Turfgrass as a possible route for pollinator exposure to lawn applied imidacloprid

Jonathan M. Gunn, Undergraduate Research Scholar, Department of Animal and Dairy Science, Mississippi State University
James D. McCurdy, Assistant Professor, Department of Plant and Soil Sciences, Mississippi State University
David W. Held, Associate Professor, Department of Entomology and Plant Pathology, Auburn University

Introduction

- There are numerous routes for pollinator exposure to insecticides, not least of which includes treatments to flowering plants within home lawns and gardens.
- Beneficial insect exposure to insecticides via guttation, the exudation of xylem-transported sap, is a more recently identified route of exposure in corn and wheat (Reetz et al., 2011). Little is known of its role in other grass species, including those most common in southern turfgrass landscapes.
- Imidacloprid is a common neonicotinoid insecticide used for the control of turf and ornamental insect pests that can be translocated into guttation fluid, potentially harming non-target insects.

Photo 1. Pollinator safety within urban ecosystems is of increasing importance to food security and biodiversity.

Objective

Explore Turfgrass Guttation as a Possible Route for Pollinator Exposure to the Lawn Applied Insecticide Imidacloprid

Materials and Methods

- Turfgrass was harvested from the R.R. Foil Plant Science Research Center at Mississippi State University using a mechanical sod harvester (5 cm uniform soil depth). Sod was transferred to 0.129 m^2 perforated plastic greenhouse flats (6.4 cm depth). The experiment was conducted as a completely randomized design, with six treated and six non-treated experimental units (flats).
- Turfgrass was sub-irrigated with 1 L of either water, a dilute imidacloprid solution (0.079 mg imidacloprid / L), or foliar application (1.58 g/L) that is representative of a standard home-lawn application rate.

Photo 2. Leaf exudate or "guttation" is a recently identified route of pollinator exposure to pesticide residue.

- Guttation fluid was collected 48 hours after treatment (HAT; Photo 2) via vacuum apparatus attached to a 1000 mL pipette tip. Guttation was transferred to a 500 mL centrifuge tube. The remaining guttation was collected by paper towel and placed into sealed plastic bags to measure guttation mass as a proxy for volume.
- High performance liquid chromatography (HPLC) was initially used to identify suspected imidacloprid; however, analysis was unable to quantify amounts below 100 ppb. Therefore, three samples from each treatment were analyzed using mass spectrometry (MS) at the Mississippi State Chemical Laboratory.

Results and Discussion

- In 2014, guttation collected 48 HAT from sub-treated bermudagrass and St. Augustinegrass contained 15.8 (± 0.7) and 13.7 (± 8.8) ppb imidacloprid, respectively (Fig 1). In 2015, sub-treated bermudagrass contained 5.23 (± 3.4) ppb (Fig 1).
- In 2015, guttation collected from foliar treated bermudagrass contained 44.8 (± 35.6) ppb imidacloprid
- These concentrations are substantially less than concentrations reported to be lethal to the European honeybee and the insidious flower bug (LC_{50} 1760 and 5493 ppb, respectively; Cresswell, 2010).
- However, similarly low concentrations have been associated with sub-lethal effects in honey-bees (10 ppb; Reetz et al., 2011).

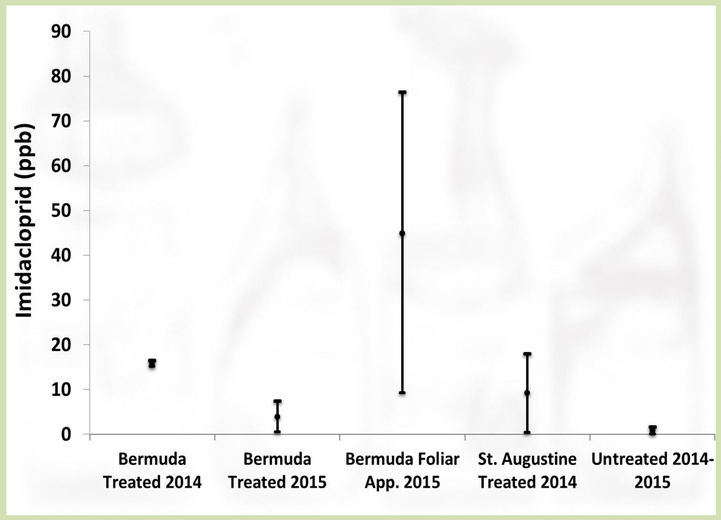

Figure 1. Imidacloprid concentrations recovered 48 hours after treatment, presented as mean estimates ± 95% confidence intervals. Overlapping CI's indicate lack of significant difference.

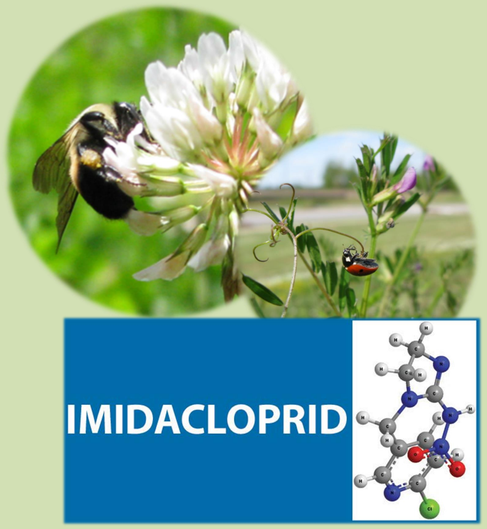

Figure 2. Imidacloprid is perhaps the most common preventative insecticide used in urban systems.

Future Research

Future research will evaluate imidacloprid concentrations of more commonly practiced foliar applications. Effects of detected imidacloprid upon caged bees should be evaluated.

Conclusions

- **Imidacloprid concentrations of treated bermudagrass and St. Augustinegrass were below concentrations reported lethal to the European honeybee and the insidious flower bug.**
- **However, imidacloprid concentrations were within amounts known to have sub-lethal effects in honeybees and the insidious flower bug – two common beneficial insects.**

References

Larson, J.L., Redmond, C.T., and Potter, D.A. (2014). *Mowing Mitigates Bioactivity of Neonicotinoid Insecticides in Nectar of Flowering Lawn Weeds and Turfgrass Guttation*.

Reetz, J.E., Zuhlke, S., Spitheller, M., Wallner, K. (2011). *Neonicotinoid insecticides translated in guttated droplets of maize and wheat; a threat to honeybees?*

Creswell, J.E. 2010. *A meta-analysis of experiments testing the effects of a neonicotinoid insecticide (imidacloprid) on honey bees*.

A quick video of the guttation harvest techniques used in this preliminary experiment can be found by scanning this QR code.