The IR-4 Program: Helping the U.S. Blueberry Industry Control High-Priority Insect, Disease, and Weed Pests

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Abstract

For over forty years, the IR-4 Project (Interregional Research Project 4) has been the primary avenue for obtaining new pest management tools for specialty crop growers, through a process of developing field residue data to support new EPA tolerances and labeled pesticide uses. In many cases, the agricultural chemical industry cannot justify the time and expense required to research much-needed crop protection products on these high-value crops, therefore IR-4 steps in to fulfill this need. Through a formal process, the blueberry industry, university pest management specialists, and IR-4 personnel have worked together to prioritize research by IR-4. These efforts have led to new EPA registrations for the blueberry industry, enhancing adoption of reduced-risk integrated pest management (IPM) strategies. We will describe how grower pest management priorities from major blueberry production regions in the United States are used to generate data that support successful applications for IR-4 residue studies. We will highlight examples of how this process has been used to provide blueberry growers with some recently-registered reduced-risk pesticides. These new pest management tools enable growers to continue delivering economic yields of highest-quality berries while also minimizing the environmental impact of blueberry production.

INTRODUCTION

The cultivated blueberry industry (highbush and rabbiteye cultivars) in the United States produced 283.5 million pounds of fruit on 52,120 acres in 2007, destined for the fresh and processed markets (USDA-NASS, 2008). In terms of bearing acreage, the top states for this crop are Michigan (18,500 acres), New Jersey (7,600 acres), Georgia and Oregon (4,500 acres each), North Carolina (4,200 acres), and Washington (3,700 acres). The lowbush blueberry industry is concentrated in Maine, where it covers approximately 60,000 acres and produced 76.9 million pounds during 2007 (Anon. 2008). Throughout the blueberry industry in the United States, growers contend with insect, disease, and weed pests that must be managed to produce high yields of fruit that will pass inspection by buyers and also retain good quality before consumption. Control of these pests often requires the use of pesticides, but agrochemical companies generally consider blueberry to be a minor crop (less than 300,000 acres) and not a large enough market to justify the investment needed to register a new compound. Since its formation in 1963, the IR-4 Project has been charged with assisting minor crop producers by identifying priority pest management tools, conducting field residue trials to support registration requests for these tools, and then providing the Environmental Protection Agency (EPA) with the petition for a new tolerance and label. Through its activities, the IR-4 Project contributes

$7.7 billion to the annual U.S. economy through the improved value and productivity of the $43 billion minor crop sector of agriculture (Miller, 2007).

To maximize the availability of pest management tools for the blueberry industry, commodity representatives and university researchers have been engaged with the IR-4 Project over the past several years. This is an essential component of a long-term strategy to ensure that pest management challenges can be met in the future. Uncertainties related to the development of pest resistance and possible government restrictions on pesticides coupled with the continued push toward fruit produced using IPM, sustainable, or environmentally-friendly practices highlight the need for safe and effective pest control strategies. Many of the more recently-developed pesticides can provide benefits for producers including improved resistance management, greater selectivity for the target pest, and lower risk to the environment and to workers.

IR-4 PRIORITY-SETTING

The IR-4 Project holds a Food Use Workshop meeting in September each year, attended by University Extension personnel, commodity group representatives, growers, agrochemical company representatives, and IR-4 personnel. In advance of this meeting, IR-4 encourages the submission of new Pesticide Clearance Requests (PCRs) for pesticides that researchers or commodity leaders consider registration priorities for minor crops. Scientists from Michigan State University, Oregon State University, University of Maine, Rutgers University, University of Florida, North Carolina State University and Washington State University have partnered with their regional blueberry industries to conduct product evaluation trials each year as a means of identifying the most effective new pesticides to target key insect, weed, and disease pests. These results provide the basis for submission of knowledge-based PCR's to IR-4.

Prior to the Food Use Workshop each year, blueberry researchers and commodity leaders across the country exchange information on the most promising new products for insect, disease, and weed control. Using knowledge of the registered pesticides and those expected within the next few years, the current blueberry pest issues, and the gaps in ability to control key pests, a consensus is developed on which pesticides to promote for conducting the residue trials needed to establish a tolerance and secure a registration. These priorities are used to make a case at the Food Use Workshop for blueberry projects to be included in subsequent residue trials. Only those projects considered to be a high priority need by those at the meeting will receive an A-priority, and will then be tested in field trials.

