There are numerous recognized routes for pollinator exposure to insecticides, not least of which includes treatments to flowering plants within home lawns and gardens. However, 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. Little is known of its role in other grass species, including those most common in southern turfgrass landscapes. Imidacloprid is a common home and commercial neonicotinoid insecticide used for the control of turfgrass insect pests that can possibly be translocated into guttation fluid, potentially harming non-target insects.

An experiment was conducted to investigate the fate of soil applied imidacloprid within 'Tifway' hybrid bermudagrass (*Cynodon dactylon* × *C. transvaalensis*) and 'Palmetto' St. Augstinegrass (*Stenotaphrum secundatum*) to explore whether levels of imidacloprid translocated to guttation fluid exceeds levels that are reportedly toxic to foraging pollinators. A greenhouse experiment was conducted as a completely randomized design, with six treated and six non-treated experimental units of both turf species. Turfgrass was sub-irrigated with 1 L of either water or a dilute imidacloprid solution (0.59 mg imidacloprid / L) within 1.3 m^2 plastic flats, which is representative of a standard home-lawn application rate. Guttation fluid was collected 48 hours after treatment. Imidacloprid concentration was determined via mass spectrometry. Means are presented ± a 95% confidence interval (CI).

Guttation collected 48 hours after treatment from bermudagrass and St. Augustinegrass contained 15.8 (± 0.7) and 13.7 (± 8.8) ppb imidacloprid, respectively, which is substantially less than concentrations reported to be lethal to the European honeybee and the insidious flower bug (LC_{50} 1760 and 5493 ppb, respectively). However, measured concentrations are similar to those associated with sub-lethal effects in honey-bees (10 ppb). Future research will evaluate imidacloprid concentrations of more commonly practiced foliar applications.

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

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There are numerous recognized 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 home and commercial neonicotinoid insecticide used for the control of turfgrass insect pests that can possibly be translocated into guttation fluid, potentially harming non-target insects. Our objective was to explore guttation as a possible route for pollinator exposure to the lawn applied insecticide imidacloprid.

Introduction

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 1.3 m^2 perforated plastic flats (6.4 cm depth) and allowed 1 week to acclimate to a field environment. 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 or a dilute imidacloprid solution (0.059 mg imidacloprid / L) representative of a standard home-lawn application rate. Guttation fluid was collected 48 hours after treatment using a vacuum line connected to a 500 µL pipette tip. Approximately 20 µL was collected and transferred to a 500 µL centrifuge tube. In order to approximate total guttation volume per area, the remaining guttation was collected by paper towel then weighed.

Analysis by High performance liquid chromatography (HPLC) was unable to quantify imidacloprid amounts below 100 ppb. Therefore, three treated and non-treated samples were analyzed using mass spectrometry (MS). Mean estimates were compared using 95% confidence intervals.

Results and Discussion

Guttation collected 48 hours after treatment from bermudagrass and St. Augustinegrass contained 15.8 (± 95% CI, 0.7) and 13.7 (± 8.8) ppb imidacloprid, respectively (Fig 1). These concentrations are substantially lower 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). Sub-irrigation methods, like the ones used in this preliminary study, are a “best-case” scenario. Broadcast (liquid or granular) applications are more common. Therefore, ongoing research seeks to evaluate imidacloprid concentrations of more commonly practiced foliar applications.

Conclusion

Imidacloprid concentrations of treated bermudagrass and St. Augustinegrass were below concentrations reported lethal to European honeybee and the insidious flower bug. However, imidacloprid concentrations were within amounts causing sub-lethal effects in the European honeybee and the insidious flower bug.

Future research will evaluate imidacloprid concentrations of more commonly practiced broadcast foliar applications.

