SUCEPTIBILITY OF TOBACCO THRIPS, *FRANKLINIELLA FUSCA*, TO THE NEONICOTINOID CLASS OF INSECTICIDES IN MID-SOUTH REGION

Chelsie Darnell
Angus Catchot
Fred Musser
Don Cook
Darrin Dodds
Jeff Gore
Mississippi State University
Mississippi State, MS
Shannon Morsello
Syngenta

Abstract

Reduced insecticidal efficacy of neonicotinoid seed treatment against tobacco thrips, *Frankliniella fusca* (Hinds), has been observed in the Mid-Southern region. Dose-response bioassays with the two commonly used neonicotinoid insecticides were performed on field-collected adult female tobacco thrips during May and June, 2014-2015. In 2014, resistance to thiamethoxam was observed, but not to imidacloprid. Resistance levels for both insecticides increased from the 2014 growing season to 2015, so tobacco thrips showed resistance to both insecticides in 2015.

Introduction

Reduced insecticidal efficacy of imidacloprid and thiamethoxam against thrips in the Mid-Southern Region is a concern for cotton producers. Four commonly found thrips species in this region are tobacco thrips, *Frankliniella fusca* (Hinds) western flower thrips, *F. occidentalis* (Pergande) flower thrips, *F. tritici* (Fitch) and soybean thrips, *Sericothrips variabilis* (Beach); however, cotton cropping systems in the South.(Cook, Herbert et al. 2011) The thrips lifecycle lasts approximately sixteen days, so resistance can develop quickly under the right environmental conditions. (Layton and Reed 1996).

Thrips can cause a delay in maturity and reduction in yield if not controlled. If infestations are severe, thrips can cause a loss of apical dominance or even kill plants. Currently, seed treatments are the primary means of controlling tobacco thrips in cotton. It is critical to understand the potential levels of resistance currently established in populations throughout the southern region of the U.S. (Layton and Reed 1996).

Materials and Methods

Populations were collected from agricultural regions in Mississippi from wild hosts as well as from insecticide-treated crops. To collect thrips, workers gently beat thrips-infested vegetation against a white tray to dislodge the thrips. Up to 50 thrips where then aspirated into one milliliter micro-centrifuge tubes which were then closed with a cap containing a 5% sugar solution. After collection thrips were stored in a cool environment for transport. Once in the lab, thrips where reared in buckets with cabbage until assayed, usually within 3 days. The rearing room was maintained at 26° C, 80 % humidity with a 14/10 L/D cycle.

Dose-response bioassays with the two commonly used neonicotinoid insecticides, namely imidacloprid and thiamethoxam, were performed on field-collected adult female tobacco thrips during May and June, 2014-2015. Five thrips where aspirated into each micro-centrifuge tube and closed with a cap containing a sugar solution with the appropriate concentration of one insecticide. Each concentration was made by serial dilutions from a stock solution of the formulated product (Gaucho 600 FS by Bayer CropScience; Cruiser 5FS by Syngenta) on the day of the assay. The five replications of each dose were kept in a growth chamber at 26˚C and mortality was recorded after forty-eight hours. Thrips were considered dead if they failed to walk when prodded by a paint brush.

Results and Discussion

In 2014 Mississippi cotton growers used imidicloprid almost exclusively due to perceived reduced insecticidal efficacy of thiamethoxam, resulting in fewer foliar insecticide treatments being applied in 2014 compared to 2012 and 2013 (Figure 1). Bioassay results for 2014 suggested that crop host was not an important factor in determining survival to neonicotinoids (data not shown), but geographical region was (Table 1). Thrips collected from the Mississippi River Delta region were less susceptible to both neonicotinoids than populations collected from the Hills part of Mississippi. When compared to a laboratory colony, field colonies from both regions were similarly susceptible to imidacloprid (RR<2) (Table 2), but less susceptible to thiamethoxam (RR>5) (Table 3).

