AgInfomatics

The Value of Neonicotinoids in Turf and Ornamentals:

A Case Study of Neonicotinoid Use for Controlling Silverleaf Whitefly in Ornamentals

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This report series, researched and produced by AgInfomatics, LLC, is a comprehensive analysis of the economic and societal benefits of nitroguanidine neonicotinoid insecticides in North America. The research was sponsored by Bayer CropScience, Syngenta and Valent in support of regulatory review processes in the United States and Canada, with Mitsui providing additional support for the turf and ornamental studies.

AgInfomatics, an agricultural consulting firm established in 1995 by professors from the University of Wisconsin-Madison and Washington State University, conducted independent analyses exploring the answer to the question: *What would happen if neonicotinoids were no longer available?* Comparing that answer to current product use revealed the value of neonicotinoids.

Robust quantitative and qualitative study methods included econometrics modeling of insecticide use, crop yield data and market impacts; surveys of growers, professional applicators and consumers; regional listening panel sessions; and in-depth case studies.

Active ingredients in the study included clothianidin, dinotefuran, imidacloprid and thiamethoxam.

The Value of Neonicotinoids in North American Agriculture

Reports include:

Estimated Impact of Neonicotinoid Insecticides on Pest Management Practices and Costs for U.S. Corn, Soybean, Wheat, Cotton and Sorghum Farmers

Methods and Assumptions for Estimating the Impact of Neonicotinoid Insecticides on Pest Management Practices and Costs for U.S. Corn, Soybean, Wheat, Cotton and Sorghum Farmers

Value of Insect Pest Management to U.S. and Canadian Corn, Soybean and Canola Farmers

A Meta-Analysis Approach to Estimating the Yield Effects of Neonicotinoids

An Economic Assessment of the Benefits of Nitroguanidine Neonicotinoid Insecticides in U.S. Crops

A Summary of Grower and Agri-Professional Perspectives From Regional Listening Sessions in the United States and Canada

A Case Study of Neonicotinoid Use in Florida Citrus

A Case Study of Neonicotinoid Use in Mid-South Cotton

Executive Summary

The Value of Neonicotinoids in Turf and Ornamentals

Reports include:

Estimating the Economic Value of Neonicotinoid Insecticides on Flowers, Shrubs, Home Lawns and Trees in the Homescape

The Value of Neonicotinoids to Turf and Ornamental Professionals

A Case Study of Neonicotinoid Use for Controlling Chinch Bug in Florida St. Augustinegrass

A Case Study of Neonicotinoid Use for Controlling Emerald Ash Borer—The Naperville, Illinois, Experience

A Case Study of Neonicotinoid Use for Controlling Silverleaf Whitefly in Ornamentals