References

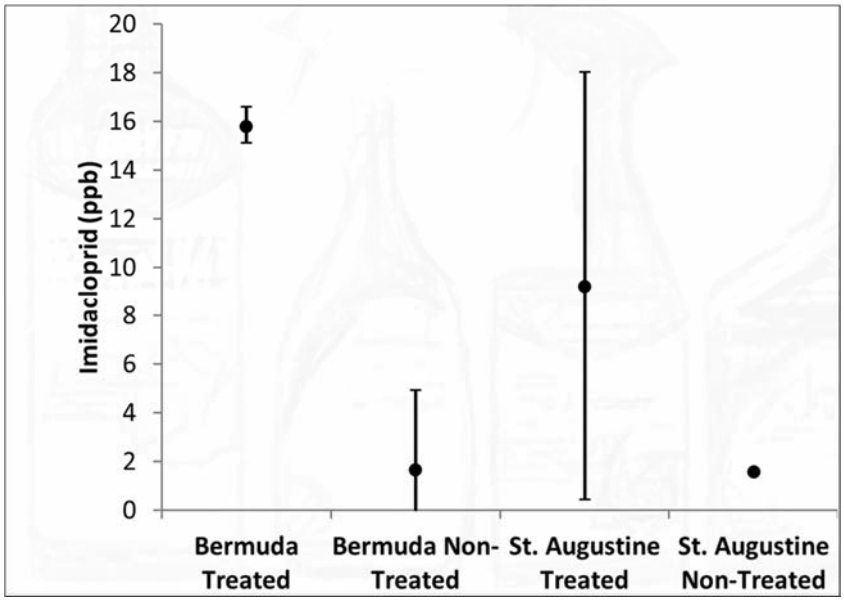
Larson, J.L., Redmond, C.T., and Potter, D.A. (2015). Mowing Mitigates Bioactivity of Neonicotinoid Insecticides in Nectar of Flowering Lawn Weeds and Turfgrass Guttation. Environmental Toxicology and Chemistry. 34: 27-32.

Reetz, J.E., Zuhlke, S., Spitheller, M., Wallner, K. (2011). Neonicotinoid insecticides translated in guttated droplets of maize and wheat; a threat to honeybees? Apidolodie. 42: 596-606.

Creswell, J.E. (2011). A meta-analysis of experiments testing the effects of a neonicotinoid insecticide (imidacloprid) on honey bees. Ecotoxicology. 20: 149-157

A quick video of guttation harvest techniques can be found by scanning this QR code.

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



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

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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 lawns.
- Imidacloprid is a common neonicotinoid insecticide used to control turf and ornamental insect pests. It may be translocated in 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 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 1.3 m^2 perforated plastic flats (6.4 cm depth) and allowed 1 week to acclimate to a field environment. 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 or a dilute imidacloprid solution (0.059 mg imidacloprid / L) representative of a standard home-lawn application rate.

Photo 2. Reetz et. al suggests that leaf exudate or "guttation" is a recently identified route of pollinator exposure to pesticide residue.

- Guttation fluid was collected 48 hours after treatment (Photo 2).
- Approximately 20 µL was collected and transferred to a 500 µL centrifuge tube.
- In order to approximate total guttation volume per area, the remaining guttation was collected by paper towel then weighed.
- Analysis by High performance liquid chromatography (HPLC) was unable to quantify imidacloprid amounts below 100 ppb.
- Therefore, three treated and non-treated samples were analyzed using mass spectrometry (MS).
- Mean estimates were compared using 95% confidence intervals.

Results and Discussion

- Guttation collected 48 hours after treatment from bermudagrass and St. Augustinegrass contained 15.8 (± 95% CI, 0.7) and 13.7 (± 8.8) ppb imidacloprid, respectively (Fig 1).
- These concentrations are substantially lower 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).
- Sub-irrigation methods, like the ones used in this preliminary study, are a "best-case" scenario. Broadcast (liquid or granular) applications are more common. Therefore, ongoing research seeks to evaluate imidacloprid concentrations of foliar applications.

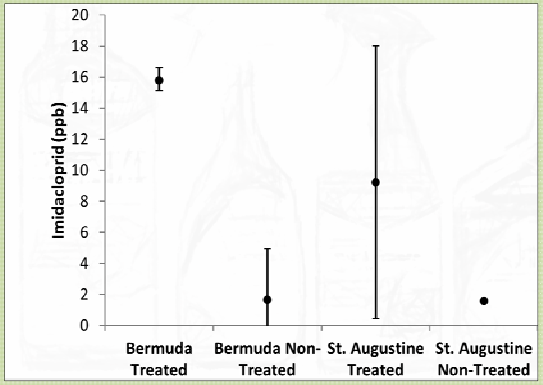

Figure 1. Imidacloprid concentrations recovered 48 hours after treatment, presented as mean estimates ± 95% confidence intervals. Overlapping CI's indicate lack of significant difference.