Gaining A-priorities for blueberry projects has been possible for a number of pest management needs in recent years, through coordinated planning and engagement in the Food Use Workshop. The chances of success within the priority setting framework are higher if these components can be demonstrated:

a) efficacy of the pesticide against key pest(s)
b) support from the manufacturer for registration
c) support from the commodity representative
d) support from multiple US regions where the crop is grown

Following this approach, some important new pest management tools have been registered for use in blueberry in the past five years. These provide growers with the ability to control key pests for which they may be losing standard pesticides, increased choice of different modes of action providing greater opportunities for pesticide resistance management, and improved worker and environmental safety.

IR-4 RESIDUE TRIALS

Once a pesticide is selected as an A-priority, plans are formulated to conduct field residue trials to develop the data set needed to establish a tolerance for that pesticide based on prescribed field rates, typical use patterns, and pre-harvest intervals for the

compound. A pesticide tolerance is the maximum amount of residue that is legally allowed on the crop at harvest and is determined by toxicological risk models and by the results of field residue trials. IR-4's field residue trials for each pesticide and crop combination are distributed across the country to regions that are representative of current national acreage patterns for the specific crop. After pesticide applications are made, crop samples are harvested and analyzed for the given pesticide in an appropriate analytical facility. These trials are conducted under EPA's GLP (Good Laboratory Practice) protocols to ensure the reliability of the resulting data. Data are summarized by IR-4 study directors and collated in preparation for submission to the EPA.

BLUEBERRY PESTICIDE REGISTRATIONS THROUGH IR-4

Below, we highlight some key pesticides that were registered by EPA using blueberry residue studies conducted by IR-4, in response to the priority-setting process described above (Table 1).

Insect management

Growers must actively manage their plantings to ensure that they harvest fruit with no detectable insect parts, and this is achieved through IPM programs that include monitoring, scouting, and judicious use of pesticides when needed. The U.S. EPA is mandated to re-evaluate registrations of broad-spectrum insecticides, including azinphosmethyl (Guthion) that growers currently depend upon in some regions for control of lepidopteran pests. The registration of tebufenozide (Confirm) and, more recently, methoxyfenozide (Intrepid) in blueberry has been a direct result of IR-4 projects. These insecticides are highly selective to Lepidoptera, have little impact on natural enemies, and have high safety to humans and the environment. Tebufenozide is used on approximately 30% of the blueberry acreage in Michigan, and we expect it to be an important component of growers' IPM programs in the future as they adapt to increasing restrictions on broad-spectrum insecticides. In recent years, IR-4 has also provided data to enable registration of fenpropathrin (Danitol), imidacloprid (Provado and Admire), acetamiprid (Assail), pyriproxyfen (Esteem), spinosad (SpinTor and Entrust), thiamethoxam (Actara and Platinum), and spinetoram (Delegate). In the near future, data generated by IR-4 are expected to support the registration of bifenthrin (Capture and Brigade) and indoxacarb (Avaunt), and other studies are underway for flubendiamide (Belt), metaflumizone (Alverde), and novaluron (Rimon).

Disease management

Various diseases caused by fungal organisms can be found in U.S. blueberry-growing regions. With about half the U.S. cultivated blueberry crop destined for the fresh market, achieving and maintaining high fruit quality from the field, through shipping, to store displays is particularly important. Anthracnose (ripe rot), caused by *Colletotrichum acutatum,* (Penz.) Penz & Sacc. is a common and often serious disease that affects fruit quality and marketable yield. The disease appears on fruit prior to harvest and as a post-harvest fruit rot, causing fruit to soften as it ripens. Under warm and moist conditions, salmon-colored spore masses form on infected berries. Even with proper irrigation management and a diligent spray regime, this disease can cause great economic loss. Field testing identified a new, effective chemical treatment for this disease and with assistance from the IR-4 Project, azoxystrobin (Abound) was granted a registration for use in blueberry. This reduced-risk pesticide has been widely accepted by growers, fits well into an integrated disease management program, and has helped reduce economic losses due to anthracnose. IR-4 has also provided data to enable the registration of cyprodinil + fludioxonil (Switch), fenbuconazole (Indar), fenhexamid (Elevate), fosetyl-Al (Aliette), pyraclostrobin (Cabrio), and pyraclostrobin + boscalid (Pristine). In the near future, data generated by IR-4 are expected to support the registration of fluazinam (Omega), metconazole (Caramba), and thiophanate-methyl (Topsin-M).