Executive Summary

For more information, please contact
AgInfomatics@gmail.com

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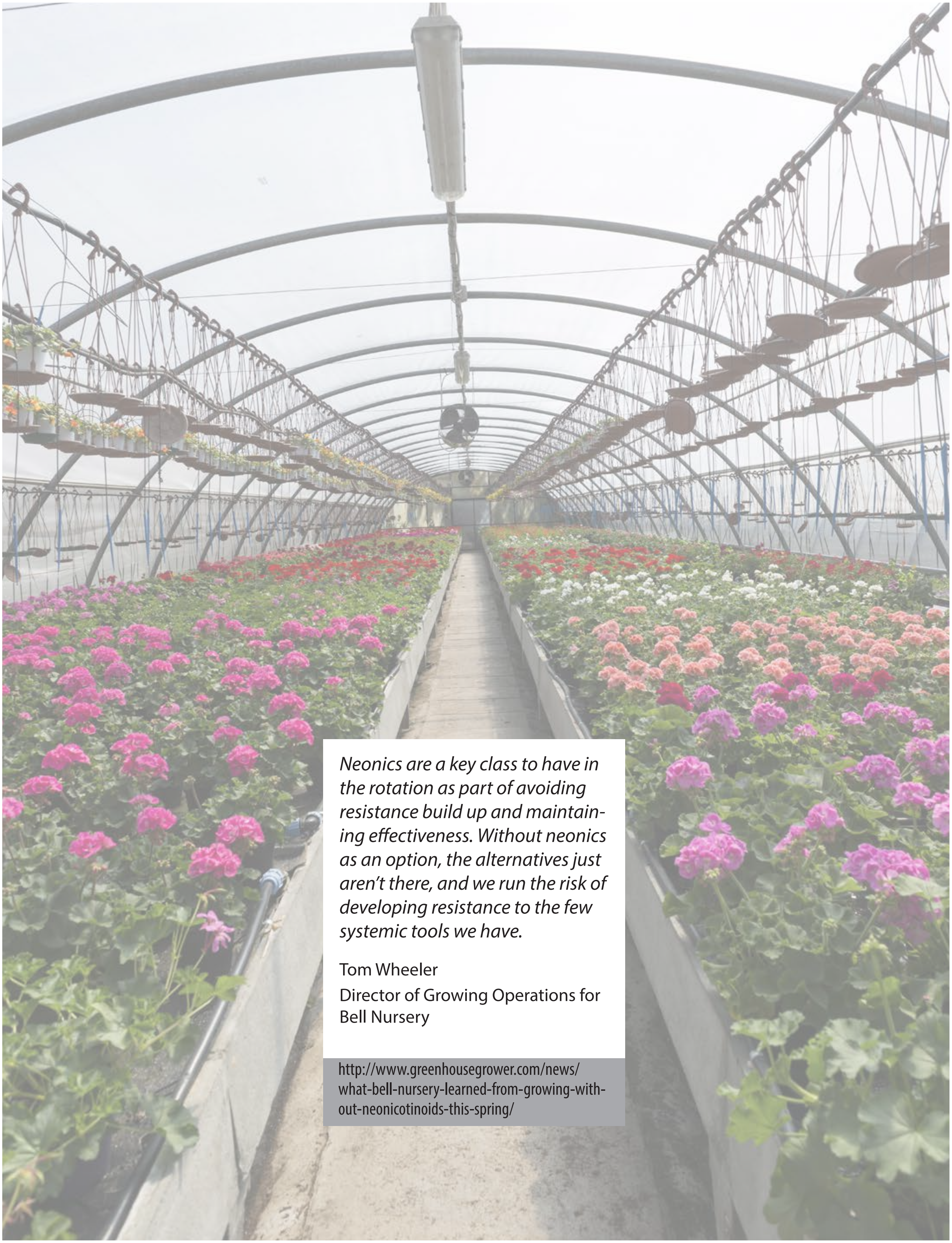


Neonics are a key class to have in the rotation as part of avoiding resistance build up and maintaining effectiveness. Without neonics as an option, the alternatives just aren't there, and we run the risk of developing resistance to the few systemic tools we have.

Tom Wheeler
Director of Growing Operations for Bell Nursery

http://www.greenhousegrower.com/news/what-bell-nursery-learned-from-growing-without-neonicotinoids-this-spring/

This case study briefly describes the floriculture and nursery industry and provides an important illustration of the essential role of neonicotinoids in successfully responding to the silverleaf whitefly, *Bemisia tabaci*. "Floriculture and nursery" includes the following types of crops: bedding plants, potted flowering plants, foliage plants, fresh-cut flowers, shrubs and trees.

