* – exhibited significant phytotoxicity at even the lowest rate.

Dimethenamid-p + Pendimethalin Crop Safety

From 2007 to 2023, IR-4 completed 726 trials on Freehand 1.75G (BAS 659 G; dimethenamid-p + pendimethalin). The data contained in this report was generated to register uses of dimethenamid-p + pendimethalin on and around environmental horticulture plants with broadcast applications, including over the top of established plants. The Freehand rates in this testing program were 2.65, 5.3, and 10.6 pounds active ingredient per acre (lb ai per A) as the 1X, 2X and 4X rates. Freehand 1.75G had been applied to 211 plant genera or species. Of these genera and species, 120 exhibited no or minimal transient injury after application at all three rates. Fourteen (14) crops exhibited little or no phytotoxicity at 2.65 lb ai per acre but did have some injury at 5.3 and/or10.6 lb ai per acre or showed injury after the second application. Twenty (20) genera or species exhibited damage at the lowest rate sufficient to recommend growers not utilize Freehand 1.75G as an over-the-top treatment for pre-emergent weed control. Thirteen (13) crops exhibited variable responses sufficient to recommend further testing of specific species or cultivars. Of the 47 crops which IR-4 has screened in under 3 trials, BASF has sufficient information to include 18 crops on the Freehand 1.75G label. Additional trials are indicated to establish species or cultivar sensitivities for the remaining crops.

Flutianil Crop Safety

Flutianil is a new fungicide being developed by OAT Agrio for the control of powdery mildew on environmental horticulture crops. The IR-4 Project completed 36 crop safety trials on 15 environmental horticulture plant species or genera during 2018 to 2021. Seven species (*Begonia sp., Coreopsis sp., Gerbera sp., Hydrangea sp., Rosa sp., Syringa sp., Viola x wittrockiana*) exhibited minimal or no injury in 3 trials and six species or genera exhibited minimal or no injury in the limited number of trials (one or two) for each crop. One species, *Saintpaulia ionantha*, showed no phytotoxicity on foliage but some phytotoxicity on open blooms. Zinnia in 2 trials exhibited no injury, but in a third trial injury was observed after the second application. Additional trials are warranted for both crops.

Isoxaben + Dithiopyr Crop Safety

Fortress (isoxaben + dithiopyr) was registered in 2018 for environmental horticulture crop uses. Between 2018 and 2022, IR-4 examined 27 crop species / genera to expand this label to other crops. Of these, 7 crop species exhibited no or transient injury. One species exhibited significant injury from isoxaben + dithiopyr at the 1X rate (*Digitalis grandiflora*).

Liverwort Efficacy

Liverworts (*Marchantia sp*.) are difficult to manage during the production of perennial environmental horticulture crops grown in containers. Liverworts are among the most serious weeds of container grown ornamentals. During the 2004 and 2009 IR-4 Environmental Horticulture Workshops, a project was prioritized to screen for products to manage post-emergent liverwort in container grown ornamentals grown primarily under cover in greenhouses or hoop houses, use sites with very few registered herbicides. Since then, liverwort has been selected as a regional research priority. Between 1976 and 2021, IR-4 sponsored 302 research trials on 37 products or product formulations with 29 actives to manage liverwort. Most research was conducted

with post-emergent applications, but active ingredients typically known for pre-emergent activity were included in some post-emergent experiments along with three experiments designed to screen for pre-emergent liverwort management.

The most effective options across these studies include Avenger Ag, baking soda, Byrophyter, Racer, Scythe, SureGuard, Tower (pre-emergent), V-10233, and WeedPharm. However, Marengo when applied pre-emergently when no liverworts were initially present did provide excellent prevention. Ronstar, Neudorff's Granular Moss Killer, Terracyte and Xeroton had variable efficacy as post emergent applications, but many of these contact products may need more frequent applications for optimal efficacy. The results from this project have successfully identified several options for pre and postemergent control of liverwort.

Mealybug Efficacy

Managing mealybugs and scale 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 often targeting stems or leaf petioles not readily accessible due to dense foliage. 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 insecticides for mealybugs to add additional species to existing registrations and screen new active ingredients. Over time, mealybug efficacy has been re-established as high priority at subsequent workshops (2019, 2021). This research was conducted between 2004 and 2022. This summary contains outcomes from 32 experiments established to screen new active ingredients for impact on mealybugs.

