SUGARCANE APHID, *MELANAPHIS SACCHARI,* AND GRAIN SORGHUM: IMPLICATIONS FOR HONEYBEES, *APIS MELLIFERA*

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Abstract

In recent years, sugarcane aphid, *Melanaphis sacchari* (Zhetner), is a severe pest of grain sorghum infesting nearly every acre grown in the southern United States. Sugarcane aphid has the potential to cause 100% yield loss if left uncontrolled. Studies have determined that insecticide seed treatments and/or in-furrow applications are an effective method for minimizing sugarcane aphid losses and reducing the need for early season foliar applications. This study was designed to evaluate the potential implications of using these chemical control methods on foraging honeybees at various stages of grain sorghum development with ranging amounts of honeydew. Studies were conducted in 2016 in Starkville, MS and Jackson, TN to evaluate the level of insecticide residue found in pollen sources when using insecticide seed treatments and in-furrow applications for managing sugarcane aphid and to evaluate the correlation between sorghum growth stages and honeydew presence on the number of foraging honeybees in grain sorghum. Levels of detection were minimal with only one detection of clothiandin at 71.6 ppb, two detections of flupyradifurone at 3.9 ppb and clothiandin at 25.7 ppb in the untreated control, and seven detections of flupyradifurone ranging from 2.1 to 8.9 ppb. Blooming grain sorghum had the highest number of foraging honeybees. There was a positive relationship between foraging honeybees and honeydew. Insecticide detections were not common and when present were below levels of toxicity to honeybees. Insecticide seed treatments and in-furrow applications play an important role in sugarcane aphid management therefore, it is important to use these tools judiciously while being aware of honeybee health.

Introduction

Since 2013, the occurrence of sugarcane aphid on grain sorghum has developed into a widespread issue in the southern region of the United States. The use of seed treatments on average provides anywhere from 40 to 50 days of control after planting, minimizing the number of foliar applications needed later in the season. However, there have been multiple factors that are impacting pollinator health whether it be pest, pathogens, management, or food source; pesticide exposure ranks among those top factors. Seed treatments play an important role in the management of sugarcane aphids; therefore, the objective of this study was to determine the impact of seed treatments and in-furrow applications on foraging honeybees in grain sorghum.

Materials and Methods

In 2016, studies were conducted in Starkville, MS and Jackson, TN to determine the frequency of foraging honeybee in various stages of grain sorghum and the potential implications from the uses of insecticide seed treatments and in-furrow applications. In Starkville, MS, eight grain sorghum fields at various growth stages ranging from V9 to late reproductive stages were scouted for three weeks, mid-day between 10:30 am and 1:30pm. Four observers walked 50 meters of row and recorded the number of foraging honeybees and the number of plants with honeydew. Data were analyzed using PROC REG and PROC MIXED in SAS 9.4.

In Starkville, MS and Jackson, TN, a randomized complete block design with four replications was implemented to evaluate various seed treatments and in-furrow applications to determine the level of insecticide detected in grain sorghum pollen. Treatments included seed treatments of imidacloprid, thiamethoxam, clothiandin, in-furrow applications of flupyradifurone at 58 g ai ha^{-1} and 102 g ai ha^{-1} and an untreated control. Grain sorghum pollen was collected from 50 heads per plot at 50% bloom. Samples were sent to the National Science Laboratory in Gastonia, NC for analysis. Data were analysis using PROC FREQ in SAS 9.4.

Results and Discussion

According to the USDA (2015), grain sorghum is only a pollinator attractive crop at certain times depending on the availability of pollen and nectar. When comparing the number of foraging honeybees in blooming and non-blooming grain sorghum, 571 honeybees per hectare were found during bloom, while only 74 honeybees were found during non-blooming stages (Table 1).

Table 1. Number of Honeybees in Blooming vs. Non-Blooming Grain Sorghum

	Honeybees per Hectare
Blooming	591
Non-Blooming	74
P-value	<0.001

Pollen serves as a main source of several important nutrients needed within the honeybee diet; therefore, the increase during blooming grain sorghum could be due to the presence of pollen (Keller et. al., 2015). There was also a positive relationship between plants with honeydew present and the number of foraging honeybees. Honeydew also serves as another food source for honeybees, the level of this relationship may need to be researched further; however, the level at which they forage may also be dependent on the availability of food (Figure 2).

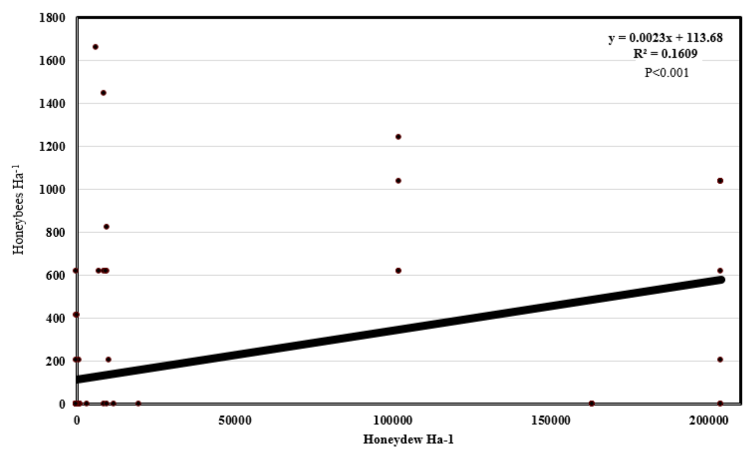

Figure 1. Honeydew and foraging honeybee relationship

In this study, the use of insecticide seed treatments and in-furrow applications resulted in minimal exposure of honeybees to insecticides through grain sorghum pollen. There was no detection of thiamethoxam or imidacloprid in any sample and only one detection of clothiandin at 71.6 ppb. However, clothianidin was detected at 25.7 ppb and flupyradifurone was detected at 3.9 ppb in the untreated control, likely due to contamination during seed packaging or planting. Flupyradifurone was detected in a total of seven samples (Table 2). At the lower rate of 58 g ai ha^{-1}, three samples were detected at 2.1, 4.8, and 5.1 ppb. At the higher rate of 102 g ha^{-1}, four samples were detected at 5.4, 5.8, 8.4, and 8.9 ppb. In respect to pollen consumed, the United States Environmental Protection Agency determined that the chronic no observed effect level (NOEL) for flupyradifurone is 0.79 micrograms ai per bee, with an estimated maximum daily intake of pollen at 9.6 mg per day (Campbell et. al., 2016). In order to reach the highest level of flupyradifurone detected in the study at 8.9 micrograms per bee, one bee would have to consume 88,764 mg or 3.13 oz of pollen per day which is 9,000 times greater than the daily maximum to reach the chronic NOEL of 0.79 micrograms.

Table 2. Insecticide Detections of Flupyradifurone

Number of Samples	Detection in PPB
58 g ai ha^{-1}	
29	0
1	2.1
1	4.8
1	5.1
102 g ai ha^{-1}	
23	0
1	5.4
1	5.8
1	8.4
1	8.9

Summary

Sugarcane aphids on average can be controlled up to 40 or 50 days after planting with the use of an insecticide seed treatment. Through the use of seed treatments, the number of foliar applications needed later in the season will likely be minimized, limiting the level of pesticide exposure to honeybees. Pollen sources where seed treatments and in-furrow applications have been used had very low levels of insecticides detected meaning honeybees would need to consume pollen at rates well above their maximum daily intake to reach concerning levels of ingested insecticide. We can conclude from this study, that in the sites selected and insecticides evaluated, seed treatments would have had minimal impact on foraging honeybees in grain sorghum.

References

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