1.0 Context and Background

The floriculture and nursery industry, also called the "green industry" or "environmental horticulture," is an economically significant part of American agriculture. The industry supplies plants grown for ornamental landscapes, which provide wildlife habitat and numerous ecosystem services. Nursery and floriculture crop receipts total approximately $11 billion annually in the United States according to the U.S. Department of Agriculture (USDA).[1] According to a report titled *Economic Contributions of the Green Industry in the United States* published by the Southern Association of Agricultural Experiment Station Directors in 2011, nursery and greenhouse production accounts for approximately 436,000 jobs in the U.S.[2]

Key characteristics of the industry relevant to this case study include the following:

Global industry. Many floricultural crops are imported to the U.S. from tropical and subtropical countries as vegetatively propogated "cuttings" and then planted and grown to maturity in the U.S. prior to being sold at nurseries, garden centers and flower shops. Rootstock and new varieties of trees and shrubs are also imported from plant breeders around the world. Because of the international nature of the industry, controlling new invasive pest species from entering the U.S. is crucial, as is the ability to control pests resulting from interstate commerce. Mitigation of the threat posed by invasive species typically requires the use of pesticides. The industry has worked hard to establish best practices that prevent the introduction and spread of invasive pests in the U.S.

High quality standards. Consumers buy plants and trees to make their homes, neighborhoods, businesses and public spaces more beautiful and environmentally friendly. Garden centers and consumers have high quality standards for plant material and will not purchase plants that are infested with pests or that appear unhealthy.

Economics. Flowers and plants are discretionary budget items, and increased costs cannot be readily passed on to consumers. Thus, higher production costs due to loss of plant material to pests would be challenging, particularly for smaller growing operations and could reduce floriculture and nursery plant production.

Environmental enhancement. Plants produced by the floriculture and nursery industries form a vital part of the urban environment. Flowers, shrubs and trees provide numerous environmental services, including reduced stormwater runoff, reduced home energy costs and improved wildlife habitat.

2.0 The Problem—Silverleaf Whitefly

The silverleaf whitefly, *Bemisia tabaci*, is one of the most damaging pests to many ornamental crops. They feed on a wide range of commonly-grown greenhouse crops, including poinsettia, gerbera daisy, hibiscus and mandevilla. They also infest other important agricultural commodities, including cotton, melons and squash.[3] Because whiteflies are ubiquitous on so many crops, the potential for resistance development to overused chemical classes is significant and of great concern to these industries.

The impact of whiteflies can be very significant. Whiteflies produce honeydew, which makes plant surfaces sticky and supports development of unsightly sooty mold. Whiteflies also transmit several damaging plant viruses.[4] Finally, their feeding degrades plant quality and can make plants unsalable.

Greenhouse-grown crops face even greater challenges from whiteflies than do some other agricultural segments and can be a source of spillover into other crops. With no life cycle suppression during cold months, whiteflies can go through six to seven life cycles in a heated greenhouse. As a result, whiteflies can evolve quickly to develop resistance to specific insecticides if chemistries are not rotated. Neonicotinoids are a key strategic component of rotation strategies.

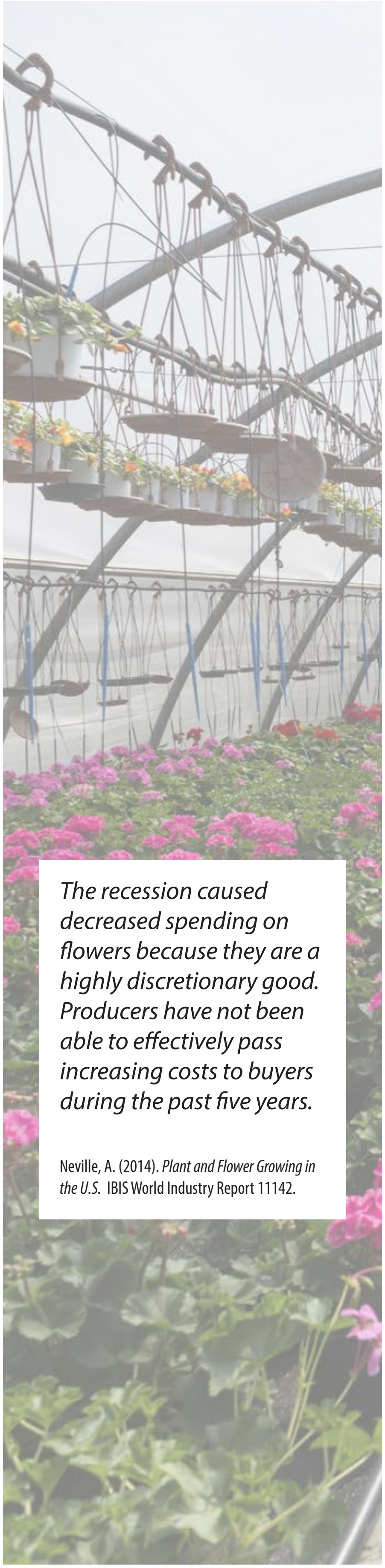
There are two major "biotypes" of silverleaf whitefly – B and Q. Biotypes are characterized by their resistance to certain insecticides.