Across crop and mealybug species, the products with the most impact on populations include ISM-555, TriStar, Orthene, Pradia, Safari, Talus, Flagship, Rycar, A169018, Aria, Kontos, and Ventigra. MBI 205, TetraCURB Concentrate, and SP3014 also provided acceptable reductions in populations. Seven different mode of action groups are represented. There is the opportunity to include mealybugs on active ingredients that are not yet registered for mealybugs and expand currently registered labels with additional mealybug species.

Mefentrifluconazole Crop Safety

Avelyo (mefentrifluconazole) is a fungicide developed by BASF that has been registered for use since May 2020. It is used for the control of diseases such as anthracnose, powdery mildew, leaf spot, scab, rust, and blight of environmental horticulture crops. The IR-4 Project has completed 90 crop safety trials on 26 environmental horticulture plant species or genera during 2019 to 2022. This summary contains data across all reports available through IR-4 since 2019.

Twenty-six species or genera exhibited no or minimal injury after drench or foliar treatments of Mefentrifluconazole. Eighteen of the tested plants exhibited no injury across multiple trials, while the remaining eight plants showed the same with less than 3 trials. All twenty-six species or genera could be added to the label based on this data, provided that BASF has similar results.

Nutsedge and Sedge Efficacy

Nutsedges and sedges (*Cyperus sp*.) are difficult to manage during the production of perennial environmental horticulture crops grown in containers or in the field. During the 2006 IR-4 Environmental Horticulture Workshop, a project was prioritized to screen for efficacious products to manage sedge and nutsedge in container or field grown environmental horticulture crops. Between 2007 and 2023, IR-4 evaluated a diverse group of products for pre- and post-emergent control of several sedges and nutsedges. During this time, IR-4 sponsored 84 research trials on 28 products or product formulations with 20 actives to manage sedges and nutsedge. Most research was conducted with pre-emergent herbicides.

The most effective options across these studies where IR-4 has at least 3 experiments include Pennant Magnum, SedgeHammer, Tower, and V-10142 for yellow nutsedge management. However, the IR-4 dataset is

limited, and several products tested show promise for managing annual sedges, rice flatsedge, purple nutsedge or compressed sedge.

Oxathiapiprolin Crop Safety
Oxathiapiprolin was registered as Segovis in the United States in 2017 for disease control on ornamental horticulture plants in greenhouse and nurseries. The commercial label contains a general list of 17 crop groups that cover virtually all environmental horticulture crops. From 2015 through 2019, the IR-4 Project completed 33 trials on 19 plant species or genera examining phytotoxicity related to drench applications of Segovis. In these trials, all species or genera exhibited minimal or no injury after drench applications. These results confirm Segovis may be used effectively for disease control across multiple crops with minimal impact on plant growth or quality.

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, Pythium* and *Phytopythium.* The IR-4 Project completed 85 crop safety trials on 16 environmental horticulture plant species or genera between 2018 and 2023. In these trials, 15 of 16 species or genera exhibited no or minimal injury. Twelve species or genera exhibited no injury in at least 3 trials. One genera, *Rosa sp*, exhibited moderate injury in one trial after two consecutive biweekly foliar applications of Picarbutrazox SC. The remaining three species or genera exhibited no or minimal injury in the limited number of trials (one or two) for each crop.

Powdery Mildew Efficacy
Powdery mildew is a highly recognizable disease with pronounced colonies of white on foliage and, for some species, on petals. Due to the high number of spores produced, powdery mildews often develop resistance quickly to fungicides. Starting in 2012, IR-4 initiated a series of regional projects to examine new fungicides and biofungicides for powdery mildew management. In addition, we performed a literature review. Contained in the project summary are outcomes from 96 experiments conducted in greenhouses and or outdoors. Specific powdery mildew pathogens included: *Erysiphe azaleae, Erysiphe knautiae, Erysiphe lagerstroemia, Erysiphe lonicerae var. lonicerae, Erysiphe monardae, Erysiphe polygoni, Erysiphe pulchra, Golovinomyces cichoracearum, Golovinomyces orontii, Oidium* spp., *Podosphaera pannosa,* and *Podosphaera xanthii*. Across species, the best performing products and actives included Aveylo, Bayleton, Broadform, Gatten, Heritage. Magus. Mural, NF-149 (cyflufenamid), SP2478, and XDE-659.