Weed management

Having no root hairs and a shallow root system, the blueberry plant generally does not compete well with weeds for moisture and nutrients, making weed management a key component in blueberry production. The IR-4 Project has initiated and completed several residue studies for herbicides that have resulted, or will result, in new herbicide chemistries for use in blueberry. IR-4 has enabled the re-registration of diuron (Karmex) and terbacil (Sinbar) by conducting residue trials that generated the residue data required by EPA. IR-4 has also conducted trials to support registration of glufosinate (Rely), clethodim (Select), clopyralid (Stinger), rimsulfuron (Matrix), sulfentrazone (Spartan), and tribenuron-methyl (Express) which is only for use in lowbush blueberry. Of the herbicide projects still in progress, one is a reduced-risk pesticide (s-metolachlor/Dual) and one is classified as a methyl-bromide alternative (halosulfuron/Sandea). A tolerance for flumioxazin (Chateau) has been established and a supplemental label has been approved for use in blueberry during the 2008 field season.

CONCLUSIONS

The IR-4 program provides an essential service to minor crop industries in the United States by enabling registration of pesticides to control key insect, disease, and weed pests. The blueberry industry has joined with Land Grant university scientists to successfully engage in the IR-4 priority-setting process, and through this effort growers have access to registered pesticides that allow improved management of key pests. Continued interaction between the IR-4 program, the blueberry industry, and the pest management research community is expected to enhance the ability of producers to continue to maintain pests below economic thresholds.

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Tables

Table 1. Pesticides registered for use by the U.S. blueberry industry through the IR-4 Program.

Pesticide	Trade Name(s)*	Chemical class	Priority pests controlled
Insecticides			
Acetamiprid	Assail	Neonicotinoid	Fruitworms, blueberry maggot, blueberry aphid
Fenpropathrin	Danitol	Pyrethroid	Fruitworms, beetles
Imidacloprid	Provado 2F	Neonicotinoid	Blueberry aphid, Japanese beetle, blueberry maggot
Imidacloprid	Admire	Neonicotinoid	Japanese beetle, Oriental beetle
Pyriproxifen	Esteem	Insect growth regulator	Scale, fruitworms
Spinosad	SpinTor/Entrust	Spinosyn	Fruitworms, other Lepidoptera, blueberry maggot
Tebufenozide	Confirm 2F	Insect growth regulator	Cranberry fruitworm, cherry fruitworm, other Lepidoptera
Thiamethoxam	Actara	Neonicotinoid	Blueberry aphid, Japanese beetle, blueberry maggot
Thiamethoxam	Platinum	Neonicotinoid	Japanese beetle, Oriental beetle
Fungicides			
Azoxystrobin	Abound	Strobilurin	Alternaria fruit rot, anthracnose
Captan	Captan	Phthalimide	Botrytis blight, mummy berry, Alternaria fruit rot, anthracnose
Cyprodinil + fludioxonil	Switch	Anilinopyrimidine + Phenylpyrrole	Botrytis blight, Alternaria fruit rot, anthracnose
Fenbuconazole	Indar	Triazole	Mummy berry
Fenhexamid	Elevate	Hydroxyanilide	Botrytis blight
Fosetyl-Al	Aliette	Phosphonate	Phytophthora root rot
Pyraclostrobin	Cabrio	Strobilurin	Alternaria fruit rot, anthracnose
Pyraclostrobin + boscalid	Pristine	Strobilurin + Pyridinecarboxamide	Botrytis blight, alternaria fruit rot, anthracnose, mummy berry
Ziram	Ziram Granuflo	Dithiocarbamate	Botrytis blight, mummy berry, Alternaria fruit rot, anthracnose
Herbicides			
2,4-D	Saber	Phenoxy	Selective, foliar-active for broadleaf weeds
Diuron	Karmex	Phenylurea	Soil-active for grass and broadleaf weeds
Glufosinate	Rely	Organophosphorus	Non-selective, foliar-active for grass and broadleaf weeds
Terbacil	Sinbar	Uracil	Soil-active for grass and broadleaf weeds

* Pesticides may have additional trade names.