The B-Biotype is believed to have originated in the Middle East. It was first introduced into the U.S. in the 1980s and soon afterward growers were faced with infestations of whiteflies that previously had been relatively easy to control, resulting in severe economic losses to greenhouse and agricultural crops in the 1990s.

Neonicotinoids were first registered in the U.S. in the 1990s and were quickly adopted as a replacement for organophosphates and systemic carbamate insecticides (e.g. Temik® and Vydate®), which had been withdrawn from the market. When the B-biotype was first detected in the 1980s, populations could typically be controlled with pyrethroid, organophosphate and carbamate insecticides. However, the pest quickly developed resistance to these chemical classes, and resistant populations spread throughout the U.S. Total control failures were common by the early 1990s, which caused major damage to floriculture and nursery operations and also to important field crops, such as vegetables and cotton. In 1992, the damage caused by this invasive pest was estimated to be in excess of $500 million in only four U.S. states (Arizona, California, Florida and Texas) in a single season.[5]

By rotating neonicotinoids and newly introduced insect growth regulators, agriculture was able to gain some measure of control over the B-biotype beginning in the mid-1990s. However, the B-biotype remains a significant pest in floriculture and nursery operations, cotton and several vegetable crops. Rotation of multiple chemistries is necessary to manage resistance.

Biotype-Q, with origins in the Mediterranean basin, is characterized by rapid resistance development and is currently resistant to many older insecticide classes (pyrethroids and organophosphates), to certain insect growth



The recession caused decreased spending on flowers because they are a highly discretionary good. Producers have not been able to effectively pass increasing costs to buyers during the past five years.

Neville, A. (2014). *Plant and Flower Growing in the U.S.* IBIS World Industry Report 11142.

regulators and neonicotinoids. The Q-biotype was first reported in the U.S. in 2005 when it was found on greenhouse plants in Arizona. Over the next several years, it was subsequently found in greenhouses in many other states. The U.S. cotton industry was particularly concerned about potential movement of this new biotype from greenhouse cuttings to field crops. As a result, the cotton, greenhouse and vegetable industries worked with the USDA and an international team of scientists to develop a management plan, which included the use of neonicotinoids. Neonicotinoids were and still are considered an essential component of an integrated pest management (IPM) approach to successfully manage the Q-biotype whitefly.

3.0 Use of Neonicotinoids to Control the Problem

Greenhouses and nurseries frequently use neonicotinoids to manage whiteflies and a wide range of other pests. Neonicotinoids can be particularly effective for controlling invasive pests where options are limited to slow their spread via other means.[6] Experts often recommend soil or container application of neonicotinoids as a primary tool for whitefly control because the products are absorbed by plant roots and move systemically to the foliage where whiteflies feed. Systemic control is often critical in floricultural and nursery crops where tight plant spacing makes it difficult to penetrate dense crop canopies with foliar sprays. Adequate canopy penetration is particularly important for whiteflies because they feed on the underside of leaves. In addition, systemic application provides longer lasting protection than foliar sprays. The systemic attributes of neonicotinoids can therefore reduce the volume and frequency of insecticide use and lower overall worker exposure to pesticides. Finally, neonicotinoids are less toxic than many older chemistries to the beneficial insects that help control whiteflies and other pests.