Prodiamine + Isoxaben Crop Safety
Prodiamine + Isoxaben (Gemini G) is a herbicide combination developed by ICL Specialty Fertilizers for pre-emergent control of grasses and broadleaf weeds on environmental horticulture crops. The IR-4 Project completed 85 crop safety trials on 29 environmental horticulture plant species or genera between 2017 and 2023. In these trials, five species (*Campanula sp., Euonymus alatus, Nepeta x fassiana, Quercus virginiana, Rosa sp.*) exhibited no injury after over-the-top applications in a minimum of 3 trials; *E. alatus* and *N. fassiana* can be added to a list of tolerant plants in the new label for this product. Three species (*Phlox paniculata, Sedum acre, Sedum rupestre*) exhibited damage at the 1X rate sufficient to recommend growers not utilize Gemini G as an over-the-top treatment for pre-emergent weed control.

Pydiflumetofen + Difenoconazole Crop Safety
Postiva (pydiflumetofen + difenoconazole) is a new fungicide registered by Syngenta for the control of foliar diseases of environmental horticulture crops. The IR-4 Project completed 43 crop safety trials on 18 environmental horticulture plant species or genera during 2019 to 2022. In addition, crop safety data were collected during efficacy experiments. Across all crops tested, Pydiflumetofen + difenoconazole generally

exhibited no or minimal negative impact. Seven crops were not injured after drench or foliar applications; while *Begonia semperflorens* did not display visible chlorosis or necrosis, but plants at the 4x rate were significantly shorter in one trial. For three crops, more information will be needed to determine response because outcomes have been variable from no impact to significant injury, six crops have been screened in less than three trials.

Rhizoctonia Efficacy

From 1999 to 2023, 44 products or active ingredients were evaluated for *Rhizoctonia solani* management in greenhouse experiments as soil drench, soil incorporation, foliar or soak application, and in field experiments as soil drenches. Experiments were conducted on begonia, boxwood, chrysanthemum, dianthus, garden impatiens, juniper, maple, marigold, petunia, poinsettia, rhododendron, snapdragon, viburnum, vinca, 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 (pyraclostrobin + boscalid*)* showed excellent efficacy. For those not yet registered for this disease, sufficient efficacy was observed with Astun, Avelyo, BAS 673, MBI-121, and SP2478 to recommend adding *R. solani* to target pathogens. SP2700 shows promise as part of an overall resistance and disease management plan.

S-Metolachlor Crop Safety

From 2004 to 2022, IR-4 completed 231 trials on Pennant Magnum (s-metolachlor). The data contained in this report was generated to register uses of s-metolachlor on and around environmental horticulture plants with over-the-top applications. The s-metolachlor rates in the testing program were 2.5, 5.0, and 10.0 pounds active ingredient per acre (lb ai per A) as the 1X, 2X and 4X rates with 4, 6, or 8 week intervals between applications. Pennant Magnus has been applied to 97 plant genera or species. Of these, 12 plant species exhibited no or minimal transient injury after application at all three rates. Ten (10) crops exhibited no phytotoxicity at 2.5 lb ai per acre but did have some injury at 5.0 and/or 10.0 lb ai per acre. Twenty-five (25) crops exhibited significant phytotoxicity at even the lowest rate. For nine crops, the response among sites was variable, and 41 crops have less than three trials completed.

Scale Efficacy

Managing scale 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. 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 2022, and this summary contains outcomes from 85 experiments received through the IR-4 Environmental Horticulture Program. Across the 24 scale species screened, the most efficacious products included ISM-555, RTSA-721, XXpire, horticultural oils, Talus, Rycar, Distance, Safari, Ventigra, dimethoate. Kontos, Tristar, Altus, Flagship, Mainspring, and Marathon also reduced populations. However, sensitivities across species varied by product and application method.

SP1770 Crop Safety

SP1770 was a new herbicide being developed by SePro. The IR-4 Project completed 41 crop safety trials on 29 environmental horticulture plant species or genera during 2016 to 2019. In these trials, 16 of the 29 species or genera tested exhibited significant injury in the limited number of trials (one or two) for each crop.

SP2478 Crop Safety

SP2478 is a new fungicide being developed by SePro for the control of diseases on environmental horticulture crops such as powdery mildew and other diseases. The IR-4 Project completed 21 crop safety trials on 9

environmental horticulture plant species or genera from 2020 through 2022. SP2478 was applied either as a foliar spray or as a drench into soilless media. In these trials, all eight species or genera treated with foliar sprays exhibited minimal or no injury in the limited number of trials (one or two) for each crop.
When SP2478 was applied as a drench application in seven species or genera, all of these seven species or genera exhibited minimal or no injury in one or two trials for each crop.