Figure 2. Imidacloprid is the most common insecticide used in urban systems that are foraged by pollinators.

Conclusion

Imidacloprid concentrations of treated bermudagrass and St. Augustinegrass were below concentrations reported lethal to European honeybee and the insidious flower bug. However, imidacloprid concentrations were within amounts causing sub-lethal effects in the European honeybee and the insidious flower bug.

Future Research

Future research will evaluate imidacloprid concentrations of more commonly practiced broadcast foliar applications.

References

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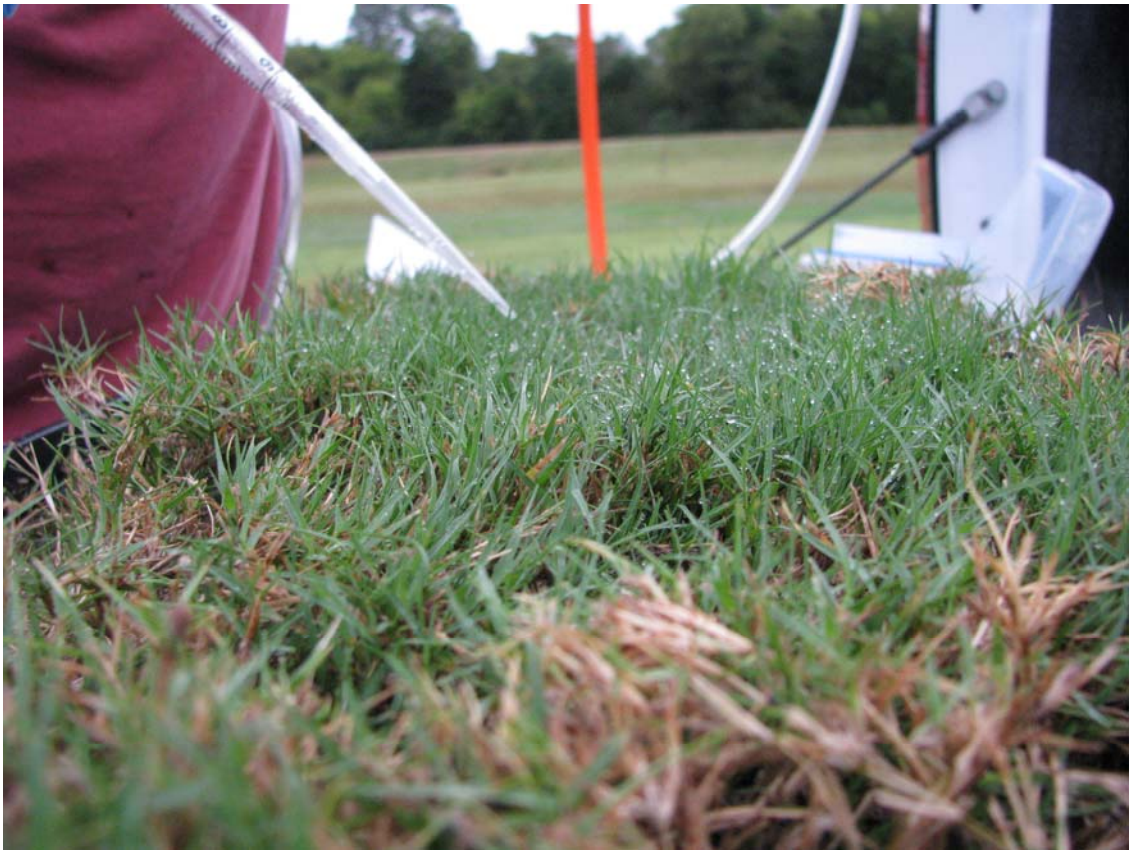


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