In addition to soil systemic application, neonicotinoids may also be applied as a foliar spray. When sprayed on plant foliage, neonicotinoids are valued for their translaminar property in which they can penetrate and move throughout the leaf. As a result, they provide more effective and longer lasting protection than older "contact" insecticides, which only kill pest insects through direct contact during application or when the insect contacts spray residues while moving over treated leaf surfaces. Due to their soil systemic and foliar translaminar properties and lower toxicity to many beneficial insects, neonicotinoids are often utilized as a core component of IPM programs. IPM integrates the use of scouting, cultural practices, biological control and insecticides and has been widely adopted in floriculture and nursery crops; many operations consider IPM practices to be critical to successful plant production.

4.0 Implications of Neonicotinoid Loss

Systemic neonicotinoids continue to be recommended as a key component of good management practices in the nursery and greenhouse industry[7] and reduce the application, volume and frequency of older broad-spectrum products. Additionally, neonicotinoids are less toxic to humans than many alternative products because they have a much higher affinity for binding receptor sites in insects than in mammals and other vertebrates. If the use

of neonicotinoids were restricted, nursery and greenhouse operators would have to turn to chemistries that are considered more toxic to human health, such as organophosphates.[7] Associations representing the nursery and greenhouse industries have expressed concern that the increased spraying of alternative pesticides that would be required if neonicotinoids were restricted would set back their progress in protecting worker safety.[8,9]

When used properly, neonicotinoids offer effective control of problem insects, such as silverleaf whitefly, while exhibiting less impact than several other chemistries on non target insects (including bees).[8] In using biological controls as part of an IPM program, it is recommended that growers phase out the use of pesticides that have longer-lasting wet residuals than neonicotinoids.[10]

Without neonicotinoids, existing quarantine requirements (e.g., for Japanese beetle and other domestic pests) mean that nurseries and greenhouses in some areas of the U.S. may lose the ability to sell to growers and consumers in other states. Neonicotinoids are a key component of pest management schemes both in the U.S. and at offshore production locations.

Limiting the industry's access to neonicotinoids could also hurt those exporting to the U.S. from developing nations, as well as their customers in the U.S., if exporters cannot ship pest-free products. In an alternative scenario, offshore producers could more heavily treat their products before sending them to the U.S., hastening the development of pest resistance to many chemicals.

Many ornamental plants (e.g. poinsettias) grown for indoor use – in houses, businesses and other places – never make it outside where pollinators might be exposed to them. Additionally, many plants grown for planting in outside landscapes are not bee-attractive or are treated long before they flower so they pose minimal risk to pollinators.

5.0 Main Insights From This Case Study

- Neonicotinoids are a critical tool for management of the silverleaf whitefly in greenhouse and nursery crops.
- Neonicotinoids are an important part of resistance management programs, which rely on rotation of products with different modes of action.
- The industry relies on neonicotinoids to control and prevent the spread of invasive and quarantine pests (and consequently, the diseases they transmit) both internationally and domestically, as well as to meet high quality standards required by consumers.
- Neonicotinoids play an important role in IPM programs that have been developed to reduce reliance on more toxic, broader spectrum foliar sprays and incorporate the use of biological controls.
- The systemic property of neonicotinoids is a primary reason they are beneficial to grower operations. The availability of non-neonicotinoid systemic insecticides is limited.

- Implications of neonicotinoid restrictions on the greenhouse and nursery industries include:
  - Loss of plant material
  - Higher production costs
  - Increased use of older insecticides
  - Greater worker exposure to insecticides
  - Faster development of pest resistance to insecticides
  - Increased risk of whitefly spread to other agricultural crops
  - Disruption of plant trade
  - Reduction of plant habitat in urban landscapes
  - Disruption of IPM and biocontrol programs

6.0 Footnotes

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