Triticonazole Crop Safety
Triticonazole was registered as Trinity 2SC in the United States in 2007 as a turf fungicide. Trinity SC was expanded to environmental horticulture diseases in 2013. Because triticonazole is in the triazole class, it could cause symptoms similar to plant growth regulators and testing was warranted on additional herbaceous and woody perennial species. Between 2010 and 2017, the IR-4 Project completed 187 trials on 42 plant genera or species examining phytotoxicity related to foliar applications of Trinity 2SC. In this report, 32 species or genera exhibited minimal or no injury after foliar treatments of Trinity 2SC (triticonazole) at 6, 12 and 24 fl oz per 100gal; 20 of these are already on the label. We recommend that the following 12 species or genera be added to the current label: *Alyssum sp, Buxus sp., Chaemerops humilis, Cornus sp., Dahlia sp., Gaillardia x grandiflora, Hedera helix, Ilex sp., Lantana sp., Pseudotsuga menziesii, Osteospermum sp*. and *Salvia officinalis*.

ATTACHMENT 7 - 2023 Environmental Horticulture Program Research Activities

Discipline	Project	Researchers	Crops	Products	Trials
Entomology	Borer & Beetle Efficacy	2	2	7	15
	BW280 Crop Safety	3	3	1	4
	BW400 Crop Safety	7	6	1	14
	Cyclaniliprole/Flonicamid	4	5	1	5
	Cyclaniliprole Crop Safety	5	4	1	7
	ISM-555 Crop Safety	5	7	1	7
	Mealybug Efficacy	4	3	9	42
	Mite (not spider mites) Efficacy	1	1	13	13
	Neem oil + Azadiractin Crop Safety	2	2	1	2
	Peppermint oil, clove oil, and sodium lauryl sulfate (NI02ES-1) Crop Safety	4	6	1	9
	Rosemary Oil Crop Safety	4	5	1	8
	Scale Efficacy	3	2	8	29
	SP3014 Crop Safety	1	1	1	1
	Thrips Efficacy	2	2	6	12
	V-10433 Crop Safety	2	2	1	2
Pathology	Botrytis Efficacy	3	2	13	36
	BW159 Crop Safety	3	6	1	13
	F6123 Crop Safety	3	4	1	10
	Florylpicoxamid (XDE-659) Crop Safety	5	9	1	12
	Fluazaindolizine Crop Safety	1	1	1	1
	Fluopyram + Trifloxystrobin Crop Safety	2	3	1	4
	Flutianil Crop Safety	3	4	1	4

	Fusarium Efficacy	2	1	7	14
	Mandestrobin Crop Safety	2	4	1	4
	Mefentrifluconazole (BAS 750) Crop Safety	5	7	1	17
	Myrothecium Efficacy	1	1	13	13
	Nematode Efficacy	1	2	5	5
	Phytophthora Efficacy	3	3	8	20
	Picarbutrazox Crop Safety	7	7	2	12
	Pyriofenone (IKF-309) Crop Safety	8	9	1	12
	Pythium Efficacy	2	2	7	14
	Rhizoctonia Efficacy	2	2	10	18
	SP2478 Crop Safety	5	6	1	11
	SP2700 Crop Safety	2	5	1	11
	TDA01 Crop Safety	3	3	1	3
	Thyme Oil Crop Safety	4	4	1	8
Weed Science	Dimethenamid-p + Pendimethalin Crop Safety	9	21	1	26
	Dimethenamid-p Crop Safety	6	15	1	20
	Dithiopyr Crop Safety	3	3	1	3
	Fatty Acid Herbicide Use Directions	1	1	2	2
	Flumioxazin + Prodiamine Crop Safety	3	8	1	8
	Flumioxazin Crop Safety	7	7	1	10
	General Weed Efficacy	3	1	12	21

Isoxaben + Dithiopyr Crop Safety	7	10	1	14
Isoxaben Crop Safety	1	1	1	1
Nostoc Efficacy	2	1	8	16
Nutsedge & Sedge Efficacy	1	1	3	3
Oxyfluorfen + Pendimethalin Crop Safety	10	8	1	24
Pendimethalin Crop Safety	7	14	1	20
Prodiamine + Isoxaben Crop Safety	9	12	1	18
Prodiamine Crop Safety	1	1	1	1
S-Metolachlor Crop Safety	8	16	1	21
SP1182/SP1190 Crop Safety	2	3	1	3
Spurge Efficacy	1	1	5	5
Trifluralin + Isoxaben Crop Safety	1	2	1	2

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