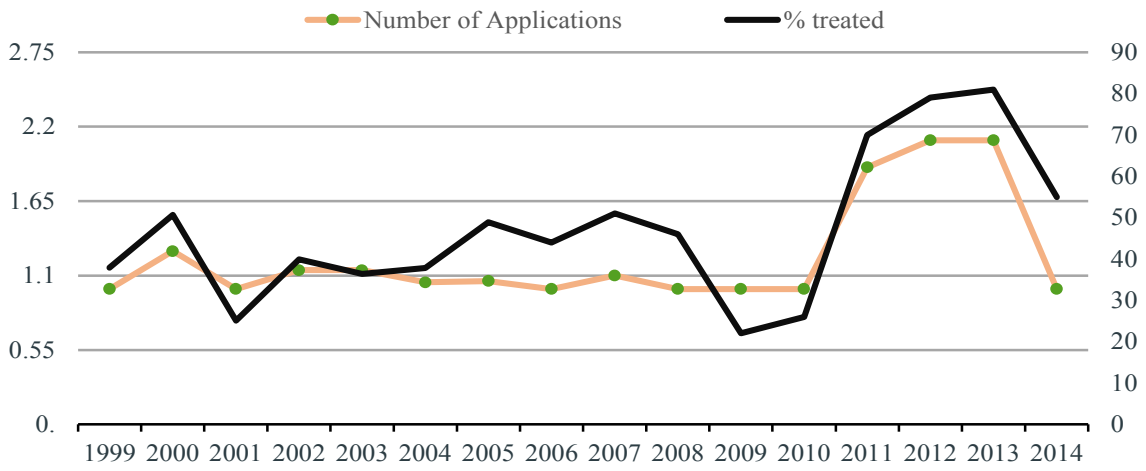

Figure 1. Recent trends in thrips foliar applications in Mississippi Cotton. (adapted from Williams 1999-2014)

Table 1. Average LC_{50} concentrations for tobacco thrips assays conducted on populations collected in Mississippi and on a long-term lab population in May-June 2014 and 2015

Region	Insecticide	# Pop. Tested 2014/2015	Average LC_{50} 2014	Average LC_{50} 2015	% Change 2014-2015
MS Hills	Imidacloprid	9/3	1.10	44.5	4045%
	Thiamethoxam	9/9	9.49	53.7	565%
MS Delta	Imidacloprid	6/8	2.50	28.6	1300%
	Thiamethoxam	12/8	35.10	149.2	425%
Lab	Imidacloprid	1/5	4.51	2.5	55%
	Thiamethoxam	3/2	1.64	0.42	25%

LC_{50} data expressed in PPM of formulated product (all products formulated at 5 lb ai/gal)

Bioassay results for 2015 were quite different. There was an increase in average LC_{50} values in both imidacloprid and thiamethoxam in both regions ranging from 425% to 4045% (Table 1). While LC_{50} levels to the two insecticides were similar in the Northeastern Hills, thiamethoxam resistance levels were much higher than imidacloprid resistance levels in the Delta.

Table 2. 2014-2015 resistance ratios (RR) for imidacloprid

Colony	Imidacloprid 2014		Imidacloprid 2015	
	LC_{50}	RR	LC_{50}	RR
MS Delta	2.50	1.5	28.6	11.4
MS Hills	1.10	0.7	44.5	17.8
Lab	4.51*	1	2.21	1

*1 assay conducted with a significant concentration.

Table 3. 2014-2015 resistance ratios (RR) for thiamethoxam

Colony	Thiamethoxam 2014		Thiamethoxam 2015	
	LC_{50}	RR	LC_{50}	RR
MS Delta	35.10	21.4	149.2	355.2
MS Hills	9.5	5.8	53.7	127.9
Lab	1.64	1	0.42*	1

*2 assays conducted and concentration not significant for either, but both had similar LC_{50} values

Summary

In conclusion, resistance to both primary neonicotinoids appears to be increasing rapidly throughout Mississippi. While there is currently greater resistance to thiamethoxam than imidacloprid in the Delta region, there was no difference in the Hills region. With the shift toward using more imidacloprid as the seed treatment option in cotton, it is likely that tobacco thrips resistance to all neonicotinoids will continue to increase, making the need for alternative thrips management strategies acute.

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